ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 1

EO M390.01 – IDENTIFY PARTS OF THE COMPASS

Total Time: 30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, 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.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TPs 1 and 2 to present background material and introduce the parts of a compass to the cadets.

Demonstration and performance was chosen for TP 3 as it allows the instructor to explain and demonstrate the skill the cadet is expected to acquire while providing an opportunity for the cadets to practice setting a predetermined declination under supervision.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have identified the parts of the compass and set a predetermined declination.

IMPORTANCE

It is important for cadets to understand the principles on how a compass works, recognize the parts of the compass and be able to set the magnetic declination on the compass. This basic knowledge will aid the cadet in learning how to use the compass as a navigational tool.

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Teaching point 1 **Explain the Principles Behind the Workings of a Compass**

Time: 5 min Method: Interactive Lecture

INTRODUCTION

The compass is an important tool used in wilderness navigation. It is not a replacement for good map-reading skills; however it is a trustworthy tool to complement and complete ground navigation. A compass user must take care to be precise in compass measurements. A small error in calculation or measurement can equal a significant error in the field.

A magnetic compass remains viable as a navigational aid, even with the advent of Global Positioning System devices, because it does not require batteries and remains reliable year after year.



CHINESE FLOATING COMPASS

Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-33)

Figure 1 Chinese Floating Compass

The Chinese had discovered the orienting effect of magnetite, or lodestone as early as the 4th century BC. In 101 BC, Chinese ships reached the east coast of India for the first time, possibly with help from a magnetic compass. By the 10th century, they had developed a floating compass for use at sea. Western Europeans had developed one by 1187, Arabs by 1220, and Scandinavians by 1300. Columbus used a magnetic compass on his first transatlantic trip in 1492.

HOW A COMPASS WORKS

Regardless of intended purpose or complexity of construction, most compasses operate on the same basic principle. A small, elongated, permanently magnetized needle is placed on a pivot so that it may rotate freely on the horizontal plane. The earth's magnetic field, which is shaped approximately like the field around a simple bar magnet, exerts forces on the compass needle causing it to rotate until it comes to rest in the same horizontal direction as the magnetic field. Over much of the earth this direction is roughly running between north and south, which accounts for the compass's importance in navigation.

The earth has a north and south magnetic pole. These magnetic poles correspond roughly with the actual geographical poles. The north magnetic pole is located (2005 estimate) at approximately 82.7 degrees N latitude and 114.4 degrees W longitude, which lies over 800 km from the north geographic pole.

The horizontal force of the magnetic field, responsible for the direction in which a compass needle is oriented, decreases in strength as one approaches the north magnetic pole. This decrease is due to the lines of force changing direction towards the vertical as they bend back into the earth at the north magnetic pole towards the south magnetic pole. The compass starts to behave erratically, and eventually as the horizontal force decreases even more, the compass becomes unusable.

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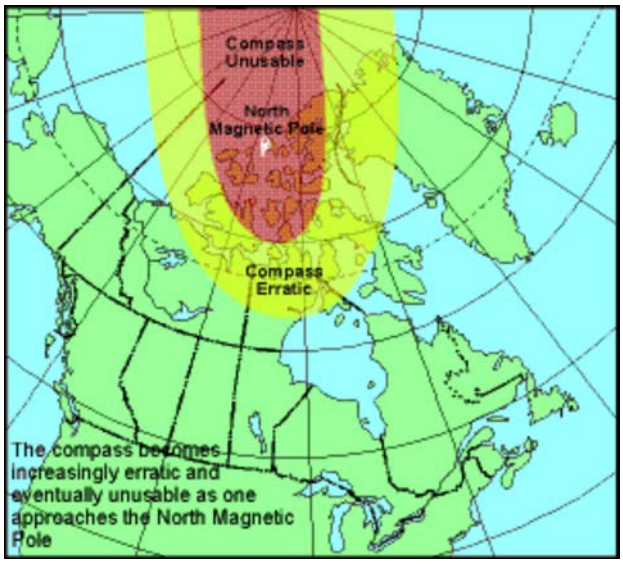

Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-33)

Figure 2 Earth's Magnetic Field

The nature of the earth's magnetic field is such that the magnetic north pole shifts geographic position about 5–10 km per year. Natural phenomena, like earthquakes, may also shift the magnetic field.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. Why is the compass such an important navigational tool?

Q2. Approximately how far can the north magnetic pole shift in a year?

Q3. Why does a compass become less accurate the further north a person travels?

ANTICIPATED ANSWERS

A1. Over much of the earth, a compass roughly indicates the direction of true north, which accounts for the compass's importance in navigation.

A2. The magnetic north pole shifts geographic position about 5–10 km per year.

A3. The horizontal force of the magnetic field, responsible for the direction in which a compass needle is oriented, decreases in strength as one approaches the north magnetic pole. This decrease is due to the lines of force changing direction towards the vertical as they bend back into the earth at the north magnetic pole towards the south magnetic pole. The compass starts to behave erratically, and eventually as the horizontal force decreases even more, the compass becomes unusable.

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Teaching point 2 **Identify and Describe the Parts of the Compass**

Time: 10 min Method: Interactive Lecture



Divide the cadets into equal groups according to the number of compasses available. Starting with the compass opened, use Figures 8-1-3 and 8-1-4 to identify the parts of the compass.

PARTS OF THE COMPASS

A – Sight. Located at the top of the compass cover. Used to align on an objective when taking a bearing or to observe one along a given bearing.

B – Compass Cover. Protects the compass dial and houses the sighting mirror.

C – Sighting Mirror. Used to see the compass dial while taking a bearing.

D – Sighting Line. Used when aligning an objective or observing along a bearing.

E – Luminous Index Point. At the top of the compass dial and where a bearing is set or read from.

F – Compass Dial. Houses the magnetic needle, the orienting arrow, the meridian lines, the declination scale (on the inside) and the dial graduations (on the outside).

G – Dial Graduations. The compass dial is graduated in 2-degree divisions from 0 to 360 degrees. The dial is rotated by hand.

H – Orienting Arrow. The black and red orienting arrow is located inside the compass dial and is used to line up with the magnetic needle when taking a bearing on the ground. The orienting arrow is what is adjusted when the magnetic declination is set.

I – Romer 1 : 25 000. Used to measure six-figure grid references (GRs) on maps with a 1 : 25 000 scale.

J – Compass Base Plate. A clear piece of flat plastic to which the cover, dial and lanyard are attached.

K – Declination Scale. Used when adjusting the orienting arrow and while setting the magnetic declination for the map being used. It is graduated in 2-degree divisions.

L – Compass Meridian Lines. Black or red lines inside the compass dial. They are used to line up the compass dial with the grid lines (eastings) on a map.

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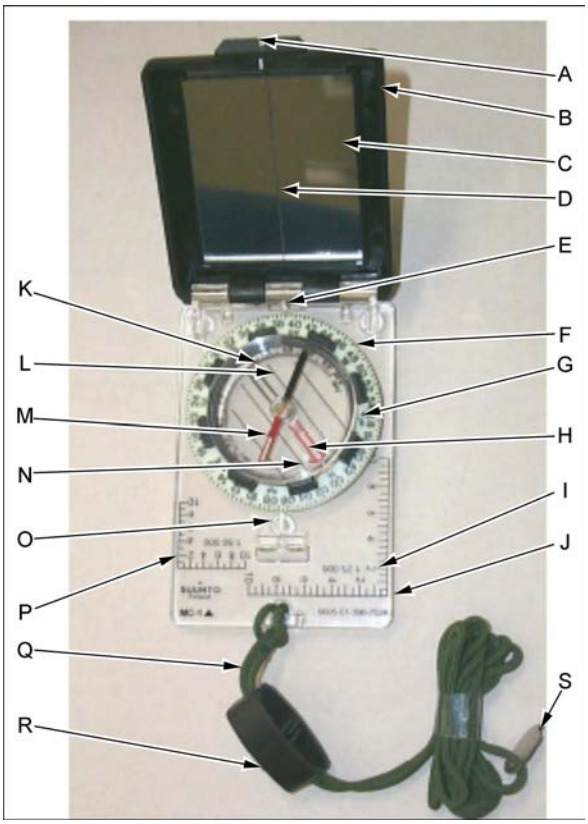

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Figure 3 Compass

M – Magnetic Needle. Spins freely and points towards magnetic north. The south end of the compass needle is black and the north end, with a luminous patch, is red.

When the magnetic needle is lined up in the red end of the orienting arrow, the mnemonic device “Red in the Bed” is used to remember that the red end of the needle belongs in the red end of the arrow.

N – Luminous Orienting Points. There are two luminous orienting points located on either side of the red end of the orienting arrow.

O – Luminous Index Point. At the bottom of the compass dial; where a back bearing is read from.

P – Romer 1 : 50 000. Used to measure six-figure GRs on maps with a 1 : 50 000 scale.

Q – Safety Cord or Lanyard. Used to fasten the compass to the wrist (never around the neck).

R – Adjustable Wrist Lock. Used to attach the compass to the wrist.

S – Screwdriver. Located at the end of the safety cord and is used to turn the screw to adjust the orienting arrow’s position on the declination scale.

T – Declination Adjusting Screw. Located on the back side of the compass dial and is used to adjust the orienting arrow’s position on the declination scale.

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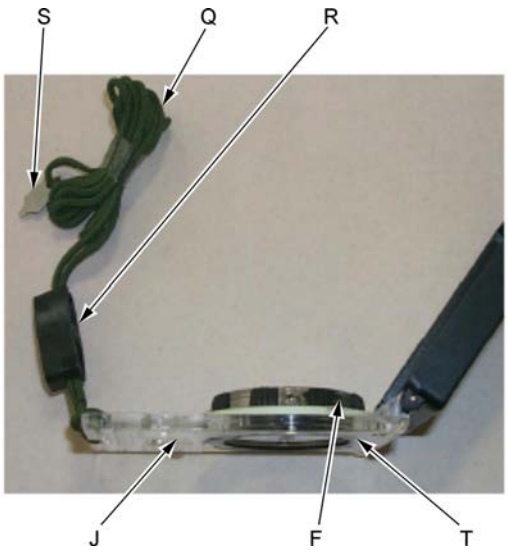

Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-34)

Figure 4 Compass

After being exposed to a strong light source, the luminous parts of the compass will glow in the dark making operating the compass at night possible.

CONFIRMATION OF TEACHING POINT 2

QUESTIONS

Q1. What is the purpose of the 1 : 25 000 and 1 : 50 000 romers?

Q2. What colour is the north end of the magnetic needle?

Q3. Where should the safety cord or lanyard of the compass never be placed?

ANTICIPATED ANSWERS

A1. The purpose of these romers is to measure six-figure GRs on maps with 1 : 25 000 and 1 : 50 000 scale respectively.

A2. The north end of the magnetic needle is red.

A3. The safety cord or lanyard of the compass should never be placed around a person’s neck.

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Teaching point 3 **Explain, Demonstrate and Have Cadets Set a Predetermined Declination**

Time: 10 min Method: Demonstration and Performance



Explain and demonstrate setting a predetermined declination as listed below, prior to the cadets' practicing. Calculating declination may be taught in EO C390.05 (Calculate Magnetic Declination, Section 10).

Do not go into too much detail about the three norths as this material will be covered in EO M390.05 (Determine Bearings on a Map and on the Ground, Section 5).

DECLINATION

Magnetic declination is the difference in bearing either between grid north and magnetic north or between true north and magnetic north. Declination will change for each topographical map and it also changes annually due to the shifting north magnetic pole.



Cadets will almost always use the magnetic declination value between grid north and magnetic north (grid declination) when navigating using a map and compass. By setting the magnetic declination on the compass, magnetic bearings are converted to grid bearings which allow bearings taken from the map to be used on the ground and vice versa.

Declination is further described by stating whether the declination is east or west of magnetic north. The declination for the map being used is calculated using the information in the declination diagram (as illustrated in Figure 18-1-5) found in the marginal information of the map.



Declinations are stated in degrees and minutes. Each degree is subdivided into 60 minutes. This is important when setting the declination as the declination scale is graduated in 2-degree divisions.

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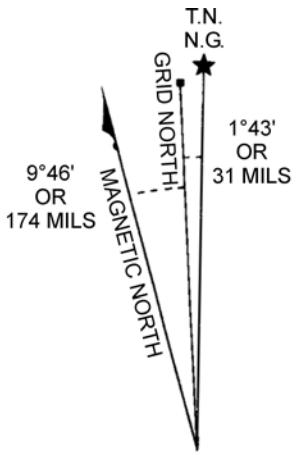

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Figure 5 Declination Diagram

ADJUSTING THE DECLINATION ON A COMPASS

The compass's declination scale must be set to compensate for the difference between grid north and magnetic north. To do this we must first have the amount of declination in degrees east or west. Then, turn the compass over and look at the back of the dial.

From the zero point, using the screwdriver, turn the declination adjusting screw to the right for west and to the left for east declination (as illustrated in Figure 18-1-6). Each small black line represents two degrees of declination.



When setting declination on a compass, it is easier to hold the screwdriver and turn the compass, especially in cold weather. The declination shall *never* be turned past the last number of the declination scale.



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Figure 6 Declination Screw

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If a person were to follow a compass bearing for one km without first adjusting for declination, for every one degree of declination, that person would be over 17 m to the left or right of their plotted bearing. This is how important declination is.

ACTIVITY

Time: 5 min

OBJECTIVE

The objective of this activity is to have cadets set magnetic declination on a compass.

RESOURCES

- Compasses, and
- Predetermined declination.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Divide the cadets into groups based on the number of compasses available.
2. Give the cadets a declination value.
3. Have the cadets turn the compass over (on its back with the declination adjusting screw facing up).
4. With the other hand have the cadet grasp the screwdriver that is attached to the safety cord/lanyard.
5. Using the screwdriver, have the cadet turn the declination adjusting screw to the right for west and to the left for east declination values.
6. Check the set declination.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 3

The cadets' participation in setting declination will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

QUESTIONS

Q1. A compass is a tool used to complement what other ground navigation skill?

Q2. What must be done to the luminous marks of the compass to make them glow?

Q3. In what direction would the declination adjusting screw be turned for an east declination value?

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ANTICIPATED ANSWERS

A1. A compass is used to complement map-reading skills.

A2. The luminous marks need to be exposed to a strong light source.

A3. The declination adjusting screw would be turned to the left.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

This EO is assessed IAW A-CR-CCP-803/PG-001, Chapter 3, Annex B, Appendix 5 (390 PC).

CLOSING STATEMENT

Map and compass skills are the core of the cadets' Proficiency Level Three survival training. Being familiar with the compass and how it works is one of the bases on which the rest of the lessons are anchored.

INSTRUCTOR NOTES/REMARKS

TP 2 may need to be modified to reflect the type of compass used for the lesson.

REFERENCES

A2-036 A-CR-CCP-121/PT-001 Director Cadets 3. (2003). *Royal Canadian Army Cadet Reference Book*. Ottawa, ON: Department of National Defence.

A2-041 B-GL-382-005/PT-001 Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.

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