ROYAL CANADIAN SEA CADETS

PHASE FOUR

INSTRUCTIONAL GUIDE

SECTION 4

EO M423.04 – PLOT A FIX

Total Time: 60 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-604/PG-001, *Phase Four Qualification Standard and Plan*, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Photocopy the Plot a Fix handout located at Attachment A for each cadet.

Set up the classroom or training area so that cadets can work in pairs at tables suitable for chartwork.

PRE-LESSON ASSIGNMENT

Nil

APPROACH

A demonstration and performance was chosen for TPs 1–3 as it allows the instructor to explain and demonstrate types of fixes while providing an opportunity for the cadets to practice the skills under supervision.

A practical activity was chosen for TP 4 as it is an interactive way for the cadets to plot a fix on a chart. This activity contributes to the development of navigation skills in a fun and challenging way.

INTRODUCTION

REVIEW

Nil.

OBJECTIVES

By the end of this lesson the cadet shall have plotted a fix, complete with track and dead reckoning.

IMPORTANCE

It is important for cadets to plot a fix complete with track and dead reckoning because it estimates a future position and contributes to the safety of the vessel.

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Teaching point 1 **Explain, demonstrate and have the cadets plot a position on a chart using a line of position fix.**

Time: 10 min Method: Demonstration and Performance



To better understand the principles outlined, it is important to know the following terms:

Heading. The direction in which the bow of the small craft is pointing. Headings are expressed in degrees (°)—000 through 360.

Bearing. A line of position sighted from a small craft to another object. Only true bearings can be plotted on charts.

Lines of Position (LOPs). Lines that are plotted on a chart for the bearings taken from objects.

Fix. The intersection of two or more LOPs. While a fix can be made with two LOPs, it is considered more accurate to use three LOPs in every fix. An ideal three-bearing fix should have 60-degree angles between the LOPs.



True bearings are obtained from a gyrocompass. Small craft are not normally fitted with a gyrocompass due to their weight and size.

If taking bearings from a small craft, a handheld magnetic compass may be used to obtain the bearings. However, these bearings must be converted to true bearings before plotting them on a chart.



Throughout this TP, all bearings given in examples and exercises are to be considered true bearings.

LINE OF POSITION

Bearings that are plotted on a chart are referred to as LOPs and are measured on the outer ring of the compass rose with a parallel ruler. A position can only be located when two or more LOPs cross.

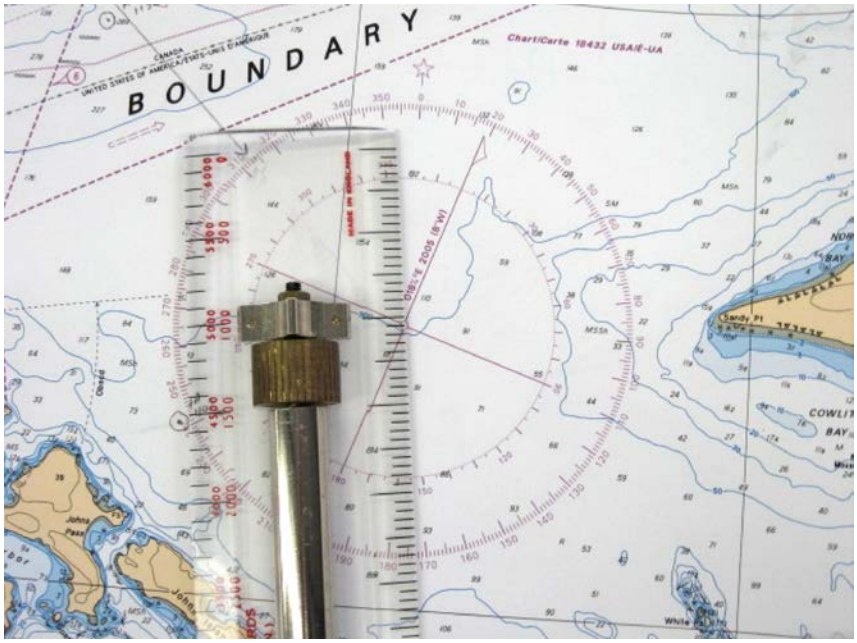
Example: Plot the following fix on *Chart 3441*:

0800	LHE Stuart Island	173°
	Tom Pt light	287°

To plot an LOP on a chart, use the following steps:

1. Align one edge of the parallel ruler with the centre of the compass rose and the number of degrees on the outer circle. In this case LHE Stuart Island bears 173°.

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Note. Created by Director Cadets 3, 2009, Ottawa, ON: Department of National Defence.

Figure 1 Line of Position Step 1

2. Roll or walk the ruler until the edge used aligns with the object from which the bearing was taken.



Note. Created by Director Cadets 3, 2009, Ottawa, ON: Department of National Defence.

Figure 2 Line of Position Step 2

3. Draw a line away from the object along the ruler.

4. Draw an arrow on the end of the line away from the object from which the bearing was taken.

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Figure 3 Line of Position Steps 3 and 4

5. Repeat Steps 1–4 for the second bearing. After the first LOP is plotted, the last LOP is only drawn across the first LOP plotted.

6. Once LOPs are drawn they can be shortened to the same size as the diameter of a quarter.

7. To finish the fix, circle the intersection of the LOPs and mark the time of the fix in the upper right corner.



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Figure 4 Line of Position Steps 6 and 7

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CONFIRMATION OF TEACHING POINT 1

The cadets' plotting an LOP will serve as the confirmation of this TP.

Teaching point 2 **Explain, demonstrate and have the cadets plot a navigational track on a chart.**

Time: 10 min Method: Demonstration and Performance

NAVIGATIONAL TRACK

A navigational track is a line that shows a projected course from a given position. It is commonly referred to as a track (TR). To plot a track on a chart, follow these steps:



Use the plotted position from TP 1 to continue demonstrating how to plot a navigational track.

Example: Plot the following fix on *Chart 3441*:

0800	LHE Stuart Island	173°
	Tom Pt light	287°
	Course	335°

Plotting

1. Plot the position on a chart (use the plotted position from TP 1).

2. Align one edge of the parallel ruler with the centre of the compass rose and the number of degrees being steered (course) on the outer circle.

3. Roll or walk the ruler until the edge aligns with the plotted position.

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Figure 5 Plotting a Track Steps 3 and 4

4. Draw a line away from the fix along the ruler in the direction of the course.

5. Draw an arrow on the end of the line showing the direction of the course.



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Figure 6 Plotting a Track Step 5

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Labelling

When a track is drawn on a chart, it must be labelled for future reference. They are always drawn showing a True heading. To label the course on the track, place the course above the track and toward the point of departure. Label the course using three digits (eg, 084°) preceded with an uppercase C (as illustrated in Figure 7).



Note. Created by Director Cadets 3, 2009, Ottawa, ON: Department of National Defence.

Figure 7 Labelling a Track

CONFIRMATION OF TEACHING POINT 2

The cadets' plotting a navigational track will serve as the confirmation of this TP.

Teaching point 3 **Explain, demonstrate and have the cadets plot a dead reckoning position on a chart.**

Time: 10 min Method: Demonstration and Performance

DEAD RECKONING

Dead reckoning (DR) is the continuous plotting of a course and position based on known facts. The facts used when making calculations for a DR include;

- time,
- speed,
- distance, and
- course steered.

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Some reasons to maintain a plot of the dead reckoned positions are:

- very rapid determination of your approximate position in the event of an emergency;
- knowledge of approximate position in order to render assistance to another vessel in an emergency;
- to be able to plot the safest and shortest course to a desired destination; and
- to be able to make important decisions as to the proper action in the event of adverse conditions, such as:
  - fog,
  - wind,
  - storm, and
  - equipment failure.

The calculations for plotting a DR are derived through standard speed-time-distance calculations.



Speed-time-distance calculations have been previously taught in EO M423.02 (Use Navigation Instruments).

A DR is normally made at 6-minute intervals to make calculations simple. A 6-minute interval is equal to 1/10 of an hour; therefore, the distance travelled is 1/10 of your speed.

It is good practice to plot two DRs, one at 6 minutes and one at 12 minutes because it gives a better view into the future safety of the vessel, especially in close navigable waters.

A DR position is indicated by placing a small line across the course and the time alongside. A small cross may be used to originate the DR if a fix or estimated position is not available.

Plotting



Use the plotted information from TP 2 to continue demonstrating how to plot a DR position.

To plot a DR on a chart, follow these steps:

1. Determine distance traveled in 6 minutes.



For this example use a speed of 5 knots (kns) and time of 6 minutes (1/10 hour), equalling a distance of 0.5 nautical mile (M).



Measuring distances has been previously taught in EO M423.03 (Describe Latitude and Longitude).

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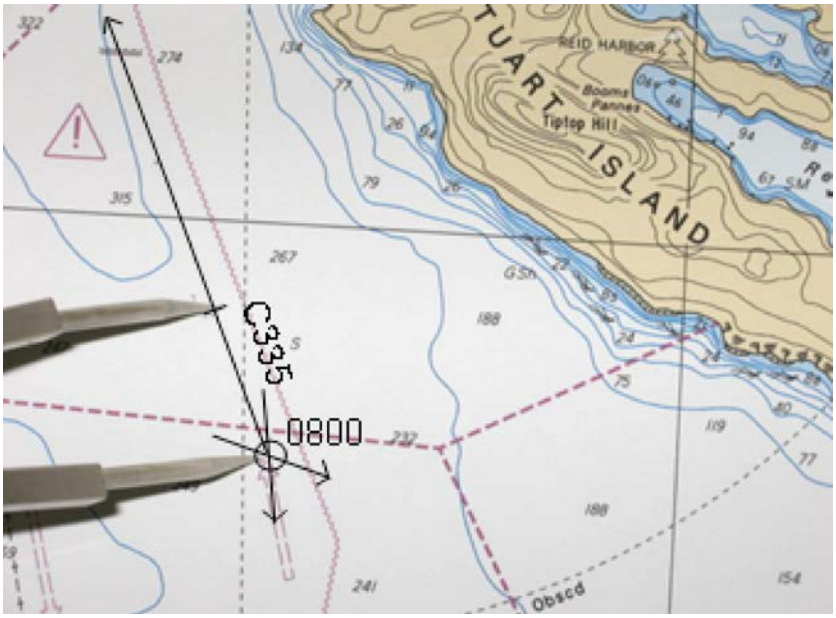
2. Measure 0.5 M of distance on the latitude scale.



Note. Created by Director Cadets 3, 2009, Ottawa, ON: Department of National Defence.

Figure 8 Plotting a DR Step 2

3. Mark the DR position 1 M (6 mins) from the plotted position and then a second DR position 1 M (6 mins) from the first DR.



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Figure 9 Plotting a DR Step 3

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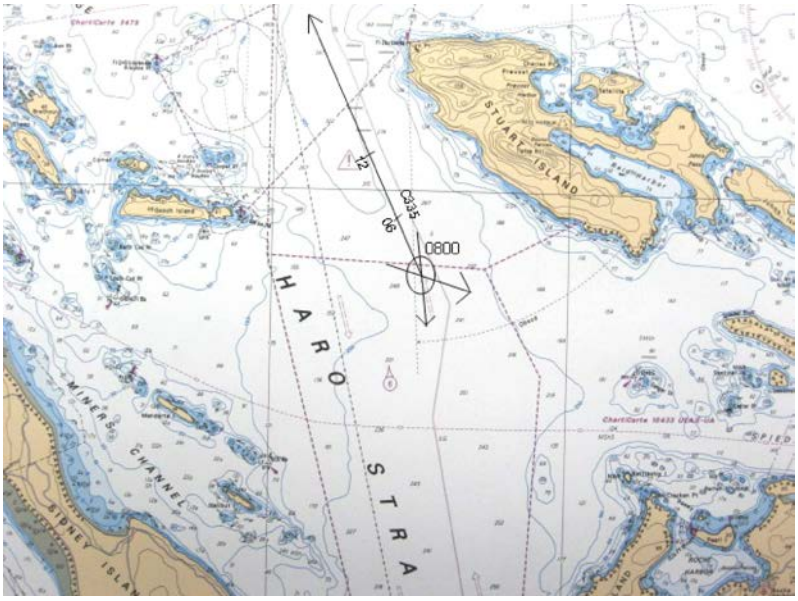


Note. Created by Director Cadets 3, 2009, Ottawa, ON: Department of National Defence.

Figure 10 Plotting a DR Step 3

Labelling

Each DR drawn on a chart must be labelled for future reference. A DR is labelled with the time in minutes (as illustrated in Figure 11).



Note. Created by Director Cadets 3, 2009, Ottawa, ON: Department of National Defence.

Figure 11 Labelling a DR

CONFIRMATION OF TEACHING POINT 3

The cadets' plotting a DR position will serve as the confirmation of this TP.

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Teaching point 4 **Conduct an activity where the cadets will plot a fix.**

Time: 20 min Method: Practical Activity

ACTIVITY

OBJECTIVE

The objective of this activity is to have the cadets practice plotting a fix, to include:

- line of position fix,
- navigational track, and
- dead reckoning.

RESOURCES

- Chart 3441 Haro Strait, Boundary Pass and / et Satellite Channel, and
- Navigation instruments.

ACTIVITY LAYOUT

1. Place *Chart 3441* and navigation instruments on each table.
2. Have the cadets sit in pairs at the tables.

ACTIVITY INSTRUCTIONS

1. On *Chart 3441*, have the cadets plot the following fixes:

0900	Gowlland Pt.	025°	0930	Thieves Bay light	050°
	Wallace Pt.	319°		Beaver Pt. light	310°
	Course	295°		Course	160°
	Speed	10 kns		Speed	10 kns
1000	RHE Russell I.	000°	1030	Pt. Fairfax light	090°
	Kanaka Bluff light	060°		Dock I. light	190°
	Speed	255°		Course	100°
		10 kns		Speed	10 kns

2. Have the cadets determine which of the DRs will take the vessel into danger of running aground.



The fix at 0930 will lead you onto Moresby Island before the DR at 0942.

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If the fixes are plotted correctly, the following symbols should be identified:

0900–Border between Canada and USA.

0930–64 m depth.

1000–Contour line around 34 m hole.

1030–44 m depth.

Check to ensure the cadets are using the correct symbols for a fix:

(1) Arrows away from the object.

(2) Circle around the intersection of the LOPs.

(3) Four digit time next to the fix.

(4) Each fix no larger than the diameter of a quarter.

(5) Each track has two DRs 1 M apart



Ensure the cadets scrub the charts at the end of the activity.

SAFETY

Nil.



Distribute the Plot a Fix handout located at Attachment A to each cadet.

CONFIRMATION OF TEACHING POINT 4

The cadets' completion of the activity will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' plotting a fix during the activity in TP 4 will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK / READING / PRACTICE

Nil.

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METHOD OF EVALUATION

This EO is assessed IAW A-CR-CCP-604/PG-001, *Phase Four Qualification Standard and Plan*, Chapter 3, Annex B, 423 PC.

CLOSING STATEMENT

Plotting a fix with a track and dead reckoning are fundamentals of navigation. Knowing where you are and where you will be at any given time leads to safe navigation.

INSTRUCTOR NOTES / REMARKS

Nil.

REFERENCES

C1-164 C-57-007-002/AF-001 Royal Navy. (1987). *Admiralty manual of navigation* (Vol. 1). (Rev. 1987). London, England: Her Majesty's Stationery Office.

C1-165 ISBN 1-57409-052-6 Larkin, F. (1998). *Basic coastal navigation*. Dobbs Ferry, NY: Sheridan House Inc.

C1-170 ISBN 0-9694958-0-3 Saunders, A. E. (1990). *Small craft piloting & coastal navigation*. Halifax, NS: Binnacle Navigation Instrument.

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PLOT A FIX

TERMINOLOGY

Heading. The direction in which the bow of the small craft is pointing. Headings are expressed in degrees (°)—000 through 360.

Bearing. A line of position sighted from a small craft to another object. Only true bearings can be plotted on charts.

Fix. The intersection of two or more LOPs. While a fix can be made with two LOPs, it is considered more accurate to use three LOPs in every fix. An ideal three-bearing fix should have 60-degree angles between the LOPs.

Line of Position (LOP). Bearings that are plotted on a chart and are measured on the outer ring of the compass rose with a parallel ruler. A position can only be located when two or more LOPs cross.

Navigational Track. A line that shows a projected course from a given position. It is commonly referred to as a track (TR).

LABELLING

When a track is drawn on a chart, it must be labelled for future reference. They are always drawn showing a True heading. To label the course on the track, place the course above the track and toward the point of departure. Label the course using three digits (eg, 084°) preceded with an uppercase C (eg, C 084°)



Note. Created by Director Cadets 3, 2009, Ottawa, ON: Department of National Defence.

Figure A-1 Labelling a Track

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The calculations for plotting a DR are derived through standard speed-time-distance calculations.

A DR is normally made at 6-minute intervals to make calculations simple. A 6-minute interval is equal to 1/10 of an hour; therefore, the distance travelled is 1/10 of your speed.

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A DR position is indicated by placing a small line across the course and the time alongside. A small cross may be used to originate the DR if a fix or estimated position is not available.

Plotting

To plot a DR on a chart, follow these steps:

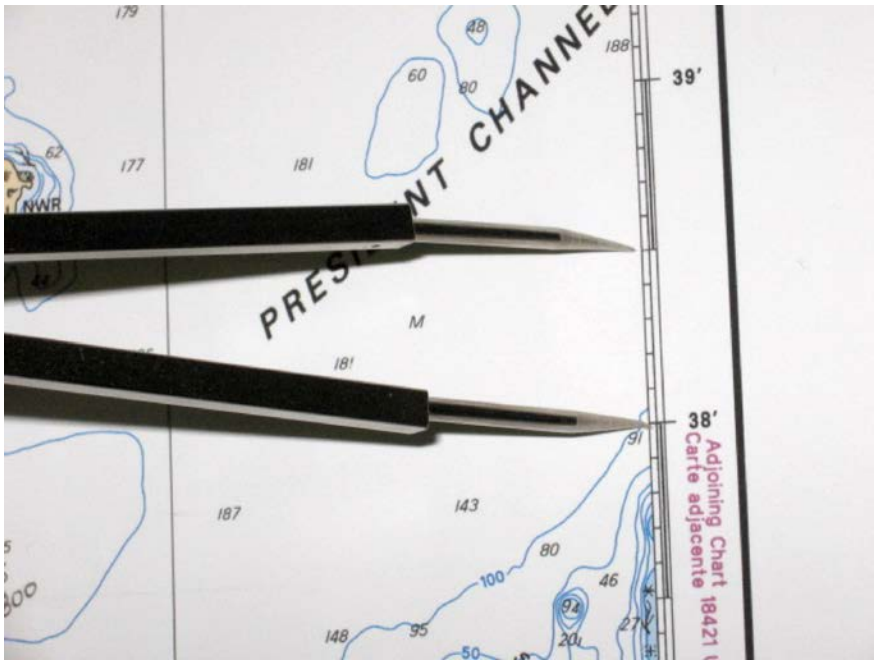
1. Determine distance traveled in 6 minutes.



For this example use a speed of 5 knots (kns) and time of 6 minutes (1/10 hour), equalling a distance of 0.5 nautical mile (M).

2. Measure 0.5 M of distance on the latitude scale.

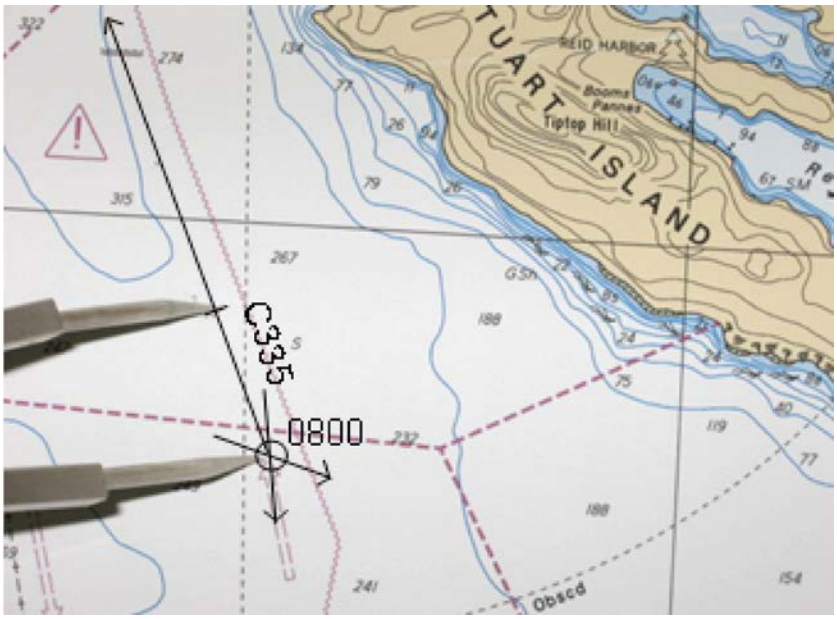
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Figure A-2 Plotting a DR Step 2

3. Mark the DR position 1 M (6 mins) from the plotted position and then a second DR position 1 M (6 mins) from the first DR.



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Figure A-3 Plotting a DR Step 3

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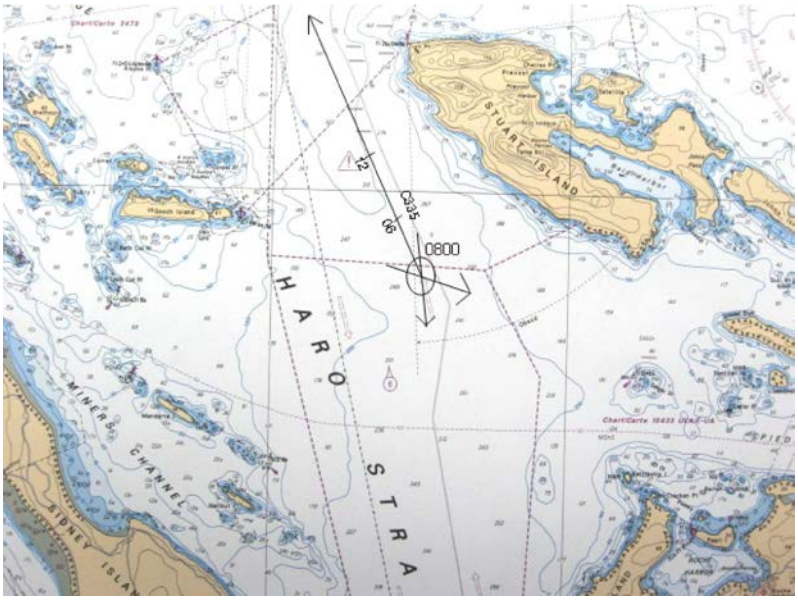


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Figure A-4 Plotting a DR Step 3

Labelling

Each DR drawn on a chart must be labelled for future reference. A DR is labelled with the time in minutes (as illustrated in Figure A-5).



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Figure A-5 Labelling a DR

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