

CHAPTER 1

GENERAL

SECTION 1 - INTRODUCTION

101. Purpose

The publication is intended for the use of all map users, however its primary purpose is to provide instructors in map reading with a comprehensive book of reference. The publication covers only the factual information common to most maps, leaving the full understanding of map reading to be attained by practical instruction and by personal experience. To be truly effective, much of the instruction must be on the ground.

102. Scope

1. The publication covers the basic information required for the reading and use of normal topographical maps, Military City Maps, Training Area Maps, and 1501 Joint Operations Graphic (AIR) maps on scales from 1:25,000 to 1:250,000. It also covers the use of map referencing systems, bearings, and compasses.
2. The uses of air photographs and of map substitutes produced from air photographs are also covered, as is basic field sketching.
3. Orienteering, an excellent method of teaching and testing practical map reading, is given comprehensive coverage. Lesson guidance has been provided to facilitate instruction in map reading.

103. Procurement of Maps

1. All military units are authorized an allowance of maps. The map requisitions and distribution procedure is detailed in CFAO 36-17. To order a map it is necessary to provide the scale of the map and both its series and map number. This information is found on the map sheet itself or in the Department of National Defence, Catalogue of Maps that is available to unit level.
2. Figure 1-1 contains the general information necessary to the understanding of the National Topographic System and Figure 1-2 is a simple index of the map coverage available in a specific series, in this case the Joint Operations Graphic (AIR).

SECTION 2 - MAP READING

104. Introduction

Map reading is a wider subject than is sometimes understood. It covers not only the ability to interpret the symbols shown on the map and to understand the information given in pictorial or written form, but it also comprises a true understanding of the ground portrayed, and an appreciation of the reliability and value of the particular map being used. These different aspects of map reading are explained more fully in the following paras.

105. Reading of Map Information

1. The full understanding of the information shown on the map is the basic requirement of map reading. This includes not only the meaning of the various symbols and conventions, but also the understanding of the supplementary information given in the margins of the maps. Conventional signs are not completely standardized, but each map generally provides all the information necessary to enable a map user, unfamiliar with the particular map, to make effective use of it.
2. The reading of map information includes the ability to locate and to give map references, the understanding of scales and the use of them for measurements, position finding, and the description and navigation of routes by day or by night. The greater part of this publication is devoted to these aspects of map reading.

106. Understanding of the Ground

1. The ability to obtain from the map a mental picture of the ground portrayed is an essential but much less frequently understood part of map reading. It is sometimes called "Mapcraft".
2. From the lines and symbols on a map it is relatively simple to gain a mental picture of natural detail, such as woods and streams, and man-made objects like roads and buildings. Real mapcraft, however, lies in the ability to visualize the shape of the ground which is shown on the map by contours and spot heights.
3. This reading of the contours and the ability to gain from them a mental picture of the ground cannot be taught from a text book. Chap 5 gives the necessary basic information on the interpretation of relief, but mapcraft is a skill which must be learned by practice on the ground, an essential to building up experience and developing a "Feel" for maps which should become instinctive.

GENERAL INFORMATION

THE NATIONAL TOPOGRAPHIC SYSTEM

ITEM

1. Under this system Canada is divided into numbered quadrangles each 4° latitude by 8° longitude (16° longitude north of 80°). Map limits and identification for each series are based on the sub-division of each primary quadrangle as follows:
 - 54..... a primary quadrangle-denotes a map of the 1:1,000,000 series.
 - 54 S.W..... a quarter of a primary quadrangle-denotes a map of the 1:500,000 (or 8 mile) series.
 - 54 H..... a lettered quadrangle-denotes a map of 1:250,000 (or 4 mile) series. South of 68° maps are one sixteenth of a primary quadrangle and lettered A to P. North of 68° maps are one eighth of a primary quadrangle and lettered A to H.
 - 54 A/N.E..... a quarter of a lettered quadrangle-denotes a map of the 1:125,000 (or 2 mile) series.
 - 54 A/8..... a sixteenth of lettered quadrangle-denotes a map of the 1:50,000 (or 1 mile) series.
 - 54 A/8a..... denotes a map of the 1:25,000 series which is one-eighth the area of a 1:50,000 quadrangle and is identified by a lower case letter suffix.
2. Some 1:50,000 scale maps were produced as two map sheets, an East half and a West half.
3. Topographical map coverage, International Maps of the World, at the scale of 1:1,000,000 is not complete. However, Canada is covered at the scale of 1:1,000,000 with Topographic maps which previously served as base maps for Aeronautical Charts.
4. Series and map numbers are shown in the Catalogue of Maps Department of National Defence; but edition numbers are not indicated. Catalogue holders are notified of new editions published through CFSO's. All demands will be filled with the latest edition.

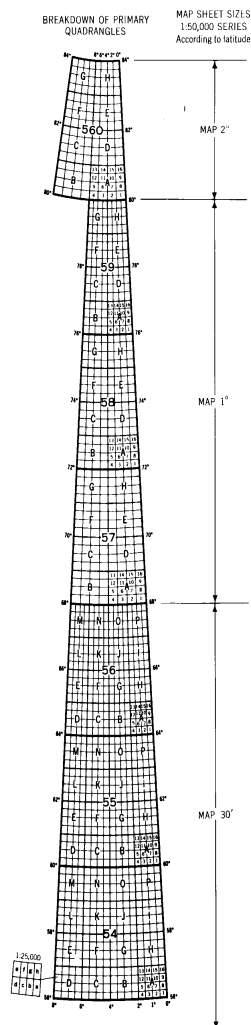


Figure 1-1 General Information, The National Topographic System

107. Appreciation of Map Value and Reliability

1. All maps are not of the same standard of accuracy, reliability, or currency. An effective map reader should be able to assess these qualities to a considerable degree from the information supplied on the map.
2. The information required to assess a map can generally be found in the margins. This should include information on the following points:
 - a. dates of surveys or of other maps from which the map has been compiled;
 - b. date and extent of the last revision; and
 - c. overall map detail.

On some maps a reliability diagram may be shown. For more details see Chap 2, Sect 3.

3. When comparing the dates of last revision of two maps, it is important to check whether the revision was complete or was made only of certain types of information, eg, roads. When comparing relief information, a map compiled from larger scale mapping is more likely to be reliable than one compiled directly at the scale of the map. Broken contours generally indicate lack of reliability.

SECTION 3 - TYPES AND SCALES OF MAPS

108. Topographical Maps

1. This is the type of map with which the publication is primarily concerned. Their purpose is to present a picture of the ground as it exists. Topographical maps show, in as much detail as the scale allows, both the physical features of the ground - rivers, woods, and hills with their heights and shapes - and the man made features - roads, railways, towns, villages, and buildings, etc. They also contain a large number of names, both specific names of towns, villages, and rivers, and also descriptive names of general features such as railways, fords, post offices, etc.

2. Topographical maps may vary in scale from about 1:25,000 to about 1:250,000. The references in this publication are chiefly to the following map series which are those commonly in use by the Canadian Forces:

- a. Canada. 1:25,000;
- b. Europe. 1:50,000; and
- c. Canada. 1:250,000.

Specimens of these maps are illustrated in Figures 4-2, 4-3, 4-4, and in Figure 5-1.

3. Variations exist in symbols and in presentation between map series even though they are at the same scale and are produced under allied mapping agreements. Therefore, it is important to emphasize that the information given in this publication is of general application only, and that each map used must be studied on its own to ensure that it is correctly interpreted.

109. Military City Maps

1. Restricted Edition. A map, 1:25,000 scale, of a city, delineating streets and showing street names, important buildings, and other urban elements of military importance which are compatible with the scale of the map. Vertical information is not normally shown. See Figure 4-5.

2. Unrestricted Civilian Edition. The same restricted military edition minus all pertinent military information.

110. Other Maps

1. Other types of maps in military use may generally be divided into two classes:

- a. Maps on Scales Smaller Than 1:250,000. These are used for strategic planning and by air forces. Map detail is generalized and only principal features are shown. Relief, if shown, is normally indicated by layer tints (see art 508), or by other general means.

- b. Special Maps. These include maps to illustrate special items of information, eg, road maps, going maps (to show suitability for vehicular cross-country movement), railway maps, and skeleton maps (showing only water and relief). None of the above maps are covered in this publication.

111. Photomaps and Map Substitutes

These are maps made up of air photographs, and are issued on special occasions. Their use and interpretation are covered in Chap 10.

SECTION 4 - FIELD SKETCHING

112. Sketching

Photography is generally the most acceptable means of supplementing map data which of course is seldom completely up to date. Such a supplement is often required to facilitate a report on special or detailed information which the map does not reflect. However, photography is not always operationally expedient and, in such cases, a field sketch is necessary. For example, a night patrol would certainly not be able to use conventional photography and a field sketch might be the only satisfactory way of recording detail commensurate with the demands of security. The panorama sketch is a very practical expedient for use in an artillery observation post (OP) for displaying targets and target data related to the zone it overlooks. These techniques are discussed in Chap 11.

SECTION 5 - TRAINING

113. Training Helps

Practical helps for setting up and running a course of instruction in map reading are provided in the final chapters of the publication. This includes an extensive discussion of use of orienteering as a means of teaching and improving map reading skills.

(114 to 119 not allocated)

CHAPTER 2

MARGIN INFORMATION

SECTION 1 - GENERAL

201. Introduction

Before using any unfamiliar map, the first essential is to have a good look at the information contained in the margins. The margins give much information essential to the full understanding and use of the map and deserve more attention than is frequently paid to them.

202. Layout

On military maps produced under allied international agreements, the layout of the margin information is to a large extent standardized. This is so that users may become accustomed to finding the different types of information they seek in the same part of the margins on all maps, even though the maps are produced by different countries and on different scales. The principal elements of this standardization will be explained in this chapter. Not all maps however, conform to these standardization rules, and users must be prepared for variation in layout, though, in general, the more essential items of information are placed in common positions.

203. Types of Information Shown

1. Certain information shown is essential to the identification of the map and the correct interpretation of its basic information. This detail is described in Sect 2.
2. The remaining information is useful to certain types of users or on those occasions when it is necessary to determine the source of information and hence the reliability of the map. This detail is described in Sect 3 and should be known and understood by the map reading instructor, but it is not essential for those who are concerned only with basic map work.

204. Languages

All Canadian military maps produced by the Canadian Forces are bilingual being printed in English and French. National Topographic System maps produced by Federal Agencies will be produced in a bilingual form. When maps are too complicated for printing as a bilingual edition, a separate map is printed in English and French. The elements appear together in a panel as in Figure 2-1.

SECTION 2 - COMMON USER INFORMATION

205. Map Identification

1. The essential elements required to identify a particular map sheet are:
 - a. map series number;
 - b. sheet number (or name, if there is no number); and
 - c. edition designation.

The elements appear together on the map sheet in a panel as shown in Figure 2-1.

Military users, refer to this map as: Référence de la carte pour usage militaire:	SERIES A901 SÉRIE MAP MCE 320 CARTE EDITION 1 ÉDITION
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Figure 2-1 Map Identification Panel

2. The map series number identifies both the area and the scale of the map; the series number can be found from the map catalogue. All operational map series are shown in the Department of National Defence, Catalogue of Maps, and indexes to series show all sheets published, though some may not be available from stock. Allied nations will, of course, possess catalogues of their maps and sometimes their overseas commands may produce separate map catalogues in which special purpose mapping of local interest will be included.
3. The edition number identifies the currency of the information shown on the map. The edition number increases at each revision. On Canadian maps a credit note appears in the lower left and lower right hand corners and indicates the authority of the edition, eg, "MCE" (Mapping and Charting Establishment (CDN)). The credit note also lists the producer, dates, and general methods of preparation or revision. This information is important to the map user in evaluating the reliability of the map as it indicates when and how the map information was obtained. On some maps, the map credits are shown in tabular form in the lower margin, with reliability information presented in a coverage diagram.
4. On allied maps, the letters following the edition indicate the authority under whom the edition has been prepared, eg, "GSGS" (Geographical Section, General Staff (UK)), "AMS" (Army Map Service (USA)), etc.
5. When indenting for a map, only the series number and the sheet number need be quoted. It is the responsibility of the map depot to provide the latest current edition. If the series number is not known, the area covered and the scale required must be stated.
6. In some cases, maps are identified by a sheet name instead of by a sheet number. This is, however, rare.

206. Scales

1. The scale of the map, eg, 1:50,000, is shown prominently at the top of the map, and also in the bottom margin, usually above the graphic scales.
2. The graphic scales are placed in the centre of the bottom margin and are normally expressed in statute miles and in kilometres, with the addition of yards and metres. When the map requires it. For more details about scales and measurement of distances see Chap 3.

207. **Unit of Elevation** Each map must carry in a conspicuous position, normally in the bottom margin, a note "Elevation in Feet" or "Elevation in Metres", as appropriate. During this period of conversion to the metric system and for some considerable time to come, it will be vitally important to determine from this note the unit of elevation used on a particular map.

208. Contour Interval

A note stating "Contour Interval.....Feet/Metres" is shown in the bottom margin near the graphic scales.

209. Conventional Signs

A table showing the conventional signs used on the sheet in their correct colours with their descriptions is shown in the bottom or side margin. Sometimes, if space does not permit, a few signs may be omitted, but the road symbols and classification are always shown. See Chap 4.

210. Instructions on the Use of the Grid

These instructions are shown in a panel in the bottom or side margin and are normally in the colour used for the grid on the face of the map. The notes explain how to give a grid reference. See also Chap 6.

211. Information on True, Grid, and Magnetic North

Each map contains the information necessary to determine the true, grid, and magnetic bearing of any line within the area covered by the map sheet. This information is given in the form of a diagram with explanatory notes. The diagram may be in the bottom or in a side margin. The diagram and its use are explained in Chap 7.

212. Index to Adjoining Sheets

A diagram showing the position of the map sheet in relation to adjoining sheets is shown near the lower margin. The diagram shows the sheet numbers of the adjoining sheets and accentuates the sheet in hand.

213. Index to Boundaries

The Index to Boundaries diagram appears in the lower or right margin of military city maps and some maps of the scale of 1:250,000. The diagram, which is a miniature of the map, shows the boundaries which occur within the map, such as country, provincial, and international boundaries.

214. Glossaries

Some maps carry glossaries of geographical terms and of abbreviations used on the map, with translations into different languages as necessary. They are usually in the lower margin. In some instances, glossaries are printed on the back of a map sheet.

215. Security Classification

The Security Classification, if any, is shown in the top and bottom margins in a prominent colour, usually red.

SECTION 3 - SPECIALIST INFORMATION

216. Technical Detail on Grids, Projections, Geodetic and Levelling Datums

Information is given on the grid or grids on the map to which lines and figures refer. Projections, spheroid(s), datums, origin, and false coordinates of origin are stated for each grid, printed in the colour of the figure of the grid to which they refer. The information appears in the lower or right margins; it is required only for specialist users.

217. Information on Map Revision and Reliability

1. A history note is given in the bottom margin to show by what unit or establishment the map was produced, the date and the information from which it has been compiled. When the map has subsequently been revised, the date of revision, the extent of the revision, and the source of the information is also stated.
2. When a map has been compiled from several sources, a compilation diagram may be provided in the bottom margin to show the extent of coverage of the basic sources for each portion of the sheet.
3. On some sheets, a reliability diagram may be included to indicate the degree of reliability of different parts of the sheet. Such a diagram will be found only when the reliability is below the standard which is normally expected at that scale and in that area.

218. Geographical Coordinates of Sheet Corners

These are shown in degrees, minutes, and seconds to an approximate accuracy in terms of the geodetic datum used for the military grid, eg, North American datum.

(219 to 299 not allocated)

CHAPTER 3

SCALES AND DISTANCE MEASUREMENT

SECTION 1 - MAP SCALE

301. Definition of Scale

The scale of a map is the relationship between the horizontal distances between two points measured on the ground and the same two points measured on the map. This relationship is constant, in whatever direction the distances are measured.

302. Methods of Expressing Scale

1. There are two methods of expressing the scale of a map:
 - a. by the representative fraction (RF), eg, 1:50,000; or
 - b. in words, eg, one inch to four miles.

303. Representative Fractions

1. The RF is now the standard method of expressing a scale on all Canadian maps and wherever the metric system is used. It must be understood by all map users. Very simply when the RF is $1/X$, one unit of distance on the map represents X units of distance on the ground.
2. For example, a scale of 1:50,000 means that one inch/centimetre/metre on the map represents 50,000 inches/centimetres/metres on the ground. The essential connection is that the same unit of measurement applies both to the map and to the ground measurement:
 - a. A distance of 3 cms on a 1/50,000 map therefore represents $3 \times 50,000$ cms on the ground = 150,000 cms = 1,500 metres.
 - b. A distance of 3 inches represents $150,005$ inches = 150,000 miles = 2.37 miles approximately.
63,360

304. Scales Expressed in Words

1. The use of scales expressed in words is obsolescent but is still in use and must also be understood. The most common example is the one inch to one mile map. In this case, one inch on the map represents one mile on the ground. If a direct comparison is required in metres, it is necessary to turn the scale into its representative fraction $1/63,360$, ie, one inch equals 63,360 inches or one mile; therefore:

$$1 \text{ cm} = 63,360 \text{ cms} = 633.6 \text{ metres.}$$

2. For smaller scale maps such as the "Quarter Inch", one may express its scale as either 1/4-inch to one mile, or four miles to one inch. The smaller the scale, however, the more likely one is to use the form "Miles to the Inch".

305. Comparisons of Map Scales

There is no clear definition of what is meant by "Large Scale" or "Small Scale" maps. The terms are applied to different map scales according to the circumstances. It is, however, important to be clear what is meant by "Larger" scale or "Smaller" scale when comparing two map scales. One map has a "Larger" scale than another if a given distance on the ground (say one mile) is represented by a greater map distance than on the other map. For example, a map scale of three inches to one mile is larger than a map scale of one inch to one mile. In the case of representative fractions, the same principle applies, but this means that the denominator in the fraction is smaller when the scale is larger, eg, a scale of 1:50,000 is larger than a scale of 1:250,000.

306. Effects on a Map of Change in Scale

It is important to realize, when map reading, the effects of a change of scale from a map of a scale of say 1:50,000 to one of 1:250,000. It is obvious that the distance between two identical points on the maps will be reduced to a fifth when changing from the larger to the smaller scale, but it is not so obvious that this reduction of the distances takes place in all directions equally, and that consequently both sides of a rectangle will also be reduced to a fifth and the resultant area will be one twenty-fifth of the area on the larger scale map. Similarly, the space between items of detail will be proportionately reduced, and detail will appear more congested. See Figure 3-1. This is an important factor in map appreciation.



Figure 3-1 Effects of Change in Scale

SECTION 2 - MEASUREMENT OF DISTANCE

307. Scales on Maps

1. All maps carry graphic linear scales (usually in the centre of the lower margin) from which any horizontal distance may be measured on the map in statute miles, kilometres, metres, yards, and nautical miles. These may appear in various combinations and various sizes depending on the type and scale of the map sheet. An example is shown in Figure 3-2.

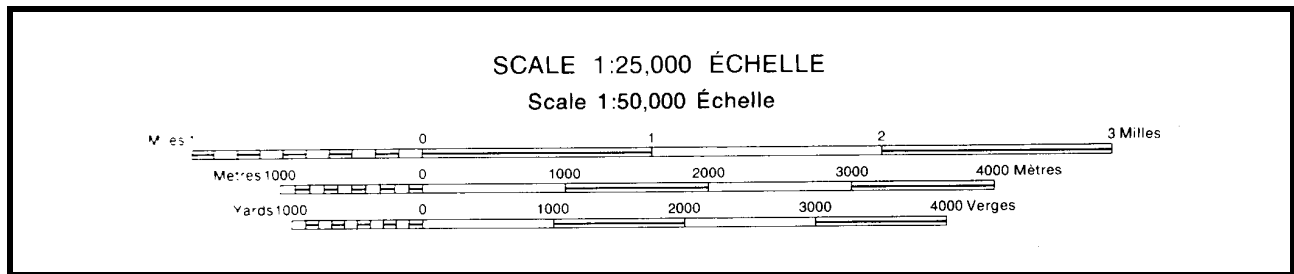


Figure 3-2 Linear Map Scale

2. The zero is set back from the left of the scale by one major division, and this division is then usually subdivided into 10 equal sub-divisions. Measurements falling between these sub-divisions must be estimated.

308. Measuring a Straight Line Distance

To measure a straight line distance between two points lay the straight edge of a piece of paper against the two points and at each point mark the paper. Then lay the paper along the scale line on the map with the right hand mark against one of the major divisions so that the left hand mark lies against the sub-divisions to the left of the zero on the scale. The total distance is then the number of major divisions plus the distance to the left of the zero.

309. Use of Separate Scales

Separate scales, such as those on the Protractor C2 (see Figure 6-4), may be used for measuring short distances on maps, but it must be remembered when measuring long distances that the paper of a map may stretch or shrink quite appreciably, whilst a metal, plastic, or wooden scale does not. The scale drawn on the map stretches or shrinks with the map, and therefore always provides a scale in conformity with the map detail. See art 310.

310. Use of Grid Lines

Most military maps carry grid lines (see Chap 6). The grid lines are a fixed distance apart and may be used to make quick estimations of distances between two points. Separate scales may be checked against the grid lines before use to make sure that the map and the scale agree.

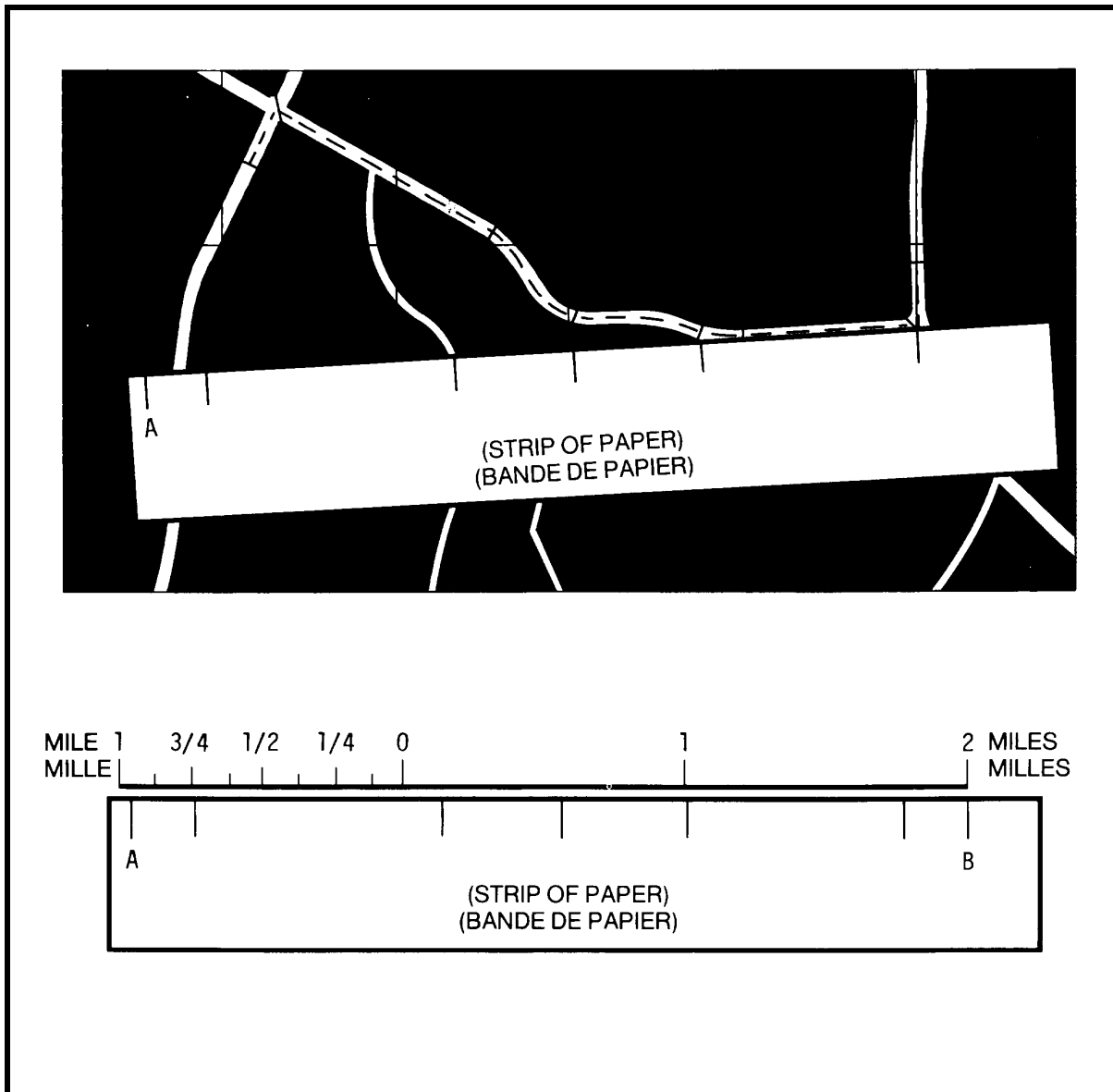


Figure 3-3 Measuring a Road Distance Off a Map

311. Measuring a Road Distance

To measure a distance which is not straight, eg, along a road, consider the road as a number of straight or nearly straight sections. Lay a piece of paper along the first section, and mark it with a tick at the starting point and another at the end of the first section. Then pivot the paper about the second tick until it lies along the second section. Mark the end of the second section with another tick, and repeat the process until the last point is marked. The total distance along the road is then recorded as a straight line on the piece of paper, and can be read off against the scale as in art 308. See Figure 3-3.

(312 to 399 not allocated)