NAVIGATION WORKBOOK

For Practice Underway

For Power-driven and Sailing Vessels

DAVID BURCH

LARRY BRANDT

Contents

Overview and Instructions

This Workbook will serve as your menu of practice exercises and logbook for onboard navigation training, either on your own or as part of a group. 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. During an onboard course this provides navigation practice 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. In a sense this is serendiptiy practice. We are not getting the exercises from a book but from what we happen to be confronted with in our travels. The order of the projects within individual sections corresponds 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 position. 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 about ±600 feet, which is all that is needed. In a few cases, when more accurate specification might be useful, use 34.56, which is about ±60 ft, or even 34.563 which is about 6 ft, however 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 the ship's log) you gain local knowledge at a much faster rate than just relying on memory alone. This Workbook is designed for those records.

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 Workbook.

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 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 might be a printed chart catalog on board, or this info can also be obtained from any of the electronic chart programs (select the option "show chart outlines"). See also downloadable version from links at www.starpath.com/getcharts.

Date	Location along voyage	Chart w. largest scale	Chart w. next scale down
7/20/15	Port Townsend	18474, 1:25,000	18465, 1:80,000

References:

Inland & Coastal Navigation, 2nd Ed. Chapter 2, Sections 2.1, 2.2

Special Communications and AIS

COM-1. Securite', Pan Pan, and Mayday Communications

It is unusual that any long distance coastal voyage can be completed without hearing at least one of these special classes of radio communications. To remind ourselves of the importance of each of these, state in your own words or obtain from an onboard reference a definition of each as follows:

Class of Transmission	Description
Securite'	
Pan Pan	
Mayday	

If you hear such a radio call, list here the date, time and your vessel location, and indicate the class of transmission together with a summary of the message.

Date	Time	Your Location	Class	Message Summary

References:

Inland & Coastal Navigation, 2nd Ed. Chapter 3

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 & Coastal Navigation, 2nd Ed. Chapter 8

Radar

R-1. Basic Radar 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, Revised Edition Chapters 1, 2

Navigation Rules

NR-1. Reading Assignments

On board you will find a copy of the Navigation Rules, or there are many options to download a pdf or other app for your phone. It appears a long book and maybe complex when just skimming it. But with guidance, it is actually easy reading and quite interesting, and needless to say valuable. This is the most important book in all of navigation. The Rules will be discussed often in the pilothouse and throughout the voyage, so you might want to check out a copy and do some reading in short segments. Here is a suggested approach, with a form to fill in the date you completed the section. Each is actually very short.

For now, read only the International Rules on the left-hand side of the page. Each assignment will take only about 15 minutes or so, with a bit more to think on it. Then bring your questions to an instructor or the skipper as they might arise. [We shall end up running the mile, by starting out walking a hundred yards at a time.]

Date	Assignment	Rules — Page count
	Part B, Sec I. Rules that apply all times, regardless of visibility	Rules 4 to 10 — 6 pages
	Part B, Sec II. Rules that apply when vessels can see each other	Rules 11 to 18 — 5 pages
	Part C, Lights and Shapes (power, fishing, and sailing)	Rules 23, 25, 26 — 12 pages
	Part C, Lights and Shapes (tow boat lights)	Rule 24 — 10 pages
	Part C, Lights and Shapes (anchored and aground)	Rule 30 — 3 pages
	Part D, Sound and Light Signals (maneuvering and warning)	Rule 34 — 2 pages
	Part D, Sound and Light Signals (“fog signals”)	Rule 35 — 2 pages
	Part D, Sound and Light Signals (distress and getting attention)	Rules 37 and 36 — 2 pages

References:

Inland & Coastal Navigation, 2nd Ed. Chapter 10

Piloting

P-1. Bearing Fix

Use a hand bearing compass to find your position from crossed bearings. Record the time of each sight and your GPS position at the time of the first sight. Use two or three objects for each fix. Record course (C) and speed (S) so we can correct these for motion later if need be. Plot the fix on paper chart or electronic and then figure the Range and Bearing from the your plotted fix to your actual position, ie the error in your fix. Also record an estimate (ie 0.2 nmi) of the uncertainty in your fix (delta).

#	Date	Time	Bearing	Target	C	S	Lat/Lon from GPS		
1									
2							Range	Bearing	delta
3									

#	Date	Time	Bearing	Target	C	S	Lat/Lon from GPS		
1									
2							Range	Bearing	delta
3									

#	Date	Time	Bearing	Target	C	S	Lat/Lon from GPS		
1									
2							Range	Bearing	delta
3									

#	Date	Time	Bearing	Target	C	S	Lat/Lon from GPS		
1									
2							Range	Bearing	delta
3									

#	Date	Time	Bearing	Target	C	S	Lat/Lon from GPS		
1									
2							Range	Bearing	delta
3									

References:

Inland & Coastal Navigation, *2nd Ed*. Chapter 6, Section 6.3

Electronic Charting

EC-1. Basic Skills

Confirm when you have learned these skills with the charting program. Note that some crew members may have learned some ahead of you, so you can learn from one another as well as from the instructor. Once you feel you have mastered the skill, log the time and date. Add to the list as you learn new operations. Keep details of the instructions in your own notebook.

Operation	Date	Time	Operation	Date	Time
Select charts and load chart of choice			R and B boat to point		
Scroll, center, zoom			R and B point to point		
Set scales, windows			Use of Cross Track Error XTE		
Read Lat/Lon of boat position			Use of Tides and Currents		
Set marks, properties, hide/show					
Set up a route, activate a waypoint					
Use of Plan Book					
Monitor GPS input signals					
Display multiple windows					
Split and join routes					
Set up projected boat position					
Use of range rings					

References:

Inland & Coastal Navigation, 2nd Ed. Chapter 7

GPS Navigation

GPS-1. Basic Skills

Record the time and date that you have learned these skills either with your own hand held unit or with the ship's GPS. Fill in new skills as learned.

Operation	Date	Time	Operation	Date	Time
Read and interpret Lat and Lon					
Entering a waypoint					
Entering a route					
Read R and B to waypoint					
Reading COG and SOG					
Read and understand XTE					
Display, zoom, and pan the plot screen					
Advance to next waypoint on a route					
Arrival alarms					
Interpret active satellite data					

References:

Inland & Coastal Navigation, 2nd Ed. Chapter 7

Dead Reckoning

DR-1. Basic Terms

Make a record that the following terms have been explained and are understood, by noting here the actual times that you first used these yourself during some navigation process. It is fundamental that these terms be understood completely.

Term	Time	Date	Term	Time	Date
Heading (H)			Knotmeter speed (S)		
Course (C)			Speed over ground (SOG)		
Course over ground			Velocity made good (VMG)		
Bearing to WP			Speed of Advance (SOA)		

References:

Inland & Coastal Navigation, 2nd Ed. Chapter 5, Section 5.1

Weather

W-1. VHF Weather Sources

On VHF radio, scroll through the weather channels and record which stations are available. A personal portable VHF would be nice for this. Record the VHF channel, the station call sign and location if given. Listen to the full broadcast and make notes of subject given, ie reports R, synopsis S, forecast F, and also record the regions covered. You may hear broadcasts that are not where you are. Some may be helpful, if you are eventually going there, others might not be.

The form below includes possibility of hearing up to 4 stations at the same time and location, but it will be more likely to hear just 1 or 2, sometimes 3. Try to do it once a day if possible. Note this exercise is not for the content, just sources. W-2 will work with the content. Remember there are Coast Guard as well as Weather Service broadcasts in some cases.

Time	Date	Lat/Lon	Description

VHF Chan	Call sign or station ID	Subjects

Time	Date	Lat/Lon	Description

VHF Chan	Call sign or station ID	Subjects

Time	Date	Lat/Lon	Description

VHF Chan	Call sign or station ID	Subjects

Celestial Navigation

CN-1. Star Spotting

"Navigational stars" are the 57 listed on the Daily Pages of the *Nautical Almanac*. They are the same throughout the year, although only some 20 or so might be visible during the night from any given location and date—others are below the horizon all night. From the *Nautical Almanac* star maps or from a 2102-D Star Finder, identify as many navigation stars as you can and make note of when you observed them.

Various phone apps are especially valuable for this. Remember, though, that this is definitely a peripheral exercise in that one does not need to know anything at all about the stars or how to find them in order to do successful celestial navigation.

We only train navigators to find the stars because other crew members are going to assume we know how to do this! Enter an estimate of the height (ie Hs = 35°) and true bearing (Zn = 075) of the star as well. Crew member with largest count gets a prize.

Date	Time	Lat/Lon	Star Name	Hs	Zn

References:

Celestial Navigation, 2nd Ed. Chapter 10

The next step beyond the classroom

This workbook has been used in onboard navigation training courses, power and sail, for many years. It was originally designed for students to carry on with practice when they were not on watch getting direct instructor training during extended training voyages. It can be used for day sails or long coastal passages.

Now available to the public, you can use this workbook to guide your own study underway to master techniques and procedures learned from classroom or home study. Once you master the skills of these exercises you can be confident you have a practical working knowledge of navigation. These are skills and procedures that every navigator should know.

It is designed to be worked on any waterway, underway or at anchor, at various times during one voyage or many. Instructions and forms are provided to document your work.

Topics include...

- Basic Chart Work
- Radar
- Special Communications and AIS
- Tides and Currents
- Navigation Rules
- Piloting
- Electronic Charting
- GPS Navigation
- Dead Reckoning
- Weather
- Celestial Navigation
- Navigation Challenges

Plus...

- Personal Logbook
- Plotting Sheets
- Valuable References

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