Effective Date: 1 August, 2023

ADVANCED NAVIGATION STANDARD

Standard Description

This standard comprises 4 modules and it is anticipated that they will be taught and examined independently. To be awarded the standard the student must complete all the modules. There is no time limit for this completion nor is there a required sequence.

Objective

To be able to demonstrate the navigational theory required to safely navigate a vessel on a multi-day voyage in tidal waters, in all conditions of visibility and weather, in accordance with a prepared passage plan, and applying the principles and techniques of safe navigation aided by conventional and electronic instruments and radar.

Prerequisites

Sail Canada Intermediate Coastal Navigation or Sail Canada Coastal Navigation

MODULE 1 - Passage Planning and Chart Work

Passage Planning

The candidate must be able to:

1. Prepare a detailed passage plan for a non-stop cruise of duration such that at least two tidal complete cycles must be allowed for. The plan must include tide and current information for passes and harbours. It shall comprise three stages:
   a) An overall plan on a small-scale chart,
   b) A detached plan on at least one large scale chart, and
   c) A detailed departure and arrival plan.
2. Use transits, leading marks, back bearings and clearing bearings in passage planning.
3. Describe safety criteria for a coastal passage regarding hazards, buoyage system and depth.
4. Demonstrate the use of all publications relevant to prudent navigation in Canadian and US waters including Charts (CHS, NOAA, NIMA (DMA)), Chart 1, List of Lights, Buoys, and Fog Signals, Sailing Directions, Radio Aids to Marine Navigation, Notices to Mariners, Tide and Current Tables, Current Atlas, Coast Pilots and Local Cruising Guides.
5. Calculate the distance at which a lighted aid to navigation can be expected to be seen, in nominal meteorological conditions, taking into account the height of the observer and the height of the light.
6. Demonstrate a working knowledge of the Canadian and International Collision Regulations rules 6, 9, 10 and 19.

Tides and Currents

The candidate must be able to:

1. Calculate using tabular methods, the height of the tide at any time for reference and secondary Canadian and US ports.
2. Calculate, using tabular methods, clearance heights at any time in a tidal cycle using Canadian and US charts and tables.
3. Calculate, using tabular methods, current rates at any time for reference and secondary Canadian and US current stations.
4. Determine current rate and direction at any time using a Canadian Current Atlas.
5. Derive estimates for tidal heights at any time using graphical solutions. (Tenths rule or Twelfths rule).

Chart Work

The candidate must be able to:

1. Describe the differences between, and uses of, Mercator, Gnomic, and Polyconic chart projections.
2. Demonstrate the use of pilot charts for passage planning purposes.
3. Determine the best course to steer to counteract the effect of current in areas where the current set and/or drift varies cyclically.
4. Demonstrate the ability to plot the following fixes:
   a) Three-bearing fix,
   b) Fix by a transit and a bearing,
   c) Running fix with known current and leeway,
   d) Fix by two horizontal angles (relative or sextant),
   e) Running fix using two circles of position, and
   f) Fix given the bearing, and measured angular height of a charted object including compensating for the height of the tide.
5. Demonstrate use of special pairs of angles and related techniques to establish running fixes and to predict the clearing distance from an object.
6. Determine EP when course to steer includes adjustments to counteract the effects of both current and leeway.
7. Demonstrate the use of vertical sextant angles as vertical danger angles (clearance circles of position) to establish a safe passage zone between two hazards using a charted object of known height.
8. Demonstrate a working knowledge of the Canadian, US, and international Buoyage Systems (day and night).

MODULE 2 - Navigation Systems

Compass

The candidate must be able to:

1. Describe the characteristics of the various compass types (conventional, GNSS, fluxgate) and describe their advantages and disadvantages.
2. Describe two procedures to swing a compass and to compile a deviation table for both binnacle and bulkhead mounted compasses.
3. Describe the procedure to adjust a compass to minimise deviation.
4. Describe the precautions to be taken when installing and using a fluxgate compass.

Global Navigation Satellite Systems (GNSS), Electronic Aids, Emergency Signals

The candidate must be able to:

1. Describe the advantages and disadvantages of GNSS Navigation.
2. Describe the operating principles of a GNSS including GPS Navstar, WAAS and the relationships to nautical chart data.
3. Explain the general operation of a GNSS-enabled device including signal acquisition and monitoring quality.
4. Explain the operation and use of an electronic depth sounder as a navigation aid.
5. Explain the operation and use of AIS.
6. Explain the operation of the Global Maritime Distress and Safety System (GMDSS) and identify equipment that is part of this system.

Electronic Displays

1. Describe a typical suite of marine electronic navigation equipment including chart plotters, knotmeters, depth sounders, GNSS enabled devices and integrated display units the typical pages, their inputs and uses.
2. Describe the process of entering and recording waypoints into a typical marine GNSS-enabled device including consideration for safe clearance at physical objects such as buoys.
3. Describe the process of building a route in a GNSS-enabled device using waypoints.
4. Determine ETA's and distances to waypoints on and off a route.
5. Describe the differences and relative advantages and disadvantages of raster and vector electronic charts.
6. Describe the operation of a PC based navigation program including:
   a) Entering waypoints and building a route, and
   b) Setting up danger bearings
   c) The use of the various pages and tools in a typical PC based navigation program.

7. When using a GNSS-enabled device describe the importance of choosing the appropriate horizontal datum on the accuracy of Latitude and Longitude positions plotted on paper charts and the procedure to correctly set up the device.

MODULE 3 - Radar

This module may be taught and evaluated using an approved RADAR Simulator.

The candidate must be able to:

1. Describe the principles of operation of Radar.
2. Explain how and when to tune and operate the radar set controls including range, gain, sensitivity, anti-sea clutter, and anti-rain clutter.
3. Describe the effects of weather and sea state on displayed radar information.
4. Describe the effects of target characteristics on detection range.
5. Discuss the quality of target identification (land, vessel, or object).
6. Discuss the quality of identification of different types of land features.
7. Discuss Radar shadows, false echoes, side echoes, multiple echoes and spoking and the means to minimize the effects.
8. Describe how to determine the Radar index error.
9. Discuss the pros and cons of parallel indexing in the various Radar modes of operation.
10. Demonstrate the use of Radar to fix a position by:
    a) Two or more radar ranges as COP's,
    b) Radar range and a bearing,
    c) Radar as a clearing line,
    d) Two or more EBL's, and
    e) Fix by range and EBL.
11. Demonstrate the use of Radar for collision avoidance by plotting the relative track, CPA, TCA, course and speed of a radar target and any necessary course alteration.
12. Describe the interface and interaction of the Radar to a GNSS-enabled chart plotter.

Definitions
EBL: Electronic Bearing Line
CPA: Closest Point of Approach
TCA: Time of Closest Approach Point
COP: Circle of Position

MODULE 4 - Weather

The candidate must demonstrate a comprehensive working knowledge of:

1. Global weather patterns.
2. The formation and movement of low pressure and high pressure systems.
3. The formation and movement of cold and warm fronts.
4. The weather associated with low or high pressure and cold or warm fronts.
5. Cloud formations associated with pressure systems and fronts.
6. Winds associated with pressure systems and fronts.
7. The anatomy of thunderstorms and line squalls.
8. Reading and interpreting a weather map including map symbols.
9. Local weather hazards or phenomenon.
10. Accessing current and forecast weather information by VHF radio and other weather information sources (including internet based weather and wave models, satellite images, down-loadable grib files and weather fax).
11. The procedure to compare actual observations with forecasted weather.
12. Barometers, wet/dry thermometers, hygrometers and their use in predicting local weather.
13. Interpreting weather charts including surface and weather aloft (the use of 500 Mbar Charts).
14. Characteristics and warning signs related to hurricanes, weather bombs, micro bursts. Appropriate actions to be taken when these are forecast.

Outcomes and Evaluation

You can attain this standard by achieving a minimum of 70% on each of the module evaluations. Performance on the written exams will be reviewed with the candidate.
Successful candidates will be awarded the Advanced Navigation standard and the certification will be noted in the candidates Sail Canada Logbook. Certification is complete when the logbook is signed by the evaluating instructor(s) and a seal affixed, and when the candidate status is updated in the Sail Canada data base. Student certification is good for life.

Additional Notes

Over time student skills may weaken and updates to training to refresh and build skill are recommended.

Physical Requirements for Candidates

None.

Further Information

For further information on navigation training contact your Provincial Sailing Association or Sail Canada