ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL FOUR

INSTRUCTIONAL GUIDE

SECTION 4

EO C437.02 – USE A VISUAL FLIGHT RULES (VFR) NAVIGATION CHART (VNC)

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-804/PG-001, *Proficiency Level 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.

Select coordinates of landmarks on a local VNC.

PRE-LESSON ASSIGNMENT

Nil.

APPROACH

An interactive lecture was chosen for TPs 1 and 2 to clarify, emphasize, and summarize types of projections and aeronautical charts.

A demonstration and performance was chosen for TPs 3–6 as it allows the instructor to explain and demonstrate using a VNC while providing an opportunity for the cadets to practice using a VNC under supervision.

INTRODUCTION

REVIEW

Nil.

OBJECTIVES

By the end of this lesson the cadet shall have used a VNC.

IMPORTANCE

It is important for cadets to use a VNC as it is a skill required for flight planning and en route navigation. The VNC is the principal chart used in flight at low altitudes and slow speeds. Many of the skills used with this chart are transferable to other types of maps both in the air and on the ground. Knowledge of this material is essential for future aviation training and potential instructional duties at the squadron.

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Teaching point 1 **Explain types of projections.**

Time: 5 min Method: Interactive Lecture

Earth is a sphere, so its surface cannot be represented accurately on a flat plane. Therefore, a map shows a portion of the Earth's surface with some distortion. There are four basic elements in map construction:

- areas,
- shapes,
- bearings, and
- distances.

Depending on the particular purpose of the map, one or more of these elements is preserved with minimal distortion, with the most distortion in the remaining elements.



Using the globe and the sheet of construction paper, demonstrate the impossibility of wrapping the sheet around the globe smoothly to create a chart.

The two principal types of chart projections used in air navigation charts are:

- the Lambert Conformal Conic Projection, and
- the Transverse Mercator Projection.

THE LAMBERT CONFORMAL CONIC PROJECTION



Using the globe and the sheet of construction paper, demonstrate superimposing a cone over the surface of the globe.

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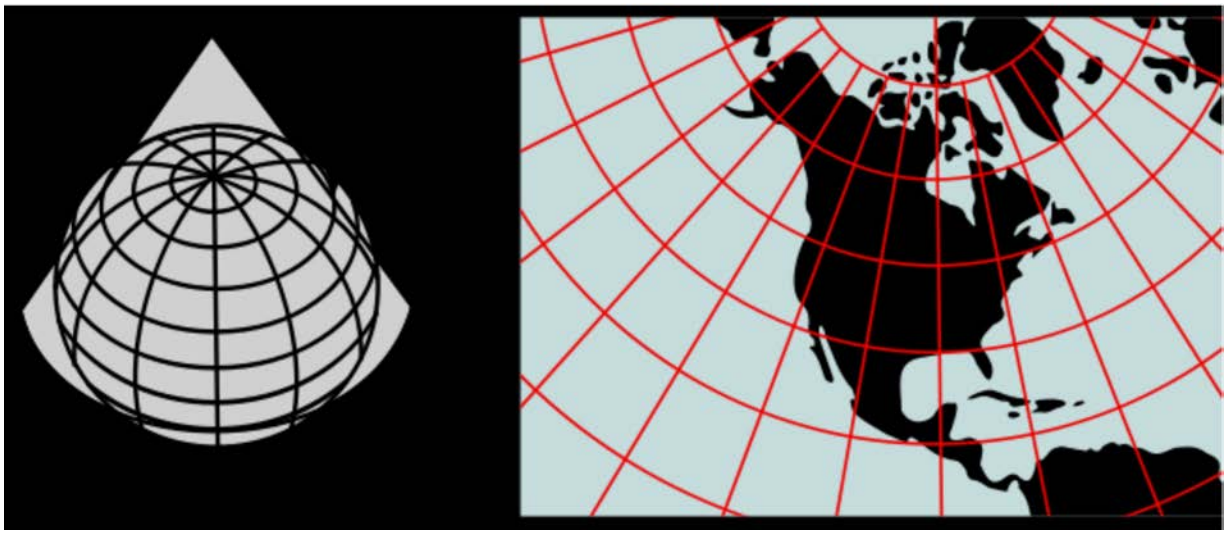

Note. From "Image: Lambert Conformal Conic", Wikimedia. Retrieved November 27, 2008, from http://commons.wikimedia.org/wiki/Image:Lambert_conformal_conic.svg

Figure 1 Lambert Conformal Conic Projection

The properties of the Lambert Conformal Conic Projection are:

- Meridians of longitude are slight curves or straight lines converging toward the nearer pole.
- Parallels of latitude are curves which are concave toward the nearer pole.
- The scale of distance is uniform throughout the entire chart.
- A straight line drawn between any two points on the chart represents an arc of a great circle.

VNCs and World Aeronautical Charts (WACs) are examples of Lambert Conformal Conic Projections.

The Transverse Mercator Projection. Applies the Mercator technique by rotating the cylinder 90 degrees so the point of tangency is a meridian of longitude rather than the equator. This projection is accurate in depicting scale, especially on charts covering a relatively small geographical area. The VFR Terminal Area (VTA) Charts are examples of Transverse Mercator Projections.



Using the globe and the sheet of flip chart paper, demonstrate wrapping a cylinder around the globe with its point of tangency at a meridian of longitude.

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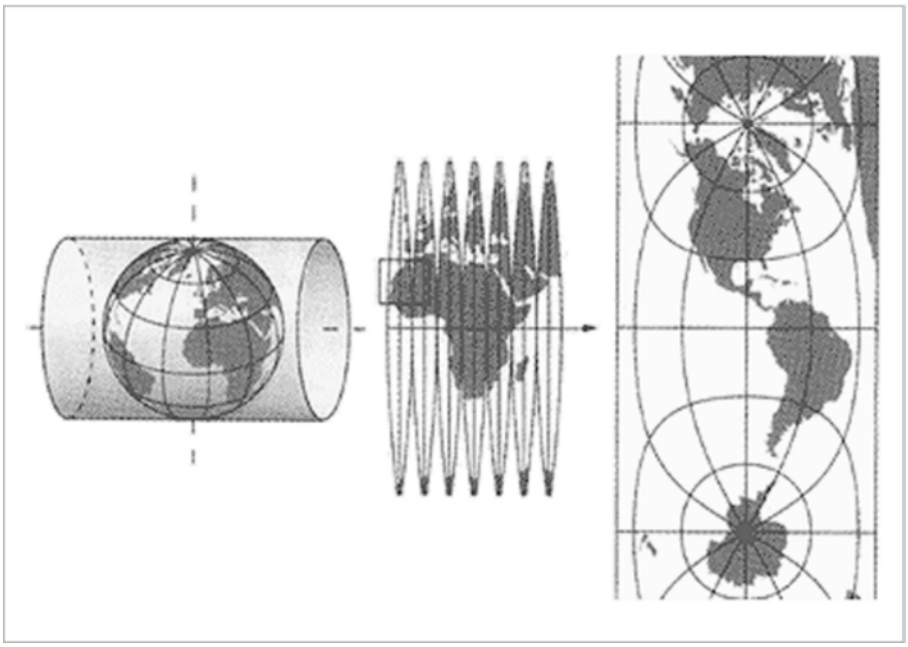

Note. From "Swiss Map Projections", 2008, Federal Office of Topography Swisstopo. Retrieved November 27, 2008, from http://www.swisstopo.admin.ch/internet/swisstopo/en/home/topics/survey/sys/refsys/projections.html

Figure 2 Transverse Mercator Projection

CONFIRMATION OF TEACHING POINT 1

QUESTIONS:

Q1. What does a straight line drawn between any two points on a Lambert Conformal Conic Projection represent?

Q2. What are two examples of Lambert Conformal Conic Projections?

Q3. What is an example of a Transverse Mercator Projection?

ANTICIPATED ANSWERS:

A1. An arc of a great circle.

A2. VNCs and WACs.

A3. A VTA Chart is an example of a Transverse Mercator Projection.

Teaching point 2 **Describe types of aeronautical charts.**

Time: 5 min Method: Interactive Lecture

VFR NAVIGATION CHART (VNC)



Show the cadets a VNC.

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VNCs are designed primarily for visual navigation at low altitudes and slow speeds. Each chart is identified by the name of a principal landmark on the chart (eg, Toronto, Winnipeg, Gander). The scale of the chart is 1 : 500 000 or about one inch to eight miles.

WORLD AERONAUTICAL CHART (WAC)



Show the cadets a WAC.

WACs are designed primarily for visual navigation at higher altitudes and greater speeds. Each chart depicts a sizeable portion of the country's geographical area—eighteen charts cover Canada. Each chart is identified by a letter and a number. For example, E17 covers the area from Marathon, Ont., west to Brandon, Man., and from the 48th parallel north to Thompson, Man. The scale of the chart is 1 : 1 000 000 or about one inch to 16 miles.

VFR TERMINAL AREA (VTA) CHART



Show the cadets a VTA Chart.

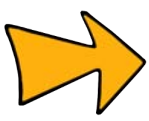
VTA Charts are large scale charts (1 : 250 000) published for airports where there is a high volume of air traffic and where there is usually a mix of controlled airspace. Radio communication information and other information that is necessary for conducting flight through the area are given on the chart.

ENROUTE CHART



Show the cadets an Enroute Chart.

Enroute Charts provide information for radio navigation over designated airways systems. Enroute Charts do not portray any cities, towns, or topographical features. They depict all radio navigation aids, including airways, beacons, reporting points, and communication frequencies. Examples of Enroute Charts are Enroute Low Altitude Charts, Enroute High Altitude Charts, and Terminal Area Charts.



Canada Flight Supplement (CFS). A joint civil / military flight information publication and a supplement of the Aeronautical Information Publication (AIP). It contains information on Canadian and North Atlantic aerodromes. The CFS is designed to be used in conjunction with all Canadian charts and should be carried by every pilot departing on a flight. It is revised and reissued every 56 days.

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CONFIRMATION OF TEACHING POINT 2

QUESTIONS:

Q1. What is the scale of a VNC?

Q2. What are WACs primarily used for?

Q3. What are Enroute Charts used for?

ANTICIPATED ANSWERS:

A1. 1 : 500 000.

A2. Visual navigation at higher altitudes and greater speeds.

A3. Radio navigation.

Teaching point 3 — **Explain, demonstrate and have the cadets practice locating landmarks on a VNC using latitude and longitude.**

Time: 15 min — Method: Demonstration and Performance



For this TP, it is recommended that the instruction take the following format:

(1) Explain and demonstrate the skill while the cadets observe.

(2) Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.

(3) Monitor the cadets' performance as they practice the skill.

Note: Assistant instructors may be used to monitor the cadets' performance.

USE LATITUDE AND LONGITUDE TO LOCATE LANDMARKS ON A VNC



The cadets were introduced to latitude and longitude in EO M437.01 (Define Air Navigation Terms). They were asked to find the coordinates of a major airport. In this TP, the cadets are given the coordinates and asked to find the landmarks. They should require minimal instruction as it is a review.



Give the cadets coordinates of several landmarks on a local VNC and have them identify the landmarks.

For example, 43°59'N, 80°17'W is a soaring site (Grand Valley).

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Note. From Toronto VFR Navigation Chart, by Geomatics Canada, 2001, Ottawa, ON: Geomatics Canada Department of Natural Resources. Copyright 2001 by NAV CANADA and Her Majesty the Queen in Right of Canada.

Figure 3 Example of a VNC

CONFIRMATION OF TEACHING POINT 3

The cadets' participation in locating landmarks on a VNC using latitude and longitude will serve as the confirmation of this TP.

Teaching point 4 **Explain, demonstrate and have the cadets practice plotting tracks between landmarks on a VNC.**

Time: 5 min Method: Demonstration and Performance



For this TP, it is recommended that the instruction take the following format:

(1) Explain and demonstrate the skill while the cadets observe.

(2) Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.

(3) Monitor the cadets' performance as they practice the skill.

Note: Assistant instructors may be used to monitor the cadets' performance.

PLOT A TRACK BETWEEN LANDMARKS ON A VNC

To plot a track between landmarks on a VNC:

1. Identify the landmarks.
2. Use a ruler to draw a straight line between the landmarks.

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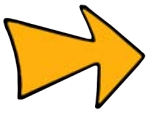
Give the cadets coordinates of a departure aerodrome and a destination aerodrome on a local VNC. Have them plot a track.



More advanced flight plan plotting (eg, 10-degree drift lines) will be taught during future aviation training.

CONFIRMATION OF TEACHING POINT 4

The cadets' participation in plotting tracks between landmarks on a VNC will serve as the confirmation of this TP.

Teaching point 5 **Explain, demonstrate and have the cadets practice measuring distances on a VNC.**

Time: 10 min Method: Demonstration and Performance



For this TP, it is recommended that the instruction take the following format:

(1) Explain and demonstrate the skill while the cadets observe.

(2) Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.

(3) Monitor the cadets' performance as they practice the skill.

Note: Assistant instructors may be used to monitor the cadets' performance.

MEASURE DISTANCE ON A VNC

Measure distance on a VNC by:

- using a scale, or
- using an International Civil Aviation Organization (ICAO) ruler.

Using a Scale

The scale of the chart is the relationship between a unit of distance (eg, one inch) on the chart to the distance that the unit represents on the surface of the Earth.

There are two scales found on a VNC:

- **Representative fraction.** A ratio representing the distance on a map in relation to the surface of the Earth. The representative fraction of a VNC is 1 : 500 000 (one inch on the map represents 500 000 inches or eight miles).
- **Graduated scale line.** Three scale lines printed on the border of the chart representing kilometres, statute miles, and nautical miles. The distance between two locations on a VNC can be compared to one of these lines to give the represented distance in any of the three units of distance.

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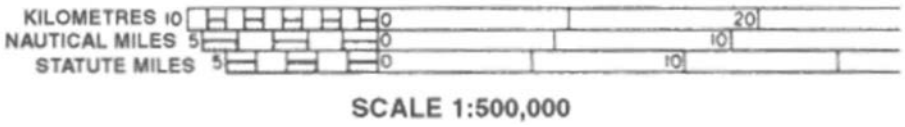


Note. From From the Ground Up: Millennium Edition (p. 123), by A. F. MacDonald and I. L. Peppler, 2000, Ottawa, ON: Aviation Publishers Co. Limited. Copyright 2000 by Aviation Publishers Co. Limited.

Figure 4 Graduated Scale Line

To measure distance on a VNC using the representative fraction:

1. Use a ruler to measure the distance between two landmarks in inches.

2. Multiply the number of inches by eight to determine the distance in statute miles.

To measure distance on a VNC using the graduated scale:

1. Use a straightedge to measure the distance between two landmarks.

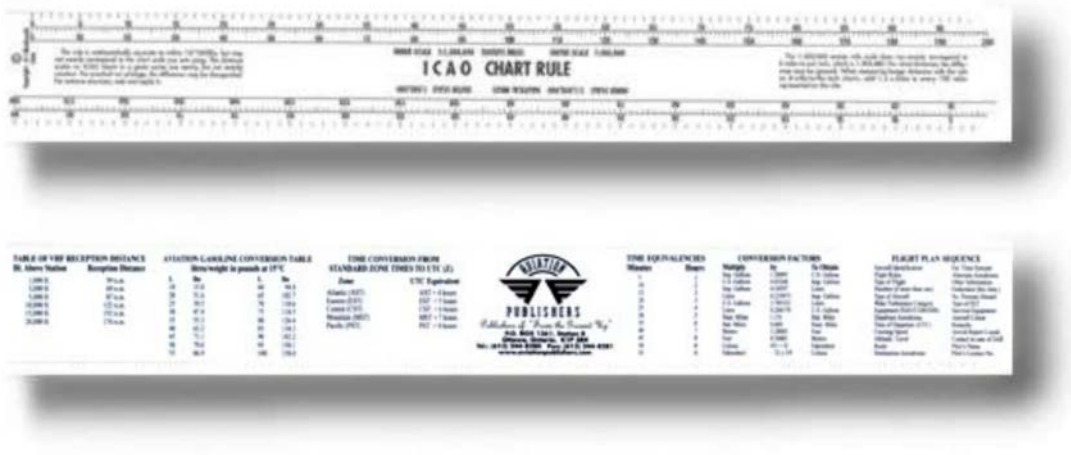
2. Line the straightedge up with the graduated scale, starting at the zero mark, to determine the distance in kilometres, nautical miles, or statute miles.



Have the cadets practice measuring distance using each technique.

Using an ICAO Ruler

ICAO ruler. A plastic straightedge graduated in both statute and nautical miles for use with 1 : 1 000 000 and 1 : 500 000 scale charts. On its reverse side, the ICAO ruler provides conversion factors, VHF reception distances, standard time conversions to Co-ordinated Universal Time (UTC), time equivalencies, flight plan sequences, and an aviation gasoline conversion table.



Note. From "Other Publications", Aviation Publishers. Retrieved November 28, 2008, from http://www.aviationpublishers.com/otherpub/icao.html

Figure 5 ICAO Ruler

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To measure distance on a VNC using an ICAO ruler:

1. Align the edge of the ruler with the track. Ensure the zero mark is at one of the landmarks.
2. Read the desired scale (nautical miles or statute miles) where the ruler meets the other landmark.



Use the edge of the ICAO ruler meant for 1 : 500 000 scale charts.



Have the cadets practice measuring distance using this technique.

CONFIRMATION OF TEACHING POINT 5

The cadets' participation in measuring distances on a VNC will serve as the confirmation of this TP.

Teaching point 6 — **Explain, demonstrate and have the cadets practice determining headings on a VNC.**

Time: 10 min — Method: Demonstration and Performance



For this TP, it is recommended that the instruction take the following format:

(1) Explain and demonstrate the skill while the cadets observe.

(2) Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.

(3) Monitor the cadets' performance as they practice the skill.

Note: Assistant instructors may be used to monitor the cadets' performance.

DETERMINE A HEADING ON A VNC

Douglas protractor. A tool used for determining headings and as a straightedge. It is transparent and has a compass rose graduated in 360 degrees marked around the outer edges.

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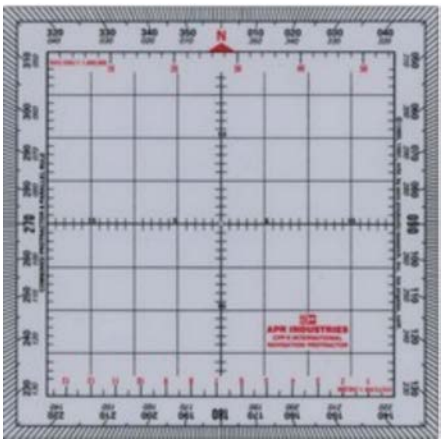

Note. From "Douglas Protractor / Parallel Ruler", VIP Pilot Centre. Retrieved November 28, 2008, from http://www.canada-shops.com/Magasin/vippilotcenter/c46907p95758.2.html

Figure 6 Douglas Protractor

To determine a heading on a VNC using a Douglas protractor:

1. Place the protractor on the chart with the hole in the centre lying on the track at a point where the north-south line on the protractor lies along the meridian of longitude. If this is not convenient, one of the vertical lines can be lined up parallel with the nearest meridian.

2. Read the heading where the track cuts the edge of the protractor.



Have the cadets determine the headings of the tracks previously plotted. Have them plot more tracks and determine the headings as time permits.

CONFIRMATION OF TEACHING POINT 6

The cadets' participation in determining headings on a VNC will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' performance of locating landmarks, plotting tracks, measuring distances, and determining headings on a VNC will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK / READING / PRACTICE

Nil.

METHOD OF EVALUATION

Nil.

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CLOSING STATEMENT

Flight planning and navigating at low altitudes and slow speeds relies on being able to use a VNC. Many of the skills used with this chart are transferable to other types of maps both in the air and on the ground.

INSTRUCTOR NOTES / REMARKS

Assistant instructors may be required for this lesson.

Cadets who are qualified Advanced Aviation may assist with this instruction.

REFERENCES

C3-116 ISBN 0-9680390-5-7 MacDonald, A. F., & Peppler, I. L. (2000). *From the ground up: Millennium edition*. Ottawa, ON: Aviation Publishers Co. Limited.

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