ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 3

EO M390.03 – DETERMINE GRID REFERENCES (GRS)

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-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.

Topographical maps are the preferred training aid for TP 2, however, the worksheet located at Annex A may be used. If required, photocopy Annex A for each cadet.

Create a slide or photocopy the training aid located at Annex B for each cadet.

Photocopy the worksheet located at Annex C for each cadet.

Based on the topographical map being used, create a list of objects for the cadets to determine six-figure GRs for, and a list of six-figure GRs for the cadets to determine what objects they represent.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TPs 1 and 4 to introduce the grid system used to identify locations on a map.

Demonstration and performance was chosen for TPs 2, 3, 5 and 6 as it allows the instructor to explain and demonstrate determining four- and six-figure GRs and the construction and use of romers while providing an opportunity for the cadet to practice these skills under supervision.

INTRODUCTION

REVIEW

The following questions are a review of EO M390.02 (Identify Marginal Information and Conventional Signs, Section 2).

QUESTIONS

Q1. What does the contour interval on a topographical map represent?

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Q2. What are conventional signs?

Q3. What is the colour green used for on topographical maps?

ANTICIPATED ANSWERS

A1. Indicates the vertical (height) interval between contour lines and is given in metres or feet.

A2. These are symbols used to indicate an object or item of detail that cannot be shown either by an outline or by a line symbol.

A3. It is used for vegetation features such as woods, orchards and vineyards.

OBJECTIVES

By the end of this lesson the cadet shall have determined four- and six-figure GRs.

IMPORTANCE

It is important for cadets to accurately determine four- and six-figure GRs in order to convey their location to others, for others to convey their location, and to plot a route on a topographical map.

Teaching point 1 **Explain the Use of Grid Lines and GR Accuracy**

Time: 5 min Method: Interactive Lecture

USE OF GRID LINES

Grid lines are used to convey a person's location to others and to plot a route on a topographical map using GRs.

The grid system is a network of intersecting vertical and horizontal blue lines superimposed on a topographical map. Maps are normally printed so that north is at the top of the sheet. The lines of the grid system are drawn evenly spaced, one scale kilometre apart, so that one set of lines run north-south (vertically) and the second set of lines run east-west (horizontally). The lines are assigned a sequential number and count up from the bottom left corner. The numbers are written along the edges of the map and occasionally within it. The intersecting grid lines at the lower left corner designate a grid square.

Eastings. Similar to the X-axis in mathematical graphing, eastings are a series of vertical parallel lines plotted as an overlay to the map sheet, which are drawn from top to bottom and numbered, with two digits, sequentially from west to east. They run north-south, similar to lines of longitude.



It is important to note that while eastings run parallel to each other, lines of longitude do not. The spacing between lines of longitude is widest at the equator and come together at the north and south poles. It is because of this difference that a bearing taken from a topographical map is a grid bearing, not a true bearing.

Northings. Similar to the Y-axis in mathematical graphing, northings are a series of horizontal parallel lines plotted as an overlay to the map sheet, which are drawn from left to right and numbered, with two digits, sequentially from south to north. They run east-west, the same as lines of latitude.

GR ACCURACY

A four-figure GR represents one grid square and is accurate within a 1 000 m square (1 km^2 or 1 000 000 m^2).

A six-figure GR represents one one-hundredth of a grid square and is accurate within a 100 m square (0.01 km^2 or 10 000 m^2).

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CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. What is the grid system of a topographical map?

Q2. What is the spacing between lines of the grid system of a topographical map?

Q3. What is a northing?

ANTICIPATED ANSWERS

A1. The grid system is a network of intersecting vertical and horizontal blue lines superimposed on a topographical map.

A2. The lines of the grid system are drawn evenly spaced, 1 km apart.

A3. Similar to the Y-axis in mathematical graphing, northings are a series of horizontal parallel lines plotted as an overlay to the map sheet, which are drawn from left to right and numbered, with two digits, sequentially from south to north. They run east-west, the same as lines of latitude.

Teaching point 2 — **Explain, Demonstrate, and Have the Cadet Practice Determining a Four-Figure GR**

Time: 10 min — Method: Demonstration and Performance



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

(1) Explain and demonstrate the complete skill while 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 complete skill.

Note: Assistant instructors may be used to monitor cadet performance.

Characteristics of a four-figure GR:

- Four-figure GRs will have four numerical digits derived from the numbers assigned to the eastings and northings on the map sheet.
- The numbers are listed by recording the two-digit easting followed by the two-digit northing.



The grid lines that intersect in the bottom left corner of the grid square are used to identify that grid square.

Steps to determine a four-figure GR:

1. Confirm the correct grid square.

2. Place a finger at the bottom left corner of the map.

3. Move that finger along the bottom of the map (left to right) up to the grid line (easting) before the grid square.

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4. Record the two-digit easting.

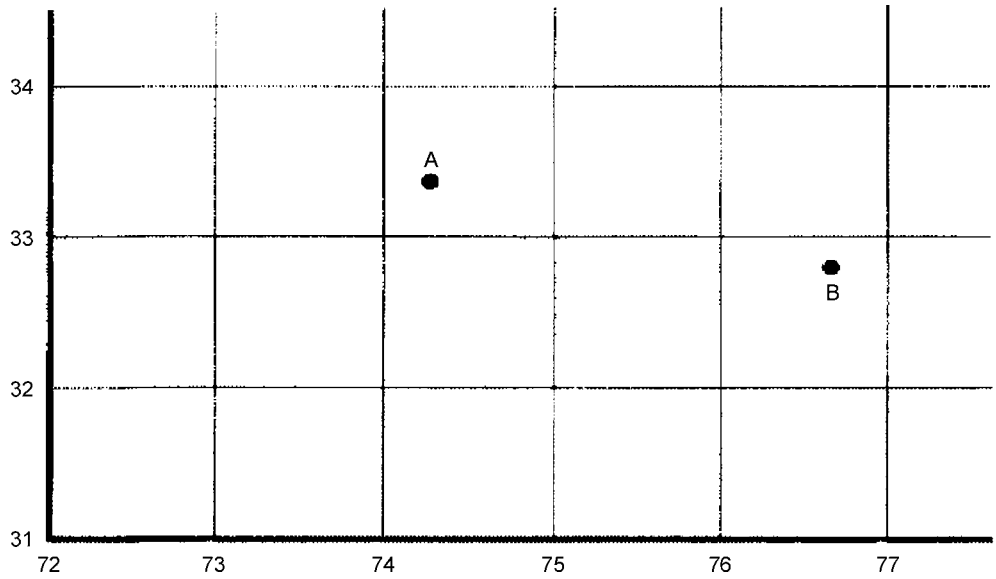
5. Place a finger at the bottom left corner of the map.

6. Move that finger along the left side of the map (bottom to top) up to the grid line (northing) before the grid square.

7. Record the two-digit northing after the two-digit easting to create the four-figure GR.

8. Confirm the four-figure GR.

In Figure 18-3-1 Building A is located at GR 7433 and Building B at GR 7632.



Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 37)

Figure 1 Four-Figure Grid References

Steps to determine a grid square using a four-figure GR:

1. Confirm the four-figure GR.

2. Place a right-hand finger at the bottom left corner of the map.

3. Move that finger along the bottom of the map (left to right) up to the grid line (easting) numbered the same as the first two digits of the four-figure GR.

4. Place a left-hand finger at the bottom left corner of the map.

5. Move that finger along the left side of the map (bottom to top) up to the grid line (northing) numbered the same as the last two digits of the four-figure GR.

6. Move the right-hand finger up the grid line and the left-hand finger right along the grid line.

7. Where the two grid lines intersect is the bottom left corner of the grid square.

8. Confirm the correct grid square.

In Figure 18-3-1, GR 7532 represents the grid square southeast of Building A and west of Building B.

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Have the cadets practice the skill either on a topographical map or the worksheet located at Annex A.

If using Annex A, check the cadets' answers using the answer key located at Annex D.

CONFIRMATION OF TEACHING POINT 2

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

Teaching point 3 **Explain, Demonstrate, and Have the Cadet Practice Estimating a Six-Figure GR**

Time: 10 min Method: Demonstration and Performance



Using either the overhead or the handout created from Annex B, explain and demonstrate how to determine a six-figure GR. Care must be taken to ensure that all cadets understand each step before proceeding to the next step.

For this skill lesson, it is recommended that instruction takes the following format:

(1) Explain and demonstrate the complete skill while 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 complete skill.

Note: Assistant instructors may be used to monitor cadet performance.

Estimate a six-figure GR by:

1. creating an imaginary grid system to divide a grid square into 100 equally sized smaller grid squares with 10 along the bottom edge and 10 along the left-side edge (as illustrated at Figure 18-3-2);

2. noting that six-figure GRs will have six numerical digits derived from the numbers assigned to the eastings and northings on the map sheet and their estimated tenths;

3. recognizing that the numbers are listed by recording the three-digit easting followed by the three-digit northing; and

4. remembering that the grid lines that intersect in the bottom left corner of the grid square are used to identify that imaginary grid square.

Steps to determine a six-figure GR:

a. Identify the object within the grid square. Note the four-figure GR.

b. Using the imaginary grid within the square, determine the three-digit easting by using the two digits of the easting combined with the number of tenths, measured from the left, to the line before the object.

c. Using the imaginary grid within the square, determine the three-digit northing by using the two digits of the northing combined with the number of tenths, measured from the bottom, to the line before the object.

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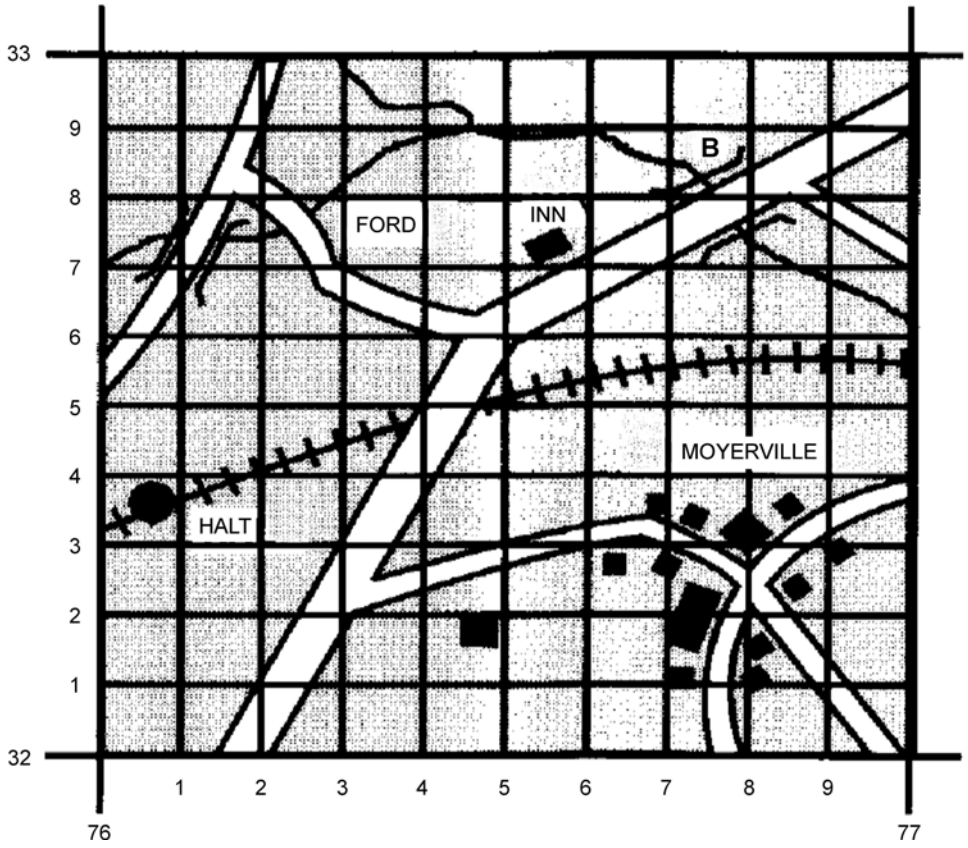
d. Combine the two sets of numbers to create the six-figure GR.



Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 38)

Figure 2 Six-Figure Grid References

Example 1: Determine the six-figure GR for the building west of the town of Moyerville.

1. Building west of the town of Moyerville is within GR 7632.
2. 76 combined with 4 tenths creates ’764’.
3. 32 combined with 1 tenth creates ’321’.
4. Building west of the town of Moyerville is located at GR 764321.

Example 2: Determine the six-figure GR for the Inn north-north-west of the town of Moyerville.

1. The Inn at the north part of the grid square at GR 7632.
2. 76 combined with 5 tenths creates ’765’.
3. 32 combined with 7 tenths creates ’327’.
4. The Inn at the north part of the grid square is located at GR 765327.



Have the cadets complete the worksheet located at Annex C.

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CONFIRMATION OF TEACHING POINT 3

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

Teaching point 4 **Define a Romer as a Device Used for Measuring a Point Within a Grid Square and Identify the Types of Romers Available for Use and Where to Find Them**

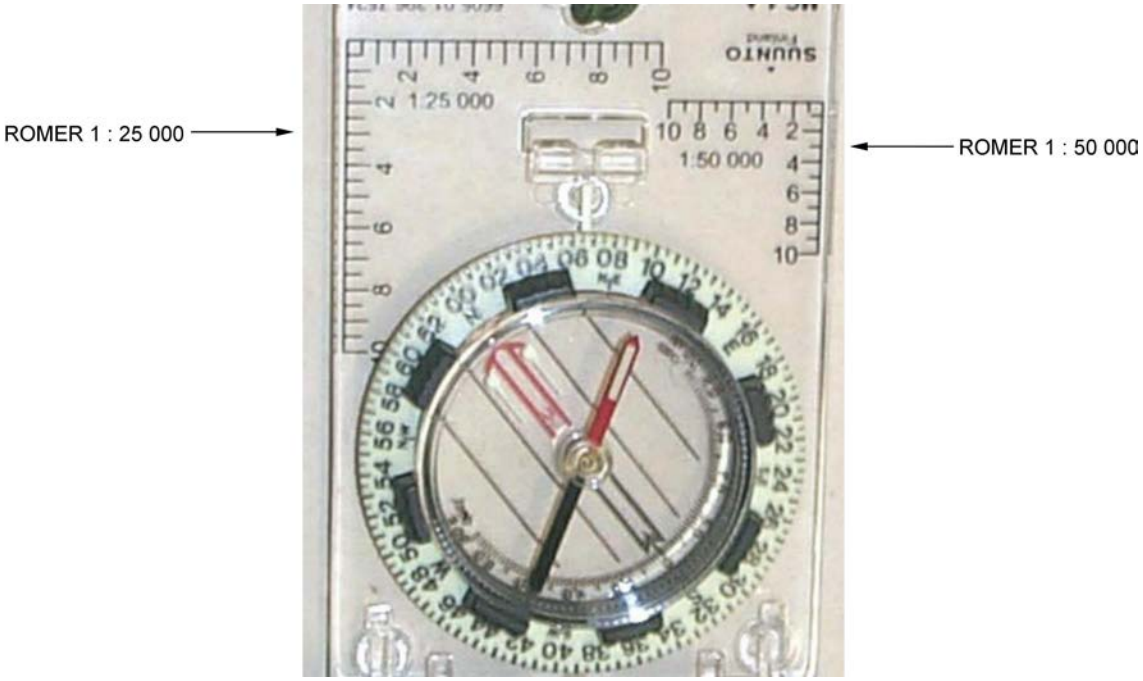
Time: 5 min Method: Interactive Lecture

Romer. A device used for measuring a point within a grid square to determine its six-figure GR.

Romers may be purchased or created. Purchased romers include compasses and protractors. Constructed romers use a small piece of paper and the scale bars of a topographical map.

COMPASS

Many compasses include romers already printed on the compass base plate. There are commonly two romers, for use with 1 : 25 000 and 1 : 50 000 scale topographical maps.



Director Cadets 3, 2008, Ottawa, ON: Department of National Defence

Figure 3 Compass

PROTRACTOR

All protractors may be used to determine a bearing on a map, however, few have romers already printed on them. The Canadian Forces has created the C2 protractor (as illustrated in Figure 18-3-4) specifically designed for use on topographical maps.

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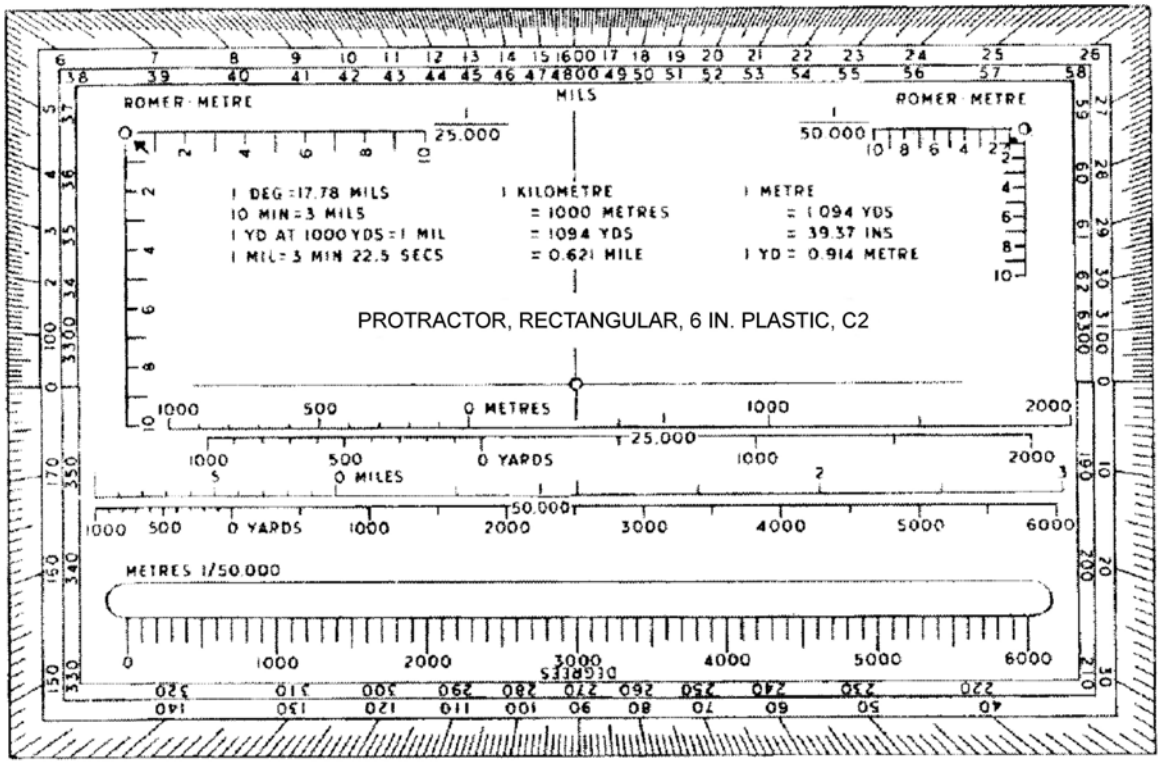

Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 41)

Figure 4 C2 Protractor

CONSTRUCTED

A constructed romer requires a piece of paper with at least one square corner and the scale bars of the topographical map. Using the scale bars of the topographical map, a romer can be constructed as illustrated in Figure 18-3-5.

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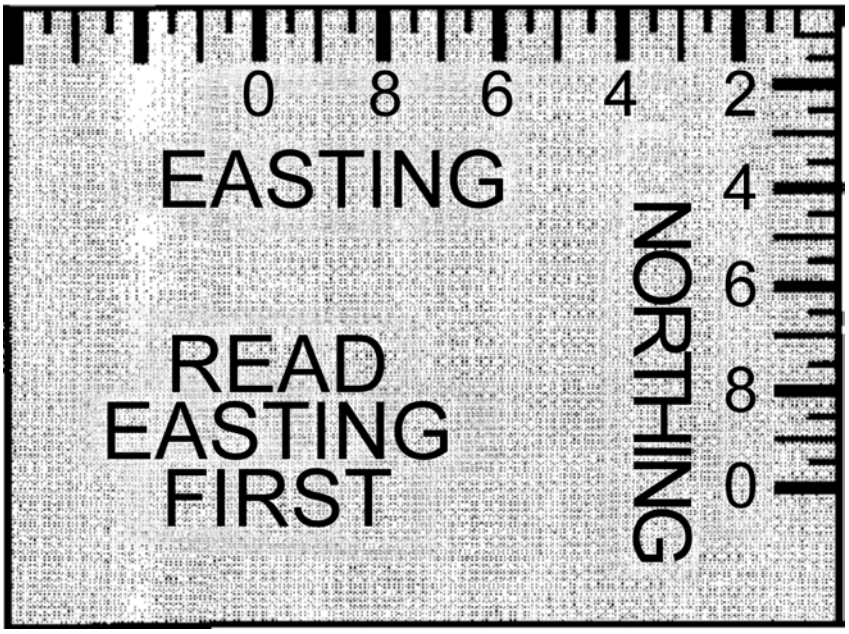

Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 41)

Figure 5 Constructed Romer

CONFIRMATION OF TEACHING POINT 4

QUESTIONS

Q1. What is a romer?

Q2. Where are the romers on a compass found?

Q3. What two things are required to construct a romer?

ANTICIPATED ANSWERS

A1. A device used for measuring a point within a grid square to determine its six-figure GR.

A2. The romers are printed on the compass base plate.

A3. A constructed romer requires a piece of paper with at least one square corner and the scale bars of the topographical map.

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Teaching point 5 **Explain, Demonstrate, and Have the Cadet Construct a Romer for Use in Determining Six-Figure GRs**

Time: 10 min Method: Demonstration and Performance



Accuracy must be stressed to the cadets when constructing a romer. Have the cadets ensure that their pencils are sharp or their pens are fine tipped.

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

(1) Explain and demonstrate the complete skill while 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 complete skill.

Note: Assistant instructors may be used to monitor cadet performance.

Construct a romer for determining six-figure GRs by:

1. obtaining a blank piece of paper with a square edge;
2. placing one side of the square edge along the 100-m scale bars;
3. marking off 100-m segments beginning at the corner of the paper and working outward;
4. numbering these markings from zero (at the corner of the paper) to ten; and
5. repeating Steps 2. to 4. on the adjacent edge (eg, completed romer as illustrated in Figure 18-3-5).



It is important to use the correct scale bar. The constructed romer's markings should match the grid lines of the topographical map; the side of a grid square must be equal to ten 100-m marks on each of the romer's two edges.

CONFIRMATION OF TEACHING POINT 5

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

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Teaching point 6 **Explain, Demonstrate, and Have Cadet Practice Determining a Six-Figure GR Using a Constructed Romer**

Time: 10 min Method: Demonstration and Performance



This TP uses all the skills from the previous TPs and it is essential that this TP not be covered until problems from the previous TPs have been corrected.

Unlike TP 3, where the cadets used the very visible 'imaginary' grid (eg, Figure 18-3-2) to determine a six-figure GR, the cadets will now be using their constructed romer from TP 5 to determine a six-figure GR and to locate objects with a six-figure GR. Much greater care and attention to detail must used by the cadets in order to ensure accuracy.

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

(1) Explain and demonstrate the complete skill while 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 complete skill.

Note: Assistant instructors may be used to monitor cadet performance.

Determine a six-figure GR using a constructed romer, by:

1. placing the corner of the constructed romer on the bottom left corner of the grid square, noting the four-figure GR;

2. moving the constructed romer to the right the number of tenths required to align the romer directly to or before (never past) the conventional sign or location for which the GR is being determined;

3. reading the value along the X-axis of the romer where it crosses the easting on the map sheet (the value at this intersection becomes the value for the third digit of the six-figure GR);

4. moving the constructed romer up the number of tenths required for the corner of the romer to be positioned on or before (never past) the conventional sign or location for which the GR is being determined;

5. reading the value along the Y-axis of the romer where it crosses the northing on the map sheet (the value at this intersection becomes the value for the sixth digit of the six-figure GR); and

6. combining the two sets of digits to create the six-figure GR.

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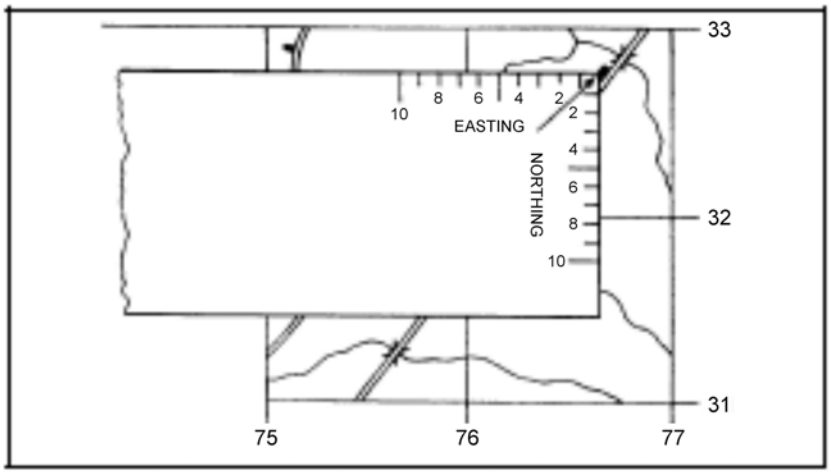

Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-20)

Figure 6 Using a Constructed Romer

Determine what a six-figure GR represents using a constructed romer, by:

1. determining the four-figure GR, by removing the third and sixth digits from the six-figure GR, to identify and locate the correct grid square;
2. placing the corner of the constructed romer on the bottom left corner of the grid square;
3. moving the constructed romer to the right the number of tenths, as identified by the third digit;
4. moving the constructed romer up the number of tenths, as identified by the sixth digit; and
5. determining the object (that is up and to the right from the tip of the romer).



Examples used will be from Annex C.

Example 1:

From Figure 18C-1, determine the six-figure GR for the Post Office.

1. Grid square GR 7632.
2. Four tenths to the right.
3. 76 combined with 4 tenths creates ‘764’.
4. Four tenths up.
5. 32 combined with 4 tenths creates ‘324’.
6. The Post Office is located at GR 764324.

Example 2:

From Figure 18C-1, determine the object located at GR 766323.

1. Four-figure GR is 7632.

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2. Place romer at the bottom left corner of grid square 7632.
3. Move the romer to the right six tenths.
4. Move the romer up three tenths.
5. GR 766323 identifies the Train Station.



Have the cadets practice using the lists created before the lesson, of objects for the cadets to determine six-figure GRs for, and of six-figure GRs for the cadets to determine what objects they represent, on the appropriate topographical map.

CONFIRMATION OF TEACHING POINT 6

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

END OF LESSON CONFIRMATION

The cadets' participation in determining six-figure GRs will serve as the confirmation of this lesson.

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

It is important for cadets to accurately determine four- and six-figure GRs in order to convey their location to others, determine where others are, and to plot a route on a topographical map. This skill will be of great benefit whenever the cadets are using topographical maps.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

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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