PROGRAMED TEXT

VARIATION AND DEVIATION

AM-59

ABOVE THE FINEST

JANUARY 1969

UNITED STATES ARMY
PRIMARY HELICOPTER SCHOOL
FORT WOLTERS, TEXAS

PROGRAMED TEXT

PROGRAM TEXT

FILE NO:	**PROGRAM TITLE**
AM-59	VARIATION AND DEVIATION

POI SCOPE: An explanation of variation and deviation, depiction of isogonic lines on aeronautical charts, and application of variation and deviation in Log #1 to solve for Compass Heading.

INSTRUCTOR REFERENCES:

TM 1-225

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PREFACE

PROBLEM: Candidate Smith has been given a cross-country mission to fly from Fort Wolters to Abilene Municipal Airport. In his preflight preparation he has computed his compass heading as shown.

LOG #1: TC $\pm$ DC = TH $\pm$ VAR = MH $\pm$ DEV = CH

253° 5°R = 258 10°E = 248° −3° = 245°

Prior to this program, you have learned to compensate for <u>Wind</u> (apply DC) in obtaining TH.

TC $\pm$ DC = TH

This program will teach you to apply <u>VARIATION</u> and <u>DEVIATION</u>.

TH $\pm$ <u>VAR</u> = MH $\pm$ <u>DEV</u> = CH

Start with frame 1 and work each frame in succession. Each frame will usually ask you a question. The correct answer is printed on the top of the next frame. If you were incorrect, turn back and restudy the information before continuing on to the next frame. When you have finished the text, complete the self evaluation exercise. Now begin by studying the performance objectives on page iv.
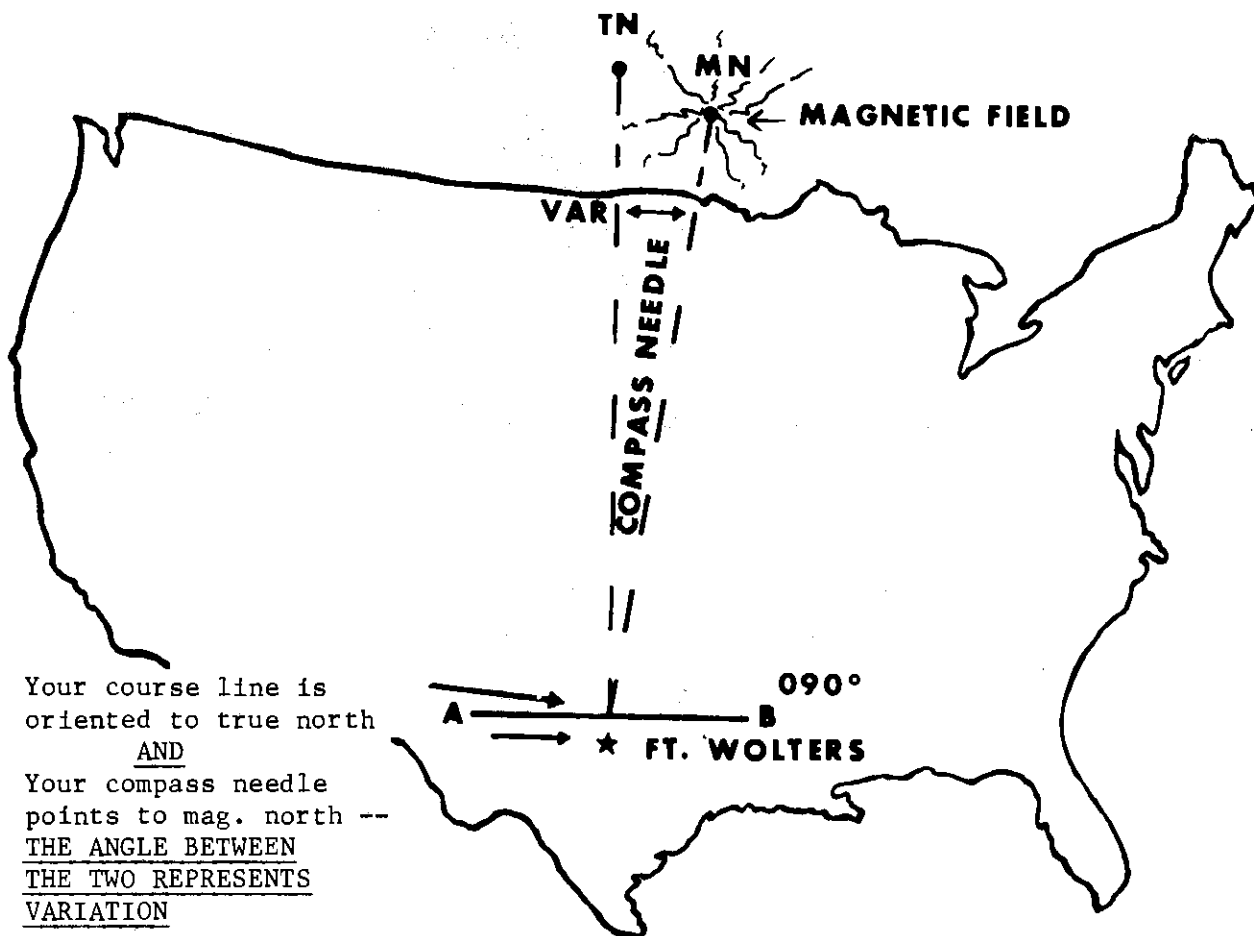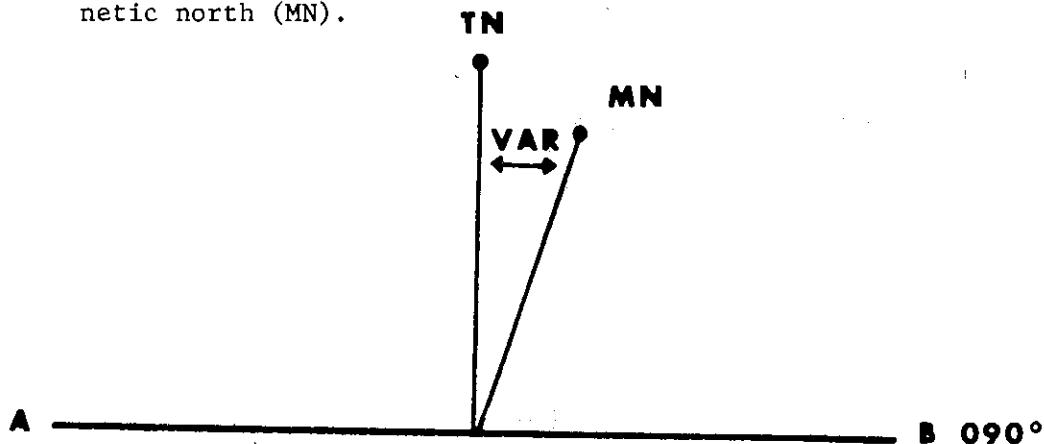
PERFORMANCE OBJECTIVES

Upon completion of this programed text, you will be able to:

1. Define and state the causes of variation and deviation.

2. Use log forms #1 and #2 to correct for drift, variation and deviation and arrive at a compass heading.

FRAME #1

DEFINITION: VARIATION is the ANGULAR DIFFERENCE between true north and mag-
              netic north (MN).

TN

MN

VAR

A ————————————————————————————————— B 090°

TN

MN

← MAGNETIC FIELD

VAR

COMPASS NEEDLE

090°

A ———————— B

★ FT. WOLTERS

Your course line is
oriented to true north
      AND
Your compass needle
points to mag. north --
THE ANGLE BETWEEN
THE TWO REPRESENTS
VARIATION
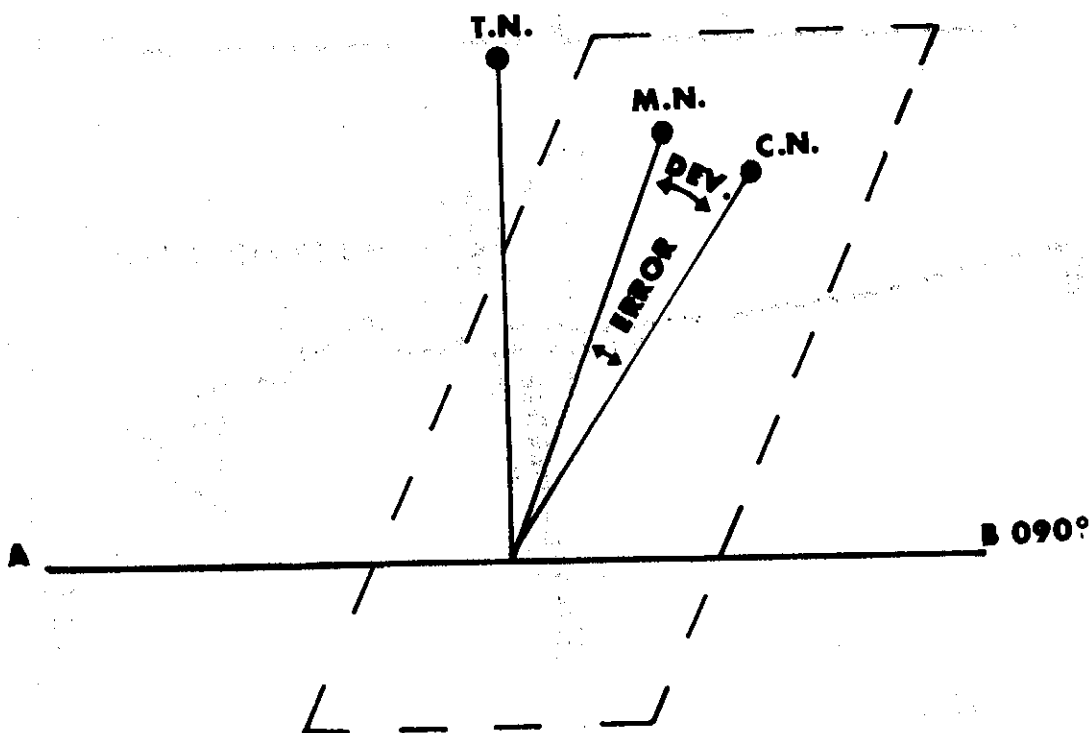
1

ANSWER: c. Compass heading

FRAME 8

DEFINITION: <u>Deviation</u> is the angular difference in degrees between magnetic north and compass north (CN).

2

The variation factor for a flight is found on your Sectional Chart in the form of <u>Isogonic Lines</u>.
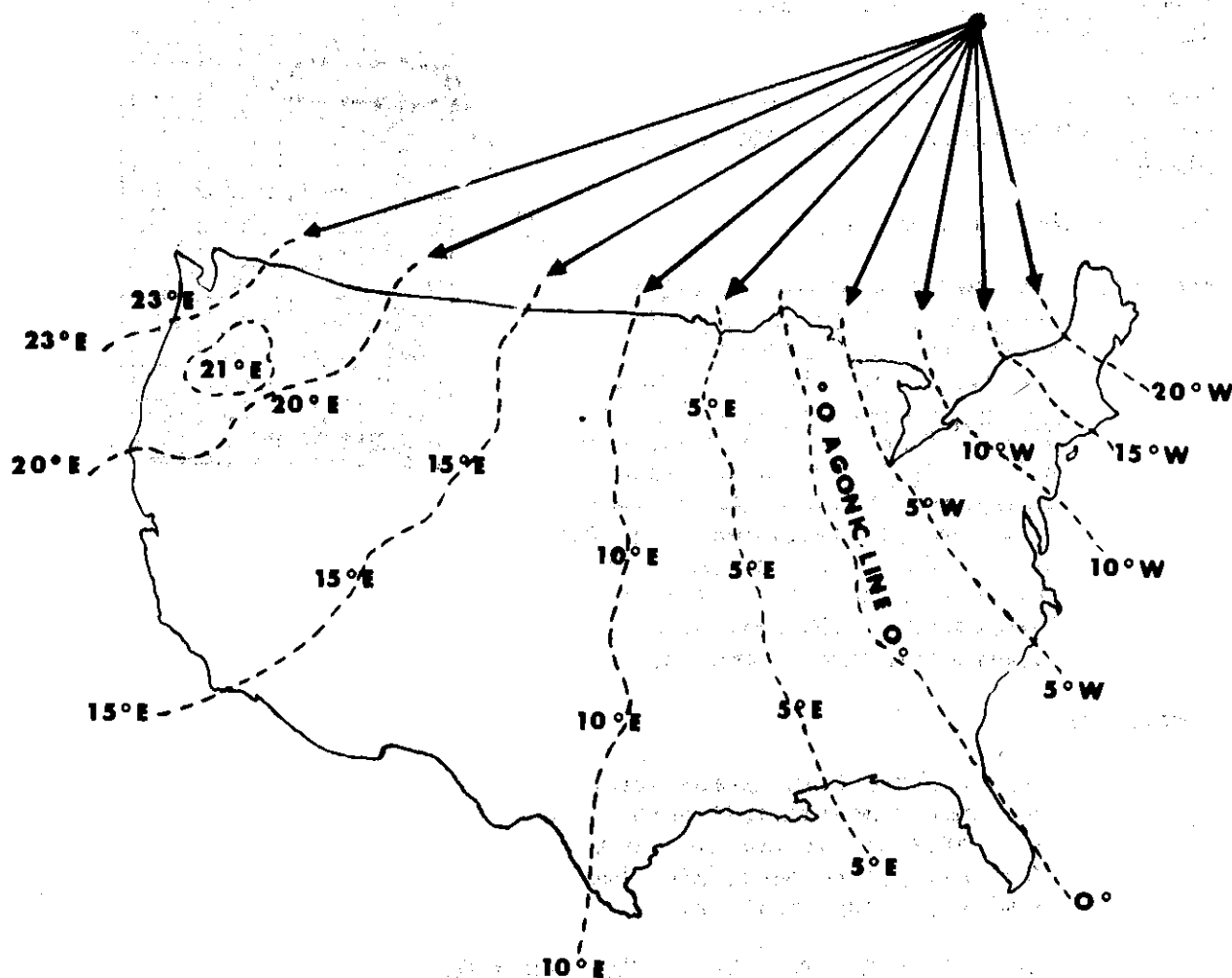
---The <u>Agonic Line</u> - Connects
points of 0° variation.

---<u>Isogonic Lines</u> - Connect
points of equal magnetic
variation.

(Using your Dallas Sectional)
What is the value of the Isogonic
Line that is nearest the city of
Mineral Wells   <u>9°E</u>   ?

Where is the deviation factor obtained?

In every aircraft there is a deviation card. It is located near the compass. ——→

From this card you will obtain the deviation factor.

You will notice, by observing the card, that deviation varies with each heading.

(Examine the card closely)

Example: You have computed a magnetic heading (to fly) of 015° in your preflight preparation. The deviation card tells you to steer a compass heading of 017°. Therefore, the deviation will be +2°. If you compute a magnetic heading that is not shown on the deviation card, then use the deviation of that heading in the "to fly" column that is closest to the magnetic heading you have computed.

COMPASS 67-15100		
SWUNG: 13 Jul 68	BY:	
N	002	180	182
15	017	195	196
30	031	210	210
45	046	225	227
60	062	240	243
75	078	255	258
90	092	270	271
105	105	285	283
120	120	300	303
130	134	315	317
150	150	330	331
165	166	345	345
TO FLY (MH)	STEER (CH)	TO FLY (MH)	STEER (CH)

PROBLEMS:

In your preflight preparation, you have compensated for DC and VAR and have obtained your MH. Using the card, find the deviation and obtain CH.
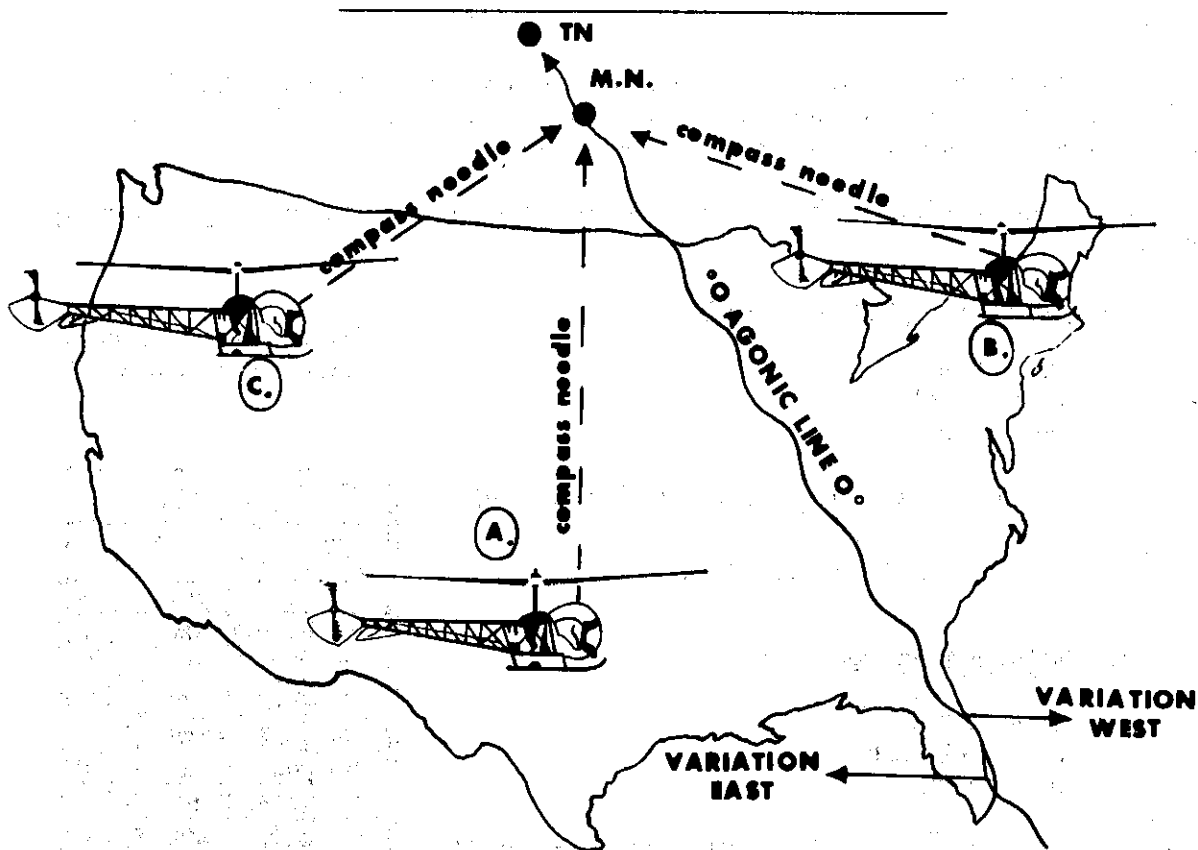
(a) TC $\pm$ DC = TH $\pm$ VAR = MH $\pm$ DEV = CH

270° 12R = 282° 3°W = 285° - 2° = 283°

(b) TC DC = TH   VAR = MH $\pm$ DEV = CH

340° 5°L = 335° 5°W = 340° +0° = 340°

FRAME 3

Whether the variation is <u>east</u> or <u>west</u> will depend on the <u>location</u> of your aircraft relative to true north and magnetic north. (East or west of the Agonic Line). Your direction of flight has no bearing on the variation.

In example A - The compass needle points <u>east</u> of geographic true north
SO variation is <u>east</u> or <u>minus</u> (-).
In example B - The compass points <u>west</u> of geographic true north <u>SO</u>
variation is <u>west</u> or <u>added</u> (+).
In example C - Is variation <u>east</u> or <u>west</u>? 4σ -

a. East
b. West

ANSWERS: a. −2°, 283
          b. 0° − In some cases there will be no deviation (0°)., 340

FRAME 10

MISSION:

You have been ordered to fly to Abilene Municipal Airport (32°25' − 99°41'), pick up a passenger and return to Fort Wolters. Weather is forecast to remain VFR for the entire flight.

Using your preflight data, compute your CH for the <u>flight out</u> and <u>flight back</u>.

a. <u>Outbound preflight data:</u>

TC − 253°
W/V − 093°/10k
DR − 4°R

$$TC \overset{+}{-} DC = TH \overset{+}{-} VAR = MH \overset{+}{-} DEV = CH$$

$$253° - 4° = 249° - 10 = 239° + 1° = 240°$$

b. <u>Return preflight data:</u>

TC − 073°
W/V −195°/15k
DR − 8°L

$$TC \overset{+}{-} DC = TH \overset{+}{-} VAR = MH \overset{+}{-} DEV = CH$$

$$073° + 8° = 081° - 9° = 072° + 0° = 072°$$

(This card is located near your compass)

COMPASS	67− 15100		
SWUNG: 13 Jul 68		BY: HEB	
TO FLY	STEER	TO FLY	STEER
N	002	180	183
15	017	195	198
30	032	210	212
45	044	225	227
60	061	240	241
75	075	255	256
90	090	270	272
105	106	285	288
120	122	300	302
135	137	315	316
150	151	330	332
165	167	345	346

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ANSWER: a.   East

FRAME 4

   RULE: In selecting the magnetic variation for a leg of your flight, use
the nearest whole degree at mid-course.   The one exception has reference to
short legs of a flight.   Where the mid-point of the course line is between
two consecutive isogonic lines as shown below.
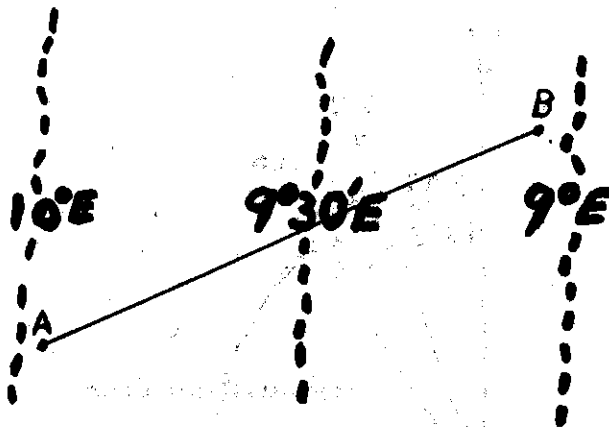
   If your destination is point "B", you will select 9°E variation but if
your destination is point "A", you will select 10°E variation.

PROBLEM: You have been assigned to fly from Fort Wolters Main Heliport
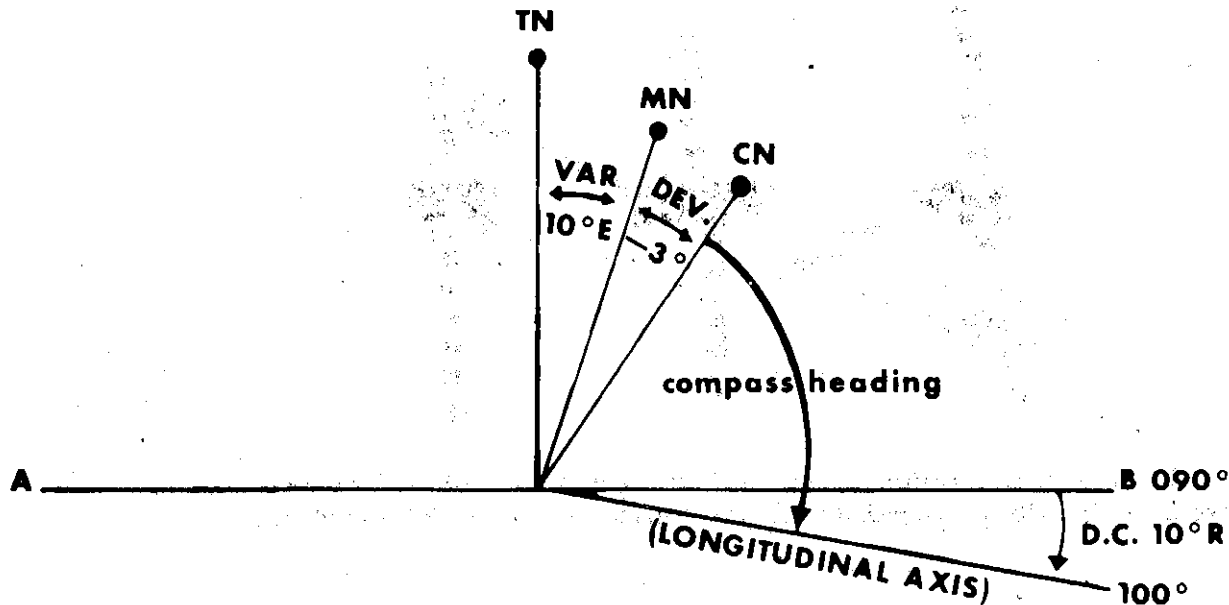   to Perrin AFB (33°42' - 96°35').   The variation for this leg
          is?

          a.   8°E   c.   9°E
          b.   8°30'E   d.   9°30'E

FRAME 11

What is a Compass Heading?

DEFINITION: Compass Heading is the <u>angle</u> measured clockwise from <u>compass</u>
<u>north</u> <u>to</u> <u>the</u> <u>nose</u> of the aircraft. (Longitudinal Axis)

If the <u>variation in this</u>
illustration is 10°E and
<u>deviation</u> is -3°, what is
the compass heading?

$$TC \overset{+}{-} DC = TH \overset{+}{-} VAR = MH \overset{+}{-} DEV = CH$$

$$90° + 10° = 100 - 10° = 90° - 3° = 87°$$

drift correction D C left = minus
                  D C right = plus

drift   OR   right = a left correction
          OR   left = a right correction

variation VAR East = minus
           VAR West = plus

FRAME 5

REMEMBER: Variation east is always subtracted from true heading (TH) to obtain magnetic heading (MH). Variation west is always added to TH to obtain MH.
This rhyme may help you remember:
EAST IS LEAST (−) AND WEST IS BEST (+)

PROBLEM: In planning a flight from Mineral Wells Airport to Abilene Municipal Airport, you have computed the following preflight information. Using the Dallas Sectional Chart, fill in the variation and magnetic heading.

$$TC \overset{+}{-} DC = TH \overset{+}{-} VAR = MH$$

$$253 \overset{+}{-} 5°R = 258 - 10° = 248'$$

DEFINITION: <u>Magnetic</u> <u>Heading</u> is the <u>angle</u> measured clockwise from <u>magnetic</u> <u>north</u> to the <u>nose</u> of the <u>aircraft</u>. (Longitudinal Axis)

ILLUSTRATION:
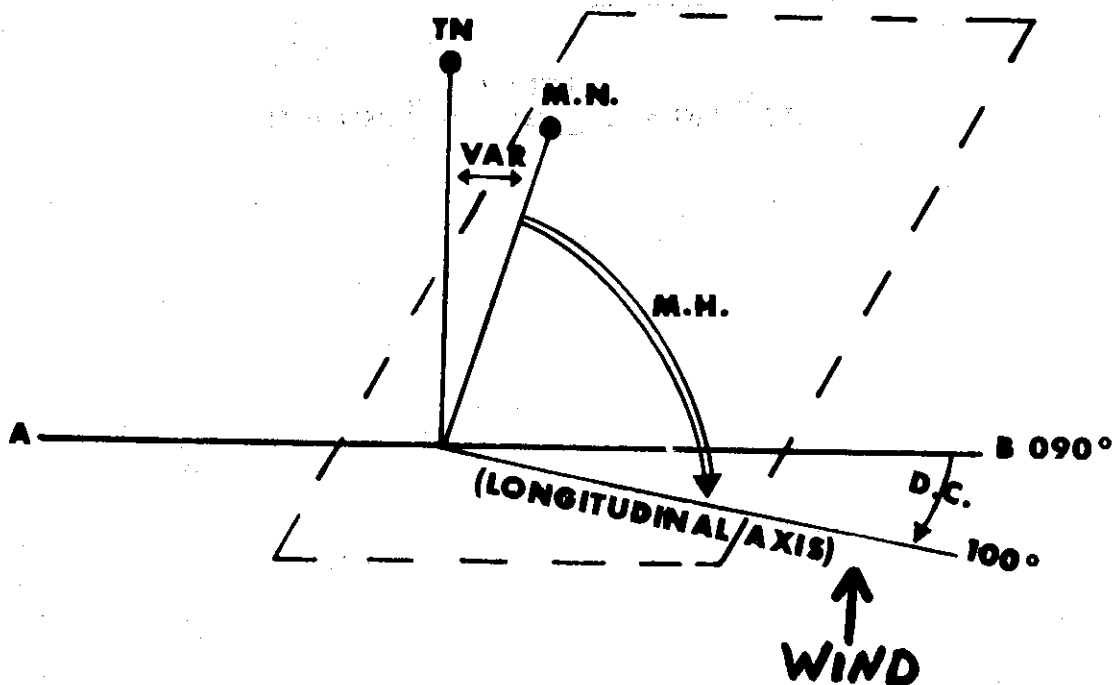
FRAME 12

The log form that you have used up to this point in this program and in previous programs is

$$TC \overset{+}{\underline{}} DC = TH \overset{+}{\underline{}} VAR = MH \overset{+}{\underline{}} DEV = CH$$
LOG #1

It is used with any chart (such as your Dallas Sectional) that is oriented to true north.

LATER ON YOU WILL HAVE A NEED FOR

$$TC \overset{+}{\underline{}} VAR = MC \overset{+}{\underline{}} DC = MH \overset{+}{\underline{}} DEV = CH$$
LOG #2

It is used with any chart (such as FLIP charts) that is oriented to magnetic north.

In comparison, the two log forms are almost identical. The same factors are used in both log forms with one exception.

What is the exception? *magnetic Course* .

$$TC \overset{+}{\underline{}} VAR = \boxed{MC} \overset{+}{\underline{}} DC = MH \overset{+}{\underline{}} DEV = CH$$
LOG #2

ANSWER: 10°E - 248°

FRAME 6

Isogonic Lines are:

   a. Lines that show the shape and elevation of terrain
   b. Lines that connect points of 0° variation
   ⓒ Lines that connect points of equal magnetic variation
   d. Lines that run east or west of the prime meridian

Mission:

You have been ordered to transport a passenger to Sheppard AFB and then return to Fort Wolters.
Given preflight data: TC - 342°
                          W/V - 035° /18k   (Use Chart)
                          DR - 9°L

$$TC \pm DC = TH \pm VAR = MH$$

$$342 + 9R = 351 + 10° = 341°$$

Your MH will be:

   a. 333°   ⓒ ~~341°~~ 342°

   b. 355°   d. 096°

Was this flight conducted east or west of the Agonic Line: (Circle the correct answer)

   a. East

   ⓑ West

Magnetic Heading is the angle measured clockwise from:

   a. TN to the nose of the aircraft
   b. TH to the nose of the aircraft
   c. Sheppard AFB to the nose of the aircraft
   ⓓ Magnetic north to the nose of the aircraft

ANSWER: Magnetic course (MC)

FRAME 13

DEFINITION: Magnetic Course (MC) is True Course (TC) corrected for
             variation.

$$\underline{TC + VAR = MC}$$

Apply the following information to Log #2 and obtain the compass
heading.

GIVEN: TC - 212°
                DC - 8°L
                VAR - 10°E
                DEV - +2°

$$TC \pm VAR = MC \pm DC = MH \pm DEV = CH$$

$$212° \underline{\ 10°\ } = 202 \cancel{}8 = 194 + 2 = 194°$$

FRAME 14

You intend to fly a MC of 090°. The wind is from 045°/10k and drift
is 5°R. (Variation if needed is 8°E.) What is your ~~MC?~~ M H

$dr = 8°R$ $TC \pm VAR = MC \pm DC = MH$

$$98° - 8° = 90° - 5° = 85°$$

a.   095°   c.   087°

(b.) 085°   d.   082°

CONTINUE TO THE SELF EVALUATION EXERCISE

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ANSWERS: c. Lines that connect points of equal magnetic variation
           c. 342^b
           b. West
           d. Magnetic north to the nose of the aircraft.

FRAME 7

NOW! You have successfully learned to compensate for variation <u>and</u>
      obtain your magnetic heading. This takes care of the <u>second</u> of
      three factors.

      The <u>third</u> and final factor is <u>DEVIATION</u>.

      $TC \pm DC = TH \pm VAR = MH \pm DEV = CH$

WHAT IS DEVIATION?

      Deviation is error caused by magnetic forces outside the
      instrument. (Compass)

EXAMPLE:

      When you get into the aircraft, the ignition and electrical systems
      are activated. This creates a magnetic field around the compass
      which causes the compass needle to vary slightly from magnetic
      north. <u>THIS DIFFERENCE</u> (IN DEGREES) <u>IS DEVIATION</u>. It must be
      applied to your MH to obtain the heading you will steer in flight.

      You will steer a:

      a. True heading   c. Compass heading
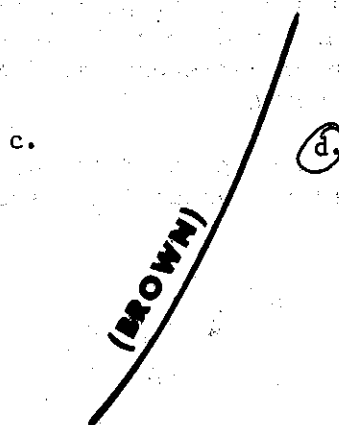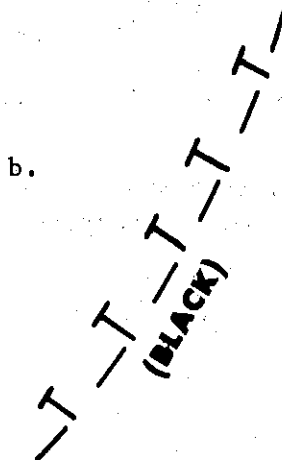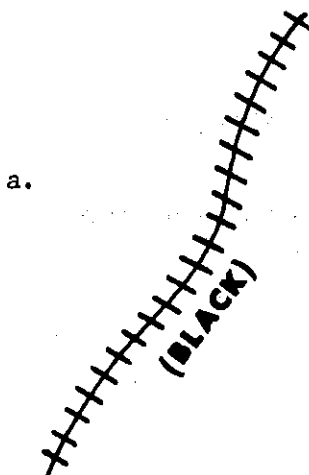
      b. Magnetic heading   d. Track

13

1. Variation can be defined as

    a. the angular difference in degrees between TN and MN.
    b. the difference in degrees between MH and CH.
    c. the angular difference in degrees between TH and CH
    d. the angle measured from TN to the actual path over the
        ground.

2. Lines that connect points of equal variation are shown on the chart in
    the form of:

    a. TC lines
    b. Isogonic lines
    c. Transmission lines

3. Easterly variation is always

    a. added to MC to obtain MH.
    b. subtracted from MC to obtain MH.
    c. added to TH to obtain MH.
    d. subtracted from TH to obtain MH.

4. Which symbol represents a Isogonic Line?

a.   b.   c.

(BLACK)   (BLACK)   (BROWN)   d.

MAGENTA   9.0

5. Magnetic heading can be defined as

    a. the intended flight path over the earth's surface
    b. the angle measured clockwise from magnetic north to the nose of the aircraft.
    c. the angle measured clockwise from compass north to the nose of the aircraft.
    d. the actual flight path of the aircraft over the ground.

6. Fill in the missing blanks in the following problems:

    a. TC $\pm$ DC = TH $\pm$ VAR = MH

        120° 5°R = 125° 8°E = _117°_

    b. TC $\pm$ DC = TH $\pm$ VAR = MH

        235°-12°L = 223°+7°W = _230°_

7. You are going to make a flight from Fort Wolters to Arledge Airport (32°54' - 99°43'). Using the Dallas Sectional, you will find the variation to be:

    a. 9°E
    b. 9°30'E
    c. 10°E
    d. 10°W

8. Deviation can be defined as

    a. the angular difference between TC and TH
    b. the intended flight path over the earth's surface.
    c. difference in degrees between TH and TRACK.
    d. the angular difference in degrees between magnetic north and compass north.

9. Deviation is a compass error caused by the metal components and operating electrical systems that surround the compass.

    a. True
    b. False

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10. The deviation factor is obtained from

    a. the Dallas Sectional Chart.
    b. base operations.
    c. your flight commander.
    d. the deviation card in the aircraft.

11. Find the compass heading in the following problems.

    a. TC $\pm$ DC = TH $\pm$ VAR = MH $\pm$ DEV = CH

        090° 10°R = 100° 8°E = 092° + 3° = _95°_

    B   TC $\pm$ DC = TH $\pm$ VAR = MH $\pm$ DEV = CH

        213° 4°L = 209° 5°E = 204° - 1° = _203°_

12. Compass Heading can be defined as

    a. the angular difference in degrees between TC and TH.
    b. the angle measured clockwise from compass north to the nose
        of the aircraft.
    c. the angle measured clockwise from TN to the nose of the air-
        craft.

    d. errors caused in instrument installation.

13. In the following problem you are given DC, Variation and Deviation.
    Fill in the missing factors.

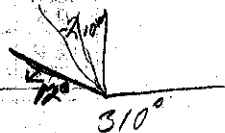   TC $\pm$ DC = TH $\pm$ VAR = MH $\pm$ DEV = CH

    120°+5°R = _125°_ 8° E = _117°_ -3° = _114°_

14. GIVEN: TC - 310°
             DC - 12°L
             VAR - 10°W
             DEV - -2°

    $310 - 12° = 298° + 10° = 308° - 2° = 306$

    Your compass heading will be:

    a. 306°   c. 331°

    b. 316°   d. 329°

15. You intend to fly a magnetic course (MC) of 080° drift is 4°L.
(Variation if needed is 11°W). What is your MH? (Log #2 - TC±
VAR = MC ± DC = MH)

$80 + 4° = 84°$

a. 084°

c. 095°

b. 076°

d. 089°

16. You are to make a flight <u>from</u> Fort Wolters main heliport <u>to</u> Clark
Field (32°13' - 98°11') at Stephenville.

<u>Given Preflight Data:</u>

TC - 190°
W/V - 085°/12k
DR - 7°R

Using your chart and deviation card find the compass heading that you
will steer in flight.

TC ± DC = TH ± VAR = MH ± DEV = CH

$190° - 7° = 183° - 9° = 174° + 3 = 177°$

COMPASS 67-15100			
SWUNG: 16 JUL 68		BY: WSB	
TO FLY	STEER	TO FLY	STEER
N	002	180	183
15	017	195	198
30	032	210	212
45	044	225	227
60	061	240	241
75	075	255	256
90	090	270	272
105	106	285	288
120	122	300	302
135	137	315	316
150	151	330	332
165	167	345	346

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ANSWERS TO SELF EVALUATION EXERCISE

1. a

2. b

3. d

4. d

5. b

6. a, 117° b 230°

7. c

8. d

9. True

10. d

11. a, 95° b 203°

12. b

13. TH = 125°   MH = 117°   CH = 114°

14. a

15. a

16. CH = 177°

    190° - 7°L = 183° - 9°E = 174° + 3 = 177°

$$TC \pm DC = TH \pm VAR = (MH \pm DEV = CH)$$

$$TC \pm VAR = MC \pm DC = (MH \pm DEV = CH)$$