ROYAL CANADIAN SEA CADETS

PHASE FOUR

INSTRUCTIONAL GUIDE

SECTION 3

EO M423.03 – DESCRIBE LATITUDE AND LONGITUDE

Total Time: 120 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.

Review *Chart 3441* and become familiar with the geographical places specified in this lesson.

Photocopy Attachments A and C for each cadet.

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

Distribute one set of navigation instruments, *Symbols Abbreviations Terms (Chart 1)* and *Chart 3441 Haro Strait, Boundary Pass and / et Satellite Channel* to each pair of cadets.

If desired, an alternative chart, such as one of the local area, may be used. If so, modify the lesson to include the information in the given examples to reflect that chart.

PRE-LESSON ASSIGNMENT

Nil.

APPROACH

An interactive lecture was chosen for TP 1 to introduce latitude and longitude to the cadets.

A practical activity was chosen for TP 2 as it is an interactive way to allow cadets to determine the latitude and longitude of given points and locate positions on a chart using different methods. This activity contributes to the development of navigation skills in a fun and challenging way.

A demonstration and performance was chosen for TP 3 as it allows the instructor to explain and demonstrate measuring distances on a chart while providing an opportunity for the cadets to practice the skills under supervision.

INTRODUCTION

REVIEW

Nil.

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OBJECTIVES

By the end of this lesson the cadet shall be expected to describe latitude and longitude and measure distances on a chart.

IMPORTANCE

It is important for cadets to know how to navigate as it introduces them to skills necessary for future training opportunities. Knowledge of this information will ensure that cadets are able to create safe and effective navigation plans for on-water activities.

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Teaching point 1 **Describe latitude and longitude.**

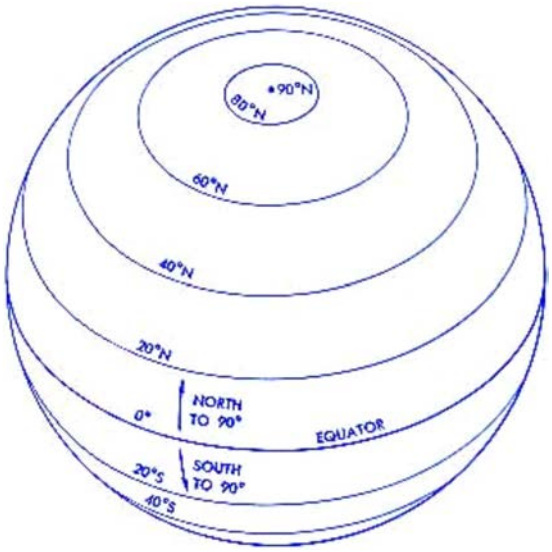
Time: 20 min Method: Interactive Lecture

DESCRIBE LATITUDE AND LONGITUDE

To know precisely a location on the surface of the earth, a simple system of reference points, based on a set of lattice lines covering the globe was invented.

This system of lattice lines can be described as:

Parallels of latitude. These lines run parallel to the equator and are measured from 000 degrees at the equator to 90 degrees north or south at the poles. Since these lines are parallel, they are used to measure distance on a chart.



Note. From "Latitude and Longitude: The Geographic Grid (Introduction)" by Dr. Rodrigue, 2000, Retrieved November 13, 2008, from http://homepages.ius.edu/PGALVIN/lat_long/Geographic%20Grid.htm

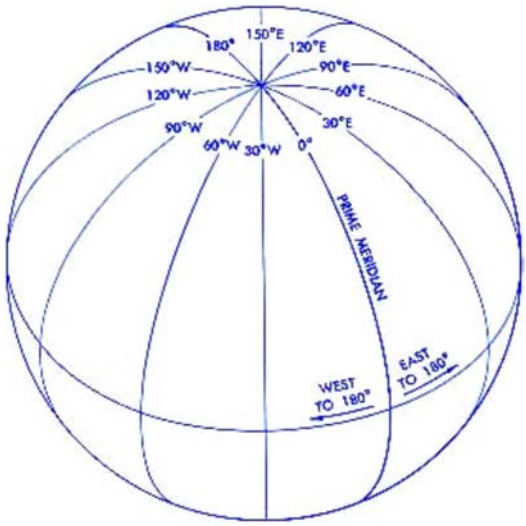
Figure 1 Parallels of Latitude



Memory Aid: "Lat. is flat."

Meridians of longitude. Lines that run perpendicular to the equator and converge or meet at the poles (as illustrated in Figure 2). These lines are measured 180 degrees east or west from the Prime Meridian (000 degrees), which runs through Greenwich, England. These lines meet at a point called the International Date Line (180 degrees) on the other side of the globe from the Prime Meridian. Since the meridians of longitude converge at the poles, they cannot be used for measuring distance on a chart.

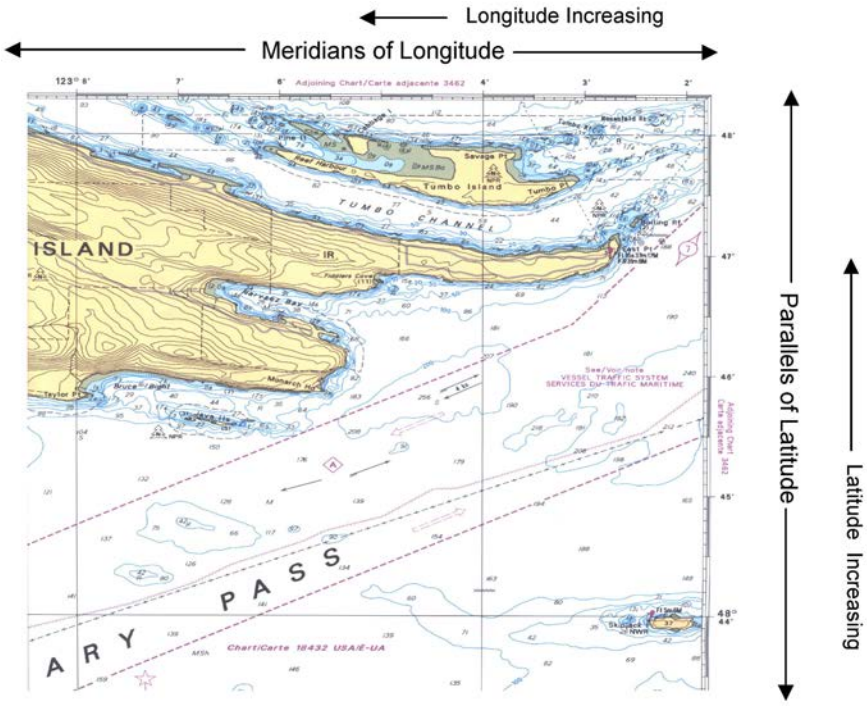
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Note. From "Latitude and Longitude: The Geographic Grid (Introduction)" by Dr. Rodrigue, 2000, Retrieved November 13, 2008, from http://homepages.ius.edu/PGALVIN/lat_long/Geographic%20Grid.htm

Figure 2 Meridians of Longitude

Any point on the earth's surface can be found by referencing the corresponding latitude and longitude. On charts, the latitude scales are found on the left and right sides while the longitude scales are found on the top and bottom.



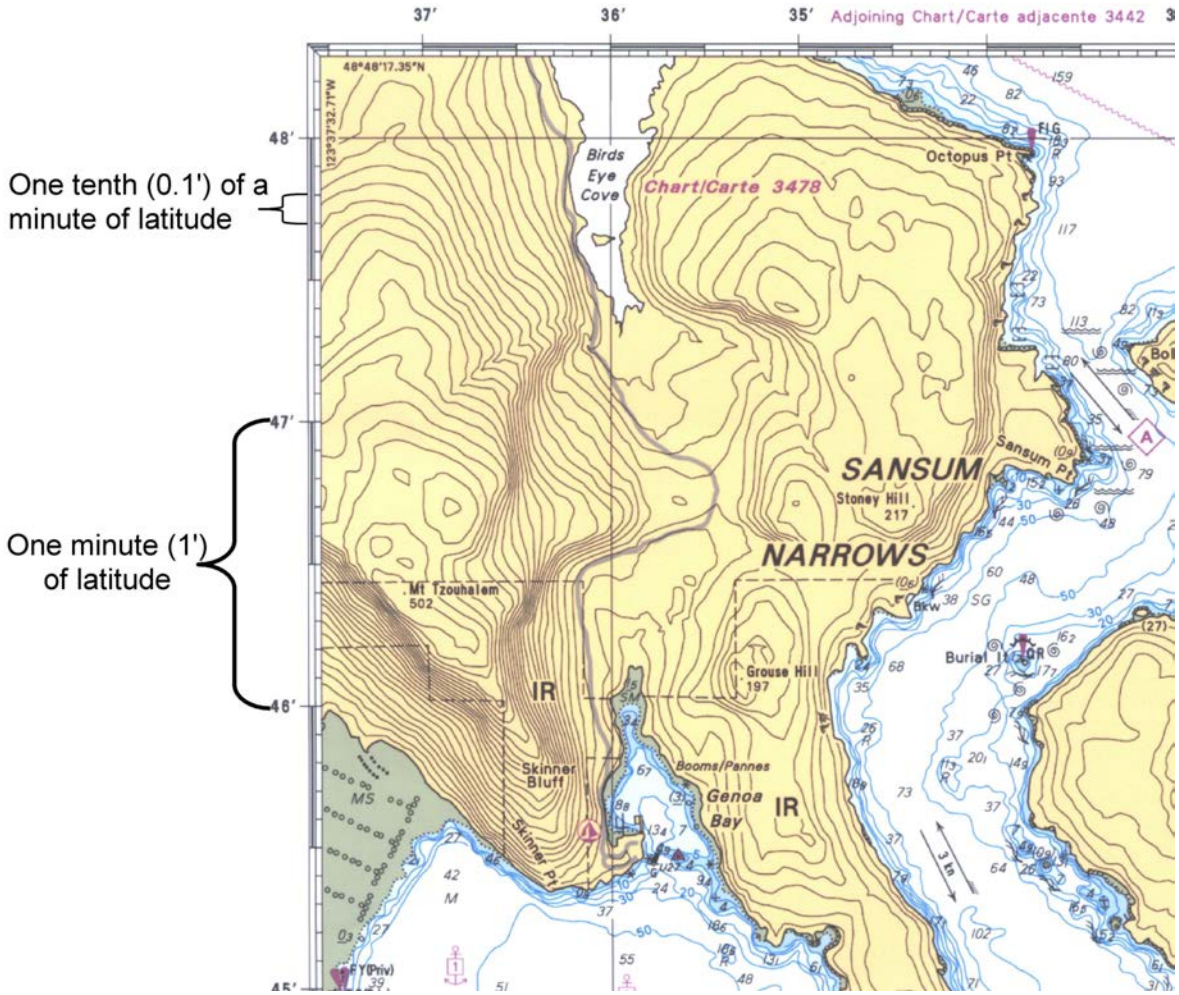
Note. From Chart 3441, Haro Strait, Boundary pass and / et Satellite Channel, 2005, ON: Canadian Hydrographic Service, Ottawa.

Figure 3 Latitude and Longitude

Chart 3441 depicts an area of British Columbia. Since this is in North America, the numbers on the latitude scale increase from the bottom of the chart to the top or as you move north. The numbers on the longitude scale increase from right to left as you move west (as illustrated in Figure 3).

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Latitude and longitude are measured in degrees, minutes and seconds. A degree is divided into 60 minutes and each minute can be divided into 60 seconds. However, when referring to positions on a chart, it is more common to use degrees, minutes and tenths of a minute.



Note. From Chart 3441, Haro Strait, Boundary pass and / et Satellite Channel, 2005, Ottawa, ON: Canadian Hydrographic Service.

Figure 4 Minutes and Tenths of Minutes

When writing the latitude and longitude of a position, latitude is always written above longitude or written first when written on the same line.

Example: The position of Senanus I. light can be written as:

1. 48° 35.55' N 123° 29.20' W or
2. 48° 35.55'N
   123° 29.20' W

Degrees of longitude are always written in three digits (eg 090°E). If the longitude is less than 100 degrees, then a 0 is placed in front to differentiate between latitude and longitude.

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CONFIRMATION OF TEACHING POINT 1

QUESTIONS:

Q1. Which lines are parallel to the equator and are measured from the equator to the poles?

Q2. What is the proper name for 000 degrees longitude?

Q3. What is the most common way of writing latitude or longitude?

ANTICIPATED ANSWERS:

A1. Parallels of latitude.

A2. The Prime Meridian.

A3. In degrees, minutes and tenths of minutes.

Teaching point 2 — **Conduct an activity where the cadets will use latitude and longitude to determine a position on a chart.**

Time: 50 min — Method: Practical Activity



The following information should be presented to the cadets prior to the activity.

With *Chart 3441*, determine the latitude and longitude of Separation Pt. light.

Two methods of finding the latitudes and longitudes are given. The cadets may use either method.

Determining Latitude (Method One)

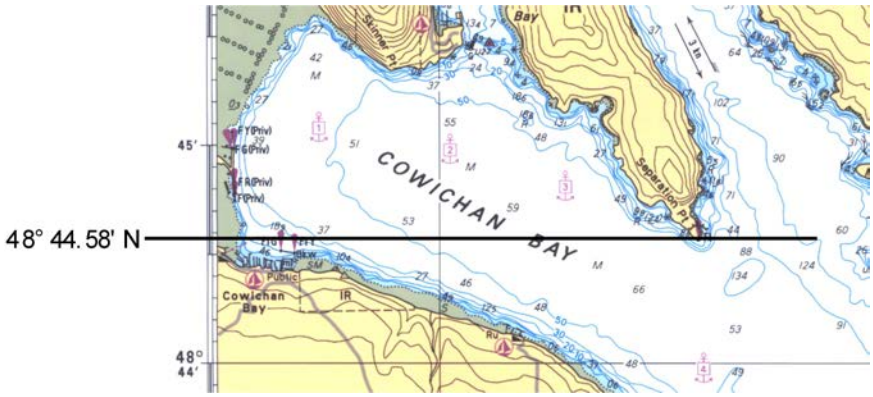
The technique for using a parallel ruler to find the latitude is as follows:

1. Align the edge of the parallel ruler along the nearest parallel of latitude on the chart. In this example, the ruler must be placed so that its left end intersects the latitude scale on the left side of the chart.

2. Roll the ruler to the light's symbol so that the black dot of the symbol falls along the edge of the ruler. Using the ruler as a guide, draw a light line on the latitude scale where the ruler intersects the scale.

3. Read and record the latitude of the object (in this case the latitude is 48° 44.58' N).

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Note. Created by Director Cadets 3, 2008, Ottawa, ON: Department of Defence.

Figure 5 Measuring Latitude

Determining Latitude (Method Two)

The technique of determining latitude using a set of dividers is as follows:

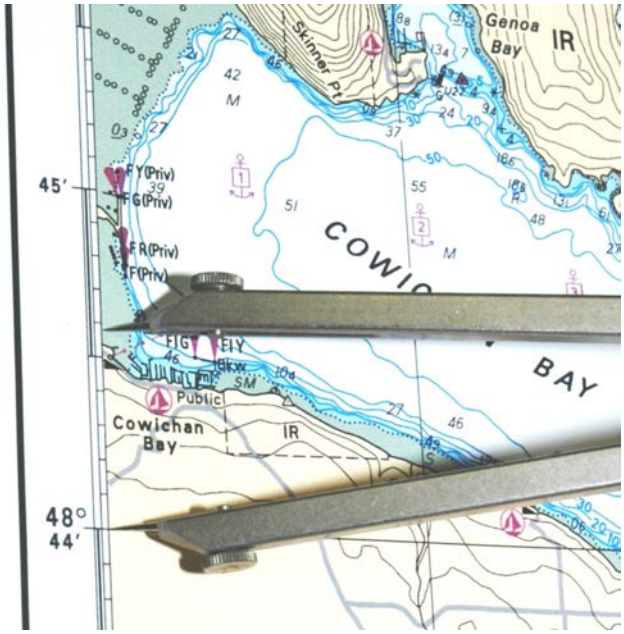
1. Align the edge of the parallel ruler with a meridian of longitude nearest Separation Pt.

2. Roll the ruler to the symbol so that the black dot at the bottom falls along the edge of the ruler.

3. Using the edge of the ruler as a guide, measure the distance from the symbol to the nearest parallel of latitude (in this case it is 48° 44' N).

4. Move the dividers to the latitude scale on the left side of the chart. Place one point on the same parallel (48° 44' N) and measure up the scale (as Separation Pt. is north of this parallel).

5. Read and record the latitude of the light (48° 44.58' N).



Note. Created by Director Cadets 3, 2008, Ottawa, ON: Department of National Defence.

Figure 6 Determining Latitude Step 4

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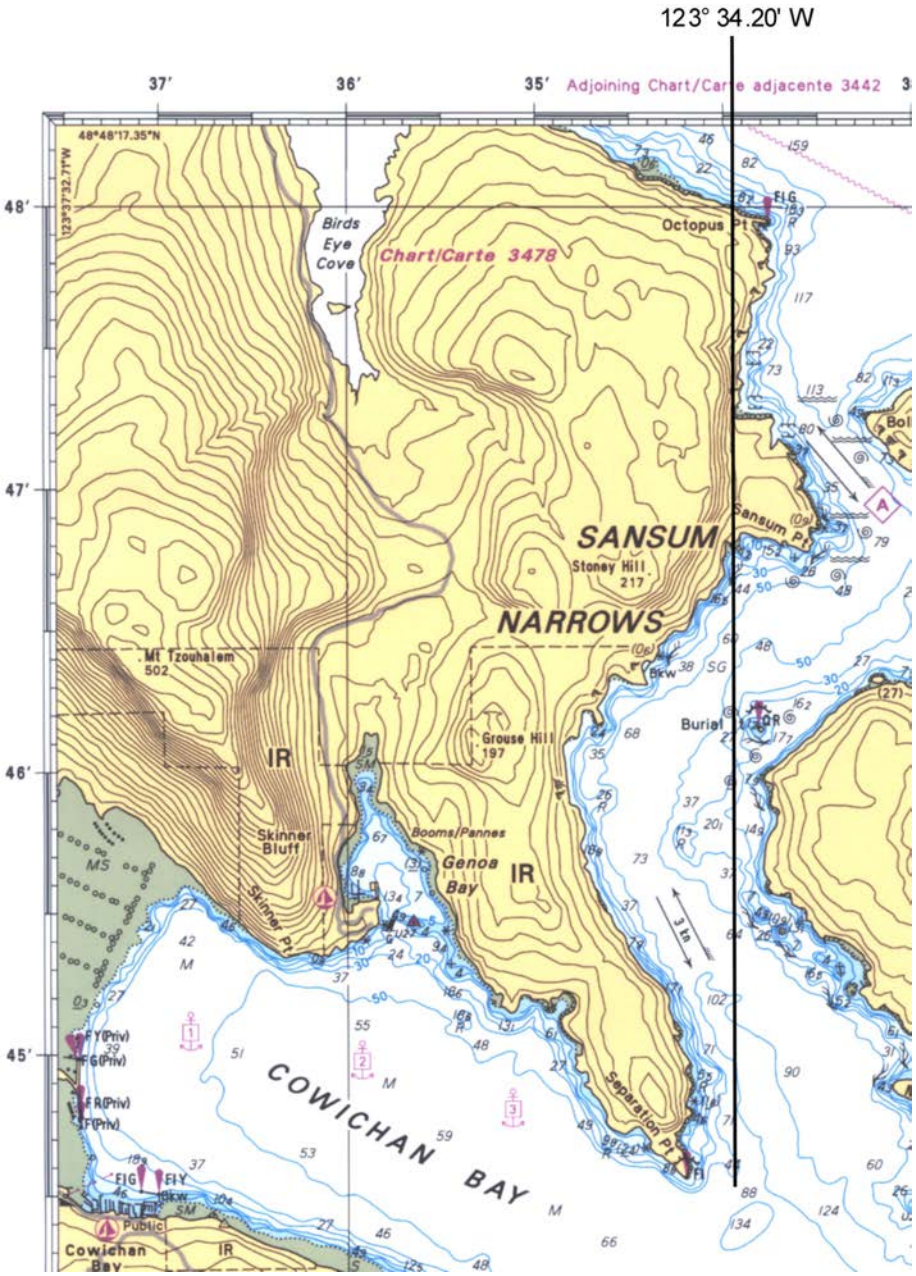
Determining Longitude (Method One)

The technique of determining the longitude of a point using a parallel ruler is as follows:

1. Place the edge of the parallel ruler along a meridian of longitude or along the longitude scale on the left side of the chart.

2. Roll the ruler to the light symbol so that the black dot of the symbol falls along the edge of the ruler. Using the ruler as a guide, draw a light line on the longitude scale at the top of the chart where the ruler intersects it.

3. Read and record the longitude of the object (in this case the longitude is 123° 34.20' W).



Note. Created by Director Cadets 3, 2008, Ottawa, ON: Department of Defence.

Figure 7 Determining Longitude

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Determining Longitude (Method Two)

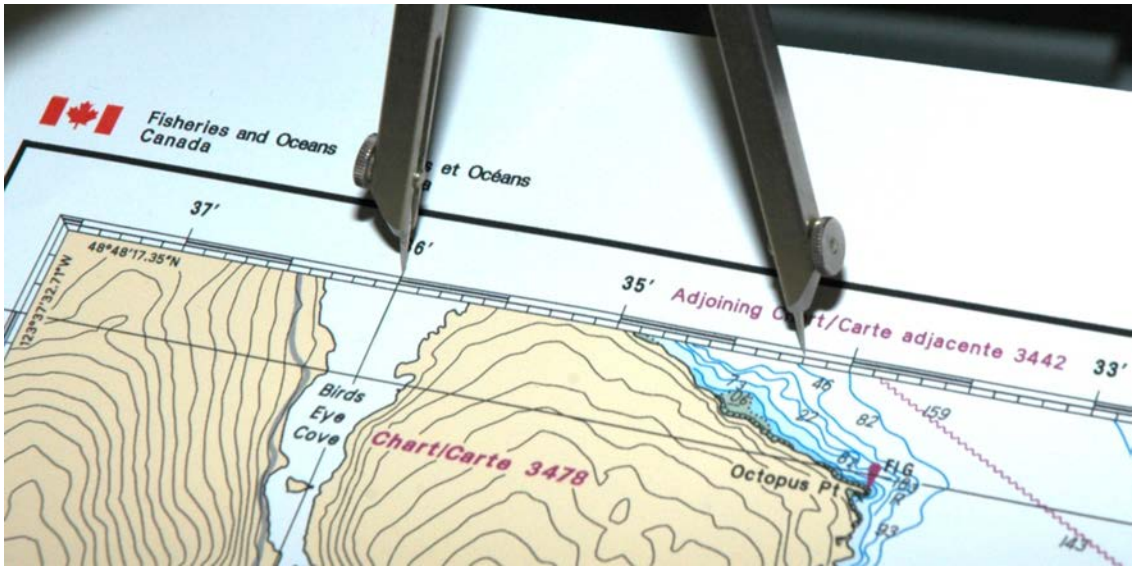
The technique of determining longitude using a set of dividers for the same point is as follows:

1. Align the edge of the parallel ruler with the parallel of latitude nearest Separation Pt.

2. Roll the ruler to the symbol so that the black dot at the bottom falls along the edge of the ruler.

3. Using the edge of the ruler as a guide, measure the distance from the symbol to the nearest meridian of longitude (in this case it is 123° 36' W).

4. Move the dividers to the longitude scale on the top of the chart. Place one point on the same meridian (123° 36' W) and measure along the scale to the right (as Separation Pt. is east of this meridian).



Note. Created by Director Cadets 3, 2008, Ottawa, ON: Department of National Defence.

Figure 8 Determining Longitude Step 4

5. Read and record the longitude of the light (123° 34.20' N).

Time: 20 min

OBJECTIVE

The objective of this activity is to have the cadets determine latitude and longitude of given points.

RESOURCES

- Navigation Instruments,
- *Chart 3441 Haro Strait, Boundary Pass and / et Satellite Channel*,
- Latitude and Longitude Worksheet located at Attachment A, and
- Position Worksheet located at Attachment C.

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ACTIVITY LAYOUT

1. Place *Chart 3441* and navigation instruments on each table.

2. Have cadets sit in pairs at the tables.

ACTIVITY INSTRUCTIONS

1. Distribute the worksheets to each cadet.

2. Have the cadets find the latitude and longitude of each point listed on the worksheets. The time allocated is 15 minutes.

3. Once the worksheets are complete, correct the cadets' answers using the answer keys located at Attachments B and D.

SAFETY

Nil.

CONFIRMATION OF TEACHING POINT 2

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

Teaching point 3 **Explain, demonstrate and have the cadets measure distances on a chart.**

Time: 40 min Method: Demonstration and Performance



The following information should be presented to the cadets prior to demonstrating the techniques for measuring distances.

MEASURE DISTANCE ON A CHART

In marine navigation the term “mile” does not refer to the land or statute mile, it refers to the nautical mile.

A nautical mile (M) measures 1853 m or 2000 yards.

A statute mile (mi) measures 1609.3 m or 1760 yards.

When measuring distance on Mercator charts, always measure from the latitude scale. The longitude scale cannot be used as the meridians of longitude converge at the poles. Therefore they are not truly parallel.

Meridians of longitude only project distance accurately at one location on the globe—the equator.

As mentioned in TP 2, the latitude scale is divided into degrees, minutes and seconds. However, when measuring distances on a chart, it is more common to use minutes and tenths of a minute.

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Latitude can be divided into:

- One degree of latitude equals 60 minutes.
- One minute of latitude equals 1 M.
- One minute can be further divided into tenths (as illustrated in Figure 4).



One M is 2000 yards long. Therefore 1/10th of a M is equal to 200 yards or one cable. In navigation, it is common for distance to be referred to in cables up to 1 M.

Technique for Measuring a Short Distance on a Chart

Distance is measured on charts using dividers. A good rule of thumb for using dividers is to keep the angle between the legs less than 60 degrees. If the dividers are opened more than 60 degrees, the accuracy of the measurement is lessened.

Follow these steps for measuring short distances on a chart:

1. Set one point of the dividers at the first point and the other at the second point. Ensure the dividers are not opened more than 60 degrees.

2. Being careful not to disturb the position of the dividers, move them to the latitude scale on either side of the chart.

3. Place one point on a whole minute of latitude and let the other point fall along the scale line.

4. Read the distance in nautical miles and tenths of miles.

Example of measuring a short distance:



Demonstrate and have the cadets perform each of the following steps.

Arachne Rf. is located south of Moresby Island in Prevost Passage.

Pt. Fairfax is located on the south end on Moresby Island.

To measure the distance between Arachne Rf. light and Pt. Fairfax light:

1. Place one point on the symbol for Arachne Rf. light.

2. Open the dividers until the second point is on the symbol for Pt. Fairfax light.

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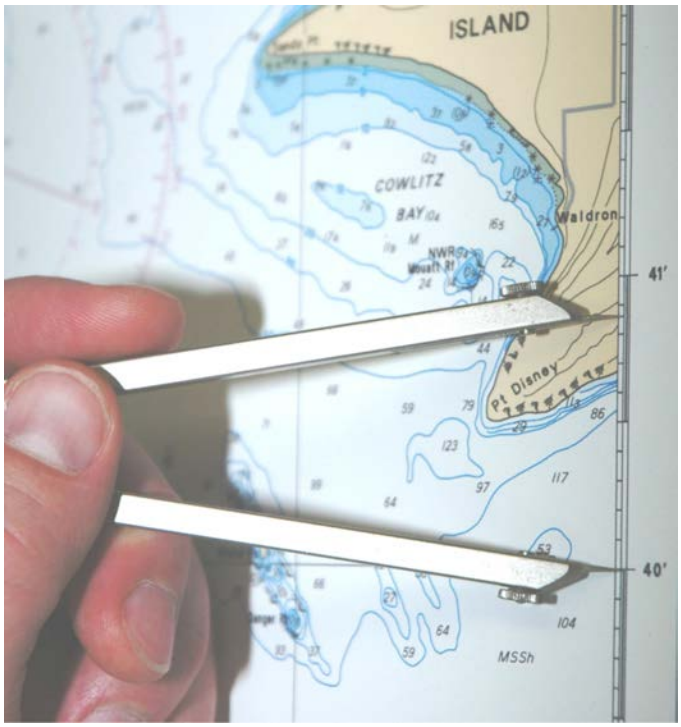
Figure 9 Measuring the Distance Between Arachne Rf. and Pt. Fairfax Step 2

3. Being careful not to disturb the position of the dividers, move them to the latitude scale on the right side of the chart.

4. Place one point on the line marking 48° 40' N.

5. Place the second point on the scale above this line and count the number of marks between the points in this example the distance is 0.86 M.

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Figure 10 Measuring the Distance Between Arachne Rf. and Pt. Fairfax Step 5



When measuring from symbols for lights, the points of the dividers are placed on the black dot at the bottom of the symbol.

Technique for Measuring a Longer Distance on a Chart

A long distance is defined as a distance that cannot be measured within the width of a pair of dividers opened to no more than 60 degrees.

Follow these steps for measuring long distances on a chart:

1. Preset your dividers to a whole mile or a multiple-mile increment.

2. Align one edge of the parallel ruler between the two points.



A parallel ruler is used to align the two points to assist the cadets with walking the dividers along a straight line. With practice, the ruler will no longer be required.

3. Place one point of the dividers at the first point and lay the other along the parallel ruler toward the second point.

4. Being careful not to disturb the position of the dividers, swing or walk them along the ruler to the second point.

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5. Count the number of times the dividers swing or walk along the ruler without passing the second point.

If the second point has not been reached but is within the distance the dividers have been set measure the remaining distance as follows:

6. Without removing the point of the dividers on the chart, compress the other arm of the dividers carefully and place its point on the destination.

7. Being careful not to disturb the opening, move your dividers to the latitude scale and measure the distance. Add the number of swings from Step 5 and the distance in Step 6 to get the total distance.

Example of measuring a long distance:



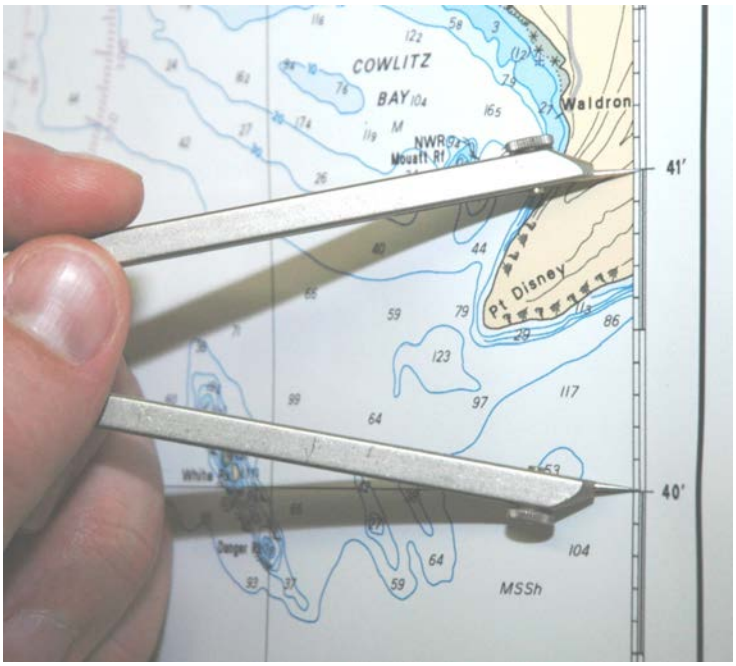
Demonstrate and have the cadets perform each of the following steps.

Sandy Pt. is located on Waldron Island on the west side of the chart.

Gowlland Pt. is located on the south end of North Pender Island.

To measure the distance between Sandy Pt. and Gowlland Pt. light:

1. Measure 1 M from the latitude scale with the dividers.



Note. Created by Director Cadets 3, 2008, Ottawa, ON: Department of National Defence.

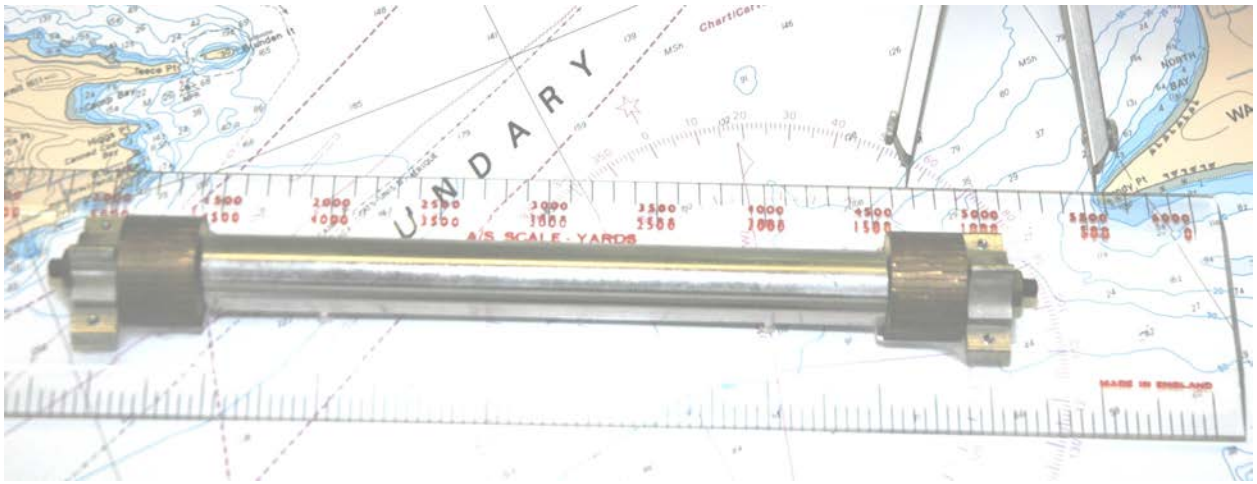
Figure 11 Measuring the Distance Between Gowlland Pt. and Sandy Pt. Step 1

2. Align the parallel ruler between Sandy Pt. and Gowlland Pt. light.

3. Place one point of the dividers on the outer edge of Sandy Pt.

4. Lay the dividers along the edge of the parallel ruler.

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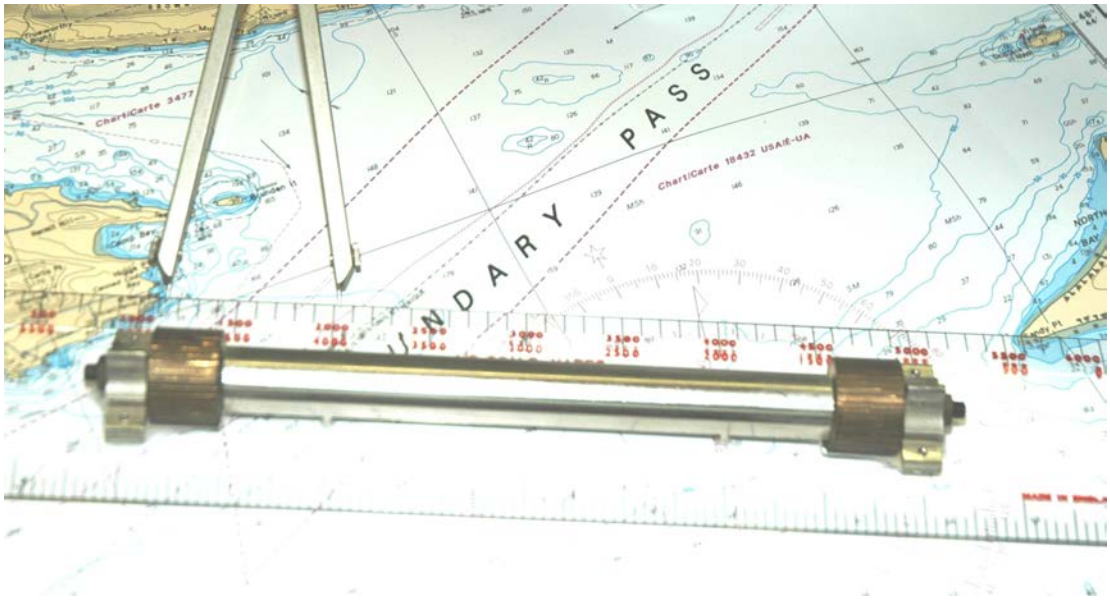
Note. Created by Director Cadets 3, 2008, Ottawa, ON: Department of National Defence.

Figure 12 Measuring the Distance Between Gowlland Pt. and Sandy Pt. Steps 3 and 4

5. Being careful not to disturb the position of the dividers, swing or walk them along the ruler toward Gowlland Pt.

6. Count the number of swings made with the dividers.

7. From Sandy Pt. to Gowlland Pt. it takes five swings. Since the dividers were set to 1 M in Step 1, the distance is 5 M.



Note. Created by Director Cadets 3, 2008, Ottawa, ON: Department of National Defence.

Figure 13 Measuring the Distance Between Gowlland Pt. and Sandy Pt. Step 5

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Have the cadets practice measuring distances between the following points:

(1) Kellet Bluff Lt. to Wymond Pt. = 2.7M

(2) Separation Pt. to Burial Is = 1.6M

(3) Patricia Bay Jetty to Mill Bay Jetty = 3.95M

(4) Thieves Bay light to Kellett Bluff light = 11.88M

CONFIRMATION OF TEACHING POINT 3

QUESTIONS:

Q1. What is the maximum opening used on dividers when measuring distances?

Q2. What does the term mile refer to in navigation?

Q3. How long is a nautical mile in yards?

ANTICIPATED ANSWERS:

A1. 60 degrees.

A2. The nautical mile.

A3. 2000.

END OF LESSON CONFIRMATION

The cadets' completion of the worksheets will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK / READING / PRACTICE

Nil.

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

Latitude and longitude are the fundamental aspects of chartwork. Knowing how to use latitude and longitude to plot positions and to measure distance will lead to a safe passage plan.

INSTRUCTOR NOTES / REMARKS

Nil.

REFERENCES

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

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LATITUDE AND LONGITUDE WORKSHEET

Object	Latitude Longitude	Symbol
0800 Voyage begins	48° 47.11' N 123° 20.7' W	
0830	48° 43.55' N 123° 17.51' W	
0900	48° 42.21' N 123° 12.6' W	
0930	48° 41.76' N 123° 07.43' W	
1000	48° 38.7' N 123° 05.98' W	
1030 Voyage ends	48° 36.76' N 123° 05.84' W	

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LATITUDE AND LONGITUDE ANSWER KEY

Object	Latitude Longitude	Symbol
0800 Voyage begins	48° 47.11' N 123° 20.7' W	Ferry Track
0830	48° 43.55' N 123° 17.51' W	100 m Contour
0900	48° 42.21' N 123° 12.6' W	Special Notes for Turn Point Special Operating Area
0930	48° 41.76' N 123° 07.43' W	Centre of Compass Rose
1000	48° 38.7' N 123° 05.98' W	Eddy or Whirlpool
1030 Voyage ends	48° 36.76' N 123° 05.84' W	Rock that dries 0.9 m above Chart Datum

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POSITION WORKSHEET

Object	Description	Latitude Longitude
Dock I. light	On west side of Dock I. located east of Sidney Harbour.	
Repulse Rk. day mark	West of Elbow Pt. in Squally Reach (Lower left corner of the chart).	
Wreck located in Reid Harbour	West side of Stuart Island in Haro Strait.	
Hay Pt. light	In Bedwell Harbour on South Pender Island.	
Fir Cone Pt. light	North west end of Coal Island in Colbourne Passage.	
Sidney Island light	Small islet northwest of Sidney Island. East of Sidney.	

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POSITION ANSWER KEY

Object	Description	Latitude Longitude
Dock I. light	On west side of Dock I. located east of Sidney Harbour.	48° 40.29' N 123° 21.40' W
Repulse Rk. day mark	West of Elbow Pt. in Squally Reach (Lower left corner of the chart).	48° 32.77' N 123° 32.39' W
Wreck located in Reid Harbour	West side of Stuart Island in Haro Strait.	48° 40.20' N 123° 11.27' W
Hay Pt. light	In Bedwell Harbour on South Pender Island.	48° 44.69' N 123° 23.30' W
Fir Cone Pt. light	Northwest end of Coal Island in Colbourne Passage.	48° 41.48' N 123° 23.30' W
Sidney Island light	Small islet northwest of Sidney Island. East of Sidney.	48° 39.22' N 123° 20.75' W

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