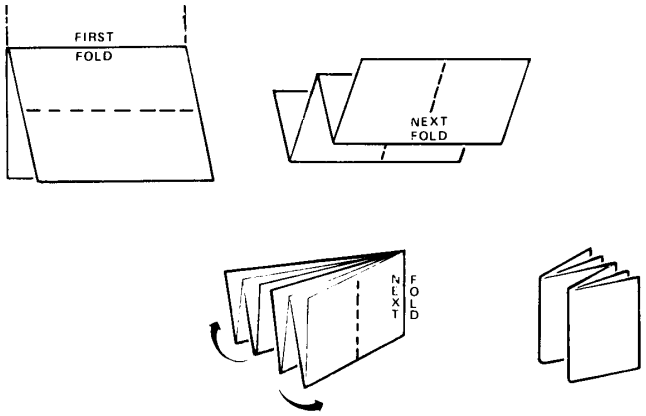
PO 405 MAP AND COMPASS

REVIEW

FOLD A MAP



TOPOGRAPHICAL MAPS

A topographical map illustrates water features , vegetation, elevation and depression, wetlands, urban development, transportation and communication routes (roads, railways, telephone lines, etc.), structures, natural features and place names. 1:50 000 or 1:250 000 scale topographical maps are produced of all areas of Canada by the federal government through Natural Resources Canada. The information is stored in the National Topographical Data Base as part of the National Topographical System (NTS). The mapping information is based on the North American Datum of 1983 (NAD 83

MAP AND COMPASS TERMS

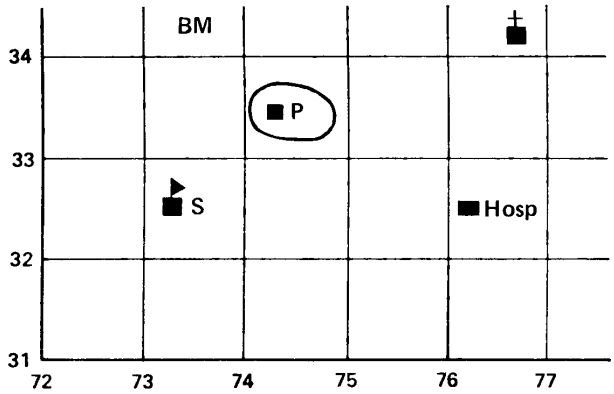
The following terms are used in map reading:

a. **Basin.** A basin is an area of fairly level ground surrounded or nearly surrounded by hills or the area drained by a river and its tributaries;
b. **Benchmark.** A permanent point used for surveying;
c. **Contour line.** A contour line is a line on the map joining points of equal elevation above mean sea level;
d. **Crest.** A crest is the highest part of a hill or mountain range;
e. **Escarpment.** An escarpment is the steep hillside formed by a sudden drop in the general ground level;
f. **Gorge.** A gorge is a narrow stream passage between steep rocky hills;

g. **Grid** A grid is a system of lines forming squares drawn on a map as a basis for a system of map references;
h. **Grid North.** Grid north is the direction of the vertical grid lines on a map;
i. **Knoll.** A knoll is a small knob-like hill (pingo);
j. **Margin.** The border of a map, containing reference information;
k. **Mean Sea Level.** The average height of the surface of the sea for all stages of tide, used as a reference surface from which elevations are measured;
l. **Plateau.** It is an elevated region of land, usually quite long and fairly level;
m. **Plot.** To mark a location or route on a map;
n. **Ravine.** A ravine is a long, deep valley worn by a stream;
o. **Re-entrant.** A re-entrant is a valley or ravine on the side of a hill or mountain often between two spurs;
p. **Ridge.** A ridge is the line along a hill or range of hills;
q. **Saddle.** The low ridge between two peaks;
r. **Spur.** A minor feature, generally in the form of a ridge, that juts out from the side of a hill or mountain;
s. **Topography.** Surface features both natural and cultural, collectively depicted on topographic maps; and
t. **Universal Transverse Mercatur (UTM) grid.** A square grid system based on the Transverse Mercatur projection, depicted on maps. Named after Gerardus Mercator who published an atlas in 1569, which projected the earth onto a cylinder.

FOUR-FIGURE GRID REFERENCES

When you identify a location using the grid system it is called using a "grid reference." For centuries, mathematicians have always stated the X coordinate (vertical) before the Y coordinate (horizontal), so map users have adopted that procedure**. Eastings are stated before Northings**. Every 1 km grid square is identified by listing the numbers of the grid lines that intersect at **its bottom left corner**.



For example: The post office circled is located in the grid square identified as 7433. The hospital is at grid reference 7632. Remember: a four-figure grid reference refers to the entire grid square. The easiest way to remember to list the eastings then northings is to say, "In the door, then up the stairs."

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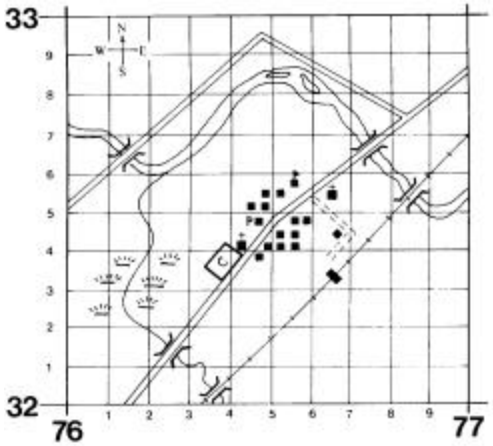
SIX-FIGURE GRID REFERENCES

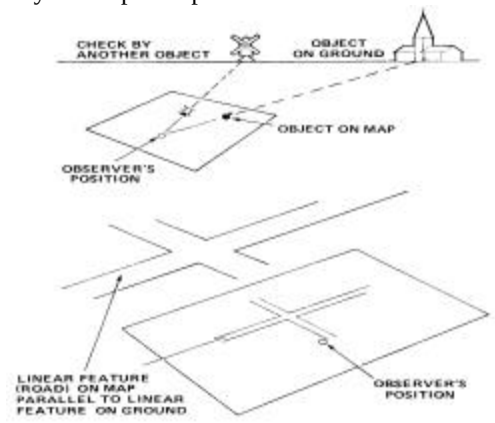
We often need to be more accurate than a 1 km square. Each small easting and northing is numbered 1 to 9, from west to east and from south to north respectively. Then each smaller (100m x 100m) square can be identified listing all eastings, then northings.



For example: Grid reference 761326 is given, the easting is 761 or 76 and 1/10, and the northing is 326 or 32 and 6/10. Locate your grid square at 7632 and then go in 1 and up 6. There is a church at grid reference 764324. There is a T-junction in the road at 768327. Remember that a six figure grid reference describes a square 100m x 100m .

ORIENT A MAP BY INSPECTION

Step 1 – identify your approximate location on the map.
Step 2 – identify 2 or 3 prominent landmarks on the ground and find them on the map. Try to use landmarks in different directions.
Step 3 – rotate your map until all identified objects on the map line up with the direction in which objects are located on the ground. If you are near a straight stretch of road, orient your map by using the road. Line up the road on the map parallel with the road on the ground.
Step 4 – check all around you to verify that the features to your front are in front of your position on the map, and so on. The top of your map now points north.



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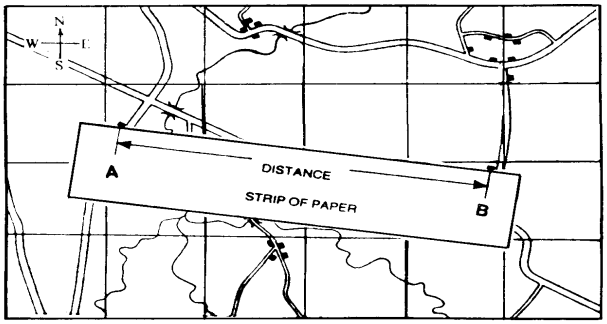
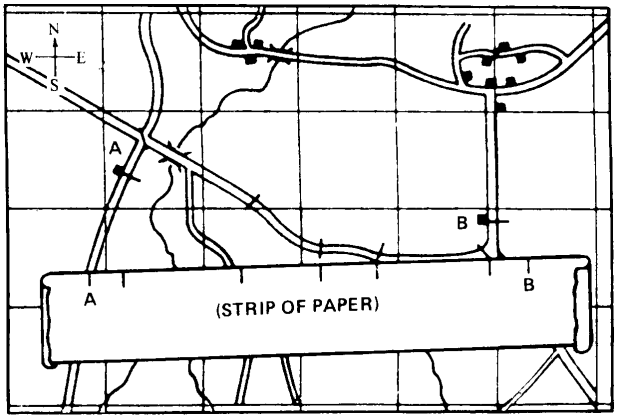
MEASURING DISTANCE BETWEEN TWO POINTS ON A TOPOGRAPHICAL MAP

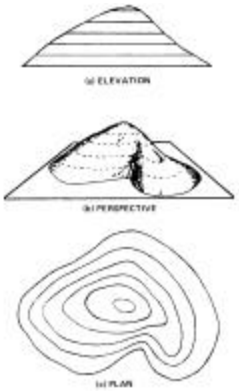




CONTOUR LINES

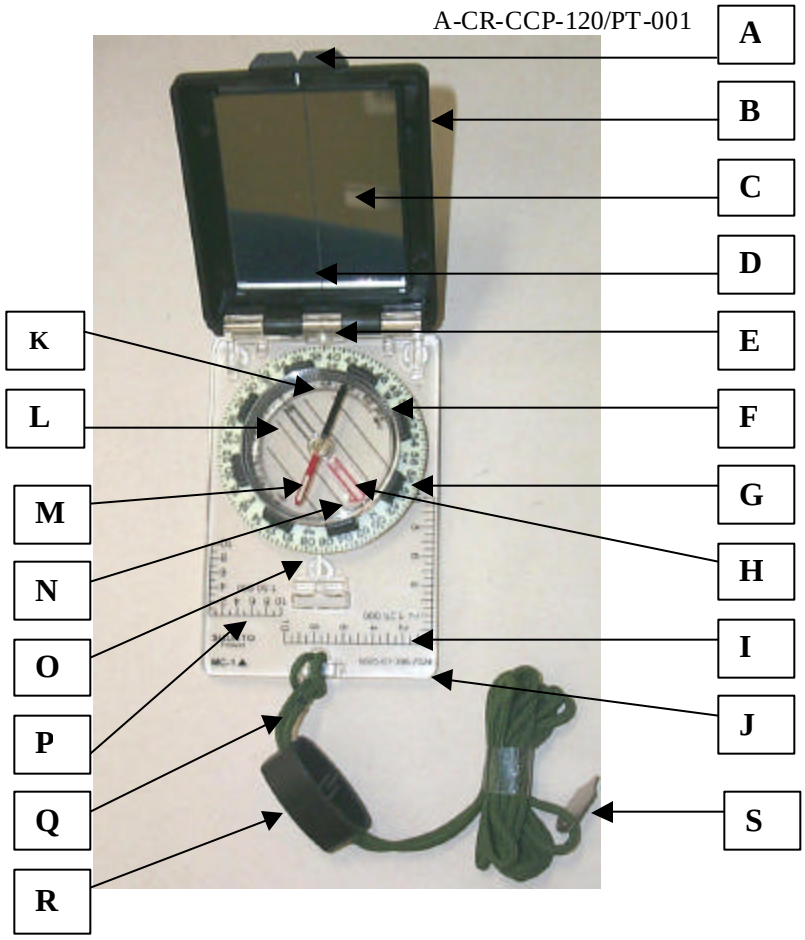
Elevation, or 'relief,' on a map is illustrated by joining all points with the same elevation to create contour lines. Now, instead of covering the entire map with contour lines, specific elevation values are selected with intervals between – e.g. every 10m. The value of the difference between the elevations of contour lines is labelled as the 'contour interval' and is printed in the bottom margin of the map. Not all maps have the same contour interval.

The contour lines are printed in light brown with every fifth line darker - called "index" contour lines. Elevation above Mean Sea Level (M.S.L.) is indicated on some lines, with the numbers (in metres or feet) always printed facing uphill.



COMPASS PARTS

LETTER	PART
A	**Sight** - used to sight your bearing.
B	**Compass cover** - folds down to protect main parts.
C	**Sighting mirror** - used to see compass dial when taking a bearing.
D	**Sighting line** - used to align the compass dial in the sighting mirror.
E	**Luminous index point** - point where bearing is read.
F	**Compass dial** - rotates to line up the compass needle when taking a bearing.
G	**Dial graduations** -in mils on edge of compass dial.
H	**Orienting arrow** - located inside the compass dial, reference that you line up with magnetic needle.
I	**1:25 000 Romer** - used to measure exact points on a map.
J	**Compass base plate** - flat clear piece of compass.
K	**Declination scale –** used to compensate for declination.
L	**Compass meridian lines** - black lines inside compass dial, used to line up the compass dial with grid lines on a map.
M	**Magnetic needle** - red needle that swings freely - points to magnetic North.
N	**Luminous orienting points** - on either side of the orienting arrow, used to line up magnetic needle at night.
O	**Luminous index point** – where the back bearing is read.
P	**1:50 000 Romer** - used to measure exact points on a map.
Q	**Safety cord or lanyard** - used to secure the compass.
R	**Adjustable wrist lock** - piece of plastic on the safety cord to adjust length around your wrist.
S	**Screwdriver**: used to adjust declination screw.
T	Declination adjustment screw.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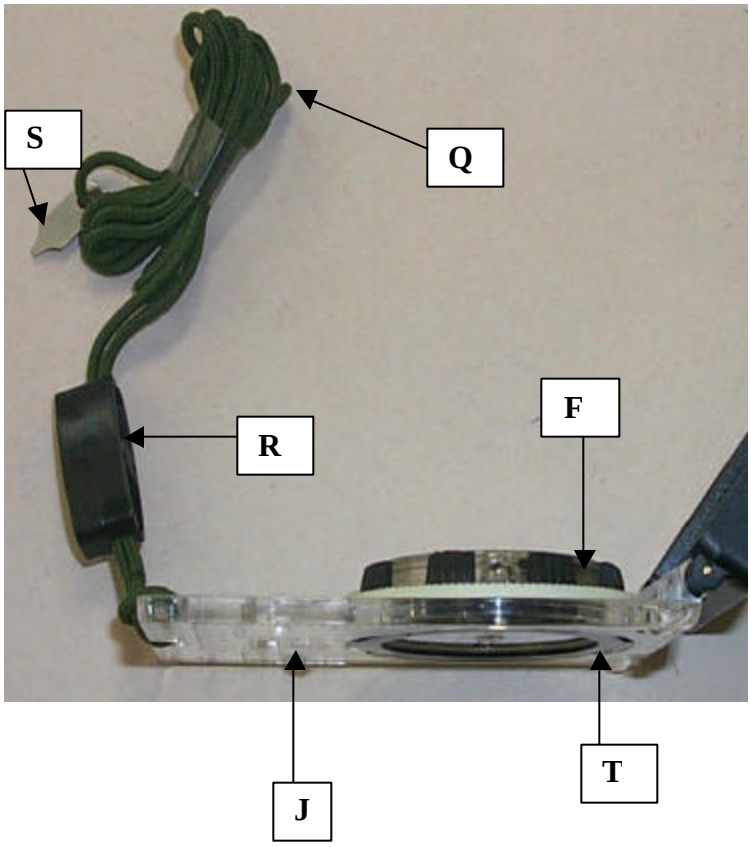
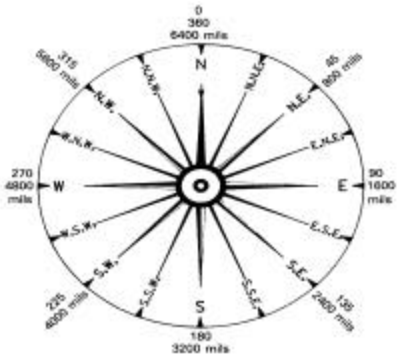
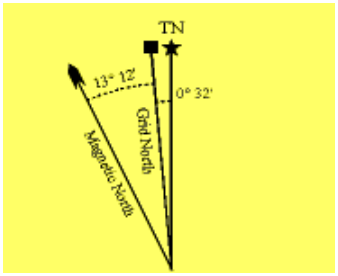


CARDINAL POINTS



THE THREE NORTHS



Magnetic North is shown with an arrow (compass), Grid North with a small square (map grid), and True North with a star (*Polaris* – the North Star).

MILS AND DEGREES

There are 360 degrees (360°) in a circle. There are 60 minutes (**60'**) in a degree, and there are 60 seconds (**60"**) in a minute.

Mils is a metric-like system for dividing a circle - map users commonly use 6400 mils in a circle. At one km each mil is about one metre wide.

In certain calculations, or when using a compass with dial graduations in degrees, you may need to convert mils to degrees or degrees to mils. For conversion purposes, there are **18** [17.78] mils in one degree.

MAGNETIC DECLINATION

'**Magnetic declination**' is the difference between true North and Magnetic North, and it is measured in degrees and minutes. Declination will change, not only depending on your geographic position, but also annually due to the shifting magnetic pole. There are only two lines in the Northern Hemisphere where the Magnetic and True Norths line up equaling a declination of 0° - one line running through central Canada and one through Russia. Declination is further described by stating whether the declination is East or West of True North.

CALCULATE DECLINATION

Example A (with east declination) – the declination as of 1991 was E 19°52' and the annual change decreasing 7.0'.

Current year:		2001
Year of declination information:		-1991
Difference of years:		10
Difference in years:	10	
Annual Change:	x 7.0'	
Total change:	70'	**or 1°10'**

Convert to degrees and minutes when 60' or more.

Annual change was **decreasing** so it is subtracted from the original declination:

Original declination:	E 19°52'
Total change:	-1°10'
Current declination:	**E 18°42'**

Example B (with west declination) – the declination as of 1993 was W 13°18' and the annual change increasing 1.7'.

Current year:		2001
Year of declination information:		-1993
Difference of years:		8
Difference in years:	8	
Annual Change:	x 1.7'	
Total change:	13.6'	**or 14'**

Round up or down as required.

Annual change was **increasing** so it is added:

Original declination:	W 13°18'
Total change:	+14'
Current declination:	**W 13°32'**

ORIENT YOUR MAP BY COMPASS

To orient your map with a compass:

a. set the current declination on your compass;
b. turn the compass dial to read;
c. lay the compass on the map with the mirror pointing North (top of the map);
d. align one side of the base plate with an Easting; and
e. holding the map and compass together at your front, turn yourself until the magnetic needle is directly over the orienting arrow inside the dial.

MEASURING A BEARING

To take a bearing you should:

a. set the current declination on your compass;
b. select the object on which a bearing is to be;
c. open the compass cover on an angle from the base plate;
d. hold the compass level at a full arms length and look through the compass sight, lining the sight on the object. Then, look in the sighting mirror and ensure the sighting line intersects the pivot in the centre of the dial;
e. glancing into the sighting mirror, rotate the compass dial with your index finger and thumb until the magnetic needle is over the orienting arrow. Ensure the sight has remained on the object; and
f. read the bearing on the compass dial at the luminous index point closest to the mirror.

SET AND FOLLOW A BEARING

To set and follow a bearing on a compass follow these steps:

a. set the current declination on your compass;
b. turn the dial until the required mils graduation is aligned with the luminous index point closest to the mirror;
c. hold the compass level and in front of you, then turn yourself until the magnetic needle is directly over the orienting arrow;
d. you are now facing the direction of the bearing –fold the cover at 45° (as above) , and raise the compass even with your eyes at a full arms length;
e. using the lanyard to align the sight and checking in the sighting mirror, move yourself until the magnetic needle is directly over the orienting arrow; and
f. look through the sight and select a prominent object aligned with the sight.

NAVIGATING WITH A MAP AND COMPASS

Map simplification – the most common simplification is:

a. locate the dangers – especially in the winter you need to be aware of bodies of water;
b. locate the primary contour features – you can even highlight or circle them;
c. look for unique features – landmarks you may be able to use along your route; and
d. establish borders – linear features that will keep you within a certain area while you navigate, including your

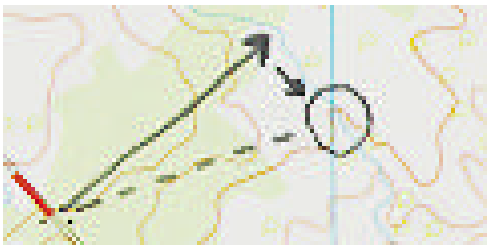
catching feature (knowing these features exist will give you more confidence as you navigate).

Route selection – can be strategized by considering the following;

a. what are the features of your target;
b. plan your route first to a nearby large landmark that's easy to find (*attack point*), then navigate from that point to your target;
   (1) ask yourself: "Can I do it? How far is it? How long should it take? What could go wrong?
c. at what speed or 'tempo' should I attempt to navigate each component of my route; and
d. what will stop me if I miss?

Note: Route planning is aided by remembering: **C**ontrol, **A**ttack point, **R**oute, **T**empo, and **S**top – **CARTS.**

Aiming off



EO 405.12: MEASURE A GRID BEARING

MEASURE A GRID BEARING WITH A PROTRACTOR

To measure a bearing using a protractor:

a. identify your start and finish points and mark them on the map;
b. draw a straight line from point A to point B (A is always your start point), this line is called a plotting ray;
c. place your protractor on the map with the centre hole over top of point A and 0 mils oriented to the top of the map (north);
d. your plotting ray should extend past the edge of your protractor, if is doesn't lengthen it;
e. ensure that the graduations where the plotting ray extends past the edge are mils and not degrees– simply rotate the protractor the other way if necessary;
f. align your protractor parallel to the grid lines by sliding the centre hole along the plotting ray (as shown below); then
g. read the bearing at the point where the plotting ray crosses through the mils graduations on the side of your protractor. The answer for the example below is 800 mils.

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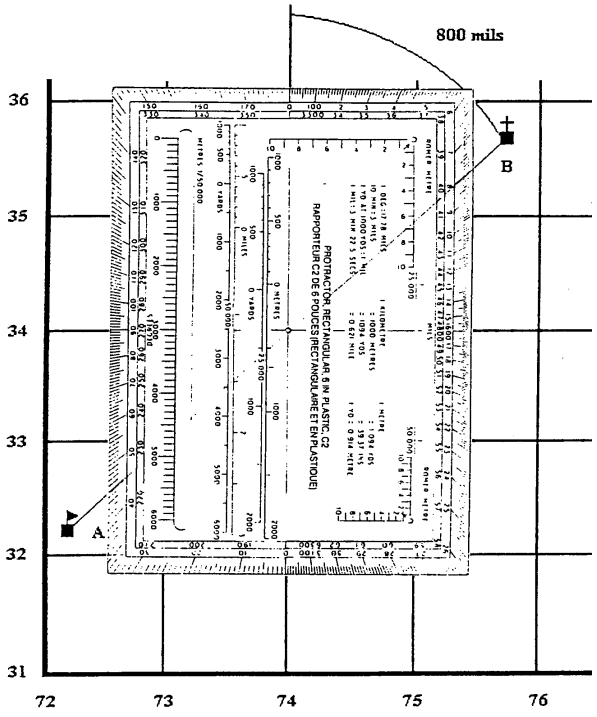
PROTRACTOR



USING A COMPASS AS A PROTRACTOR

To use your compass as a protractor:

a. draw your plotting ray from point A to point B;
b. open your compass fully, lay it on the map with compass **mirror pointing in your direction of travel** (point B);
c. place the edge of your compass on the plotting ray;
d. rotate the dial so that the compass meridian lines are lined up Eastings on your map, and ensure **north on the dial indicates north on the map**; and
e. read of the bearing at the luminous index point closest to the mirror.

REMEMBER – *the magnetic needle is not involved*!

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EO 405.13: CONVERT GRID BEARINGS TO MAGNETIC BEARINGS AND VICE VERSA

The first step - is to make the unit of measure for the declination and bearings the same – i.e. mils declination and mils bearings, or degrees declination and degrees bearings. Remember that there are 18 mils in one degree for conversion purposes.

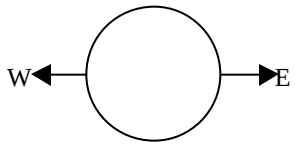
This simple table will assist you in converting bearings:

Grid	Declination	Magnetic

For West declination add going west

For East declination add going east

Always set up your table: **M**agnetic – **D**eclination - **G**rid –- **MDG** or *'My Dog's Groovy.'* Then always add in the direction referred to by the declination.



WEST DECLINATION TABLE

Example 1:

Magnetic	Declination	Grid
1725 mils	W 125 mils	1600 mils

◄——— For West declination add going west ———►

Or the mathematical formula: 1600 mils + 125 mils = 1725 mils

Example 2:

Magnetic	Declination	Grid
3200 mils	W 250 mils	x
3200 mils	W 250 mils	2950 mils

◄——— For West declination add going west ———►

Or the mathematical formula: **x** + 250 mils = 3200 mils
then: **x** = 3200 – 250
and: **x** = 2950 mils

Example 3:

Magnetic	Declination	Grid
5450 mils	W 16°	x
5450 mils	W 288 mils	
5450 mils	W 288 mils	5162 mils

The final magnetic bearing was rounded down to the closest 25 mils.

◄——— For West declination add going west ———►

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EAST DECLINATION TABLE

Example 1:

Magnetic	Declination	Grid
4800 mils	E 300 mils	5100 mils

For East declination add going east →

Example 2:

Magnetic	Declination	Grid
	E 100 mils	2200 mils
2100 mils	E 100 mils	2200 mils

For East declination add going east →

Practice:

Magnetic	Declination	Grid
	E 344 mils	6000 mils
1600 mils	E 270 mils	
2900 mils	E 21°	
	E 222mils	0100 mils

For East declination add going east →

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