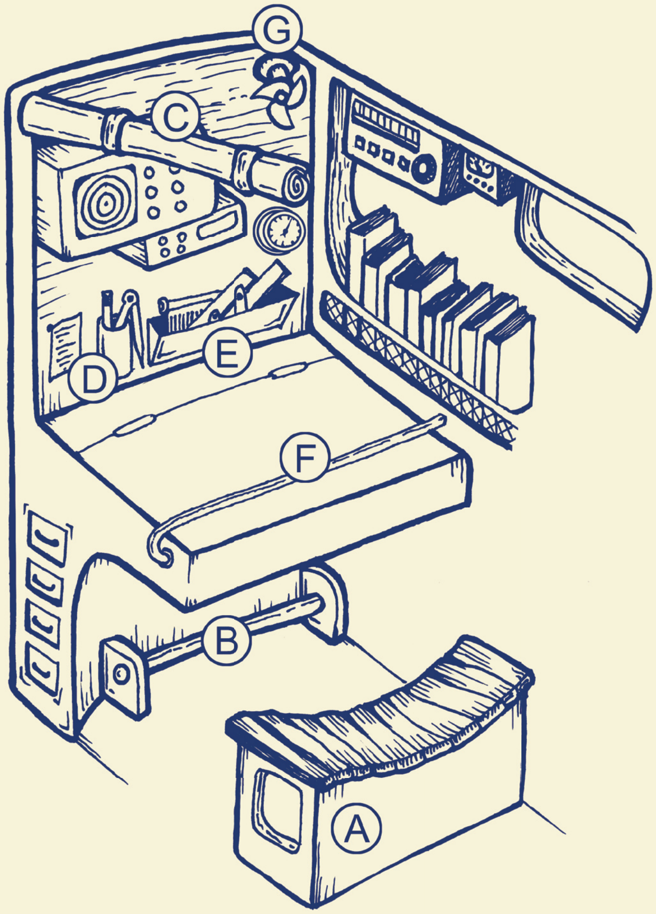
Navigation Exercises for Practice Underway



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The next step beyond textbook and classroom

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Contents

Overview and Instructions

This Exercise Book will serve as your menu of practice exercises and logbook for onboard navigation training. Please skim through it to see what is covered. Once you know what is here, you will always have some navigation exercise to work on if you like, even when the instructor is working with other crew members at the moment. At the end of the voyage, it will be your documentation and souvenir of the voyage.

The goal is to work as many of these exercises each day as your time and interest permits. Some may require reviewing the topic from your reference materials, but after that you have the forms to carry out more examples on your own. Some exercises you can work alone, others you can share with other crew members.

There is no order to the projects. Just take whatever project might be convenient at the time, or choose ones related to the day's discussions. The order of the projects in each section corresponds very roughly to the complexity of the exercise. The exercises are grouped in subject headings, although many are interrelated.

For most exercises, the first thing to record is the Date, Time, and Position. You get the latter from the chart or the nearest GPS. Record both Lat-Lon and a brief text description, ie 1.5 mi SW of Point Sheridan. In most cases, Lat-Lon to the nearest tenth of a minute will be adequate, ie 47° 34.6′ N. That corresponds to 600 feet, which is all that is needed. In a few cases, when more accurate specification might be useful, use 34.56, which is 60 ft, or even 34.563 which is 6 ft none of the instrumentation will be that accurate, but it can indeed be more accurate than 60 ft.

Some of these exercises are very basic and quick, others will take more time. In either case, it will be instructive to record your results, not just do them. You will want to document what has been covered. There is always the possibility to learn many things on any extended voyage, so we need some way to organize what we have done so we can be most effective with the time we have. The entry will document when you actually did the exercises and what is left to do. This is also true for your own general sailing. If you keep a written record of navigation experiences (separate from ships log) you gain local knowledge at a much faster rate than just relying on memory alone.

You may want to practice some of them on scratch paper before entering in this book, or use pencil, so if an exercise gets started that does not get finished, you can erase it. Also for some of them, you may want more detailed records than there are places in the forms, in which case there is often extra space on the pages. When using a separate notebook, if you label your notes such as GPS-1 on May 22, for example, you will be able to correlate notebook and Exercise Book.

Also note a few exercises take some time to complete, involving a longer run, with data gathered at the beginning and end only, or only periodically throughout the day, in which case you might be working on more than one at a time. Start a longer one, then if you like, work on others while the longer one is cooking.

Basic Chart Work

CW-1 Use of Chart Catalog

Refer to the appropriate nautical chart catalog to see what charts are available at your present location. Do this towards the beginning, middle, and end of the voyage. Record the chart number and scale of the largest scale chart (1) and the next smaller (2), ie at Port Townsend, WA in Catalog 2 we find 18474 at 1:25,000 as the most detailed and 18465 at 1:80,000 as the next one smaller. "Larger scale" means things are larger, ie more detailed. There will be chart catalogs on board and this info can also be obtained from any of the electronic chart programs.

Date	Lat/Lon	Description	1 Chart / scale	2 Chart / scale

References:

Inland and Coastal Navigation Chapter 2, Sections 2.1, 2.2

CW-2 Lat/Lon, range and bearings

For any chart onboard, mark any two points in the water that are about one or two outstretched hand spans apart. Read the Lat and Lon of the two points and measure the distance between them (R in nmi), then the true bearing (B) from one to the other, and note the magnetic variation at the area of the marks. Do this at some point with a small scale chart (1:80,000 or greater) and also with a large scale chart (1:40,000 or smaller). Record the Lat/Lon to nearest 0.01′ if you can. This will depend on the chart scale. [We will use these same points for CW-3 so make a small light mark in pencil on the chart so you can find them again easily.]

#	Date	Chart No / scale	Point 1 Lat/Lon	Point 2 Lat/Lon	R	B (T)	Var
1							
2							
3							
4							
5							
6							
7							
8							

References:

Inland and Coastal Navigation Chapter 2, Sections 2.9, 2.10

CW-3 Depths and soundings

For the examples worked in CW-2, record the depth units used for the chart (feet, fathoms, meters), then record the charted depths at the first and second points, interpolating between nearest soundings as needed. Then find the deepest water and shallowest water between the two points. Again, you may have to interpolate to get the answer. Have an instructor check your work at some point. Then look on the chart to find the value of Mean High Water (MHW) at the location of the points.

#	Date	Depth units	Depth at Point 1	Depth at Point 2	Deepest	Shallowest	MHW
1							
2							
3							
4							
5							
6							
7							
8							

References:

Inland and Coastal Navigation Chapter 2, Sections 2.5, 2.7

CW-4. Buoys

On any coastwise voyage we rely much on buoys to confirm our route. There are many types of buoys with different meanings. The main reference for meaning is the chart, from which it is usually apparent what a buoy marks. For more information see the USCG and NIMA *Light Lists* which lists every buoy in the waterway and includes info not on the chart. Next is the booklet *Chart No. 1*, which gives a general description of what the chart symbols might mean. There will be copies of both books available for working these exercises.

Vector chart programs also include some Light List information on various aids to navigation. For each new type of buoy you observe, record the location, then use a Light List to find its official number—at which time you will learn more about the aid. Every light and buoy has a unique number. There is a US and International numbering system, plus tables that correlate the numbers. We have a separate exercise (CW-5) for Light Houses, but you might include here prominent daymarks or beacons as well as buoys.

Date	Time	Lat/Lon	Buoy description	LL number	Chart – LL differences

References:

Inland and Coastal Navigation Chapter 2, Sections 2.11, 2.13

CW-5. Lighthouses

What's a lighthouse? Let's just call them any prominent light in some prominent structure, that sort of looks like a house. This is just a record of these key landmarks along the voyage. The main exercise is to use the Light List and compare the Light List description with the chart description. You can also use this form for any prominent light, even if it is not a lighthouse. *Read the discussion with CW-4 above*. We have another exercise (5-NR-3) where we record vessel lights. This is for permanent navigation lights.

Date	Time	Lat/Lon	Light description	LL number	Chart – LL differences

References:

Inland and Coastal Navigation Chapter 2, Sections 2.11, 2.12

CW-6. Coast Pilots and Sailing Directions

The goal of the *Coast Pilots* are to present crucial navigation information that is not on the chart. These are important aids to any voyage. They are also referred to as *Sailing Directions* in Canada. There will be copies on board both in paper and as computer files. The latter have the advantage of being able to be quickly searched electronically, but they are not always convenient to access when you might need them. Ideally, every leg of a route that is new to you should be researched in the corresponding Sailing Directions ahead of time. There is always something interesting to learn.

Record here the sections that you have read relating to the present voyage, plus the name of the book. There are US versions for US waters, US versions for Canadian waters (as well as all other parts of the world) and there are excellent Canadian versions for their own waters. The British Admiralty also makes a very extensive (and very expensive) set for the world.

Date	Time	Region studied	Book title	Notes / Comments

References:

Inland and Coastal Navigation Chapter 3, Sections 3.1, 3.2, 3.3

CW-7. Broadcast Notice to Mariners

Charts are updated annually by the Light List, weekly by the printed Notices to Mariners, and daily by the Broadcast notice to mariners (as well as Internet). Underway, our most convenient up to date source of chart information as well as any other special announcement relevant to navigation is the Broadcast Notices given on USCG VHF channel 22. Schedules are usually on the marine weather services charts or might be found online. There are also Canadian counterparts.

Record here your examples of listening to these reports. They also repeat weather information, which can be a valuable supplement to the regular VHF weather broadcasts.

Date	Time	VHF channel / Station	Notes / Comments

References:

Inland and Coastal Navigation Chapter 2, Section 2.4

Tides and Currents

TC-1 Tides at anchor

For one or more of our anchorages, record the depth from the depth sounder, then compare that with the charted depth and the predicted tides for that location. You will need to know the “draft” of the transducer, which can be learned from the skipper, and you will need to use whatever tide source you have. There are books on board with tide height information, or they can be obtained even more easily from the electronic chart program.

This will also give practice on interpolating the tide tables, but if you use the computer, you can find it directly at the exact time you care about. The “Error” list in the table is the difference between measured water depth plus draft and the charted depth plus the present value of the tide for your location and time. Error = Sum 1 – Sum 2, or vice versa.

Date						
Time						
Lat						
Lon						
Description						
Measured depth						
Draft						
Sum 1						
Charted depth						
Tide height						
Sum 2						
Error						

References:

Inland and Coastal Navigation Chapter 8

TC-2 Currents underway

At any time in the passage, compare the speed over ground (SOG) with the knotmeter speed (S) and the course over ground (COG) with your present magnetic heading (H). That is Part A. Just make a few recordings of these measurements to become more aware of the differences.

Part B is at any later time, use the above information to compute the Set and Drift of the current which might account for the differences observed. Then Part C, look up the currents for the time and place of your observations to see how well they agree. Part B requires learning how to solve the vector triangle, or just cranking out the solution with a calculator like the Starpath StarPilot.

Part C requires learning how to interpolate and extrapolate the current tables, or, when using electronic charting, how to extrapolate the given data at nearby locations into the location of interest for the problem. You will usually not have to interpolate in this method since you can find the data for any specific time, whereas the tables only give the data for the peak and slack times.

Part A									
Date									
Time									
Lat									
Lon									
Description									
Knotmeter speed									
SOG									
Heading									
COG									
Part B									
Computed Set									
Computed Drift									
Part C									
Predicted Set									
Predicted Drift									

References:

Inland and Coastal Navigation Chapter 8

Radar

R-1. Check out basic controls

Enter the times and dates that you have learned how to use the listed functions of the radar. Only make the entry after you feel confident that you know how these functions work. Note that some sound simple, but there may be nuances, so do not hesitate to ask about these if questions arise. Fill in other learned functions as they occur.

Function	Date	Time	Function	Date	Time	Function	Date	Time
On / Off / Warm-up			Plot / wake options					
Brilliance								
Gain								
Range								
Range Rings								
VRM								
EBL								

References:

Radar For Mariners Chapters 1, 2

R-2. Confirm GPS position using Radar Range and Bearing

This is a standard procedure in navigation. From the GPS position either plotted on a chart or shown on an electronic chart, choose what might appear to be a conspicuous radar target and then determine from the chart what the range and bearing should be to that object. Then turn to the radar to confirm that this is right.

Date	Time	Lat/Lon	Description	Chart R and B	Radar R and B

References:

Radar For Mariners Chapters 1, 2

R-3. Distinguish buoys and moving vessels

Buoys move straight down the radar screen with a speed of relative motion (SRM) equal to your own speed (S). Moving vessels can travel in any direction on the screen at various speeds. To prepare for more advanced analysis, start by identifying several buoys, anchored vessels, islets, etc that are not moving. Confirm identification by measuring their SRMs and compare with your knotmeter speed. Measurements will not often be exact, but should be close enough for identification.

Date	Time	Range	SRM	S	Date	Time	Range	SRM	S

References:

Radar For Mariners Chapter 3

R-4. Closest Point of Approach

A key question to be answered by radar is how close will an approaching vessel pass us if we both remain on the same course and speed. This is best evaluated using the plot option on the radar, which can then be projected forward to estimate the CPA. Record several examples of your predicting the CPA and record at what range you made the observation.

Then use the SRM or other tricks to figure the time of the CPA (TCPA). If you ended up passing without course alterations (your's or their's)—in which case their trails will remain a straight line (ie more or less strait smear)—then record the actual time and CPA of the passing. If someone needed to alter course, then skip last two answers and mark through the spaces.

Date	Time	Range	CPA	TCPA	CPA real	TCPA real	Comments

References:

Radar For Mariners Chapter 6