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IDENTIFIERS	*Aerographers Mates; Air Force

ABSTRACT

This course trains Air Force personnel to perform duties prescribed for weather specialists and aerographer's mates. Training includes meteorology, surface and ship observation, weather radar, operation of standard weather instruments and communications equipment, and decoding and plotting of surface and upper air codes upon standard maps and diagrams. A plan of instruction details criterion objectives for each unit of instruction, time, training standard correlation, and support materials and guidance. Student materials include programmed instruction for identification of weather message headings, sound ray theory, evaluating and encoding bathythermograph data, APT predict message and tracking board, shipboard weather office, decoding RADFO message and International Analysis Code, radar reports, and oceanic circulation; study guides on orientation and observation; study guide/workbooks on meteorology, weather equipment operation, pilot-to-metro service, preparation of weather charts, Terminal Aerodrome Forecast Code, and map plotting; workbooks on sky condition, cloud forms, visibility and present weather, additive data, Metar Code, PIREP Code, weather codes and messages, observation, weather plotting, radar, and scope interpretation; a weather codes plotting guide; and a study guide on Metar encoding and dissemination. Study guides, workbooks, and study guide/workbooks contain exercises or objectives, introduction, information, and questions, exercises, and/or projects. (YLB)

WEATHER SPECIALIST/
AEROGRAPHER'S MATE

CHANUTE TECHNICAL TRAINING CENTER

POI C3ABR25130 000
POI C3ABR25130 002

(PDS Code AXE)
(PDS Code VOG)

PLAN OF INSTRUCTION

(Technical Training)

WEATHER SPECIALIST/
AEROGRAPHER'S MATE
(C-420-2010-A1)

CHANUTE TECHNICAL TRAINING CENTER

9 January 1985 - Effective 9 January 1985 with class 850109

ATC FORM 214 (JAN 75) OBSOLETES ATC FORMS 214, MAY 59, 522, NOV 53 AND 523, MAY 71 STANDARD COVERSHEET

POI C3ABR25130 000
POI C3ABR25130 002

LIST OF CURRENT PAGES

This POI consists of 69 current pages issued as follows:

Page No.	Issue
Title	Original
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DEPARTMENT OF THE AIR FORCE
3330 Technical Training Wing (ATC)
Chanute Air Force Base, Illinois 61868

PLAN OF INSTRUCTION C3ABR25130 000
(PDS Code AXE)
C3ABR25130 002
(PDS Code VCG)
9 January 1985

FOREWORD

1. PURPOSE: This publication is the plan of instruction (POI) when the pages listed on page A are bound into a single volume. The POI contains the qualitative requirements for courses C3ABR25130 000, Weather Specialist, and C3ABR25130 002, Aerographer's Mate (C-420-2010-A1) in terms of criterion objectives for each unit of instruction and shows time, training standard correlation, and support materials and guidance. When separated into units of instruction, it becomes the lesson plan/Part I. This POI was developed according to AFR 50-8, Instructional System Development, and ATCR 52-18, Plans of Instruction, Lesson Plans and Course Validation.

2. COURSE DESIGN/DESCRIPTION: The instructional design for these courses are Group Pace. The Weather Specialist course trains airmen to perform duties prescribed in AFR 39-1 for Weather Specialists, AFSC 25130. Training includes meteorology, observing, recording, encoding and transmitting of weather elements for a surface observation; weather radar; operation of standard weather instruments and communications equipment; and decoding and plotting of both surface and upper air codes upon standard maps and diagrams. The Aerographer's Mate course trains Navy and Marine personnel to perform duties prescribed in NAV PERS 18068D for Aerographer's Mate (AG). Training includes meteorology, observing, recording, encoding and transmitting of weather elements for a ship or surface observation; operation of standard weather instruments and communications equipment; and decoding and plotting of both surface and upper air codes upon standard maps and diagrams. In addition, military training is provided on commander's calls/briefings, etc. for both courses.

NOTE 1: The teaching sequences of units of instruction and/or criterion objectives may be varied to ensure maximum utilization of limited facilities.

NOTE 2: Course C3ABR25130 000 is combined with all units of Block I and II for course C3ABR25130 002. The Unique Block IIIs are included for both courses. Pages 25-42 are USAF only and 43-64 are USN only.

3. TRAINING EQUIPMENT: The number shown in parentheses after equipment listed as Training Equipment and under SUPPORT MATERIALS AND GUIDANCE is the planned number of students assigned to each equipment unit.

4. REFERENCES: This POI is based on Specialty Training Standard 251X0, February 1981, and Course Chart C3ABR25130 000, 1 August 1983. The USN CTS references are from CTS C-420-2010, 16 November 1979 (CNO Ltr Ser 592/753413, 20 Nov 80) and Course Chart C3ABR25130 002, 1 August 1983.

FOR THE COMMANDER

J. R. POND, Colonel, USAF
Commander, 3350 Technical Training Group

Supersedes PCI C3ABR25130 000, 22 November 1983 and PCI C3ABR25130 002, 22 November 1983.
OPR: 3350 Technical Training Group
DISTRIBUTION: Listed on Page A

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PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE Weather Specialist Aerographer's Mate (C-420-2010-A1)

BLOCK TITLE
Basic Weather

1. COURSE CONTENT	2. TIME
1. Orientation and Study Techniques	3
a. Completion of locator card. STS: None CTS: None Meas: None	
b. Diagnostic testing. STS: None CTS: None Meas: None	
c. School orientation conducted IAW CR 50-18, Attachment 3 outline. STS: None CTS: None Meas: None	

SUPERVISOR APPROVAL OF LESSON PLAN

SIGNATURE AND DATE	SIGNATURE AND DATE

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR25130-SG-101, Orientation

Training Methods
Discussion (3 hrs)

Instructional Guidance
Privacy act statement for all personal data forms are available for student to read if he wishes. Observe students closely during class and emphasize safety. Stress conservation of energy and materials and the requirement to turn in all training literature in serviceable condition upon completion of block.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE Weather Specialist Aerographer's Mate (C-420-2010-A1)

BLOCK TITLE
Basic Weather

1. COURSE CONTENT	2. TIME
2. Meteorology	33
a. Without reference, select the definitions of climatological terms to a minimum of 75% accuracy. STS: 13a CTS: None Meas: PC	(.5)
b. Without reference, select the facts about the important climatic elements to a minimum of 75% accuracy. STS: 13b CTS: None Meas: PC	(.3)
c. Without reference, select facts about climatic controls to a minimum of 75% accuracy. STS: 13c CTS: 2f Meas: PC	(.4)
d. Without reference, select facts about the interface between the air and the sea to a minimum of 75% accuracy. STS: 13d CTS: 2f Meas: PC	(.3)
e. Without reference, select the facts about the chemical properties of the atmosphere to a minimum of 75% accuracy. STS: 14b(1) CTS: 2a Meas: PC	(.7)
f. Without reference, select the facts about the atmospheric regions to a minimum of 75% accuracy. STS: 14b(2) CTS: 2a Meas: PC	(.8)
g. Without reference, select the facts about the atmospheric variables to a minimum of 75% accuracy. STS: 14b(3) CTS: 2a, 2e Meas: PC	(3)
h. Without reference, select the facts about radiation to a minimum of 75% accuracy. STS: 14i(1) CTS: 2b Meas: PC	(.4)
i. Without reference, select the facts about conduction to a minimum of 75% accuracy. STS: 14i(3) CTS: 2b Meas: PC	(.4)
j. Without reference, select the facts about the convection to a minimum of 75% accuracy. STS: 14i(2) CTS: 2b Meas: PC	(.4)
k. Without reference, select the facts about advection to a minimum of 75% accuracy. STS: 14i(4) CTS: 2b Meas: PC	(.4)
l. Without reference, select the facts about the adiabatic processes to a minimum of 75% accuracy. STS: None CTS: 2f Meas: PC	(.4)

SUPERVISOR APPROVAL OF LESSON PLAN

SIGNATURE AND DATE	SIGNATURE AND DATE

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m. Without reference, select the facts about the earth-sun relationships to a minimum of 75% accuracy. STS: None CTS: 2b Meas: PC (.5)

n. Without reference, select the fundamental concepts of temperature to a minimum of 75% accuracy. STS: 14a(3) CTS: None Meas: PC (.5)

o. Without reference, select the fundamental concepts of pressure to a minimum of 75% accuracy. STS: 14a(2) CTS: 2e Meas: PC (1)

p. Without reference, select the facts about the constant level surfaces to a minimum of 75% accuracy. STS: 14b(5) CTS: 2h Meas: PC (1)

q. Without reference, select the facts about the atmospheric laws to a minimum of 75% accuracy. STS: 14a(5) CTS: 2e Meas: PC (.3)

r. Without reference, select facts about the forces related to winds to a minimum of 75% accuracy. STS: 14c(2) CTS: 2e Meas: PC (.5)

s. Without reference, select facts about the types of wind conditions to a minimum of 75% accuracy. STS: 14c(1) CTS: 2e Meas: PC (.3)

t. Without reference, select facts about the characteristics of winds to a minimum of 75% accuracy. STS: 14c(3) CTS: 2e Meas: PC (.7)

u. Without reference, select facts about the definition of a jet stream to a minimum of 75% accuracy. STS: 14f(1) CTS: 2i Meas: PC (.3)

v. Without reference, select facts about the general circulation of the atmosphere to a minimum of 75% accuracy. STS: 14b(4) CTS: 2e Meas: PC (1)

w. Without reference, select facts about local circulations to a minimum of 75% accuracy. STS: 14c(6) CTS: 2f Meas: PC (1)

x. Without reference, select the terms related to pressure systems to a minimum of 75% accuracy. STS: 14d(1) CTS: 2g Meas: PC (1)

y. Without reference, select the characteristics of a pressure systems to a minimum of 75% accuracy. STS: 14d(3) CTS: 2g Meas: PC (1)

z. Without reference, select the fundamental concepts of moisture to a minimum of 75% accuracy. STS: 14a(4) CTS: 2c Meas: PC (1.8)

aa. Without reference, select facts about moisture as it pertains to clouds to a minimum of 75% accuracy. STS: 141(1) CTS: 2c Meas: PC (.2)

bb. Without reference, select facts about the formation processes of clouds to a minimum of 75% accuracy. STS: 141(2) CTS: 2c Meas: PC (1.5)

cc. Without reference, select facts about the dissipation processes of clouds to a minimum of 75% accuracy. STS: 141(3) CTS: 2c Meas: PC (.3)

dd. Without reference, select facts about precipitation from clouds to a minimum of 75% accuracy. STS: 141(4) CTS: 2c Meas: PC (.2)

ee. Without reference, select facts about airmass source regions to a minimum of 75% accuracy. STS: 13f CTS: 2g Meas: PC (.2)

ff. Without reference, select facts about airmass types to a minimum of 75% accuracy. STS: 13e CTS: 2g Meas: PC (.2)

gg. Without reference, select the characteristics of airmasses to a minimum of 75% accuracy. STS: 13g CTS: 2g Meas: PC (.8)

hh. Without reference, select facts about the modification of airmasses to a minimum of 75% accuracy. STS: 13h CTS: 2g Meas: PC (.8)

ii. Without reference, select the facts about fog to a minimum of 75% accuracy. STS: None CTS: 2d Meas: PC (1)

jj. Without reference, select facts about the definition of a front to a minimum of 75% accuracy. STS: 14e(1) CTS: 2g Meas: PC (.2)

kk. Without reference, select facts about the types of fronts to a minimum of 75% accuracy. STS: 14e(3) CTS: 2g Meas: PC (.8)

ll. Without reference, select the characteristics of fronts to a minimum of 75% accuracy. STS: 14e(4) CTS: 2g Meas: PC (.8)

mm. Without reference, select the facts about frontal passage indices to a minimum of 75% accuracy. STS: 14e(6) CTS: 2g Meas: PC (.2)

nn. Without reference, select the definitions of severe weather to a minimum of 75% accuracy. STS: 14m(1) CTS: 2j Meas: PC (.3) oo. Without reference, select the facts about severe winds to a minimum of 75% accuracy. STS: 14m(4) CTS: 2j Meas: PC (.3)

pp. Without reference, select the facts about severe precipitation to a minimum of 75% accuracy. STS: 14m(5) CTS: 2j Meas: PC (.3)

qq. Without reference, select facts about the types of thunderstorms to a minimum of 75% accuracy. STS: 14m(3)(a) CTS: 2j Meas: PC (.5)

rr. Without reference, select facts about the formation of thunderstorms to a minimum of 75% accuracy. STS: 14m(3)(b) CTS: 2j Meas: PC (1.3)

ss. Without reference, select facts about the characteristics of thunderstorms to a minimum of 75% accuracy. STS: 14m(3)(c) CTS: 2j Meas: PC (1.2)

tt. Without reference, select facts about the types of tropical weather systems to a minimum of 75% accuracy. STS: 14n(1) CTS: 2k Meas: PC (1.5)

uu. Without reference, select the characteristics of tropical weather systems to a minimum of 75% accuracy. STS: 14n(2) CTS: 2k Meas: PC (1.5)

SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR25130-HO-100, Weather Glossary
C3ABR25130-SG-102, Basic Meteorology

Audio Visual Aids
TF 46-3974MB, Introduction to Weather
TF 1-5206A, Wind and the Navigator
27437AV, Unchained Goddess
NWS-AG-A-018 A/V, Part I, Cloud Slide Presentation
27500 MW, Airmasses and Fronts
52190 AB, Tornado, A Spotter's Guide
MN 10781B, Thunderstorms
MN 10781A, Hurricanes

Training Methods
Lecture/Discussion (33 hrs)

Instructional Guidance
Define climatological terms. Lecture on the gases and impurities in the atmosphere and the three lowest layers. Discuss the distribution of temperature and pressure in the atmosphere. Discuss the types of heat transfer and other factors influencing heat distribution and the measurement of heat. Discuss rotation and revolution and their effects

of the earth's heat balance. Discuss pressure terms. Show films 27437AV and TF 1-5206A. Define the atmospheric laws, then lecture on the forces affecting circulation. Lecture on the types of wind conditions and the characteristics of winds. Define a jet stream. Lecture on the general circulation and local circulation. Discuss Chinook winds. Lecture on the characteristics of atmospheric pressure. Lecture on the three states of moisture and the processes of state changes. Define saturation, relative humidity and dew point. Explain what happens when the atmosphere goes beyond saturation. Define a cloud, then discuss the moisture pertaining to, the dissipation and formation processes of, and the precipitation associated with clouds. Briefly discuss the 27 reportable cloud types and inform students they must become very familiar with these for later on in the block. Show cloud slide tape presentation NWS-AG-A-018 A/V, Part I to depict the different forms and basic types. Define the source regions of airmasses and the different types of airmasses. Lecture on the characteristics of airmasses and the factors which cause them and climates, in general, to become modified. Show film 27500 MW. Discuss different types of fog and the conditions necessary for formation. Define a front. Define the different types of fronts and discuss the characteristics of cold, warm, stationary, and occluded fronts. Lecture on frontal passage indices. Define severe weather. Discuss severe winds and precipitation, stressing safety precautions. Discuss the types of thunderstorms and the formation processes and characteristics of thunderstorms, stressing safety precautions. Show films 52190 AB and MN 10781B. Define the different types of tropical weather and the characteristics of each type. Show films MN 10781A and TF 46-3974MB. Administer progress checks as needed. Emphasize safety.

3. Sampling Written Test and Critique 2

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE Weather Specialist, Aerographer's Mate (C3420-2010-A1)

BLOCK TITLE

Basic Weather

1. COURSE CONTENT	2. TIME
4. Sky Condition	37
a. Without reference, select those facts which relate to sky condition and clouds to a minimum of 75% accuracy. STS: 7a(1) CTS: 3a(1) Meas: PC	(2)
b. Given the FMH-1B, weather scenarios, and handout, encode the required sky condition entries on an AWS Form 10 to a minimum of 80% accuracy. STS: 7d(1) CTS: 3b(1) Meas: PC	(35)

SUPERVISOR APPROVAL OF LESSON PLAN

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR25130-HO-10CA, Reference Pages for FMH-1B
AWS Form 10
C3ABR25130-HO-104, 10 and 30 Gram Balloon Ascension Rates
C3ABR25130-HO-104A, Student Checklist
C3ABR25130-WB-104, Sky Condition
C3ABR25130-WB-104b, Cloud Forms
FMH-1B, Surface Observation
C3ABR25130-HO-100B, Airways Remarks

Audio Visual Aids
NWS-AG-A-018 A/V, Parts II through V, Cloud Slide Presentation
Transparency, Sky Condition

Training Methods
Lecture/Discussion (16 hrs)
Demonstration/Performance (21 hrs)

Multiple Instructor Requirements
Performance (2)

Instructional Guidance
Distribute FMH-1B and discuss its content and use. Discuss observational methods for evaluating sky condition layers. Discuss the remarks needed to enhance the basic sky condition entries to include remarks for special cloud types. Show cloud slide tape presentation NWS-AG-A-018 A/V, Parts II thru V. Observe students closely and administer progress checks as required. Emphasize safety.

MIR: During performance hours, 2 instructors will be available for supervision when class size exceeds 15 students.

5. Sampling Written Test and Critique 1

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE Weather Specialist Aerographer's Mate (C-420-2010-41)
BLOCK TITLE Basic Weather	

1. COURSE CONTENT	2. TIME
6. Visibility and Present Weather	37
a. Without reference, select those facts which relate to visibility to a minimum of 75% accuracy. STS: 7a(2) CTS: 3a(2) Meas: PC	(.3)
b. Without reference, select those facts which relate to present weather to a minimum of 75% accuracy. STS: 7a(3) CTS: 3a(3) Meas: PC	(3.7)
c. Given the FMH-1B, weather scenarios, and handout, encode the required visibility, RVR, and present weather entries on an AWS Form 10 to a minimum of 80% accuracy. STS: 7d(1) CTS: 3b(1) Meas: PC	(33)

SUPERVISOR APPROVAL OF LESSON PLAN

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR25130-HC-100A
AWS Form 10
C3ABR25130-HC-106A, Student Checklist
C3ABR25130-WB-106, Visibility and Present Weather
C3ABR25130-HO-100B
FMH-1B

Audio Visual Aids
Transparencies, Visibility and Present Weather

Training Methods
Lecture/Discussion (11 hrs)
Demonstration/Performance (26 hrs)

Multiple Instructor Requirements
Performance (2)

Instructional Guidance
Discuss observational methods and techniques needed to observe vsibility and present weather. Stress the rules governing the Form 10 entries. Observe the students closely and administer the progress checks as required. Emphasize safety.

MIR: During the performance hours, 2 instructors will be available for supervision when class size exceeds 15 students.

7. Sampling Written Test and Critique 1

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE Weather Specialist Aerographer's Mate (G-420-2010-A1)
BLOCK TITLE Basic Weather	

1. COURSE CONTENT	2. TIME
8. Temperature, Wind and Pressure	28
a. Without reference, select those facts which relate to atmospheric temperatures to a minimum of 75% accuracy. STS: 7a(4) CTS: 3a(6) Meas: PC	(.3)
b. Without reference, select those facts which relate to wind to a minimum of 75% accuracy. STS: 7a(5) CTS: 3a(4) Meas: PC	(.4)
c. Without reference, select those facts which relate to pressure to a minimum of 75% accuracy. STS: 7a(6) CTS: 3a(5) Meas: PC	(.3)
d. Given the FMH-1B, weather scenarios, psychrometric calculator, pressure conversion table and handout, encode the required temperature, wind and pressure entries on an AWS Form 10 to a minimum of 80% accuracy. STS: 7d(1) CTS: 3b(1) Meas: PC	(27)

SUPERVISOR APPROVAL OF LESSON PLAN

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SUPPORT MATERIALS AND GUIDANCE

<u>Student Instructional Materials</u>
C3ABR25130-HO-100A
AWS Form 10
C3ABR25130-HO-108, Pressure Conversion Table
C3ABR25130-HO-108A, Student Checklist
C3ABR25130-WB-108, Temperature, Wind and Pressure
FMH-1B
C3ABR25130-HO-100B
<u>Audio Visual Aids</u>
Psychrometric Computer Transparency - High Range X11H53-A
Psychrometric Computer Transparency - Low Range X11H53-B
Transparencies, Temperature, Wind, and Pressure
<u>Training Equipment</u>
Psychrometric Calculator, ML-429/UM (1)

<u>Training Methods</u>
Lecture/Discussion (11 hrs)
Performance (17 hrs)

<u>Multiple Instructor Requirements</u>
Performance (2)

<u>Instructional Guidance</u>
Discuss observational methods and techniques needed to observe and encode the data on the Form 10. Discuss and demonstrate the correct procedures for determining the dew point on the psychrometric calculator. Discuss reading wind traces. Discuss procedures for reading barometers and computing station pressure and altimeter settings using the pressure conversion table. Stress the rules governing the Form 10 entries. Discuss pressure remarks. Observe students closely and administer the progress checks as required. Emphasize safety.

MIR: During performance hours, 2 instructors will be available for supervision when class size exceeds 15 students.

9. Sampling Written Test and Critique 1

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE Weather Specialist Aerographer's Mate (C-420-2010-A1)

BLOCK TITLE
Basic Weather

1. COURSE CONTENT	2. TIME
10. Additive Data	17
a. Given the FMH-1B, weather scenarios, pressure conversion table and handout, encode the required additive data entries on an AWS Form 10 to a minimum of 80% accuracy. STS: 7d(1) CTS: 3b(1) Meas: PC	(17)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR25130-HO-100A
C3ABR25130-HO-108
C3ABR25130-HO-110A, Student Checklist
C3ABR25130-WB-104b
C3ABR25130-WB-110, Additive Data
AWS Form 10
FMH-1B
C3ABR25130-HC-100B

Audio Visual Aids
MWS-AG-A-018 A/V Cloud Slide Presentation, Parts II thru V
Transparencies, Additive Data

Training Methods
Lecture/Discussion (7 hrs)
Performance (10 hrs)

Multiple Instructor Requirements
Performance (2)

Instructional Guidance
Lecture on additive data requirements and demonstrate observational techniques as required. Circulate among students and check performance. Administer progress checks as required. Emphasize safety.

MIR: During performance hours, 2 instructors will be available for supervision when class size exceeds 15 students.

11. Sampling Written Test and Critique 1

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE. Weather Specialist Aerographer's Mate (C-420-2010-A1)

BLOCK TITLE

Basic Weather

1. COURSE CONTENT	2. TIME
12. Types of Observations	27
a. Given the FMH-1B, weather scenarios and pressure conversion table, encode 8 consecutive observations in Airways code on an AWS Form 10 to a minimum of 80% accuracy. STS: 7d(1) CTS: 3b(1) Meas: PC	(16)
b. Given the FMH-1B and weather scenarios, encode 2 one hourly observations in METAR code on an AWS Form 10a to a minimum of 80% accuracy. STS: 7d(2) CTS: 3b(2) Meas: PC	(6)
c. Given the study guide and necessary information, encode 2 pilot reports in PIREP code on an AWS Form 12 to a minimum of 80% accuracy. STS: 11c CTS: 3b(5) Meas: PC	(3)
d. Given the study guide, decode 2 pilot reports from the PIREP code into plain language on an AWS Form 12 to a minimum of 80% accuracy. STS: 11a(3) CTS: 3c(5) Meas: PC	(2)

SUPERVISOR APPROVAL OF LESSON PLAN

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR25130-HC-100A
C3ABR25130-HC-108
C3ABR25130-SG-112c/d, PIREP Code
C3ABR25130-WB-112a, Types of Observations
C3ABR25130-WB-112b, METAR
C3ABR25130-WB-112, Types of Observations
AWS Form 10
AWS Form 12, Pilot Report
AWS Form 10a
FMH-1B
C3ABR25130-HC-100B

Audio Visual Aids
Transparencies, Types of Observations

Training Methods
Lecture/Discussion (11 hrs)
Performance (16 hrs)

Multiple Instructor Requirements
Performance (2)

Instructional Guidance
Lecture on different types of observations and criteria for encoding special and local observations. Demonstrate observational techniques as required. Lecture on entries required for METAR code. Lecture on proper procedures for encoding and decoding pilot reports (PIREPS). Circulate among students and provide assistance as needed. Administer progress checks as required. Emphasize safety.

MIR: During performance hours, 2 instructors will be available for supervision when class size exceeds 15 students.

13. Sampling Written Test and Critique 1

14. Military Training (Identified in course chart) 11

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE Weather Specialist Aerographer's Mate (C-420-2010-A1)
BLOCK TITLE Map Plotting	

1. COURSE CONTENT	2. TIME
1. Surface Charts	43
a. Without reference, decode the elements of airways observations to a minimum of 75% accuracy. STS: 11a(1) CTS: 3c(1) Meas: PC	(2)
b. Given the appropriate plotting guide and airways observations, plot 40 stations within 30 minutes with no more than 5 errors in the 10 stations graded. STS: 11b(1) CTS: 3d(1) Meas: PC	(13)
c. Without reference, decode the elements of land synoptic observations to a minimum of 75% accuracy. STS: 11a(2) CTS: 3c(2) Meas: PC	(2)
d. Given the appropriate plotting guide and land synoptic observations, plot 30 stations within 20 minutes with no more than 5 errors in the 10 stations graded. STS: 11b(2) CTS: 3d(2) Meas: PC	(13)
e. Without reference, decode the elements of ship synoptic observations to a minimum of 75% accuracy. STS: 11a(2) CTS: 3c(4) Meas: PC	(1)
f. Given the appropriate plotting guide and ship synoptic observations, plot 25 stations within 30 minutes with no more than 5 errors in the 10 stations graded. STS: 11b(2) CTS: 3d(3) Meas: PC	(12)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR25130-HO-200, 300, Weather Codes Plotting Guide
C3ABR25130-WB-201, 202 (201) Weather Codes
C3ABR25130-HO-201A, Location Identifier
Map DOD WPC 1-4-24
Map DOD WPC 1-10-3

Audio Visual Aids
Present Weather Symbol Study Cards Device 5SC5

Training Methods
Lecture (8 hrs)
Performance (35 hrs)

Multiple Instructor Requirements
Supervision (2)

Instructional Guidance
Orient students on group paced instruction. Montior students' progress providing assistance as required. Grade and critique as required. Emphasize safety in handling maps (paper cuts) and proper conduct in the classroom.

MIR: During the performance hours, 2 instructors will be available for supervision of practice, speed runs, and progress checks for grading and critique when more than 15 students are in a class.

2. Sample Written Measurement and Critique 2

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE Weather Specialist Aerographer's Mate (C-420-2010-A1)

BLOCK TITLE

Map Plotting

1. COURSE CONTENT	2. TIME
3. Upper Air Charts	22
a. Without reference, decode the elements of rawinsonde reports to a minimum of 75% accuracy. STS: 11a(6) CTS: 3c(8) Meas: PC	(3)
b. Given the appropriate rawinsonde data, plot one thermodynamic diagram (Skew-T) within 20 minutes with no more than 5 errors. STS: 11b(5) CTS: 3d(5)(a), 3d(5)(b), 3d(5)(c), 3d(5)(d), 3d(5)(e) Meas: PC	(16)
c. Given the appropriate rawinsonde data, plot 25 stations on a constant pressure chart within 10 minutes with no more than 5 errors in the 10 stations graded. STS: 11b(3) CTS: 3d(4) Meas: PC	(3)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR25130-WB-201, 202 (201)
Chart, DOD WPC 9-16, Skew-T Log P Diagram
Map, DOD WPC 1-10-3

Audio Visual Aids
Skew-T Log P Diagram, C182-1392 0-14b

Training Methods
Lecture (6 hrs)
Performance (16 hrs)

Multiple Instructor Requirements
Supervision (2)

Instructional Guidance
Orient students on group paced instructions. Montior students' progress providing assistance as required. Grade and critique as required. Emphasize safety in handling maps and charts (paper cuts) and proper conduct in the classroom.

MIR: During the performance hours, 2 instructors will be available for supervision of practice, speed runs, and progress checks for grading and critique when more than 15 students are in a class.

4. Sample Written Measurement and Critique 1

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE Weather Specialist Aerographer's Mate (C-420-2010-A1)
BLOCK TITLE Map Plotting	

1. COURSE CONTENT	2. TIME
5. COMEDS	6
a. Using a COMEDS model 40 terminal and the appropriate handout, operate the terminal to transmit 4 airways observations to 100% accuracy with no more than 2 instructor assists per observation. STS: 18b(2) CTS: 4a(12), 4b(1) Meas: P	(2)
b. Using a COMEDS model 40 terminal and the appropriate handout, operate the terminal to transmit 2 terminal airdrome forecasts (TAFs) to 100% accuracy with no more than 2 instructor assists per forecast. STS: 18b(2) CTS: 4a(12) Meas: P	(1)
c. Using a COMEDS model 40 terminal and the appropriate handout, operate the terminal to transmit 2 radar reports (RAREPs) to 100% accuracy with no more than 2 instructor assists per report. STS: 18b(2) CTS: 4a(12) Meas: P	(1)
d. Using a COMEDS model 40 terminal and the appropriate handout, operate the terminal to transmit 2 pilot reports (PIREPs) to 100% accuracy with no more than 2 instructor assists per report. STS: 18b(2) CTS: 4a(12), 4b(4) Meas: P	(.5)
e. Using a COMEDS model 40 terminal and the appropriate handout, operate the terminal to transmit 2 notices to airmen (NOTAMs) to 100% accuracy with no more than 2 instructor assists per notice. STS: 18b(2) CTS: 4a(12) Meas: P	(.5)
f. Using a COMEDS model 40 terminal and the appropriate handout, operate the terminal to transmit 4 automatic response queries (ARQs) to 100% accuracy with no more than 2 instructor assists per query. STS: 18c(2) CTS: 4a(12) Meas: P	(1)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C. ""25130-HO-205, Weather Message Formats
C3ABR25130-HO-~~205A~~, Additional Information on COMEDS
2034

Training Equipment
COMEDS model 40 Equipment (1)

Training Methods
Lecture (3 hrs)
Performance (3 hrs)

Instructional Guidance
Student will prepare and transmit weather messages using COMEDS model 40 and perform turn on/off procedures for communications equipment. Stress electrical safety precautions when using communications equipment. Turn off all electrical equipment not in use.

6. Performance Test and Critique 2

7. Military Training (Identified in Course Chart) 4

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Weather Specialist

BLOCK TITLE
Air Force Unique Subjects

1. COURSE CONTENT	2. TIME
1. Weather Equipment Operation and Safety	14
a. Given basic facts related to safety precautions, select to 75% accuracy those which apply to electrical equipment. STS: 3a(1) Meas: PC	(1)
b. Without references, select procedures relating to the operation of cloud measuring equipment to 75% accuracy. STS: 7b(1) Meas: PC	(3)
c. Without references, select procedures relating to the operation of visibility measuring equipment to 75% accuracy. STS: 7b(2) Meas: PC	(2)
d. Without references, select procedures relating to the operation of temperature measuring equipment to 75% accuracy. STS: 7b(6) Meas: PC	(2)
e. Without references, select procedures relating to the operation of precipitation measuring equipment to 75% accuracy. STS: 7b(7) Meas: PC	(1)
f. Without references, select procedures relating to the operation of wind measuring equipment to 75% accuracy. STS: 7b(4) Meas: PC	(2)
g. Without references, select procedures relating to the operation of pressure measuring equipment to 75% accuracy. STS: 7b(5) Meas: PC	(3)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR25130-SW-301, Weather Equipment

Audio Visual Aids
35mm Slides, Safety
Film Clips:
25-3, Barograph, Chart Replacement
25-4, Rotating Beam Ceilometer
25-5, Mercurial Barometer
25-6, Transmissometer, Chart Replacement
25-7, Wind Recorder, Chart Replacement

Training Equipment
AN/FMN-1, Runway Visual Range Computer (15)
AN/GMQ-32, Transmissometer (15)
AN/GMQ-13, Rotating Beam Ceilometer (15)
AN/GMQ-20, Wind Measuring System (15)
AN/TMQ-11, Temperature/Humidity Measuring Set (15)
ML-17, Rain Gauge (15)
ML-24, Psychrometer, Sling (15)
ML-75, Precipitation Measuring Stick (1)
ML-102, Aneroid Barometer (3)
ML-113, Clinometer (3)
ML-121, Ceiling Light (15)
ML-512A, Mercurial Barometer (3)
ML-563/UM, Barograph (3)
RO-362, Wind Recorder (15)
RO-658/GM, Digital Altimeter-Barometer (15)

Training Methods
Lecture/Discussion/Demonstration (14 hrs)

Instructional Guidance
Discuss and demonstrate the operation of the equipment with special emphasis on care and safety. Check students' workbooks carefully for appropriate entries. Give assignments daily in preparation for the following day's work. Emphasize equipment hazards and personnel safety during operation of the equipment. Introduce the purpose, nomenclature and procedures involved in obtaining the needed information from the equipment. Stress how to use the controls and what happens in each position of the controls. Stress safety with special attention given to precautions and how to disconnect electrical equipment in an emergency.

2. Sampling Written Measurement and Critique 1

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Weather Specialist

BLOCK TITLE
Air Force Unique Subjects

1. COURSE CONTENT	2. TIME
3. Weather Communications	4
a. Without reference, select facts that pertain to the mission of DOD/DCS Global Weather Communication System to 75% accuracy. STS: 18a Meas: PC	(1)
b. Without reference, select facts that pertain to the composition of the DOD/DCS Global Weather Communication System, to 75% accuracy. STS: 18a Meas: PC	(1)
c. Without reference, select facts that pertain to weather data processing to 75% accuracy. STS: 18c(1) Meas: PC	(1)
d. Without reference, select facts relating to quality control summaries to 75% accuracy. STS: 18c(3) Meas: PC	(1)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR25130-WB-303, Weather Communications

Audio Visual Aids
35mm Slides, Weather Communications

Training Methods
Lecture/Discussion (4 hrs)

Instructional Guidance
Discuss the basic facts concerning the weather communications network. Insure student understanding in this area.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Weather Specialist

BLOCK TITLE
Air Force Unique Subjects

1. COURSE CONTENT	2. TIME
4. Pilot-to-Metro Service (PMSV)	3
a. Without references, select facts relating to Pilot-To-Metro Service to 75% accuracy. STS: 18b(3) Meas: PC	(3)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
AWSR 105-12, Pilot-to-Metro Service
AWS Form 30, AWS Pilot-to-Metro Service (PMSV) Log
AWS Form 42, Weather Equipment/Communications Service Record
C3ABR25130-SW-304, Pilot-to-Metro Service (PMSV)

Audio Visual Aids
35mm Slides, PMSV

Training Methods
Lecture/Discussion (3 hrs)

Instructional Guidance
Discuss basic PMSV procedures and current AWS policies and procedures concerning use of equipment. Stress conservation of energy and materials and the requirement to turn in all training materials in serviceable condition upon completion of Block III.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Weather Specialist

BLOCK TITLE
Air Force Unique Subjects

1. COURSE CONTENT	2. TIME
5. AWS Mission, Airman Career Field and Supply	3
a. Without reference, select facts relating to the mission of AWS to 75% accuracy. STS: 1a Meas: PC	(1)
b. Without reference, select facts relating to the organization of AWS to 75% accuracy. STS: 1a Meas: PC	(1/2)
c. Without reference, select facts relating to the duties in the Airman Career field to 75% accuracy. STS: 1b Meas: PC	(1)
d. Without reference, select facts pertaining to supply responsibility/accountability to 75% accuracy. STS: 4h Meas: PC	(1/2)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR25130-SW-305, Weather Career Field
C3ABR25130-SW-305A, Property Responsibility and Accountability
C3ABR25130-SW-305B, AWS Mission and Organization

Audio Visual Aids
35mm Slides, AWS Mission

Training Methods
Lecture/Discussion (1 hr)
Performance (2 hrs)

Instructional Guidance
Students will be given a certain amount of information. Study guides will instruct them on how to complete the appropriate exercises. After they have completed the exercises, check their responses and have them correct any errors they might have made. Monitor students' progress and provide assistance as required.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Weather Specialist

BLOCK TITLE

Air Force Unique Subjects

1. COURSE CONTENT	2. TIME
6. Communications Security and Operations Security	3
a. Without references, select statements relating to the principles of the classification of information and the use of EEFIs to 75% accuracy. STS: 2a(1) Meas: PC	(1)
b. Without references, select statements relating to the principles of the prevention of security violations to 75% accuracy. STS: 2a(2) Meas: PC	(1)
c. Without references, select facts relating to OPSEC vulnerabilities in the weather career field to 75% accuracy. STS: 2b(6) Meas: PC	(1)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
3350 TTW-PT-76-1, Security
C3ABR25130-SW-306, Operations Security (OPSEC)

Audio Visual Aids
TF 6650, Communications Security/COMSEC and You
35mm Slides, Security

Training Methods
Lecture/Discussion (2 hrs)
Performance (1 hr)

Instructional Guidance
Pass out 3350 TTW-PT-76-1 and SW-306 for the students to complete. Discuss with the students the reasons and importance of the types of security and how it pertains to this career field.

7. Sampling Written Measurement and Critique 1

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Weather Specialist

BLOCK TITLE

Air Force Unique Subjects

1. COURSE CONTENT	2. TIME
8. Radar Storm Detection	38
a. Without references, select statements relating to the principles of weather radar to 75% accuracy. STS: 9a Meas: PC	(11)
b. Without references, select statements relating to high voltages and antenna radiation for the FPS-77 Radar Set to 75% accuracy. STS: 3a(4) Meas: PC	(1/4)
c. Given an FPS-77 Severe Storm Detection Radar Set, in normal mode and necessary references, operate its scopes and associated controls IAW checklist with no more than 6 procedural errors. STS: 9b Meas: PC	(11 3/4
d. Given simulated radar scope presentations, Intensity Nomogram, Echo Tops Correction Graph and Weather Radar Manual, Part A, observe, encode and record information on Air Weather Service Form 104 to at least 75% accuracy. STS: 9d Meas: PC	(15)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR25130-WB-308, Radar Theory
C3ABR25130-WB-308A, AN/FPS-77 Radar
C3ABR25130-WB-308B, Scope Interpretation Theory
C3ABR25130-WB-308C, Radar Scope Interpretation
FMH 7, Parts A and C
AWS VA 105-16, AN/FPS-77 Intensity Nomogram
AWS VA 105-19, Corrections for Echo Tops Graph (AN/FPS-77)
AWS Form 104, Radar Weather Observations

Audio Visual Aids
Mock-Up of Radar, Meteorological Radar Set AN/FPS-77
AN/FPS-77, Instructional Panels
Transparencies, Radar, AN/FPS-77

Training Equipment
Meteorological Radar Set AN/FPS-77

Training Methods
Lecture/Discussion (28 hrs)
Performance (10 hrs)

Instructional Guidance
The objectives may be accomplished in any order depending upon facilities available. Define and explain radar theory and terms using the chalkboard to expound on the transparencies as necessary.

Give a reading assignment from the FMH-7, Part C. Teach the section on components and controls in the room with a live FPS-77. Use the mock-up and/or instructional panels as a back-up. Define and explain the components/controls while demonstrating. Stress personal and radar equipment safety precautions. While teaching encoding, use the chalkboard to highlight the information found in the FMH-7, Part A. Students' performance will be strictly supervised and in compliance with the FPS-77 operational procedures checklist.

9. Sampling Written Measurement and Critique 1

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE Weather Specialist

BLOCK TITLE
Air Force Unique Subjects

1. COURSE CONTENT	2. TIME
10. Weather Station Operations	46
NOTE 1: Persons assigned in the CONUS are taught METAR to a 1a level. In accordance with AWS requirements only persons assigned overseas are taught METAR to a 2b level in Block III.	
a. Given all the necessary references and a checklist, compute meteorological and climatological data with WBAN computers for airways observations with no more than 1 error per observation. STS: 12a, 12b Meas: P	(2)
b. Given all the necessary references and a checklist, transmit airways observations locally and longline within 5 minutes with no more than 3 errors per observation. STS: 18b(1), 18b(2) Meas: P	(6)
c. Given all the necessary references and a checklist, observe and record all weather elements for airways observation within 12 minutes with no more than 2 errors per observation. STS: 7b(1), 7b(2), 7b(3), 7b(4), 7b(5), 7b(6), 7b(7), 7d(1) Meas: P	(8)
d. Given information, references and forms, document a minimum of 6 simulated equipment and communication outages with no more than 2 errors per outage. STS: 6d, 18c(4) Meas: P	(1)
e. Given all required references, forms, and weather data, decode weather information and operate the PMSV radio:	(3)
(1) According to the proper PMSV procedures allowing 3 instructor assists. STS: 18b(3) Meas: P	
(2) One surface observation with no more than 1 instructor assist. STS: 11a(1) Meas: P	
(3) One Terminal Aerodrome Forecast (TAF) with no more than 2 instructor assists. STS: 11a(8) Meas: P	
f. Using the necessary forms, receive a pilot report over the PMSV radio and encode it on AWS Form 12 with no more than 2 errors. STS: 11c Meas: P	(1)
g. Given all necessary equipment, references, teletype data weather charts and supplies:	(5)

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(1) File teletype data according to their MANOP heading. STS: 18c(1), 18c(3) Meas: P

(2) Highlight weather features by posting them on charts IAW 105-22. STS: 18c(1) Meas: P

h. Given a chart, references and available data, decode and plot one local area work chart (LAWC) in airways code with a minimum of 60 stations within 3 hours with no more than 2 errors on the ten graded stations. STS: 11a(1), 11b(1) Meas: P (3)

i. Given a chart, references and available data, decode and plot one surface chart in synoptic code with a minimum of 60 stations within 3 hours with no more than 3 errors on the ten graded stations. STS: 11a(2), 11b(2) Meas: P (3)

j. Given charts, references and available CONUS teletype data, decode and plot the 850mb, 700mb and 500mb levels with a minimum of 50 stations per level within 3 hours with no more than 3 errors on the 15 graded stations. (5 graded on each level) STS: 11a(6), 11b(3) Meas: P (3)

k. Given diagrams, references and available teletype data, decode and plot two thermodynamic diagrams (Skew-Ts) within 2 hours with no more than 3 errors on the one graded Skew-T. STS: 11a(6), 11b(5) Meas: P (3)

l. Given 10 radar reports (RAREPS), a programmed text and a chart, decode and plot the RAREPS with no more than 10 errors. STS: 11a(5), 11b(4) Meas: P (3)

m. Given expendable supplies, perform operator organizational maintenance on weather equipment IAW applicable 31M series technical orders. STS: 6a, 6b, 6c Meas: P (1)

n. Given simulated communications and operations publications post 7 out of the 10 changes correctly. STS: 4g Meas: P (1)

o. Given all the necessary references, encode and record 4 observations in METAR code with no more than 3 errors per observation. STS: 7d(2) Meas: P (3)

SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials

C3ABR25130-HO-310 (203, 301), Weather Message Format
C3ABR25130-WB-310, Surface Observations
C3ABR25130-WB-300, Observation Workbook
C3ABR25130-HO-200, 300, Weather Codes Plotting Guide

C3ABR25130-HO-310B, Location Identifier
C3ABR25130-PT-310, Radar Reports
C3ABR25130-WS-310, Radar Reports (RAREPS)
C3ABR25130-SW-310, Preparation of Weather Charts
C3ABR25130-SW-310A, Posting Publications Changes
C3ABR25130-SW-310B, Terminal Aerodrome Forecast Code - TAF
C3ABR25130-SW-310C, Map Plotting
C3ABR25130-SG-310, METAR Encoding and Dissemination
FMH-1B, Federal Meteorological Number 1B Surface Observations
Meteorological Form 1-10 (MF1-10)
AWS Form 10a
AWS Form 12, Pilot Reports
AWS Form 30, AWS Pilot-to-Metro Service (PMSV)
AWS Form 42, Weather Equipment/Communications Service Records
Map, DOD WPC 1-10-3, Synoptic/Constant Pressure
Map, DOD WPC 1-4-21, Airways
Chart, DOD WPC 9-16, Skew-T Log P Diagram
Current Facsimile Charts
Current Weather Teletype Data

Audio Visual Aids
Cloud Type Photographs
Visibility Diagram Clipboard
STT-Q0-0333, Introduction to METAR and TAF Codes

Training Equipment
AN/FMN-1, Runway Visual Range Computer (5)
AN/GMQ-13, Cloud Height Set (5)
AN/GMQ-20, Wind System (5)
AN/GMQ-32, Transmissometer (5)
AN/TMQ-11, Temperature/Humidity Set (5)
Precipitation Measuring Equipment (5)
ML-24, Sling Psychrometer (5)
ML-102, Aneroid Barometer (5)
ML-429/UM, Psychrometric Calculator (1)
ML-512A, Mercurial Barometer (5)
ML-563, Barograph (5)
ML-658/GM, Digital Altimeter Barometer (5)
RO-362, Wind Recorder (5)
CP-402/UM, Pressure Reduction Computer (1)
COMEDS Model 40 (1)
Simulated Electrowriter (1)

Training Methods
Lecture/Discussion (16 hrs)
Demonstration (9 hrs)
Performance (21 hrs)

Multiple Instructor Requirements
Facilities (3)

Instructional Guidance
Weather Station Operations is divided into two separate modules of instruction. Days 36-42 are designed as lab preparation. Days 43-53 are designated as the period of evaluation for the students under simulated weather station conditions. Lab preparation is composed of three subject areas; Surface Observations, Map Plotting, and Duty Observer related tasks. The Surface Observations area is structured around the evaluation, encoding and dissemination of the five basic observation types used by AWS. During Surface Observations, discuss the rules for the Basic Weather Watch, MF1-10 entries as well as tranmission procedures for local and longline dissemination. Students going to overseas assignments utilizing METAR code will take observations and disseminate them in METAR on days 41-53. All other students will use METAR on days 51-53. Review the METAR code using the slide presentations and C3ABR25130-SG-310, METAR Encoding and Dissemination. Use the METAR lesson plan provided to bring students to a higher skill level. Stress prudent use of all safety procedures while using electrical equipment. Days 41-42, the students will take practice observations from the official point of observation.

When not taking observations, use the lesson plan to review map plotting procedures before assigning homework. Show and emphasize the use of all reference materials, proper charts and plotting tools. Days 36-42 follow the homework schedule provided to aid students in maintaining proficiency in the area of map plotting.

Show and discuss the tasks required of the Duty Observer. After completion of the PMSV/TAF portion of the lesson plan, practice PMSV procedures in class and hand out study guide for completion as homework as well as reference in WSO. Demonstrate the proper procedures for processing teletype data during the lesson presentation. Have each student save at least one AXXX bulletin from the TTY data for an example. Discuss and demonstrate the proper procedures for posting facsimile charts. Hand out the study guide/workbook for Preparation of Weather Charts to be completed by day 43 or reference in WSO.

Days 43-53 are designated as the period of evaluation for the students under simulated weather station conditions. Training groups are divided into teams of five students and assigned to a lab under close instructor supervision. During WSO, the teaching guide will be used daily. Assigned duties are rotated to insure each student performs all duties within the station at least twice. Students will take representative observations and record the information on the MF1-10. Students will disseminate airways observations on the simulated electrowriter and COMEDS Model 40 as necessary. Stress electrical safety precautions when using communications equipment. Stress roof, hallway and lab safety at all times.

The students will plot maps when not taking observations. Students finishing their assignments early will perform tasks in any other objective area designated by the instructor. The students will identify manop headings and demonstrate procedures for processing teletype messages under the instructor's supervision. The student will disseminate weather messages over the PMSV and post facsimile charts.

Only two new subjects will be introduced in the WSO portion of Block III. Day 44 pass out the Publications SW. Discuss and demonstrate the posting of publications. The workbook will be completed in class. End of day 51, pass out the Radar Reports PT for completion as homework. Day 52 critique the students RAREPS homework.

MIR: One instructor is required in lab for every 6 students to monitor, evaluate and critique the students.

11.	Weather Station Operations Measurement	24
12.	Course Critique and Graduation	1
13.	Military Training (Identified in Course Chart)	13
	a. Physical Conditioning	(6)
	b. Commander's Call	(1)
	c. End-of-Course Appointments	(6)

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Aerographer's Mate (C-420-2010-A1)

BLOCK TITLE

Navy/Marine Unique Subjects

1. COURSE CONTENT	2. TIME
NOTE: The objectives in Block III may be accomplished in any order within the measurement areas because of different class start dates and military training.	
1. Land Synoptic Code	17
a. Given aviation weather data and using the FMH-2, encode two (2) six hourly observations in the land synoptic code with a maximum of seven errors within 45 minutes. CTS: 3b(3) Meas: PC	(17)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR25130-2-HO-300A, Pressure Conversion Tables
C3ABR25130-2-HO-301Q, Land Synoptic Encoding Worksheet
C3ABR25130-2-WS-305, Pressure Computation Sheet
FMH-2, Synoptic Code Manual
C3ABR25130-2-WB-300, Weather Codes and Messages

Audio Visual Aids
Synoptic Code Symbolic Format Chart

Training Methods
Lecture/Discussion (10 hrs)
Performance (7 hrs)

Multiple Instructor Requirements
Supervision (2)

Instructional Guidance
Issue FMH-2, pressure computation sheets and pressure conversion tables and discuss proper use. Explain proper procedures for encoding the land synoptic code. Multiple instructors will be employed on a 4:1 student to instructor ratio during all performance phases, to monitor student progress.

MIR: Multiple instructors will be employed on a 4:1 student to instructor ratio during the performance phase of instruction for individual supervision and aid in accomplishing the objective.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Aerographer's Mate (C-420-2010-A1)

BLOCK TITLE
Navy/Marine Unique Subjects

1. COURSE CONTENT	2. TIME
2. Typing	6.8
a. Given a typewriter and typing paper, type 20 words per minute for five minutes with no more than ten errors in the first 100 words. CTS: 4a(14) Meas: P	(6.8)

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SUPPORT MATERIALS AND GUIDANCE

Training Equipment
IBM Selectric Typewriter (1)
Plato Computer (1)

Training Methods
Lecture/Discussion (.5 hr)
Performance (6.3 hrs)

Multiple Instructor Requirements
Supervision (2)

Instructional Guidance
During the first half hour of typing, students will be given a pre-test for screening to determine individual ability. Those students who type less than 20 words per minute will be assigned to the PLATO typing program. Those students who type 20 words per minute or more will return to the classroom to practice plotting.

MIR: During the performance segment of this course, some students are required to utilize PLATO computers. Constant individual attention is required to insure satisfactory individual completion of the task. In addition, students not requiring the PLATO instruction will be tasked with other objectives, consequently, two instructors are required.

3. Performance Measurement and Critique .2

   a. Performance Test

   b. Test Critique

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Aerographer's Mate (C-420-2010-A1)

BLOCK TITLE

Navy/Marine Unique Subjects

1. COURSE CONTENT	2. TIME
4. Shipboard Observations and Ship Synoptic Code	12.5
a. Given a true wind computer (CP-264/U) and simulated ship data, compute true wind data to + or - ten degrees in direction and + or - two knots in speed. CTS: 3g(8) Meas: PC	(.5)
b. Given weather data, NAVOCEANCOMINST 3144.1C and equipment, record two weather observations on CNOC 3140/8 with no more than six errors within 30 minutes. CTS: 3a(1), 3a(2), 3a(3), 3a(4), 3a(5), 3a(6) Meas: PC	(4)
c. Given shipboard weather data and using NAVOCEANCOMINST 3144.1C encode two six-hourly observations in the ship synoptic code with no more than seven errors within 45 minutes. CTS: 3b(4) Meas: PC	(8)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR25130-2-EO-300A, Pressure Conversion Tables
C3ABR25130-2-WS-305, Pressure Computation Sheets
CNOC 3140/8 Shipboard Observation Form
NAVOCEANCOMINST 3144.1C, Manual for Ship's Surface Weather Observations

Audio Visual Aids
ML-429/UM Psychrometric Calculator (1)
CP-264/U True Wind Computer (1)

Training Methods
Lecture/Discussion (4.5 hrs)
Performance (8 hrs)

Multiple Instructor Requirements
Supervision/Equipment (2)

Instructional Guidance
Issue NAVOCEANCOMINST 3144.1C psychrometric calculator, true wind computer, pressure conversion tables, pressure computation sheets and review proper use of each. Explain the proper procedures for recording and encoding shipboard observations. Emphasize safety. Multiple instructors will be employed on a 4:1 student to instructor ratio during all performance phases, to monitor student progress.

MIR: Instructors are required on a 4:1 student to instructor ratio during the performance phase of instruction for individual supervision and aid in accomplishing the objectives.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Aerographer's Mate (C-420-2010-A1)

BLOCK TITLE
Navy/Marine Unique Subjects

1. COURSE CONTENT	2. TIME
5. Map Plotting	29
a. Given airways reports and plotting guide, plot 40 stations within 20 minutes with no more than five errors in the ten graded stations. CTS: 3d(1) Meas: PC	(7)
b. Given land synoptic reports and plotting guide, plot 40 stations within 20 minutes with no more than five errors in the ten graded stations. CTS: 3d(2) Meas: PC	(6)
c. Given shipboard synoptic reports and plotting guide, plot 25 stations within 25 minutes with no more than five errors in the ten graded stations. CTS: 3d(3) Meas: PC	(6.5)
d. Given part A of the rawinsonde message and plotting guide, plot constant pressure data. Plot 25 stations within 10 minutes with no more than three errors in the ten graded stations. CTS: 3d(4) Meas: PC	(1)
e. Given the appropriate rawinsonde message, plot one Skew-T Log P diagram in accordance with a checklist within 20 minutes with no more than four errors. CTS: 3c(8) Meas: PC	(6)
f. Given a plotted Skew-T Log P diagram, compute the following data without error in 20 minutes.	(2.5)
(1) CCL CTS: 3d(5)(a) Meas: PC	
(2) LCL CTS: 3d(5)(b) Meas: PC	
(3) LFC CTS: 3d(5)(c) Meas: PC	
(4) Freezing Level CTS: 3d(5)(d) Meas: PC	
(5) SI CTS: 3d(5)(e) Meas: PC	

SUPERVISOR APPROVAL OF LESSON PLAN

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR25130-2-HO-300, Weather Codes Plotting guide
C3ABR25130-2-HO-305, Location Identifier
C3ABR25130-2-HO-408a, Analysis of Skew-T Log P Diagram
C3ABR25130-2-HO-305a, Airways State Identifier
C3ABR25130-2-HO-305, 313, Weather Plotting
DOD-WPC 1-10-3, Synoptic Plotting Chart
DOD-WPC 1-4-24, Airways Plotting Chart
DOD-WPC 9-16, Skew-T Log P Diagram

Training Methods
Performance (27.5 hrs)
Lecture/Discussion (1.5 hrs)

Instructional Guidance
Issue plotting guides and brief students on the location of plotting charts and support manuals. Stress to students to correct all errors on the plotted Skew-T, because they will be using them when they get to the Skew-T analysis. Monitor students performance closely.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Aerographer's Mate (C-420-2010-A1)

BLOCK TITLE

Navy/Marine Unique Subjects

1. COURSE CONTENT	2. TIME
6. Meteorological Satellites	16
a. Given an APT predict message and an APT plotting board, prepare meteorological satellite orbit and tracking data by constructing a subpoint track and worksheets for two satellite passes. All work is to be completed within one hour, with no more than fifteen errors. CTS: 3f(1), 3f(2), 3f(3) Meas: PC	(16)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR25130-2-HO-305, Elevation Angle for APT Tracking Worksheet
NAVEDTRA 40590, APT Predict Message and Tracking Board
C3ABR25130-2-WS-309, APT Tracking Worksheet
C3ABR25130-2-WS-309A, Predict Message Worksheet

Training Equipment
Grease Pencil (1)
APT Tracking Board (1)

Training Methods
Lecture/Discussion (3 hrs)
Demonstration (2 hrs)
Performance (11 hrs)

Multiple Instructor Requirements
Supervision, Equipment (2)

Instructional Guidance
Issue grease pencils, worksheets and tracking boards. Monitor student progress providing assistance as required. Caution students on the need of handling the tracking board and diagram carefully as they are easily damaged. Multiple instructors will be employed on a 4:1 student to instructor ratio during all demonstration and performance phases.

MIR: Multiple instructors will be employed on a 4:1 student to instructor ratio to assist students in the performance phase of this objective, enabling student to properly plot APT data on individual tracking boards.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Aerographer's Mate (C-420-2010-A1)

BLOCK TITLE
Navy/Marine Unique Subjects

1. COURSE CONTENT	2. TIME
7. Meteorological Equipment	7
a. Given meteorological equipment and applicable references, operate the equipment to obtain meteorological data in accordance with a checklist. CTS: 3g(1), 3g(2), 3g(3), 3g(4), 3g(5), 3g(6) Meas: P	(3)
b. Given meteorological equipment and applicable references perform routine operator maintenance in accordance with a checklist. CTS: 3h(1), 3h(2), 3h(3), 3h(5) Meas: P	(1)
c. Given communications equipment and applicable references, operate the equipment to obtain environmental data in accordance with a checklist. CTS: 4a(1), 4a(2), 4a(3), 4a(4), 4a(5), 4a(6), 4a(7), 4a(8), 4a(9), 4a(10), 4a(11), 4a(15) Meas: P	(3)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
Aerographer's Mate 3 & 2 Training Manual
World-Wide Marine Weather Broadcast Manual
NAVEDTRA 40140, The Shipboard Weather Office

Training Equipment
AN/GMQ-29B, Automatic Meteorological Station (1)
AN/PMQ-3, Hand Held Anemometer (1)
AN/UGC 6K, Teletypewriter (Pony Loop) (1)
AN/UGC 20, Teletypewriter (1)
ML-119, Clinometer (1)
ML-448/UM, Precision Aneroid Barometer (1)
ML-450A/UM, Electric Psychrometer (1)
ML-563A/UM, Barograph (1)
CV-172A/U, Frequency Shift Converter (1)
CV-2979/UX, Frequency Shift Converter (1)
ML-429/UM, Psychrometric Calculator (1)
R10513/URR, Radio Receiver (1)
R390A/URR, Radio Receiver (1)
RF505A, Radio Receiver (1)
SB1203A/UD, Communications Patch Panel (Loop Jack) (1)
SB973/SRR, Switchboard Receiver Transfer (1)
URA-17, Frequency Shift Converter (1)
Marine Barograph (1)
Sling Psychrometer (1)
519 Alden Marine Facsimile Recorder (1)
9244T Alden Facsimile Recorder (1)
RD-108, Wind Recorder (1)
ML-217, 4 Inch Rain Gauge
ML-558, Tipping Bucket Rain Gauge

Training Methods
Lecture/Discussion (1.5 hrs)
Demonstration (2.5 hrs)
Performance (3 hrs)

Multiple Instructor Requirements
Supervision (2)
Equipment (2)

Instructional Guidance
Issue student instructional materials at appropriate times. Explain and demonstrate proper use and procedural methods for operation of meteorological equipment in order that weather related data can be obtained. Stress safety precautions when working with electronic equipment. Allow students to practice with/use meteorological equipment after demonstration. Monitor student progress closely and provide assistance as necessary. Multiple instructors will be employed on a 4:1 student to instructor ratio during all demonstration and performance phases.

MIR: Two instructors are needed to assist students with meteorological equipment and to insure that proper safety is maintained when using this identified equipment.

8. Performance Measurement and Critique 1.5

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR

COURSE TITLE
Aerographer's Mate (C-420-2010-A1)

BLOCK TITLE
Navy/Marine Unique Subjects

1. COURSE CONTENT	2. TIME
NOTE: This unit of instruction is for U.S. Navy personnel only and parts are classified CONFIDENTIAL. Titles and information in this POI are UNCLASSIFIED. U.S. Marine Corps personnel will be in Pibal during this unit of instruction.	
9. Commander Naval Oceanography Command and Air Ocean Environment	16
a. Without reference, select terms which relate to mission and basic organization of Commander Naval Oceanography Command (CNOC) to 75% accuracy. CTS: 1a Meas: PC	(2)
b. Without reference, identify basic facts about ocean bottom topography to 75% accuracy. CTS: 2m Meas: PC	(1)
c. Without reference, select the statement depicting principles of sea water temperature to 75% accuracy. CTS: 2q Meas: PC	(1.5)
d. Without reference, identify basic facts about composition of sea water to 75% accuracy. CTS: 2n Meas: PC	(1.5)
e. Without reference, identify basic facts about physical properties of sea water to 75% accuracy. CTS: 2n Meas: PC	(1)
f. Without reference, identify basic facts about ocean circulation to 75% accuracy. CTS: 2o Meas: PC	(1)
g. Without reference, select the statement depicting principles of sea and swell to 75% accuracy. CTS: 2p Meas: PC	(1)
h. Without reference, identify basic properties and characteristics of sound to 75% accuracy. CTS: 2l Meas: PC	(1)
i. Without reference, select facts which relate to underwater sensors to 75% accuracy. CTS: 2s Meas: PC	(1.5)
j. Given a Bathythermograph sounding, encode selected temperatures and depths within 15 minutes with no more than three errors. CTS: 3b(6) Meas: PC	(1.5)
k. Given a Bathythermograph message, plot all temperatures and depths within 15 minutes with no more than three errors. CTS: 3c(6) Meas: PC	(1)

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NOTE: These objectives are classified CONFIDENTIAL.

l. Without reference, select facts related to anti-sub marine warfare to 75% accuracy. CTS: 2r (.5)

m. Without reference, select facts related to Bathythermograph (BT) Systems to 75% accuracy. CTS: 2s (.5)

n. Without reference, select facts related to Acoustic Sensor Range Prediction (ASRAP) to 75% accuracy. CTS: 2t (.5)

o. Without reference, select facts related to Ships/Helicopter Acoustic Range Prediction System (SHARPS) to 75% accuracy. CTS: 2u (.5)

SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR25130-2-PT-401, Properties of Sea Water
CHAFT-L131 PAT, Sound Ray Theory
C3ABR25130-2-PT-403, Oceanic Circulation
C3ABR25130-2-HO-304A, Completing the BT Log Sheet
C3ABR25130-2-HO-401D, AOE Glossary (Naval Weather Glossary)
OCEANAV 3167/1(6-72), Bathythermograph Log
NWS-AG-A-C50, Evaluating and Encoding Bathythermograph (BT) Data

Audio Visual Aids
Sippican Expendable Bathythermograph
Shipboard Nonexpendable Bathythermograph
Ocean Bottom Topography Charts
Armed Forces Information Film 35798DN "Tracking The Threat"
Armed Forces Information Film MN-10317 "Nature of Sea Water-Environmental Services"
AN/SSQ-36 Bathythermograph
Armed Forces Information Film MN11319 "The Weather Eye"

Training Methods
Lecture/Discussion (13 hrs)
Performance (3 hrs)

Instructional Guidance
Send USMC personnel to Pibal school during this period of instruction. Issue student instructional material at appropriate times. Emphasize the use of the topography charts during applicable portions of the lecture/discussion.

NOTE: (Para 9j) Portions of the material covered in this area of instruction are classified CONFIDENTIAL. Students are not to take notes nor discuss any of the information learned outside the classroom.

10. Sampling Written Measurement and Critique 1

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Aerographer's Mate (C-420-2010-A1)

BLOCK TITLE
Navy/Marine Unique Subjects

1. COURSE CONTENT	2. TIME
NOTE: This unit of instruction is for US Marine Corps personnel only. US Navy personnel will be in Air Ocean Environment during this unit of instruction.	
11. Pibal	15
a. Given a pilot balloon and related equipment, inflate one balloon within 15 minutes. CTS: 3g(10) Meas: P	(1)
b. Given a theodolite, prepare for pibal observation within 15 minutes. CTS: 3g(10) Meas: P	(3)
c. Given a theodolite and working as a team, track a pilot balloon for a minimum of 10 minutes. CTS: 3g(10) Meas: P	(3)
d. Given a plotting board and related forms, evaluate, encode and decode wind data for a minimum of 20 minutes, with no more than twelve errors. CTS: 3b(7), 3c(9) Meas: P	(8)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
FMH-5, Winds Aloft Observations
FMH-6, Upper Level Winds Code
Tables for Computing Horizontal Distance of Pilot Balloons (30 Grams)
Tables for Computing Horizontal Distance of Pilot Balloons (100 Grams)
Winds Aloft Plotting Chart OPNAV Form 3140-27
C3ABR25130-2-WS-311, Winds Aloft Data Sheet

Training Equipment
ML-474/GM, Theodolite
ML-575/UM, Weight Set
USN-1938, Aerological Plotting Board
ML-78-R, Tripod

Training Methods
Lecture/Discussion (5 hrs)
Performance (10 hrs)

Multiple Instructor Requirements
Supervision (2)

Instructional Guidance
Caution students on the need of handling the tracking board and theodolite carefully as they are easily damaged. Monitor student progress providing assistance as required.

MIR: Multiple instructors will be employed on a 4:1 student to instructor ratio for individual supervision and aid in accomplishing the objective.

12. Performance Measurement and Critique 2

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Aerographer's Mate (C-420-2010-A1)

BLOCK TITLE
Navy/Marine Unique Subjects

1. COURSE CONTENT	2. TIME
13. Practice Lab	37
a. Given necessary equipment, compute pressure altitude and density altitude values in accordance with a checklist. CTS: 3g(7) Meas: PC	(1)
b. Using the facilities of the weather lab, record weather conditions in accordance with a checklist. Each observation will be completed within 15 minutes with no more than three errors. CTS: 3a(1), 3a(2), 3a(3), 3a(4), 3a(5), 3a(6) Meas: PC	(8)
c. Given aviation weather data and an FMH-1B, encode two 3-hourly observations in the airways code within 15 minutes with no more than three errors. CTS: 3b(1) Meas: PC	(1)
d. Given aviation weather data and an FMH-1B, encode two 6-hourly observations in the airways code within 15 minutes with no more than three errors. CTS: 3b(1) Meas: PC	(1)
e. Given simulated ship and oceanographic data, observe and record actual weather conditions for a minimum of 10 hourly observations in the shipboard code. Each observation will be completed within 15 minutes with no more than three errors. CTS: 3a(1), 3a(2), 3a(3), 3a(4), 3a(5), 3a(6) Meas: PC	(5)
f. Given the facilities of the weather lab, observe and record actual weather conditions in the METAR code. Each observation will be completed within 15 minutes, with no more than three errors. CTS: 3a(1) 3a(2), 3a(3), 3a(4), 3a(5), 3a(6) Meas: PC	(5)
g. Given METAR code weather reports, decode selected elements with a maximum of three errors. CTS: 3c(3) Meas: PC	(1)
h. Given aviation weather data, encode one observation in METAR code with a maximum of three errors. CTS: 3b(2) Meas: PC	(2)
i. Given the appropriate meteorological reports, prepare each for transmission in accordance with a checklist, with a maximum of five errors. CTS: 4b(1), 4b(2), 4b(3), 4b(4), 4b(5), 4b(6) Meas: PC	(2)

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j. Given teletype data and facsimile products, file/post data according to a checklist with no more than fi[illegible] errors. CTS: 4d(1), 4d(2), 4d(3), 4d(4), 4d(5) Meas: PC (3)

k. Given facsimile products, color code and display each chart without error within 20 minutes. CTS: 4d(5) Meas: PC (2)

l. Given environmental warning data, plot a high wind and a high sea warning within 30 minutes with no more than one error. CTS: 3e(1), 3e(2) Meas: PC (2)

m. Given the appropriate programmed text and a preburst prediction message, decode the message with no more tha one error. CTS: 3c(7) Meas: PC (3)

n. Given a telephone and information related to proper telephone communication in the military, verbally perform correct military telephone answering techniques for the instructor without error. CTS: 4a(13) Meas: PC (.5)

o. Given the appropriate programmed text, learn the basic concept/reason for usage of the international analysis code (IAC). CTS: 3c(10) Meas: PC (.5)

SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials

C3ABR25130-2-HO-300A, Pressure Conversion Tables
C3ABR25130-2-HO-302A, Fallout Warning Worksheet
C3ABR25130-2-WS-305, Pressure Computation Sheet
C3ABR25130-2-PT-305J, Decoding RADFO Messages and Plotting RADFO Diagrams
CNOC 3140/7 (MF1-10), Surface Observation Form
CNOC 3140/8, Shipboard Observation Form
AWS 10a (MF-10), METAR Observation Form
FMH-1B, Surface Observations
FMH-2, Synoptic Code Manual (with Appendix A)
Aerographer's Mate 3 & 2 Training Manual
NAVAIR 50-1P-11, International Meteorological Codes and Worldwide Synoptic Manual
International Cloud Atlas
Worldwide Marine Weather Broadcast Manual
FAA Contractions Manual
Local Visibility Marker Charts
DOD-WPC 1-10-3, Synoptic Plotting Chart
C3ABR25130-2-WB-305, 313, Weather Plotting
NAVOCEANCOMINST 3144.1C, Manual for Ship's Surface Weather Observations
NAVWEPRA 10C140, Shipboard Weather Office
C3ABR25130-2-PT-313, Decoding and Plotting of the International Analysis Code
NWS-AG-A-100, Identification of Weather Message Headings

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Training Equipment
AN/GMQ-29B, Automatic Meteorological Station (1)
AN/PMQ-3, Hand-Held Anemometer (1)
ML-217/UM, Clinometer (1)
ML-445/UM, Precision Aneroid Barometer (1)
ML-450A/UM, Electric Psychrometer (1)
ML-563A/UM, Barograph (1)
ML-429/UM, Psychrometric Computer (1)
CP-718/UM, Density Altitude Computer (1)
CP-264/U, True Wind Computer (1)
RD108, Wind Recorder (1)
Telephone, Local
Sling Psychrometer (1)
Electric Psychrometer (1)

Training Methods
Lecture/Discussion (3 hrs)
Performance (31 hrs)
Demonstration (3 hrs)

Multiple Instructor Requirements
Supervision (2)
Equipment (2)

Instructional Guidance
Issue student instructional materials at appropriate times. Instruct students on rules, procedures and safety precautions for taking observations. Stress safety while working with electrical equipment. Monitor student progress closely and provide assistance as necessary.

MIR: While in practice lab, two instructors will be required constantly for all performance areas.

14. Sampling Written Measurement and Critique 1

15. End-of-Course Measurement and Critique 2.5

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Aerographer's Mate (C-420-2010-A1)

BLOCK TITLE
Navy/Marine Unique Subjects

1. COURSE CONTENT	2. TIME
16. Live Weather Station	1
a. Given live weather data, plot a 1200Z and 1800Z synoptic chart with a minimum of 200 stations, with no more than ten errors. Each chart must be completed in a maximum of four hours. CTS: 3c(2), 3c(4), 3d(2), 3d(3) Meas: P	(.1)
b. Given live weather data, plot a 1200Z and 1800Z airways chart with a minimum of 200 stations, with no more than ten errors. Each chart must be completed in a maximum of four hours. CTS: 3c(1), 3d(1) Meas: P	(.1)
c. Given live weather data, plot a 1200Z series of constant pressure charts in accordance with checklist, with a minimum of 80 stations with no more than four errors per chart in three hours. CTS: 3c(8), 3d(4) Meas: P	(.1)
d. Given live weather data, plot a 1200Z and 1800Z Skew-T Log P diagram to determine the convective condensation level (CCL), lifted condensation level (LCL), level of free convection (LFC), freezing level, and stability index with no more than 3 errors per chart. Each chart must be completed in a maximum of 90 minutes. CTS: 3d(5)(a), 3d(5)(b), 3d(5)(c), 3d(5)(d), 3d(5)(e) Meas: P	(.1)
e. Given environmental warning data, plot five high sea and high wind warnings on the appropriate chart with no more than three errors on each chart. CTS: 3e(1), 3e(2) Meas: P	(.1)
f. In accordance with checklist, perform step-by-step procedures necessary to obtain teletype and facsimile data. All data received will be readable to the extent permitted by atmospherics and equipment capabilities. CTS: 4a(1), 4a(2), 4a(3), 4a(4), 4a(5), 4a(6), 4a(7), 4a(8), 4a(9), 4a(10), 4a(11), 4a(15), 4c Meas: P	(.1)
g. Using incoming weather data, file the data according to [illegible] heading, with no more than three errors. CTS: 4d(1), 4d(2), 4d(3), 4d(4), 4d(5) Meas: P	(.1)

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h. Given the facilities of the weather lab and reference materials, observe and record actual weather conditions in accordance with a checklist. Special and Local observations will be taken as criteria is met. All observations will be completed within 15 minutes with no more than two errors. CTS: 3a(1), 3a(2), 3a(3), 3a(4), 3a(5), 3a(6) Meas: P (.1)

i. Given prepared work sheets, receive/record satellite pictures. CTS: 3c(2) Meas: P (.1)

j. Given technical maintenance manuals, perform routine maintenance on the GMQ-33/(V) in accordance with applicable instructions. CTS: 3h(4) Meas: P (.1)

SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials

C3ABR25130-2-HO-300, Weather Codes Plotting Guide
C3ABR25130-2-HO-300A, Pressure Conversion Tables
C3ABR25130-2-HO-305, Location Identifier
C3ABR25130-2-WS-305, Pressure Computations Sheet
CNOC 3140/7 (MF1-10), Surface Observation Forms
CNOC 3140/8, Shipboard Observation Forms
AWS 10a (MF1-10), METAR Observation Forms
FMH-1B, Surface Observations
FMH-2, Synoptic Code Manual
Aerographer's Mate 3 & 2 Training Manual
NAVAIR 50-1P-11, International Meteorological Codes and Worldwide Synoptic Manual
International Cloud Atlas
Worldwide Marine Weather Broadcast Manual
FAA Contractions Manual
FAA Location Identifier
H.O. Pub No. 119, Weather Station Identifier
Local Visibility Marker Charts
DOD-WPC 1-10-3, Synoptic Plotting Chart
DOD-WPC 1-4-24, Airways Plotting Chart
DOD-WPC 9-16, Skew-T Log P Diagram
NAVOCEANCOMINST 3144.1C, Manual for Ship's Surface Weather Observations

Training Equipment

AN/GMQ-10, Transmissometer (1)
AN/GMQ-13, Cloud Height Set (1)
AN/GMQ-29B, Automatic Meteorological Station (1)
AN/UMQ-5, Wind Measuring Set (1)
AN/PMQ-3, Hand-Held Anemometer (1)
AN/GRA-120, Filter Assembly (Antenna Patch Panel) (1)
AN/UGC-6[illegible], Teletypewriter (Full Loop) (1)

Training Equipment (Continued)
AN/UGC-20, Teletypewriter (1)
ML-119, Clinometer (1)
ML-448/UM, Precision Aneriod Barometer (1)
ML-450/UM, Electric Psychrometer (1)
ML-563/UM, Barograph(1)
CP-718/UM, Density Altitude Computer
CP-264/U, True Wind Computer (1)
CV-172A/U, Frequency Shift Converter (1)
CV-2979/UX, Frequency Shift Converter (1)
GP-165A/UM, Psychrometric Computer (1)
R1051B/URR, Radio Receiver (1)
R390A/URR, Radio Receiver (1)
SB1203A/UD, Communications Patch Panel (Loop Jack) (1)
SB973/SRR, Switchboard Receiver Transfer (1)
SMQ-6B/(V), Satellite Receiver (1)
URA-17, Frequency Shift Converter (1)
Marine Barograph (1)
Sling Psychrometer (1)
Apt Satellite Tracking Board (1)
DCMED Model 40 (1)
519 Alden Marine Facsimile Recorder (1)
9244T Alden Facsimile Recorder (1)
AM3729/SR Amplifier, Audio Frequency (1)

Training Methods
Lecture/Discussion (1 hr)
Performance (37 hrs)

Multiple Instructor Requirements
Performance (2)

Instructional Guidance
The objectives in Live Weather Station will be completed by the student in the live lab over a five day period. These objectives can be accomplished in any order. A checklist will be used to check off each objective as the student completes it. Keep a watch on all students so that any problem areas can be taken care of. Call the duty observer at various times during the day to give them emergencies that require action on their part.

17.	Performance Measurement and Critique	37
18.	Course Critique and Graduation	1
19.	Military Training	13.5
	a. Physical Conditioning	(8)
	b. Commander's Call	(1)
	c. End-of-Course Appointments	(4.5)

HANDOUT
3ABR25130-HO-100

Technical Training

Weather Specialist

WEATHER GLOSSARY

A collection of commonly used terms as found in meteorological and related scientific writings.

21 March 1978

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE
DO NOT USE ON THE JOB

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WEATHER GLOSSARY

A

absolute. - Applied in climatology to the extreme highest and lowest values of any given meteorological element which occur during a particular period at the place of observation.

absolute ceiling. - The maximum height above sea level at which an airplane would be able to maintain horizontal flight under standard air conditions.

absolute humidity. - The mass of water vapor present per unit volume of space, i.e., the density of water vapor; usually expressed in grams per cubic meter or grains per cubic foot.

absolute instability. - The condition of a parcel of moist air, the lapse rate in which is greater than the dry-adiabatic rate. Conversely, absolute stability is characterized by a lapse rate less than the moist-adiabatic.

absolute temperature scale. - A temperature scale defined by the thermodynamic scale of Lord Kelvin, and hence also known as the Kelvin scale, which is independent of the specific properties of any substance, and is the fundamental or ultimate standard of reference to which all other temperature scales are referred.

The absolute temperature scale is almost universally used in the physical sciences, including dynamic meteorology, though the centigrade and Fahrenheit scales are generally employed in recording temperatures for daily weather and climatological purposes. The absolute temperature reading of 0° is equal to -273° C.

absorption. - In meteorology, a general term for the depletion which radiant energy undergoes in traversing the earth's atmosphere (either from sun to earth or from earth to space), and also in penetrating the oceans or other bodies of water and the solid earth.

acclimation. - The process of becoming acclimated or spontaneously accustomed to a different climate.

actual pressure. - The atmospheric pressure obtained from the observed reading of the barometer by applying the necessary corrections for temperature, gravity, and instrumental errors.

adiabat. - A line of constant potential temperature on an adiabatic chart, or the path along which a thermodynamic change takes place in a system when there is no exchange of heat with the environment.

In the case of the atmosphere, two kinds of adiabats are distinguished: the dry and the wet (or moist). A dry adiabat is a temperature-height or temperature-pressure curve along which a rising or sinking air parcel will move, provided no saturation occurs and provided, of course, that no heat is given to or taken from the air during its motion. Similarly, wet adiabat (saturation or condensation adiabat) is a temperature-height or temperature-pressure curve along which a parcel of saturated air will travel.

adiabatic. - Applied to a thermodynamic process during which no heat is communicated to or withdrawn from the body or system concerned. In the atmosphere, adiabatic changes of temperature occur only in consequence of compression or expansion, accompanying an increase or decrease of atmospheric pressure.

adiabatic chart. - A thermodynamic diagram with pressure and temperature as coordinates, which shows "the thermodynamic states of atmospheric air over a wide range of conditions and by which the changes of state and the energy transformations during any prescribed process may be traced out."

adiabatic process. - A thermodynamic process in which no heat exchange occurs between the working system and its environment; closely approximated in the atmosphere by an element of air in a rapidly ascending or descending current. Dry adiabatic lapse approximately 5.5° F per 1000 ft. Moist adiabatic lapse approximately 3.2° F per 1000 ft.

advection. - Horizontal flow of air at the surface or aloft; one of the means by which heat is transferred from one region of the earth to another.

advection fog. - A type of fog due to the transport of warm air over a cold surface, either land or water, or to the transport of cold air over a warm-water surface.

A. Types due to the transport of warm air over a cold surface.
   1. Monsoon fog.
   2. Sea fog occurring near contrasting water temperatures.
   3. Tropical air fog.
   4. Tropical air haze.
B. Types due to the transport of cold air over a warm-water surface.
   1. Arctic sea smoke.
   2. Autumn early morning steam mists over lakes, rivers, etc.

advective. - Pertaining to atmospheric phenomena or conditions in which advection, or the transfer of air by horizontal motion, is the dominating influence.

aerology. - A term often used synonymously with meteorology, and thus meaning the science of the atmosphere. The fundamental principles of meteorology and aerology are the same.

aeronautical meteorology. - The branch of meteorology concerned with weather insofar as it affects aviation.

air. - The mixture of gases comprising the earth's atmosphere.

air current. - A stream of air moving in any direction other than the horizontal, especially in the vertical. Air flowing in a nearly horizontal direction is ordinarily called wind.

air drainage. - The flow of air down a slope or channel. Air tends to flow downhill, due to gravity, when its density is greater than that of the adjacent air at the same level.

air mass. - A wide-spread body of air which approximates horizontal homogeneity; that is, its physical properties, level for level, are about the same over a wide area.

SYMBOL	DENOMINATION
A	Arctic air.
cPk, cPw	Polar continental air, colder or warmer than the underlying surface.
mPk, mPw	Polar maritime air, colder or warmer than the underlying surface.
cTk, cTw	Tropical continental air, colder or warmer than the underlying surface.
mTk, mTw	Tropical maritime air, colder or warmer than the underlying surface.
E	Equatorial air.
M	Monsoon air.
S	Superior air.

air-mass meteorology. - Roughly synonymous with air-mass analysis, the study of the current weather over a region in terms of the air masses affecting it and their interactions.

air pocket. - A term introduced in the early days of aviation to account for the sensation of being suddenly lifted or dropped that was occasionally experienced by the occupants of an airplane.

air trajectory. - The path followed by a particle of air for a given time.

albedo. - The rate of solar radiation reflected by a planet or satellite compared to that received.

Aleutian low. - The semi-permanent cyclone or low that is usually located near the Aleutian Islands. It represents one of the centers of action, especially in winter when it is quite strong and influential. In summer it moves north and all but disappears.

almanac. - A book or table containing a calendar of the days, weeks, and months of the year, a register of ecclesiastical festivals and Saints' days, predictions of various astronomical phenomena, etc. Many almanacs also contain weather prognostications of doubtful merit for a year in advance.

altimeter. - An aneroid barometer graduated to show height instead of pressure.

Altimeter scales are based on the assumption of a certain distribution of temperature with altitude. If the current distribution is different from the adopted one, the elevations indicated by the instrument are only approximate.

altimeter setting. - A barometric pressure in inches and based on sea level. Used for setting a pressure-scale-type altimeter when a pilot takes off, and as often as possible during the entire flight. Contraction - ALSTG

altitude. - A term used in meteorology to denote height above ground.

altocumulus. - A form of middle cloud, in the international cloud classification. It is a layer (or patches) composed of laminae or rather flattened globular masses, the smallest elements of the regularly arranged layer being fairly small and thin, with or without shading. These elements are arranged in groups, in lines, or waves, following one or two directions, and are sometimes so close together that their edges join.

The thin and translucent edges of the elements show irisations which are rather characteristic of this class of cloud, as distinguished from cirrocumulus or stratocumulus.

altocumulus castellanus. - A species of altocumulus which, when near the zenith, presents to an observer on the ground the typical appearance of masses arranged in lines and showing a pronounced cumuliform development with little turrets formed in lines resting on a common horizontal base.

altostratus. - A form of middle cloud, in the cloud classification. It is a striated or fibrous veil, more or less gray or bluish in color. Altostratus prevents ground objects from casting shadows, and gives the appearance of ground glass. Precipitation is continuous. Halo never occurs with altostratus. Altostratus may result from the transformation of a sheet of altocumulus or may break up into altocumulus.

anemometer. - An instrument for measuring the speed or force of the wind.

anticyclogenesis. - The sum of the processes which create and develop a new anticyclone or intensify an already existing one.

anticyclone. - An area of relatively high pressure with closed isobars, the pressure gradient being directed from the center so that the wind blows spirally outward in a clockwise direction in the northern hemisphere, counterclockwise in the southern.

anvil cloud. - Popular name of cumulonimbus having a cirriform, anvil-like upper portion. If a thundercloud is seen from the side, the anvil form of the cloud mass is very noticeable.

aphelion. - The point on the earth's orbit which is farthest from the sun. It is now reached about July 1st, but the time varies irregularly by a few days from year to year.

Arctic air. - An air mass originating over the ice-covered Arctic.

Arctic sea smoke. - Same as steam fog; but often specifically applied to steam fog rising from small areas of open water within sea ice.

argon. - An inert, invisible gas; one of the constituents of air.

arid. - In climatology, a term applied to climates which have insufficient rainfall to support vegetation.

atmosphere. - The gaseous envelope surrounding the earth; the highest of the layers in its structure, the lowest being the lithosphere (the solid portion), then the hydrosphere (the water portion), and lastly the atmosphere, which is again divided into the troposphere and stratosphere.

Gases and their volume percentages for dry air, i.e., air without vapor:

Nitrogen------------	78.09	100 percent
Oxygen--------------	20.95	
Argon---------------	0.93	
Carbon dioxide------	0.03	

atmospheric pressure. - The force per unit area exerted by the atmosphere in any part of the atmospheric envelope.

aurora. - A luminous glow sometimes seen at night in the northern and southern skies; in the northern sky it is called aurora borealis, and in the southern, aurora australis.

azimuth. - The arc of the horizon intercepted between a given point and an adopted zero point. In pilot balloon observations for the National Weather Service, north is the zero point, east is 90°, south is 180°, etc; so that if the balloon were, at a given instant during its flight, due west of the observer, its horizontal angle or azimuth would be 270°.

B

back. - To change direction counterclockwise; applied to the wind when it so changes, as, for example, from the north to northwest, east to northeast, etc.

balloon. - A bag, more or less airtight, and filled with some gas lighter than air, for the purpose of ascent in the atmosphere.

barograph. - A barometer which makes a continuous record of barometric changes. Barographs are generally of the aneroid variety.

barometer. - An instrument for measuring atmospheric pressure. There are two kinds of barometers, mercurial and aneroid.

barometric tendency. - The net change of barometric pressure within a specified time (usually 3 hours) before an observation, together with the proper sign, indicating not only the amount of change but whether the pressure is rising or falling, and also the characteristics of the rise or fall, such as "rising or falling," "unsteady," etc.

Beaufort wind scale. - As generally given in most meteorological texts, the Beaufort scale consists of thirteen degrees of wind speed, numbered from 0 (calm) to 12 (hurricane), with corresponding descriptions of the effects of the different winds on land and sea, and their limiting velocities in knots, miles per hour, meters per second, etc.

Bermuda high. - The name often given to the high pressure cell usually found over the Atlantic Ocean near the Bermuda Islands, though it varies in position and intensity.

blizzard. - A violent, intensely cold wind, laden with snow mostly or entirely picked up from the ground.

blowing snow. - Snow raised from the ground and carried by the wind so that the horizontal visibility becomes less than 7 miles, although no real precipitation is falling. The snow is carried up so high from the ground that the vertical visibility is reduced considerably.

boiling point. - The temperature at which the saturation vapor pressure of a liquid is in equilibrium with the external pressure on the liquid. The boiling point therefore varies with the external pressure; this explains why "the higher you go, the lower is the temperature at which water boils. To use an approximate figure the boiling point is lowered 1.8 degrees F. for each 1,000 feet of altitude."

Bourdon tube. - A device which may be used to measure atmospheric pressure, and, in another form, to measure temperature.

Boyle's law. - A thermodynamic law which states that the volume of a gas varies inversely as its pressure, the temperature remaining constant. Expressed mathematically:

$$pV = c$$

where p = pressure; V = volume; c = a constant.

breeze. - 1. In general, a light wind. 2. In the Beaufort wind scale, a wind speed ranging from 4 to 27 knots.

broken sky. - The condition of the sky when it is more than five-tenths, but not more than nine-tenths, covered by clouds or obscuring phenomena aloft.

Buys Ballot's law. - The principle governing the relation of wind direction to pressure distribution: "If one stands with his back to the wind, the pressure on his left hand is lower than on his right." Thus stated, the law applies in the Northern Hemisphere; but in the Southern Hemisphere, its reverse is true.

C

calm. - An entire or almost entire absence of wind. In the Beaufort wind scale, this condition is reported when smoke is observed to rise vertically and the wind speed is less than 1 mile per hour.

capillarity correction. - The correction which must be made to the reading of a mercurial barometer to allow for the fact that the meniscus in the tube is convex upwards, thereby leading to the so-called capillary depression of the top of the mercury column because of which the column does not reach as high as it should in response to the atmospheric pressure.

castellanus. - A species of cloud "with cumuliform protuberances or turrets in the upper portion. Common to cirrus, curocumulus, altocumulus, and stratocumulus.

ceiling. - Ceiling is the lowest height above ground at which all clouds at and below that level hide more than one-half of the sky. Also the vertical visibility into surface based obscuring phenomena.

ceiling balloon. - A balloon used to calculate the height of the ceiling. It is inflated with either hydrogen or helium and may be white, purple, black or red.

ceiling light. - Also called a ceiling projector; a vertically directed light which is used at night to project a narrow beam of light onto the base of a cloud in order to measure its height.

ceilometer. - An instrument for determining throughout the entire day and night the height of the cloud ceiling and the rate at which the ceiling is lifting and lowering.

centigrade scale. - The thermometric scale in which the fundamental interval, between the temperature of melting ice, and the temperature of the vapor of boiling water at 760 mm. normal atmospheric pressure, is divided into 100 equal parts, each part being called a centigrade degree. The boiling point is labeled 100°, the freezing point 0°.

To convert centigrade degrees (C.°) to Fahrenheit degrees (F.°):

$$F^\circ = 9/5\ C^\circ + 32^\circ$$

To convert Fahrenheit degrees to centigrade degrees:

$$C^\circ = 5/9\ (F^\circ - 32^\circ)$$

change of state. - The process by which a substance passes from one to another of the solid, the liquid, and the gaseous states, and in which marked changes in its physical properties and molecular structure occur. The change from the solid to the liquid state is called fusion or melting the reverse change, freezing; the change from the liquid to the gaseous state is called vaporization, the reverse change, condensation; and the change from the solid directly to the vapor state is called sublimation, the reverse change, in meteorology is also called sublimation.

Charles' law. - The physical law which states that, for each rise of 1° C in temperature, all the common gases expand by the same fraction (about 1/273) of their volume at 0° C, the pressure being kept constant; or

$$V_t = V_o\ (1 + at^\circ)$$

where V_t is the volume at temperature t in centigrade degrees, V_o is the volume at 0° C, and a, the coefficient of expansion, is about 1/273 or 0.003660, since its precise value varies with the pressure, temperature, and nature of the gas considered.

chinook. - Name given in the western United States and Canada to a warm, dry, southwest wind along the eastern slopes of the Rocky Mountains, identical with the European foehn.

circulation. - In a broad sense the general, principal, or primary circulation of the atmosphere. It consists of the polar easterlies, the westerlies of middle latitudes, the trade winds of the subtropical regions; together with the high pressure cells at 30° north and south latitudes, separating the trades from the westerlies, and the low-pressure calm belt or doldrums, north of the equator, between the northeast and southeast trades.

cirrocumulus. - A cloud layer or patch composed of small white flakes or of very small globular masses, usually without noticeable shadows, which are arranged in groups or lines, or more often in ripples resembling those of the sand on the seashore.

cirrostratus. - A thin whitish veil of cloud which does not blur the outlines of the sun or moon, but often gives rise to a halo.

cirrus. - Detached high cloud of delicate and fibrous appearance, without shading, generally white in color, often of a silky appearance.

civil time. - Legally accepted time: it is based on mean solar time; and the civil day period is from one midnight to the next midnight, or 24 hours long.

clear. - 1. Applied, in general use, to a cloudless sky or to a day of negligible cloudiness and good visibility. 2. The state of the sky when it is cloudless or less than one-tenth covered by clouds. 3. The character of the day's weather from sunrise to sunset, when the average cloudiness, as determined by frequent observations, either has been zero, or the clouds have been so few that not more than one-tenth of the sky has been covered.

clear ice. - Ice with a glassy surface which varies from clearness to translucency: it is identical with the glaze which forms on trees, etc, when freezing rain falls to earth, or on parts of airplanes.

clinometer. - A portable instrument used with a ceiling light to measure cloud heights at night.

cloud bank. - A mass of clouds stretching across the sky and usually of considerable vertical extent.

cloudburst. - A sudden and extremely heavy downpour of rain; especially one in which the water falls in a continuous stream rather than in drops.

cloud classification. - A scheme of distinguishing and grouping clouds according to their appearance, elevation, or method of formation. The one in general use, based on a classification introduced by Luke Howard in 1803, is that proposed in 1929 by the International Meteorological Commission for the study of clouds. It is the following:

High Clouds

1. Cirrus
2. Cirrocumulus
3. Cirrostratus

Middle Clouds

4. Altocumulus
5. Altostratus
6. Nimbostratus

Low Clouds

7. Stratocumulus
8. Stratus

Low Clouds With Vertical Development

9. Cumulus
10. Cumulonimbus

These ten main types, each of which is discussed under a separate heading, are further subdivided into several species and varieties.

cloud symbols. - A set of ideograms used for a weather map to represent the various cloud types, such as cumulus humilis, altocumulus castellatus, cirrocumulus, et al. They are given in most texts on meteorology.

col. - A neck of relative low pressure between two anticyclones; also called a saddle or neutral point.

cold air mass. - Broadly speaking, an air mass that is cold relative to neighboring air masses.

cold front. - The line of discontinuity at the earth's surface (or at the intersection of the cold frontal surface with a horizontal plane in the atmosphere) along which a wedge of cold air is underrunning and displacing a warmer air mass.

cold-front thunderstorm. - A thunderstorm attending a cold front.

cold-front type occlusion. - An occlusion formed generally on the east coasts of northern continents when the cold air in the rear of a cold front is colder than the air in advance of the front and hence will underrun the latter.

cold wave. - A rapid and marked fall of temperature during the cold season of the year.

condensation. - The process by which a vapor becomes a liquid.

condensation level. - See lifting condensation level.

condensation nucleus. - A particle upon which condensation of water vapor begins in the free atmosphere. Condensation in the free atmosphere invariably takes place on hygroscopic dust or hygroscopic gases present. The common sources of hygroscopic dust and gases are sea salt, products of combustion, and dust blown up from the earth's surface.

conditional instability. - The state of moist unsaturated air in which the lapse rate is intermediate between the dry- and the moist-adiabatic; so called because the stability is conditional on the water vapor content and the occurrence of lift.

conduction. - The transference of heat within and through a substance by means of internal molecular activity and without any obvious external motion. In the atmosphere, since air is a poor conductor, conduction is important only in heating layers of air in direct contact with the ground.

constant level chart. - Any chart which represents the synoptic distribution of one or more meteorological elements at any fixed geometric elevation (including zero) above sea level. The sea level or ten-thousand-foot pressure maps are examples of constant level charts.

constant pressure chart. - A chart which contains the synoptic contour lines of the height above sea level of any selected isobaric surface in the free atmosphere. In the selected isobaric surface the synoptic distribution of any other meteorological element may be represented on the constant pressure chart.

contact weather. - Weather in which all elements are such that the pilot of an airplane may operate without instruments, i.e., he can control his flight by means of visual reference to the ground or water.

continental polar air. - Cold dry air formed over sub-polar land regions.

continental tropical air. - Hot dry air formed over a low latitude landmass.

contour line. - A line on a map drawn through points having the same elevation above or below sea level. Contour lines, therefore, indicate the ground relief; lines close together signify steepness of slope, and far apart the reverse. The interval between the lines depends largely upon the scale of the map but sometimes upon the mean slope of the country represented.

convection. - In physics, the circulation resulting in a fluid of non-uniform temperature, owing to differences in density and the action of gravity. In meteorology, the vertical movement of air is called convection.

convective instability. - Also called potential instability; the condition of an unsaturated layer of air having a stratification of humidity such that, upon being lifted, the lower part of the layer becomes saturated first, and hence cools thereafter at a slower rate than does the upper, drier portion, until the lapse rate of the whole layer becomes equal to the saturation adiabatic and any further lifting results in instability.

convergence. - The increase of mass within a given layer of the atmosphere when the winds are such that there is a net horizontal inflow of air into the layer.

cooperative observer. - An unpaid observer of the U.S. Weather Bureau; formerly called a voluntary observer. His station, which is usually equipped by the Weather Bureau with the necessary meteorological instruments, is called a cooperative station.

Coriolis effect. - The deflection of winds due to the influence of the rotation of the earth. Owing to this effect, winds in the northern hemisphere are deflected to the right, and in the southern, to the left.

corona. - A set of one or more rainbow-colored rings of small radii concentrically surrounding the sun, moon, or other source of light when covered by a thin cloud veil.

The corona can be distinguished from the halo by the fact that the color sequence is opposite in the two, the red of the corona being on the outside, while that of the halo is on the inside. Also is smaller in diameter.

crepuscular rays. - Beams of light apparently diverging from the sun, seen both before and after sunrise and sunset, especially in a hazy or humid atmosphere. The beams are rendered luminous by the dust or water vapor, and are especially striking when they shine through rifts in the clouds. They are actually parallel: their apparent divergence is surely the result of perspective.

cross section. - As used in meteorology, the representation of conditions prevailing in the atmosphere in a vertical plane from the surface up to any desired height, along a line from one weather station to another.

cumulonimbus. - A cumulus cloud of very great vertical development (often 4 miles or more deep from base to summit) and comparable horizontal extent, the top of which is composed of ice crystal clouds, its most distinguishing characteristic.

cumulonimbus mamma. - Previously called cumulonimbus mammatus. A cumulonibus cloud with hanging protuberances, like pouches, on the underside.

cumulus. - A cloud with vertical development, the mean lower level of which is 1,600 feet. The summit of the cloud, in general dome-shaped, shows rounded bulges, while the base is usually horizontal. It appears variously white, shaded, or dark, according to its position with reference to the sun. Its base is generally of a gray color.

cumulus fractus. - A species of cumulus, a low, small, ragged cloud, lacking the clear-cut outlines of ordinary cumulus, generally seen in bad weather under a sheet of altostratus or nimbostratus.

current. - The vertical component of air motion; an air current is thus distinguished from the wind, which is the horizontal component.

cycle. - A regularly recurring succession of events, such as the cycle of the seasons.

cyclogenesis. - The process which creates a new cyclone or which intensifies the circulation around a pre-existing one.

cyclone. A circular or nearly circular area of low atmospheric pressure around which the winds blow counterclockwise in the northern hemisphere, clockwise in the southern.

D

damp haze. - Obstruction to vision due to the presence in the air of small water droplets or very hygroscopic particles, which do not, however, reduce the horizontal visibility to less than 1 1/4 miles.

deepening. - The process by which the central pressure of a system, usually a low, decreases with time. The rate of deepening is equal to the barometric tendency in the center of the system

degree. - On the centigrade and absolute thermometer scales, 1/100th of the interval from the freezing point to the boiling point of water under standard conditions; on the Fahrenheit scale, 1/180th of this interval.

degree day - A measure of the departure of the mean daily temperature from a given standard (65° F). One degree day for each degree of departure below the standard during one day, and the number of degree days in a month, or other interval, is the sum of all the daily values. No consideration is given to days when the mean temperature for the day is above 65° F.

density. - The ratio of the mass to the volume of a substance. If the masses of all equal volumes of a substance are identical, the density is uniform and is equal to the mass in any unit of volume.

departure. - The amount by which the value of a meteorological element (either the instantaneous value or the mean over a brief period) differs from the value taken as normal for the given time.

depression. - A common term for an extensive area of relatively low barometric pressure. Other terms having roughly the same meaning are: cyclone, tropical cyclone, extratropical cyclone, hurricane, low, etc.

depression of the wet-bulb. - The difference in degrees between the current temperatures of the dry- and the wet-bulb thermometers of a psychrometer.

deviation. - The algebraic difference between the mean of a series of data and an individual member of the series.

devil. - A name applied in India to a dust devil of dust whirl. The "desert devil" of South Africa and the "dancing devil" of southwestern United States are the same phenomenon.

dew. - Water condensed onto objects near the ground whose temperatures have fallen below the dew point of the adjacent air due to radiational cooling during the night, but are still above freezing; frost occurs when the temperatures are below freezing.

dew point. - The temperature to which air must be cooled, at constant pressure and constant water vapor content, in order for saturation, to occur.

direction of the wind. - The point of the compass from which the wind blows, not that toward which it is moving. Wind direction is also expressed in degrees measured clockwise from north: thus an east wind has a direction of 90°, a northwest wind, of 315°.

discontinuity. - A zone or layer in the atmosphere within which there is a comparatively rapid transition of any of the meteorological elements from one value to another.

diurnal. - Daily; applied to many meteorological phenomena having a distinctive daily behavior.

divergence. - In fluid motion, a net outflow of mass across a closed surface bounding a limited volume of the fluid. This condition exists in the atmosphere, e.g., when the distribution of winds within a given layer of air is such that there is a net horizontal outflow of air from the region.

doldrums. - The equatorial belt of calms or light fitful winds, lying between the northeast trade winds of the Northern Hemisphere and the southeast trades of the Southern. The doldrums are variable in position, and tend to move north and south with the sun, with a lag of about six weeks, though they are more often north than south of the equator.

fair. - Used in a general sense to signify fine weather.

filling. - The process, opposite to deepening, in which the central pressure of a cyclone increases.

flash flood. - A local flood which rises and subsides rapidly.

flood. - A rise of the sea above its normal tidal height, due to storm or volcanic action; a rise of a river or stream above its banks, generally on account of a heavy snowfall or excessive rainfall in the watershed through which it passes, and most frequently in spring.

flurry. - A shower of snow, brief, and accompanied by a gust of wind. One speaks of a "flurry of snow," or "snow flurries."

foehn. - A dry wind with a strong downward component, warm for the season, characteristic of many mountainous regions, notably the Alps, and also the Rockies, where it is known as the chinook.

fog. - A cloud formed at the surface of the earth by the condensation of atmospheric water vapor into a multitude of minute water droplets (average diameter about 40 microns) or, less frequently, tiny ice crystals, and interferring to varying degrees with the horizontal visibility at the surface.

a. Air-mass fogs, in which the principal factor of formation is cooling of the air to its dew point. They consist of three main types, advection fog, radiation fog, and upslope fog.

b. Frontal fogs, in which the evaporation of water vapor into the air from falling precipitation, acts to raise the dew point while other factors lower the temperature so that condensation results.

forecast. - A prediction of coming weather for a definite period and area. The United States Weather Bureau issues forecasts for the general public four times daily, at 4 a.m. and 10 a.m., and at 4 p.m. and 10 p.m., E.S.T., for periods varying from 36 to 48 hours in advance.

Fortin barometer. - A portable mercurial barometer, the principal feature of which is the means provided to raise or lower the level of the mercury in the cistern. This is accomplished by a screw operating against the leather bottom of the mercury cistern.

fractus. - A suffix added to the name of a basic cloud form to indicate a torn, ragged, and scattered appearance caused by strong winds.

free air. - That portion of the atmosphere not influenced by disturbances due to the presence of terrestrial objects, and out of the range of surface recording instruments.

electric storm. - Name sometimes given to a thunderstorm, on account of its accompanying electrical phenomena.

elevation. - The height of any point above mean sea level; distinguished from altitude, which usually means height above ground.

equator. - 1. The terrestrial equator: the great circle on the earth midway between the poles. It is the zero of all measurements of latitude. 2. The celestial equator: the great circle in which the plane of the earth's equator, extended, intersects the celestial sphere.

equatorial air. - Warm and moist air, originating in equatorial regions.

equinox. - The moment, occurring twice each year, when the sun, in its apparent annual motion among the fixed stars, crosses the celestial equator; so called because then the night is equal to the day, each being twelve hours long over the whole earth. The autumnal equinox occurs on or about September 22d, when the sun is traveling southward; the vernal equinox on or about March 21st, when it is moving northward.

equivalent-potential temperature. - The temperature to which air would come if it were brought adiabatically to the top of the atmosphere (i.e., to zero pressure), so that all its moisture content were condensed and precipitated and the latent heat of condensation given to the air, and then lowered and compressed to a level having the standard pressure of 1,000 mbs.

equivalent temperature. - Defined by Rossby and most modern authors as the temperature to which air would come if subjected to a pseudoadiabatic process until all its water vapor content had been condensed, and then returned dry-adiabatically to its initial pressure.

evaporation. - The process by which a liquid changes to the gaseous state; in meteorology, ordinarily understood to refer to the change of liquid water into water vapor, which process continues, under the proper conditions, until saturation is reached. The rate of evaporation from a free-water surface depends on many factors, but is greatest, in general, with high temperature and low vapor pressure just above the surface. Hence, water evaporates most quickly in hot dry climates.

evaporation gage. - Any of the various types of instruments for measuring evaporation; also known as an atmometer or evaporimeter.

F

Fahrenheit. - A temperature scale used mainly in the United States, with the freezing point of water at 32 degrees and the boiling point at 212 degrees. Named after Daniel Gabriel Fahrenheit.

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free air. - That portion of the atmosphere not influenced by disturbances due to the presence of terrestrial objects, and out of the range of surface recording instruments.

free lift. - The actual lifting force of an inflated pilot balloon, expressed in grams. The free lift plus the weight of the balloon is the total lift.

freeze. - The condition which exists when over a widespread area the surface temperature of a whole air mass remains below 0° C. or 32° F. for a sufficient time to constitute the characteristic feature of the weather.

freezing point. - In meteorology, the temperature at which pure water freezes or pure ice melts, i.e., 0° C. or 32° F. In other words, it is the temperature of a mixture of pure water and pure ice, and serves as one of the fiducial points of thermometry.

freezing rain. - Precipitation in the form of rain, a portion of which freezes and forms a smooth coating of ice (or glaze) upon striking exposed objects.

front. - The line of intersection of a frontal surface with a horizontal plane (e.g., the earth's surface); or the line on the earth's surface, or at higher levels, where two different air masses meet. Frequently referred to as a line of discontinuity between air masses of different densities.

frontal surface. - The surface of separation between two different and adjacent air masses. Frontal surfaces are not mathematical surfaces, but rather layers or zones of transition; though their thicknesses are so small compared with the size of the adjacent air masses that they may be considered surfaces for all practical purposes.

frontal zone. - The region of transition between two air masses; a sloping layer of the atmosphere, separating air of different temperature, density, or wind velocity, wherein there is a gradual change in the values of such elements.

frontogenesis. - The creation of a new front, or regeneration of an old one, which occurs, generally speaking, in a region where there is a large temperature gradient and a converging wind system, combining to bring into close proximity air particles of different temperature, density, and speed and direction of movement.

frontolysis. - The process to which a front weakens or dissolves, owing to the fact that the air masses it separates have become homogeneous whole.

frost. - A light, feathery deposit of ice caused by the sublimation of water vapor, directly in the crystalline form, on terrestrial objects whose temperatures are below freezing, the process being the same as that by which dew is formed, except that the latter occurs only when the temperature of the bedewed object is above freezing.

funnel cloud. - A tornado or water spout not touching the surface.

fusion. - In general, the transition of a substance from the solid to the liquid state, or the melting together of two substances. In meteorology, however the term is used with reference to the melting of ice, which takes place at the temperature of 0° C. or 32° F. under standard pressure, 760 mm.

G

gage (or gauge). - General name for any measuring instrument; often used in combination with a specific term, such as rain gage or snow gage. A barometer is sometimes called a weather gage.

gale. - In general, a wind with a velocity exceeding 30 miles an hour; the precise limiting velocities vary among the different meteorological services.

gas. - A substance that is in a state "in which the cohesion is so negligibly small that it will diffuse throughout any enclosure in which it is placed; specifically, when the substance is at a temperature above its critical temperature."

general circulation. - The average or prevailing large-scale movements of the atmosphere as represented by the yearly means of all available records of surface and upper-air wind velocities, which fit into the average annual pressure patterns. Thus, in general circulation is the mean condition and, to some extent, an idealized picture of the atmospheric circulation. The actual circulation on individual days includes the modifications and variations due to the migratory cyclones and anticyclones of middle latitudes; on the whole, the general circulation is most apparent in the prevailing westerlies and the trade winds.

geostrophic wind. - A steady horizontal air motion along straight, parallel isobars in an unchanging pressure field, with gravity the only external force, and in a direction perpendicular to that in which the Coriolis force (due to the earth's rotation) and the pressure gradient force are acting equally and oppositely.

geostrophic wind scale. - A graphical device by means of which the geostrophic wind velocity may be conveniently determined from a constant pressure chart.

glacier. - An extensive, slowly flowing body of ice, formed on land in a cold region where more snow falls than is melted; the snow is transformed into ice by pressure and, together with frozen liquid water, constitutes the body of the glacier.

glacier wind. - A shallow gravity wind along the icy surface of a glacier, caused by the temperature difference between the air in contact with the glacier and the free air at the same altitude.

gradient. - The rate of change in the value of any quantity with distance in any given direction; in practice usually the rate of change in a horizontal or vertical plane, in the direction of the maximum rate of change.

gradient wind. - Steady, horizontal, functionless, atmospheric motion in which the wind blows parallel to curved isobars in an unchanging pressure field, and the centrifugal, Coriolis, and pressure-gradient forces balance. The gradient wind velocity is the wind speed attained under these conditions. It does not occur at the earth's surface, due to friction, but is closely realized at a height of, roughly, 1,500 feet.

gram. - A c. g. s. unit of mass; originally defined as the mass of 1 cubic centimeter of water at 4° C.; but now taken as the one-thousandth part of the standard kilogram, a mass preserved by the International Bureau of Weights and Measures.

granular snow. - In the description of hydrometeors proposed by International Meteorological Organization, "precipitation of white, opaque, snowlike grains, similar to soft hail, but more or less flattened or oblong in shape and generally less than 1 mm. in diameter, at least in one direction."

gravity. - The apparent force per unit mass with which the earth attracts bodies near its surface, as measured by the acceleration of a freely falling body relative to the surface of the earth.

gravity correction. - A quantity which must be applied to the readings of all mercurial barometers not located at sea level at 45° north or south latitude where the value of gravity is taken as a standard of reference.

ground fog. - A shallow but often dense fog of the radiation type, through which the stars may be observed at night and the sun in daytime. It appears first at the ground and remains there even after it thickens.

ground frost. - A freezing condition injurious to vegetation, which is considered to have occurred when a minimum thermometer exposed to the sky and just above a grass surface records a temperature of 30.4° F. or below.

gust. - A sudden brief increase in the force of the wind of more transient character than a squall and followed by a lull or slackening of the wind. All winds near the earth's surface display alternate gusts and lulls.

gustiness. - The irregularity in the velocity of the wind, caused either by the mechanical effect of surface irregularities, which create eddy currents that disrupt the smooth air flow, or by convection currents due to surface heating.

hail. - Precipitation in the form of balls or irregular lumps of ice, snow, and sometimes rime. Falls from convective clouds.

hailstone. - A single unit of hail varying in size from that of a pea to that of a grapefruit, and sometimes even larger.

hair hygrograph. - An instrument for measuring and recording humidity by means of the variations in length of a strand of human hair; when freed from natural oils, hair has the property of increasing in length about 2 1/2 percent of its original length when the relative humidity changes from 0 to 100 percent.

hair hygrometer. - A device for measuring relative humidity, less frequently used in meteorology than the hair hygrograph.

halo. - General name of a class of optical meteors, which appear as colored or whitish rings and arc about the sun or moon, when seen through an ice crystal cloud or in a sky filled with ice crystals; they are due to the refraction of the light which passes through the crystals, and, in the case of the whitish halos, to reflection from their surfaces.

haze. - Fine dust or salt particles dispersed through the atmosphere, so small that they cannot be felt or distinguished individually by the unaided eye, but which diminish horizontal visibility and give the atmosphere a characteristic hazy and opalescent appearance, casting a uniform bluish or yellowish veil over the landscape and subduing its colors. These colorations serve to distinguish haze from the grayish mist.

heat. - A form of energy, most commonly manifested to the senses by a rise in the temperature of a material body to which heat is being transferred.

heat lightning. - Illumination from distant lightning flashes, generally seen near the horizon, toward or during the evening, often with a clear sky overhead; "usually explained as the reflection from the hazy air of the lightning flashes of storms below the horizon and too distant to be audible. It is called heat lightning because it is characteristic of hot weather when local thunderstorms occur."

heat of condensation. - The amount of heat given up by a unit mass of a substance when passing from the vapor to the liquid state; or, the amount of heat absorbed by a unit mass of a substance when passing from the liquid to the vapor state, both at constant temperature. The amount is the same in both cases for the same substance at the same temperature.

heat of fusion. - The amount of heat required to convert unit mass of a solid to its liquid state, at constant temperature; or, the amount of heat given up by 1 gram of a substance in passing from the liquid to the solid state, while the temperature remains constant. For one and the same substance, the two amounts are the same. The heat of fusion of ice (or latent heat) is 79.7 calories per gram.

heat of sublimation. - The amount of heat used when a solid changes directly to its gaseous state in doing external work (that of expansion) and internal work (that required to increase the molecular velocity). Also, the amount of heat given up when a mass in the gaseous state changes to a solid. It is customarily measured in calories per gram, and would equal the sum of the heats of fusion and of vaporization if all these processes took place at the same temperature.

heat wave. - A period of abnormally high temperatures, lasting more than a day or so; also known as a hot, or warm wave.

height. - 1. Commonly, vertical distance, expressed as so many linear units (e.g., feet of meters) above sea level or above some other specified reference basis. 2. Any measure or index of vertical distance.

high pressure area. - Synonymous with high barometric area, high or anticyclone.

hoarfrost. - Atmospheric moisture deposited through sublimation upon terrestrial objects in the form of ice crystals by the same process which causes dew but at a time when the temperature of the objects is at or below freezing.

hodograph. - In meteorology, a line connecting the end points of the vectors that represent upper wind velocities, derived by computation from a pilot balloon observation, when these vectors are plotted on polar coordinate paper.

homogeneous atmosphere. - A hypothetical atmosphere in which the density is the same throughout, and the pressure at the surface is the same as that of the actual atmosphere. Such an atmosphere would have an approximate altitude of 8,000 meters.

horizon. - 1. Astronomical: the great circle on the celestial sphere halfway between zenith and nadir. 2. Geographical: the line where earth and sky appear to meet.

humidity. - The state of the atmosphere with respect to water vapor content; it may be measured in many different ways. See: absolute humidity; dew point; mixing ratio; relative humidity; specific humidity; vapor pressure; water vapor.

hurricane. - A tropical cyclone, especially one in the West Indian Region. A cyclone originating in this region and passing northward into the Temperature Zone is often called a "West India hurricane," even after it has assumed the character of an extratropical cyclone. If it is sufficiently severe, it justifies the display of "hurricane warnings" at ports on the east coast of the United States.

hydraulics. - A branch of engineering which comprises the study of the flow of fluids, especially the flow of water in rivers, canals, etc.

hydrology. - The science which treats of the phenomena of water in all its states; of the distribution and occurrence of water in the earth's atmosphere, on the earth's surface, and in the soil and rock strata; and of the relation of these phenomena to the life and activities of man.

hydrometeor. - Any product from condensation of atmospheric water vapor, whether formed in the free atmosphere or at the earth's surface.

hydrometeorology. - A branch of meteorology dealing with the water in the atmosphere, precipitation and its aftereffects such as runoff, floods, etc.

hydrosphere. - 1. The water portion of the earth; as distinguished from the solid part which is called the lithosphere. 2. In a more inclusive sense, the water vapor in the atmosphere, the sea, the rivers and the ground waters.

hygrometer. - An instrument which indicates either the relative humidity or, in the case of the dew point hygrometer, the dew point of the air.

hygrothermograph. A self-recording instrument, combining the registration of both relative humidity and temperature on one record sheet. Different colored inks are used to prevent confusion.

I

ice. - The solid state of water, which may be attained in the atmosphere either by the freezing of liquid water or by sublimation directly from water vapor. Many forms of ice exist in nature: among them are snow, ice spicules, clear ice, anchor ice, glacier and iceberg ice, glaze, and icing on aircraft. As far as known, ice appears in nature only in the crystalline form.

ice age. - A period of geologic history during which considerable portions of the earth were covered with glacial ice. There have been many ice ages in the geological history of the earth; during some, the ice sheets were situated in the polar regions, but in others they were in equatorial regions. In the last ice age, the Pleistocene, about one-fifth of the earth's surface was glaciated at one time or another, but not all at one time, and the ice sheets did not radiate from the poles in a regular manner.

iceberg. - A mass of land ice, which has broken away from its parent formation on the coast, and either floats in the sea or is stranded in the shallows; sometimes referred to as berg.

ice cap. - A perennial cover of ice and snow over an extensive area of land or sea. There are several ice caps in the world, the most important being those on the Antarctic Continent, on Greenland, and in the Polar Sea which lies to the north of North America and eastern Siberia and extends beyond the Pole.

ice crystals. - 1. The form in which ice, always (as far as known) occurs in nature. Five types have been distinguished: hexagonal columns, hexagonal pyramids, hexagonal plates, triangular plates, and twelve-sided plates. 2. A hydrometeor, which never falls in showers, consisting as it does of tiny unbranched spicules of ice which seem to float in the air. It is distinguished from ice fog, by the greater visibility it permits.

ice fog. - A hydrometeor, which consists of a fog formed of ice spicules, usually under conditions of clear, cold, windless weather. Most frequent in the higher latitudes, it also is known as frost in the air, frozen fog, pogonip, etc. Temperatures are usually at or below -20° F.

Icelandic low. - The semipermanent low pressure area centered over the northern part of the Atlantic Ocean, generally in the vicinity of Iceland. Like the Aleutian low, it is an important center of action, for the weather of the middle and high northern latitudes, especially in the winter.

Ice pellets. - Precipitation of transparent or translucent pellets of ice having a diameter of 0.2 inch (5 mm) or less. The pellets usually rebound when striking hard ground. There are two main types: A. Hard grains of ice consisting of frozen raindrops (sometimes called sleet) which fall as continuous precipitation. B. Pellets of snow encased in ice which fall as showery precipitation.

ice storm. - A storm characterized by the falling of rain from a relatively warm layer of air aloft to the surface of the earth when the latter is at subreezing temperatures, and the consequent freezing of the rain as a film of ice on terrestrial objects; also called freezing rain, silver thaw, glaze, and, mistakenly, sleet storm.

icing. - The formation of ice on an aircraft in flight, often to the extreme peril of its occupants; it is caused by the freezing of liquid water droplets which strike the leading edges and exposed surfaces. "There are only two fundamental conditions for ice formation: first, the plane must be flying through visible water in the form of rain or cloud; and second, the temperature of the liquid droplets must be 32° F. or below when they strike the aircraft.

index. - An indicator, usually numerically expressed, of the relation of one phenomenon to another. For an example, see the zonal index.

Indian summer. - Any spell of warm, quiet, haze weather that may occur in October or even in early November; in some years there may be only a few days of such weather or none at all, while in other years there may be one or more extended periods.

infiltration. - In hydrology, the movement of water from the surface into the soil.

insolation. - The rate at which radiant energy is incident directly from the sun per unit horizontal area at any place on or above the surface of the earth. Its value depends upon: (a) the solar constant, (b) the distance of the point from sun, (c) the inclination of the suns' rays to the horizontal plane at the point under consideration, and (d) the transparency of the atmosphere.

instability. - A state in which the vertical distribution of temperature is such that an air particle, if given either an upward or a downward impulse, will tend to move away with increasing speed from its original level. (In the case of unsaturated air, the lapse rate for instability will be greater than the dry adiabatic lapse rate; in that of saturated air, greater than the saturated adiabatic lapse rate.) The principal kinds of instability - absolute, conditional convective, and latent - are each discussed under an individual entry.

instability line. - See squall line.

instrumental (or scale) error, - In general, an error in the reading of an instrument that is due to one or more imperfections of the instrument, including those of the graduations on its scale. In the U.S. National Weather Service, it is the practice to combine all these errors into one correction in the case of the barometer and its scale.

instrument shelter. - In the United States, a structure with louvered sides and a double roof for ventilation, in which thermometers and other instruments may be exposed.

international index numbers. - The numbers agreed upon by an international committee to designate meteorological stations.

inversion. - The condition which exists in the atmosphere when the temperature increases rather than decreases with height through a layer of air. An inversion at the earth's surface is due most commonly to radiational cooling of the lower levels, which does not affect the air above. In the free air, an inversion exists obviously when a warmer air mass overlies a colder one: this is called a frontal inversion.

iridescent clouds. - Cirrostratus or cirrocumulus clouds which exhibit brilliant spots or borders of colors, usually red and green: observed up to 30° or more from the sun.

isallobar. - A line connecting points on a weather map having the same barometric tendency, both with regard to magnitude and direction (positive or negative) of change.

isallobaric wind. - The component of the wind which blows at right angles to the isallobars, in the direction of the largest pressure falls.

isentropic analysis. - An analysis, by means of data obtained from aerological soundings, of the physical and dynamic processes taking place in the free atmosphere on the basis of the location and configuration of the various isentropic surfaces and the distribution of air properties and air movement on these surfaces. Isentropic charts and vertical cross sections are used principally in this analysis.

iso. - A combining form from the Greek, meaning "equal;" a familiar word with this prefix is isotherm.

isobar. - A line connecting places having the same barometric pressure.

isohyet. - A line drawn on a map through points having the same amount of precipitation for any specified period.

isotherm. - A line connecting points having the same temperature. An isotherm may be drawn to represent the temperature at any particular time, or the average temperature for any specified period. Thus, there are, for instance, isotherms on daily weather charts indicating instantaneous temperatures, and on climatological charts, indicating the mean temperatures for the months of the year.

isothermal layer. - Any layer in the atmosphere through which the temperature does not change appreciably with height.

ivory point. - A small marker, projecting downwards from the top of the cistern in the Fortin type of mercurial barometer.

K

katabatic wind. - Air flowing down an incline; caused by the cooling of surface air, which then, impelled by gravity, flows downward. Also called mountain wind, canyon wind, and gravity wind.

L

lag. - A difference between the indicated reading of an instrument and the actual current value of the quantity it is designed to measure, due to a failure of the instrument to respond instantaneously to variations of this quantity.

lake breeze. - A wind, generally light, produced by the differential heating of the waters of a lake and the surrounding land, in much the same manner as the sea breeze.

land breeze. - The breeze that blows from the land to the sea on many coasts from about 10 or 11 p.m. to sunrise in summer due to the nocturnal cooling of the shore and its surface layer of air.

lapse rate. - 1. In general, the rate of change in the value of any meteorological element with elevation. 2. Usually restricted to rate of decrease of temperature with elevation; thus the lapse rate of temperature is synonymous with the vertical temperature gradient.

latent heat. - The heat absorbed by a substance, without change in temperature, while passing from a liquid to a vapor state, or from a solid to a liquid, and released in the reverse change of state.

latent instability. - The state of that portion of a conditionally unstable air column lying above the level of free convection.

law of the conservation of energy. - A physical law, based on experimental evidence, which states that energy can neither be created nor destroyed, or, in other words, that the total amount of energy in the universe is a constant.

leader stroke. - The first of the component strokes of a lightning discharge, also called the "stepped leader" because it stops or hesitates many times in its downward course from cloud to ground. See lightning.

lenticular cloud. - A cloud, resembling a huge lens being broad in its middle and base, tapering at the ends, and having a smooth appearance; formed above a hill or mountain by the condensation of an ascending current of moist air, and sometimes over plains or rolling surfaces by the same process. The cloud continually evaporates on its leeward side, and the air current passes through it, but condensation of the constant supply of ascending moist air from windward sustains it and makes it seem unmoving.

lifting condensation level. - The level at which air becomes saturated when it is lifted adiabatically.

lightning. - A discharge of electricity from one part of a thundercloud to another part, from cloud to another cloud, or between cloud and earth.

line squall. - A squall or series of squalls occurring along a squall line, usually marked by a sudden change of wind direction, generally from the southeast or south to west, northwest, and north; and frequently accompanied by heavy rain, snow, or hail, thunder and lightning, a sudden fall of temperature, and a rise of pressure and relative humidity.

lithometeor. - Generic term for a class of atmospheric phenomena, among which dry haze and smoke are the most common examples. In contrast to a hydrometeor, which consists largely of water, a lithometeor is composed of solid dust or sand particles, or the ashy products of combustion.

long range forecast. - A forecast or the weather made for periods longer than 36 or 48 hours, i.e., a forecast of the weather for a period longer than can be made by methods used for making the 36- or 48-hour forecast.

low. - A region of the atmosphere where the barometric pressure is below normal, usually surrounded by closed isobars with the point of minimum pressure in the center.

lull. - 1. Same as calm i.e., an absence of wind. 2. Often used to denote merely a temporary lessening of the wind speed below the current average. Thus, one may speak of the wind stream as being composed of gusts and lulls.

luminous cloud. - 1. A cloud illuminated by an interior electrical discharge, a phenomenon described under sheet lightning, 2. Name sometimes given to nacreous clouds and noctilucent clouds.

M

mackerel sky. - A formation of rounded and isolated cirrocumulus clouds resembling the pattern of scales on a mackerel.

macrometeorology. - A study of the large scale aspects of the atmosphere.

magnetic lines of force. - Lines in a magnetic field that are everywhere in the direction of the magnetic force; i.e., the magnetic force at any point is tangent to the line through that point.

mamma. - Any cloud whose lower surface is in the form of pouches or hanging protuberances. Formerly called mammatus.

map projection. - A systematic representation of the latitude and longitude lines of the earth on a plane surface, by means of any geometrical construction that sets up a correspondence between the points of the earth's surface and the points of a region in a plane.

In meteorology, the Lambert conformal conical projection is almost universally used for weather analysis in the middle latitudes; the standard parallels (the latitude lines along which the scale is taken as standard) are 30° N. and 60° N., or 30° S. and 60° S., by international agreement.

mares' tails. - Long well-defined wisps of cirrus clouds, thicker at one end than the other.

maximum. - The highest value of a given meteorological element observed during a specified period.

maximum thermometer. - A thermometer which automatically registers the highest temperature occurring since its last setting.

maritime polar air. - Cold, moist air masses formed over subpolar waters.

maritime tropical air. - Hot, moist air masses formed over low latitude water areas.

mean. - The sum of a set of individual values of any quantity, divided by the number of values in the set.

median. - The value of the middle term of a series if the number of terms in the series is odd, or the average of the middle two terms if the number of terms is even.

melting point. - The temperature at which fusion takes place. All crystalline solids have definite melting points under specified pressures.

meniscus. - The curved upper surface of a liquid observed in a tube. It may be either concave or convex.

mercury. - A metallic liquid resembling silver in appearance, used in barometers as a weight, and in many thermometers as the expanding and contracting medium.

meteorology. - Originally, knowledge and lore of the weather and all other phenomena of the atmosphere; now, often restricted to the branch of physics dealing only with the phenomena that are directly involved in the weather (the meteorological elements), with more or less of a distinction drawn between meteorology and climatology, which is primarily connected with average, not actual, weather conditions. Meteorology may be subdivided, according to the methods of approach and the applications to human activities, into the following special sciences, each of which is discussed under its individual entry: aerology, aeronautical meteorology, dynamic meteorology, hydrometeorology, macrometeorology, micrometeorology, physical meteorology, synoptic meteorology.

meter. - A primary standard of length.

microbarograph. - A barograph designed to record very minute variations of atmospheric pressure, smaller than can be detected by the barographs in general use.

micrometeorology. - A study of the small scale aspects of the atmosphere.

millibar. - A subunit of pressure, being one one-thousandth of a bar; in meteorology it is equal to a force of 1,000 dynes per square centimeter. The values of atmosphere pressure are now usually expressed in millibars, and 1,013 millibars is standard atmospheric pressure.

minimum. - The lowest observed value of temperature, pressure, or other weather element during any given period.

minimum thermometer. - A thermometer that automatically registers the lowest temperature which occurs after it has been set.

mirage. - An optical illustion due to the refraction of light as it passes through nonhomogeneous layers of the atmosphere.

mixing ratio. - The mass of water vapor per unit mass of perfectly dry air in a humid mixture.

mode. - The value which occurs most frequently in a set of observed values of a quantity, and which may therefore be taken as a typical value.

monsoon. - A seasonal wind blowing from continental interiors (or large land areas) to the ocean in winter, and oppositely in summer. These winds result from the temperature differences arising between land and ocean; and their directions, since their paths are long, are greatly influenced by the earth's rotation. They are most pronounced over India.

mother-of-pearl clouds. - Same as nacreous clouds.

mountain breeze. - A breeze that blows down mountain slopes, due to gravity flow of cooled air. It is of the same type as canyon, gravity, and katabatic winds.

N

nacreous clouds. - Luminous, iridescent clouds that occasionally occur in the stratosphere at about the 25-kilometer level; also sometimes called mother-of-pearl clouds. They resemble cirrostratus, and are seen before sunrise and after sunset while the observer's part of the earth is in shadow.

nimbostratus. - A low, amorphous, and rainy cloud layer, of a dark gray color, usually nearly uniform; feebly illuminated seemingly from within. When it gives precipitation, it is in the form of continuous rain or snow; but precipitation alone is not a sufficient criterion to distinguish the cloud, which should be called nimbostratus even when no rain or snow falls from it. Nimbostratus usually forms in the middle cloud range.

nimbus. - Luke Howard's name for a rain cloud. It originally meant any thick layer of formless cloud from which rain or snow falls. It is not now in the international cloud classification, except as a combining term.

nitrogen. - A colorless, tasteless, and odorless gaseous element. It is the most abundant constituent of the atmosphere, amounting to about 78% by volume of dry air.

noctilucent cloud. - A luminous cloud about 82 kilometers above sea level; it resembles cirrus, is silvery or bluish-white, and is rendered luminous by the sun.

nocturnal radiation. - Synonymous with effective terrestrial radiation, which is the better term. The difference between the outgoing infrared terrestrial radiation of the earth's surface and the downcoming infrared counterradiation from the atmosphere.

normal. - The average value which, in the course of years, any meteorological elements are found to have on a specified date or during a specified month or other portion of the year, or during the year as a whole.

northeaster. - 1. A wind or gale from the northeast. 2. A moderate to strong wind blowing from the northeast over the New England and Middle Atlantic States.

northern lights. - See: Aurora.

nucleus. - In meteorology, a particle of any nature whatsoever on which condensation of atmospheric moisture occurs.

O

observer. - In the U.S. Natural Weather Service, a person (man or woman) who takes observations of the weather, of any kind whatsoever, and of river stages.

occluded front. - The front formed when and where the cold front overtakes the warm front in an extratropical cyclone.

occlusion. - 1. The process in which the warm sector of an extratropical cyclone is gradually restricted in size, and ultimately lifted entirely from the earth's surface, as the cold front overtakes the warm front; the warm sector then exists as a trough of warm air aloft until the cyclone dissolves. 2. An extratropical cyclone in which the warm air is entirely aloft, so that the cold air masses originally in advance of the warm front (which has now vanished) and behind the cold front (also gone) are separated at the surface by an occluded front. Depending on the relative coldness of the two air masses, three types of occlusions are distinguished: (a) warm front type, in which the air in advance is colder than the air behind, (b) cold-front type, in which the air behind is colder, and (c) neutral type, in which both air-masses are at approximately the same temperature.

oscillation. - Any periodic recurrence of a meteorclogical phenomenon.

overcast. - The state of the sky when more than nine-tenths of the visible canopy is covered with clouds.

oxygen. - In its free form, a colorless, tasteless, and odorless gaseous element: the second most abundant gas in the earth's atmosphere and a prerequisite of virtually all forms of animal life. It comprises about 21% by volume of dry air.

ozone. - A form of molecular oxygen, each molecule consisting of three atoms; it is colorless, but has a characteristic odor. Ozone is produced in the high atmosphere principally by the action on oxygen of the ultraviolet radiation from the sun.

P

pack ice. - A body of drift ice consisting of separate pieces, covering more than half of the visible surface.

parallax. - The change in apparent position of an object as seen from two different points. Observers in reading some meteorological instruments must take care that their line of sight is perpendicular to the scale so as to avoid errors of parallax. This is particularly true in the case of liquid-in-glass thermometers, for reading with the eye below the true level of the mercury will give too high a temperature, while reading from above will give a value below the actual.

partial potential temperature. - The temperature to which the dry air component would come if reduced from its partial pressure to 1,000 mb. That is,

$$\theta_d = \frac{T}{\left(\frac{p_d}{P}\right)^k} = T\left(\frac{1000}{p - e}\right)^{0.288}$$

where θ_d = partial potential temperature; T = absolute temperature of air; p_d = partial pressure of dry air; P = standard pressure; k = 0.288; p = total air pressure; and e = partial pressure of water vapor.

perihelion. - That point on the earth's orbit which is nearest the sun. It is now reached by the earth on about January 1, but the date varies irregularly from year to year and also has a slow secular change.

phase. - In wave motion, an angular measure of the stage reached by the vibration in its progress through its cycle. Waves of the same phase travelling in the same path reinforce each other, while waves of opposite phases tend to destroy each other.

physical meteorology. - The branch of meteorology which seeks to explain all atmospheric phenomena by the accepted principles of physics. It, therefore, deals with the mechanics and thermodynamics of the atmosphere, and also explains electrical, optical, and accoustical phenomena.

pibal. - An artificial word, blended from and meaning pilot balloon observation.

pileus. - A cap or hood; applied principally to cumulus or cumulonimbus clouds which have a veil-like structure partially obscuring the bulging or cauliflower heads.

pilot balloon. - A small rubber balloon which, when inflated with helium and released and observed with a theodolite during its ascent, furnishes data from which may be calculated the direction and speed of the wind at all levels from the surface to the end of its flight.

pirep. - An artificial word, abbreviated from pilot report, and referring to information on conditions in the atmosphere supplied by airplane pilots.

Pitot tube. - A tube with an end open square to a fluid stream. It is exposed with the open end pointing upstream to detect an impact pressure.

polar air. - Cold air formed in the subpolar anticyclones, and divided into two types of air masses, continental polar (cP) and maritime polar (mP), which are discussed under separate entries. See Air mass; source region.

polar front. The frontal zone between air masses of polar origin and those of tropical origin.

potential energy. - The capacity of a body to do work due to its position or dynamical configuration. Water in a dam has potential energy due to its position, and a bent spring possesses potential energy because of its configuration.

potential temperature. - The temperature to which air would come were it reduced adiabatically to the standard pressure of 1,000 millibars. It is invariant for dry-adiabatic ascent and descent provided no condensation or evaporation occurs. Its value is

$$\theta = T\left(\frac{1000}{p}\right)^{0.288}$$

where θ = potential temperature, T = absolute temperature of the air, p = pressure (total) of the air.

precipitation. - A general term for all forms of falling moisture, which, more specifically, include rain, snow, hail, sleet, and their modifications. The more common term, rainfall, is also used in this general sense.

pressure. - Force per unit area; in meteorology, most commonly expressed either in terms of the length in inches of the column of mercury sustained by the force, or in terms of millibars, though dynes per square centimeter and millimeters of mercury are sometimes used.

prevailing visibility. - The greatest visibility equalled or exceeded throughout one-half or more of the horizon circle which need not necessarily be continuous.

prevailing wind. - The direction from which the wind blows during the greatest proportion of the time.

primary circulation. - The prevailing fundamental atmospheric circulation.

pseudoadiabatic chart, (or diagram). - An adiabatic chart, to which two more sets of lines are added - curves of constant saturation mixing ratio, and pseudoadiabats. The abscissa is temperature in degrees centigrade, the ordinate is the 0.288 power of the pressure in millibars; dry adiabats are shown by the sloping, straight lines. On this chart, both dry- and pseudo- (or saturated) adiabatic motions of air may be determined, and many useful data derived, such as the dew point, condensation level, a rough estimate of the possible precipitation to be derived from the air, etc.

psychrometer. - An instrument containing both wet and dry bulb thermometers, and now widely used at meteorological observatories to determine the free air temperature and the amount of atmospheric moisture.

psychrometric chart. - A nomograph for graphically obtaining relative humidity, absolute humidity, and dew point from wet- and dry-bulb thermometer readings.

psychrometric tables. - Tables prepared from the psychrometric formula, and used for obtaining the vapor pressure, relative humidity, and dew point from the readings of the wet- and dry-bulb thermometers.

R

rabal. - An artificial word, signifying records of upper wind speed and direction and obtained by following the progress of radiosonde balloons by a theodolite.

radiation. - 1. Radiant energy. 2. The process by which energy is transferred through space or through a material medium from one place to another in the form of electromagnetic waves.

radiosonde. - An instrument equipped with elements for determining the pressure, temperature, and relative humidity of the upper air, and with radio units for automatically transmitting the measurements to ground stations.

rain. - Precipitation which reaches the earth's surface as water droplets.

rainbow. - A circular arc of concentric spectrally-colored bands, seen on a sheet of water drops - rain, fog, spray, etc. - the common center of which "is on the line connecting the observer's eye with the existing light (sun, moon, electric arc, etc) or rather, except rarely, on that line extended in the direction of the observer's shadow."

rain cloud. - Any cloud from which rain falls.

raindrop. - A drop of liquid water formed in the atmosphere from cloud particles.

rain (and snow) gage. - An instrument designed to measure the vertical depth of rain or snow (or its water equivalent.)

range. - A measure of the variability of a quantity, being the difference between the largest and the smallest values in the sequence of values of the quantity.

raob. - An artificial word introduced as an abbreviated term for "radiosonde observation," and coined from the initial letters of these words.

rawin. - A winds aloft observation made by balloon and radio methods, without optical aid.

reflection. - The process by which part of the radiation impingent upon any interface separating two media of different densities is in general turned back into the first medium.

reflectivity. - The ratio of the radiant energy reflected to the total amount incident.

refraction. - The change in direction of propagation that occurs when sound or light waves pass obliquely from one medium to another of different density.

relative humidity. - The ratio of the amount of moisture in a given volume of space to the amount which that volume would contain were it in a state of saturation.

representative (air mass) property. - Any property "which characterizes an extensive region of the atmosphere adjacent to the point of observation. For example, the temperature at any level in a uniform air mass is representative. On the other hand, the temperature at the surface below a nocturnal inversion varies with the cloudiness and wind and so cannot be considered a representative property."

ridge. - An anticyclonic center which is greatly elongated; or, the elongated extension of an anticyclone.

rime. - A white or milky opaque, granular deposit of ice, which forms on airplanes, fences, trees, telegraph poles, and other exposed objects at temperatures below the freezing point. "Its surface is ordinarily relatively rough."

roaring forties. - The region of the southern oceans between 40° and 50° S. lat., characterized by prevailingly strong westerly winds.

Rossby diagram. - A diagram used in identifying air masses and named after its inventor, C.G. Rossby; the ordinate is partial potential temperature on a logarithmic scale and the abscissa is mixing ratio on a linear scale; lines of constant equivalent-potential temperature appear as curves running diagonally across the diagram.

St. Elmo's fire. - A luminous brush discharge of electricity from pointed objects on the earth to the air; a phenomenon often seen under stormy conditions. It appears most strongly developed at such exposed points as a ship's masts and spars and on steeples, but may be seen on mountaintops, and even on the ears of horses, the heads of their riders, horns of cattle, brass bed posts, blades of grass, et al. It is also known as corposant.

sandstorm. - A windstorm on the desert which raises and carries along quantities of sand often so dense as to restrict the visibility considerably. See: Duststorm.

Santa Ana. - Local name for a foehn wind in southern California, which in winter often markedly affects the weather of that region.

saturated-adiabatic lapse rate. - The rate of decrease of temperature of a parcel of saturated air as it rises. This rate is less than that for dry air due to the liberation of latent heat as condensation occurs. This rate is not constant, but varies inversely with the temperature and somewhat with change of pressure.

saturation. - The condition in which the pressure exerted by water vapor is equal to the maximum vapor pressure possible at the prevailing temperature.

saturation adiabat. - A curve on an adiabatic chart which indicates the temperature-height or temperature-pressure curve along which a parcel of saturated air will travel.

saturation curve. - A curve on an adiabatic chart giving for various temperatures the saturation moisture content of the atmosphere in grams of water vapor per kilogram of dry air, or the saturation vapor pressure corresponding to a given temperature.

scarf cloud. - A thin, cirrus-like cloud, sometimes observed above a developing cumulus, "caused by the elevation and consequent expansion and cooling of the air immediately, and to some distance above, the rising mass of the cumulus.

scattering. - A diffuse reflection of light: it occurs when a beam of light falls upon an irregular surface, as a piece of paper, in which case the reflected rays are scattered in all directions.

scud. - Low, ragged, detached fragments of cloud, with elevation from 100 to 300 meters, usually associated with nimbostratus and a stormy sky.

sea. - In marine meteorology, a term equivalent to "state of the sea"; described as calm, smooth, slight, moderate, etc.

sea breeze. - The breeze that blows from the sea to the land on many coasts from about 10 or 11 a.m. to sunset on sunny days in summer; due to the diurnal heating of the shore and its surface layer of air.

sea fog. - Fogs formed at sea, and caused by the transport of air from a warm-water surface to a cold-water surface, with subsequent cooling.

sea level. - A term commonly used informally in meteorology when mean sea level is actually meant. The latter is defined as the average of the actual heights of the sea surface over a long period.

season. - A division of the year generally determined by some annually recurrent natural phenomenon, such as the state of vegetation or the meteorological conditions. Various different divisions into seasons have been in use among different peoples according to the particular vegetal, meteorological, or other phenomenon taken as a basis.

secondary. - A small low pressure center accompanying a primary cyclone, around which it travels in a counterclockwise direction in the northern hemisphere.

secondary circulation. - A collective name for such wind systems as the monsoons, tropical and extratropical cyclones, and anticyclones.

secondary cold front. - A cold front which forms in back of the original cold front; the essential features for its development are "the rapid movement of a mass of cold air, and a strong latitudinal temperature gradient."

secondary front. - A term applied to the one or more fronts which not infrequently form behind and follow an active advancing front.

selective absorption. - The process in which a substance absorbs, either completely or partially, only certain wave lengths of incident radiation, and freely transmits the other regions of the radiation spectrum. A familiar example is furnished by red glass, which transmits radiation in the red and some in the infrared portions of the spectrum, but absorbs all other wave lengths.

sensible temperature. - The apparent temperature indicated by the sensations of the human body, as distinguished from the actual physical air temperature given by a thermometer.

shear of wind. - The rate of change of wind velocity (speed and direction) with distance.

shift. - As applied to the wind, to change in direction. The wind is said to "veer" when it changes direction clockwise; to "back" when it changes direction counterclockwise; and to "shift" regardless of the direction of the change.

shower. - Precipitation of a convective origin. Showers are characterized by the suddenness with which they start and stop, and the rapid changes of intensity.

single station analysis. - A technique of forecasting from the data available at just one station, recently developed at the University of Chicago in order to enable military meteorologists at isolated bases to gain some idea of coming weather.

sky. - The meteorological term for sky condition, or state of the sky in respect to amount, kind, height and direction of movement of clouds present. Skies are classified as clear, scattered, broken, and overcast, with many subdivisions and variants.

sling psychrometer. - The most common type of psychrometer which "consists essentially of two thermometers, mounted in a frame which can be rotated rapidly about an axis at right angles to its length."

slope of a front. The tangent of the angle formed by the frontal surface with a horizontal plane, most frequently the surface of the earth; given approximately by the well-known Margules formula.

slush. - Snow on the ground that has been reduced by a warm spell or by rain to a soft, watery mixture.

smog. - A term coined in 1905 by Dr. Des Voeux to signify a mixture of smoke and fog; as yet neither technically defined nor adopted into standard meteorological usage.

smoke. - The presence of particles of foreign matter in the air resulting from combustion.

snow. - A form of precipitation composed of ice crystals. When atmospheric water vapor crystallizes at temperatures below 0° C, ice crystals may be formed and may fall to the ground as single crystals, though it is more usual for them to fall as snowflakes, which are aggregations of individual ice crystals.

snow blindness. - Temporary blindness caused by the glaring light reflected from snow surfaces. Travellers prevent this by wearing dark glasses.

snow burn. - The tanning or burning of the skin by light rays reflected from snow surfaces.

snow cover. - Fallen snow which covers the earth's surface; in northern latitudes a snow cover generally remains throughout the winter.

snow grains. - White, opaque particles, like snow in structure, and resembling snow crystals, but more or less flat or oblong and generally less than 0.04 inch across in at least one direction.

snow line. - Climatic or vertical snow line. "The altitude to which the continuous snow cover of high mountains retreats in summer . . . chiefly controlled by the depth of the winter snowfall and by the temperature of the summer."

snow pellets. - White, opaque, round or sometimes conical grains of snow-like structure, about .02-.20 in. in diameter in all directions.

solenoid. - In meteorology, the column of atmosphere bounded by two isobaric and two isosteric (constant specific volume) surfaces.

solstices. - Points on the ecliptic midway between the equinoxes, or points where the sun attains its greatest north and its greatest south declinations. The summer solstice, or the sun's most northern point of the ecliptic, occurs about June 22; and the winter solstice, or the sun's most southern point of the ecliptic, occurs about December 22.

source region. - Any extensive area of the earth's surface characterized by essentially uniform surface conditions and so placed with respect to the general atmospheric circulation that an air mass may remain in contact with it long enough to acquire its characteristic properties.

specific heat. - The amount of heat required to raise the temperature of unit mass of a substance by unit amount; it varies slightly with temperature, and may depend greatly on the conditions under which the heat is added.

specific humidity. - The mass of water vapor in a unit mass of moist air, usually expressed as so many grams per gram or per kilogram of moist air.

spectrum. - A dispersion or separation, into a linear sequence according to wave length, of the individual simple waves into which any complex wave disturbance may be resolved.

speed. - The numerical magnitude of a velocity; speed is a scalar quantity, whereas velocity involves direction as well as magnitude, and is a vector quantity.

spell. - A period during which fairly constant weather conditions prevail in a region where variable weather is ordinarily expected.

squall. - A wind of considerable intensity caused by atmospheric instability; it comes up and dies down quickly, and is sometimes accompanied by thunder, lightning, and precipitation. In the U.S. the wind must increase by 15 knots and attain 20 knots or more for at least one minute.

squall line. - Any non-frontal line or narrow band of active thunderstorms (with or without squalls). It is sometimes called an instability line. They are frequently found parallel to and 50 to 150 miles ahead of inactive cold fronts.

stability. - A state of vertical equilibrium in which the vertical distribution of temperature is such that an element of air will resist displacement from the level at which it is in equilibrium with its environment.

standard atmosphere. - A conventional vertical structure of the atmosphere, used principally in aeronautics and ballistics, characterized by a uniform decrease of temperature (T) with height up to the level at which T = - 55 C, its assumed limit, according to the equation

$$T = 15 - 0.0065\, h,$$

in which T = the temperature in centigrade degrees at the height h in meters above sea level. Further specifications for the standard atmosphere are given in the following table:

STANDARD ATMOSPHERE-STANDARD VALUES

	Symbol	Metric	English
Standard temperature	t	15° C	59° F
Standard temperature absolute	T	288° A	550.4° R
Standard pressure	p	760 mm of Hg	29.9213 in. of Hg.
Standard pressure	p	1013.25 mb	2116.229 lb/ft.^{2}
Standard gravity	g	9.80665 m/sec^2	32.1740 ft/sec.^{2}
Standard specific weight	gp	1.2255 kg/m^3	0.07651 lb/ft.^{3}
Standard density	ρ	0.001225 gm/cm^3	
Standard temperature gradient	a	6.5 C°/km	3.56617F°/1000 ft
Standard isothermal temperature	t_i	-55°	-67° F.
Standard gas constant for air	R	29.2708	53.33089.

standard pressures. - Adopted values of pressure used for specific purposes. (1) The value of a standard pressure of one atmosphere, used in the determination of gas densities, is defined as the pressure produced by a column of pure mercury 76.0 cm. in height at a temperature of 0° C. under standard gravity. (2) The value of 1,000 mb. has been adopted as the reference pressure to which the potential temperature corresponds. The potential temperature of dry air is the temperature which the air would attain if it were brought dry-adiabatically from its existing conditions of temperature and pressure to a pressure of 1,000 mb.

standard time. - Time used at a place, in accordance with a plan agreed upon by an international conference in 1884. This plan states that standard meridians will be used at intervals of 15 degrees (or one hour) east and west of Greenwich, England, and the ideal standard time at any place would be the local civil time of the standard meridian nearest that place.

state of the sky. - The aspect of the sky in reference to the cloud cover. The state of the sky is fully described when the amounts, kinds, directions, and heights of all clouds are given.

static. - Electromagnetic waves that interfere with radio reception.

stationary front. - A front, along which one of the two air masses separated by it is not displacing the other.

station pressure. - In the U.S. National Weather Service, that pressure corresponding to an adopted station elevation, which may differ slightly from the actual elevation of the barometer.

station model. - A term applied to the arrangement of data (figures and symbols) around the station circle on a weather chart, which arrangement is in accordance with the international station model.

steam. - In meteorology, visible condensed vapor rising from ground or water, best exemplified by the steaming of rivers in times of intense frost.

steam fog. - Fog formed when cold air having a low vapor pressure passes over warm water.

steering. - The directing influence exercised on the trajectories of surface disturbances by the flow patterns at 10,000 feet or some other upper level.

storm. - In general, a disturbance of the average conditions of the atmosphere which unless specifically qualified, may include any or all meteorological disturbances, such as wind, rain, snow, hail, thunder, etc. Cyclones are frequently called storms.

storm paths. - Lines drawn on maps indicating the paths of the centers of all the lows for a certain period, or the average tracks or paths for each of the various types of lows; also called storm tracks, tracks of lows, etc.

storm warnings. - Displays of signals on masts or on other high structures to indicate the approach of a storm. For this purpose, flags and lanterns are used in the United States, cones in Great Britain.

storm wave. - A rise of the sea over low coasts not ordinarily subject to overflow; also included under the term tidal wave.

stratocumulus. - A cloud layer (or patches) composed of laminae, globular masses or rolls; the smallest of the regularly arranged elements are fairly large; they are soft and gray, with darker parts. These elements are arranged in groups, in lines, or in waves, aligned in one or in two directions. Very often the rolls are so close that their edges join; when they cover the whole sky, they have a wavy appearance.

stratosphere. - The region of the upper atmosphere characterized by little or no temperature change with altitude; there may even be a slight increase of the temperature upward.

stratus. - A low uniform layer of cloud, resembling fog, but not resting on the ground. When this very low layer is broken up into irregular shreds it is designated stratus fractus.

stratus fractus. - A remnant of a broken-up layer of stratus, or a shred-like wispy cloud of independent formation, which may develop into a thin, low layer below a sheet of altostratus or nimbostratus, which may be visible through the interstices of the stratus fractus.

streamlines. - Lines which are everywhere parallel to the instantaneous direction of motion in a fluid.

subgradient winds. - Wind whose velocity is less than that indicated by the existing pressure gradient; it occurs most frequently when air is moving to a region of increasing pressure gradient (converging isobars). It should be evidenced by a component of the wind across the isobars towards lower pressure.

sublimation. - The transition of a substance directly from the solid state to the vapor state, or vice versa, without passing through the intermediate liquid stage.

subsidence. - The slow settling or sinking of a stagnant mass of air, generally accompanied by divergence in the lower layers. In its slow movement downwards, the air is compressed and warmed at the dry adiabatic rate, so that its thermal structure is changed and its stability enhanced.

subsidence inversion. - An increase in temperature vertically through a layer of the atmosphere, caused by subsidence.

subtropical. - 1. Pertaining to a type of climate which is found at the tropical margins of the temperate zones. 2. Designation applied to the belts of high pressure and of calms of variable winds in the general vicinity of 30° N. and 30° S. lat.

sultry. - Term used to describe weather which is hot and humid.

sun pillar. - A glittering shaft of light, white, or reddish, extending above and below the sun, most frequently observed near sunrise or sunset.

sunrise. - 1. The phenomenon of the sun's appearance on the eastern horizon as a result of the earth's rotation. 2. Short expression for the "time of sunrise" which is defined by the U.S. National Weather Service as the instant when the upper limb of the sun appears on the ideal or sea level horizon.

sunset. - 1. The phenomenon of the sun's disappearance below the western horizon as a result of the earth's rotation. 2. Short expression for the "time of sunset" which is defined by the U.S. National Weather Service as that instant when the upper limb of the sun disappears below the ideal or sea level horizon.

sunspot numbers. - The numbers of sunspots apparent on the sun at different times; they are sometimes called "Wolf's Sunspot Numbers."

superadiabatic lapse rate. - A temperature lapse rate in the free atmosphere such that the potential temperature decreases with height, or such that any air particle which is displaced adiabatically upward or downward from its initial position finds itself increasingly warmer or colder, respectively, than the surrounding atmosphere.

supergradient wind. - A wind velocity in excess of that required by the gradient wind balance of forces, or greater than the gradient velocity for the existing pressure gradient.

supersaturation. - The condition existing in a given space when it contains more water vapor than is needed to cause saturation.

surface inversion. - An increase of temperature with height in the layer of air just above the earth's surface, which is especially frequent in winter in continental interiors, and which often prevails in the morning after a cold, clear, still night when the earth and the air in contact with it have lost heat by radiation to space, whereas the atmosphere at roughly 1,500 meters has not correspondingly cooled and is hence warmer than the ground.

sylphon. - The trade name of the evacuated cell used in some aneroid barometers, barographs, and altimeters.

synoptic. - Atmospheric conditions existing at a given time over an extended region, e.g., a synoptic weather map, which is drawn from observations taken simultaneously at a network of stations over a large area, thus giving a general view of weather conditions.

synoptic chart. - A map of a limited region of the earth, which contains data of weather conditions at many observation points taken simultaneously, or nearly so.

synoptic meteorology. - A branch of meteorology concerned with the problem of interpreting collective meteorological observations made simultaneously at the surface or aloft at a number of places over a large area of the earth.

T

temperature. - 1. The thermal state of a substance with respect to its ability to communicate heat to its environment. 2. The measure of this thermal state on some arbitrarily chosen numerical scale. See: absolute, Centigrade and Fahrenheit temperature scales.

temperature anomaly. - The difference between the mean temperature of a place and that of the parallel of latitude on which it is situated.

temperature correction. - The correction applied to a mercurial barometer reading to allow for expansion or contraction of the mercury column and the metal scale.

terrestrial radiation. - The total infrared radiation emitted from the earth's surface.

thaw. - To melt; when ice or snow melts, it is said to thaw.

theodolite. - An optical instrument in which a telescope rotates around vertical and horizontal axes and is equipped with graduated circles to measure horizontal and vertical angles.

thermal. - Term applied to weather phenomena which are caused by heat, such as a thermal (or heat) low, or to a thermal belt or zone. Popular expression, in connection with gliding, for an ascending air current of thermal origin.

thermograph. - An instrument designed to make an automatic record of temperature.

thermometer. - An instrument for measuring temperature. It is most commonly based on the change in volume of some substance with changes in temperature.

thermometer shelter. - A structure in which thermometers are exposed in order that they may attain, as closely as possible, the same temperature as that of the free air.

thin. - A term used in weather reports "in describing the cloudiness whenever the solar or lunar disk or stars are faintly visible through them."

threatening. - A term applied to the sky or weather, having no official definition or meaning, but used in popular speech to signify an appearance of the atmosphere which seems to betoken a storm.

thunderhead. - A popular term for the anvil of a cumulonimbus cloud.

thunderstorm. - A local storm invariably produced by a cumulonimbus cloud, and always accompanied by lightening and thunder, usually with strong gusts of wind, heavy rain, and sometimes hail. In U.S. weather observing procedure, a thunderstorm is reported when thunder is heard within the past 15 minutes.

thunderstorm cirrus. - Cirrus extending from a cumulonimbus cloud and composed of the debris of the upper parts of these clouds above the freezing level.

tidal wave. - In meteorological and popular usage, a large, isolated, travelling ocean wave which suddenly inundates the land, most frequently caused by a seismic disturbance; or a rapid abnormal rise in sea level caused by the strong winds associated with a hurricane or severe gale, often reinforced by the astronomical tide, and also known as a storm wave.

tidal wind. - A light breeze caused by the tide at places where the tidal rises and falls are very large; in rising, the tide displaces considerable air which flows away, and in falling leads to a return of the air.

timber line. - The line in high latitudes poleward of which, and on mountains in all latitudes above which, trees do not grow.

tornado. - A rotary storm, one of the most violent types of storms known, of small diameter, which travels across the country and leaves great devastation along a narrow path.

tornado belt. - That portion of the central United States where tornadoes are most frequent. The Mississippi, Ohio, and lower Missouri Valleys are the regions of greatest frequency.

trade inversion. - A sharp increase in temperature, or at least a rapid decrease in moisture, through a layer of air in a subtropical subsiding air aloft and the moist tropical maritime air below.

trade winds. - The planetary winds that blow from the belts of high pressure centered at about 30° N. and 30° S. latitude toward the equator. Thus there are two belts of trade winds, the northeast trades in the northern hemisphere, and the southeast trades in the southern.

trigger action. - The collective name for the processes necessary to set off convection in an unstable condition of the atmosphere, such as surface heating or sudden forced lifting at mountain ranges or frontal surfaces.

triple point. - The point on a pressure-temperature phase diagram at which all three phases - solid, liquid, and vapor - of a pure substance are in mutual equilibrium. The point where an occluded front and its associated cold and warm fronts meet is sometimes called the triple point.

tropical cyclone. - The general term for a cyclone that originates over tropical oceans. At maturity, the tropical cyclone is one of the most intense and most feared storms of the world; winds exceeding 175 knots (200 mph) have been measured, and its rains are torrential.

Tropics. - 1. A collective name commonly given to both the Tropic of Cancer and the Tropic of Capricorn. 2. Any portion of the earth characterized by a tropical climate.

tropopause. - The boundary or zone of transition between the troposphere, and the stratosphere.

troposphere. - The region of the atmosphere extending from the surface up to the tropopause; characterized by convective air movements and a pronounced vertical temperature gradient, in contrast to the convectionless and almost vertically isothermal stratosphere above the tropopause.

trough. - An elongated area of relatively low pressure, extending from the center of a cyclone. "The trough may have U-shaped or V-shaped isobars, the latter being associated with fronts."

trough line. - A line in a trough of a low pressure area. It is the locus of points in the isobars where the curvature is at a maximum.

tundra. - A treeless plain, between the shores of the polar seas and the taiga; it has a growth of mosses, lichens, small shrubs such as birches willows, sedges, and the like.

turbulence. - Irregular motion of a moving fluid, caused by an impediment in the stream, by friction, or by vortex action.

turbulence inversion. - An inversion, of temperature in the atmosphere between a turbulent layer and the layer immediately above which is unaffected by turbulence.

turbulent mixing. - The vertical stirring by turbulence of a layer of the atmosphere, producing a turbulence inversion, beneath which the lapse rate approximates the dry adiabatic if the air is unsaturated, the saturated adiabatic if it is saturated, and in the upper part of which a stratiform cloud may form.

twilight. - The intervals of incomplete darkness following sunset and preceding sunrise; the time at which evening twilight ends or morning twilight begins is determined by arbitrary convention.

U

ultraviolet. - Applied to the radiation wave band just beyond the violet end of the visible spectrum and extending to the X-rays; one may speak of ultraviolet light, though it is not visible to the eye.

undulatus. - Applied to clouds composed of elongated and parallel elements, like waves on the sea.

unsettled. - Term occasionally used in forecasts to describe weather which may be fair at the time but is liable to develop into rainy, cloudy, or stormy conditions.

updraft. - A relatively small scale current of air with a marked vertical (upward) motion. Updrafts are a major cause of turbulence.

upper air. - A general term, denoting not a definite region of the atmosphere but that part at a greater or less elevation above the earth's surface.

upper air charts. - Charts depicting the weather conditions at various levels as 3,000, 5,000, 10,000, and 20,000 feet and or 850, 700, 500 mb chart. They are drawn much the same as charts of surface conditions and exhibit all data obtained from pilot reports, balloons, radiosondes, etc.

upper front. - A front at some level in the free air instead of at the surface, which as it passes aloft often produces at the surface some of the characteristic phenomena of a frontal passage at the ground, such as cloudiness, pressure changes, and precipitation.

vacuum correction. - The correction to the reading of a mercurial barometer, necessitated by the fact that the vacuum above the mercury column is never perfect.

valley breeze. - A gentle wind blowing up a valley or mountain slope in the absence of cyclonic or anticyclonic winds; it is caused by the warming of the mountainside and valley floor by the sun.

vane. - An instrument which indicates the direction of the wind.

vapor. - The gaseous phase of any substance below its critical temperature. Above the critical temperature, it becomes a gas.

vapor pressure. - In meteorology, vapor pressure is used almost exclusively to denote the partial pressure of the water vapor in the atmosphere.

variation. - The manner and degree of change in value of meteorological or climatological element throughout any given period, such as a day or a year.

vector. - A quantity represented by a line which has magnitude and direction.

veer. - With respect to the wind, to shift in a clockwise direction. Veering is the opposite of backing.

velocity. - The vector-time rate of change of position, including both direction of motion and rapidity.

Venturi tube. - A tube designed to measure the rate of flow of fluids; used in water-flow meters and in measuring the speed of aircraft in the air.

verification. - The determination, generally by statistical methods, of the degree of accuracy of a forecast.

vernier. - An instrumental device applied to any graduated scale, linear or circular, which provides a means, when the index (a part of the vernier) is not exactly opposite one of the graduation marks of the scale, for estimating the portion of the division indicated by the index. Verniers are found on barometer and theodolite scales.

virga. - Wisps, or streaks of water or ice particles falling out of a cloud but evaporating before reaching the ground.

virtual temperature. - The temperature at which dry air would have the same pressure and same density as air with the current humidity and temperature.

viscosity. - The internal friction of fluids.

visibility. - A meteorological element defined as follows in U.S. Natural Weather Service practice: "The greatest distance at which selected objects can be seen and identified by the normal eye unaided by special optical devices, such as binoculars, telescopes, glare-eliminators, goggles, et. See Prevailing Visibility.

vorticity. - In a general sense, rotational circulation of air about a center, the axis of rotation being in any direction whatsoever; usually applied, however, to the circulation in whirling storms, such as cyclones and tornadoes, and in anticyclones.

W

warm front. - The line of discontinuity along the earth's surface, or a horizontal plane aloft, where the forward edge of an advancing current of relatively warm air is replacing a retreating colder air mass.

warm-front type occlusion. - An occlusion formed when the air in the rear of a front is somewhat warmer than the air in advance of the front. This occurs in regions adjacent to the west coasts of northern continents, where the air in the rear of the front comes from the oceans, and that in advance of the front from a cold continent, and hence the former will overrun the latter.

warm sector. - The area at the earth's surface bounded by the cold and warm fronts of a cyclone, over which relatively warm air is present, and which gradually narrows and ultimately disappears in the process of occlusion.

water. - A chemical compound, symbol H_2O, in which each molecule consists of two hydrogen atoms and one oxygen atom.

waterspout. - A small whirling storm over the oceans or inland waters, whose chief characteristic is a funnel-shaped cloud extending, in a fully developed spout, from the surface of the water to the base of a cumulus type cloud. Usually, a tornado occurring over water.

water vapor. - The gaseous form of water; one of the most important constituents of the atmosphere. Its amount varies, and is expressed by any one of the following quantities, each of which is discussed in a separate entry: absolute humidity, relative humidity, specific humidity, mixing ratio.

wave. - Any propagated disturbance in a continuous medium.

wave cyclone. - An extratropical cyclone that first develops as a wave along a front.

wave length. - The least distance between particles situated in the same phase of vibration in wave motion.

weather. - 1. The state of the atmosphere, defined by measurement of the six meteorological elements, visibility, air temperature, barometric pressure, wind velocity, humidity, clouds, and precipitation. 2. The state of the sky - clear or cloudy, rainy or fair, etc. 3. Also commonly used to mean bad weather: a meteorologist may say "We're going to have weather" when a storm is approaching.

weather map. - A map showing the weather conditions prevailing over a considerable area, constructed from the results of weather observations taken at the same time at a number of stations; so known as a synoptic chart. The weather elements are shown by figures and symbols, and usually include temperature, pressure, precipitation, state of the weather, wind, air masses, fronts; and often other data differing according to the practices of the various weather organizations. This kind of map may be called "the general weather map." Since weather data needed for forecasting purposes are too numerous to be all included on the general map, it is the custom to make additional maps showing temperature changes and pressure changes; isentropic charts; charts of conditions at the 5,000-foot and 10,000-foot and higher levels; and pilot balloon data of the winds at various levels. Cross sections of the atmosphere and pseudoadiabatic diagrams or other thermodynamic charts are also prepared.

weather stations. - In the National Weather Service of the U.S., places where weather observations are taken for various purposes.

wedge. - Same as a ridge.

wet-bulb temperature. - The lowest temperature to which air can be cooled by evaporating water into it at constant pressure, when the heat required for evaporation is supplied by the cooling of the air. This temperature is given by a well-ventilated wet-bulb thermometer.

wet-bulb thermometer. - One of the two thermometers comprising the sling (or whirling) psychrometer; its bulb is covered with muslin which is wetted just before an observation is taken; hence its name.

whirlwind. - Any revolving mass of air, including at one extreme the hurricane and at the other the dust whirl of our street corners, but usually applied to small wind eddies of local origin, such as dust or sand whirls, often seen during a dry spell anywhere, and especially on level deserts.

wind. - 1. In general, air in natural motion relative to the surface of the earth, in any direction whatever and with any velocity. 2. In meteorology, the component of air motion parallel to the earth's surface, the direction of which is indicated by the weather vane, wind cone, etc.

wind pressure. - The pressure exerted on the exposed surface of an object by the moving air, called the velocity pressure.

wind rose. - A diagram which indicates, at a given station, the average percentage of winds coming from each of the principal compass points, together with the percentage occurrence of calm air.

wind scale. - A numerical scale for expressing the different degrees of wind speed, in a fashion suitable for easy communication and rapid plotting on a weather map; the form in almost universal use is the beaufort wind scale.

wind vane. - An instrument used to indicate wind direction; known by various other names, weather vane and weather cock among them.

Z

zodiacal light. - A cone of faint light, most frequently observed stretching along the ecliptic after the sunset twilight has faded in the western sky.

zonal index. - A measure of the intensity of the west-east component of the general atmospheric circulation, usually between 35° and 55° N. lat. expressed either by the difference in millibars between the mean pressures prevailing along these latitude circles, or by the mean geostrophic zonal wind velocity corresponding to this pressure difference; taken as positive when the pressure is higher at 35° N. than at 55° N. and the circulation component is directed eastward.

Weather Observer Branch
Chanute AFB, Illinois

C3ABR25130-HO-100B
C3ABR25130-2-HO-100B
13 March 1984

AIRWAYS REMARKS

OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 600; DAV - 1

Designed for ATC Course Use. Do Not Use on the Job.

Table 3-15. (Continued)

	A	B
	When condition observed is:	Then enter:
	d. Thunderstorm in progress	"T," ~~time of beginning (see Note below),~~ distance from station (if known), direction from station, and direction of movement (if known); e.g., T OVHD MOVG SE, T~~B03~~ SW MOVG NE.
	e. Thunderstorm ending	"T," ~~time of ending or beginning and ending (see Note below),~~ and direction of movement; e.g., T MOVD SE, T~~B49~~ MOVD E.
	f. Lightning	Frequency ("FQT" or "OCNL"), type, and direction from station; e.g., OCNL LTGCCCG N, FQT LTGCAIC S-W. Direction may be omitted if the same as T or CB/CBMAM remark.
	g. Hail	~~"A" and time of beginning, ending, or beginning and ending (see Note below),~~ "HLSTO" and diameter (in inches) of the largest stone; e.g., HLSTO 1, ~~AB13B14~~ HLSTO 1/4.
	h. Intermittent precipitation occurring at observation time	"INTMT," type, and intensity; e.g., INTMT R-.
	i. Precipitation varying in intensity during the period of observation	Type and intensity for condition at time of observation, "OCNLY," and type and intensity to which it varied during the period of observation; e.g., R- OCNLY R, SW OCNLY SW-.
	j. Precipitation at a distance from (but not at) the station	Type and intensity (or "U" if unknown), and direction from station; e.g., RWU SW, SW OVR MTNS N.
	k. Shallow ground fog (less than 6 feet in depth) or known fog depth	Description and approximate depth, in feet; e.g., SHLW GFDEP 4, FDEP 40, GFDEP 10.
	l. Drifting snow (height less than 6 feet; no blowing snow reported)	"DRFTG SNW"
	m. Dust devils	"DUST DEVILS" and direction from station; e.g., DUST DEVILS SW AND W.
	n. Obscuring phenomena at a distance from (but not at) station	Description and direction from station; e.g., F BANK NE-SE
4.	a. Wind direction varying by 60° or more during period of observation, with wind speed of 7 knots or more	"WND" followed by extremes of variability, entered in clockwise order and separated by a "V," e.g., WND 27V34.
	~~b. Magnetic wind direction (at locations disseminating observations locally and longline by Teletype, using a single tape)~~	~~Using symbolic form "MAGdd" ("dd" = wind direction in tens of degrees); e.g., MAG16.~~

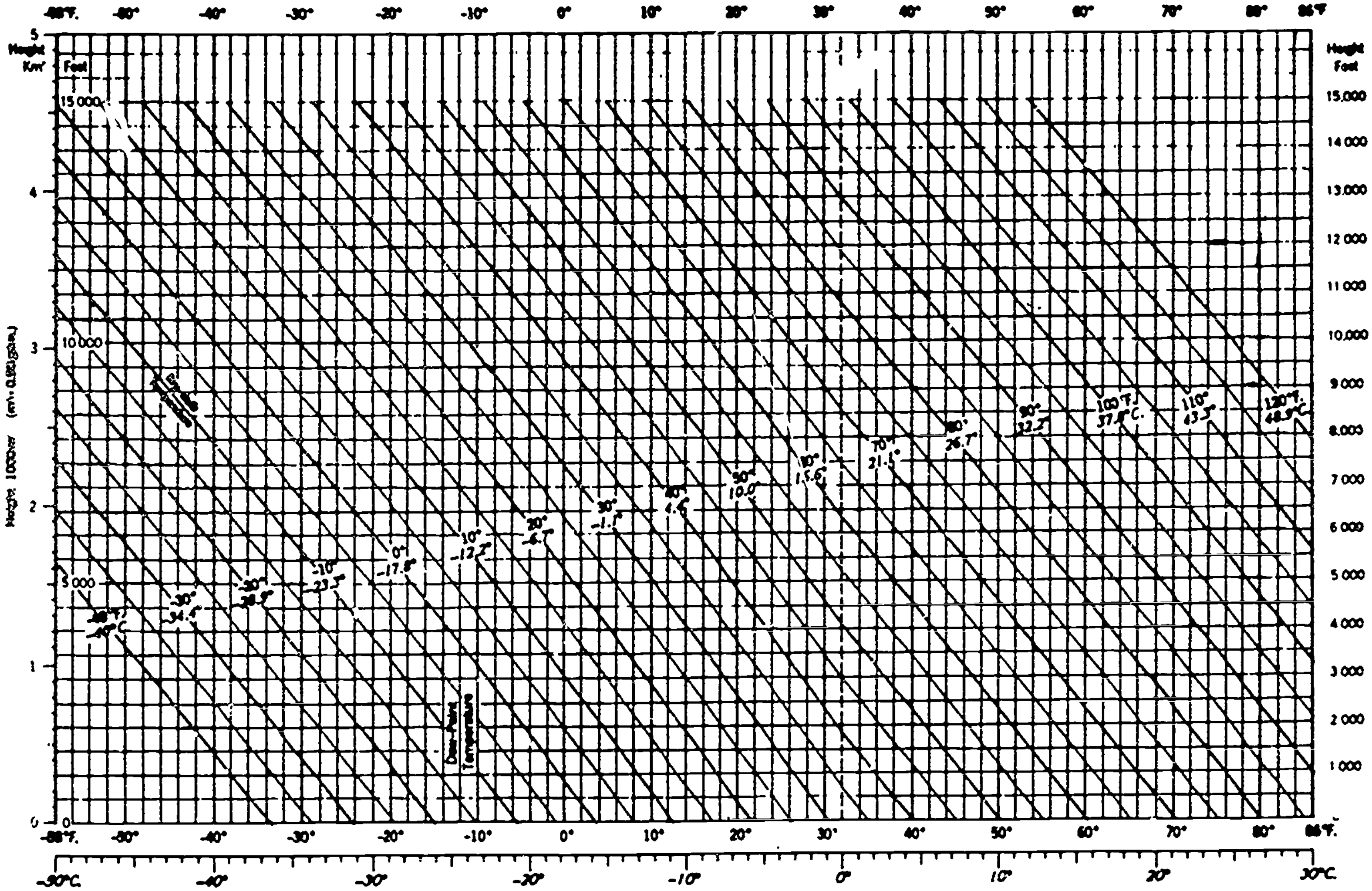
NOTE:

If the initial special observation taken for the beginning and/or ending of tornadic activity, thunderstorm, or hail was not transmitted on longline Teletype, include the time of beginning (B) and/or ending (E) with the current (most recent) remark in the next SP, RS, or SA observation which is transmitted longline. Enter the indicator B and/or E and the appropriate time(s) immediately following the phenomena reported; e.g., TB35 MOVD E AB37E39 HLSTO 3/4. These B and/or E times are entered for longline transmission only.

Table 3-16. Airways Remarks Significant to Meteorologists

	A When Condition Observed Is:	B Then Enter:
1.	a. Obscuring phenomena aloft	Type, height, and corresponding sky cover symbol (as reported in Column 3); e.g., K10 SCT
2.	~~a. Snow depth increase of 1 inch or more in the past hour~~	~~"SNOINCR" and amount of increase in snow depth, in inches, in the next Record observation; e.g., SNOINCR 2.~~
	~~b. Wet snow (snow that contains a great deal of liquid)~~	~~"WET SNOW"~~
3.	a. Pressure rising or falling at a rate of 0.06 inch Hg per hour or more, totalling a change of 0.02 inch Hg or more, at the time of observation.	"PRESRR" or "PRESFR," as appropriate.
	~~b. Pressure unsteady, as shown by sharp barogram troughs and crests that depart from the mean trend by at least 0.03 inch Hg.~~	~~"PRES UNSTDY."~~
	~~c. Barogram "V". (See Chapter 8). Recorded on the next Record observation only.~~	~~LOWEST PRES", the lowest sea-level pressure in tens, units, and tenths of a millibar, and the time of occurrence; e.g., LOWEST PRES 631 2345.~~
4.	a. Wind shift	"WSHFT" and time of beginning; followed by "FROPA" if reasonably certain the shift was the result of a frontal passage; e.g., WSHFT 30, WSHFT 23 FROPA. Also, if the initial entry is not transmitted on longline Teletype, enter the remark in the next observation which is transmitted longline.
	b. Recorded wind speed having exceeded 25 knots since the last Record observation and this speed was not included in the body of a Special observation transmitted on longline Teletype.	"PK WND", the direction and highest speed, a "/" and time of occurrence (in minutes) in the next Record observation following its occurrence; e.g., PK WND 2728/03. If the speed occurred more than once, encode the first of the occurrence. Omit the remark if the speed is included in the body of this Record observation.
~~5.~~	~~a. Aurorae observed in the past hour at station North of 45° North latitude.~~	~~"AURBO" in the next Record observation (to include each subsequent Record observation throughout the period of occurrence.~~

CONVECTIVE CLOUD-BASE HEIGHT DIAGRAM



BEST COPY AVAILABLE

STUDY GUIDE
C3ABR25130 000-SG-101
C3ABR25130 002-SG-101

Technical Training

Weather Specialist
Aerographer's Mate

ORIENTATION

11 October 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

Designed for ATC Course Use.

Do Not Use on the Job.

Weather Observer Branch
Chanute AFB, Illinois 61868-5000

C3ABR25130 000-SG-101
C3ABR25130 002-SG-101

ORIENTATION

OBJECTIVE

After completing this study guide, you will be familiar with the scope of the Weather Specialist and Aerographer's Mate course and the operating procedures of the Weather Training Branch.

PROCEDURE

This study guide will be completed as directed by your instructor.

Supersedes C3ABR25130-SG-101, C3ABR25130-1-SG-101, C3ABR25130-2-SG-101, 11 February 1983.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 600; DAV - 1

INTRODUCTION

The purpose of the Weather Specialist, Meteorological Observations, and Aerographer's Mate courses are to train you in the theory and practice of weather observing as employed by the Air Force, Navy, Marines, and Army. As an entering student and prospective graduate, the courses and their goals should be of interest to you. Additionally, you should be aware of your own responsibilities and privileges as a student. To provide this information, the following events are scheduled for the first four class hours:

Hour 1: Filling out Student Data cards and diagnostic testing.

Hour 2-4: Orientation IAW CR 50-18, Overview of the course, blocks, subject matter and classroom management.

STUDENT CRITIQUE PROGRAM

The student critique is a constructive criticism, by the students, of various factors that affect laerning. These factors include instruction received in training courses, the classroom and laboratory environment, and base support facilities and services.

The purpose of the program is to obtain constructive and meaningful criticism toward improvement of training and student environment. These critiques provide commanders and supervisors with useful information for directing and maintaining training programs and base facilities.

ATC Forms 736, Student Critique, may be obtained from any member of the staff and are also available on the bulletin board in each classroom. A critique may be submitted by a student at any time. Critiques may be turned in to any member of the staff or may be brought directly to the Branch office. The ATC Form 736 is used to obtain student comments on training and/or base support facilities. Make your comments specific referring to actual events or instances; general observations are difficult to act upon. Names are optional, but it is recommended that you enter them so feedback can be provided. Please bear in mind that the purpose of the critique program is to effect improvement. Do not use the critique program to "get even" with course personnel for perceived injustices.

PROFICIENCY STANDARDS

The minimum standard of training is in accordance with the Specialty Training Standard for AFSC 25130, Weather Specialist. Your ability to meet this standard will be determined by progress checks (PC) and written measurements. A percentage system is the basis of grading for measurements and the overall course average. A student must pass each objective before progressing.

Homework

Instructors give appropriate home study assignments to their students for each lesson which requires home study. These assignments normally can be completed by the average student in two hours or less. Instructors check on accomplishment of assignments given.

Special Individual Assistance (SIA)

Extra instruction will be conducted during nonregular school hours for those students having marginal or failing grades and other students needing help as deemed necessary by the instructor or higher authority. Students scheduled for remedial instruction are required to be present for this instruction.

Instructor

The instructor or their assistant is completely in charge of each class. Any instructor in the Weather Training Branch, regardless of rank, has authority over any student as long as the student is under the jurisdiction of the Weather Training Branch.

Instructors are responsible for the military appearance of the students and cleanliness of the classroom, halls, corridors, and latrines. Instructors have the authority to assign student details to accomplish this.

All instructors have previous field experience in Weather Service and are qualified to teach their subjects. Their prime responsibility is to provide the best instruction possible.

Student Class Leader

The student with senior date of rank will be the class leader. The course supervisor also has the authority to replace any class leader for cause. The class leader undertakes the following responsibilities:

1. Assist in the enforcement of branch and department policies concerning class schedules, military conduct and appearance, uniform regulation and special instructions given by the instructor or school authorities.

2. Assist the instructor by rendering an attendance report at the beginning of each class period.

3. Post a schedule for classroom and supervise assigned students during the cleanup.

4. Monitor hallways during "break" periods for student conduct and area cleanliness as required.

5. Assign students to correct any noted discrepancies in cleanliness as required.

6. Represent the class in reporting to the branch or department authorities on matters pertaining to instruction.

7. Exercise command control over the class in the absence of the instructor.

8. Assist in maintaining prompt starting time for each period of instruction.

Class leaders will be delegated authority to balance their responsibility, but will not be authorized to restrict personnel or give extra training. Student positions are authorized solely for the purpose of assisting the instructor. Student positions do not occupy a space in the chain of command.

Student

In keeping with the school policy of maintaining a high standard of conduct and cleanliness in the building and classrooms, all students are expected to conduct themselves in a manner which will be a credit to the Air Force, Navy, Marines and Army. In this respect, students observe the following list of responsibilities:

1. The uniform worn will be prescribed by the commander.

2. Sitting or lounging on the floor, tables, trash cans, walks, railing, or grounds outside is not permitted.

3. Use of profane or obscene language is not tolerated at any time.

4. Scuffling or boisterous activity in the classroom, halls, or corridors will not be permitted at any time.

5. A ten minute break is normally allowed at the end of each fifty minute period of instruction. Corridor break areas are marked by the yellow line. Do not attempt to visit friends in break areas on ramps outside the department area. Maintain reasonable quiet and keep voices at a conversational level during break.

6. Maintain standards of military courtesy and cleanliness (uniform, haircut, etc.) as established by service regulations. Keep hands out of pockets, except for getting items out.

7. Coats, jackets, and hats will not be placed on chairs or tables. Ample coatrack space is provided. "Book bags" are to be suspended in the proper manner on the edge of the student desk.

8. Do not leave books, maps, or papers in the classroom at the end of the day. Students will carry these items to and from school each day.

9. Be punctual for all classes.

10. Reading literature other than weather training material is forbidden. Calculators or tape recorders will not be permitted in the classroom at any time. Class time cannot be used for personal letter writing.

11. Cigarette smoking is only allowed in designated areas, which will be outlined by black paint on the floor. Cigarette butts must be extinguished before disposal and placed in butt cans <u>only</u>. To prevent the annoying fumes of smoldering paper, do <u>not</u> mix waste paper and smoking matter in disposal receptacles.

12. Students are not permitted in the instructor's area or branch offices without specific authority. Telephones are for official business only. Obtain specific permission each time before using office phones.

13. Vending machines are placed in the break area for your convenience. Dispose of soft drink cans and cups in the receptacles provided, but first empty the cups of any fluid before placing into receptacle. Food is not to be taken in the classroom. Drinks may be taken back to class.

14. Accomplish any clean-up that is directed by the instructor or class leader.

15. Classroom bulletin boards are to be read daily. Students will be responsible for all information posted on these bulletin boards.

16. Strive to remain attentive during classes (no slouching). You are not required to stand when answering questions or participating in discussions.

17. SLEEPING IN THE CLASSROOM IS NOT TOLERATED AT ANY TIME. Stand in the back of the classroom if you feel drowsy.

18. Leave the desks straightened and chairs pushed next to the desks before each break and upon leaving class for the day. When occupying chairs, DO NOT tilt backward on chair legs.

19. Re-entry slips (ATC Form 50) will be required after being absent from any type of instruction. Re-entry slips are obtained from the block and/or course supervisors.

STUDENT DISCREPANCY REPORT

In cases where students do not meet these required standards, the instructor will make on-the-spot corrections of minor infractions. Major or repeated discrepancies either in conduct or appearance are reported by the instructor on the appropriate forms. These reports may be signed by the branch supervisor and forwarded to the student supervisor and squadron commander for any necessary action.

EMERGENCY BRIEFING PROCEDURES

By following the recommended procedures below, valuable time may be saved if any emergency situation arises during your tour as a student.

1. In the event that the student's presence is required at home, it is suggested that the family contact the hometown Red Cross Chapter.

2. Give your squadron telephone number to those persons who may need to contact you through the Red Cross. This will expedite communications during an emergency.

MISCELLANEOUS INFORMATION

Basic students of the 3351st School Squadron and the Navy/Marine Detachments will march to and from school, to include marching to lunch. NCO and Petty Officers may drive, but parking is limited. The center parking lots of P-3 are for permanent party only. Students will park on the flight line ONLY.

Students and staff are to be addressed by Rank/Rate/Title and last name, i.e., Master Sergeant Smith, Petty Officer Jones, Captain Smith, Mister Jones.

NCOs/POs are dismissed only after cleanup is completely finished and the basic students are given the command "Form it up".

CENTER, WING, GROUP, SQUADRON, BRANCH, AND COURSE PERSONNEL

Center Commander ______________________

Wing Commander ______________________

Group Commander ______________________

Branch Chief ______________________

Course Supervisor ______________________

Block I Supervisor ______________________

Block II Supervisor ______________________

Block III Supervisor ______________________

Class Advisor/Class Chief ______________________

Marine Student Advisor ______________________

AIR FORCE

Squadron Commander ______________________

First Sergeant ______________________

NAVY DETACHMENT

Officer in Charge ______________________

Assistant OIC ______________________

Command Master Chief ______________________

Navy Liasion ______________________

Student Manager ______________________

MARINE DETACHMENT

Officer in Charge ______________________

NCO in Charge ______________________

THIS PAGE INTENTIONALLY IS LEFT BLANK.

To be filled out and turned in to the instructor:

1. By my signature, I certify that I have read all information in the Orientation Study Guide (C3ABR25130-SG-101).

Name: ______________________________ Rank/Rate: __________

Last First (MI)

____

Signature

____

Date

PROGRAMMED INSTRUCTION

IDENTIFICATION OF WEATHER MESSAGE HEADINGS

NWS-AG-A-100

PROGRAMMED INSTRUCTION

IDENTIFICATION OF WEATHER MESSAGE HEADINGS

NWS-AG-A-100

Revised and Edited by:

NAVAL OCEANOGRAPHY COMMAND FACILITY

Bay St. Louis, MS

May 1982

This Programmed Instruction supersedes CNTT-L178.

IDENTIFICATION OF ENVIRONMENTAL MESSAGE HEADINGS

INTRODUCTION

As an observer, you will be required to perform tasks using the various environmental messages that arrive over the teletype circuits. These tasks may include: sorting environmental messages for the plotting of environmental charts; preparing local environmental messages for transmission; relaying to the forecaster or pilot the latest environmental information that affects aircraft operations.

To be able to perform these tasks, you as the observer must readily identify environmental message headings. This program is designed to enable you to become proficient in these identifications.

IDENTIFICATION OF ENVIRONMENTAL MESSAGE HEADINGS

OBJECTIVES

Upon completion of this programmed instruction, the learner will:

1. Identify given environmental message headings as to type, geographical area, originator, date and time, and change indicators. Weather communications (Policies and Procedures), AWSR 105-2 and Attachments dated 01 December 1980, or the Appendix of this program may be used as needed.

FRAME 1

The first two lines of all environmental messages will be the communications heading. The first line of the heading, SOM (Start of Message), will vary somewhat for those received over CONUS Meteorological Data System (COMEDS) and those that are received through Radioteletype. The second line will maintain a fairly consistent trend through a symbolic format used by all communicators.

********************NO RESPONSE NECESSARY********************

FRAME 2

The first line received over the COMEDS will consist of the four-digit computer time of the message, GMT (Greenwich Mean Time).

Example heading: 1308
WWUS1 KGWC 301300

This first line received over the COMEDS will be the ________ digit __________ time of the message.

* *

ANSWER: four, computer

FRAME 3

Copied radioteletype messages contain a first line heading completely different from that received over COMEDS. This line will consist of two groups: the first group being the channel designator or channel number prefix; the second group containing the three-letter identifier of the sending station plus the sequential bulletin number issued for that message since 0000 GMT.

Example Heading: ZCZC WBC647
~~SMBZ9~~ ~~SBBR 1~~71200 RTD

ZCZC = channel designator

WBC647 = sending station identifier and bulletin number

The first line of the radioteletype message will contain _______ groups; the ___________ designator or channel number prefix, then the identifier for the sending station as well as the sequential bulletin number issued for that message since ________ _________.

* *

ANSWER: two, channel, 0000 GMT

The SOM functions, mentioned previously, will vary from circuit to circuit but are necessary controls to interject messages into the environmental communications system.

FRAME 4

The second line of the message heading will deal mainly with the following environmental information:

1. The content of the message (type of data).
2. The geographical area.
3. Message originator or compiler.
4. Date, time, and change indicator.

You are not expected to memorize these headings; this will come once you start working in a weather office.

********************NO RESPONSE NECESSARY********************

FRAME 5

To insure a uniform source for identifying message information, a symbolic format has been composed, spaced as indicated, of the following printed letter groups:

Symbolic format: TTAA(ii) CCCC(k) YYGGgg (BBB)

Example: SMCN1 KWBC 020600 RTD

Refer to the example above as well as to the Appendix with this program to identify the parts of the symbolic format.

********************NO RESPONSE NECESSARY********************

FRAME 6

Symbolic format: TTAA(ii)

TT - Data designator. This will designate the type of data furnished in the message text that follows. Refer to the example in Frame 5. The corresponding data designator for TT is SM. Now turn to the Appendix and find the meaning for SM. Six-hourly synoptics is correct. From this point, you now know that all data listed in this message/bulletin is of the six-hourly synoptic category.

Using the data designators or their meanings listed in the Appendix, fill in the appropriate blanks below.

1. SI ____________________
2. ____________________ Terminal Forecasts
3. UP ____________________
4. AB ____________________
5. ____________________ Aviation specials
6. ____________________ Weather Warnings other than hurricanes and typhoons
7. AS ____________________
8. SA ____________________
9. UW ____________________
10. OA ____________________
11. MT ____________________
12. DF ____________________
13. ____________________ Area Forecast
14. ____________________ Aircraft Report (PIREP)

FRAME 6 (CONTD.)

* *

ANSWER:

1. Three-hourly synops
2. FT
3. Pibal data
4. Misc. Weather Summaries
5. SP
6. WW
7. Surface analysis
8. Aviation hourlies
9. Rawin
10. ASRAP
11. Sea surface temp.
12. Fallout Data
13. FA
14. UA

FRAME 7

Symbolic format: TTAA(ii)

AA - Geographical designator. This will designate the geographical area of the world for which the message/bulletin data applies. Refer again to the example in Frame 5. The corresponding geographical designator for AA is CN. Using the Appendix, find the meaning for the designator CN. Canada is correct. By combining the designators of TT and AA, you determine that the text of the message/bulletin contains six-hourly synoptic data from Canada.

Using the geographical designators listed in the Appendix, fill in the appropriate blanks on the following page.

FRAME 7 (CONTD.)

1. AF____	6. ____Pacific	11. ____North America
2. US____	7. AK____	12. ____Caribbean
3. FR____	8. CN____	13. AU____
4. ____Chad	9. JP____	14. CU____
5. ____Greenland	10. ____Mexico	15. VS____

* *

ANSWER:

1. Africa	6. PA	11. NA
2. United States	7. Alaska	12. CA
3. France	8. Canada	13. Australia
4. CD	9. Japan	14. Cuba
5. GL	10. MX	15. Vietnam

FRAME 8

Symbolic format: TTAA(ii)

(ii) - Number(s) used to make a distinction in the environmental information that is contained in a series of environmental messages. This group is mandatory in all surface and upper-air observations but should be used only when absolutely required in other environmental messages.

1. One digit (i): Differentiates between two or more messages/ bulletins of similar contents from the same geographical area, e.g.,

FRAME 8 (CONTD.)

SMCN1 - first series of Canadian six-hourly synoptics

SMCN2 - second series of Canadian six-hourly synoptics

2. Two digits (ii): Usually indicates the WMO block number of stations contained in an environmental message/bulletin, e.g.,

SMKO47 (Block number 47 - Korea)

SMMO44 (Block number 44 - Mongolia)

NOTE: This subgroup indicator (ii) can and is modified to meet other environmental needs on selected messages/bulletins. If needed, these messages/bulletins can be decoded through the AWSP 105-52, Vol. III.

*********************NO RESPONSE NECESSARY*********************

FRAME 9

Symbolic format: TTAA(ii) CCCC(k)

CCCC - The international four-letter location indicator of the station originating or compiling the message.

NOTE: In some weather collectives (a series of weather messages under one heading), this may appear as numbers, letters, or a combination of numbers and letters. A few location indicators are listed in the Appendix.

FRAME 9 (CONTD.)

Using the Appendix, identify the following international location indicators:

1. KWBC ____________________
2. RPMK __________ __________
3. MKPB ____________________
4. AMML ____________________
5. KAWN ____________________
6. KNKA ____________________

* *

ANSWER: 1. Washington, D.C. (National Weather Service)

2. Clark AFB, Philippines

3. Barbados

4. Balboa, Canal Zone

5. Carswell AFB, TX (Automated Weather Network)

6. Kansas City, MO (FAA National Communications Center)

FRAME 10

Symbolic format: TTAA(ii) CCCC (k)

(k) - This identifier is used by agencies other than Department of Defense (DOD) agencies when required, in addition to (ii), for manual operations to indicate the content and distribution of a message/bulletin as follows:

FRAME 10 (CONTD.)

1. N: Northern Hemisphere data for global distribution.
2. S: Southern Hemisphere data for global distribution.

*3. A: Region VI data for interregional exchange to Region IV.

4. The use of other letters is a matter of regional or interregional agreement.

*NOTE: Region data can be identified through the use of the AWSP 105-52, Vol. II station index.

********************NO RESPONSE NECESSARY********************

FRAME 11

Symbolic format: TTAA(ii) CCCC(k) YYGGgg

YYGGgg - This six-digit identifier stands for the date-time group (DTG) of the message/bulletin and will be expressed with reference to Greenwich Mean Time (GMT), e.g., 020600. This group is broken down as follows:

YY - Day of the month, e.g., 020600, second day of the month.

GGgg - Time of the message/bulletin in hours and minutes as specified by the various reported elements, e.g., 020600, 0600 GMT.

1. Observations (except specials): Scheduled time of the observation.
2. Specials: Actual time of the observation.
3. Forecasts: The full hour preceding the scheduled file time, e.g., file time 1530Z, format time 1500Z.

FRAME 11 (CONTD.)

4. Analyses and Advisories: Time of the data base used to derive the product.

5. AIREPS, PIREPS, and other variable data: Actual time of message/bulletin preparation for transmission.

6. Routine Delayed Reports (RTD). Corrected Messages (COR) or Amended Forecasts (AMD): Time of the original environmental message to which it refers.

********************NO RESPONSE NECESSARY********************

FRAME 12

Using the Appendix, identify the following message headings as to type, geographical area, originator, date and time.

1. SAUS8 KAWN 021900

____

2. FPUS10 KWBC 171312

____

3. ABUS13 KWBC 717312

____

4. SICA1 KAWN 182100

____

5. SAPM AMML 182200

____

FRAME 12 (CONTD.)

6. SPUS KNKA 230816

____

7. ASAK KAWN 081200

____

8. WHUS KWBC 261500

____

9. AUNT KWBC 300000

____

10. UPMX1 KAWN 021200

____

* *

ANSWER:

1. Aviation hourly, United States, Carswell AFB, TX, 2nd day, 1900 GMT.
2. Public Forecast, United States, Washington, D.C., 2nd day, 1115 GMT.
3. Miscellaneous Weather Summaries, United States, Washington, D.C., 17th day, 1312 GMT.
4. Three-hourly synoptics, Caribbean, Carswell AFB, TX, 18th day, 2100 GMT.
5. Aviation hourly, Panama, Balboa, Canal Zone, 18th day, 2200 GMT.

FRAME 12 (CONTD.)

6. Aviation Special, United States, Kansas City, MO, 23rd day, 0816 GMT.
7. Surface Analysis, Alaska, Carswell AFB, TX, 8th day, 1200 GMT.
8. Hurricane Warning, United States, Washington, D.C., 28th day, 1500 GMT.
9. Upper Air Analysis, North Atlantic, Washington, D.C., 30th day, 0000 GMT.
10. Pibal data, Mexico, Carswell AFB, TX, 2nd day, 1200 GMT.

FRAME 13

Symbolic format: TTAA(ii), CCCC(k), YYGGgg (BBB)

(BBB) - Used to indicate that a change has taken place in an environmental message/bulletin. This special three-letter indicator will be added one space after the DTG and on the same line. The following are authorized indicators:

1. RTD: Routine Delayed Environmental Message. Used to identify messages/bulletins that have been delayed and are being transmitted after their regularly scheduled transmission time.
2. COR: Used as an indicator for Correction.
3. AMD: Contraction of the word Amendment. Used as an indicator when an amendment is issued to a previously transmitted forecast or environmental warning.

FRAME 13 (CONTD.)

List below the three, three-letter indicators used to indicate environmental message/bulletin changes and their respective abbreviated meanings.

1. ____ ______________________________

____

2. ____ ______________________________

____

3. ____ ______________________________

____

* *

ANSWER: 1. RTD - Routine Delayed Environmental Message/ Bulletin

2. AMD - Amendment

3. COR - Correction

FRAME 14

To increase your proficiency at identifying message headings, identify the following series of message headings using the Appendix.

1. SMJP1 KAWN 031800

____

2. UACA KNKA 141402 COR

____

3. ASNT KWBC 061200

____

4. FTAF KAWN 080000

____

5. UPPM AMML 121130 RTD

____

6. WWXX KNKA 181800

____

7. DFUS1 KAWN 130000

____

8. SDUS KAWN 050423 AMD

____

9. ABUS2 KNKA 061800

____

10. FDMX MKPB 101200

____

FRAME 14 (CONTD.)

11. SIBE KWBC 311500

____

12. UJAK KAWN 250000

____

13. WHNT AMML 191745

____

14. SPAU KWBC 020230

____

15. UXCN KAWN 121200

____

* *

ANSWER:

1. Six-hourly synoptics, Japan, Carswell AFB, TX, third day, 1800 GMT.
2. Aircraft report, Caribbean, Kansas City, MO, 14th day, 1400 GMT, Correction.
3. Surface Analysis, North Atlantic, Washington, D.C., 06th day, 1200 GMT.
4. Terminal Forecasts, Africa, Carswell AFB, TX, 8th day, 0000 GMT.
5. Pibal data, Panama, Canal Zone, Balboa, Canal Zone, 12th day, 1130 GMT, Routine Delayed Report.

FRAME 14 (CONTD.)

6. Weather Warnings other than hurricanes and typhoons, Miscellaneous, Kansas City, MO, 18th day, 1800 GMT.
7. Fallout Data, United States, Carswell AFB, TX, 13th day, 0000 GMT.
8. Radar summary data, United States, Carswell AFB, TX, 5th day, 0423 GMT, Amendment.
9. Miscellaneous Weather Summaries, United States, Kansas City, MO, 6th day, 1800 GMT.
10. Upper wind and temp forecasts, Mexico, Barbados, 10th day, 1200 GMT.
11. Three-hourly synoptics, Bermuda, Washington, D.C., 31st day, 1500 GMT.
12. Upper wind, temp, and constant pressure, Alaska, Carswell AFB, TX, 25th day, 0000 GMT.
13. Hurricane Warning, North Atlantic, Balboa, Canal Zone, 19th day, 1745 GMT.
14. Aviation specials, Australia, Washington, D.C., 2nd day, 0230 GMT.
15. Miscellaneous (Upper Air Data), Canada, Carswell AFB, TX, 12th day, 1200 GMT.

FRAME 15

This concludes this programmed instruction. Be aware that some environmental code groups require another four letter symbolic identifier ($M_iM_iM_jM_j$), immediately below and after the message/bulletin heading. That format does not fall within the scope of this programmed instruction, but can be found in the publication, NAVAIR 50-1P-11, International Meteorological Codes, 1981 Revised Edition, e.g., ZCZC WBC647

SMUS9 KWBC 171200 RTD

AAXX 17124

72203 31348 82209 10239 20228 40135 53017 71011 87601

********************NO RESPONSE NECESSARY********************

Now begin the Criterion Test on the next page.

IDENTIFICATION OF ENVIRONMENTAL MESSAGE HEADINGS

CRITERION TEST

Using the Appendix, identify the following message headings as to type, geographical area, originator, date and time, and change indicators.

1. SAUS 8 KAWN 021900 RTD

   ____

2. SMJP 1 KAWN 031800

   ____

3. UPMX 1 KAWN 121200

   ____

4. SDBE KAWN 070423 COR

   ____

5. FPUS 10 KWBC 131115

   ____

6. FDMX MKPB 101200

   ____

7. AUNT KWBC 300000

   ____

8. WHNT AMML 191745 AMD

   ____

9. SICA 1 KAWN 042100

   ____

10. UXCN KAWN 121200

    ____

IDENTIFICATION OF ENVIRONMENTAL MESSAGE HEADINGS

CRITERION TEST (CONTD.)

11. ABUS 14 KWBC 151200

12. SMMX KAWN 061800

IDENTIFICATION OF ENVIRONMENTAL MESSAGE HEADINGS

CRITERION TEST ANSWERS

1. Aviation hourly, United States, Carswell AFB, TX, 2nd day, 1900 GMT, Routine Delayed Report.
2. Six-hourly synoptic, Japan, Carswell AFB, TX, 3rd day, 1800 GMT.
3. Pibal data, Mexico, Carswell AFB, TX, 12th day, 1200 GMT.
4. Radar Report, Bermuda, Carswell AFB, TX, 7th day, 0423 GMT, Correction.
5. Public forecast, United States, Washington, D.C., 13th day, 1115 GMT.
6. Upper wind and temperature forecast, Mexico, Barbados, 10th day, 1200 GMT.
7. Upper Air Canal, North Atlantic, Washington, D.C., 30th day, 0000 GMT.
8. Hurricane warning, North Atlantic, Balboa Canal Zone, 19th day, 2100 GMT, Amendment.
9. Three-hourly synoptic, Caribbean, Carswell AFB, TX, 4th day 2100 GMT.
10. Miscellaneous upper air data, Canada, Carswell AFB, TX, 12th day, 1200 GMT.
11. Miscellaneous weather summary, United States, Washington D.C., 15th day, 1200 GMT.
12. Six-hourly synoptic, Mexico, Carswell AFB, TX, 6th day, 1800 GMT.

APPENDIX

DATA DESIGNATORS

TYPE OF REPORT

ANALYSIS

AH - Thickness
AP - Tropical Weather Summaries
AS - Surface
AU - Upper Air
AW - Wind

FORECASTS AND PROGNOSIS

FA - Area Forecasts (ARFOR)
FB - Aviation Forecast
FD - Upper wind and temp forecasts
FF - Flight Forecasts
FP - Public Forecasts
FR - Route Forecasts (ROFOR)
FS - Surface Prognostic Chart
FT - Terminal Forecasts
FU - Upper Air Prognostic Chart
FX - Miscellaneous

SURFACE DATA

SA - Aviation hourlies
SD - Radar Reports
SI - Three-hourly synops (intermediate)
SM - Six-hourly synops
SP - Aviation Specials
SX - Miscellaneous

UPPER AIR DATA

UA - Aircraft Report (PIREP)
UI - Pilot/Pilot Ship (A & B)
UJ - Upper wind, temp, and constant pressure height data
UP - Pibal Data
UR - Reconnaissance Flight (regular)
US - Radiosonde/Rawinsonde (Part A)
UW - Rawin
UX - Miscellaneous

APPENDIX

DATA DESIGNATORS (CONTD.)

WARNINGS

WH - Hurricane Warnings (Advisories
WW - Weather Warnings other than h ricanes and typhoons

MISCELLANEOUS

AB - Miscellaneous Weather Summaries
DF - Fallout Data
MT - Sea surface temp.
OA - ASRAP

GEOGRAPHICAL DESIGNATORS

AF - Africa
AK - Alaska
AU - Australia
BE - Bermuda
BR - Barbados
CA - Caribbean
CD - Chad
CN - Canada
CU - Cuba
FR - France
GA - Gulf of Alaska
GL - Greenland
GX - Gulf of Mexico
HW - Hawaiian Islands
JP - Japan
MX - Mexico
NA - North America
NT - North Atlantic
PA - Pacific
PM - Panama, Canal Zone
US - United States
VS - Vietnam

LOCATION INDICATORS

AMML - Balboa, Canal Zone
KAWN - Carswell, AFB, Texas (Automated Weather Network)
KNKA - Kansas City, MO (FAA National Communications Center)
KWBC - Washington, D.C. (National Weather Service)
MKPB - Barbados (off Venezuela)
RPMK - Clark, AFB, Philippines

PROGRAMMED INSTRUCTION

SOUND RAY THEORY

Naval Air Technical Training Command

CNATT-L131 PAT

FOR U.S. NAVY TRAINING PURPOSES ONLY

SOUND RAY THEORY

INTRODUCTION

The sophisticated weaponry of the modern Navy requires better and more accurate information as regards the environment of the weapon. The "Sound Ray Theory" discusses the effect of the ocean's environment on the transmission of sound.

This program is written in a linear format; that is, the trainee progresses from frame to frame. Read the objectives on page ii of the program; then, do the program. Upon completion of the program, reread the objectives. If you can answer each objective, commence the self-test. Turn to page ii and begin the program.

SUGGESTED READING TIME 45 MINUTES

NAME ______________________ CLASS ______________________

SOUND RAY THEORY

OBJECTIVES

Upon completion of the program, the student will:

1. Complete statements concerning the relationship of the velocity of sound in the oceans to temperature, pressure, and salinity.

2. State the predominant sound-velocity modifier in the upper and lower layers of the three-layered ocean model.

3. a. Given a series of diagrams, select the diagram(s) which illustrate(s) refraction.

   b. Complete statements concerning the relationship of refraction to sound velocity and intensity.

4. a. Select the general principle of Snell's law from a given list.

   b. Given a series of diagrams showing the direction that a sound ray enters a layer of different velocity, select the diagram which illustrates the greatest amount of refraction and the one which illustrates no refraction.

5. On given diagrams, label the limiting ray.

6. a. Given diagrams of temperature and velocity versus depth, label each with the term which applies to the profile.

   b. Match each profile diagram with the illustration of the sound pattern which would occur with it.

   c. Select the sound-velocity profile with which a sound channel would occur.

7. Given a list of statements, select those which are true concerning the effect of sea-surface and ocean-bottom conditions on the reflection of sound.

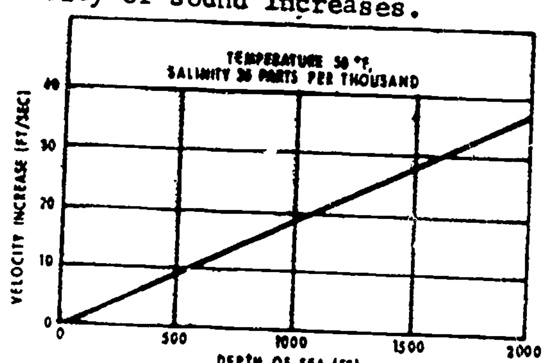
	1. Sound, as you know, travels about 4.5 times faster through sea water than through air. The velocity of sound in sea water is modified by the TEMPERATURE, PRESSURE, and SALINITY of the water. TEMPERATURE is the predominant modifier of sound in the upper 500 meters (mixed layer). Generally, the velocity of sound will increase at a rate of 6 feet per second with each temperature increase of 1°F. Therefore, if the temperature were increased by 3°F., the velocity of sound would increase/decrease (Circle one.) by ______ ft./sec.
increase 18	2. Conversely, if the temperature of the mixed layer is decreased by 2°F., the velocity of sound will increase/decrease (Circle one.) by 12 ft./sec.
decrease	3. From the information in the two previous frames, we can draw the following conclusions. a. The velocity of sound increases with a/an increase/decrease (Circle one.) in temperature. b. The velocity of sound decreases with a/an increase/decrease (Circle one.) in temperature.

a. increase

b. decrease

4. In the mixed layer (the upper 500 meters), the effect of temperature on sound velocity is so great that it negates the effect of pressure. Below 50ↄ meters, temperature change is sufficiently reduced, thus allowing pressure to become the predominant modifier of sound velocity.

The graph below depicts the relationship of sound velocity to depth (pressure). A close examination of the graph reveals that as the depth increases, the velocity of sound increases.



If the depth of a sound source is increased by 50ʻ feet, the velocity of sound would increase by ________________ feet per second.

---

9 $\pm$ 1

5. The effect of pressure on sound is a direct relationship; that is, as pressure increases, sound velocity increases; and as pressure decreases, sound velocity increases/decreases.
(Circle one.)

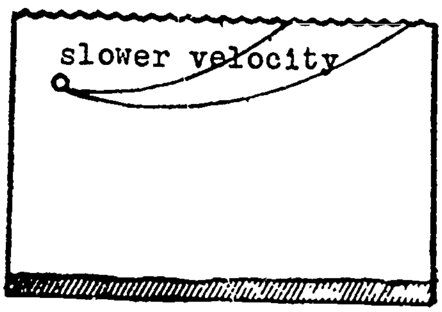
decreases	6. We know the following facts: As temperature increases, sound velocity increases. AND As pressure increases, sound velocity also increases. THEREFORE An increase in both temperature and pressure will result in a/an increase/decrease in sound velocity. (Circle one.)
increase	7. The remaining modifier of sound velocity is SALINITY. Salinity gradients are slight in the open oceans and generally are neglected. However, near coasts, where large quantities of fresh water enter the sea, salinity gradients may be of major importance. Salinity gradients affect sound velocity in the same manner that temperature and pressure affect sound velocity. As salinity increases by 1 $^{o}/oo$, sound velocity increases by 4 feet per second. Therefore, if salinity increases from 33 $^{o}/oo$ to 37 $^{o}/oo$, the velocity of sound will increase/decrease by ________ ft./sec. (Circle one.)

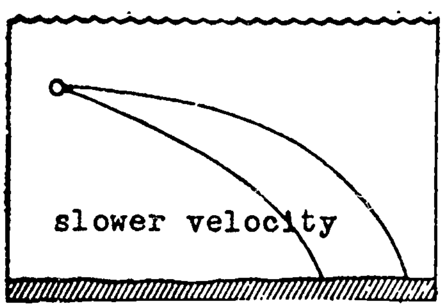
increase 16	8. Salinity, as was stated in the previous frame, affects sound velocity in the same manner as temperature and pressure. Therefore, if the temperature, pressure, and salinity of a body of water are decreased, the velocity of sound in th water will increase/decrease. (Circle one.)
decrease	9. Complete the statements below by circling the correct terms. a. With an increase in any of the modifying variables, sound velocity increases/decreases. (Circle one.) b. Sound velocity in water will increase with a/an increase/decrease in salinity. (Circle one.) c. A decrease in temperature will result in a/an increase/decrease in sound velocity. (Circle one.) d. The velocity of sound will increase with a/an increase/decrease in ressure. (Circle one.)
a. increases b. increase c. decrease d. increase	10. a. The predominant sound-velocity modifier in the mixed layer (upper 500 meters) is __________. b. The predominant sound-velocity modifier in the deep layer is __________.

temperature

pressure

11. We have established that sound velocity varies with a variation of temperature, pressure, and salinity. What effect does this velocity variation have on a sound ray? Sound rays are REFRACTED (bent) in the direction of slower velocities. The diagrams below illustrate that a sound ray may be refracted either up or down.

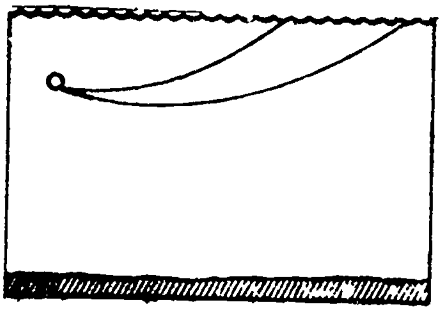




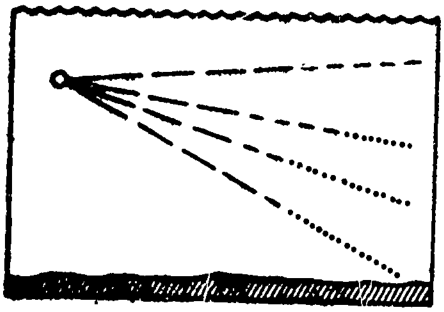
The direction towards which a sound ray is refracted depends upon the direction of the lower

intensity/velocity.
(Circle one.)

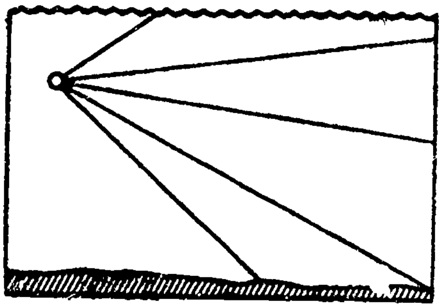
velocity	12. Select the diagram(s) below which illustrate(s) refraction by placing the letter "R" beside the diagram(s).



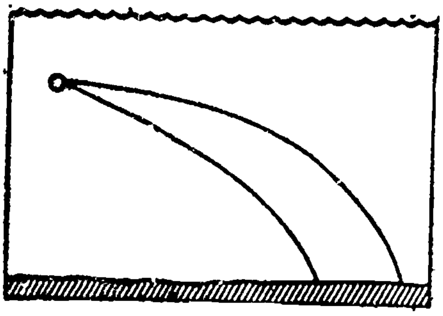
a. ____



b. ____



c. ____



d. ____

a. R b. ___ c. ___ d. R	13. The question may come to mind as to the importance of refraction, and any other effects it may or may not have on sound. First, refraction DOES NOT affect the intensity of sound. Secondly, the manner in which a sound pattern is spread is dependent upon refraction. Finally, the amount and direction of refraction can be determined by the application of Snell's law. (Snell's law will be fully explained in the next teaching sequence.) **No response required. Continue to frame 14.**
	14. Select the statements which are true concerning refraction. _____a. Refraction affects the intensity of sound. _____b. Refraction determines the type of spreading for a sound pattern. _____c. The application of Snell's law determines the amount and direction of refraction. _____d. Refraction does not affect the intensity of sound.

____ a.	
T b.	15. Complete the following statements by circling the correct terms.
T c.	a. The intensity of sound is increased/not changed (Circle one.) by refraction.
T d.	b. The application of Snell's law/Specular's law (Circle one.) determines the amount and direction of refraction.
	c. Refraction does/does not (Circle one.) determine the type of spreading.

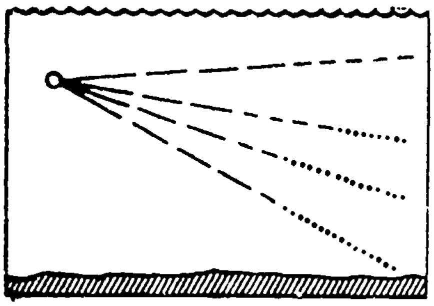
Answer to frame 15.

a. not changed

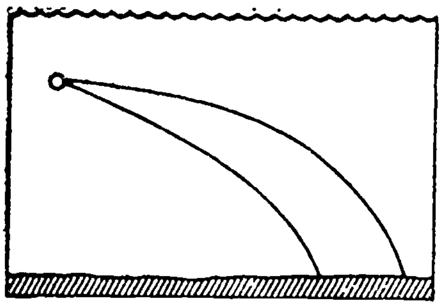
b. Snell's law

c. does

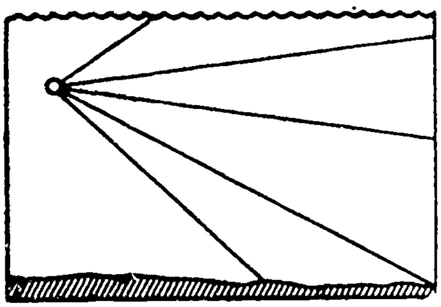
16. a. Select the diagram(s) below which illustrate(s) refraction by placing the letter "R" beside the diagram(s).



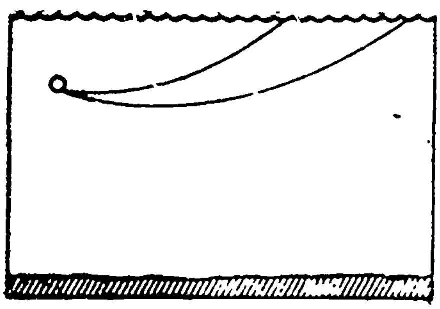
1. ______



2. ______



3. ______



4.___

16. (con.)

b. Complete the following statements by circling the correct terms

1. Refraction does/does not determine (Circle one.) the type of spreading.

2. Refraction increases/does not change (Circle one.) the intensity of sound.

3. The application of Snell's/Specular's law (Circle one.) determines the amount and direction of refraction.

Answer to frame 16.

a. 1. ____

2. R

3. ____

4. R

b. 1. does

2. does not change

3. Snell's

17. Snell's law was mentioned in frame 13. This law shows: There is a definite relationship between the angle at which a sound ray enters a layer of different velocity and the amount of refraction which occurs. To explain this law, let's look at it in relation to driving a car from a paved road into sand. If the car is eased into the sand one wheel at a time, it will swerve (refract) into the sand (lower velocity). Now, if the car enters the sand with both front wheels at once (perpendicular), there is no refraction or swerving. The velocity of the car changes, but the car remains on a straight line. If car is driven fast, the amount of refraction will be greater than a car driven slowly.

No response required. Continue to frame 18.

18. Select the general principle of Snell's law from the list of principles below by circling the letter of the correct principle.

a. There is NO relationship between the angle at which a sound ray enters a layer of differen velocity and its speed in the different laye s.

b. The actual velocity of sound is irrelevant; it is the direction of sound that determines the degree of refraction.

c. There is a definite relationship between the angle at which a sound ray enters a layer of different velocity and the amount of refract on which occurs.

---

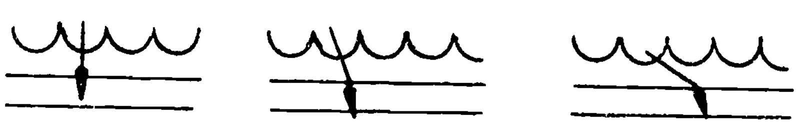
c.

19. Sound rays react in the same manner as did the c in frame 17; that is, the rays will not refract when they enter a layer of differing velocity at 90° to the layer. Conversely, the greater the angle is from 90°, the greater the amount of

______________________.

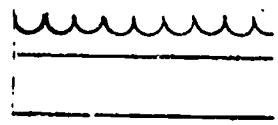
The diagrams below illustrate this principle.

(The arrows represent sound ray paths; solid lines delineate a layer of lower velocity.)

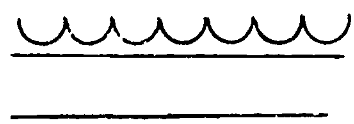


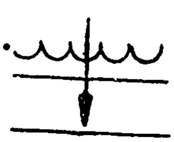
No refraction. | Some refraction. | Large amount of refraction.

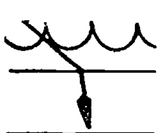
<table>
<tr>
<td>refraction</td>
<td>20. a. On the diagram below, 'raw an arrow which would illustrate a sound ray with NO refraction.



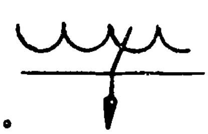
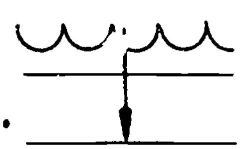
b. On the diagram below, draw an arrow which would strate a sound ray with a large amount of refraction.

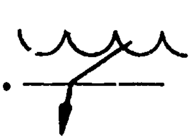
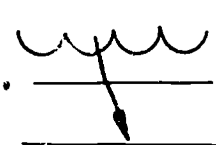


(Solid lines delineate a layer of lower velocity.)</td>
</tr>
<tr>
<td>a. 

b. </td>
<td>21. Select, by circling the letter of the diagram, the diagram which would have the greatest amount of refraction; place the letter "L" beside the diagram which would have no refraction.

(The arrows show the direction of sound rays entering layers of different velocities.)

a.  ___   b.  ___

c.  ___   d.  ___</td>
</tr>
</table>

a. ____

b. L ____

c. ____

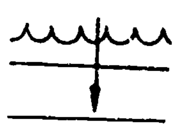
d. ____

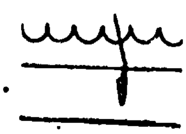
22. a. Select the general principle of Snell's law by circling the correct number.

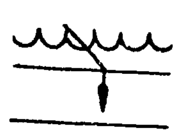
1. The actual velocity of sound is irrelevant; it is the direction of sound that determines the degree of refraction.
2. There is a definite relationship betwee the angle at which a sound ray enters a layer of different sound velocity and the amount of refraction which occurs.
3. There is NO relationship between the angl at which a sound ray enters a layer of varying velocity and its speed in the different layers.

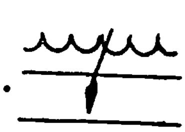
b. Select, by circling the number of the diagra the diagram which would have the greatest am unt of refraction, AND place the letter "L" besi e the diagram which would have NO refraction.

(The arrows show the direction of sound ra entering layers of differing velocities.)

1.  ____

2.  ____

3.  ____

4.  ____

a. 2

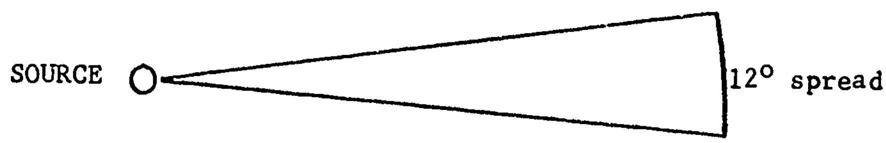
b. 1. L

2. ___

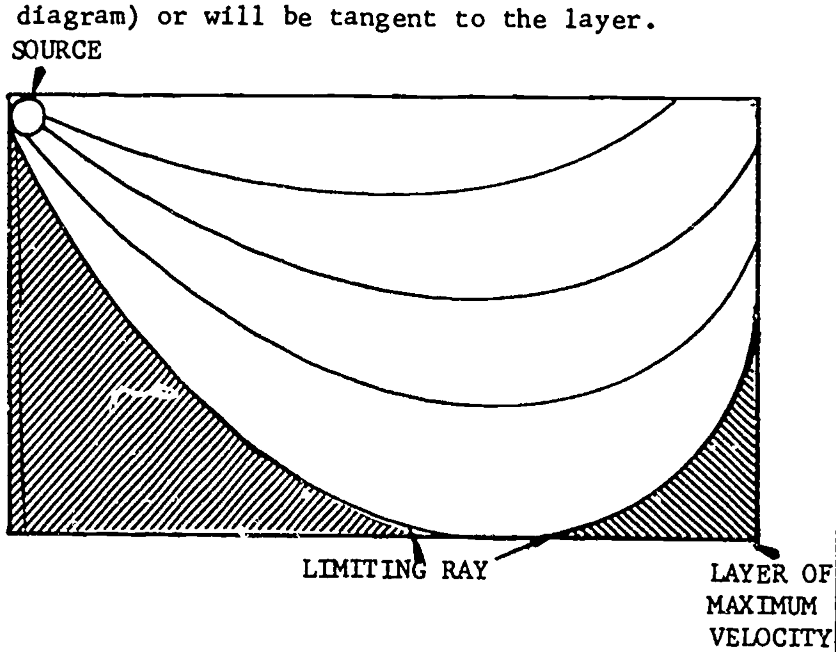
3. ___

4. ___

23. When a sound beam is emitted from a directional source, nearly all the acoustic energy is concentrated within a cone of about 12°.

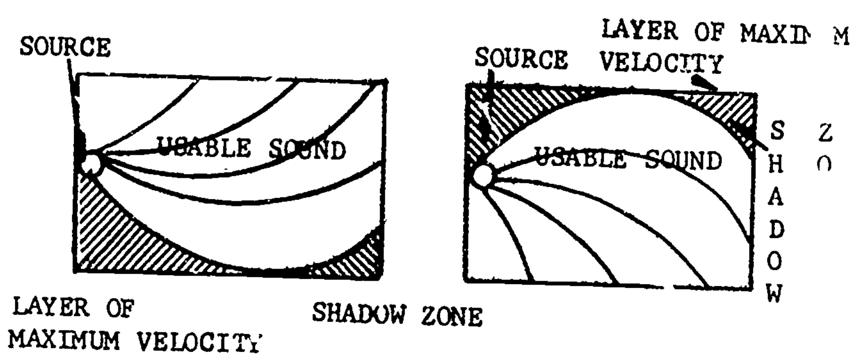


Of all rays transmitted within a sound beam, ONE will reach the depth of MAXIMUM VELOCITY. When this ray reaches the depth of maximum velocity, it will have an inclination angle of 0° (see diagram) or will be tangent to the layer.



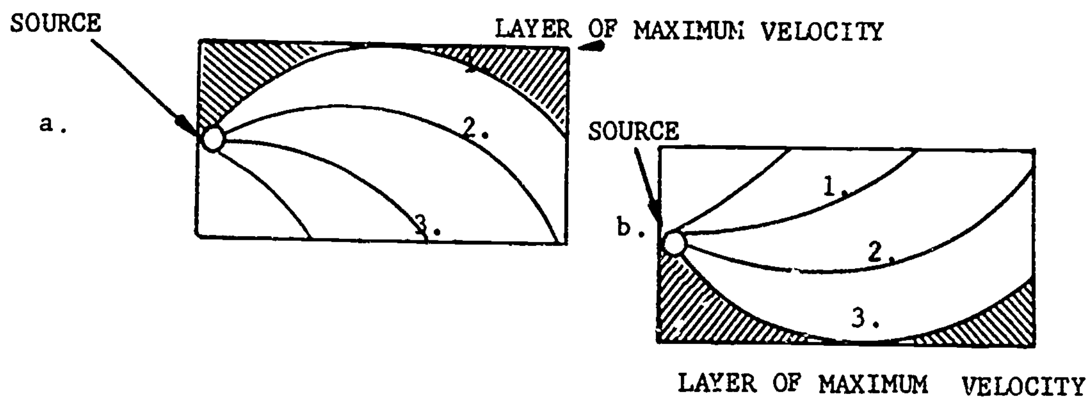
The ray which becomes tangent is called the "LIMITING RAY."

No response required. Continue to frame 24.

	24. Of all rays transmitted within a sound beam, ______________ will reach the depth of maximum velocity. This ray will be ______________ to the layer depth and is called the ______________ ______________.
one tangent limiting ray	25. The layer of maximum velocity could be at some depth or at the surface, depending upon oceanographic conditions at the time of transmission. (See diagrams below.)  The diagrams above illustrate that all usable sound energy is within the area bounded by the limiting ray and the sound source. The area outside the limiting ray is a silent area called the ______________ ______________.

shadow zone

26. On the diagrams below, circle the numbered ray which would be the limiting ray.



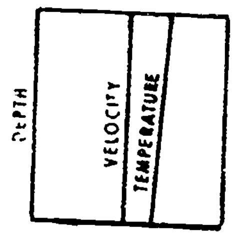
a. 1.

b. 3.

27. The thermal structure of the ocean governs the refractive conditions for a given water mass. Although there are infinite vertical temperature variations in the ocean, the temperature structure generally can be related to five basic types with attendant sound patterns. In this objective, you will learn the basic temperature/velocity structures (profiles) and match them with their attendant sound patterns.

No response required. Continue to frame 28.

28. The first temperature/velocity profile is named for its velocity. This profile is "ISOVELOCITY." The thermal structure is essentially isothermal th a decrease in temperature of about 0.2°F. per 100 feet. The temperature decrease is countered by e increasing pressure. An isovelocity profile is illustrated below.

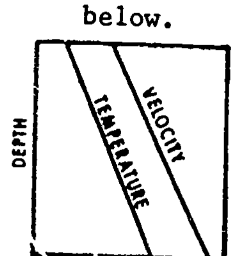


If the temperature of a body of water decreases a rate of 0.1°F. per 25 feet, the temperature profile would/would not be termed isovelocity.
(Circle one.)

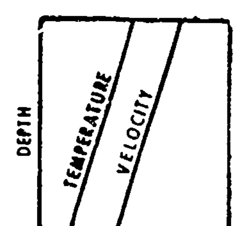
---

would not

29. The next two profiles are POSITIVE and NEGATIVE. A positive profile shows an increase in temperat re/ velocity with depth (slants to the right); a negative profile is the opposite, showing a ____________(slants to the left) in temperature/ velocity with depth. Both profiles are illustrated below.



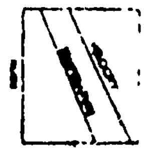
POSITIVE



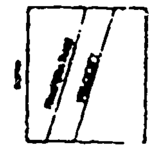
NEGATIVE

decrease

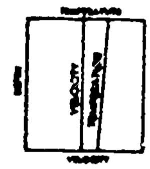
30. Label each diagram below with the term which applies to the profile.



a. ______



b. ______



c. ______

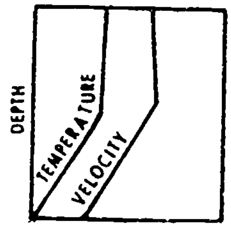
---

a. Positive.

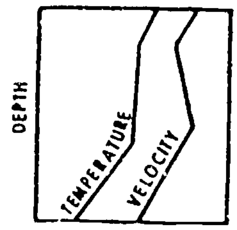
b. Negative.

c. Isovelocity.

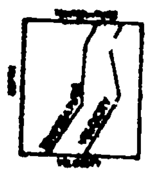
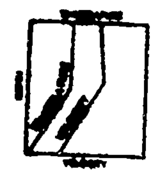
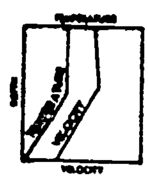
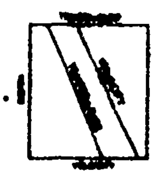
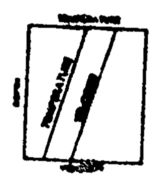
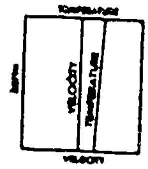
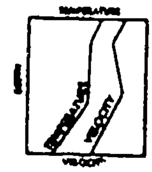
31. The remaining two profiles are a combination of the positive and negative profiles. The first we will discuss is the positive profile over a negative profile. This profile is characterized by an increase in temperature/velocity over a decrease in temperature/velocity. Conversely, a negative profile over a positive has a/an ______________ in temperature/velocity over a/an ______________ in te perature/velocity. Both profiles are illustrated below.



POSITIVE OVER NEGATIVE.



NEGATIVE OVER POSITIVE.

decrease increase	32. Label each diagram below with the term which applies to the profile. a.  ______________ b.  ______________
a. Negacive over positive. b. Positive over negative.	33. Label each diagram below with the term which appli to the profile. a.  ______________ b.  ______________ c.  ______________ d.  ______________ e.  ______________

a. Positive over negative.

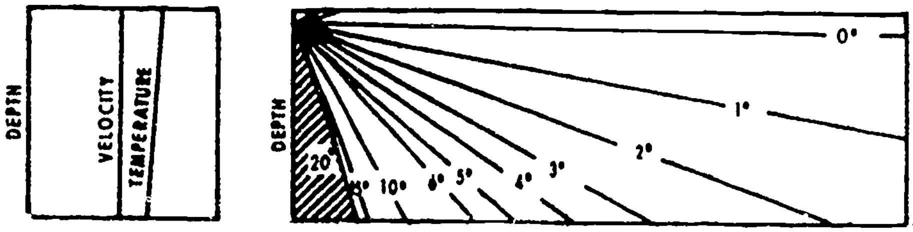
b. Positive.

c. Negative.

d. Iso-velocity.

e. Negative over positive.

34. Now that the various temperature/velocity profiles have been identified, let's see how each affects the transmission of sound. The sound pattern associated with an isovelocity profile (see diagram) indicates rays leaving a sound source in straight lines that continue with little change in angle at increased distance from the source. Long ranges are possible when this type of structure is present.

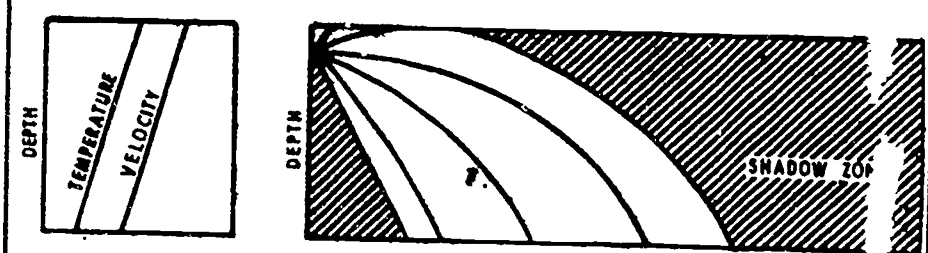


The profile which has a sound pattern characterized by straight lines and long ranges is

________________________.

isovelocity

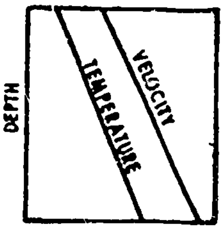
35. A negative profile (temperature/velocity decreasing with depth) causes sound rays from a near surface source to be bent sharply downward within ranges .. 1,000 yards or less. (See diagram.) The sharpness of the temperature gradient determines the sprea(of the sound beam. If the decrease in temperature f m the surface to a depth of about 30 feet totals 1° or more, most of the sound beam would miss a shallow target at a range of 1,000 yards.

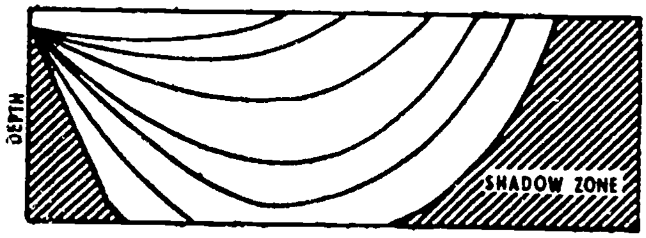


If the temperature of a body of water decreases rapidly with depth, most of the sound from a beam would/would not miss a target at a range of 1,000 yards.
(Circle one.)

would

36.





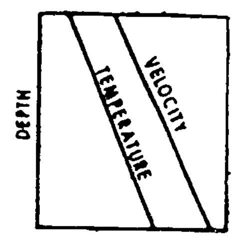
The positive temperature gradient, illustrated above, causes the velocity of sound to increase with depth, thus, causing a sound beam from a near surface source to bend ______________________.

up or
upwards

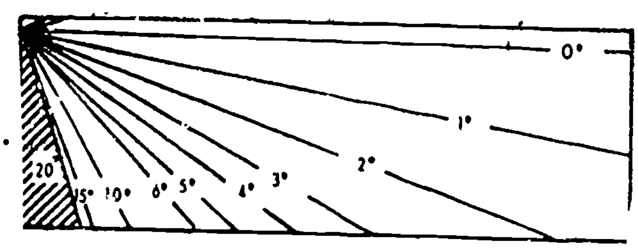
37. Match each profile in column A with the illustration of the sound pattern in column B which would occur with it by placing the number of the profile in the space provided.

A. | B.

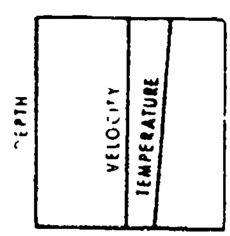
1.



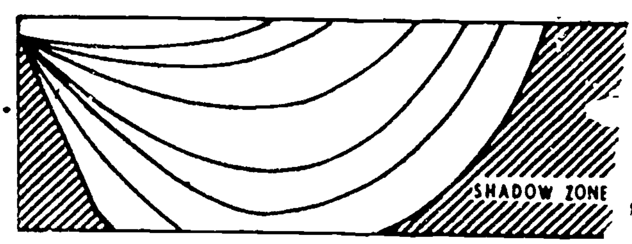
___ a.



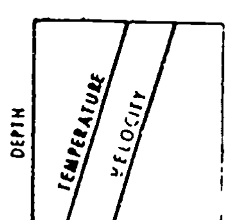
2.



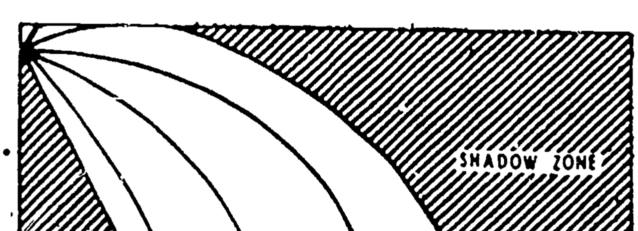
___ b.



3.



___ c.

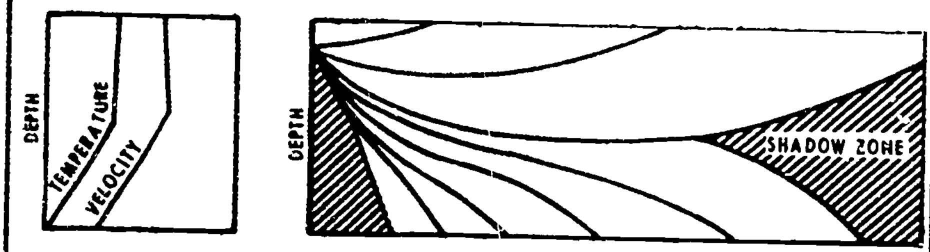


2 a.

1 b.

3 c.

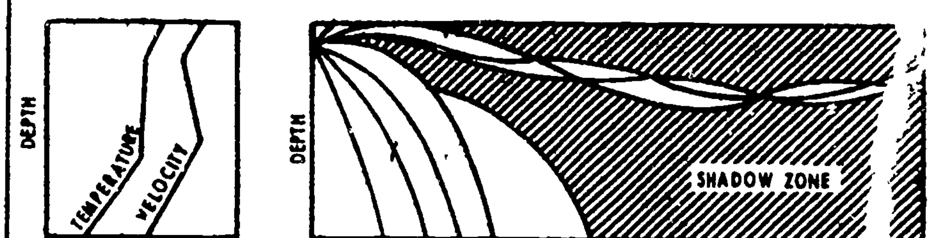
38. A SPLIT BEAM pattern is the result of a positive gradient overlying a negative gradient.



A close examination of the diagram above will reveal that the split in a sound beam occurs approximately where the temperature starts to ________________ with depth.

decrease

39. When a negative gradient overlies a positive gradient, the result is a SOUND CHANNEL. The negative gradient causes sound rays to be refracted down, while the positive causes the sound rays to be refracted upwards. This results in sound rays being trapped in a channel. Sound in a sound channel is capable of traveling thousands of miles.



In the upper layers of the oceans, a sound channel is rare, since the thermal conditions which cause it are unstable.

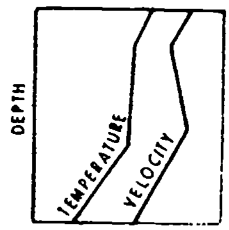
The profile which would cause the <u>greatest</u> ranges for a sound beam is the ________________ gradient over the ________________ gradient.

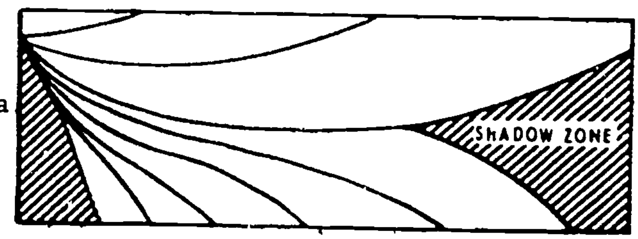
negative

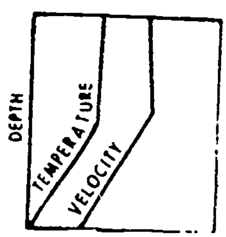
positive

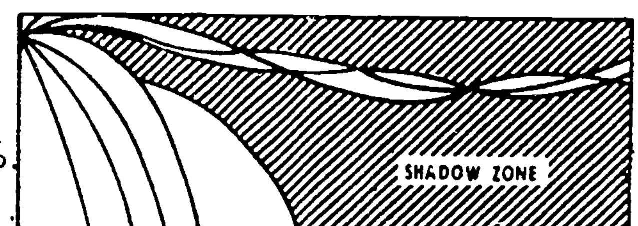
40. Match each profile in column A with the illustration of the sound pattern, in column B, which would occur with it by placing the number of the profile in the space provided.

A. B.

1. 

____ a 

2. 

____ b. 

__2__ a.

__1__ b.

Continue to page 28.

Answer to frame 41.

__5__ a.

__4__ b.

__2__ c.

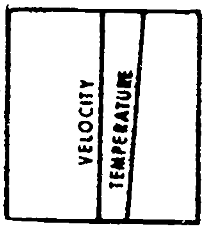
__3__ d.

__1__ e.

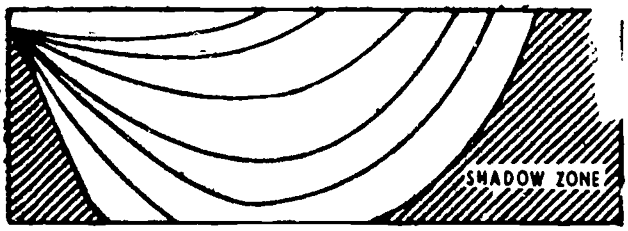
41. Match each profile in column A with the illustration of the sound pattern, in column B, which would occur with it by placing the number of the profile in the space provided.

A. | B.

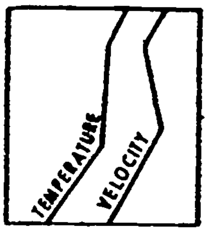
1.



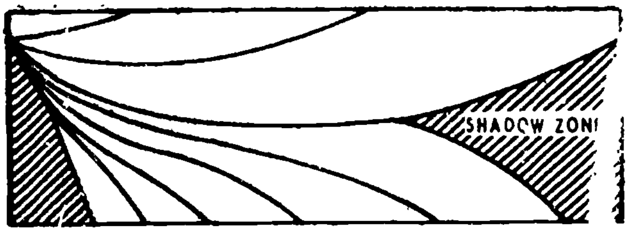
___a.



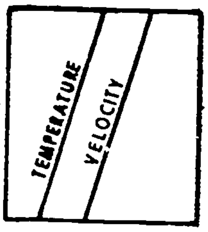
2.



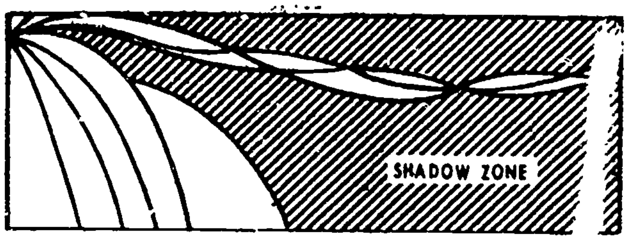
___b.



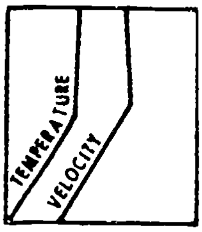
3.



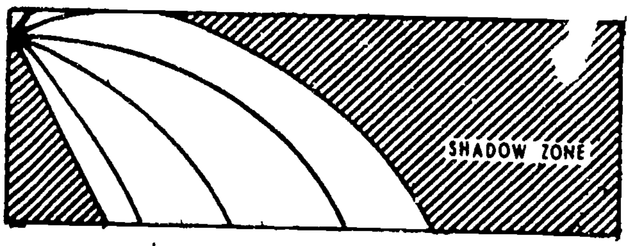
___c.



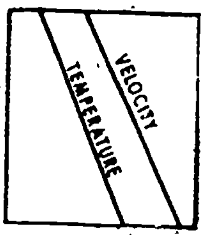
4.



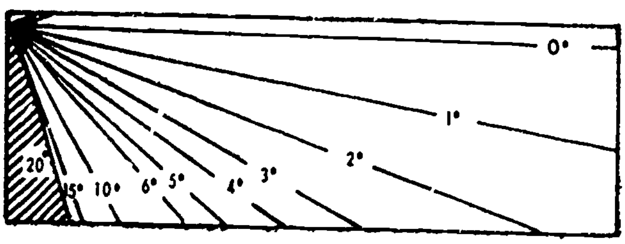
___d.



5.

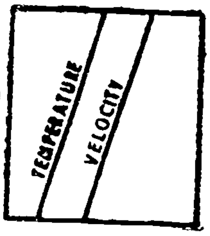


___e.

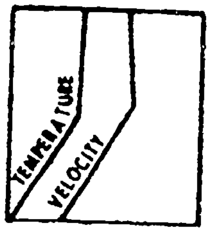


Answer to frame 41 on page 27.

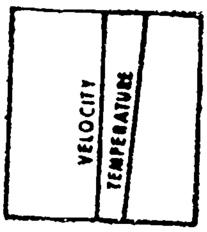
	42. State the sound-velocity profile with which a sound channel would occur. ____________ ____________
Negative over positive.	43. a. Label each diagram below with the term which applies to the profile.

(1) 

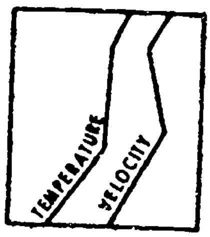
____

(2) 

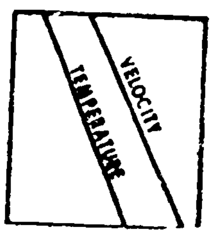
____

(3) 

____

(4) 

____

(5) 

____

a.

(1) Negative.

(2) Positive over negative.

(3) Iso-velocity.

(4) Negative over positive.

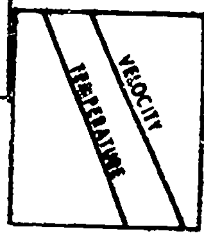
(5) Positive.

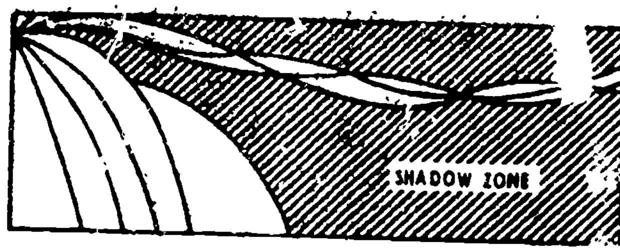
43. (con.)

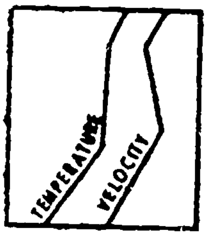
b. Match each profile in column A with the illustration of the sound pattern, in column B, which would occur with it by placing the number of the profile in the space provided.

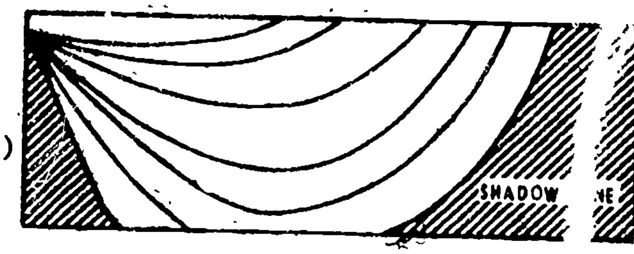
A.

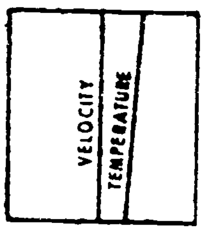
B.

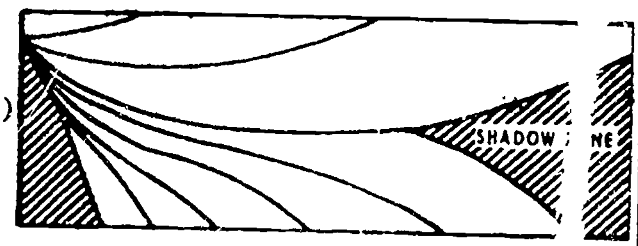
1. 

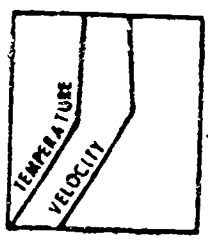
___(a) 

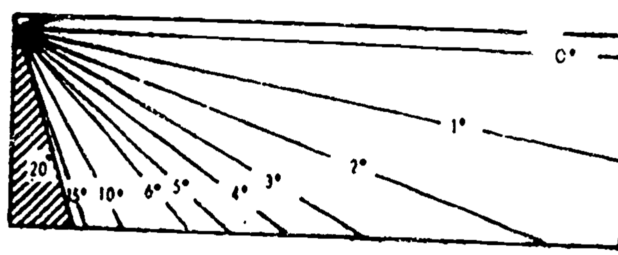
2. 

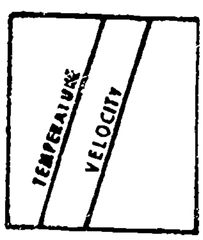
___(b) 

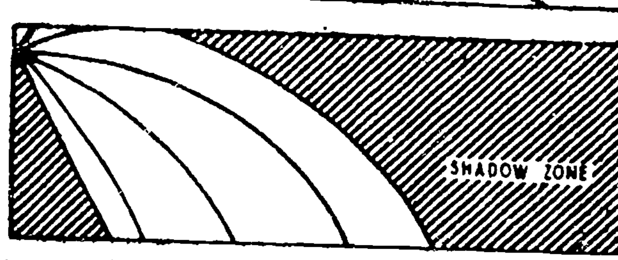
3. 

___(c) 

4. 

___(d) 

5. 

___(e) 

43. (con.)

c. Write the number of the sound-velocity profile (from column A of frame 43.b.) with which a sound channel would occur.

____

Answer to frame 43. (con.)

b. (a) 2

(b) 1

(c) 4

(d) 3

(e) 5

c. 2

44. The final factor affecting sound transmission in water, which we will study, is REFLECTION. A sound beam striking a surface may be affected in three ways. These are:

(1) The sound may be reflected with little loss . intensity.

(2) The sound may be reflected in many directions with a high intensity loss.

(3) The sound may be absorbed by the medium.

This objective will show how the ocean bottom affects sound in these three ways. Before continuing with reflection, you must understand the term SPECULAR REFLECTION. Specular reflection is simply mirror reflection, such as the mirror of car, the mirror over a vanity or wash basin. Th s, if a sound beam were reflected specularly, it w(ld fall under which category above? ________________

(1)

45. Sound reflects off the surface and bottom of the ocean. Let's consider the surface reflection first. We all know that the ocean's surface is seldom perfectly smooth. If it were, however, it would reflect sound specularly (as a mirror). But each ripple, wave, or wake of a ship creates a multitude of surfaces which are constantly changing. This constant change scatters the sound rather than reflecting it specularly.

From the information above, we can draw the conclusion that the surface of the ocean always/seldom reflects sound specularly.
(Circle one.)

seldom

46. There are three general bottom types which will be discussed. These are SAND, ROCK, and MUD. Because of its smoothness, sand makes a good reflector of sound. Rock bottoms are potentially the best reflectors of sound. A <u>smooth</u> rock bottom is the BEST bottom for reflection. Unfortunately most rock bottoms are rough and irregular, and reflect sound in many directions. The worst type of bottom for reflection is mud, because it absorbs much more sound than it reflects.

Complete the following statements.

a. The best possible bottom for sound reflection is a ______________ ______________ ______________.

b. Sand is a good reflector of sound, because it is generally ______________.

c. The worst reflector is mud, because it ______________ more sound than it ______________.

a. smooth rock bottom

b. smooth

c. absorbs

reflects

47. Select, by placing a "T" in the space provided, the statements which are true concerning the effect of sea-surface and ocean-bottom conditions on the reflection of sound.

_____a. A smooth sand bottom reflects sound effectively.

_____b. A smooth mud bottom is a good reflector.

_____c. The surface of the sea ALWAYS reflects sound specularly.

_____d. A smooth rock bottom is the best reflector.

_T_ a.

_____b.

_____c.

_T_ d.

This completes the program. Return to the front of the program and reread the objectives. If you can answer all the objectives, commence the self-test.

SOUND RAY THEORY

SELF-TEST

1. Complete the following statements by circling the correct terms. (frame 1)

   a. The velocity of sound will increase/decrease (Circle one.) with a decrease in temperature.

   b. The velocity of sound will increase with a/an increase/decrease (Circle one.) in pressure.

   c. Sound velocity, in water, will increase with a/an increase/decrease (Circle one.) in salinity.

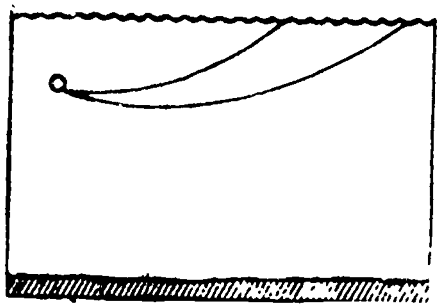
   d. Sound velocity increases/decreases (Circle one.) with an increase in any of the three controlling variables.

2. Complete the following statements.

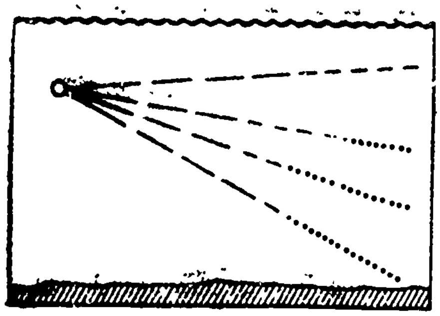
   a. The predominant sound-velocity modifier in the mixed layer (upper 500 meters) is ____________________. (frame 1)

   b. The predominant sound-velocity modifier in the deep layer is ____________________. (frame 4)

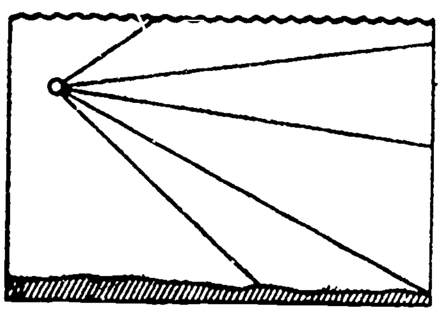
3. a. Select the diagram(s) below which illustrate(s) refraction by placing the letter "R" beside the diagram(s). (frame 11)



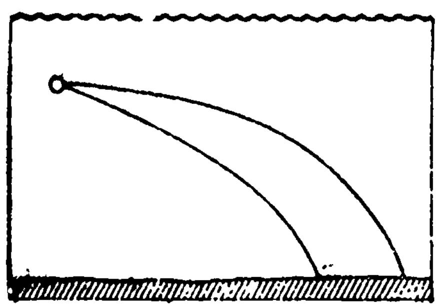
1. ________



2. ________



3. ________



4. ________

3. (con.)

b. Complete the following statements by circling the correct terms. (frame 13)

1. Refraction reduces/increases/does not change the intensity of sound.
(Circle one.)

2. The application of Snell's law/Specular's law determines the amount and direction of refraction.
(Circle one.)

3. Refraction does/does not determine the type of spreading.
(Circle one.)

4. a. Select, by circling the number of the statement, the principle of Snell's law from the list below. (frame 17)

1. There is NO relationship between the angle at which a sound ray enters a layer of different velocity and its speed in the different layers.

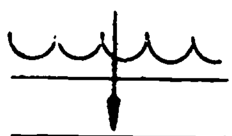
2. The actual velocity of sound is irrelevant; it is the direction of sound that determines the degree of refraction.

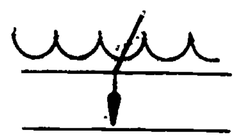
3. There is a definite relationship between the angle at which a sound ray enters a layer of different sound velocity and the amount of refraction which occurs.

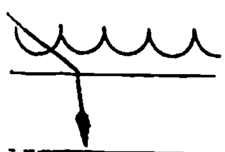
4. (con.)

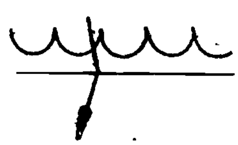
b. Select, by circling the number of the diagram, the diagram which would have the greatest amount of refraction; place the letter "L" beside the diagram which would have no refraction.

(The arrows show the direction of sound rays entering layers of different velocity.) (frame 19)

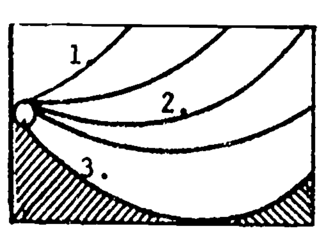
(1)  ___

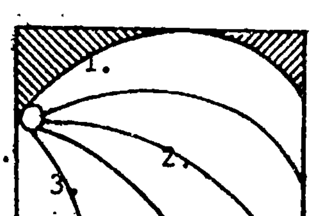
(2)  ___

(3)  ___

(4)  ___

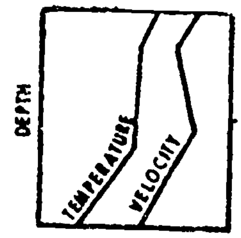
5. On the diagrams below, circle the numbered ray which would be the limiting ray. (frame 23)

a. 

b. 

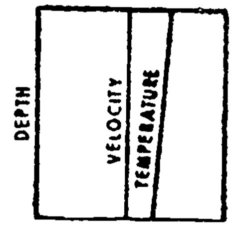
6. a. Label each diagram below with the term which applies to the profile. (frame 28)

(1)



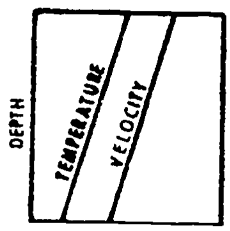
____

(2)



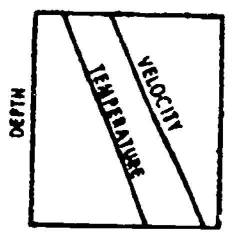
____

(3)



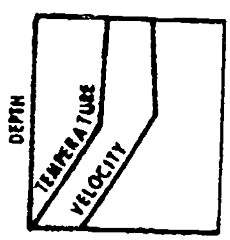
____

(4)



____

(5)

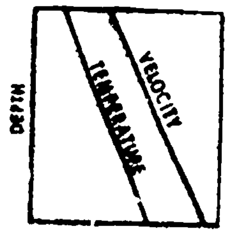


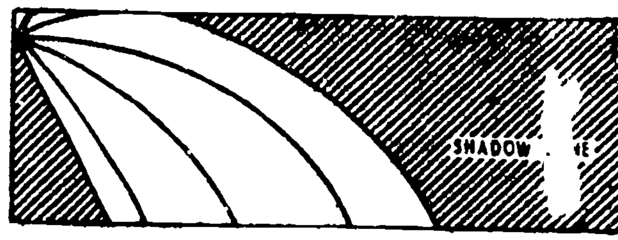
____

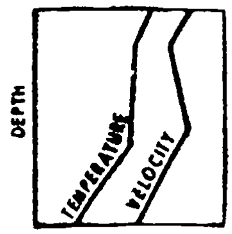
6. (con.)

b. Match each profile in column A with the illustration of the sound pattern, in column B, which would occur with it by placing the number of the profile in the space provided. (frame 34)

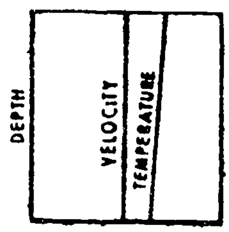
A. B.

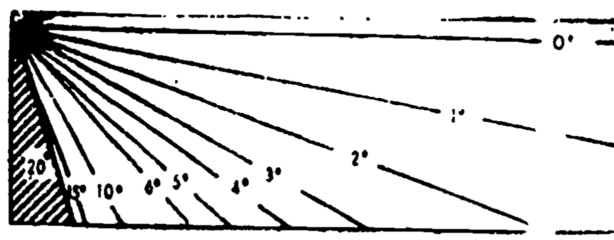
(1) 

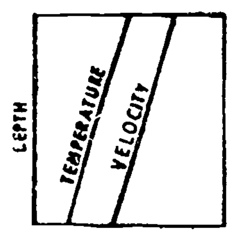
______(a) 

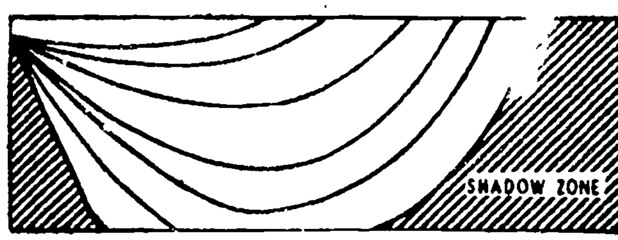
(2) 

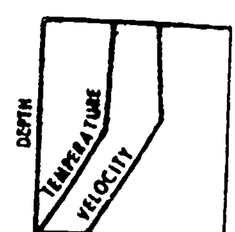
______(b) 

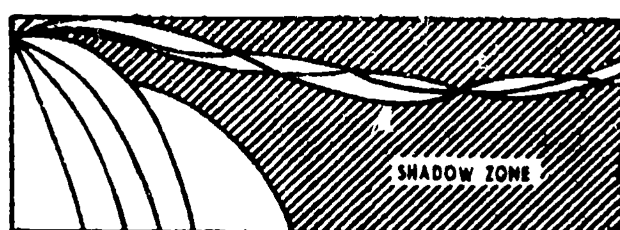
(3) 

______(c) 

(4) 

______(d) 

(5) 

______(e) 

6. (con.)

c. Write the number of the sound-velocity profile (from column A of 6.b.) with which a sound channel would occur.

_______________ (frame 39)

7. Select, by placing a "T" in the space provided, the statements which are true concerning the effect of sea-surface and ocean-bottom conditions on the reflection of sound. (frame 44)

_____a. The surface of the sea always reflects sound specularly.

_____b. A smooth sand bottom reflects sound very effectively.

_____c. A smooth mud bottom is a good reflector.

_____d. A smooth rock bottom is the best reflector.

SOUND RAY THEORY

ANSWERS TO SELF-TEST

1. a. decrease
   b. increase
   c. increase
   d. increase

2. a. temperature
   b. pressure

3. a. 1. __R__ 2. ____ 3. ____ 4. __R__

   b. 1. does not change
      2. Snell's law
      3. does

4. a. 3

   b. (1) __L__ 3

5. a. 3 b. 1

6. a. (1) Negative over positive.
      (2) Isovelocity.
      (3) Negative.
      (4) Positive.
      (5) Positive over negative.

   b. __(4)__ (a)
      __(5)__ (b)
      __(3)__ (c)
      __(1)__ (d)
      __(2)__ (e)

   c. __(2)__

7. ____ a.
   __T__ b.
   ____ c.
   __T__ d.

THE UNITED STATES NAVY

GUARDIAN OF OUR COUNTRY

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends; the United States Navy exists to make it so.

WE SERVE WITH HONOR

Tradition, valor, and victory are the Navy's heritage from the past. To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

THE FUTURE OF THE NAVY

The Navy will always employ new weapons, new techniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war.

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

NAVEDTRA 40650

NAVAL OCEANOGRAPHY COMMAND
PRACTICAL TRAINING PUBLICATION

EVALUATING AND ENCODING BATHYTHERMOGRAPH (BT) DATA

PREPARED BY
NAVAL OCEANOGRAPHY COMMAND FACILITY
BAY ST. LOUIS, NSTL, MS 39529

Practical Training

Publication

NAVEDTRA 40630

Prepared by

Naval Oceanography Command Facility

Bay St. Louis, MS

June 1984

Questions or comments on this publication are solicited and should be referred to:

Commanding Officer
Naval Oceanography command Facility
Bay St. Louis, MS 39529

EVALUATING AND ENCODING BATHYTHERMOGRAPH (BT) DATA

INTRODUCTION

This program teaches the criteria for evaluating and encoding bathythermographic traces. There are various methods for selecting points which are representative of a given trace, but this programmed instruction will be restricted to a few rules to guide the observer in the selection of a minimum number of points to adequately represent a bathythermograph trace. The points selected for encoding purposes from a bathythermograph trace will vary from observer to observer. The most important aspect of point selection is that points selected must accurately and completely describe the trace. Ideally the points selected would give a perfect description of the trace, but practical limitations (which will be explained later) force the observer to seek a representative description of the original trace. Bathythermograph informtion is replotted by users and is used to update oceanography data in the computer bank at Monterey. Bathythermograph data disseminated to users must therefore be representative of the original BT* trace.

The procedure for entering data in Part III of the Bathythermograph Log, CNOC form 3167/2, will also be covered in detail.

*The abbreviation "BT" is popularly used for the term bathythermograph. This abbreviation is occasionally used in this programmed instruction.

EVALUATING AND ENCODING BATHYTHERMOGRAPH (BT) DATA

OBJECTIVE

Given a ship's position, date, a bathythermograph trace, and the time of bathythermograph drop; evaluate the trace, and enter all the information in Part III of the Bathythermograph Log (CNOC 3167/2) for radio message transmission. Tolerances: within $\pm$ 0.5° Celsius and $\pm$ 20 meters for required points.

FRAME 1

Before you evaluate a BT trace for encoding, there are three terms you should be able to define. These are positive temperature gradient, negative temperature gradient, and isothermal gradient.

NO RESPONSE NECESSARY

FRAME 2

The first term, positive temperature gradient, is defined as an increase in water temperature with depth. When the water gets warmer as the depth increases, it is indicative of a ___________ gradient.

****

ANSWER: positive

FRAME 3

The second term, negative temperature gradient, is the opposite of positive temperature gradient, and is defined as a decrease in water temperature with depth. In a negative temperature gradient, the water gets warmer/cooler as the depth increases
(Circle one)

****

FRAME 3 (CONTD.)

ANSWER: cooler

FRAME 4

The final term is isothermal gradient. It is defined as no change in water temperature with depth. The type of temperature gradient where water temperature remains constant (no change) with depth is ______________________________.

****

ANSWER: isothermal

FRAME 5

Match the following terms with their definition:

_____a.	Positive temperature gradient	1.	No change in water temperature with depth
_____b.	Negative temperature gradient	2.	An increase in water temperature with depth
_____c.	Isothermal gradient	3.	No change in water depth with latitude
		4.	A decrease in water temperature with depth

****

FRAME 5 (CONTD.)

ANSWER: 2 a.

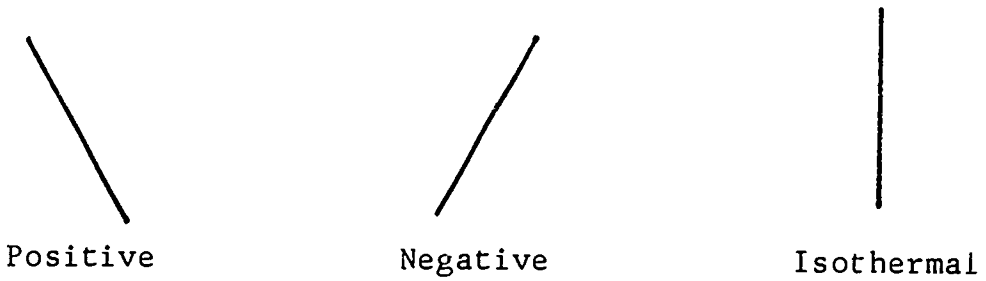
4 b.

1 c.

If you missed any answers, go back and review the ones you missed before going on to the next frame.

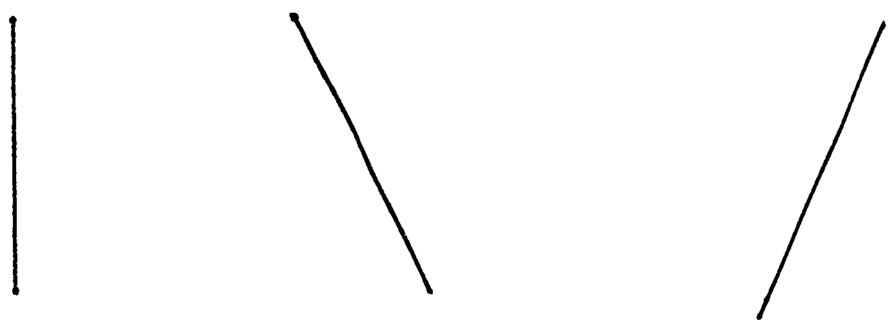
FRAME 6

Positive, negative, and isothermal water temperature gradients can be readily recognized on a BT trace. The slopes of these respective gradients as they appear on a BT trace are depicted below:



FRAME 6 (CONTD.)

Label the following slopes of water temperature gradients as they appear on BT traces as either positive, negative, or isothermal:



a. ________________ b. ________________ c. ________________

****

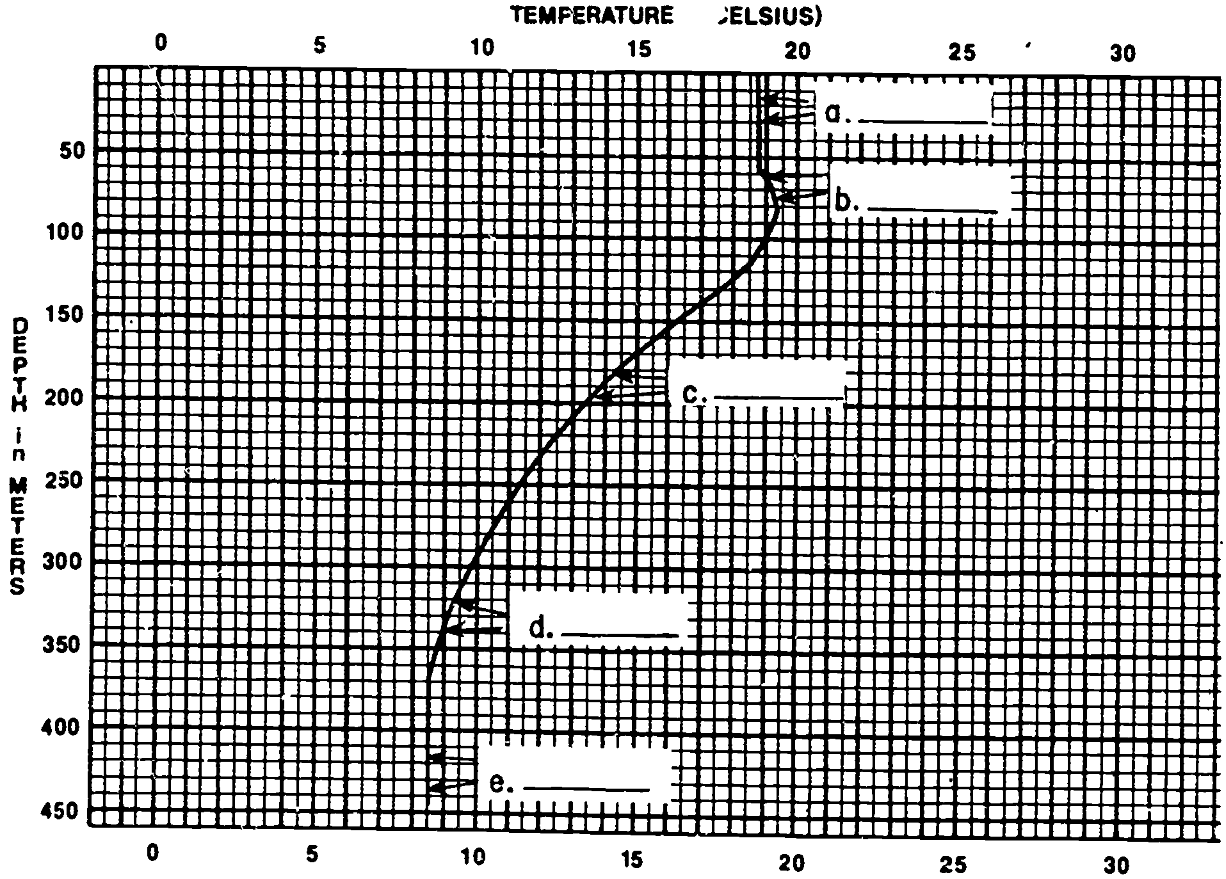
ANSWERS: a. Isothermal

b. Positive

c. Negative

FRAME 7

On the BT trace shown below, apply the definition you have learned to determine the type of gradient between the specified points.



****

FRAME 7 (CONTD.)

ANSWER: a. Isothermal

b. Positive

c. Negative

d. Negative

e. Isothermal

FRAME 8

Write the definitions of the following terms in the space provided.

a. Positive temperature gradient: ______________________

____

b. Isothermal gradient: ______________________________

____

c. Negative temperature gradient: ______________________

____.

****

ANSWER: a. An increase of water temperature with depth.

b. No change in water temperature with depth.

c. A decrease of water temperature with depth.

FRAME 9

The procedure for the selection of points from a bathythermograph trace will now be explained. The points selected should provide a fairly accurate representation of the trace when connected by straight lines.

The surface temperature is always the first point chosen for encoding. If the surface temperature is unreadable, the first readable temperature in the upper 10 meters will be chosen.

The first point chosen for encoding is the ______________ temperature.

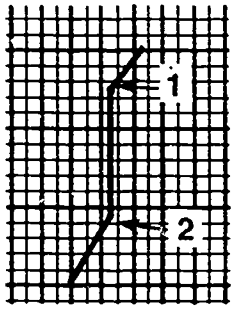
****

ANSWER: surface

FRAME 10

Two more points that are always chosen are the top and bottom of isothermal gradients or the points where the trace first begins to be completely vertical, and when it ceases to be completely vertical, as illustrated in the diagram on the next page.

FRAME 10 (CONTD.)



At point 1, the trace becomes isothermal.

At point 2, it stops being completely vertical, and is no longer isothermal.

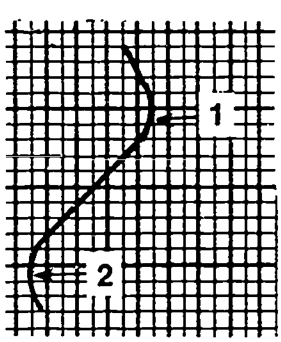
The top and bottom of isothermal gradients are sometimes/always (Circle one.) chosen for encoding.

****

ANSWER: always

FRAME 11

Any point showing the beginning of a change in temperature gradient will be chosen for encoding, as illustrated below.



At point 1, the temperature changes from a positive to negative temperature gradient and at point 2 changes back to a positive temperature gradient.

FRAME 11 (CONTD.)

When the trace changes from a negative temperature gradient to a positive temperature gradient, the point where the change begins will be chosen for encoding.

True/False
(Circle one)

****

ANSWER: True

FRAME 12

One more point that is always included when choosing points for encoding is the deepest point of the trace. This is either where the BT has dropped to its full depth, or has hit the ocean bottom.

The deepest point of the trace is encoded only if it is an ocean bottom reading.

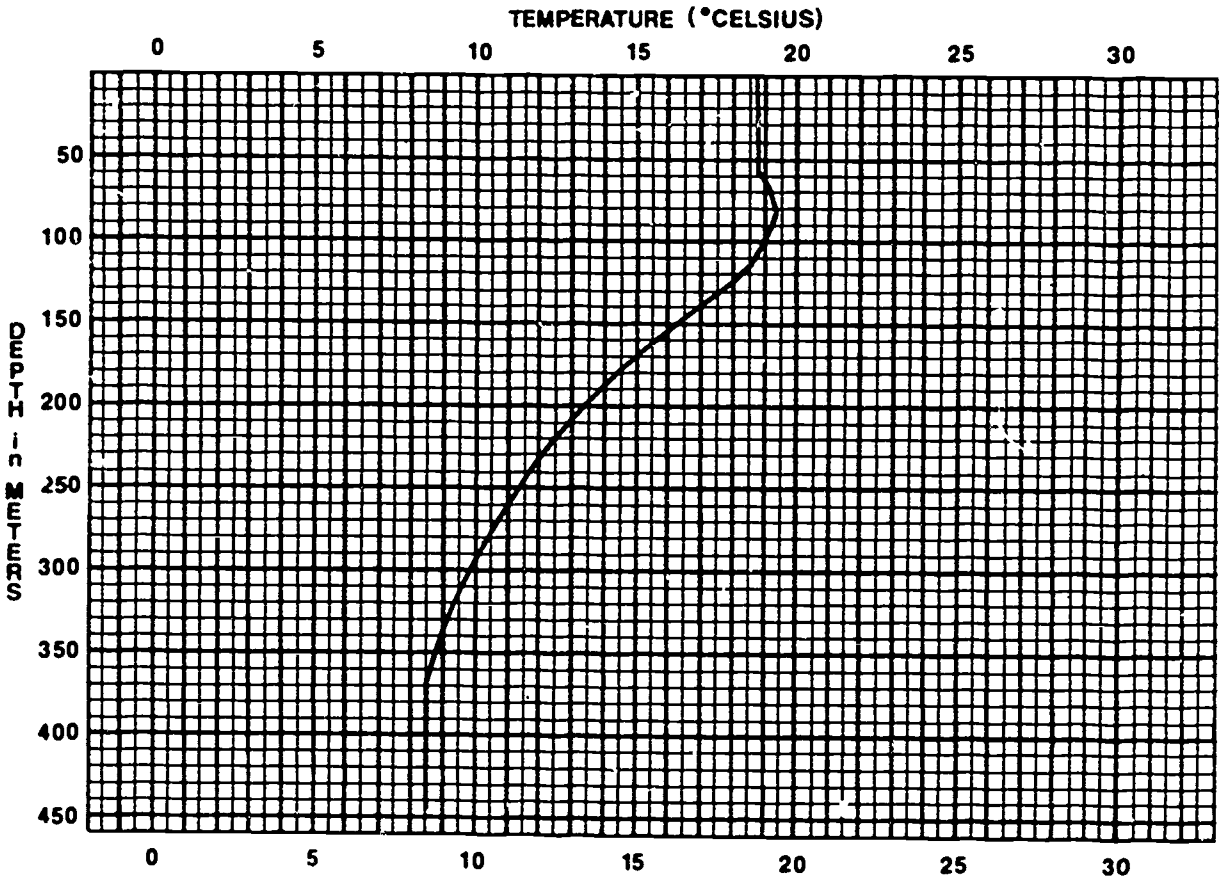
True/False
(Circle one)

****

ANSWER: False

FRAME 13

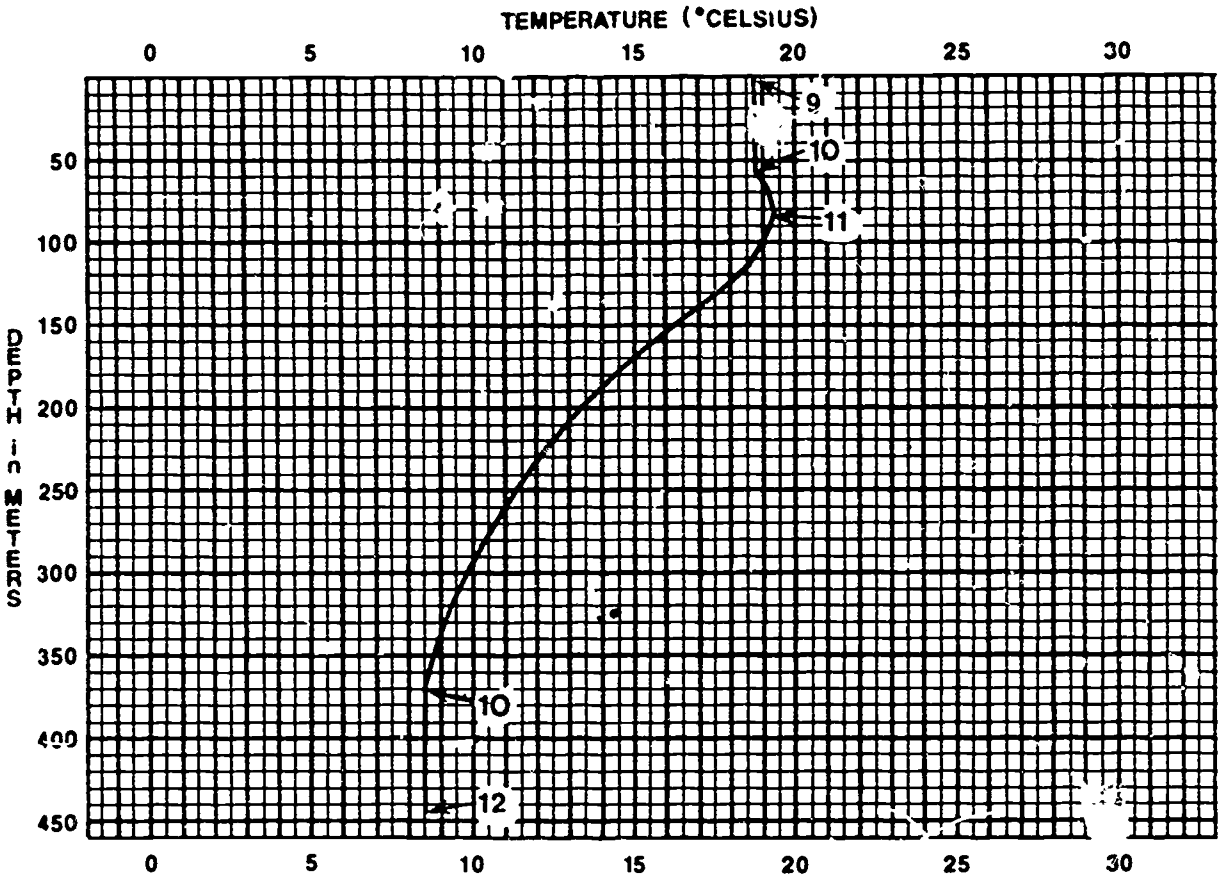
On the trace illustrated below, draw an arrow to the following points: surface temperature, top and bottom of isothermal gradients, changes in temperature gradient, and the deepest point of the trace.



****

FRAME 13 (CONTD.)

ANSWER:



If you missed any of the points, review the appropriate frame(s) (numbered next to the arrows) before continuing the program.

FRAME 14

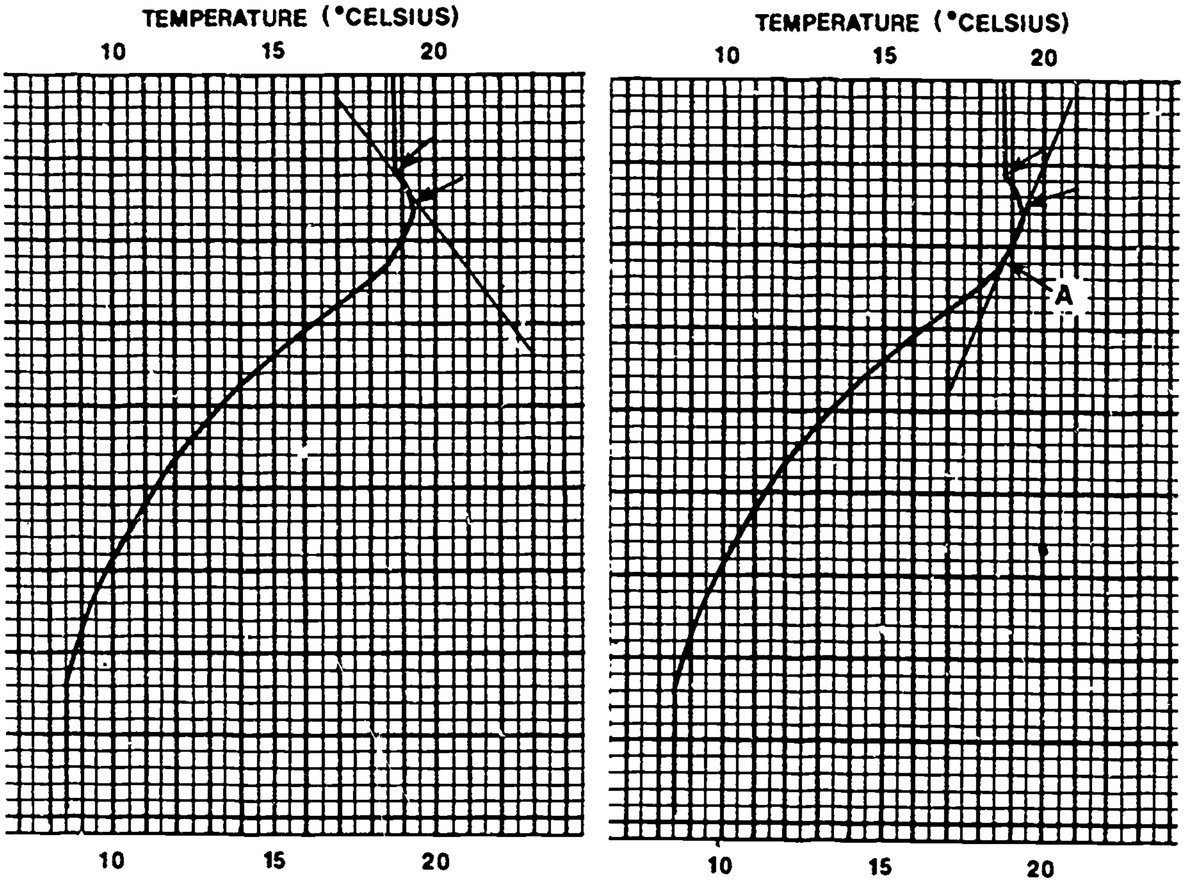
In answer to Frame 13, notice that the points depicted poorly describe the trace, therefore, more points must be selected. All points selected and connected by a straight line from point to point should duplicate the original BT trace as closely as possible. The points selected on an original BT trace are of utmost importance because the points are encoded and disseminated to users of BT information. These users must also be able to duplicate the original trace based on the points selected and transmitted. Methods for the selection of additional points will be explained next.

NO RESPONSE NECESSARY

FRAME 15

Starting at the top of the trace and descending, the next step is to pick out all the points not already covered. The first step is to use a straightedge, and identify any significant deviations in curvature. Examples are shown in the following illustrations.

FRAME 15 (CONTD.)



By using a straightedge, you can see that there is little deviation in curvature between the 2 arrows.

Here, however, notice that the trace starts to deviate at Point A.

NO RESPONSE NECESSARY

FRAME 16

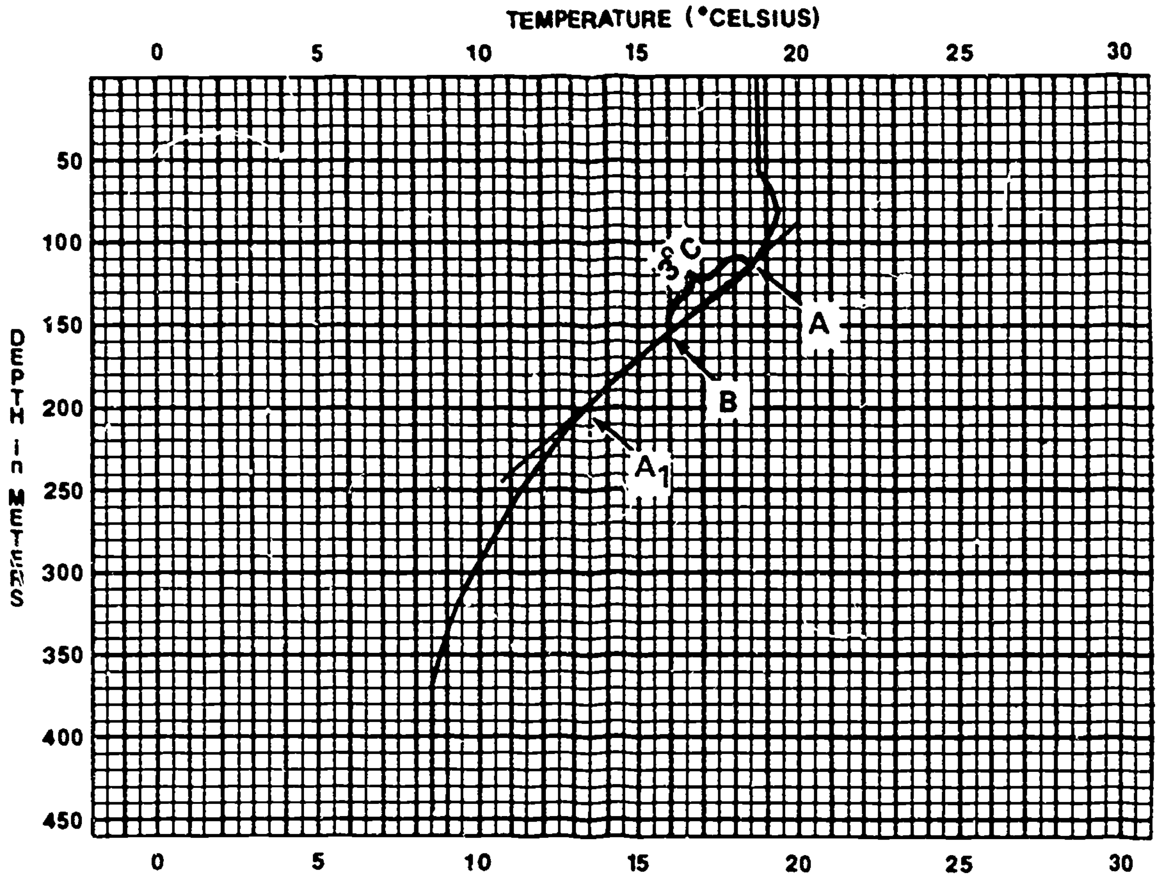
Before we continue with the straightedge, the "3^{o} rule" must be explained. This rule means that there will be no more than $3^{o}C$ temperature deviation between any two points chosen for encoding. This temperature, however, is rounded to the nearest whole degree, possibly giving you more than a 3 degree spread.

NO RESPONSE NECESSARY

FRAME 17

In the illustration shown on the next page, you can see that there is little deviation in curvature between points A and A_1, but with the "3^{o} rule" Point B must be the next point selected.

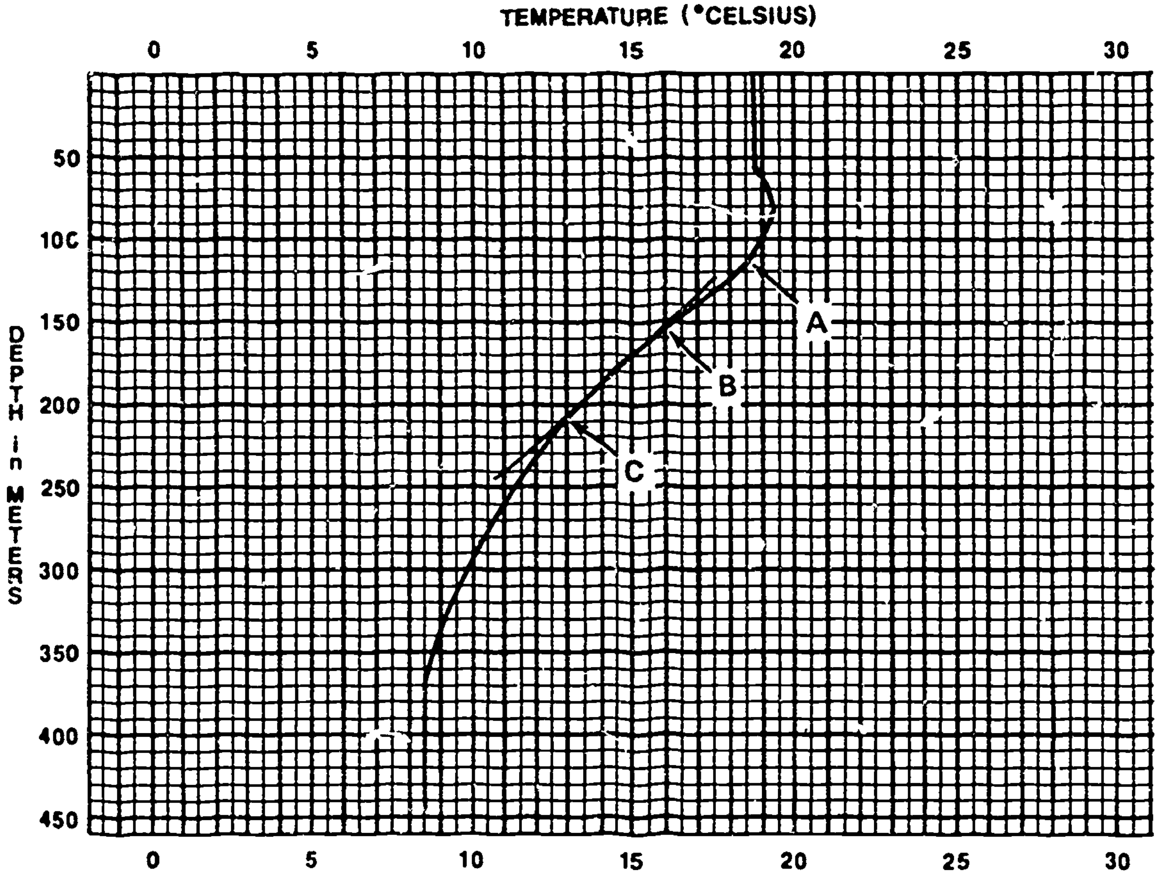
FRAME 17 (CONTD.)



NO RESPONSE NECESSARY

FRAME 18

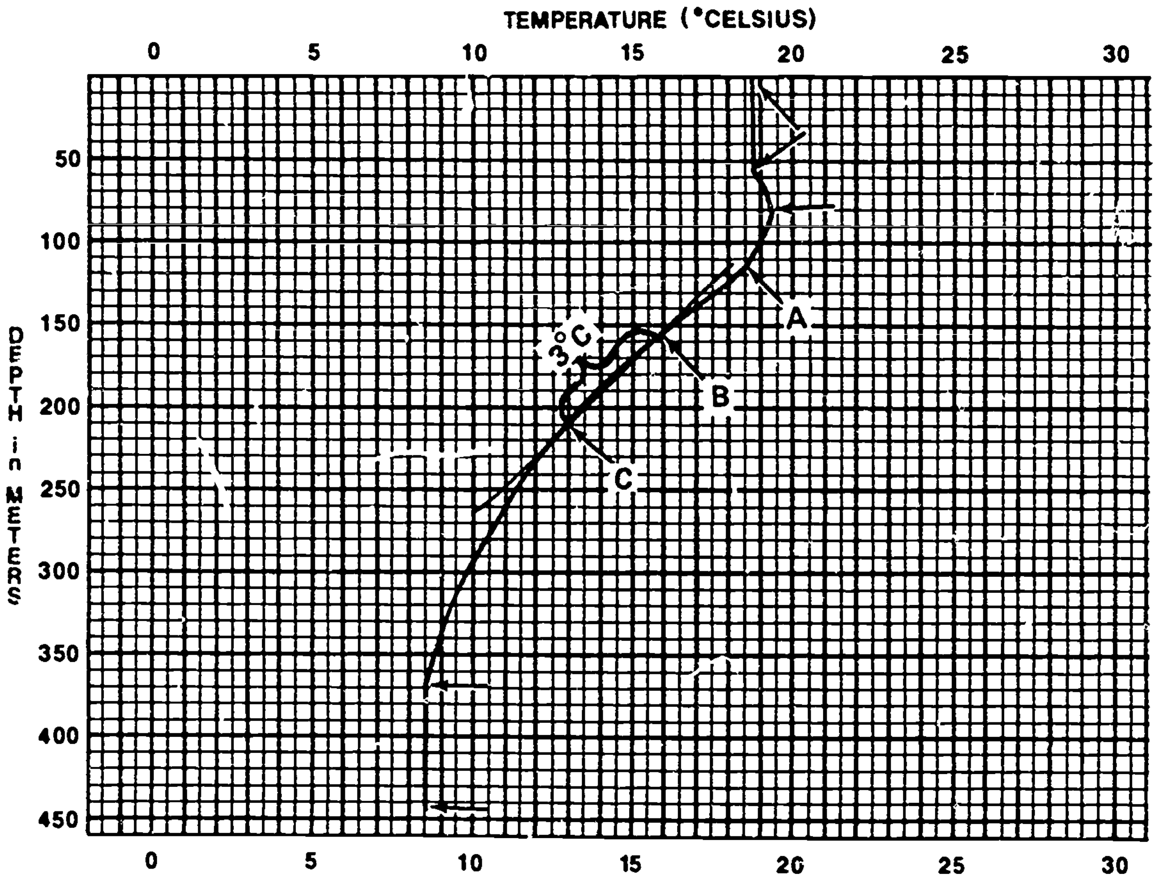
Since you are working downward, start at Point B to find the next point to encode. In the illustration below, Point C is picked because it starts to show linear deviation, and it is $3^{\circ}C$ from Point B.



NO RESPONSE NECESSARY

FRAME 19

Use a straightedge and the "3° rule' to determine all other point(s) needed to accurately describe the trace. Draw a short arrow to identify the point(s) you choose and be sure to doublecheck your work.

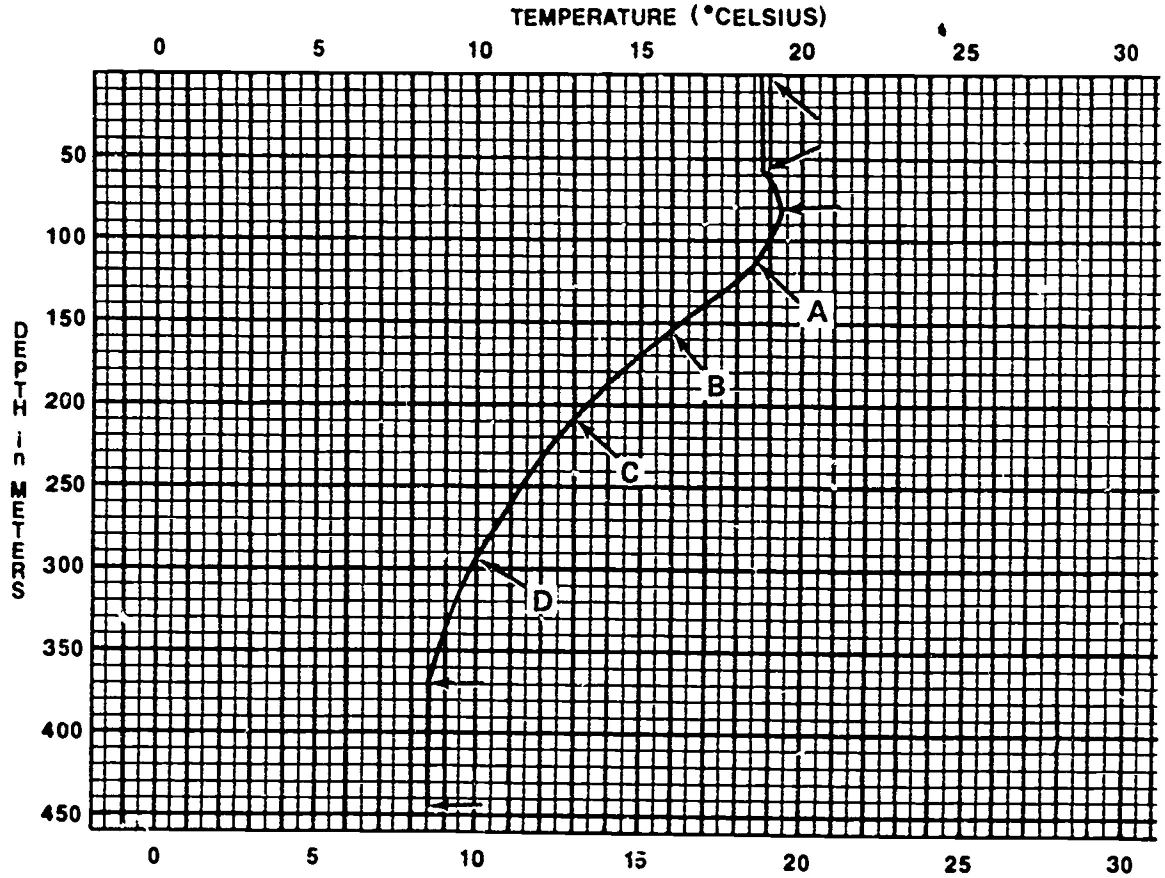


In the space provided below, state the reason(s) you used to select the point(s) on the trace illustrated in Frame 19.

****

FRAME 19 (CONTD.)

ANSWER:



POINT D: Selected for the "3° rule"

FRAME 20

As you look at the answer to Frame 19, you can see that the points depicted describe the trace within a fair degree of accuracy. If you are not sure how the points were selected, or why they were selected, go back and review the previous frames before you continue with the program.

NO RESPONSE NECESSARY

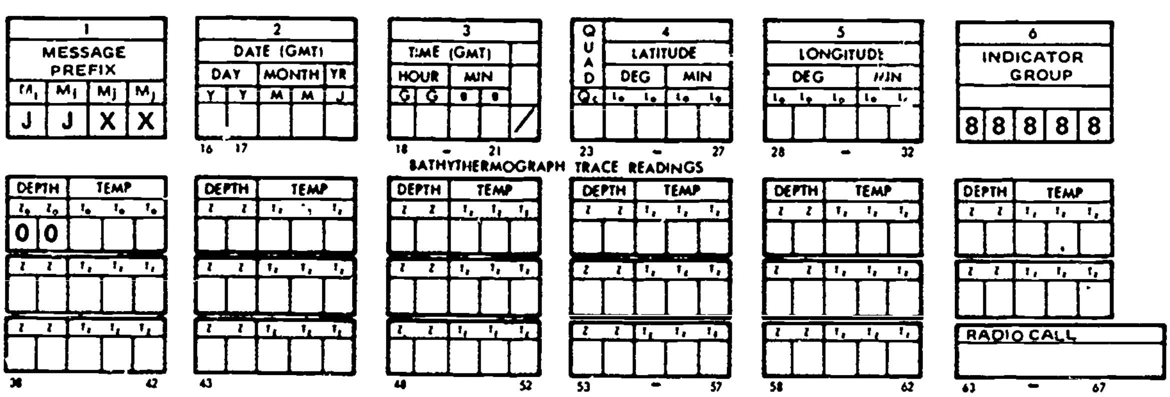
FRAME 21

Before continuing, turn to the back cover of this programmed instruction and unfold the bathythermograph form (fold-out page) for reference purposes. Study it briefly and then continue with the program.

(Note: The current BT log (CNOC 3167/2 (8-82)) has an error in part 3. It states there are both Metric and English coding examples while showing only the Metric code. This error should be corrected with future printings of the BT log.)

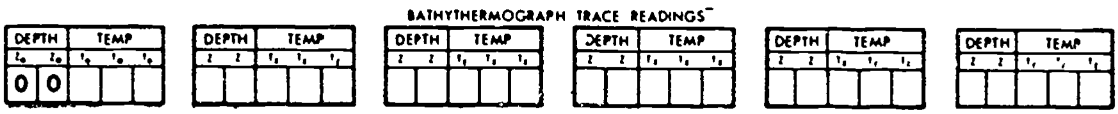
The portion of the Bathythermograph Log (CNOC 3167/2) shown below has two parts, blocks 1-6 and BT trace readings.

The BT trace readings will be covered first.



NO RESPONSE NECESSARY

FRAME 22



In the illustration shown above, notice the code above the spaces in the first block. Z_oZ_o is the depth (the first block is surface), and the $T_oT_oT_o$ is surface temperature. The remainder of the blocks shown above all have the code $ZZT_zT_zT_z$. The ZZ is the tens and units of depth to the nearest meter, and $T_zT_zT_z$ is the temperature at depth to the nearest tenth of a degree Celsius. If a trace is in feet and degrees Fahrenheit, use Tables 5 and 6 of the BT Log to convert depth/temperature groups to Celsius for encoding.

In the code group $ZZT_zT_zT_z$, ZZ is depth to the nearest ___ and $T_zT_zT_z$ is temperature to the nearest ________________

____

****

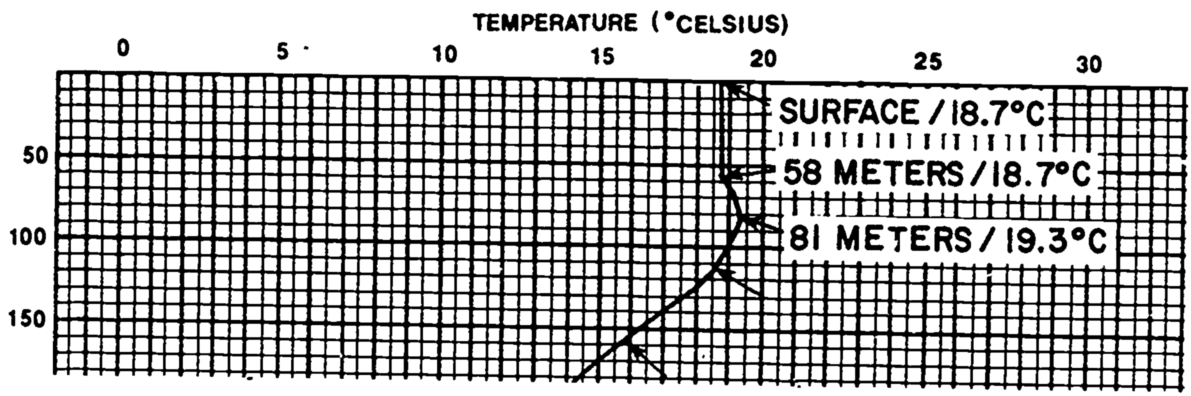
FRAME 22 (CONTD.)

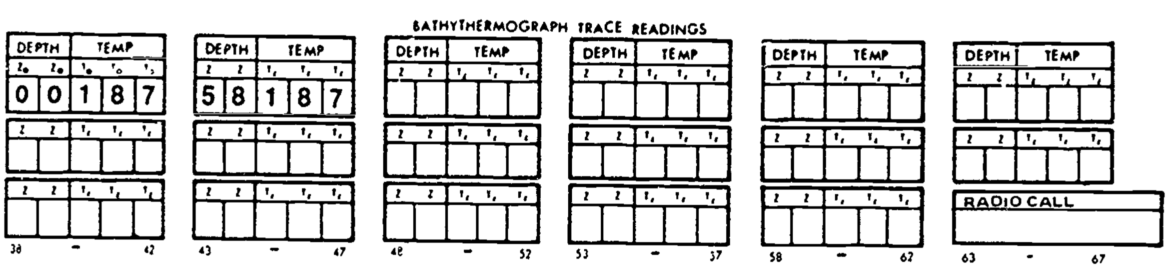
ANSWER: meter

tenth of a degree Celsius or 0.1°C

FRAME 23

The illustration shown below is a section of the trace used earlier, and also Part III of the BT Log. The surface temperature is 18.7°C and is entered as 187. The second point that must be selected is 58 meters (bottom of isothermal layer), and a temperature of 18.7°C. The entry is 58187. Enter the third point, 81 meters/19.3°c, on the log below.





****

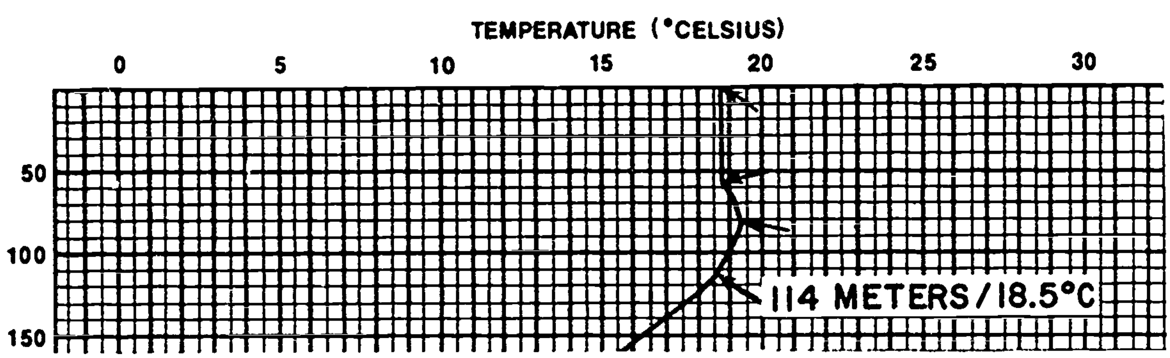
FRAME 23 (CONTD.)

ANSWER:

8	1	1	9	3

FRAME 24

The fourth point shown on the trace illustrated below, is at 114 meters/18.5^{o}C. It should be noted that ZZ (depth) is entered in whole meters and that there are only two spaces allotted for depth entries on the Bathythermograph Log. Depths of less than 100 meters (2 digits) are easily inserted in the Log using the tens and units digits. For depths of 100 meters or more a special code group (999NN) is used to denote the hundreds value of depth.



What code group is used to denote the hundreds value for depths of 100 meters or more in the Bathythermograph Log?

____

****

FRAME 24 (CONTD.)

ANSWER: 999NN

FRAME 25

Code group 999NN is used to denote the hundreds value of one of more depth/temperature group(s) following it. The depth portion (ZZ) of the depth/temperature group(s) following a 999NN group is/are recorded in units and tens.

What does NN denote in the code group 999NN?

____

____

****

ANSWER: The hundreds value of one or more depth/temperature group(s) following it.

(Or words to that effect)

FRAME 26

The table below illustrates the use of the 999NN code group. The 999 portion of the group is an indicator and does not change. NN represents the hundreds figure of depth for the range indicated in the table below:

DEPTH (meters)	999NN group used
00-99	None
100-199	99901
200-299	99902
300-399	99903
400-499	99904
etc.	etc.

What is recorded for NN in the following instances:

_____ a. 600 meters

_____ b. 900 meters

_____ c. 1200 meters

****

ANSWER: 06 a.

09 b.

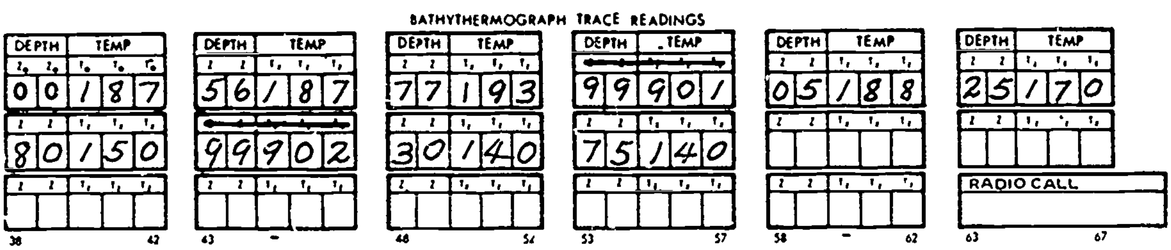
12 c.

FRAME 27

The code group 999NN is used once preceding each change in the hundreds value of depth regardless of the number of depth/temperature ($ZZT_zT_zT_z$) points selected/reported in the interim. In other words, suppose that points to be reported are as follows:

00 meters/18.7°C
56 meters/18.7°C
77 meters/19.3°C
105 meters/18.8°C
125 meters/17.0°C
180 meters/15.0°C
230 meters/14.0°C
275 meters/14.0°C

Based on the information above, the entries are as follows:



Note that the 999NN group was used once to indicate the hundreds value for the three depths recorded between 100 and 199 meters and once again preceding a depth of 230 meters.

FRAME 27 (CONTD.)

Complete the portion of the BT Log below by entering the appropriate data based on the following depth/temperature values:

DEPTH/TEMPERATURE

00/17.9°C
50/17.9°C
105/15.0°C
175/14.0°C
230/12.0°C

BATHYTHERMOGRAPH TRACE READINGS

DEPTH	TEMP	DEPTH	TEMP	DEPTH	TEMP	DEPTH	TEMP	DEPTH	TEMP	DEPTH	TEMP
00											
										RADIO CALL	
38 - 42		43 - 47		48 - 52		53 - 57		58 - 62		63 - 67	

****

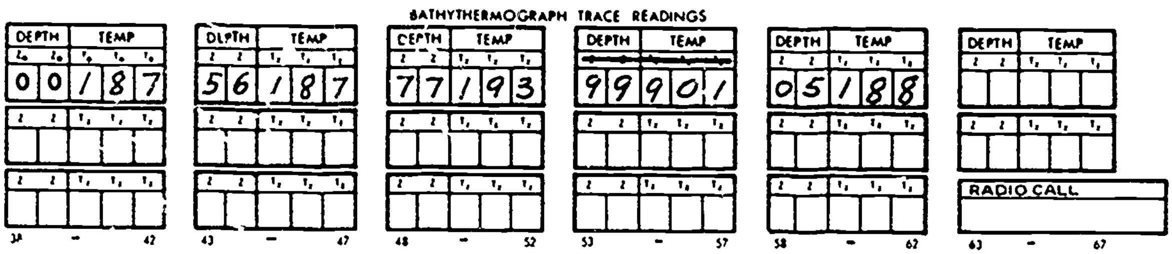
ANSWER:

BATHYTHERMOGRAPH TRACE READINGS

DEPTH	TEMP	DEPTH	TEMP	DEPTH	TEMP	DEPTH	TEMP	DEPTH	TEMP	DEPTH	TEMP
00	179	50	179	99	901	05	150	75	140	99	902
30	120										
										RADIO CALL	
38 - 42		43 - 47		48 - 52		53 - 57		58 - 62		63 - 67	

FRAME 28

When the code group 999NN is entered in the log, draw a line through the $ZZT_zT_zT_z$ printed above the entry as illustrated below.



NO RESPONSE NECESSARY

FRAME 29

1. What 2 digits would be used for NN to indicate a depth of 423 meters? ______________________

2. What is done to the printed $ZZT_zT_zT_z$ above a 999NN group entered in the BT Log? ______________________

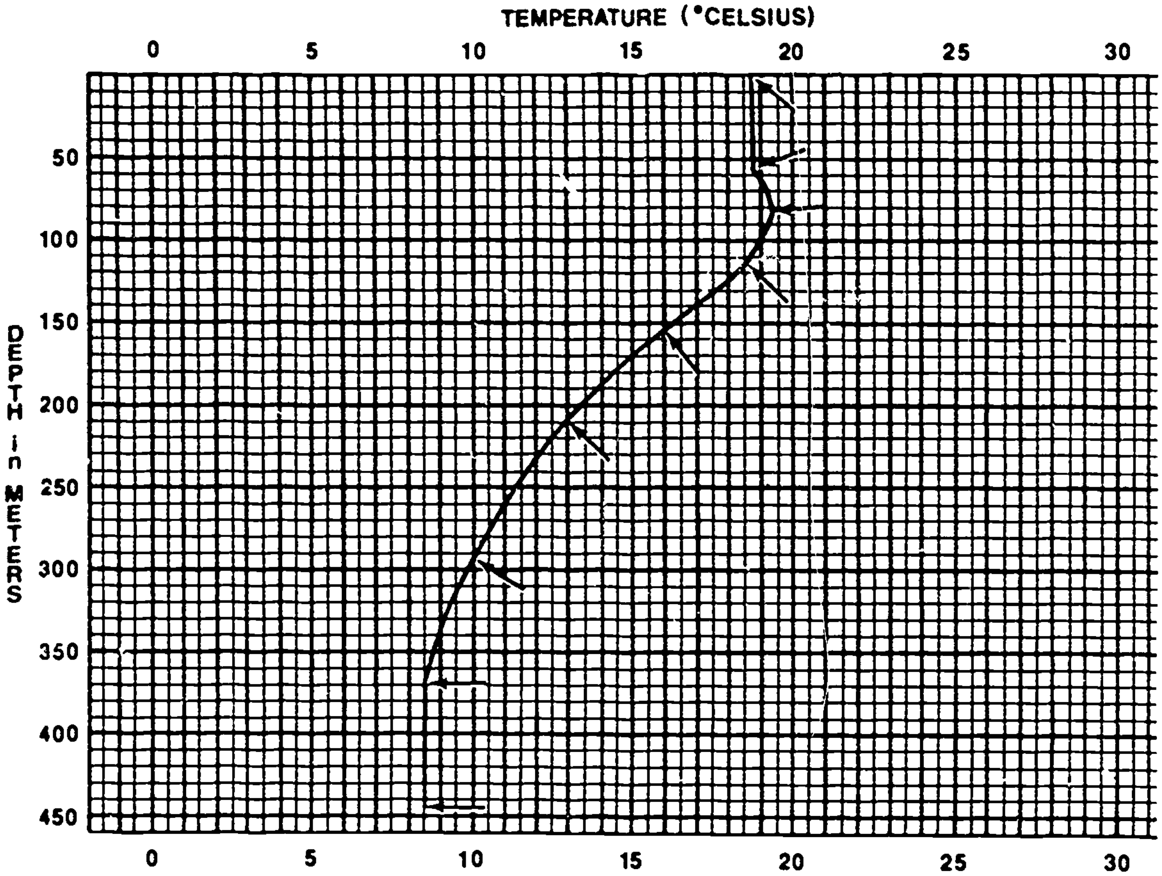
____

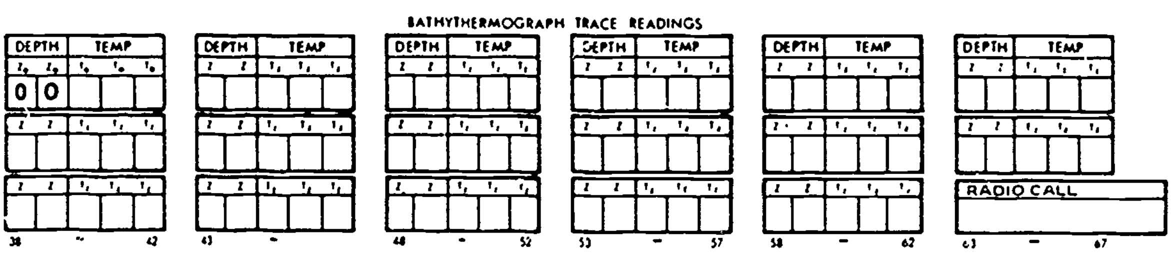
****

ANSWER: 1. 04

2. It is crossed off or lined out

FRAME 30





Encode the above trace, entering depth/temperature groups and the 999NN groups for the points indicated on the portion of the BT Log provided.

****

FRAME 30 (CONTD.)

ANSWER:

BATHYTHERMOGRAPH TRACE READINGS

DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP
00187	58187	81193	99901	14185	55160
99902	10130	94100	99903	70085	99904
46085					RADIO CALL
38 – 42	43 – 47	48 – 52	53 – 57	58 – 62	63 – 67

All points should have been within $\pm$ 0.5°C and $\pm$ 20 meters. If not, try again and recheck your answer.

FRAME 31

Sea water freezes at 28°F or -2°C. Sea water temperatures below 0°C are encoded/reported using the code $5T_zT_z$ to encode or report negative (minus) temperatures in degrees and tenths of a degree. A temperature of -0.7°C is encoded/reported as 507, a temperature of -1.4°C is reported as 514 etc. Remember that sea water freezes at -2.0°C so that no problem should arise in the use of the code $5T_zT_z$.

The code $5T_zT_z$ is used to encode/report all sea water temperature values of less than ________ °C.

****

ANSWER: 0

FRAME 32

There are two more code groups to cover, 00000 and Radio Call. The code group 00000 is reported after the last depth/temperature group if, and only if, the last depth/temperature group is an ocean bottom reading. If a 00000 is entered in the Log, cross out the preprinted $ZZT_zT_zT_z$ above it, as illustrated in the following frame.

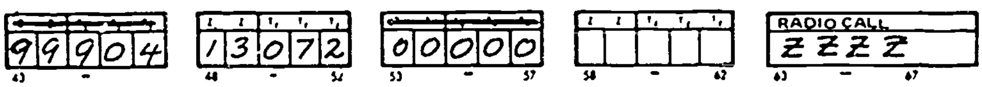
When the last depth/temperature group encoded from a trace is an ocean bottom reading, what code group is used to identify it? ____________

****

ANSWER: 00000

FRAME 33

The code groups 00000 and Radio Call are illustrated below:



The ocean bottom is at 413 meters with a water temperature of 7.2°C. The code group 00000 immediately following the depth/temperature group indicates it is an ocean bottom reading.

FRAME 33 (CONTD.)

The code group Radio Call is always the last group of a BT message. It is simply the ship or aricraft call letters. The Radio Call always goes in the designated space regardless of the number of blank $ZZT_zT_zT_z$ spaces preceding it. The last group encoded in a BT message is the ____________

______________________.

****

ANSWER: Radio Call

FRAME 34

A maximum of 20 points for encoding/reporting purposes is allowed in the upper 500 meters of a BT trace. This limit of 20 points is normally more than adequate to describe that portion of the trace. Bear in mind that users will decode and plot BT messages and these plotted reproduction should approximate the original BT trace as closely as possible.

What is the limit on the number of points allowed for reporting purposes in the upper 500 meters of a BT trace?

____

****

ANSWER: 20

FRAME 35

Fill in the blanks:

1. The code group 00000 is used after the last depth/ temperature group to indicate that the last depth/temperature group is a(n) ____________________.

2. The final code group in a BT message is the ____________________.

3. What is the maximum number of depth/temperature groups that can be reported in the upper 500 meters?

____________________.

****

ANSWER: 1. ocean bottom reading

2. Radio Call

3. 20

FRAME 36

When the number of points selected from a BT trace exceeds the number of blocks allotted for encoding a single BT message in the BT Log, the overflow is inserted in appropriate blocks of the following message blocks as illustrated on the next page. Prior to making entries in the second message blocks, the Radio Call block of the first message, and blocks 1 through 6 along with the surface data block of the second message are lined-out as shown.

FRAME 36 (CONTD.)

III. RADIO MESSAGE INFORMATION

1 MESSAGE PREFIX (M_i M_i M_j M_j)	2 DATE (GMT) DAY / MONTH / YR (Y Y M M J)	3 TIME (GMT) HOUR / MIN (G G g g)	Q U A D (Q_c) 4 LATITUDE DEG / MIN	5 LONGITUDE DEG / MIN	6 INDICATOR GROUP
J J X X		/			8 8 8 8 8
	16 17	3 – 21	23 – 27	28 – 32	

BATHYTHERMOGRAPH TRACE READINGS

DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP
0 0 1 4 3	2 3 1 4 3	2 9 1 4 7	4 9 1 4 2	7 1 1 3 9	8 6 1 4 1
9 8 1 3 1	9 9 9 0 1	2 5 1 1 6	7 7 0 9 4	9 1 0 9 3	9 9 9 0 2
1 4 0 8 7	5 2 0 8 0	9 9 9 0 3	0 0 0 6 1	3 8 0 5 9	~~RADIO CALL~~
38 – 42	43 – 47	48 – 52	53 – 57	58 – 62	63 – 67

1 MESSAGE PREFIX (M_i M_i M_j M_j)	2 DATE (GMT) DAY / MONTH / YR (Y Y M M J)	3 TIME (GMT) HOUR / MIN (G G g g)	Q U A D (Q_c) 4 LATITUDE DEG / MIN	5 LONGITUDE DEG / MIN	6 INDICATOR GROUP
~~J J X X~~		/			~~8 8 8 8 8~~
	16 17	8 – 21	23 – 27	28 – 32	

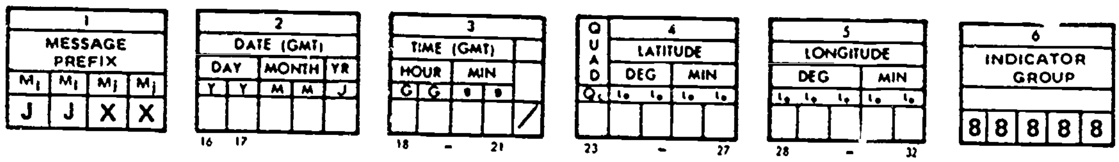
BATHYTHERMOGRAPH TRACE READINGS

DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP
~~0 0~~	8 3 0 4 7	9 9 9 0 4	2 9 0 4 7	4 2 0 4 9	0 0 0 0 0
					RADIO CALL YYYY
38 – 42	43 – 47	48 – 52	53 – 57	58 – 62	63 – 67

****NO RESPONSE NECESSARY****

FRAME 37

Now refer to blocks 1-6.



Block 1 - $M_iM_iM_jM_j$, message prefix

This is the preprinted message prefix. The preprinted JJXX indicates a BT message follows, and is always written just as given.

Block 2 - YYMMJ, Date (GMT)

YY is the day of the month, and is always two digits, e.g., the 14th is 14, the 3rd. is 03, etc.

MM is the month of the year in two digits, e.g., January is 01, August is 08, December is 12, etc.

J is the last digit of the year, e.g., 1978 is 8, the year 2000 is 0, etc.

Block 3 - GGgg, Time (GMT)

GGgg is the time (GMT) in whole hours and minutes that the Bathythermograph was dropped, not the time you encode the resulting trace.

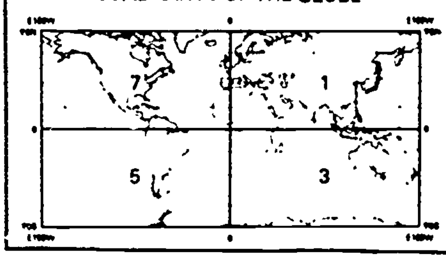
The preprinted solidus (/) will be explained later.

FRAME 37 (CONTD.)

Block 4 - $Q_cL_aL_aL_aL_a$, Quadrant and Latitude

Q_c is the quadrant of the globe in accordance with Table 7 of the BT Log (shown below).

Table 7
QUADRANTS OF THE GLOBE



$L_aL_aL_aL_a$ is the latitude of the ship or aircraft dropping the BT in whole degrees and minutes. An example is shown in the next portion (Block 5).

Block 5 - $L_oL_oL_oL_oL_o$, Longitude

$L_oL_oL_oL_oL_o$ is the longitude of the ship or aircraft dropping the BT in whole degrees and minutes. Block 4 and 5 would be encoded as follows: A ship at 30°15'N, 56°47'W is entered as:

QUAD	4 LATITUDE				5 LONGITUDE				
	DEG		MIN		DEG			MIN	
Q_c	L_a	L_a	L_a	L_a	L_o	L_o	L_o	L_o	L_o
7	3	0	1	5	0	5	6	4	7
23		-		27	28		-		32

251

FRAME 37 (CONTD.)

Block 6 - Indicator Group

The preprinted 88888 indicates the encoded trace readings follows.

****NO RESPONSE NECESSARY****

FRAME 38

Refer back to the preprinted solidus(/) in Block 3. In the event the BT trace is in degrees Fahrenheit and the depth is in feet and Tables 5 and 6 of the Log or some other means of converting to Celsius and meters is available, then the solidus will be changed to a nine (9) and transmitted as such. If conversion is not possible, the same rules apply for encoding. Temperatures will be encoded as they are: e.g., 45.4°F is recorded as 454, 30.1°F is recorded as 301. Depths will be recorded following the Metric rules except that the 999NN group will be used for thousands of feet vice hundreds of meters and that only the hundreds and tens digits will be used; e.g., 53 feet is recorded 05, 367 feet is recorded 36 (do not round up). If a trace is in degrees Fahrenheit and feet, and conversion is not possible, what must be done to the preprinted solidus (/) in Block 3?

___

****

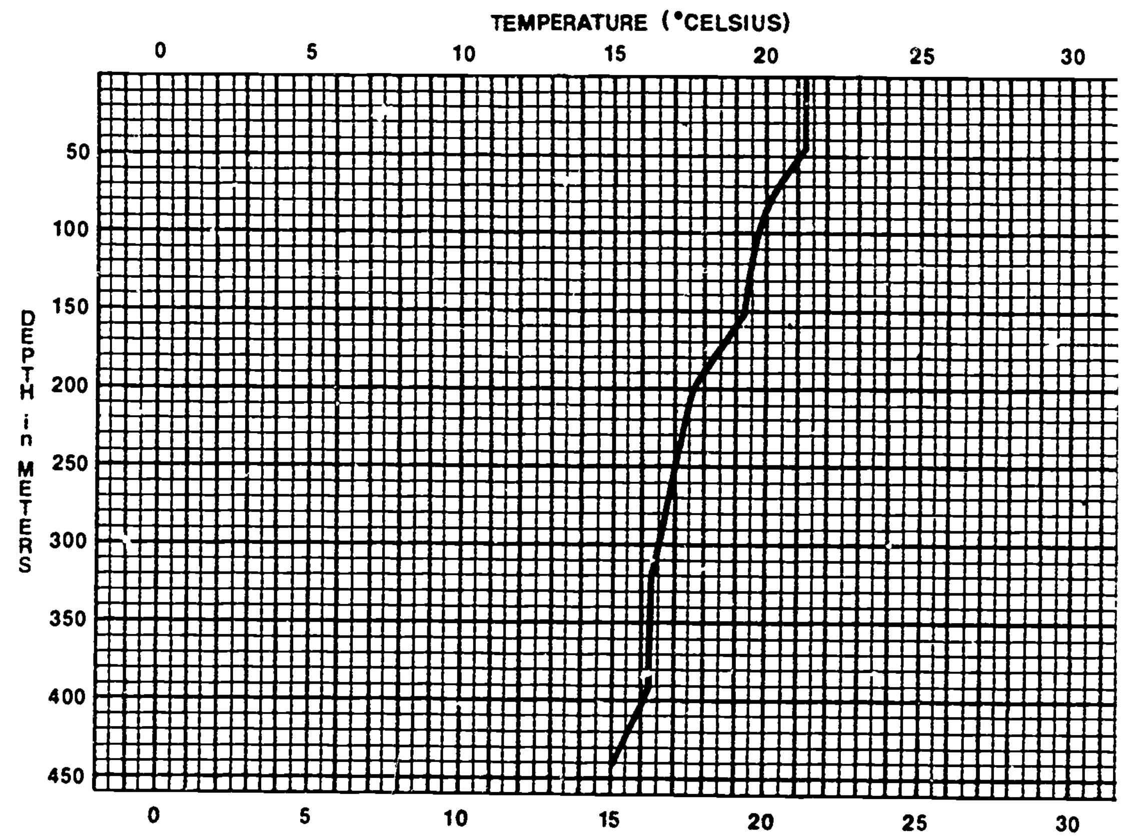
ANSWER: It must be changed to a nine(9).

(Or words to that effect)

FRAME 39

From the following information and BT trace, fill in Part III of the BT Log provided. Be sure to double check your work.

Your ship, the U.S.S. Alwaysail (Radio Call YYYY), is located at 17°23'S, 177°19'W on the 18th of May, 1992. At 1803Z, a bathythermograph is dropped, and the following trace results.



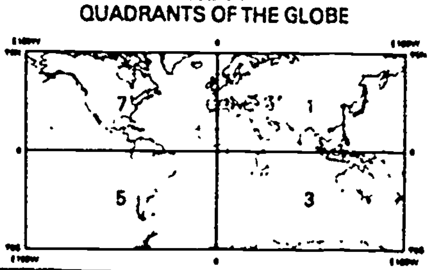
FRAME 39 (CONTD.)

1	2	3	4	5	6
MESSAGE PREFIX	DATE (GMT)	TIME (GMT)	QUAD / LATITUDE	LONGITUDE	INDICATOR GROUP
M_i M_i M_j M_j	DAY / MONTH / YR	HOUR / MIN	DEG / MIN	DEG / MIN	
	Y Y M M J	G G g g	Q_c L_a L_a L_a L_a	L_o L_o L_o L_o L_o	
J J X X		/			8 8 8 8 8
	16 17	18 – 21	23 – 27	28 – 32	

BATHYTHERMOGRAPH TRACE READINGS

DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP
z_o z_o T_o T_o T_o	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t
0 0					
z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t
z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	RADIO CALL
38 – 42	43 – 47	48 – 52	53 – 57	58 – 62	63 – 67

Table 7
QUADRANTS OF THE GLOBE



FRAME 39 (CONTD.)

ANSWER:

1 MESSAGE PREFIX	2 DATE (GMT)	3 TIME (GMT)	4 QUAD / LATITUDE	5 LONGITUDE	6 INDICATOR GROUP
M_i M_i M_j M_j	DAY Y Y, MONTH M M, YR J	HOUR G G, MIN	Q_c, DEG L_a L_a, MIN L_a L_a	DEG L_o L_o L_o, MIN L_o L_o	
J J X X	/ 8 0 5 2	/ 8 0 3 /	5 / 7 2 3	/ 7 7 / 9	8 8 8 8 8
	16 17	18 – 21	23 – 27	28 – 32	

BATHYTHERMOGRAPH TRACE READINGS

DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP
0 0 2 / 2	4 6 2 / 2	8 4 2 0 0	9 9 9 0 /	5 0 / 9 3	9 9 9 0 2
0 0 / 7 6	9 9 9 0 3	2 0 / 6 3	[illegible] 0 / 6 2	9 9 9 0 4	4 / / 5 0
					RADIO CALL YYYY
38 – 42	43 – 47	48 – 52	53 – 57	58 – 62	63 – 67

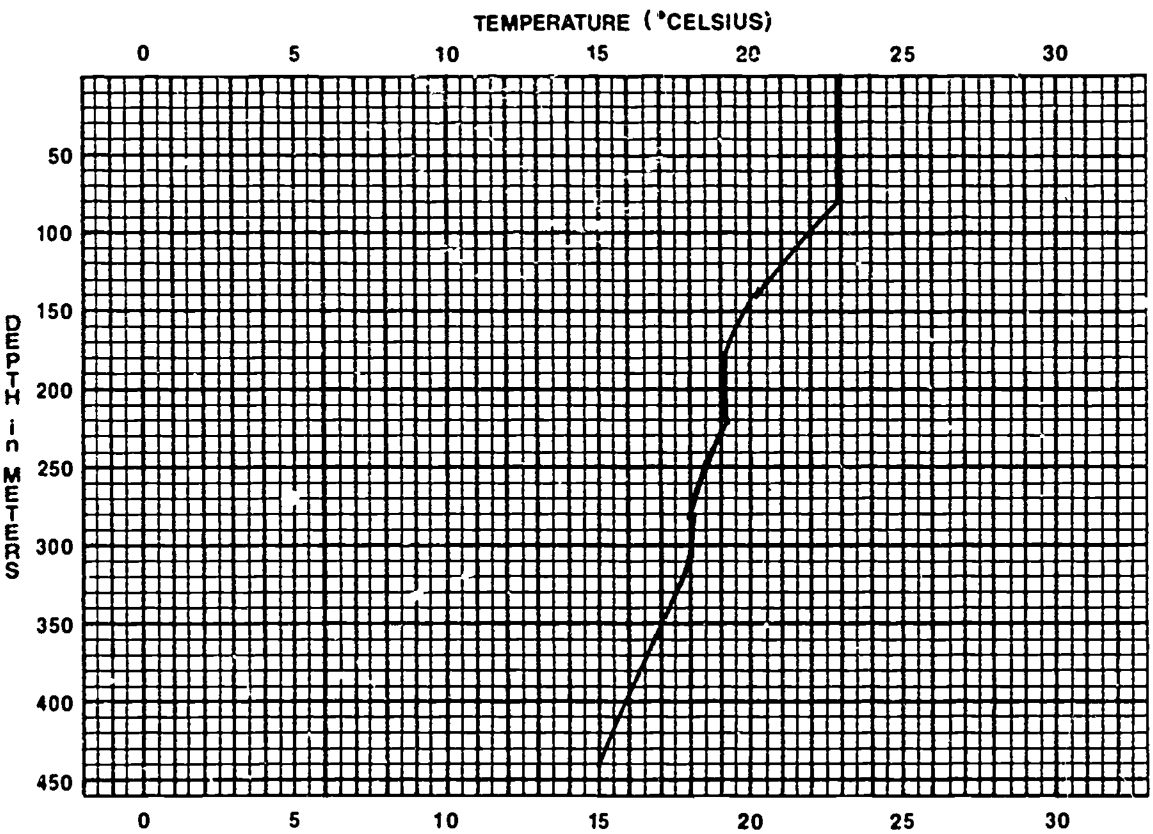
The points selected should have been within a tolerance of $\pm$ 0.5°C and $\pm$ 20 meters of the above.

THIS CONCLUDES THE PROGRAM.

EVALUATING AND ENCODING BATHYTHERMOGRAPH (BT) DATA

CRITERION TEST

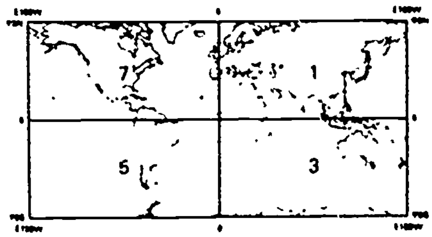
Your ship, the U.S.S. Neverdock (Radio Call XXXX), is located at 163°24'E, 40°51'N on the 23rd of July 1977. At 0927Z, a bathythermograph is dropped, and the following trace results. Enter all data on Part III of the Bathythermograph Log CNOC 3167/2 for radio transmission. All required points must be within ± 0.5°C and ± 20 meters.



EVALUATING AND ENCODING BATHYTHERMOGRAPH (BT) DATA

CRITERION TEST (CONTD.)

Table 7
QUADRANTS OF THE GLOBE



1 MESSAGE PREFIX	2 DATE (GMT)	3 TIME (GMT)	4 QUAD LATITUDE	5 LONGITUDE	6 INDICATOR GROUP
M_i M_i M_j M_j	DAY: Y Y; MONTH: M M; YR: J	HOUR: G G; MIN: g g	Q_c; DEG: L_a L_a; MIN: L_a L_a	DEG: L_o L_o L_o; MIN: L_o L_o	
J J X X		/			8 8 8 8 8
	16 17	18 – 21	23 – 27	28 – 32	

BATHYTHERMOGRAPH TRACE READINGS

DEPTH TEMP	DEPTH TEMP	DEPTH TEMP	DEPTH TEMP	DEPTH TEMP	DEPTH TEMP
z_o z_o T_o T_o T_o	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t
0 0					
z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t
z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	RADIO CALL
38 – 42	43 – 47	48 – 52	53 – 57	58 – 62	63 – 67

1 MESSAGE PREFIX	2 DATE (GMT)	3 TIME (GMT)	4 QUAD LATITUDE	5 LONGITUDE	6 INDICATOR GROUP
M_i M_i M_j M_j	DAY: Y Y; MONTH: M M; YR: J	HOUR: G G; MIN: g g	Q_c; DEG: L_a L_a; MIN: L_a L_a	DEG: L_o L_o L_o; MIN: L_o L_o	
J J X X		/			8 8 8 8 8
	16 17	18 – 21	23 – 27	28 – 32	

BATHYTHERMOGRAPH TRACE READINGS

DEPTH TEMP	DEPTH TEMP	DEPTH TEMP	DEPTH TEMP	DEPTH TEMP	DEPTH TEMP
z_o z_o T_o T_o T_o	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t
0 0					
z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t
z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	z z T_t T_t T_t	RADIO CALL
38 – 42	43 –	48 – 52	53 – 57	58 – 62	63 – 67

EVALUATING AND ENCODING BATHYTHERMOGRAPH (BT) DATA

CRITERION TEST ANSWERS

III. RADIO MESSAGE INFORMATION

1 MESSAGE PREFIX	2 DATE (GMT) DAY / MONTH / YR	3 TIME (GMT) HOUR / MIN	QUAD 4 LATITUDE DEG / MIN	5 LONGITUDE DEG / MIN	6 INDICATOR GROUP
J J X X	2 3 0 7 7	0 9 2 7 /	/ 4 0 5 /	/ 6 3 2 4	8 8 8 8 8

BATHYTHERMOGRAPH TRACE READINGS

DEPTH TEMP	DEPTH TEMP	DEPTH TEMP	DEPTH TEMP	DEPTH TEMP	DEPTH TEMP
0 0 2 2 9	8 0 2 2 9	9 9 9 0 /	4 6 2 0 0	8 0 / 9 2	9 9 0 0 2
2 3 / 9 2	8 0 / 8 0	9 9 9 0 3	2 5 / 8 0	9 9 9 0 4	4 5 / 5 0
					RADIO CALL XXXX
38 - 42	43 - 47	48 - 52	53 - 57	58 - 62	63 - 67

Blocks 1-6 and Radio Call have no allowable error, and must be encoded as shown above. The above points (trace readings) are mandatory, and must be reported within ± 0.5°C. and ± 20 meters. Make sure there are no more than 20 points reported. This does not include the four mandatory 999NN groups.

85 75460

CNOC 3167/2 (8-82)
NOAA Form 77 22 (5-77)
NSN 0108-LF-031-6710

BATHYTHERMOGRAPH LOG

Prepared by the COMMANDER, NAVAL OCEANOGRAPHY COMMAND
and the NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
in accordance with specifications established by the
INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (IOC)
and WORLD METEOROLOGICAL ORGANIZATION (WMO)

FOR NAVY SHIP USE

B	A	SHIP TYPE	HULL NUMBER	YR	MON	Z	T
1	2	3 - 4	5 - 7	12	13 - 14	15	22

FOR NAVY AIRCRAFT USE

B	A	SQDN TYPE	SQDN NMBR	SORTIE NUMBER	YR	MON	Z	T
1	2	3 - 4	5 - 7	8 - 11	12	13 - 14	15	22

I. REFERENCE INFORMATION

PLATFORM		
TYPE	NAME	DESIGNATOR
COUNTRY	INSTITUTION	
CRUISE NUMBER	PROJECT	
STATION NUMBER	OBSERVATION NUMBER	INSTRUMENT

II. OPTIONAL ENVIRONMENTAL INFORMATION

DEPTH TO BOTTOM (METERS) 1	WIND 2 DIR	WIND SPEED	SEA LEVEL PRESSURE 3	AIR TEMP 4 ±	DRY BULB	AIR TEMP 5 ±	WET BULB
I_u	d d	f f	P P P P	S_n	T T T	S_n	T T T

SEA TEMP 6 °C	INSTR	WAVE 7 PER	WAVE HT	SWELL 8 DIR	SWELL PER	SWELL HT	SOLAR RADIATION 9	PRECIP 10	TRANS 11
$T_w T_w T_w$		$P_w P_w$	$H_w H_w$	$d_w d_w$	P_w	$H_w H_w$	LANG/MIN	R R	METERS

I. REFERENCE INFORMATION

STATION NUMBER	OBSERVATION NUMBER	INSTRUMENT

II. OPTIONAL ENVIRONMENTAL INFORMATION

DEPTH TO BOTTOM (METERS) 1	WIND 2 DIR	WIND SPEED	SEA LEVEL PRESSURE 3	AIR TEMP 4 ±	DRY BULB	AIR TEMP 5 ±	WET BULB
I_u	d d	f f	P P P P	S_n	T T T	S_n	T T T

SEA TEMP 6 °C	INSTR	WAVE 7 PER	WAVE HT	SWELL 8 DIR	SWELL PER	SWELL HT	SOLAR RADIATION 9	PRECIP 10	TRANS 11
$T_w T_w T_w$		$P_w P_w$	$H_w H_w$	$d_w d_w$	P_w	$H_w H_w$	LANG/MIN	R R	METERS

I. REFERENCE INFORMATION

STATION NUMBER	OBSERVATION NUMBER	INSTRUMENT

II. OPTIONAL ENVIRONMENTAL INFORMATION

DEPTH TO BOTTOM (METERS) 1	WIND 2 DIR	WIND SPEED	SEA LEVEL PRESSURE 3	AIR TEMP 4 ±	DRY BULB	AIR TEMP 5 ±	WET BULB
I_u	d d	f f	P P P P	S_n	T T T	S_n	T T T

SEA TEMP 6 °C	INSTR	WAVE 7 PER	WAVE HT	SWELL 8 DIR	SWELL PER	SWELL HT	SOLAR RADIATION 9	PRECIP 10	TRANS 11
$T_w T_w T_w$		$P_w P_w$	$H_w H_w$	$d_w d_w$	P_w	$H_w H_w$	LANG/MIN	R R	METERS

REMARKS:

III. RADIO MESSAGE INFORMATION

a. METRIC Coding Example

1 MESSAGE PREFIX	2 DATE (GMT) DAY / MONTH / YR	3 TIME (GMT) HOUR / MIN	QUAD	4 LATITUDE DEG / MIN	5 LONGITUDE DEG / MIN	6 INDICATOR GROUP
$M_i M_i M_j M_j$	Y Y M M J	G G g g	Q_c	$L_a L_a L_a L_a L_a$	$L_o L_o L_o L_o L_o$	
J J X X		/				8 8 8 8 8

BATHYTHERMOGRAPH TRACE READINGS

DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP
$z_0 z_0 T_0 T_0 T_0$	z z T T T	z z T T T	z z T T T	z z T T T	z z T T T
0 0					
z z T T T	z z T T T	z z T T T	z z T T T	z z T T T	z z T T T
z z T T T	z z T T T	z z T T T	z z T T T	z z T T T	RADIO CALL

1 MESSAGE PREFIX	2 DATE (GMT) DAY / MONTH / YR	3 TIME (GMT) HOUR / MIN	QUAD	4 LATITUDE DEG / MIN	5 LONGITUDE DEG / MIN	6 INDICATOR GROUP
$M_i M_i M_j M_j$	Y Y M M J	G G g g	Q_c	$L_a L_a L_a L_a L_a$	$L_o L_o L_o L_o L_o$	
J J X X		/ /				8 8 8 8 8

BATHYTHERMOGRAPH TRACE READINGS

DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP
$z_0 z_0 T_0 T_0 T_0$	z z T T T	z z T T T	z z T T T	z z T T T	z z T T T
0 0					
z z T T T	z z T T T	z z T T T	z z T T T	z z T T T	z z T T T
z z T T T	z z T T T	z z T T T	z z T T T	z z T T T	RADIO CALL

b. ENGLISH Coding Example

1 MESSAGE PREFIX	2 DATE (GMT) DAY / MONTH / YR	3 TIME (GMT) HOUR / MIN	QUAD	4 LATITUDE DEG / MIN	5 LONGITUDE DEG / MIN	6 INDICATOR GROUP
$M_i M_i M_j M_j$	Y Y M M J	G G g g	Q_c	$L_a L_a L_a L_a L_a$	$L_o L_o L_o L_o L_o$	
J J X X		/				8 8 8 8 8

BATHYTHERMOGRAPH TRACE READINGS

DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP	DEPTH / TEMP
$z_0 z_0 T_0 T_0 T_0$	z z T T T	z z T T T	z z T T T	z z T T T	z z T T T
0 0					
z z T T T	z z T T T	z z T T T	z z T T T	z z T T T	z z T T T
z z T T T	z z T T T	z z T T T	z z T T T	z z T T T	RADIO CALL

Not to scale

45

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NAVEDTRA 40590
NAVAL OCEANOGRAPHY COMMAND
PRACTICAL TRAINING PUBLICATION

APT PREDICT MESSAGE AND TRACKING BOARD

PREPARED BY
NAVAL OCEANOGRAPHY COMMAND FACILITY
BAY ST. LOUIS, NSTL, MS 39529

Practical Training
Publication

NAVEDTRA (40590)

Prepared by

Naval Oceanography Command Facility

Bay St. Louis, MS

MAY 1983

Questions or comments on this publication are solicited and should be referred to:

Commanding Officer
Naval Oceanography Command Facility
Bay St. Louis, MS 39529

THE APT PREDICT MESSAGE

INTRODUCTION

A new source of data became available with the launching of the first meteorological satellite, TIROS I, in 1960. The data now received through satellite pictures provides up-to-date information on world-wide weather parameters and aids in local forecasting, as well as aviation and ship route forecasting and severe weather forecasting.

Personnel operating ground equipment require prediction data in the form of the APT Predict Message which, when decoded, offers the information needed to operate ground equipment and receive satellite photos.

This programmed instruction introduces new terminology and procedures to be used by Aerographer's Mates in computing the APT Message. The observer has the responsibility for decoding and working up the satellite track. Accuracy not speed should be the guideline. An inaccurate satellite pass is of no use, thus hampering naval operations.

This program proceeds step by step in the plotting of satellite prediction data. There are detachable APT Message worksheets and tracking worksheets at the end of the program for use in completing the exercise. Appendix 1 is included for a quick reference for the APT Predict Message.

If you encounter problems, consult your Training Petty Officer.

Personnel will require a Satellite Tracking Board to complete this program.

THE APT PREDICT MESSAGE

OBJECTIVES

1. List three uses of weather satellites.
2. On a given diagram, label with satellite terminology significant points of a satellite's orbit.
3. From a given list of satellite terminology, correctly select their corresponding definitions.
4. Write the definition of tracking.
5. On a given diagram of the APT meteorological satellite plotting board, label the component parts.
6. Correctly select the weather message that supplies satellite tracking data.
7. From a given APT message heading, correctly decode its contents.
8. List the information contained in Part I of an APT predict message.
9. Correctly decode the contents of a given Part I, APT predict message.
10. List the procedures for computing satellite nodal increments in the Eastern and Western Hemisphere.
11. Correctly complete an APT worksheet from a given message.
12. From the APT Predict Message, Part II and Part III correctly decode specified minutes.
13. Correctly plot the subpoint track orbit on a Tracking Board Diagram from a given APT Predict Message.
14. Complete a tracking worksheet for a specified orbit.
15. From a given APT message, select the APT Transmission Frequency.

FRAME 1

The modern meteorological satellites are quite versatile due to their improved detection devices and advanced electronics. However, their initial use, cloud observation, is still the most important to the daily weather forecaster. The satellite cloud observations are especially valuable in areas of sparse weather reports.

The most important use of meteorological satellites to the daily weather forecaster is __________ ________________.

* *

ANSWER: cloud observation

FRAME 2

Satellites can observe cloud systems with television cameras, infrared scanning radiometers (devices that scan the surface of the earth with infrared sensors), and various other scanning devices. The image that these devices sense is transmitted via radio waves to anyone with the proper receiving equipment. Thus, a weather office that has one of these receivers can make use of the satellite's cloud observing capabilities.

********************NO RESPONSE NECESSARY*******************

FRAME 3

Satellites have provided increased capabilities in the field of weather communications. Just like television signals that are transmitted from Europe to the United States, weather data can be transmitted from the National Environmental Satellite Center (Suitland, Maryland) to a satellite, then the satellite relays the data to any receiving station in its view.

The most important use of meteorological satellites to a forecaster at a small weather office is __________ ______________.

When a satellite is being used to rebroadcast data it received from a weather center, it is aiding in ______________

__________________.

* *

ANSWER: cloud observation

weather communication

FRAME 4

The third use of meteorological satellites is scientific research. The words "scientific research" cover such projects as measuring atmospheric radiation, polar ice limits, pollution effects, etc. The projects are many, varied, and conducted by several agencies, including the Environmental Satellite Service, U.S. Naval Environmental Prediction Research Facility, and the Smithsonian Institute. Name the third use of meteorological satellites.

____________ ______________.

FRAME 4 (CONTD.)

ANSWER: scientific research

FRAME 5

To review, there are 3 major uses of meteorological satellites. First, they can provide ____________ ________________ to the daily forecaster, especially in areas of no data. Second, they can be used as relay stations for ____________ ______________, and third, they can measure many natural phenomena which aid in ______________ ______________.

* *

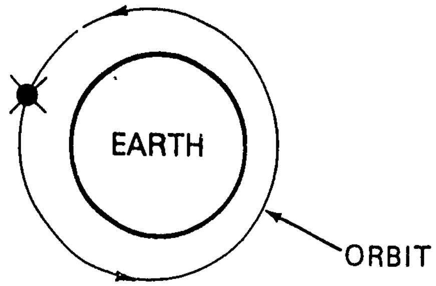
ANSWER: cloud observation

weather communication

scientific research

FRAME 6

When a satellite is launched by a rocket, it is placed into orbit. This means that the satellite is taken to such a height that the forces acting on the satellite cause it to constantly circle the earth instead of falling back down to the earth's surface. As shown in the following diagram, one complete circling of the earth by a satellite from any reference point back to the same point is called one ______________.

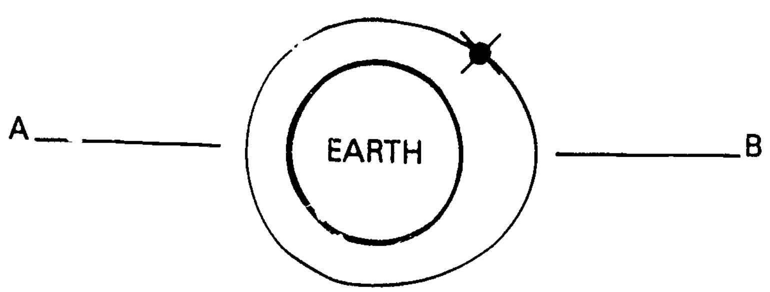


* * * * * * * * * * * * * * * * * ** * * * * * * * * * * * * *

ANSWER: orbit

FRAME 7

Most orbits that satellites have are not perfect circles, but are elliptical as shown in the diagram in Frame 6. The point in the orbit at which the satellite is farthest from the center of the earth is called the apogee. Likewise, the point in the orbit at which the satellite is closest to the center of the earth is called the perigee. On the diagram below label the apogee and perigee of the satellite. (Note: The apogee and perigee below are greatly exaggerated.)



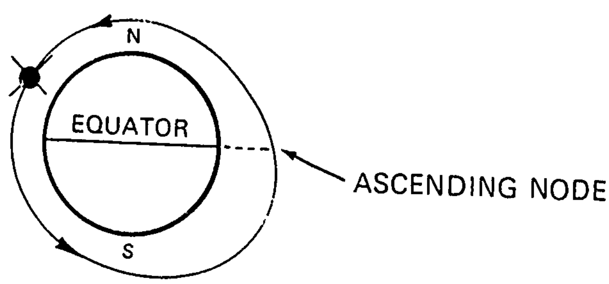
FRAME 7 (CONTD.)

ANSWER: A. perigee B. apogee

FRAME 8

For convenience, it is good to have one or two reference points in a given satellite orbit. One such point for most satellites is called the ASCENDING NODE. This is the point at which the satellite in its orbital motion crosses the equator going from south to north.

In other words, it is the point at which the satellite crosses from the _____________ Hemisphere to the _____________ Hemisphere.

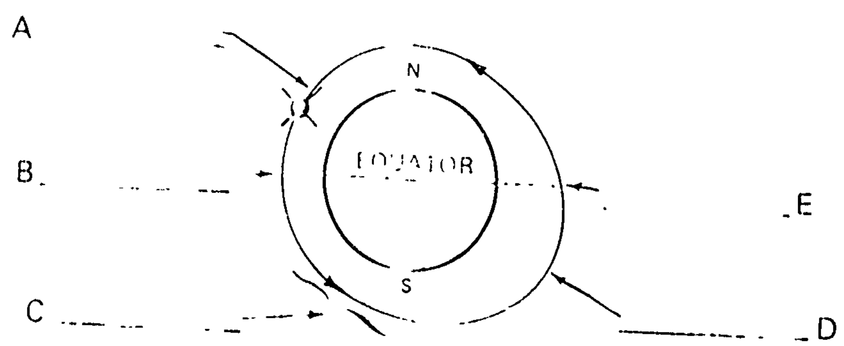


* *

ANSWER: Southern, Northern

FRAME 9

This direction (from south to north) is the direction that all weather satellites move at the time of ascending node. The ascending node is usually referred to as the beginning of an orbit. On the diagram below, label the satellite's ascending node.



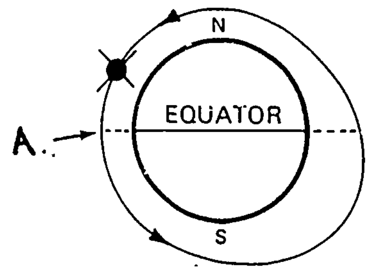
* *

ANSWER: E

FRAME 10

As the satellite crosses the equator into the Southern Hemisphere, it enters into the Descending Node as shown on the following page. If the earth were stationary, the descending node would be exactly 180° longitude from the ascending node. How- 'er, due to the earth' 'tion beneath the orbiting satellite, the descending node is less than 180°, Point (A) indicates the position of the satellite as it begins its descending node along the equator.

FRAME 10 (CONTD.)



*********************NO RESPONSE NECESSARY********************

FRAME 11

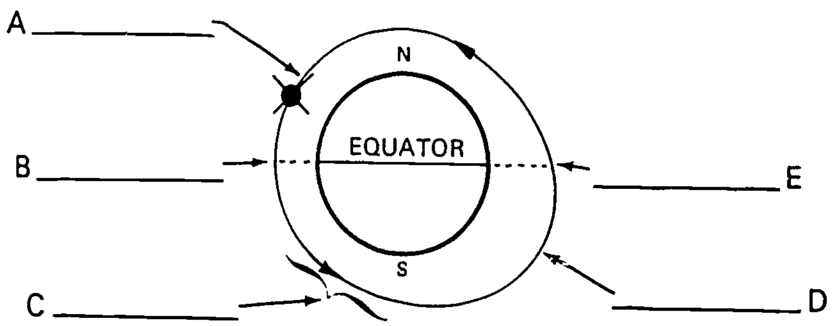
When the satellite crosses the equator going from south to north, this is called the satellite's ________ ________.
And when the satellite crosses the equator going from north to south, this is called the satellite's ________ ________.

* *

ANSWER: ascending node
descending node

FRAME 12

On the diagram below, label the satellite's Orbit, Apogee, Perigee, Ascending Node and Descending Node.



* *

ANSWER: A. Perigee

B. Descending Node

C. Orbit

D. Apogee

E. Ascending Node

FRAME 13

Satellites can be launched into several types of orbits. Meteorological satellites are generally launched into either a sun synchronous orbit or earth synchronous orbit.

The earth synchronous is the easiest to understand and picture. With this type of orbit, a satellite moves with the speed and

FRAME 13 (CONTD.)

direction of the earth, and the rotating earth appears stationary to a person on the earth's surface. In other words, the satellite moves in an easterly direction and makes one complete orbit every 24 hours. The orbit may be over any latitude circle but will always be over the same location.

NOTE: Satellites that are earth synchronous orbits do not have ascending or descending nodes.

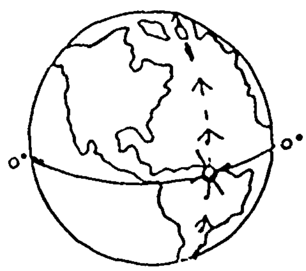
The orbit illustrated above is a/an ______________ synchronous orbit.

* *

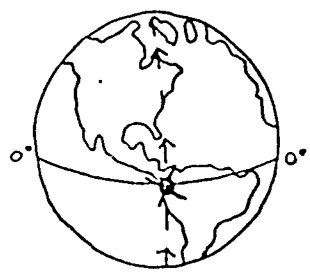
ANSWER: earth

FRAME 14

The sun synchronous orbit is usually a polar orbit. This means that the satellite always passes over the equator at the same sun time AND the satellite passes (or nearly passes) over both of the earth's poles. The following diagrams illustrate a sun synchronous polar orbit.



Here we see a satellite crossing the equator over Sao Luis, Brazil, at 0915 Local Standard Time (1415Z).



Now one orbit later, the satellite is again crossing the equator. Only this time, it is over Quito, Ecuador, and it is now 0915 Local Standard Time at Quito (1615Z). The satellite's orbit did not change. The earth rotated beneath it.

If a satellite passes over both poles, it is said to have a __________ orbit, and if this satellite always passes over the equator at the same sun time on each orbit, it is said to be in a __________________________________ orbit.

* *

FRAME 14 (CONTD.)

ANSWER: polar

sun synchronous

FRAME 15

The point on the earth directly below the satellite at any given time during its orbit is called the subpoint. The point on the earth tha the satellite camera is focused is called the principal point. Newer satellites are designed so that the camera is always pointed directly toward the earth below.

********************NO RESPONSE NECESSARY*******************

FRAME 16

Correctly match the terms in Column A to their definitions in Column B.

Column A	Column B
1. Polar orbit	A. An orbit that causes the satellite to always pass over the earth at the same time.
2. Subpoint/Principal point	B. Point on the earth's surface directly below the satellite and the point where the camera is focused on.
3. Orbit	C. An orbit that passes over (or near to) both poles.
4. Earth synchronous orbit	D. On complete revolution of a satellite from any reference point back to the same point.
5. Sun synchronous orbit	E. An orbit that will cause the satellite to pass over the equator always at the same sun time.
	F. An orbit that makes the satellite appear stationary to a person on the earth's surface.

* *

ANSWER: 1. C

2. B

3. D

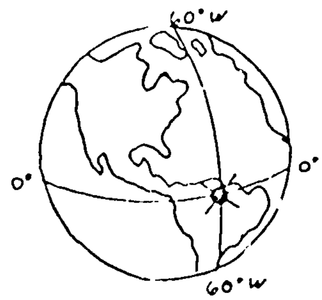
4. F

5. E

FRAME 17

There are various terms relating to satellites that you should know. ASCENDING NODE TIME is the time when the satellite crosses the equator going from south to north. The ASCENDING NODE LONGITUDE is the longitude of the satellite's principal point when it crosses the equator going north. The time the satellite crosses the equator from the Southern Hemisphere to the Northern Hemisphere is called the _________ ______ ___________ and the longitude over which the satellite crosses the equator is the _____________ _________ ________________.

The satellite in the diagram below is crossing the equator over the 60^{o} west longitude line at 1410Z. Therefore, its ascending node longitude is ___________, and its ascending node time is _____________.



* *

ANSWER: ascending node time

ascending node longitude

60^{o}W

1410Z

FRAME 18

The amount of time between successive passages of the satellite through the ascending nodes is called the NODAL PERIOD. If a satellite takes 1 hour and 50 minutes to go from one ascending node to another, this satellite would have a ________ ________ of 110 minutes. NOTE: Nodal period should be converted to hours and minutes.

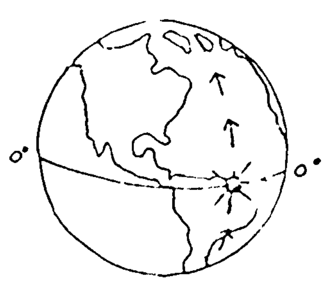
* *

ANSWER: nodal period

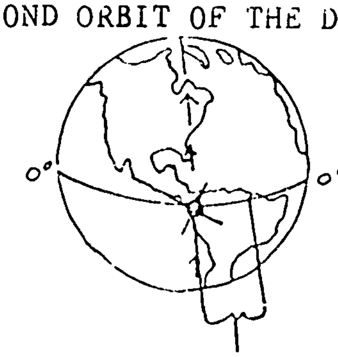
FRAME 19

Remember the earth rotates underneath the satellite's orbit as shown in the two diagrams below.

FIRST ORBIT OF THE DAY



SECOND ORBIT OF THE DAY



The number of degrees longitude at the equator that the earth turns between successive ascending nodes is defined as the satellite's NODAL INCREMENT. In the diagram above, the earth has turned 30 degrees longitude; therefore, the ________ ________ of this satellite is 30 degrees.

FRAME 19 (CONTD.)

After satellites are launched, the Space Administration keeps track of the number of orbits a satellite makes. The orbits are numbered consecutively beginning with the orbit after the first ascending node of the satellite; therefore, ORBIT NUMBER refers to a particular circuit beginning at the satellite's ascending node.

* *

ANSWER: Nodal increment

FRAME 20

With a certain satellite, the first orbit on 28 January 1974 is number 682. On orbit 682, a satellite crosses the equator going north at 68°W longitude when the time is 0800. On orbit 683, the satellite crosses the equator at 100°W longitude when the time is 1000. For this satellite, 0800 is the first ________ ________ ________ on 28 January. Thirty-two degrees longitude is the satellite's ________ ________ and 2 hours or 120 minutes is its ________ ________.

* *

ANSWER: Ascending node time
Nodal increment
Nodal period

FRAME 21

Let's review the following satellite terminology:

1. The time elapsing between successive passages of the satellite through the ascending node is called the ______________ ____________.

2. At any given time during a satellite's orbit, the point on the the earth directly below the satellite is referred to as the _________ __________.

3. The time when the satellite crosses the equator going north is referred to as the ______________ ____________ ___________.

4. A satellite that appears to move westward 30° each successive orbit is said to have a ___________ ______________ of 30 degrees.

5. The National Space Center keeps track of each satellite and assigns a/an ___________ ____________, the number is assigned to the first circuit of a satellite after its first ascending node.

6. The longitude of the satellite's principal point when it crosses the equator going north is called the ______________ _________ _______________.

* *

ANSWER:
1. Nodal period
2. Subpoint
3. Ascending node time
4. Nodal increment
5. Orbit number
6. Ascending node longitude

FRAME 22

Since most meteorological satellites cross the celestial dome (horizon to horizon) at a definite time for any given point on the earth, any weather station that needs to obtain data from the satellite must know where the satellite is. The procedures for keeping the antenna of the receiving equipment pointed toward the satellite as it moves through its orbit are called tracking. An observer works up various procedures to enable him to keep the antenna of his satellite receiving equipment pointed toward the satellite as it moves through its orbit.

This is called ____________.

* *

ANSWER: tracking

FRAME 23

There are several pieces of equipment other than the receiving equipment that helps you to determine the satellite's track. The first is the TRACKING OR PLOTTING BOARD. This is a polar projection diagram of the earth centered at either pole and extending to 30 degrees latitude past the equator into the other hemis-

FRAME 23 (CONTD.)

phere. See the diagram on the next page. The board has radials from the pole representing one-degree intervals of longitude; each fifth radial is accentuated. Concentric circles on the board represent latitude, with the equator being a heavier circle. From the picture of the plotting board on the next page, select the correct letter (s) for latitude lines, longitude lines and the equator.

1. Latitude line ______________

2. Longitude lines ______________

3. Equator ______________

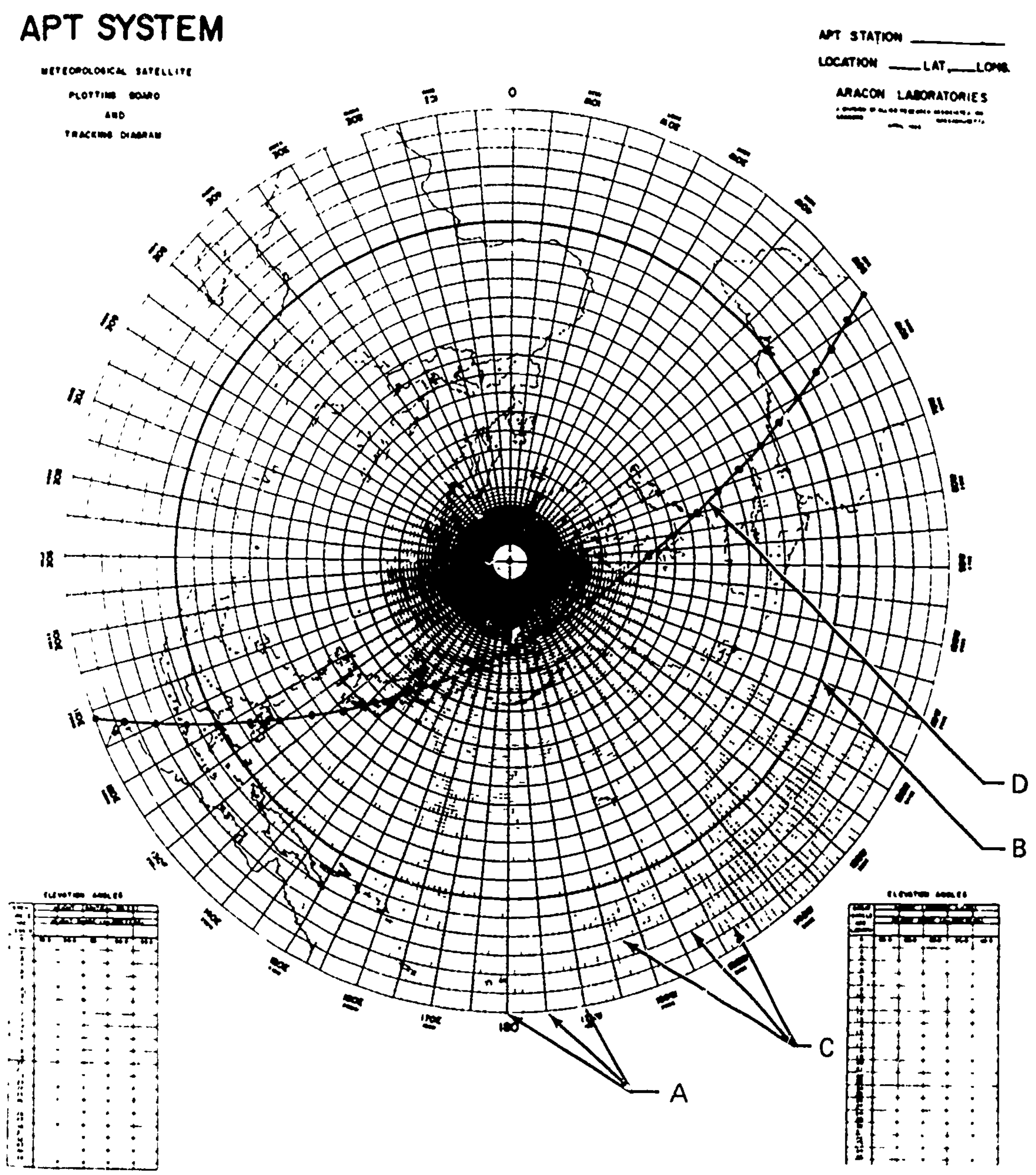
*

ANSWER: 1. C

2. A

3. B

FRAME 23 (CONTD.)



FRAME 24

A clear, circular piece of plastic centered at the poles is attached to and covers the plotting board. This piece of plastic is called the TRACKING OVERLAY which protects the board from being moved or damaged. On the tracking overlay, the SUBPOINT TRACK is plotted in grease pencil. The subpoint track is the projection of the satellite's orbit on the rotating earth. From information obtained on the subpoint track, the antenna can be pointed in the direction of the satellite. This information can be entered in the two blocks at the bottom of the plotting board.

Refer to Frame 23 and select the correct letter for subpoint track.

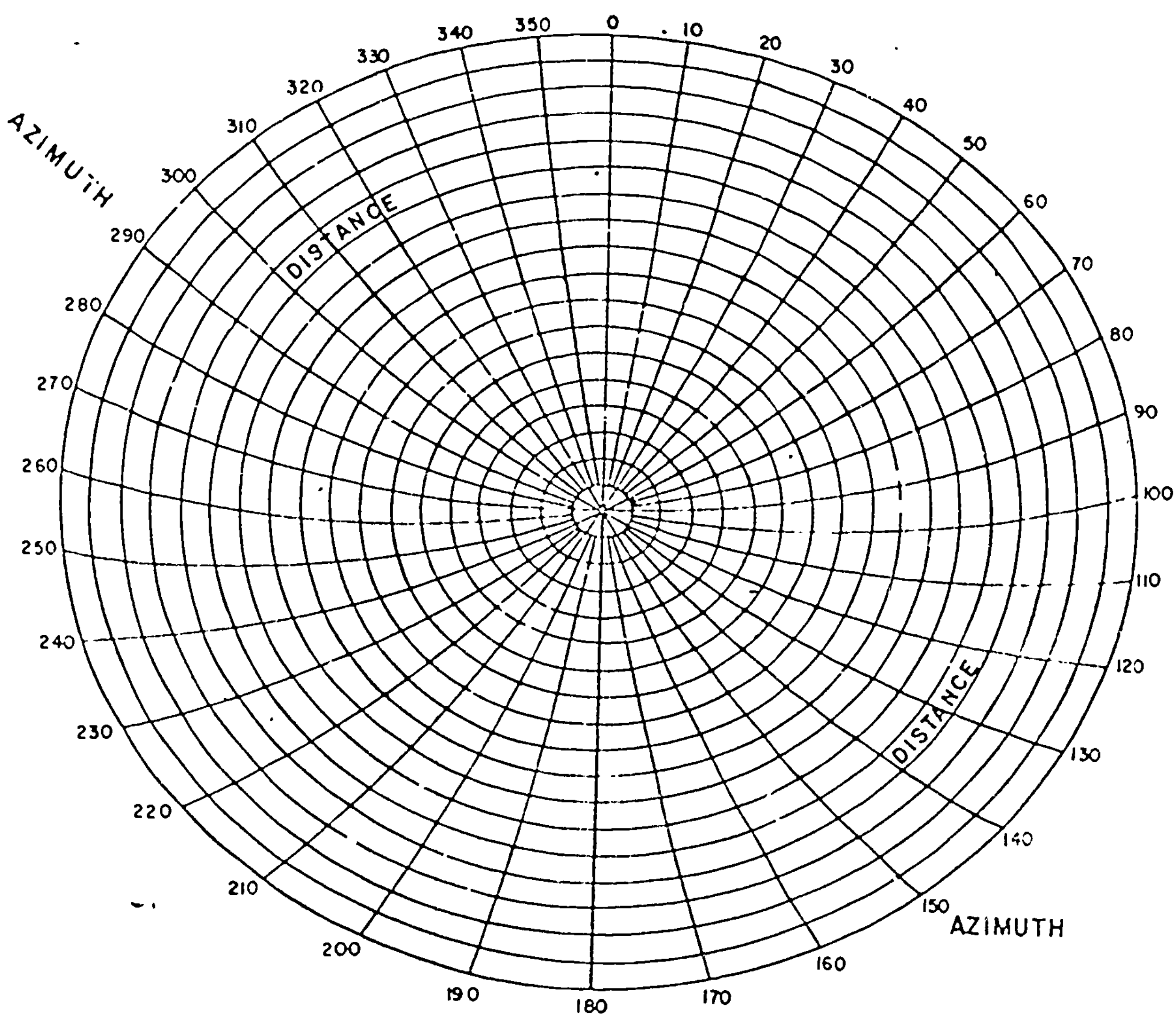
Subpoint track ________

* *

ANSWER: D

FRAME 25

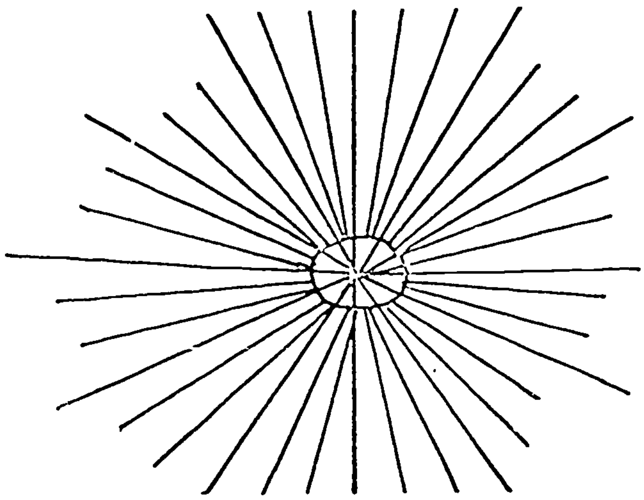
TRACKING DIAGRAMS like the one shown below are constructed for each 5 degrees of latitude and are used to get elevation angle and azimuth (direction) for the receiving equipment antenna. The diagram with the proper latitude is centered at your station's position and taped to the plotting board. Printed on the diagrams are concentric elliptical circles that measure great circle arc distance. These lines can be converted into elevation angles. There are also radial lines coming from the center of the diagram. These lines are called azimuth lines and determine what direction the antenna should be pointed. The lines are labeled for every 10 degrees.



FRAME 25 (CONTD.)

The tracking diagram has 2 sets of lines:

The radial lines are called ____________ and appear like this:



The other set of lines is oval shaped; these lines measure

__________ ___________ _______ _____________.

* *

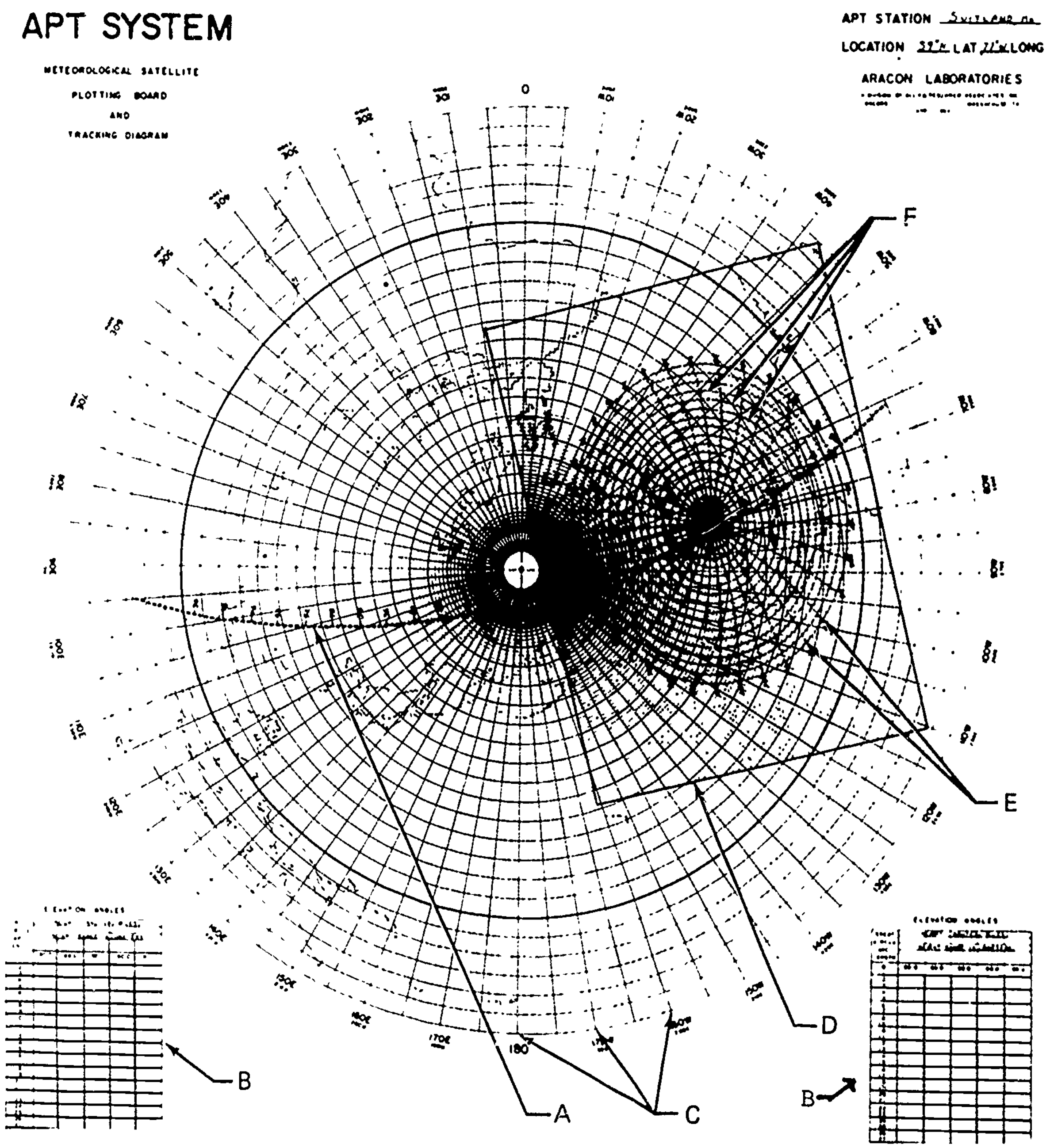
ANSWER: azimuth

great circle arc distance

286

FRAME 26

The diagram below shows the Plotting Board and Tracking Diagram. Label the component parts as listed below.



A ______________________

B ______________________

C ______________________

D ______________________

E ______________________

F ______________________

* *

FRAME 26 (CONTD.)

ANSWER: A. Track   D. Tracking diagram

B. Data block   E. Azimuth

C. Longitude   F. Great circle arc length

FRAME 27

The weather message that contains satellite tracking information plotted on the tracking board is called the "APT" (Automatic Picture Transmission) Predict Message. This message can be produced in two different forms: A weekly message or daily message.

The message that contains satellite tracking data is called the ________________ ________________ ________________ message.

* *

ANSWER: APT (Automatic Picture Transmission)

FRAME 28

The daily message contains all the information needed to track all meteorological satellites for one particular day. It is distributed via teletype to most Navy weather stations. The weekly message contains information needed to track all meteorological satellites for one particular week. The weekly message

FRAME 28 (CONTD.)

is usually delivered via mail. The two forms contain the same information for any given day. The weekly predict is used for stations not having teletype and in the event that it is impossible to disseminate the daily message.

The two forms of the APT Predict Message are:

1. ____________________

2. ____________________

* *

ANSWER: 1. Daily

2. Weekly

FRAME 29

As with all weather messages, the APT Predict Message has a heading. The symbolic form of the APT Predict Message heading is shown below:

TBUS 1 KWBC $YYGG_{gg}$

APT PREDICT

MM YY NAME SS

TB - APT Predict

US - Geographical location

(1) - satellite has a north to south daytime picture taking orbit. (Daylight descending satellite)

(2) - satellite has a south to north daytime picture taking orbit. (Daylight ascending satellite)

(3 and 4) - Geostationary - earth synchronous satellite.

FRAME 29 (CONTD.)

KWBC - call letters of station originating message. Washington, D. C., in this case.

YYGGgg - date and time message was transmitted.

APT PREDICT - identifies message content.

MM - month of the year.

YY - day of the month that data is valid for.

NAME - name of satellite.

SS - series number of spacecraft.

Below is an actual APT heading. Answer the questions below on this heading.

TBUS 2 LERT 081800

APT PREDICT

0112 NOAA 3

A. On what day was the message transmitted?

____

B. The satellite has a (north to south/south to north) daytime
(Circle one)

picture taking orbit.

C. For what month and what day is the message valid?

______________ _____

D. What is the name of the satellite?

____

* *

ANSWER: A. 8th

B. south to north

C. Jan 12

D. NOAA

FRAME 30

Now without looking back, answer t.. questions concerning the APT heading below.

TBUS 1 KWBC 211800

APT PREDICT

0823 ESSA 8

A. What station transmitted the data? ____________________

B. What day and what time was the message transmitted?

____________ ____________

C. For what month and what day is the message valid?

____________ ____________

D. What is the series number of the satellite? ____________

* *

ANSWER: A. Washington, D. C.

B. 21st; 1800Z

C. August 23rd

D. 8

FRAME 31

Besides the heading, the APT message contains four parts. Part I contains information on the first orbit of the day (GMT), and orbits four, eight, and twelve for that day. The ascending node longitude and ascending node time for these orbits is given as well as nodal period and nodal increment. Parts II and III contain the satellite's altitude and subpoint track.

FRAME 31 (CONTD.)

Part II is for the Northern Hemisphere and Part III is for the Southern Hemisphere. Parts II and III are further divided into day and night portions of the orbit.

Finally Part IV is reserved for remarks pertinent to the operation of the satellite.

From the above statement concerning the various parts of the APT message, answer the questions below.

A. In what part of an APT message would you find subpoint data for the Southern Hemisphere? ____________________

B. The satellite's nodal period is contained in Part ______ of the APT Predict.

C. The altitude of the satellite over the Northern Hemisphere is given in Part _________ of the APT Predict.

D. Besides the nodal increment, nodal period, and ascending node longitude, what other information is contained in Part I of the APT Predict?

1. ________________________________

2. ________________________________

* *

ANSWER: A. III

B. I

C. II

D. 1. orbit number

2. ascending node time

FRAME 32

Now let's see just how this information is encoded in the APT Predict Message. Part I will be covered first; the symbolic code for this part is shown below, as well as an actual message.

PART I (CODE)

$ON_rN_rN_rN_r$ $OY_rY_rG_rG_r$ $Og_rg_rs_rs_r$ $Q_4L_oL_ol_ol_o$ Tggss $LL_oL_ol_ol_o$

$N_4N_4N_4N_4G_4$ $G_4g_4g_4s_4s_4$ $Q_4L_oL_ol_ol_o$

$N_8N_8N_8N_8G_8$ $G_8g_8g_8s_8s_8$ $Q_8L_oL_ol_ol_o$

$N_{12}N_{12}N_{12}N_{12}G_{12}$ $G_{12}g_{12}g_{12}s_{12}s_{12}$ $Q_{12}L_oL_ol_ol_o$

PART I (MESSAGE)

01482 00312 05443 23471 T1442 L2867

14862 03332 32000

14900 41221 19468

14941 15109 25064

$ON_rN_rN_rN_r$

01 4 8 2

A. 0 - This first zero is an indicator and tells you that the data for the reference orbit (first orbit of the day) follows. $N_rN_rN_rN_r$ is the orbit number for the reference orbit; in this case, 1482.

$O\ Y_r\ Y_r\ G_r\ G_r \quad O\ g_r\ g_r\ s_r\ s_r$

0 0 3 1 2 0 5 4 4 3

B. These two groups contain the day and <u>ascending node time</u> (Zulu) of the reference orbit (first orbit of the day). <u>The zeros at the beginning of each group are fillers</u>

FRAME 32 (CONTD.)

and have no meaning. Y_rY_r is the day. G_rG_r g_rg_r is the hours and minutes, and s_rs_r is the seconds. Therefore, the day of this example is the ____________ and the time is ______________Z.

Q_r	L_o	L_o	l_o	l_o
2	3	4	7	1

C. The Q of this group gives the octant. The $L_oL_ol_ol_o$ gives the longitude of the ascending node. The diagram below illustrates the octants of the globe. Octant two covers the area between ___________ and _________E/W in the ______ _____ Hemisphere. The tens, units, tenths, and hundredths digits of the longitude are given. The hundreds digit is omitted. The ascending node longitude of the reference orbit is _________________.

180^o		90^oW		0^o		90^oE		180^o
	OCT 1		OCT 0		OCT 3		OCT 2	
			EQUATOR					
	OCT 6		OCT 5		OCT 8		OCT 7	

OCTANTS OF GLOBE

FRAME 32 (CONTD.)

T gg ss

T 14 42

D. This group contains the satellite's nodal period in minutes and seconds. The T is an indicator; gg is the minutes, and ss is the seconds. The hundreds digit of the minutes is not given, but the normal period of a satellite is around 110 minutes. Therefore, our example shows that the satellite has a period _____ minutes and ___ seconds which equals _______ hour(s) _______ minutes and ________ seconds. Nodal period is usually expressed in hours and minutes.

L L_o L_o l_o l_o

L 2 8 6 7

E. The L is the indicator for this group and contains the nodal increment. Longitude and latitude are given to the nearest tenth or hundredth throughout the APT Predict Message, NOT degrees and minutes of longitude. The increment is given in tens, units, tenths, and hundredths of degrees longitude. What is the Nodal increment of this satellite? ____________

FRAME 32 (CONTD.)

$N_4N_4N_4N_4G_4$
1 4 8 6 2

F. These N_4's give the orbit number of the (R+4) orbit, i.e., 4 orbits after the reference.

G_4 g_4 g_4 s_4 s_4
0 3 3 3 2

This group contains the ascending node time of R+4 orbit.

NOTE: There are no filler zeros here.

The ascending node time for R+4 is ____________Z.

$Q_4L_oL_ol_ol_o$
3 2 0 0 0

G. This group contains the octant and ascending node longitude for R+4 which is __________ Octant/Longitude E/W. The data for R+8 (8 orbits after reference) and R+12 are decoded in the same manner as that of R+4. In some messages there will not be data for R+12.

* *

ANSWER: B. 3rd, 12:54:43Z

C. 90°E, Northern, 134.71°E

D. 114, 42, 1:53:42

E. 28.67 longitude

F. 20:33:32Z

G. 3, 20.00°E

FRAME 33

Below is Part I from another APT Predict Message. Answer the questions printed below it.

PART I

04489 00320 05716 00553 T1611 L2904

44930 44201 12171

44971 22646 22209

45012 01131 30590

A. What is the reference orbit number? ____________

B. On which day of the month does the reference orbit occur?

____

C. What is the nodal period? ______ min/sec or ______ hr/min/sec

D. What is the ascending node time of R+4? ______________

E. What is the ascending node longitude of R+4? ____________

F. What is the ascending node time of R+8? ______________

G. What is the ascending node longitude of R+8? ____________

* *

ANSWER: A. 4489

B. 03

C. 116 min, 11 sec or 1 hr, 56 min, 11 sec

D. 04:42:01Z

E. 121.71

F. 12:26:46Z

G. 122.09°E

FRAME 34

From these orbits, R, R+4, R+8 and R+12, the ascending node time and the ascending node longitude can be computed for R+1, R+2, R+3, R+5, R+6, R+7, R+9, R+10 and R+11. The following example will illustrate this:

PART I

04489 00320 03716 00553 T1611 L2904

44930 44201 12171

44971 22646 22209

45012 01131 30509

To find the ascending node longitude of R+1 (one orbit after reference), perform the following steps:

FIRST: Find the ascending node longitude of R --------------------5.53°W

SECOND: Add one nodal increment 29.04
34.57°W

In the Western Hemisphere one nodal increment is always added for each successive orbit.

In the Eastern Hemisphere one nodal increment is always subtracted for each successive orbit.

Just remember:

If EAST Longitude - Subtract

If WEST Longitude - Add

Therefore the ascending node longitude of R+2 is found by adding 2 nodal increments to the ascending node longitude of R and would be __________E/W. For R+3, once again add 1 nodal increment to R+2 longitude.

This would give you __________°E/W as the ascending node longitude for R+3.

FRAME 34 (CONTD.)

NOTE: The reason that data for ascending nodes of R+4, R+8, and R+12 orbits are given is that it simplifies computing and gives accuracy to the hundredths digit.

* *

ANSWER: 63.61°W

92.65°W

FRAME 35

Now, using the message in Frame 34, determine the ascending node longitude for R+5 and R+6.

_______________E/W

_______________E/W

* *

ANSWER: 150.75W

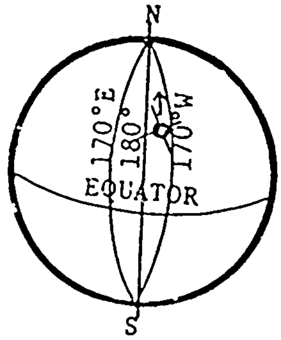
179.79W

FRAME 36

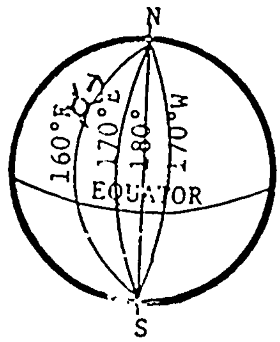
Problem: What do you do when you approach 180 degrees? For example R+8 = 172.50°W.

Find R+9 when the nodal increment is 28.50°. (Remember, the satellite always seems to move westward because of the earth's rotation.)

FRAME 36 (CONTD.)



(R+8)



(R+9)

R+8 ascending node longitude = 172.50°W
When you add 28.50°W
You have 201.00°

Since 201° is over 180°, you must determine how far into east longitude the satellite is. To do this you must subtract 180° from 201°, and you get 21.00°.

21° is how far the satellite has moved into east longitude.

To get the ascending node longitude of R+9 you will subtract 21.00° from 180.00° since it is in east longitude. Ascending node longitude for R+9 is 159.00°E.

********************NO RESPONSE NECESSARY********************

FRAME 37

Another problem exists when the satellite moving westward approaches zero degrees longitude.

For example: R+10 = 5.58°E

Find R+11 when the nodal increment is 28.50°.

FRAME 37 (CONTD.)

Nodal increment	=	28.50°
Ascending node longitude	=	-5.58°
R+11		22.92°

You need to move 28.50°W. Subtract the ascending node longitude of 5.58° from the nodal increment of 28.50°. This will equal the ascending node longitude for R+11 of 22.92°W.

Determine R+1 when R is 22.82°E. The nodal increment is 28.14°.

__________ is the ascending node longitude for R+1.

* *

ANSWER: 5.32°W

FRAME 38

From the partial APT message below, determine the ascending node longitude of R through R+3. Be sure to state whether it is east or west longitude.

APT PREDICT

0130 NOAA 3

PART I

00490 00114 02816 33028 T0652 L2750

04941 . . . .

ASCENDING NODE LONGITUDE

R ______________________

R+1 ______________________

R+2 ______________________

R+3 ______________________

* *

FRAME 38 (CONTD.)

ANSWER: R, 30.28°E

R+1, 2.78°E

R+2, 24.72°W

R+3, 52.22°W

FRAME 39

From the partial APT message below, determine the ascending node longitude of R through R+3 and note east or west longitude.

APT PREDICT

0220 NOAA 3

PART I

00542 02212 01858 15162 T0652 L2750

05461 . . . .

ASCENDING NODE LONGITUDE

R ____________________

R+1 ______________________________

R+2 ______________________________

R+3 ______________________________

* *

ANSWER: R, 151.62°W

R+1, 179.12°W

R+2, 153.38°E

R+3, 125.88°E

FRAME 40

Finding the ascending node time is easier than finding the ascending node longitude. You simply obtain the time of the ascending node for R, R+4, R+8, or R+12 from the message; if you want to know the time of an orbit other than these, add one, two or three nodal periods to the given time. The example below will be used to illustrate this:

PART I

04489 00320 03716 00553 T1611 L2904

44930 44201 12171

44971 22646 22209

45012 01131 30509

To find the ascending node time of R+1, take:

Ascending node time of R	=	20:37:16
ADD one nodal period	=	1:56:11
		22:33:27

(60 min. = 1 hour) - (24 hours = 1 day)

NOTE: Remember the nodal period is given in minutes and seconds and the hundreds digit is omitted. Therefore, the period of this satellite is 116 min. 11 sec. which converts to 1 hr. 56 min. 11 sec.

Similarly, to find the ascending node time of R+2, you must add 2 nodal periods to R or add 1 nodal period to R+1, i.e.,

20:37:16	or	22:33:27
1:56:11		1:56:11
1:56:11		

Ascending node time of R+2 = ______________________

* *

ANSWER: 00:29:38Z

FRAME 41

Utilizing the message below, determine the ascending node times for:

R+4 ________________Z

R+5 ________________Z

R+6 ________________Z

R+7 ________________Z

PART I

04489 00320 03716 00553 T1611 L2904

44930 44201 12171

44971 22646 22209

45012 01131 30509

* *

ANSWER: R+4; 04:42:01Z

R+5; 06:38:12Z

R+6; 08:34:23Z

R+7; 10:30:34Z

NOTE: If your answers to Frame 41 were incorrect, go back and review the frame and try again. Remember - use the ascending node time of R+4 in the message.

FRAME 42

Now, review the procedures for computing ascending node longitude and ascending node time. The ascending node longitude is given for orbits R, R+4, R+8, and sometimes R+12 in Part

FRAME 42 (CONTD.)

____ of the ______ message. In the Western Hemisphere to find ascending node longitude of any orbit other than R, R+4, R+8 and R+12, you must add/subtract (Circle one) one period/increment (Circle one) for each successive orbit. When in the Eastern Hemisphere, you must add/subtract (Circle one) one nodal ______________ for each successive orbit. To find the ascending node time, one nodal ______________ must be added for each successive orbit. These two parameters are generally worked out together for each orbit of a satellite.

* *

ANSWER: I

APT

add

increment

subtract

increment

period

FRAME 43

Look at one of these APT Predict Message worksheets at the end of this program. This worksheet has been developed to simplify the computations and keep them all together. When you use this sheet, be sure that the heading is entered first. On the following page are two APT Predict Messages. Using one of the extra worksheets provided, compute ascending node times for orbits R through R+11 for each message.

FRAME 43 (CONTD.)

(Keep these worksheets, they will be used later.)

MESSAGE I:

APT PREDICT

1222 NOAA 4

PART I

00466 02221 03140 01280 T1500 L2875

04700 51141 12783

04741 25141 21715

04782 03141 30215

MESSAGE II:

APT PREDICT

1103 ESSA 8

PART I

00977 00312 05443 23471 T1442 L2867

69812 03332 32000

69850 41220 19469

69891 15109 25059

Now compare your answers on your worksheets to the worksheets on the following two pages for NOAA 4 and ESSA 8.

ANSWER TO FRAME 43

APT PREDICT MESSAGE WORKSHEET

Satellite: NOAA 4 Date: DECEMBER 22

Nodal Period: 1:55:00 (Hr. Min. Sec.) Nodal Increment: 28.75° (Degree Hnd.)

Note: Ascending nodes progress westward around the globe. All longitude computations in east longitude must be subtracted. Those in west longitude are added.

Ascending Node Time	Hr. Min. Sec.	Ascending Node Longitude (From Message)	Degree Hnd. E/W
Orbit Number 466	Hr. Min. Sec.	(From Message)	Degree Hnd. E/W
Reference orbit	21:31:40	Reference orbit	12.80°W
Plus one nodal per.	1:55:00	+ or - one nodal increment	28.75°
Reference orbit + 1	23.26:40	Reference orbit + 1	41.55°W
Plus one nodal per.	1:55:00	+ or - one nodal increment	28.75°
Reference orbit + 2	01:21:40	Reference orbit + 2	70.30°W
Plus one nodal per.	1:55:00	+ or - one nodal increment	28.75°
Reference orbit + 3	03:16:40	Reference orbit + 3	99.05°W
Orbit Number 468	Hr. Min. Sec.	(From Message)	Degree Hnd. E/W
Reference orbit + 4	05:11:41	Reference orbit + 4	127.83°W
Plus one nodal per.	1:55:00	+ or - one nodal increment	28.75°
Reference orbit + 5	07:06:41	Reference orbit + 5	156.58°W
Plus one nodal per.	1:55:00	+ or - one nodal increment	28.75°
Reference orbit + 6	09:01:41	Reference orbit + 6	174.67°E
Plus one nodal per.	1:55:00	+ or - one nodal increment	28.75°
Reference orbit + 7	10.56:41	Reference orbit + 7	145.92°E
Orbit Number 472	Hr. Min. Sec.	(From Message)	Degree Hnd. E/W
Reference orbit + 8	12:51:41	Reference orbit + 8	117.15°E
Plus one nodal per.	1:55:00	+ or - one nodal increment	28.75°
Reference orbit + 9	14:46:41	Reference orbit + 9	88.40°E
Plus one nodal per.	1:55:00	+ or - one nodal increment	28.75°
Reference orbit + 10	16:41:41	Reference orbit + 10	59.65°E
Plus one nodal per.	1:55:00	+ or - one nodal increment	28.75°
Reference orbit + 11	18:36:41	Reference orbit + 11	30.90°E
Orbit Number 476	Hr. Min. Sec.	(From Message)	Degree Hnd. E/W
Reference orbit + 12	20:31:41	Reference orbit + 12	2.15°E

BEST COPY AVAILABLE

ANSWER to frame 43

APT PREDICT MESSAGE WORKSHEET

Satellite: ESSA 8 Date: NOVEMBER 03

Nodal Period: 1:54:42 (Hr. Min. Sec.) Nodal Increment: 28.67° (Degree Hnd.)

Note: Ascending nodes progress westward around the globe. All longitude computations in east longitude must be subtracted. Those in west longitude are added.

Ascending Node Time	Hr. Min. Sec. (From Message)	Ascending Node Longitude	Degree Hnd. E/W
Orbit Number 977			
Reference orbit	12:54:43	Reference orbit	134.71°E
Plus one nodal per.	1:54.42	+ or - one nodal increment	28.67°
Reference orbit + 1	14:49:25	Reference orbit + 1	106.04°E
Plus one nodal per.	1:54:42	+ or - one nodal increment	28.67°
Reference orbit + 2	16:44:07	Reference orbit + 2	77.37°
Plus one nodal per.	1:54:42	+ or - one nodal increment	28.67°
Reference orbit + 3	18:38:49	Reference orbit + 3	48.70°
Orbit Number 981			
Reference orbit + 4	20:33:32	Reference orbit + 4	20.00°E
Plus one nodal per.	1:54:42	+ or - one nodal increment	28.67°
Reference orbit + 5	22:28:14	Reference orbit + 5	8.67°W
Plus one nodal per.	1:54:42	+ or - one nodal increment	28.67°
Reference orbit + 6	00:22:56	Reference orbit + 6	37.34°W
Plus one nodal per.	1:54:42	+ or - one nodal increment	28.67°
Reference orbit + 7	02:17:38	Reference orbit + 7	66.01°W
Orbit Number 985			
Reference orbit + 8	04:12:20	Reference orbit + 8	94.69°W
Plus one nodal per.	1:54:42	+ or - one nodal increment	28.67°
Reference orbit + 9	06:07:02	Reference orbit + 9	123.36°W
Plus one nodal per.	1:54:42	+ or - one nodal increment	28.67°
Reference orbit + 10	08:01:44	Reference orbit + 10	152.03°W
Plus one nodal per.	1:54:42	+ or - one nodal increment	28.67°
Reference orbit + 11	09:56:26	Reference orbit + 11	179.30°E
Orbit Number 989			
Reference orbit + 12	11:51:09	Reference orbit + 12	150.59°E

FRAME 44

Now let's cover Parts II and III. Notice from the symbolic format below that there are two Part II's and two Part III's.

PART II (NIGHT)

$02Z_{02}Z_{02}Q_{02}$ $L_aL_al_aL_oL_ol_o$ $04Z_{04}Z_{04}Q_{04}$ $L_aL_al_aL_oL_ol_o$

$06Z_{06}Z_{06}Q_{06}$ $L_aL_al_aL_oL_ol_o$ $08Z_{08}Z_{08}Q_{08}$ $L_aL_al_aL_oL_ol_o$

$10Z_{10}Z_{10}Q_{10}$ $L_aL_al_aL_oL_ol_o$ .... to terminator (Near No. Pole)

PART III (NIGHT)

$02Z_{02}Z_{02}Q_{02}$ $L_aL_al_aL_oL_ol_o$ $04Z_{04}Z_{04}Q_{04}$ $L_aL_al_aL_oL_ol_o$

$06Z_{06}Z_{06}Q_{06}$ $L_aL_al_aL_oL_ol_o$ $08Z_{08}Z_{08}Q_{08}$ $L_aL_al_aL_oL_ol_o$

$10Z_{10}Z_{10}Q_{10}$ $L_aL_al_aL_oL_ol_o$ ....to terminator (Near So. Pole)

PART II (DAY)

$28Z_{28}Z_{28}Q_{28}$ $L_aL_al_aL_oL_ol_o$ $30Z_{30}Z_{30}Q_{30}$ $L_aL_al_aL_oL_ol_o$

$32Z_{32}Z_{32}Q_{32}$ $L_aL_al_aL_oL_ol_o$ ....to last point north of equator

PART III (DAY)

$56Z_{56}Z_{56}Q_{56}$ $L_aL_al_aL_oL_ol_o$ $58Z_{58}Z_{58}Q_{58}$ $L_aL_al_aL_oL_ol_o$

$60Z_{60}Z_{60}Q_{60}$ $L_aL_al_aL_oL_ol_o$ .... to terminator (Near So. Pole)

PART II (NIGHT): Contains the satellite's altitude and subpoint data at 2-minute intervals for that portion of the orbit which is in darkness north of the equator.

PART III (NIGHT): Contains the satellite's altitude and subpoint data at 2-minute intervals for that portion of the orbit in darkness south of the equator, <u>prior</u> to the ascending node.

PART II (DAY): Contains the satellite's altitude and subpoint data at 2-minute intervals over the sunlit portion of the orbit north of the equator.

FRAME 44 (CONTD.)

PART III (DAY): Contains the satellite's altitude and subpoint data at 2-minute intervals over the sunlit portion of the orbit south of the equator.

********************NO RESPONSE NECESSARY********************

FRAME 45

1. Both Parts II and III give subpoint positions for every _______ minutes.
2. The satellite's ____________ is also given in both parts.
3. Data for the Northern Hemisphere are given in Part _______.
4. There are two sections to both Parts II and III. These two sections divide the data between _________ and ________ positions.

* *

ANSWER: 1. two 3. II

2. altitude 4. day, night

FRAME 46

On the following page is an example of Parts II and III of an APT Predict Message:

FRAME 46 (CONTD.)

NIGHT PART II

02422 062329 04422 124311 06422 186292 08422 247273 10422 309251
12422 371228 14422 432201 16422 492170 18422 552131 20422 610080
22422 666009 24422 718902 26423 760726 28423 783452 30433 775145
32430 740076

NIGHT PART III

02437 061364 04437 123382 06447 185401 08447 247420 10457 308442
12457 369465 14467 429491 16467 489522 18477 548560 20477 606609
22487 661677 24487 713778 26486 756658

DAY PART II

34430 692211 36430 638297 38430 581356 40430 522400 42430 462434
44430 401463 46430 340488 48440 279510 50440 217531 52440 156550
54440 094568 56450 032586

DAY PART III

58455 028603 60455 090621 62465 151639 64465 213658 66465 274678
68475 335700 70475 395724 72485 455752 74485 514786 76485 573828
78485 630884 80496 684963 82496 732085 84496 770286 86496 784578
88487 768734 90487 729540

Both Parts II and III are made up of a series of "paired" groups as in the example on the next page. Notice that the first group has five digits and the second group has six digits.

FRAME 46 (CONTD.)

$02Z_{02}Z_{02}Q_{02}$ $L_aL_al_aL_oL_ol_o$

02 4 2 2 0 6 2 3 2 9

The first two digits in each paired group indicates the minutes after ascending node. (See note below) In the example, the 02 tells you that the data in these two groups are for the second minute after ascending node.

NOTE: Remember that only Part III night gives the data in minutes p r i o r to ascending node.

If the first two digits of Part II day are 34, this means that the data contained in the first two groups are for the ________ minute before/after ascending node.
(Circle one)

* *

ANSWER: 34th, after

FRAME 47

$Z_{02}Z_{02}$ gives the satellite's altitude in tens and hundreds of kilometers. The thousands digit is always a "1" and is not given. The units digit is always a "0" and is not given. Therefore, in our example the satellite is at an altitude of 1420 kilometers. An altitude encoded as 18 would mean that the satellite was ________ kilometers high.

* *

ANSWER: 1180

FRAME 48

Q_{02} This gives the octant of the globe that the satellite is in two minutes after the ascending node. The diagram at left illustrates all of the octants. In our example, Q_{02} was "2" which means the satellite was in the Northern Hemisphere between 90° and 180°E. If Q_{02} had been a "0," the satellite would have been between _____° and _____°E/W.

180° 90°W 0° 90°E 180°

OCT 1	OCT 0	OCT 3	OCT 2
	EQUATOR		
OCT 6	OCT 5	OCT 8	OCT 7

OCTANTS OF GLOBE

* *

ANSWER: 0, 90°W

FRAME 49

$L_aL_al_a$ gives the latitude of the satellite's subpoint for the second minute in tens, units, and tenths of a degree. In this case the latitude is 6.2°N.

FRAME 49 (CONTD.)

$L_oL_ol_o$ gives the longitude of the satellite's subpoint for the second minute in tens, units, and tenths of a degree.

The hundreds digit is not necessary since this is obtained from Q_{02}. Therefore, in our example, the longitude is

______.

(Circle one)

A. 32.9°W

B. 132.9°W

C. 32.9°E

D. 132.9°E

$L_aL_al_aL_oL_ol_o$

0 6 2 3 2 9

Don't forget to consider the octant.

* *

ANSWER: D.

FRAME 50

You have now decoded the first subpoint of the orbit. For more practice, decode the following subpoints in the same manner:

24422 718902

26423 760726

MINUTE 24

ALTITUDE	______	LATITUDE	______
OCTANT	______	LONGITUDE	______

FRAME 50 (CONTD.)

MINUTE 26

ALTITUDE ______ LATITUDE ______

OCTANT ______ LONGITUDE ______

32430 740076 34430 692211

36430 638297 38430 581356

MINUTE 32

ALTITUDE ______ LATITUDE ______

OCTANT ______ LONGITUDE ______

MINUTE 34

ALTITUDE ______ LATITUDE ______

OCTANT ______ LONGITUDE ______

MINUTE 36

ALTITUDE ______ LATITUDE ______

OCTANT ______ LONGITUDE ______

MINUTE 38

ALTITUDE ______ LATITUDE ______

OCTANT ______ LONGITUDE ______

* *

ANSWER:

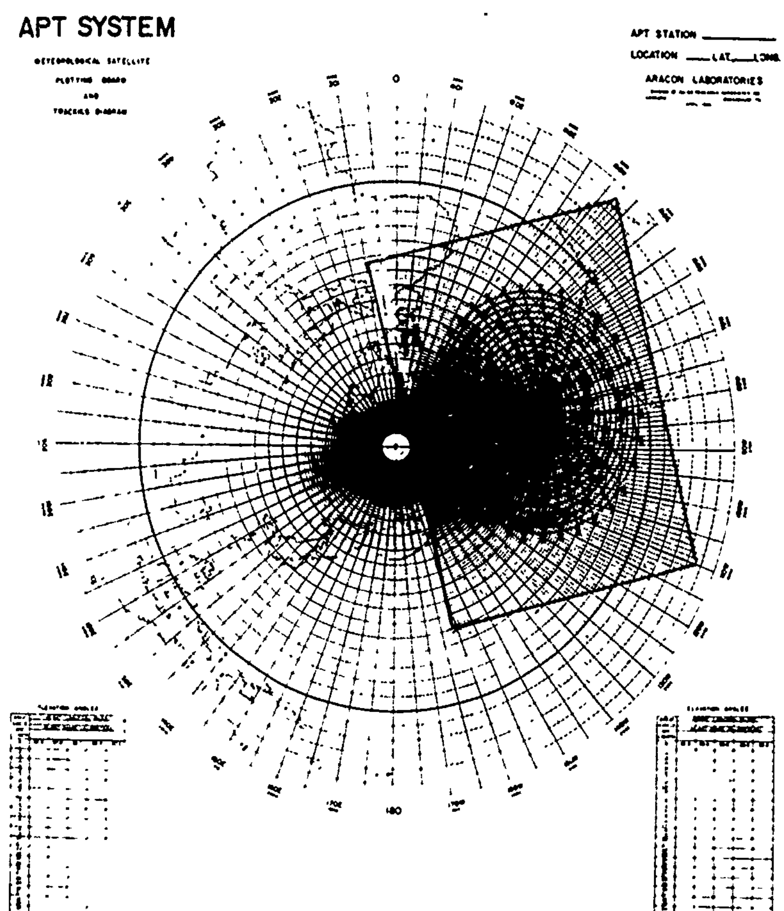
MIN 24		MIN 26		MIN 32	
ALT.	1420	ALT.	1420	ALT.	1430
OCT.	2	OCT.	3	OCT.	0
LAT.	71.8N	LAT.	76.0N	LAT.	74.0N
LONG.	90.2E	LONG.	72.6E	LONG.	7.6W

FRAME 50 (CONTD.)

MIN 34		MIN 36		MIN 38	
ALT.	1430	ALT.	1430	ALT.	1430
OCT.	0	OCT.	0	OCT.	0
LAT.	69.2N	LAT.	63.8N	LAT.	58.1N
LONG.	21.1W	LONG.	29.7W	LONG.	35.6W

FRAME 51

Now we will use this data to plot the actual satellite track. First, place your plotting board beside this program. Then obtain a grease pencil; a 2-inch piece of both scotch tape and masking tape, and a tracking diagram for 40°N, if there is not one already on your board. Lift up the clear plastic overlay; take the tracking diagram and center it on your station on the plotting board. (In this example, we are using 40°N - 74°W Lakehurst, N.J.) Be sure that you orient the "0" radial of the diagram towards true north on the plotting board. (See diagram below.) Tape the diagram with scotch tape to the board.



FRAME 51 (CONT.D.)

If you are at a land station, the previous operation will be done only whe   ›u receive a new plotting board. However, if you are aboard ship, you will have to choose the "correct" diagram. They are made up for every 5^{o} latitude and relocate daily to the position of the ship.

********************NO RESPONSE NECESSARY********************

FRAME 52

Now we will plot an actual satellite track. Using the message below and the instructions following it. Plot the information provided on the Night Part II track of NOAA 4.

APT PREDICT

1222 NOAA 4

PART I

00466 02221 03140 01283 T1500 L2875

04700 51141 12783

04741 25141 21715

04782 03141 30215

NIGHT PART II

02460 061146 04460 123164 06460 184182 08460 245202 10460 306223
12460 367247 14460 428273 16460 488305 18460 547343 20460 605392
22460 660461 24460 712563 26460 755728 28461 780987 30461 776292
32461 745524 34461 699669 36451 645760

FRAME 52 (CONTD.)

NIGHT PART III

02465 061110 04465 122092 06465 184073 08465 245054 10475 306032

12475 367009 14478 427016 16478 487047 18488 546085 20488 603134

22488 659202

DAY PART II

38452 589777 40452 531731 42452 471695 44452 411665 46452 350640

48442 289617 50442 228596 52442 166577 54442 105558 56442 043540

DAY PART III

58447 018522 60457 080504 62457 141486 64457 203467 66457 264447

68467 325425 70467 386401 72467 446373 74477 506340 76477 564299

78477 621245 80477 676169 82487 726053 84488 765864 86488 783583

88488 770290 90488 733085 92485 685040 94485 631121

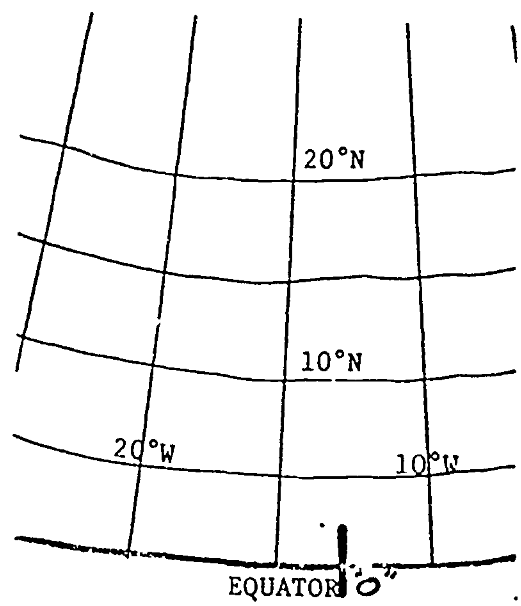
* *

ANSWER: See the diagram in Frame 53 for a comparison of your plotted track.

FRAME 53

First plot the ascending node longitude of R at the equator on the overlay (remember this is given in Part I). With a grease pencil make a line on the equator about 3/4 of an inch at 12.83°W, the ascending node longitude. (See the diagram on the following page.) This mark we call Point "O."

FRAME 53 (CONTD.)

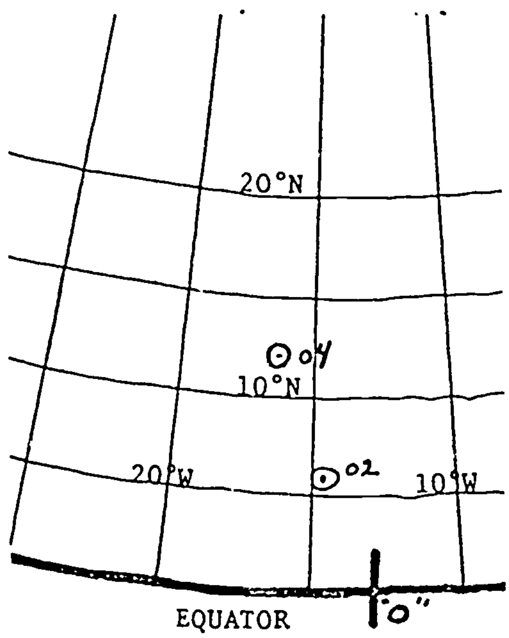


Now, we will plot the track of the satellite over the Northern Hemisphere given in Part II. The steps for doing this are:

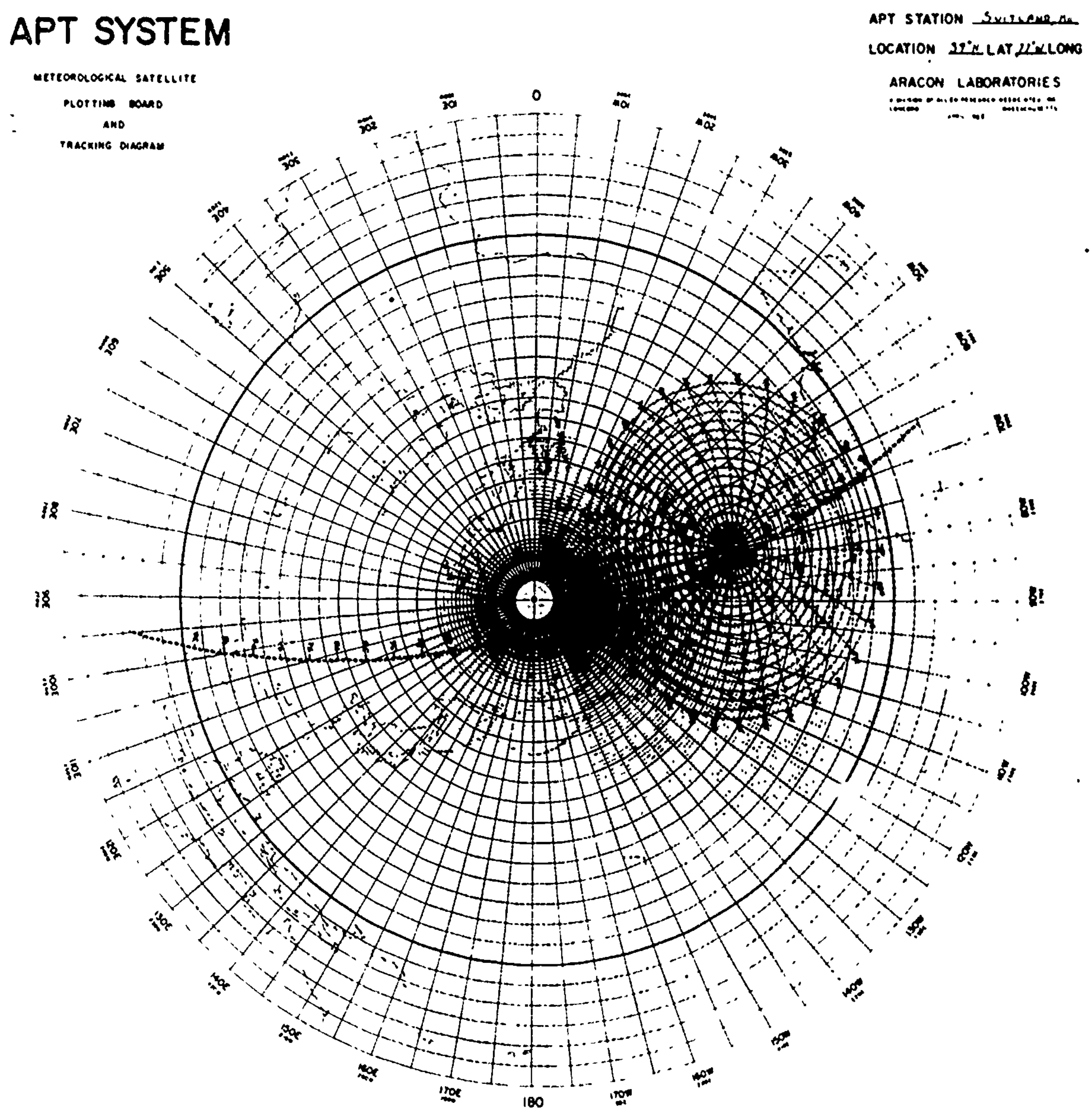
1. Decode the position for the subpoint.
2. Locate this position on the plotting overlay.
3. Make a small dot at this position.
4. Circle the dot.
5. Write the minutes past ascending node beside the circle.

FRAME 53 (CONTD.)

The first encoded subpoint position in Night Part II is 02460 061146. When decoded, this gives a position of 6.1°N and 14.6°W or in other words slightly north and west of Point "O." (See the diagram below.) Minute 04 is located at 12.3°N 16.4°W and plotted in the same manner.



FRAME 53 (CONTD.)



NOTE: The track shown here is not the track that you are plotting, but yours should have a similar appearance.

FRAME 54

Now, in the same diagram, plot the Day Part II data in the same manner at minute 38 which is at 58.9°N and 177.7°E. When you have plotted all the points for Part II Day and Night, label as being day or night, and place the satellite's name and series number along the track. Again, compare your completed plot to the one in Frame 53.

Let's review the procedure for plotting a SATELLITE TRACK.

1. Select the correct Tracking Diagram for your latitude.
2. Center the Tracking Diagram over your station's latitude on the Plotting Board and securely tape down.
3. Tape down the Plotting Overlay.
4. Determine the ascending node longitude from Part I and draw a line on the overlay at this point on the Plotting Overlay. (Point "O")
5. Starting with minute 02 in Part II Night, plot all of the subpoints in both night and day Part II.
6. Complete by labeling the track as to night and day and satellite number.

*********************NO RESPONSE NECESSARY********************

FRAME 55

Although the ESSA 8 satellite is no longer in use, for additional practice in plotting a track, use the tracking diagram given, and plot Day Part II for ESSA 8 from the following message.

APT PREDICT

1103 ESSA 8

PART I

06977 00312 05443 23471 T1442 L2867

69812 03332 32000

69850 41220 19469

69891 15109 25059

NIGHT PART II

02422 062329 04422 124311 06422 186292 08422 247273 10422 309251
12422 371228 14422 432201 16422 492170 18422 552131 20422 610080
22422 666009 24422 718902 26423 760726 28423 783452 30433 775145
32430 740076

NIGHT PART III

02437 061364 04437 123382 06447 185401 08447 247420 10457 308442
12457 369465 14467 429491 16467 489522 18477 548560 20477 606609
22487 661677 24487 713778 26486 756658

DAY PART II

34430 692211 36430 638297 38430 581356 40430 522400 42430 462434
44430 401463 46430 340488 48440 279510 50440 217531 52440 156550
54440 094568 56450 032586

FRAME 55 (CONTD.)

DAY PART III

58455 028603 60455 090621 62465 151639 61465 213658 66465 274678

68475 335700 70475 395724 72485 455752 74485 514786 76485 573828

78485 630884 80496 684963 82496 732085 84496 770286 86496 784578

88487 768734 90487 729540

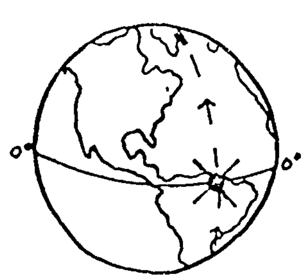
* *

ANSWER: Compare your plot with the plot in Frame 53 to check for accuracy.

FRAME 56

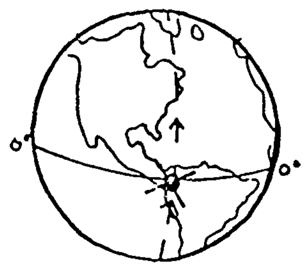
Once a given satellite track is plotted, it is good as long the satellite is operational.

The actual satellite orbit always remains the same, only the earth turns beneath the orbiting satellite.



FRAME 56 (CONTD.)

The diagram on the preceding page shows a satellite moving north on reference orbit. Ascending node is over eastern South America.



Now one orbit later, the earth has turned about 30° of longitude (one nodal increment) and the satellite is crossing over western South America. But the important thing to note is that the actual satellite orbit is the same. Therefore all you need to know in order to obtain the complete track for any orbit is the ascending node longitude.

********************NO RESPONSE NECESSARY********************

FRAME 57

By rotating the plotted track to each of the ascending node longitudes, you can display the track for each orbit of the day. However, you do not need every orbit since you can receive data from the satellite only when it is within your area of reception. Your next problem then is to determine from which orbit you can receive data. To do this, turn the plotting overlay until point "0" in the plotting overlay is over the ascending node longitude of R. See if at least 4 plotted points fall within the outer circle of the tracking diagram centered at your station. If it does, this is an orbit worth tracking.

NOTE: Four plotted points (8 minutes) is usually considered to be the minimum amount of time required to receive a usable picture. This requirement may be different at other stations.

*********************NO RESPONSE NECESSARY*********************

FRAME 58

Let's review the procedure for determining if an orbit can be received at your station. Remember, once the satellite's track has been plotted on the tracking overlay from Parts II and III of the APT Predict Message, the plot can be used as long as the satellite is operational.

To find out if any orbit can be received:

a. Determine the orbit's ascending node longitude.

FRAME 58 (CONTD.)

b. Rotate the plotting overlay so that minute 0 (the line drawn at the equator on the overlay) is over the ascending node longitude of the orbit.

c. Check to see if at least 4 plotted points (8 minutes) of the orbit fall within the concentric circles printed on the tracking diagram.

********************NO RESPONSE NECESSARY********************

FRAME 59

In order to track and receive a satellite pass, you must know where to point the antenna. This is accomplished by knowing the satellite's azimuth (direction from your station) and elevation (angle above the horizon). This information is entered on the Tracking Worksheet (the short worksheet at the end of the program). A new tracking worksheet is needed for every orbit you want to track. The next several pages will instruct you on entering the columns on the worksheet.

********************NO RESPONSE NECESSARY********************

FRAME 60

First, fill out the heading of your tracking worksheet. For the following examples, use the APT Worksheet for ESSA 8 that you completed in Frame 43. Now, fill out the heading on your tracking worksheet for orbit R+1 of ESSA 8.

* *

FRAME 60 (CONTD.)

ANSWER:

TRACKING WORKSHEET

DATE OF ORBIT November 03

SATELLITE ESSA 8 ASCENDING NODE TIME 1:54:42

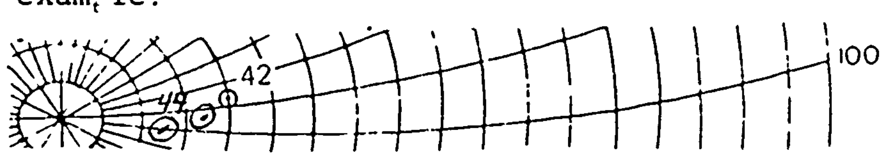
ORBIT NUMBER 978 (R+1) ASCENDING NODE LONGITUDE 106.04E

FRAME 61

The following steps must be completed in the order presented here to obtain the azimuth and elevation angles for any orbit.

a. From the plotting overlay determine all plotted minutes that fall within the outermost circle on the tracking diagram and write the minutes in the extreme left column (time AAN) of the tracking worksheet. Also include the minute that is closest to the station if it is not one of the minutes already listed.

For example:



Minute 43 would be included in this example because it is when the satellite is closest to the station. Finally include the minute when the satellite first crosses into and leaves the tracing diagram. In some cases this will be a minute between the plotted minutes.

FRAME 61 (CONTD.)

On your tracking worksheet, this will be filled in as follows:

TIME AAN MIN	TIME Z HR MIN SEC	AZIMUTH DEGREES	ALTITUDE KM
42			
43			
44			

*********************NO RESPONSE NECESSARY*********************

FRAME 62

To enter the time in the (Z) columns, you must add the minutes you listed in the time (AAN) you are tracking. For example, if the orbit you are tracking has an ascending node time of 14:49:25 and the next receivable minutes are 33, 34, and 36, compute the information as follows:

Orbit ascending node time	14:49:25
ADD 1st receivable min.	+ 33
Time (Z) for min. 33	15:22:25
ADD 1 min. (33+1=34th min.)	+ 1
Time (Z) for min. 34	15:23:25
ADD 2 min. (34+2=36th min)	2
Time (Z) for min. 36	15:25:25

This information is entered on your tracking worksheet as shown below:

TIME AAN MIN	TIME (Z) HR MIN SEC
33	15:22:25
34	15:23:25
36	15:25:25

What is the time of the 35th minute?

* *

FRAME 62 (CONTD.)

ANSWER: 15:24:25

FRAME 63

You are tracking orbit R+2 of NOAA 4. Using your APT Worksheet from Frame 43, enter the heading, time (AAN), and time (Z) for minutes 24, 26, 28, 29 and 30 after the ascending node time. (Use one of the worksheets at the end of the program).

* *

ANSWER:

TRACKING WORKSHEET

DATE OF ORBIT DECEMBER 22

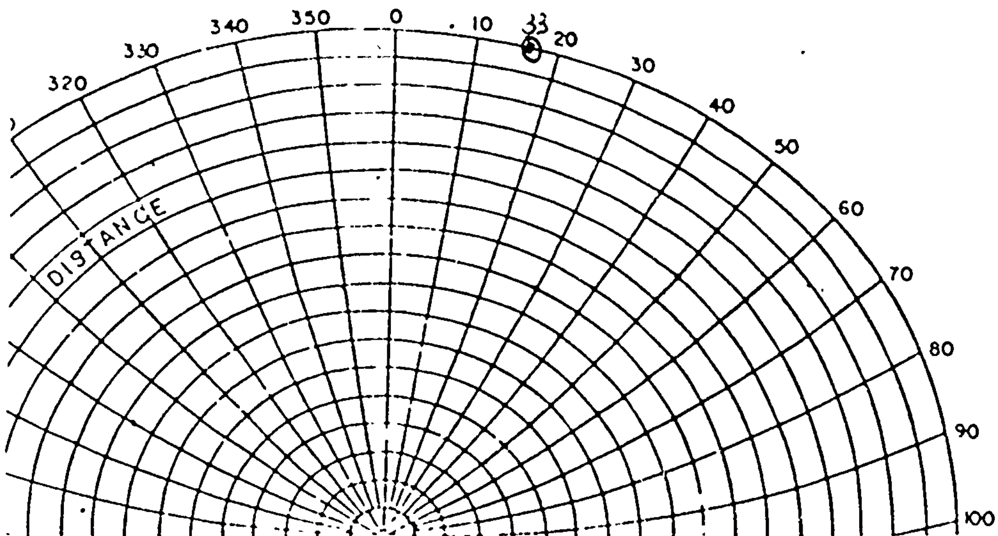
SATELLITE NOAA 4 — ASCENDING NODE TIME 01:24:40

ORBIT NUMBER 468 (R+2) — ASCENDING NODE LONGITUDE 70.33 W

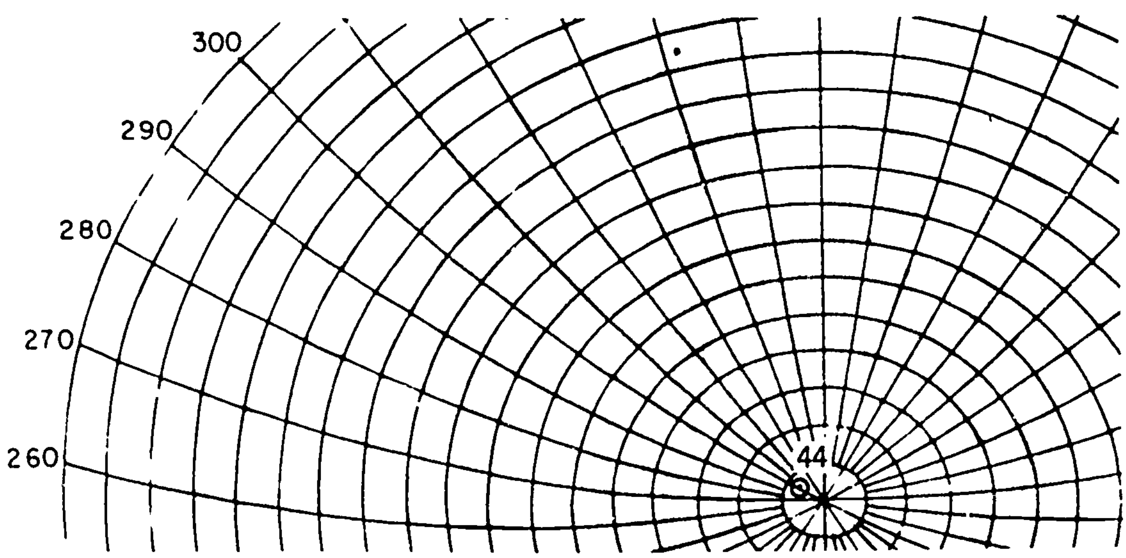
TIME AAN Min.	TIME Z Hr Min Sec	AZIMUTH Degrees	ARC LENGTH	ALTITUDE Km	ELEVATION Degrees	PICTURE EVENT Time
24	01:48:40					
26	01:50:40					
28	01:52:40					
29	01:53:40					
30	01:55:40					

FRAME 64

The azimuth angle is the easier of the two angles to determine. To find this angle, use the radial lines as shown on the tracking diagrams in the following examples:



The 33rd minute is a little more than halfway between 10 and 20 degrees; therefore, the azimuth minute 33 is approximately 16^{o}.



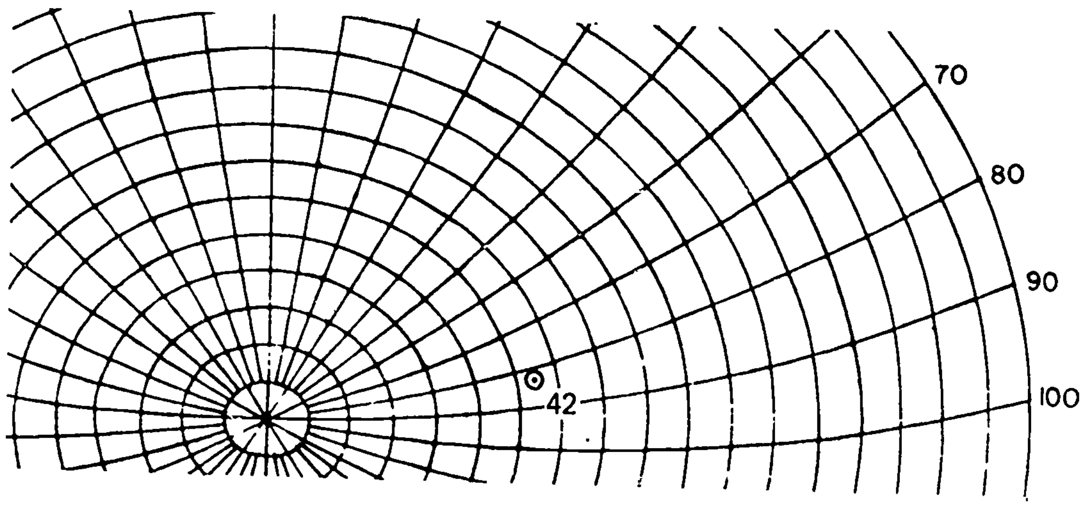
Minute 44 is right on the 300 degree radial; therefore, the azimuth for minute 44 is 300^{o}. Follow this procedure for all receivable minutes. Enter data in azimuth column on tracking worksheet.

FRAME 64 (CONTD.)

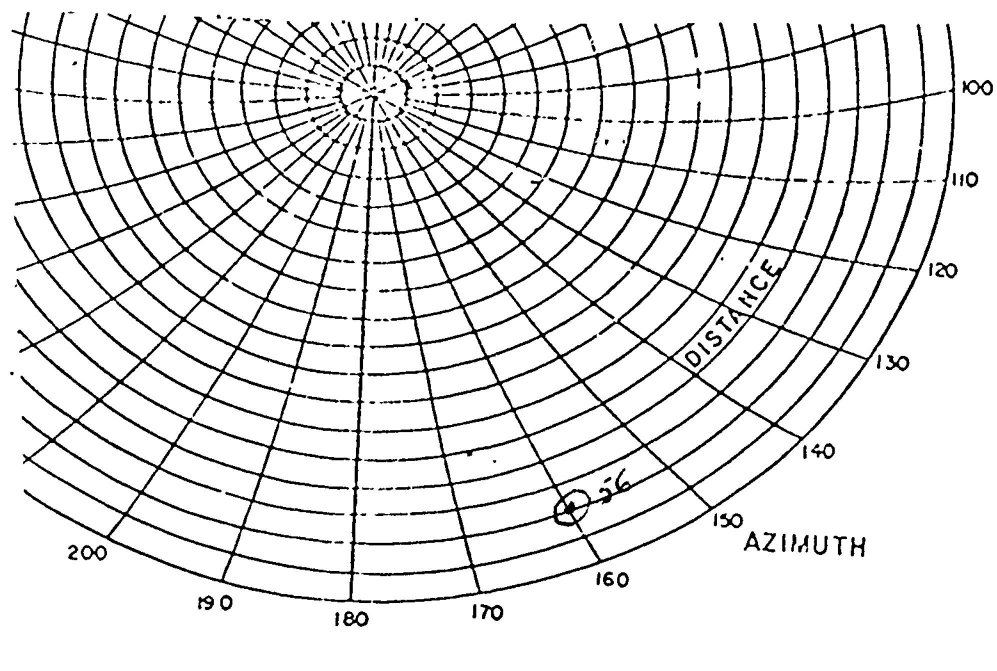
Determine the azimuth angle(s) for the following examples.

(NOTE: If the plotted minute is between two radials, estimate the azimuth angle.)

1.

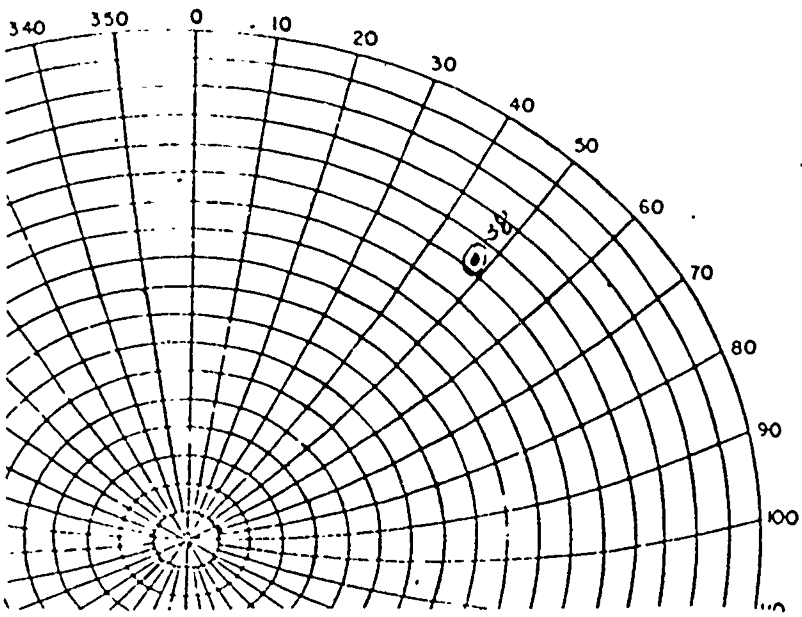


2.



FRAME 64 (CONTD.)

3.



* *

ANSWER: 1. 83°

2. 160°

3. 47°

FRAME 65

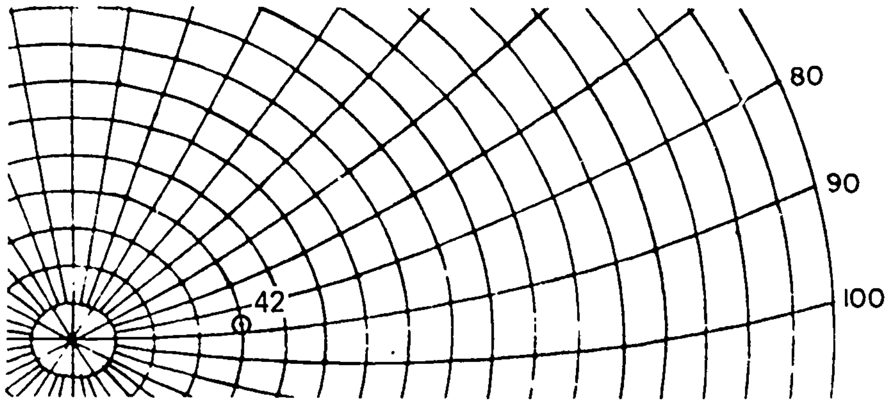
The next column entitled Arc Length is the number of the concentric circle that the minute is plotted on. Number the concentric circles beginning with 2 (the innermost) and ending with 36 (the outermost). You must interpolate to the nearest whole number.

EXAMPLE: We said earlier that minute 33 was on the outermost circle; therefore, the arc length for minute 33 is 36. For minute 44 the plotted minute is about halfway between 0 and the circle labeled "2." Therefore, the arc length for minute 44 would be "1."

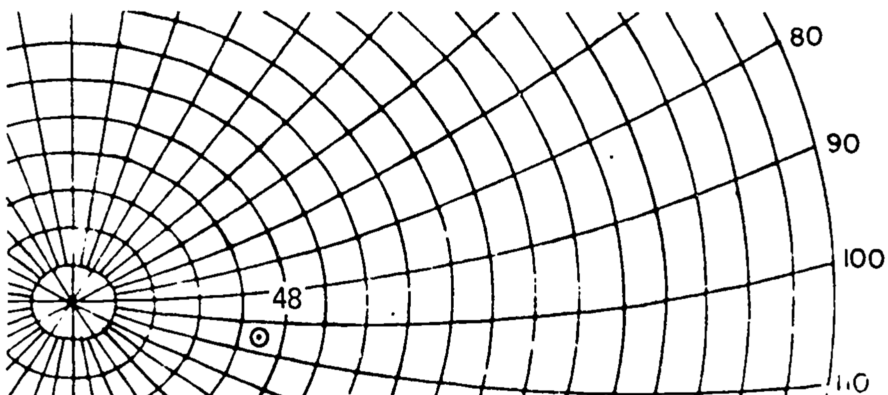
FRAME 65 (CONTD.)

Follow this procedure for all the receivable minutes.

EXAMPLE:

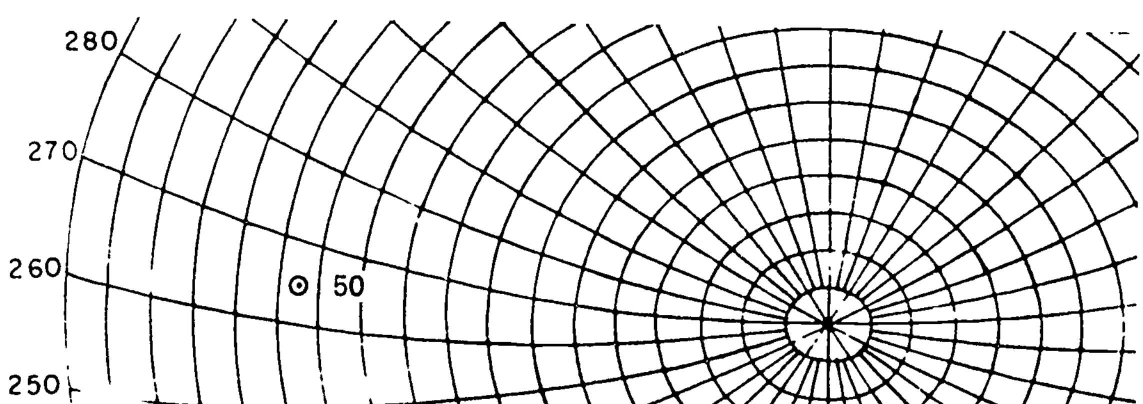


Exactly 8 arc lengths.



9 arc lengths

How many arc lengths are represented by minute 50? ____________



* *

FRAME 65 (CONTD.)

ANSWER: 23 arc lengths

FRAME 66

The next column, altitude, is obtained from the APT message. For each of the receivable minutes, determine the altitude from Part II of the APT predict. For example, the altitude of minute 33 is encoded as "43" which means that the figure you will place in the altitude column for that minute would be 1430 KM. Do this for all receivable minutes.

What is the satellite's altitude that is encoded here?

28530 389150 ____________

* *

ANSWER: 1530 KM

FRAME 67

Now using the arc length, the altitude and table found on the following page, determine the elevation angle for each minute. Minute 33 with an altitude of 1430 and an arc length of 36 gives an elevation angle of 0 degrees. Minute 44 has an arc length of "1," an altitude of 1430 KM. Therefore, its elevation angle is 84. These two examples are underlined on the following page. What would the elevation angle be if the altitude was 1480 kilometers and the arc length was 10? __________

* *

FRAME 67 (CONTD.)

ANSWER: 45.1

ELEVATION ANGLE AS FUNCTION OF GREAT ARC LENGTH AND ALTITUDE

ARC LENGTH	ALTITUDE RANGE (KILOMETERS) 1367 to 1413	1414 to 1459	1460 to 1505
0	90.0	90.0	90.0
1	84.2	84.3	84.5
2	79.2	79.4	79.7
3	73.8	74.2	74.6
4	68.6	69.1	69.7
5	63.7	64.3	64.9
6	59.1	59.8	60.4
7	54.8	55.5	56.2
8	50.7	51.5	52.3
9	46.9	47.7	48.5
10	43.3	44.3	45.1
11	40.2	41.0	41.8
12	37.1	38.0	38.8
13	34.3	35.2	36.0
14	31.8	32.6	33.4
15	29.3	30.1	30.9
16	27.0	27.8	28.6
17	24.9	25.7	26.4
18	22.8	23.6	24.4
19	21.0	21.7	22.4
20	19.2	19.9	20.6
21	17.4	18.2	18.8
22	15.8	16.5	17.2
23	14.3	15.0	15.6
24	12.8	13.5	14.1
25	11.4	12.0	12.7
26	10.1	10.7	11.3
27	8.8	9.4	10.0
28	7.5	8.1	8.7
29	6.3	6.9	7.4
30	5.1	5.7	6.2
31	4.0	4.5	5.1
32	2.9	3.4	4.0
33	1.9	2.4	2.9
34	.8	1.3	1.8
35	0.0	.3	.8
36	0.0	0.0	0.0

FRAME 68

You now have all the information required to track a meteorological satellite with any type of ground equipment. The far right column of the worksheet, "Picture Event Time," will not be discussed in this programmed instruction.

********************NO RESPONSE NECESSARY********************

FRAME 69

Remember, the satellite track is usually plotted only once, i.e., when the satellite is launched. Therefore, you basically have three major steps for obtaining satellite tracking data.

a. Work up an APT Predict Worksheet for the day.

b. Using the ascending node longitude data from the APT Predict Worksheet, determine which orbits you can track.

c. Complete a tracking worksheet for each orbit you want to track.

********************NO RESPONSE NECESSARY********************

FRAME 70

So far, this program has covered a significant amount of material. As a review, answer the questions on the following page:

FRAME 70 (CONT'D.)

a. Where in the APT Predict Message do you find the ascending node longitude for reference orbit? ____________________

b. Where in the APT Predict Message would you find the position points for the track of reference orbit? ____________

c. The encoded group T1442 means the satellite has a period of ____ min ___ sec and converts to ____ hr ____ min ___ sec

d. If reference orbit has an ascending node longitude of $5.28^{\circ}E$ and the satellite's increment is 28.67°, what would be the ascending node longitude of R+1? ____________________

e. How do you determine if you can receive data from a satellite on a given orbit? ______________________________

____

f. What angle is read directly from the tracking overlay?

____

g. To determine elevation angle, you must have: 1. __________ ____________ 2. ______________ and Table 5.

* *

ANSWER:

a. Part I

b. Parts II and III

c. 114 minutes 42 sec or 1 hour 54 minutes 42 seconds

d. $23.29^{\circ}W$

e. If at least 4 plotted points (8 minutes) fall within the outer oval of the tracking diagram.

f. azimuth

g. 1. Great circle arc length. 2. altitude

FRAME 71

1. Complete an APT Worksheet for the message below:

APT Predict

0112 NOAA 4

PART I

00729 01221 03708 01417 T1500 L2875

07330 51708 12917

07371 25709 21582

07412 03709 30082

NIGHT PART II

02450 061159 04450 123177 06450 184196 08450 246216 10450 307237

12450 368260 14450 428287 16450 488318 18450 547357 20450 605406

22450 661475 24450 713578 26450 756744 28451 781005 30451 776310

32451 744541 34451 698684 36451 645774

NIGHT PART III

02465 061123 04465 123105 06465 184087 08465 245067 10475 306046

12475 367022 14478 427003 16478 487034 18488 546072 20488 603121

22488 659189 24488 710289

DAY PART II

38452 588763 40452 530717 42452 470681 44452 410651 46452 349626

48452 288603 50452 227582 52452 165563 54452 103545 56452 042527

DAY PART III

58457 019509 60457 081491 62457 142473 64467 204454 66467 265433

68467 326412 70467 386387 72477 447360 74477 506327 76477 565286

78487 622232 80487 676155 82487 726039 84488 765850 86488 783569

88488 770277 90488 733072 92485 685053 94485 631135

FRAME 71 (CONTD.)

2. Complete an APT Tracking Worksheet for R+2. Receivable minutes are: 02, 04, 06, 08, 10, 12, 14, 16, 18, 20, 22 and 24.

3. Complete an APT Tracking Worksheet for R+9. Receivable minutes are: 34, 36, 38, 40, 42, 44, 46, 48, 50, 52 and 54.

Check your answers on page 77 and 78 before continuing.

APT PREDICT MESSAGE WORKSHEET

Satellite: NOAA 4 Date: JANUARY 12

Nodal Period: 1:55:00 (Hr. Min. Sec.) Nodal Increment: 28.75° (Degree Hnd.)

Note. Ascending nodes progress westward around the globe. All longitude computations in east longitude must be subtracted. Those in west longitude are added.

Ascending Node Time	Hr. Min. Sec. (From Message)	Ascending Node Longitude	Degree Hnd. E/W
Orbit Number 729			
Reference orbit	21:37:08	Reference orbit	14.17°W
Plus one nodal per.	1:55:00	+ or - one nodal increment	28.75°
Reference orbit + 1	23:32:08	Reference orbit + 1	42.92°W
Plus one nodal per.	1:55:00	+ or - one nodal increment	28.75°
Reference orbit + 2	01:27:08	Reference orbit + 2	71.67°W
Plus one nodal per.	1:55:00	+ or - one nodal increment	28.75°
Reference orbit + 3	03:22:08	Reference orbit + 3	100.42°W
Orbit Number 733			
Reference orbit + 4	05:17:08	Reference orbit + 4	129.17°W
Plus one nodal per.	1:55:00	+ or - one nodal increment	28.75°
Reference orbit + 5	07:12:08	Reference orbit + 5	157.92°W
Plus one nodal per.	1:55:00	+ or - one nodal increment	28.75°
Reference orbit + 6	09:07:08	Reference orbit + 6	173.33°E
Plus one nodal per.	1:55:00	+ or - one nodal increment	28.75°
Reference orbit + 7	11:02:08	Reference orbit + 7	144.58°E
Orbit Number 737			
Reference orbit + 8	12:57:09	Reference orbit + 8	115.82°E
Plus one nodal per.	1:55:00	+ or - one nodal increment	28.75°
Reference orbit + 9	14:52:09	Reference orbit + 9	87.07°E
Plus one nodal per.	1:55:00	+ or - one nodal increment	28.75°
Reference orbit + 10	16:47:09	Reference orbit + 10	58.32°E
Plus one nodal per.	1:55:00	+ or - one nodal increment	28.75°
Reference orbit + 11	18:42:09	Reference orbit + 11	29.57°
Orbit Number 741			
Reference orbit + 12	20:37:09	Reference orbit + 12	00.82°E

TRACKING WORKSHEET

DATE OF ORBIT 1-13

SATELLITE NOAA 4 ASCENDING NODE TIME 01:27:08

ORBIT NUMBER 731 (R+2) ASCENDING NODE LONGITUDE 71.67°W

TIME AAN Min.	TIME Z Hr Min Sec	AZIMUTH Degrees	ARC LENGTH	ALTITUDE Km	ELEVATION Degrees	PICTURE EVENT Time
02	01:29:08	154	36	1450	0.0	
04	01:31:08	153	30	1450	5.7	
06	01:33:08	152	24	1450	13.7	
08	01:35:08	150	18	1450	23.6	
10	01:37:08	145	11	1450	41.0	
12	01:39:08	128	05	1450	64.3	
14	01:41:08	29	03	1450	74.2	
16	01:43:08	355	09	1450	47.7	
18	01:45:08	348	15	1450	30.1	
20	01:47:08	347	22	1450	16.5	
22	01:49:08	3[illegible]5	28	1450	8.1	
24	01:51:08	345	34	1450	1.3	

TRACKING WORKSHEET

DATE OF ORBIT 1-13

SATELLITE NOAA 4

ORBIT NUMBER 737 (R + 9)

ASCENDING NODE TIME 14:52:09

ASCENDING NODE LONGITUDE 87.07°E

TIME AAN Min.	TIME Z Hr Min Sec	AZIMUTH Degrees	ARC LENGTH	ALTITUDE Km	ELEVATION Degrees	PICTURE EVENT Time
34	15:26:09	015	33	1450	2.4	
36	15:28:09	011	26	1450	10.7	
38	15:30:09	010	20	1450	19.9	
40	15:32:09	050	14	1450	32.6	
42	15:34:09	354	08	1450	51.5	
44	15:36:09	291	04	1450	69.1	
46	15:38:09	232	08	1450	51.5	
48	15:40:09	219	14	1450	32.6	
50	15:42:09	214	19	1450	21.7	
52	15:44:09	211	26	1450	10.7	
54	15:46:09	210	32	1450	3.4	

FRAME 72

Part IV of the APT Message contains data on the high precision orbital elements, transmission frequencies and plain language remarks. A complete breakdown on the symbolic code is given in Appendix 2. (Normally land stations do not use this portion of the message.)

********************NO RESPONSE NECESSARY********************

FRAME 73

There is one other type of satellite information that is obtained in the APT Predict Message. The data under the heading TBUS 3 or TBUS 4 gives information on the transmission schedule of the geostationary weather satellites. These satellites are earth synchronous and receive and transmit data from weather centrals. An earth synchronous orbit occurs when the motion of a satellite

FRAME 73 (CONTD.)

is synchronized with the motion of the earth, so that the satellite will appear stationary in time and space. The data contained in TBUS 3 and 4 deal with satellites that remain in one position relative to the earth. These satellites are called ______________.

* *

ANSWER: geostationary

FRAME 74

Since these satellites are always in the same position, the only information an APT operator needs is when the satellite will be transmitting. This is what is contained in the TBUS 3 and 4 portions of the APT Message. The weather facsimile transmission from these satellites is called WEFAX.

Below is a sample TBUS 3 and an explanation of its parts.

TBUS KWBC 191900

This is the heading and is the same as all other APT Messages except the "3" and "4" designates an earth synchronous satellite.

ATS 4 WEFAX SCHEDULE

Satellite's Name Self-explanatory

SERIES Number

12 January

Date of schedule

0000 to 0100 GMT

1200 to 1245 GMT

Times that the satellite will be transmitting.

FRAME 74 (CONT'D.)

Answer the following questions concerning the WEFAX Message below:

TBUS 4

ATS 3 WEFAX SCHEDULE

12 January

0300 to 0345 GMT

0830 to 0915 GMT

A. The name and number of this earth synchronous orbit is

______________.

B. The times this satellite will be transmitting are

__________________ and ______________.

* *

ANSWER: A. ATS 3

B. 0300 to 0345 GMT

0830 to 0915 GMT

* * * THIS CONCLUDES THE PROGRAM * * *

Now turn the page to complete the Criterion Test.

THE APT PREDICT MESSAGE

CRITERION TEST

1. List in the spaces below the 3 uses of weather satellites.

   A.

   B.

   C.

2. On the diagram supplied below, label the satellite's

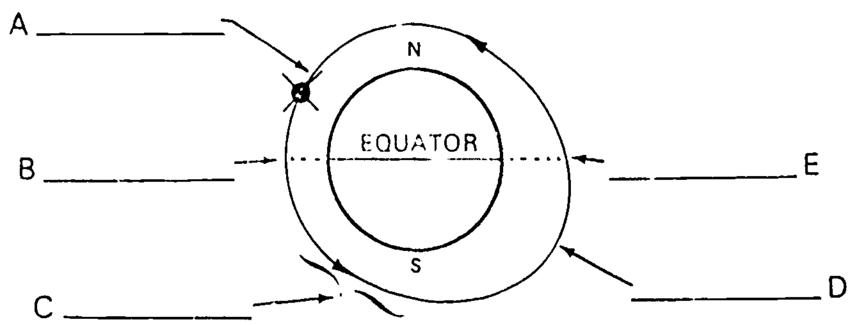
   a. Orbit

   b. Apogee

   c. Perigee

   d. Ascending node

   e. Descending node



CRITERION TEST (CONTD.)

3. From the given satellite terminology in Column A, select the corresponding definitions in Column B.

Column A

1. Polar orbit
2. Sun synchronous
3. Ascending node longitude
4. Ascending node time
5. Nodal period
6. Nodal increment
7. Orbit number
8. Subpoint/Principal Point

Column B

A. An orbit in which the satellite will always pass over the equator at the same sun time on each of its orbits.

B. An orbit such that the satellite would pass over (or very close to) both of the earth's poles.

C. The longitude of the satellite's principal point as it crosses the equator going from south to north.

D. The angle between the principal point axis and the subpoint axis measured at the camera.

E. Point on the earth's surface directly below the satellite and the point where the camera is focused.

F. Consecutive number assigned to orbits starting with the first ascending node after launch of the satellite.

G. Degrees of longitude between successive ascending nodes.

H. The time elapsing between successive passages of the satellite through the ascending nodes.

I. Time when the satellite passes the equator going from south to north.

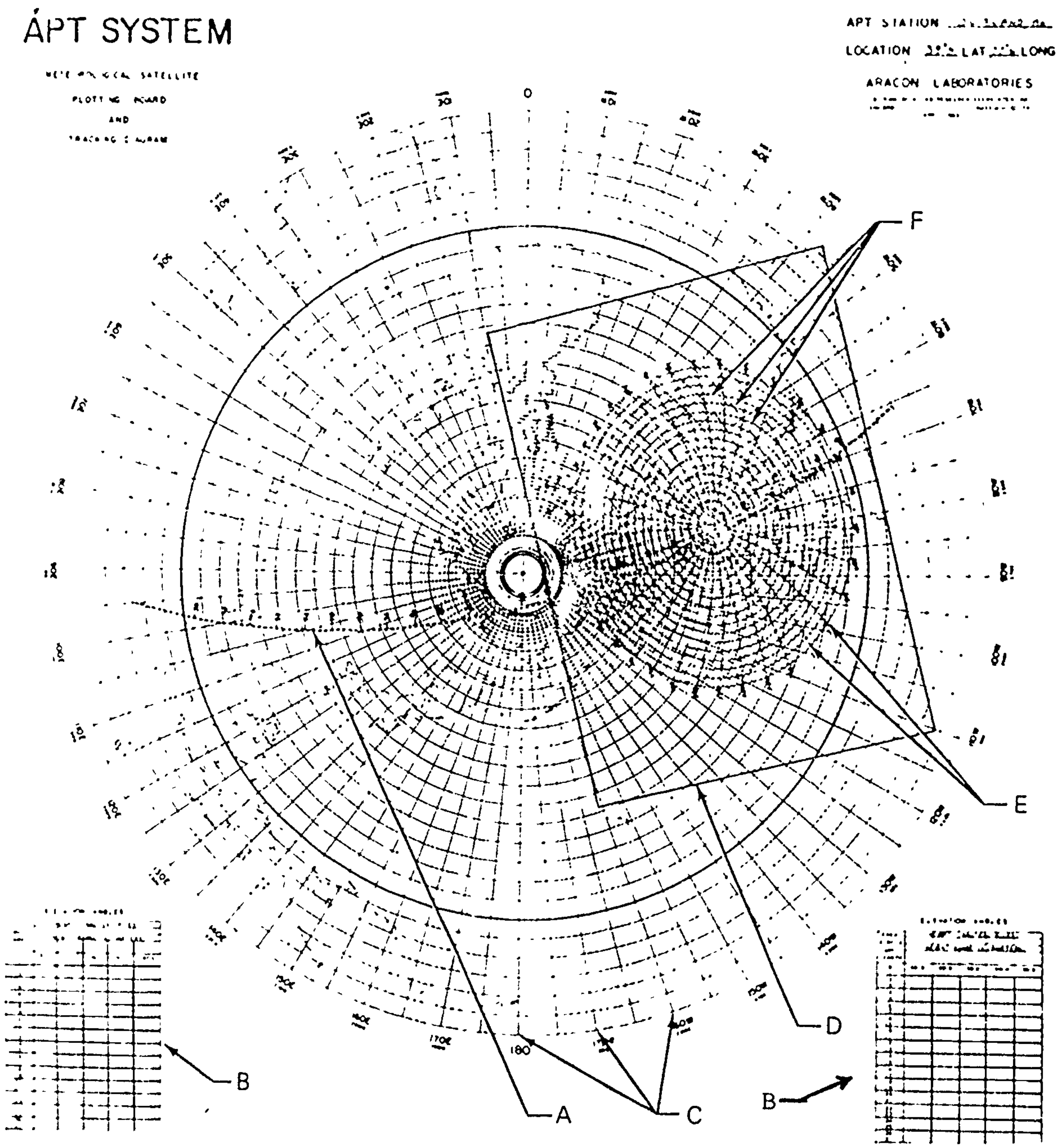
J. An orbit which keeps the satellite over the same spot on the earth's surface.

CRITERION TEST (CONTD.)

4. Define Tracking. ______________________________

____

5. Name and label the features/components of the APT Meteorological Satellite Plotting Board.



A ______________________ D ______________________

B ______________________ E ______________________

C ______________________ F ______________________

CRITERION TEST (CONTD.)

6. The weather message that supplies information in support of obtaining satellite tracking data is ________________ ____________ message.

7. From the APT message heading below answer questions A through C.

   TBUS 1 KWBC 031505

   APT PREDICT

   1205 NOAA 6

A. What day and time was the message transmitted?

____

B. What month and day is the message valid?

____

C. What is the series number of the satellite?

____

8. List the information contained in Part I of the APT Predict Message.

   1. ____________

   2. ____________

   3. ____________

   4. ____________

   5. ____________

CRITERION TEST (CONTD.)

9. From the given Part I of an APT Predict Message, answer questions A through E.

PART I

04489 00320 05716 00553 T1611 L2904

44930 44201 12171

44971 22646 22209

45012 01131 30590

A. What is the reference orbit number in the above message?

B. On which day of the month does the reference orbit occur?

____

C. What is the nodal period? ________________

D. What is the ascending node time of R+4? ________________

E. What is the ascending node time of R+8? ________________

10. Write the procedure for computing satellite nodal increments in the Eastern and Western Hemisphere. ________________

____

____

11. Correctly complete the APT Worksheet for the APT Predict Message on the following page.

CRITERION TEST (CONTD.)

TBUS KWBC 201900

APT PREDICT

082330 IROS

PART I

09596 02316 04047 01632 T0115 L2550

96002 32855 11835

96040 61703 23961

96081 30512 33758

DAY PART II

02860 069180 04860 139196 06860 209214 08860 279232 10860 349252

12860 418275 14860 487302 16860 555337 18860 622383 20860 686453

22860 748575 34860 796819 26861 808243 28851 774583 30851 718752

32852 654757 34852 549500

DAY PART III

02865 069148 04865 139131 06865 209114 08875 279096 10875 348076

12875 417053 14875 485026 16888 553007 18888 620053

NIGHT PART II

36852 520662 38852 40842 382606 4282[illegible] 311585 44842 46842 172548

48842 103531 50842 031515

NIGHT PART III

52847 038499 54857 108483 56057 178466 58857 248448 60857 318429

62167 387407 64687 456382 66871 525352 68776 592311 70877 658254

72887 721162 74887 776989 76888 809642 78888 795224 80885 746012

82883 686131 84885 621200 86885 554246

CRITERION TEST (CONTD.)

PART IV

2368008230000 910191610 000124 147995 205301 099004 722758

260108

APT TRANSMISSION FREQUENCY 137.62 MHZ.

HRPT TRANSMISSION FREQUENCY 1707 MHZ.

BEACON (SB) FREQUENCY 137.7 MHZ.

APT DAY/NIGHT ¼

12. Using the message on the previous page and above, decode minutes 08, 10, 12, and 14 of DAY PART II.

	MIN 08	MIN 10	MIN 12	MIN 14
Altitude				
Octant				
Latitude				
Longitude				

13. Using a blank plotting board diagram at the end of this program, plot the subpoint track for DAY PART II from the the message given in Question 11.

14. From the receivable minutes given below, complete a tracking worksheet for orbit R+3 from the IROS message in Question 11.

    DAY PART II R+3 02, 04, 06, 08, 10, 12, 14, 16, 18, 20

15. Using Part IV of the IROS message in Question 11, determine the satellite's APT Transmission Frequency ________________ ____________________.

THE APT PREDICT MESSAGE

CRITERION TEST ANSWERS

1. A. Cloud observation

   B. Weather communications

   C. Scientific research (Any order)

2. 1. (c)

   2. (d)

   3. (a)

   4. (e)

   5. (b)

3. 1. B

   2. A

   3. C

   4. J

   5. I

   6. H

   7. G

   8. F

4. A procedure that keeps the receiving ground equipment antenna aimed at the satellite. (Or words to that effect)

5. A. Track D. Tracking Diagram

   B. Data Block E. Azimuth

   C. Longitude F. Great Circle Arc Length

6. APT Predict Message

CRITERION TEST ANSWERS (CONTD.)

7. A. 3rd, 1505Z

   B. December 5th

   C. NOAA 6

8. 1. Nodal increment

   2. Nodal period

   3. Ascending node longitude

   4. Orbit number

   5. Ascending node time

9. A. 4489

   B. 3rd

   C. 116 min 11 sec, or 1 hr 56 min 11 sec

   D. 04:42:01Z

   E. 122.00°E

10. In the Eastern Hemisphere, one nodal increment is added for each successive orbit, and one is subtracted in the Western Hemisphere.

(Or words to that effect)

11. See page 96.

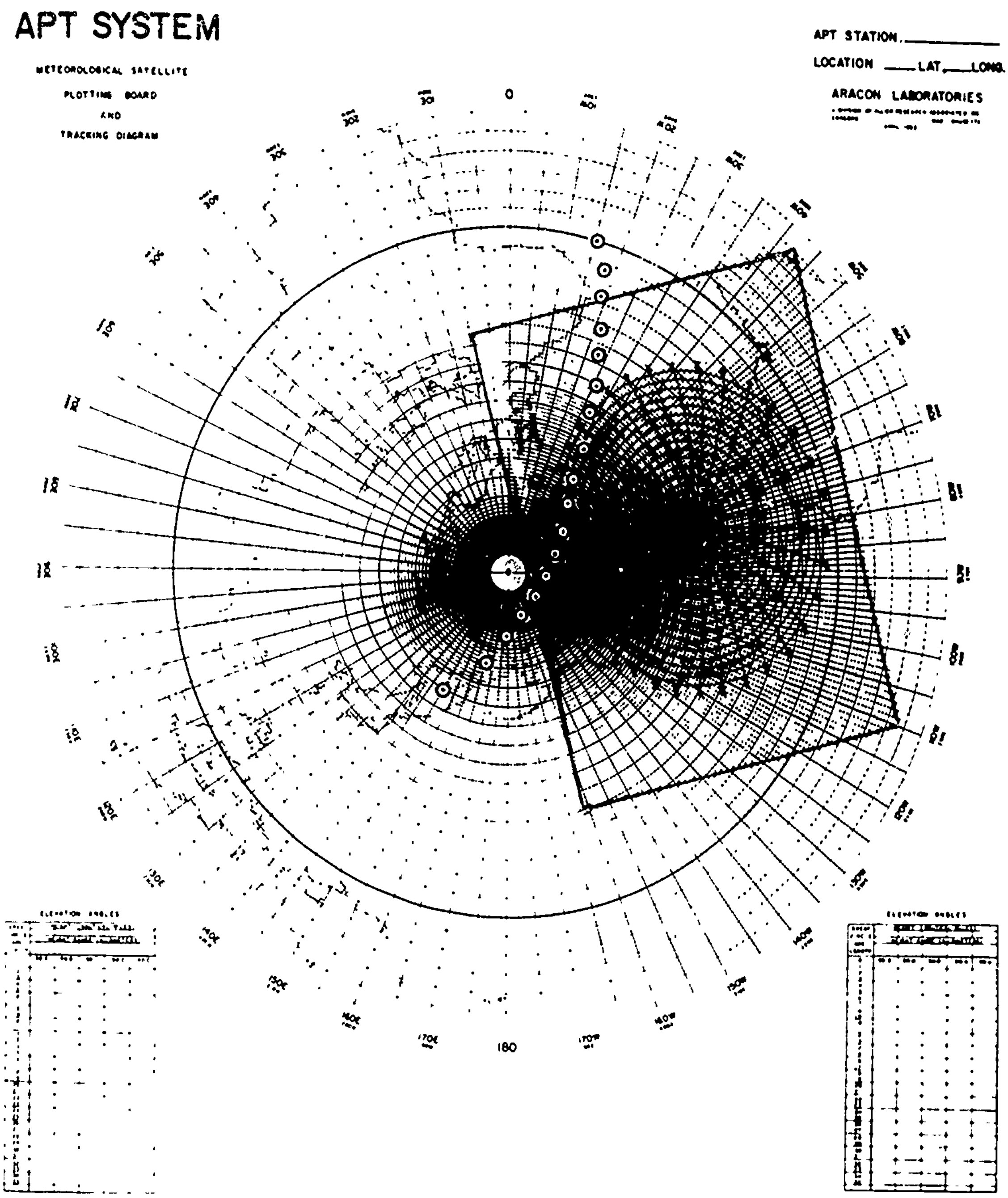
12.	MIN 08	MIN 10	MIN 12	MIN 14
Altitude	1860	1860	1860	1860
Octant	0	0	0	0
Latitude	27.9N	34.9N	41.8N	48.7N
Longitude	23.2W	25.2W	27.5W	30.2W

CRITERION TEST ANSWERS (CONTD.)

13. See page 95.

14. See page 97.

15. 137.62 MHZ


APT SYSTEM
METEOROLOGICAL SATELLITE
PLOTTING BOARD
AND
TRACKING DIAGRAM
APT STATION
LOCATION LAT LONG
ARACON LABORATORIES
0
180

APT PREDICT MESSAGE WORKSHEET

Satellite: TIROS Date: 8-23

Nodal Period: 1 : 41 : 15 (Hr. Min Sec.) Nodal Increment: 25 . 50 (Degree Hnd.)

Note: Ascending nodes progress westward around the globe. All longitude computations in east longitude must be subtracted. Those in west longitude are added.

Ascending Node Time	Hr. Min. Sec.	Ascending Node Longitude (From Message)	Degree Hnd. E/W
Orbit Number 596			
Reference orbit	16:40:47	Reference orbit	16.32 W
Plus one nodal per.	1:41:15	+ or - one nodal increment	25.50
Reference orbit + 1	18:22:02	Reference orbit + 1	41.82 W
Plus one nodal per.	1:41:15	+ or - one nodal increment	25.50
Reference orbit + 2	20:03:17	Reference orbit + 2	67.50 W
Plus one nodal per.	1:41:15	+ or - one nodal increment	25.50
Reference orbit + 3	21:44:32	Reference orbit + 3	92.82 W
Orbit Number 600	Hr. Min. Sec.	(From Message)	Degree Hnd. E/W
Reference orbit + 4	23:28:15	Reference orbit + 4	118.35 W
Plus one nodal per.	1:41:15	+ or - one nodal increment	25.50
Reference orbit + 5	01:10:10	Reference orbit + 5	143.85 W
Plus one nodal per.	1:41:15	+ or - one nodal increment	25.50
Reference orbit + 6	02:51:25	Reference orbit + 6	169.35 W
Plus one nodal per.	1:41:15	+ or - one nodal increment	25.50
Reference orbit + 7	04:32:40	Reference orbit + 7	165.15 E
Orbit Number 604	Hr. Min. Sec.	(From Message)	Degree Hnd. E/W
Reference orbit + 8	06:17:03	Reference orbit 8	139.61 E
Plus one nodal per.	1:41:15	+ or - one nodal increment	25.50
Reference orbit + 9	07:58:18	Reference orbit + 9	114.15 E
Plus one nodal per.	1:41:15	+ or - one nodal increment	25.50
Reference orbit + 10	09:39:33	Reference orbit + 10	88.65 E
Plus one nodal per.	1:41:15	+ or - one nodal increment	25.50
Reference orbit + 11	11:20:48	Reference orbit + 11	63.15 E
Orbit Number 608	Hr. Min. Sec.	(From Message)	Degree Hnd. E/W
Reference orbit + 12	13:05:02	Reference orbit + 12	37.58 E

TRACKING WORKSHEET

DATE OF ORBIT 8-23

SATELLITE IROS

ORBIT NUMBER 596 (R+3)

ASCENDING NODE TIME 21:44:32

ASCENDING NODE LONGITUDE 12.32°W

TIME AAN Min.	TIME Z Hr Min Sec	AZIMUTH Degrees	ARC LENGTH	ALTITUDE Km	ELEVATION Degrees	PICTURE EVENT Time
02	21:46:32	193	35	1860	.8	
04	21:48:32	200	28	1860	8.7	
06	21:50:32	210	22	1860	17.2	
08	21:52:32	225	16	1860	28.6	
10	21:54:32	250	13	1860	36.0	
12	21:56:32	280	13	1860	36.0	
14	21:58:32	308	17	1860	26.4	
16	22:00:32	320	22	1860	17.2	
18	22:02:32	330	28	1860	8.7	
20	22:04:32	335	34	1860	1.8	

APT PREDICT MESSAGE WORKSHEET

Satellite.______________ Date:________________

Nodal Period.______________ Hr. Min. Sec. Nodal Increment:____________ Degree Hnd.

Note: Ascending nodes progress westward around the globe. All longitude computations in east longitude must be subtracted. Those in west longitude are added.

Ascending Node Time		Ascending Node Longitude	
Orbit Number____	Hr. Min. Sec. (From Message)		Degree Hnd. E/W
Reference orbit		Reference orbit	
Plus one nodal per.		+ or - one nodal increment	
Reference orbit + 1		Reference orbit + 1	
Plus one nodal per.		+ or - one nodal increment	
Reference orbit + 2		Reference orbit + 2	
Plus one nodal per.		+ or - one nodal increment	
Reference orbit + 3		Reference orbit + 3	
Orbit Number____	Hr. Min. Sec. (From Message)		Degree Hnd. E/W
Reference orbit + 4		Reference orbit + 4	
Plus one nodal per.		+ or - one nodal increment	
Reference orbit + 5		Reference orbit + 5	
Plus one nodal per.		+ or - one nodal increment	
Reference orbit + 6		Reference orbit + 6	
Plus one nodal per.		+ or - one nodal increment	
Reference orbit + 7		Reference orbit + 7	
Orbit Number____	Hr. Min. Sec. (From Message)		Degree Hnd. E/W
Reference orbit + 8		Reference orbit + 8	
Plus one nodal per.		+ or - one nodal increment	
Reference orbit + 9		Reference orbit + 9	
Plus one nodal per.		+ or - one nodal increment	
Reference orbit + 10		Reference orbit + 10	
Plus one nodal per.		+ or - one nodal increment	
Reference orbit + 11		Reference orbit + 11	
Orbit Number____	Hr. Min. Sec. (From Message)		Degree Hnd. E/W
Reference orbit + 12		Reference orbit + 12	

TRACKING WORKSHEET

DATE OF ORBIT________________

SATELLITE________________ ASCENDING NODE TIME________________

ORBIT NUMBER________________ ASCENDING NODE LONGITUDE________________

TIME AAN Min.	TIME Z Hr Min Sec	AZIMUTH Degrees	ARC LENGTH	ALTITUDE Km	ELEVATION Degrees	PICTURE EVENT Time

APPENDIX 1

The following is an encoded APT Message. This particular example is valid for NOAA 8 on 03JUN83 the major features of the message are decoded on the following pages.

```
RR KQNF
DE KAWN 011534Z JUL 83
ZUI KQNF UNKDTG
TBUS2 KWBC 301900
APT PREDICT
070332 NOAA   7
PART I
00450 00315 01113 00061 T0158 L2549
04542 15907 10258
04580 44701 25544
04621 13455 35347
DAY PART II
02840 070023 04840 140040 06840 210057
08840 280075 10840 350096 12840 420119
14840 489146 16850 557181 18850 625228
20850 690300 22850 750424 24860 797675
26861 808103 28861 772435 30861 716599
32861 652687 34861 586742 36861 518781
38862 449787
DAY PART III
02848 070008 04848 140C~5 06848 210042
08858 280060 10858 3500o0 12858 419107
14868 488131 16868 556165
NIGHT PART II
40862 380763 42862 311742 44862 241722
46862 171705 48862 101688 50862 031672
NIGHT PART III
52867 038656 54867 108640 56867 177623
58867 247605 60867 317586 62877 386565
64877 455540 66877 523509 68877 590469
70877 656413 72877 719322 74877 775152
76878 808810 78878 796389 80878 748147
82878 687026 84875 622043 86865 55089
88865 487124
PART IV
1981 059A 10386 180100599500 830629022451797 3128246
01019168 01019745 00134239 01691349 14371724 09899887
34325572 07224383 M058207323 P042730725 P000000242
P00696763 P00930511 P07344787 002181506 135132019 9449
0000499999 M00287648 P00100468 P00508650 SPARESPARE
```

FREQUENCIES APT 137.62 MHZ, HRPT 1707 MHZ, BEACON DSB 137.77 MHZ. APT DAY/NIGHT 2/4. APT VIS CH. 2 0.725 TO 1.10 MICROMETERS/ AND IR CH. 4/10.3 TO 11.3 MICROMETERS/ WILL BE XMTD CONTINUOUSLY.
DCS TIME DAY 115 72180.124
EFFECTIVE 6/7/83 at 00Z, NOAA 8 WILL REPLACE NOAA 6 AS THE OPERATIONAL MORNING DESCENDING S/C. NOAA 6 WILL BE IN A TEST PHASE UNTIL FURTHER NOTICE AND MAY OR MAY NOT BE TRANSMITTING USUABLE REALTIME DATA. REALTIME USER SHOULD NOT RELY ON NOAA 6 FOR DATA.

You may want to xerox a copy of this appendix for your convenience.

DECODED MESSAGE

PART I

00450 00315 01113 T0158 L2549

0450	Reference orbit
03	Day of the month
15011	Ascending node time (15:01:11) for orbit 0450
0	Octant 0 (90.0W - 0)
1113	11.13W (Equator crossing for orbit 0450 in Octant 0)
0158	Orbital period 101 minutes (101 min 58 sec, 1 hr, 51 min, 58 sec)
2549	Nodal longitude increment 25.49 degrees

04542 15907 10258

0454	R+4 Orbit number
215907	Ascending node time 21:59:07 for orbit 0454
1	Octant 1 (180 - 90.0W)
0258	102.58W (Equator crossing for orbit 0454)

04580 44701 25544 Decode in same manner as previous line of data

04621 13455 35347

DAY PART II

02840 070023 04840 140040

06840 210057 . . . . . . 38862 449787

02	2 minutes after equator crossing
84	Altitude 1840 KM
0	Octant 0 (90.0W - 0)
070	Latitude - 7.0N
023	Longitude 2.3W
04	4 minutes after equator crossing

84 Altitude 1840 KM

0 Octant 0 (90W - 0)

140 Latitude 14.0N

040 Longitude 4.0W

06840 . . . . . 38862 449787 Decode in the same manner as previous line of data

DAY PART III

02848 070008 04848 140025 Decode in the same manner as DAY PART II data

NIGHT PART II

40862 380763 42862 311742 Decode in the same manner as DAY PART II data
. . . . . 50862 031672

NIGHT PART III

52867 038656 54867 108640 . . . . . Decode in the same manner as DAY PART II data
88865 487124

NOTE 1

TBUS 1 - Northbound equator crossing takes place on nightside of orbit.

TUBS 2 - Northbound equator crossing takes place on day side of orbit.

NOTE 2

TBUS II DAY PART II (TBUS I NIGHT PART II)

DAY PART III NIGHT PART III

NIGHT PART II DAY PART II

NIGHT PART III DAY PART III

PART 4

1983 059A	Spacecraft identification (International designator)
10386	Orbit number at epoch
180100599500	Time of ascending node
830629022451797	Epoch, year, month, day, hour, minute, second (to three decimal places)
3128246	Greenwich hour angle
G1019168	Anomalistic period
01019745	Nodal period
00134239	Eccentricity
01691349	Augment of perigee
14371724	Right ascension of ascending node
09899887	Inclination
34325572	Mean an. naly
01224383	Semi r axis
M058207323	Sign a epoch x position component
P042730725	Sign and epoch 2 position component
P0069676B	Sign and epoch X, Y 2 velocity component
P00936511	Ballistic coefficient
P07344787	Daily solar flux value

002181506	90 day mean solar flux
135132019	Planetary magnetic index
9449	Drag modulation coefficient
0000499999	Radiation pressure coefficient
M00287648	Perigee motion
P00100468	Motion of right ascension of the ascension node
P005086509	Change of mean anomaly at epoch
SPARESPARE	Spares

APT Transmission frequency XXX.XX MHZ
137.50 or 137.62 MHZ

HRPT Transmission frequency XXX.XX MHZ
169.0, 1702.5 or 1707.0 MHZ

Beacon (DSB) Transmission frequency XXX.XX MHZ 136.77 or 137.77 MHZ APT Day X/X APT Night X/X
AVHRR channels uses for APT transmissions
DCS time DDD XXXXX.XXX data collection system clock re-set time (seconds) at 0000Z on pay "DDD"
Additional plain language remarks when needed

APPENDIX 2

PART IV

AAAAAAA BBBBB CCCCCCCCCCCC DDEEFFGGHHIIIII JJJJJJJ KKKKKKK

LLLLLL MMMMMMMM NNNNNNNN OOOOOOOO PPPPPPPP QQQQQQQQ RRRRRR

SSSSSSSSSS TTTTTTTTTT UUUUUUUUUU VVVVVVVVV WWWWWWWWW XXXXXXXXXX

XXXXXXXX ZZZ aaabbb cccc dddddddddd eeeeeeeee fffffff

ggggggggg

SPARESPARE

Frequencies APT XXX.XX MHZ, HRPT XXX.XX MHZ,

Beacon DSB XXX.XX MHZ APT Day/Night X/X

Plain Language remarks

DCS Time Day XXX XXXXX.X

Additional plain language remarks

PART IV (Contains high precision orbital elements, transmission frequencies, and remarks).

Symbol	Explanation
AAAAAAAAA	Spacecraft identification (International designator - see "COPSAR Guide to Rocket and Satellite Information and Data Exchange Information Bulletin #9, July 1962).
BBBBB	Orbit number at epoch.
CCCCCCCCCCCC	Time of ascending node (days from January 1 at 00Z, to nine decimal places.
DD	Epoch year
EE	Epoch month

FF	Epoch day
GG	Epoch hour
HH	Epoch minute
IIIII	Epoch second, to three decimal places
JJJJJJJ	Greenwich Hour Angle at Aries at epoch, to four decimal places.
KKKKKKKK	Anomalistic period (minutes), to four decimal places.
LLLLLLLL	Nodal period (minutes), to four decimal places.
MMMMMMMM	Eccentricity, to eight decimal places.
NNNNNNNN	Argument of perigee (degrees), to five decimal places.
OOOOOOOO	Right Ascension of the ascending node (degrees), to five decimal places.
PPPPPPPP	Inclination (degrees), to five decimal places.
QQQQQQQQ	Mean anomaly (degrees), to five decimal places.
RRRRRRRR	Semi-major axis (km), to three decimal places.
SSSSSSSSSS	Sign and epoch X position component (km), to four decimal places.
TTTTTTTTTT	Sign and epoch Y position component (km), to four decimal places.
UUUUUUUUUU	*Sign and epoch Z position component (km), to four decimal places.
VVVVVVVVVV	*Sign and epoch X velocity (Xdot) component (km/sec), to six decimal places.
WWWWWWWWWW	*Sign and epoch Y velocity (Ydot) component (km/sec), to six decimal places.
XXXXXXXXXX	*Sin and epoch Z velocity (Zdot) component (km/sec), to six decimal places.
YYYYYYYYY	Ballistics coefficient CD-A/M (m^2/kg), to eight decimal places.
ZZZ	Daily solar flux value (10.7 cm) (10^{-7} watt/m^2).

aaa	90-day running mean of solar flux (10^7 watts/m^2).
bbb	Planetary magnetic index ($2x10^{-5}$) gauss).
cccc	Drag modulation coefficient, to four decimal places.
dddddddddd	Radiation pressure coefficient (m^2/kg), to ten decimal places.
eeeeeeeee	Sign and perigee motion (deg/day), to five decimal places.
ffffffff	Sign and motion of Right Ascension of the ascending node (deg/day), to five decimal places.
ggggggggg	Sign and rate of change of mean anomaly at epoch (deg/day), to two decimal places.
SPARESPARE	spares

- -

* -- All signed values in PART IV are preceded by a "P" or "N" to denote a plus (+) or minus (-) value.

- -

APT TRANSMISSION FREQUENCY XXX.XX MHz
HRPT TRANSMISSION FREQUENCY XXXX.XX MHz
BEACON (DSB) TRANSMISSION FREQUENCY XXX.XX MHz
APT DAY X/X APT NIGHT X/X where X will identify channels being used.
CDS CLOCK TIME DAY XXX XXXXX.X
Followed by PLAIN LANGUAGE messages when necessary.

NAVEDTRA 40140
NAVAL OCEANOGRAPHY COMMAND
PRACTICAL TRAINING PUBLICATION

THE SHIPBOARD WEATHER OFFICE

PREPARED BY
NAVAL OCEANOGRAPHY COMMAND FACILITY
NSTL STATION, BAY ST. LOUIS, MS 39529

PROGRAMMED INSTRUCTION

THE SHIPBOARD WEATHER OFFICE

NAVEDTRA 40140

This programmed instruction was prepared by:

NAVOCEANCOMFAC JACKSONVILLE

Reviewed and Edited by:

NAVAL OCEANOGRAPHY COMMAND FACILITY

Bay St. Louis, MS

THE SHIPBOARD WEATHER OFFICE

INTRODUCTION

Aerographer's Mates assigned (permanent change of station) to U. S. Navy ships are not under the direct management or control of the Commander, Naval Oceanography Command as in the case of weather centers, facilities, detachments, etc. Instead, they operate under the procedures and control of the respective fleet commanders and ultimately under the commanding officer of the ship. Aboard ship, the Aerographer's Mates are assigned to the Operations Department. When the ship is underway, the meteorological office operates on a 24-hour basis daily. In ports where weather support is available from a nearby shore-based weather activity, the shipboard meteorological office normally secures operations. Operating procedures and equipment differ to some degree from one type of ship to another, but the information contained in this programmed instruction will be useful aboard all types of ships.

This program consists of seven parts, which cover some of the major unique procedures of a shipboard weather office. As additional programs for shipboard routines are subsequently developed and distributed, they should be added to this binder.

PART I

SHIPBOARD OBSERVATIONS - SURFACE WIND

SHIPBOARD OBSERVATIONS - SURFACE WIND

INTRODUCTION

Shipboard procedures for determining wind speed and direction differ from land-station procedures because the ship is moving and the air is moving -- sometimes they move in the same direction, sometimes in opposite directions, and sometimes at an angle to each other. In this program, you will learn the meanings of the terms "apparent wind" and "true wind," the procedures for observing apparent wind, for computing true wind with the True Wind Computer CP-264/U, and for estimating true wind based on observed sea conditions.

You should obtain a copy of NAVOCEANCOMINST 3144.1( ), a True Wind Computer CP-264/U and a grease pencil to get the utmost benefit from this program. However, a good insight can be obtained on shipboard environments and usage of the computer even though the above items may not be available.

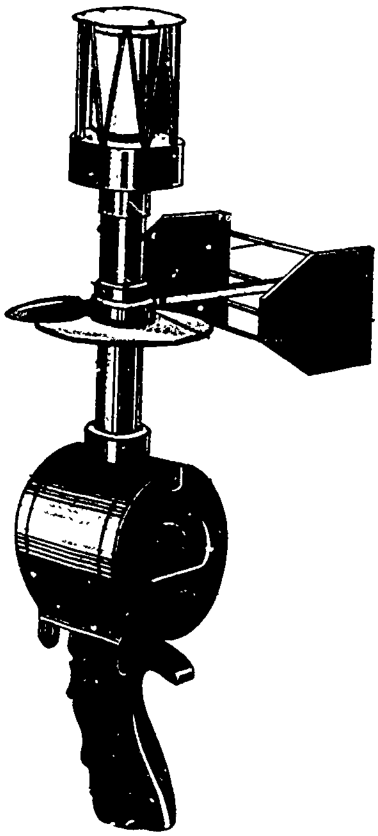
Read the objectives on the next page, and then proceed with the program.

SHIPBOARD OBSERVATIONS SURFACE WIND

OBJECTIVES

1. List the two standard wind-indicating equipments used to observe apparent wind speed and direction.
2. Enter the period of time that apparent wind speed and direction should be observed at each observation to ensure that an average is obtained.
3. Write the definition of the term "apparent wind."
4. Estimate apparent wind speed and direction from local indications. (A table in NAVOCEANCOMINST 3144.1( ) may be used.)
5. Write the definition of the term "true wind."
6. Solve true wind problems using the CP-264/U True Wind Computer.
7. Estimate true wind speed and direction by observing sea waves. (A table in NAVOCEANCOMINST 3144.1 ( ) may be used.)

FRAME 1



There are two types of meteorological wind equipment in standard use for the shipboard weather office; the B-3 Wind Measuring Set, shown above left, and the PMO-3 Wind Measuring Set, shown above right.

The synchro-repeater of the B-3 Wind Measuring Set has two dials. One indicates the wind direction and is graduated in five-degree increments of the compass, and one indicates the speed of the wind in knots.

FRAME 1 (CONTD.)

On the PMQ-3 Wind Measuring Set (hand-held anemometer), the direction of the wind is obtained from the azimuth plate, which is graduated in one-degree increments. The speed of the wind is obtained by using one of the two scales -- 0-15 knots or 0-60 knots.

List the two meteorological wind-measuring instruments in standard use for the shipboard weather office.

____

____

* *

ANSWER: B-3

PMQ-3

(Any order)

FRAME 2

On both wind measuring sets the wind direction is indicated in ____________ and the speed is indicated in __________.

* *

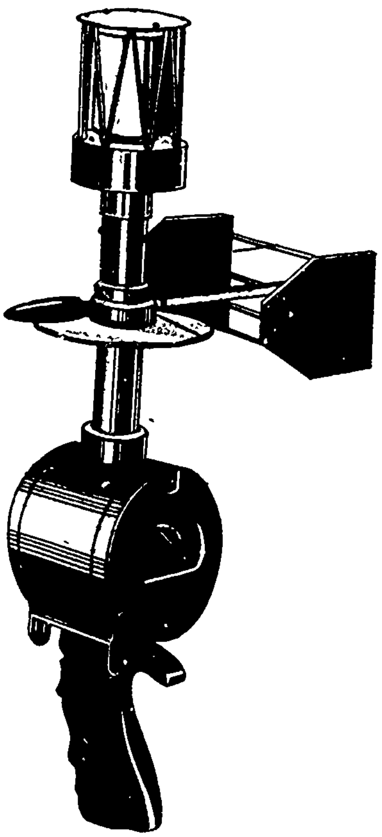
ANSWER: degrees

knots

FRAME 3

Identify each of the instruments shown below.

A.



B.

* *

ANSWER: A. PMQ-3 (hand-held anemometer)

B. Synchro-Repeater B-3 System

FRAME 4

When taking wind observations aboard ship, observe the wind instruments for a minimum period of one minute. This is to ensure that the observed wind direction and speed are average values. This first observation of the combination of wind speed and direction provides an apparent wind, which will be discussed more fully later in this program.

The wind is observed for a minimum of a one-minute period to ensure that the observed wind is an ______________.

* *

ANSWER: average

The combination of direction and speed of the wind when taken from the B-3 synchro-repeater or from the PMO-3 hand-held anemometer on a ship provides an ________________ wind.

* *

ANSWER: apparent

FRAME 5

During periods of gusty winds, a glance at the wind indicators may show a peak gust (maximum speed) of 45 knots, while the average wind may be only 30 knots. To ensure that the average is observed (rather than the peak), the wind should be observed and averaged for a minimum period of ________ minute(s).

* *

ANSWER: one (1)

FRAME 6

Apparent wind is the speed and direction from which wind blows as measured at a point that is moving on the earth's surface. When you take a wind observation while underway, the ship will be moving. This movement will cause a flow of air across the ship. The ship's motion plus the true wind combine to produce the apparent wind.

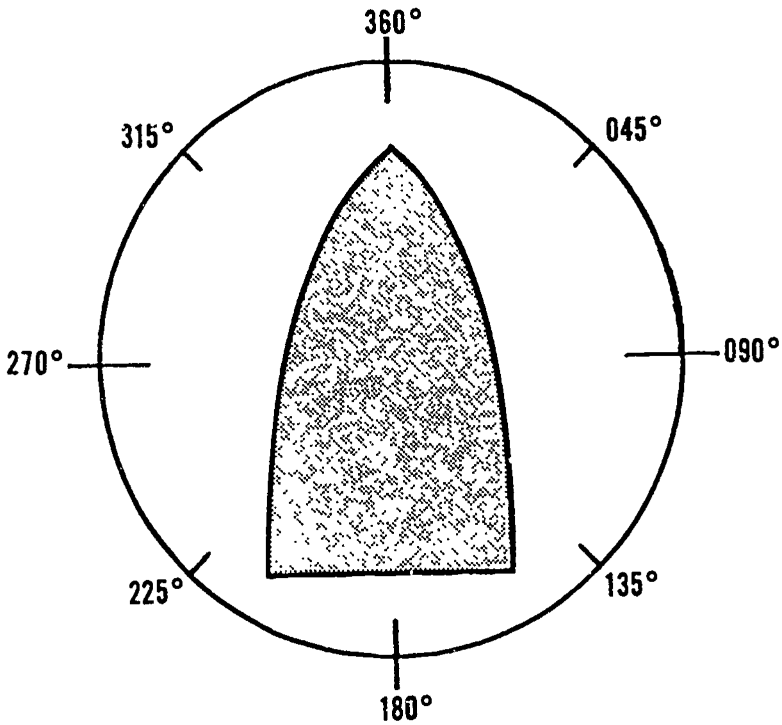
Apparent wind is the combination of true wind and the ship's

______________________________.

* *

ANSWER: motion or movement

FRAME 7



The direction from which this apparent wind speed is coming is the apparent wind direction. When taking wind observations aboard ship, the ship's bow will always be 360°.

A wind blowing directly at starboard would be an apparent wind (apparent to the bow of the ship) of 090°. A wind directly at the stern would be an apparent wind of ________.

* *

ANSWER: 180°

FRAME 8

The apparent wind is the speed and directio rom which wind blows as measured at a point that is ________ on the earth's surface.

* *

ANSWER: moving

FRAME 9

Define apparent wind.

____

____

* *

ANSWER: The speed and direction from which wind blows as measured at a point that is moving on the earth' surface.

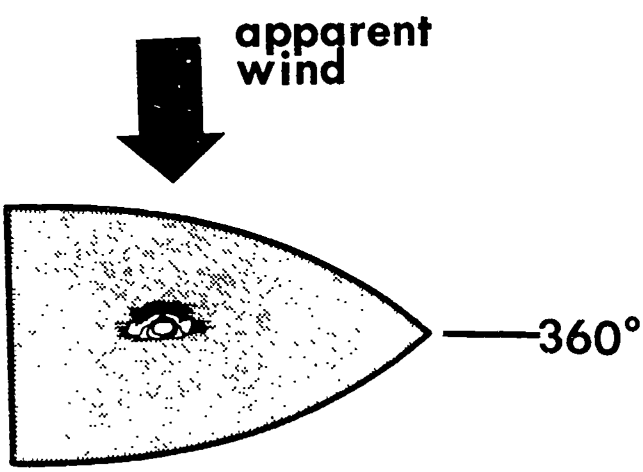
(Or words to that effect)

FRAME 10

Apparent wind direction may be estimated, when necessary, by facing directly into the wind. Use the bow as the basis for your direction (the bow as 360°) and estimate the apparent wind direction to the nearest 10 degrees.

The observer below is facing the port side, looking directly into the wind. What is the estimated apparent wind direction?

____



* *

ANSWER: 270°

FRAME 11

The copy of Table 10-4 shown below comes from the Manual for Ship's Surface Weather Observations - NAVOCEANCOMINST 3144.1 ( ). This table gives the local indication and the speed of an apparent wind necessary to cause that effect.

Table 10-4 - Apparent wind speed

Speed(knots)	Indication
Less than 1	Calm;smoke rises vertically.
1-3	Smoke drifts from funnel.
4-6	Wind felt on face.
7-10	Wind extends light flag.
11-16	Wind raises dust, cinders, loose papers, etc.
17-21	Wind waves and snaps flag briskly.
22-27	Whistling in rigging.
28-33	Inconvenience felt walking against wind.
34-40	Generally impedes progress.

If you heard whistling in the rigging, what would be the apparent wind speed range?

_________________knots

* *

ANSWER: 22-27

FRAME 12

Refer to the copy of Table 10-4. What would be the estimated apparent wind speed and direction if the wind was extending a light flag and you were facing directly into the wind when looking toward the starboard side? __________/__________

* *

ANSWER: 7-10 kts 090°

FRAME 13

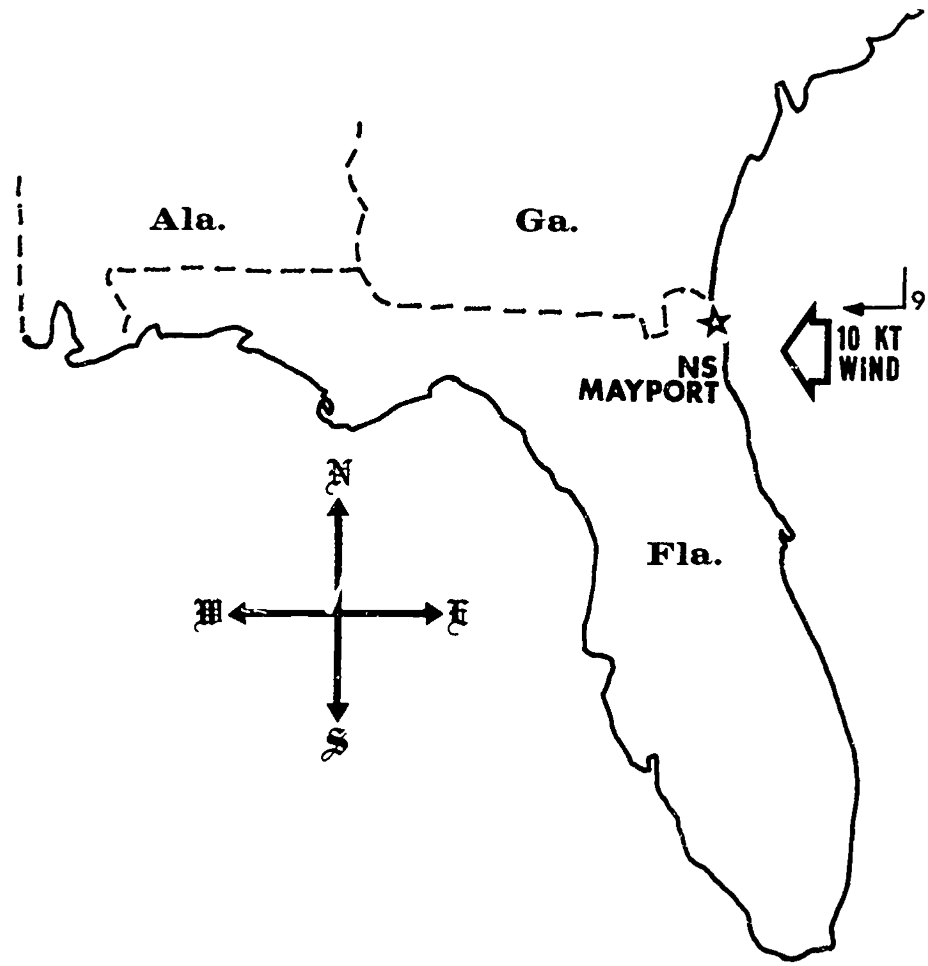
True wind is the true speed of the wind and the true direction from which it blows, as measured from a fixed position on the earth. With your ship moored to the pier, the wind you feel would be true wind speed because you are standing on a fixed point of the earth. However, for true wind direction the ship's actual heading would still have to be considered.

True wind is always measured from a _________ point on earth.

* *

ANSWER: fixed

FRAME 14



The wind observed aboard your ship moored at NS Mayport is shown by the arrow above. Will the measurement be a true wind measurement? _______ Why? ____________________ What is the true wind direction? ____________________ True wind speed?

__________ ___________

* *

FRAME 14 (CONTD.)

ANSWER: Yes

Fixed position

090° or East

10 knots

FRAME 15

Define true wind.

____

____

* *

ANSWER: The speed of the wind and the direction from which it blows, as measured from a fixed position on the earth. (Or words to that effect)

FRAME 16

Now that you have learned apparent wind and true wind, you can begin to compute true wind direction and speed. Four items are necessary to compute true wind. They are:

a. Apparent wind direction

b. Apparent wind speed

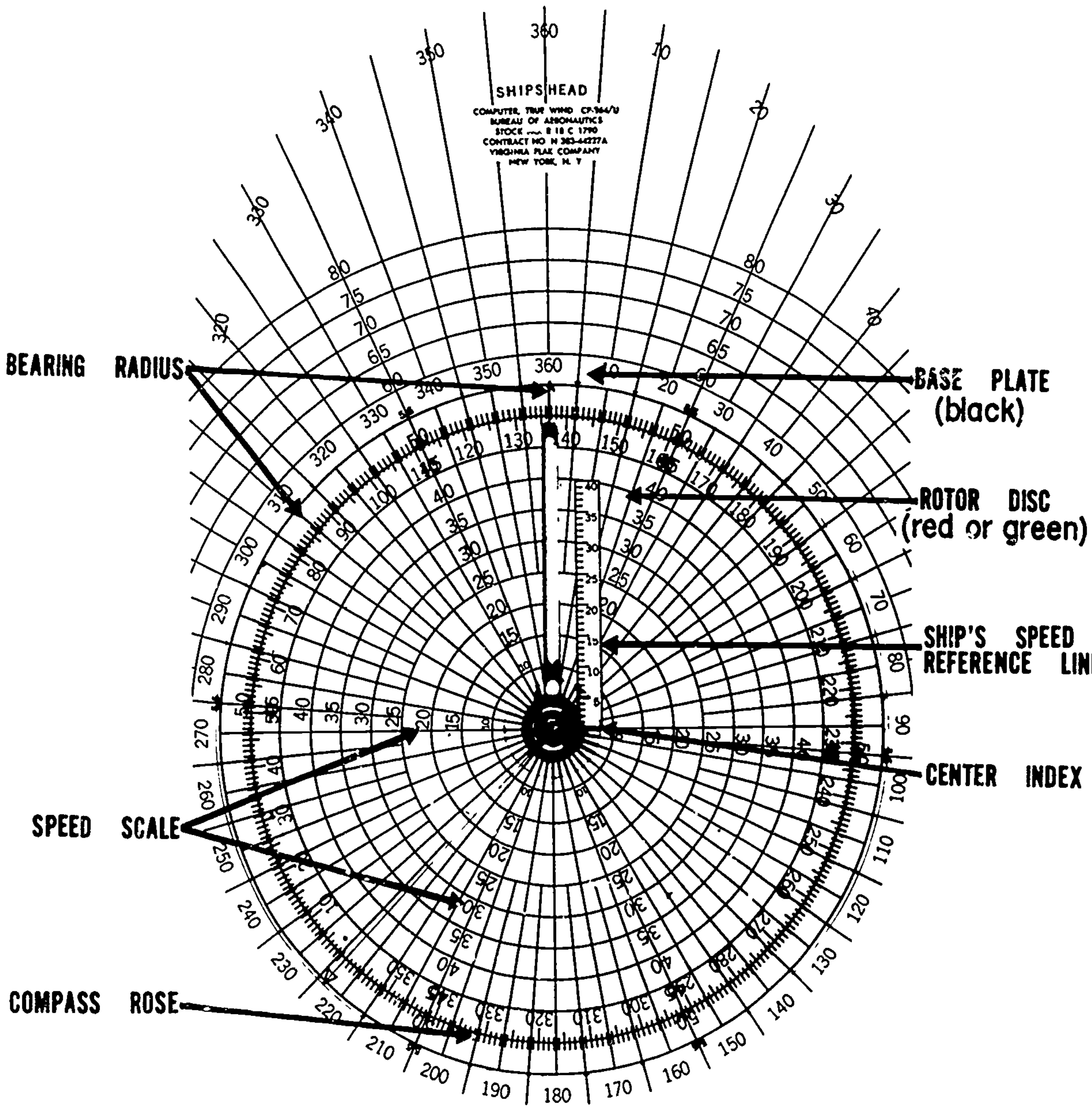
c. Ship's course

d. Ship's speed

********************NO RESPONSE NECESSARY********************

FRAME 17

The most widely used method of computing true wind for the shipboard weather office is by using the true wind computer (CP-264/U) shown below. Detailed instructions on the use of the computer are found on the back. We will go through a true wind computation step by step using the computer, so that you will be familiar with it.



330

FRAME 17 (CONTD.)

The CP-264/U is the ________ _______ computer.

* *

ANSWER: true wind

FRAME 18

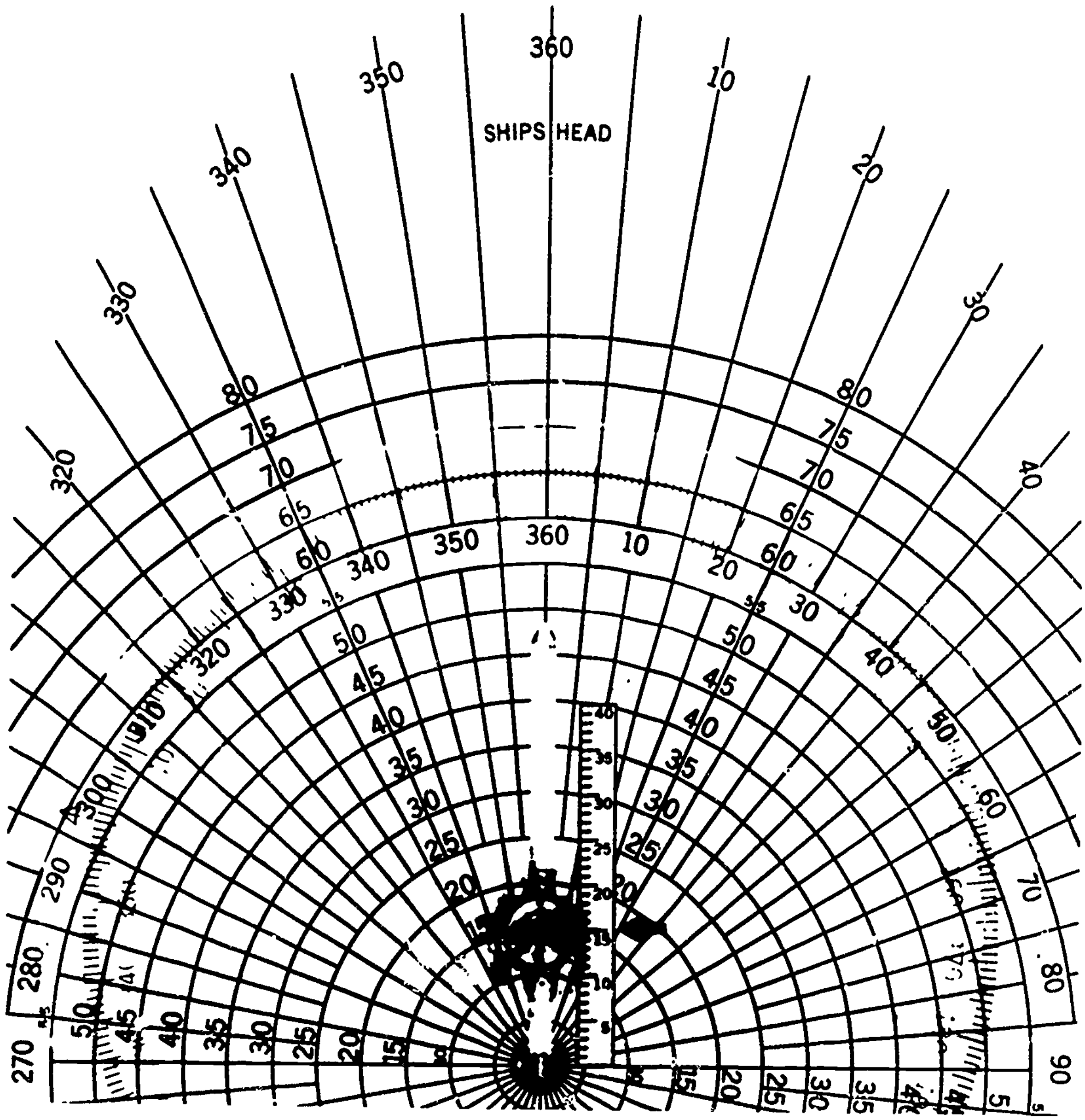
Use the true wind computer, which you have, as we discuss the computation sequence. Determine the true wind from the information below. Steps for using the computer are in succeeding frames.

Apparent wind direction	- 300°
Apparent wind speed	- 18 kts
Ship's course	- 080°
Ship's speed	- 16 kts

*********************NO RESPONSE NECESSARY********************

FRAME 19

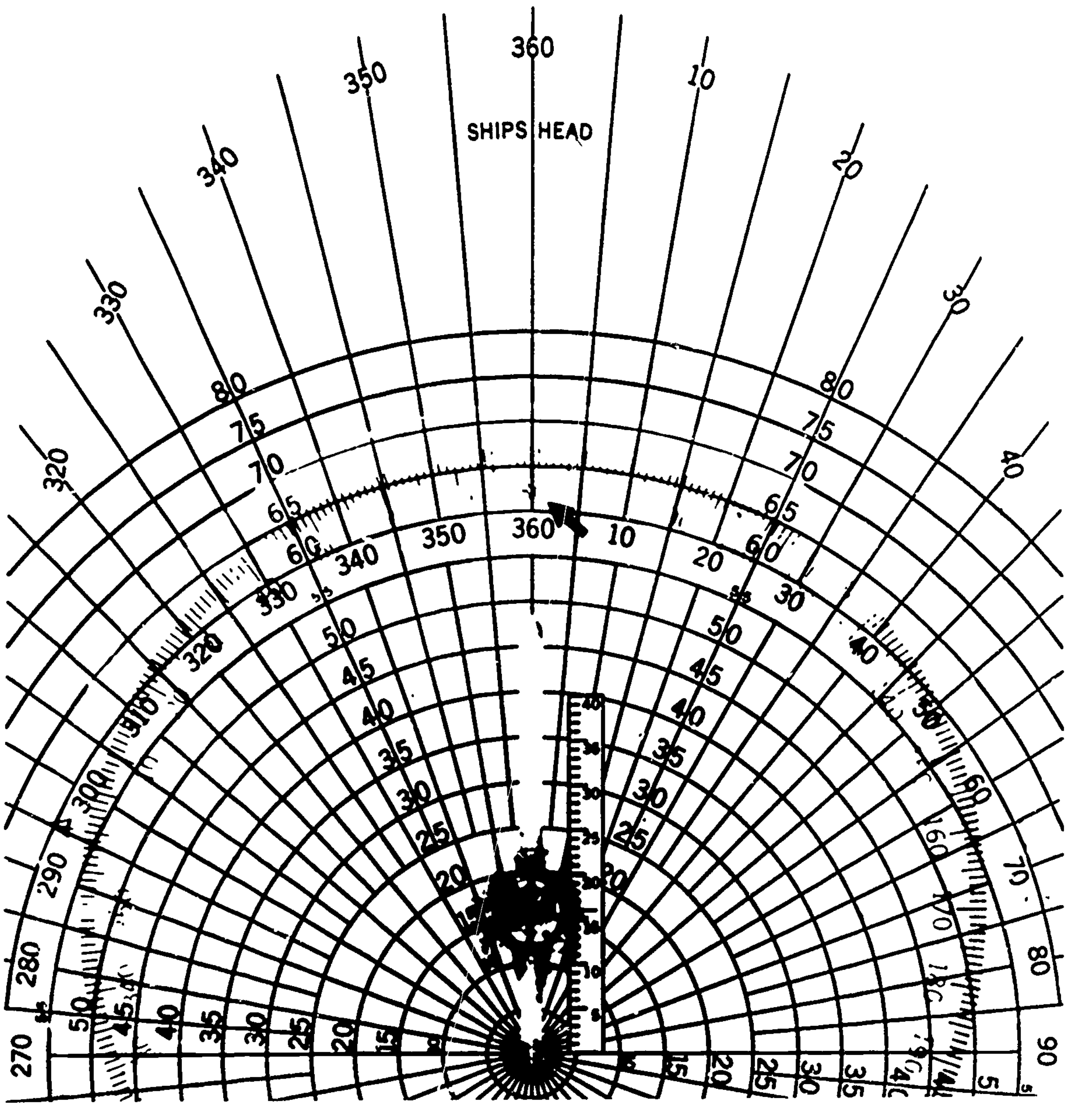
First, line up the center index of the rotor disc with the 16 knot (the ship's speed) mark on the ship's speed reference line. (In the figure below and in the ones that follow, the markings on the base plate are shown in bold black; those on the rotor disc are shown in light gray.)



*********************NO RESPONSE NECESSARY*********************

FRAME 20

Second, rotate the rotor disc until the ship's course, 080°, on the compass rose of the rotor disc (green/red etchings), is directly over the 360° bearing radius of the base plate (black etchings).



The compass rose of the rotor disc has ____________ etchings; the bearing radius of the base plate has __________ etchings.

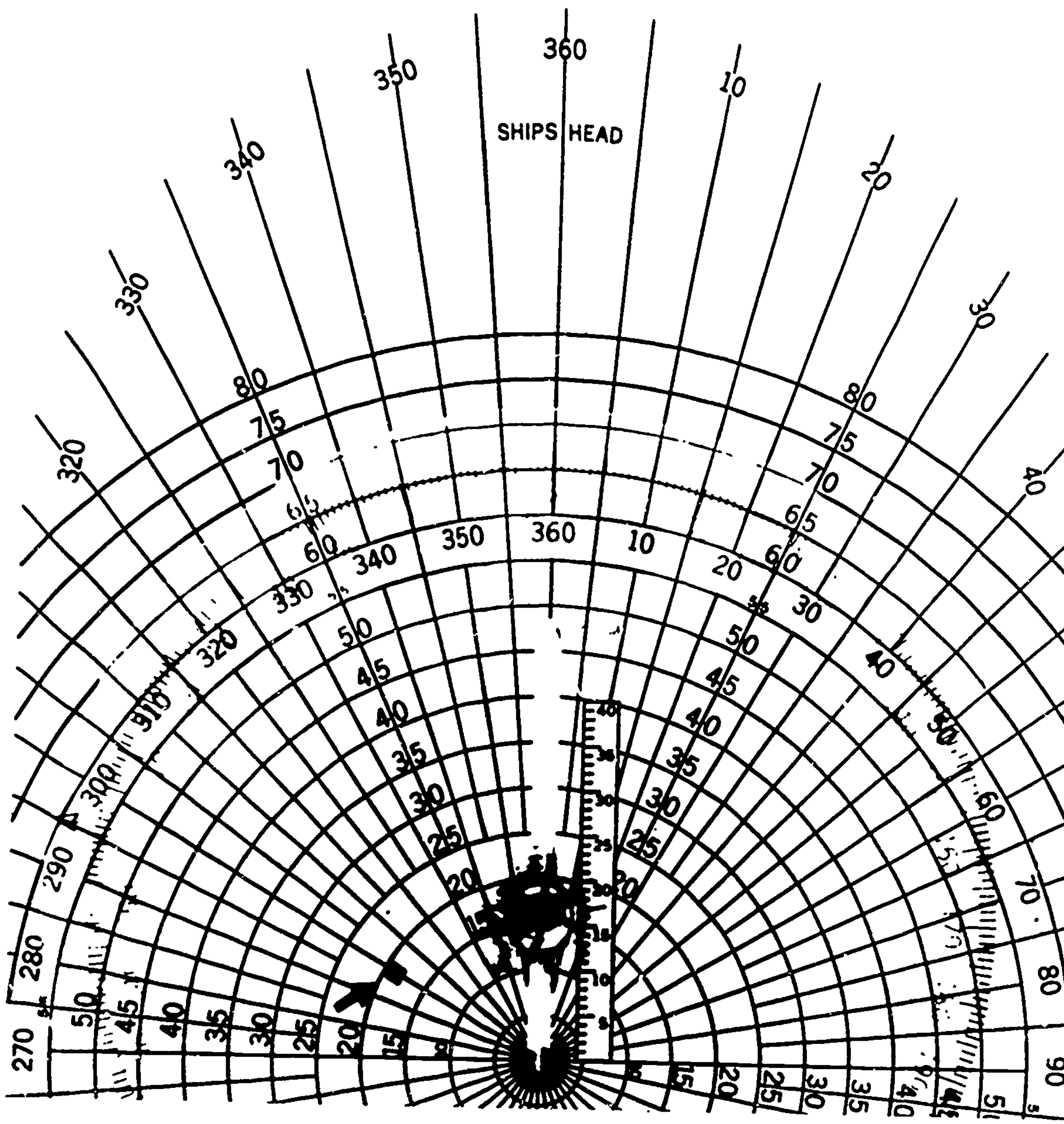
* *

FRAME 20 (CONTD.)

ANSWER: green/red
black

FRAMF 21

The third step is to plot the apparent wind on the computer. On the bearing radius of the base plate, locate the 300° direction line. Proceed along this line from the center of the base plate until you reach 18 kts on the speed scale. Make a dot on the rotor disc at this point with a grease pencil.



FRAME 21 (CONTD.)

When plotting the apparent wind, always use the ________ plate grid which is ______________ in color.

* *

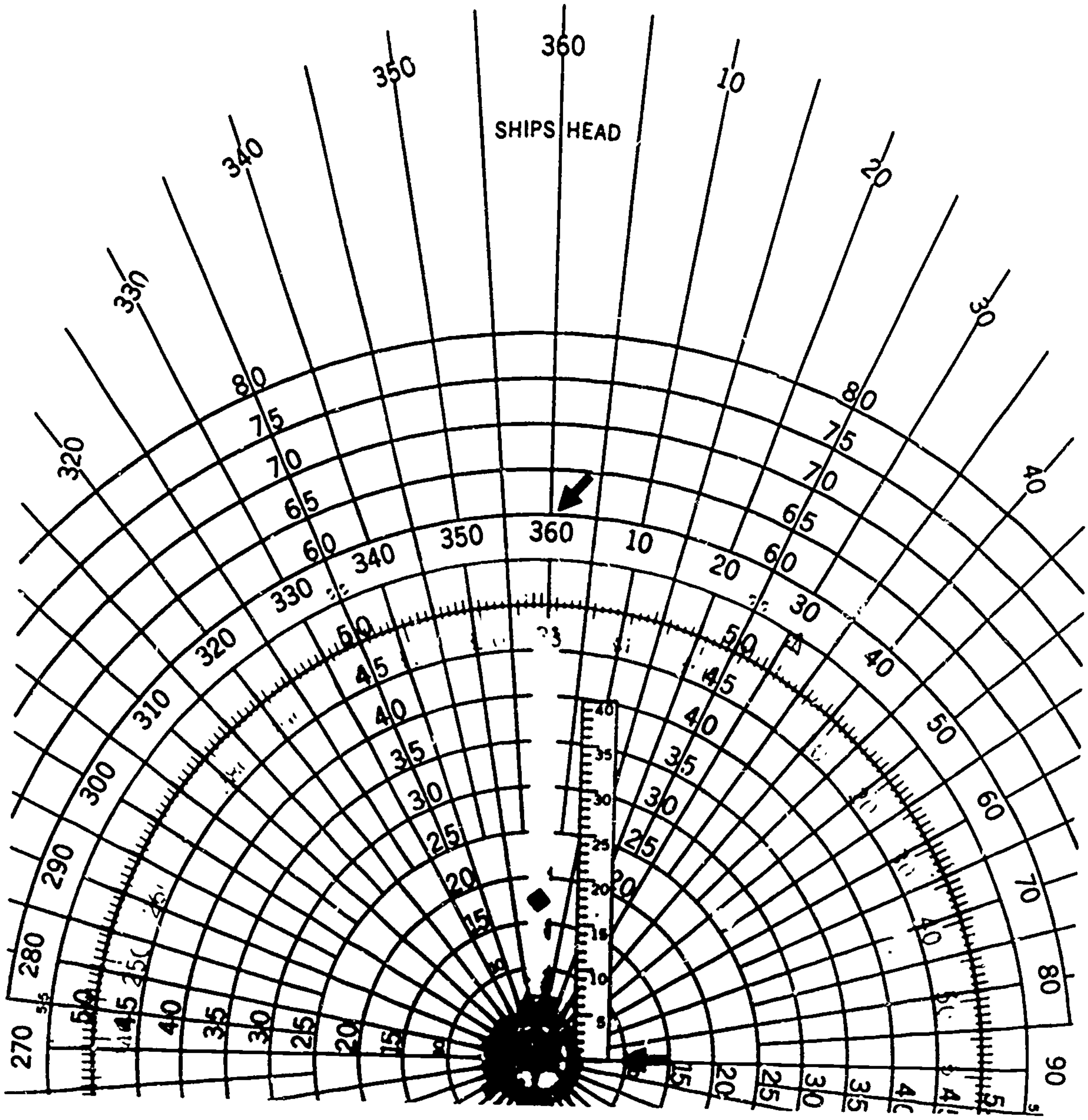
ANSWER: base

black

FRAME 22

Next, slide the rotor disc back to zero on the ship's speed reference index and rotate the rotor disc until the dot you plotted lies along the 360° bearing radius of the base plate.

FRAME 22 (CONTD.)



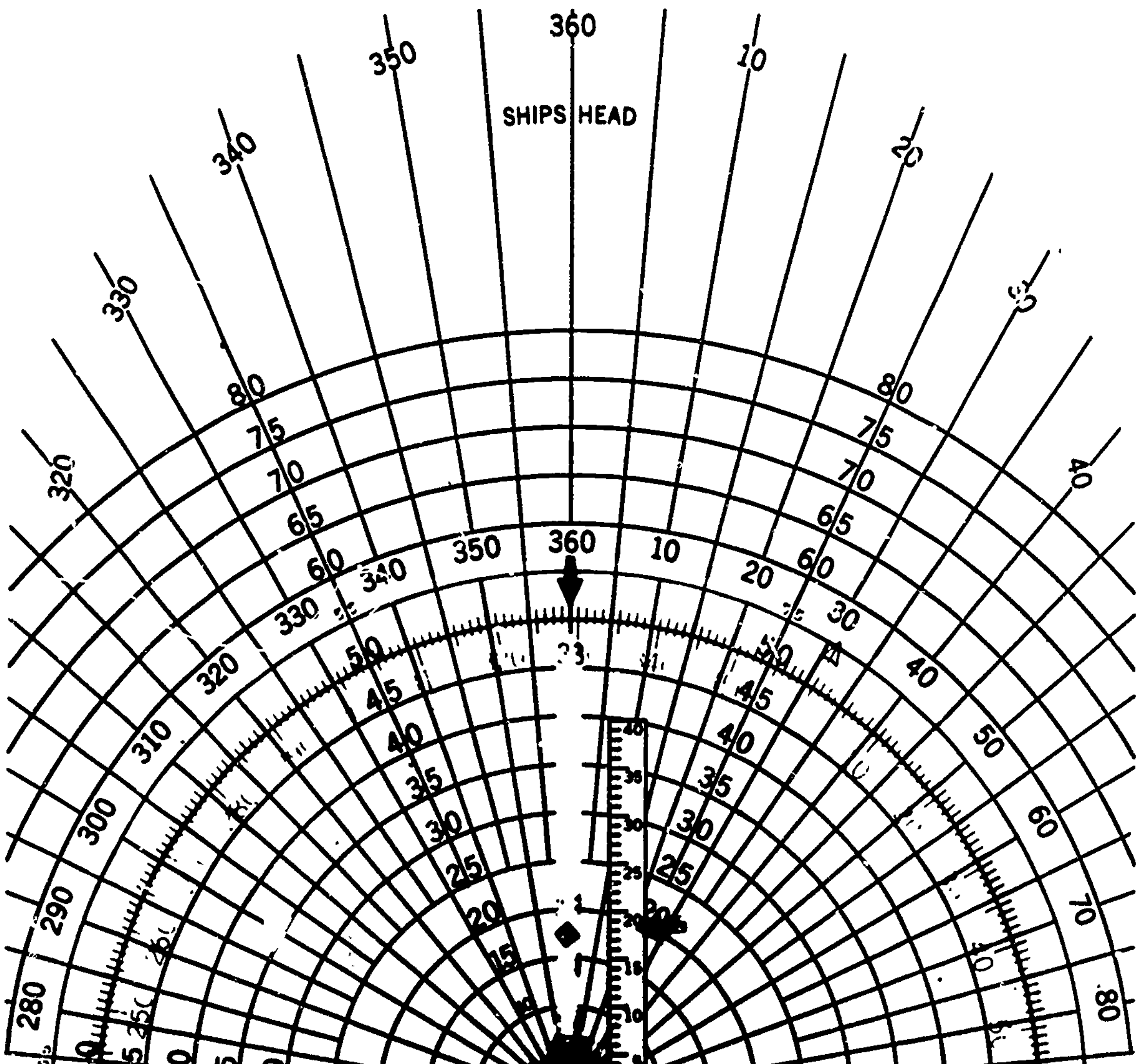
Remember to slide the rotor disc to ________ on the ship's speed reference index.

* *

ANSWER: zero

FRAME 23

The last step is to read the true wind from the computer. The direction is read off the rotor disc compass rose over the 360° bearing radius of the base plate. The true wind speed is read from the ship's speed reference index at the position of the dot.



FRAME 23 (CONTD.)

What is the true wind direction and speed in this problem?

_____________/_________________

* *

ANSWER: $329^{\circ}(\pm 5)$, $18.0(\pm 2)$ kts

FRAME 24

Use the true wind computer to determine the true wind direction and speed for the information below.

Apparent wind direction	-	340°
Apparent wind speed	-	20 kts
Ship's course	-	150°
Ship's speed	-	14 kts

True Wind: ____________________/____________________

* *

ANSWER: $096^{\circ}(\pm 5)$, $8.5(\pm 2)$ kts

FRAME 25

Compute the true wind using the CP-264/U True Wind Computer and the information below.

Apparent wind direction	-	070°
Apparent wind speed	-	22 kts
Ship's course	-	350°
Ship's speed	-	12 kts

True Wind: __________/__________

* *

ANSWER: 092°(±5) 21.5(±2) kts

FRAME 26

True wind speed and direction may be estimated by observing sea waves. To estimate true wind direction using sea waves, observe the direction from which the waves are coming. Then, using the ship's compass as a guide, estimate the direction to the nearest 10 degrees.

When estimating true wind from sea waves, use the ship's __________ as a guide.

* *

ANSWER: compass

FRAME 27

To estimate the speed of true winds using sea waves, observe the characteristics of the waves. Table 10-3 of NAVOCEANCOM-INST 3144.1( ) (a copy of which is shown below) gives the sea condition and approximate wind speed ranges for each condition. From the table, what would be the wind-speed range causing sea waves that are very high with long overhanging crests?________

SCALE FOR ESTIMATING WIND SPEED

Knots	Sea conditions	Probable wave height* in ft.
0–1	Sea smooth and mirror-like.	–
1–3	Scale-like ripples without foam crests.	1/4
4–6	Small, short wavelets; crests have a glassy appearance and do not break.	1/2
7–10	Large wavelets; some crests begin to break? foam of glassy appearance. Occasional white foam crests.	2
11–16	Small waves, becoming longer; fairly frequent white foam crests.	4
17–21	Moderate waves, taking a more pronounced long form; many white foam crests; there may be some spray.	6
22–27	Large waves begin to form; white foam crests are more extensive everywhere, there may be some spray.	10
28–33	Sea heaps up and white foam from breaking waves begin to be blown in streaks along the direction of the wind; spindrift begins.	14
34–40	Moderately high waves of greater length; edges of crests break into spindrift; foam is blown in well-marked streaks along the direction of the wind.	18
41–47	High waves; dense streaks of foam along the direction of the wind; crests of waves begin to topple, tumble, and roll over; spray may reduce visibility.	23
48–55	Very high waves with long overhanging crests. The resulting foam in great patches is blown in dense white streaks along the direction of the wind. On the whole, the surface of the sea is white in appearance. The tumbling of the sea becomes heavy and shocklike. Visibility is reduced.	29
56–63	Exceptionally high waves that may obscure small and medium-sized ships. The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility reduced.	37
64 and over	The air is filled with foam and spray. Sea completely white with driving spray; visibility very much reduced.	45

*This table is only intended as a guide to show roughly what may be expected in the open sea, with unlimited fetch, remote from land. It should never be used in the reverse way, i.e., for estimating or reporting the state of the sea.

* *

ANSWER: 48-55 kts

FRAME 28

You are using sea waves to estimate the true wind speed and direction. You observe the direction from which the sea waves are coming and compare it with the ship's compass: the direction is nearly due south. You observe the sea wave characteristics: the waves are small, becoming longer, with fairly frequent white foam crests.

What would be your true wind estimate? __________/__________

* *

ANSWER: 180°, 11-16 kts

FRAME 29

Whenever you can, try estimating the apparent wind and true wind. Then, compare your estimates with the readings from your equipment and computations. It is good practice, and you can see how valid your estimates are.

*********************NO RESPONSE NECESSARY********************

THIS CONCLUDES SHIPBOARD OBSERVATIONS - SURFACE WIND. NOW, TURN TO THE CRITERION TEST AND COMPLETE IT.

SHIPBOARD OBSERVATIONS - SURFACE WIND

CRITERION TEST

1. List the two standard wind-indicating equipments used aboard ship to observe apparent wind speed and direction.

   ____

   ____

2. To ensure an average wind speed and direction, the apparent wind speed and direction should be observed for a minimum time of ______________.

3. Write the definition of the term apparent wind.

   ____

   ____

   ____

4. Estimate the apparent wind from the following information:

   When facing into the wind, you are looking directly toward starboard. The wind is waving and snapping the ship's flag briskly. (Use the table on page 1-27).

   ________ / ________

5. Write the definition of the term true wind.

   ____

   ____

CRITERION TEST (CONTD.)

6. Solve the following problem using the CP-264/U True Wind Computer.

Apparent wind direction	-	270^{o}
Apparent wind speed	-	19 kts
Ship's course	-	220^{o}
Ship's speed	-	16 kts

True wind ________________/________________

7. The sea waves are coming from the southeast, according to comparison with the ship's compass. The waves are small and short, have a glassy appearance, and do not break. Estimate the true wind speed and direction from the above observation of the sea waves. (Use the table on the following page.)

________________/________________

CRITERION TEST (CONTD.)

SCALE FOR ESTIMATING WIND SPEED

Knots	Sea conditions	Probable wave height* in ft.
0–1	Sea smooth and mirror-like.	–
1–3	Scale-like ripples without foam crests.	1/4
4–6	Small, short wavelets; crests have a glassy appearance and do not break.	1/2
7–10	Large wavelets; some crests begin to break? foam of glassy appearance. Occasional white foam crests.	2
11–16	Small waves, becoming longer; fairly frequent white foam crests.	4
17–21	Moderate waves, taking a more pronounced long form; many white foam crests; there may be some spray.	6
22–27	Large waves begin to form; white foam crests are more extensive everywhere; there may be some spray.	10
28–3[illegible]	[illegible] from breaking waves begi[illegible] ks along [illegible] drift begins	

APPARENT WIND SPEED

Speed (knots)	Indication
Less than 1	Calm; smoke rises vertically.
1–3	Smoke drifts from funnel.
4–6	Wind felt on face.
7–10	Wind extends light flag.
11–16	Wind raises dust, cinders, loose papers, etc.
17–21	Wind waves and snaps flag briskly.
22–27	Whistling in rigging.
28–33	Inconvenience felt walking against wind.
34–40	Generally impedes progress.

SHIPBOARD OBSERVATIONS - SURFACE WIND

CRITERION TEST ANSWERS

1. B-3
   PMQ-3
   (Any order)

2. one minute

3. Apparent wind is the combination of speed and direction from which wind blows as measured at a point that is moving on the earth's surface.

   (Or words to that effect)

4. 090°, 17-21 kts

5. True wind is the combination of the speed of the wind and the direction from which it blows, measured at a fixed point on the earth.

   (Or words to that effect)

6. 090°, 26 kts

7. 135°, 4-6 kts

PART II

SHIPBOARD OBSERVATIONS - SEA CONDITION

SHIPBOARD OBSERVATIONS - SEA CONDITION

INTRODUCTION

One of the very important elements of shipboard observations is sea condition -- sea waves and/or swell waves (height, direction, and period). The accuracy of sea condition observations cannot be overemphasized because of the important role they play in routine and tactical operations, and in the preparation of numerical (computer) environmental products including Optimum Track Ship Routing (OTSR).

Read the objectives on the next page, and then proceed with the program.

SHIPBOARD OBSERVATIONS - SEA CONDITION

OBJECTIVES

1. Match the terms crest, trough, length, period and height with a given wave diagram.
2. Write the definition of sea waves.
3. Write the definition of swell waves.
4. From a given list, select statements that describe sea waves and those that describe swell waves.
5. Write the definition of wave direction and determine the apparent wave direction from a given diagram.
6. State how the reported wave height is determined.
7. List some of the more common items which may be used as reference points to help observe sea conditions.
8. When sea and swell or two systems of swell are present, state which should be observed first.
9. List the minimum time that should be allowed for an observation of sea conditions.
10. Write the definition of wave period.
11. Determine wave period from information provided.
12. Identify diagrams to demonstrate knowledge regarding procedures for observing wave heights.

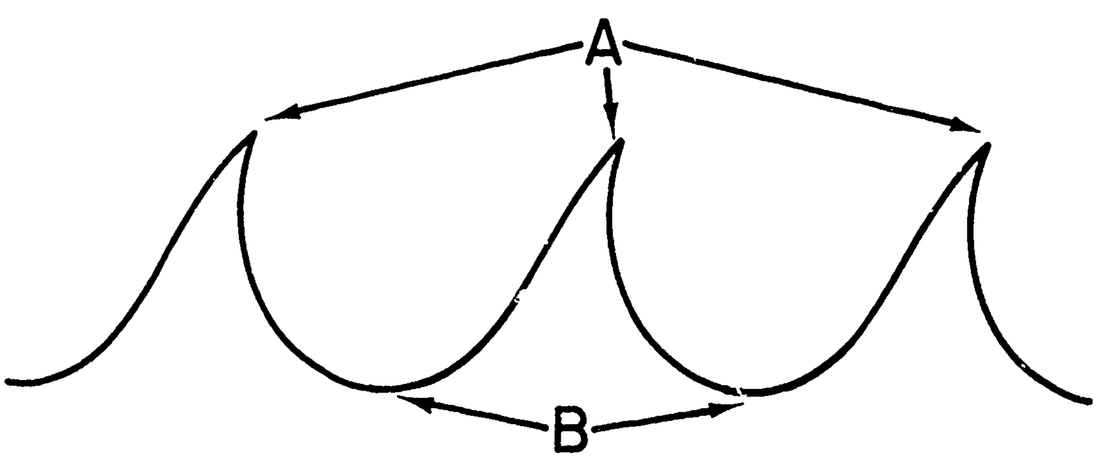
FRAME 1

Observing waves requires a measurement of their direction, period, and height. In order for you to do this, you must be able to identify the five main physical characteristics of waves -- trough, crest, height, length and period.

* * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 2

The "tops" of waves are crests. The "bottoms" of waves are troughs. In the diagram below, "A" points to ______________, and "B" points to ______________.



* *

ANSWER: crests

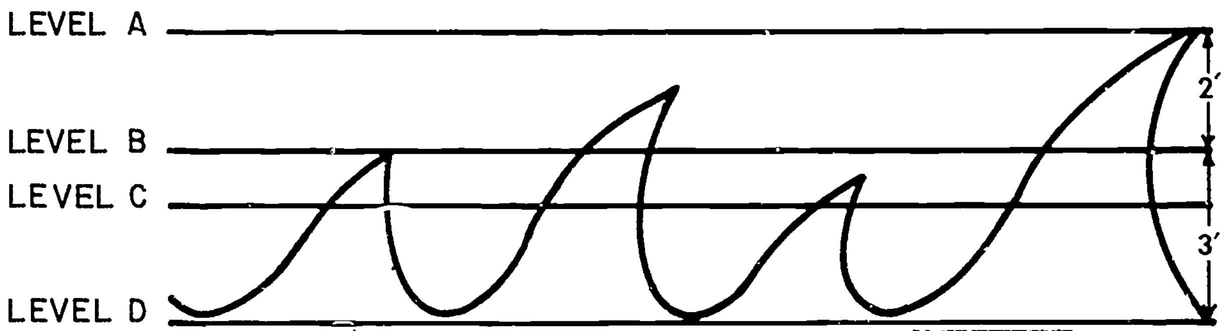
troughs

FRAME 3

The third characteristic is wave height. Wave height is the vertical distance between the level of the crest and the level of the trough -- measured in whole feet.

In the diagram below, between what levels is the height of the highest wave measured?

A-B / A-D / C-B / B-D
(Circle one)



What is the height of the highest wave? _____ feet

* *

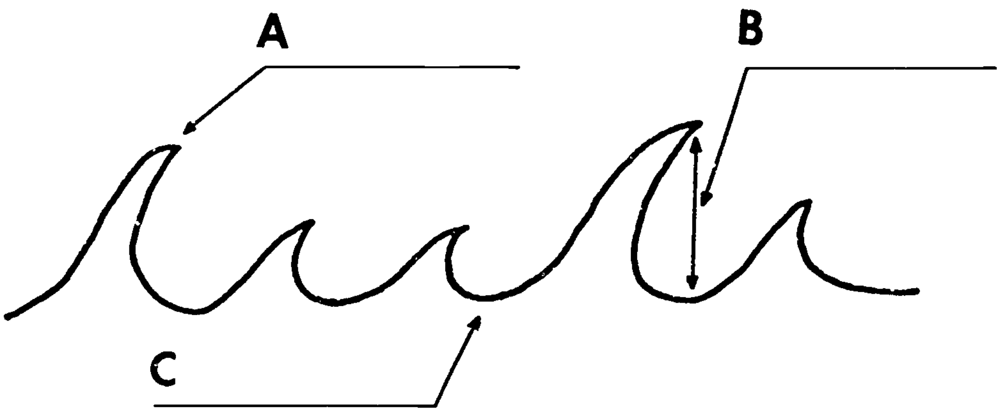
ANSWER: A-D

5

4i0

FRAME 4

On the diagram below, label the crest, trough, and height.



* *

ANSWER: A. Crest

B. Height

C. Trough

FRAME 5

The length of a wave is the horizontal distance in feet from crest to crest or trough to trough. The wave period is the time interval in seconds between the passage of two successive crests of well-formed waves past a fixed point.

411

FRAME 5 (CONTD.)

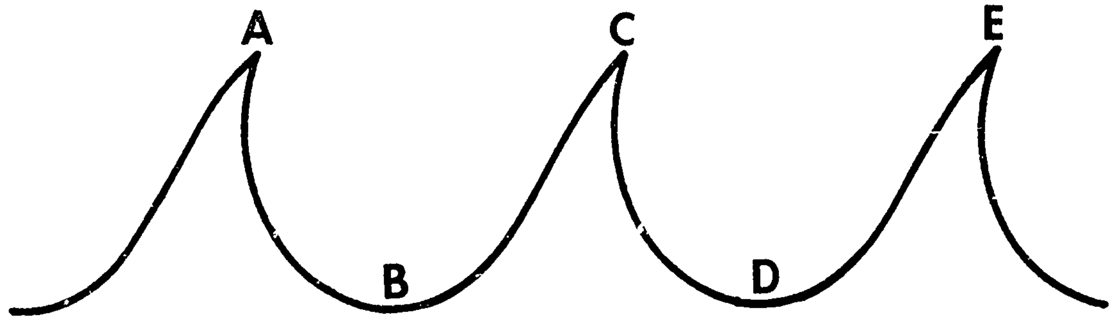
The time it takes for the passage of two successive crests to pass a fixed point is the wave __________.

* *

ANSWER: period

FRAME 6

On the diagram below, the wave period in seconds would be measured from ____________ or ____________.



* *

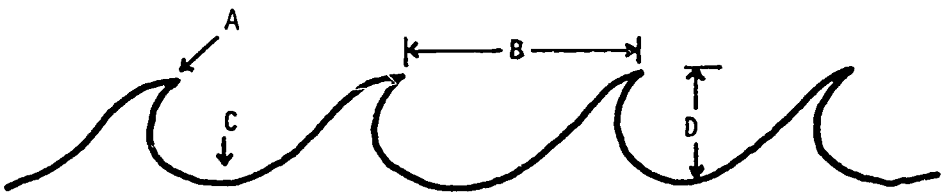
ANSWER: A to C

C to E

(Any order)

FRAME 7

Match the letters of the wave diagram with the terms listed below it.



_____ a. Wave height

_____ b. Wave crest

_____ c. Wave length

_____ d. Wave trough

* *

ANSWER: __D__ a.

__A__ b.

__B__ c.

__C__ d.

FRAME 8

There are two kinds of waves in the oceans -- sea waves which are generated by the wind blowing in the local area and swell waves which are waves that have traveled outside of their generating area. Both have crests, troughs, heights, periods, and directions. But there is usually considerable difference between them.

Sea waves are usually short, "choppy" waves with distinct crests. They can range from ripples to phenomenal heights in excess of 50 feet.

Swell waves are long, undulating waves which seem to roll under the ship. They have a longer and more even period than the se ıves do.

FRAME 8 (CONTD.)

Look at the sea and swell records shown below and note the differences. Then answer the questions below.

Record A

Record B

a. The waves in Record A are generated by the wind blowing in the __________ area.

b. The waves in Record B were generated by the wind ____________ the local area.

* *

ANSWER: a. local

b. outside

FRAME 9

Sea waves are defined as the waves generated by ___________

__________.

* *

ANSWER: local winds

FRAME 10

Swell waves are defined as being waves which have _________ outside their generating area.

* *

ANSWER: traveled

FRAME 11

The definition of sea waves is ____________________________

____.

* *

ANSWER: waves generated in the local area

FRAME 12

The definition of swell waves is ______________________________

____.

* *

ANSWER: waves which have traveled outside their generating area (or waves which were generated outside the local area).

FRAME 13

In the list below, place an "S" beside each characteristic of a sea wave, and an "L" beside each characteristic of a swell wave.

___ a. Long distance between crests

___ b. Generated by the local wind

___ c. Distinct crests

___ d. Long and even periods

___ e. Large range in height

* *

ANSWER: _L_ a.

_S_ b.

_S_ c.

_L_ d.

_S_ e.

FRAME 14

Since sea waves are created by local wind, their direction is assumed to be the same as the local wind. Swell waves are created outside the local area; therefore, their direction is often different from the sea waves.

* * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 15

If the true wind at your ship were from the west, and:

a. Low, long waves were coming from the north, you would know that they were __________ waves.

b. If waves with distinct crests were coming from the west, you would know that they were ________ waves.

* *

ANSWER: a. swell

b. sea

FRAME 16

Sometimes only a sea wave exists. Sometimes only a swell wave exists. Sometimes neither exists. Sometimes both exist. Combinations will exist such as sea waves plus swells from two different directions. Since the wind can only blow from

FRAME 16 (CONTD.)

one direction at a time, only one sea wave can exist at any one time.

If the characteristics listed below pertain to a sea wave, put an "S" on the line preceding it. If they are characteristic of a swell wave, put an "L" on the line preceding it. If they apply to both sea and swell waves, put an "S" and an "L" on the line preceding it.

____a. Generated by wind outside the local area

____b. Two or more may be present from different directions

____c. Only one can be present

____d. Distinct crests

____e. May exist without the other being present

____f. Long and even period

____g. Direction is always the same as the local wind

____h. Generated in the local area

____i. Short and choppy

____j. Long distances from crest to crest

____k. Short periods

* *

FRAME 16 (CONTD.)

ANSWER: L a.

L b.

S c.

S d.

L S e.

L f.

S g.

S h.

S i.

L j.

S k.

FRAME 17

Wave direction, like wind direction, is the direction from which the waves are coming. Wave direction is determined with reference to true north.

Wave direction is the direction __________ which waves are coming.

* *

ANSWER: from

FRAME 18

A wave is moving from 040^{o} toward 220^{o}. Its direction is _______^{o}.

*

ANSWER: 040

FRAME 19

Define wave direction.

____

*

ANSWER: The direction from which the wave moves.

FRAME 20

The heights of waves vary considerably. To ensure that representative and pertinent data is obtained, the height to be recorded is the significant wave height, which is the height of the highest one-third of the waves observed.

The value that is observed and recorded for the wave height is the ____________________ height of the observed waves.

*

FRAME 20 (CONTD.)

ANSWER: significant or highest one-third (either one)

NOTE: There are two additional values of wave height that may be of interest to Operational Tactical Commanders (OTC's). These values are the "Highest One-Tenth" of all the waves (self-explanatory), and the average height of all waves that are observed.

* * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 21

In order to get a wave height that is truly representative of the sea state you are observing, a minimum of 50 waves should be averaged. The accuracy will increase as the number of height measurements approaches 100; this number of observations has been shown to give a good representative value of the wave height in a given sea.

The minimum number of waves you should observe to get a representative height is ________, and the accuracy increases as the number of measurements gets closer to ________.

* *

ANSWER: 50

100

FRAME 22

To describe the physical characteristics of the sea surface as related to height, period, and direction of the sea, the observer must continue to use his experience while comparing the sea surface to some existing reference object. This means using reference points such as the ship's bow and/or stern, objects in the sea such as buoys, floating debris, foam, drifting objects, etc.

List six of the more common items which may be used as reference points to help observe sea conditions.

____

____

____

____

____

____

* *

ANSWER: Ship's bow

Ship's stern

Buoys (Any order)

Floating debris

Foam

Drifting objects

FRAME 23

When both sea waves and swell waves or two systems of swell waves are present at the same time, observations will be more difficult. You should estimate the higher system of waves first, then repeat the process for the lower system.

When two or more systems of waves are present, the ____________ should be observed first.

* *

ANSWER: highest

FRAME 24

For your observation to be representative of the existing sea conditions, it should be made over a minimum of 15 minutes and preferably longer.

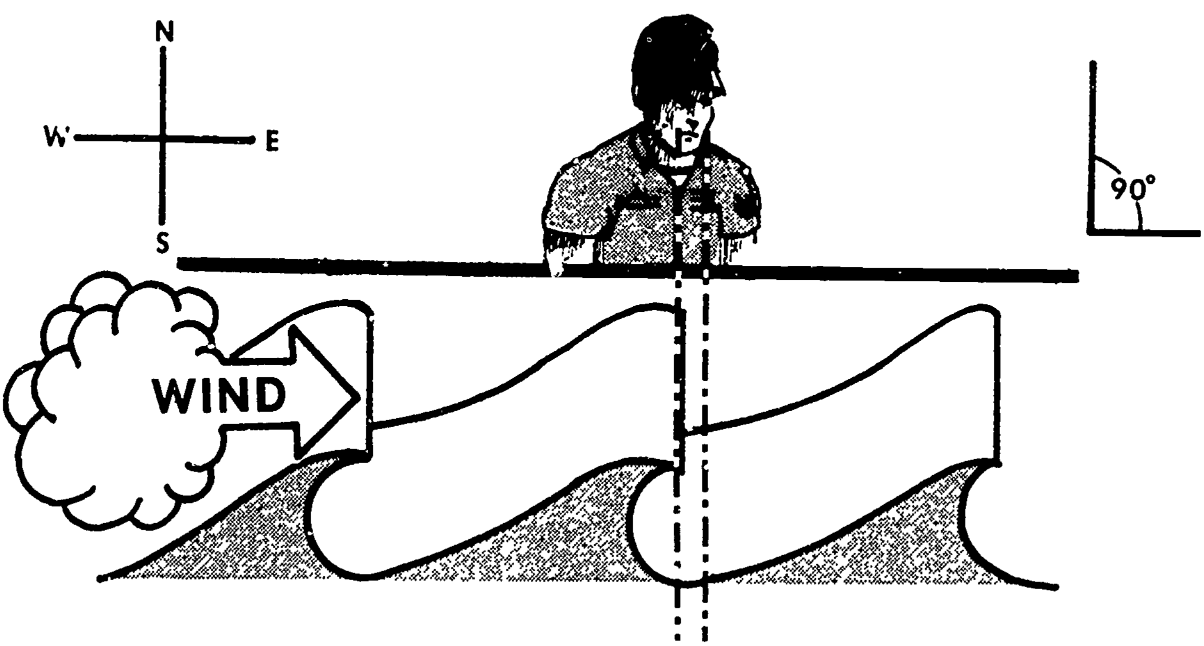
The minimum time that should be allowed for an observation of sea conditions is ____________ minutes.

* *

ANSWER: 15

FRAME 25

Probably the simplest method of determining the direction from which the waves are coming is by sighting along the wave crests. As you sight along the crests, you will be looking at a right angle to where the waves are coming from. You need simply to add 90° to the bearing you are sighting if the waves are moving from your right to your left, and subtract 90° if they are moving from your left to your right. Remember, the reported direction is the direction from which the waves are coming. This is illustrated below.



If the waves are moving from your right to your left, 90° is __________ to the bearing; if they are moving from your left to your right, you ______________ 90°.

* *

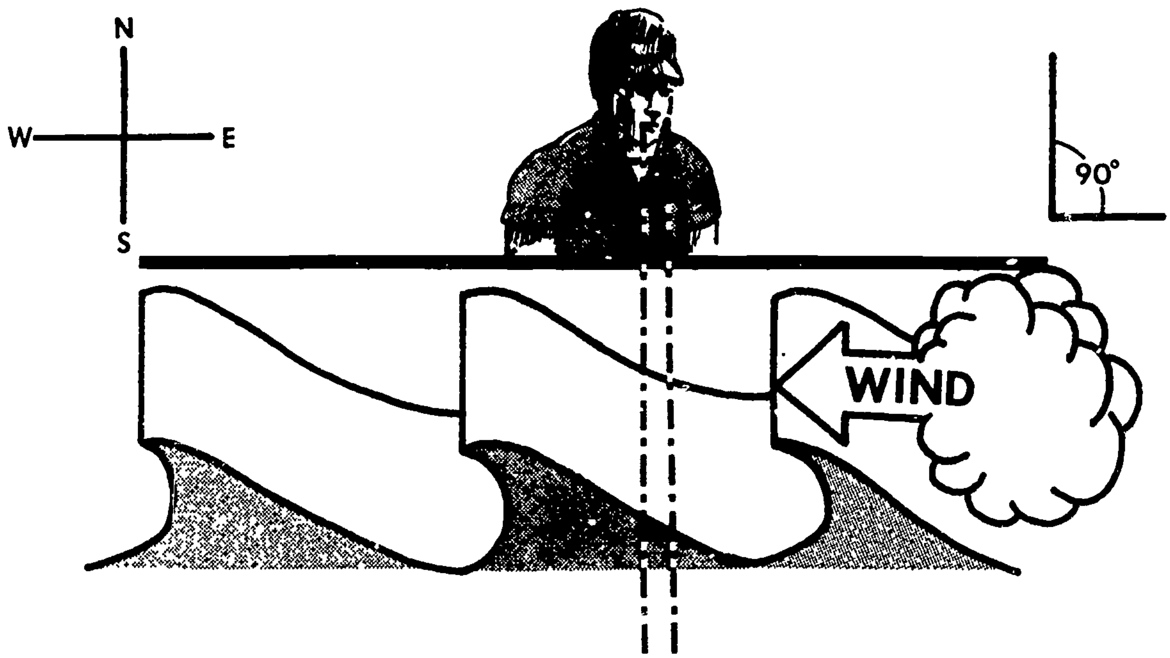
FRAME 25 (CONTD.)

ANSWER: added

subtract

FRAME 26

In the following diagram, you are looking South (180°). From what direction are the waves coming? ____________



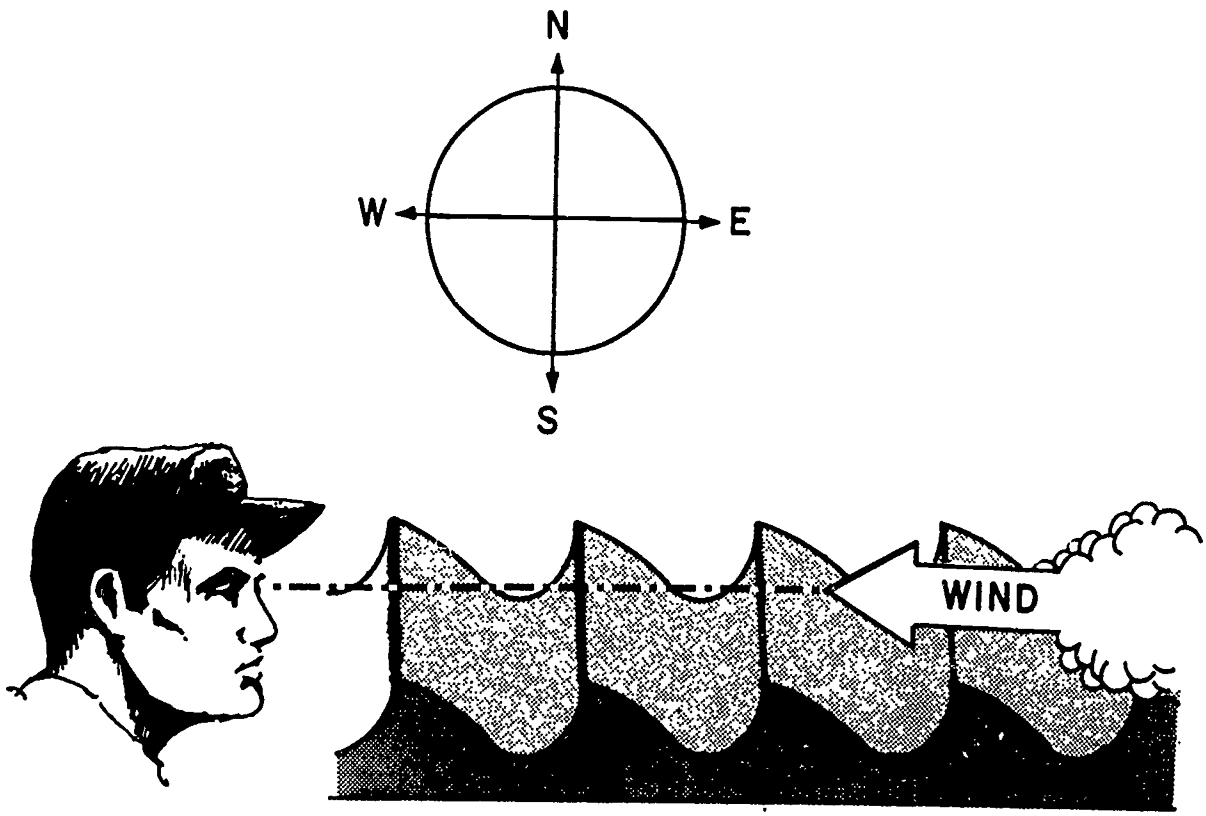
* *

ANSWER: East (90°)

FRAME 27

Wave direction may also be determined by facing the oncoming crests. In the diagram below, the wave direction is

____________________.



* *

ANSWER: east or 090°

FRAME 28

You may stand in either of two positions relative to wave crests in order to determine wave direction. They are:

_______________________ the wave crests

_______________________ the wave crests

* *

ANSWER: Facing

Sighting along

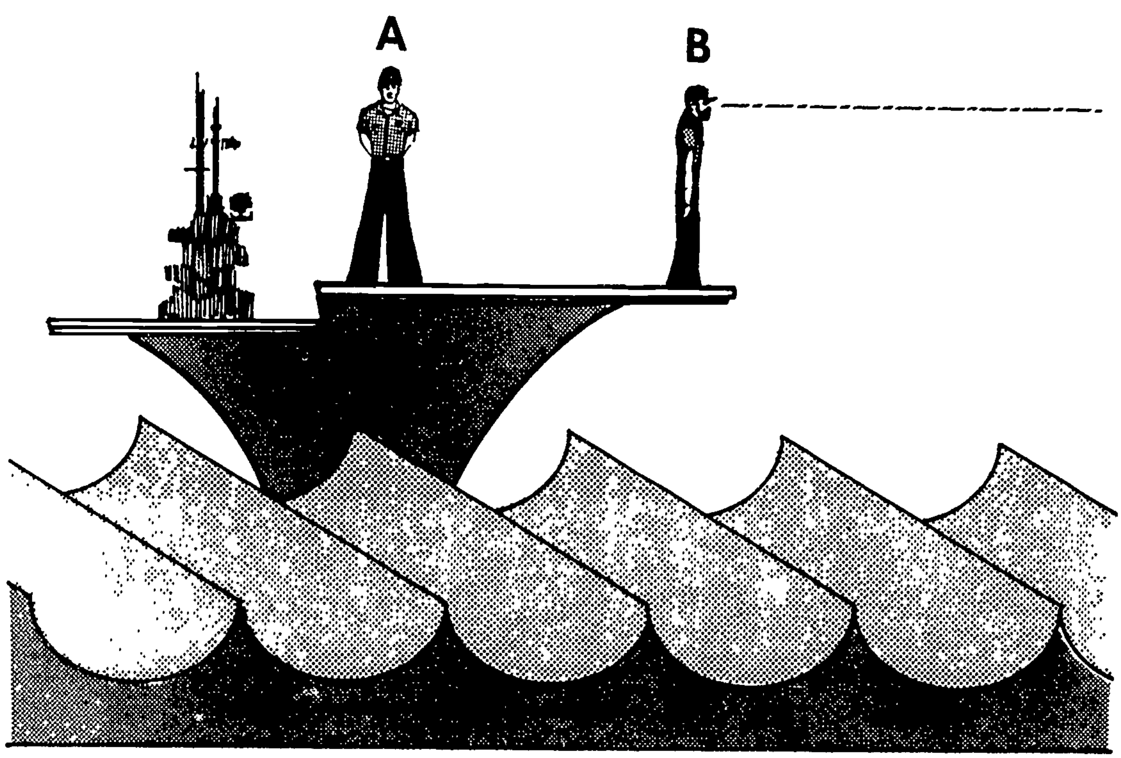
(Any order)

NOTE: In either case, the direction reported is the direction from which the waves are moving.

FRAME 29

In the diagram below, which is the correct position for the observer to stand to determine wave direction?

A ONLY, / B ONLY, / A AND B, / NEITHER A NOR B
(Circle one)



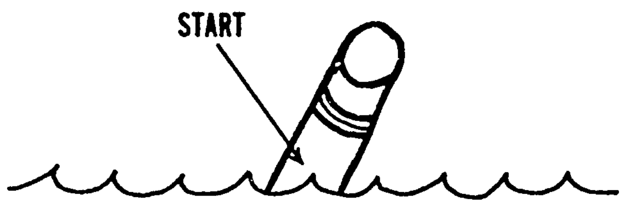
* *

ANSWER: A AND B

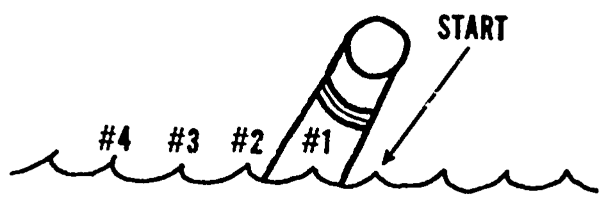
FRAME 30

To determine wave period, time the interval in seconds that it takes a series of crests to pass a fixed object in sight; then, divide the time interval by the number of crests. (A buoy or another ship at anchor is a good fixed reference point.) For example:

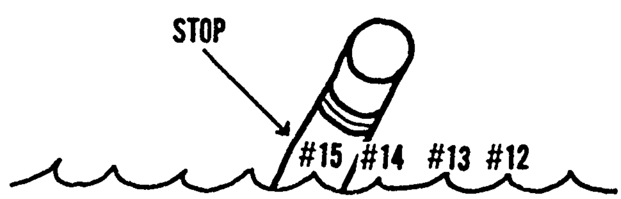
a. Start the stopwatch.



b. Count the succeeding crests.



c. Stop stopwatch (a minimum number of 15 waves is required).



d. Divide the time interval by the number of crests counted.

e. Round off to the nearest whole second.

FRAME 30 (CONTD.)

If in the example, the 15th wave crest passed the fixed object in 30 seconds, the wave period would be _____ seconds.

* *

ANSWER: 2

FRAME 31

If you count 20 sea waves passing a piling in one minute, what is the wave period?

_____a. Two seconds

_____b. Three seconds

_____c. Four seconds

_____d. Five seconds

* *

ANSWER: b

FRAME 32

If a fixed object is not in sight, try to select a distinctive patch of foam, a clump of seaweed or any other floating object at a distance far enough so that its movement is not affected by the wake of your ship or another ship. (Experience has shown that the preferred area to observe wave periods is one or two ship lengths ahead of the observation point on the windward side of the ship.) The marker you selected will bob up and down as the waves pass. Start the stopwatch when the mark is at the top of the wave. After at least 15 waves have been counted, stop the watch at the last counted crest. Then, find the period by _____________ the _________________ by the ______________________________.

* *

ANSWER: dividing

time interval

number of crests

FRAME 33

The only real difference in the two methods for determining wave period, discussed in the previous frames, is that in one, the counting marker which the crests pass was ________ and in the other, it was ____________.

* *

ANSWER: fixed (stationary)
floating (free)
(Any order)

FRAME 34

If there is no fixed marker or no floating marker already in the water, you may provide your own. A piece of wood makes a good marker. (A word of caution -- be sure that you have secured permission from the officer of the deck prior to throwing any objects overboard.) If no other method is available, estimate the passage of the crests past some part of your ship.

* * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 35

To determine the most reliable estimate of wave height, use reference points such as the side of your own ship, another ship in company or the horizon. When reading off another ship, the draft markings near the bow are useful in estimating heights. However, in all cases make sure you are not estimating bow waves.

* * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 36

Wave heights observed from a carrier are almost always underestimated. When judging wave heights using the horizon, you should make your observation from the lowest safe position on the ship. The observation should be made as close to amidships as possible so that the ship's motion is minimal. Judge the crest heights relative to the horizon. Observe as many heights as necessary (a minimum of 50), and use an average of the highest one-third, rounded off to the nearest whole foot.

Your observations should be made from the ___________ safe position and as close to ______________ as possible. Heights are rounded off to the nearest whole __________.

* *

FRAME 36 (CONTD.)

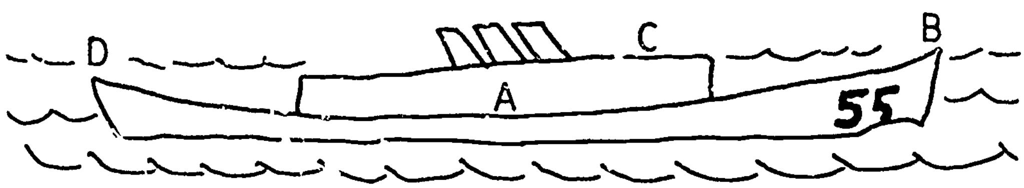
ANSWER: lowest

amidships

foot

FRAME 37

Where is the best spot on this ship to take an observation for wave height?



A / B / C / D
(Circle one)

Why? ______________________________

____

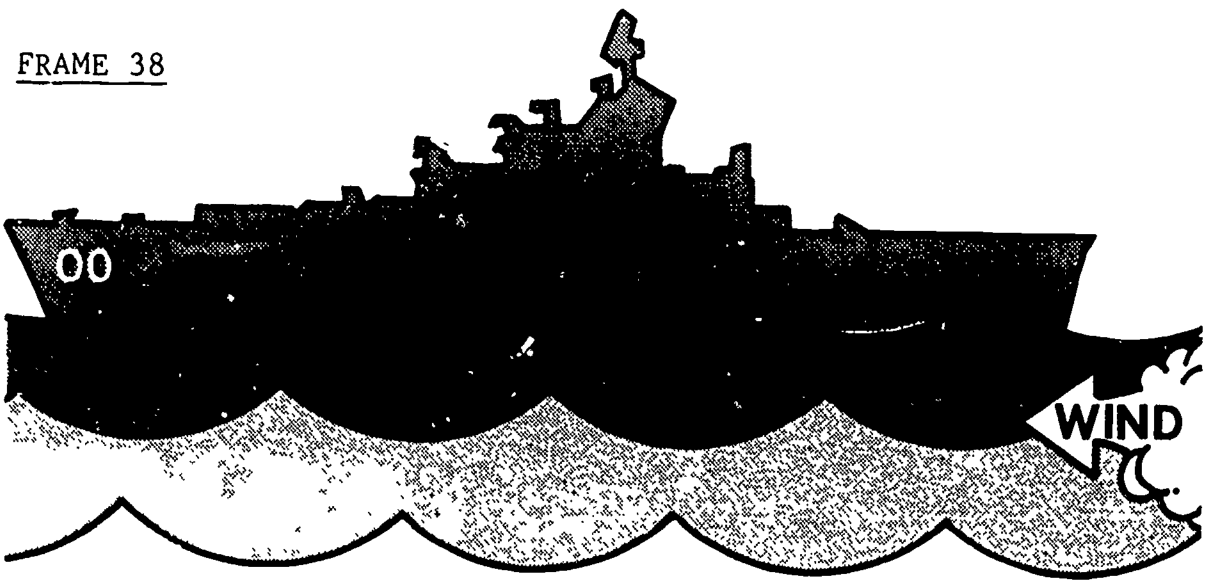
* *

FRAME 37 (CONTD.)

ANSWER: A

It is nearest to sea level and amidships; motion of the sh'p will be minimal.

FRAME 38



What is the sea-wave direction in the above diagram?

_____a. From ahead

_____b. From port

_____c. From starboard

_____d. From astern

* *

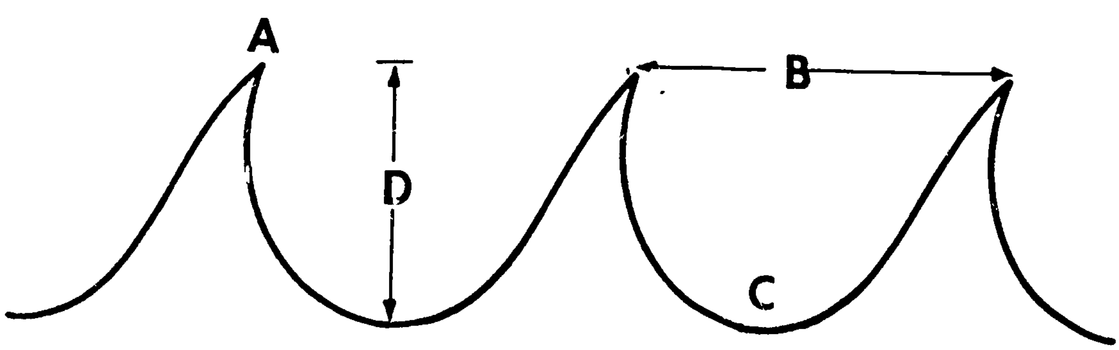
ANSWER: d.

THIS CONCLUDES SHIPBOARD OBSERVATIONS - SEA CONDITION. NOW, TURN TO THE CRITERION TEST AND COMPLETE IT.

SHIPBOARD OBSERVATIONS - SEA CONDITION

CRITERION TEST

1. Match the letters of the wave diagram with the terms listed below it.



_____a. Wave crest

_____b. Wave trough

_____c. Wave height

_____d. Wave length

2. Write the definition of sea waves.

____

3. Write the definition of swell waves.

____

SHIPBOARD OBSERVATIONS - SEA CONDITION

CRITERION TEST (CONTD.)

4. If the characteristics listed below pertain to a sea wave, put an "S" on the line preceding it. If they are characteristic of a swell wave, put an "L" on the line preceding it. If they apply to both sea and swell waves, put an "S" and an "L" on the line preceding it.

_____a. Distinct crests

_____b. Generated by wind outside the local area

_____c. Generated in the local area

_____d. Long and even period

_____e. Short periods

_____f. Two or more may be present from different directions

_____g. Direction is always the same as the local wind

_____h. Long distances from crest to crest

_____i. Short and choppy

_____j. May exist without the other being present

_____k. Only one can be present

5. Write the definition of wave direction.

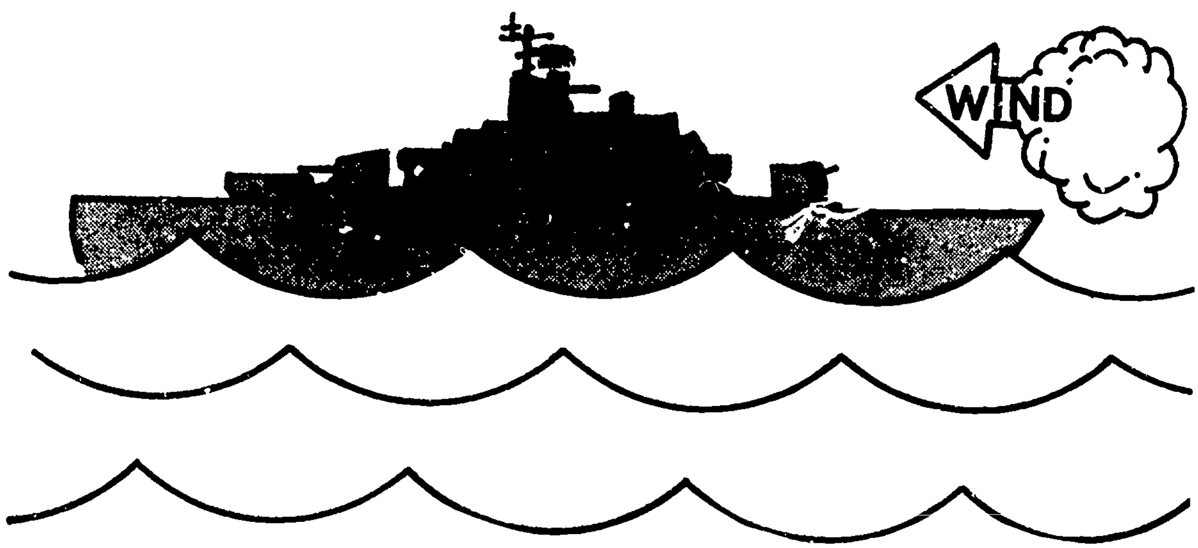
____

____

SHIPBOARD OBSERVATIONS - SEA CONDITION

CRITERION TEST (CONTD.)

6. What is the sea wave direction in this diagram?



_____a. From ahead

_____b. From port

_____c. From starboard

_____d. From astern

7. How is the reported value for wave height determined?

____

8. List at least four of the more common items which may be used as reference points to help observe sea conditions.

____________________ ____________________

____________________ ____________________

SHIPBOARD OBSERVATIONS - SEA CONDITION

CRITERION TEST (CONTD.)

9. When sea waves and swell waves or two systems of swell waves are present, which should be observed first?

____

10. What is the minimum time that should be allowed for an observation of sea conditions?

____

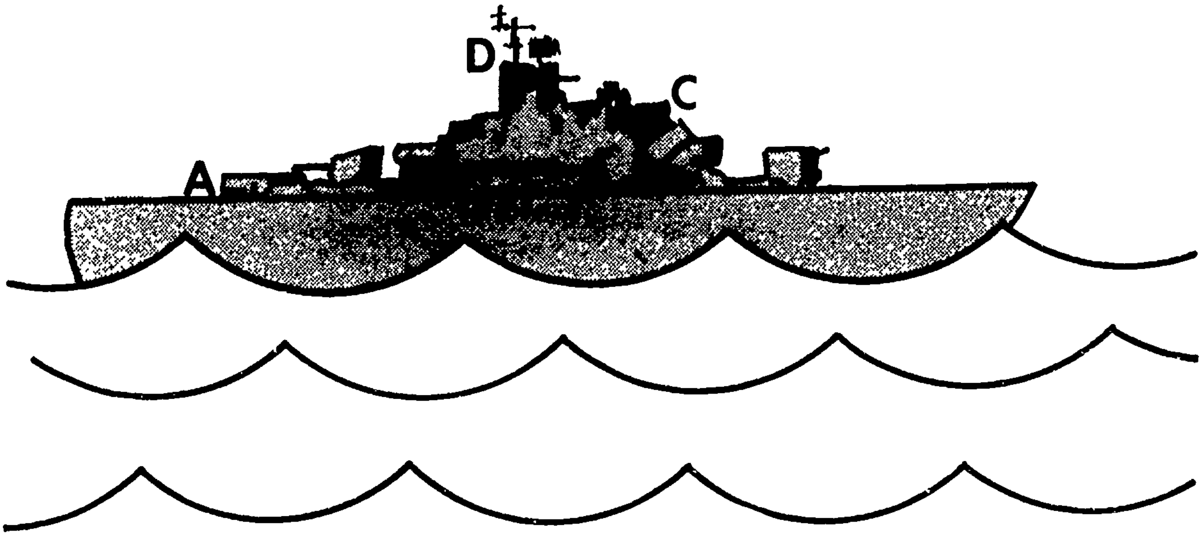
11. Wave period is defined as ________________________

____.

12. If you count 15 sea waves passing a piling in one minute, what is the wave period?

____

13. Where would you take a wave height observation on the following diagram? A / B / C / D
(Circle one)



SHIPBOARD OBSERVATIONS - SEA CONDITION

CRITERION TEST ANSWERS

1. _A_ a. _C_ b. _D_ c. _B_ d.

2. Sea waves are waves generated by local winds.

3. Swell waves are waves which have traveled outside of their generating area.

4. __S__ a.

   __L__ b.

   __S__ c.

   __L__ d.

   __S__ e.

   __L__ f.

   __S__ g.

   __L__ h.

   __S__ i.

   _L S_ j.

   __S__ k.

5. Wave direction is the direction from which the waves are coming.

6. a.

7. Average the heights of the highest one-third or significant waves.

SHIPBOARD OBSERVATIONS - SEA CONDITION

CRITERION TEST ANSWERS (CONTD.)

8. Ship's bow, stern, buoys, floating debris, foam, drifting objects

(Any four)

9. The highest system

10. 15 minutes

11. The elapsed time between successive crests or troughs.

12. 4 seconds

13. B

PART III

SHIPBOARD OBSERVATIONS - RECORDING OF PARAMETERS

SHIPBOARD OBSERVATIONS - RECORDING OF PARAMETERS

INTRODUCTION

An observation that is not recorded correctly and subsequently transmitted correctly can be of little use to the recipient. The observations you take aboard ship are recorded on CNOC Form 3140/8. Obtain a copy of this form to reference during this and the following part of this program. Further instructions on the entries to make on this form are contained in the Manual for Ship's Surface Weather Observations, NAVOCEANCOMINST 3144.1 ( ).

Read the objectives on the next page, then complete the program.

SHIPBOARD OBSERVATIONS - RECORDING OF PARAMETERS

OBJECTIVES

1. Enter observed data on CNOC Form 3140/8 columns listed below.

    Column A - Ship's position

    Column B - Ship's course

    Column C - Ship's speed

    Column D - Sea-water temperature

    Column E - Sea waves (period - height)

    Column F - Swell waves (direction - period - height)

2. List how ship's position, course, and speed are obtained.

3. Write where and by what means sea-water temperature is obtained.

FRAME 1

In Column A, enter the ship's position. The entry will consist of the quadrant of the globe, latitude, and longitude. This information, with exception of the quadrant, can be obtained from the Navigation Department.

POSITION [illegible] (A)	COURSE (B)	SPD (C)	SEA WATER ($\frac{1}{10}$ °F) (D)	SEA WAVES PERIOD HEIGHT (E)	SWELL WAVES DIRECTION PERIOD HEIGHT (F)

What three parameters are entered for ship's position on CNOC Form 3140/8?

____

____

____

* *

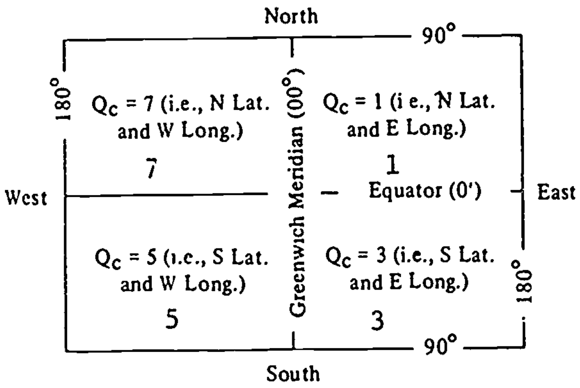
ANSWER: Quadrant

Latitude (Any order)

Longitude

FRAME 2

The first of the parameters used is the quadrant of the globe. The following diagram shows the system used in dividing the earth into quarters.



(a) When the ship is precisely on the Greenwich Meridian (i.e., $L_oL_oL_oL_o$ = 0000) either code figure 1 or 7 (Northern Hemisphere) or code figure 3 or 5 (Southern Hemisphere) may be reported, as appropriate with respect to latitude.

(b) When the ship is precisely on the Equator (i.e., $L_aL_aL_a$ = 000) either code figure 1 or 3 (Eastern Hemisphere) or code figure 5 or 7 (Western Hemisphere) may be reported, as appropriate with respect to longitude.

Q_c is entered as a single digit.

If your ship is at 36° south and 130° east, what would Q_c be?

____

* *

ANSWER: 3

FRAME 3

The second of the parameters used in Column A .. latitude. This parameter is entered in two digits to the nearest whole degree.

Your ship is located at 35.7° north. What would you enter in Column A for latitude? ____________

* *

ANSWER: 36

Your ship is located at 23.4° north. What would you enter in Column A for latitude? ___________

* *

ANSWER: 23

FRAME 4

The third and final parameter reported in Column A is longitude. Longitude is also reported to the nearest whole degree and is entered in three digits. If you are at a longitude less than 100°, precede the value with a zero.

Your ship is located at 165.6° east. What would you enter in Column A for longitude? _____________

* *

FRAME 4 (CONTD.)

ANSWER: 166

Your ship is located at 57.3° west. What would you enter in Column A for longitude? ____________

* *

ANSWER: 057

FRAME 5

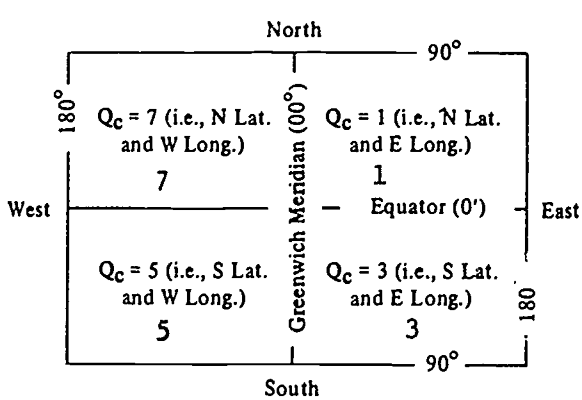
Using the following information, enter the ship's position in Column A of the form below. The Q_c table is provided for your convenience.

a. 33.6°N LAT 146.2°W LONG

b. 55.5°S LAT 127.3°W LONG

c. 21.3°S LAT 82.6°E LONG

	POSITION SCLIII (A)	COURSE (B)	SPD (C)	SEA WATER ($\frac{1}{10}$° F) (D)	SEA WAVES PERIOD HEIGHT (E)	SWELL WAVES DIRECTION PERIOD HEIGHT (F)
a.						
b.						
c.						



* *

FRAME 5 (CONTD.)

ANSWER:

	POSITION OLLIII (A)	COURSE (B)	SPD (C)	SEA WATER ($\frac{1}{10}$° F) (D)	SEA WAVES PERIOD HEIGHT (E)	SWELL WAVES DIRECTION PERIOD HEIGHT (F)
a.	734146					
b.	556127					
c.	321083					

FRAME 6

In Column B, enter the ship's true course to the nearest whole degree. If the ship is not underway, enter a dash (-). If you do not have a ship's course and speed indicator located in your office, obtain this information from the ship's Navigation Department.

POSITION OLLIII (A)	COURSE (B)	SPD (C)	SEA WATER ($\frac{1}{10}$° F) (D)	SEA WAVES PERIOD HEIGHT (E)	SWELL WAVES DIRECTION PERIOD HEIGHT (F)
	090				
	-				

FRAME 6 (CONTD.)

In Column B, enter the ship's ________ course to the nearest ________ ________. If the ship is not underway, enter a ____________.

* *

ANSWER: true

whole degree

dash (-)

FRAME 7

If your ship is heading due west, how would you enter the ship's course in Column B? ______________

* *

ANSWER: 270

FRAME 8

In Column C, enter the ship's speed to the nearest knot. Enter a dash if the ship is not underway.

POSITION OLLIII (A)	COURSE (B)	SPD (C)	SEA WATER ($\frac{1}{10}$ F) (D)	SEA WAVES PERIOD HEIGHT (E)	SWELL WAVES DIRECTION PERIOD HEIGHT (F)
		12			
		—			

In Column C, enter the ship's speed to the nearest ________.

Enter a dash if the ship is not ____________.

* *

ANSWER: knot

underway

FRAME 9

Your ship's speed is 15.2 knots. How do you enter ship's speed in Column C? ________

* *

ANSWER: 15

FRAME 11 (CONTD.)

injection temperature. Other methods include the dipping bucket and the bathythermograph.

With the dipping bucket, which is rarely used at the present time, a sample of sea water is obtained by throwing a bucket, with a line attached, over the side, and the temperature of the water is then measured with a thermometer after the sample is brought aboard.

The bathythermograph (BT) is an instrument designed to measure sea water temperature versus depth. With the older model, the mechanical BT, temperature versus depth was recorded on a slide contained within the instrument, and the trace was evaluated after the instrument had been lowered into the sea and then brought back aboard. With the newer models, the expendable BTs, the temperature is transmitted back to a recorder aboard the ship, and a trace of temperature versus depth is obtained as the BT sinks to its designed depth.

In Column D, enter the current ____________ temperature to the nearest ____________ degree FAHRENHEIT.

* *

ANSWER: sea water

tenth (0.1)

453

FRAME 10

a. From what department can you obtain the ship's position (latitude and longitude)? ____________________

b. If the weather office does not have direct readout of ship's course and speed, from what department can the information be obtained? _______________

* *

ANSWER: a. Navigation

b. Navigation

FRAME 11

POSITION OLLIII	COURSE	SPD	SEA WATER [illegible]	SEA WAVES PERIOD HEIGHT	SWELL WAVES DIRECTION PERIOD HEIGHT
(A)	(B)	(C)	(D)	(E)	(F)
			23.2		

In Column D, enter the current sea-water temperature to the nearest 0.1° Fahrenheit. This information is normally obtained from the Engineering Department and is referred to as sea-water

FRAME 12

The sea water temperature is 67.3^{o} Fahrenheit. How would you enter it in Column D? __________

* *

ANSWER: 67.3

FRAME 13

a. From what department is sea water temperature normally obtained?

____

b. What term is used in reference to this temperature?

____

c. What are two other means of obtaining sea water temperature?

____

____

* *

ANSWER: a. Engineering

b. Sea water injection temperature

c. Dipping bucket

Bathythermograph

(Any order)

455

FRAME 14

Column E requires a four-digit entry. The first two represent the average period of the sea waves in seconds, and the last two represent the significant height of the sea waves in feet. This example shows how to enter sea waves with a 3 second period and a significant height of 10 feet.

In Column E, enter the average __________ of sea waves in seconds and in feet for the significant __________ of the sea waves.

* *

ANSWER: period

height

FRAME 15

When there are no sea waves, enter 0000 in Column E. If the sea is confused, use the following rules:

a. If the period cannot be estimated due to a confused sea enter 99 for the period and the code value for the significant wave height in feet.

b. When the period and height cannot be estimated due to a confused sea, enter 99// in Column E.

c. If wave data cannot be observed, will be left blank.

********************NO RESPONSE NECESSARY********************

FRAME 16

EXAMPLE

POSITION OLLIII (A)	COURSE (B)	SPD (C)	SEA WATER ($\frac{1}{10}$°F) (D)	SEA WAVES PERIOD HEIGHT (E)	SWELL WAVES DIRECTION PERIOD HEIGHT (F)
					090715

FRAME 16 (CONTD.)

When swells are observed, enter six digits in column "F." The first two represent the swell direction in tens of degrees; the second two represent the average period of the swell in seconds, and the last two represent the significant height of the swell in feet. When swell is not observed, leave the column blank.

What would be entered to indicate the following conditions: swell waves from 120° with an eight-second period and a significant height of 16 feet? ______________

* *

ANSWER: 120816

THIS CONCLUDES SHIPBOARD OBSERVATIONS - RECORDING OF PARAMETERS. NOW, COMPLETE THE CRITERION TEST.

SHIPBOARD OBSERVATIONS - RECORDING OF PARAMETERS

CRITERION TEST

1. Enter the following data on the segment of CNOC Form 3140/8 shown below:

	A	B	C
POSITION	37.8°N 157.3°E	20.3°S 70.8°E	50.2°N 160.7°W
COURSE	180°	280°	090°
SPEED	14.6 kts	12.3 kts	18.7 kts
SEA WATER TEMPERATURE	21.8°C	25.2°C	10.6°C
SEA WAVES	6 ft 3 sec	2 ft 2 sec	9 ft 4 sec
SWELL WAVES	10ft 7 sec 180°	NO SWELL	20ft 8 sec 190°

	POSITION QLLIII (A)	COURSE (B)	SPD (C)	SEA WATER ($\frac{1}{10}$ °F) (D)	SEA WAVES PERIOD HEIGHT (E)	SWELL WAVES DIRECTION PERIOD HEIGHT (F)
A.						
B.						
C.						

CRITERION TEST (CONTD.)

2. List how the ship's position, course, and speed are obtained.

____

____

____

3. Write where and by what means sea water temperature is obtained.

____

____

____

SHIPBOARD OBSERVATIONS - RECORDING OF PARAMETERS

CRITERION TEST ANSWERS

1.

	QUARTERMASTER			AEROGRAPHER'S MATE		
	POSITION OLLIII (A)	COURSE (B)	SPD (C)	SEA WATER (°F) (D)	SEA WAVES PERIOD HEIGHT (E)	SWELL WAVES DIRECTION PERIOD HEIGHT (F)
A.	138157	180	15	71.2	0306	180710
B.	320071	280	12	77.4	0202	
C.	750161	090	19	51.1	0409	190820

2. The position is obtained from the Navigation Department, and the course and speed are obtained by direct readout of instruments in the weather office or from the Navigation Department.

3. Sea water temperature (injection temperature) is obtained from the Engineering Department. The dipping bucket and bathythermograph are alternate methods.

PART IV

SHIPBOARD OBSERVATIONS - ENCODING

SHIPBOARD OBSERVATIONS - ENCODING

INTRODUCTION

Getting accurate shipboard weather observations to other weather units, particularly to Fleet Numerical Oceanography Center, is exceedingly important. Observations from ocean areas are very widely spaced compared to land station observations; consequently, each observation is significant in analyzing the current weather situation and in forecasting future weather conditions which affect fleet operations. Shipboard weather data is transmitted in a code form very similar to the code form used for land station reports.

This program assumes that the learner is already familiar with land station synoptic encoding and therefore covers only those areas of the synoptic code which are peculiar to shipboard weather reports. More detailed information on the shipboard synoptic code can be obtained from NAVOCEANCOMINST 3144.1( ). Refer to CNOC Form 3140/8. You will notice that the symbolic format and spaces for encoding each observation are provided in Part II of the form.

Read the objectives on the next page, then complete the program.

SHIPBOARD OBSERVATIONS - ENCODING

OBJECTIVES

Encode the following mandatory synoptic groups from data entered on Part I of CNOC Form 3140/8 and other data as provided:

Synoptic Group	Description
Section 0	
DDDD	Ship's call letters
$YYGGi_w$	Day of month, time and wind indicator
$99L_aL_aL_a$	Latitude
$Q_cL_oL_oL_oL_o$	Quadrant and longitude
Section 2	
$222D_sv_s$	Section 2 identifier and ship's course and speed
$0s_nT_wT_wT_w$	Sea water temperature
$2P_wP_wH_wH_w$	Period and height of sea waves
$3d_{w1}d_{w1}d_{w2}d_{w2}$	Direction for swell wave or waves
$4P_{w1}P_{w1}H_{w1}H_{w1}$	Period and height of swell wave or waves
$5P_{w2}P_{w2}H_{w2}H_{w2}$	
$6I_sE_sE_sR_s$	Accretion of ice on ship
Ice $c_iS_ib_iD_iz_i$	Presence and state of sea ice and ice of land origin

464

FRAME 1

The complete symbolic format for a shipboard report is shown below. The underlined groups are encoded identically for both land and shipboard reports and, as stated in the Introduction, will not be discussed in this program. Only those peculiar to shipboard messages will be taught.

$M_iM_iM_jM_j$ DDDD $YYGGi_w$ $99L_aL_aL_a$ $Q_cL_oL_oL_oL_o$ i_Ri_xhVV $\underline{Nddff}$
$\underline{1s_nTTT}$ $\underline{2s_nT_dT_dT_d}$ $\underline{4PPPP}$ 5appp $\underline{7wwW_1W_2}$ $\underline{8N_hC_LC_MC_H}$ $222D_sv_s$
$0s_nT_wT_wT_w$ $2P_wP_wH_wH_w$ $3d_{w1}d_{w1}d_{w2}d_{w2}$ $4P_{w1}P_{w1}H_{w1}H_{w1}$
$5P_{w2}P_{w2}H_{w2}H_{w2}$ $6I_sE_sE_sR_s$ ICE $c_iS_ib_iD_iz_i$

* * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 2

The first group $M_iM_iM_jM_j$ identifies the report as a ship observation or land observation. In a collection of shipboard observations, called a bulletin, BBXX is always used for shipboard reports. This group is not encoded locally; rather, it is programmed into the reports by collection points such as Carswell AFB. The group BBXX has now been deleted from the CNOC form 3140/8.

* * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 3

The DDDD group will always be your ship's four letter call sign. This group is not entered on the observation form, but should be included with every message that is transmitted.

* * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 4

The next group is $YYGGi_w$. This group tells the recipient when the observation was taken; how the wind speed contained in the report was obtained, and whether it is being reported in meters per second or knots.

$YYGGi_w$

YY - Day of the month. The first day of the month is encoded as 01, the twenty-fourth as 24, etc.

GG - Time of the observation. The observation taken at 1200Z would be encoded as 12.

i_w - Wind indicator. Use the following table to encode this entry.

FRAME 4 (CONTD.)

Code
Figure

0 - Wind speed in meters per second (estimated)

1 - Wind speed in meters per second (measured)

3 - Wind speed in knots (estimated)

4 - Wind speed in knots (measured)

/ - Solidus (/) is reported when the wind speed is not available

* * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 5

The next two groups $99L_aL_aL_a$ $Q_cL_oL_oL_oL_o$ are used to identify the location of the report. The 99 indicates that th- ship's position follows to the nearest tenth of a degree for lati- tude and longitude, with the quadrant of the globe being indicated.

$L_aL_aL_a$ is the latitude at the point of observation in tens, units, and tenths of degrees. Tenths of degrees are obtained by dividing the number of minutes (') by six and disregarding the remainder. If your latitude is less than 10^o, precede the value with a zero.

FRAME 5 (CONTD.)

What would you log for $L_aL_aL_a$, if at the point of observation your ship's location was as follows:

a. 25° 32'N _______

b. 9° 25'S _______

* *

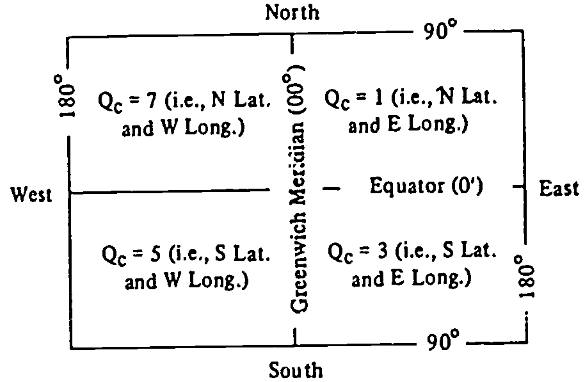
ANSWER: a. 255

b. 094

FRAME 6

The second group is $Q_cL_oL_oL_oL_o$. It breaks into two parts. Q_c is the quadrant of the globe. Determining the quadrant of the globe was discussed in Part III; so only the diagram will be shown here.

Symbol Q_c–Quarter of the globe



* * * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 7

$L_oL_oL_oL_o$ is the longitude of the point of observation in hundreds, tens, units, and tenths of degrees. Tenths of degrees are obtained in the same manner as for latitude -- divide the number of minutes by six and disregard the remainder. If you do not have a value with four digits, precede the value with zeros to make a four-digit entry.

What would you log for $L_oL_oL_oL_o$, if at the point of observation, your ship was located as follows:

a. 137^o 24' ________

b. 52^o 12' ________

* *

ANSWER: a. 1374

b. 0522

FRAME 8

Using the information below, encode the following synoptic groups for transmission.

DDDD $YYGGi_w$ $99L_aL_aL_a$ $Q_cL_oL_oL_oL_o$

a. Your ship is located at 32.5°N 41.3°W on the 16th of May at 1800Z. The ship's call letters are KYPZ, and your ship has wind equipment calibrated in knots.

________ ________ ________ ________

b. The ship is located at 1.7°S 170.7°E on the 29th of June. The time is 0600Z, and your ship is equipped with an anemometer in knots. Your ship's call letters are KIPT.

________ ________ ________ ________

* *

ANSWER: a. KYPZ 16184 99325 70413

b. KIPT 29064 99017 31707

FRAME 9

Although the $i_R i_x hVV$ group is applicable to both the land and shipboard synoptic codes, there are some differences in their encoding. Since ships do not measure precipitation amounts, i_R is always encoded as a 4 with this entry having been preprinted on CNOC Form 3140/8.

* * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 10

Visibility for shipboard observations is reported in nautical miles using code figures 90-99 as shown below.

VV -- Horizontal visibility at surface

Code Figure	Kilometers	Nautical miles
90	Less than .05	Less than 1/16
91	0.05	1/16
92	0.20	1/8
93	0.50	1/4
94	1.00	1/2
95	2.00	1
96	4.00	2
97	10.00	5
98	20.00	10
99	Not reported	Not reported

* * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 11

The next group is 5appp. While the actual encoding of this group is identical for both land and ship reports, it is only included in a ship report when the ship has been at anchorage, moored for the past three hours preceding the time of observation.

* * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 12

The next code group is $222D_sv_s$. 222 identifies the beginning of Section 2 of the shipboard synoptic code and is preprinted on CNOC Form 3140/8.

D_s is the ship's course (true) made good during the three hours preceding the time of observation. This is the direction from the ship's position three hours ago to its present location.

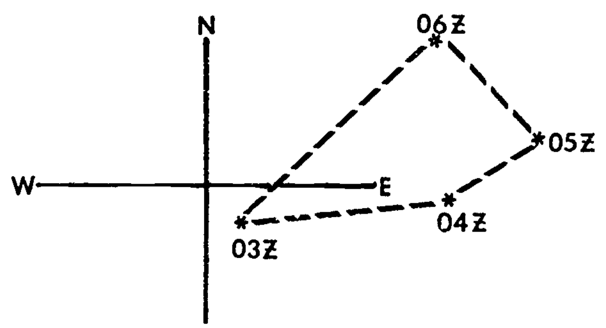
FRAME 12 (CONTD.)

D_s is encoded using the following table.

Code Figure	Direction
0	Stationary
1	Northeast
2	East
3	Southeast
4	South
5	Southwest
6	West
7	Northwest
8	North
9	Unknown

The figure below represents a ship's position at 03Z, 04Z, 05Z and 06Z. At 06Z, what is its "course (true) made good" during the preceding three hours? ______________

This would be encoded as a ______________.



* *

ANSWER: 045° or northeast

Code figure 1

FRAME 13

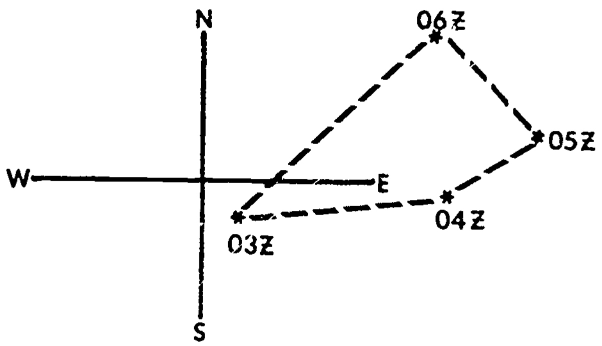
v_s is the ship's average speed made good during the three hours preceding the time of observation. It is obtained by dividing the distance from the ship's position three hours ago to its present position by the elapsed time (3 hours).

v_s is encoded using the following code table.

Code Figure	Knots
0	0
1	1-5
2	6-10
3	11-15
4	16-20
5	21-25
6	26-30
7	31-35
8	36-40
9	over 40 knots

FRAME 13 (CONTD.)

If, in the figure below, the distance from the 03Z position to the 06Z position is 24 nautical miles, what is the "speed made good" which would be used to determine the code figure for v_s? ______ knots; v_s would be encoded as a ______.



* *

ANSWER: 8, 2

FRAME 14

The next group is the sea surface temperature $0s_nT_wT_wT_w$. The first character, 0, indicates that sea surface temperature is to follow. The second character, s_n, indicates whether the sea surface temperature is positive or negative and is encoded as shown below:

Code
Figure

0 - Temperature is positive or zero

1 - Temperature is negative

The last three characters, $T_wT_wT_w$, are the sea surface temperature entered to a tenth of a degree Celsius. It is always encoded as a three digit number. For example, a sea surface temperature of 0.7°C would be encoded as $T_wT_wT_w$ = 007. If for any reason the sea surface temperature is not available, then the entire group is left out of the report.

* * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 15

The next group is $2P_wP_wH_wH_w$. This group is used to report wind wave (sea wave) data. The first character, 2, is the indicator for sea wave data to follow. The characters P_wP_w (wave period) will be repeated as it appeared in Column (E), while the characters H_wH_w (wave height) will be encoded from Table 4-14 in the Manual.

When there are no wind waves, but swell waves are present, the $2P_wP_wH_wH_w$ group will be encoded 20000.

* * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 16

The next three groups, $3d_{w1}d_{w1}d_{w2}d_{w2}$ $4P_{w1}P_{w1}H_{w1}H_{w1}$ $5P_{w2}P_{w2}H_{w2}H_{w2}$, are used to report one or two groups of swell waves. These groups should be used only when swell can be distinguished from wind waves. If only one system of swell is observed:

(a) its direction, period, and height should be indicated respectively by $d_{w1}d_{w1}$, $P_{w1}P_{w1}$, $H_{w1}H_{w1}$

(b) $d_{w2}d_{w2}$ should be encoded as //

(c) group $5P_{w2}P_{w2}H_{w2}H_{w2}$ should be omitted.

If a second swell system is observed: (a) its direction, period and height would be indicated respectively by $d_{w2}d_{w2}$. $P_{w2}P_{w2}$, $H_{w2}H_{w2}$. The swell wave period and height are encoded the same as $2P_wP_wH_wH_w$. The direction of the swell ($3d_{w1}d_{w1}d_{w2}d_{w2}$) is encoded as true direction, in tens of

FRAME 16 (CONTD.)

degrees, from which the swell is moving. Examples of groups are: $3d_{w1}d_{w1}d_{w2}d_{w2}$ $4P_{w1}P_{w1}H_{w1}H_{w1}$ $5P_{w2}P_{w2}H_{w2}H_{w2}$.
One swell system is observed moving from 170° with period of 6 seconds and an average height of 1.3 feet.

Encode as: 317// 40601

* * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 17

The next group, $6I_sE_sE_sR_s$, is used to report ice accretion on exposed surfaces of a ship. A complete breakdown of this group is contained in Chapter 4 of NAVOCEANCOMINST 3144.1( ), and the FMH-2.

* * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 18

The last group in the synoptic code is used to report sea ice or ice of land origin. The indicator for the group is the plain language word "ICE." The symbolic format is $c_iS_ib_iD_iz_i$. A complete explanation of this group is contained in NAVOCEANCOMINST 3144.1( ), and the FMH-2.

* * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

THIS CONCLUDES SHIPBOARD OBSERVATIONS - ENCODING.

NOW, COMPLETE THE CRITERION TEST.

NOTE: While this part was concerned with only those groups that are peculiar to shipboard observations, the criterion test has been developed to increase your familiarity with the complete synoptic code.

SHIPBOARD OBSERVATIONS - ENCODING

CRITERION TEST

Use the following information to encode Sections 0, 1 and 2 of the shipboard synoptic code:

1. Your ship is located at 18.7°S 137.6°E at 0600 GMT on 3 FEB 1982. The true wind as determined from instruments is 270°, 8 knots with stratocumulus that was not formed by spreading cumulus covering the entire sky, bases are at 2300 feet. The air temperature is 26.2°C, dew point 22.5°C and sea surface temperature 19.1°C. Your ship has been stationary for the last 4 hours. The sea level pressure 3 hours ago (0300 GMT) was 1017.5 and has increased steadily to its present value of 1021.3. The wind waves are 2 feet with an average period of 3 seconds. There are no swell waves present nor is there any significant present or past weather to report with visibility 10 nautical miles.

CRITERION TEST (CONTD.)

SECTION 0			
DDDD	$YYGGI_w$	99 $L_aL_aL_a$	$Q_cL_oL_oL_oL_o$
TRANSMIT	00	99	
BUT	03	99	
DO NOT	06	99	
ENCODE	09	99	
ON THIS	12	99	
FORM	15	99	
	18	99	
	21	99	

OPTIONAL ENCODE ONLY IF SIGNIFICANT, UPON REQUEST, OR ANCHORED

SECTION 1							
i_ri_xhvv	Nddff	1 S_nTTT	2 $S_nT_dT_dT_d$	4 PPPP	5 aPPP	7 wwW_1W_2	8 $N_hC_LC_MC_H$
4		1	2	4	5	7	8
4		1	2	4	5	7	8
4		1	2	4	5	7	8
4		1	2	4	5	7	8
4		1	2	4	5	7	8
4		1	2	4	5	7	8
4		1	2	4	5	7	8
4		1	2	4	5	7	8

SECTION 2									
222 D_sv_s	0 $S_nT_wT_wT_w$	2 $P_wP_wH_wH_w$	3$d_{w1}d_{w1}$	$d_{w2}d_{w2}$	4$P_{w1}P_{w1}H_{w1}H_{w1}$	5$P_{w2}P_{w2}H_{w2}H_{w2}$	6 $I_sE_sE_sR_s$	ICE	$c_iS_ib_iD_iz_i$
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	

SHIPBOARD OBSERVATIONS - ENCODING CRITERION TEST (CONTD.)

2. Your ship is located at 37.8°N 60.0°W at 1200 GMT on 5 JAN 1982. The weather at 0600 GMT was drizzle and fog, changing to continuous moderate rain at 1100 GMT. The visibility has increased to 1 nautical mile in rain. The wind is estimated to be from 120° at 28 knots. The sky is overcast with 4/8 of Stratus Fractus at 500 feet under an overcast layer of Nimbostratus. Your ship has been going south at a rate of 12 knots for the past 4 hours. The air temperature is 18.5°C with a dew point of 18.4°C, the sea surface temperature is 21.1°C. The sea level pressure is presently 998.2. The wind waves are averaging 11 feet with a period of 8 seconds. There are two distinct swell waves present, the predominant swell wave is from 230° with a period of 12 seconds at an average height of 14 feet. The secondary swells are from 330° with a period of 10 seconds and an average height of 11 feet.

CRITERION TEST (CONTD.)

SECTION 0				
DDDD	$YYGGI_Y$	99	$L_aL_aL_a$	$Q_cL_oL_oL_oL_o$
	00	99		
TRANSMIT BUT	03	99		
DO NOT	06	99		
ENCODE ON	09	99		
THIS FORM	12	99		
	15	99		
	18	99		
	21	99		

OPTIONAL ENCODE ONLY IF SIGNIFICANT, UPON REQUEST, OR ANCHORED

SECTION 1							
i_Ri_xhVV	Nddff	1 S_nTTT	2 $S_nT_dT_dT_d$	4 PPPP	5 aPPP	7 wwW_1W_2	8 $N_hC_LC_MC_H$
4		1	2	4	5	7	8
4		1	2	4	5	7	8
4		1	2	4	5	7	8
4		1	2	4	5	7	8
4		1	2	4	5	7	8
4		1	2	4	5	7	8
4		1	2	4	5	7	8
4		1	2	4	5	7	8

SECTION 2									
222 D_sv_s	0 $S_nT_wT_wT_w$	2 $P_wP_wH_wH_w$	3 $d_{w1}d_{w1}$	$d_{w2}d_{w2}$	4 $P_{w1}P_{w1}H_{w1}H_{w1}$	5 $P_{w2}P_{w2}H_{w2}H_{w2}$	6 $I_sE_sE_sR_s$	ICE	$c_iS_ib_iD_iz_i$
222	0	[illegible]	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	

SHIPBOARD OBSERVATIONS - ENCODING

CRITERION TEST ANSWERS

1.

SECTION 0				
	DDDD	$YYGGi_w$	99 $L_aL_aL_a$	$Q_cL_oL_oL_oL_o$
TRANSMIT		00	99	
BUT		03	99	
DO		03 06 4	99 187	31376
NOT		09	99	
ENCODE		12	99	
ON		15	99	
THIS		18	99	
FORM		21	99	

OPTIONAL. ENCODE ONLY IF SIGNIFICANT, UPON REQUEST, OR ANCHORED.

SECTION 1							
4 i_Ri_xhVV	Nddff	1 S_nTTT	2 $S_nT_dT_dT_d$	4 PPPP	5 appp	7 wwW_1W_2	8 $N_hC_LC_MC_H$
4		1	2	4	5	7	8
4		1	2	4	5	7	8
4 2598	82708	1 0262	2 0225	4 0213	5 2038	7	8 85//
4		1	2	4	5	7	8
4		1	2	4	5	7	8
4		1	2	4	5	7	8
4		1	2	4	5	7	8
4		1	2	4	5	7	8

SECTION 2									
222 D_sv_s	0 $S_nT_wT_wT_w$	2 $P_wP_wH_wH_w$	3 $d_{w1}d_{w1}$	$d_{w2}d_{w2}$	4 $P_{w1}P_{w1}H_{w1}H_{w1}$	5 $P_{w2}P_{w2}H_{w2}H_{w2}$	6 $I_sE_sE_sR_s$	ICE	$c_iS_ib_iD_iz_i$
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222 00	0 0191	2 0301	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	

SHIPBOARD OBSERVATIONS - ENCODING

CRITERION TEST ANSWERS (CONTD.)

2.

SECTION 0

DDDD	$YYGGi_w$	$99\ L_aL_aL_a$	$Q_cL_oL_oL_oL_o$
TRANSMIT	00	99	
BUT	03	99	
DO	06	99	
NOT	09	99	
ENCODE	05 12 3	99 378	70600
ON	15	99	
THIS	18	99	
FORM	21	99	

OPTIONAL. ENCODE ONLY IF SIGNIFICANT, UPON REQUEST, OR ANCHORED

SECTION 1

4 i_Ri_xhVV	Nddff	1 S_nTTT	2 $S_nT_dT_dT_d$	4 PPPP	5 appp	7 wwW_1W_2	8 $N_hC_LC_MC_H$
4		1	2	4	5	7	8
4		1	2	4	5	7	8
4		1	2	4	5	7	8
4		1	2	4	5	7	8
4 1295	81228	1 0185	2 0184	4 9982	5	7 6354	8 4721
4		1	2	4	5	7	8
4		1	2	4	5	7	3
4		1	2	4	5	7	8

SECTION 2

222 D_sv_s	0 $S_nT_wT_wT_w$	2 $P_wP_wH_wH_w$	3 $d_{w1}d_{w1}$	$d_{w2}d_{w2}$	4 $P_{w1}P_{w1}H_{w1}H_{w1}$	5 $P_{w2}P_{w2}H_{w2}H_{w2}$	6 $I_sE_sE_sR_s$	ICE	$c_iS_ib_iD_iz_i$
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222 43	0 0211	2 0807	3 23	33	4 1209	5 1007	6	ICE	
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	
222	0	2	3		4	5	6	ICE	

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PART V

SHIPBOARD OBSERVATIONS - DISSEMINATION

SHIPBOARD OBSERVATIONS - DISSEMINATION

INTRODUCTION

This program will present the rules and procedures used aboard U. S. Navy ships for getting the surface weather observations, which you have made, recorded, and encoded, to users of this important information.

Read the objectives, and then continue with the learning sequence.

SHIPBOARD OBSERVATIONS - DISSEMINATION

OBJECTIVES

1. Write the reason why prompt transmission of weather observations from a ship is important.

2. List at what times synoptic observations are transmitted.

3. List at what times and for what reasons intermediate synoptic observations are transmitted.

4. Write the definition and purpose of an AIG.

5. Determine the proper AIG for a synoptic observation, given the ship's position.

6. Write the definition of precedence as it pertains to communications.

7. List the message precedence for synoptic observations with surface winds of 33 knots or less.

8. Write the message precedence for synoptic observations with surface winds of 34 knots or greater.

9. List the three offices aboard a "carrier" (ship) to which all surface observations are normally disseminated.

FRAME 1

Synoptic observations should be transmitted from your ship in a timely manner. The synoptic observation is very perishable, and if not received on time, it will have little value except as climatic (historical) data.

Your observation should be transmitted promptly because the information in it is very ________________.

* *

ANSWER: perishable

FRAME 2

Synoptic observations are transmitted every six hours GMT, commencing at 0000 GMT.

What are the four times daily that synoptic observations are transmitted?

_____ GMT _____ GMT _____ GMT _____ GMT

* *

ANSWER: 0000, 0600, 1200, 1800

FRAME 3

Intermediate synoptic observations are at the three-hour interval between the synoptic observations. The times are 0300, 0900, 1500, 2100 GMT. Ships observing 34 knots of wind or greater, or in the vicinity of tropical storms or other unusual or dangerous weather, are required to transmit intermediate synoptic observations.

Intermediate synoptic observations are transmitted for what reasons?

____

____

____

* *

ANSWER: Wind speed of 34 knots or greater

Ships in the vicinity of tropical storms

Ship's experience unusual or dangerous weather

(Any order)

FRAME 4

An "AIG" (Address Indicating Group) provides a single address group to represent a number of addressees. The purpose of AIGs is to increase the speed of traffic handling.

An AIG provides a __________ address group to represent a __________ of addressees.

FRAME 4 (CONTD.)

* *

ANSWER: single

number

FRAME 5

a. What do the initials AIG stand for?

____

b. What is the purpose of an AIG?

____

____

* *

ANSWER: a. Address Indicating Group

b. To increase the speed of traffic handling.

FRAME 6

Two AIGs have been established for use by U. S. Fleet Units for reporting environmental observations -- AIG 7608 and AIG 7641. Basically, AIG 7608 is for use in the Pacific, Indian Ocean, and all areas south of 60° South. AIG 7641 is for the Atlantic, Mediterranean and all areas north of 60° North. NAVOCEANCOMINST 3140.1 ( ) further specifies the areas.

FRAME 6 (CONTD.)

There are _______ AIGs for use by U. S. Fleet Units for reporting environmental observations. For the Pacific, Indian Ocean, and areas south of 60° South, the AIG is _________; for the Atlantic and areas north of 60° North, the AIG is _______.

* *

ANSWER: two

7608

7641

FRAME 7

NAVOCEANCOMINST 3140.1 ( ) contains the exact description of the areas contained in each AIG and also lists the addressees (ADEES) to which each will be sent. When in doubt as to which AIG to use, consult 3140.1 ( ).

Which NAVOCEANCOMINST contains all pertinent data in regards to the two environmental AIGs? ________________

* *

ANSWER: 3140.1 ( )

FRAME 8

a. Your ship is operating 100 nautical miles north of Guam. What AIG would you use? ____________

b. Your ship is operating 75 nautical miles east of Bermuda. What AIG would you use? ____________

* *

ANSWER: a. 7608

b. 7641

FRAME 9

Precedence is an important concept in disseminating shipboard observations. The precedence indicates the relative order in which a message must be handled and delivered. Due to the perishability of weather observations, delivery should be effected in a minimum of time.

Precedence indicates the relative ________ in which a message must be ____________ and ____________.

* *

ANSWER: order

handled

delivered

FRAME 10

Write the definition of precedence as it pertains to communications.

____

____

* *

ANSWER: Precedence indicates the relative order in which a message must be handled and delivered.

FRAME 11

Synoptic observations are assigned a precedence of either Priority or Immediate, depending upon the wind speed of the observation. According to NWP-16, observations with surface winds of 33 knots or less have precedence of PRIORITY. Observations with surface winds of 34 knots and greater are transmitted as IMMEDIATE.

Observations with winds of 33 knots or less are assigned the precedence of ____________ -- with 34 knots and greater ______________.

* *

ANSWER: Priority

Immediate

FRAME 12

Aboard carriers (CVs, CVNs), plain-language surface observations are normally disseminated every hour to three main areas. They are Air Operations, Air Intelligence, and all ready rooms. The method of dissemination will vary depending upon the particular ship.

Aboard carriers (CVs, CVNs), the three areas which normally receive hourly surface observations are:

____

____

____

* *

ANSWER: Air operations

Air Intelligence (Any order)

All ready rooms

THIS CONCLUDES SHIPBOARD OBSERVATIONS - DISSEMINATION. NOW, COMPLETE THE CRITERION TEST.

SHIPBOARD OBSERVATIONS - DISSEMINATION

CRITERION TEST

1. Write the reason why prompt transmission of weather observations from your ship is important.

   ____

2. Synoptic observations are transmitted every _______ hours GMT commencing at _________ GMT.

3. At what times and for what reasons are intermediate observations transmitted?

   ____

   ____

   ____

4. Write the definition and purpose of an AIG.

   ____

   ____

5. Your ship is located in the Gulf of Mexico. To which AIG is your synoptic observation transmitted?

   ____

6. Your ship is located in the Indian Ocean. To which AIG is your synoptic observation transmitted?

   ____

7. Write the definition of precedence as it pertains to communications.

   ____

CRITERION TEST (CONTD.)

8. What is the message precedence for synoptic observations with surface winds of 33 knots or less?

____

9. What is the message precedence for synoptic observations with surface winds of 34 knots or greater?

____

10. List the three offices aboard a "carrier" (ship) where all surface observations are normally disseminated.

____

____

____

SHIPBOARD OBSERVATIONS - DISSEMINATION

CRITERION-TEST ANSWERS

1. It is perishable.

2. six (6)

   0000

3. At three-hour intervals between synoptic observations; due to ship's observing 34 knots or greater, or in vicinity of tropical storms, or other unusual or dangerous weather.

4. Address Indicating Groups (AIG) provide a single address group to represent a number of addressees, and increase the speed of traffic handling.

5. 7641

6. 7608

7. Precedence indicates the relative order in which a message must be handled and delivered.

8. Priority

9. Immediate

10. Air Operations

    Air Intelligence

    All ready rooms

    (Any order)

PART VI

DATA SOURCES - COMMUNICATIONS EQUIPMENT

DATA SOURCES - COMMUNICATIONS EQUIPMENT

INTRODUCTION

Because a ship operates in the vast ocean area where weather conditions impact not only the safety of the ship and its personnel, but also the conduct of naval operations, receipt of teletype and facsimile data is exceedingly important to the shipboard weather office. The data is received via radio transmission; consequently, considerably more communications equipment is required aboard the ship than at a land station.

This part of "The Shipboard Weather Office" teaches the layout of radio-receiving communications equipment in the weather office aboard U. S. Navy ships. By the use of block diagrams, this program progressively traces the path of a radio signal from the receiving antenna through the various components, and finally, to teletype printers and facsimile recorders. The intent of this program is to teach the designation, the location (sequence), and the functions of the component parts of this system. The operation of equipment components has been intentionally excluded from this program because on-the-job training and the appropriate manufacturer's "operating instructions" adequately serve this purpose.

Now, read the objectives on the next page, and proceed with the program.

DATA SOURCES - COMMUNICATIONS EQUIPMENT

OBJECTIVES

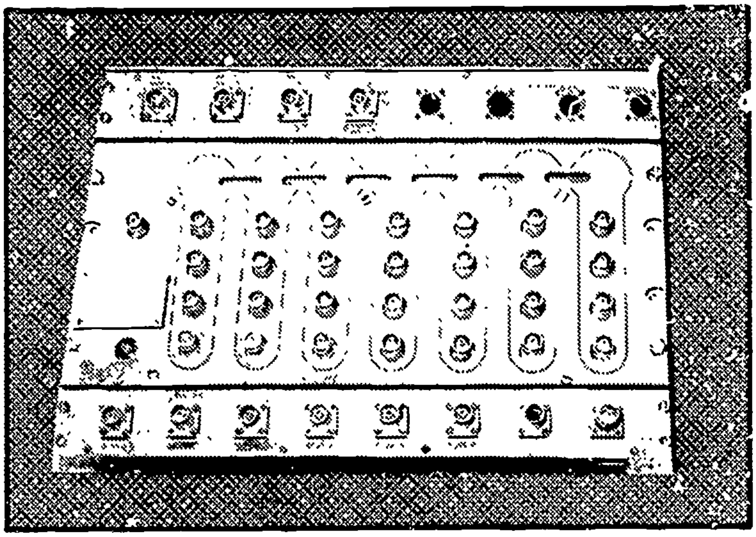
1. List the nine components/subcomponents associated with facsimile and teletype communications equipment of the shipboard weather office.

2. Given a block diagram of communication equipment in a shipboard weather office, label each unit, and select from a given list the function which pertains to each.

3. Depict on a block diagram the path of a signal from the antenna through the various specified equipments to a given teletype or facsimile receiver.

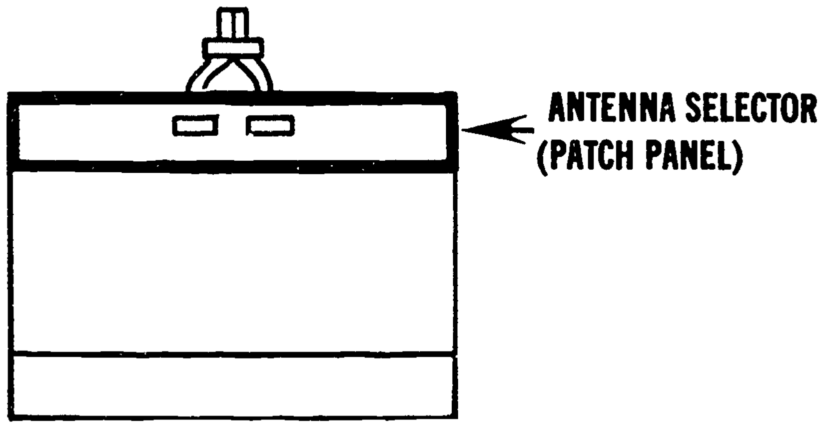
FRAME 1

The first component of the communications equipment is actually comprised of three individual sections, or subcomponents, each with its own name. The picture below shows the equipment as it may appear in your shipboard weather office. Though this unit has three parts, it is designated in the whole as the AN/SRA-12 Antenna Filter.



FRAME 2

The first section to be discussed is the antenna selector (patch panel). This section makes it possible to select the antenna and to feed the antenna filter assembly by utilizing a coaxial patch cord. The equipment is outlined in the picture below.



The antenna selector (patch panel) makes it possible to select the antenna and to feed the antenna ______________________.

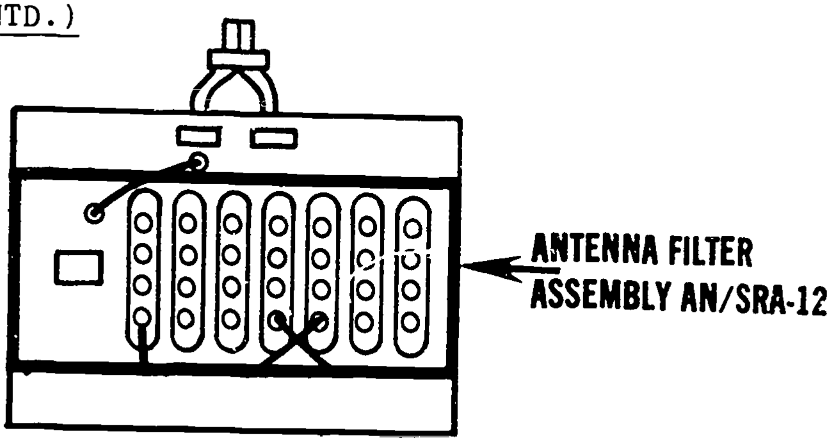
* *

ANSWER: filter assembly

FRAME 3

The second section is the Antenna Filter Assembly AN/SRA-12. This section provides seven channels in the frequency range from 14kHz to 32MHz. Any or all of these channels may be used independently of, or simultaneously with, any of the other channels. The equipment is shown outlined in the picture on the following page.

FRAME 3 (CONTD.)



Which section (subcomponent) of the equipment provides seven channels in the frequency range from 14kHz to 32MHz?

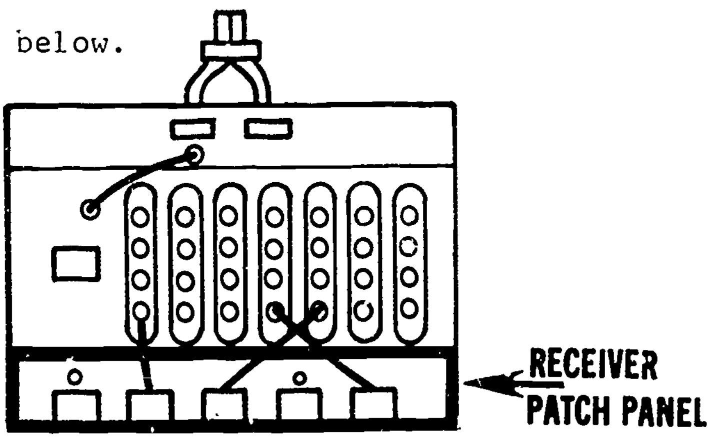
____

* *

ANSWER: Antenna Filter Assembly AN/SRA-12

FRAME 4

The third and final part of this component is the Receiver Patch Panel. This section enables, by means of coaxial patch cords, one or more selected radio receivers to be patched into a required frequency. This subcomponent is shown outlined in the picture below.



FRAME 4 (CONTD.)

Which section (subcomponent) enables, by means of coaxial patch cords, one or more selected radio receivers to be patched to a required frequency?

____

* *

ANSWER: Receiver Patch Panel

FRAME 5

Match the three subcomponents of equipment, listed below, with their functions.

______a. Antenna Selector (Patch Panel)

______b. Antenna Filter Assembly AN/SRA-12

______c. Receiver Patch Panel

1. Provides seven channels in the frequency range 14kHz to 32MHz. (Any or all of these channels may be used independently of, or simultaneously with, any of the other channels).

2. Enables, by means of coaxial patch cords, one or more selected radio receivers to be patched to a required frequency.

3. Makes it possible to select the antenna to feed the antenna filter assembly.

* *

FRAME 5 (CONTD.)

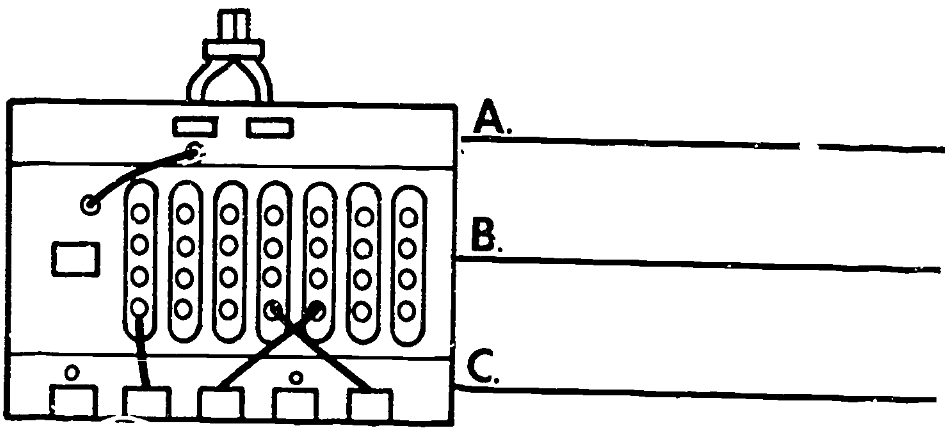
ANSWER: 3 a.

1 b.

2 c.

FRAME 6

In the following diagram, label the three parts of this component.



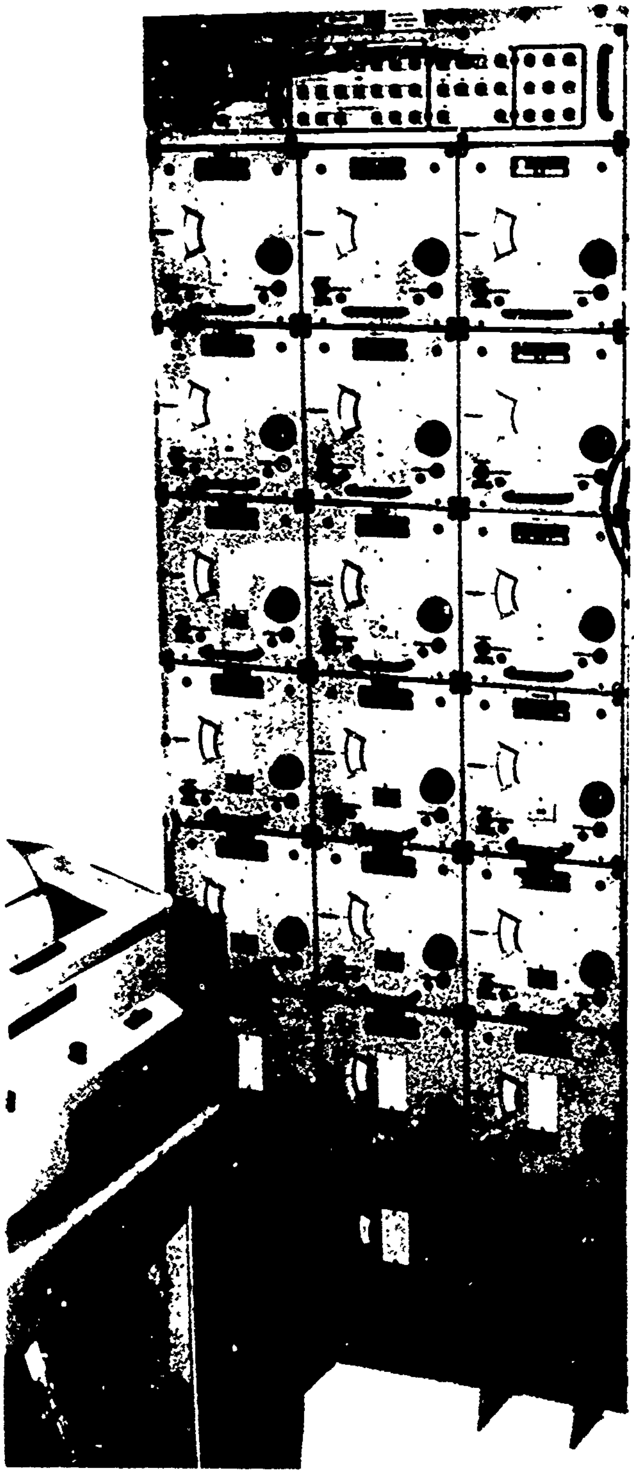
* *

ANSWER: A. Antenna Selector (Patch Panel)

B. Antenna Filter Assembly AN/SRA-12

C. Receiver Patch Panel

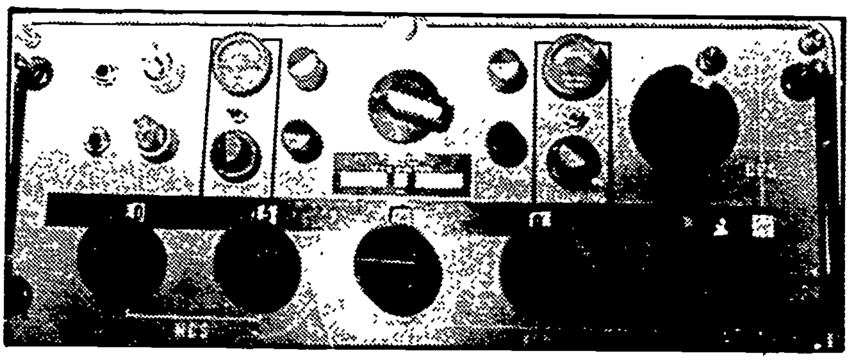
NOTE: The AN/SRA-49 Multi-Coupler (shown on the following page) has the same capabilities as the AN/SRA-12 Antenna Filter Assembly. The AN/SRA-12 is being replaced by the AN/SRA-49 that is less complex with only one dial to adjust and filter the radio signal.



FRAME 7

The equipment pictured below is a Radio Receiver R-1051. It is one of the newest radio receivers and is capable of receiving any type of radio signal in the frequency range of 2 to 30 MHz. This equipment is designated as standard equipment for use aboard all ships.

Normally each carrier weather office will have four receivers.



The equipment pictured above is a ____________________.

The number of receivers in a carrier weather office normally is __________.

* *

ANSWER: Radio Receiver R-1051

four

FRAME 8

The Radio Receiver R-1051 receives a radio frequency signal and converts it to an audio signal.

What function does the R-1051 perform?

____

____

* *

ANSWER: Receives radio frequency signal and converts it to an audio signal.

FRAME 9

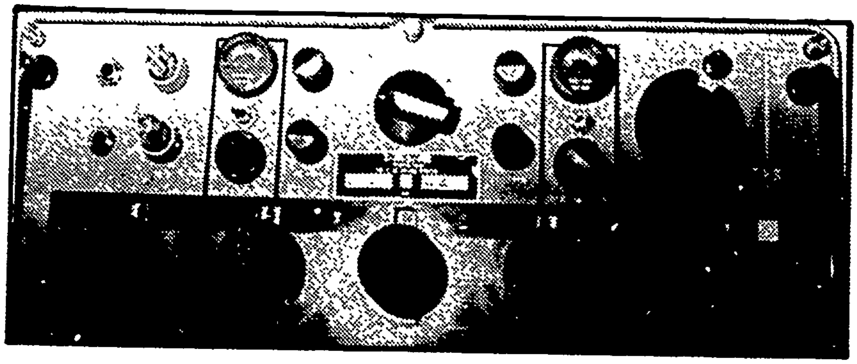
The Radio Receiver R-1051 takes the converted audio signal and feeds it to a receiver transfer switchboard.

The R-1051 feeds the converted audio signal to a/an __________ ______________________.

* *

ANSWER: receiver transfer switchboard

FRAME 10



a. What is the name and designation of the piece of equipment pictured above?

____

b. On the lines below, write the function of the above equipment.

____

____

____

* *

ANSWER: a. Radio Receiver R-1051

b. Receives a radio frequency signal, converts it to an audio signal, and then feeds the audio signal to a receiver transfer switchboard.

(Or words to that effect)

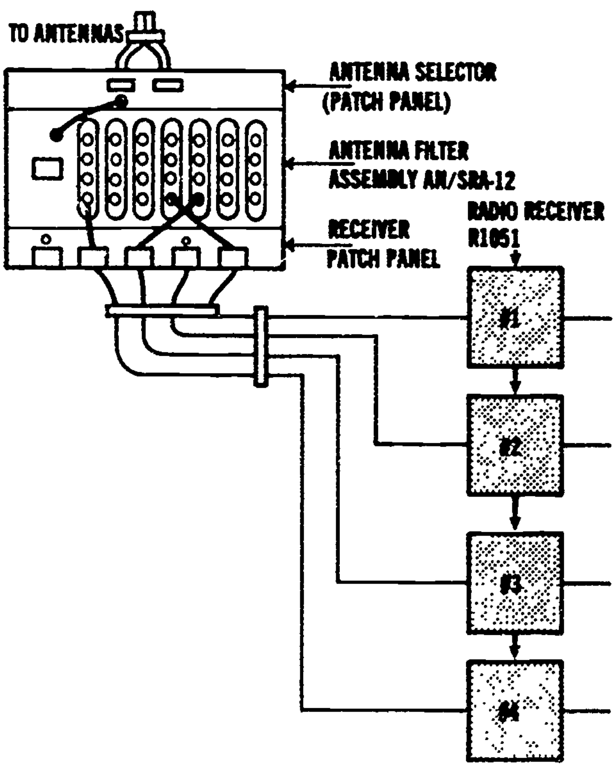
FRAME 11

The Radio Receiver R-1051 enables you, through tuning, to select the proper frequency to obtain whatever data you require. This is accomplished by use of the five control knobs on the front of the receiver. This process will be explained in detail by your OA Division section leader aboard your ship.

********************NO RESPONSE NECESSARY********************

FRAME 12

The following diagram shows the position of the Radio Receiver R-1051 in the flow pattern of the carrier weather office communications equipment. (The emphasized equipment shows the radio receivers.)



********************NO RESPONSE NECESSARY********************

FRAME 13

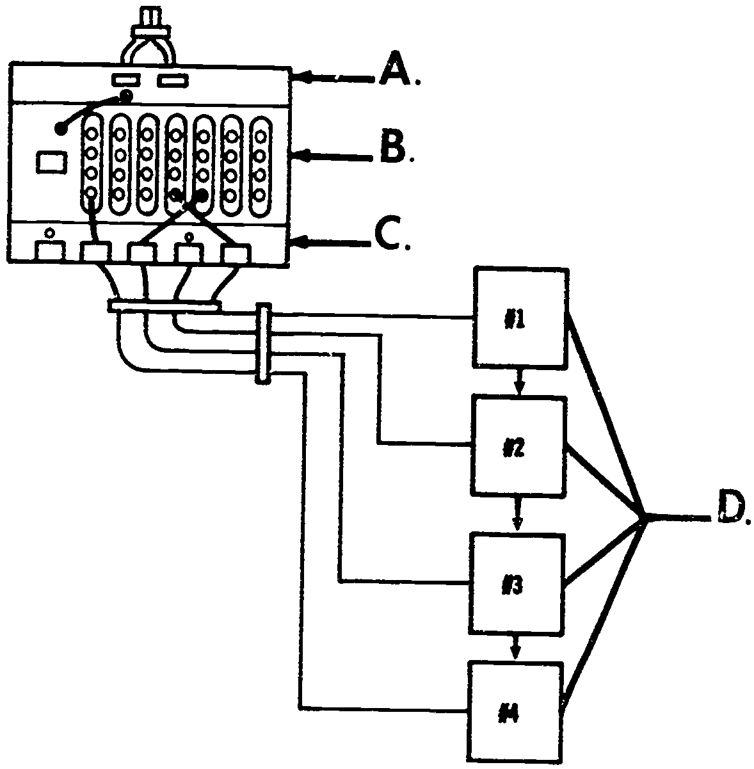
Match the following equipment designators to the locations in the block diagram.

______a. Antenna filter assembly

______b. Radio receiver

______c. Antenna selector

______d. Receiver patch panel



* *

ANSWER: __B__ a.

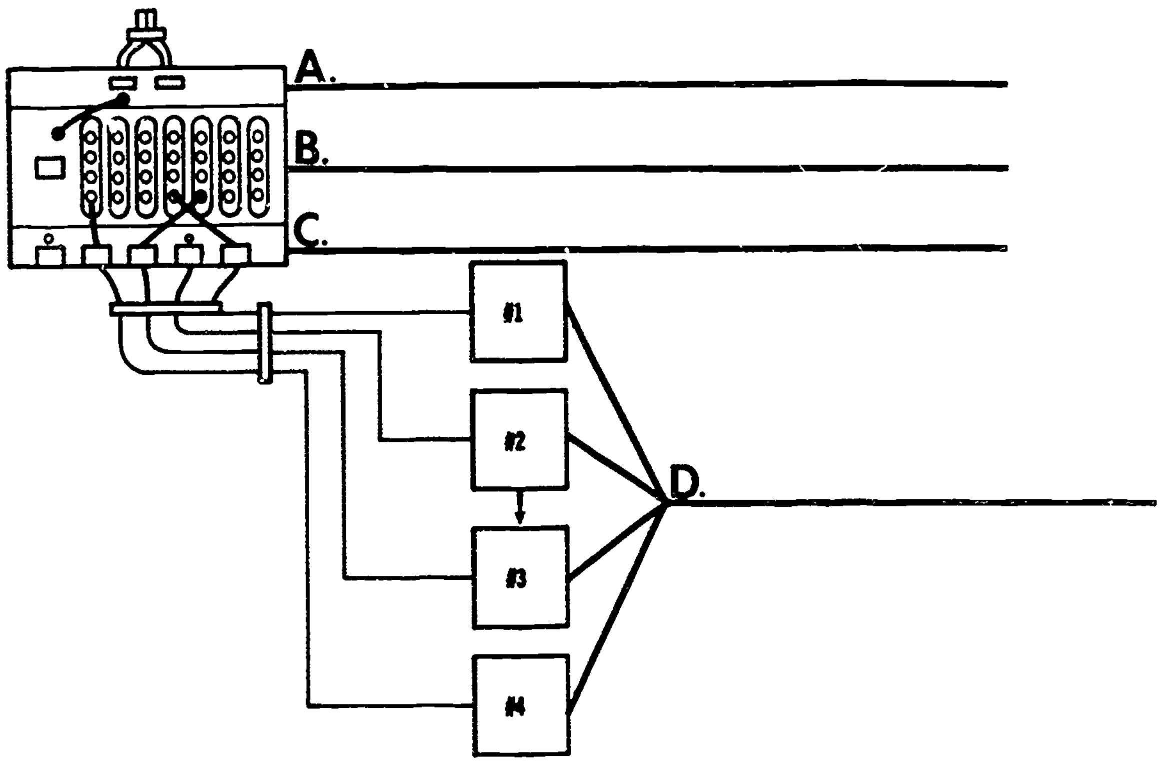
__D__ b.

__A__ c.

__C__ d.

FRAME 14

Label each piece of communications equipment in the following block diagram.

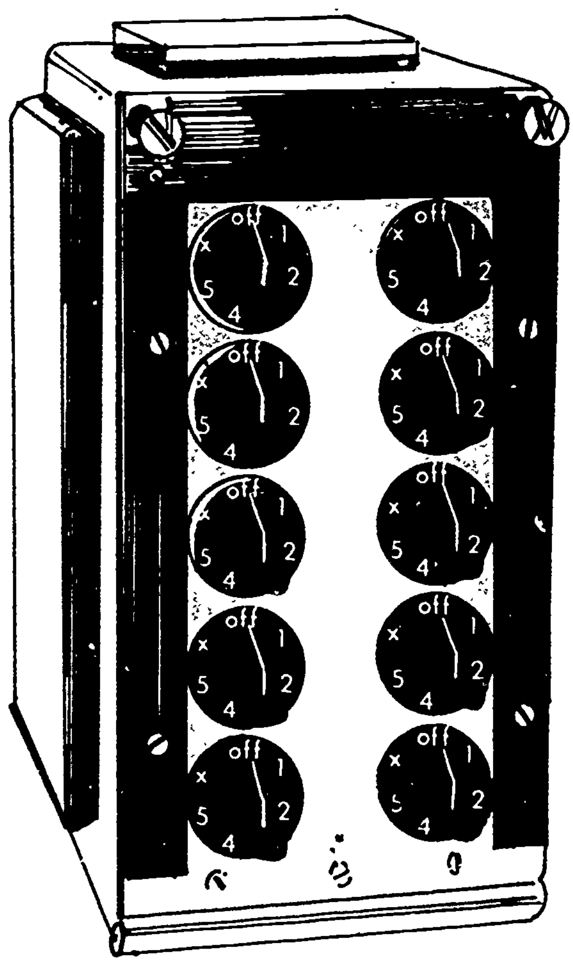


* *

ANSWER:
A. Antenna Selector (Patch Panel)
B. Antenna Filter Assembly AN/SRA-12
C. Receiver Patch Panel
D. Radio Receiver R-1051

FRAME 15

The equipment pictured below is the Receiver Transfer Switchboard (SB-973/SRR). It receives an audio signal from a radio receiver and provides for transferring it to either a facsimile converter or a teletype converter.



FRAME 15 (CONTD.)

The equipment shown in the picture on the facing page is the

____ (SB-973/SRR).

* *

ANSWER: Receiver Transfer Switchboard

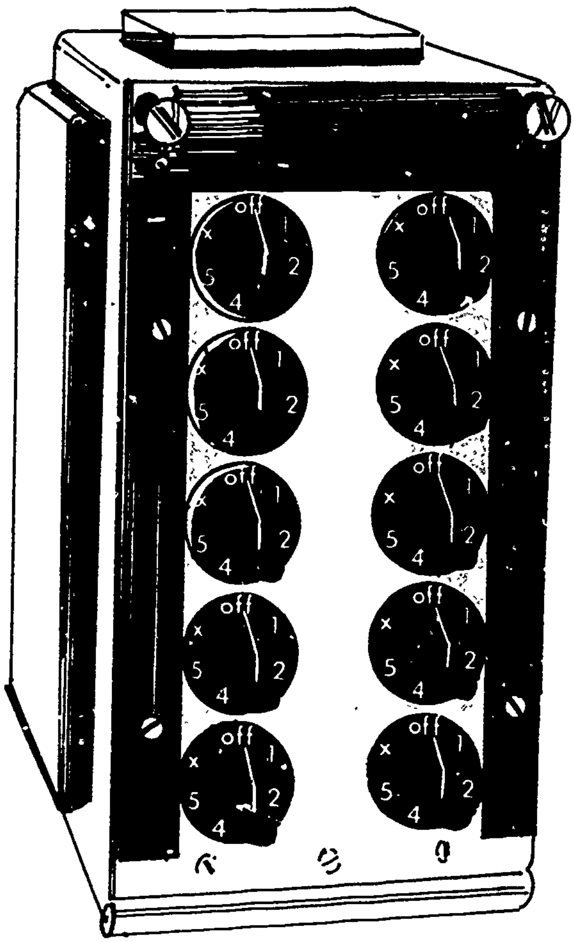
FRAME 16

The Receiver Transfer Switchboard SB-973/SRR provides for transferring the audio output from the radio receivers to teletype comparator/converters and frequency shift converters. This switchboard contains 10 seven-position switches. Each switch relates to a teletype comparator/converter or a frequency shift converter, and each switch position (1 through 5) relates to a radio receiver. Position X on each switch serves to transfer the circuits to additional switchboards if necessary.

********************NO RESPONSE NECESSARY********************

NOTE: The terms "teletype converter" and "facsimile converter" are interchangeable with "converter/comparator" and "frequency shift converter," respectively.

FRAME 17



a. What is the name and designation of the equipment pictured above?

_______________________________________ (____________)

b. On the lines below, write the function of the above equipment.

____

____

____

* *

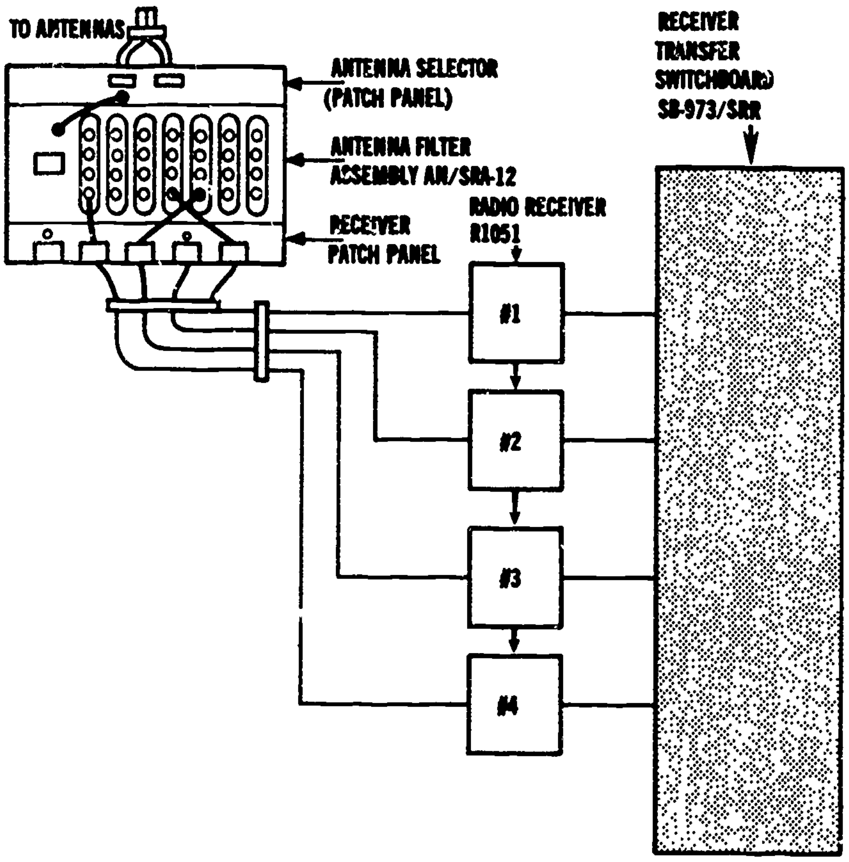
FRAME 17 (CONTD.)

ANSWER: a. Receiver Transfer Switchboard (SB-973/SRR)

b. Receives an audio signal from a radio receiver and provides for transferring it to either a facsimile converter or a teletype converter.

FRAME 18

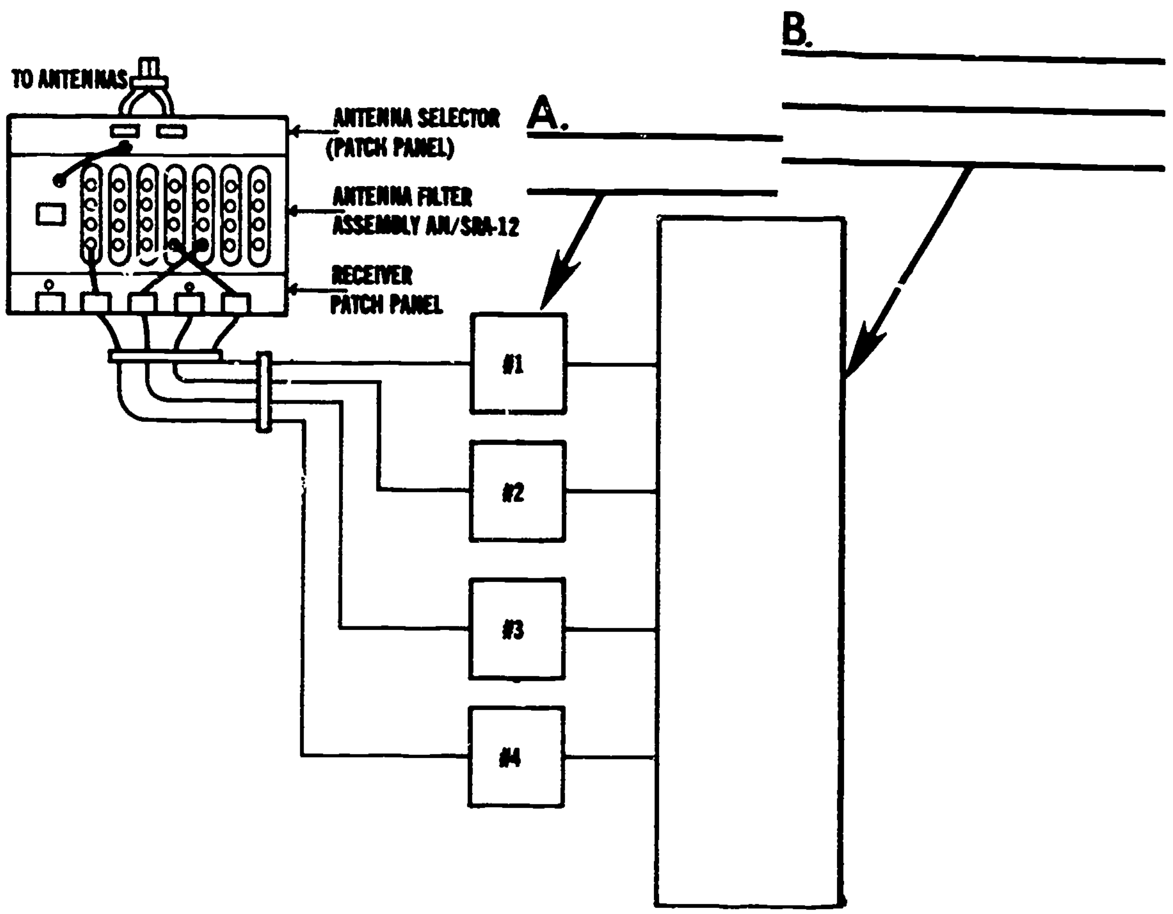
The following diagram shows the position of the Receiver Transfer Switchboard (SB-973/SRR) in the flow pattern of the communications equipment in the shipboard weather office. (The emphasized equipment is the Receiver Transfer Switchboard SB-973/SRR.)



********************NO RESPONSE NECESSARY********************

FRAME 19

Label the component parts "A" and "B" in the following block diagram.



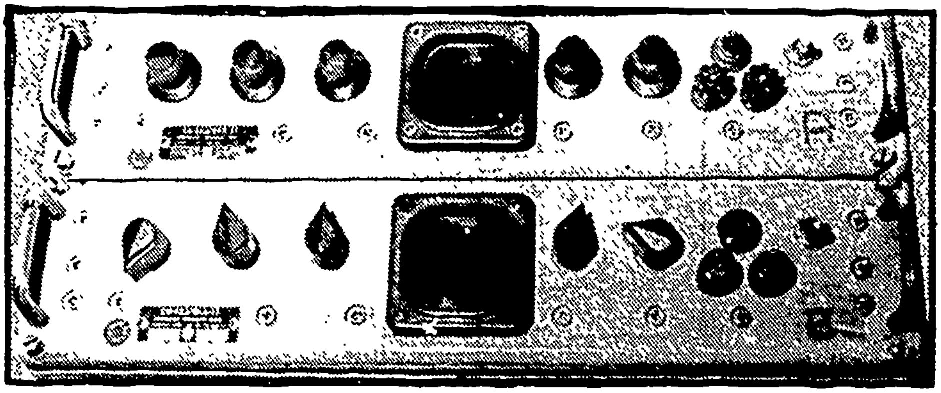
* *

ANSWER: A. Radio Receiver R-1051

B. Receiver Transfer Switchboards SB-973/SRR

FRAME 20

The equipment pictured below is the Converter/Comparator Group AN/URA-17. It receives an audio signal from the Receiver Transfer Switchboard SB-973/SRR and converts it to a signal compatible to a teletype receiver. Normally, each carrier weather office will have two converter/comparator groups for teletype.



a. What component of the weather communication equipment receives an audio signal and converts it to a signal compatible to a teletype receiver?

____

b. Each carrier weather office normally has __________ of these.

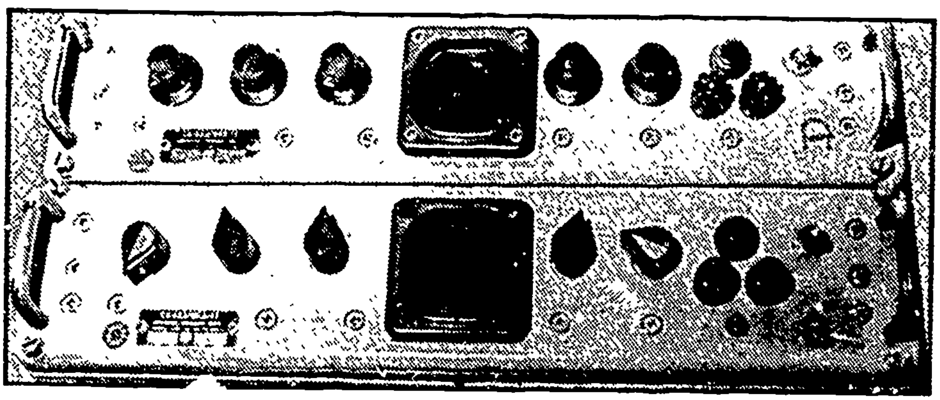
* *

ANSWER: a. Converter/Comparator Group AN/URA-17

b. two

FRAME 21

The Converter/Comparator Group AN/URA-17 is comprised of two identical converter units, a picture of which is shown below. Each converter may function individually with separate teletypes. To perform this operation, the function switch must be in the single position.



a. The Converter/Comparator Group AN/URA-17 is comprised of how many converters? ____________

b. For each converter to operate individually, the function switch must be in the ____________ position.

* *

ANSWER: a. two

b. single

FRAME 22

Each converter also has its own comparator circuitry. For each of them to operate in this capacity, the "function switch" must be in the diversity position. When the AN/URA-17 is used as a comparator, two separate signals are compared, and the strongest one is passed via a patch panel to the teletype printer.

a. For the AN/URA-17 to operate as a comparator, the "function switch" must be in the ________________ position.

b. After the two signals are compared, which signal is passed to the teletype printer? ________________

* *

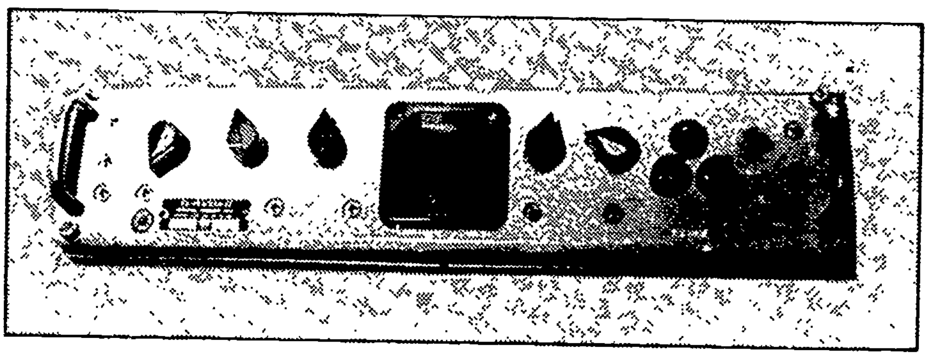
ANSWER: a. diversity

b. The Strongest

FRAME 23

a. What is the name and designation of the piece of equipment pictured below?

____



b. On the lines below, write the functions of the above equipment.

____

____

____

* *

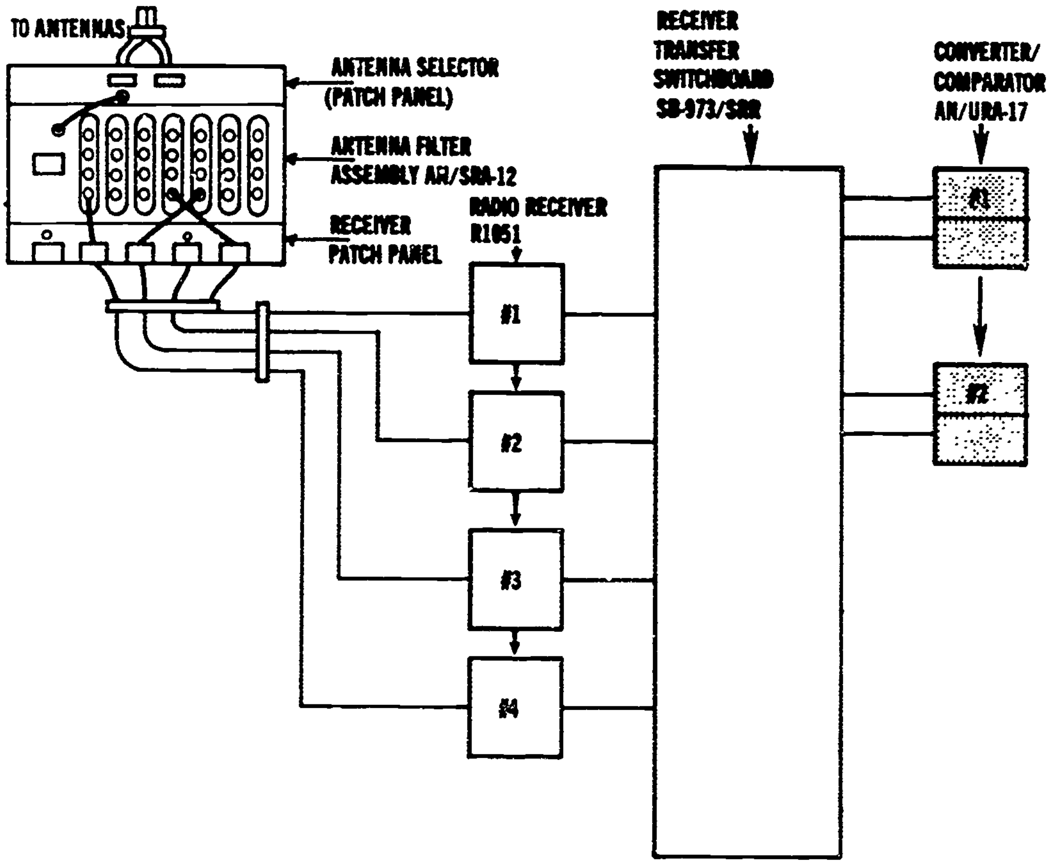
ANSWER: a. Converter/Comparator Group AN/URA-17

b. Converts audio signals to teletype signals. Has the capability to compare two signals and pass the strongest to a teletype printer via a patch panel.

(Or words to that effect)

FRAME 24

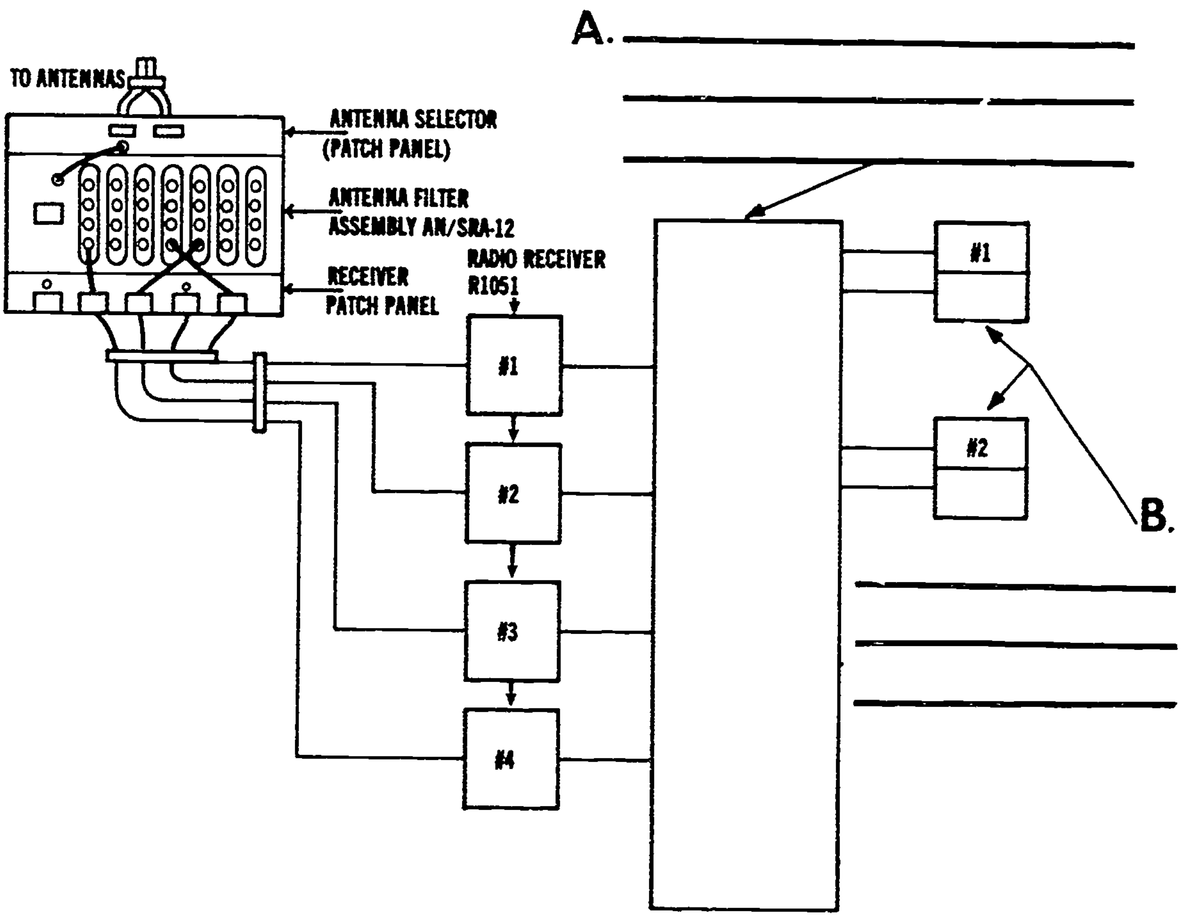
The following diagram shows the position of the Converter/ Comparator AN/URA-17 in the flow pattern of the carrier weather office communications equipment. (The emphasized equipments are the Converter/Comparators AN/URA-17.)



*********************NO RESPONSE NECESSARY*********************

FRAME 25

Label the component parts "A" and "B" in the following block diagram.



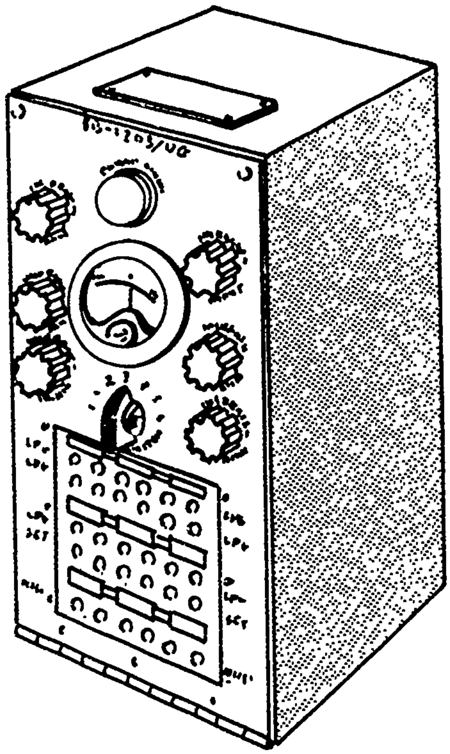
* *

ANSWER: A. Receiver Transfer Switchboards SB-973/SRR

B. Converter/Comparator AN/URA-17

FRAME 26

The equipment pictured below, the Communications Patching Panel SB-1203/UG, receives the teletype signal from one or more converter/comparators and passes it to one or more selected teletype printers.



a. The above pictured equipment is the ___________________ ______________________________ SB-1203/UG.

b. This communications equipment component allows the teletype signal to pass from one or more converter/comparators to one or more selected _______________ ______________.

* *

ANSWER: a. Communications Patching Panel SB-1203/UG

b. teletype printers

FRAME 27

On the lines below, write the function of the Communications Patching Panel SB-1203/UG.

___

___

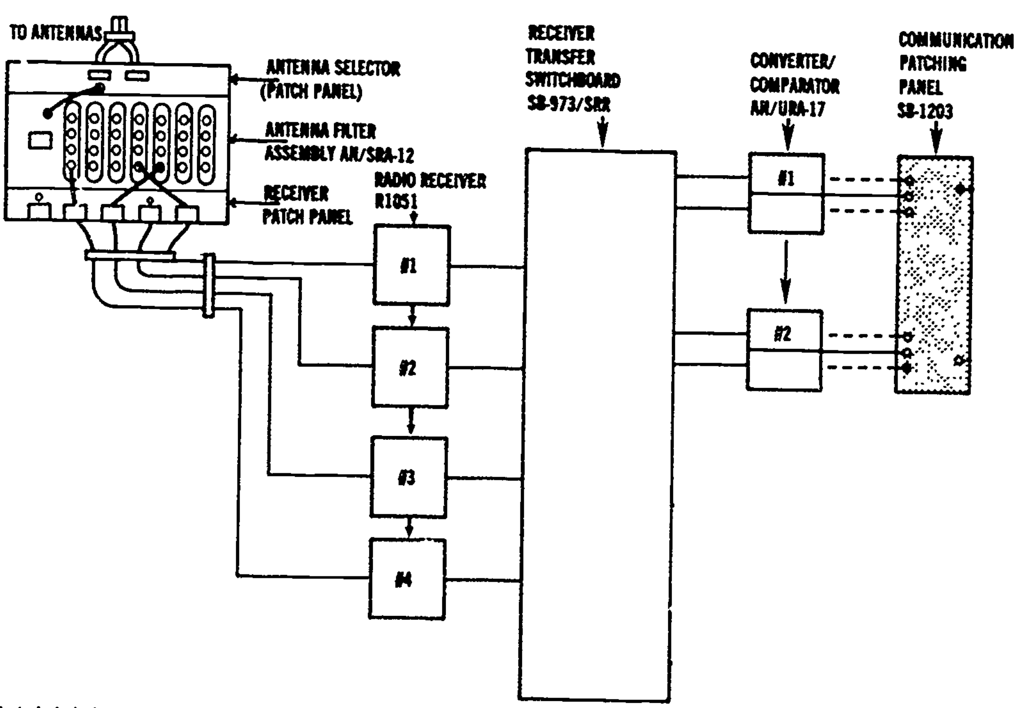
___

* *

ANSWER: Receives the teletype signal from one or more converter/comparators and passes it to one or more selected teletype printers.

FRAME 28

The following diagram shows the position of the Commmunications Patching Panel SB-1203/UG, in the flow pattern of the carrier weather office communications equipment. (The emphasized equipment is the Communications Patching Panel SB-1203/UG.)



*******************NO RESPONSE NECESSARY*******************

FRAME 29

Match the component/subcomponent letter designations in the block diagram with four of the seven component/subcomponent names listed below.

______a. Radio receivers

______b. Converter/comparator

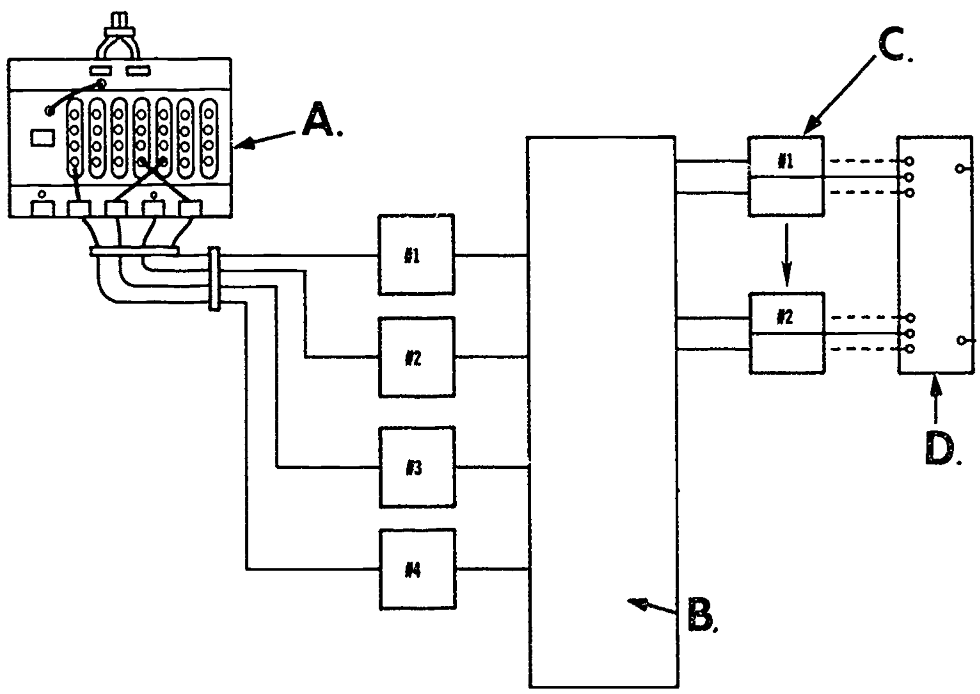
______c. Antenna selector

______d. Communications patching panel

______e. Antenna filter assembly

______f. Receiver patch panel

______g. Receiver transfer switchboard



* *

FRAME 29 (CONTD.)

ANSWER: ____ a. __A__ e.

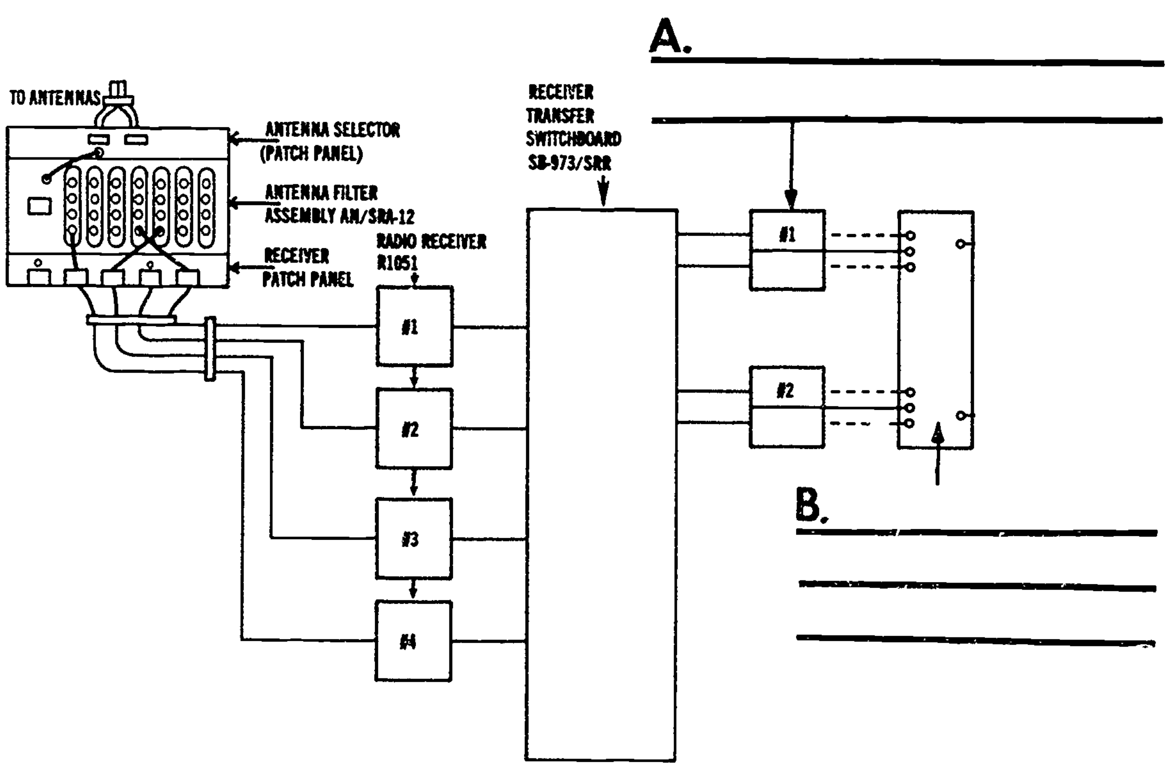
__C__ b. ____ f.

____ c. __B__ g.

__D__ d.

FRAME 30

Label the component parts "A" and "B" in the following block diagram.



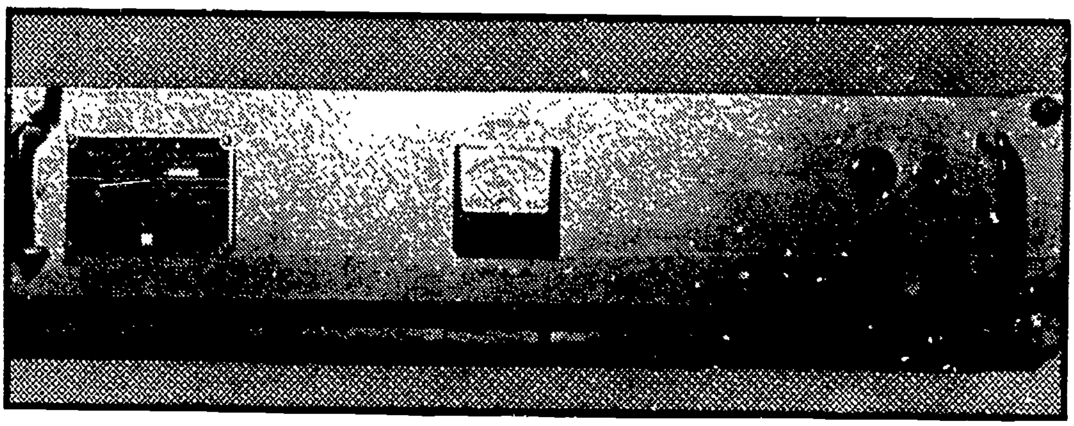
* *

ANSWER: A. Converter/Comparator AN/URA-17

B. Communication Patching Panel SB-1203

FRAME 31

The equipment pictured below is the Frequency Shift Converter CV-2979/UX. An audio signal is received from the Receiver Transfer Switchboard SB-973/SRR and converted to a signal compatible to a facsimile recorder. Normally each carrier weather office will have two frequency shift converters for facsimile.



a. The above pictured equipment is the ________________ ________________ CV-2979/UX.

b. Normally, each carrier weather office has __________ of these.

* *

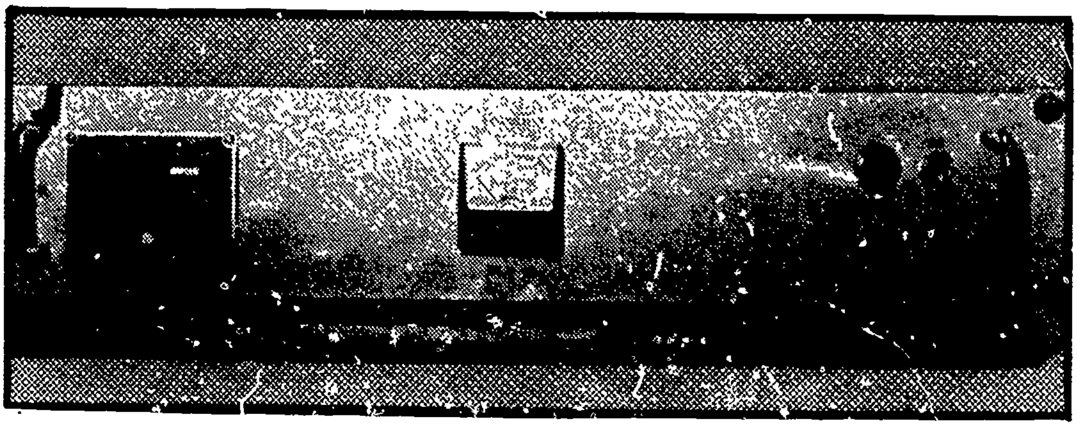
ANSWER: a. Frequency Shift Converter

b. two

FRAME 32

a. What is the name and designator of the piece of equipment pictured below?

____



b. On the lines below, write the function of the above equipment.

____

____

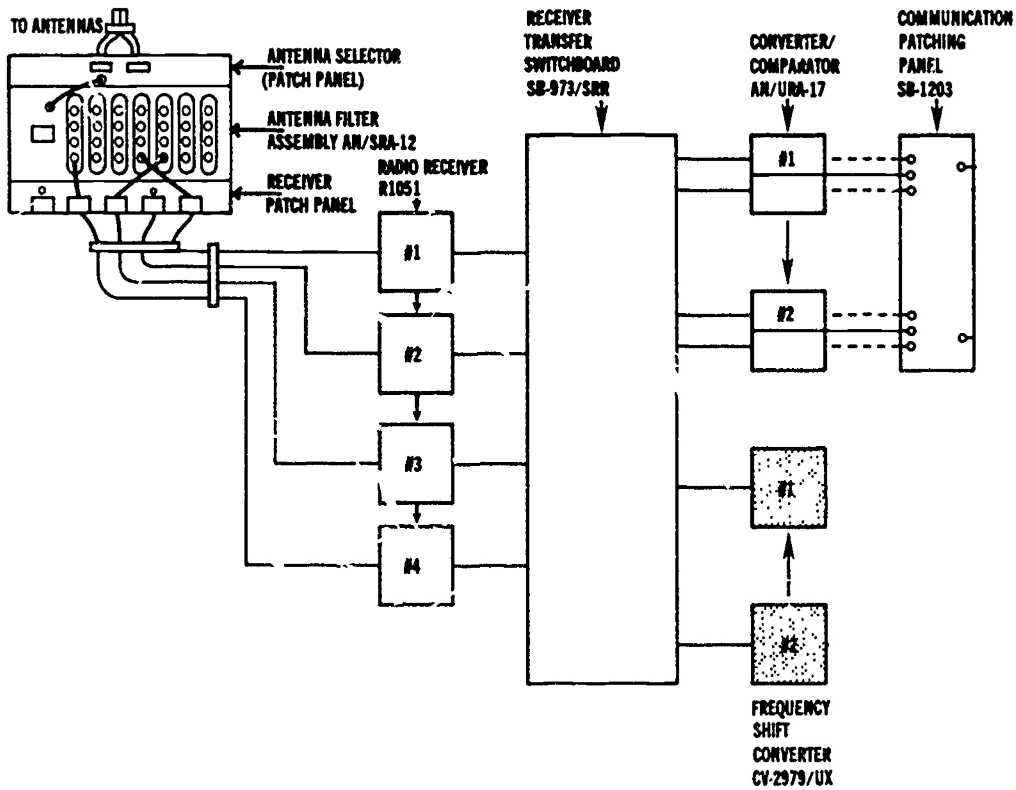
* *

ANSWER: a. Frequency Shift Converter CV-2979/UX

b. Receives an audio signal and converts it to a signal compatible to a facsimile recorder.

FRAME 33

The following diagram shows the position of the frequency shift converter in the flow pattern of the carrier weather office communications equipment. (The emphasized equipments are the Frequency Shift Converters CV-2979/UX.)



*********************NO RESPONSE NECESSARY*********************

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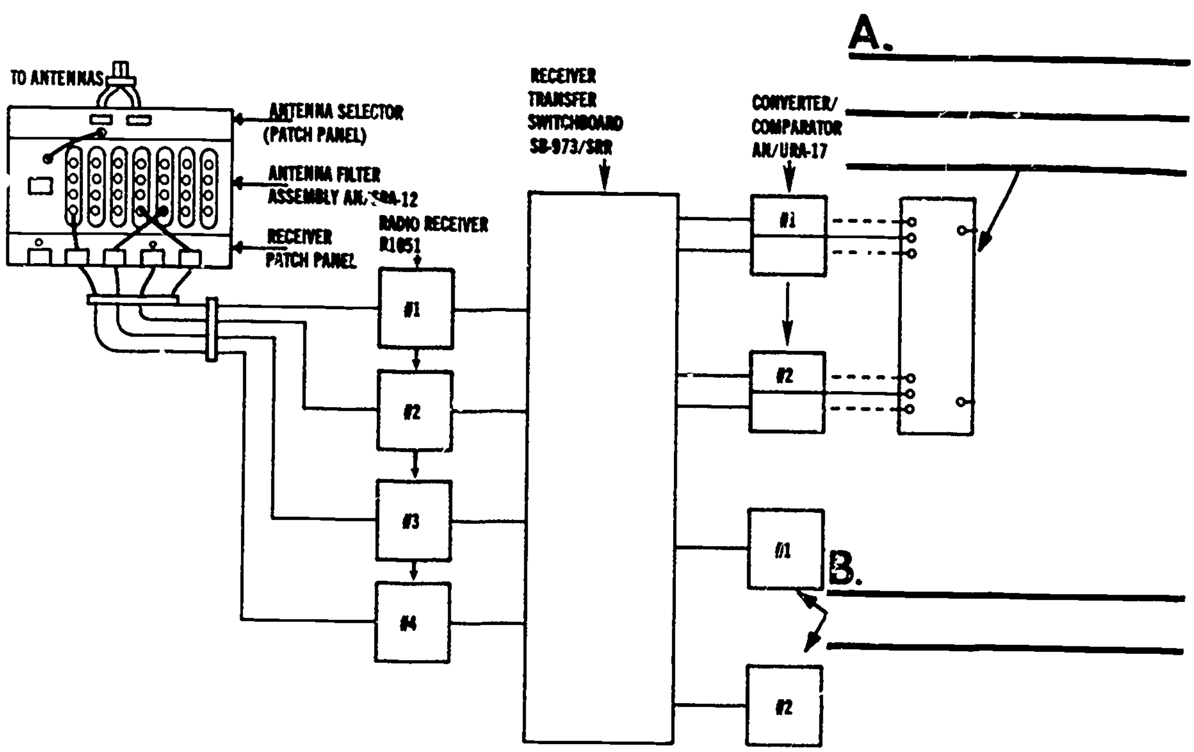
FRAME 34

Label the component parts "A" and "B" in the following block diagram.



* *

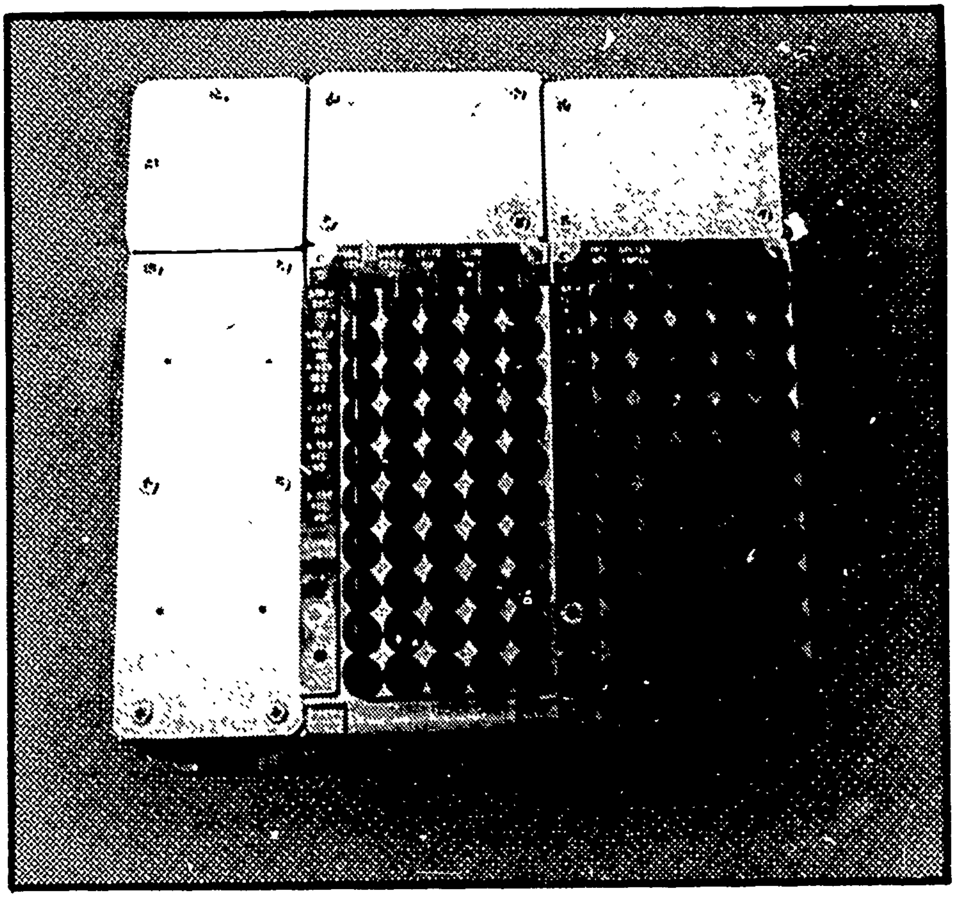
ANSWER: A. Communications Patching Panel SB-1203

B. Frequency Shift Converter CV-2979/UX

FRAME 35

The equipment pictured on the following page is a Receiver Transfer Switchboard SB-82/SRR. It receives a facsimile signal from one or more frequency shift converters and transfers it to one or more selected facsimile recorders.

FRAME 35 (CONTD.)



a. The above pictured equipment is a ______________________

____.

b. It transfers a signal from a frequency shift converter to one or more selected ______________________.

* *

ANSWER: a. Receiver Transfer Switchboard SB-82/SRR

b. facsimile recorders

FRAME 36

On the lines below, write the function of the Receiver Transfer Switchboard SB-82/SRR.

____

____

____

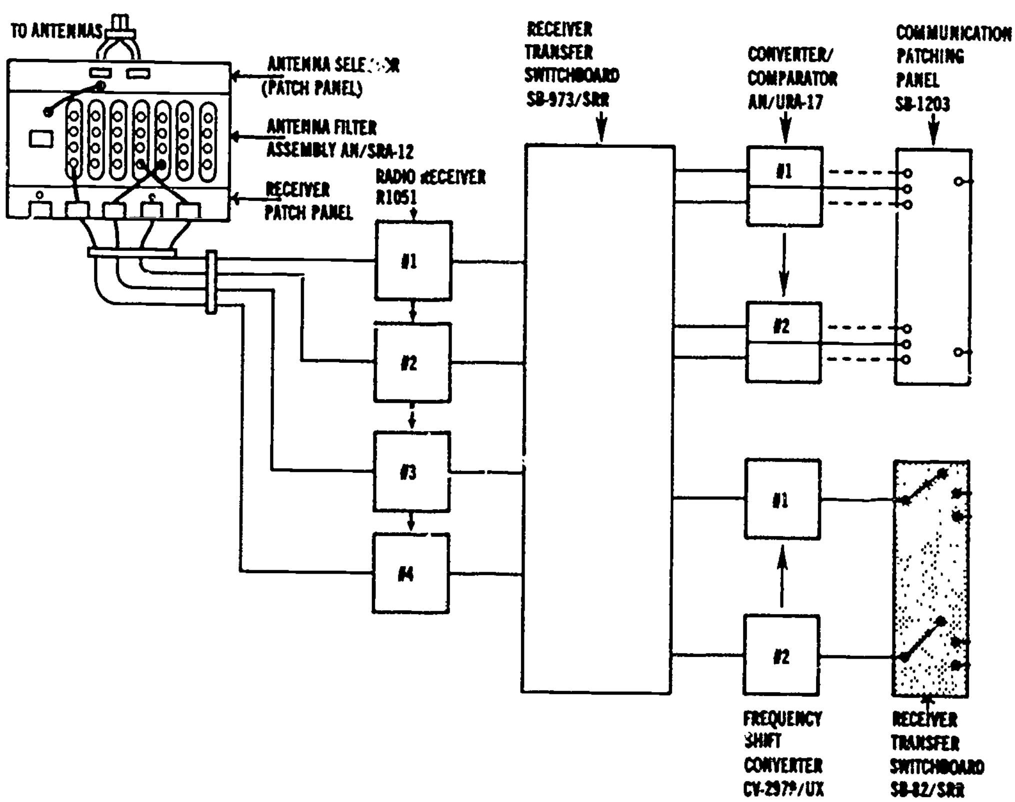
* *

ANSWER: Receives a facsimile signal from one or more frequency shift converters and feeds it to one or more selected facsimile recorders.

(Or words to that effect)

FRAME 37

The following diagram shows the position of the Receiver Transfer Switchboard SB-82/SRR in the flow pattern of the carrier weather office communications equipment. (The emphasized equipment is the Receiver Transfer Switchboard SB-82/SRR.)



********************NO RESPONSE NECESSARY********************

FRAME 38

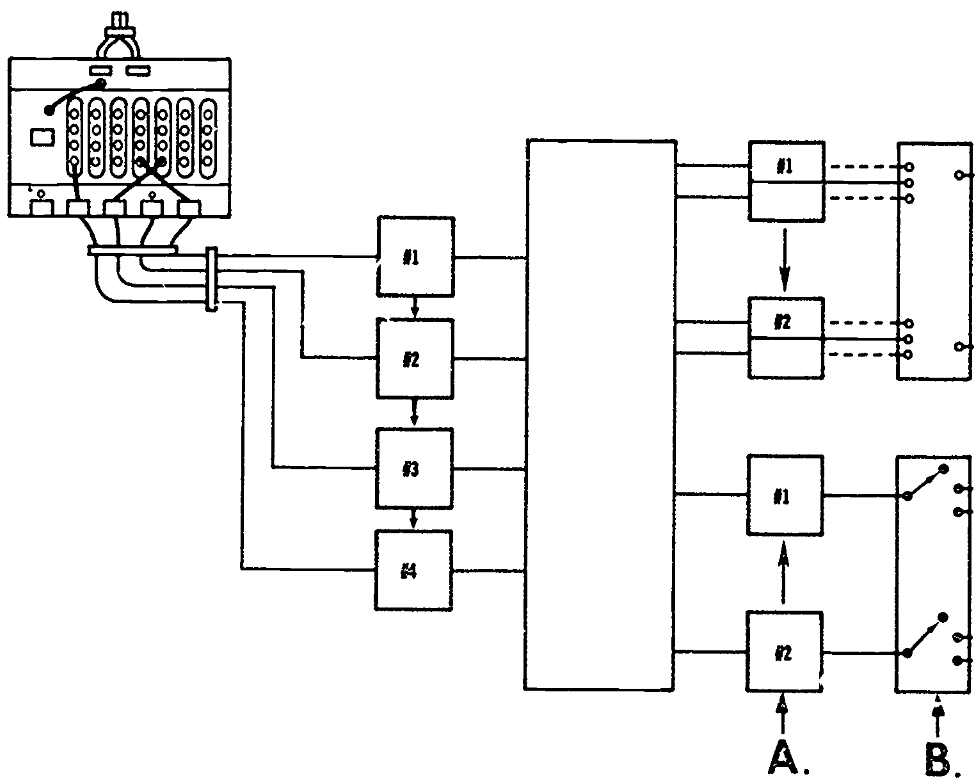
Match the designated pieces of equipment in the block diagram to the following equipment name and/or number designators.

______a. Frequency Shift Converter CV-2979/UX

______b. Communications patching panel

______c. Receiver Transfer Switchboard SB-973/SRR

______d. Receiver Transfer Switchboard SB-82/SRR



* *

ANSWER: __A__ a.

______ b.

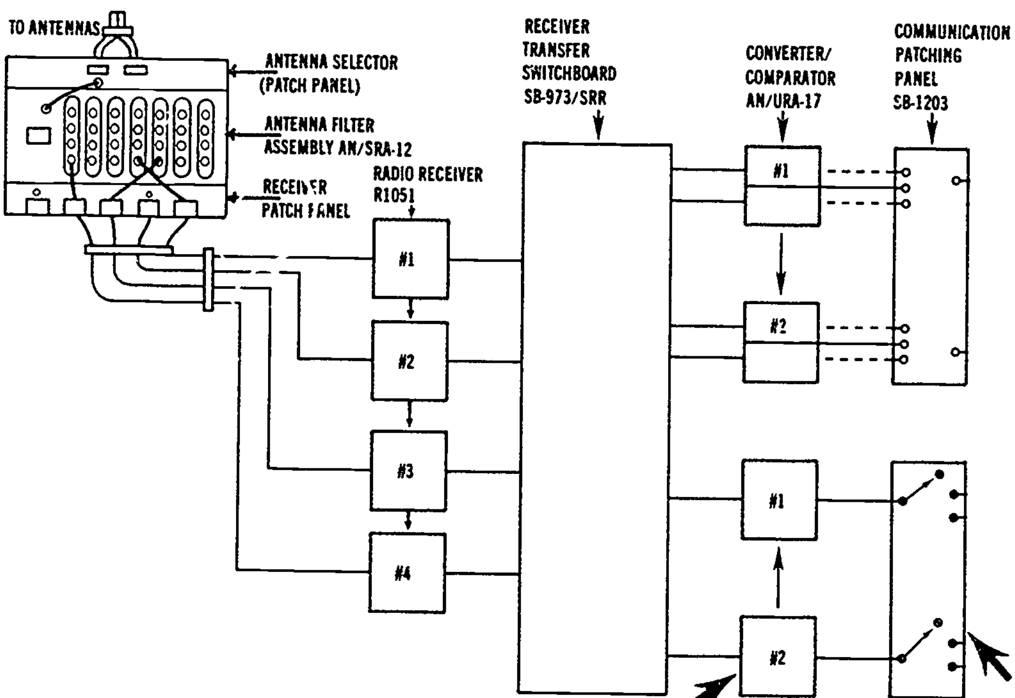
______ c.

__B__ d.

535

FRAME 39

Label the component parts "A" and "B" in the following block diagram:



A. ______________________ B. ______________________

* *

ANSWER: A. Frequency Shift Converter CV-2979/UX

B. Receiver Transfer Switchboard SB-82/SRR

FRAME 40

The remaining equipment is the terminal equipment. It will be discussed briefly for your information. For the purpose of this lesson, terminal equipment will refer to teletype printers and facsimile recorders.

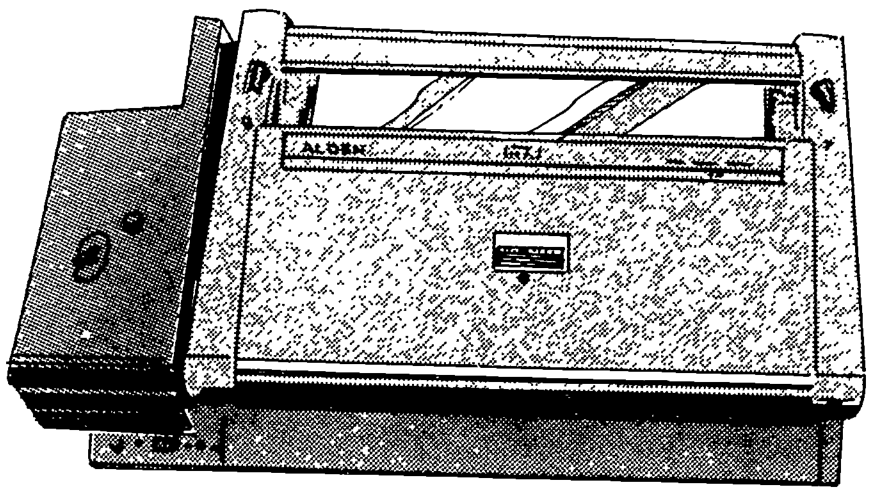
*********************NO RESPONSE NECESSARY********************

FRAME 41

The equipment pictured above is the Teletypewriter AN/UGC-25. It is a receive-only, compact, table-model teletype set. Though some ships will have the newer UGR-4 and UGR-16 Teletype printers, their appearance is similar to the UGC-25 shown above. Signals are fed to the teletype printer from the communications patching panel.

*********************NO RESPONSE NECESSARY********************

FRAME 42

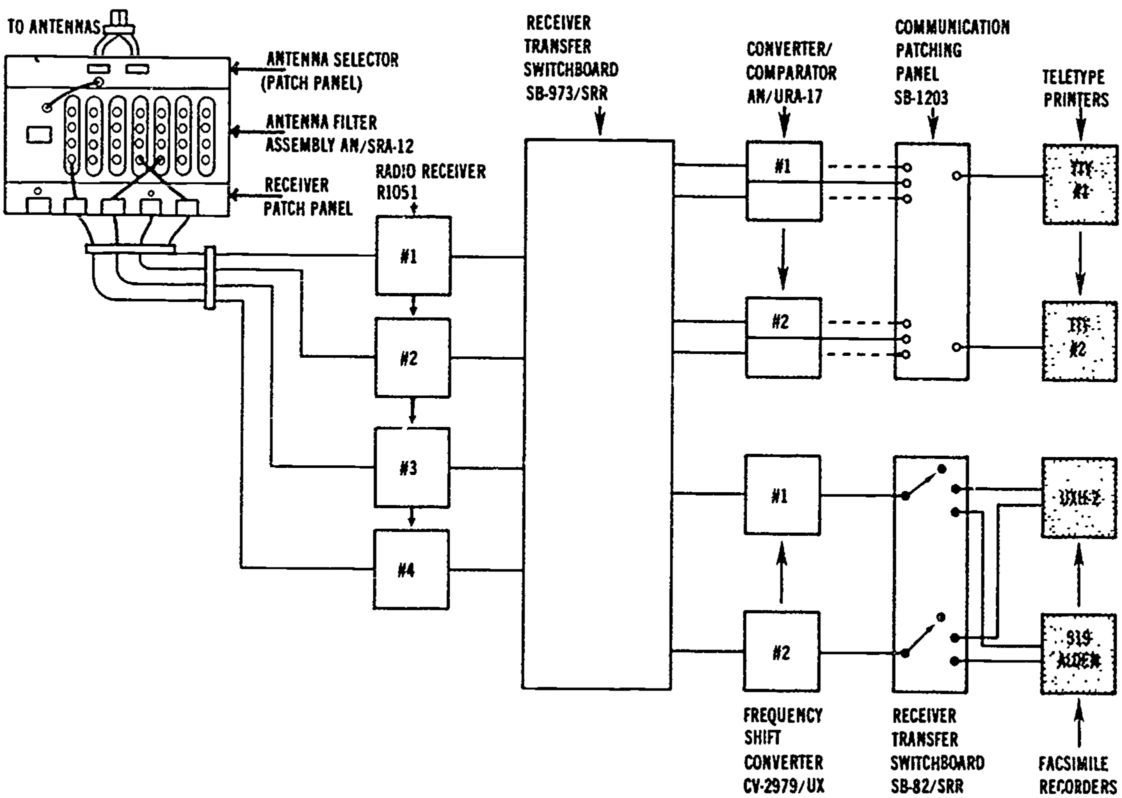


The above pictured equipment is an Alden Facsimile Recorder. It is a continuous page recorder designed to operate at 60, 90, or 120 scans per minute. The set may be operated automatically or manually. There are two facsimile recorders used in the Carrier Weather Office. The other is the Facsimile Recorder Set AN/UXH-2, which will not be discussed in this lesson.

********************NO RESPONSE NECESSARY********************

FRAME 43

The following block diagram shows the position in the flow pattern of the basic units of communications equipment normally found in the shipboard weather office. It is a complete diagram showing the position of the terminal equipment, which is emphasized. Review the location of each component, and try to recall the function of each.



*********************NO RESPONSE NECESSARY********************

FRAME 44

Match the following equipment designators to the proper position in the block diagram below.

______a. Antenna Filter Assembly AN/SRA-12

______b. Radio Receiver R-1051

______c. Converter/Comparator AN/URA-17

______d. Receiver Transfer Switchboard SB-82/SRR

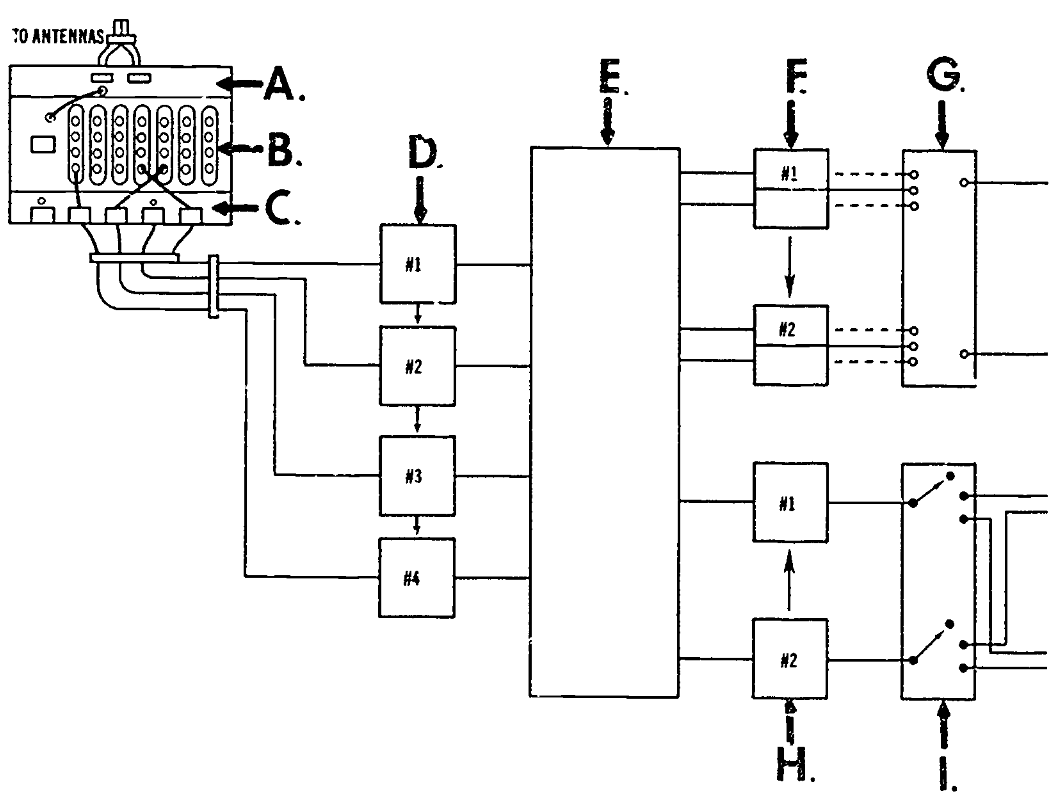
______e. Antenna Selector (Patch panel)

______f. Frequency Shift Converter CV-2979/UX

______g. Receiver Patch Panel

______h. Communication Patching Panel SB-1203

______i. Receiver Transfer Switchboard SB-973/SRR



* *

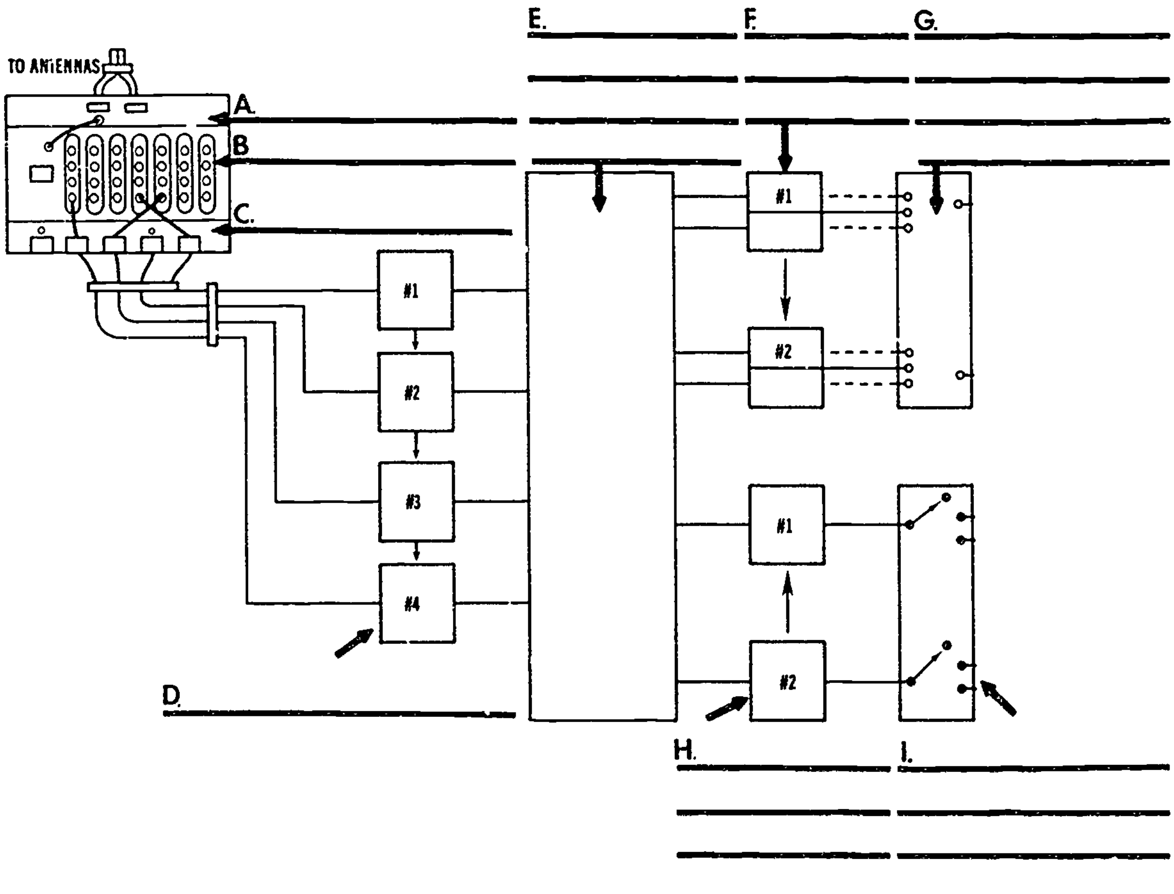
FRAME 44 (CONTD.)

ANSWER:

B	a.	H	f.
D	b.	C	g.
F	c.	G	h.
I	d.	E	i.
A	e.		

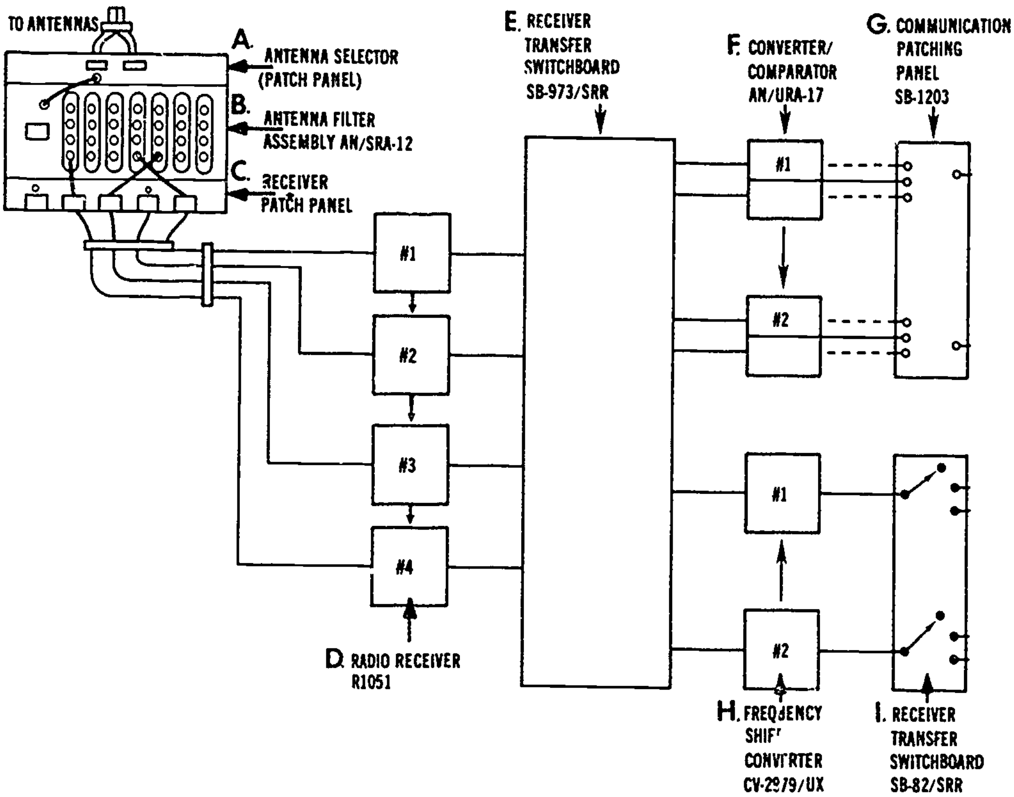
FRAME 45

Label each communications equipment component in the block diagram below with its designator.



FRAME 45 (CONTD.)

ANSWER:



FRAME 46

From the answer diagram above, match each component with its function in the list below and on the following page.

____a. Provides seven channels in the frequency range from 14kHz to 32MHz. Any or all of these channels may be used independently of, or simultaneously with, any of the other channels.

____b. Performs two separate and distinct functions:
1. (Converter) As a converter, two audio signals can be received and converted to teletype signals for use by two teletype printers.
2. (Comparator) As a comparator, two separate audio signals are received, converted and compared, with the strongest signal being passed to a teletype printer via a patch panel.

FRAME 46 (CONTD.)

___c. Makes it possible to select one of two antennas to feed the antenna filter assembly.

___d. Receives the teletype signal from one or more converter/comparators and feeds it to one or more selected teletype printers.

___e. Enables, by means of a coaxial patch cord, one or more selected radio receivers to be patched into a required frequency.

___f. Receives an audio signal and converts it to a signal compatible to a facsimile recorder.

___g. Receives the facsimile signal from one or more frequency shift converters and feeds it to one or more selected facsimile recorders.

___h. Receives an audio signal from a radio receiver and provides for transferring it to either a facsimile converter or a teletype converter.

___i. Receives a radio frequency signal, converts it to an audio signal, and then feeds it to a receiver transfer switchboard.

* *

ANSWER:

B a.	H f.
F b.	I g.
A c.	E h.
G d.	D i.
C e.	

THIS CONCLUDES DATA SOURCES - COMMUNICATIONS EQUIPMENT. NOW, COMPLETE THE CRITERION TEST.

DATA SOURCES - COMMUNICATIONS EQUIPMENT

CRITERION TEST

1. List the nine components/subcomponents associated with facsimile and teletype communications equipment of the Shipboard Weather Office.

____

____

____

____

____

____

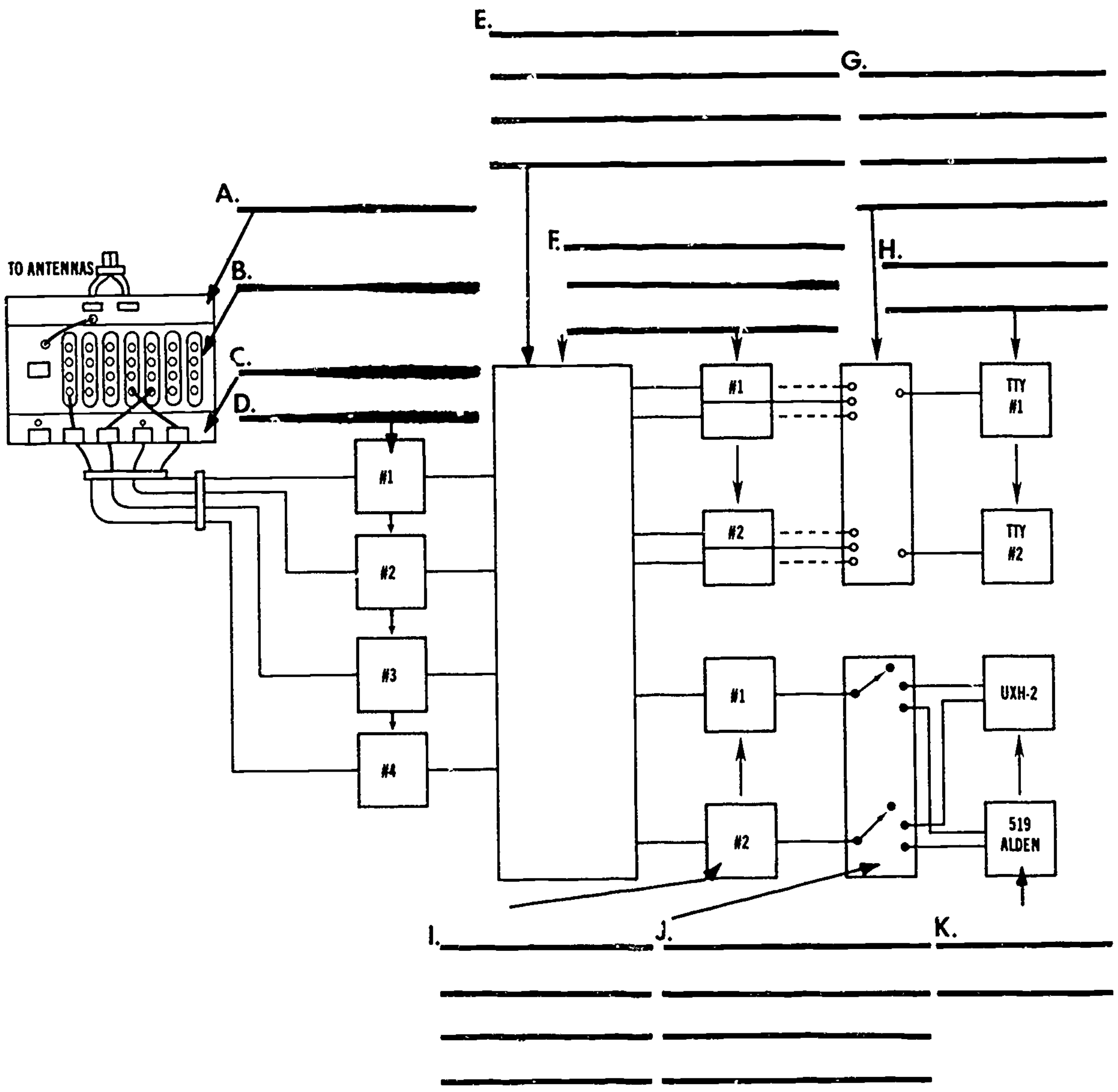
____

____

____

CRITERION TEST (CONTD.)

2. Label the block diagram below with the name of each component.



CRITERION TEST (CONTD.)

3. Match the component/subcomponent functions listed below with the equipment components shown on the block diagram for item #2 on the facing page.

____a. Performs two separate and distinct functions:
1. (Converter) As a converter, two audio signals can be received and converted to teletype signals for use by two teletype printers.
2. (Comparator) As a comparator, two separate audio signals are received, converted and compared, with the strongest signal being passed to a teletype printer via a patch panel.

____b. Receives an audio signal and converts it to a signal compatible to a facsimile recorder.

____c. Provides seven channels in the frequency range from 14kHz to 32MHz. Any or all of these channels may be used independently of, or simultaneously with, any of the other channels.

____d. Receives a radio frequency signal, converts it to an audio signal, and then feeds it to a receiver transfer switchboard.

____e. Receives the teletype signal from one or more converter/comparators and feeds it to one or more selected teletype printers.

____f. Makes it possible to select the antenna to feed the antenna filter assembly.

____g. Receives the facsimile signal from one or more frequency shift converters and feeds it to one or more selected facsimile recorders.

____h. Enables, by means of coaxial patch cord, one or more selected radio receivers to be patched into a required frequency.

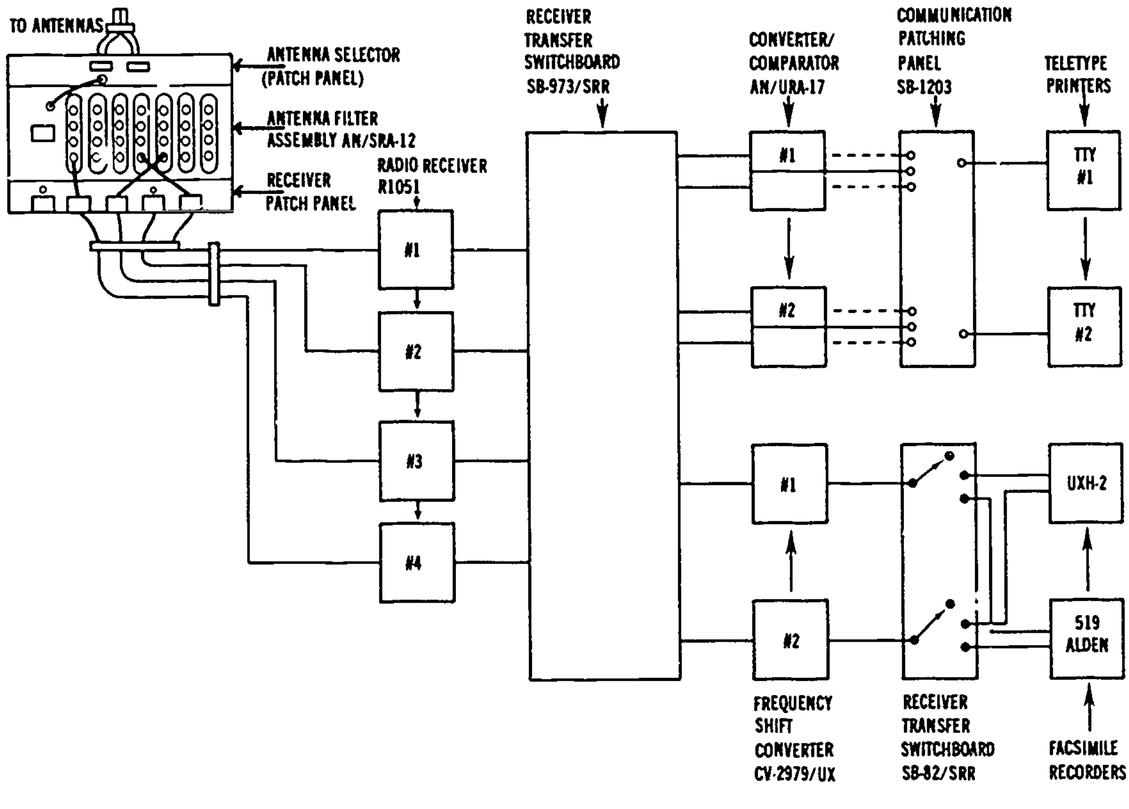
____i. Receives an audio signal from a radio receiver and provides for transferring it to either a facsimile converter or a teletype converter.

CRITERION TEST (CONTD.)

4. Using the block diagram below, show the proper patching and switching positions by darkening in the path of the following cases:

   a. Show the path of the signal from the receiver patch panel through receiver #1, through converter/comparator #2 to teletype #1.

   b. Show the path of the signal from the receiver patch panel through receiver #3, through frequency shift converter #2, then to the UXH-2.



DATA SOURCES - COMMUNICATIONS EQUIPMENT

CRITERION TEST ANSWERS

1. Antenna Selector

   Antenna Filter Assembly AN/SRA-12

   Receiver Patch Panel

   Radio Receiver R-1051

   Receiver Transfer Switchboards SB-973/SRR

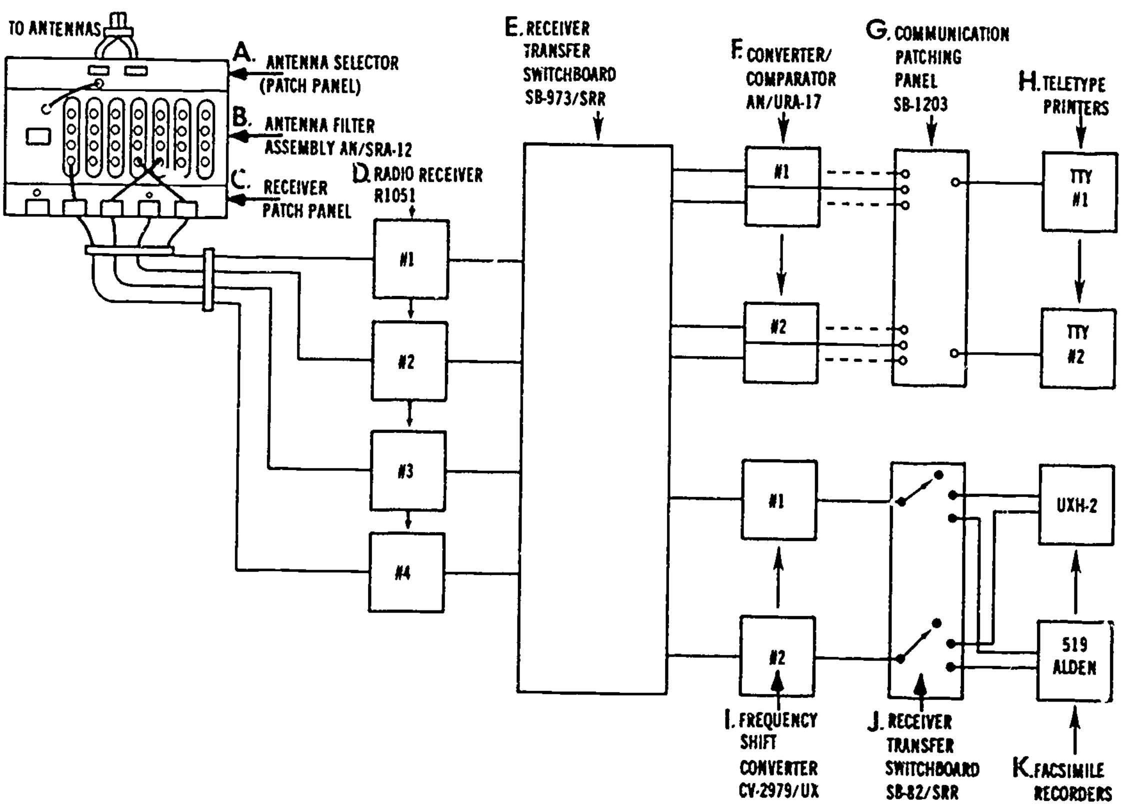
   Converter/Comparator AN/URA-17

   Communications Patching Panel SB-1203

   Frequency Shift Converter CV-2979/UX

   Receiver Transfer Switchboard SB-82/SRR

   (Any order)

2. 

CRITERION TEST ANSWERS (CONTD.)

3. F a. A f.

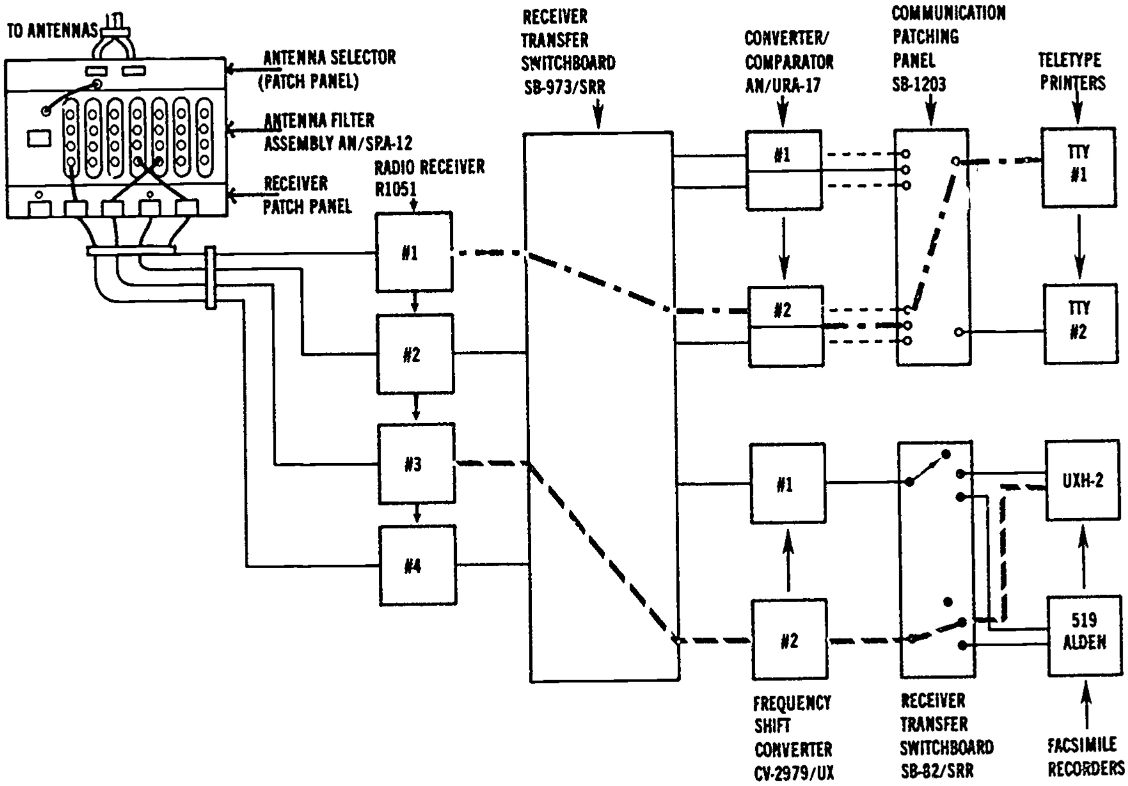
I b. J g.

B c. C h.

D d. E i.

G e.

4.



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PART VII

DATA SOURCES - PUBLICATIONS

DATA SOURCES - PUBLICATIONS

INTRODUCTION

There are two primary publications used by U.S. Navy ships to obtain information regarding the teletype and/or facsimile weather data which are broadcast by transmitting stations worldwide. These two publications must be constantly referred to by personnel on ships traveling the vast ocean areas of the world in order that they may obtain the necessary information to set up (tune) radio receiving equipment to copy the required weather data. The two publications are:

Worldwide Marine Weather Broadcasts, U.S. Department of the Navy -- Naval Weather Service

International Meteorological Codes ( ) and Worldwide Synoptic Broadcasts, NA 50-1P-11

If you have them available, refer to them as you do this program. Because both of these publications are subject to change, the excerpts used in this program may not be identical with the edition of the publication which you have.

Now, read the objectives, and complete the program.

DATA SOURCES - PUBLICATIONS

OBJECTIVES

1. List the two sections of the Worldwide Marine Weather Broadcasts manual that are of primary concern to the shipboard weather office.

2. Write the name of the two sections of NAVAIR 50-1P-11.

3. List the information available in the two sections of Worldwide Marine Weather Broadcasts manual and Section II of NAVAIR 50-1P-11.

4. Using excerpts from the Worldwide Marine Weather Broadcasts manual, find marine weather broadcast information -- specifically, transmitting stations, times, contents, and frequencies.

5. Using excerpts from Section II of NAVAIR 50-1P-11, find information on synoptic weather broadcasts for marine areas -- specifically, transmitting stations, times, contents, and frequencies.

FRAME 1

There are two primary publications used in the shipboard weather office to obtain detailed information pertaining to weather broadcasts. They are NAVAIR 50-1P-11 (International Meteorological Codes and Worldwide Synoptic Broadcasts) and Worldwide Marine Weather Broadcasts.

The two primary publications used to obtain detailed information pertaining to weather broadcasts are:

NA____________________

____

* *

ANSWER: 50-1P-11

Worldwide Marine Weather Broadcasts

FRAME 2

The first publication to be discussed is the Worldwide Marine Weather Broadcasts. It is comprised of five sections of which two are of primary concern to the shipboard weather office. They are as follows:

Section 3 - Radiofacsimile Broadcasts

Section 4 - Radioteleprinter Broadcasts

FRAME 2 (CONTD.)

The two sections of Worldwide Marine Weather Broadcasts of primary concern to the shipboard weather office are:

Section 3 - ______________________

Section 4 - ______________________

* *

ANSWER: Radiofacsimile Broadcasts

Radioteleprinter Broadcasts

FRAME 3

Section 3 of Worldwide Marine Weather Broadcasts contains details of radiofacsimile transmissions. Broadcasts are arranged according to ocean areas. In a particular geographical area, the radio stations providing service for the high seas areas are usually listed first. All the information you need about facsimile transmissions for your weather office is in Section 3 of the Worldwide Marine Weather Broadcasts manual.

* * * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 4

MEDITERRANEAN SEA

Radio station, area, frequency, and broadcast time	*Contents*	*Radio station, area, frequency, and broadcast time*	*Contents*
3-0190-2		**3-0250-2**	
ROTA, SPAIN (AOK)		**SOFIA, BULGARIA (LZA8)**	
Note: Transmitted only on request by U.S. Navy ships. Frequency list supplied by station when answering requests		*Area:* 30°N, 20°W; 28°N, 34°E; 64°N, 45°W, 60°N, 63°E	
3-0200-2		Frequency(kHz): 4813	
MADRID, SPAIN		0430, 1110	Surface analysis [1]
See 3-0170-1		[1] Transmission speed 90 scans/minute	

Shown above is a partial page of Section 3 - Radiofacsimile Broadcasts. You can see that this section provides the following information:

a. Radio station

b. Area

c. Frequency (kHz)

d. Broadcast time

e. Contents

FRAME 4 (CONTD.)

List the information found in Section 3.

____

____

____

____

____

* *

ANSWER: Radio station

Area

Frequency (kHz)

Broadcast time

Contents

(Any order)

FRAME 5

The first information provided is the radio station and its abbreviation. This is the station transmitting the data.

* * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 6

The second item is area. This is a general description of the area coverage for each station. It can be listed by geographical area or borders delineated by degrees of latitude and longitude or by both. Examples are shown below.

ANKARA, TURKEY (YMA) Area: Mediterranean Sea	Geographical area
SOFIA, BULGARIA (LZA8) Area: 30°N, 20°W; 28°N, 34°E; 64°N, 45°W; 60°N, 63°E	Boundaries delineated by degrees of latitude and longitude
CAIRO, EGYPT (5YE) Area: Mediterranean Sea, Red Sea and waters around Africa, North of 10°S	Geographical areas and degrees of latitude

FRAME 6 (CONTD.)

The three ways by which an area can be described are:

____

____

____

* *

ANSWER: Geographical areas

Boundaries delineated by degrees of latitude and longitude

Geographical areas and degrees of latitude and longitude

(Any order)

FRAME 7

The third item is frequency. This is the numerical value of the frequencies in use. The listing is in kilohertz (kHz). The hours that a frequency is in use will be in parentheses immediately following the frequency. There is no indication of time if the frequency is used 24 hours a day. Examples are shown below.

Frequency (kHz):
3377(1600-0030)
4560(0500-1400)
6790(0500-1400)

Frequency (kHz)
4813

FRAME 7 (CONTD.)

Frequencies are listed in ____________________. The hours that a frequency is used are listed in parentheses following the ______________. There is no indication of time if the frequency is used ________ hours a day.

* *

ANSWER: kilohertz (kHz)

frequency

24

FRAME 8

The fourth and fifth items are broadcast times and contents. All times are Greenwich Mean Time (GMT) (Z). Only radio-facsimile charts of interest to most mariners are listed. Detailed schedules of transmission of products on U.S. Naval radio broadcast stations are subject to change and are not included. A current schedule is broadcast at a fixed time each day to list the specific times. If amplification is necessary, it is done by means of footnotes.

All times listed are _____________________ time (Z). A time is listed for a daily current schedule for all

____.

* *

FRAME 8 (CONTD.)

ANSWER: Greenwich Mean

U.S. Naval radio broadcast stations

FRAME 9

Using the data on the next page, answer the following:

a. Which station serves the Queen Elizabeth Islands?

____

b. A 36-hr surface/500-mb prognosis is broadcast from Halifax, N. S. Canada (CFH) at what times?

____

c. AT 2307Z, Brentwood, NY, USA (WFH/WFK) broadcasts a chart. What is the chart and frequency of transmission?

(1) ____________________ ___________

(2) ______________________________

d. Norfolk, VA, USA (NAM) broadcasts a schedule of transmissions at what time? ___________

* *

ANSWER: a. Frobisher N.W.T. Canada (VRC3)

b. 0520Z and 1720Z

c. (1) 24-hr surface/sea and wind prog

(2) 17436.5 kHz

d. 0000Z

FRAME 9 (CONTD.)

NORTH ATLANTIC OCEAN

Radio station, area, frequency, and broadcast time	Contents

3-0010-1

FROBISHER N.W.T., CANADA (VRC 3) [1]

Area:

Hudson Strait, Hudson Bay, East Coast Baffin Island, Foxe Basin, Lancaster Sound, Queen Elizabeth Islands

Frequency (kHz):

3253, 7710

1815	Ice information
0815	Ice information (repeat)

[1] Broadcast July 1-Oct. 15

3-0020-1

HALIFAX, N.S., CANADA (CFH)

Area:

Western North Atlantic

Frequency (kHz):

4271, 9890, 13510, 17560, 133.15 [1]

0316, 0916, 1516, 2116	Early surface analysis
0500, 1100, 1700, 2300	Final surface analysis
0000, 1200	Ice information
0416, 1616	Wave analysis/12-hr prognosis
0616, 1816	24/36-hr wave prognoses
0520, 1720	36-hr surface/500 mb prognoses
1120, 2320	42/48-hr surface/500 mb prognoses
1020	Surface extended prognosis [2]
0800, 2000	Sea surface temperature analysis
2220	Test chart

[1] 133.15 kHz not used 1200-1600 on Wednesday
[2] For 3rd, 4th and 5th days

Radio station, area, frequency, and broadcast time	Contents

3-0040-1

BRENTWOOD, N.Y., U.S.A. (WFH/WFK)

Area:

Western North Atlantic [1]

Frequency (kHz):

9290(0712-1212)
9389.5(0712-1212)
11035(0712-1212)
17436.5(1950-2350)

0750, 1950	Surface analysis
1046, 2307	24-hr surface/sea and wind prognoses [2]
1150	36-hr wind wave/swell prognosis; 24-hr/36-hr combined sea height prognoses [2]

[1] Transmissions beamed towards Caribbean, Central and South America on a mean bearing of 165°
[2] Sea height in meters

3-0050-1

NORFOLK, VA., U.S.A. (NAM) [1]

Area:

North Atlantic Ocean

Frequency (kHz):

3357, 4975, 8080
10865, 16410, 20015

0000	Schedule
1200	Test chart

[1] U.S. Navy Fleet Broadcast (NFAX)

FRAME 10

Section 4 of the Worldwide Marine Weather Broadcasts manual contains details of radioteleprinter broadcasts. Only transmission schedules of forecasts, warnings, or analysis are listed in this section.

FRAME 10 (CONTD.)

Section 4 - Radioteleprinter broadcasts of the Worldwide Marine Weather Broadcast manual lists transmission schedules of ______________, ______________, or ________________.

* *

ANSWER: forecasts

warnings (Any order)

analysis

FRAME 11

As you can see from the following page, the format of Section 4, Radioteleprinter Broadcasts, is the same as Section 3. The information, of course, pertains to teletype broadcasts.

Data provided are:

a. Radio station - Station transmitting data

b. Area - Area serviced by broadcasts. Areas will sometimes refer to figures. They are marine weather forecast areas that are pictured in the back of the Worldwide Marine Weather Broadcasts manual.

c. Broadcast time - All times are in Greenwich Mean Time (Z)

d. Frequency - Transmitting frequency in kilohertz (kHz)

e. Contents - Listing of forecasts, warnings, or analysis transmitted. If a broadcast part is encoded, the cod is identified by a footnote.

* * * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 11 (CONTD.)

NORTH ATLANTIC OCEAN

Radio station, area, frequency, and broadcast time	Contents

4–0010–1

NEW YORK, N.Y., U.S.A. (WSY70)

Area:
Eastward to 30°E, 15°N-75°N
Frequency (kHz):
5940, 8110, 13620, 16250.5, 20907

0200, 0800, 1400, 2000	Surface analysis for United States, Southern Canada and the coastal areas of the Atlantic [1]

[1] Code FM 45.D

4–0020–1

NEW YORK, N.Y., U.S.A. (KJFK)

Area:
North Atlantic
Frequency (kHz):
Night-4055, 8130
Day-12180, 16220, 16280, 23211

0537, 1137 1737, 2337	Surface analysis for North Atlantic area: 10°N-80°N, 35°W-100°W [1]
0020, 1220	30-hour surface prognosis for 20°N-90°N, 25°W-155°W [1]

[1] Code FM 45-D

4–0030–1

MIAMI, FLA., U.S.A. (WBR)

Area:
Broadcast point to 40°S, 30°W-105°W
Frequency (kHz):
4061.5, 8140, 13624, 18765

0500, 1100, 1700, 2300	Surface weather map for United States, Southern Canada, and coastal areas of the Atlantic [1]
0515, 1715	36-hour forecast for eastern Caribbean
0630, 1830	Tropical analysis and discussion for equator-30°N, 50°W-110°W. Geographical coordinates in form Q La La Lo Lo
0845	48-hour surface prognosis for 20°N-60°N, 50°W-145°W [1]

[1] Code FM 45.D

4–0040–1

MOBILE, ALABAMA, U.S.A. (WLO)

Area: [1]
Southwest North Atlantic, Caribbean Sea, and Gulf of Mexico
Frequency (kHz):
8714.5

0020, 1120, 1720	Forecasts and warnings

[1] See figure 3

4–0050–1

STOCKHOLM, SWEDEN (SMA)

Area:
Northern Europe
Frequency (kHz):
5172.5, 10998

0840, 1140 2040	Storm/gale warnings; forecasts; ice reports [1]

[1] Baltic ice code.

4–0060–1

KANO, NIGERIA

Area:
25°N-5°S, 3°W-20°E
Frequency (kHz):
12190
5155 (1800-0600)
17535 (0600-1800)

1130	Surface analysis

4–0070–1

DAKAR, SENEGAL (6VY, 6VU)

Area:
Equator-35°N, 22.5°E-35°W
Frequency (kHz): [1]
4784, 10380, 13667.5, 19750 (0000-2400);
7616 (1800-0830)

0930-1030	Surface analysis [2]
1230-1330	24-hour forecast
1530-1630	Surface analysis [2]
2130-2230	Surface analysis [2] 24-hour forecast

[1] Transmissions are centered 2.55 Hz below listed frequencies
[2] Code FM 45.D

FRAME 12

Using the data shown below, answer the following:

NORTH ATLANTIC OCEAN

Radio station, area, frequency, and broadcast time	*Contents*
4–0010–1	
NEW YORK, N.Y.. U.S.A. (WSY70)	
Area: Eastward to 30°E, 15°N-75°N	
Frequency (kHz): 5940, 8110, 13620, 16250.5, 20907	
0200, 0800, 1400, 2000	Surface analysis for United States, Southern Canada and the coastal areas of the Atlantic [1]

[1] Code FM 45.D

Radio station, area, frequency, and broadcast time	*Contents*
4–0020–1	
NEW YORK, N.Y., U.S.A. (KJFK)	
Area: North Atlantic	
Frequency (kHz): Night-4055, 8130 Day-12180, 16220, 16280, 23211	
0537, 1137 1737, 2337	Surface analysis for North Atlantic area: 10°N-80°N, 35°W-100°W [1]
0020, 1220	30-hour surface prognosis for 20°N-90°N, 25°W-155°W [1]

[1] Code FM 45-D

Radio station, area, frequency, and broadcast time	*Contents*

[1] Code FM 45.D

Radio station, area, frequency, and broadcast time	*Contents*
4–0040–1	
MOBILE, ALABAMA, U.S.A. (WLO)	
Area: [1] Southwest North Atlantic, Caribbean Sea, and Gulf of Mexico	
Frequency (kHz): 8714.5	
0020, 1120, 1720	Forecasts and warnings

[1] See figure 3

Radio station, area, frequency, and broadcast time	*Contents*
4–0050–1	
STOCKHOLM, SWEDEN (SMA)	
Area: Northern Europe	
Frequency (kHz): 5172.5, 10998	
0840, 1140 2040	Storm/gale warnings; forecasts; ice reports [1]

[1] Baltic ice code.

a. Which station serves northern Europe? ____________ ______________________

b. What frequencies are used at night by New York, NY, USA (KJFK)? ______________________________

c. What are the contents of the broadcasts transmitted from Mobile, AL, USA (WLO)? ______________________

* *

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FRAME 12 (CONTD.)

ANSWER: a. Stockholm, Sweden (SMA)

b. 4055 kHz and 8130 kHz

c. Forecast and warnings

FRAME 13

The second publication covers the International Meteorological Codes and Worldwide Synoptic Broadcasts-NAVAIR 50-1P-11. It is divided into two sections - Section I which is entitled "International Meteorological Codes" and Section II, "Worldwide Synoptic Broadcasts." In this lesson, we will cover only Section II.

* * * * * * * * * NO RESPONSE NECESSARY * * * * * * * * * *

FRAME 14

Section II of NAVAIR 50-1P-11 contains all known synoptic weather broadcasts which contain information for marine areas. The schedules of transmission times are not listed because of the frequent and numerous corrections that are issued. U.S. Navy ships that require the schedule of transmission times for specific operations may request the latest schedules of the required station or stations from the nearest Naval Oceanography Command Center.

FRAME 14 (CONTD.)

Should you require a schedule of transmission times for specific operations, you may request the latest schedule from the nearest ______________________________.

* *

ANSWER: Naval Oceanography Command Center

FRAME 15

REPUBLIC OF THE PHILIPPINES

MANILA (DUM)

Sub-regional broadcast
Intended reception area: Parts of Asia and Southwest Pacific.

Call sign	Time of broadcast	Frequency (kHz)	Class of emission	Power (kw)
DUM 2	1200-2400	5880		
DUM 3	0000-2400	8920	F1	7.5
DUM 4	0000-2400	15832.5		

INFORMATION AVAILABLE

SYNOP	IAC	STORM WARNINGS	Plain language(Engl
SHIP	CLIMAT	AIREP	Plain language
PILOT	CLIMP	RETARD	Appropriate form
TEMP	CLIMAT/TEMP	RECCO	

DESCRIPTION OF TRANSMISSIONS

SYNOP, PILOT, TEMP	*Selected reports throughout the Pacific and Asia*
SHIP	*All available ship reports*
IAC	*Surface analysis for the area: 10S-35N, 100E-150E*
CLIMAT, CLIMAT/TEMP	*Selected reports throughout the Pacific and Philippine Islands; blocks 91,98*
CLIMP	*Selected reports for the area: 5N-25N, 115E-135E*
STORM WARNINGS	*Given in clear English and the area is bounded by a line from 25N 120E to 25N 135E to 5N 135E to 5N 115E to 15N 115E to 21N 120E to 25N 120E. Storm warnings for neighboring ocean areas as received from other storm warning centers will be re-broadcast under Storm Warnings. Only one warning on each tropical cyclone will be broadcast.*

566

FRAME 15 (CONTD.)

Shown on the preceding page is a partial page from Section II, NAVAIR 50-1P-11. Indicated are the data that are of concern to the shipboard weather office. They are as follows:

a. Station

b. Area

c. Time of broadcast

d. Frequency

e. Information available

f. Description of transmission

List the data found in Section II of NAVAIR 50-1P-11 that are of concern to the shipboard weather office.

____

____

____

____

____

____

* *

FRAME 15 (CONTD.)

ANSWER: Station

Area

Time of broadcast

Frequency

Information available

Description of transmission

(Any order)

FRAME 16

Using the partial page shown below, answer the questions on the following page.

REPUBLIC OF THE PHILIPPINES

MANILA (DUM)

Sub-regional broadcast
Intended reception area: Parts of Asia and Southwest Pacific.

Call sign	Time of broadcast	Frequency (kHz)	Class of emission	Power (kw)
DUM 2	1200-2400	5880		
DUM 3	0000-2400	8920	F1	7.5
DUM 4	0000-2400	15832.5		

INFORMATION AVAILABLE

SYNOP	IAC	STORM WARNINGS	Plain language(Engl
SHIP	CLIMAT	AIREP	Plain language
PILOT	CLINP	RETARD	Appropriate form
TEMP	CLIMAT/TEMP	RECCO	

DESCRIPTION OF TRANSMISSIONS

SYNOP,PILOT,TEMP	*Selected reports throughout the Pacific and Asia*
SHIP	*All available ship reports*
IAC	*Surface analysis for the area: 10S-35N, 100E-150E*
CLIMAT,CLIMAT/TEMP	*Selected reports throughout the Pacific and Philippine Islands; blocks 91,98*
CLINP	*Selected reports for the area: 5N-25N, 115E-135E*
STORM WARNINGS	*Given in clear English and the area is bounded by a line from 25N 120E to 25N 135E to 5N 135E to 5N 115E to 15N 115E to 21N 120E to 25N 120E. Storm warnings for neighboring ocean areas as received from other storm warning centers will be re-broadcast under Storm Warnings. Only one warning on each tropical cyclone will be broadcast.*

FRAME 16 (CONTD.)

a. What is the intended reception area?

____

b. What is the frequency used for the 1200-2400 transmission? ______________

c. What ship reports are transmitted by the station?

____

d. What is the name of the station transmitting?

____

* *

ANSWER: a. Parts of Asia and Southwest Pacific

b. 5880 kHz

c. All available ship reports

d. Manila (DUM)

THIS CONCLUDES DATA SOURCES - PUBLICATIONS. NOW, COMPLETE THE CRITERION TEST.

DATA SOURCES - PUBLICATIONS

CRITERION TEST

1. List the two sections of the Worldwide Marine Weather Broadcasts manual that are of primary concern to the shipboard weather office.

    ____

    ____

2. Write the two sections into which NAVAIR 50-1P-11 is divided.

    ____

    ____

3. List the information available in the two sections of the NAVAIR 50-1P-11 publication.

    ____

    ____

    ____

    ____

    ____

DATA SOURCES - PUBLICATIONS

CRITERION TEST (CONTD.)

4. Some excerpts from Sections 3 and 4 of the Worldwide Marine Weather Broadcasts manual are shown below and on the next page. From this data, answer the following questions.

   a. What are the standard frequencies, from 0000-2400, and transmission speed of the radiofacsimile transmission from Stockholm, Sweden (SAY, SMA)?

   ______________ (Frequencies) ______________ (Transmission speed)

   b. What area is serviced by radiofacsimile broadcasts from Helsinki, Finland (OFA-83)? ______________

   c. List the times that a 36-hour surface prognosis is transmitted from Tokyo, Japan (JMG).

   ____

   d. List the times that a surface-analysis, in code form, is transmitted from Tokyo, Japan (JMG).

   ____

   e. In what code form is the surface analysis transmitted from Tokyo, Japan (JMG)? ______________

SECTION 3

RADIOFACS MILE BROADCASTS

3-0110-1

STOCKHOLM, SWEDEN (SAY, SMA)

Area:
Northeast Atlantic and Baltic Sea
Frequency (kHz):
119.85(0300-1700)
4037.5(0000-2400)
6901(0000-2400)
8077.5(0000-2400)

0355 [1], 1020, 1555 [1] 2205	Surface analysis
0735, 1845	18/30-hr surface prognoses
0940	30-hr surface prognosis
1130	48-hr surface prognosis
0645 [1], 1420 [1]	Ice Chart (Baltic Sea)

[1] 90 scans/minute

3-0120-1

HELSINKI, FINLAND (OFA 83)

Area:
Baltic Sea
Frequency (kHz):
83.1, 8018 [1]

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CRITERION TEST (CONTD.)

SECTION 3 (CONTD.)

3-0320-4

SAN FRANCISCO, CALIF., U.S.A. (NMC)

Area:
Eastern North Pacific; South Pacific, Equator-20°S and east of 160°W
Frequency(kHz):
4344.1,[1] 8680.1, 12728.1,
17149.3[2]

0000	Schedule (Monday only)
0100	36-hr surface prognosis[3,4]
	36-hr sea/swell prognosis[3,4]
	Surface analysis[4]
	Mean wind and weather prognosis[4,5]
	Mean sea and swell prognosis[4,5]
0520	72/96-hr extended outlook[6]
	Surface analysis[3]
	Significant weather/sea state prognosis[3]
0700	72/96-hr extended outlook[6]
	Surface analysis[3,4]
	Significant weather/sea state prognosis[3,4]
1500	Mean wind and weather prognosis[5]
1820	Surface analysis[3]
	Significant weather/sea state prognosis[3]
	Wind and weather analysis[5]
2000	Surface analysis[3,4]
	Significant weather/sea state analysis[3,4]
	Wind and weather analysis[4,5]
	36-hr surface prognosis[3]
	36-hr sea/swell prognosis[3]
2300	36-hr surface prognosis[3,4]
	36-hr sea/swell prognosis[3,4]
	Surface analysis[3]
	Mean wind and weather prognosis[5]
	Mean sea/swell prognosis[5]

[1] Not used for 1820, 2000, and 2300 transmissions
[2] Used for 1820, 2000, and transmissions only
[3] For area north of 20°N, east of 160°E
[4] Repeated transmission
[5] For area 20°S-30°N, east of 160°W
[6] For North Pacific and North Atlantic

3-0321-4

SAN FRANCISCO, CALIF., U.S.A. (WMM 55)

Area:
South West Pacific
Frequency (kHz):
15700

2000-2100	Surface analysis[1]

SECTION 4

RADIOTELEPRINTER BROADCAST

4-0110-4

TOKYO, JAPAN (JMG)

Area:
Equator - 60°N, 95°E-175°W
Frequency (kHz):
3670, 5102.5,
7402.5, 14880, 19529, 22728

0300-0400	Warnings and Synopsis
0400-0500	Surface analysis[1]
0900-1000	Warnings and synopsis
1000-1100	Surface analysis[1]
1500-1600	Warning and synopsis
1600-1700	Surface analysis[1]
2100-2200	Warnings and synopsis
2200-2300	Surface analysis[1]

[1] Code FM 45.D

4-0130-4

JAKARTA, INDONESIA (8BB)

Area:
10°S 10°N, 90°E-145°E
Frequency (kHz):
11500, 16200

0645, 1245,	Warnings

CRITERION TEST (CONTD.)

5. Some excerpts from Section II, synoptic broadcasts, of NA 50-1P-11 are shown below and on the following page. From this data, answer the following questions.

   a. What frequencies are listed for continuous synoptic broadcasts from Bracknell (GFL) in the United Kingdom?

   ____

   b. What information is available from the station Archangel (RVH, RVZ) USSR?

   ____

   c. Selected synoptic reports from Brasilia, Brazil, (PPN9) are available from what blocks?

   ____

UNITED KINGDOM

BRACKNELL (GFL)

Regional and sub-regional European broadcast.

Call sign	Time of broadcast	Frequency (kHz)	Class of emission	Power (kw)
GFL 26	continuous	4489		
GFL 22	1800-0600	6835		
GFL 23	continuous	9886.5	F1	7
GFL 24	continuous	14356		
GFL 25	0600-1800	18230		

INFORMATION AVAILABLE

SYNOP	PILOT/SHIP
SYNOP/RETARD	TEMP
AERO	TEMP/SHIP
SHIP	IAC
PILOT	SFLOC
	AIREP Plain language

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DATA SOURCES - PUBLICATIONS

CRITERION TEST (CONTD.)

ARCHANGEL (RVH,RVZ)

Call sign	Time of broadcast	Frequency (kHz)	Class of emission	Power (kw)
RVH 76 RVH 77 RVZ 73	0000-2400	5335 8050 7600 4550 3655	F1	35 MV

INFORMATION AVAILABLE

SYNOP
TEMP
PILOT

DESCRIPTION OF TRANSMISSIONS

SYNOP	*Selected reports for blocks 20,21,22,23,25,26,27,28,33,34,35,37, and available ships.*
TEMP	*Selected reports for blocks 20,22,23,26,27,28*
PILOT	*Selected reports for blocks 20,22,23,26,27,34*

BRAZIL

BRASILIA (PPN9)

Regional broadcast (AMERSUD)

Call sign	Time of broadcast	Frequency (kHz)	Class of emission	Power (kw)
PPN 9	0000-0400	10225	F1	2.5
	0600-2400	18080	F1	10

INFORMATION AVAILABLE

SYNOP	PILOT	IAC	CLIMAT
SHIP	TEMP	TAFOR	CLIMAT/RETARD

DESCRIPTION OF TRANSMISSIONS

SYNOP, CLIMAT	*Selected reports from blocks 80-88*
SHIP	*Selected ship reports*
PILOT	*Selected reports from blocks 80-87*
TEMP	*Selected reports from blocks 80,82-85,87*
TAFOR	*Selected reports from blocks 82,83*

DATA SOURCES - PUBLICATIONS

CRITERION TEST ANSWERS

1. Section 3 - Radiofacsimile Broadcasts

   Section 4 - Radioteleprinter Broadcasts

2. Section I - International Meteorological Codes

   Section II - Worldwide Synoptic Broadcasts

3. Radio station

   Area

   Frequency (Any order)

   Broadcast time

   Contents (description of transmission)

4. a. Frequency - 4037.5 kHz, 6901 kHz, 8077.5 kHz
      Transmission speed - 90 scans/ minute

   b. Baltic Sea

   c. 0100, 2000, 2300

   d. 0400-0500, 1000-1100, 1600-1700, 2200-2300

   e. FM 45.D

5. a. 4489 kHz, 9886.5 kHz, 14356 kHz

   b. SYNOP, TEMP, PILOT

   c. 80-88

STUDY GUIDE/WORKBOOK

C3ABR25130-SW-102
C3ABR25130-2-SW-102

Technical Training

Weather Specialist
Aerographer's Mate

BASIC METEOROLOGY

1 March 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE ONLY

DO NOT USE ON THE JOB

RGL: 10.6

BASIC METEOROLOGY

This study guide and workbook was designed to provide you with all the information you will need during the first week (Basic Meteorology) of Block I.

Use the information as a text to supplement the lectures and as directed by the instructor.

CONTENTS

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CHAPTER 1

CLIMATE AND CLIMATOLOGY

OBJECTIVES

Without reference, select the definitions of climatological terms to a minimum of 75% accuracy.

Without reference, select the facts about the important climatic elements to a minimum of 75% accuracy.

Without reference, select facts about climatic controls to a minimum of 75% accuracy.

Without reference, select facts about the interface between the air and the sea to a minimum of 75% accuracy.

INTRODUCTION

We think of weather as the day-to-day changes in the atmosphere. On the other hand, the climate of an area is determined over periods of many years and represents the general weather characteristics of an area or locality. The climate is generally based on average conditions, using climatic elements such as temperature, wind, precipitation and amount of sunshine received.

Learning the "language" of meteorology is also important. There are terms, and their definitions, that are somewhat unique to the weather profession. To understand the climate, you must understand the terms that are used to describe it.

INFORMATION

DEFINITIONS OF TERMS

Meteorology - the science of the atmosphere and its phenomena.

Climatology - the scientific study of climate.

Climate - the average state of the earth's atmosphere at any given location or area within a specified period of time.

Weather - the state of the atmosphere at a given time and place in terms of wind, visibility, temperature, pressure, humidity, clouds and precipitation.

Synoptic Meteorology - a study of weather conditions over a large area based on simultaneous weather observations.

Temperature - a measure of the average kinetic energy of the molecules of the air.

Wind - the horizontal motion of air past a given point, measured in terms of direction and speed.

Precipitation - a general term for all forms of falling moisture, which includes rain, snow, hail, etc.

Cloud Cover - a term used to denote the portion of the sky which is covered by clouds.

CLIMATIC ELEMENTS

Temperature

The temperature is undoubtedly the most important of all climatic elements. All the other elements are controlled to some extent by temperature. Migratory weather systems that affect the day-by-day weather conditions are governed in their formation and intensification by temperature changes. Agriculture looks to seasonal temperature changes when deciding when and what to plant.

Rainfall

Average rainfall amount is also important to farmers and city planners. The water supply for cities is regulated by the precipitation that is received within an area. A change in the seasonal average of snow can become very important to city budgets. Since two cities could have the same amount of annual precipitation, but it could occur in different months, or days during these months, and the intensity could also vary, it often becomes necessary to include such factors as average number of days with precipitation, average amount per day and other factors.

Cloud Cover

Further, since precipitation amounts are directly associated with amount and type of clouds, cloud cover must also be included along with a precipitation study. Cloud cover is usually expressed in tenths of sky cover. Cloud climatology also includes such phenomena as fog and thunderstorms.

Wind

A climatology study would not be complete without some information of wind conditions. Wind is usually discussed in terms of direction and speed. Frequently, it is expressed in terms of "prevailing" wind direction, average speed, and maximum gusts. The prevailing wind direction will determine the orientation of runways when airfields are constructed and the speed of the wind will dictate the type of building structures.

CLIMATIC CONTROLS

Latitude

The variation of climatic elements from place to place and from season to season is caused by several factors called climatic controls. The same basic factors that cause weather in the atmosphere also determine the climate of an area. These controls, acting in different combinations and with varying intensities act upon temperature, winds, cloud cover and precipitation to produce many types of weather and therefore climate. Perhaps no other climatic control has such a marked effect upon these elements as does latitude.

The position of the earth relative to the sun will determine the angle at which rays of sunlight reach the earth. The number of "sun" hours each day depend upon the distance from the equator. The length of the day, like the angle of the sun's rays, influence the temperature. The length of the day varies with the latitude and season of the year.

A place near the equator has about 12 hours of daylight every day in the year. Because of this, and because the sun is always high in the sky (giving nearly direct rays), equatorial regions do not have pronounced seasonal temperature changes. In the far north (polar regions) long hours of winter darkness produce cold temperatures, while the long hours of summer daylight tend to have the opposite effect. Also, the sun's rays in reaching the earth's surface in polar regions make such a small angle with the earth's surface that the energy received per unit area is extremely small. Therefore, the sun's effectiveness is minimized even though it may shine for days without ceasing.

Topography

A powerful influence on climates is mountainous terrain, especially the long high chains of mountains that act as climatic divides. These obstacles deflect the tracks of weather systems and block the passage of air masses in the lower levels of the atmosphere. If the migratory weather systems are strong enough to force their way across these mountain barriers, they will be modified to a great extent, thus changing the climate on both sides of the range.

A mountain range that is oriented East-West will separate a mild climate to the south from the harsh climate to the north of the range. A good example of this type of mountain range is the Himalayans, which separate the very cold winter climates of Siberia from the much milder winters of India, to the south.

A mountain range that is oriented in a North-South configuration will separate moist air from dry air. An example of this type of range is the Rocky Mountains of the United States and Canada. The moist air will be confined on the windward side as a result of being forced up the mountain slopes (coastal areas of the Pacific Northwest). While on the leeward side, there will be relatively small amounts of rainfall, due to the air being drier as it descends the mountain slopes (Mojave Desert).

AIR/SEA INTERFACE

Coastal Climates

Air that has been moving over water for a considerable distance will have a high moisture content. This moisture is usually deposited on the adjacent coastal land areas. Therefore, coastal areas will often have much larger rainfall (snowfall) amounts than inland regions. The monsoon seasons of eastern and southern Asia are very pronounced examples of the effect of wind flow crossing large moisture sources before reaching coastal climates. These same conditions also exist, to a lesser extent, along the coastal plains of North America.

Ocean Currents

The other feature that has a tendency to change the climate is ocean currents: there are two basic types, warm and cold currents. A warm current will transport warm water northward toward the pole and will actually keep the coastal area temperatures a bit warmer during the wintertime (Gulf Stream). A cold current will transport cold water southward toward the equator and will keep the high summer temperatures lower along the coast (California Current).

REVIEW EXERCISE 1

INSTRUCTIONS. From memory, answer the following questions. Check your answers against the text.

1. State the definition of meteorology.

2. The average state of the earth's atmosphere at any given location or area best defines ______________ .

3. What is the definition of weather?

4. ______________ is a term used to denote the portion of the sky that is covered by clouds.

5. Of all the climatic elements, which one is the most important and why?

6. Why is rainfall an important climatic element?

7. How does a north-south oriented mountain range affect the climate?

8. How do ocean currents affect the temperature of coastal areas?

CHAPTER 2

EARTH'S ATMOSPHERE

OBJECTIVES

Without reference, select the facts about the chemical properties of the atmosphere to a minimum of 75% accuracy.

Without reference, select the facts about the atmospheric regions to a minimum of 75% accuracy.

Without reference, select the facts about the atmospheric variables to a minimum of 75% accuracy.

INTRODUCTION

The earth's atmosphere is a gaseous envelope that completely covers the earth and has motion relative to the earth's motion. This mixture of gases forms into distinct layers, or regions, that can be identified primarily by their temperature, moisture, and pressure distribution.

Even though scientists have determined that "the atmosphere" has many different layers, we will restrict our discussion to the three layers that are most near the earth's surface. These three make up what we will define as the "earth's" atmosphere. Therefore, when the term atmosphere is used you must understand that we are speaking of the three layers only. The regions above the earth's atmosphere have very little, if any, effect on our weather.

INFORMATION

COMPOSITION OF THE ATMOSPHERE

The earth's atmosphere is composed of a mixture of various gases. A given volume of pure, dry air would consist of about 78 percent nitrogen, 21 percent oxygen and a 1 percent mixture of other gases, mostly argon. These proportions are about the same in all parts of the world and remain relatively constant in pure, dry air.

Suspended in the air is always some amount of water vapor which is also a gas. The amount will vary from a trace (less than 1 percent) to 5 percent by volume. Water vapor acts as an independent gas which does not mix with dry air, but rather displaces it. It will remain suspended in r as long as it is in vapor form. Since water vapor will condense when cooled, it usually grows to a size large enough to fall to the earth as precipitation. Meteorologists consider water vapor to be the most important gas found in the atmosphere because without it there would be no weather.

Even when the atmosphere seems to be clear, it contains an enormous amount of impurities. These impurities, called condensation nuclei, serve as a core upon which water vapor can condense to form droplets. The most common types of impurities found in the atmosphere are salt, soot and dust, resulting from sea and ocean spray, forest fires and dust storms.

ATMOSPHERIC REGIONS

Troposphere

The three lowest layers of the atmosphere are primarily the ones that concern meteorologists. Each of these layers have certain properties and characteristics that are, for the most part, unique to that layer. The lowest layer is known as the troposphere. It extends outward from the earth's surface to an average height of 7 miles. The height of the top of the layer will vary from summer to winter. During the summer, the atmosphere is heated, thus the expansion causes a greater thickness. In winter, there is less depth due to colder temperatures. This same relationship of warm to cold causes the top of the tropsosphere to slope downward from an average height of 55,000 feet over the equator to 28,000 feet over the poles. Another significant feature of the troposphere is that almost all the water vapor contained in the atmosphere is found there. Since moisture is a necessary ingredient in the formation of weather, it is also true that most weather systems are restricted to this layer.

Tropopause

Located immediately above the troposphere is the tropopause. This layer acts as a "lid" in that it resists the vertical exchange of air between the troposphere and the stratosphere above. This boundary effect explains why almost all the water vapor is found in the troposphere.

Stratosphere

The atmospheric layer just above the tropopause is the stratosphere. The average height of the top of this layer is 22 miles. Characteristics of the layer are the near absence of water vapor and clouds. There is also a substantial increase in the amount of ozone found in the stratosphere. Ozone absorbs most of the deadly, ultra-violet radiation from the sun. This absorption allows life to exist on the earth and therefore, plays an important role in our everyday lives.

ATMOSPHERIC VARIABLES

Atmospheric Pressure

DEFINITION. Early scientists, having weighed a pig's bladder (balloon) empty, then filled with air, and finding no difference in the weight of each, concluded that air was not only invisible, but without weight as well. This theory held true until the early 16th century when a "plumber" told the great Italian scientist Galileo that there was nothing wrong with his hand water pump; that all suction pumps failed to work when the water level fell to below 18 cubits (about 27 feet). Galileo concluded, and rightfully so, that air did have weight.

The earth's atmosphere is a virtual ocean of air that extends upward for several miles above the surface. This ocean of air differs in one major way from an ocean of water. Water is nearly incompressible. A cubic foot of water on an ocean bottom weighs about the same as a cubic foot of water at the surface. But the air of the "atmospheric ocean" is highly compressible; a cubic foot of air at the surface weighs billions of times as much as a cubic foot at the outer edge of the atmosphere. The atmosphere thins so rapidly as one leaves the earth that, only 18,000 feet (approximately 3½ miles) up, one-half the atmosphere by weight would lie below you. Three-quarters of the weight of the atmosphere is found below 36,000 feet and 97 percent is below 18 miles. The weight of the atmosphere exerts pressure upon the surface of the earth. The force per unit area exerted by the atmosphere, on any given surface, as a result of its weight, is known as atmospheric pressure.

As air becomes colder it will increase in density and weight. So that an area of higher pressure usually indicates that the air is relatively colder in that area than the area surrounding it. This indicates also, that the atmospheric pressure changes inversely with a change in temperature; as the temperature in an area warms, the atmospheric pressure decreases or as the temperature drops (becomes colder), the pressure will increase. It should always be remembered that we are speaking in relative terms. A low pressure area with an average temperature of 40 degrees is relatively warmer than an area of "relatively higher" pressure, where the temperature is 30 degrees.

PRESSURE MEASURING INSTRUMENTS. Scientists since the days of Galileo have continuously experimented with ways of measuring atmospheric pressure. A student of Galileo's, Evangelista Torricelli, developed, during the 17th century, the first crude instrument used for that purpose. By filling a long glass tube to the brim with mercury, sealing it with his thumb, inverting it and placing the open end into a pan which was also filled with mercury, then releasing his thumb, Torricelli noticed that the mercury in the tube flowed into the pan of mercury until it reached a level of about 30 inches in the tube and leaving in its wake a vacuum that still bears his name - the Torricelli vacuum. By painstakingly carrying this crude contraption up a mountain, Torricelli noticed that the higher he took it, the less mercury in the tube. But he noticed, too, that the level returned to the original, approximately 30 inches when he returned to near sea level. The device, basically the same as that used today, became known as a barometer, meaning weight meter. Mercury continues in use as the indicator fluid because of its weight. For instance, a similar column of water would require a tube in excess of 32 feet tall to measure sea level barometric pressure.

Mercurial Barometer. One of the instruments that is used by meteorologists today is the mercurial barometer. It uses a column of mercury in a vacuum tube. The distance the mercury is forced up into the tube by the weight of the atmosphere is known as the atmospheric pressure for that particular location. Numerous experiments showed that at points near sea level the pressure of the atmosphere causes the mercury to rise on the average of 29.92 inches. This average is now used as a standard for all sea level points even though variations exist. (These variations will be discussed in later chapters). The mercurial barometer is the most accurate pressure measuring instrument commonly used today. It requires a somewhat complicated procedure for reading, which is time consuming, and therefore is not widely used on a routine basis.

Aneroid Barometer. The necessity for a more convenient and portable pressure instrument resulted in the aneroid (meaning "containing no fluid") barometer. The aneroid barometer consists of a cell, made of thin metal to make it flexible, that is partially evacuated of air so that it will respond more readily to changes of atmospheric pressure. These changes in pressure cause an attached pointer to move along a dial that is marked with pressure readings. The unit of measure is millibars, but it can also be read in inches of mercury.

In the United States, inches of mercury as a unit of measurement of atmospheric pressure is used in dealing with the public at large. However, inches of mercury do not directly express pressure in terms of force per unit area. A common unit of pressure that does is the millibar (mb); a unit of measurement that equals a force of 1,000 dynes per square centimeter. The dyne is a unit of force in the metric system. The standard atmospheric pressure at sea level in millibars is 1013.2, which corresponds to 29.92 inches of mercury.

Barograph. At times it is necessary to have a record of the pressure patterns and changes that have occurred during the past several hours. This can be accomplished by using a barograph. The barograph is a type of aneroid barometer with a graph attached, that makes a trace of ink, of the pressure patterns. Since the barograph is an aneroid barometer, the unit of measure is millibars. However, the graph is usually marked to indicate inches of mercury, therefore it is most commonly read in inches of mercury. If for any reason, the primary aneroid barometer becomes inoperative, the barograph can serve as a replacement.

Atmospheric Temperature

LAPSE RATE. The vertical temperature distribution varies with each layer of the atmosphere. In the troposphere, the temperature decreases with height, while the tropopause is characterized by a pronounced change in the rate at which the air cools. In this layer, the temperature becomes nearly isothermal; showing little or no change with height. The temperature through the stratosphere will show an apparent, slight increase with height. This change in temperature with a change in height is called the lapse rate and is expressed as an amount of change per unit distance.

When the temperature decreases with an increase in height, this is known as a positive lapse rate. If, for some reason, the temperature increases with an increase in height, it is said to have a negative lapse rate. In the troposphere, the expected or "normal" condition is a positive lapse rate. It is only when the atmosphere does not act "normally" that a negative lapse rate develops. These shallow layers of the atmosphere, where a negative lapse rate has developed, are called inversions.

SURFACE INVERSION. As already defined, a shallow layer of the atmosphere with a negative lapse rate is an inversion. The most frequent type of inversion to occur over land is that produced immediately above the ground on a clear, relatively still night. The ground loses heat rapidly through terrestrial radiation, cooling the layer of air next to it. The amount of cooling decreases rapidly with altitude, and the temperature of the air a few hundred feet above the ground is affected very little or not at all. Terrestrial radiation thus causes the lowest layer of air to be colder than the air just above that layer. An inversion formed in this manner is known as a surface inversion.

FRONTAL INVERSION. Inversions are also found in association with movement of colder air under warm air or the movement of warm air over cold air. Such inversions are often called frontal inversions, since these conditions usually exist in frontal zones.

SUBSIDENCE INVERSION. An inversion sometimes forms as a result of widespread sinking of air (subsidence) within a relatively thick layer aloft, while the air below this layer is essentially unchanged. This sinking air is heated by compression, and it may become warmer than the air below it. When this condition occurs, it is usually associated with high pressure areas and is known as a subsidence inversion.

Restrictions to vision, such as fog, haze, smoke, and low clouds are often found in or below inversions.

REVIEW EXERCISE 2

INSTRUCTIONS. From memory, answer the following questions. Check your answers against the text.

1. What are the gases, and their respective amounts, that make up the composition of the earth's atmosphere?

2. What is the most important gas to meteorologists and why?

3. State the layers of the earth's atmosphere in ascending order.

4. Is the mesosphere a layer of the earth's atmosphere? Why?

5. The average height of the top of the troposphere is _______________ feet over the poles and _______________ feet over the equator.

6. Why does the thickness of the troposphere vary between summer and winter?

7. What is the most significant feature of the tropopause?

8. What is the definition of atmospheric pressure?

9. What are the three most common pressure measuring instruments?

10. When the temperature decreases with an increase in height, it would have a ______________ lapse rate.

11. The normal lapse rate in the troposphere is ____________.

12. What causes a surface inversion?

CHAPTER 3

EARTH'S HEAT BALANCE

OBJECTIVES

Without reference, select the facts about radiation to a minimum of 75% accuracy.

Without reference, select the facts about conduction to a minimum of 75% accuracy.

Without reference, select the facts about convection to a minimum of 75% accuracy.

Without reference, select the facts about advection to a minimum of 75% accuracy.

Without reference, select the facts about the adiabatic processes to a minimum of 75% accuracy.

Without reference, select the facts about the earth-sun relationships to a minimum of 75% accuracy.

INTRODUCTION

The earth's heat balance is governed primarily by the position of the earth in relation to the sun. That relationship is continuously undergoing change as the earth moves in its orbit around the sun. One result of this continuous change is the seasons. As the seasons change, the amount of heat that is received also changes.

Heat is a form of energy and can be transferred from one substance to another. The direction of transfer is always from hot to cold. As this transfer takes place, it affects the heat balance of the atmosphere. We will discuss the four primary methods of heat transfer and how they affect the earth's atmosphere, as well as the earth-sun relationship.

INFORMATION

RADIATION

When heat is transferred by electromagnetic waves, without any medium, it is called radiation. The heat that is produced by the sun is solar radiation and is in the form of short waves which can penetrate clouds to reach the earth's surface. Heat is radiated from the earth by outgoing radiation, called terrestrial radiation. It is in the form of long waves and cannot penetrate clouds. Cooling results at night as terrestrial radiation continues and insolation (solar radiation) ceases. If there is a layer of cloud cover present, which the long wave terrestrial radiation cannot penetrate, the result will be a trapping of the heat between the earth's surface and the cloud layer. This explains why the temperature is usually colder on a clear, cloudless night than on an overcast night. This is known as the greenhouse effect.

CONDUCTION

Conduction is the transfer of heat by direct contact. In the atmosphere, when warm air moves over a colder surface, it will be cooled from below. This cooling is a result of heat from the air being transferred to the colder surface, thus the temperature of the air is decreased. If the surface is warmer than the air above, the heat will be transferred from the surface to the air, causing the temperature of the air to increase. In either case, the method of heat transfer would be conduction.

CONVECTION

It is known that the earth's surface heats and cools more rapidly than the air above. At times, the earth is heated by the sun until it becomes warmer than the air. The air is then heated, mainly by contact with the warmer earth. When air is warmed, it expands and becomes lighter. A layer of air, warmed by contact with the earth, rises and is replaced by colder air which flows in and under it. This cold air, in turn, is warmed and rises, and it, too, is replaced by colder air. This transfer of heat by vertical motion of the ir is called convection. Convection usually occurs rapidly over small areas.

ADVECTION

The final method of heat transfer, in our discussion, usually occurs slowly and over large geographical areas. It is called advection, which is the transfer of heat by the horizontal movement of air. As large bodies of air move out of an area, such as Canada or the northwestern sections of North America, they will, normally, be colder than the air ahead of their movement. Since the colder "airmass" has a greater density than the warmer, it will push the warm air as it moves. As the warm air is replaced by the colder air, it causes the temperature of an area to become considerably cooler. The same results occur as warm air moves into an area that has been vacated by a colder airmass. These large scale movements of air effect the climate throughout the world.

Heat is continually being transferred between the various substances of the atmosphere. Each substance will heat and cool independently, according to its individual molecular structure. This imbalance of heat causes temperatures to change as the energy is transferred through one or more of the methods just discussed. Although we define each method and relate it as an individual and independent action, in fact, at any given time, all four are occurring within the atmosphere; probably within the same airmass. Convection occurs rapidly over small areas and is important in the development of local weather conditions. A thunderstorm during a summer afternoon, that affects your particular area, would most likely be the result of convection. That convection was probably initiated by conduction. A change in the weather pattern over large areas can be attributed to advection. This newly developed weather condition, which may be advected over and through continents, could have an effect on the weather conditions on a very large scale. Thus, it becomes apparent that, to world meteorology, advection plays the most important role.

ADIABATIC PROCESS

There are other factors that influence atmospheric temperature. These are not considered to be methods of heat transfer. However, they still play an important role in the temperature distribution throughout the atmosphere.

The gases that make up our atmosphere are subject to processes that heat and cool them. When heated, these gases expand and become lighter. As a result they will rise, seeking equilibrium with the gases above. There are other ways air can be lifted, such as through the thermodynamic processes of a thunderstorm or mechanically, such as having colder, denser air move under it or by lifting as it flows up over a mountain slope.

Whatever the cause of the lifting the effect is the same. As it rises, the pressure becomes less and the "parcel" is allowed to expand until it reaches an altitude similar in pressure and density to its own. As it expands it cools. This is done through a thermodynamic process in which there is no transfer of heat or mass across the boundaries of the system in which it operates and is known as the adiabatic process.

Adiabatic Cooling and Heating

As air rises, it is cooled because it is expanding by moving from a surface where the pressure is greater to an altitude of lesser pressure and therefore less compression. This is called adiabatic cooling (cooling by expansion). When the process is reversed and air is forced downward, it is compressed, causing it to heat. This is called adiabatic heating (heating by compression). The rate at which the air will rise and cool or sink and warm is determined by its temperature and moisture content. Once the air starts to move it will continue to rise or sink until its temperature is in balance with the surrounding atmosphere.

Dry Adiabatic Lapse Rate

If the air is unsaturated (dry or relatively free of moisture content), the rate of decrease (or increase) in temperature is about 5½ degrees Fahrenheit (3 degrees Celsius) for each 1,000 feet of altitude. This is known as the dry adiabatic lapse rate.

Moist Adiabatic Lapse Rate

If the air is saturated (relatively high in moisture content), the lapse rate will be less, depending upon the existing temperature and amount of moisture in the air. The more water vapor the air contains, the slower it will cool or warm. Since the lapse rate is dependent on the amount of moisture in the air and its temperature, the moist adiabatic lapse rate cannot be given a fixed value. For our discussions, we consider the moist adiabatic lapse rate to be 3½ degrees Fahrenheit (1.8 degrees Celsius) per 1,000 feet of altitude.

EARTH-SUN RELATIONSHIPS

Rotation

The earth has two basic motions within the solar system with relation to its sun (Figure 3-1). The first is the daily rotation of the earth about its axis. A complete rotation of the earth about its axis takes approximately 24 hours, so that each hour represents 15 degrees rotation. This rotation causes periods of daylight and darkness which, in turn, produce numerous weather effects and cause a curious effect on the flow of wind on the surface of the earth.

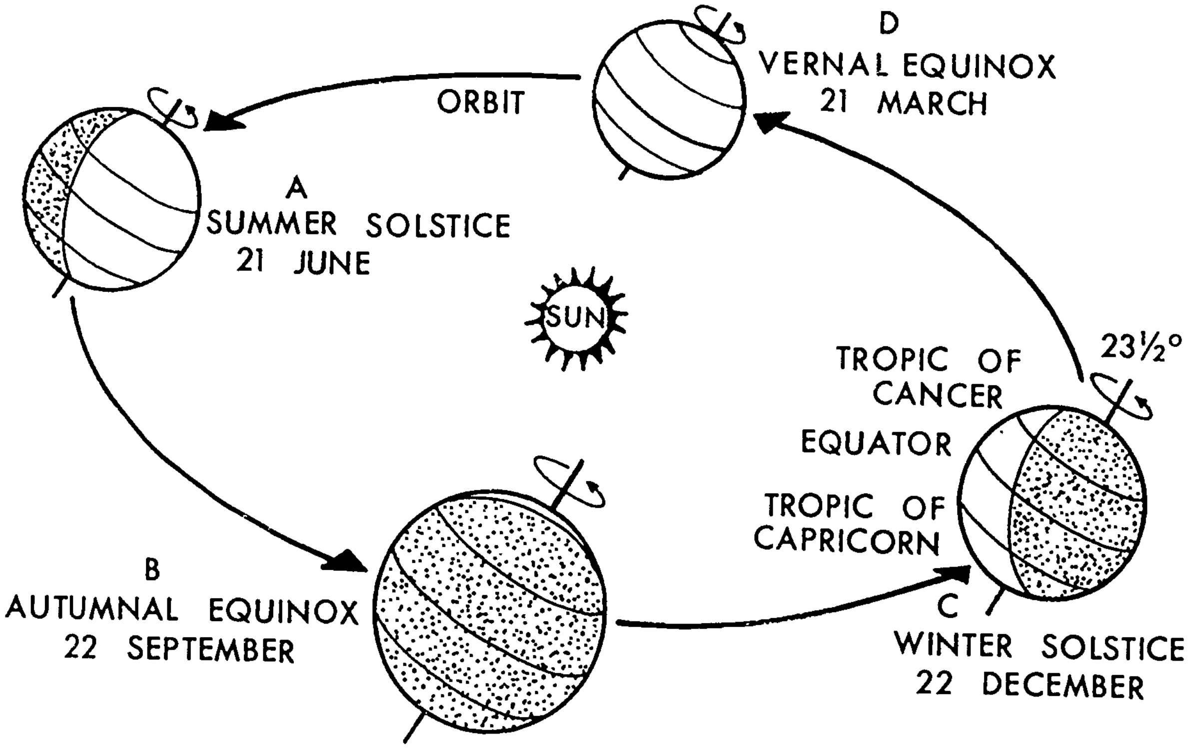

Figure 3-1. Earth-Sun Relationships

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Revolution

The other basic motion is its slightly elliptical orbit (revolution) about the sun which is completed each 365¼ days. The plane of the earth's orbit around the sun is called the plane of the ecliptic. If the earth's axis was perpendicular to that plane, we would not experience seasons (summer, fall, winter and spring). That is, the daily amount of sunshine would vary only slightly throughout the year. To someone at the equator, the sun would be exactly overhead at noon every day; to someone at either pole, the sun would remain on the horizon throughout the year.

Seasons

Actually, we do have seasons and the reason is that the earth's axis is not perpendicular to the plane of the ecliptic, but is tilted about 23½ degrees from the vertical to the plane of the ecliptic as shown in figure 3-1. The tilt of the axis accounts for the great seasonal variations in weather that occur in the middle and high latitudes. Refer to figure 3-1 and note that when the earth is at position "A" in its orbit, the north pole tilts towards the sun. The northern hemisphere is then experiencing summer because it is receiving the most solar energy (insolation). When the south pole tilts towards the sun (position "C"), the southern hemisphere is having summer. Spring and fall begin when the earth has moved to a respective location in its orbit which results in nighttime and daylight hours of equal length anywhere on earth (positions "B" and "D"). These positions in the earth's orbit are called equinoxes and occur on or about March 21 and September 22.

REVIEW EXERCISE 3

INSTRUCTIONS. From memory, complete each statement in column A by selecting a word or phrase from column B. Each word or phrase in column B may be used once, more than once, or not at all.

COLUMN A

1. _____ causes the seasons.
2. _____ will not penetrate clouds.
3. _____ causes day and night.
4. _____ is the transfer of heat by direct contact.
5. _____ occurs rapidly over small areas.
6. _____ is caused by the expansion of air.
7. _____ could possibly cause a local thunderstorm.
8. _____ is short waves received from the sun.
9. _____ is the transfer of heat by the vertical motion of air.
10. _____ is the most important method of heat transfer to world meteorology.
11. _____ occurs slowly over large geographical areas.
12. _____ is the transfer of heat by the horizontal movement of air.
13. _____ occurs at night, when the sky is covered with clouds.

COLUMN B

a. Adiabatic cooling
b. Adiabatic heating
c. Advection
d. Conduction
e. Convection
f. The earth's revolution
g. The earth's rotation
h. The greenhouse effect
i. Radiation
j. Solar radiation
k. Terrestrial radiation

CHAPTER 4

CONCEPTS OF TEMPERATURE AND PRESSURE

OBJECTIVES

Without reference, select the fundamental concepts of temperature to a minimum of 75% accuracy.

Without reference, select the fundamental concepts of pressure to a minimum of 75% accuracy.

Without reference, select the facts about constant level surfaces to a minimum of 75% accuracy.

Without reference, select the facts about the atmospheric laws to a minimum of 75% accuracy.

INTRODUCTION

There are some fundamental concepts of temperature and pressure that you must understand. A change in the temperature or pressure structure of the atmosphere can result in changes in the weather conditions. As a weather observer, you will be required to report those changes.

Station pressure, sea level pressure, pressure centers and isobaric surfaces are just a few of the terms that will be important to you as you report the weather conditions at your station. You will report pressure and temperature measurements. Therefore, we will begin our discussion with some fundamental concepts in those areas.

INFORMATION

TEMPERATURE MEASUREMENTS

Temperature is a measurement of the average heat and expresses the degree of molecular activity. Different substances will heat and cool at different rates due to their separate molecular structures. For example, a land surface becomes hotter than a water surface when equal amounts of heat are added to each. The degree of "hotness" or "coldness" of a substance, as measured with a thermometer, is known as its temperature. Fahrenheit and Celsius (centigrade) are the names given to the two temperature scales used most often by weather observers. On the Fahrenheit (F) scale, the freezing point is 32 degrees and the boiling point is 212 degrees. On the Celsius (C) scale, the freezing point is at 0 degrees and the boiling point at 100 degrees. The temperature reported in aviation weather observations are those of the free air.

The range of temperature between night and day varies considerably, both with season and location. The daily variance is large near the surface of barren high-level places, over sand, plowed fields, and rocks, often ranging from 30 degrees to 50 degrees Fahrenheit. The variance is much smaller over thick vegetation and deep water surfaces where it may be only about 2 degrees Fahrenheit. Land areas heat and cool rapidly while water surfaces are very slow to change temperature. The air will change temperature more rapidly than water, but slower than land surfaces. Practically no change of temperature occurs between night and day in the stagnant free air 4,000 feet or more above the surface within the troposphere.

PRESSURE TERMS

Station Pressure

The atmospheric pressure at a specific location is usually reported in inches of mercury. It represents the pressure at that particular field elevation, which is above sea level. The pressure at a specific field elevation is known as station pressure. Due to changes in the distance above sea level of individual stations, the station pressure is usually different at a station, for example, at Denver, Colorado and one at Galveston, Texas; with the lower pressure being reported at the station with the higher elevation. This difference could be attributed to the known fact that, atmospheric pressure decreases with height. However, it could also be caused by, or at least compounded by, a change in the overall pressure patterns.

Sea Level Pressure

In order to see the true pressure pattern over an area, the meteorologist must be able to know what the pressure would be at each of the points depicted, if they were all at the same level. By taking the station pressure and mathematically changing it to what it would be if the station were located at sea level, that pattern can be shown. The meteorologist then has a picture of the true pressure pattern, because all the effects of the terrain have been removed. The station pressure after it has been converted to what it would be if the station were at sea level is called sea level pressure. The sea level pressure is usually expressed in millibars and is used for comparing the pressure between stations.

Pressure Centers

A weather chart such as the ones used by weather forecasters is an instantaneous picture of the atmosphere. The sea level pressure for each station has been plotted and the points that have the same pressure are connected with a line called an isobar. The isobars show the actual pressure pattern. Areas that are surrounded by higher pressure are called low pressure centers; areas surrounded by lower pressure are known as high pressure centers. These differences in pressure, shown on the weather chart as "highs" and "lows", can now be assumed to be the result of something other than the difference in elevation of the reporting stations. Figure 4-1 shows a typical weather chart with pressure patterns.

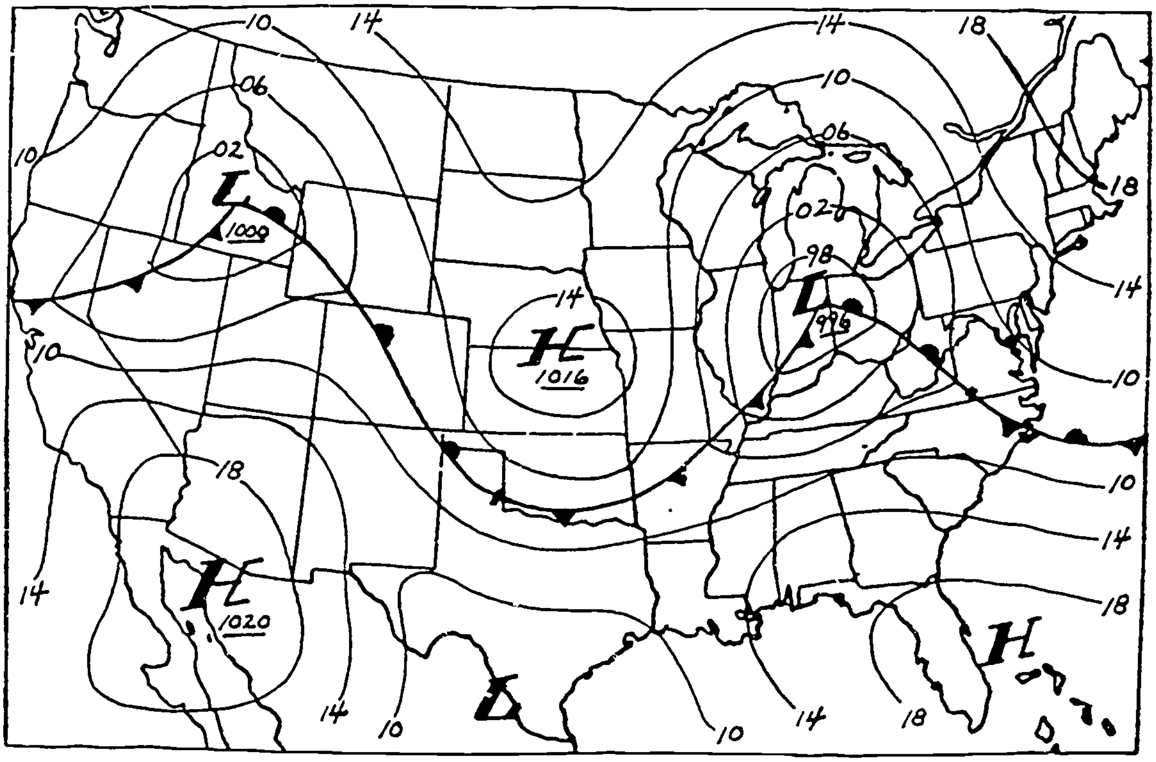


Figure 4-1. Surface Weather Chart

Pressure Gradient

The horizontal pressure difference between two points is known as the pressure gradient. Both, large and small scale atmospheric circulations result from these horizontal pressure differences. These differences are most often expressed as a change in pressure per unit distance (i.e., 10 millibars of change per 100 miles distance). The pressure gradient is the force that initiates the movement of air from higher to lower pressure. To better understand this movement, think of a high pressure area as a "mound" of air and a low pressure area as a "valley"; the air is constantly trying to flow down into the valley from the top of the mound. This tendency to move from high to low pressure is caused by the pressure gradient between the two points.

PRESSURE SURFACES

Isobaric Surface

An isobaric surface is a level at which the pressure remains constant, but the height of the surface may vary. This concept may be understood more easily by following the path of an aircraft, travelling from Chicago to New York, with an over flight of Cleveland. The pilot climbs to an altitude of 18,000 feet over Chicago and, at that level, the atmospheric pressure as indicated by an aneroid barometer is 500 millibars. He then proceeds to Cleveland, maintaining a flight level at which the atmospheric pressure continues to be 500 millibars. When the aircraft is over Cleveland, the pilot again takes a reading of his actual flight level and finds that he is at 19,000 feet above the surface. The flight is continued to New York at a level where the pressure is still 500 millibars. When the flight reaches New York, the 500 millibar pressure level is determined to be at an altitude of 17,000 feet. From this illustration, it is evident that the actual height of the 500 millibar pressure level has varied, while the pressure reading (500 millibars) remained constant.

Constant Level Surface

Again, let us follow the same flight, only this time we will maintain a constant level surface. That means we are going to maintain a level at which the height remains constant, but the pressure will vary. Now, the aircraft climbs to 18,000 feet over Chicago and determines that the pressure is 500 millibars. The pilot continues on to Cleveland remaining at a flight level of 18,000 feet above the ground and finds the pressure (at 18,000 feet) over Cleveland is 600 millibars. Then on to New York, still at 18,000 feet, and he determines the pressure there to be 400 millibars. In this example, the height remained constant (18,000 feet), but the pressure varied.

Constant Pressure Charts

Map analysis includes not only surface weather charts, but also upper air charts. The upper air charts used in conjunction with the surface charts are essential for accurate weather forecasting. By using upper air charts, the forecaster can get a 3-dimensional view of the weather patterns. The wind flow pattern in the free atmosphere above the earth's surface can be an indicator of the type of weather that will occur at the surface.

In order to determine the wind patterns, the meteorologist may analyze isobaric surfaces at various levels. These charts, referred to as constant pressure charts, are designed to show the height above the surface that a particular atmospheric pressure is found.

Although constant pressure charts may be prepared for any isobaric surface, the most common charts in use are the 850-, 700-, 500- and 300-MB charts. The approximate heights of these isobaric surfaces are as follows:

Millibar Chart	Height (feet)
850	5,000
700	10,000
500	18,000
300	30,000

It should be noted that these are only average heights and they will vary with different weather patterns. From time to time and from place to place, due to these changes in weather patterns, there are different pressures at a patticular level in the atmosphere. A specific pressure (i.e., 850-MB, 700-MB, etc.) will usually be found at a higher level over areas of high pressure and at a lower level over areas of low pressure. These concepts are illustrated in figure 4-2.

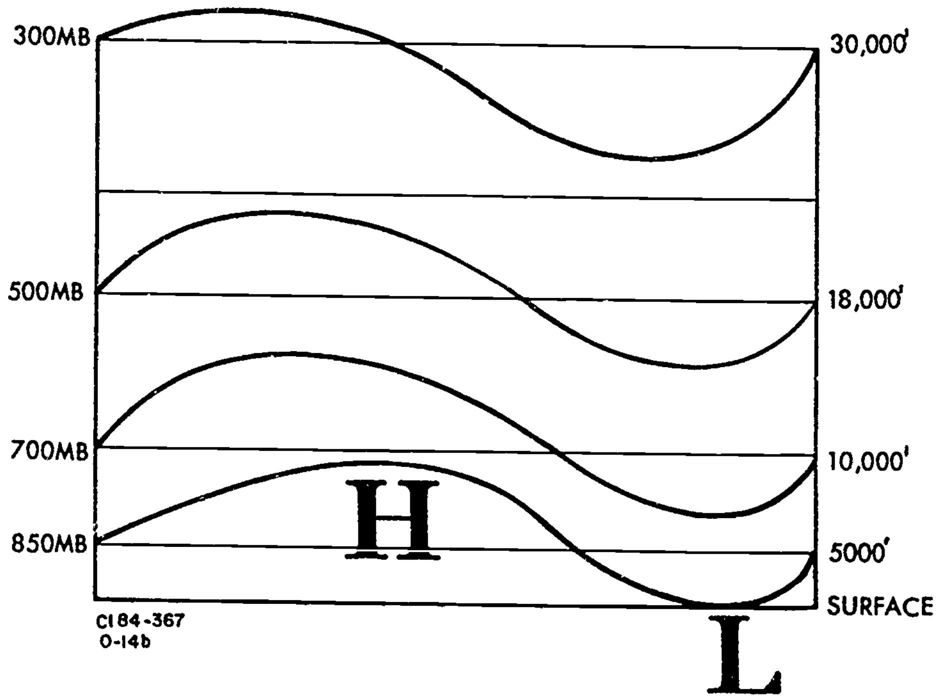


Figure 4-2. Isobaric Surfaces

Contours

Contours are lines that connect points of equal heights above sea level on a constant pressure chart. These contours show the height of the constant pressure surface in question. They are the upper air equivalent of isobars, and look much the same as isobars, but are usually much smoother. Contours are drawn for height intervals rather than pressure intervals, as are isobars.

The contours on a constant pressure chart will normally parallel the wind direction and are spaced inversely proportional to the wind speed. When the contours are close together, the wind is strong; when the contours are far apart, the wind is weak. Closed high and low pressure centers appear less frequently on constant pressure charts than on surface charts.

High and low areas can be located by the reported height values. Lows have a lower height value at the center than the surrounding reported heights. Conversely, highs have higher values at the center than the surrounding reported heights. High and low systems on constant pressure charts are labeled in the same manner as on surface charts. A "H" in blue denotes a high and a "L" in red denotes a low.

ATMOSPHERIC LAWS

Laws of Motion

Everything about us in the world moves. Even an object on the surface of the earth that appears to be at rest (motionless) is actually moving with the rotation of the earth. We can see from this that the terms "rest" and "motion" are relative terms. The change in position of any matter (substance) is actually motion. The atmosphere, being a gas, is subject to much motion. Temperature, pressure and density act to produce the motions of the atmosphere. These motions are subject to well defined laws.

Newton's first law of motion deals with the principle of inertia and states that every body continues in a state of rest or of uniform motion, in a straight line, unless acted upon by some external force.

The second law states that when a net force acts on a body, it produces an acceleration in the direction of the net force. The degree of acceleration depends on the weight of the body and the amount of force applied.

Newton's third law of motion concerns the principle of action and reaction, and states that to every action, there is an equal and opposite reaction

Gas Laws

Boyle's Law, Charles' Law and the Universal Gas Law, when applied to the atmosphere, help to explain the interaction between pressure and temperature. The behavior of any gas depends upon the variations in temperature, pressure and density. Since the atmosphere is a mixture of gases, its behavior is governed by these well-defined gas laws.

When the pressure upon a given volume of gas increases, it will cause the temperature of that gas to increase; when the pressure decreases, the temperature will also decrease. This relationship between pressure and temperature is the result of an increase or decrease in the molecular activity within the gas. In each case, it is assumed that the volume always remains constant. These same basic principles of the gas laws are applicable to the atmosphere.

Buys Ballot's Law

If an observer in the northern hemisphere stands with his back to the wind, the low pressure area will be on his left. This is called Buys Ballot's Law and it will always hold true. It obeys all the laws of motion, as well as many of the other forces that act upon atmospheric circulation. These other forces will be discussed in later chapters of this text.

REVIEW EXERCISE 4

INSTRUCTIONS. From memory, complete the following statements by placing a word or phrase in the blank space. Check your answers against the text.

1. The temperature scales used most often by weather observers are _______________ and _______________.

2. The _______________ is the atmospheric pressure at a specific field elevation and is usually reported in _______________.

3. The sea level pressure is expressed in _______________.

4. The _______________ is used for comparing the atmospheric pressure between stations.

5. On a surface weather chart, a low pressure center will be colored _______________ and will be surrounded by _______________ pressure.

6. An area surrounded by lower pressure would be a _______________ pressure center.

7. The horizontal pressure difference between two points is known as the _______________.

8. An _______________ surface is a level at which the pressure remains constant.

9. The average heights of the most common isobaric surfaces are: 850 MB; _______________ feet, 700 MB; _______________ feet, 500 MB; _______________ feet; 300 MB; _______________ feet.

10. _______________ are lines that connect points of equal heights above sea level on a constant pressure chart.

11. The gas laws can be used to explain the interaction between ______________ and ______________ within the earth's atmosphere.

12. In the Northern Hemisphere, if you stand with your back to the wind, low pressure will be on your ______________, according to ______________.

CHAPTER 5

WIND

OBJECTIVES

Without reference, select the facts about the forces related to winds to a minimum of 75% accuracy.

Without reference, select the facts about the types of wind conditions to a minimum of 75% accuracy.

Without reference, select the facts about the characteristics of winds to a minimum of 75% accuracy.

Without reference, select the facts about the definition of a jet stream to a minimum of 75% accuracy.

INTRODUCTION

There are four basic forces that affect the circulation of our atmosphere; pressure gradient force (PGF), coriolis effect, centrifugal force and frictional force. These forces, working together, cause the air to move.

The direction that the air moves is determined by the forces that are affecting it at a particular time. Also, the different names given to the movement of the air (geostrophic wind, gradient wind, etc.) depends on what forces are affecting it. Let's take a brief look at each individual force and its effect on the circulation system.

INFORMATION

WIND FORCES

Pressure Gradient Force

The first force we mention is pressure gradient force (PGF). As you recall from a previous chapter, pressure gradient is a horizontal pressure difference between two points; therefore, PGF is that resulting force that initiates or starts the air moving from higher to lower pressure. There is a direct relationship between the pressure gradient and PGF; the larger the pressure gradient, the stronger the resulting PGF, which will produce a wind speed of greater velocity.

Coriolis Effect

The next force is not an actual force, but rather it is an apparent deflective force caused by the actual rotation of the earth and is called the coriolis effect. In the northern hemisphere, the results of the coriolis effect are that any moving air will be deflected to the right of its path of motion. This deflection to the right is directly proportional to the speed of the wind; the faster the wind speed, the greater the deflection to the right, and conversely, the slower the wind speed, the less the deflection to the right will be. Finally, this apparent deflective force is stronger at the polar regions than at the equator.

Centrifugal Force

The third force is centrifugal force which is due to inertia. Inertia is defined as the tendency for a body at rest to remain at rest, and the tendency for a body in motion to remain in motion. Centrifugal force will pull an object outwards from the center of a turn, similar to what happens when you are driving your car and make a right turn being pulled to the left (outward from the center of the turn). This force is directly proportional to the wind speed; the faster the wind, the stronger the outward force.

Frictional Force

The last of the four basic forces is frictional force. This force is a result of moving air being in contact with the surface of the earth, which results in a decrease of the wind speed. The greatest effect is felt at the surface and will decrease as you increase in altitude (inversely proportional), until you reach a level at which frictional force has little, if any, effect on the speed of the wind. That level is called the gradient level.

Summarizing, the four basic forces and their effects were: PGF, which starts the air moving from higher to lower pressure, Coriolis effect, which deflects air to the right of its path of motion in the northern hemisphere, Centrifugal force, which pulls air outwards from the center of a turn, and Frictional force, which causes a decrease in the wind speed below the gradient level.

WIND TYPES

Geostrophic Wind

Geostrophic wind is a steady, horizontal motion of air along <u>straight</u>, parallel contours on a constant pressure chart. This occurs at a level above the gradient level, therefore, the only forces acting on a geostrophic wind are pressure gradient force (PGF) and coriolis effect. Let us consider, then, a parcel of air from the time it begins to move until it develops into a geostrophic wind (Figure 5-1).

As soon as a parcel of air starts to move due to the pressure gradient force, the coriolis force begins to deflect it away from the direction of the PGF. The parcel will continue to be deflected to the right (in the northern hemisphere) of its direction of motion, causing the direction of the parcel to be changed, until the PGF and coriolis are in balance. When the two forces are equal and opposite, the wind will flow parallel to the straight contours.

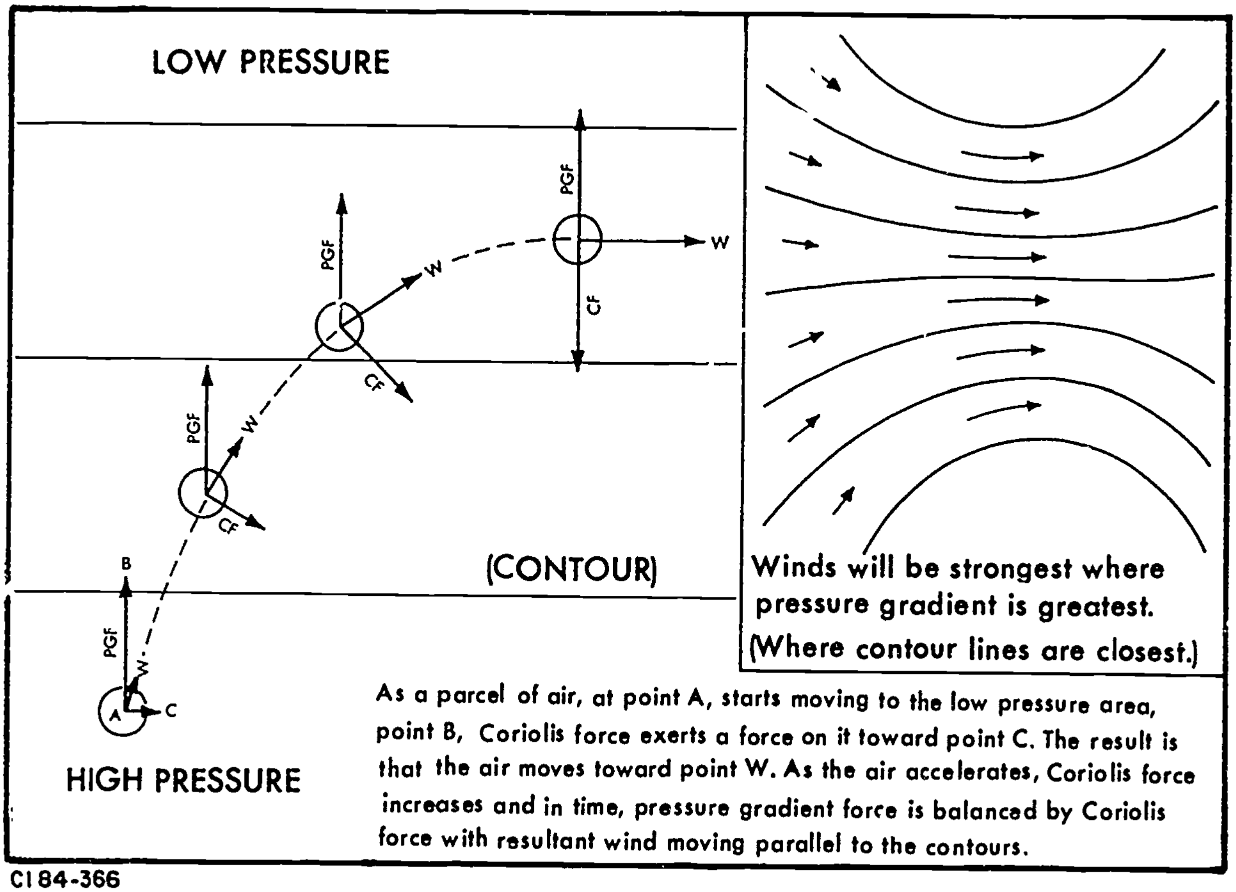


Figure 5-1. Geostrophic and Gradient Wind

Gradient Wind

Gradient wind is a wind that flows parallel to <u>curved</u> contours, as depicted in the inset of figure 5-1. In this case an additional force, centrifugal, is acting on the wind. Friction is still absent from the gradient wind because it is also above the gradient or friction level. As the three forces; PGF, coriolis and centrifugal, become in balance, the result is a slower wind that will continue to flow parallel to the contours, but in a curved path.

Surface Wind

A surface wind is located below the gradient level and flows across the isobars toward lower pressure. The surface wind is usually slower than the geostrophic wind. This reduction in wind speed is caused by friction.

Since the coriolis force varies with the speed of the wind, a reduction in the wind speed by friction means a reduction in the coriolis force. This results in a momentary disruption of the balance and when the new balance of forces; PGF, coriolis, centrifugal, and now, friction, is reached, the air flows at an angle across the isobars from high pressure to low pressure. The angle varies from 10 degrees over the ocean (smooth terrain) to as much as 45 degrees over rugged terrain.

WIND CHARACTERISTICS

Direction and Speed

DIRECTION. The direction from which the wind is blowing is the wind direction. A "north wind" is one that is coming from the north. In aviation weather observations, the wind direction is reported in degrees. Therefore, a "north wind" would be reported as a 360 degree wind.

SPEED. Wind speed is defined as the rate of movement of the air past a given point. Using this definition, a calm wind is a condition when there is no apparent motion of the air. Therefore, when the wind is calm, it will be without direction or speed.

A simple report of direction and speed does not always completely describe the observed wind condition. It is necessary to use terms such as "gusts", "squalls", "variable wind direction", and "wind shift" to give an accurate description of what is actually occurring.

Gusts

Gustiness causes an aircraft to react in ways that complicate the takeoff and landing procedures. These complications are similar, but far more serious, to the problems experienced when driving an automobile in these conditions. A gust is defined as a rapid fluctuation in wind speed within a short period of time.

Squall

A squall is distinguished from a gust by a sudden, and very large, increase in the wind speed that has a duration on the order of minutes. The squall will decrease in speed just as suddenly as it increased. Usually after the squall has ended, the wind speed will return to approximately what it was before the increase. Squalls will most often be associated with a thunderstorm that passes over or near the airfield.

Variable Wind Direction

A condition in which the wind direction is rapidly fluctuating is classified as a variable wind direction. This usually occurs when the air is very turbulent and is often accompanied by gusts. There are many weather conditions that can cause the wind direction to become variable. Therefore, it is not uncommon. A less frequent occurrence is a wind shift, which should not be confused with the variable wind direction.

Wind Shift

When the wind changes direction by 45 degrees or more and continues from the new direction without returning to the original, the condition would be called a wind shift. Wind shifts are usually associated with a frontal passage.

A typical synoptic situation that would produce a shift in the wind direction is the passage of a cold front. The wind direction preceeding the front is usually from the south and after the front has passed the airfield, the new wind direction will be from the northwest. All frontal passages will cause some shifting of the wind direction, but none is more pronounced than a cold frontal wind shift.

JET STREAM

A jet stream is a band of strong winds of 50 knots or more that is located in the upper troposphere. The "jet" usually meanders vertically and horizontally around the hemisphere in wavelike patterns. At times it is a continuous band, but more often it is broken up into several discontinuous segments, or it is split at several points.

One jet stream rarely occurs alone in the atmosphere. Multiple "jets", each having several segments are more the general rule. By definition, each segment must cover 300 miles or more in length and have a minimum speed of 50 knots. These segments often appear as "fingers" extending off of the main jet stream.

The position of the "main" jet stream has been found to very often correspond with the surface position of the Polar Front. Therefore, it is sometimes referred to as the Polar Jet. It should be noted that there is usually more than one jet stream existing in the atmosphere at any time. These can be located at different latitudes and elevations around the earth, including the southern hemisphere. The general characteristics that have been mentioned here are based on what is known of jet streams in the northern hemisphere.

REVIEW EXERCISE 5

INSTRUCTIONS. From memory, complete the statements in column A with a word or phrase from column B. The words and phrases in column B may be used once, more than once, or not at all. Check your answers against the text.

COLUMN A		COLUMN B
1.	_____ is due to inertia.	a. Centrifugal force
2.	_____ must be 50 knots or more.	b. Coriolis effect
3.	_____ is caused by the rotation of the earth.	c. Geostrophic Wind
4.	_____ flows along straight, parallel contours.	d. Jet Stream
5.	_____ are usually associated with thunderstorms.	e. Pressure Gradient Force (PGF)
6.	_____ must have a duration on the order of minutes.	f. Squalls
7.	_____ is caused by all four wind forces acting together.	g. Surface Wind
8.	_____ is usually associated with a frontal passage.	h. Wind Direction
9.	_____ results from pressure gradient force and coriolis effect.	i. Wind Gusts
10.	_____ deflects moving objects to the right in the Northern Hemisphere.	j. Wind Shift
11.	_____ initiates the movement of air from higher to lower pressure.	k. Wind Speed
12.	_____ are a rapid fluctuation in wind speed within a short period of time.	

CHAPTER 6

ATMOSPHERIC CIRCULATION

OBJECTIVES

Without reference, select facts about the general circulation of the atmosphere to a minimum of 75% accuracy.

Without reference, select facts about local circulations to a minimum of 75% accuracy.

Without reference, select the terms related to pressure systems to a minimum of 75% accuracy.

Without reference, select the characteristics of pressure systems to a minimum of 75% accuracy.

INTRODUCTION

The term "circulation" may be considered as simply the movement of air relative to the earth's surface. Since the atmosphere is fixed to the earth by gravity and rotates with the earth, there would be no circulation were it not for forces which upset the atmosphere's equilibrium.

The sun heats the earth's surface unevenly. The most direct rays of the sun strike the earth in the vicinity of the equator, thus heating equatorial regions much more than the polar regions. In addition, equatorial regions reradiate less heat to space than is received from the sun while the reverse is true at the poles. Yet, the equatorial regions do not continue to get hotter and hotter, nor the polar regions colder and colder. The reason for this is that heat is transported from one latitude to another by the actual circulation of the atmosphere.

INFORMATION

GENERAL CIRCULATION

Thermal Circulation

Before explaining thermal circulation, which is the stepping stone for the actual circulation, we must make two assumptions, both hypothetical. The first assumption is that the earth does <u>not</u> rotate and the other is that the earth's surface is <u>uniform</u>. Now, with those two assumptions, let us look at thermal circulation and why it would occur.

At the equator there will always be a perpetual oven that will constantly be heating the air and producing rising currents. These rising currents of warm air will produce less atmospheric weight on the equator and result in lower pressure. The warm, rising air at the equator will then begin to move towards the polar regions until they are cooled to the point where they sink back towards the earth's surface at the north pole creating more weight and higher pressure. This cold polar air then moves along the earth's surface back towards the equator where it will be warmed and the process starts all over again (Figure 6-1).

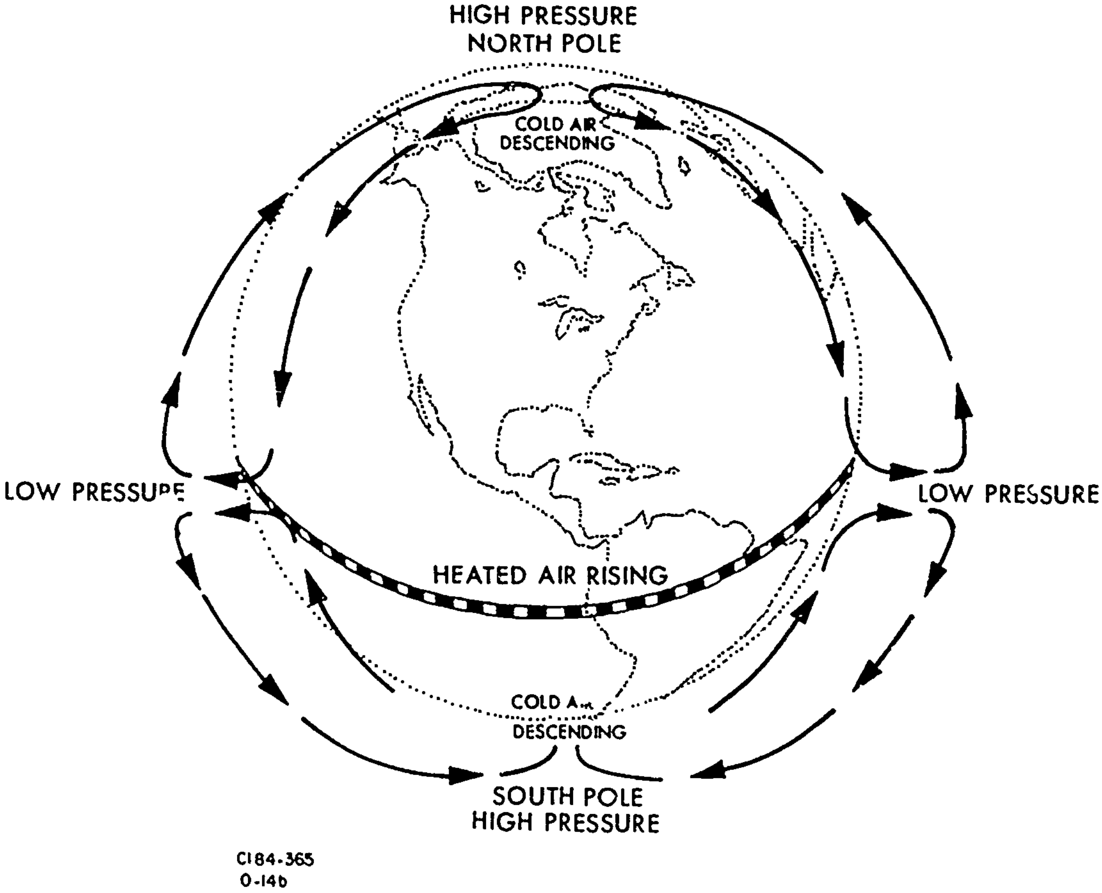


Figure 6-1. Thermal Circulation

Three Cell Theory

Actually the earth's circulation system is not this way because the earth really does rotate and the surface is not uniform (mountains, valleys, continents, oceans, deserts, etc.), so the thermal circulation theory is not correct, but it is a starting point. The three cell theory is the result of a breakdown of the thermal circulation, caused by the actual rotation and unequal surface heating of the earth. The three cell theory results in three major wind cells and four major pressure belts being formed.

WIND CELLS. First, we will still have warm rising air at the equator and cold sinking air at the polar regions, but that is where the similarity to the thermal circulation theory ends. As the warm rising air at the equator begins the journey north to the polar regions, it begins to cool, and by the time it reaches 30 degrees North Latitude, it is cool enough to sink back to the earth's surface. This cool air hits the surface and spreads out; the air that moves back southward towards the equator will begin to warm, and by the time it reaches the equator, it will rise and complete the first cell. Now, the air that is moving southward on the surface between 30 degrees North Latitude and the equator, will be deflected to the right of its path by coriolis effect, thus becoming the northeast tradewinds which is the first of the three wind cells.

The remainder of that cool sinking air at 30 degrees North Latitude moves northward along the earth's surface until it reaches 60 degrees North Latitude where it will run head-on into the air that will be moving southward from the polar regions. This head-on collision of air will cause a rising current due to the convergence. This northward moving body of air at the surface between 30 degrees and 60 degrees North Latitude will be deflected to the right of its path, again due to coriolis, thus creating the prevailing westerlies, the second of the three wind cells.

Finally, the rising air at 60 degrees North Latitude will flow towards the north pole in the upper troposphere until it is cooled down and sinks back to the earth at the pole. This cold sinking air will then spread out over the polar region and begin to move south towards the equator, but by the time it reaches 60 degrees North Latitude, it has warmed up enough to begin rising and complete the pattern of circulation. It is the southward moving air along the surface that will be deflected by coriolis to the right of its path thus creating the third and final wind cell, called the polar easterlies, located between 60 degrees North Latitude and the north pole (Figure 6-2).

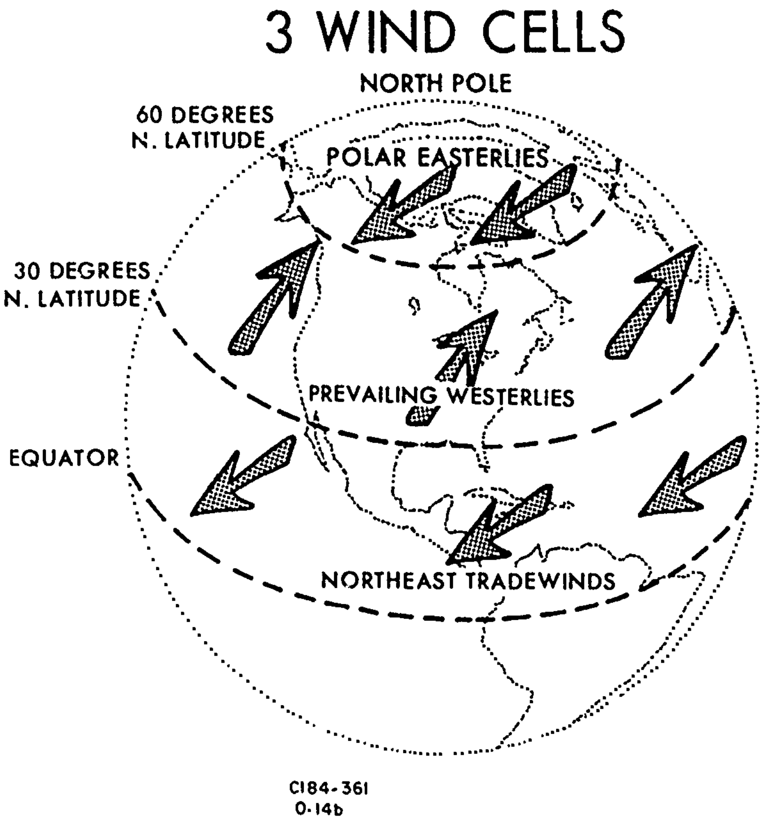
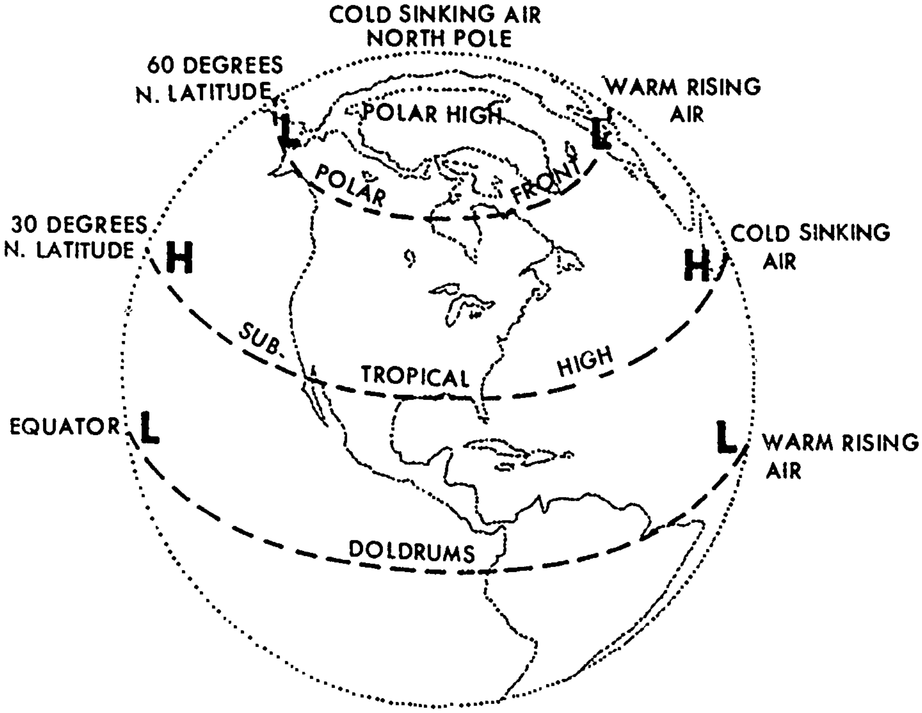


Figure 6-2.

PRESSURE BELTS. These warm, rising air currents (low pressure) and cold, sinking air currents (high pressure) result in the four major pressure belts which complete the earth's circulation system. These pressure belts and their "average" positions are as follows: (1) Doldrums - an area of low pressure caused by the warm, rising air currents at the equator, (2) Subtropical High - an area of high pressure caused by the cool, sinking air located at 30 degrees North Latitude, (3) Polar Front - an area of low pressure caused by convergence and warm, rising currents of air located at 60 degrees North Latitude, and (4) Polar High - an area of high pressure caused by cold, sinking air located at the north pole (Figure 6-3).

4 MAJOR PRESSURE BELTS



CI 84-362
0-14b Figure 6-3.

LOCAL CIRCULATIONS

Our discussion of the local circulations will cover the tertiary or "local winds" that are caused by localized unequal heating. The term "local", as used here, applies to areas that are usually less than the size of the average state. There are five types of local winds that we will discuss in this section; land breeze, sea breeze, valley breeze, mountain breeze and the chinook wind.

Land/Sea Breeze

The land/sea breeze are most common along ocean coastal areas and shores of large lakes. The unequal heating between the land and water will cause a pressure difference that, in turn, becomes responsible for the direction of the wind. Since the land heats and cools faster than water, let's look at the land in terms of temperature to see how each breeze (land or sea) starts and is best developed.

LAND BREEZE. The land breeze will flow from the land to the sea during the nighttime. Since the land will cool faster than the water at night, there is a pocket of cool, sinking air over the land and warm, rising air over the water. You have already learned that the pressure system associated with warm, rising air is a "low", and "high" pressure is found in cool, sinking air. Since pressure gradient force (PGF) causes air to flow from higher to lower pressure, the land breeze is formed. This breeze is best developed when the temperature difference is the greatest between the land and sea; this occurs at night during the winter (Figure 6-4).

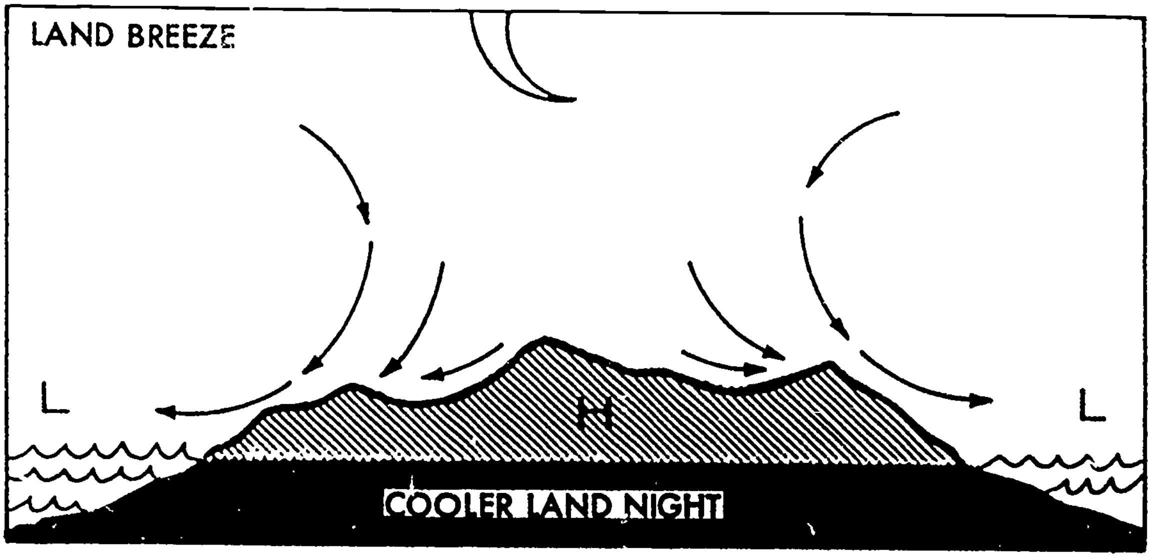


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Figure 6-4.

SEA BREEZE. The sea breeze flows from the sea to the land during the daytime. During the day, the land will be warmer, creating rising currents of air, while the sea is cooler, resulting in sinking currents of air. This causes pressure differences between the sea and land; high pressure is over the sea and low pressure is over the land. Again, PGF causes the flow to be from high to low pressure (from the sea to the land). Conditions for the sea breeze are best developed during the mid-afternoon in summer (Figure 6-5).

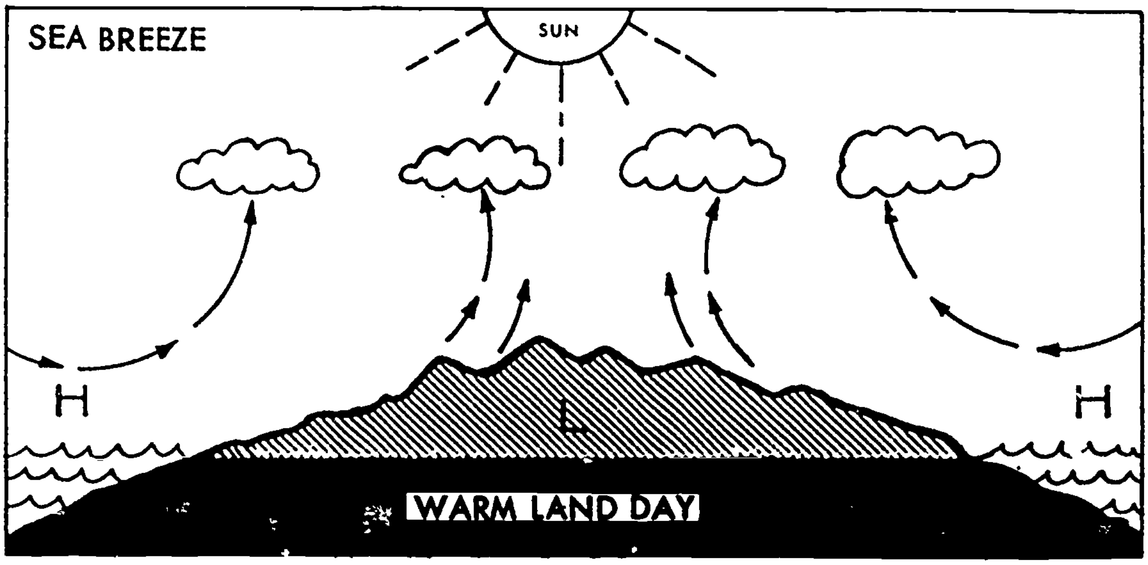

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Figure 6-5.

Valley/Mountain Breeze

The valley/mountain breezes have the same causes for their existence as the land and sea breezes; temperature and pressure differences. The valley breeze (Figure 6-6) will flow from the valley up the mountain slopes during the daytime as a result of the mountain slopes receiving the sun's rays earlier in the morning, causing the slopes to be warmer. This will cause rising currents of air on the mountain slopes thus creating a low pressure area while the temperatures in the valley will remain cooler thus creating an area of high pressure due to the sinking air currents. The winds will flow from the high to the low because of PGF, creating the valley breeze. The valley breeze is best developed during the summertime when the temperature difference between the valley and the mountain slopes are the greatest. The mountain breeze (Figure 6-7) is just the opposite; the high pressure is located on the mountain slopes and the low pressure is in the valley because the mountain slopes will be colder and snowcapped creating the sinking air currents while the valley will be warmer with rising currents of air. The mountain breeze is best developed during the winter nights.

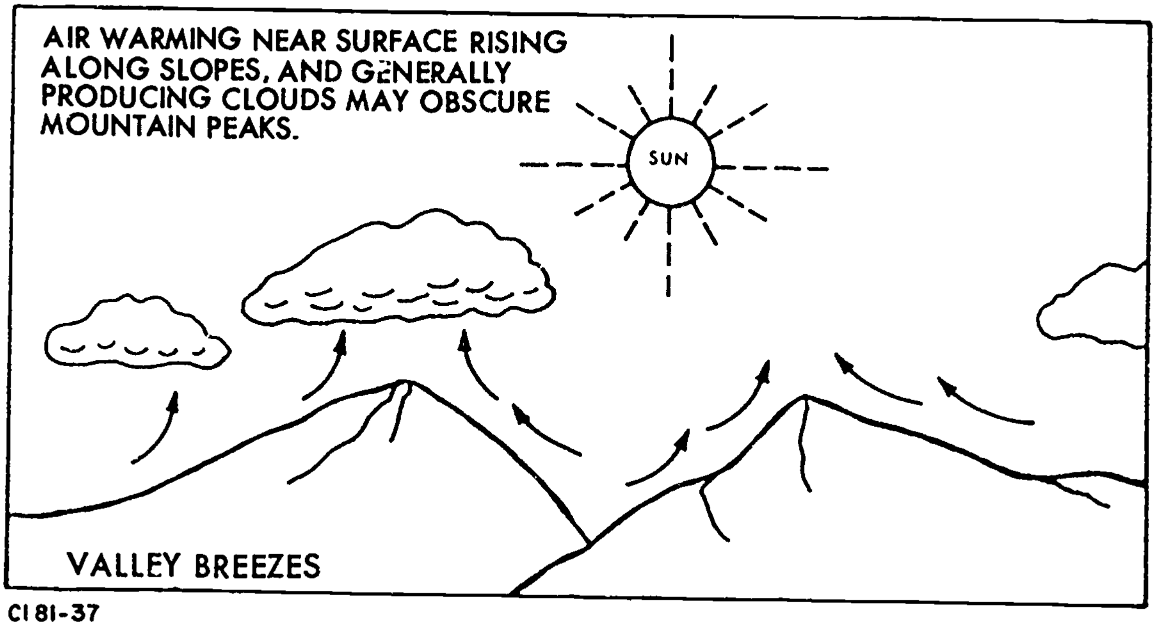

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Figure 6-6.

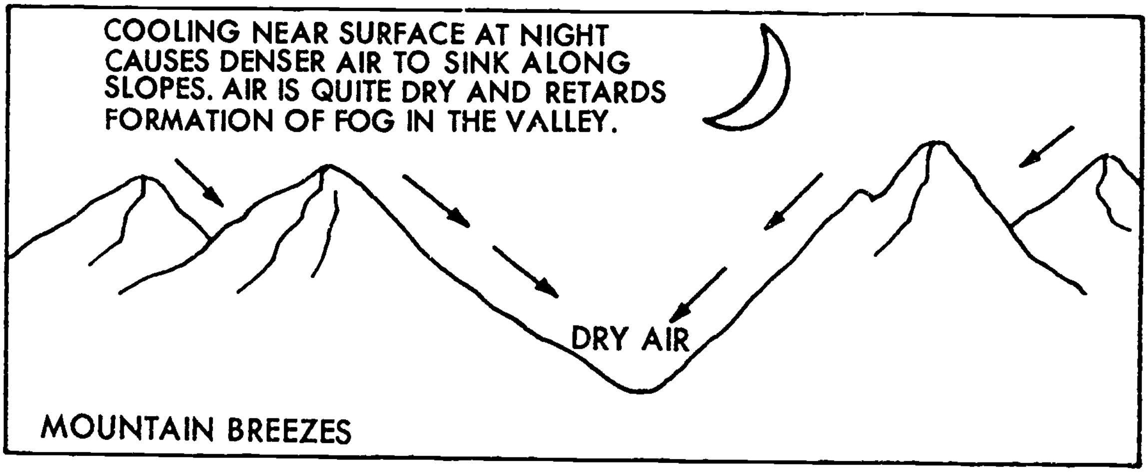

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Figure 6-7.

Chinook Wind

The final type of local wind is called the chinook wind (Figure 6-8). This wind is located on the leeside or eastern slopes of the Rocky Mountains and is a warm, dry wind that blows down the mountain, caused by adiabatic heating due to compression.

Summarizing, the properties of circulation all have one thing in common: they all rely on some type of unequal heating which causes pressure differences that result in a particular direction of wind circulation.

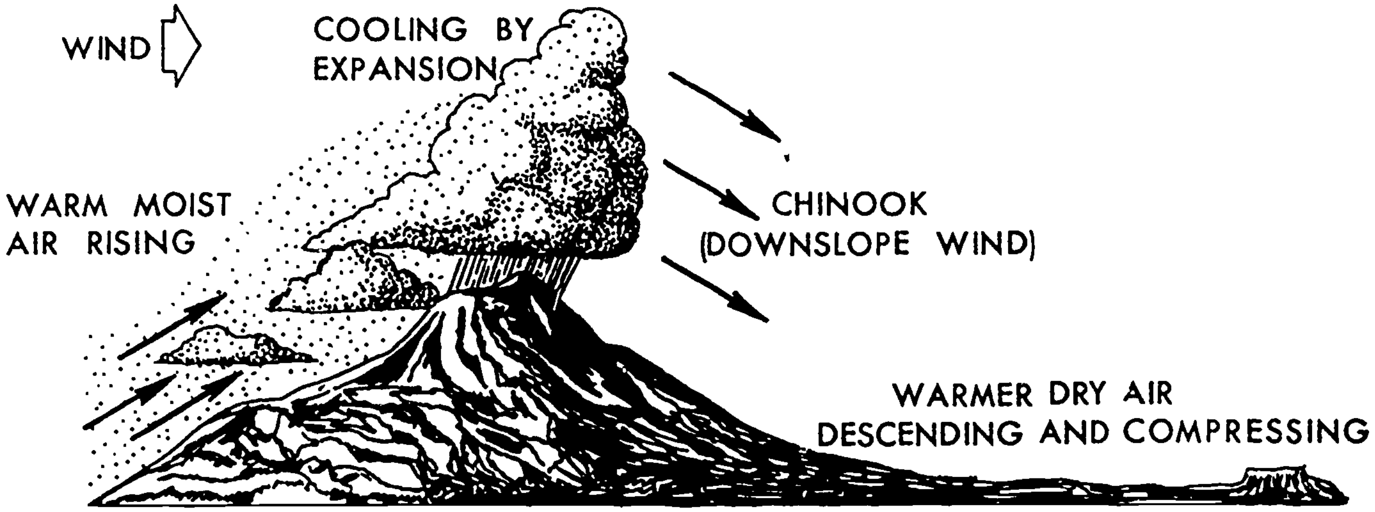

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Figure 6-8. Chinook Wind

TERMS RELATED TO PRESSURE SYSTEMS

Semi-permanent Pressure Systems

The semi-permanent pressure systems are low (cyclones) and high (anticyclones) pressure areas that remain in "approximately" the same location all year round. However, they do shift their positions with a change in the seasons; northward in summer and southward in winter. Examples of these systems are the Bermuda and Pacific Highs (anticyclones), which are the dominant systems affecting the United States in summer, when they are at their farthest north position; and the Icelandic and Aleutian Lows (cyclones), which move south and become the dominant systems during the winter.

Migratory Pressure Systems

The "highs" and "lows" that move from place to place are also known as anticyclones and cyclones, respectively. These systems can sometimes be observed to migrate across continents and oceans. Most localized weather conditions are associated with these migratory pressure systems. (The surface weather chart in figure 4-1 illustrates migratory pressure systems.)

CHARACTERISTICS OF PRESSURE SYSTEMS

Cyclones

The cyclones are areas of low pressure that have counterclockwise circulation. The wind flow is spiraling inward toward the center of the system. Frontal systems and generally bad weather are associated with these low pressure areas.

Anticyclones

The anticyclones are just the opposite of the cyclone. The wind flow in these systems is clockwise with the circulation being outward from the center. These high pressure areas usually result in relatively good weather conditions.

REVIEW EXERCISE 6

INSTRUCTIONS. From memory, answer the following questions. Check your answers against the text.

1. What would the earth's circulation be like if the earth was uniform and did not rotate?

2. What causes the three cell theory of circulation to occur?

3. What is the name of the wind cell located between the Doldrums and the Subtropical High?

4. Where are the prevailing westerlies located?

5. Where is the polar front located?

6. What major pressure belt is located at the north pole?

7. In what direction does the air move at the equator and why?

8. What causes the local winds to occur?

9. At what time of day is the sea breeze strongest?

10. Explain how the valley breeze occurs.

11. Explain how a chinook wind occurs.

12. What are the dominant semi-permanent pressure systems affecting the United States during the winter?

13. What are the characteristics of a cyclone?

14. What are the characteristics of an anticyclone?

CHAPTER 7

ATMOSPHERIC MOISTURE

OBJECTIVES

Without reference, select the fundamental concepts of moisture to a minimum of 75% accuracy.

Without reference, select facts about moisture as it pertains to clouds to a minimum of 75% accuracy.

Without reference, select facts about the formation processes of clouds to a minimum of 75% accuracy.

Without reference, select facts about the dissipation processes of clouds to a minimum of 75% accuracy.

Without reference, select facts about precipitation from clouds to a minimum of 75% accuracy.

INTRODUCTION

Moisture is the most important single element in the production of clouds and other visible weather phenomena. More than two-thirds of the earth's surface is covered with water. Water from this extensive source is continually evaporating into the atmosphere, cooling by various processes, condensing, and then falling to the earth again as precipitation. This never-ending process is referred to as the hydrologic cycle. This cycle keeps the atmosphere supplied with moisture.

In this chapter, you will learn how weather phenomena forms as a result of the changes of state of this abundance of moisture.

INFORMATION

FUNDAMENTAL CONCEPTS OF MOISTURE

States of Moisture

Moisture can be found in the atmosphere in three states: solid, liquid or gas. Most of the moisture is concentrated in the lower troposphere, and only rarely is it found in significant amounts above the tropopause. It is introduced into the atmosphere as a gas, from sources such as oceans, lakes, rivers, swamps, etc., and can travel great distances before it is eventually removed as liquid or solid precipitation.

Changes of State

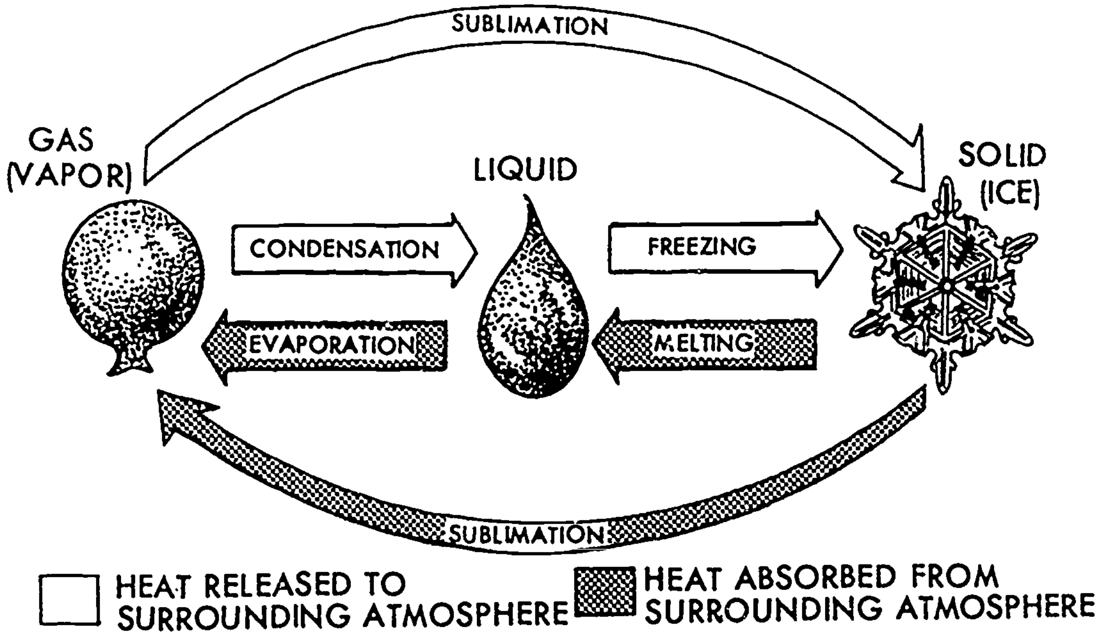
When moisture changes state (as depicted in figure 7-1) it affects the heat balance of the moisture. Any change of state involves a heat transaction: releasing heat into the atmosphere or taking heat away. The heat that is exchanged is not lost, but remains hidden or latent in, either the water vapor or the atmosphere, and can cause a cooling or warming effect upon the atmosphere.

There are five processes by which moisture can change state. In the change of water to a gas, molecules escape from the surface of the liquid and enter the air as water vapor. This process is known as evaporation. The heat required for the evaporation process is taken from the atmosphere and remains latent in the water vapor. When the vapor changes back to liquid water, this heat reappears.

Heat is also required to melt ice or snow into liquid water. Upon freezing, the same heat is released into the atmosphere. Thus evaporation and melting both cool the air, or at least retard temperature increases that may be produced by other processes occurring simultaneously. Conversely, condensation (change of water vapor to liquid) and freezing raise the temperature of the air, or at least retard its rate of temperature decrease.

It is possible for ice to change directly to water vapor without apparently passing through the liquid state. Many of us have, at times, observed the disappearance of snow on the ground with no melting. This process, called sublimation, is somewhat like evaporation, but more heat energy is required for the escape of molecules from solid **surfaces** than from liquid surfaces. The heat required to sublimate a given amount of ice is the sum of the heat required to melt it and that required to evaporate the liquid water (even though no melting or evaporation takes place). Solid forms of precipitation, in addition to snow and ice surfaces, supply water vapor through the sublimation process. The amount of water vapor added to the atmosphere by the sublimation process is small compared to that added through evaporation.

Ice can form directly from water vapor. This process, which is the reverse of that described in the preceding paragraph, is also called sublimation, and is exemplified by the formation of frost on a cold, clear night.



C184-364
0-14b Figure 7-1. Changes of State Processes

Moisture Content

There is a limit to the amount of water vapor that air, at a given temperature, can hold. When the atmosphere is holding all the water vapor possible, at a constant temperature and pressure, it is said to be saturated. The higher the air temperature, the more water vapor the air can hold before saturation is reached and condensation occurs. For approximately every 20 degrees Fahrenheit increase in temperature, the capacity of a volume of air to hold water vapor is about doubled.

Unsaturated air, containing a given amount of water vapor, will become saturated if its temperature decreases sufficiently. Since saturated air is lighter than unsaturated air, it will try to rise. As it rises, the air will cool adiabatically, causing further condensation to occur.

In addition to cooling the air, saturation will also be reached if moisture is added to the air. If the air continues to cool or if moisture is added, after saturation is reached, some of the water vapor will be forced to condense as fog, clouds or precipitation.

Relative Humidity

Relative humidity is the ratio of the amount of water vapor actually in the air to the maximum amount it could hold at saturation, expressed as a percentage. When the air is saturated, the relative humidity is 100 percent. A relative humidity of 50 percent indicates that the air contains half of the water vapor which it is capable of holding at its temperature.

Dew Point

The temperature to which the air must be cooled, at a constant pressure, for saturation to occur is called the dew point. When this temperature is below freezing, it is sometimes called the frost point. The difference between the actual air temperature and the dew point temperature is an indication of how close the air is to saturation. The temperature difference is commonly called the spread, or dew point depression. Relative humidity increases as the temperature spread decreases and is 100 percent when the spread is 0 degrees.

Results of Going Beyond Saturation

The most frequent cause of saturation is cooling of the air and often results when: (1) air moves over a colder surface, (2) air is lifted (cooled by expansion), or when (3) air near the ground is cooled at night as a result of radiational cooling. If this cooling continues after the air is saturated, condensation will occur. The results of the air being forced beyond saturation is the formation of dew, frost, fog or clouds.

The most common forms of condensation are clouds and fog. They form when very minute water particles condense on microscopic water-absorbent particles of solid matter in the air (such as salt from evaporating sea spray, dust, and products of combustion). The abundance of these particles on which the droplets form, called condensation nuclei, permits condensation to occur generally as soon as the air becomes saturated. The basic difference between clouds and fog is that clouds form in the atmosphere above the surface of the earth and fog is at the surface.

Due to radiational cooling at night, dew will form on surfaces that have temperatures below the dew point temperature. This is caused by the condenstaion of saturated air that is in contact with those surfaces. If the temperature of the surface is below freezing, frost will form. Frost is the result of sublimation; as the moisture changes state from a gas to a solid, without going through the liquid state.

MOISTURE PERTAINING TO CLOUDS

At any given time the atmosphere contains some amount of moisture. The effect that the moisture has on the weather is dependent on its state. If it remained in its original state, water vapor, it would never cause any weather to form. However, when it changes from a gas (water vapor) to either a liquid or frozen state, some form of "weather" will occur. This change of state is brought about by cooling the moisture.

A cloud is a visible accumulation of minute water droplets and/or ice particles suspended in the atmosphere above the earth's surface. It is the result of moisture being cooled until condensation occurs. The type of cloud that forms is determined by the state of the moisture: liquid or frozen.

Clouds that form with their bases between, near the surface and 23,000 feet (low and middle ranges), will usually be composed of liquid water droplets, while high level cloud layers are composed of ice particles. The temperature of the atmosphere will vary with changes in altitude and also with latitudinal changes, therefore clouds composed of ice particles may be found at lower heights during the winter and near the poles. When classifying clouds it is necessary that you have some knowledge of the atmospheric temperature distribution.

After the atmosphere becomes saturated and clouds have formed, any addition of moisture, or any further cooling, will usually result in precipitation.

CLOUD FORMATION

Conditions Necessary for Cloud Formation

There must be an aboundance of moisture (water vapor) in the air for a cloud to form. At temperatures between 0 degrees Celsius and -15 degrees Celsius, clouds are composed primarily of supercooled water droplets, but usually contain some ice crystals. When the temperature is lower than -15 degrees Celsius, the clouds usually consist entirely of ice crystals. However, at times supercooled droplets exist at temperatures as low as -60 degrees Celsius.

The average size of cloud particles is only about one-thousandth of an inch in diameter, but they become visible by being clustered closely together. However, for precipitation to be produced the droplets must grow enormously. (The average raindrop contains about a million times the water of that in a cloud droplet.)

Condensation nuclei, composed of microscopic water-absorbent particles of solid matter in the air (such as salt, soot and dust), compose the centers of cloud particles. The abundance of these particles on which the droplets form, permits condensation to occur generally as soon as the air becomes saturated.

Condensation is most often caused by cooling of the air, another ingredient necessary for cloud formation. Cooling usually results from one of the following methods: (1) air moves over a colder surface, (2) air near the ground is cooled at night due to radiation, or when (3) air is lifted (adiabatic cooling).

Cloud Forms

CUMULIFORM. Clouds formed as a result of localized vertical currents carrying moist air upward to the condensation level are called cumuliform. Cumuliform means "accumulation" or "heap", and clouds in this classification have a lumpy or billowy appearance. Cumuliform clouds are associated with unstable airmasses and generally have some degree of turbulence within them because of the vertical air currents.

STRATIFORM. The second of the cloud forms, stratiform, meaning "spread out", generally appears in a horizontal layer or sheet. Stratiform clouds are associated with stable airmasses, and since there is little or no vertical motion within them, they will also bear little, if any, turbulence.

CIRRIFORM. Last of the three cloud forms, cirriform, almost always consists of ice particles, rather than supercooled water droplets because it is always found at higher altitudes. Cirriform clouds are fibrous, wispy or feathery in appearance.

Methods of Classification

FORM. There are three methods of classification. Form, which was just discussed, is one of the three methods. We must determine which form, or combination of forms, a cloud takes, in helping to classify it.

APPEARANCE. Another method of classification is appearance. This method includes several items, such as dimension, shape, structure, texture, luminance and color. We can further pursue these differences. For example, does a cumuliform cloud have little, moderate, or strong vertical development? Is the cloud puffy or flattened? Does it have special characteristics such as standing lenticular or tops in the shape of domes or towers? Is it mostly transparent or mostly dense and opaque? Is the sun hidden by the cloud or can it be dimly seen through the cloud? Is the cloud or base of the cloud light or dark in color? All of these questions relate to the clouds' appearance.

HEIGHT. The third classification method is height. That is, how high is the base of the cloud above the surface? Cloud height is broken down into three ranges. The clouds are placed in their respective ranges by the height at which the base of the cloud formed. The low range extends from near the surface to 6,500 feet. The middle range starts at 6,500 feet and extends up to 23,000 feet. High range cloud bases begin at 16,500 feet and extend up to 45,000 feet. The reason for the overlap between middle and high range clouds is due to seasonal temperature changes in the mid-latitudes.

Basic Cloud Types

In discussing the basic cloud types we are actually combining the form, height and appearance already mentioned. We will once again classify them in terms of low clouds, middle clouds and high clouds, with reference to the mid-latitudes. Illustrations of the 10 basic cloud types can be seen in Figure 7-2.

LOW CLOUDS. Low clouds include stratus, stratocumulus, cumulus and cumulonimbus, with bases ranging from near the surface to 6,500 feet.

Stratus (ST). Stratus is a low, uniform sheet-like cloud. It is often associated with fog, and the combination can become a problem for flying operations. Stratus is most often formed by the lifting of stable air over sloping terrain or by radiation from the top of a haze layer.

Stratocumulus (SC). Stratocumulus clouds are usually formed in rolls, and appear soft and gray with darker shading. They often result from a layer of stable air being lifted and mixed by the wind blowing over rough terrain. Terrestrial radiation may cool a layer of air at the ground, but mixing of that layer at lower levels by the wind prevents saturation at the ground, and the stratocumulus will form at the top of the mixing layer. This cloud can also form from the breaking up of a stratus layer, or from the spreading out of cumulus clouds.

Cumulus (CU). Cumulus are dense, dome-shaped and often isolated clouds characterized by relatively flat bases with dark shading and round protuberances from the dome-shaped area. If in full sunlight, they are usually brilliant white, but may be dark blue or gray if in the deep shadows of other clouds. They are generally known as fair weather cumulus. However, they can also include towering cumulus (TCU) and have turbulence and icing present as they reach the stage of strong vertical development prior to thunderstorm development.

Cumulonimbus (CB). Cumulonimbus are cumulus clouds of great vertical development which may either have cauliflower-like tops or be crowned with veils of dense cirrus called an anvil. This cloud has violent up and down drafts and is known as the thunderstorm cloud. Another variety is the cumulonimbus mammatus (CBMAM), which is most often associated with severe weather, including hail and tornadoes, and is characterized by bulbous protuberances or pouches extending from the underside of the cumulonimbus, either from the base or from a higher outward extension of the cloud. Although the cumulonimbus cloud originates as a low cloud, it usually extends upward into the middle and high ranges and is associated with showery precipitation.

MIDDLE CLOUDS. Middle clouds, which have bases ranging from 6,500 feet to 23,000 feet include altostratus, nimbostratus and altocumulus. They are often characterized by a corona (a colored circle or arcs of a circle). The corona can be distinguished from a halo by its much smaller diameter and its coloring. The color sequence is from blue inside to red outside (the reverse of that in a halo) and its colors are much brighter. The corona results from light passing through liquid water droplets, while the halo is characteristic of ice crystals.

Altostratus (AS). Altostratus is a gray or bluish veil or layer of clouds having a fibrous appearance. Through it, the outline of the sun or moon shows dimly, as through frosted glass. Altostratus is formed by lifting stable air either by convergence or over another surface.

Nimbostratus (NS). Nimbostratus is a dark, gray, shapeless, thick cloud layer accompanied by continuous rain or snow, or having a "wet" appearance. Fragments of stratus (stratus fractus) that drift under the rain clouds are sometimes called scud. Scud is formed in the saturated air below the nimbostratus as a result of the falling precipitation. Condensation subsequently occurs as a result of the cooling received from the cool precipitation falling through the air. Nimbostratus forms in the middle cloud range and builds downward into the low range.

Altocumulus (AC). Altocumulus is white or gray-colored patches or layers of clouds with the cloud elements having a rounded or roll-like appearance. Altocumulus often develops from the spreading out of cumulus or cumulonimbus, which have built up into the middle range. Some important varieties of altocumulus are altocumulus castellanus (ACCAS) and altocumulus standing lenticular (ACSL). The ACCAS forms when an unstable layer becomes saturated near its base, either from lifting or from radiation from the top of a moist, unsaturated layer. ACSL (or rotor clouds) are associated with mountainous terrain or hills, or they may form as the result of disturbed air flow over the top of strong vertical currents. The atmosphere sets up waves by winds blowing over these large surface obstructions. Condensation in the ascending portion of the wave forms the cloud. In the wave's descending portion, the cloud evaporates, due to adiabatic heating. Thus the cloud appears not to move, although the wind blows through it. They are characterized by their smooth, polished edges.

HIGH CLOUDS. High clouds consist of cirrus, cirrostratus and cirrocumulus and their bases range from 16,500 feet to 45,000 feet.

Cirrus (CI). Cirrus clouds are thin, wispy and featherlike in appearance and are composed entirely of ice crystals. They are generally formed by lifting or convergence. If these clouds are arranged in bands or connected with cirrostratus or altostratus or otherwise systematically arranged, they may be a sign of approaching bad weather. They can also be the tops of cumulonimbus clouds, sometimes remaining attached to the main cloud and other times being blown away from it, leaving only the ice crystal portion.

Cirrostratus (CS). Cirrostratus is a thin, whitish cloud layer appearing like a sheet or veil and may appear diffuse or sometimes partly striated or fibrous. Halo phenomena, a large luminous circle or arcs of a circle with the sun or moon at the center, frequently accompany this cloud. The halo generally appears to be white, but sometimes a closer inspection will reveal a prismatic coloration with the red nearest the center. The halo has a fixed angular diameter of 22 degrees, a characteristic of light which has been refracted through ice crystals. Cirrostratus clouds occur only in stable layers and may also be a sign of approaching bad weather.

Cirrocumulus (CC). Cirrocumulus are thin clouds; the individual elements of which appear as small white flakes or patches of cotton, usually showing brilliant and glittering quality suggesting the presence of ice crystals. Cirrocumulus may result from the lifting of a shallow unstable layer, but more often it is developed from a layer of cirrostratus. Radiational heat loss occurs from the top of the cirrus layer and the cooler air on top sinks into the cloud, setting up shallow convective currents within the layer.

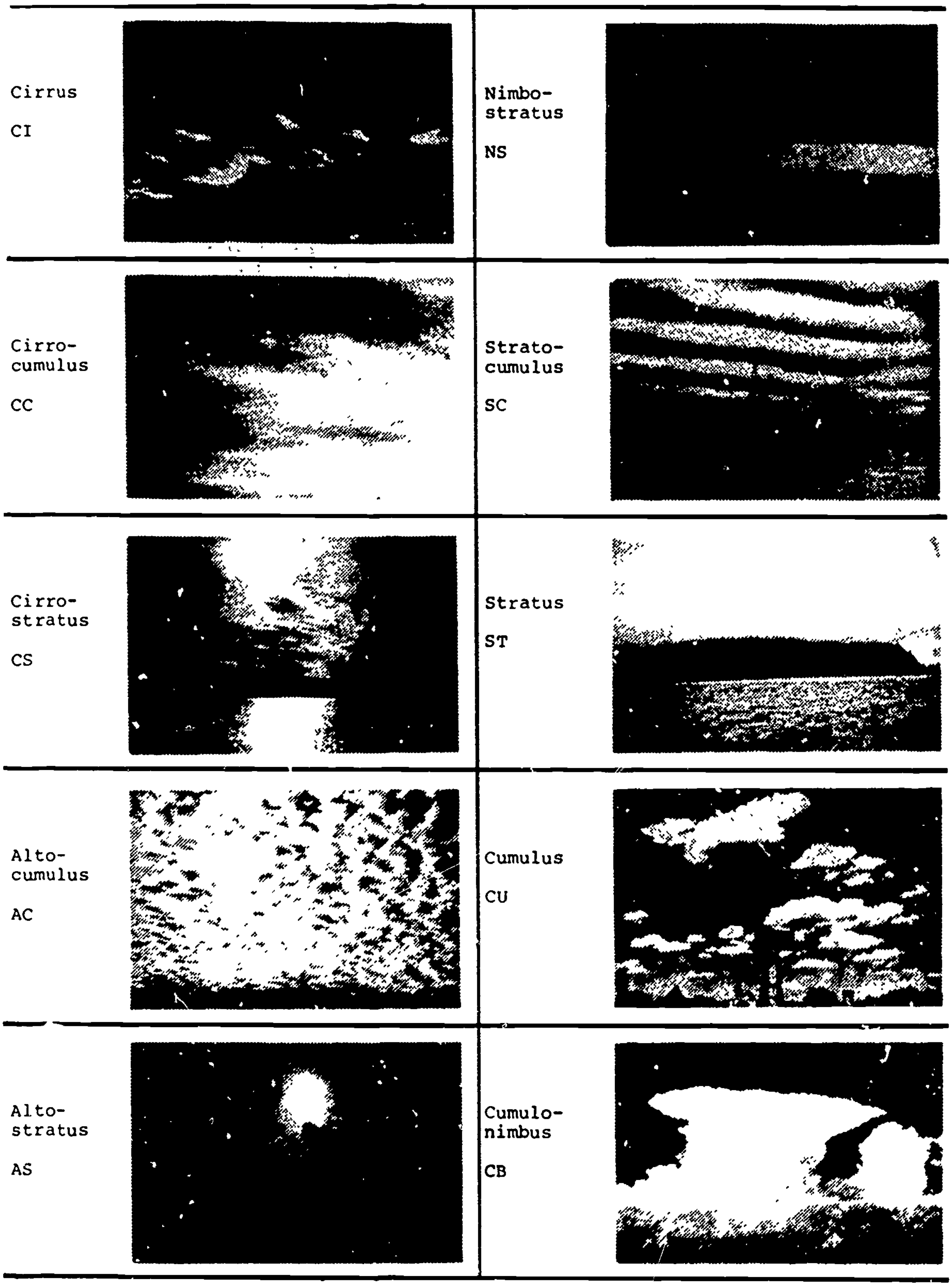


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Figure 7-2. Basic Cloud Types

CLOUD DISSIPATION PROCESSES

Decrease the Moisture

Since one of the requirements for clouds to exist is moisture, then, if the moisture is reduced the cloud will dissipate. There are various ways by which the moisture can be lost. However, the most common are precipitation and drying (or scattering) by the wind.

As precipitation continues to fall from a cloud system, the moisture is taken away with the precipitation. If the moisture is not replaced, from some source, the cloud will eventually "rain itself out". Also, if clouds are continuously blown about by the wind, the effect will be a reduction in the amount of moisture. The clouds will break apart and become scattered. As they are scattered, more and more of the moisture is absorbed into the atmosphere until the cloud is finally dissipated.

Warm the Air

Warm air can hold more moisture than cold air. When air is saturated and clouds have formed, any warming of the air will increase its ability to hold moisture. In effect, the warming will cause the air to become drier. This drying will cause any clouds that have formed to dissipate.

There are two primary ways that the air can be warmed; by the adiabatic processes or by advection of warmer air into an area. You have already learned that when air is forced to sink (descend) it will be compressed and warmed. In addition, if clouds are being formed by the active process of rising and cooling (adiabatic cooling) of the air and that process is stopped, the clouds will also stop forming.

Advection has already been defined as the transfer of heat by the horizontal movement of air. This same process can result in the dissipation of clouds. Remember, any warming of the air, without an increase in the amount of moisture, will result in a lower relative humidity. In order for the clouds to form, the relative humidity had to be 100 percent. As the relative humidity decreases, through warm air advection, the clouds will dissipate. The reduction in the amount of cloud cover will be proportional to the decrease in the relative humidity.

PRECIPITATION FROM CLOUDS

Type

The specific type of precipitation (liquid, frozen or freezing) will depend entirely upon the temperature structure of the atmosphere. Temperatures above freezing will produce liquid precipitation such as rain or drizzle, while temperatures below freezing will cause frozen precipitation to occur (i.e., snow, ice pellets, snow grains, etc.). However, if the temperature just above the surface is above freezing, while the surface temperature is below freezing (an inversion), the result will be rain or drizzle that is falling through the air in a liquid state, but is freezing upon contact with the surface (freezing precipitation).

Intensity

The intensity gives an indication of the amount of precipitation falling at a particular time. It is expressed as light, moderate or heavy.

Character

The character of precipitation is a classification based primarily on the cloud form (stratiform or cumuliform) with which it is associated. The character is indicative of whether or not the precipitation is falling at a fairly steady rate.

CONTINUOUS. The intensity changes gradually, if at all. Any precipitation falling from stratiform clouds will be continuous.

INTERMITTENT. The intensity changes gradually, if at all, but the precipitation must have stopped and restarted at least once within the hour preceding the observation. Intermittent precipitation will also be associated with stratiform clouds.

SHOWERY. Precipitation changes intensity or starts and stops abruptly. Showers fall exclusively from cumuliform clouds.

REVIEW EXERCISE 7

INSTRUCTIONS. From memory, answer the following questions. Check your answers against the text.

1. What are the three states in which moisture can be found in the atmosphere?

2. When moisture changes state from liquid to frozen, what is the process called?

3. What affect does the process of condensation have on the temperature of the air?

4. Define saturation.

5. Name two ways in which the air may become saturated.

6. Which would be lighter, air with a relative humidity of 90% or air with a relative humidity of 50%? Why?

7. What is the difference between clouds and fog?

8. What are the three conditions necessary for cloud formation?

9. Name the three methods of classifying clouds.

10. If the atmosphere is cooled, without changing the moisture content, what will happen to the relative humidity?

11. What are the heights of the following cloud range?

Low range:

Middle range:

High range:

12. Name the basic cloud types in each range.

Low range:

Middle range:

High range:

13. Name the two conditions that will cause clouds to dissipate.

14. What cloud form produces showery precipitation?

CHAPTER 8

AIR MASSES AND FOG

OBJECTIVES

Without reference, select facts about air mass source regions to a minimum of 75% accuracy.

Without reference, select facts about air mass types to a minimum of 75% accuracy.

Without reference, select facts about the characteristics of air masses to a minimum of 75% accuracy.

Without reference, select facts about the modification of air masses to a minimum of 75% accuracy.

Without reference, select the facts about fog to a minimum of 75% accuracy.

INTRODUCTION

An air mass is a large body of air which has approximately the same temperature and moisture properties in a horizontal plane. It usually covers an area of 1,000 miles or more across and the temperature and moisture content will be fairly constant throughout the air mass. Horizontal changes of these properties are usually very gradual.

In addition to our discussion about air masses, this chapter will also cover some of the different types of fog that you will be reporting as part of your job as an aviation weather observer.

INFORMATION

AIR MASS SOURCE REGIONS

The region where an air mass acquires its identifying properties of temperature and moisture is called its source region. The ideal source region has a uniform surface (all land or all water), a uniform temperature, and is an area in which air stagnates to form high pressure systems. In general, the best source regions are large snow or ice-covered polar regions, tropical oceans, and large desert areas. Mid-latitudes are poor source regions. Air has little opportunity to stagnate in the mid-latitudes since weather and pressure patterns are on the move.

Source regions for air masses affecting North America are: the plains of northern Canada, the polar ice cap, the broad ocean areas of the North Atlantic and North Pacific, the Atlantic and Pacific near 30 degrees North Latitude, the Gulf of Mexico, and the arid regions of the southwestern United States and northern Mexico.

AIR MASS TYPES

The identifying features of an air mass are its temperature and moisture properties. These are also the factors that determine the air mass type. So, just by knowing the type of an air mass you will have an indication of its temperature and moisture content. You will remember that an air mass acquires these identifying features while it is in its source region. In this section, we will present a general description of the air masses affecting the weather of the continental United States.

Continental Polar (cP)

Air stagnating over northern continental regions forms continental polar air masses. They are cold and dry.

Continental Tropical (cT)

Arid continental regions give rise to continental tropical air masses, which are hot and dry.

Maritime Polar (mP)

Maritime polar air masses form over northern oceanic areas. They are generally not as cold as continental polar air masses (especially in winter) and have a higher moisture content.

Maritime Tropical (mT)

Maritime tropical air masses form over warm oceanic areas nearer the equator. They are very humid and generally produce more precipitation than the other air masses.

CHARACTERISTICS OF AIR MASSES

The amount of clouds and precipitation that is produced by any air mass, will, of course, be determined by the moisture that is available. For example, continental tropical air masses, due to their warm temperatures and the absence of water vapor, produce few showers and the showers that do develop have comparatively high bases and yield small rainfall amounts. The ability of the air to hold moisture (warm vs.

cold air) is the primary factor in determining air mass characteristics.

Cold Air Mass

When the air is colder than the surface that it is moving over, it is considered to be a cold air mass. The characteristics of a cold air mass are: (1) unstable conditions (gusty surface winds), (2) cumuliform clouds, (3) showery precipitation, and (4) generally good visibility.

Warm Air Mass

A warm air mass is warmer than the surface it is moving over and its characteristics are: (1) stable conditions (light or steady winds), (2) stratiform clouds, (3) continuous precipitation, and (4) generally poor visibility.

AIR MASS MODIFICATION

Just as an air mass tends to take on the temperature and moisture properties of its source regions, it also tends to have these same properties changed when it moves out of its source region. The degree of modification of an air mass is dependent on: (1) the speed with which it travels, (2) the nature of the region it is moving over, and (3) the temperature difference between the new surface and the air mass.

There are numerous ways in which various atmospheric processes modify an air mass. Cold air masses are heated from below, warm air masses are cooled from below; moisture is lost as they move across mountain ranges, moisture is added as they pass across large water bodies. The modification of the temperature properties may change the type of precipitation; snow changing to rain or rain changing to snow. Keep in mind that more than one of the processes is usually in progress at the same time. Figure 8-1 shows air masses that have moved out of their source regions and become modified.

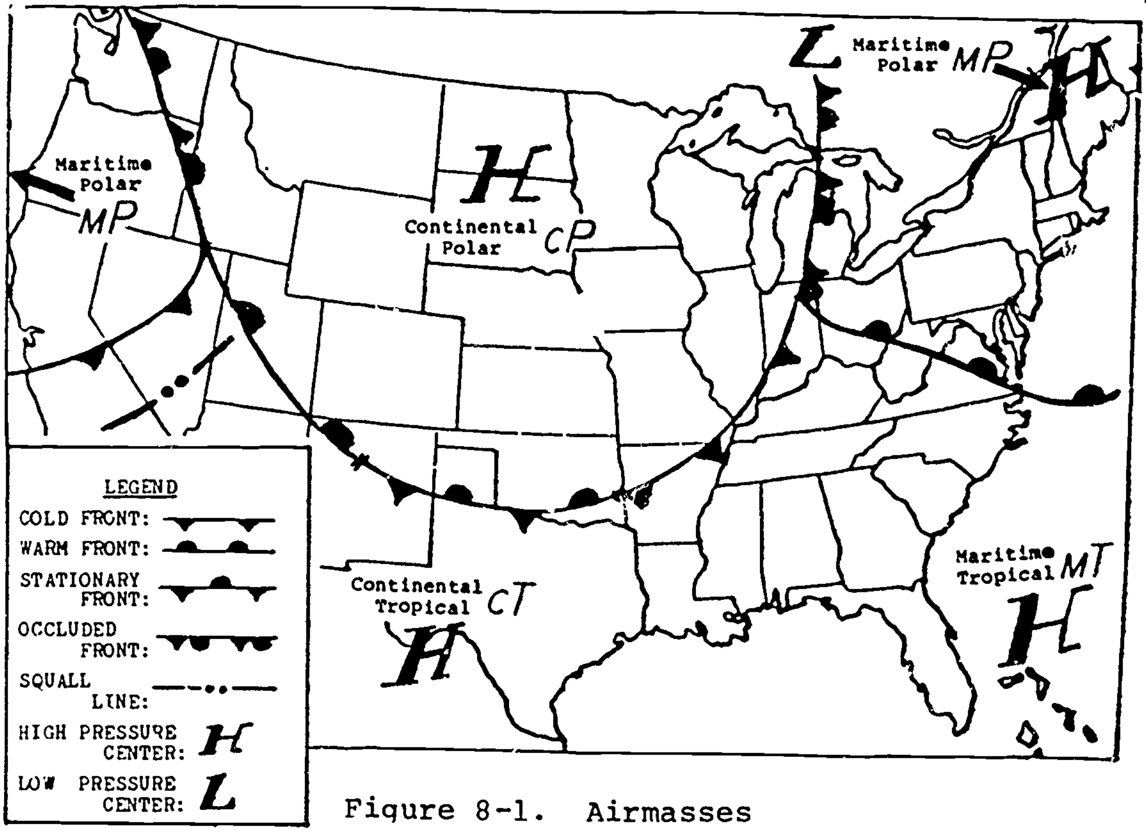

Figure 8-1. Airmasses

FOG

Fog is defined as minute water droplets suspended in the atmosphere, at the surface, in amounts great enough to restrict visibility. Most fog occurs "within" the air mass as opposed to being associated with a frontal system. That is not to say that fog does not accompany frontal systems, it is just more frequent away from the front. The following types of fog, with the exception of precipitation induced fog, occur most often well-away from any frontal activity.

Conditions Necessary for Fog Formation

Ideal atmospheric conditions for the formation of fog are (1) high water vapor content (high relative humidity), (2) an abundance of condensation nuclei, (3) light surface wind and (4) some cooling process to start condensation. Therefore, fog is more prevalent in coastal areas where moisture is abundant. Fog also occurs frequently in the colder months.

Radiation Fog

Radiation fog forms as a result of radiational cooling of the ground on clear, calm nights and therefore it is widely known as ground fog. With this type, the ground cools the air in contact with it to the dew point temperature. Since water areas do not have much daily temperature variation, radiation fog is restricted to land areas. It forms almost exclusively at night or in the early morning hours and usually disappears within a few hours after sunrise. Light wind (usually less than 5 knots) produces a slight mixing of the air, which tends to deepen the fog by spreading the cooling through a deeper layer. Radiation fog usually is very shallow where there is no wind flow.

Advection Fog

Advection fog forms when warmer, moist air moves over colder ground or water and is very common along coastal areas. When it occurs over the open sea, it is often called sea fog. It can also form as a radiation fog which is then advected by the prevailing wind over surrounding areas. Advection fog deepens as the wind speed increases, up to about 15 knots. Much stronger winds lift the fog into a layer of low stratus.

The west coast of the United States is rather vulnerable to advection fog and stratus, where the fog forms offshore, largely as a result of very cold water rising from the ocean depths to the water surface. The resulting cold air is carried inland by the wind as fog or stratus. Along the Gulf coast and the southeastern United States, advection fog is a frequent winter time occurrence, resulting from the moist tropical air moving over colder ground.

Upslope Fog

Upslope fog forms as a result of moist, stable air being cooled by forced ascension up a sloping land surface. An upslope wind is necessary, not only for its formation, but also for its continued existence. This type is common over the eastern slopes of the Rockies, including the High Plains, and somewhat less frequently east of the Appalachians.

Steam Fog

The movement of cold air over much warmer water causes intense evaporation, which usually adds enough water vapor to the cold air to saturate it, forming steam fog. Steam fog rises from the water surface like smoke, and is sometimes referred to as sea smoke. Since steam fog, unlike advection fog, forms over a warm surface, heating from below tends to make the air unstable. Therefore, turbulence and icing are often encountered in steam fog.

Although steam fog occurs frequently in the winter over open bodies of water in polar regions, it is sometimes observed over rivers and lakes in the middle latitudes in autumn when the water surfaces cool much more slowly than land and are still relatively quite warm, compared to an invading cold air mass.

Ice Fog

Ice fog is a man-made Arctic phenomena which forms in moist, calm air at temperatures generally below -20 degrees Fahrenheit (-29 degrees Celsius) and is composed of irregular ice particles formed by the condensation and freezing of water vapor from any source (such as aircraft, automobiles, laundries, etc.). The density of ice fog builds up over a period of time and is generally limited to the immediate vicinity of the water vapor source. As such, the visibility decrease is dependent on the level of moisture producing activity. The duration of ice fog depends upon the duration of the cold temperature in the area, which can be from minutes to weeks. The minimum visibility at almost any temperature can range from several miles to less than 1/16th of a mile.

Precipitation Induced Fog

Precipitation induced fog is caused by the addition of moisture to the air through evaporation of rain or drizzle. Evaporation can occur both when the precipitation is falling through the air and after it reaches the ground. This type is most common with fronts, but it can occur with nonfrontal precipitation as well, in which case, it will not last long before it dissipates. When associated with a front, precipitation induced fog usually forms rapidly, covering a large area, especially when it accompanies warm frontal precipitation.

REVIEW EXERCISE 8

INSTRUCTIONS. For questions 1 through 8, answer from memory. Check your answers against the text.

1. What is an air mass?

2. What type of pressure system forms in air mass source regions?

3. What type of air mass would be formed in central Canada?

4. What are the characteristics of a cold air mass?

5. What would be the characteristics of an air mass that formed in the Gulf of Mexico?

6. What are the conditions necessary for fog formation?

7. Define Fog.

8. How does temperature modify air masses?

INSTRUCTIONS (Questions 9 through 13). From memory, match the cause of fog formation (Column A) with the type of fog that is formed (Column B). The types of fog may be used once or not at all.

COLUMN A

9. _____ caused by radiational cooling.

10. _____ caused by moist air being forced up a mountain.

11. _____ caused by moist air moving over a cooler surface.

12. _____ caused by the condensation and freezing of moisture with temperatures below -20 degrees F.

13. _____ caused by the addition of moisture to the air through the evaporation of rain or drizzle.

COLUMN B

a. Advection Fog

b. Ice Fog

c. Precipitation Induced Fog

d. Radiation Fog

e. Steam Fog

f. Upslope Fog

CHAPTER 9

FRONTS

OBJECTIVES

Without reference, select facts about the definition of a front to a minimum of 75% accuracy.

Without reference, select facts about the types of fronts to a minimum of 75% accuracy.

Without reference, select the characteristics of fronts to a minimum of 75% accuracy.

Without reference, select the facts about frontal passage indices to a minimum of 75% accuracy.

INTRODUCTION

Fronts cause most of the weather that occurs in the world. Since fronts play such an important part in the production of local weather conditions, they will also determine, to a great extent, what your day to day routine as a weather observer will be. The study of frontal systems and their characteristics can be interesting as well as informative.

INFORMATION

DEFINITION OF A FRONT

A front is a transition zone between air masses of different properties. The identifying features that make one air mass different from another are their temperature and moisture content. Air masses, because of their location, will have different amounts of moisture. An air mass that has formed close to a major water body, such as an ocean, will have a greater moisture content than one that has formed over a continental region. The same is true of the temperature properties. Northern regions, such as Canada and Alaska, produce cold air masses while the Gulf of Mexico and the southwestern United States form air masses that are warm. This contrast in the temperature and moisture content will cause a mixing or transition zone to form between the two air masses. This transition zone, or the front, is also a trough of low pressure.

The center of each air mass is a high pressure area.

Therefore, there must be an area of lower pressure separating the two. This area of separation is located at the edge of each air mass, or in the frontal zone. The front will form in this trough of lower pressure.

TYPES OF FRONTS

There are four basic types of fronts (as indicated in Figure 8-1): cold, warm, stationary and occluded. Each front is significantly different from the others by its definition.

Cold Front

A cold front will be shown as a line on a surface weather chart with triangles to indicate the direction toward which the front is moving. When colored, the line will be blue. The front will have cold air replacing warm air at the surface.

Generally speaking, cold fronts move faster than all other types of frontal systems. The speed of the front is usually indicative of the degree of severity of the associated weather. Fast moving frontal systems usually produce weather that is more violent than that produced by slower systems.

Warm Front

On the surface weather chart, a warm front is depicted as a line with half-circles indicating the direction of movement. A warm front is colored as a solid red line. The front will have warmer air replacing colder air at the surface and will usually move slower than a cold front.

Stationary Front

A stationary front is formed when neither of the air masses that it separates is moving or being replaced by the other. Each air mass will have clearly identifiable differences in their temperature and moisture properties; thus, they must be separated by a front. However, neither air mass is dominant or strong enough to cause the other to move. As a result, the front will have little or no movement (less than 5 knots) and may persist in the area for several days.

The stationary front is depicted on a surface weather chart as a line with triangles and half-circles alternating on opposite sides. If colored, alternating red and blue will be used.

Occluded Front

The final type of frontal system in our discussion is the occluded front. This front is caused when a cold front actually overtakes a slower moving warm front. The occlusion occurs where the two fronts have come together, and is depicted as a line with triangles and half-circles on the same side, indicating the direction of movement. An occlusion, when colored, is purple.

CHARACTERISTICS OF FRONTS

A front is characterized by the weather it produces. The cold front has very pronounced, and somewhat unique, characteristics, while the warm and stationary fronts cause weather conditions that are very similar. When a cold and warm front come together to form an occlusion, the results will be characteristic of both the cold and warm fronts.

Cold Front

The characteristics of a cold front are: (1) cumuliform clouds, (2) gusty surface winds, (3) generally good visibility, (4) a drop in temperature (after passage), (5) a narrow weather band, and (6) showery precipitation. A fast moving cold front may produce thunderstorms and hail along with the showery precipitation.

Another characteristic, but not one that is associated with all cold fronts, is the squall line or instability line. This line is found ahead of (approximately 50-300 miles) and usually parallel to some fast moving cold fronts. A squall line is often characterized by a wall of cumulonimbus clouds and very turbulent weather; possibly thunderstorms and tornadoes. A squall line is shown on a surface weather chart as an elongated dash, two dots, elongated dash, two dots, etc. (as depicted in Figure 8-1).

Warm Front and Stationary Front

The general weather conditions characteristic of the warm and stationary fronts are: (1) stratiform clouds, (2) generally poor visibility, (3) a wide, non-violent weather band, (4) continuous precipitation, and (5) gradually rising temperatures (after passage).

With the stationary front, due to its non-movement, these rather poor, but non-violent, conditions may persist in your area for days.

Occluded Front

Since occlusions are the result of one frontal system overtaking a slower moving system, they combine the weather of both a warm and cold front into one large system. Showers and thunderstorms, that are typical of a cold front, merge with the stratiform clouds of the warm front. Precipitation, both showery and continuous, is widespread over a large area on either side of the surface position of the occlusion. In addition, strong winds may accompany the showers and thunderstorms as they move through the system.

You should remember that weather conditions change rapidly in occluded fronts, giving more reason for you to remain alert and provide a continuous weather watch.

FRONTAL PASSAGE INDICES

Has the front gone through yet? This is a question that you will have to answer many times during your career as a weather observer. In order to answer the question, you should understand how things change, during and just after, the passage of a front. Differences in the properties of adjacent air masses, such as temperature, wind, and pressure, cause observable changes to occur as the front passes your station. You should realize that each of the indices mentioned will not always give an absolute indication that the front has passed. However, enough of these indicators will occur to enable you to give an accurate answer.

Wind

Near the earth's surface the discontinuity of wind across a front is primarily a matter of change in direction. Wind speed often is very much the same on both sides of a front. In many cases, however, when a cold front passes, the wind speed increases abruptly since, in general, wind speeds are greater in the cold air mass.

Temperature

Temperature is one of the most easily recognized discontinuities across a front. At the surface the passage of a front usually causes a noticable temperature change. The passage of a cold front will usually be accompanied by a decrease in the temperature, while the temperature will show a gradual increase behind a warm front.

Pressure

Since a front lies in a pressure trough, the pressure is higher on both sides of the front. Thus, when a front is approaching a station, the pressure is usually decreasing. Pressure normally rises abruptly after frontal passage.

REVIEW EXERCISE 9

INSTRUCTIONS. From memory, answer the following questions. Check your answers against the text.

1. What is the definition of a front?

2. Name the four types of fronts.

3. What type of front would be associated with cold air replacing warm air?

4. What is the result of a cold front overtaking a warm front?

5. What are the characteristics of a cold front?

6. What are the characteristics of a warm front?

7. What will happen to the pressure pattern as a front passes your station?

8. Name three frontal passage indices.

CHAPTER 10

SEVERE WEATHER

OBJECTIVES

Without reference, select the definitions of severe weather to a minimum of 75% accuracy.

Without reference, select the facts about severe winds to a minimum of 75% accuracy.

Without reference, select the facts about severe precipitation to a minimum of 75% accuracy.

INTRODUCTION

When we think of severe weather, we usually think of tornadoes or thunderstorms. However, if we consider the safety of individuals and property, we must realize that freezing rain, strong winds, and heavy snow can also result in severe weather conditions. Each year many people die as a direct result of severe weather, usually connected with tornadoes or severe thunderstorms. Although more deaths are directly attributable to lightning than any other single element, major winter storms are the indirect cause of most property damage and deaths each year. Snow packed or icy roads often result in accidents, many heart attacks occur while individuals are shoveling snow, and the icing of aircraft wings can lead to aviation accidents. Military, as well as personal, property is damaged each year by hail and strong surface winds. The criteria for determining when the weather occurrence should be classified as "severe" will depend on many things, such as types of aircraft, building construction, military mission, etc.. These criteria will be established by each individual station.

INFORMATION

DEFINITIONS OF SEVERE WEATHER

The occurrence of any of the following criteria is generally considered to constitute severe weather: (1) thunderstorms with wind gusts of 50 knots or more and/or hail that is three-fourths of an inch in diameter or larger, (2) tornadic activity, (3) wind speed of 50 knots or greater, (4) 2 inches or more of rain during a 12 hour period, (5) snow accumulating 2 inches or more during a 12 hour period, or (6) any type of freezing precipitation.

Thunderstorms and tornadic activity will be discussed in chapter 11.

SEVERE WINDS

Each station has its own standard for classifying strong winds as severe weather. A station that supports helicopters could not withstand wind speeds that a station supporting cargo aircraft could. However, we usually consider wind speeds of 50 knots or more as severe. Strong winds can cause damage to building structures and unhangared or light aircraft. Strong winds are most often associated with convective storms, cold fronts, and strong pressure gradients.

SEVERE PRECIPITATION

Heavy Rain

The criteria for classifying rain as severe weather is also based on local requirements and mission. Usually an accumulation of 2 inches or more in 12 hours is considered severe. Heavy rain can cause local flooding and hinders aircraft braking action on runways. Heavy rain is associated with convective storms, tropical cyclones, and strong frontal systems.

Heavy Snow

Heavy snow can bring entire base operations to a complete standstill. It can affect airfield operations and prevent the successful completion of the mission. Geographical location determines the criteria for its severity in most cases. For example, Alabama could not operate with the normal snow fall of Montana or North Dakota due to the lack of snow removal equipment. However, usually an accumulation of 2 inches in a 12 hour period is considered severe. Also, blowing snow (snow being picked up by gusty surface winds) can extremely limit visibility and cause large drifts. Deep low pressure systems and strong frontal systems are usually the cause of heavy snow.

Freezing Precipitation

Entire airfields and communities can become crippled during periods of freezing precipitation. This condition occurs when precipitation (rain or drizzle) falls through the air in a liquid state and freezes upon contact with the surface. The surface temperature must be below freezing for this to occur. Freezing precipitation is extremely hazardous to aircraft operations. It destroys lift capabilities of the aircraft and causes slippery runways. In some cases, runways are completely closed when freezing rain or drizzle occurs. As well, freezing precipitation is hazardous to public travel because of slick roads and sidewalks. This form of precipitation is most often associated with warm frontal systems.

REVIEW EXERCISE 10

INSTRUCTIONS. From memory, answer the following questions. Check your answers against the text.

1. Name six criteria that is usually classified as severe weather.

2. What type of weather systems are severe winds most often associated with?

3. What type weather systems is heavy rain usually associated with?

4. Which of the following weather criteria would not be classified as severe weather?

   _____ A thunderstorm with calm winds and hail 1 inch in diameter.

   _____ An accumulation of 6 inches of snow in 12 hours.

   _____ Surface winds of 35 knots.

   _____ Freezing drizzle.

   _____ Ice Pellets.

CHAPTER 11

THUNDERSTORMS

OBJECTIVES

Without reference, select facts about the types of thunderstorms to a minimum of 75% accuracy.

Without reference, select facts about the formation of thunderstorms to a minimum of 75% accuracy.

Without reference, select facts about the characteristics of thunderstorms to a minimum of 75% accuracy.

INTRODUCTION

Each day thousands of thunderstorms occur around the globe. These storms range from brief showers to the type which produce wind speeds of 50 knots or greater and large, damaging hail. The common factor in all these storms is the cumulonimbus (CB) cloud in which they form. The storms are usually formed in an individual cell, five to ten miles in diameter, but can form in clusters of cells and cover an area as large as one hundred miles in diameter. As weather observers, it is important that we locate, track, and report these storms.

INFORMATION

THUNDERSTORM TYPES

There are basically two types of thunderstorms: frontal and air mass. Frontal thunderstorms are by definition, associated with fronts, but the most violent in nature are usually associated with cold fronts. As well, frontal thunderstorms are most numerous and normally form in continuous lines. Air mass thunderstorms are generally isolated or widely scattered over a large area. They form within a warm, moist air mass. The lifting action is provided by convergence, convection or orographic lift.

THUNDERSTORM FORMATION

Atmospheric Stability

Atmospheric stability is, to say the least, a very complex subject that involves many variables. It is not the purpose of this course to give you a thorough knowledge in the area of stability. That would require more time than we have available. Anyway, as a weather observer, you will only need to understand some of the basic concepts that pertain to atmospheric stability.

The factors that govern the stability of an air mass are primarily the temperature and moisture content. Stability runs the spectrum from absolutely stable to absolutely unstable, and the atmosphere usually is in a delicate balance somewhere in between. A change in temperature or the moisture content within the air mass can tip the balance. Generally, the following statements will hold true concerning air masses:

(1) Warm air is unstable; cold air is stable.
(2) Moist air is unstable; dry air is stable.
(3) Warm, moist air is very unstable.
(4) Cold, dry air is very stable.

STABLE. When the atmosphere is stable, air that is forced to rise will return to its original level when the force is removed. This means that a stable atmosphere is in "balance" and is relatively calm. When stable air begins to rise due to some force, such as terrain, it will only rise to the level where the force is removed and then stop or sink back to its original level. This results in a flat or stratified cloud form that does not produce thunderstorms.

UNSTABLE. An unstable atmosphere contains air that, when forced to rise, will continue to rise even after the force is removed. This is an "unsettled" and turbulent situation that can result in some very severe weather conditions. If the air is forced to rise, it will continue to become more and more "out of balance" with its surroundings, causing it to rise even faster. Becoming more unbalanced and turbulent, it causes large cumuliform clouds to form, and possibly thunderstorms to develop.

Conditions Necessary for Thunderstorm Formation

Before a thunderstorm can form, there are some basic requirements that must be met; (1) there must be an unstable air mass, (2) the air must have a high moisture content, and (3) some type of lifting action is required to "trigger" the air and start it to rise. If any of these three are missing, a thunderstorm will not develop.

We have already discussed moisture and stability, the first two ingredients, now let's look closer at the third. The most common "trigger" that prodcues thunderstorms on a summer afternoon in the United States, is convection. The heating of the surface by the sun warms the air at low levels and causes it to rise. If the air has enough moisture, a cumuliform cloud will form, and if the air is unstable, the upward motion will continue and build into a thunderstorm. A second lifting action, common to mountains, is called orographic lift. This happens when the surface wind pushes moist air into an area of higher terrain and the air is forced upward. The third occurs when the surface wind is from opposing directions and comes together. This is called convergence; when the air converges and, because it has no other place to go, is forced to rise. Convergence is usually associated with low pressure systems and fronts.

Stages of Development

CUMULUS STAGE The first stage of a thunderstorm is the cumulus stage. The in features of this stage is the updrafts which continu to build the cloud upward. Even though thunder may not be heard in this stage, it is still the first stage of development of a thunderstorm. The majority of cumulus clouds never develop beyond this initial stage. However, if the cloud continues to build upward, the mature stage begins.

MATURE STAGE. The beginning of precipitation at the earth's surface initiates the mature stage. As the precipitation falls, the drops drag the air with them and cause downdrafts. Now, there are both updrafts and downdrafts occurring. The mature stage is the most violent and may have hail, extreme turbulence, and gusty surface winds.

DISSIPATING STAGE. The final stage of thunderstorm development is called the dissipating stage. At this time, the precipitation generally decreases or stops. The updrafts will nearly end and the downdrafts will become most prevalent. The dissipating stage is usually the most prolonged of the three stages of a thunderstorm.

It should be understood that all thunderstorms do not produce precipitation. Therefore, some thunderstorms never reach the mature stage. Whenever you hear thunder, you must report a thunderstorm. However, by definition, the mature stage is not reached until precipitation begins at the surface. Sometimes a cumulonimbus cloud will develop to the point where thunder is heard, but precipitation never begins; technically the storm is still in the cumulus stage. It is possible that it could dissipate without ever reaching the mature stage (i.e., producing precipitation).

CHARACTERISTICS OF THUNDERSTORMS

Precipitation

By definition, thunder and lightning must accompany a thunderstorm. Precipitation, such as rain or snow, may, but does not always occur. Some thunderstorms may also have gusty surface winds. Tornadic activity and hail are also characteristic of some thunderstorms (although statistics show that only about 10 percent of all thunderstorms have hail that reaches the surface).

Tornadic Activity

Tornadic activity is defined as a violently, rotating column of air that extends from a thunderstorm cloud system. It occurs most frequently in the spring, but may occur at any time. The vortex is the funnel shaped appendage that identifies the type of tornadic activity that is occurring. It has an average size of one hundred feet to one-half mile in diameter and its speed ranges from nearly stationary to approximately 70 miles per hour. When the vortex touches a land surface, it is classified as a Tornado, when it touches a water surface, it is called a Waterspout, and if the vortex does not touch a surface at all, it is called a Funnel Cloud.

Much destruction is common with tornadic activity. Strong wind and violent updrafts are disastrous to building structures. Extreme low pressure has been known to literally "blow up" buildings. Probably the lack of warning and unpredictability are the most hazardous aspects of tornadic activity.

If you are ever faced with protecting yourself from any type of tornadic activity, keep calm and stay away from windows and doors. A basement or cellar is the best place to be. If you are outside, lie flat and cover your head. Always take warnings of possible tornadic activity seriously and protect yourself and your loved ones.

REVIEW EXERCISE 11

INSTRUCTIONS. From memory, answer the following questions. Check your answers against the text.

1. What are the two types of thunderstorms? Which is the most severe?

2. What two factors determine the stability of the air?

3. Warm, moist air is very _______________.

4. Name the three conditions necessary for thunderstorm formation.

5. What are three types of lifting action?

6. Name the three stages of thunderstorm development.

7. When is the mature stage of a thunderstorm reached?

8. Define Tornadic activity.

CHAPTER 12

TROPICAL WEATHER SYSTEMS

OBJECTIVES

Without reference, select facts about the types of tropical weather systems to a minimum of 75% accuracy.

Without reference, select the characteristics of tropical weather systems to a minimum of 75% accuracy.

INTRODUCTION

In our discussion, the tropics will include that region of the earth which lies between 23½ degrees North Latitude (Tropic of Cancer) and 23½ degrees South Latitude (Tropic of Capricorn). Due to the warmer temperatures and rising air currents, this area is predominantly a zone of low pressure. The prevailing surface wind flow is from the east.

Weather in the tropics is primarily air mass: not associated with frontal systems. Since the area has a very weak pressure gradient, there are no well-defined surface pressure systems (except in tropical cyclones) in the region. Frontal systems are almost non-existent in the tropics. Most weather occurs as a result of change within the air mass.

INFORMATION

TYPES OF TROPICAL SYSTEMS

Tropical Cyclones

Generally speaking, a tropical cyclone is simply a low pressure center (cyclonic circulation) that has developed in the tropics. Their favored area for development is between 5 and 15 degrees North and South Latitude. The ones that affect the United States originate over the warm tropical waters of the Atlantic Ocean, the Caribbean Sea, the Gulf of Mexico, the coasts of Central America and Mexico, and the eastern part of the Pacific Ocean.

Tropical cyclones usually move westward in the prevailing easterly wind flow of the tropics, until some external atmospheric influence destroys them. Those that continue their development will curve toward the northwest until they often begin to recurve and move in a northeast to east direction, following the prevailing westerly wind flow. The speed of movement of these storms vary from 10 to 12 knots while near the equator, to sometimes faster than 50 knots once they are in the prevailing westerly wind flow.

The season of North Atlantic tropical cyclones is August, September and October. They are very rare from December until May. An average of about eight tropical storms (including five hurricanes) threaten the contiguous United States each year.

Monsoon

Monsoon winds are defined as a reversal in the prevailing wind direction between winter and summer. The name "monsoon" comes from the Arabic word "mausin" meaning season and was first applied to the winds over the Arabian Sea. Monsoons occur because the surface of the earth consists of great land and water areas which have unequal heating and cooling capabilities. Because of the size of the continent, the monsoon is most pronounced over southern and southeastern Asia.

CHARACTERISTICS OF TROPICAL SYSTEMS

Tropical Cyclones

STAGES. There are four stages in the development of tropical cyclones. The classification of each particular stage is based primarily on the accompanying wind speed and flow pattern.

Tropical Disturbance. The tropical disturbance stage is identified by light surface winds and a weak cyclonic flow pattern. In this stage, the pressure pattern will still have a weak gradient with no "closed" isobars.

Tropical Depression. When the system intensifies to the extent that a definite cyclonic (counter-clockwise) circulation can be detected, it is classified as being a tropical depression. The surface winds at this time will begin to increase; however, by definition, they must still be 33 knots or less. By far, the majority of tropical cyclones never develop beyond this stage.

Tropical Storm. If the low pressure continues to deepen, the system will intensify rapidly, and is classified as a tropical storm when the accompanying winds reach speeds between 34 and 63 knots (inclusive). While in this stage, the storm will be given a name which it will retain for the remainder of its life span.

Hurricane or Typhoon. The final stage in the development of a tropical cyclone is a hurricane or typhoon. Most Americans know them as hurricanes, and this name is used when the surface wind reaches a speed of 64 knots or greater, except when the storm has formed in the western Pacific, where they are called typhoons.

EYE. Each tropical storm or hurricane has a relatively clear area in the center, 10 to 15 miles across, called the eye. The sky in the storm center often is so clear that the sun or stars become visible, and the wind is comparatively calm. Around this eye is an encircling wall of violent hurricane-force winds. When the eye passes over any location, this calm center is preceded by winds of great violence from one direction and is followed by violent winds from the opposite direction.

DAMAGE. Even though the torrential rainfall accompanying a mature tropical cyclone will flood interior land regions, while the violent winds bring much destruction, the greatest loss of life and property is usually a result of inundation of coastal areas by rises in the level of the sea. These abnormally high tides are known as storm surges and may be as much as 10 to 15 feet above normal tide. A storm surge which occurs at a time of day when the tide is normally high will cause much more flooding than it would at other times.

Hurricanes (including typhoons) are the most destructive of all storms. Although tornadoes have winds which are stronger and more violent, they cover a much smaller area than hurricanes. Some of the larger hurricanes have a diameter of up to about 1,000 miles, with destructive winds over an area as large as 500 miles in diameter. In some small, but intense hurricanes, the path of destructive winds may not be wider than 25 miles.

Monsoon

WINTER. During the winter season, because of the large Siberian High, polar air flows southward across the Himalayan mountain range toward the equator (although the mountains interfere significantly with the flow and keep the coldest air from reaching India). This air is relatively dry and is warmed adiabatically as it flows down the southern slopes of the mountains. This is the "dry" or winter (northeast) monsoon.

SUMMER. Air from an equatorial source flows up over the mountains from the south, during the summer season. The lifting of moist air in this area produces extensive cloudiness and widespread rain. The summer (southwest) monsoon is responsible for some of the heaviest rains on earth. Stations in India report more than 400 inches of rainfall in a year, with most falling between the months of June and October.

REVIEW EXERCISE 12

INSTRUCTIONS. From memory, answer the following questions. Check your answers against the text.

1. Where is the favored area for development for tropical cyclones?

2. When do most tropical cyclones occur in the North Atlantic?

3. Define Monsoon.

4. The four stages of tropical cyclone development are based primarily on what?

5. Tropical Depressions have wind speeds of how many knots?

6. When is a tropical cyclone named?

7. Hurricanes have wind speeds of ________________ knots or more.

8. Name the greatest cause of destruction with hurricanes.

9. What causes the summer monsoon?

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WORKBOOK

C3ABR25130-2-WB-300

Technical Training

Aerographer's Mate
(C-420-2010-A1)

WEATHER CODES AND MESSAGES

13 March 1984

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Weather Training Branch
Chanute AFB, Illinois

C3ABR25130-2-WB-300

WEATHER CODES AND MESSAGES

OBJECTIVES

6. Meteorological Satellites

a. Given an APT predict message and an APT plotting board, prepare meteorological satellite orbit and tracking data by constructing a sub-point track and worksheets for two satellite passes. All work is to be completed within one hour, with no more than fifteen errors.

1. Land Synoptic Code

a. Given aviation weather data and using the FMH-2, encode two (2) six hourly observations in the land synoptic code with a maximum of seven errors within 45 minutes.

4. Shipboard Observations and Ship Synoptic Code

a. Given a true wind computer (CP-264/U) and simulated ship data, compute true wind data to + or - ten degrees in direction and + or - two knots in speed.

b. Given weather data, NAVOCEANCOMINST 3144.1C and equipment, record two weather observations on CNOC 3140/8 with no more than six errors within 30 minutes.

c. Given shipboard weather data and using NAVOCEANCOMINST 3144.1C encode two six-hourly observations in the ship synoptic code with no more than seven errors within 45 minutes.

11. Pibal

d. Given a plotting board and related forms, evaluate, encode and decode wind data for a minimum of 20 minutes, with no more than twelve errors.

9. Commander Naval Oceanography Command and Air Ocean Environment

j. Given a bathythermograph sounding, encode selected temperatures and depths within 15 minutes with no more than three errors.

k. Given a bathythermograph message, plot all temperatures and depths within 15 minutes with no more than three errors.

13. Practice Lab

m. Given the appropriate programmed text and a preburst prediction message, decode the message with no more than one error.

OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 100; DAV - 1

SATELLITES

Exercise 1

```
TBUS1 KWBC Ø719ØØ
APT PREDICT
1Ø1Ø31 NOAA  6
PART I
Ø1892 Ø1Ø21 ØØ13Ø Ø2Ø59 TØ111 L253Ø
1896Ø 34618 12179
19ØØ1 Ø31Ø6 237ØØ
19Ø41 71554 3358Ø
NIGHT PART II
Ø28ØØ Ø7Ø223 Ø48ØØ 14124Ø Ø68ØØ 212256
Ø88ØØ 283274 1Ø8ØØ 353294 1281Ø 423317
1481Ø 493344 1681Ø 562379 1881Ø 63Ø426
2Ø81Ø 696499 2282Ø 757629 24821 8Ø39Ø1
26821 8Ø9353
NIGHT PART III
Ø28Ø5 Ø7Ø192 Ø4815 141176 Ø6815 212159
Ø8815 282141 1Ø825 353121 12825 422Ø98
14825 492Ø71 16835 561Ø37 18838 628ØØ8
2Ø838 694Ø8Ø 22848 7552Ø5 24848 8Ø2467
26847 81Ø913 28847 772242
DAY PART II
28821 769671 3Ø822 71Ø778 32822 645697
34822 577645 36822 5Ø96Ø9 38822 43958Ø
4Ø822 369557 42822 299537 44822 229518
46822 1585Ø1 48522 Ø88485 5Ø822 Ø17469
DAY PART III
52827 Ø53453 54827 123437 56827 194421
58837 2644Ø3 6Ø837 334384 62837 4Ø4362
64837 473337 66847 5423Ø5 68847 6Ø9263
7Ø847 6762Ø1 72847 734Ø95 74848 791885
76848 813474
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671

EXERCISE 2

TBUS2 KWBC Ø719ØØ
APT PREDICT
1Ø1Ø32 NOAA 7
PART I
Ø1541 Ø1Ø14 Ø5448 ØØ541 TØ2Ø1 L255Ø
15452 14254 1Ø743
1549Ø 431Ø1 25Ø53
15531 119Ø7 34851
DAY PART II
Ø284Ø Ø7ØØ7Ø Ø484Ø 14ØØ86 Ø684Ø 21Ø1Ø3
Ø884Ø 28Ø122 1Ø84Ø 35Ø142 1285Ø 42Ø165
1485Ø 489192 1685Ø 557226 1885Ø 624273
2Ø86Ø 689343 2286Ø 75Ø466 2486Ø 798715
26861 8Ø9145
DAY PART III
Ø2845 Ø7ØØ38 Ø4845 14ØØ21 Ø6855 21ØØØ4
Ø8858 28ØØ13 1Ø858 35ØØ33 12858 419Ø56
14868 488Ø83 16868 556117 18878 623164
2Ø878 688233 22878 749354 24878 797599
26877 8Ø9Ø25
NIGHT PART II
28861 773482 3Ø861 717647 32861 653735
34861 58779Ø 36862 51977Ø 38862 45174Ø
4Ø862 382716 42862 312695 44862 243676
46862 173658 48862 1Ø3642 5Ø862 Ø33625
NIGHT PART III
52867 Ø3661Ø 54867 1Ø6593 56867 176577
58867 245559 6Ø877 31554Ø 62877 384519
64877 453494 66877 521464 68877 589425
7Ø877 65537Ø 72877 718281 74877 774114
76878 8Ø9775 78878 797348

EXERCISE 3

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TBUS1 KWBC Ø819ØØ
APT PREDICT
1Ø1131 NOAA 6
PART I
Ø19Ø6 Ø112Ø Ø3818 Ø1479 TØ111 L2529
191ØØ 323Ø6 11599
19141 ØØ754 2428Ø
19181 65242 3416Ø
NIGHT PART II
Ø28ØØ Ø7Ø163 Ø48ØØ 14118Ø Ø68ØØ 212196
Ø88ØØ 283214 1Ø8ØØ 353234 1281Ø 423257
1481Ø 493284 1681Ø 562319 1881Ø 63Ø366
2Ø81Ø 696439 2282Ø 757568 2482Ø 8Ø384Ø
26821 8Ø9292
NIGHT PART III
Ø28Ø5 Ø7Ø132 Ø4815 141116 Ø6815 212Ø99
Ø8815 282Ø81 1Ø825 353Ø61 12825 423Ø38
14825 492Ø11 16838 561Ø22 18838 628Ø69
2Ø838 69414Ø 22848 755266 24848 8Ø2528
26847 81Ø974
DAY PART II
28821 76961Ø 3Ø821 71Ø761 32822 645757
34822 5777Ø6 36822 5Ø9669 38822 43964Ø
4Ø822 369617 42822 299597 44822 229578
46822 158561 48822 Ø88545 5Ø822 Ø17529
DAY PART III
52827 Ø52513 54827 123497 56827 193481
58837 264463 6Ø837 334444 62837 4Ø3422
64837 473397 66847 541365 68847 6Ø9323
7Ø847 676261 72847 738156 74847 791945
76848 813535
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EXERCISE 4

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TBUS2 KWBC Ø819ØØ
APT PREDICT
1Ø1132 NOAA 7
PART I
Ø1555 Ø1114 Ø4311 ØØ25Ø TØ2Ø1 L255Ø
15592 13118 1Ø452
1563Ø 41924 25344
15671 1Ø731 35142
DAY PART II
Ø284Ø Ø7ØØ42 Ø484Ø 14ØØ58 Ø684Ø 21ØØ75
Ø884Ø 28ØØ94 1Ø85Ø 35Ø114 1285Ø 42Ø137
1485Ø 489164 1685Ø 557198 1886Ø 624245
2Ø86Ø 689315 2286Ø 75Ø438 2486Ø 798687
26861 8Ø9116
DAY PART III
Ø2845 Ø7ØØ1Ø Ø4848 14ØØØ5 Ø6858 21ØØ22
Ø8858 28ØØ41 1Ø858 35ØØ61 12858 419Ø84
14868 488111 16868 556145 18868 623191
2Ø878 688261 22878 749382 24878 797627
26877 8Ø9Ø53
NIGHT PART II
28861 774453 3Ø861 717619 32861 6547Ø7
34861 587762 36862 519798 38862 451768
4Ø862 382744 42862 313722 44862 2437Ø3
46862 173686 48862 1Ø3669 5Ø862 Ø33653
NIGHT PART III
52867 Ø36637 54867 1Ø6621 56867 1756Ø5
58867 245587 6Ø877 315568 62877 384547
64877 453522 66877 521492 68877 589453
7Ø877 655398 72877 7183Ø9 74877 774142
76878 8Ø98Ø3 78878 797376
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EXERCISE 5

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TBUS1 KWBC Ø919ØØ
APT PREDICT
1Ø1231 NOAA 6
PART 1
Ø192Ø Ø122Ø Ø15Ø7 ØØ899 TØ111 L2529
1924Ø 25955 11Ø19
1928Ø 94443 2486Ø
19321 62931 3474Ø
NIGHT PART II
Ø28ØØ Ø7Ø1Ø7 Ø48ØØ 141124 Ø68ØØ  1214Ø
Ø88ØØ 283159 1Ø8ØØ 353178 1281Ø 4232Ø1
1481Ø 493228 1681Ø 562263 1881Ø 63Ø31Ø
2Ø81Ø 696383 2282Ø 757512 2482Ø 8Ø3784
26821 8Ø9236
NIGHT PART III
Ø28Ø5 Ø7ØØ76 Ø4815 141Ø6Ø Ø6815 212Ø43
Ø8815 282Ø25 1Ø825 353ØØ5 12828 423Ø17
14828 492Ø44 16838 561Ø78 18838 628124
2Ø853 694196 22848 755322 24848 8Ø2584
26847 81ØØ31
DAY PART II
28821 769554 3Ø821 71Ø7Ø5 32821 645786
34822 577761 36822 5Ø9725 38822 439696
4Ø822 369673 42822 299652 44822 229634
46822 159617 48822 Ø886Ø1 5Ø822 Ø17585
DAY PART III
52827 Ø52569 54827 123553 56827 193537
58837 264519 6Ø837 3345ØØ 62837 4Ø3478
64837 473453 66847 541421 68847 6Ø9379
7Ø847 675317 72847 738212 74847 791ØØ1
76848 813591
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EXERCISE 6

TBUS2 KWBC Ø919ØØ
APT PREDICT
1Ø1232 NOAA 7
PART I
Ø157Ø Ø1216 Ø1337 Ø25Ø9 TØ2Ø1 L255Ø
15742 3Ø144 12712
1578Ø 5495Ø 23Ø84
15821 23757 32882
DAY PART II
Ø284Ø Ø7Ø268 Ø484Ø 14Ø285 Ø684Ø 21Ø3Ø2
Ø884Ø 28Ø32Ø 1Ø85Ø 35Ø34Ø 1285Ø 42Ø363
1485Ø 48939Ø 1685Ø 557425 1886Ø 624471
2Ø86Ø 689542 2286Ø 75Ø664 24861 797913
26861 8Ø9342
DAY PART III
Ø2845 Ø7Ø236 Ø4845 14Ø22Ø Ø6855 21Ø2Ø3
Ø8855 28Ø185 1Ø855 35Ø165 12855 419142
14865 488115 16865 556Ø8Ø 18865 623Ø34
2Ø878 688Ø35 22878 749156 24878 7974ØØ
26878 8Ø9827
NIGHT PART II
28861 774679 3Ø862 717754 32862 654666
34862 587611 36862 52Ø572 38862 451542
4Ø862 382517 42862 313496 44862 243477
4Ø862 17346Ø 48862 1Ø3443 5Ø862 Ø33427
NIGHT PART III
52867 Ø36411 54867 1Ø5395 56867 175378
58867 245361 6Ø867 315342 62877 384321
64877 453296 66877 521266 68877 589227
7Ø877 655171 72877 718Ø82 74877 774916
76878 8Ø9577 78878 79715Ø

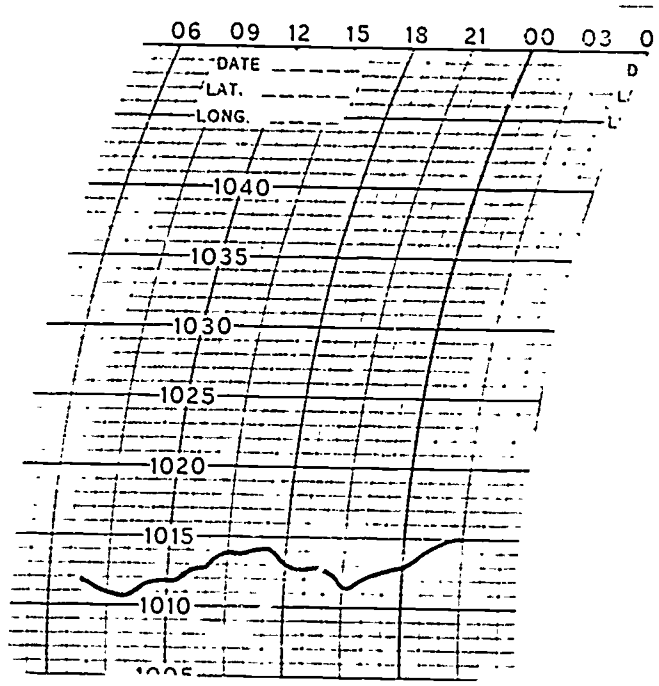
EXERCISE 7

TBUS1 KWBC 1Ø19ØØ
APT PREDICT
1Ø1331 NOAA 6
PART I
Ø1934 Ø1319 Ø5155 ØØ319 TØ111 L2529
1938Ø 23642 1Ø439
1942Ø 9213Ø 2544Ø
19461 6Ø618 3532Ø
NIGHT PART II
Ø28ØØ Ø7ØØ5Ø Ø48ØØ 141Ø66 Ø68ØØ 212Ø83
Ø88ØØ 2831Ø1 1Ø8ØØ 35312Ø 1281Ø 42314[illegible]
1481Ø 49317Ø 1681Ø 5622Ø5 1881Ø 63Ø252
2Ø81Ø 696325 2282Ø 757454 2482Ø 8Ø3726
26821 3Ø9178
NIGHT PART III
Ø28Ø5 Ø7ØØ18 Ø4815 141ØØ2 Ø6818 212Ø14
Ø8818 282Ø32 1Ø828 353Ø52 12828 423Ø75
14828 4921Ø2 16838 561136 18838 628182
2Ø838 694254 22848 75538Ø 24848 8Ø2642
26847 81ØØ89
DAY PART II
28821 769496 30821 71Ø647 32821 645728
34821 57778Ø 36322 5Ø9783 38822 439754
4Ø822 37Ø731 42822 29971Ø 44822 229692
46822 159675 48822 Ø88659 5Ø822 Ø17643
DAY PART III
52827 Ø52627 54827 123611 56827 193595
58837 263477 6Ø837 333558 62837 4Ø3536
64837 473511 66847 541479 68847 6Ø9437
7Ø847 675375 72847 73627Ø 74847 791Ø6Ø
76848 813649

SURFACE WEATHER OBSERVATIONS (AIRWAYS)	LATITUDE 40°18'N	LONGITUDE 88°09'W	STATION ELEVATION (H_p) +760 Feet (MSL)	TIME CONVERSION (GMT to LST) ⊕ − 6 Hrs	MAG to TRUE ⊕ 11 Deg	DAY (LST) 12	MONTH APR.	YEAR 1982	STATION (or grid coord) & STATE or COUNTRY NOCD CHANUTE

TYPE (1)	TIME (GMT) (2)	SKY CONDITION (3)	PVLG VSBY (miles) (4)	WEATHER AND OBSTRUC TO VISION (5)	SEA LEVEL PRES (mb) (6)	TEMP (°F) (7)	DEW-POINT (°F) (8)	WIND DRCTN (true) (9)	WIND SPEED (knots) (10)	WIND CHARACTER (knots) (11)	ALSTG (inches) (12)	REMARKS AND SUPPLEMENTARY CODED DATA (All times GMT. Desired order of entry: SFC based obsc phenomena, other remarks elaborating on preceding coded data, coded additive data groups, radiosonde data, runway conditions, weather modification.) (13)	STATION PRESSURE (inches) (17)	TOTAL SKY COVER (21)	OBS INIT (15)
SA	0555	25 SCT	15			78	66	22	08				29.880	2	AG
SA	0655	25 SCT	15			78	65	23	09				29 880	2	AG
SA	0755	25 SCT	15			78	65	24	08				29 870	2	AG
SA	0855	25 SCT	15			77	66	23	07				29865	3	AG
SA	0955	25 SCT	15			78	66	25	06				29 855	5	AG
SP	1005	25 SCT	10	RW-				20	10						AG
SP	1014	25 SCT	10					23	09						AG
SA	1055	25 SCT	10			71	63	22	06			SCT V BKN	29.870	5	AG
SA	1155	25 SCT	10			78	65	23	05				29 880	5	AG
SA	1255	25 SCT	15			78	64	22	07				29.900	5	AG
RS	1355	E25 BKN	15			79	65	24	02				29.915	6	AG
SA	1455	E25 BKN 45 BKN	15			79	67	24	12				29940	6	AG
SA	1555	E28 BKN 45 BKN	15			81	67	20	13	G26			29.940	8	AG
SP	1628	E28 BKN 45 BKN	10	RW-				25	17			VSBY LWR W-N RW- OCNLY RW			AG
SP	1635	10 SCT E28 BKN 45 BKN	2	RW+				30	08			VSBY N 1½			AG
SP	1640	10 SCT E28 BKN 45 BKN	15					25	11			RWU 5			AG
SA	1655	10 SCT E28 BKN 45 BKN	15			77	65	24	15			RWU 5	29.950	8	AG
SA	1755	10 SCT E28 BKN 45 BKN	15			80	66	21	10	G33			29 915	8	AG
SP	1801	10 SCT E28 BKN 45 BKN	2	RW+				29	20			VSBY W 1			AG
SP	1811	10 SCT E28 BKN 45 BKN	5	RW-				22	14			VSBY N 1½			AG
SP	1821	10 SCT E28 BKN 45 BKN	10					30	09						AG
RS	1855	10 SCT E25 BKN 45 BKN	2	RW		73	66	31	11			VSBY N ½ NW ¾	29.910	8	AG
SP	1905	10 SCT E25 BKN 45 BKN	10					01	18	G27					AG
RS	1955	10 SCT 25 SCT E45 BKN	15			76	65	33	11				29.905	7	AG
SA	2055	45 SCT E150 BKN 200 BKN	15			81	63	16	05				29.865	7	AG
SA	2155	E45 BKN 150 BKN 200 BKN	15			79	63	29	04				29 880	7	AG
SA	2255	E45 BKN 150 BKN 200 BKN	7			78	62	30	07				29.900	8	AG
SA	2355	45 SCT E150 BKN 200 BKN	7			77	60	33	04				29 915	8	AG
SA	0055	25 SCT 150 SCT 250 SCT	15			75	62	25	03				29.945	4	AG
SA	0155	25 SCT 150 SCT E250 BKN	7			74	62	00	00				29.965	6	AG
SA	0255	25 SCT 150 SCT E250 BKN	7			73	64	25	02				29.980	8	AG

/S FORM APR 10b PREVIOUS EDITION WILL BE USED.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DATE
LAT.
LONG.
1040
1035
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1025
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1015
1010

12 APR 1982

SURFACE WEATHER OBSERVATIONS (AIRWAYS)	LATITUDE	LONGITUDE	STATION ELEVATION (H_p) Feet (MSL)	TIME CONVERSION GMT to ⊕ LST	MAG to TRUE Deg	DAY (LST)	MONTH	YEAR	STATION (or grid coord) & STATE or COUNTRY
	40°18'N	88°09'W	+760	− 6 Hrs	⊕ 11 Deg	04	MAR	1982	NCCD CHANUTE

TYPE (1)	TIME (GMT) (2)	SKY CONDITION (3)	PVLG VSBY (miles) (4)	WEATHER AND OBSTRUC TO VISION (5)	SEA LEVEL PRES (mb) (6)	TEMP (°F) (7)	DEW-POINT (°F) (8)	WIND DRCTN (true) (9)	WIND SPEED (knots) (10)	WIND CHARACTER (knots) (11)	ALSTG (inches) (12)	REMARKS AND SUPPLEMENTARY CODED DATA (All times GMT. Desired order of entry: SFC based obsc phenomena, other remarks elaborating on preceding coded data, coded additive data groups, radiosonde data, runway conditions, weather modification.) (13)	STATION PRESSURE (inches) (17)	TOTAL SKY COVER (21)	OBS INIT (15)
SA	0555	15 SCT E80 BKN 200 OVC	7			34	24	02	17	G24			28.935	10	AG
SP	0646	M12 BKN 80 OVC	7					03	12	G22					AG
SA	0655	M12 BKN 80 OVC	7			33	23	02	16	G20			28.960	10	AG
RS	0755	12 SCT E200 OVC	7			32	19	02	13	G22			28.975	10	AG
SP	0835	12 SCT M24 BKN 200 OVC	7					02	17	G24					AG
SA	0855	12 SCT M24 OVC	7			30	18	02	16	G26			28.995	10	AG
SA	0955	12 SCT E24 BKN 80 OVC	7			28	16	03	18	G23			29.025	10	AG
SA	1055	12 SCT E24 BKN 40 OVC	7			26	12	02	16	G23			29.065	10	AG
RS	1155	9 SCT E20 OVC	7			24	9	36	20				29.095	10	AG
SP	1231	9 SCT 20 SCT E80 OVC	7					36	14						AG
RS	1255	7 SCT E25 BKN 80 OVC	7			22	5	36	15				29.140	10	AG
SA	1355	7 SCT E25 OVC	7			21	3	35	18	G21			29.185	10	AG
SP	1430	9 SCT 25 SCT E80 OVC	7					01	16	G23					AG
SA	1455	9 SCT 25 SCT E80 OVC	7			21	3	33	16	G21			29.225	10	AG
SP	1520	9 SCT 25 SCT E80 OVC	6	S-				34	16						AG
SA	1555	9 SCT 30 SCT E80 OVC	6	S-		18	2	35	14				29.235	10	AG
RS	1655	30 SCT 50 SCT E80 OVC	7			18	2	33	20	G22			29.230	10	AG
SA	1755	30 SCT E70 BKN	7			18	2	34	12	G23			29.220	8	AG
SA	1855	15 SCT 70 SCT	7			22	2	35	10				29.205	5	AG
SA	1955	25 SCT 70 SCT	7			22	2	34	10	G24			29.210	3	AG
SA	2055	25 SCT	7			18	7	34	16	G24			29.240	1	EP
SA	2155	25 SCT	7			18	5	33	16	G24			29.255	1	AG
SA	2255	CLR	7			18	5	34	14	G22			29.275	0	AG
SA	2355	CLR	7			18	-1	33	16				29.315	0	AG
SA	0055	CLR	7			18	-5	32	14	G21			29.325	0	AG
SA	0155	CLR	7			15	-7	34	15				29.335	0	AG
SA	0355	CLR	7			16	-7	32	12	G21			29.340	0	AG
SA	0355	CLR	7			15	-7	32	10	G15			29.335	0	AG
SA	0455	CLR	7			14	-6	33	11				29.335	0	AG

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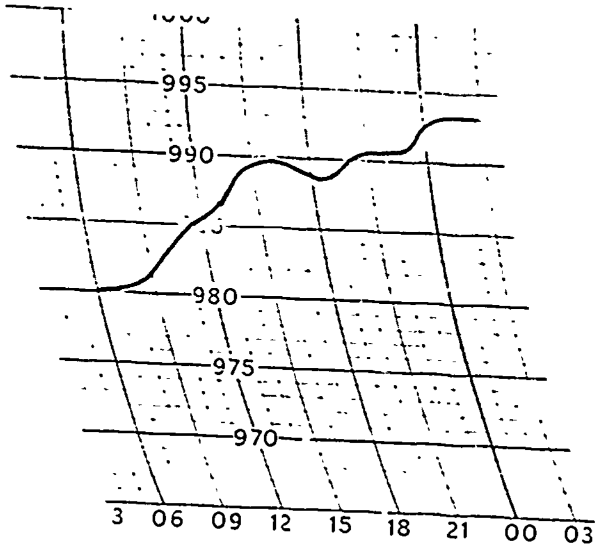
NWS FORM APR 10b PREVIOUS EDITION WILL BE USED.



04 MARCH 1982

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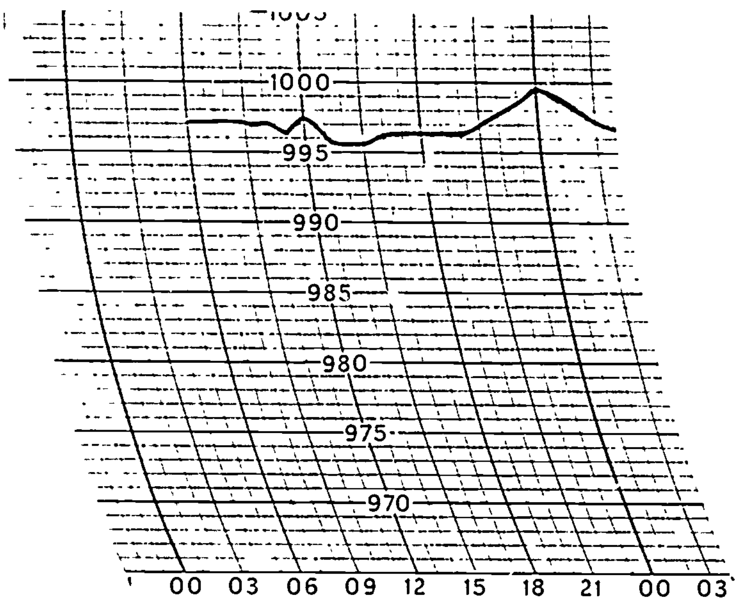
SURFACE WEATHER OBSERVATIONS (AIRWAYS)

LATITUDE	LONGITUDE	STATION ELEVATION (H_p)	TIME CONVERSION (GMT to ⊕/− LST)	MAG to TRUE	DAY (LST)	MONTH	YEAR	STATION (or grid coord) & STATE or COUNTRY
40°18'N	88°09'W	+760 Feet (MSL)	6 Hrs	⊕11 Deg	18	FEB	1982	NCCD CHANUTE

TYPE (1)	TIME (GMT) (2)	SKY CONDITION (3)	PVLG VSBY (miles) (4)	WEATHER AND OBSTRUC TO VISION (5)	SEA LEVEL PRES (mb) (6)	TEMP (°F) (7)	DEW-POINT (°F) (8)	WIND DRCTN (true) (9)	WIND SPEED (knots) (10)	WIND CHARAC-TER (knots) (11)	ALSTG (inches) (12)	REMARKS AND SUPPLEMENTARY CODED DATA (All times GMT. Desired order of entry: SFC based obsc phenomena, other remarks elaborating on preceding coded data, coded additive data groups, radiosonde data, runway conditions, weather modification.) (13)	STATION PRESSURE (inches) (17)	TOTAL SKY COVER (21)	OBS INIT (15)
RS	0558	W1X	1/4	F		40	39	00	00				29.455	10	AG
SA	0658	W1X	1/8	F		40	39	00	00				29.455	10	AG
SA	0758	W2X	1/2	F		41	39	07	02				29.455	10	AG
RS	0858	W2X	1	F		41	39	08	02				29.455	10	AG
SA	0958	W2X	1	F		42	40	00	00				29.450	10	AG
SP	1013	W2X	1/16	L-F				00	00						AG
SA	1058	W2X	1/16	L-F		41	40	00	00				29.435	10	AG
SP	1117	W2X	1/2	F				00	00						AG
SA	1158	W2X	1/2	F		43	41	09	03				29.455	10	AG
RS	1258	-X E4OVC	1 1/2	F		44	41	07	03			F7	29.430	10	AG
SA	1358	-X E4OVC	1 1/2	F		41	39	08	04			F6	29.400	10	AG
SP	1419	-X E7OVC	2	F				09	06			F4			AG
RS	1458	-X E7OVC	1/8	LF		40	38	07	05			LF8	29.400	10	AG
SP	1516	WOX	0	LF				06	02						AG
SP	1532	-X E7OVC	2	F				07	04			F3			AG
RS	1558	-X E7BKN 15OVC	4	F		39	36	07	06			F1	29.410	10	AG
SA	1658	E7BKN 15OVC	6	F		37	33	08	07				29.420	10	AG
SP	1705	E7BKN 15OVC	6	R-F				07	07						AG
RS	1758	E7BKN 15OVC	2 1/2	RF		35	31	09	05				29.420	10	AG
SA	1858	E7BKN 15OVC	2 1/2	RF		34	30	08	06				29.420	10	AG
SA	1958	E7BKN 15OVC	2 1/2	RF		33	29	06	07				29.420	10	AG
SP	2012	E7BKN 15OVC	2	ZRF				09	06						AG
SA	2058	E7BKN 15OVC	2	ZRF		31	28	10	04				29.450	10	AG
SP	2117	7SCT E15OVC	6	F				11	07						AG
SA	2158	7SCT E15OVC	6	F		30	27	13	05				29.470	10	AG
RS	2258	7SCT 15SCT	7			28	21	16	09				29.490	5	AG
SA	2358	15SCT	7			26	17	15	11				29.510	3	AG
SA	0058	CLR	7			26	16	17	13	G18			29.490	0	AG
SA	0158	CLR	7			26	16	16	12	G21			29.470	0	AG
SA	0256	CLR	7			25	14	18	18	G27			29.450	0	AG



18 FEBRUARY 1982

1158: 6 hr. precip: trace — 24 hr. precip: .76 inches

24 hr. max. temp: 46.2°F — 12 hr. min. temp: 37.3°F

1458: CLDS, 2/10 Stratus Fractus

1758: CLDS, 7/10 Stratus Fractus, 3/10 Nimbostratus

6 hr. precip: .03 inches — 24 hr. precip: .54 inches

12 hr. precip: .03 inches — 18 hr. min. temp: 34.8°F

2058: CLDS, 6/10 Stratus Fractus, 4/10 Nimbostratus

2358: CLDS, 3/10 Stratocumulus

6 hr. precip: .76 inches — 24 hr. precip: 1.24 inches

12 hr. max. temp: 43.4°F — 18 hr. min. temp: 25.5°F

SURFACE WEATHER OBSERVATIONS (AIRWAYS)	LATITUDE 40°18'N	LONGITUDE 88°09'W	STATION ELEVATION (H_p) +760 Feet (MSL)	TIME CONVERSION GMT to ⊕ LST) − 6 Hrs	MAG to TRUE ⊕ − 11 Deg	DAY (LST) 20	MONTH JUN	YEAR 1982	STATION (or grid coord) & STATE or COUNTRY NCCD CHANUTE

TYPE (1)	TIME (GMT) (2)	SKY CONDITION (3)	PVLG VSBY (miles) (4)	WEATHER AND OBSTRUC TO VISION (5)	SEA LEVEL PRES (mb) (6)	TEMP (°F) (7)	DEW-POINT (°F) (8)	WIND DRCTN (true) (9)	WIND SPEED (knots) (10)	WIND CHARACTER (knots) (11)	ALSTG (inches) (12)	REMARKS AND SUPPLEMENTARY CODED DATA (All times GMT. Desired order of entry: SFC based obsc phenomena, other remarks elaborating on preceding coded data, coded additive data groups, radiosonde data, runway conditions, weather modification.) (13)	STATION PRESSURE (inches) (17)	TOTAL SKY COVER (21)	OBS INIT (15)
SA	0557	CLR	3	H		53	40	13	07				29.000	0	AG
SA	0657	CLR	5	H		58	47	11	06				28.970	0	AG
SA	0757	CLR	6	H		63	52	12	05				28.940	0	AG
SA	0857	CLR	6	H		66	54	14	03				28.930	0	AG
SA	0957	30 SCT	7			68	56	13	05				28.900	1	AG
SA	1057	CLR	7			70	59	13	08				28.900	0	AG
SA	1157	120-SCT 250-SCT	7			72	61	12	07				28.900	2	AG
SA	1257	120-SCT 250-SCT	7			72	62	13	08				28.890	2	AG
SA	1357	120 SCT 250 SCT	7			73	64	15	10				28.850	3	AG
SA	1457	30SCT 120SCTE250BKN	7			74	67	14	09				28.800	6	AG
SA	1557	30SCT 120SCTE250BKN	7			74	68	14	11				28.785	6	AG
SA	1657	30SCT 120SCTE250BKN	7			74	67	15	08				28.765	7	AG
SA	1757	30SCTE120BKN250OVC	6	K		75	67	14	12				28.745	10	AG
RS	1857	E25BKN 120 OVC	6	K		77	69	13	09				28.745	10	AG
SA	1957	E25BKN 120OVC	6	K		77	70	13	10				28.745	10	AG
SA	2057	E25 BKN 120 OVC	7			79	72	12	12			RWU SW	28.705	10	AG
SA	2157	E25 BKN 120 OVC	7			80	74	15	14			CB SW MOVG NE OCNL DSNTLTG S	28.670	10	AG
SP	2206	E25 BKN 120 OVC	7	T				14	12	G20		TB6 SW MOVG NE OCNL LTGCG			AG
SP	2214	E25 OVC	5	TRW-				15	13			T SW MOVG NE OCNL LTGCG			AG
SA	2257	E25 OVC	5	TRW-		76	70	17	10			TNE MOVG NE OCNL LTGCG	28.640	10	AG
SP	2331	E25BKN 100 OVC	5	RW-				16	08			TE31 MOVD NE			AG
SA	2357	E25BKN100BKN250OVC	6	RW-		75	69	19	11			CB 25 NE MOVG NE	28.660	10	AG
SP	0009	E25BKN100BKN250OVC	7					19	09						AG
RS	0057	E25BKN100BKN250OVC	7			73	66	21	13				28.680	10	AG
SA	0157	25SCT100SCTE250BKN	7			70	58	23	14				28.700	7	AG
SA	0257	25SCT 100SCT 250 SCT	7			70	57	22	12			ACCAS N	28.680	5	AG
SA	0357	25SCT 100SCT 250 SCT	7			70	57	22	09				28.700	4	AG
SA	0457	100 SCT 250 SCT	7			70	56	24	13				28.740	2	AG

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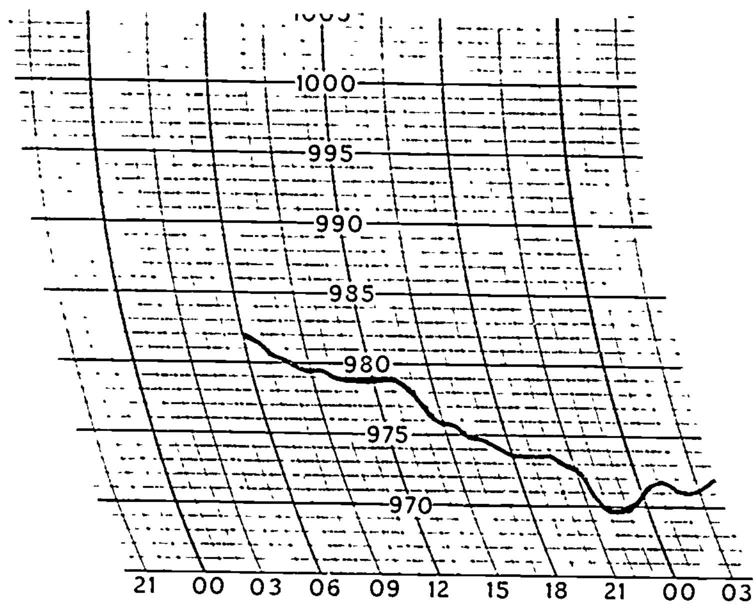
FORM APR 10b PREVIOUS EDITION WILL BE USED.



20 JUNE 1982

1158: CLDS, 1/10 Altostratus, 1/10 Cirrostratus

3 hr. precip: None

1457: CLDS, 2/10 Cumulus Humulus, 2/10 Altostratus, 2/10 Cirrostratus progressively invading the sky, continuous veil below 45 degrees.

1757: CLDS, 3/10 Cumulus Mediocris, 3/10 Altostratus and Altocumulus, 4/10 Cirrostratus

6 hr. precip: None

2057: CLDS, 7/10 Cumulus Mediocres, 3/10 Altocumulus RWU estimated to be 4 miles from station

2357: CLDS, 6/10 Cumulus Mediocris, 1/10 Cumulonimbus Capillatus, 2/10 Altocumulus Cumulunimbogenitus, 1/10 Cirrus Spissatus Cumulonimbogenitus

6 hr. precip: .42 inches

0257: CLDS, 1/10 Cumulus Fractus, 2/10 Altocumulus Castellanus, 2/10 Cirrocumulus

SURFACE WEATHER OBSERVATIONS (AIRWAYS)	LATITUDE	LONGITUDE	STATION ELEVATION (H_p) Feet (MSL)	TIME CONVERSION GMT to LST Hrs	MAG to TRUE Deg	DAY (LST)	MONTH	YEAR	STATION (or grid coord) & STATE or COUNTRY
	40°18'N	88°09'W	+760	− 6	+ 11	2	JUL	1982	

TYPE (1)	TIME ( ) (2)	SKY CONDITION (3)	PVLG VSBY (miles) (4)	WEATHER AND OBSTRUC TO VISION (5)	SEA LEVEL PRES (mb) (6)	TEMP (°F) (7)	DEW-POINT (°F) (8)	WIND DRCTN (true) (9)	WIND SPEED (knots) (10)	WIND CHARACTER (knots) (11)	ALSTG (inches) (12)	REMARKS AND SUPPLEMENTARY CODED DATA (All times GMT. Desired order of entry: SFC based obsc phenomena, other remarks elaborating on preceding coded data, coded additive data groups, radiosonde data, runway conditions, weather modification.) (13)	STATION PRESSURE (inches) (17)	TOTAL SKY COVER (21)	OBS INIT (15)
SA	0558	15 SCT E100 BKN 250 OVC	7			80	73	07	10			TCU E	29.520	10	AG
SP	0617	E15 BKN 100 OVC	6	RW-				09	10			CB E MOVG W			AG
RS	0658	E15 OVC	2	TRW		80	75	07	15	G20		TB58 E MOVG W OCNL LTGICCG	29.500	10	AG
SP	0713	E15 OVC	1/2	TRW+				10	12	G22		T OVHD MOVG W OCNL LTGICCG			AG
SP	0736	E15 BKN 80 OVC	6	TRW-				08	07			T W MOVG W OCNL LTGICCG			AG
RS	0758	E15 BKN 80 OVC	7	T		79	73	08	08			T W MOVG W OCNL LTGICCG	29.480	10	AG
SP	0812	E15 BKN 80 OVC	7					08	06			TE12 MOVD W			AG
SA	0858	E15 BKN 80 BKN 250 OVC	7			81	73	09	07			TCU S-W RWU S	29.475	10	AG
RS	0958	15 SCT E80 BKN 250 OVC	7			83	74	11	06			TCU S RWU S	29.485	10	AG
SA	1058	15 SCT 80 SCT E250 BKN	7			85	77	10	08				29.475	8	AG
SA	1158	15 SCT E80 OVC	7			88	79	12	09				29.450	10	AG
SP	1217	E16 BKN 80 OVC	7					11	05			TCU E AND S			AG
SA	1258	E15 BKN 80 OVC	7			91	82	13	10			CB 20S MOVG W TCU W OCNL			/
/												LTGIC	29.430	10	AG
SA	1358	E15 BKN 80 OVC	7			93	85	12	12			CB E AND SW MOVG W OCNL LTGIC	29.405	10	AG
SP	1412	E15 BKN 80 OVC	5	TRW-				14	16	G23		CB SW MOVG W TB12 E MOVG W			/
/												FQT LTGICCACG PRESFR			AG
SP	1416											TORNADO B16 E MOVG SW			AG
SP	1418	M9 OVC	1/4	TORNADO				15	43	G72		TORNADO E MOVG SW T E MOVG W			/
/				T+RW+A								FQT LTGICCG AB18 HLSTO 1 1/4			AG
SP	1420											TORNADO E20 DSIPTD			AG
SP	1431	M9 OVC	1 1/2	T+RW				14	33	G53		T OVHD MOVG W FQT LTGCG			/
/												AE30 HLSTO 1 1/2			AG
RS	1458	M9 OVC	3	T+RW		81	78	14	26	G50		TW MOVG W FQT LTGCG	29.300	10	AG
SP	1523	9 SCT E15 OVC	7					16	15	G21		TE23 MOVD W			AG
SA	1558	E15 BKN 80 OVC	7			82	75	15	12				29.280	10	AG
SA	1658	E15 BKN 80 OVC	7			82	74	16	13				29.260	10	AG
SP	1737	E15 OVC	7	RW-				16	12			TCU S			AG
RS	1758	E15 BKN 80 BKN 250 OVC	7			81	75	17	13			TCU SW	29.240	10	AG
SA	1858	E15 BKN 80 BKN 250 OVC	7			81	74	17	11				29.215	10	AG
RS	1958	15 SCT E80 BKN 250 OVC	7			80	74	16	12	G20			29.200	10	AG

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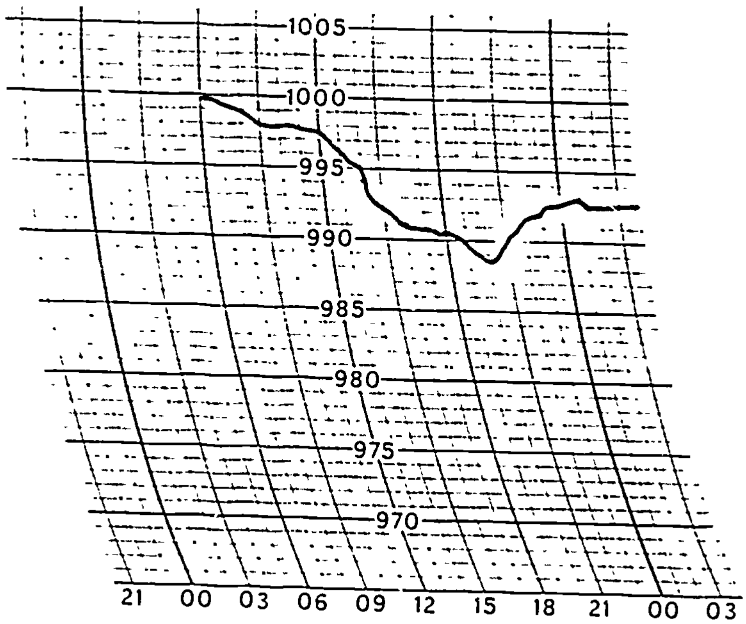
S FORM APR 7? 10b PREVIOUS EDITION WILL BE USED.

SURFACE WEATHER OBSERVATIONS (AIRWAYS)	LATITUDE	LONGITUDE	STATION ELEVATION (H_p) Feet (MSL)	TIME CONVERSION (GMT to LST)	MAG to TRUE	DAY (LST)	MONTH	YEAR	STATION (or grid coord) & STATE or COUNTRY
	40°18'N	88°09'W	+760	⊕ 6 Hrs	⊕ 11 Deg	2	JUL	1982	

TYPE (1)	TIME ( ) (2)	SKY CONDITION (3)	PVLG VSBY (miles) (4)	WEATHER AND OBSTRUC TO VISION (5)	SEA LEVEL PRES (mb) (6)	TEMP (°F) (7)	DEW-POINT (°F) (8)	WIND DRCTN (true) (9)	WIND SPEED (knots) (10)	WIND CHARACTER (knots) (11)	ALSTG (inches) (12)	REMARKS AND SUPPLEMENTARY CODED DATA (All times GMT. Desired order of entry: SFC based obsc phenomena, other remarks elaborating on preceding coded data, coded additive data groups, radiosonde data, runway conditions, weather modification.) (13)	STATION PRESSURE (inches) (17)	TOTAL SKY COVER (21)	OBS INIT (15)
SA	2058	15 SCT E80BKN250BKN	7			77	69	23	17			WSHFT 32 FROPA	29.245	9	AG
SA	2158	15SCT 80SCTE250BKN	7			76	65	24	16	G23			29.270	9	AG
SA	2258	15SCT 80SCT E250BKN	7			74	60	24	15	G25		PK WND 2331/29	29.305	8	AG
SA	2358	80 SCT E250 BKN	7			73	57	25	16	G22		PK WND 2434/17	29.310	7	AG
SA	0058	80 SCT 250 SCT	7			73	56	24	12				29.320	5	AG
SA	0158	80 SCT 250 SCT	7			72	52	25	10				29.310	3	AG
SA	0258	250 SCT	7			72	M	25	10				29.310	2	AG
SA	0358	250 SCT	7			72	M	26	07				29.330	1	AG
SA	0458	CLR	7			70	M	27	06				29.335	0	AG



02 JULY 1982

0858: CLDS, 6/10 Towering Cumulus, 2/10 Altocumulus formed by the spreading out of a CB, 2/10 Cirrus which was the top of a CB

1158: CLDS, 4/10 Cumulus of moderate vertical extent, 6/10 Altocumulus formed by the spreading out of a CB

6 hr. precip: .37 inches   24 hr. precip: .92 inches

24 hr. max. temp: 94.7°F   12 hr. min. temp: 78.6°F

1458: CLDS, 10/10 Cumulonimbus with an anvil top

1758: CLDS, 7/10 Towering Cumulus, 2/10 Altocumulus formed by the spreading out of a CB, 1/10 Cirrus which was the top of a CB

6 hr. precip: 1.36 inches   24 hr. precip: 2.67 inches

12 hr. max. temp: 93.5°F   24 hr. min. temp: 78.6°F

2058: CLDS, 3/10 Cumulus Fractus, 4/10 Altocumulus and Altostratus, 3/10 Cirrostratus

2358: CLDS, 4/10 Altostratus, 3/10 Cirrostratus

6 hr. precip: None   24 hr. precip: 2.67 inches
12 hr. max. temp: 93.5°F   18 hr. temp: 72.9°F

0258: CLDS, 2/10 Cirrostratus

SURFACE WEATHER OBSERVATIONS (AIRWAYS)

LATITUDE	LONGITUDE	STATION ELEVATION (H_p) Feet (MSL)	TIME CONVERSION GMT to LST	MAG to TRUE	DAY (LST)	MONTH	YEAR	STATION (or grid coord) & STATE or COUNTRY
40°18'N	88°09'W	+760	⊕ 6 Hrs	⊕ 11 Deg	2	JAN	1982	NOCD CHANUTE IL.

TYPE (1)	TIME ( ) (2)	SKY CONDITION (3)	PVLG VSBY (miles) (4)	WEATHER AND OBSTRUC TO VISION (5)	SEA LEVEL PRES (mb) (6)	TEMP (°F) (7)	DEW-POINT (°F) (8)	WIND DRCTN (true) (9)	WIND SPEED (knots) (10)	WIND CHARAC-TER (knots) (11)	ALSTG (inches) (12)	REMARKS AND SUPPLEMENTARY CODED DATA (All times GMT. Desired order of entry: SFC based obsc phenomena, other remarks elaborating on preceding coded data, coded cumulative data groups, radiosonde data, runway conditions, weather modification.) (13)	STATION PRESSURE (inches) (17)	TOTAL SKY COVER (21)	OBS INIT (15)
RS	0558	15 SCT E20 BKN	7	SW-		28	20	33	14				29.300	7	AG
RS	0658	E20 BKN	7			27	17	36	11				29.310	8	AG
SA	0758	E20 OVC	7			29	16	34	11				29.320	10	AG
SA	0858	E20 OVC	7			29	14	33	09			MDT CU W	29.325	10	AG
SA	0958	E20 OVC	7			29	14	33	09				29.330	10	AG
SA	1058	E20 OVC	7			28	15	33	12				29.335	10	AG
SA	1158	E20 OVC	7			28	15	32	11	G20			29.345	10	AG
SA	1258	E20 OVC	7			28	15	33	14				29.355	10	AG
SA	1358	E25 BKN 70 OVC	7			29	14	33	10				29.365	10	AG
SP	1435	E25 BKN 70 OVC	5	SP-SW-				33	12						AG
SA	1458	E25 BKN 70 OVC	6	SP-SW-		28	17	32	06				29.370	10	AG
SP	1515	E25 BKN 70 OVC	7					34	10						AG
SP	1540	E25 BKN 70 OVC	6	SW-				34	09						AG
SA	1558	E25 BKN 70 OVC	6	SW-		29	17	34	08				29.370	10	AG
SA	1658	E25 BKN 40 OVC	6	SW-		29	17	32	10				29.360	10	AG
SP	1707	E25 BKN 40 OVC	7					32	12						AG
SP	1723	-X E25 OVC	4	SW-				32	10			55			AG
SP	1743	W5X	1 1/2	SW-				02	16						AG
RS	1758	W3X	1 1/2	SW-		28	21	36	11				29.360	10	AG
SP	1801	W5X	2	SW-				03	09						AG
SP	1809	E7OVC	2 3/4	SW-				33	11						AG
SP	1815	E10 OVC	4	SW-				32	12						AG
SP	1830	E14 OVC	7					32	13						AG
SP	1840	E25 OVC	7					31	14						AG
SP	1844	E14 OVC	4	SW-				32	10						AG
SP	1851	E9 OVC	2	SW-				32	11						AG
SA	1858	E9 OVC	2	SW-		28	21	34	12				29.345	10	AG
SP	1906	W4X	1 1/2	SW-				35	14						AG
SP	1915	-X E20 OVC	4	SW-				34	15	G24		58			AG
SA	1958	-X E20 BKN 180 BKN	4	SW-		29	21	34	16			56	29.345	9	AG
SP	2009	W2X	1/2	SPSW				36	13						AG

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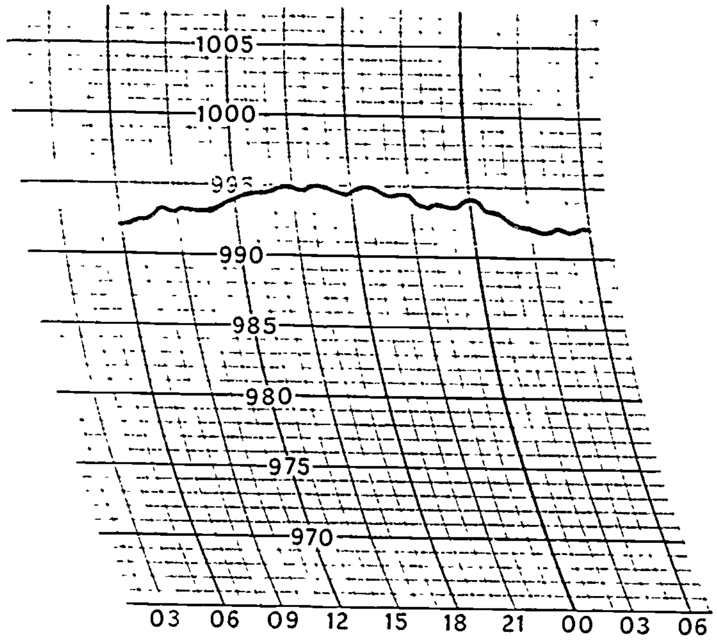
SURFACE WEATHER OBSERVATIONS (AIRWAYS)

LATITUDE	LONGITUDE	STATION ELEVATION (H_p) Feet (MSL)	TIME CONVERSION GMT to ⊕ LST	MAG to TRUE	DAY (LST)	MONTH	YEAR	STATION (or grid coord) & STATE or COUNTRY
40°18'N	88°09'W	+760	6 Hrs −	⊕ 11 Deg −	2	JAN	1982	NOCD CHANUTE IL.

TYPE (1)	TIME (GMT) (2)	SKY CONDITION (3)	PVLG VSBY (miles) (4)	WEATHER AND OBSTRUC TO VISION (5)	SEA LEVEL PRES (mb) (6)	TEMP (°F) (7)	DEW-POINT (°F) (8)	WIND DRCTN (true) (9)	WIND SPEED (knots) (10)	WIND CHARACTER (knots) (11)	ALSTG (inches) (12)	REMARKS AND SUPPLEMENTARY CODED DATA (All times GMT. Desired order of entry: SFC based obsc phenomena, other remarks elaborating on preceding coded data, coded additive data groups, radiosonde data, runway conditions, weather modification.) (13)	STATION PRESSURE (inches) (17)	TOTAL SKY COVER (21)	OBS INIT (15)
SP	2012	W4X	1/2	SPSW				35	18	G22					AG
SP	2015	-XE20 OVC	3/4	SP-SW-				35	17	G22		S9			AG
SP	2018	-XE25 BKN 40 OVC	6	SW-				35	16	G22		S3			AG
SP	2028	E25 BKN 40 BKN	7					34	17			SWU S			AG
RS	2058	-XE25BKN40BKN180OVC	4	SW-		29	20	33	17			S3	29.335	10	AG
SP	2120	E25BKN40BKN180OVC	7					34	15	G24					AG
SP	2130	-XE25BKN40BKN180OVC	5	SW-				34	14			S2			AG
SP	2137	W3X	1/2	SW-				34	14						AG
RS	2158	W3X	1 1/2	SW-		28	21	33	17				29.335	10	AG
SP	2220	-XE25BKN 40 OVC	1 1/2	SW-				33	19	G29		S8			AG
SP	2230	-XE25 BKN 40 OVC	4	SW-				34	20	G29		S5			AG
RS	2258	E25BKN40BKN180OVC	7			29	20	33	16				29.335	10	AG
SP	2315	E25 BKN 40 OVC	4	SW-				33	17						AG
SP	2335	E25 BKN 40 OVC	7					33	15						AG
SA	2358	E25 BKN 40 OVC	7			29	20	34	12	G28			29.345	10	AG
SP	0005	E20 OVC	6	SW-				32	15	G23					AG
SP	0025	M20 OVC	7					33	13	G23					AG
SP	0035	E20 OVC	6	SW-				32	13						AG
SA	0058	E20 OVC	6	SW-		30	19	32	15	G22			29.325	10	AG
SP	0110	E20 OVC	7					33	13						AG
SA	0158	E20 OVC	7			30	16	31	14	G21			29.310	10	AG
SA	0258	E20 OVC	7			29	18	32	13	G24		PK WND 3326/12	29.305	10	AG
SP	0315	-XE20 OVC	4	SW-				33	18	G23		S3			AG
SP	0340	E20 OVC	7					32	14	G20					AG
SA	0358	E20 OVC	7			29	19	31	14	G24			29.290	10	AG
SA	0458	E20 OVC	7			29	18	31	13	G26			29.210	10	AG



02 JANUARY 1982

0858: CLDS, Cumulus of moderate vertical extent

1158: CLDS, Cumulus of moderate vertical extent

6 hr. precip: Trace of snow 24 hr. Precip: 1.2 inches of snow
*snow depth: 2 inches

24 hr. max. temp: 31.2°F 12 hr. min. temp: 26.4°F

1458: CLDS, 7/10 Cumulus of moderate vertical extent, and Altocumulus

1758: 6 hr. precip: Trace of snow 24 hr. precip: 1.2 inches of snow
*snow depth: 2 inches

12 hr. max. temp: 29.7°F 18 hr. min. temp: 26.4°F

2058: CLDS, 5/10 Cumulus of moderate vertical extent, 1/10 Stratus not formed by the spreading out of Cumulus, 1/10 Cirrostratus

2358: CLDS, 7/10 Cumulus of moderate vertical extent, 3/10 Stratocumulus not formed by spreading out of Cumulus

6 hr. precip: 1.0 inches of snow
24 hr. precip: 2.6 inches of snow
Snow depth: 3 inches
12 hr. max. temp: 29.9°F 18 hr. min. temp: 27.2°F

0258: CLDS, Cumulus Humulis

SURFACE WEATHER OBSERVATIONS (AIRWAYS)	LATITUDE	LONGITUDE	STATION ELEVATION (H_p) Feet (MSL)	TIME CONVERSION GMT to LST	MAG to TRUE	DAY (LST)	MONTH	YEAR	STATION (or grid coord) & STATE or COUNTRY
	40°18'N	88°09'W	+760	⊕ 6 Hrs	⊕ 11 Deg	28	DEC	1983	NOCD CHANUTE, IL

TYPE (1)	TIME ( ) (2)	SKY CONDITION (3)	PVLG VSBY (miles) (4)	WEATHER AND OBSTRUC TO VISION (5)	SEA LEVEL PRES (mb) (6)	TEMP (°F) (7)	DEW-POINT (°F) (8)	WIND DRCTN (true) (9)	WIND SPEED (knots) (10)	WIND CHARAC-TER (knots) (11)	ALSTG (inches) (12)	REMARKS AND SUPPLEMENTARY CODED DATA (All times GMT. Desired order of entry: SFC based obsc phenomena, other remarks elaborating on preceding coded data, coded additive data groups, radiosonde data, runway conditions, weather modification.) (13)	STATION PRESSURE (inches) (17)	TOTAL SKY COVER (21)	OBS INIT (15)
SA	0558	25 SCT	6	H		62	55	18	07				29.975	3	EH
SA	0658	25 SCT	6	H		63	56	19	06				30.030	4	EH
RS	0758	E25 BKN	6	H		64	57	17	06			TCU E-SW	30.060	6	EH
SA	0858	E25 BKN	6	H		66	58	19	07			TCU ALQDS	30.065	6	EH
SA	0958	E25 BKN 80 OVC	7			67	58	20	05			TCU ALQDS	30.075	10	EH
SA	1058	E25 BKN 80 OVC	7			70	59	21	06			RWU SE	30.075	10	EH
RS	1158	E25 BKN 80 OVC	6	RW-		70	63	23	07			TCU ALQDS	30.075	10	EH
SA	1258	E25 BKN 80 OVC	5	RW-		71	64	22	08				30.055	10	EH
RS	1358	8 SCT E25 OVC	3	RW-		71	66	23	10			CB SE MOVG NE FQT LTGICCG	30.025	10	EH
SA	1458	8 SCT E25 OVC	3	RW-		73	67	24	10			CB SE MOVG NE FQT LTGICCG	29.960	10	EH
RS	1558	8 SCT E25 OVC	1	RW+		72	68	25	10			CB SE MOVG NE FQT LTGICCG	29.870	10	EH
RS	1658	8 SCT E25 OVC	1/2	RW+		71	66	21	08			CB E MOVG NE FQT LTGICCG	29.850	10	EH
SP	1711	E8 BKN 25 OVC	1/2	TRW+				24	10			CB NE MOVG NE TB11 SE			/
/												MOVG NE FQT LTGICCG			EH
SA	1758	E8 BKN 25 OVC	1/2	TRW+		68	64	26	06			CB NE MOVG NE TE MOVG NE			/
/												FQT LTGICCG	29.840	10	EH
SP	1817	8 SCT E25 OVC	1/2	RW+				25	12	G24		CB NE MOVG NE TE17 MOVG NE			/
/												FQT LTGICCG			EH
RS	1858	8 SCT E25 OVC	2	RW		68	63	24	10			TCU N	29.840	10	EH
RS	1958	E[illegible] BKN 80 OVC	5	RW-		68	63	23	06			TCU NE	29.850	10	EH
SA	2058	[illegible] BKN 80 OVC	5	RW-		67	62	21	04			TCU NE	29.860	10	EH
RS	2158	E[illegible] BKN 80 OVC	7			67	62	22	05				29.875	10	EH
RS	2258	25 SCT 80 SCT	7			66	63	21	06				29.885	5	EH
SA	2358	25 SCT 80 SCT	7			66	60	20	05			RWU N	29.885	5	EH
SA	0058	25 SCT 80 SCT	7			65	60	20	03				29.880	5	EH
SA	0158	25 SCT 80 SCT	6	F		63	59	23	04				29.880	4	EH
SA	0258	80 SCT 250 SCT	5	F		62	59	21	06				29.885	2	EH
SA	0358	80 SCT 250 SCT	4	F		61	58	23	02				29.905	2	EH
RS	0458	250 SCT	2	F		60	57	20	02				29.925	2	EH

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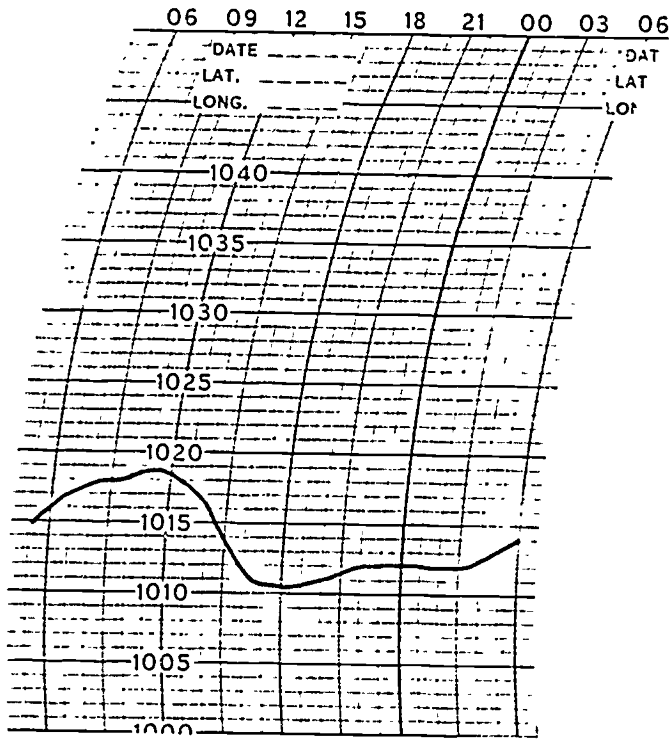
FORM [illegible] APR [illegible]0b PREVIOUS EDITION WILL BE USED.



28 DEC 1983

0858: CLDS, 6/10 Towering Cumulus

1158: CLDS, 6/10 Towering Cumulus, 4/10 Altocumulus

6 hr. precip: trace   24 hr. precip: .66 inches

24 hr. max. temp: 71.5°F   12 hr. min. temp: 61.6°F

1458: CLDS, 3/10 Cumulonimbus without anvil, 7/10 Towering Cumulus

1758: CLDS, 6/10 Cumulonimbus without anvil, 4/10 Towering Cumulus

6 hr. precip: .89 inches   24 hr. precip: 1.55 inches

12 hr. max. temp: 73.3°F   24 hr. min. temp: 60.5°F

2058: CLDS, 6/10 Towering Cumulus, 4/10 Altocumulus resulting from the spreading out of cumulonimbus

2358: CLDS, 3/10 Cumulus Humulis, 2/10 Altocumulus

6 hr. precip: .50 inches   24 hr. precip: 2.05 inches

12 hr. max. temp: 73.3°F   18 hr. min. temp: 62.2°F

RW are 6km North of the station

0258: CLDS, 1/10 Altocumulus, 1/10 Cirrus Uncinus

SURFACE WEATHER OBSERVATIONS (AIRWAYS)	LATITUDE 40° 18' N	LONGITUDE 88° 09' W	STATION ELEVATION (H_p) +760 Feet (MSL)	TIME CONVERSION GMT to LST ⊕ 6 Hrs	MAG to TRUE ⊕ 11 Deg	DAY (LST) 04	MONTH MAR	YEAR 1983	STATION (or grid coord) & STATE or COUNTRY NOCD CHANUTE IL

TYPE (1)	TIME (2)	SKY CONDITION (3)	PVLG VSBY (miles) (4)	WEATHER AND OBSTRUC TO VISION (5)	SEA LEVEL PRES (mb) (6)	TEMP (°F) (7)	DEW-POINT (°F) (8)	WIND DRCTN (true) (9)	WIND SPEED (knots) (10)	WIND CHARACTER (knots) (11)	ALSTG (inches) (12)	REMARKS AND SUPPLEMENTARY CODED DATA (All times GMT. Desired order of entry: SFC based obsc phenomena, other remarks elaborating on preceding coded data, coded additive data groups, radiosonde data, runway conditions, weather modification.) (13)	STATION PRESSURE (inches) (17)	TOTAL SKY COVER (21)	OBS INIT (15)
SA	0558	-X 4 SCT M10 OVC	1/2	BS		21	14	34	21			BS3	28.790	10	EH
SA	0658	-X 4 SCT M 10 OVC	1/2	BS		23	16	32	18			BS3	28.815	10	EH
RS	0758	-X M4 BKN 10 OVC	1/2	BS		24	18	36	15			BS4	28.850	10	EH
SA	0858	-X M4 BKN 10 OVC	1/4	BS		26	20	33	12			BS3	28.865	10	EH
SP	0933	-X M4 BKN 10 OVC	1/4	S+BS				31	11			BS2			EH
SP	0945	M4 BKN 10 OVC	1/4	S+				29	10						EH
SA	0958	M 4 BKN 10 OVC	1/8	S+		28	24	30	08				28.865	10	EH
SA	1058	M 4 BKN 10 OVC	1/8	S+		27	24	28	06				28.885	10	EH
SP	1112	M 4 BKN 10 OVC	3	S-				31	05						EH
RS	1158	M 4 BKN 8 OVC	1/2	S		29	26	30	06			CB SE MOVG E	28.920	10	EH
SA	1258	M4 BKN 8 OVC	1/2	S		30	27	32	08			CB SE MOVG E	28.965	10	EH
SA	1358	M4 BKN 8 BKN													/
/		12 OVC	1/2	S		31	28	26	10			CB SE MOVG E	28.885	10	EH
SP	1408	M4 BKN 8 BKN													/
/		12 OVC	1/2	TSW				35	12			CB S MOVG E TB08 SE MOVG			/
/												E OCNL LTGIC			EH
SP	1436	M4 BKN 8 OVC	3	TSW-				30	15			CB E MOVG E TSE MOVG E			/
/												OCNL LTGIC			EH
RS	1458	M4 BKN 8 OVC	4	SW-		33	27	36	10			CB E MOVG E TE58 MOVD E	28.830	10	EH
SA	1558	M4 BKN 8 BKN													/
/		12 OVC	3	RW-SW-		35	29	32	11			CB SW MOVG E	28.845	10	EH
RS	1658	M4 BKN 8 BKN													/
/		12 OVC	2	RW-		37	29	34	06			CB SW MOVG E	28.855	10	EH
SA	1758	M4 BKN 12 OVC	2	R-		39	32	24	08				28.855	10	EH
SA	1858	M4 BKN 12 OVC	2	R-		38	33	26	05				28.850	10	EH
SP	1910	M4 BKN 12 OVC	7					21	04						EH
SA	1958	M4 BKN 12 OVC	7			36	32	24	10				28.850	10	EH
RS	2058	M4 BKN 12 OVC	4	S-F		34	32	21	02				28.875	10	EH
RS	2158	M4 BKN 12 OVC	2	S-F		28	26	00	00				28.875	10	EH
RS	2258	M4 BKN 12 OVC	1	S-F		24	23	00	00				28.825	10	EH
RS	2358	M4 BKN 12 OVC	1/2	SF		22	21	09	02			709	28.815	10	EH

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SURFACE WEATHER OBSERVATIONS (AIRWAYS)

LATITUDE	LONGITUDE	STATION ELEVATION (H_p)	TIME CONVERSION	MAG to TRUE	DAY (LST)	MONTH	YEAR	STATION (or grid coord) & STATE or COUNTRY
40°18N	88°09'W	+750 Feet (MSL)	GMT to LST − 6 Hrs	+ 1 Deg	04	MAR	1983	NOCO CHANUTE IL

TYPE (1)	TIME (2)	SKY CONDITION (3)	PVLG VSBY (miles) (4)	WEATHER AND OBSTRUC TO VISION (5)	SEA LEVEL PRES (mb) (6)	TEMP (°F) (7)	DEW-POINT (°F) (8)	WIND DRCTN (true) (9)	WIND SPEED (knots) (10)	WIND CHARACTER (knots) (11)	ALSTG (inches) (12)	REMARKS AND SUPPLEMENTARY CODED DATA (All times GMT. Desired order of entry: SFC based obsc phenomena, other remarks elaborating on preceding coded data, coded additive data groups, radiosonde data, runway conditions, weather modification.) (13)	STATION PRESSURE (inches) (17)	TOTAL SKY COVER (21)	OBS INIT (15)
SP	0018	−X M 4 OVC	1	S-F				01	03			SF3			EH
SP	0037	−X M 4 OVC	1/2	SF				06	02			SF5			EH
SA	0058	W4X	1/4	S+F		20	18	04	01				28.810	10	EH
SP	0140	W4X	1	S-F				06	03						EH
SP	0146	−X M 4OVC	3	F				03	04			F3			EH
RS	0158	−X M 4OVC	1	S-F		21	17	02	03			SF5 INTMT S−	28.800	10	EH
SP	0215	−X M 4OVC	1/2	SF				01	02			SF5			EH
SP	0233	−X M 4OVC	1/2	F				00	00			F7			EH
SP	0249	−X M 4OVC	1/2	SF				00	00			SF8 INTMT S			EH
SA	0258	W4X	1/4	S+F		21	18	00	00			INTMT S+	28.800	10	EH
SA	0358	W2X	1/4	S+F		20	16	01	01				28.810	10	EH
SA	0458	W0X	0	S+F		20	19	00	00				28.855	10	EH

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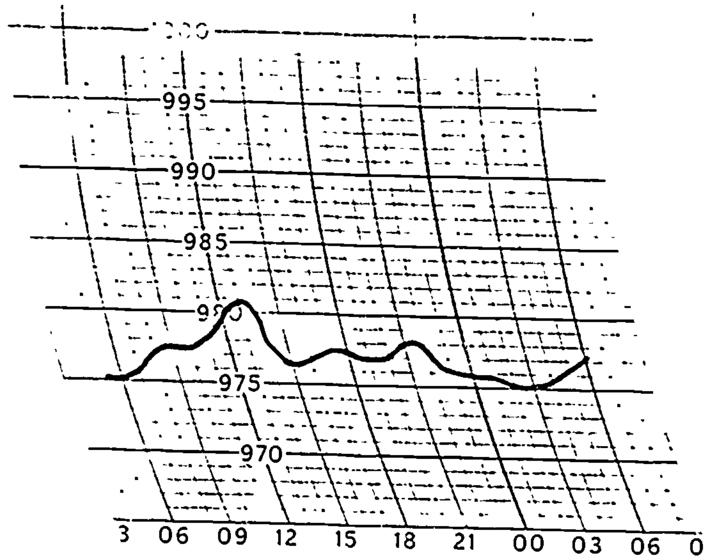
PREVIOUS EDITION WILL BE USED.



04 MARCH 1984

0858: CLDS, 3/10 Stratus Fractus, 4/10 Nimbostratus

1158: CLDS, 6/10 Stratus Fractus, 4/10 Nimbostratus

6 hr. precip: 2.0 inches of snow
*snow depth: 6 inches

24 hr. precip: 3.5 inches of snow

24 hr. max. temp: 29.3°F   12 hr. min. temp: 18.6°F

1458: CLDS, 7/10 Stratus Fractus, 3/10 Cumulonimbus without anvil

1758: CLDS, 8/10 Stratus Fractus, 2/10 Nimbostratus

6 hr. precip: .64 inches of precip
*snow depth: 7.4 inches

6 hr. snowfall: 1.4 inches

24 hr. precip: 4.8 inches of snow, .50 inches of rain

12 hr. max. temp: 39.2°F   18 hr. min. temp: 18.6°F

2058: CLDS, 6/10 Stratus Fractus, 4/10 Nimbostratus

2358: CLDS, 7/10 Stratus Fractus, 3/10 Nimbostratus

6 hr. precip: .28 inches of precip
*snow depth: 4.8 inches

6 hr. snowfall: 1 inch

24 hr. precip: 5.4 inches of snow, .68 inches of rain

12 hr. max. temp: 39.2°F 18 hr. min. temp: 20.8°F

TRUE WIND COMPUTER
Exercise 1

PROBLEM 1

Ships Course and Speed	140° 10 KTS
Relative Wind	140° 15 KTS

PROBLEM 2

Ships Course and Speed	350° 25 KTS
Relative Wind	250° 10 KTS

PROBLEM 3

Ships Course and Speed	050° 08 KTS
Relative Wind	100° 05 KTS

PROBLEM 4

Ships Course and Speed	120° 12 KTS
Relative Wind	040° 12 KTS

Problem 5

Ships Course and Speed	360° 25 KTS
Relative Wind	180° 10 KTS

PROBLEM 6

Ships Course and Speed	300° 05 KTS
Relative Wind	250° 15 KTS

PROBLEM 7

Ships Course and Speed	005° 19 KTS
Relative Wind	060° 09 KTS

PROBLEM 8

Ships Course and Speed	190° 30 KTS
Relative Wind	320° 20 KTS

PROBLEM 9

Ships Course and Speed	007° 15 KTS
Relative Wind	150° 30 KTS

PROBLEM 10

Ships Course and Speed	150° 11 KTS
Relative Wind	220° 10 KTS

SHIPBOARD OBSERVATIONS
Columns A thru F
Exercise 1

PROBLEM 1

0000Z 12 JULY

Ships Position	02° 15'N 176° 59'W
Course and Speed	240° at 20 KTS
Relative Wind	110° at 15 KTS
Temperature and Dewpoint	86.2°F, 64.3°F
Sea Water Temperature	77.4°F
Sea Waves	06 Sec 09 FT
Swell Waves	170° 06 Sec 04 FT

PROBLEM 2

0300Z 12 JULY

Ships Position	01° 31'N 178° 29'W
Course and Speed	260° at 22 KTS
Relative Wind	210° at 10 KTS
Temperature and Dewpoint	86.3°F, 59.6°F
Sea Water Temperature	83.4°F
Sea Waves	04 Sec 14 FT
Swell Waves	210° 09 Sec 10 FT

PROBLEM 3

0600Z 12 JULY

Ships Position	01° 29'S 179° 01'W
Course and Speed	170° at 18 KTS
Relative Wind	320° at 10 KTS
Temperature and Dewpoint	88.6°F, 56.1°F
Sea Water Temperature	76.4°F
Sea Waves	08 Sec 05 FT
Swell Waves	090° 06 Sec 07 FT

PROBLEM 4

0900Z 12 JULY

Ships Position	02° 05'S 179° 38'E
Course and Speed	190° at 19 KTS
Relative Wind	040° at 15 KTS
Temperature and Dewpoint	87.9°F, 57.8°F
Sea Water Temperature	75.8°F
Sea Waves	01 Sec 05 FT
Swell Waves	110° 07 Sec 09 FT

PROBLEM 5

1200Z 12 JULY

Ships Position	01° 00'N 178° 59'E
Course and Speed	330° at 25 KTS
Relative Wind	080° at 12 KTS
Temperature and Dewpoint	84.1°F, 61.1°F
Sea Water Temperature	75.6°F
Sea Waves	05 Sec 11 FT
Swell Waves	180° 03 Sec 18 FT

PROBLEM 6

1500Z 12 JULY

Ships Position	04° 18'N 177° 29'E
Course and Speed	280° at 17 KTS
Relative Wind	260° at 10 KTS
Temperature and Dewpoint	82.8°F, 60.4°F
Sea Water Temperature	75.2°F
Sea Waves	07 Sec 09 FT
Swell Waves	330° 08 Sec 11 FT

PROBLEM 7

1800Z 12 JULY

Ships Position	06° 31'N 179° 53'E
Course and Speed	320° at 14 KTS
Relative Wind	350° at 10 KTS
Temperature and Dewpoint	80.9°F, 53.8°F
Sea Water Temperature	76.2°F
Sea Waves	10 Sec 03 FT
Swell Waves	360° 10 Sec 05 FT

PROBLEM 8

2100Z 12 JULY

Ships Position	08° 46'N 178° 47'W
Course and Speed	050° at 15 KTS
Relative Wind	360° at 10 KTS
Temperature and Dewpoint	74.8°F, 48.8°F
Sea Water Temperature	76.9°F
Sea Waves	12 Sec 07 FT
Swell Waves	030° 09 Sec 09 FT

PROBLEM 9

0000Z 13 JULY

Ships Position	10° 41'N 176° 44'W
Course and Speed	030° at 21 KTS
Relative Wind	090° at 13 KTS
Temperature and Dewpoint	74.9°F, 53.7°F
Sea Water Temperature	77.4°F
Sea Waves	05 Sec 12 FT
Swell Waves	250° 06 Sec 10 FT

PROBLEM 10

0300Z 13 JULY

Ships Position	11° 18'N 179° 04'W
Course and Speed	290° at 20 KTS
Relative Wind	200° at 19 KTS
Temperature and Dewpoint	76.8°F, 56.8°F
Sea Water Temperature	75.9°F
Sea Waves	03 Sec 18 FT
Swell Waves	190° 05 Sec 15 FT

PROBLEM 11

0600Z 13 JULY

Ships Position	13° 19'N 179° 31'E
Course and Speed	330° at 27 KTS
Relative Wind	270° at 05 KTS
Temperature and Dewpoint	78.7°F, 61.4°F
Sea Water Temperature	75.8°F
Sea Waves	06 Sec 13 FT
Swell Waves	100° 05 Sec 18 FT

PROBLEM 12

0900Z 13 JULY

Ships Position	15° 18'N 179° 57'W
Course and Speed	070° at 18 KTS
Relative Wind	140° at 10 KTS
Temperature and Dewpoint	79.0°F, 59.6°F
Sea Water Temperature	75.9°F
Sea Waves	08 Sec 14 FT
Swell Waves	230° 07 Sec 09 FT

PROBLEM 13

1200Z 13 JULY

Ships Position	17° 29'N 179° 04'W
Course and Speed	020° at 16 KTS
Relative Wind	210° at 15 KTS
Temperature and Dewpoint	81.9°F, 55.1°F
Sea Water Temperature	76.8°F
Sea Waves	06 Sec 15 FT
Swell Waves	290° 08 Sec 11 FT

PROBLEM 14

1500Z 13 JULY

Ships Position	19° 31'N 178° 57'E
Course and Speed	290° at 25 KTS
Relative Wind	020° at 35 KTS
Temperature and Dewpoint	85.6°F, 51.1°F
Sea Water Temperature	77.2°F
Sea Waves	07 Sec 08 FT
Swell Waves	090° 06 Sec 06 FT

PROBLEM 15

1800Z 13 JULY

Ships Position	21° 29'N 178° 29'E
Course and Speed	350° at 19 KTS
Relative Wind	100° at 08 KTS
Temperature and Dewpoint	89.6°F, 54.3°F
Sea Water Temperature	75.3°F
Sea Waves	08 Sec 10 FT
Swell Waves	140° 04 Sec 03 FT

Exercise 2

PROBLEM 1

0000Z 29 APRIL

Ships Position	14° 42'N 160° 13'E
Course and Speed	240° at 14 KTS
Relative Wind	087° at 21 KTS
Temperature and Dewpoint	56.7°F, 50.0°F
Sea Water Temperature	49.6°F
Sea Waves	10 Sec 07 FT
Swell Waves	120° 14 Sec 08 FT

PROBLEM 2

0300Z 30 APRIL

Ships Position	22° 16'N 141° 48'W
Course and Speed	200° at 25 KTS
Relative Wind	091° at 15 KTS
Temperature and Dewpoint	62.9°F, 60.0°F
Sea Water Temperature	60.4°F
Sea Waves	08 Sec 05 FT
Swell Waves	240° 15 Sec 04 FT

PROBLEM 3

0600 01 APRIL

Ships Position	38° 14'N 72° 31'E
Course and Speed	110° at 07 KTS
Relative Wind	223° at 18 KTS
Temperature and Dewpoint	40.0°F, 37.2°F
Sea Water Temperature	47.6°F
Sea Waves	04 Sec 08 FT
Swell Waves	310° 04 Sec 11 FT

PROBLEM 4

0000Z 15 APRIL

Ships Position	12° 31'S 89° 45'E
Course and Speed	075° 14 KTS
Relative Wind	077° 28 KTS
Temperature and Dewpoint	78.0°F, 66.2°F
Sea Water Temperature	61.3°F
Sea Waves	12 Sec 11 FT
Swell Waves	100° 11 Sec 07 FT

PROBLEM 5

1200Z 30 MARCH

Ships Position	45° 38'N 76° 26'W
Course and Speed	045° at 17 KTS
Relative Wind	032° at 13 KTS
Temperature and Dewpoint	76.5°F, 72.0°F
Sea Water Temperature	68.0°F
Sea Waves	05 Sec 06 FT
Swell Waves	045° 09 Sec 05 FT

PROBLEM 6

1500Z 1 OCTOBER

Ships Position	50° 40'N 54° 52'E
Course and Speed	060° at 11 KTS
Relative Wind	250° at 23 KTS
Temperature and Dewpoint	29.2°F, 27.0°F
Sea Water Temperature	29.6°F
Sea Waves	07 Sec 12 FT
Swell Waves	030° 06 Sec 03 FT

PROBLEM 7

1800 2 SEPTEMBER

Ships Position	41° 41'N 71° 06'W
Course and Speed	180° 19 KTS
Relative Wind	146° at 07 KTS
Temperature and Dewpoint	85.2°, 80.6°F
Sea Water Temperature	80.4°F
Sea Waves	09 Sec 4 FT
Swell Waves	200° 5Sec 8FT

PROBLEM 8

2100Z 4 NOVEMBER

Ships Position	36° 06'N 12° 19'W
Course and Speed	350° 12 KTS
Relative Wind	210° at 25 KTS
Temperature and Dewpoint	52.2°F, 45.1°F
Sea Water Temperature	44.3°F
Sea Waves	11 Sec 08 FT
Swell Waves	180° 07 Sec 08 FT

PROBLEM 9

0000Z 5 DECEMBER

Ships Position	25° 29'N 82° 29'W
Course and Speed	340° at 10 KTS
Relative Wind	021° at 19 KTS
Temperature and Dewpoint	73.2°F, 65.4°F
Sea Water Temperature	66.1°F
Sea Waves	06 Sec 10 FT
Swell Waves	090° 10 Sec 04 FT

PROBLEM 10

0300Z 15 DECEMBER

Ships Position	22° 04'N 46° 14'W
Course and Speed	360° at 26 KTS
Relative Wind	207° at 14 KTS
Temperature and Dewpoint	66.6°F, 60.9°F
Sea Water Temperature	59.9°F
Sea Waves	13 Sec 10 FT
Swell Waves	050° 18 Sec 2 FT

PROBLEM 11

0600Z 29 DECEMBER

Ships Position	68° 00'S 179° 56'E
Course and Speed	095° at 15 KTS
Relative Wind	030° at 30 KTS
Temperature and Dewpoint	46.2°F, 40.0°F
Sea Water Temperature	41.4°F
Sea Waves	10 Sec 15 FT
Swell Waves	050° 15 Sec 5 FT

PROBLEM 12

0900Z 3 JANUARY

Ships Position	48° 02'N 121° 50'W
Course and Speed	005° at 13 KTS
Relative Wind	010° at 40 KTS
Temperature and Dewpoint	51.0°F, 42.0°F
Sea Water Temperature	47.6°F
Sea Waves	12 Sec 08 FT
Swell Waves	Calm

PROBLEM 13

1200Z 26 JANUARY

Ships Position	64° 54'S 58° 19'E
Course and Speed	345° at 13 KTS
Relative Wind	340° at 40 KTS
Temperature and Dewpoint	28.0°F, 26.2°F
Sea Water Temperature	31.6°F
Sea Waves	13 Sec 05 FT
Swell Waves	130° 06 Sec 10 FT

PROBLEM 14

1500Z 22 FEBRUARY

Ships Position	14° 14'S 23° 17'W
Course and Speed	120° at 20 KTS
Relative Wind	120° at 20 KTS
Temperature and Dewpoint	61.6°F, 50.2°F
Sea Water Temperature	51.8°F
Sea Waves	10 Sec 03 FT
Swell Waves	210° 14 Sec 15 FT

PROBLEM 15

1800Z 26 MARCH

Ships Position	15° 00'S 15° 00'E
Course and Speed	180° at 40 KTS
Relative Wind	090° at 25 KTS
Temperature and Dewpoint	81.1°F, 70.0°F
Sea Water Temperature	72.1°F
Sea Waves	03 Sec 02 FT
Swell Waves	140° 08 Sec 06 FT

PART II SURFACE WEATHER OBS (SHIP/AVIATION)	USS CHANUTE	DATE 24 JUNE 1983	QUARTERMASTER / AEROGRAPHER'S MATE X

TYPE (1)	TIME (2)	SKY AND CEILING (3)	VSBY (4)	WX AND OBSTR TO VIS (5)	SLP (6)	TEMP (7)	DEWPT (8)	DRCTN (9)	SPEED (10)	CHAR (11)	ALSTG (12)	REMARKS AND SUPPLEMENTARY CODED DATA (13)	OBS	STATION PRESS (17)	SKY CVR (21)	POSITION QLLIII (A)	COURSE (B)	SPEED (C)	SEA WATER (D)	SEA WAVES PERIOD HEIGHT (E)	SWELL WAVES DIRECT PERIOD HEIGHT (F)
SA	2358	250-OVC	4	H		63.5	51	36	10				AG	29.875	10	733118	340	10	64.0	0102	280813
SA	0058	250-OVC	4	H		64.0	52	31	15				AG	29.875	10	733118	340	7	64.0	0102	280813
SA	0158	250-OVC	5	H		63.2	54	34	13				AG	29.880	10	733118	340	12	64.0	0102	280810
SA	0258	250-BKN	5	H		63.9	54	34	10				AG	29.880	6	733118	240	10	64.9	0102	280810
SA	0358	250-BKN	5	H		63.2	53	33	10				AG	29.885	6	733118	360	22	64.9	0102	270810
SA	0458	120 SCT 250-BKN	5	H		63.0	54	01	12				AG	29.885	8	733118	180	27	64.9	0102	270810
SA	0558	120 SCT E250 OVC	5	H		64.0	52	01	09				AG	29.890	10	733118	010	15	64.9	0102	280810
SA	0658	120 SCT E250 OVC		H		64.5	54	01	09				AG	29.890	10	733118	135	16	64.9	0102	280810
SA	0758	E120 BKN 250 OVC	7			63.0	55	24	16				AG	29.840	10	732118	145	14	64.9	0102	280810
RS	0858	E100 OVC	5	R-H		64.5	54	36	14				AG	29.875	10	732118	195	13	64.9	0102	280810
RS	0958	E100 OVC	5	H		64.2	54	35	10				AG	29.905	10	732117	150	13	64.9	0102	280810
RS	1058	E100 OVC	4	R-H		63.0	53	36	09				AG	29.920	10	732117	310	13	63.1	0102	280810
SA	1158	E80 BKN 200 OVC	6	R-		63.2	54	01	25				AG	29.910	10	732118	310	15	63.0	0102	270810
RS	1258	E80 SCT E200 OVC	7			63.5	53	36	13				AG	29.905	10	732118	110	15	63.0	0102	270810
SA	1358	E80 BKN 200 OVC	7			62.5	56	03	14				AG	29.915	10	732118	310	15	63.0	0102	270810
RS	1458	E70 BKN 200 OVC	7	R-		61.8	55	03	15				AG	29.920	10	732118	065	17	63.0	0102	270610
SA	1558	E70 BKN 200 OVC	7	R-		61.0	56	02	19				AG	29.935	9	732118	300	17	63.0	0103	280813
RS	1658	E60 BKN 150 BKN 200 BKN	7			62.7	57	06	19				AG	29.940	9	732118	210	17	63.0	0203	290914
SA	1758	E60 BKN 150 BKN 200 BKN	7			63.8	57	04	20				AG	29.945	8	732119	000	15	63.0	0205	290713
SA	1858	E60 BKN 140 BKN 200 BKN	7			66.0	57	04	18				AG	29.935	9	732118	000	15	64.9	0204	290713
RS	1958	E50 BKN 140 BKN 200 BKN	6	R-		63.2	55	10	15				AG	29.930	9	732118	110	15	64.9	0204	290712
RS	2058	35 SCT E100 BKN 200 BKN	7			63.0	56	14	10				AG	29.900	7	732118	280	22	64.9	0202	290712
SA	2158	35 SCT E100 BKN 200 BKN	7			63.9	55	16	04				AG	29.875	8	732118	155	18	64.9	0202	290712
SA	2258	30 SCT E100 BKN 200 BKN	7			63.0	54	00	00				AG	29.880	8	732118	340	24	64.9	0000	290812

42

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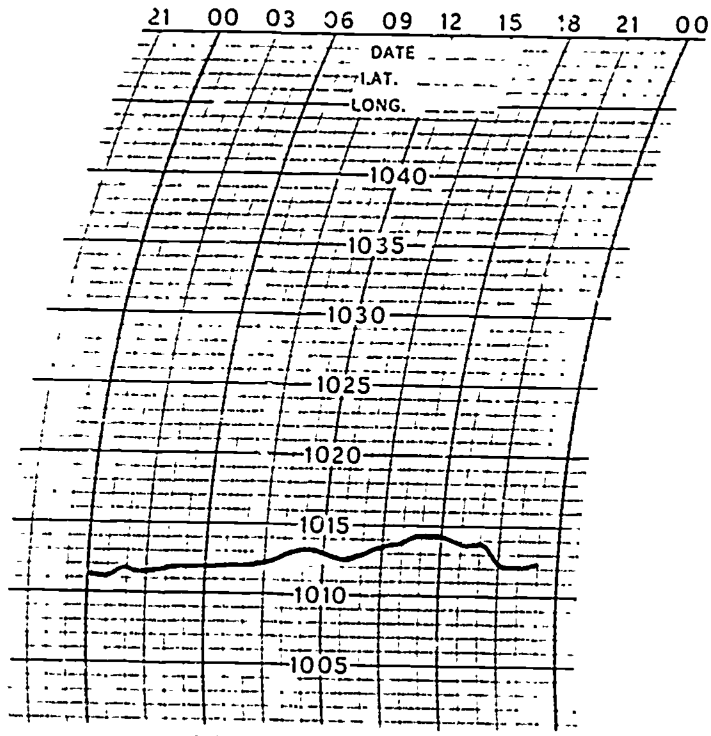

24 JUNE 1983

0258: CLDS: 6/10 Cirrus Uncinus
Posit: 32°58'N 117°55'W Posit 3hr. ago: 32°58'N 118°02'W

0558: CLDS: 4/10 Altostratus, 6/10 Cirrus Spassatus
Posit: 32°43'N 118°03'W

0858: CLDS: 10/10 Nimbostratus
Posit: 32°14'N 117°54'W

1158: CLDS: 8/10 Nimbostratus, 2/10 Cirrostratus
Posit: 32°07'N 118°08'W

1458: CLDS: 9/10 Nimbostratus, 1/10 Cirrostratus
Posit: 32°15'N 117°59'W

1758: CLDS: 6/10 Nimbostratus, 1/10 Altostratus, 1/10 Cirrostratus
Posit: 32°19'N 118°32'W

2058: CLDS: 2/10 Stratocumulus, 4/10 Altostratus, 1/10 Cirrostratus
Posit: 32°32'N 118°15'W

720

PART I SURFACE WEATHER OBS. (SHIP/AVIATION)	USS CHANUTE	DATE 20 NOV. 1983	QUARTERMASTER	X
			AEROGRAPHER'S MATE	X

TYPE (1)	TIME (2)	SKY AND CEILING (3)	VSBY (4)	WX AND OBSTR. TO VIS (5)	SLP (6)	TEMP (7)	DEW PT (8)	DRCTN (9)	SPEED (10)	CHAR (11)	ALSTG (12)	REMARKS AND SUPPLEMENTRY CODED DATA (13)	OBS	STATION PRESS (17)	SKY CVR (21)	POSITION QLLLL (A)	COURSE (B)	SPEED (C)	SEA WATER (D)	SEA WAVES PERIOD HEIGHT (E)	SWELL WAVES DIRECTION PERIOD HEIGHT (F)
SA	2358	200 SCT	5	H		60.9	53	33	08				AG	29.935	4	732118	300	18	60.1	0102	270606
SA	0058	-X 200 SCT	5	H		61.5	56	28	08			H2	AG	29.940	5	732118	170	23	60.1	0102	270606
SA	0158	-X 200 SCT	5	H		59.8	55	32	08			H1	AG	29.950	3	732118	325	15	60.1	0102	270606
SA	0258	-X 200 SCT	5	FH		59.8	55	31	06			FH2	AG	29.955	3	732118	340	14	64.9	0102	270506
SA	0358	-X 200 SCT	5	FH		60.0	57	30	07			FH1	AG	29.965	3	733118	335	15	64.9	0104	280506
SA	0458	-X200 SCT	4	FH		60.0	57	35	10			FH3	AC	29.975	4	732118	345	15	64.9	0104	280606
RS	0558	-X200 SCT	2	FH		60.0	57	35	07			FH2	AG	29.970	3	733118	345	15	64.9	0104	280606
RS	0658	-X 200 SCT	4	FH		60.0	57	35	10			FH2	AG	29.980	3	732119	210	15	64.9	0104	280606
SA	0758	-X 200 SCT	4	FH		60.0	57	36	07			FH2	AG	29.970	3	732119	210	15	64.9	0104	280606
SA	0858	200-SCT	4	H		59.1	56	02	05				AG	29.955	1	732119	140	14	64.0	0104	280606
SA	0958	CLR	4	H		59.0	57	00	00				AG	29.955	0	732119	320	15	64.0	0000	280608
SA	1058	-X	5	H		58.9	57	00	00			H2	AG	29.955	2	732119	140	15	64 0	0000	280606
SA	1158	-X	5	H		59.2	57	09	04			H1	AG	29.950	1	732119	320	15	64.0	0102	280608
SA	1258	X	5	H		59.1	57	02	06			H2	AG	29.940	2	732119	140	15	64 0	0102	280608
SA	1358	-X	4	H		59.0	57	01	06			H3	AG	29.930	3	732119	140	15	64.0	0102	280608
RS	1458	-X12 SCT E100 BKN	2	H		59.5	58	03	06			H3	AG	29.940	6	732119	320	15	64 0	0102	281016
RS	1558	-X 250 BKN	1½	H		60.0	58	01	0[illegible]			H3	AG	29.955	6	732119	330	15	64 0	0102	281016
RS	1658	-X 250 - BKN	4	H		60.5	57	35	08			H3	AG	29.970	8	732119	320	22	64 0	0102	281016
SA	1758	-X 250-BKN	5	H		62 8	57	03	08			H1	AG	29.975	6	732119	110	22	64.0	0102	281013
SA	1858	-X 250- SCT	5	H		64.0	56	02	12			H1	AG	29.970	5	732118	080	22	64.0	0102	281013
SA	1958	250 - SCT	7			65.5	55	01	06				AG	29.940	5	732118	220	20	64.0	0102	281013
SA	2058	250 - SCT	7			64 0	56	34	10				AG	29.905	4	732118	065	25	64 0	0102	280813
SA	2158	250 - BKN	7			63.1	56	35	17				AG	29.870	9	733118	065	25	64.0	0102	280813
SA	2258	250 - OVC	7			64 0	56	34	10			H ALQDS	AG	29.870	10	733118	340	15	63.1	0102	280813

44

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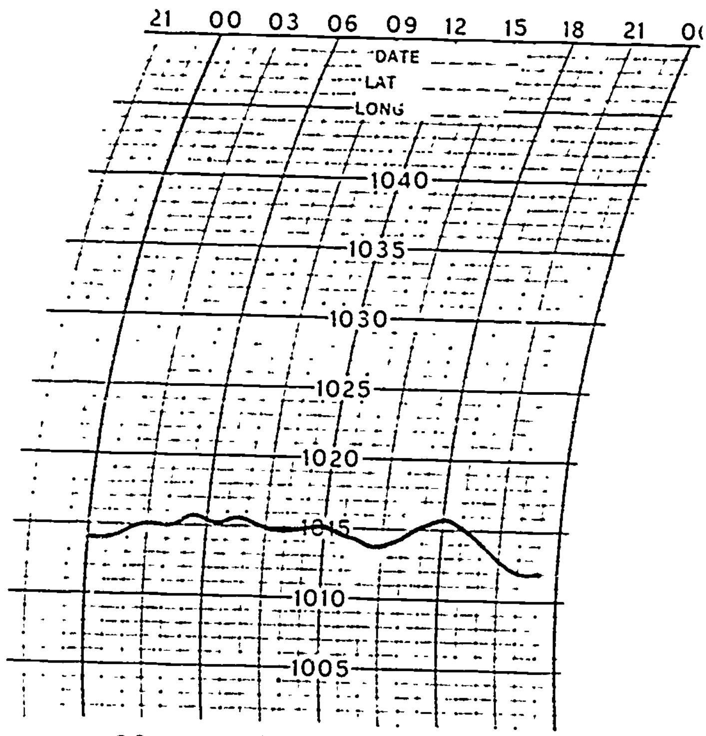
21



20 November 1983

0258: CLDS: 1/10 Cirrus Spissatus
Posit: 32°20'N 118°12'W Posit 3hr. ago: 34°26'N 118°19'W

0558: CLDS: 1/10 Cirrus Spissatus
Posit: 32°36'N 118°21'W

0858: CLDS: 1/10 Cirrus
Posit: 32°08'N 118°88'W

1158: Posit: 32°08'N 118°44'W

1458: CLDS: 2/10 Stratus Fractus, 1/10 Altostratus
Posit: 32°08'N 118°30'W

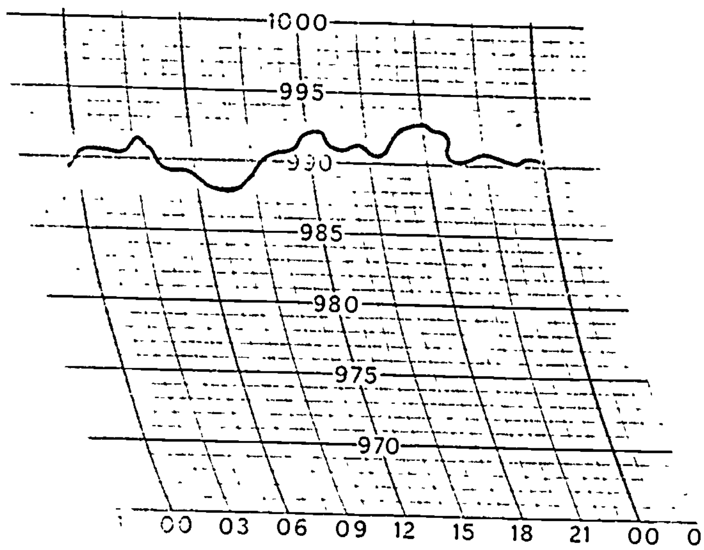
1758: CLDS: 5/10 Cirrus Uncinus
Posit: 32°20'N 118°31'W

2058: CLDS: 4/10 Cirrus Uncinus
Posit: 32°19'N 118°16'W

PART I SURFACE WEATHER OBSERVATIONS (SHIP/AVIATION) | U.S.S. MIDWAY CV-41 | DATE 05 NOV 1983 | QUARTERMASTER AEROGRAPHER'S MATE X

TYPE (1)	TIME (2)	SKY AND CEILING (3)	VSBY (4)	WX AND OBSTRN TO VIS (5)	SLP (6)	TEMP (7)	DEW PT (8)	DRCTN (9)	SPEED (10)	CHAR (11)	ALSTG (12)	REMARKS AND SUPPLEMENTARY CODED DATA (13)	OBS (15)	STATION PRESSURE (17)	SKY CVR (21)	POSITION QLLIII (A)	COURSE (B)	SPEED (C)	SEA WATER (D)	SEA WAVES PERIOD HEIGHT (E)	SWELL WAVES DIRECTION PERIOD HEIGHT (F)
SA	2358	CLR	6			62.5	58	26	10				EH	29.230	0	138152	340	10	59.4	0404	010606
SA	0058	20 SCT	6			62.8	58	29	14				EH	29.255	2	138152	330	18	59.3	0405	010607
SA	0158	20 SCT	6			63.8	59	33	13				EH	29.245	4	138152	240	12	60.1	0405	010607
RS	0258	E20 BKN	5	RW-		63.9	59	28	20				EH	29.265	6	138152	310	10	55.8	0406	010607
SA	0358	E20 BKN	4	RW-		64.6	60	27	16				EH	29.230	7	138152	220	15	56.9	0406	010607
RS	0458	E20 BKN	6			65.4	60	26	16				EH	29.215	8	138152	200	14	57.2	0406	010708
SA	0558	E20 BKN 80 BKN	6			66.1	62	24	10				EH	29.195	8	138152	010	12	54.9	0506	010708
SA	0658	E20 BKN 80 BKN	6			67.6	64	30	06				EH	29.175	8	138152	185	18	55.7	0505	020709
SA	0758	E20 BKN 80 OVC	6			68.8	64	32	12				EH	29.180	10	138151	290	13	53.5	0504	020708
RS	0858	E20 BKN 80 OVC	5	RW-		69.8	65	36	05				EH	29.205	10	138151	240	16	52.6	0504	020708
SA	0958	E20 BKN 80 OVC	5	RW-		69.9	66	28	18				EH	29.250	10	138151	095	14	52.6	0504	010607
SA	1058	E20 BKN 80 OVC	5	RW-		70.3	66	24	13				EH	29.265	10	137152	100	20	58.5	0404	010607
SA	1158	E20 BKN 80 OVC	4	F		70.6	67	25	10				EH	29.295	10	137152	120	21	53.7	0403	360606
RS	1258	20 SCT E80 BKN	4	F		69.8	67	34	15				EH	29.280	9	137152	085	13	52.4	0403	360606
SA	1358	20 SCT E80 BKN	4	F		69.7	67	34	10				EH	29.265	9	137152	005	13	50.9	0403	360506
SA	1458	20 SCT 80 SCT	4	F		69.5	67	33	10				EH	29.260	5	138153	020	10	49.9	0303	350505
RS	1558	-X 20 SCT 80 SCT	2	F		68.4	66	01	18			F2	EH	29.275	5	138153	080	14	49.4	0202	350405
SA	1658	-X 20 SCT	2	F		67.0	66	02	15			F3	EH	29.310	5	138153	060	10	49.0	0202	350405
RS	1758	-X E20 BKN	1	F		66.2	65	05	05			F5	EH	29.325	7	138153	140	09	50.2	0202	340305
RS	1858	-X E20 BKN	1/2	F		66.1	64	36	18			F7	EH	29.305	9	138153	150	18	51.2	0201	340305
RS	1958	W4X	1/2	F		64.7	63	36	13				EH	29.245	10	137154	150	16	51.3	0201	330305
RS	2058	W3X	1	F		62.6	62	01	10				EH	29.260	10	137154	130	13	51.6	0101	330304
SA	2158	W2X	1	F		63.1	61	33	10				EH	29.245	10	137153	280	11	51.2	0101	330304
RS	2258	W2X	1/2	F		58.7	59	35	15				EH	29.250	10	137153	195	12	50.9	0000	330304

725



05 NOV 1983

0258: CLDS, 6/10 Cumulus Mediocres

Posit Now: 38° 18'N 152° 03'E
Posit 3 hr. ago: 38° 10'N 152° 27'E

0558: CLDS, 6/10 Cumulus Mediocres, 2/10 Altocumulus resulting from the spreading out of cumulus

Posit: 38° 02'N 151° 35'E

0858: CLDS, 7/10 Cumulus Mediocres, 3/10 Altocumulus resulting from the spreading out of cumulus

Posit: 37° 45'N 151° 00'E

1158: CLDS, 6/10 Cumulus Mediocres, 4/10 Altocumulus

Posit: 37° 05'N 152° 15'E

1458: CLDS, 2/10 Cumulus Humulus, 3/10 Altocumulus

Posit: 37° 40'N 152° 38'E

1758: CLDS, 2/10 Cumulus Humulus

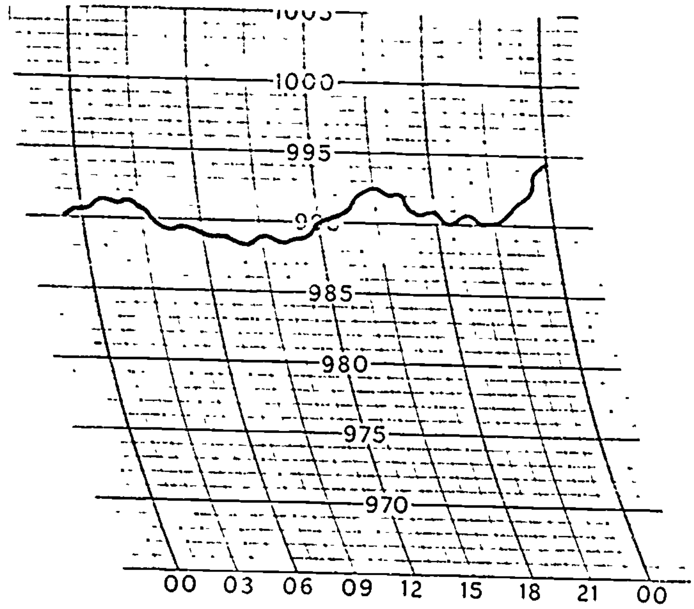
Posit: 37° 46'N 153° 05'E

2058: Posit: 37° 12'N 153° 48'E

PART I SURFACE WEATHER OBSERVATIONS (SHIP/AVIATION) | U.S.S. SARATOGA | DATE 29 JAN 84 | QUARTERMASTER / AEROGRAPHER'S MATE X

TYPE (1)	TIME (2)	SKY AND CEILING (3)	VSBY (4)	WX AND OBSTRN TO VIS (5)	SLP (6)	TEMP (7)	DEWPT (8)	DRCTN (9)	SPEED (10)	CHAR (11)	ALSTG (12)	REMARKS AND SUPPLEMENTARY CODED DATA (13)	OBS (15)	STATION PRESSURE (17)	SKY CVR (21)	POSITION QLLIII (A)	COURSE (B)	SPEED (C)	SEA WATER (D)	SEA WAVES PERIOD HEIGHT (E)	SWELL WAVES DIRECTION PERIOD HEIGHT (F)
SA	2358	-X 30 SCT	5	BY		58.6	54	12	22			BY3	EH	29.255	4	301179	160	14	49.5	0610	200813
SA	0058	-X 30 SCT	5	BY		57.5	53	15	28			BY3	EH	29.275	5	301179	140	18	48.8	0610	200813
SA	0158	-X 30 SCT	5	BY		55.9	52	16	22			BY3	EH	29.270	5	301179	100	15	50.4	0711	211015
SA	0258	-X 30 SCT	5	BY		55.4	51	16	25			BY3	EH	29.265	5	301180	090	14	50.6	0711	211015
SA	0358	30 SCT 80 SCT	6			56.3	51	18	21				EH	29.220	5	501180	180	05	51.0	0712	241116
SA	0458	30 SCT E80 BKN	6			57.1	53	18	20				EH	29.220	6	501180	-	-	51.4	0712	241116
SA	0558	30 SCT E80 BKN	6			58.8	54	19	10			RWU E	EH	29.210	6	501179	120	10	51.6	0611	241014
RS	0658	E30 BKN 80 BKN	5	RW-		59.5	56	17	23				EH	29.190	6	501179	120	08	51.2	0712	261116
SA	0758	E30 BKN 80 BKN	5	RW-		60.2	58	16	28				EH	29.180	6	501178	090	15	51.3	0813	281116
SA	0858	E30 BKN 80 OVC	5	RW-		60.4	58	11	33			OCNL LTGIC E	EH	29.190	10	502178	130	10	52.8	0913	291116
SA	0958	E30 BKN 80 OVC	5	RW-		60.3	58	08	29			OCNL LTGIC E	EH	29.190	10	502178	180	10	51.9	0914	291018
RS	1058	30 SCT 80 SCT 250 SCT	6			60.8	57	07	25			OCNL LTGIC E	EH	29.200	5	503178	165	10	52.9	0915	301018
SA	1158	30 SCT 80 SCT 250 SCT	6			64.3	59	06	20			OCNL LTGIC E	EH	29.235	5	503178	150	14	52.6	0915	301320
SA	1258	80 SCT 250 SCT	6			68.4	61	03	20				EH	29.260	5	503178	245	10	52.3	1016	311420
SA	1358	80 SCT 250 SCT	6			70.6	62	36	19				EH	29.290	5	503178	215	17	51.5	1017	281519
SA	1458	80 SCT 250 SCT	6			71.8	63	36	25				EH	29.305	5	504178	210	13	52.0	1016	261719
SA	1558	20 SCT E80 BKN	6			70.5	64	02	13				EH	29.290	7	504178	195	11	51.2	0915	241818
SA	1658	20 SCT E80 BKN	6			70.0	66	07	18				EH	29.265	8	504178	170	12	51.0	0915	231818
RS	1758	8 SCT E25 BKN 80 OVC	4	RW-		70.1	66	14	21			CB E MOVG W	EH	29.250	10	505178	170	15	51.3	0814	211817
RS	1858	8 SCT E25 BKN 80 OVC	4	RW-		68.8	65	12	15			CB E MOVG W	EH	29.245	10	505178	090	13	51.4	0813	211617
RS	1958	E8 BKN 20 OVC	3	TRW-		67.7	62	06	12			TB58 OVHD MOVG W	EH	29.235	10	505178	075	12	50.0	0712	201516
RS	2058	E8 BKN 20 OVC	1	TRW		63.3	61	04	17			TW MOVG W OCNL LTGIC	EH	29.240	10	504178	005	14	48.5	0711	191310
RS	2158	E8 BKN 20 OVC	2	TRW-		62.2	60	07	21			TW MOVG W OCNL LTGIC	EH	29.260	10	504178	355	18	48.0	0610	181008
RS	2258	E8 BKN 20 OVC	1	TRW		60.8	58	08	24			TW MOVG W OCNL LTGIC	EH	29.310	10	503178	320	19	47.5	0609	160306

48



29 JAN 1984

0258: CLDS, 2/10 Towering Cumulus

Posit Now: 01° 40'S 179° 50'E
Posit 3 hr. ago: 01° 05'S 179° 20'E

0558: CLDS, 3/10 Towering Cumulus, 3/10 Altocumulus spreading from cumulus

Posit: 01° 30'S 179° 28'W

Rainshowers are 3km west of the station

0858: CLDS, 6/10 Towering Cumulus, 4/10 Altocumulus spreading from cumulus

Posit: 01° 33'S 178° 20'W

1158: CLDS, 2/10 Towering Cumulus, 2/10 Altocumulus spreading from cumulus, 1/10 Cirrus (anvil)

Posit: 02° 45'S 178° 01'W

1458: CLDS, 3/10 Altocumulus, 2/10 Cirrus (filaments)

Posit: 03° 58'S 178° 23'W

1758: CLDS, 3/10 CB, 3/10 Towering Cumulus, 4/10 Altocumulus from cumulus

Posit: 04° 40'S 178° 25'W

2058: CLDS, 6/10 CB, 4/10 Towering Cumulus

Posit: 04° 26'S 178° 00'W

PIBAL
EXERCISE 1

Time of Observation: 22 October 1500Z

Observation taken at: Chanute AFB (72531)

Observation transmitted from: Chanute AFB (72531)

Time (Minutes)	Elevation	Azimuth
01	35.64	021.59
02	31.92	034.29
03	29.89	048.79
04	28.28	056.00
05	27.61	063.92
06	26.89	068.90
07	26.58	073.41
08	25.69	077.21
09	24.79	080.19
10	23.69	082.45
11	22.51	084.89
12	21.79	086.00
13	21.00	086.56
14	20.49	086.45
15	20.11	086.28
16	19.56	085.40
17	19.02	085.21
18	18.46	085.00
19	18.11	085.12
20	17.44	085.19

730

EXERCISE 2

Time of Observation: 24 October 1800Z

Observation taken at: Moffett Field Ca. (72493)

Observation transmitted from: Fallon Nv. (72583)

Time (Minutes)	Elevation	Azimuth
01	22.42	096.51
02	24.78	105.92
03	26.60	111.89
04	26.41	111.90
05	24.82	111.09
06	22.88	109.90
07	21.71	107.88
08	20.40	103.59
09	19.72	100.68
10	19.21	099.22
11	18.87	098.39
12	18.66	097.01
13	18.38	096.39
14	18.19	096.21
15	17.99	096.30
16	17.76	096.49
17	17.57	097.28
18	17.34	098.50
19	17.13	099.20
20	16.97	099.58

EXERCISE 3

Time of Observation: 26 October 1200Z

Observation taken at: Glenview, Il. (72534)

Observation Transmitted From: Chanute, Il. (72531)

Time (Minutes)	Elevation	Azimuth
01	18.05	165.89
02	M	M
03	16.75	175.71
04	17.20	185.17
05	16.95	190.90
06	16.70	195.55
07	16.77	196.52
08	16.94	198.54
09	17.07	201.36
10	17.12	202.73
11	16.86	203.67
12	16.65	204.55
13	16.33	205.14
14	16.27	205.68
15	16.06	206.20
16	16.04	207.11
17	15.63	207.68
18	15.25	208.45
19	14.82	209.76
20	14.57	210.89

732

EXERCISE 4

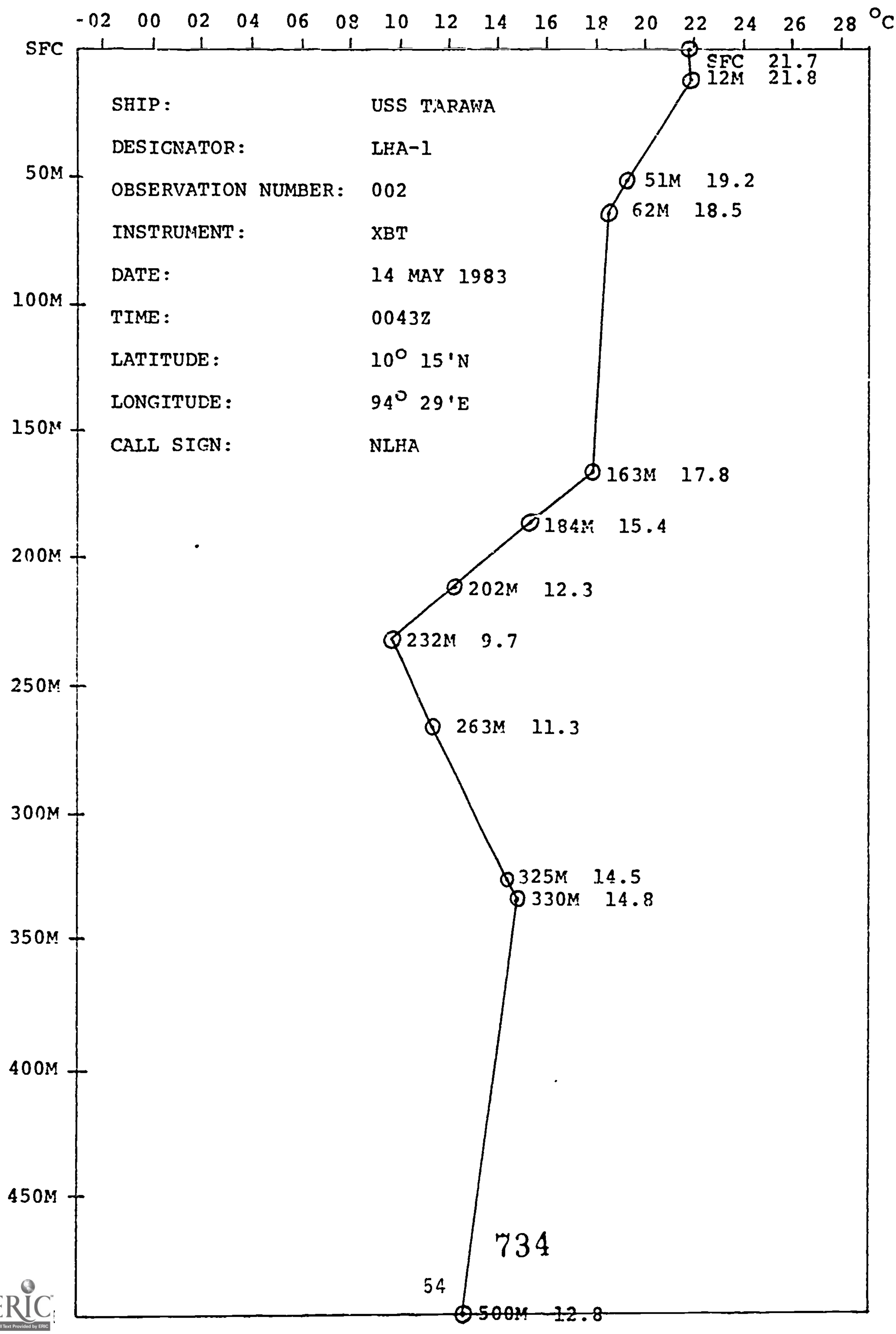
Time of Observation: 15 Septemb... 1700Z

Observation taken at: Peoria, Il. (72532)

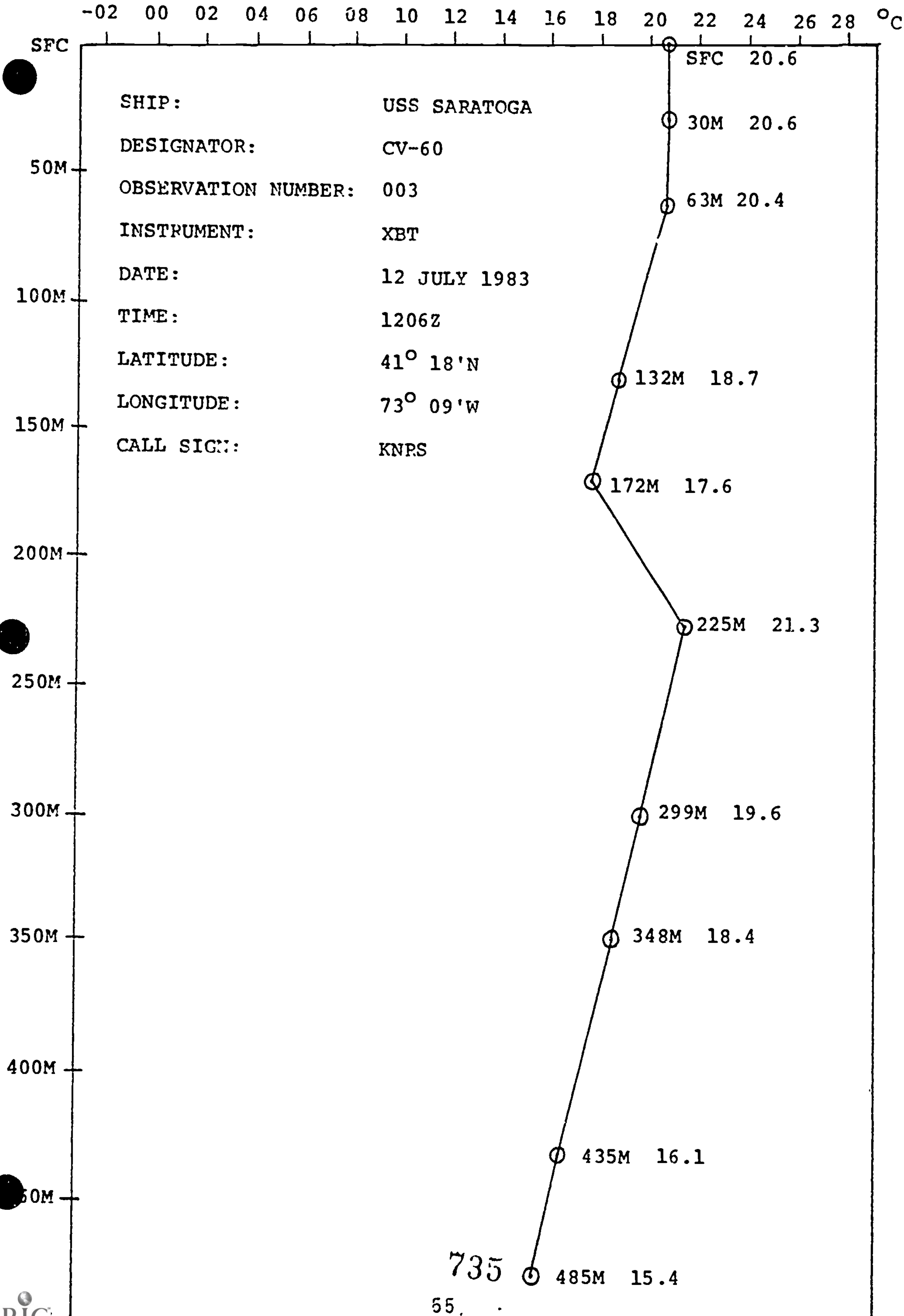
Observation transmitted from: Chanute, Il. (72531)

Time (Minutes)	Elevation	Azimuth
01	30.15	180.00
02	27.27	180.14
03	25.36	180.21
04	28.21	180.33
05	31.04	180.21
06	35.07	180.00
07	40.21	176.04
08	53.76	170.47
09	61.54	162.31
10	69.77	122.01
11	75.21	076.14
12	70.33	060.41
13	62.14	048.84
14	57.56	042.24
15	52.14	037.73
16	47.93	032.29
17	43.01	029.08
18	40.00	025.76
19	35.14	021.41
20	29.99	012.12

EXERCISE 1


-02 00 02 04 06 08 10 12 14 16 18 20 22 24 26 28 °C
SFC
50M
100M
150M
200M
250M
300M
350M
400M
450M
SHIP: USS TARAWA
DESIGNATOR: LHA-1
OBSERVATION NUMBER: 002
INSTRUMENT: XBT
DATE: 14 MAY 1983
TIME: 0043Z
LATITUDE: 10° 15'N
LONGITUDE: 94° 29'E
CALL SIGN: NLHA
SFC 21.7
12M 21.8
51M 19.2
62M 18.5
163M 17.8
184M 15.4
202M 12.3
232M 9.7
263M 11.3
325M 14.5
330M 14.8
500M 12.8

EXERCISE 2



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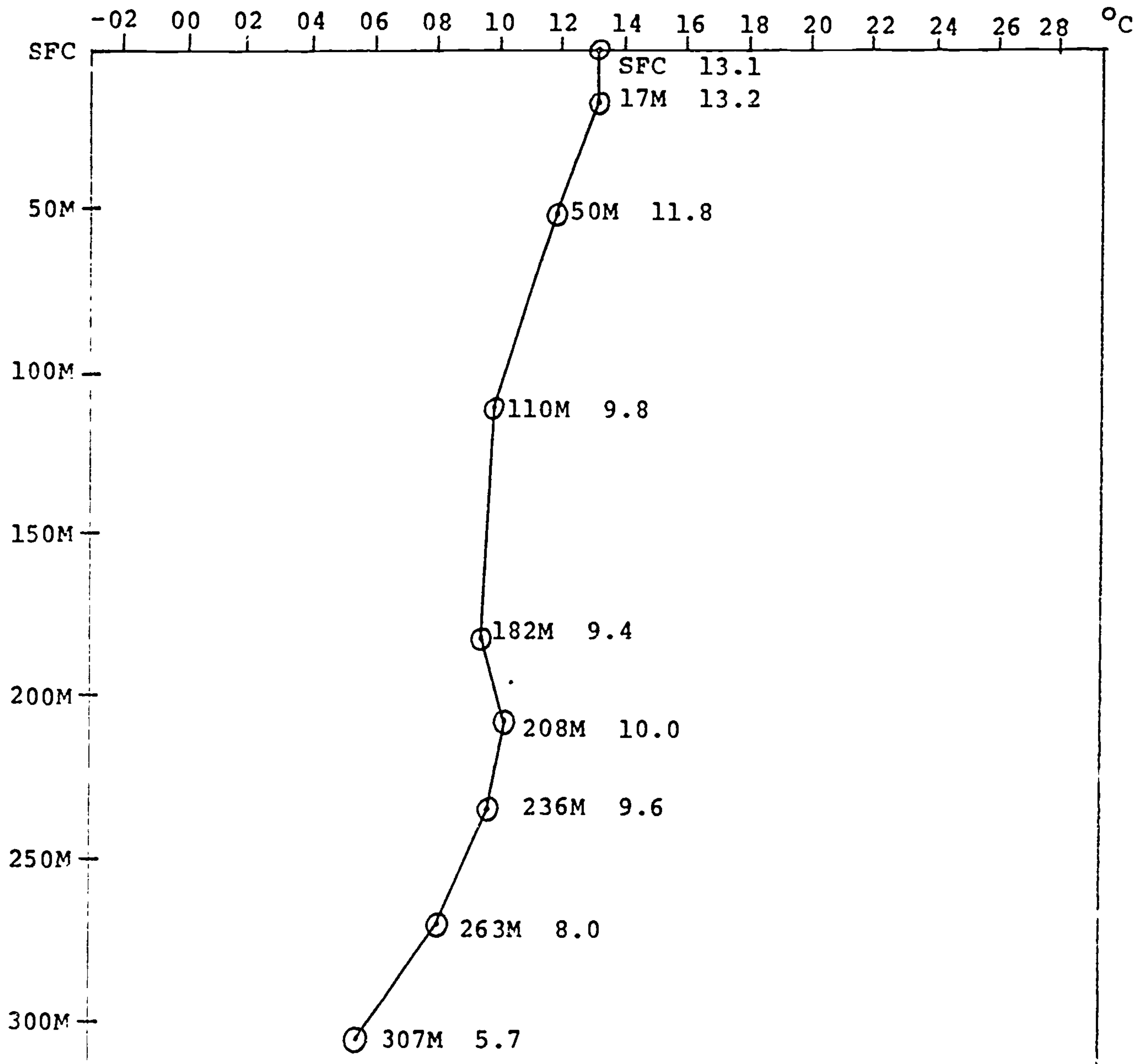
EXERCISE 3



SHIP:	USS NEW ORLEANS
DESIGNATOR:	LPH-11
OBSERVATION NUMBER:	001
INSTRUMENT:	XBT
DATE:	25 DECEMBER 1983
TIME:	2348Z
LATITUDE:	42° 18'N
LONGITUDE:	76° 09'W
CALL SIGN:	NLPH

350M 400M 450M

DECODING BATHYTHERMOGRAPH

1 MESSAGE PREFIX	2 DATE (GMT)	3 TIME (GMT)	QUAD / 4 LATITUDE	5 LONGITUDE	6 INDICATOR GROUP
JJXX	14074	20551	1625	16620	88888

BATHYTHERMOGRAPH TRACE READINGS

DEPTH TEMP	DEPTH TEMP	DEPTH TEMP	DEPTH TEMP	DEPTH TEMP	DEPTH TEMP
00194	51194	90187	99901	36168	99902
74136	99903	22121	68104	99904	45098
84081	99905	00072	00000		RADIO CALL NJFK

1 MESSAGE PREFIX	2 DATE (GMT)	3 TIME (GMT)	QUAD / 4 LATITUDE	5 LONGITUDE	6 INDICATOR GROUP
JJXX	13044	17551	73221	17217	88888

BATHYTHERMOGRAPH TRACE READINGS

DEPTH TEMP	DEPTH TEMP	DEPTH TEMP	DEPTH TEMP	DEPTH TEMP	DEPTH TEMP
00220	20230	98216	99901	50163	97147
99902	48133	99903	12117	99904	21110
71108	00000				RADIO CALL USMC

1 MESSAGE PREFIX	2 DATE (GMT)	3 TIME (GMT)	QUAD / 4 LATITUDE	5 LONGITUDE	6 INDICATOR GROUP
JJXX	05014	11451	34015	14510	88888

BATHYTHERMOGRAPH TRACE READINGS

DEPTH TEMP	DEPTH TEMP	DEPTH TEMP	DEPTH TEMP	DEPTH TEMP	DEPTH TEMP
00231	35231	75224	99901	35217	99902
40194	85181	99903	50171	96165	99904
60161	00000				RADIO CALL NJRB

737

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DECODING RADFO MESSAGES

Exercise 1

A. PRE BURST PREDICTION, 36HR FCST FROM 06Z 05 FEB 84
27405 53135 00748 12125 00610

B. PRE BURST PREDICTION, 24HR FCST FROM 12Z 13 MAR 84
14735 41840 00810 20545 00905

C. PRE BURST PREDICTION, 12HR FCST FROM 18Z 09 APR 84
30508 63247 00940 31430 00740

D. PRE BURST PREDICTION, 48HR FCST FROM 00Z 16 MAY 84
08964 52735 00630 10840 00890

E. PRE BURST PREDICTION, 36HR FCST FROM 12Z 03 JUNE 84
71435 40850 01050 21965 01650

Exercise 2

A. PRE BURST PREDICTION, 12HR FCST FROM 12Z 04 JULY 84
64525 63435 00640 12926 00480

B. PRE BURST PREDICTION, 24HR FCST FROM 18Z 07 AUG 84
85565 52035 00710 23640 00870

C. PRE BURST PREDICTION, 36HR FCST FROM 06Z 14 SEPT 84
29095 41839 00840 30570 01410

D. PRE BURST PREDICTION, 48HR FCST FROM 00Z 21 OCT 84
07075 62241 00860 13470 01140

E. PRE BURST PREDICTION, 12HR FCST FROM 18Z 23 NOV 84
54035 51830 00580 21425 00390

SERVICE TEST
HANDOUT
C3ABR25130-HO-200, 300
C3ABR25130-2-HO-300

Technical Training

Weather Observer

WEATHER CODES PLOTTING GUIDE

12 May 1982

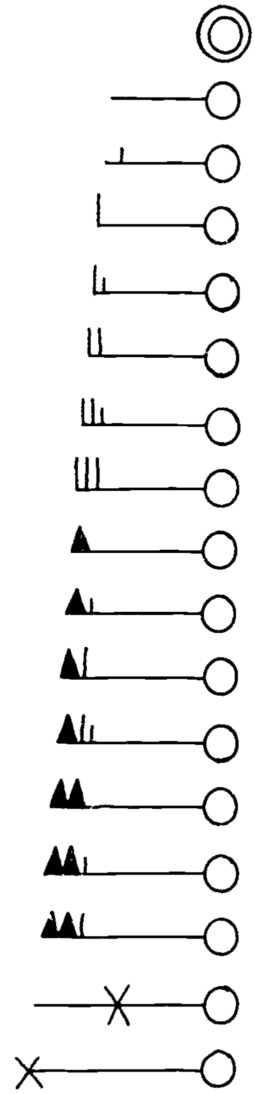
CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

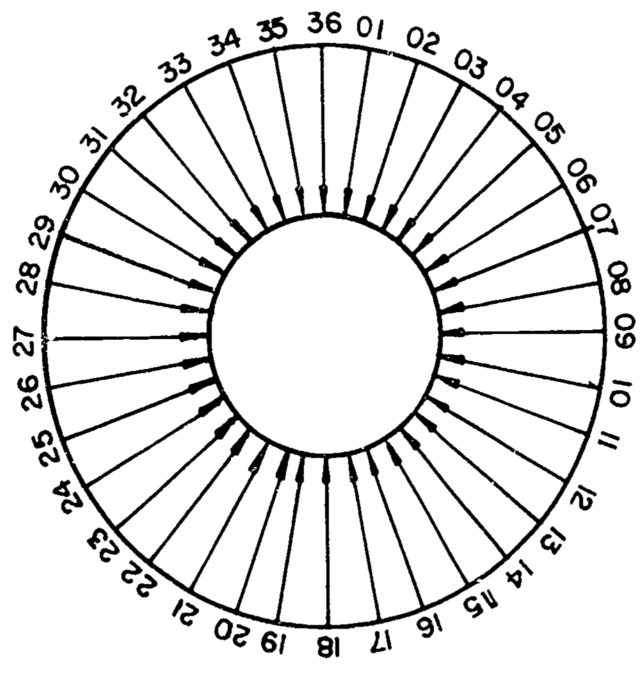
DESIGNED FOR ATC COURSE USE
DO NOT USE ON THE JOB

RCL: N/A

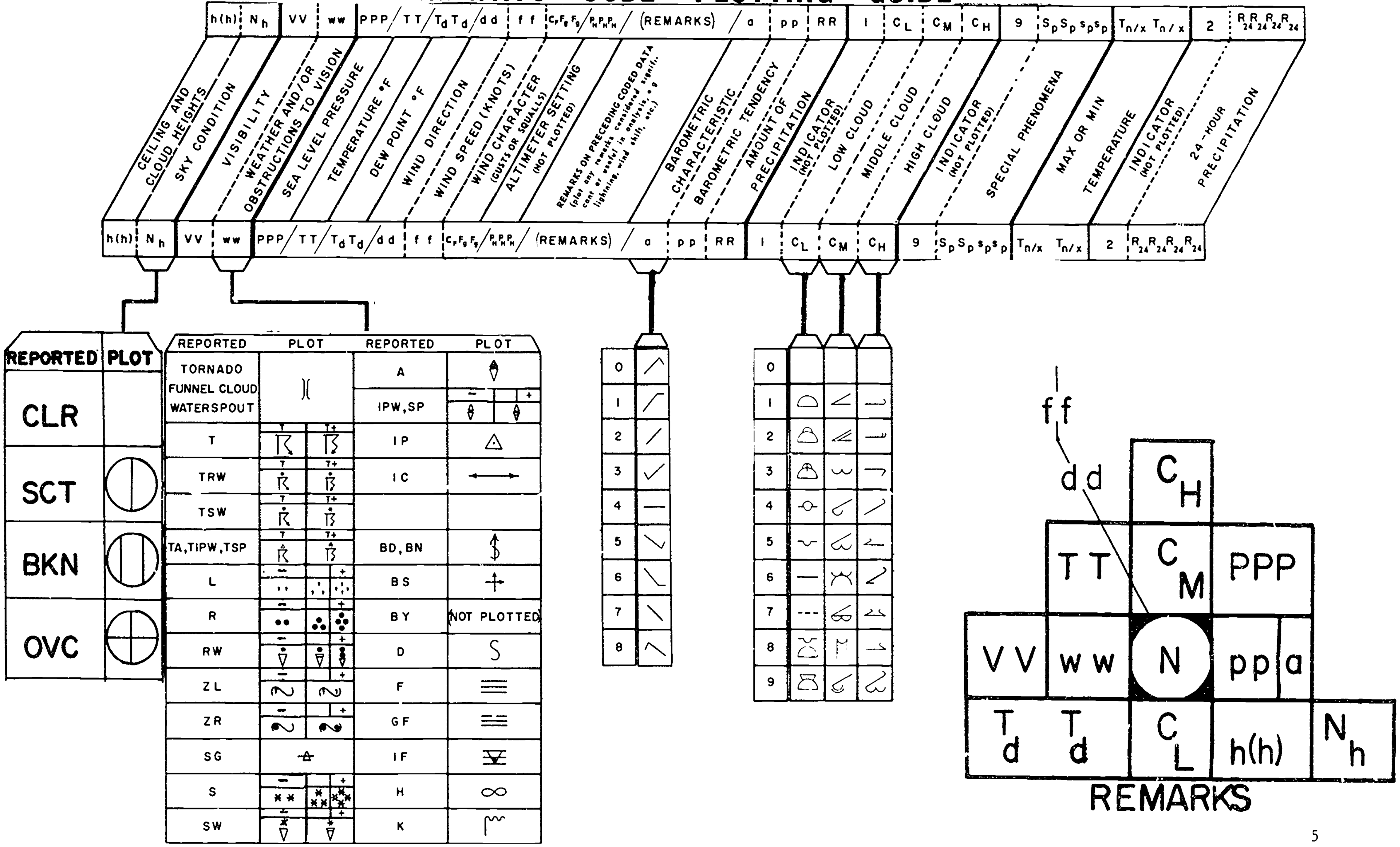
WIND PLOTTING GUIDE

CALM	
1 - 2 KNOTS	
3 - 7 KNOTS	
8 - 12 KNOTS	
13 - 17 KNOTS	
18 - 22 KNOTS	
23 - 27 KNOTS	
28 - 32 KNOTS	
48 - 52 KNOTS	
53 - 57 KNOTS	
58 - 62 KNOTS	
63 - 67 KNOTS	
98 - 102 KNOTS	
103 - 107 KNOTS	
108 - 112 KNOTS	
MISSING, OR GARBLED WIND DIRECTION	
MISSING, OR GARBLED WIND SPEED	
MISSING, OR GARBLED SPEED AND DIRECTION	(NO PLOT)





AIRWAYS CODE PLOTTING GUIDE



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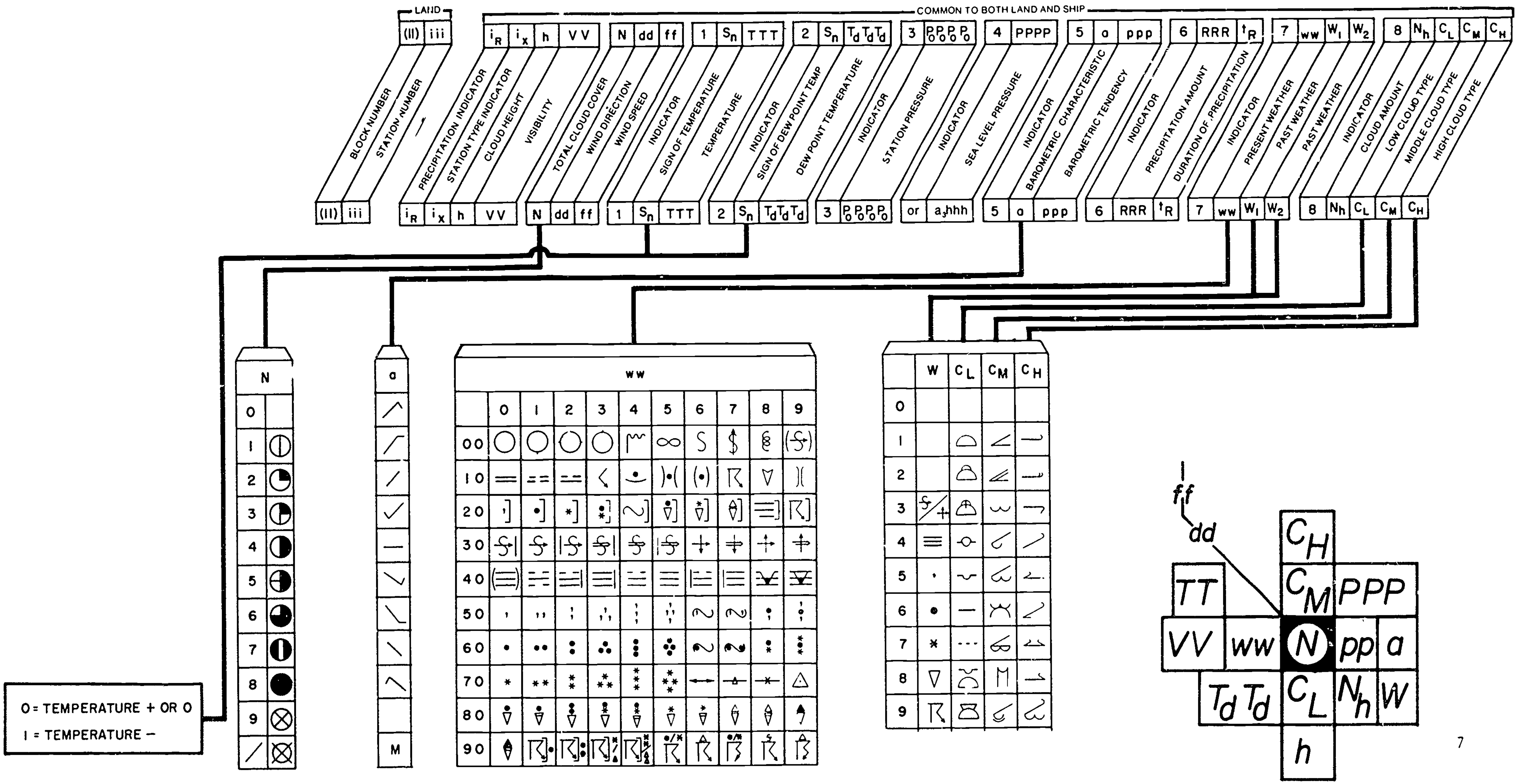
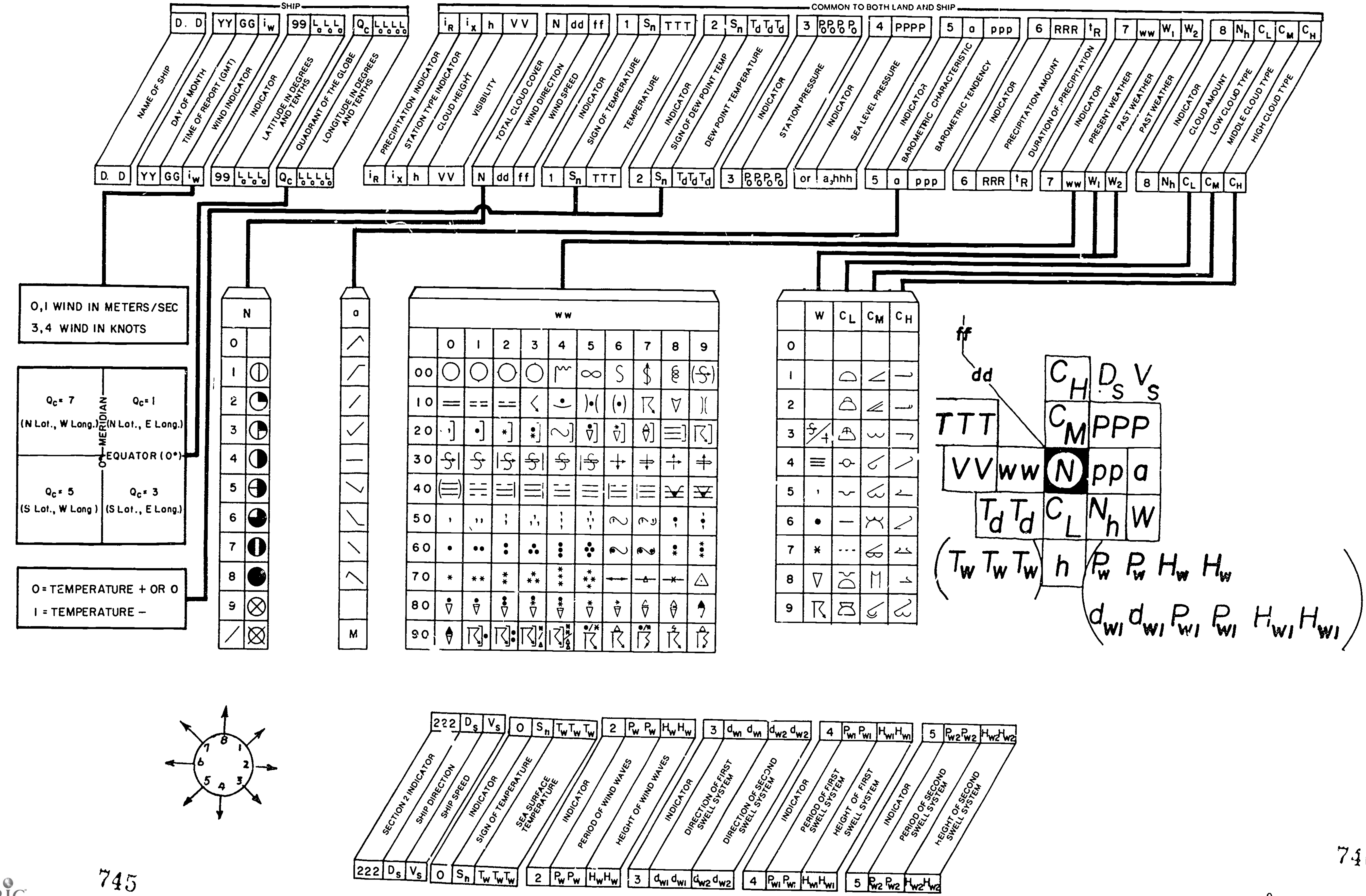
SYNOPTIC CODE PLOTTING GUIDE



7

SHIP SYNOPTIC CODE PLOTTING GUIDE



PART A	Data up to and including 100 mbs.
TTAA YYGGId IIiii	Section 1 Identification.
99PoPoPo ToToTaoDoDo dodofofofo	Surface Data
00hhh TTTaDD ddfff	
85hhh TTTaDD ddfff	
70hhh TTTaDD ddfff	
50hhh TTTaDD ddfff	Section 2 Mandatory Levels
40hhh TTTaDD ddfff	
30hhh TTTaDD ddfff	
25hhh TTTaDD ddfff	
20hhh TTTaDD ddfff	
15hhh TTTaDD ddfff	
10hhh TTTaDD ddfff	
88PtPtPt TTTaDD ddfff	Section 3 Tropopause Data
77 or 66 $P_mP_mP_m$ ddfff $4V_bV_bV_aV_a$	Section 4 Maximum Wind, and Vector Data
PART B	Data up to and including 100 mbs.
TTBB YYGG/ IIiii	Section 1 Identification
00PoPoPo ToToTaDoDo	Surface Data
11PPP TTTaDD	
22PPP TTTaDD	Section 5 Significant Levels
33PPP TTTaDD	
51515 $101A_{df}A_{df}$	ction 9 Additional Data
PPBB $YYGGa_4$ IIiii	ction 1 Identification
$9t_nU_1U_2U_3$ ddfff ddfff ddfff	Section 6 Significant Level Winds

STUDY GUIDE/WORKBOOK

C3ABR25130 000-SW-301

Technical Training

Weather Specialist

WEATHER EQUIPMENT OPERATION

7 September 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

Designed for ATC Course Use.

Do Not Use on the Job.

Weather Training Branch
Chanute AFB, Illinois

C3ABR25130 000-SW-301

WEATHER EQUIPMENT OPERATION

OBJECTIVE

1. Given basic facts related to safety precautions, select to 75% accuracy those which apply to electrical equipment.

2. Given information on functions and procedures necessary to operate and obtain measurements or presentations on weather equipment, select to 75% accuracy the correct response for the following equipment items:

a. Rotating beam ceilometer
b. Ceiling light and clinometer
c. Visibility measuring equipment
d. Temperature measuring equipment
e. Precipitation measuring equipment
f. Wind measuring equipment
g. Pressure measuring equipment

3. Completion of this study guide/workbook will enable you to understand the purpose of the major component parts and the operation of cloud measuring, visibility, temperature-humidity, precipitation, wind and pressure equipment.

PROCEDURE

The exercises in this study guide/workbook will be completed by inserting the correct words and answering the appropriate questions.

1. Safety (Electrical Equipment)

a. Electrical equipment - hazards associated with the use of electric powered equipment are ______________ ______________, burns, particles in the eye, ______________ ______________ and ______________.

b. Safety precautions to observe when working with electrical equipment such as sensors or recorders:

(1) Do ________ wear jewelry while working around electrical equipment.

(2) Keep your ______________, ______________ and ______________ dry, if at all possible.

Supersedes C3ABR25130-SW-301, 1 November 1983.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 550; DAV - 1

(3) ______________ fuses, ______________ circuit breakers or ______________ circuits from their source of power to protect yourself and the equipment. This would be accomplished when ____________ ____________ or when performing ____________ ____________ ____________.

(4) Never use ______________/______________ solvents for cleaning purposes.

2. Fire Hazards

a. Always be alert for any fire hazards within your section or organization and ______________ them.

b. Fires that start in ______________ ______________ can usually be arrested by turning off the AC (______________ ______________) power supply to the equipment.

c. Other factors or causes for electrical fires are:

(1) ______________ or ______________ AC power cords.

(2) Dirty, oily electrical ______________.

(3) Broken power ____________ and ____________.

d. Prevention

(1) Don't take anything for granted when working with electrical equipment.

(2) Stay alert to unusual smells, ______________ or ______________ that may be the first sign of trouble.

(3) Know where the correct type of fire ____________ is located.

(4) Practice good housekeeping.

Using the information given above, answer the following list of questions.

1. When can jewelry be worn while working around electrical equipment?

2. List three factors or causes that may lead to electrical fires.

3. What kind of cleaning solvents can be used for performing preventive maintenance?

4. List five hazards associated with the use of electric powered equipment.

5. When and how do you protect yourself from a power source when working on equipment?

6. List two ways of preventing fires around electrical equipment.

AN/GMQ-13A, CLOUD HEIGHT SET

Functional Description

Cloud Height Set, AN/GMQ-13A, is a rotating-beam ceilometer which provides measurements of the height of the lowest layer of clouds. When the lowest layer of clouds is less than overcast, it may provide measurements of the base of a higher layer. The set is capable of observing cloud heights at night as well as day. It is normally used with a baseline of 400 feet and with this baseline, can measure cloud heights between 50 feet and approximately 4000 feet above the surface. Tables are prepared in accordance with instructions in Federal Meteorological Handbook No. 1 to adjust cloud height indications to height above field elevation. Measuring sweeps of the beam are 3 seconds in duration and are separated by 3-second baseline checks. A mean cloud height is computed by averaging the value of 4 separate sweeps. The major components are: Projector, Cloud Height, ML-506A/GMQ-13; Detector, ML-507A/GMQ-13; and Indicator, Cloud Height, IP-327A/GMQ-13. The projector and detector are located in the approach zone of instrumented runway, and the indicator is the weather station. As many as six additional indicators may be located at other points around the base. Choice of any one of six indicator scales, which are calibrated in feet, is based upon the projector-to-detector baseline.

Accuracy

For any given baseline, the absolute error decreases with decreasing angle. The relative accuracy of cloud measurements is about 10% for elevations of six times the baseline, and about 20% for elevations of a little over ten times the baseline.

Remarks

Falling snow, heavy precipitation or drizzle, or in some cases virga or wet uneven stratus, will not permit a sharp reflection of the projected beam of light to the detector. When this occurs the AN/GMQ-13A will not show a clearly-marked cloud deck. The AN/GMQ-13A is the operational AWS ceiling-measuring equipment.

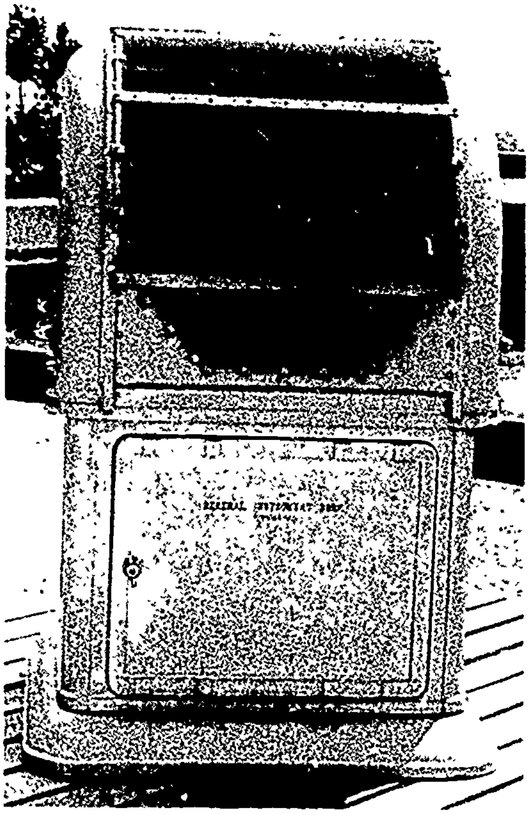


Figure 1. AN/GMQ-13A Projector.

Figure 2. AN/GMQ-13A Detector.

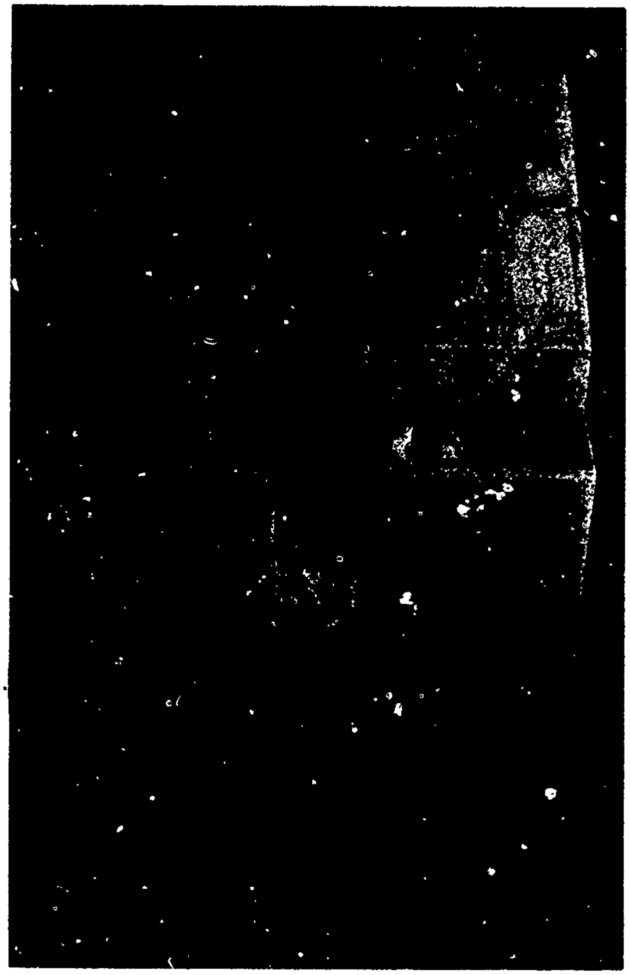


Figure 3. AN/GMQ-13A Indicator.

ROTATING BEAM CEILOMETER (AN/GMQ-13A)

1. State the purpose of the rotating beam ceilometer.

2. State the purpose of each of the components of the RBC:

a. Projector (see figure 1):

b. Detector (see figure 2):

c. Indicator (see figure 3):

3. How often does a sweep appear on the CRT?

4. Explain why every other sweep on the RBC is a measuring sweep.

5. Indicate how the 2-degree step appears on the RBC CRT.

6. What is the purpose of the 2-degree step presentation on the CRT?

7. There must be what sweep expansion for an indication to be considered a cloud height (at least 3/8")?

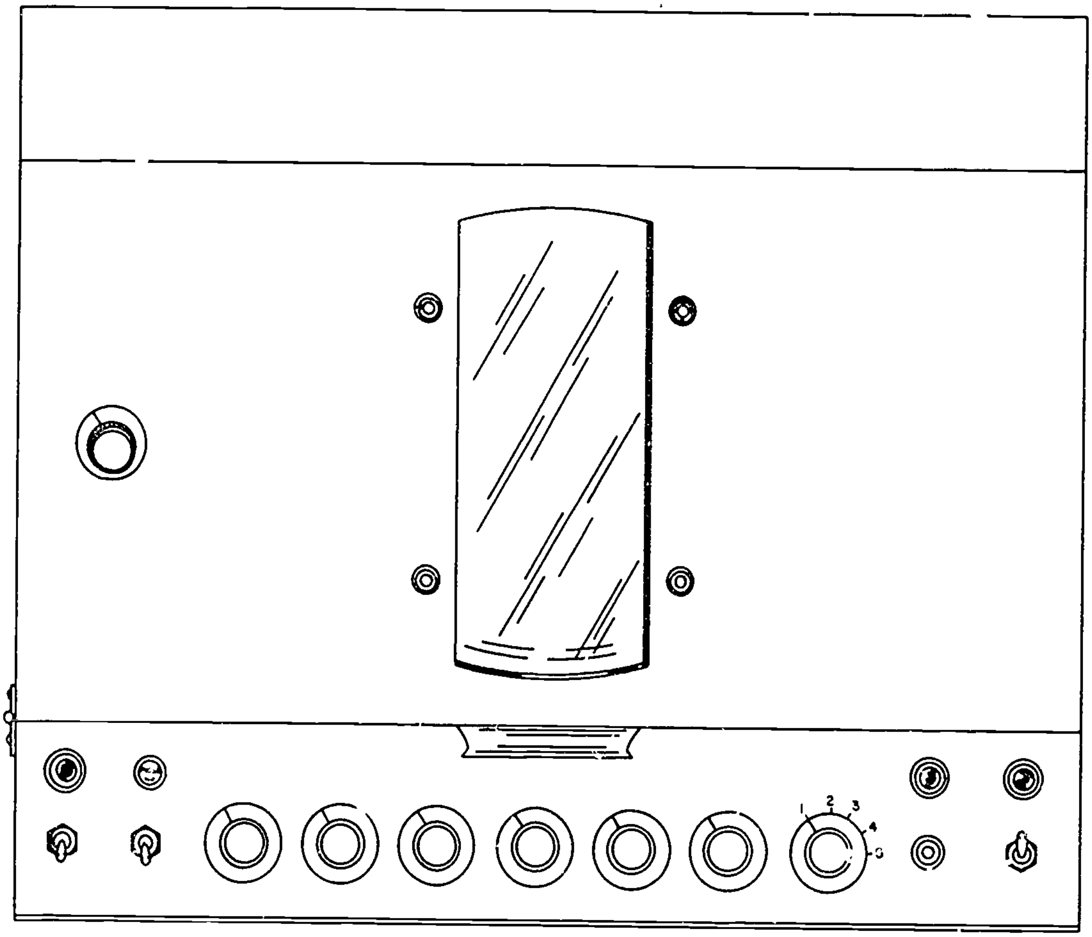
8. List the two periods during which the RBC must be in operation.

9. When returns from a single broken or overcast layer are present on the scope, consider the spot of _______________ deflection as an instantaneous height value.

10. For a totally obscured sky, consider the point at which the deflection on the scope becomes _______________ as an evaluation of vertical visibility.

11. To determine a representative indefinite ceiling height on the RBC, what procedure must the operator follow?

12. Using figure 4, label each of the controls on the diagram.



1.	"Z MODULATION"	7.	"HORIZ CENTER"
2.	"CALIBRATE"	8.	"FOCUS"
3.	"POWER"	9.	"SWEEP LENGTH"
4.	"SYNC"	10.	"BRIGHTNESS"
5.	"PROJECTOR"	11.	"VERT CENTER"
6.	"HORIZ GAIN"	12.	"SCALE LIGHT"

Figure 4.

13. Match the RBC indicator control with its proper function.

Power _____

Z-Modulation _____

Focus _____

Horizontal Gain _____

Horizontal Center _____

Vertical Center _____

Brightness _____

Calibrate _____

Position 1 _____

Position 2 _____

Position 3 _____

Position 4 _____

Position 5 _____

Scale light _____

Sync button _____

Projector _____

Sweep length _____

a. Applies signal to CRT.

b. Adjusts sweep sideways.

c. Adjusts the intensity of sweep.

d. Normal sweep position.

e. Sweep appears every 18° on CRT.

f. Insures vertical sweep on CRT coincides with projector lights.

g. Sweep remains at 90° for adjustment purposes.

h. Adjusts sweep up or down.

i. Supplies current to indicator.

j. Sweep remains at 0° for adjustment.

k. Regulates intensity of display edge lighting.

l. Adjusts sharpness of display.

m. Remote control starting switch for projector.

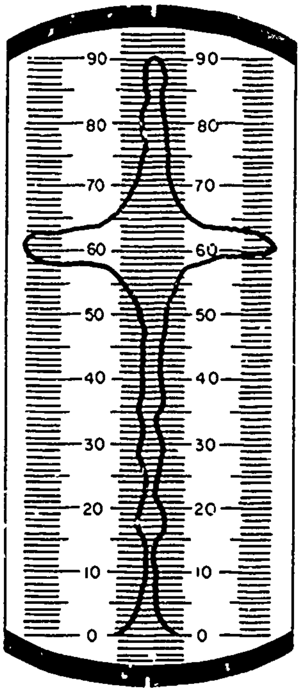
n. Sweep remains at 45° for adjustment.

o. Used to correctly position sweep within the CRT overlay.

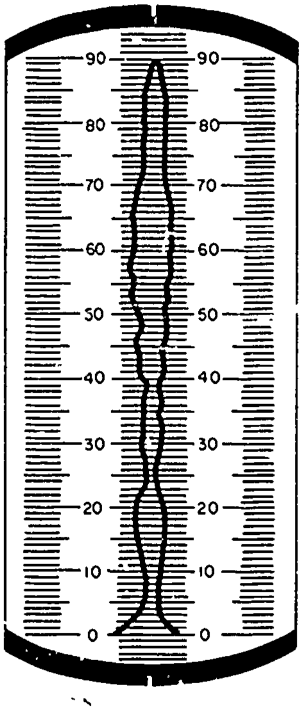
p. Adjusts width of sweep on CRT.

q. Adjusts length of sweep on CRT.

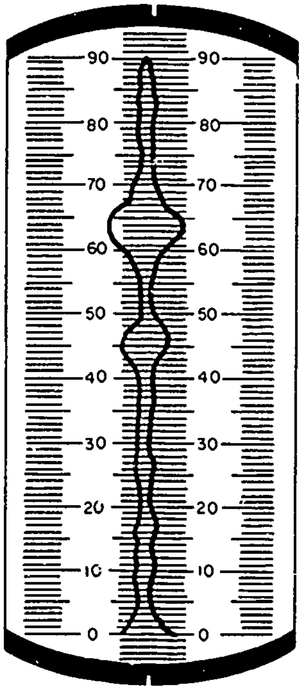
14. Match the sky condition with the appropriate RBC presentation.



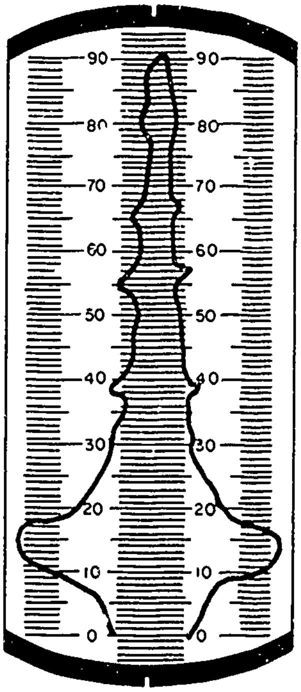
A ____________



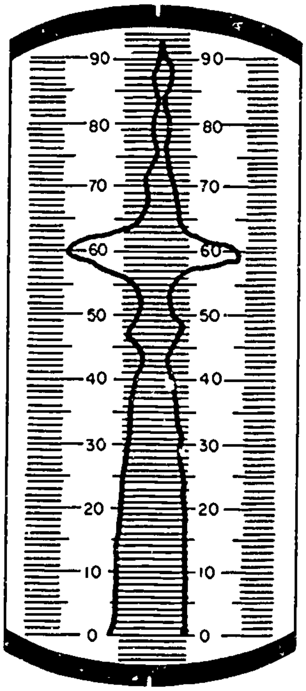
B. ____________



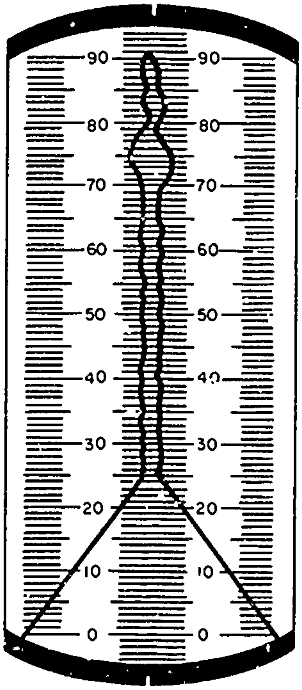
C. ____________



D. ____________



E. ____________



F. ____________

1. SNOW TAPER WITH CLOUD SIGNAL
2 SURFACE BASED OBSCURING PHENOMENA (FOG)
3. LOW CEILING
4. SCOPE CLEAR
5. MULTIPLE CLOUD
6. SINGLE CLOUD

Figure 5.
10

ML-121-( ) CEILING LIGHT PROJECTOR

Functional Description

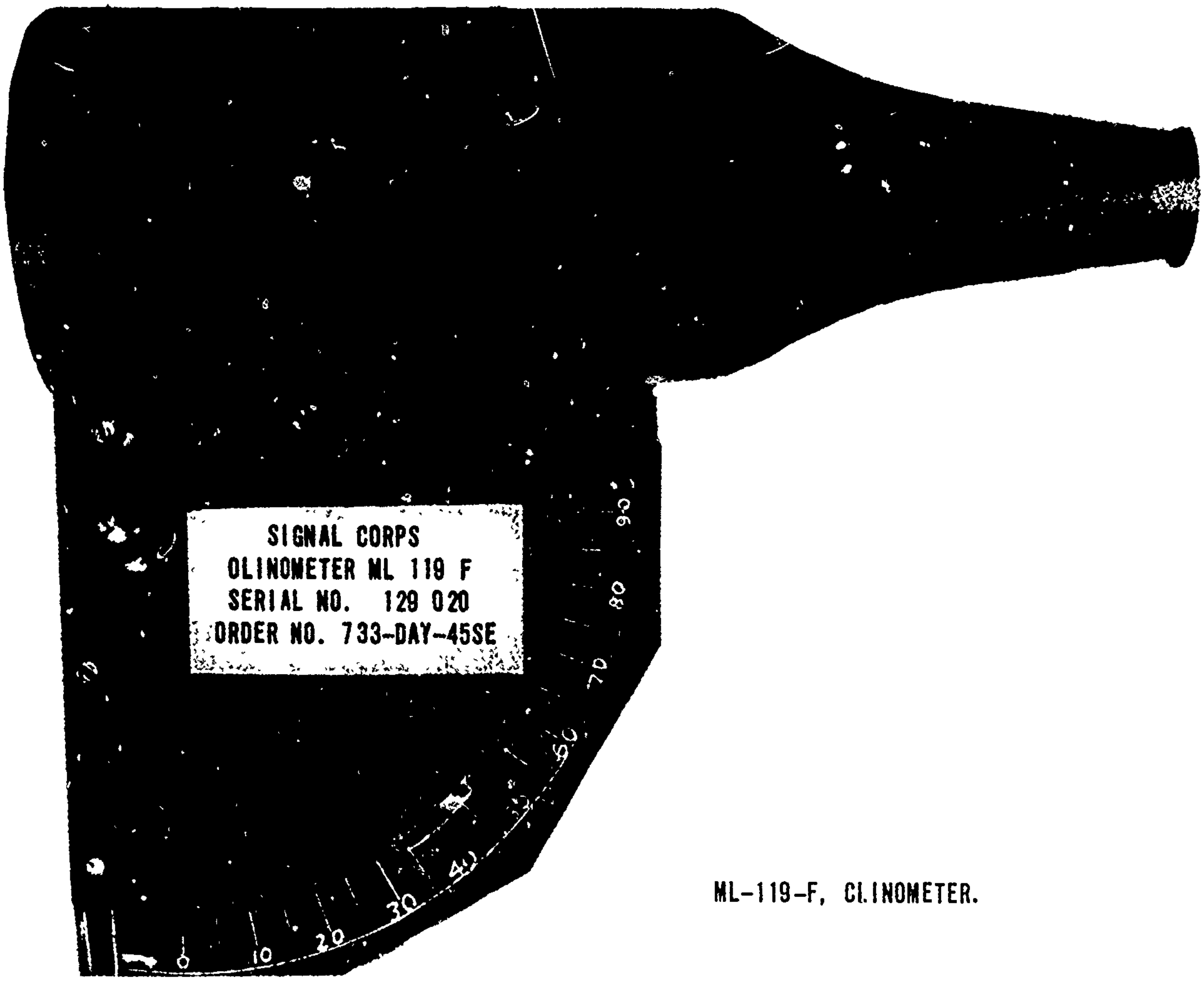
Ceiling Light Projector, ML-121-( ), is used in conjunction with Clinometer, ML-119-( ), at night to determine cloud heights up to 10,000 feet. It is a fixed installation consisting of a powerful incandescent lamp with a reflector system and focusing arrangement which are housed in a weatherproof drum. It projects a concentrated beam of light vertically upon the cloud base so that an observer, located at a measured distance (750 to 1000 feet) from the projector, and sighting with a Clinometer ML-119-( ), can determine the cloud height from the angle of inclination indicated by the clinometer.

Technical Characteristics

Beam Intensity: 2 million candlepower
Beam Spread: 4 degrees
Lamp Type: GE420G25P
Lamp Life: (average): 100 hours
Parabolic mirror (primary)
  Focal Length: 8 inches
  Diameter: 16 3/4 inches
Spherical mirror diameter: 4 1/2 inches

REMARKS

The ML-121-( ) is used at a limited number of stations where the AN/GMQ-13A is not installed.



ML-119-F, CLINOMETER.

Functional Description

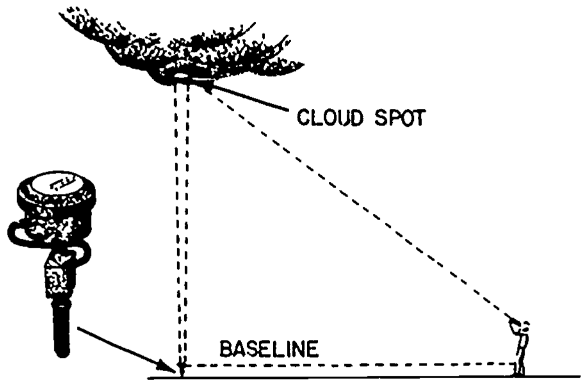
Clinometer, ML-119-F, is a lensless sighting tube with crossed wires at its larger end and a quadrant plate assembly which is graduated in 1° intervals from 0° to 90°. It is used to measure the angle of inclination of a spot of light projected on the base of a cloud by a ceiling light projector. The usual baseline is 1000 feet.

Accuracy

Measurement accuracy is ± 0.5°, when 3 or more readings are averaged.

REMARKS

This equipment is used with Ceiling Light Projector, ML-121-( ) at fixed installations.



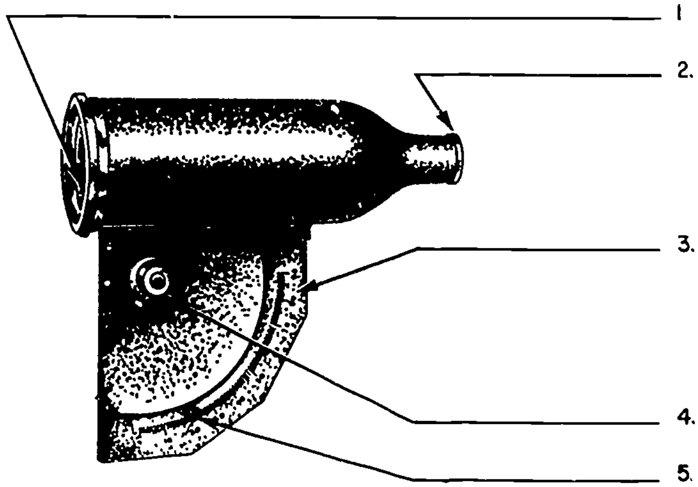


Figure 6.

CLINOMETER (ML-119) AND CEILING LIGHT PROJECTOR (ML-121)

1. Using your notes and figure 6, label the different parts of the clinometer.

2. State the purpose of the clinometer.

3. The angle plate can be read to nearest _____ degree.

4. What is the purpose of the clutch assembly?

5. What is the purpose of the pendant?

6. To determine the height of a layer using the clinometer, what is the minimum number of readings that must be taken?

7. Match the procedure with the appropriate sky condition:

Single layer aloft _____

Multiple layers aloft _____

Total obscuration _____

a. Sight crosshairs on the point where light ceases to penetrate.

b. Sight crosshairs on the brightest part of the light beam spot.

c. Noticeable by the appearance of two or more light spots.

d. Height of layer at the apparent top of light beam.

e. Height of layer at the lowest portion of light beam.

8. List a limitation of the ceiling light projector and clinometer.

9. State the purpose of the ceiling light projector.

AN/GMQ-32-( ), TRANSMISSOMETER SET

Functional Description

Transmissometer Set, AN/GMQ-32-( ), provides a continuous record of the atmospheric transmission of light along a 250 or 500-foot path between a projector and receiver. These sets are located along a baseline that is parallel with the center line of the approach-end and the run-out-end of the runway. The major components of the set are: Projector, Receiver, Indicator, and recording facilities. A recorder is located in the WOS. The projector and receiver are mounted on rigid stands or concrete pads at least 10 feet above the level of the runway. The output of the set is a series of voltage pulses whose frequency is proportional to the intensity of the projected light beam after arrival at the receiver. These pulses are furnished as input to:

a. A transmissometer meter and a chart-type recorder.

b. The AN/FMN-1 Computing Set (RVR) for automatic computing and display of runway visual range (RVR) values in feet.

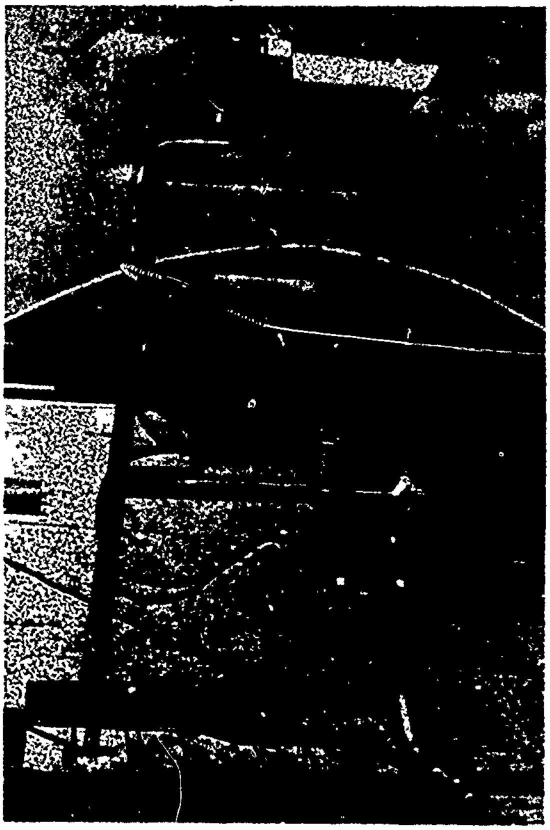
The transmissivity is determined by reading the meter and the past one-minute trace from the recorder record. A corrected value of transmissivity is obtained by subtracting the transmissivity factor for current background illumination from the representative value of transmissivity. Measurements are made in the range of 1/4 mile to 1 mile.

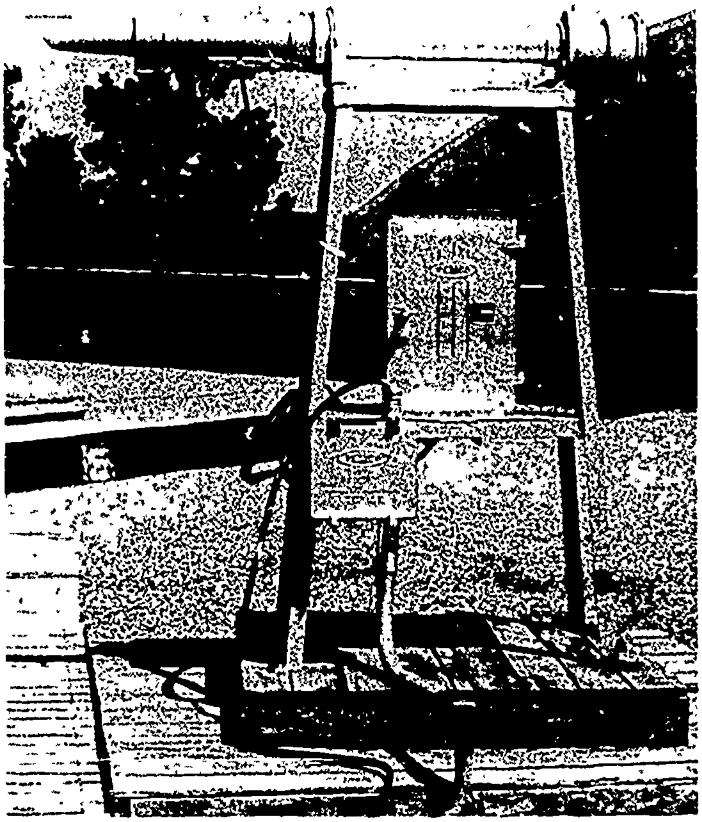
Accuracy

It is estimated that accuracies are approximately ± 10% for visibilities up to 5 times the length of the baseline, and ± 20% for visibilities near 10 times the length of the baseline.

REMARKS

The AN/GMQ-32-( ) is the standard AWS visibility-measuring equipment.





7. AN/GMQ-10 Projector. Figure 8. AN/GMQ-32 Receiver.

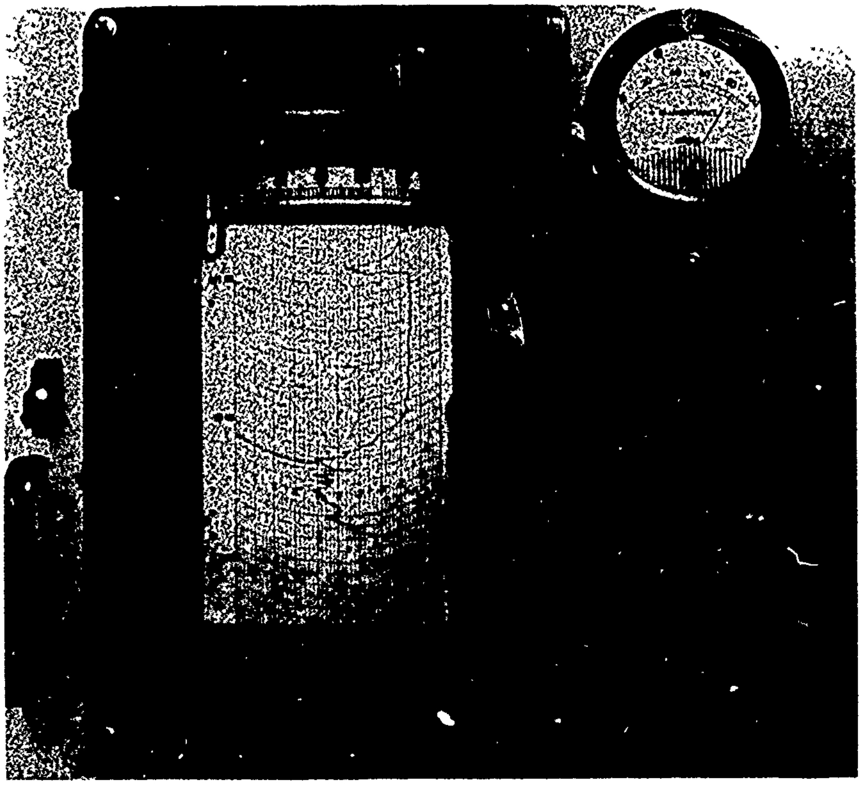


Figure 9. AN/GMQ-32 Indicator-Recorder.

TRANSMISSOMETER (AN/GMQ-32)

1. What is the purpose of the transmissometer?

2. List the three components of the transmissometer and the purpose of each (see figures 7, 8, and 9).

3. When is the range switch on the indicator-recorder placed in high mode and why?

4. What is the purpose of the background check and how often is it taken?

5. What is the period of operation for the transmissometer?

6. List the five times when an annotation is made on the transmissometer chart.

7. Figure 10 shows sample chart annotations. Study these for use in the lab.

8. Briefly explain the procedures used to convert transmissivity into reportable RVR values.

9. Procedure for changing chart:

a. Fold beginning of new chart to form arrow or point.

b. Turn GMQ-32 power switch to OFF.

c. Open chart chamber and remove both the char eroll and chart supply roll from chamber.

d. Remove end of chart reroll without gear.

e. Remove old chart by pulling chart to the right and place used chart aside.

f. Place new chart on chart supply roll.

g. Place chart supply roll back into chamber with oval holes to the right.

h. Feed arrow or point over rollers and under the set knob.

i. Pull paper until the paper engages the set knob. Turn the set knob to insure the paper has been engaged. Insure both sides of chart are engaged.

j. Using the set knob, feed paper until sufficient to connect into the chart reroll.

k. Slide paper into slit in chart reroll.

l. Replace end of chart reroll and insure paper is engaged by end of chart reroll.

m. Replace the chart reroll in the GMQ-32.

n. Turn GMQ-32 power switch to ON.

o. Adjust the GMQ-32 to GMT time and annotate.

p. Wind clock.

q. Close cabinet.

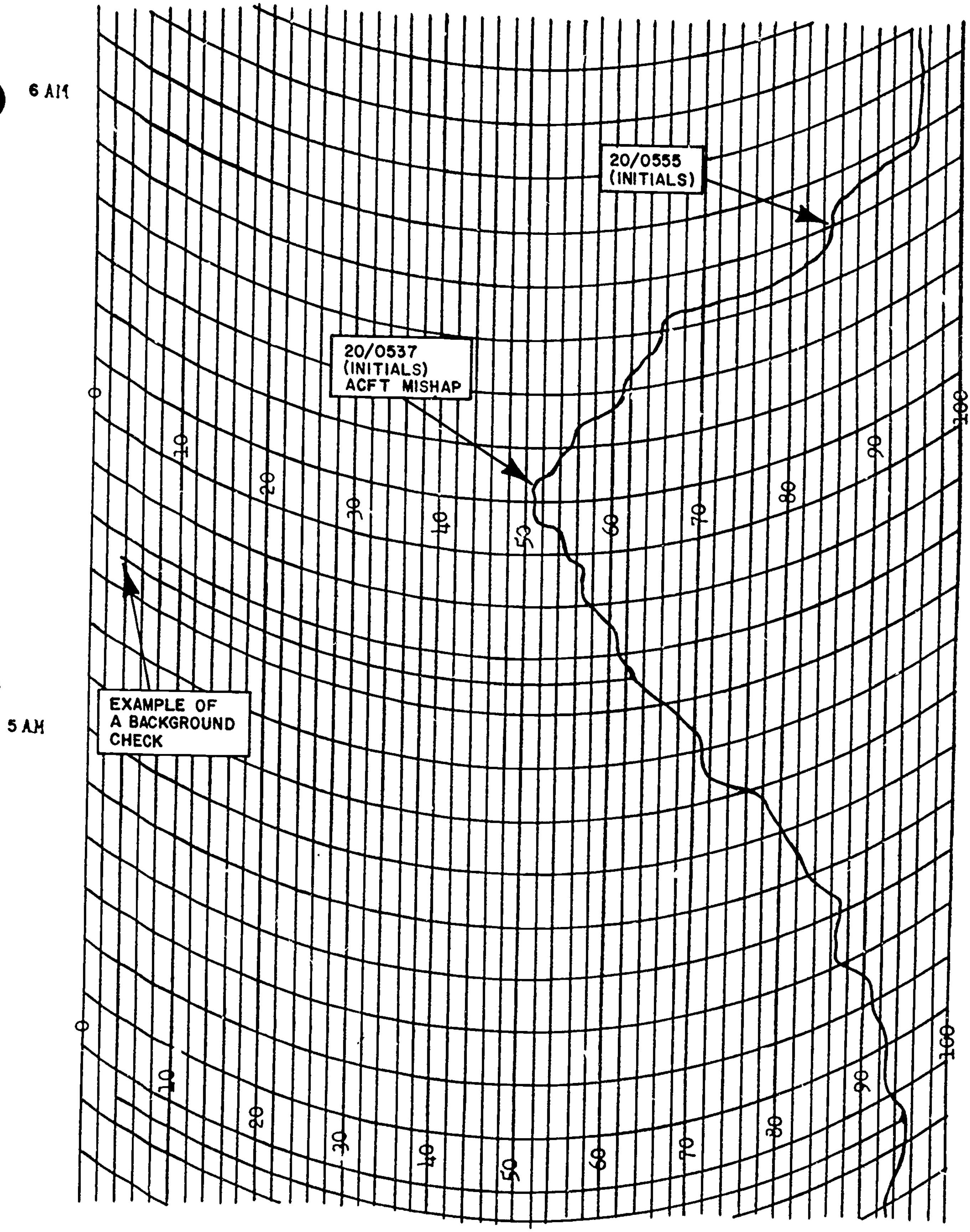

6 AM
20/0555
(INITIALS)
20/0537
(INITIALS)
ACFT MISHAP
EXAMPLE OF
A BACKGROUND
CHECK
5 AM
0
10
20
30
40
50
60
70
80
90
100

Figure 10.

AN/FMN-1, COMPUTING SET, RUNWAY VISUAL RANGE

Functional Description

Computing Set, Runway Visual Range, AN/FMN-1, receives input data from the Transmissometer Set, AN/GMQ-10( ), a photoelectric day/night switch, and runway light setting, processes these inputs into RVR values, and displays the RVR data in digital readout on an indicator in the observing location. The RVR is computed every 51 seconds over the range 1,000 to 6,000 feet, and displayed in increments of 200 feet between 1,000 and 4,000 feet and in increments of 500 feet between 4,000 and 6,000 feet.

Technical Characteristics

Operating conditions
- Temperature
  - Computer: +10°F to +125°F
  - Detector: -65°F to +160°F

Non-operating conditions
- Temperature: -67°F to 160°F
- Humidity: 95% RH for period of 2 hours
- Pressure: 3.42 inches of mercury for 2 hours
- Shock: 20g of 11 ± 1 millisecond duration

Availability display: Approximately 3 minutes after turn on

Accuracy: The range accuracy is ± 1% of the reading, in the range of RVR readout from 1,000 to 2,100 feet. The overall measurement accuracy is dependent upon the accuracy of the AN/GMQ-10( ).

REMARKS

RVR is an instrumentally-derived value, based on standard calibrations and reported in hundreds of feet, that represents the horizontal distance a pilot will see down the runway from the approach end; it is based on the sighting of either the high intensity runway lights or on the visual contrast of other targets, whichever yields greater visual range.

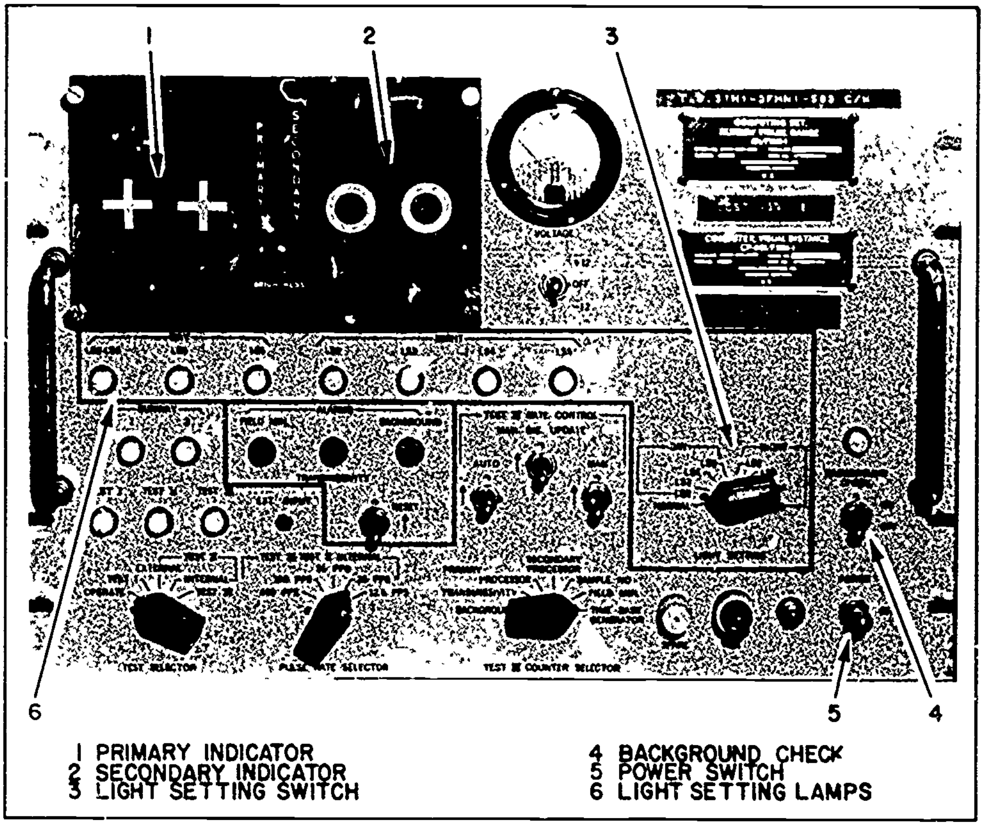


Figure 11.

FMN-1 (Runway Visual Range Computer) See Figure 11

1. What is the purpose of the FMN-1?

2. What is the period of operation for the FMN-1 computer?

3. Upon what piece of equipment does the FMN-1 depend for accuracy of information?

4. What is the effective warm-up period for the FMN-1 computer?

5. After warmup, readings are available at what time intervals?

6. Readouts are obtained from which set of windows, and what does the readout indicate?

7. How is the runway visual range entered on the AWSF 10?

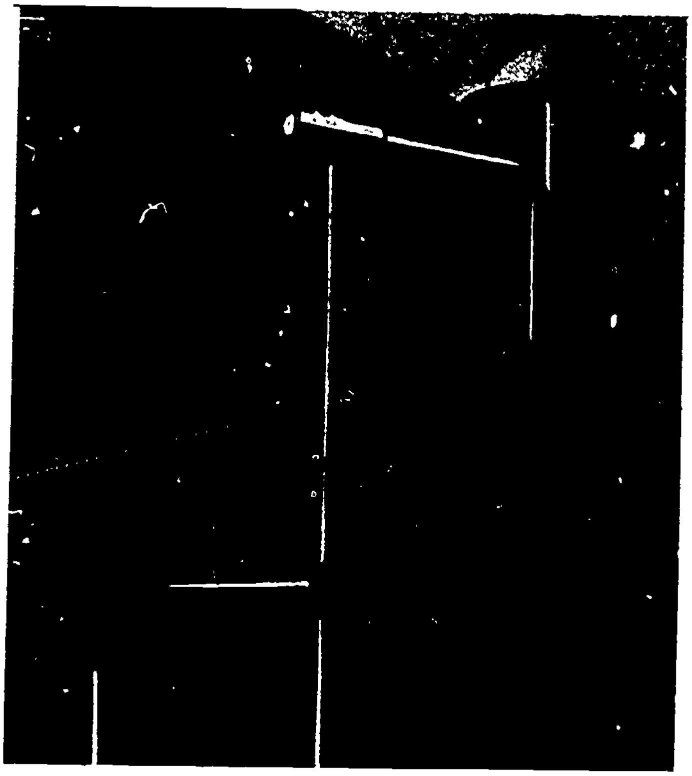
AN/TMQ-11(V), HUMIDITY - TEMPERATURE MEASURING SET

Functional Description

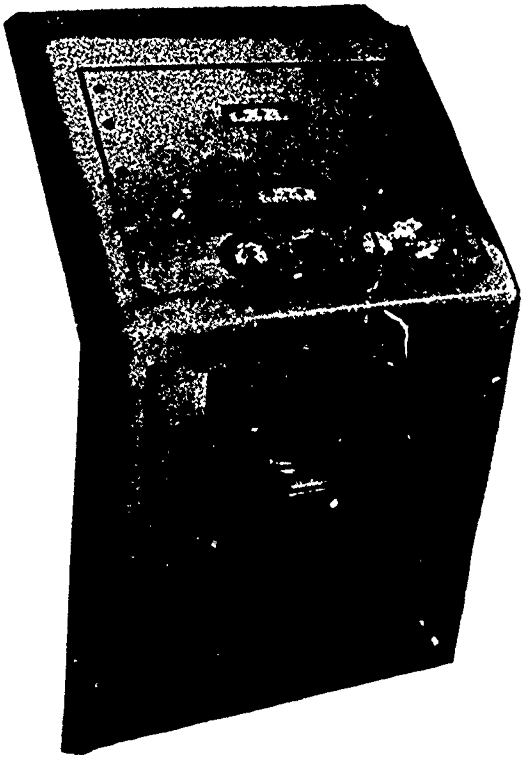
Humidity - Temperature Measuring Set, AN/TMQ-11(V) measures and indicates or records ambient air temperature and dewpoint temperature of air which is drawn by a forced-air system past the temperature- and humidity-sensing elements. Meter readouts of temperature and dewpoint are provided on the TMQ-11 indicator. The AN/TMQ-11(V) makes use of an automatic null-balancing system in which an adjustable calibrated voltage is connected to oppose the voltage being measured. When these voltages become unequal, an error signal is used, by input to a balancing motor and mechanical linkage, to adjust the calibrated voltage. The temperature sensor is a resistance thermometer encased in a stainless steel cylinder. The dewpoint sensor consists of a pair of parallel gold alloy wires wound around a wick of woven glass tape which, in turn, is wound around an electrical temperature sensor. The wick is impregnated with lithium chloride. This system operates on the principle that, for any given water vapor pressure in contact with a saturated salt solution, there is one temperature (the equilibrium temperature), at which the solution will not absorb or release moisture to its environmental atmosphere. If the amount of water vapor in the air increases (temperature below equilibrium), the lithium chloride absorbs moisture and heat must be applied to bring the salt solution to a new and higher temperature. At temperatures above equilibrium, the solution releases moisture until a new equilibrium is reached. With the relatively thin lithium chloride film used in the sensor, the change from moist to dry salt at the equilibrium point is made in a few seconds. The dewpoint accuracy varies with relative humidity and temperature. At temperatures above +32°F, the humidity element becomes inaccurate at humidities below 12 to 14%; at -30°F, the element is inaccurate at humidities below 28% (ie., the colder the temperature, the higher the relative humidity below which accurate readings are not possible).

Technical Characteristics

Indicator Data
- Type: Long-scale, moving drum
- Scale range: -80°F to +130°F, with 1° divisions
  - Scale length: 21 inches
- Dewpoint sensing data
  - Dewpoint range: -50°F to +90°F
  - Dewpoint accuracy: ± 2°F
- Temperature sensing data
  - Temperature range: -80°F to +130°F
  - Temperature accuracy: ± 1°F



OA-1165/TMQ-11, Transmitter Group
AN/TMQ-11.



ID-553/TMQ-11,
Indicator

TEMPERATURE HUMIDITY MEASURING SET (AN/TMQ-11)

1. What is the purpose of the AN/TMQ-11?

2. What are the two main components and describe their purpose.

3. What is the period of operation for the AN/TMQ-11?

4. How long does it take the TMQ-11 to give accurate readings after turn on?

5. How will the temperature be rounded whenever the indicator shows an indication half-way between two whole numbers?

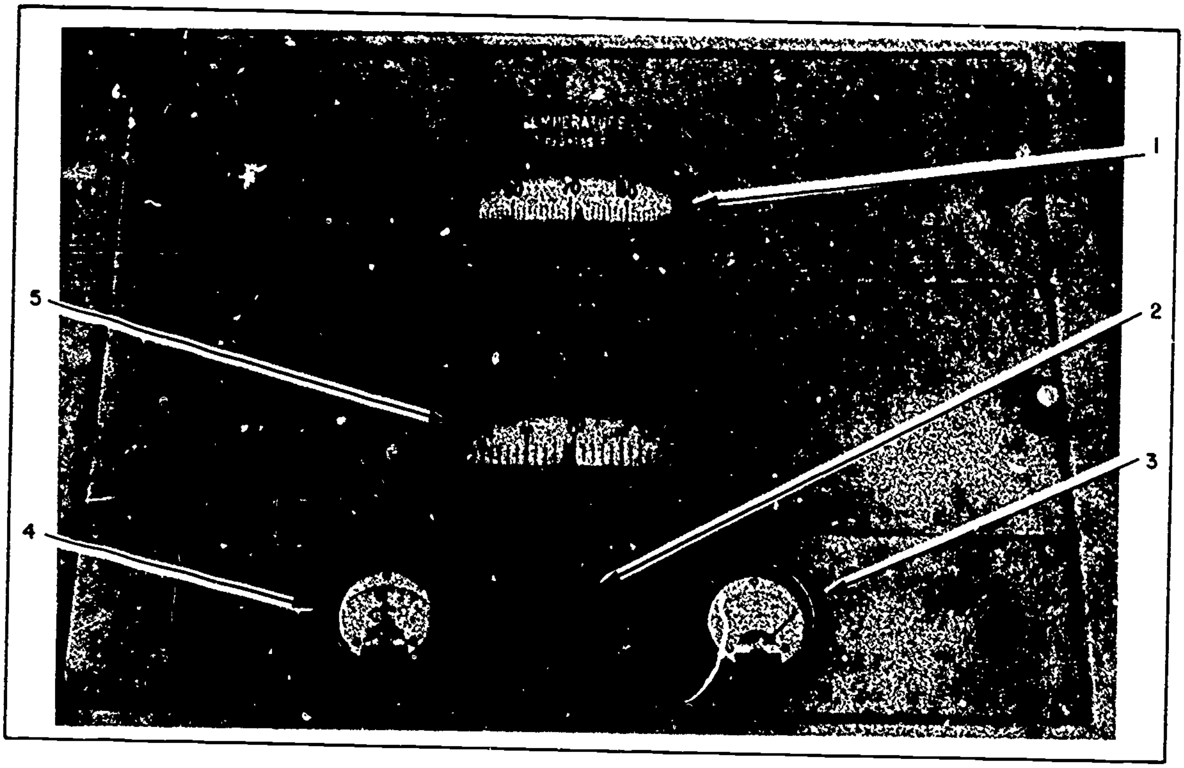


Figure 12.

6. Match the component parts with their proper statements and label in figure 12 above.

Temperature Scale _____

Dewpoint Scale _____

Scale Illumination Control _____

Dewpoint Heater Meter _____

Aspirator Meter _____

NOTE: There is more than one match per item.

a. Read to nearest whole degree

b. Free air temperature.

c. Should read between 1.0 to 1.3 amps.

d. -50°F lowest temperature indicated.

e. -80°F lowest temperature indicated.

f. +130°F highest temperature indicated.

g. +90°F highest temperature indicated.

h. Temperature to which a parcel of air must be cooled to reach saturation.

i. Reading entered in column 7 of AWSF 10.

j. Reading entered in column 8 of AWSF 10.

k. Lights scales that they can be read at night.

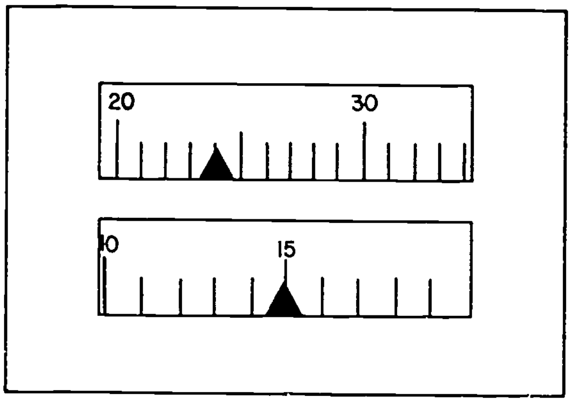
l. Graduated every whole degree Fahrenheit.

m. Numbered every 5°F

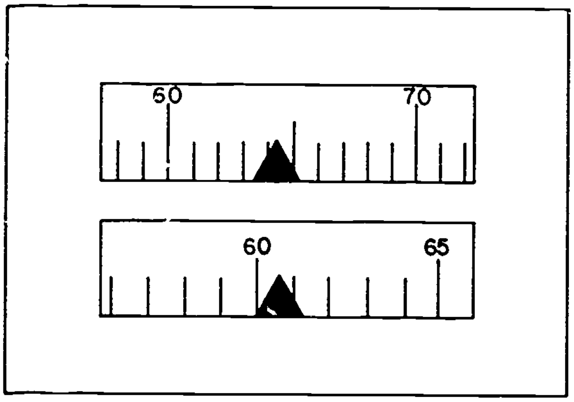
n. Numbered every 10°F.

o. Reading will vary with humidity.

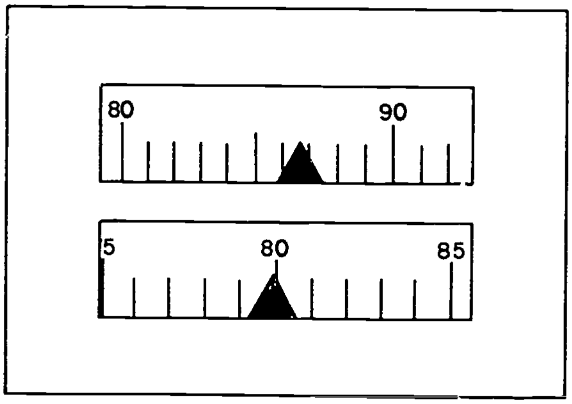
7. Read the temperature and dewpoint scales on the AN/TMQ-11 indicators and enter appropriate temperature and dewpoint in areas provided in figure 13 below.



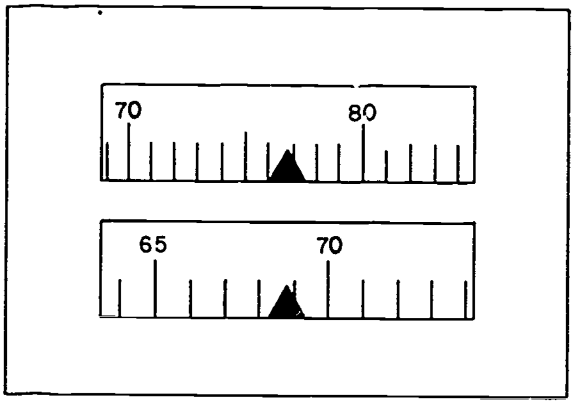
T________ Td ________



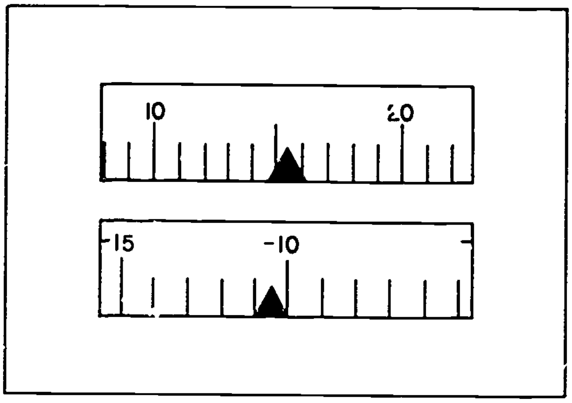
T________ Td ________



T________ Td ________



T________ Td ________



T________ Td ________

Figure 13.

Functional Description

Psychrometers ML-24 and ML-224 consist of two identical mercury thermometers, mounted parallel to each other, which are used to measure the ambient temperature and the water vapor content of the air. The wet-bulb thermometer, with wick, is mounted about 1 1/2 inches lower than the dry-bulb thermometer. The psychrometer is "ventilated" by rotating it rapidly about an axis at right angles to its length, using a sling or rotor. From the two different temperature readings (wet-bulb and dry-bulb), the dewpoint and relative humidity, may be determined. The ML-24 Psychrometer uses thermometers which are calibrated in degrees Fahrenheit whereas the ML-224 Psychrometer uses thermometers which are calibrated in degrees Centigrade.

Technical Characteristics

ML-24 Data

- Temperature Range
  - General: -35°F to +115°F
  - Tropical: -10°F to +145°F
- Accuracy
  - ± 0.4°F from +145°F to +32°F
  - ± 0.6°F from +32°F to 0°F
  - ± 0.8°F from 0°F to -35°F

Scale Graduations: 1°F, numbered each 10°F

Ventilation: Hand sling or rotor

SLING PSYCHROMETER (ML-24)

1. What is the purpose of the sling psychrometer?

2. Describe the ML-24.

3. How often is the muslin sack replaced on wet-bulb thermometer? Normal conditions __________; areas of excessive pollutants __________.

4. To what piece of equipment does the sling psychrometer serve as a backup?

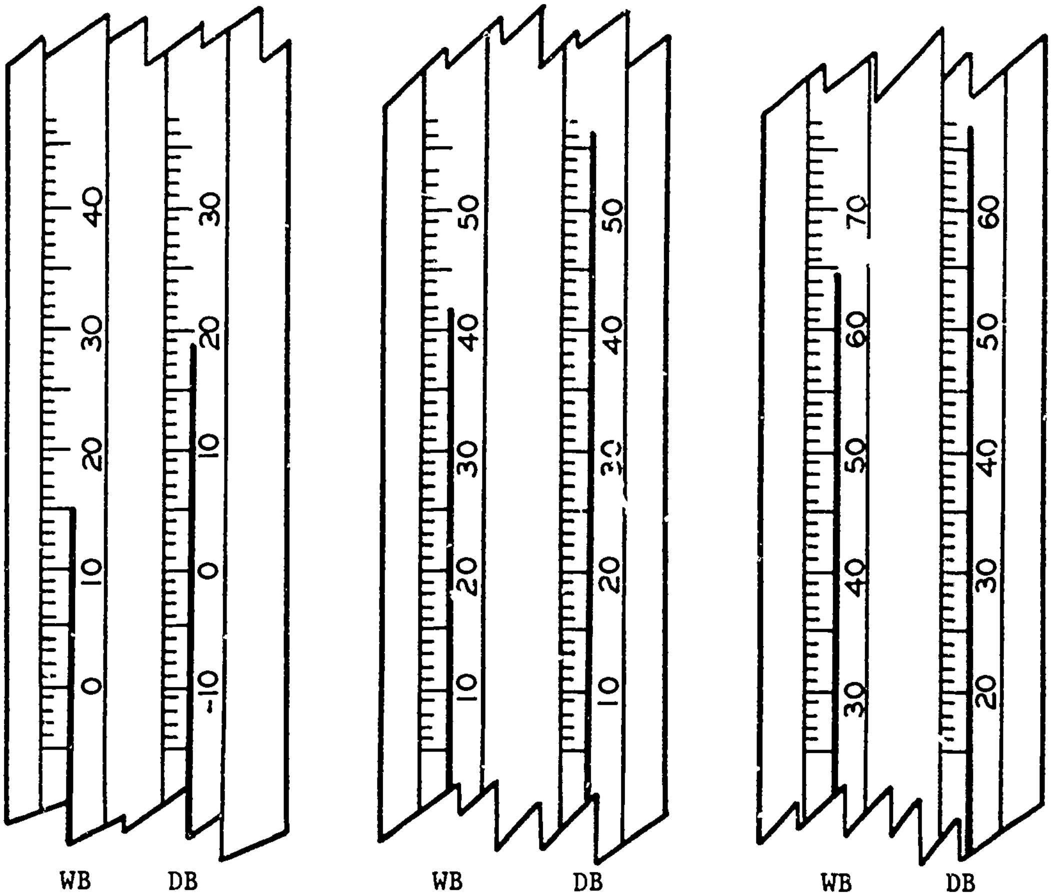
5. Define wet-bulb temperature.

6. Briefly describe the ventilating procedures for the sling psychrometer.

7. When should the sling psychrometer be brought indoors?

8. To compute dewpoint on the psychrometric calculator for entry on AWSF 10, what three elements are necessary?

10. Using diagrams in figure 14, determine the wet-bulb and dry-bulb temperatures and place answers in spaces provided.



wet bulb _____° wet bulb _____° wet bulb _____°

dry bulb _____° dry bulb _____° dry bulb _____°

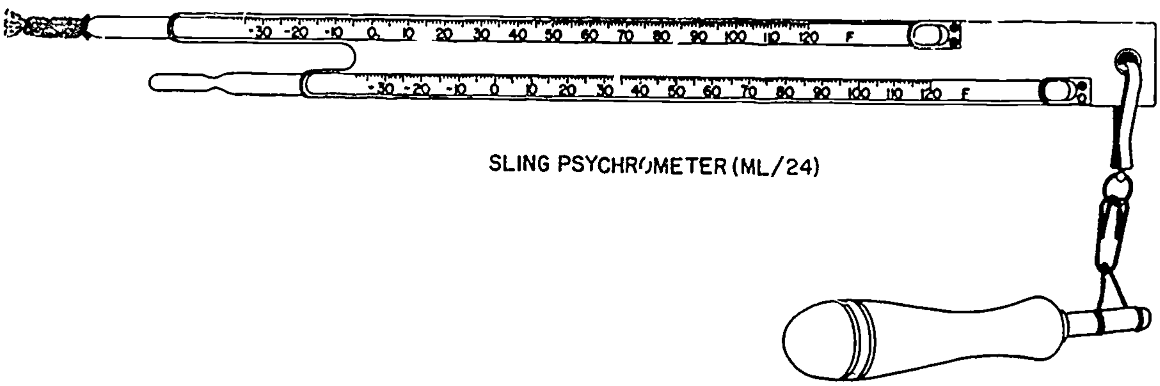
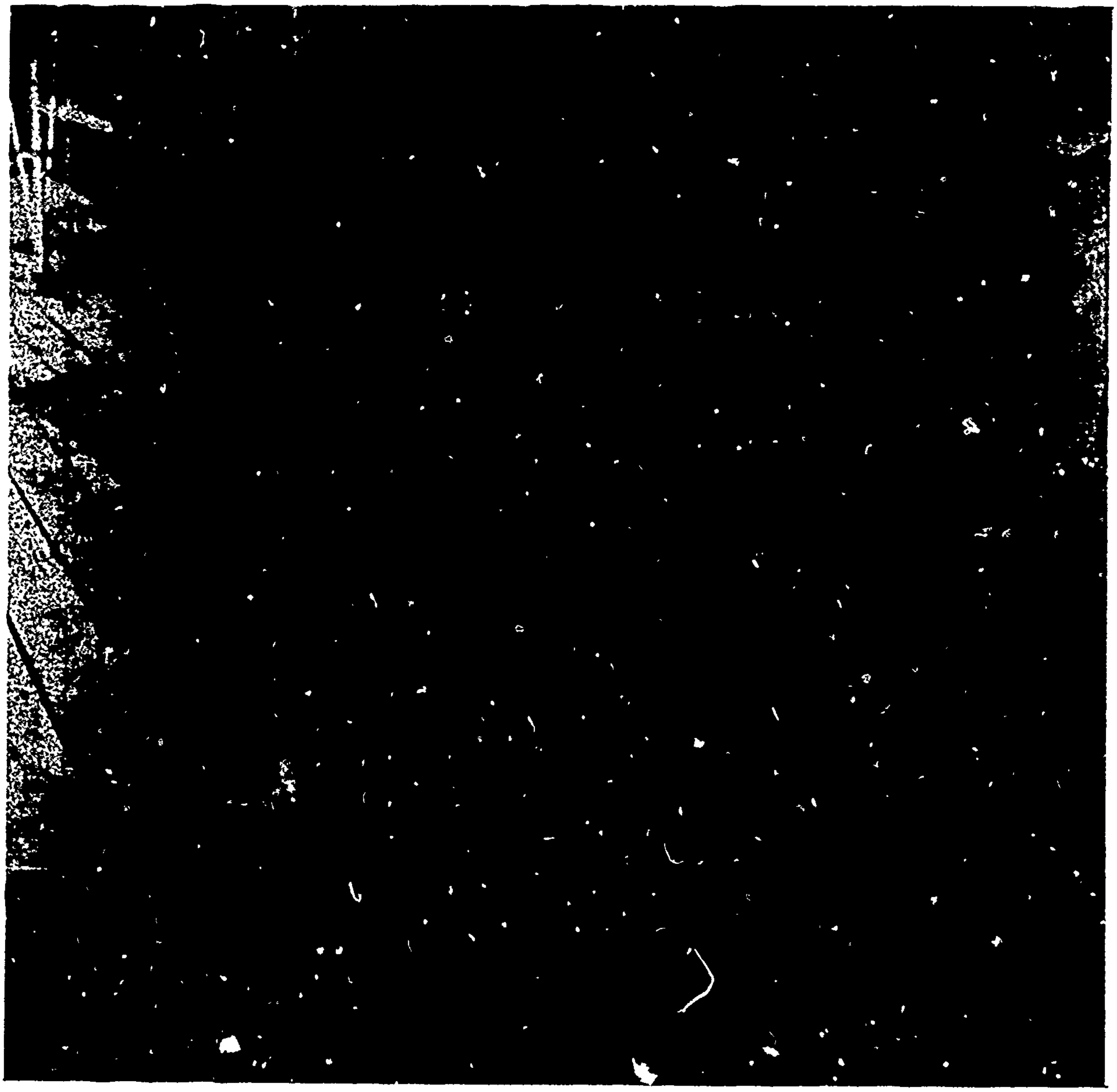


Figure 14.



ML-17 Rain Gauge; ML-75 Scale.

Functional Description

Gauge ML-17 is used to measure the amount of precipitation which has fallen at a given station. This gauge is equipped with a measuring stick ML-75 which is a red cedar scale, 24 inches in length. The scale is calibrated so that each 10 inches in length represents 1 inch of precipitation when used with Gauge ML-17. Capillary action of red cedar is very slow and, with its red color to aid in reading the water level, its use results in accuracy to within 0.005 inch. Supports ML-199 or ML-214 are used to support Gauge ML-17 at the correct height above ground or roof, as applicable.

REMARKS

These gauges are standard items at fixed stations.

PRECIPITATION MEASURING EQUIPMENT (ML-17 and ML-75)

1. State the purpose of the ML-17 rain gauge.

2. State the purpose of the ML-75 measuring stick.

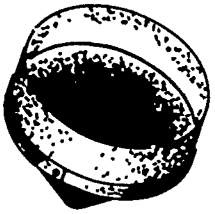
3. List the three components of the rain gauge.

4. Describe the procedure to be followed when solid or freezing precipitation is occurring or forecasted to occur.

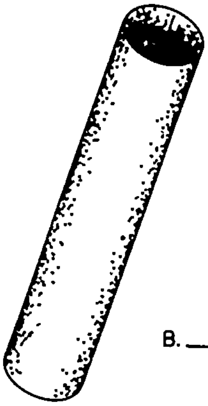
5. Briefly describe the measuring stick.

6. When are precipitation measurements taken for observational purposes?

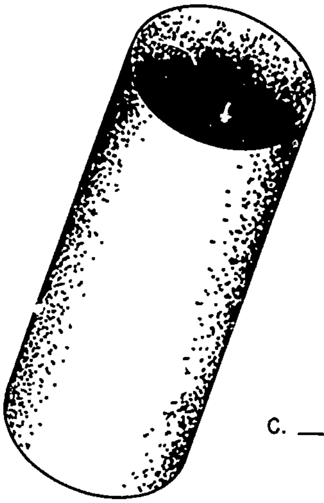
9. Label each component shown in figure 15 below.



A. ____________



B. ______________



C. ______________

Figure 15.

AN/GMQ-20, WIND-MEASURING SET

Functional Description

The AN/GMQ-20, Wind-Measuring Set, measures wind speed and direction and provides a visual readout of the measurements. The set can accommodate up to 10 indicators or recorders. The transmitter consists of a three-bladed impeller directly coupled to an internal detector to give direct current proportional to the wind speed. The transmitter is sited where it will best measure winds representative of the touchdown area and is mounted on a mast 13 feet above ground. An internal synchro transmitter sends directional data to synchro receivers in the indicators and recorders. The recorder installed in the weather observation site, gives a continuous chart record of wind speed and direction.

Technical Characteristics

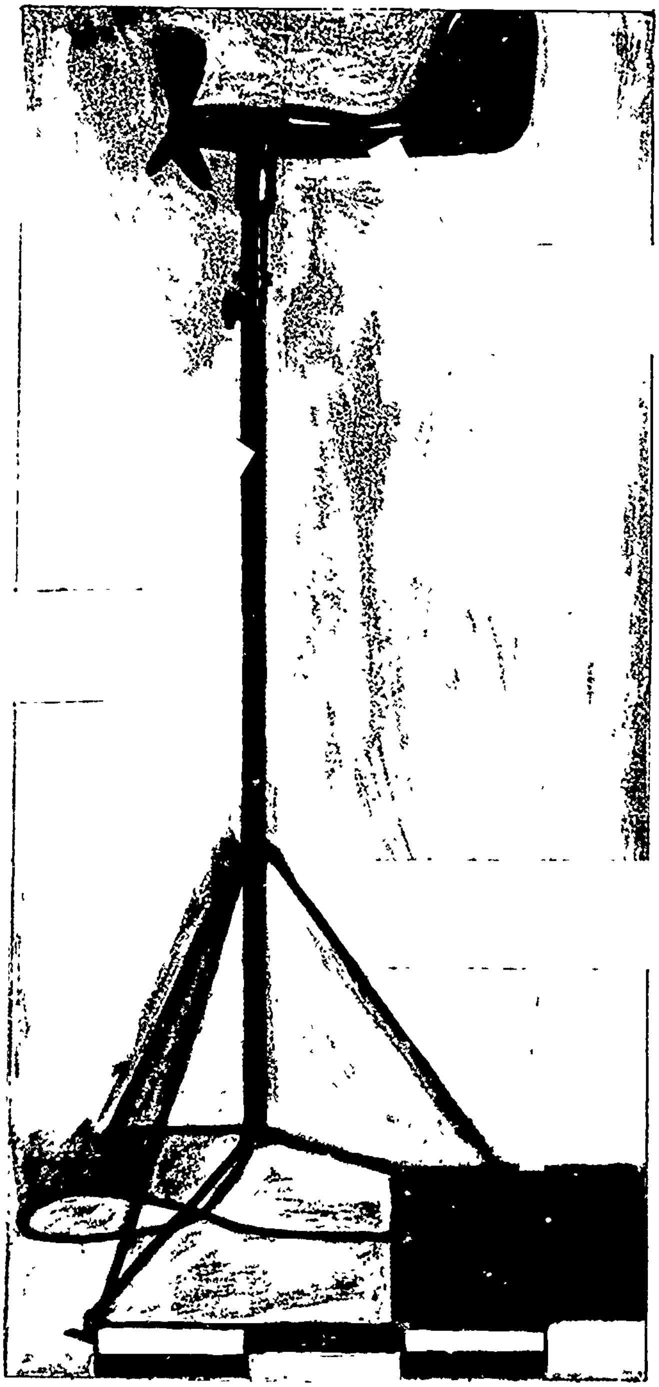
Measurement range
- Direction indicator: 0° to 360°, in increments of 5°
- Speed indicator: 0 to 120 knots, in increments of 2 knots

Accuracy
- Wind speed ± 1%
- Wind direction: ± 2°

Recorder
- Wind speed pen: ± 2.4 knots (0 to 120 knots)
  ± 4.8 knots (0 to 240 knots)
- Wind direction pen: ± 4% full range
- Repositioning response time: 6 seconds

REMARKS

The AN/GMQ-20 may be procured as a package or in components and provide standard wind information for AWS operations.



AN/GMQ-20, Wind-Measuring Set.

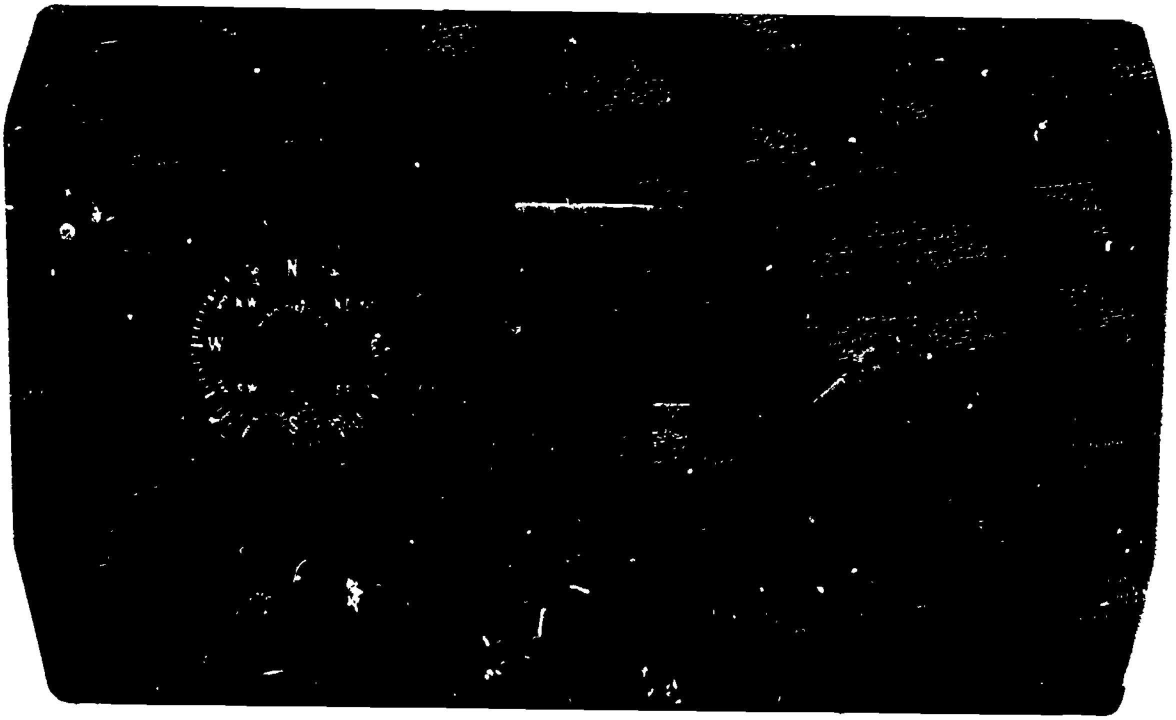


Figure 16. Indicator AN/GMQ-20 (11).

WIND MEASURING EQUIPMENT (AN/GMQ-20(11) - Figure 16

1. State the purpose of the AN/GMQ-20.

2. How is the speed meter of the indicator graduated and numbered?

3. How is the direction meter of GMQ-20 indicator graduated, numbered and lettered?

4. Explain the procedures for determining columns 9, 10 and 11 entries on the AWSF 10 for the GMQ-20.

5. Is the wind direction meter of the GMQ-20 indicator in degrees true or magnetic?

b. Label the components of the transmitter group of the GMQ-20 wind system (figure 17).

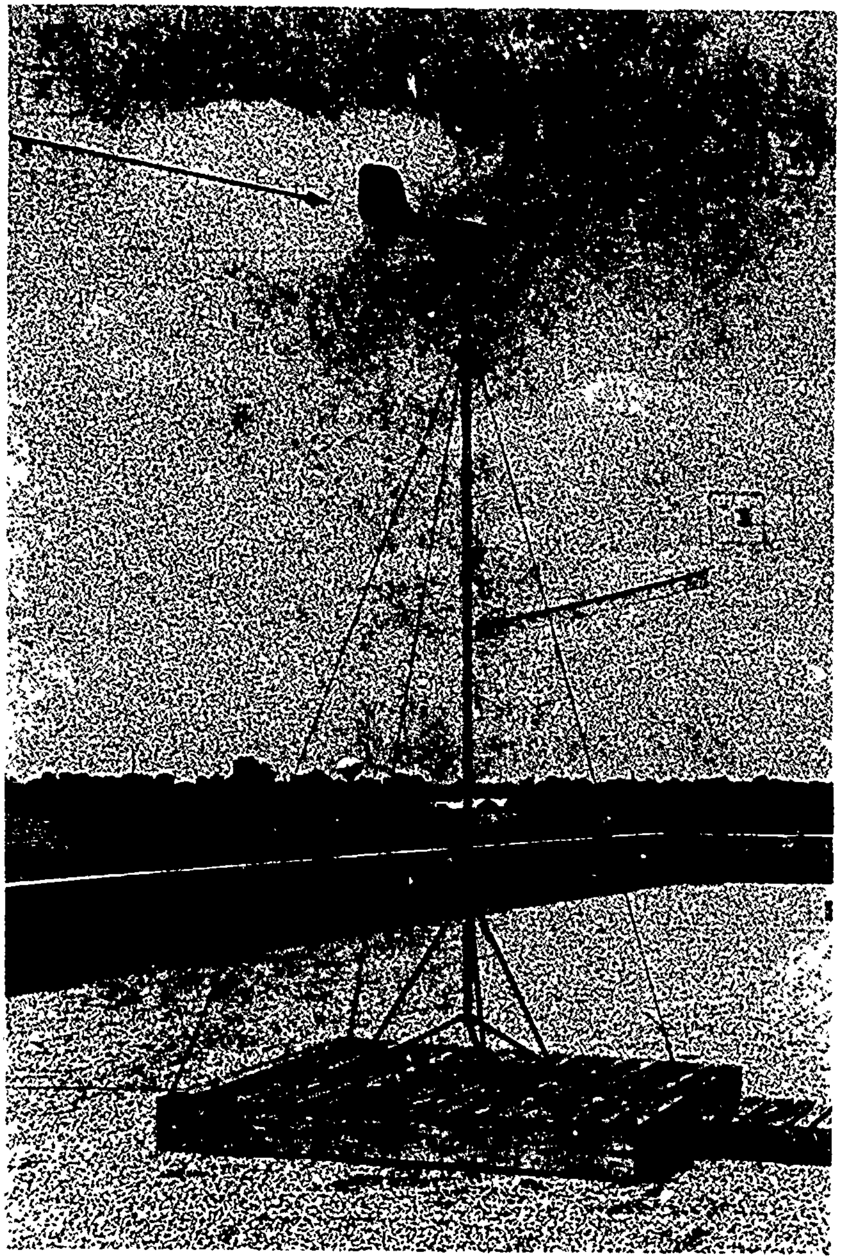


Figure 17. AN/GMQ-20, Wind Transmitter and Support.

RO-362/GMQ, WIND DIRECTION AND SPEED RECORDER

Functional Description

Wind Direction and Speed Recorder RO-362/GMQ is a two-element recorder that simultaneously produces, in separate channels, inked traces of wind direction and speed on a continuous strip paper chart. The mechanism is housed in a cast aluminum case. The unit basically consists of a wind direction mechanism, a wind speed mechanism, chart drive mechanism, chart guide-pen lift mechanism, chart, and case.

Technical Characteristics

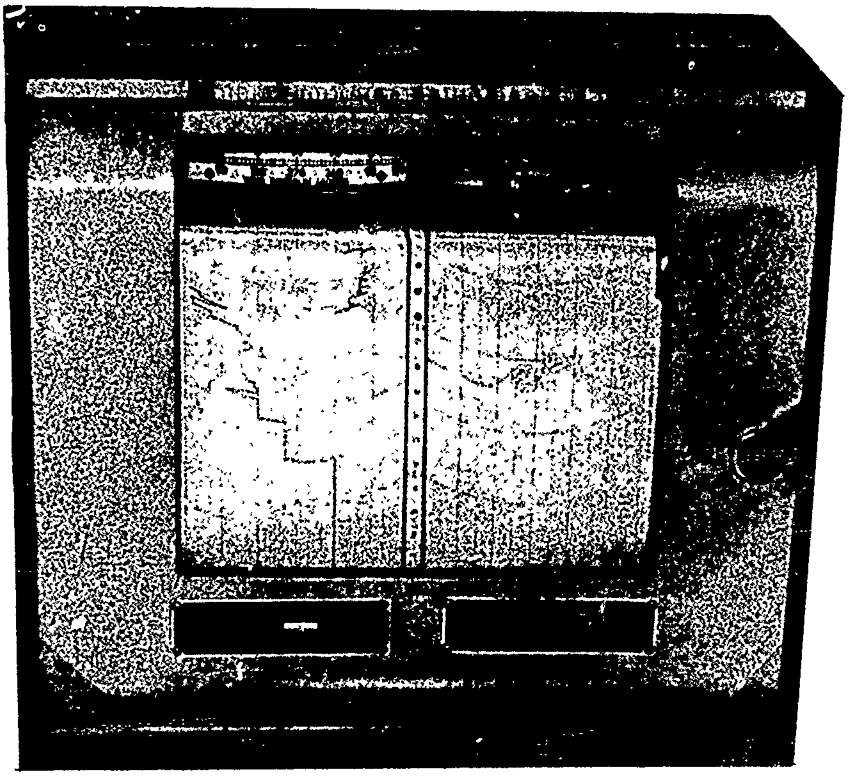
Range of Measurements
- Wind Direction: 360°
- Wind Speed: 0 to 120 knots or 0 to 240 knots

Recorder Accuracy
- Wind Direction: ± 3°
- Wind Speed: ± 1.5 knots

Running Time: 15 days at chart speed of 3 inches per hour.

REMARKS

The RO-362/GMQ is used as the recorder in the AN/GMQ-20, Wind Measuring Set.



RO-362/GMQ, Wind Direction and Speed Recorder.

WIND RECORDER (RO-362/363)

1. State the purpose of the RO-362/363.

2. List the five times that the wind recorder roll is annotated.

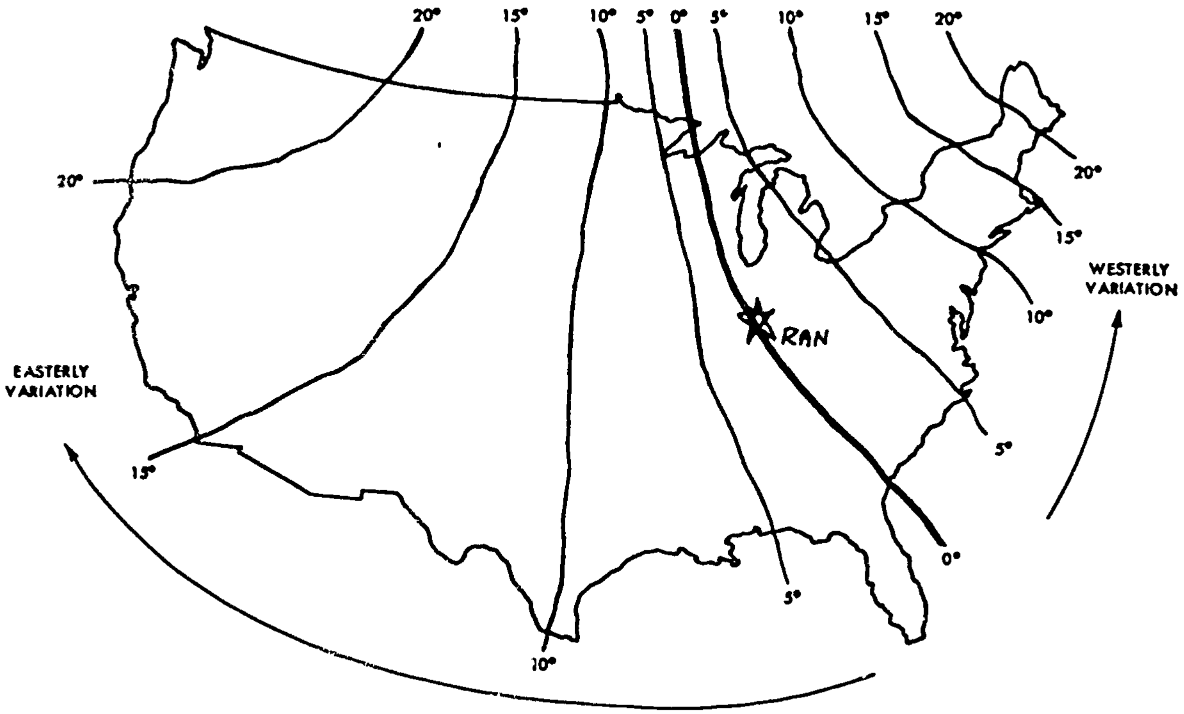


Figure 18. Magnetic Variations Across the U.S.

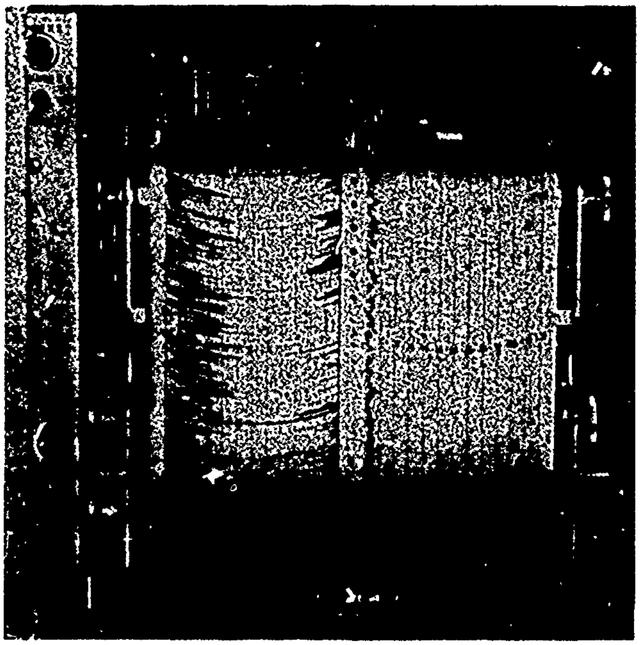


Figure 19.

3. Match the controls to their proper statements.

Range Switch X1 _____

Range Switch X2 _____

Chart Feed Switch _____

Power Switch _____

Light Switch _____

Feed Roll Knob _____

a. Illuminates contents in case.

b. Supplies current to chart drive mechanism.

c. Used when wind speeds are in excess of 90 knots are forecasted to exceed 90 knots.

d. Selects chart drive speed of 3"/min or 3"/hour.

e. Normal position for wind speeds from 0-120 knots.

f. Used to manually adjust chart forward or backward.

4. Procedures for replacing chart on RC-362:

a. Prepare chart by folding into arrow.

b. Lift pens from old chart using pen lifters.

c. Insure detent engages the knurled knob.

d. Remove old chart.

e. Thread new chart.

f. Insure center holes engage chart gear in center of roller.

g. Attach new chart to takeup roll.

h. Insure time is set to GMT.

i. Lower pens to chart and close cabinet.

5. Circle the following items:

Wind Shift - maximum gust - wind direction and speed at 3 a.m. (read and indicate columns 9, 10 and 11 for this time).

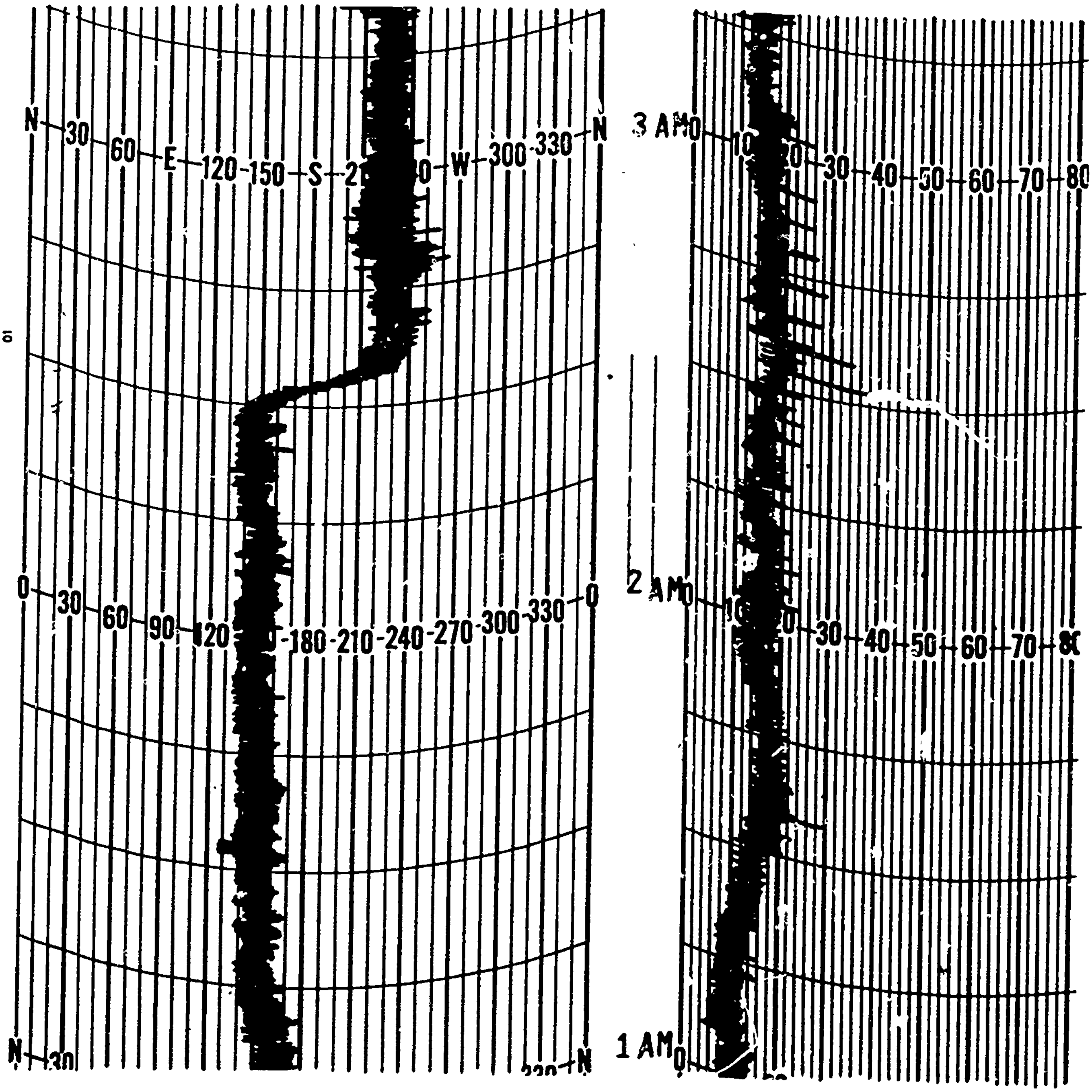


Figure 20.

ML-512-A, BAROMETER

Functional Description

Barometer ML-512-A is a Fortin-type mercurial barometer, calibrated in both inches of mercury and millibars, intended for permanent indoor installation. The inch scale of this equipment covers a range of 22 to 32 inches. Because of the length of the vernier used with the scales the maximum value of atmospheric pressure that can be read is approximately 31.3 inches of mercury and/or 1060 millibars. The minimum readable value which can be read on the scales is approximately 21.7 inches of mercury and/or 735 millibars. The upper and lower sections of the adjustable cistern are constructed of boxwood and fastened together with a split-ring clamp. A mercurial thermometer of the non-registering type is included with this barometer so that the observer can make the necessary corrections in the environmental atmospheric pressure readings to compensate for variations in the prevailing temperatures.

Technical Characteristics

- Barometer Data
  - Range: 22 to 32 inches
  - Inches of mercury: 21.7 to 31.3
  - Millibars: 735 to 1060
- Graduations: 1/20 inch
- Accuracy
  - Calibrated: ± 0.002 inch
  - Non-calibrated: ± 0.01 inch
- Thermometer Data
  - Range
    - Fahrenheit: -10° to +100°
    - Centigrade: -23° to +38°
  - Graduations
    - Fahrenheit: Each whole degree
    - Centigrade: Each half degree

REMARKS

The ML-512-A is the AWS mercurial barometer in use at permanent installations.

ML-512/GM, Barometer.

MERCURIAL BAROMETER (ML-512)

1. State the purpose of the mercurial barometer.

2. What is the primary use of the mercurial barometer?

3. What is the reason for tapping the top of the mercury column?

4. How is the inch scale graduated, numbered and read?

5. How is the vernier scale graduated, numbered and read?

6. If a line on the vernier scale coincides with a line on the inch scale, how is the vernier scale read?

7. If two lines on the vernier scale fall between two lines on the inch scale, how is the vernier scale read?

8. The attached thermometer is read to the nearest ______ degree.

9. Why is the mercury backed off 1/4 inch from ivory point and what will happen if mercury adjusting screw is turned too far counterclockwise?

10. Name this piece of equipment ____________________

Label items A thru G.

A ____________________

B ____________________

C ____________________

D ____________________

E ____________________

F ____________________

G ____________________

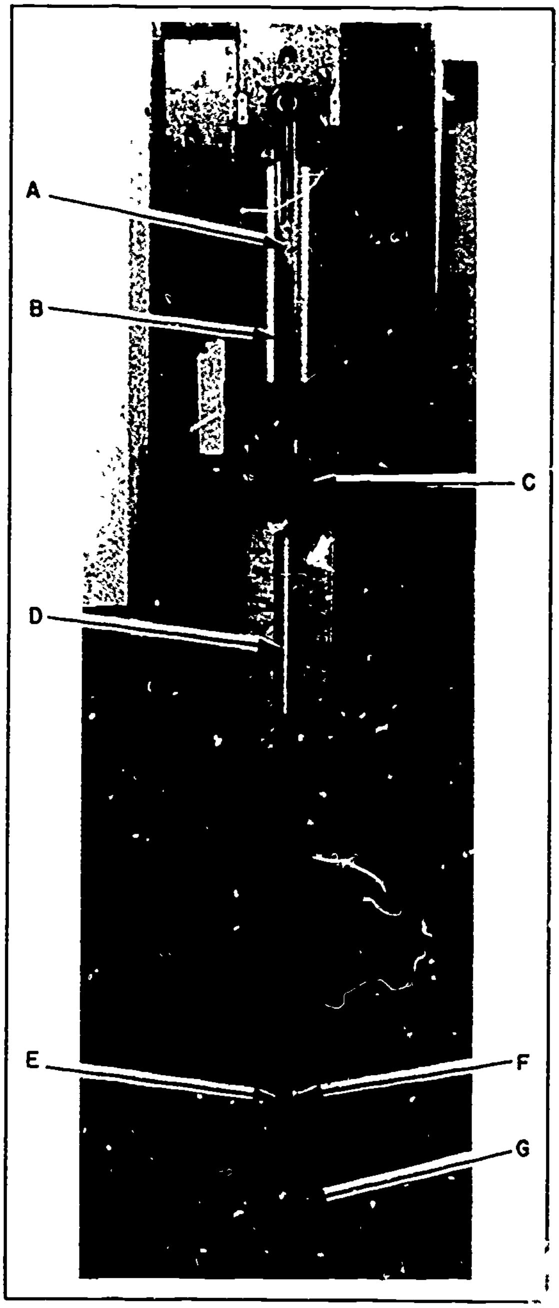
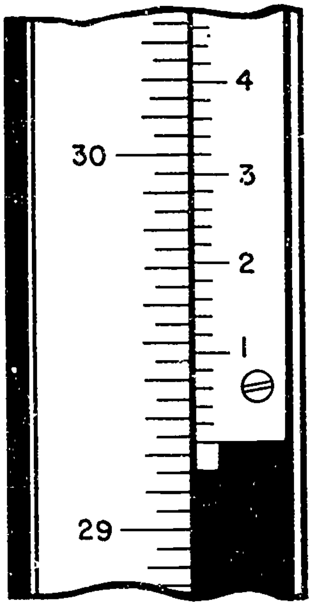


Figure ?1.

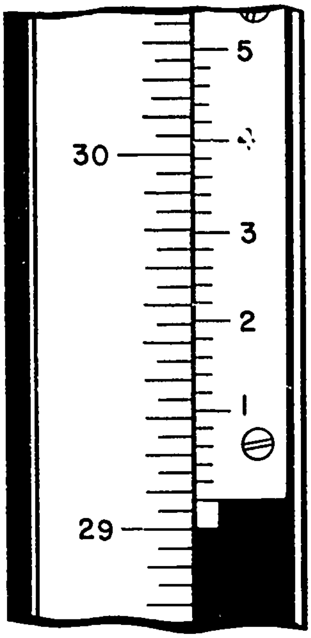
11. Determine the observed barometer reading for the mercurial barometers on pages 45, 46, and 47.



INCH SCALE ____________

VERNIER SCALE ________

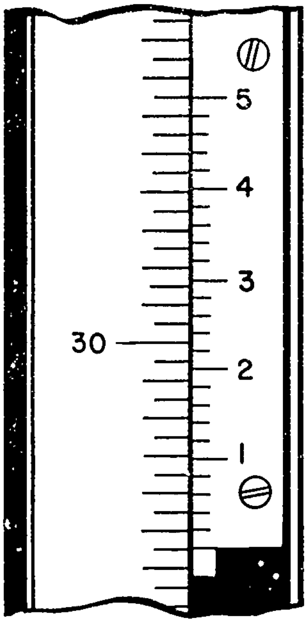
OBSVD BAROMETER ____________



INCH SCALE ____________

VERNIER SCALE ________

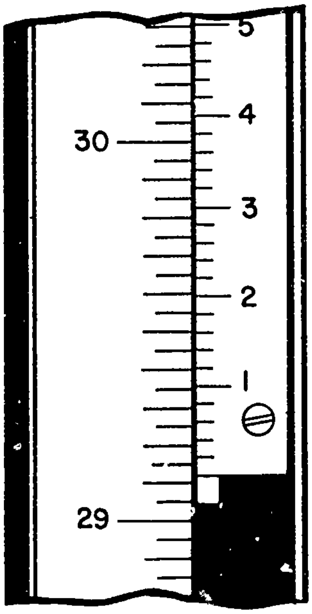
OBSVD BAROMETER ____________



INCH SCALE ____________

VERNIER SCALE ________

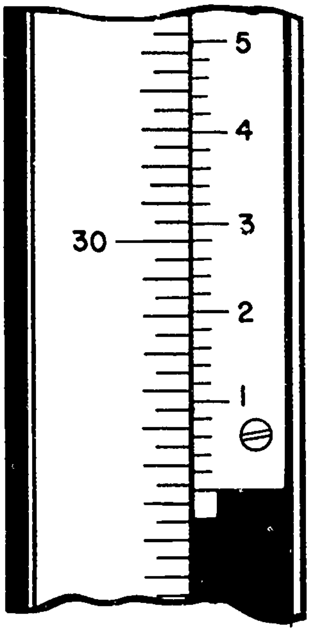
OBSVD BAROMETER ____________



INCH SCALE ____________

VERNIER SCALE ________

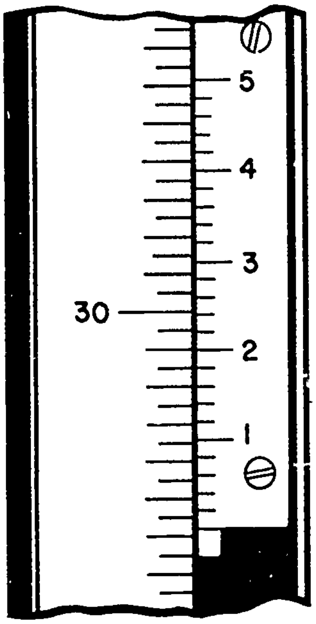
OBSVD BAROMETER ____________



INCH SCALE ____________

VERNIER SCALE ____________

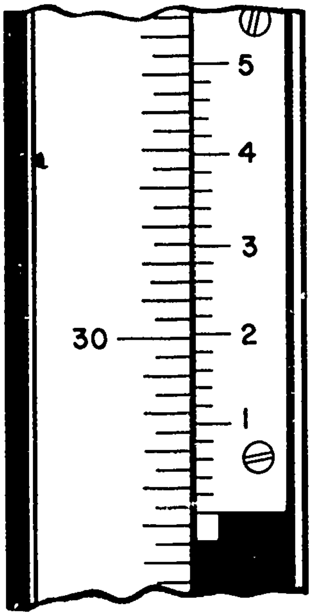
OBSVD
BAROMETER ____________



INCH SCALE ____________

VERNIER SCALE ____________

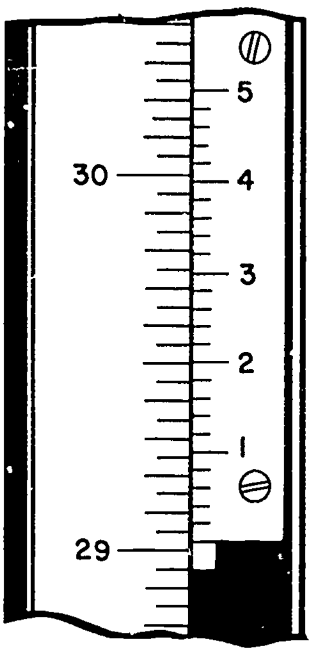
OBSVD
BAROMETER ____________



INCH SCALE ____________

VERNIER SCALE ____________

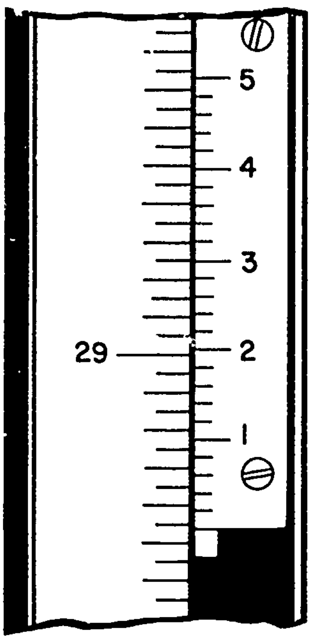
OBSVD
BAROMETER ____________



INCH SCALE ____________

VERNIER SCALE ____________

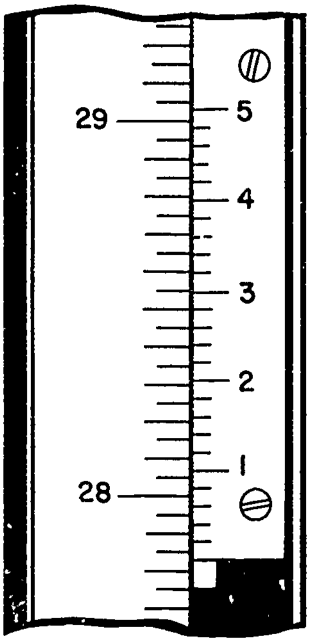
OBSVD BAROMETER ____________



INCH SCALE ____________

VERNIER SCALE ____________

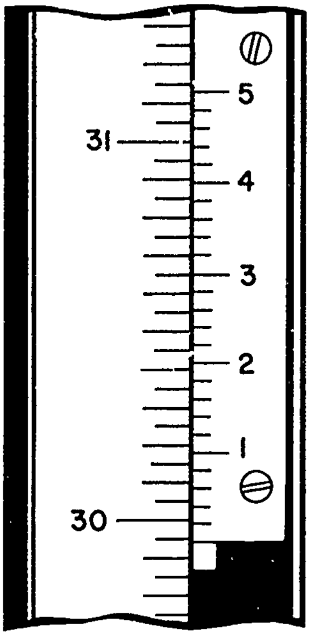
OBSVD BAROMETER ____________



INCH SCALE ____________

VERNIER SCALE ____________

OBSVD BAROMETER ____________



INCH SCALE ____________

VERNIER SCALE ____________

OBSVD BAROMETER ____________

ML-102-( ), BAROMETER

Functional Description

Barometer ML-102-( ) is a portable, highly-accurate aneroid barometer which is designed for use in fixed or mobile stations and for transportation by hand or in vehicles. The different models of ML-102-( ) all consist of an almost completely evacuated metal cell (or cells) sensitive to changes in atmospheric pressure, a system of levers and gears by which the motion of the cell is magnified and transmitted to a pointer, and a dial on which the pointer indicates the changes or pressure. Parallax errors are eliminated by incorporating a concentric mirror ring.

Technical Characteristics

Model	Pressure Ranges Millibars	Pressure Ranges Inches	Accuracy	Reading Position
ML-102-B	1085-745	31.5 - 22	± 0.4 mb	Vertical
ML-102-D	1065-745		± 0.3 mb	Horizontal
ML-102-E	1085-745	31.5 - 22	± 0.3 mb	Vertical
ML-102-F	1085-745	31.5 - 22	± 0.7 mb	Vertical
ML-102-G	1065-745		± 0.3 mb	Horizontal

REMARKS

Barometer ML-102-( ) is the standard aneroid barometer which is used to obtain routine pressure measurements at permanent and tactical weather stations.

ANEROID BAROMETER (ML-102)

1. State the purpose of the aneroid barometer.

2. Explain how the error of parallax can be avoided.

3. How is the aneroid barometer graduated, numbered and read?

4. Read the aneroid barometer, figure 22 in inches of mercury to the nearest .005.

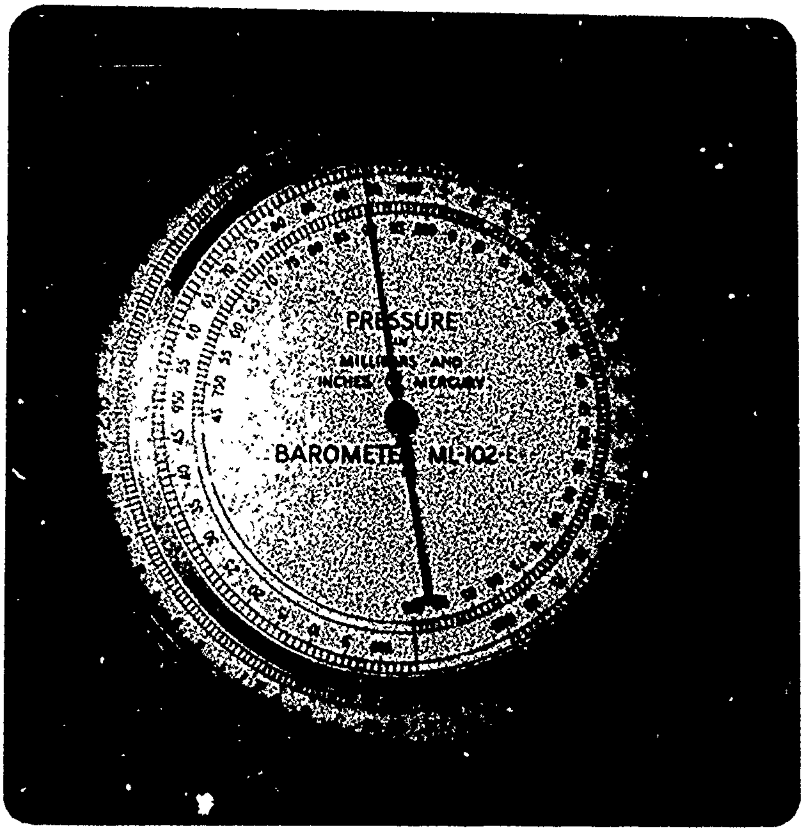


Figure 22.

ML-563/UM, BAROGRAPH

Functional Description

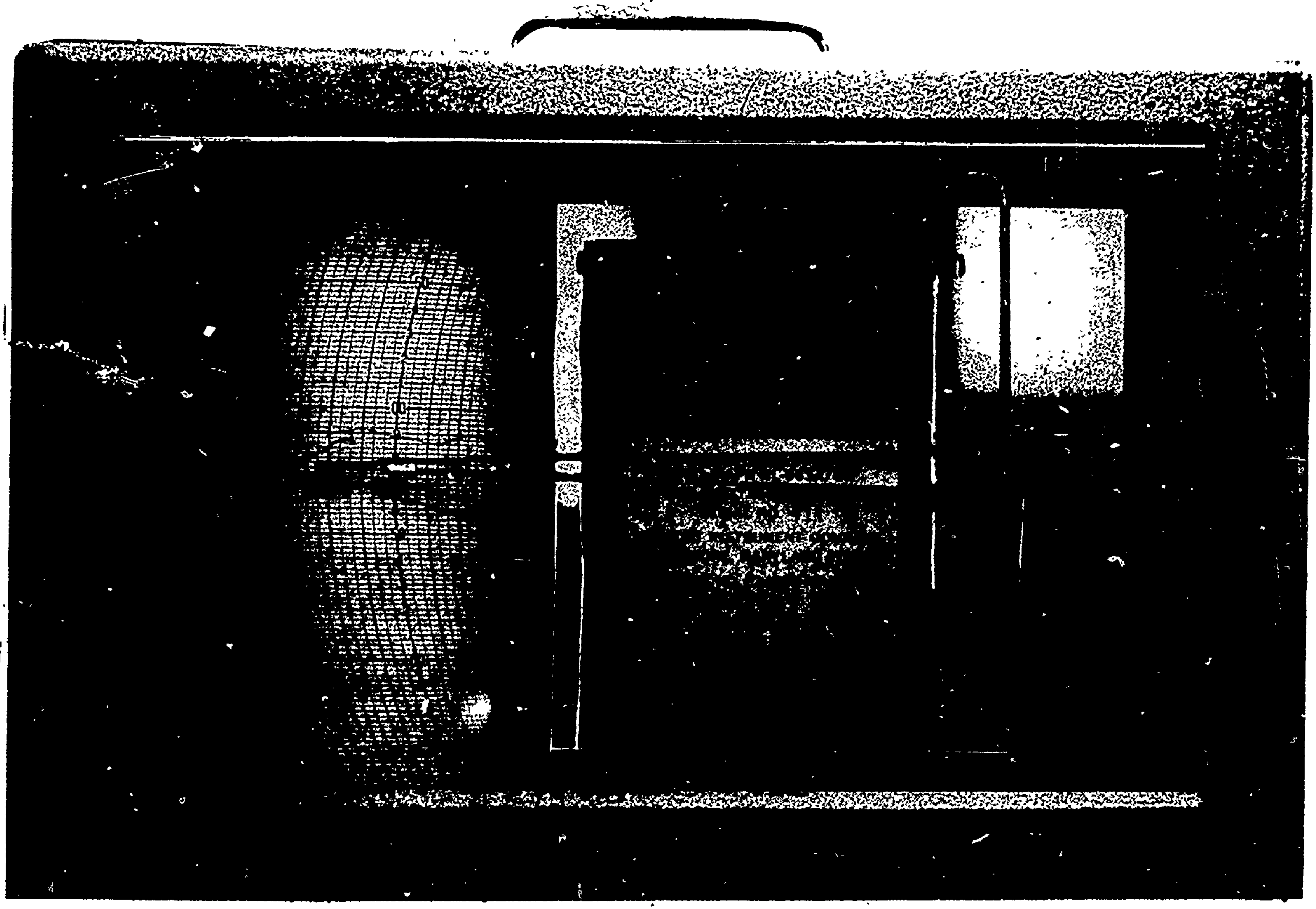
Barograph ML-563/UM is a portable, precision instrument which measures and records atmospheric pressure. It provides a continuous record for a four-day period on a paper chart which is mounted on a rotating cylinder. The pressure-measuring mechanism consists of a pressure-sensitive unit with two bellows which activates a recording pen through a system of levers. Vertical movements of the pen due to pressure variations causes the tracing of a record of these pressure changes on the chart. Dashpots are used to damp out the effects of vibrations and small-scale pressure fluctuations. The barograph may be used to obtain station pressurs by applying a correction to the reading. This instrument is also used to determine the amount and the characteristic of the pressure tendency for a 3-hour period ending at the actual time of the observation.

Technical Characteristics

Type: Aneroid
Indicator: Recording pen
Range: 23.5 to 31 inches of mercury
Scale Graduations: 1/50 inch, numbered each 1/10 inch

REMARKS

Barograph ML-563/UM replaced ML-30 as the standard AWS barograph.



ML-563A/UM, Barograph.

BAROGRAPH (ML-563/UM)

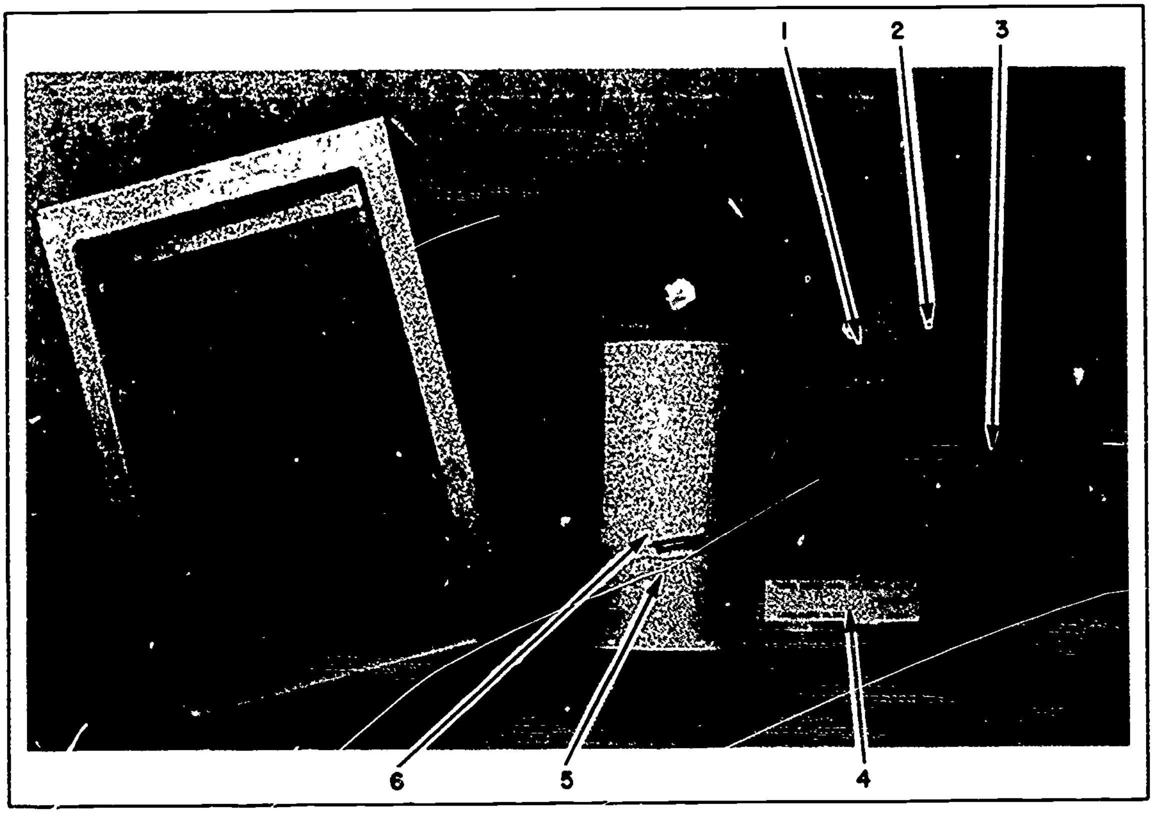
1. State the purpose of the barograph.

2. The barograph chart provides a ______________ pressure record. How long does it take for the chart to make one revolution?

3. How is the barograph graduated, numbered and read?

4. How many revolutions are made before the chart is changed?

5. Using the barograph as the primary measuring instrument and after initial standardization is made, when must the barograph be adjusted and how?



1 PRESSURE CELL ADJUSTMENT
2 PEN LIFTER
3 LEVER SYSTEM
4 PRESSURE CELL HOUSING
5 CHART AND CYLINDER
6 PEN

Figure 23.

6. Procedures for changing barograph chart:

a. Open the case and push shifting lever to hold pen away from cylinder.

b. Remove thumbnut and chart cylinder.

c. Wind the 8-day clock.

d. Take a new chart and notate the ".00" lines according to the local pressure range.

e. Remove old chart and replace with new chart.

f. Replace cylinder and thumbnut and set to GMT.

g. Set pen to the correct station pressure using the adjustment knob and lightly tap the base of the barograph.

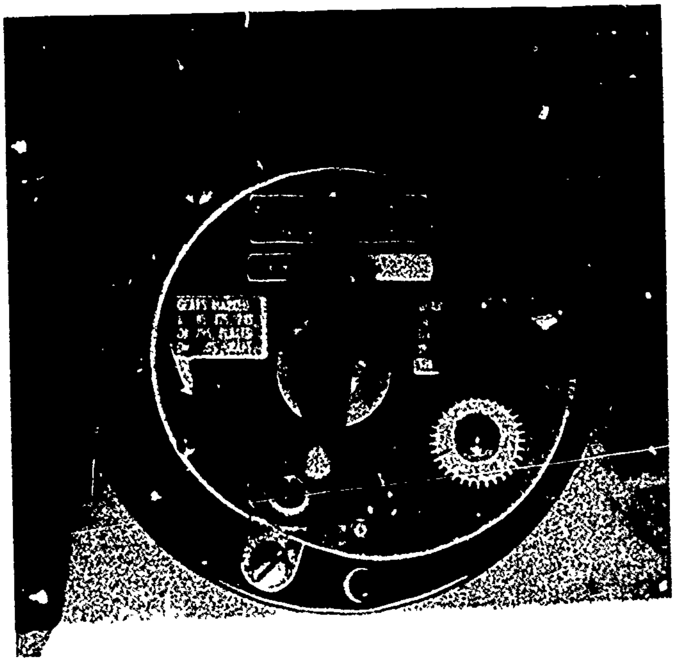


Figure 24.

7. Read the barograph, figure 25, to nearest .005 for the times indicated.

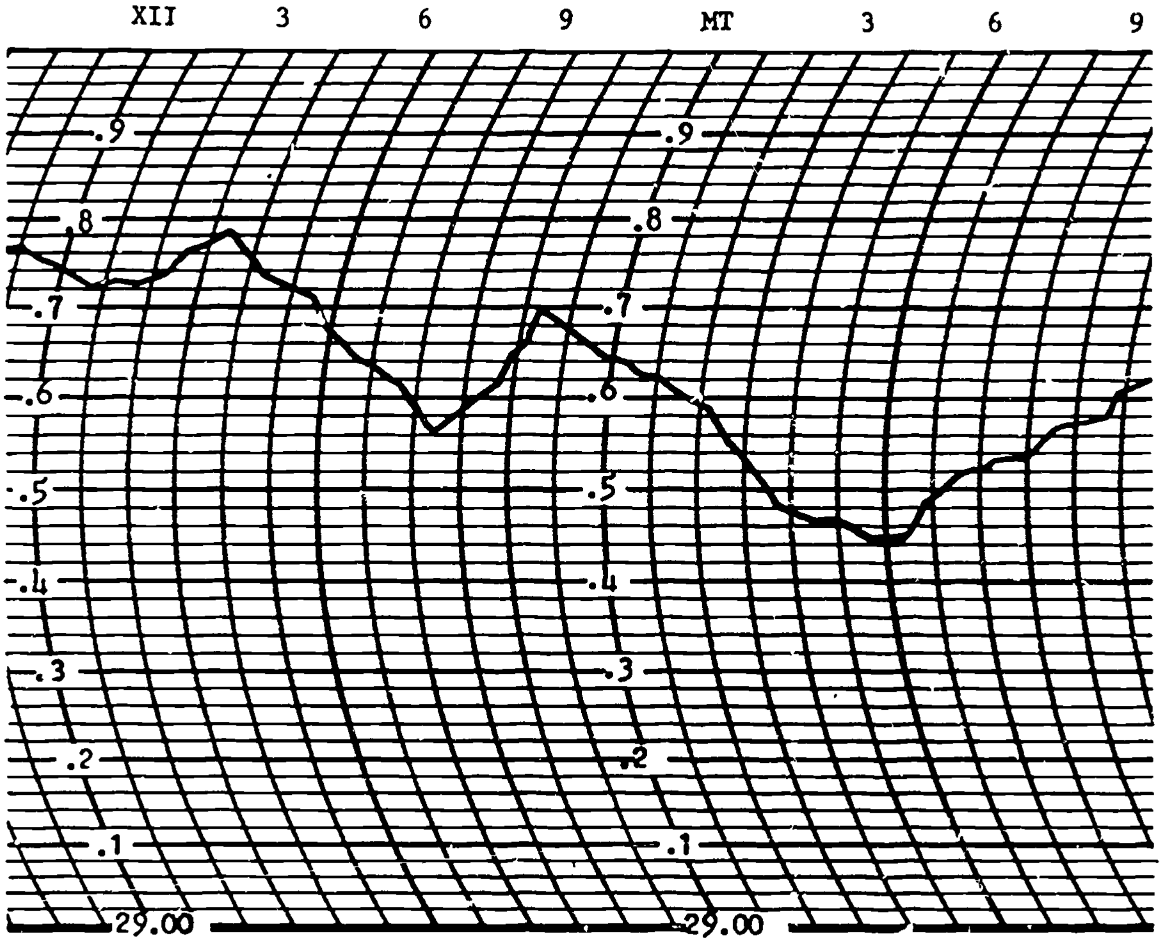


Figure 25.

1200	______________	2120	______________
1525	______________	0300	______________
1700	______________	0655	______________
2025	______________	1000	______________

8. Whenever information obtained from weather equipment appears questionable, what should be done?

801

DIGITAL ALTIMETER-BAROMETER ML-658/GM

DESCRIPTION AND PURPOSE- Digital Altimeter-Barometer ML-658/GM is a self-contained rack mounted unit designed to display altimeter setting or station pressure at military base weather stations. The altimeter setting is supplied to an aircraft pilot as a flight altimeter reference.

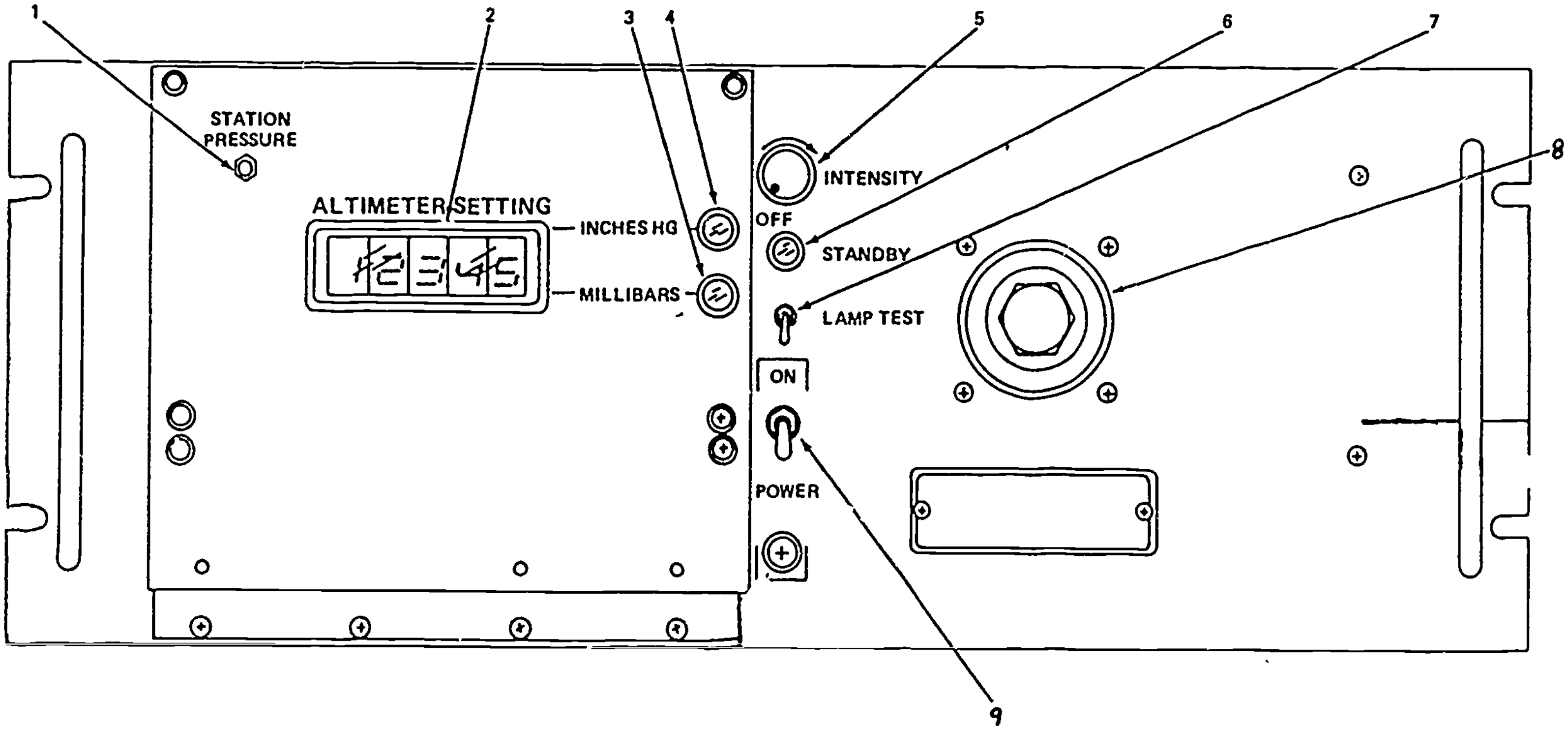
Case, Digital Altimeter-Barometer CY-8017/GM is provided for the transportation and storage of the ML-658/GM.

RANGE AND ACCURACY CHARACTERISTICS

Altimeter setting range-	27.000 to 32.000 inches or Hg
Altimeter setting accuracy-	±0.005 inches of mercury; ±0.2 MB
Station pressure range-	16.000 to 32.500 inches of Hg
Station pressure accuracy-	±0.005 inches of Hg; ±0.2 MB

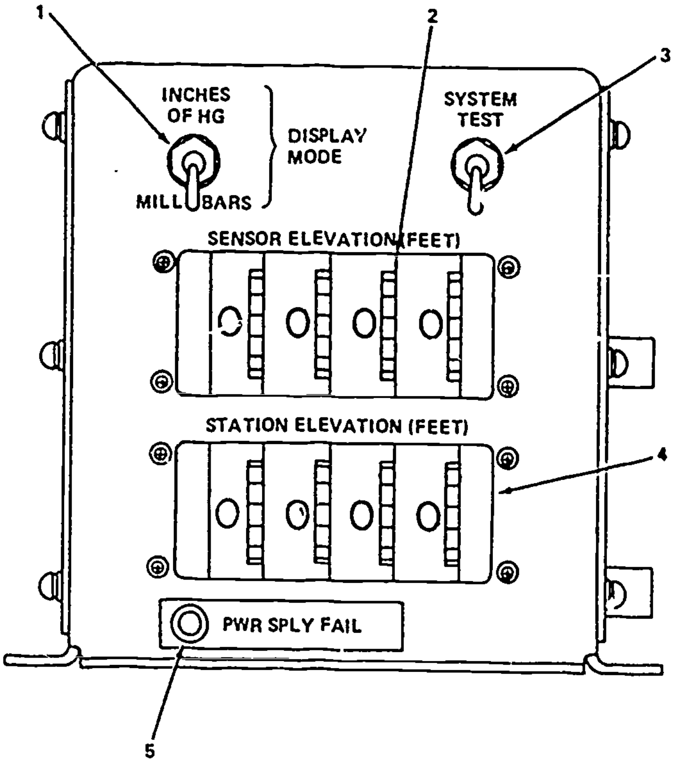
WARM-UP TIMES

SHUT-DOWN TIME	WARM-UP TIME REQUIRED
Less than 1 minute	2 minutes
1 to 5 minutes	15 minutes
5 to 10 minutes	30 minutes
10 to 40 minutes	60 minutes
Over 40 minutes	90 minutes



1. Station Pressure switch
2. Altimeter Setting display
3. Millibars indicator
4. Inches Hg indicator
5. Intensity control
6. Standby indicator
7. Lamp test switch
8. Desicator Assembly - absorbs moisture
9. Power ON switch

Figure 26. ML-658/GM Front Panel, Controls and Indicators.

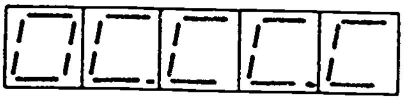


Located behind the front panel inside the equipment.

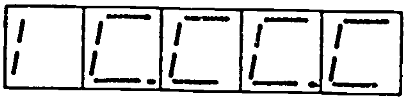
1. Display Mode switch
2. Sensor Elevation switches
3. Test switch-Down for normal use
4. Station Elevation switches
5. Power supply Fail indicator

Figure 27. Thumbwheel Switch Assembly, Controls and Indicators.

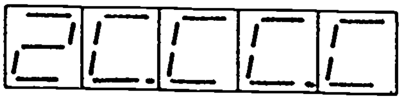
Built-In-Test (BIT) Operation. Built-in-test operation is initiated by momentarily activating the SYSTEM TEST switch. Six separate tests are then automatically and sequentially performed during an approximate 30-second interval. The test results are monitored on the ALTIMETER SETTING display via a "unique" set of segments that flash continually for approximately five seconds per test.



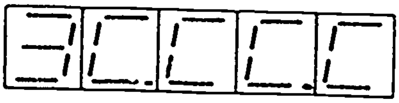
Indicates Normal Operation



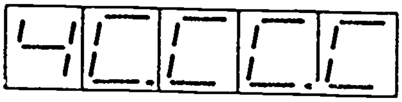
Indicates Checksum Error in Calibration PROM



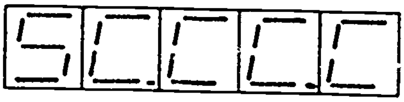
Indicates Out-of-Range Input (High or Low Pressure Range)



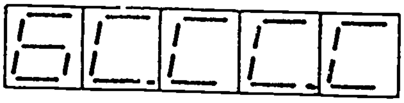
Indicates No Transducer Signal To Processing and Memory Card



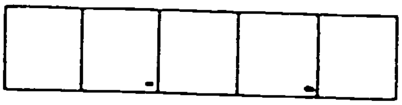
Indicates Illegal Switch Settings (Either below -100 feet or above 8,000 feet)



Indicates Perceived Change In Elevation Switches After Power Turn On

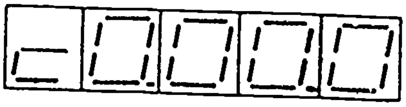


Indicates Perceived Change In Offset or Gain Strapping



Indicates ROM or RAM Error. (RAM error detected only at power turn on or when POWER circuit breaker is toggled.)

A. ERROR CODES



Indicates All Switches Are Set At "0"

B. SENSOR ELEVATION SWITCHES

NOTES: 1. All displays flash for approximately five seconds.
2. Decimal points appear as indicated in diagrams.

Figure 28. Built-In Test (BIT) Indications.

DIGITAL ALTIMETER - BAROMETER (ML-658/GM)

1. State the purpose of the Digital Altimeter-Barometer.

2. Warmup time for the Digital Altimeter-Barometer is ________ minutes. Readings may be ______________ before the _______________ light extinguishes.

3. Push __________ the _____________ _____________ switch to read station pressure to the nearest _____________.

4. It may be _____________ to aircraft operation if correct _____________ _____________ and _____________ _____________ have not been set on the thumbwheel switches.

HANDOUT

C3ABR25130-HO-203, 301

Technical Training

Weather Specialist

WEATHER MESSAGE FORMAT

9 June 1982

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE

DO NOT USE ON THE JOB

RGL: N/A

Supersedes 3ABR25130-HO-203, 301, 2 May 1980.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 50; DAV - 1

RECORDS, SPECIALS, AND RECORD SPECIALS

1.	2.	3.	4.	5.	6.
CCC	DATYP	MOD	GGgg	TEXT;	(NL)

1. CCC - The three letter location identifier of the reporting station.
2. DATYP - Data type identifier;
   SA - Hourly reports.
   RS - Record Specials.
   SP - Specials.
3. MOD - Modifier such as COR or RTD as required. When needed it is placed between DATYP and GGgg, with a space before and after the MOD.
4. GGgg - Time GMT from column 2 of Form 10.
5. Text - Message text followed by a semi-colon at the end of each weather transmission.
6. (NL) - If more than one line is needed for the text, use the new line key (NL) and indent four spaces. (Max 69 characters and/or spaces on a line.)
7. etx - This character is entered at the end of each message immediately following the semi-colon. However in school use (NL) after semi-colon and then the etx.

EXAMPLES:

```
1.  RAN SA 1255 20 SCT E50 BKN 15 120/75/68/3008/999/TCU E;(NL)
    etx
2.  RAN SA 1456 -X M30 BKN 70 OVC 4FH 123/50/38/0000/003/F3/ 305(NL)
        1578;(NL)
    etx
3.  RAN SP COR 1526 12 SCT 60 SCT 6K 2715G25/000/12 SCT V BKN;(NL)
    etx
```

PIREPS

1.	2.	3.	4.
CCC	DATYP	MOD	TEXT;(NL)
etx.			

1. CCC - Station call letters.
2. DATYP - Type of data identifier - UA - for PILOT REPORTS.
3. MOD - Modifier as needed - COR or RTD.
4. TEXT - Message from the PILOT REPORT form. If more than one line is needed for the text use (NL) and indent four spaces. End with semi-colon,(NL), etx.

EXAMPLE:

```
RAN UA /OV BLV 1310 FL 053/TP C411/SK 040 SCT 053/260 OVC/IC LGT 035-053(NL)
    /RM CLR ABV;(NL)
etx.
```

RAREPS

```
 1.    2.    3.    4.    5.
CCC   DATYP MOD  GGgg  TEXT;(NL)
etx
```

1. CCC - Station call letters.

2. DATYP - Type of data identifier - SD - for Radar Reports.

3. MOD - Modifier if needed - COR or RTD.

4. GGgg - The time from column 2 of WBAN Form 60.

5. TEXT - Message text. If more than one line is needed use (NL) and indent four spaces. End with semi-colon, (NL), etx.

EXAMPLE:

```
RAN SD 0138 AREA 3TRW+/+ 35/145 350/80 40W A3020 C3115 MT 500 AT (NL)
    21/96;(NL)
etx.
```

NOTAMS

```
    1.             2.                   3.           4.          5.
NOTAM(NL)  BASE SEQUENCE NUMBER, NOTAM NUMBER, STATION(NL), TEXT (NL) etx.
```

1. After typing NOTAM use new line (NL) but don't indent.

2. Base sequence number - 0000 for Chanute AFB.

3. NOTAM number taken from the NOTAM form.

4. Station - Chanute AFB IL.

5. Text - Message from the NOTAM form. If more than one line is needed for the text use (NL) and indent four spaces.

EXAMPLE:

```
NOTAM(NL)
0000 N15 CHANUTE AFB IL(NL)
PAR IN(NL)
etx
```

FORECASTS

1.	2.	3.	4.	5.
CCC	DATYP	GGGG	MOD	TEXT

1. CCC - Your station call letters.

2. DATYP - Data type identifier - TAF - for forecasts.

3. GGGG - Valid time of the forecast. (0808 = 0800 today until 0800 tomorrow)

4. MOD - Modifier such as COR, RTD, or AMD used as necessary. When using COR type COR again with the actual time GMT of the correction at the end of the forecast before the semi-colon.

5. TEXT - Message as found on the form. After the first line indent all lines four spaces. Each forecast period must begin on a new line.

EXAMPLE:

```
WRB TAF 0808 22006 9999 7CS200 QNH2997INS CIG200
    GRADU 0911 4800 10BR 05HZ 2AC100 7CS200 QNH2995INS CIG200
    GRADU 1214 32010 9999 WX NIL 1CU030 4AC100 7CS200 QNH2994INS CIG100;(NL)
etx
```

ARQ

Individual station requests - Example #1
Complete Wx message request-- Example #2
Request for data missed during circuit outage - Example #3

1.	2.	3.	4.	5.
ARQ	(NL)	DATYP	TEXT	etx.

1. ARQ - Automatic Response to Query.
2. (NL) - After typing ARQ, hit the new line key (NL) but DON'T indent.
3. DATYP - Use the 2 letter identifier (SA,SD,etc....)
4. Text - Call letters of stations requested separated by a space.
5. etx - End of text function after last station call letters, however in school use (NL) and then etx.

Example #1	Example #2	Example #3
ARQ(NL)	ARQ(NL)	ARQ(NL)
SA LTS FWH(NL)	SAUS 22 KAWN(NL)	TYPNO/TYPOK 191445 191525(NL)
TW CMI DCA(NL)	etx	etx
etx		

NOTE: The number of stations requested cannot exceed 9 per line with no more than 5 lines. Each line must begin with a data type-no data types within lines.

TYPNO-Equipment is out of order.
TYPOK-Equipment is back in operation.
YYGGgg YYGGgg - DTG outage began and ended.

Code Form: (CCCC) (GGgg) () $dddff/f_mf_m$ VVVV R(P) (M) $V_RV_RV_RV_R$ w'w'

$N_sCCh_sh_sh_s$ $T'T'/T_d'T_d'$ $P_HP_HP_HP_H$INS/CIG(D)hhh

(Other remarks and supplementary coded data);

1. Record Observations:

   a. (EDAR) VRB07 1300 R1220 61RA 2FG/// 3ST008 8NS012 01/M01 2938INS/ CIGM012 CIG010V015 WND 040V100 VIS N2200 PK WND 0531/08 WR//;

   b. (RJTY) 02010/17 1400 R0730 05HZ 7HZ/// 1ST007 2SC020 6AS070 20/17 3019INS/CIGE020 VIS N3200 RCD SCT045/BKN090 QFF 1015;

   c. (EDIU) 30003 9999 M04/M10 3003INS/ 90402 20001;

2. Special Observations:

   a. (EDAR) 0731 25003 1700 R1220 10BR 5ST006/CIGM006;

   b. (RJTY) 1614 02005 0600 R0420 51DZ 2FG/// 1ST006 2ST016/CIGM016 OCNL CIGNO VIS 0400V0800 TWR VIS 1000 CIG LWR W;

   c. (RPMK) 0307 R1160;

Weather Training Branch
Chanute AFB, Illinois

C3ABR25130-WB-303
5 April 1984

WEATHER COMMUNICATIONS

OBJECTIVES

1. Without reference, select facts that pertain to the mission of DOD/DCS Global Weather Communication System to 75% accuracy.

2. Without reference, select facts that pertain to the composition of the DOD/DCS Global Weather Communication System to 75% accuracy.

3. Without reference, select facts that pertain to weather data processing to 75% accuracy.

4. Without reference, select facts relating to quality control summaries to 75% accuracy.

PROCEDURE

Answer the following questions.

1. What is the overall mission of the DOD/DCS Global Weather Communication System?

2. What are the four major components of the DOD/DCS Global Weather Communication System?

3. What is the primary mission of the Automated Weather Network (AWN)?

4. What is the nucleus of the DOD/DCS Global Weather Communication System?

5. What does ADWS stand for?

6. What are the locations of the ADWSs?

7. What does the contraction COMEDS stand for?

Supersedes C3ABR25130-WB-303, 13 August 1982.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 550; DAV - 1
Designed for ATC Course Use. Do Not Use on the Job.

8. What is the name of the USAF weather facsimile system?

9. The facsimile system transmits over certain networks, what are they?

10. Where do they transmit to?

11. What is AFMEDS?

12. What is AFMEDS composed of?

13. How does the M-28 system differ from COMEDS?

14. What is scheduled to happen to the M-28 system in the near future?

15. What is an AXXX bulletin?

16. What is a MANOP heading?

17. What is the "TT" in the MANOP heading?

18. What are the five parts of the MANOP heading?

19. What response is required for an AXXX(NN) CCCC bulletin?

20. What is an AXUS1 KGWC bulletin?

21. When is it issued?

22. How do you respond to an AXUS1 KGWC bulletin?

23. Listed below are the first two parts of a MANOP heading. Using attachment 1, identify the following data content designators and geographical designators. Example: SAUE - Airways observations for the eastern United States.

    a. SDUM

    b. ABUS

    c. FTUW

    d. UAAK

    e. WTBE

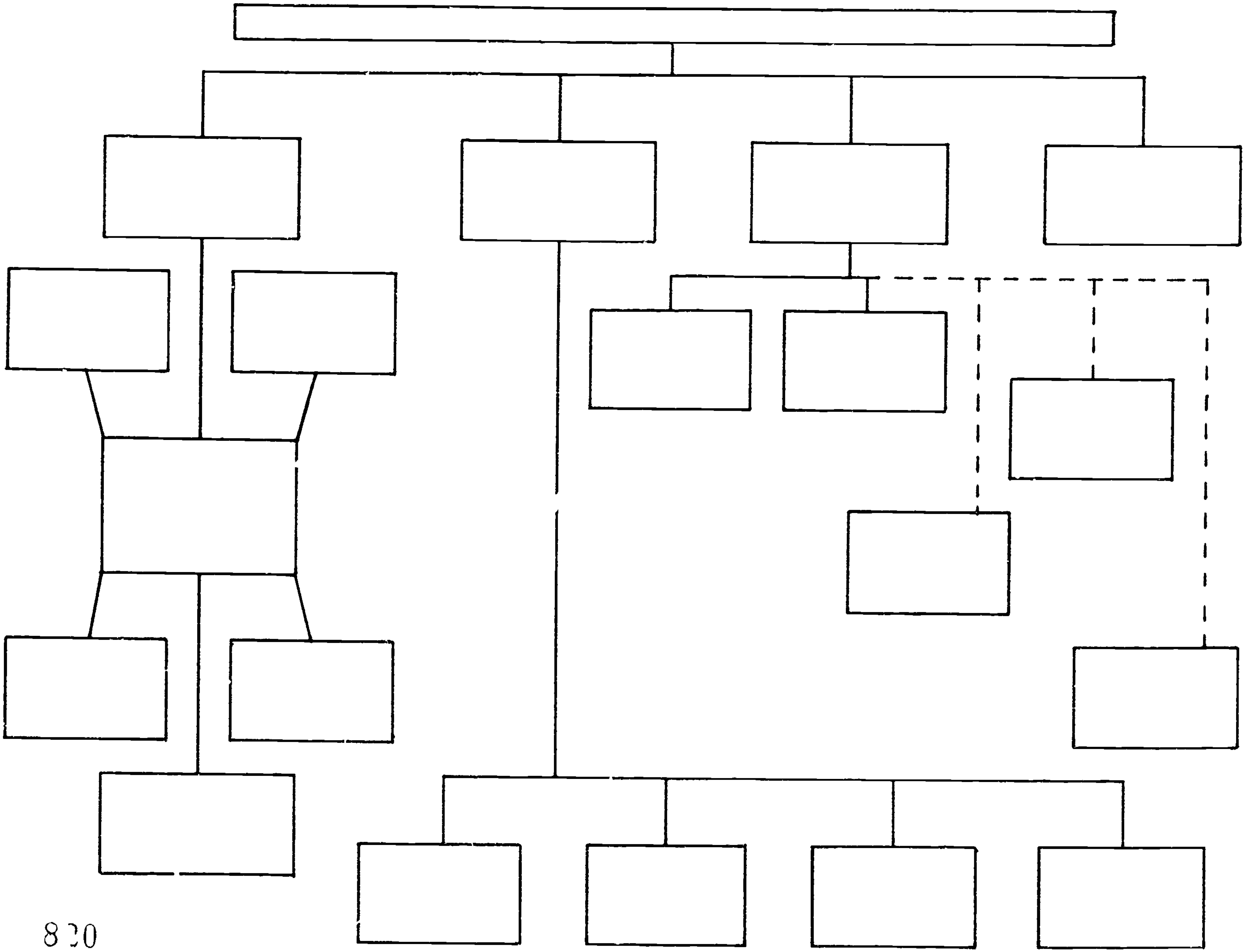
    f. SMEU

    g. AXUS

    h. SHUK

    i. SAUM

24. Complete figure 1 with the aid of your instructor.



8 20

Figure 1. Weather Communication Organization Diagram.

ATTACHMENT 1

A partial listing of Data Content Designators (TT) for use in abbreviated headings.

SURFACE DATA

SA - Airways/Aero/Metar Hourly and Half-Hourly
SD - Radar Reports
SH - Ship/Shred
SM - Synop/Ship Main Hours
SP - MMMMM/BBBBB/SPESH/SPECI/Airways Specials

UPPER-AIR DATA

UA - AIREP/PIREP/COMBAR/SACWXR
UJ - Combined TEMP/PILOT (Rawinsonde Data - Skew T)
UX - Miscellaneous

ANALYSES

AB - Weather Summary
AN - Nephanalyses
AR - Radar Analysis
AX - Miscellaneous

FORECASTS

FC - TAF - Period of Validity, 12 Hours or Less
FM - Temperature Extreme Forecasts
FP - Public Forecasts
FT - TAF - Period of Validity, Greater than 12 Hours

WARNINGS

WH - Hurricane Warnings
WO - Warnings (other including SVR RAREPs and PIREPs)
WT - Tropical Cyclone (TYPHOON) Warnings
WW - Military Weather Warnings

A partial listing of Geographical Designators (AA) for use in abbreviated headings:

AK - Alaska
AZ - Azores
BE - Bermuda
BZ - Brazil
CA - Caribbean
CN - Canada
EU - Europe
EW - Western Europe
GM - Guam
GX - Gulf of Mexico
HK - Hong Kong
HW - Hawaiian Island
JP - Japan
KO - Korea, Republic of
MX - Mexico
NA - North America
PA - Pacific
PH - Philippines
PM - Panama
RA - USSR (ASIA)
RS - USSR (EUROPE)
UE - United States (EAST)
UK - United Kingdom (Great Britian and Northern Ireland)
UM - United States (MIDDLE)
US - United States
UW - United States (WEST)
XX - For use when other designators are not appropriate

Technical Training

Aerographer's Mate (C-420-2010-A1)

PROPERTIES OF SEA WATER

24 March 1983

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

RCL: 10.1

Supersedes 3ABR25130-2-PT-304, 20 April 1981.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 250; DAV - 1

PROPERTIES OF SEA WATER

INSTRUCTIONS

This booklet contains a programmed lesson on the properties of sea water and was developed and designed to allow you to progress through the subject matter at your own speed. It is written in a linear format; that is, you will work through the program from "frame" to succeeding "frame."

Be sure you read the program objectives on pages iii and iv very carefully before beginning to work, and keep them in mind as you work through the program. Complete each frame in the program. Use your answer cover sheet to keep the desired responses (to the left of succeeding frame) covered until you have made your response to a particular frame. As you make the required responses in each frame, check them to be sure they are correct. If you make an error, feel free to turn back into the program and review until the point is clarified. If you become confused, or if there is some material which you do not understand, ask the instructor for assistance.

After you have read the introduction on page ii and the objectives on pages iii and iv, turn to frame 1 on page 1 and begin the program. Follow all directions explicitly, and read and work at your own pace, but steadily and diligently.

SUGGESTED READING TIME 48 MINUTES

NAME ______________________ CLASS ______________

PROPERTIES OF SEA WATER

INTRODUCTION

Sea water, in addition to having the unique qualities of pure water, has some distinct qualities of its own. For example, sea water contains, in dissolved form, all the known gases found in the atmosphere. Sea water also has, in solution, nearly all the elements, minerals, and salts known to science today.

Also, there are certain physical properties possessed by sea water which make it quite different from other water. To assist you in understanding the effects of sea water on the equipment, methods, and techniques used in predicting and operating in the ocean environment, it is essential that the properties of sea water covered in this programmed lesson be understood.

1. Given information pertaining to oceanography, accomplish the following to a 72% accuracy:

   a. Identify basic facts about the composition and physical properties of sea water. CTS: 2n Meas: W

	1. There are three major physical properties that control sea-water physics. In the following sequence, you will learn these three properties, and you will learn which of these three properties is the most important in controlling sea-water physics. NO RESPONSE.
	2. The first of the three major physical properties that control sea-water physics, and the most important property, is TEMPERATURE. Temperature is defined as a measure of the warmth or coldness of a substance with reference to some standard value. Since nearly all other physical and chemical properties of sea water are dependent on the sea-water temperature, we classify temperature as the most/least (Circle one.) important physical property.
most	3. The second of the three major physical properties that control sea-water physics is PRESSURE. Pressure in oceanography, is basically a measure of depth, since a usable ratio of pressure to depth has been established. For routine oceanographic measurements, atmospheric pressure is always neglected, and the pressure at the sea surface is zero, while maximum pressure is always at maximum depth. The reason submarines have an established crush depth, which they must not exceed, is because of the increasing ______________ with depth in the oceans.

pressure	4. The two major physical properties that control sea-water physics which you have just learned are, in decreasing order of importance, ______________ and ______________.
temperature pressure	5. The third major physical property that controls sea-water physics is <u>SALINITY</u>. Salinity is defined as the <u>total</u> amount of solid material dissolved in sea water. Salinity is <u>not</u>, as the name might imply, just the dissolved salt in the sea water. It includes <u>all</u> the dissolved material contained in sea water. Therefore, to express the total dissolved materials in sea water, we may use the term ______________.
salinity	6. Match the terms in column A below with the correct statements in column B. <u>A</u> ______ Pressure ______ Temperature ______ Salinity <u>B</u> a. Measure of warmth or coldness of a substance. b. Basically a function of depth, as used in oceanography. c. May be described as the weight of sea water. d. The total amount of solid material dissolved in sea water.
b. a. d.	7. On the lettered lines below, list the three major physical properties that control sea-water physics, <u>and</u> place an "X" on the short line to the left of the most important controlling property. ___a. ____________ ___b. ____________ ___c. ____________

X a. Temperature __ b. Pressure __ c. Salinity (Any order)	8. A knowledge of the physical properties of sea water, along with an understanding of the associated concepts to be introduced here, is essential to your understanding lessons to follow. In the next several sequences, information pertinent to temperature, pressure, and salinity of sea water will be presented. NO RESPONSE.
	9. The temperature in the open ocean varies between approximate limits of <u>$-2^{o}C.$ to $+30^{o}C.$</u> The lower limit ($-2^{o}C.$) is regulated by the freezing point of sea water, which is always warmer than (above) $-2^{o}C.$; consequently, sea ice will form before the water temperature falls below this level. Circle the letter of the correct temperature range in the open ocean. a. $-2^{o}F.$ to $+30^{o}F.$ b. $-2^{o}C.$ to $+30^{o}C.$ c. $+2^{o}C.$ to $-30^{o}C.$
b.	10. The upper temperature limit ($+30^{o}C.$) is maintained as a result of the interaction between the heating capacity of the sun (the major heat source of the oceans) and evaporation (the major cooling process of the oceans). As the sun increases the temperature of the sea water, the process of evaporation is speeded up until a balance is reached. Judging by the temperature limits given above, this balance is reached when the sea-water temperature reaches _____.

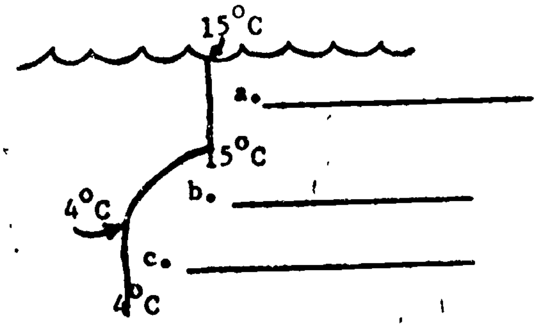
+30°C.	11. On the line below, write the temperature range found on the surface of the open oceans. ______________
-2°C. to +30°C.	12. If you read frame 10 very carefully, you will recall that the major heat source and the major cooling process of the oceans were mentioned. Match the items in column A below with the correct item in column B. A / B _____ Major oceanic heat source. — a. Advection _____ Major oceanic cooling process. — b. Sun c. Evaporation d. Moon e. Condensation
b. c.	13. The major heat source of the ocean is the __________; the major cooling process is ______________.

sun evaporation	14. Generally, sea-surface temperatures decrease (get colder) with an increase in latitude (moving from the equator toward either pole). However, the maximum surface temperature does not occur at the geographical equator (0°), but is displaced several degrees north of the geographical equator in the vicinity of the THERMAL EQUATOR. Keeping in mind the fact that sea-surface temperatures usually decrease from the thermal equator poleward, we would expect to find sea-surface tempera.ures at the geographical equator warmer/cooler (Circle one.) than temperatures at the thermal equator.
cooler	15. Latitudinal (north-south) variations of temperature in the open oceans show maximum sea-surface temperatures at the poles/thermal equator/geographical equator (Circle one.), decreasing equatorward/poleward (Circle one.).
thermal equator poleward	16. In addition to surface temperature variation because of geographical distribution, there are variations in surface temperature that are diurnal (daily or from day to day) in nature. These diurnal variations are slight, on the average from 0.2°C. to 0.3°C., and are related to the amount of heat which is absorbed from the sun during the day and radiated from the sea surface during the night. Additionally, such things as cloud cover and precipitation will affect the diurnal range. Circle the letter of the correct diurnal temperature range in the open ocean. a. 0.2°F. to 0.3°F. b. 2.0°C. to 3.0°C. c. 0.2°C. to 0.3°C.

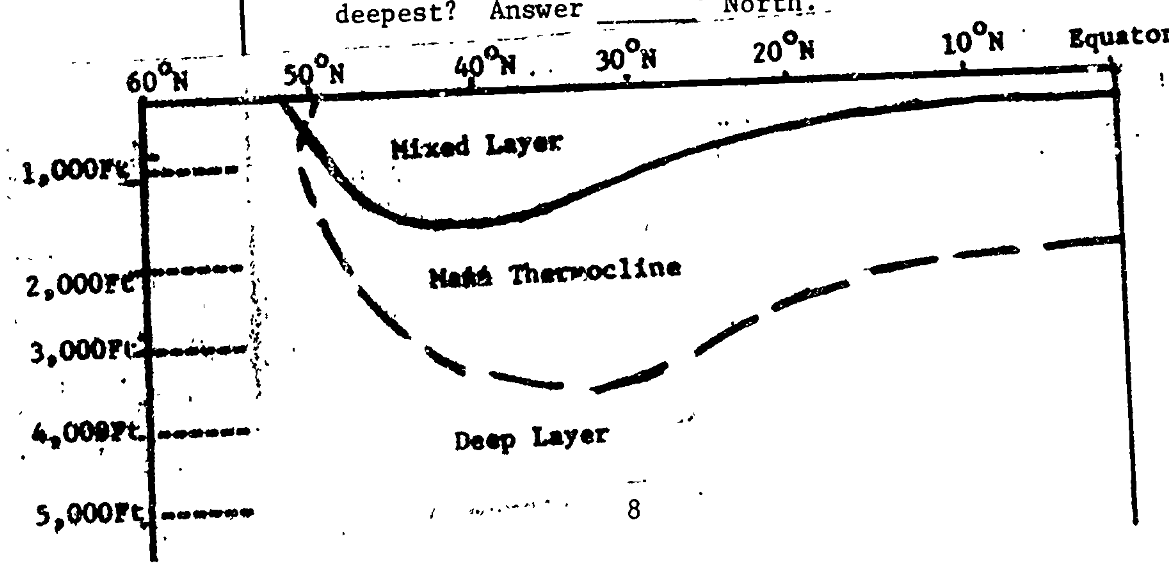
c.	17. The diurnal or daily sea-surface temperature variations are slight/great, ranging on the average from ______________. (Circle one.) (Diurnal range)
slight 0.2° to 0.3°C.	18. Examine the t .perature ranges below, and place an "X" on the line beside the temperature limits found in the open oceans, and place a "Y" on the line beside the diurnal sea-surface temperature range. _____a. -0.2°C. to +0.3°C. _____c. 0.2°C. to 0.3°C. _____b. -2°C. to +30°C. _____d. 0.2°C. to 30.0°C.
_X_ b. _Y_ c.	19. The sea also has vertical variations in temperatures. A convenient method of visualizing the sea is to divide it into layers in much the same way that we do the atmosphere. The term applied to this concept is the "three-layered ocean." The most variable layer is located near the sea surface and it is appropriately called the mixed layer. The sea may be divided into ______ vertical layers and the layer located nearest the sea surface is called the ________ layer.

three mixed	20. Temperatures in the mixed layer are fairly constant and generally exhibit isothermal qualities from the top of the layer to the bottom. The depth of the mixed layer is generally deepest in the middle latitudes (about 1,500 feet) and shallowest near the Equator (about 150 feet). The upper most layer in the "three-layered ocean" is called the ________ layer and its temperature is ________ with depth.
mixed constant or isothermal	21. Below the mixed layer the temperature decreases rapidly with depth. This layer is called the main thermocline. Temperatures in the mixed layer are ________ but decrease rapidly in the main ____________.
constant or isothermal thermocline	22. The temperature in the main thermocline decreases rapidly until the third layer is reached. Temperatures in the third layer are cold (less than 4° C) and nearly isothermal. The third layer is called the deep layer. The deep layer is characterized by temperatures that are ________ and nearly ________.

cold isothermal	23. On the diagram below, label the three layers of the ocean.



a. mixed layer b. main thermocline c. deep layer	24. You may have noted that the high latitudes were omitted in this discussion of the "three-layered" ocean concept. The three layered ocean concept does not apply to these regions of the oceans. Instead, the Arctic and Antarctic Oceans consist of one layer which resembles the deep layer of the "three-layered ocean." Temperatures in the high latitude oceans are cold and __________ from the sea surface to the ocean bottom.
constant or isothermal	25. The diagram below illustrates the north-south distribution of a simple three-layered ocean. Note that the deep layer extends to the sea surface in the area north of 50°N. Where is the mixed layer deepest? Answer ______° North.



40° North

26. Select from column B the statement(s) which best describe(s) the layer in column A.

Column A	Column B
_____ 1. Mixed layer	a. Temperature decreases rapidly through this layer.
_____ 2. Main thermocline	b. Cold and nearly isothermal temperatures.
_____ 3. Deep layer	c. This layer exists from the sea surface to the oceans' bottom in high latitudes.
	d. Isothermal layer which is normally deepest in the mid-latitudes

1. d
2. a
3. b, c

27. List the three vertical layers found in middle and low latitude ocean areas and describe their temperature variation with depth.

____

____

____

____

____

Mixed layer - isothermal or constant temperature with depth
Main thermocline - temperature decreases rapidly with depth
Deep layer - isothermal or constant temperature with depth

28. Now, let's consider pressure and its related concepts. In oceanography, pressure is expressed in <u>DECIBARS</u> and is actually a function of depth, such that <u>1 meter of depth is equal to roughly 1 decibar of pressure</u>. Using this 1 to 1 ratio, complete the table below.

DEPTH meters		PRESSURE Decibars
10	=	_____
_____	=	35
150	=	_____

10 = 10 35 = 35 150 = 150	29. In meteorology, pressure is normally expressed in millibars, but in oceanography, pressure is expressed in ____________________.
decibars	30. One meter of depth in the ocean is equal to ________ ______________________ of pressure.
one decibar	31. The one parameter most often mentioned in any discussion of sea water is salinity. You learned earlier that the term salinity is used to describe the total amount of dissolved material in sea water. Salinity is expressed in parts of dissolved material per thousand parts of water. Salinity may also be expressed as grams per kilogram (grams per thousand grams). The symbol typically used to represent salinity is $^{0}/oo$. This symbol is suffixed to the numerical value for salinity and is read as salinity in parts per thousand. Using the symbol for salinity, we would write a salinity of 35 parts per thousand as __________________.
$35^{0}/oo$	32. The total amount of dissolved material in sea water expressed in parts per thousand is the definition of ____________________.
salinity	33. Salinity is the total amount of ______________ material in sea water expressed in ______________ per ____________________.

dissolved parts thousand	34. The ________________ amount of dissolved ________________ in sea water expressed in ____________ per ____________ is the definition of ________________.
total material parts thousand salinity	35. On the lines below, write the definition of salinity. ____________________________________ ____________________________________ (For answer, see frame 22 or 23.)
	36. On the line below, write the symbol used to express salinity. ________________
$^{o}/oo$	37. Like temperature, salinity varies latitudinally and seasonally. The normal range of salinities found in the open ocean is from $33^{o}/oo$ to $37^{o}/oo$, making the average in the vicinity of $35^{o}/oo$. The controlling factor in salinity distribution is the difference between evaporation and precipitation; that is, in areas where evaporation exceeds precipitation, we would expect to find relatively high salinity, because evaporation removes only the water and leaves a higher ratio of dissolved solids in the remaining water. In the vicinity of 20° to 30° north and south latitude, we find an area where evaporation greatly exceeds precipitation. In these regions, we would expect to find an area of maximum/minimum salinity. (Circle one.)

maximum	38. In areas where precipitation exceeds evaporation, more water is added to ocean water, thereby reducing the ratio of dissolved material to water. Such an area is found near the geographic equator where frequent showers and thundershowers add large amounts of fresh water to the sea water. Near the thermal equator, we would expect to find an area of maximum/minimum salinity. (Circle one.)
minimum	39. The lowest salinity values found in the oceans, or the absolute minimum salinity, are found near the poles where abundant precipitation, in conjunction with ice melt and low evaporation, results in these absolute minimum salinity areas. To summarize then, from the thermal equator toward either pole, the following conditions exist: a. At the geographic equator, an area of maximum/minimum salinity exists. (Circle one.) b. Between 20° and 30° north and south latitude, an area of maximum/minimum salinity exists. (Circle one.) c. At the poles, an area of absolute maximum/minimum salinity will be found. (Circle one.)

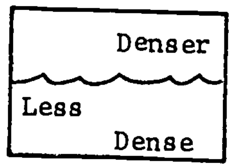
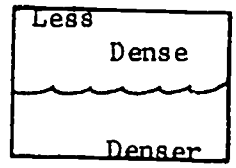
minimum maximum minimum	40. Circle the letter of the normal range of salinity values found in the open oceans. a. 3.3 to 3.7°/oo c. 20 to 30°/oo b. 30 to 70°/oo d. 33 to 37°/oo
d.	41. The controlling factor in average surface-salinity distribution is the difference between ____________ and ____________.
precipitation evaporation	42. On the line below, write the normal range of salinity values found in the open oceans. (Include the proper symbol.) ____________ to ____________
33°/oo to 37°/oo	43. On the line below, write the controlling factor in average surface-salinity distribution. ____________________
Difference between evaporation and precipitation.	44. Match the terms below with the areas in which they are located. _____ Minimum salinity a. Near the poles. _____ Maximum salinity b. 20° to 30° N. and S. latitude. _____ Absolute minimum salinity c. Near the thermal equator. d. 45° N. and S. latitude. e. Geographical equator.

e. b. a.	45. Annual variations in salinity are also a result of the difference between evaporation and precipitation. Annual maximum salinity values occur during the spring month of March, at the end of a continued evaporation period during winter. Conversely, annual minimum salinity values are recorded during the fall month of November, after the period of summer and early fall rains. Annual maximum salinity values occur during the spring months, because during the winter months, precipitation/evaporation (Circle one.) exceeds precipitation/evaporation. (Circle one.)
evaporation precipitation	46. Annual minimum salinity values occur during the fall months, because during the summer months, precipitation/evaporation (Circle one.) exceeds precipitation/evaporation. (Circle one.)
precipitation evaporation	47. Match the terms below with the season of the year in which each occurs. ______ Annual salinity maximum a. Summer ______ Annual salinity minimum b. Winter c. Fall d. Spring

d. c.	48. You now have a basic knowledge of the three major physical properties that control sea-water physics -- temperature, pressure, and salinity -- and their related concepts. In the following sequences, you will learn how these three major properties are related to, and affect, another important property of sea water -- density. NO RESPONSE.
	49. Ordinarily, in physics, we define density as mass per unit volume. But in oceanography, density may be referred to as the <u>weight of sea water</u>. The density, or weight, of sea water is controlled by three factors: temperature, pressure, and salinity. First, let's consider the effects of changes in temperature on the density of a given volume of sea water. If we <u>increase</u> the <u>temperature</u> of a given volume of water, the molecules will expand, and the density will <u>decrease</u>. And if we decrease the temperature of a volume of sea water, we will expect the density to ____________________.
increase	50. If the temperature of sea water is changed from $20^{o}C.$ to $30^{o}C.$, the density of this water will <u>increase/decrease</u> (Circle one.) as a result of molecular <u>expansion/contraction</u>. (Circle one.)

decrease expansion	51. A direct relationship exists between changes in salinity and changes in density, such that an increase in salinity will cause an increase in density. In this case, more solid material (mass) is being added to the volume of water, thereby increasing the density. On the basis of this direct relationship, if the salinity of a volume of water were decreased from $37^{o}/oo$ to $33^{o}/oo$, the density of this volume of water would increase/decrease. (Circle one.)
decrease	52. Complete the statements below. a. An increase in temperature will increase/decrease (Circle one.) density; a decrease in temperature will increase/decrease (Circle one.) density. b. An increase in salinity will increase/decrease (Circle one.) density; a decrease in salinity will increase/decrease (Circle one.) density.
a. decrease increase b. increase decrease	53. Like salinity, a direct relationship also exists between changes in pressure and density, so that an increase in pressure (depth) will cause an increase in density because of compression. Conversely, a d[illegible]e in pressure will result in the expansion of the water molecules and increase/decrease density. (Circle one.)

de·rease	54. We can summarize, then, by saying that an increase in pressure will increase/decrease (Circle one.) density, and a decrease in pressure will increase/decrease (Circle one.) density.
increase decrease	55. Under normal conditions, density will increase with depth. It may do so as a result of decreasing temperature, increasing pressur: or increasing salinity, or any combination of changes in these properties. When density increases with depth; that is, less dense water is overlying denser water, the condition of stability is said to be STABLE. A stable condition exists when sea-water density increases/decreases (Circle one.) with depth.
increases	56. The density of sea water normally increases/decreases (Circle one.) with depth. This condition is said to be stable/unstable. (Circle one.)
increases stable	57. When density decreases with depth; that is, when denser water is overlying less dense water, the condition of stability is said to be UNSTABLE. An unstable condition exists when sea-water density increases/decreases (Circle one.) with depth.

decreases	58. An unstable condition is not normal; sea-water density normally ______________ with depth.
increases	59. On the line below, write the normal change in sea-water density with depth. ______________________________
Density normally increases with depth.	60. Label the diagrams below as illustrating STABLE or UNSTABLE conditions.   a. ______________ b. ______________
a. Unstable b. Stable	61. Match the terms below with the correct descriptive statement of each. _____ Stable _____ Unstable a. Denser water over less dense water. b. Increase in pressure with depth. c. Less dense water over denser water. d. Decrease in salinity with depth.

c. a.	62. When unstable conditions exist, the heavier, denser water sinks through the lighter, less dense water below it. As this sinking takes place, mixing is also accomplished to a depth at which the density is equal to the sinking water. This is termed CONVECTIVE mixing and results from a layer of dense water overlying a layer of less dense water. Convective mixing is one of the major methods by which the mixed layer is formed. If we noticed that a layer of denser water were overlying a layer of less dense water, immediately we would expect ________ mixing to occur.
convective	63. Another form of convective mixing is caused by temperature and salinity variations in the water. This is termed THERMOHALINE CONVECTIVE mixing. These variations in temperature and salinity cause changes in the density of the water, and assist in increasing the depth of the mixed layer. Therefore, if we noticed an increase in the depth of the mixed layer, due to a change in density brought about by temperature and salinity variations, we would know that ____________ ___________ mixing is occurring.
Thermohaline convective	64. The other important method by which mixing is accomplished is termed MECHANICAL mixing, and occurs as a result of wind waves, tides, currents, and the like. Mechanical mixing is a result of some type of physical action and is independent of the stability condition. If we observed increasing density with depth, along with a deep mixed layer, we would know that this mixed layer was probably the result of ____________ mixing.

mechanical	65. Match the terms below with the correct descriptive statement of each. _____ Convective mixing _____ Mechanical mixing _____ Thermohaline convective mixing a. Mixing accomplished by wind, wave action, and currents. b. Mixing caused by density changes, brought about by temperature and salinity variations. c. Mixing accomplished as a result of denser water sinking through less dense water.
c. a. b.	66. There are four major processes which affect changes in sea-surface density. Two of these processes, evaporation and ice formation, increase density; the other two, precipitation and ice disintegration, decrease density. Evaporation and ice formation increase density by removing only pure water from the water mass, leaving a higher concentration of dissolved solid material in the remaining water. Precipitation and ice disintegration, on the other hand, decrease density by adding purer water to the existing water mass, thereby diluting it and decreasing the density. NO RESPONSE
	67. The two processes which decrease sea-surface density are __________ and ____ __________. The two processes which increase sea-surface density are __________ and ____ __________.

precipitation ice disintegration evaporation ice formation	68. Match each process below with the statement that describes how the process affects sea-surface density. _____a. Evaporation _____c. Precipitation _____b. Ice formation _____d. Ice disintegration 1. Decreases density; pure rain or snow is added and dilutes the sea water. 2. Decreases density; pure water from melting ice is added and dilutes the sea water. 3. Increases density; pure water is removed in the form of water vapor, leaving a higher amount of solid material. 4. Doesn't change density; related to changes in temperature and pressure only. 5. Increases density; pure water is removed, and the saline particles are squeezed out of the ice into the remaining cold water.

PROPERTIES OF SEA WATER

SELF-TEST

1. On the lines below, list the three major physical properties that control sea-water physics, and place an "X" on the short line to the left of the most important controlling property. (Frames 1-6)

_____ a. ______________________________

_____ b. ______________________________.

_____ c. ______________________________

2. Complete the statement below by placing the appropriate words in the blanks to make the statement true. (Frames 8-12)

The major heat source of the ocean is the ______________; the major cooling process is ______________________.

3. On line A below, write the temperature range found on the surface of the open ocean; and on line B, write the average diurnal temperature range of the surface of the open ocean. (Frames 8-17)

A. ______________________ B. ______________________

C. Complete the statement below by circling the word(s) that make(s) the statement correct. (Frames 14-15)

Latitudinal variations of temperature in the open oceans show maximum temperatures at the poles/thermal equator/geographical equator, decreasing equatorward/poleward.

4. a. On the line below, write the unit used to express pressure in oceanography. (Frame 28)

____

b. Complete the statement below:

One meter of depth in the ocean is equal to ______________ of pressure. (Frames 28-30)

5. a. On the line below, write the definition of salinity. (Frame 31)

____

b. In the space below, write the symbol used to express salinity.

________________________ (Frame 31)

c. On the line below, write the normal range of salinity values found in the open ocean. (Include the proper symbol.)

________________________ to ________________________. (Frame 37)

d. In your own words, state the controlling factor in average surface salinity distribution. (Frame 37)

__________ ____

e. Match the terms below with the areas in which they are located. (Frames 37-43)

_____Minimum salinity	1. Near the poles.
_____Maximum salinity	2. 20^{o} to 30^{o} N. and S. latitude.
_____Absolute minimum salinity	3. Near the thermal equator.
	4. 45^{o} N. and S. latitude.
	5. Near the geographical equator.

f. Match the terms below with the season of the year in which each occurs. (Frames 45-46)

_____Annual salinity maximum	1. Summer	3. Winter
_____Annual salinity minimum	2. Fall	4. Spring

6. Complete the statements below by circling the correct response.

When all other factors are held constant: (Frames 48-54)

a. An increase in temperature will increase/decrease density.

b. A decrease in salinity will increase/decrease density.

c. A decrease in temperature will increase/decrease density.

d. An increase in pressure will increase/decrease density.

e. An increase in salinity will increase/decrease density.

f. A decrease in pressure will increase/decrease density.

7. a. On the line below, write the normal change in density with depth found in the ocean. (Frame 55)

____

b. Match the terms below with the correct descriptive statement of each. (Frames 55-60)

_______ Stable

_______ Unstable

a. Denser water over less dense water.

b. An increase in pressure with depth.

c. Less dense water over denser water.

d. A decrease in salinity with depth.

8. Match the terms below with the correct descriptive statement of each. (Frames 62-63)

_____Convective mixing

_____Mechanical mixing

a. Mixing accomplished by wind, wave action, and currents.

b. Mixing accomplished as a result of pressure differences in the water masses.

c. Mixing accomplished as a result of denser water sinking through less dense water.

9. Match each process below with the statement that describes how the process affects sea-surface density. (Frames 65-66)

_____Evaporation

_____Ice formation

_____Ice disintegration

_____Precipitation

a. Decreases density; pure rain or snow is added and dilutes the sea water.

b. Decreases density; pure water from melting ice is added and dilutes the sea water.

c. Increases density; pure water is removed in the form of water vapor, leaving a higher amount of solid material in the water.

d. Doesn't change density; related to changes in temperature and pressure.

e. Increases density; pure water is removed, and the saline particles are squeezed out of the ice into the remaining cold water.

Technical Training

Weather Specialist

PILOT-TO-METRO SERVICE (PMSV)

25 June 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE

DO NOT USE ON THE JOB

Weather Training Branch C3ABR25130-SW-304
Chanute AFB, Illinois

PILOT-TO-METRO-SERVICE (PMSV)

OBJECTIVES

Without references, select facts relating to Pilot-to-Metro Service to 75% accuracy.

PROCEDURE

Follow the instructions at the beginning of Section I. Use that information to answer the True-False questions. Give a brief reason for your answer. Sections II, III, IV and V give the proper format to follow when answering PMSV contacts. Your instructor will make assignments and review your work.

SECTION I

PMSV

INSTRUCTIONS

Use the notes you took in class to complete or answer the following.

1. State the purpose of PMSV. ____________________

____

____

2. What does PMSV stand for? ____________________

____

3. Who may operate the PMSV? ____________________

____

____

4. What must you do when responding to PMSV contacts? ________

____

Supersedes C3ABR25130-SW-304, 25 June 1983.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 550; DAV - 1

5. List the information that you may relay over PMSV and what data you cannot interpret.

________, ________, ________.

________, ________; ________.

6. What must the observer do when the weather station has limited forecasting hour or their PMSV facil'ty is out of service? ________

____

____

7. Match the correct terminology you can use on PMSV with their definition.

a. CORRECTION ____

b. GO AHEAD ____

c. OUT ____

d. OVER ____

e. ROGER ____

f. STAND-BY ____

1. Conversion ended, no response expected.

2. My transmission is ended and I expect a response from you.

3. An error has been made in the transmission (or message indicated).

4. Proceed with your message.

5. I must pause for a few seconds.

6. I have received all of your last transmission - to acknowledge receipt (do not use for any other purpose).

8. List the words that will not be used in PMSV transmission due to brevity.

________, ________, ________, ________, ________,

________, ________, ________, ________, ________,

________, ________, ________,

9. All codes in the U.S. will be converted to ________.

10. What forms will PMSV contacts and outages be logged on? ____

____

____

Using the information you completed in Section I to answer the following statements either TRUE or FALSE. Give a brief reason for your choice.

1. PMSV stands for Pilot-To-Metro-Service.

2. Any forecaster or observer may operate PMSV.

3. Observers responding to PMSV calls should identify themselves as an observer.

4. The observer can interpret forecasts for any PMSV contacts.

5. The word "OVER" means my conversation is ended, no response expected.

6. The word "ROGER" means I have received all of your last transmission.

7. All PMSV contacts will be logged on AWS Form 30.

8. Any PMSV outages will be logged on AWS Form 12.

9. Pilots can remain on PMSV for any length of time.

10. The observers must refer pilots to appropriate stations when needing forecasting assistance when there is no forecaster available or on duty.

SECTION II

PMSV PROCEDURES
COMMUNICATIONS

When replying to a call from an aircraft, identify the calling aircraft using the complete call sign as received. Say the words THIS IS, identify your location followed by METRO, also identify yourself as the observer and conclude the reply with the word OVER. (EXAMPLE:

AIR FORCE TWO ONE THREE FIVE - THIS IS SCOTT METRO - OBSERVER - OVER)

After communications have been established, and when confusion is unlikely, shorten transmission by using only the last three digits of the aircraft identification; by omitting the words THIS IS from call-up or reply; or by omitting the facility identification; and by transmitting the message immediately after call-up (without waiting for the aircraft to reply). Emphasize appropriate digits, letters, or words to distinguish between similar aircraft identifications.

ONE THREE FIVE - METRO - SURFACE OBSERVATION - SEVEN HUNDRED SCATTERED . . .

Use the ICAO phonetic alphabet and numbers found in the FLIP enroute supplement. (See page 13.)

Within continental North America convert all codes to AIRWAYS FORMAT when briefing pilots via PMSV. At oversea locations brief from METAR and TAF codes without translating them to the AIRWAYS FORMAT.

Use the following words and phrases in radio communications, as appropriate:

CORRECTION	An error has been made in the transmission (or message indicated). The correct version is . . .
GO AHEAD	Proceed with your message.
OUT	This conversation is ended and no response is expected.
OVER	My transmission is ended and I expect a response from you.
ROGER	I have received all of your last transmission - to acknowledge receipt (do not use for any other purpose).
STAND-BY	I must pause for a few seconds. (If the pause is longer than a few seconds, or if used to prevent another station from transmitting, add the ending "OUT.")

Do not use the following words in transmission: CURRENT, LATEST, FEET, MILES, INCHES, KNOTS, TRUE (wind speed/direction), DEGREES, FAHRENHEIT, CELSIUS, SETTING (altimeter setting), DECIMAL or POINT (altimeter setting).

SECTION III

AIRWAYS

When a pilot requests the latest Airways Observations for a particular base, read the information directly from the TTY Collective. If he requests your latest observations, read it directly from the Local Disseminating Device.

DECODING

WHEN DECODING YOU WOULD BEGIN FIRST WITH THE SKY CONDITION AND THEN PROCEED TO VISIBILITY, WEATHER AND/OR OBSTRUCTION TO VISION, ETC., AND DECODE THROUGH THE CODE AS IT WOULD BE PLACED ON AWS FORM 10. DO NOT REPORT SEA LEVEL PRESSURE OR STATION PRESSURE.

SKY CONDITION

State cloud heights in thousands and hundreds of feet. Report each cloud layer using the proper contractions. Report ceiling designators as MEASURED (for M), ESTIMATED (for E), and INDEFINITE (for W).

Reported	Decoded As
15 -SCT M30 BKN	ONE THOUSAND FIVE HUNDRED THIN SCATTERED, MEASURED CEILING THREE THOUSAND BROKEN

Announce partly obscured and obscured conditions as follows:

-X: SKY PARTIALLY OBSCURED

X: SKY OBSCURED

Reported	Decoded As
-X E20 BKN	SKY PARTIALLY OBSCURED, ESTIMATED CEILING TWO THOUSAND BROKEN
W2 X	INDEFINITE CEILING TWO HUNDRED, SKY OBSCURED

VISIBILITY

Report visibility in statute miles.

Reported	Decoded As
1/2	VISIBILITY ONE-HALF
1V	VISIBILITY ONE VARIABLE
15	VISIBILITY ONE FIVE

Report RVR in thousands and hundreds of feet, to include the runway number when available.

Reported	Decoded As
R18VR24	RUNWAY ONE EIGHT VISUAL RANGE TWO THOUSAND FOUR HUNDRED
RVR50	RUNWAY VISUAL RANGE FIVE THOUSAND

WEATHER AND/OR OBSTRUCTION TO VISION

Report weather and obstruction to vision using plain language. Announce intensity as LIGHT, MODERATE, HEAVY (SEVERE FOR T+).

Reported	Decoded As
R-F	LIGHT RAIN AND FOG
SW+	HEAVY SNOWSHOWERS
TRWA	THUNDERSTORM, MODERATE RAINSHOWERS AND HAIL

TEMPERATURE AND DEW POINT

Report air and dew point temperatures in degrees Fahrenheit. Announce below zero temperature data with the word MINUS. Use the word PLUS only when reported values are close to zero and are subject to misinterpretation by the pilot.

Reported	Decoded As
37/16	TEMPERATURE THREE SEVEN, DEW POINT ONE SIX
-1/-5	TEMPERATURE MINUS ONE, DEW POINT MINUS FIVE

WIND

Report wind direction to the nearest 10 degrees using three digits. Report wind speed in knots using one or more digits, and include gust or squalls if reported. Report magnetic winds when reporting local surface conditions and true winds when relaying surface observations from other installations and winds aloft.

Reported	Decoded As
1512	WIND ONE FIVE ZERO AT ONE TWO
3615G27	WIND THREE SIX ZERO AT ONE FIVE PEAK GUSTS TWO SEVEN
0000	WIND CALM
E0315	ESTIMATED WIND ZERO THREE ZERO AT ONE FIVE

ALSTG

Report the current altimeter setting in four digits. When the reported VALUE IS BELOW 29.50 inches Hg., request the pilot to read back the altimeter setting.

Reported	Decoded As
989	ALTIMETER TWO NINER EIGHT NINER
939	ALTIMETER TWO NINER THREE NINER, READ BACK ALTIMETER
004	ALTIMETER THREE ZERO ZERO FOUR
E975	ESTIMATED ALTIMETER TWO NINER SEVEN FIVE

REMARKS

Report remarks, which are considered significant to the pilot, using plain language.

State sector visibility in the same manner as prevailing visibility.

Report pressure altitude and sea-level pressure only when specifically requested.

Report RSC/RCR data when relaying surface observations from another installation.

Report amount and type for partly obscured condition as:

Reported	Decoded As
F5	SKY PARTIALLY OBSCURED, FIVE-TENTHS FOG

The following is an example of surface observations in coded format, and the manner in which it would be decoded when briefing pilots via PMSV:

Pilot: "Scott Metro - Seven Niner One - Request the surface weather observation for Selfridge AFB - Over"

Observer: "Roger - Seven Niner One - Stand-By"

MTC SA 2055 -X M10 OVC 3L-F 151/42/40/3607/958/F3 WND 32V03/ 115 16//;

SEVEN NINER ONE, METRO, THE SELFRIDGE - SELFRIDGE AIR BASE SURFACE OBSERVATION - SKY PARTIALLY OBSCURED, MEASURED CEILING ONE THOUSAND OVERCAST - VISIBILITY THREE, WITH LIGHT DRIZZLE AND FOG - TEMPERATURE FOUR TWO, DEW POINT FOUR ZERO - WIND THREE SIX ZERO AT SEVEN - ALTIMETER TWO NINER FIVE EIGHT - SKY PARTIALLY OBSCURED, THREE-TENTHS FOG - WIND VARIABLE BETWEEN THREE TWO ZERO AND ZERO THREE ZERO - OVER

NOTE: BE SURE TO REQUEST A PILOT REPORT BEFORE THE TRANSMISSION IS ENDED.

SECTION IV

TERMINAL AERODROME FORECAST CODE - TAF

SYMBOLIC FORMAT

CCC $G_1G_1G_2G_2$ dddff/f_mf_m VVVV w'w' $N_sCCh_sh_sh_s$ $6I_ch_ih_ih_it_L$ $5Bh_Bh_Bh_Bt_L$

$QNHP_2P_2P_2P_2$INS REMARKS

See HO-310C(309C) for symbolic breakdown of TAF Code.

Note: The data given in the initial forecast condition for clouds, visibility, weather and/or obstructions to vision, surface winds and minimum altimeter will remain the same throughout the forecast period unless they are modified by a change group (GRADU, RAPID, or INTER group).

DECODING

WIND

Report wind direction to the nearest 10 degrees using three digits. Report wind speed in knots using one or more digits and include the maximum wind speed if it is forecast.

Reported	Decoded As
02008	WIND ZERO TWO ZERO AT EIGHT
36015/27	WIND THREE SIX ZERO AT ONE FIVE, MAXIMUM SPEED TWO SEVEN
0000	WIND CALM
VRB10	WIND VARIABLE AT ONE ZERO

VISIBILITY

Report visibility in statute miles. Announce "9999" as visibility 7 and above.

Reported	Decoded As
0100	VISIBILITY ONE-SIXTEENTH
2400	VISIBILITY ONE AND ONE-HALF
9999	VISIBILITY SEVEN AND ABOVE

WEATHER

Report present weather as the plain language equivalent of the coded weather group. Announce intensity as LIGHT, MODERATE, HEAVY (SEVERE for TS+ or XXTS).

Reported	Decoded As
50DZ	LIGHT DRIZZLE
72SN	MODERATE SNOW
95TS	THUNDERSTORM WITH RAIN/SNOW
80RASH	LIGHT RAINSHOWERS
99XXTSGR 82XXSH	SEVERE THUNDERSTORM WITH HAIL, AND HEAVY RAINSHOWERS

SKY CONDITION

Reported in eights, the amount of sky cover forecast for each cloud layer and must be converted into Airways Code Format. Omit reference to cloud types, except Cumulonimbus and refer to Cumulonimbus as Thunderstorm if no remark or weather is reported for a Thunderstorm. State cloud heights in thousands and hundreds of feet. When a total obscuration is present, brief as:

Reported	Decoded As
9//002	INDEFINITE CEILING TWO HUNDRED, SKY OBSCURED

Announce "CEILING" .... before reporting the height and sky cover of the cloud layer that constitutes the ceiling. A "CIG" group will be included in the remarks section to identify the ceiling layer.

Reported	Decoded As
2ST005 6CU025 CIG025	FIVE HUNDRED SCATTERED, CEILING TWO THOUSAND FIVE HUNDRED BROKEN
5SC030 2CI250 CIG030	CEILING THREE THOUSAND BROKEN, TWO FIVE THOUSAND BROKEN
SKC	CLEAR SKY

ICING CONDITION - 6 GROUP

Forecast group for icing conditions. When no icing is forecast, this group will be omitted. See PT-310 and HO-310(405A), tables 7 and 5, for decoding this group.

Reported	Decoded As
620305	LIGHT ICING IN CLOUD (LIGHT RIME) FROM THREE THOUSAND TO EIGHT THOUSAND

TURBULENCE CONDITION - 5 GROUP

Forecast group for turbulence conditions. When no turbulence is expected to occur, this group will be omitted. See PT-310 and HO-310A(405A), tables 3 and 4, for decoding this group.

Reported	Decoded As
510506	LIGHT TURBULENCE FROM FIVE THOUSAND TO ONE ONE THOUSAND

NOTE: IF THE ICING AND TURBULENCE CONDITIONS ARE GIVEN YOU WILL REPORT THEM AFTER THE MINIMUM ALTIMETER.

ALSTG

Report the forecast minimum altimeter setting in four digits. The "QNH" group identifies the minimum altimeter follows. When the reported value is below 29.50 inches Hg, request the pilot to read back the altimeter setting.

Reported	Decoded As
QNH2980INS	MINIMUM ALTIMETER TWO NINER EIGHT ZERO
QNH2938INS	MINIMUM ALTIMETER TWO NINER THREE EIGHT, READ BACK ALTIMETER
QNH3000INS	MINIMUM ALTIMETER THREE ZERO ZERO ZERO

REMARKS

Report remarks, which are considered significant to the pilot, using plain language.

DECODING

WHEN DECODING YOU WOULD BEGIN FIRST WITH THE SKY CONDITION AND THEN PROCEED TO VISIBILITY, WEATHER AND/OR OBSTRUCTION TO VISION, ETC., AND DECODE THROUGH THE CODE AS IT WOULD BE PLACED ON AWS FORM 10.

The following is an example of a TAF as it would appear in coded format, and the manner in which it would be decoded when briefing pilots via PMSV:

Pilot: "Whiteman Metro - Air Force Seven Five Niner One - Request the Scott AFB Forecast at Zero Zero Zero Zero Zulu - Over"

Observer: "Roger - Air Force Seven Niner One - Standby"

BLV 1010 36005 9999 SKC QNH3018INS CIGNO
GRAUD 1314 05008 9999 2AC100 5CI250 QNH2995INS CIGNO
GRAUD 2223 07008 9999 3SC030 5AC100 8CI250 620258 QNH2995INS CIG 100
GRAUD 0506 07008 9999 6SC025 8AC100 QNH2990INS CIG025

FIVE NINER ONE, METRO, THE SCOTT - SCOTT AIR FORCE BASE FORECAST - ZERO ZERO ZERO ZERO ZULU - THREE THOUSAND SCATTERED, CEILING ONE ZERO THOUSAND BROKEN, TWO FIVE THOUSAND OVERCAST, VISIBILITY SEVEN AND ABOVE, WIND ZERO SEVEN ZERO AT EIGHT, MINIMUM ALTIMETER TWO NINER NINER FIVE. LIGHT ICING IN CLOUD (LIGHT RIME) FROM TWO THOUSAND FIVE HUNDRED TO ONE ONE THOUSAND - OVER

Note: BE SURE TO REQUEST A PILOT REPORT BEFORE THE TRANSMISSION IS ENDED.

SECTION V

PILOT REPORTS

In all PMSV contacts be sure to request a pilot report and log it in the proper format on AWS Form 12. Also log all PMSV contacts on AWS Form 30.

Observer: ONE THREE FIVE - METRO - REQUEST A PILOT REPORT - OVER

Pilot: "METRO - ONE THREE FIVE - ROGER - BASES AT SIX THOUSAND FIVE HUNDRED - SKY COVER - SCATTERED - TOPS EIGHT THOUSAND - BASES AT ONE TWO THOUSAND - SKY COVER BROKEN - TOPS ONE FIVE THOUSAND - ENCOUNTERED LIGHT TO MODERATE TURBULENCE AT EIGHT THOUSAND TO ONE TWO THOUSAND - TRACE RIME ICING AT FLIGHT LEVEL - WINDS FROM THREE ONE FIVE AT NINER FIVE - TEMPERATURE MINUS TWO FIVE - FLIGHT LEVEL TWO ZERO THOUSAND - TORNADO SOUTH MOVING NORTHEAST - TYPE OF AIRCRAFT CHARLIE ONE THREE ZERO - FOUR SIX NORTHEAST OF SCOTT AFB, IL AT ONE FIVE ZERO FIVE ZULU - OVER"

Observer: ONE THREE FIVE - METRO - ROGER - OVER

PIREP

1. DATE/TIME PIREP RECEIVED: 15/1515 (Z)

2. LOCATION OR EXTENT OF PHENOMENA: 46 NE OF SCOTT AFB IL

3. TIME OBSERVED: 1505 (Z)

4. PHENOMENA AND ALTITUDE: BASES 6,500 - SKY COVER - SCT - TOPS 8,000 - BASES 12,000 SKYCOVER - BKN TOPS 15,000 LGT TO MDT TURBC, 8,000 TO 12,000 TRACE RIME ICING AT FLIGHT LEVEL WINDS FROM 315° AT 95 TEMP MINUS TWO FIVE FLIGHT LEVEL 20,000 TORNADO SOUTH MOVING NORTHEAST

5. AIRCRAFT TYPE: C130

Legend → SPACE SYMBOL • ONLY IF DIFFERENT FROM FL • • ONLY IF CA... REPORT...

(U) UA → /OV → BLV 045046 → 1505 → FL → 200 TP → C130

MSG TYPE | LOCATION OF PHENOMENA 3-LTR IDENT RADIAL/DISTANCE | TIME (Z) | FLT LVL | TYPE ACFT

/SK → 065 SCT 080/120 BKN 150 TA → -25

CLOUD BASE AMOUNT TOP/BASE AMOUNT TOP ETC | TEMPERATURE

/WV → 315095 TB → LGT-MDT 080-120 IC → TRACE RIME

WIND (DIRECTION SPEED) | TURBULENCE INTENSITY TYPE•• ALTITUDE• | ICING INTENSITY TYPE ALTITUDE

RM → TORNADO S MOVE NE

REMARKS PLAIN TEXT (most hazardous element entered first)

6. EVALUATION FOR DISSEMINATION (For A, B, and C "X" as appropriate)

A. LOCAL DISSEMINATION	B. LONGLINE DISSEMINATION	C. FOR USE IN ... OBSERVATION	7. INITIALS	
X	X	X	LC	SF

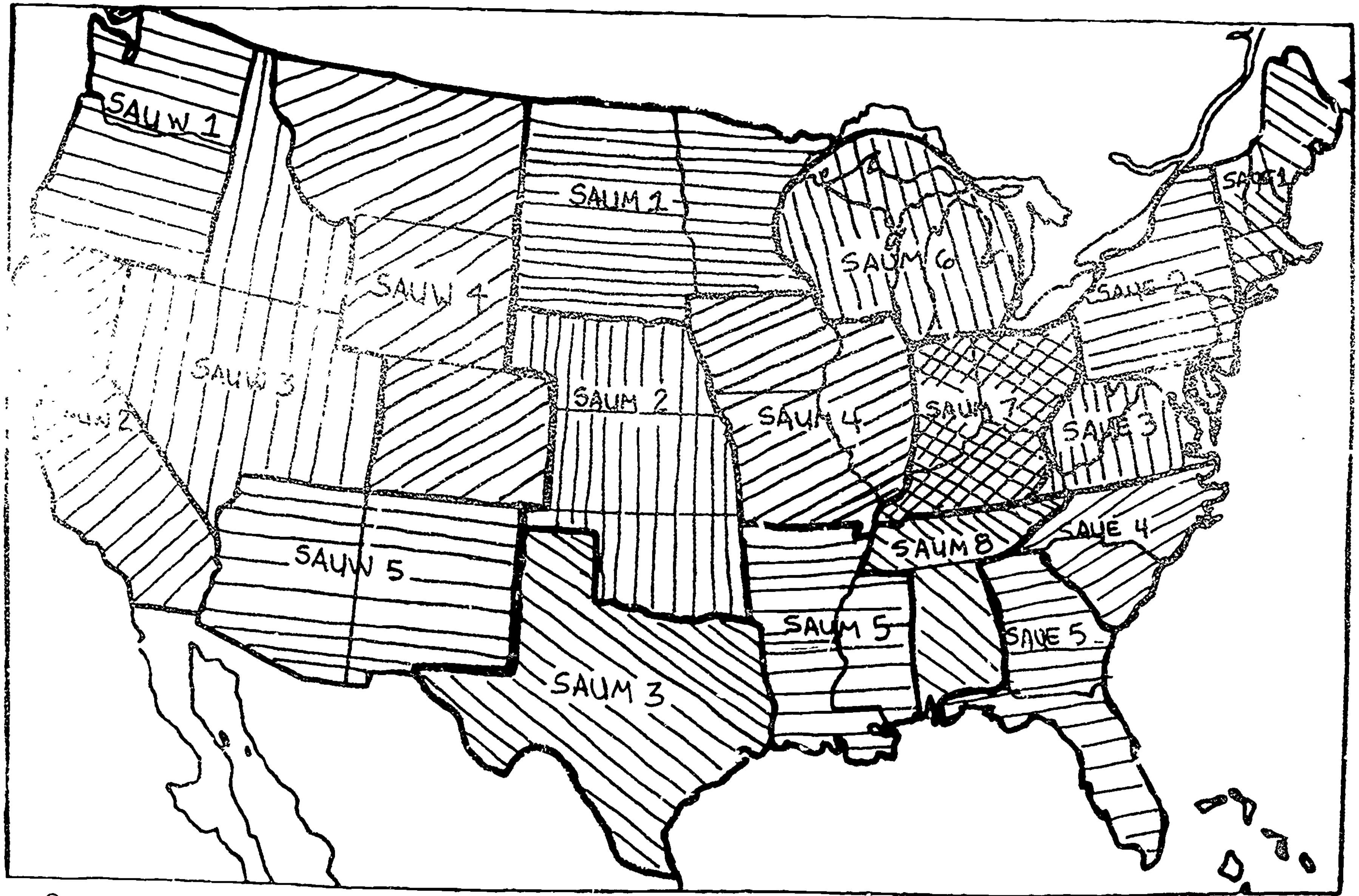
AWS FORM SEP 76 12 PREVIOUS EDITION WILL BE USED PILOT REPORT

ICAO PHONETIC ALPHABET

Alfa	AL-FAH	November	NO-VEM-BER
Bravo	BRAH-VOH	Oscar	OSS-CAH
Charlie	CHAR-LEE or SHAR-LEE	Papa	PAH-PAH
Delta	DELL-TAH	Quebec	KEH-BECK
Echo	ECK-OH	Romeo	ROW-ME-OH
Foxtrot	FOKS-TROT	Sierra	SEE-AIR-RAH
Golf	GOLF	Tango	TANG-GO
Hotel	HOH-TELL	Uniform	YOU-NEE-FORM or OO-NEE-FORM
India	IN-DEE-AH	Victor	VIK-TAH
Juliett	JEW-LEE-ETT	Whiskey	WISS-KEY
Kilo	KEY-LOH	Xray	ECKS-RAY
Lima	LEE-MAH	Yankee	YANG-KEY
Mike	MIKE	Zulu	ZOO-LOO

Note: Numbers will be announced as reported except for 9 and it will be announced as NINER.

UNITED STATES-OUTLINE MAP



Weather Observer Branch
Chanute AFB, Illinois

3ABR25130-2-HO-304
21 April 1981

GLOSSARY OF TERMS

ABSORPTION - Sound intensity loss caused by the conversion of sound energy into heat as it passes through water.

AMBIENT NOISE - Noise in the sea due to such effects as biologics, shipping, precipitation, and sea surface agitation caused by winds and terrestrial movements. Self-made noise and reverberation are not considered noise.

ASRAP - Acoustic Sensor Range Prediction.

ATTENUATION - The reduction in sound intensity (db/kyd) caused by the absorption and scattering of sound in water.

AXBT - Aircraft Expendable Bathythermograph.

BACKGROUND NOISE - All unwanted sounds, other than reverberation, received by a hydrophone; includes ambient and self-made noise.

BACKSCATTERING - That part of the reflected sound energy that returns to the transducer; equivalent to reverberation.

BATHYTHERMOGRAPH - An instrument used to obtain a permanent, graphical record of water temperature (degrees F or C) with depth (feet or meters) as it is lowered and raised in the sea. Various models record temperatures to depths of 180 feet, others to as much as 6000 feet.

BOTTOM BOUNCE - Sound transmissions in which sound rays strike the bottom in deep water at steep angles and are reflected to the surface; one reflection may attain ranges of about 20,000 yards. Bottom reflected ray paths are defined by the limiting and critical angle rays.

CONTINENTAL RISE - A gentle slope with a generally smooth surface found at the base of a continental slope.

CONTINENTAL SHELF - A zone adjacent to a continent and extending from the low waterline to a depth at which there is a marked increase of bottom slope to a greater depth (usually about the 100-fathom line).

CONTINENTAL SLOPE - A steep slope bounded by the outer edge of the continental shelf and the ocean basin.

CONVECTION CURRENTS - Whenever the surface water undergoes intensive cooling, evaporation, or freezing, the density of the surface water increases beyond that of the underlying water. As this denser water sinks to levels of the same density, currents are produced by warmer water flowing in to replace the sinking surface water.

Supersedes 3ABR25130-2-HO-304, 14 July 1978. RGL: 10.1
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 300; DAV - 1

Designed for ATC Course Use. Do Not Use on the Job.

CONVERGENCE ZONE - The region where sound rays, refracted from the depths, are focused at, or near, the surface in successive intervals; symbol is CZ.

CRITICAL ANGLE - The grazing angle of a sound wave with the sea bottom at which complete or total reflection occurs.

DECIBEL (db) - A value that expresses the comparison of sound of two different intensities.

DEEP LAYER - The layer of water between the lower edge of the main thermocline and the ocean bottom. It is characterized by a nearly constant temperature and a positive sound speed gradient caused by pressure.

DEEP SCATTERING LAYER (DSL) - The statified population(s) of organisms in oceanic waters that scatter sound. The scattered sound is recorded on echo-sounder records as a uniform horizontal band or stripe. These layers are generally found during the day at depths from 100 to 400 fathoms. A layer is rarely less than 25 fathoms thick and may be as much as 100 fathoms thick. Several layers often are recorded at the same time and may be continuous for many miles. Most layers typically undergo diurnal vertical movements. Also called false bottom or phantom bottom.

DENSITY - The density of sea water is the mass per unit volume. It increases with increasing salinity and pressure and decreases with increasing temperature.

DEPTH EXCESS - The difference between the bottom depth and the depth at which the maximum, near-surface sound speed recurs.

DEPTH REQUIRED - Minimum depth required for a reliable convergence zone to exist. It is the depth below the conjugate depth where the sound speed is 30 feet per second greater than the sound speed at the source.

DYNE - A unit of force in the centimeter-gram-second system of measurement that is defined as the force that gives a 1-gram mass an acceleration of $1 cm/sec^2$.

ECHO - The sound signal that is reflected from the target in active sonar back to the source.

ECHO RANGING - Determination of distance by measuring the time interval between emission of a sonic signal and the return of its echo from a reflector.

FIGURE OF MERIT (FOM) - A measure of the effectiveness of a sonar set for a particular situation. It is the maximum allowable propagation loss that a signal can suffer for a system to meet a desired performance criterion.

FNWC - Fleet Numerical Weather Central.

FREQUENCY SOUND - The number of sound waves passing a point in a given time; usually measured in Hertz; 1 Hz = 1 cycle/second.

FWC - Fleet Weather Central.

GRADIENT - The rate of change in a given distance of an environmental variable. For example, in the sea, a vertical temperature gradient is the change of temperature with depth; a positive gradient is a temperature increase with depth; and a negative gradient is a temperature decrease with depth.

GRAZING ANGLE - The angle a sound ray makes with an ocean boundary. Measured in degrees to the horizontal.

HYDROPHONE - An acoustic device that receives and converts underwater sound energy into electrical energy.

ICAPS - Integrated Carrier ASW Prediction System.

INSONIFY - To project sound energy into any part of the sea.

INTENSITY, SOUND - The amount of sound energy per second crossing a unit area.

INTERNAL WAVE - A wave that occurs in the ocean medium either at a surface of density discontinuity (as in fronts) or at the boundary between the mixed layer and the thermocline.

ISOTHERMAL - Of equal or constant temperature with respect to space or time (no increase or decrease in temperature with depth).

IVDS - Independent Variable Depth Sonar.

LAYER DEPTH - The depth of the lower edge of the surface layer. Also the depth of maximum sound speed near the surface.

LAYER EFFECT - When sound passes through a layer in which little or no bending of the ray path occurs and then passes into a layer with a strong negative gradient (causing sharp downward bending of the ray), increased spreading occurs with a consequent loss of sound intensity.

LIMITING RAY - The sound ray that becomes tangent at the depth where the sound speed is at maximum, and delineates the outer boundary of direct (before reflection) sound rays.

LRAPP - Long Range Acoustic Propagation Project.

MAIN THERMOCLINE - The layer of water between the surface layer and the deep layer; it is characterized by a negative sound speed gradient.

MIXED LAYER DEPTH - The depth of the surface layer that is mixed through mechanical, convective, and thermohaline convective actions.

NWSED - Naval Weather Service Environmental Detachment.

PASSIVE SONAR - See SONAR.

PHITAR - Predesignated High Interest Tactical Area.

PLANKTON - All passively drifting or weakly swimming plant and animal life in the sea; usually microscopic or rather small in size.

RAREFACTION - The condition in a sound wave where the pressure is lower than the average pressure exerted by the medium in which the wave propagates.

RAY PATH - A path perpendicular to the acoustic wavefront as the wave travels through the water.

RAY THEORY - The transmission of underwater sound as based on Snell's Law. This law describes the change in the sound ray path as it passes through different layers of water.

REFLECTION LOSS - The component of propagation loss resulting from imperfect reflections at the ocean boundaries.

REFRACTION SOUND - The bending or curving of a sound ray when the ray passes from a region of one sound speed to a region of a different speed. The amount of ray bending is dependent upon the difference between sound speeds.

SEA STATE - A numerical representation of the roughness of the sea surface; symbol is SS.

SHADOW ZONE - A region in which very little sound energy penetrates. It is usually bounded by the surface layer boundary and the limiting ray.

SHARPS - Ship Helicopter Acoustic Range Prediction System.

SNELL'S LAW - The relationship that exists between the angle a sound wave enters a medium of differing velocities and the amount of refraction that occurs.

SOFAR CHANNEL - A special deep sound channel with its axis at the bottom of the main thermocline.

SONAR - Sound Navigation And Ranging. The method or equipment for determining, by underwater sound techniques, the presence, location, or nature of objects in the sea. A system for determining the location and distance of an underwater object by measuring the time interval between transmission of a sound signal and its reflection back to the projector (ACTIVE SONAR). Evaluation of a signal received by a hydrophone from a target (PASSIVE SONAR).

SONIC LAYER DEPTH - The depth of the maximum sound velocity below the surface and above the deep sound channel.

SONOBUOY - A free-floating or anchored device that includes a buoy with radio telemetering equipment and a hydrophone suspended beneath.

Sound signals received at the hydrophone are transmitted by radio to a nearby receiver for analysis.

SXBT - Shipboard Expendable Bathythermograph.

HANDOUT
3ABR25130-2-HO-304A

Technical Training

Weather Specialist

COMPLETING THE BATHYTHERMOGRAPH LOG SHEET

23 March 1981

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE
DO NOT USE ON THE JOB

RGL: N/A

Supersedes 3ABR25130-2-WS-401, 16 June 1978.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 600; DAV - 1

INSTRUCTIONS FOR PREPARING THE BATHYTHERMOGRAPH LOG SHEET

INTRODUCTION

The bathythermograph (BT) log sheet is designed to meet two basic needs 1. To provide a message format for radio transmission of synoptic BT data for oceanographic forecasting 2. To provide the National Oceanographic Data Center (NODC) with information required for BT analog and digital processing This radio message format supersedes all other formats previously used for shipboard or aircraft BT message reporting

The instructions describe (1) how and where to mail slides, log sheets, and recorder charts, (2) how to obtain additional log sheets; (3) how to address radio messages; (4) how to mark the BT slide and/or XBT recorder chart after the observation is taken, (5) the procedures for filling in the "REFERENCE INFORMATION," "OPTIONAL ENVIRONMENTAL INFORMATION," and "RADIO MESSAGE INFORMATION" portions of the log sheet· (6) the required interpretation of the temperature-depth trace, and (7) special instructions for NAVY use.

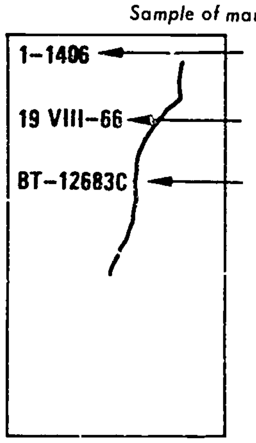
These instructions also serve to amplify the following directives, the latest editions of which are applicable and should be rigidly followed:

1. OCEANAVINST 3160.9
2. COMSCINST P3121 3
3. COMSCINST P3120.2
4. COMDT USCG INST 3161 1
5. NAVWEASERVCOMINST 3140 1

HOW TO MARK THE BT SLIDE AND XBT RECORDER CHART

Immediately after removing the BT slide from the bathythermograph, rinse the slide in fresh water, holding it by the edges to avoid marring of the coating Then mark the slide as indicated below using a sharp pencil. Do not touch, write over, or otherwise obscure the trace.

Sample of marked slide;



Slide number—GMT hours and minutes

Day—month (Roman Numerals)—year (use last two digits).

BT instrument number—Found near nose of instrument and stamped on lower right side of BT grid Report complete number with prefix and suffix if given. If the BT instrument number and the grid number do not agree, do not use the BT

Enter on the face of each XBT recorder chart the information listed below in the same sequence If the format for this information is not preprinted on the XBT recorder chart write it in.

Record N or S and E or W after latitude and longitude, respectively. Record time and date according to GMT. DO NOT OBSCURE THE TEMPERATURE TRACE.

Ship
Cruise
Latitude
Longitude
Time (GMT)
Da/Mo/Yr
Observation #
Bottom Depth*

* optional entry.

HOW AND WHERE TO MAIL BT SLIDES, LOG SHEETS AND RECORDER CHARTS*

Mail all completed bathythermograph log sheets, BT slides and XBT recorder charts (preferably uncut) to

National Oceanic and Atmospheric Administration
National Oceanographic Data Center
Rockville, Maryland, U S A. 20852

To protect your slides so that NODC has the necessary information to process them, proceed as follows·

1 Place slides in issue box.
2. Put no material between slides
3 Pad top of slides (use issue pad) before replacing cover.
4. Paste on standard mailing label, NOAA Form 61-19 (11-70) and fill in information required.
5 Pad box well and pack in cardboard box
6 Wrap securely and label clearly, repeating information in item (4) above

*DO NOT MAIL CLASSIFIED BT DATA TO NODC MAIL CLASSIFIED BT DATA TO FLEET NUMERICAL WEATHER CENTRAL, MONTEREY, CALIFORNIA 93940

HOW TO OBTAIN ADDITIONAL BT LOG SHEETS

1 All naval activities in the Atlantic area (including the Gulf of Mexico, Panama Canal Zone, European and Mediterranean area) shall submit completed Form DD-1149 to·

Officer in-Charge
Naval Oceanographic Distribution Center
5801 Tabor Avenue
Philadelphia, Pennsylvania, U.S A 19120

2. All naval activities in the Pacific area (including Antarctic and Indian Oceans) shall submit completed Form DD-1149 to

Officer-in-Charge
Naval Oceanographic Distribution Center
Clearfield, Utah, U.S A 84016

3 All NOAA or NOAA sponsored ships should submit their requests for log sheets (NOAA Form 77-22) and BATHY Report for Radio Transmission (NOAA Form 77-21) to

Central Logistic Supply Center
National Oceanic and Atmospheric Administration
619 Hardesty St, Kansas City, Missouri 64124

COMPLETING THE BATHYTHERMOGRAPH LOG SHEET

Follow SAMPLE BATHYTHERMOGRAPH LOG (see below) as guide for recording data.

I. REFERENCE INFORMATION

Record PLATFORM TYPE (from Table 1), NAME and DESIGNATOR (Hull Number). Enter the Squadron Designator in the space labeled NAME when the observations are made from an aircraft. Record COUNTRY and name of INSTITUTION or activity sponsoring the cruise, and when applicable, originators CRUISE NUMBER and national or international PROJECT name.

Table 1
PLATFORM TYPE CODE

1. Ship	5. Submersible
2. Lightship	6. Aircraft
3. Buoy	7. Ice Island
4. Fixed Tower	8. Fixed Coastal Station

For each observation enter STATION NUMBER, OBSERVATION NUMBER and INSTRUMENT used according to:

a. STATION NUMBER—Enter when applicable

b. OBSERVATION (Consecutive) NUMBER—This number should correspond to that entered on BT slides or XBT charts. They should start with number 1 for the first bathythermograph observation taken after leaving port and ending with the last observation of the cruise.

c. INSTRUMENT Type (BT, XBT, or STD)—When using a BT enter its grid number and letter

II. OPTIONAL ENVIRONMENTAL INFORMATION (enter as available)

1. DEPTH TO BOTTOM (METERS)—Enter depth to ocean bottom to the nearest meter

2. WIND ($i_u$ddff)
   - i_u Wind speed units indicator—Enter "0" if speed in meters per second and "1" if speed in knots.
   - dd True wind direction—Enter the true wind direction, in tens of degrees, from which the wind is blowing Enter "00" for calm, 36 for a direction of 355 to 004 degrees, etc
   - ff True wind speed—Enter true wind speeds in meters per second or knots Enter "00" for calm

3. SEA LEVEL PRESSURE (PPPP)—Enter the corrected sea level barometric pressure to tenths of a millibar Omit first digit for pressure values equal to or above 1000 0 millibars

4. AIR TEMP —DRY-BULB (s_nTTT)—
   - s_n Air Temperature sign indicator—Enter "0" for positive temperatures and "1" for negative temperatures
   - TTT Air Temperature—Record the air temperature to tenths of a degree Celsius

5. AIR TEMP —WET-BULB (s_nTTT)—
   - s_n Air Temperature sign indicator—Enter "0" for positive temperatures and "1" for negative temperatures
   - TTT Wet-Bulb temperature—Record the wet-bulb temperature to tenths of a degree Celsius.

6. ... T_wT_w INSTR)—
   - $T_wT_wT_w$ Sea surface temperature—Record the temperature to tenths of a

8 SWELL ($d_wd_wP_wH_wH_w$)
- d_wd_w Swell direction—Enter the direction from which the swell is coming in tens of degrees, using "01-36" for directions 010° to 360°, "00" for calm, and "99" for a confused sea sea with direction indeterminate.
- P_w Swell period—Use Table 4 to code the period of the swell in seconds. Note that this period code differs from that used for the wave period
- H_wH_w Swell height—Use the half-meter code given in Table 3. The code is based on wave heights (swell) estimated to the nearest half-meter.

9. SOLAR RADIATION—Enter the average value of the solar radiation in langleys per minute to the nearest hundredths. The average should be for the hour preceding the synoptic hour.

10. PRECIPITATION (PRECIP)—Enter the amount of precipitation (RR) for the 6 hours preceding the synoptic hour to the nearest 0 2 mm.

11 WATER TRANSPARENCY (TRANS)—When taken, enter the average value to the nearest meter.

Table 3
HEIGHTS OF WIND WAVES AND SWELL

Use "00" for calm Use two slants "//" when the height was not observed for any reason

Half Meters Code Figure	Feet	Half-Meters Code Figure	Feet	Half-Meters Code Figure	Feet	Half-Meters Code Figure	Feet
01	2	11	18	21	34	31	51
02	3	12	20	22	36	32	52
03	5	13	21	23	38	33	54
04	7	14	23	24	39	34	56
05	8	15	25	25	41	35	57
06	10	16	26	26	43	36	59
07	12	17	28	27	44	37	61
08	13	18	30	28	46	38	62
09	15	19	31	29	48	39	64
10	16	20	33	30	49	40	66

Table 4
PERIOD OF SWELL

Code Figure	Average Period in sec	Code Figure	Average Period in sec.
5	5 or less	0	10
6	6	1	11
7	7	2	12
8	8	3	13
9	9	4	14 or more
		/	Calm or not determined

III. RADIO MESSAGE INFORMATION

A. EVALUATING TRACE FOR RADIO MESSAGE INFORMATION ENTRIES. (See SAMPLE RECORDER TRACE below)

To facilitate the use of bathythermograph (BATHY) information for synoptic forecasting, the subsequent procedures must be followed·

1. The trace should be read to the nearest tenth of a degree in temperature and to the nearest whole unit of depth. If temperature is in Fahrenheit and/or depth in feet convert to metric units Use Table 5 for temperature conversions and Table 6 for depth conversions

2. When interpreting and encoding the bathythermograph trace, always include:

   a. Water temperature at the sea surface (or the first readable temperature in the upper 10 meters) and at the deepest point of the trace.

3. Time (GGgg/)
   - GG Hour—Enter the GMT hour of observation.
   - gg Minutes—Enter the GMT time in minutes when bathythermograph entered water.
   - / Preprinted symbol. Enter "9" if temperature is recorded in Fahrenheit and depth is recorded in feet

4. LATITUDE ($Q_cL_aL_aL_aL_a$)
   - Q_c Quadrant of globe—From Table 7 enter the quadrant of globe
   - $L_aL_aL_aL_a$ Latitude—Enter latitude in degrees and minutes.

5. LONGITUDE ($L_oL_oL_oL_oL_o$)—Enter longitude in degrees and minutes.

Table 7
QUADRANT OF THE GLOBE

CODE	QUADRANT
1	NE
3	SE
5	SW
7	NW

	180°	0°	180°	
0°	NW = 7	NE = 1		0°
	SW = 5	SE = 3		
	180°	0°	180°	

6. INDICATOR GROUP 88888—Temperatures at significant depths follow.

BATHYTHERMOGRAPH TRACE READINGS

Surface Depth—Temperature ($Z_oZ_oT_oT_oT_o$)

- Z_oZ_o Water surface, 00 is preprinted
- $T_oT_oT_o$ Enter the surface water temperature Value (°C) as read from the BT trace to the nearest tenth of a degree. When the temperature trace is unreadable in the first 10 meters enter Solidi (///).
- $ZZT_zT_zT_z$ This group is repeated as many times as necessary to describe adequately the BT trace.
- ZZ For subsurface depths to 99 meters enter in whole meters the depth at which corresponding temperature values are read from the trace. Example: For 5m, record 05; for 97m, record 97

SPECIAL CODING INSTRUCTIONS

- 999NN NOTE Always include a 999NN group before recording depths of 100 meters, 200 meters and each succeeding 100-meter interval to termination. NN is coded as 01 for 100 to 199 meters; 02 for 200 to 299 meters, etc. When the 999NN code is entered mark out the $ZZT_zT_zT_z$ heading.
- ZZ For depths between 100 and 200 meters, 200 and 300 meters, etc., enter the tens and units digits only Example: for 101m, record 01; for 256m, record 56; for 375m, record 75.
- $T_zT_zT_z$ Temperature Group—Enter water temperature at depth ZZ in °C to tenths of degrees All temperature values of less than 0°C will be coded as $5T_zT_z$ (5 indicates that a negative reading follows).
- 00000 Indicator Group—Inserted after last $ZZT_zT_zT_z$ group only if last group is an ocean bottom reading.

876

12-14. Enter last digit of current calendar year in space 12. Enter two digit number of current month in spaces 13-14: Example: August 1972 is coded as 2 08

Navy aircraft, in addition to filling out the reference and radio information sections, will fill in the FOR NAVY AIRCRAFT USE section in the upper right corner of the log sheet, as follows:

- 3-4 Enter first two letters of squadron type in boxes 3-4. (Exception: VAW squadrons enter "AW")
- 5-7. Enter squadron number in spaces 5-7; precede by zeroes if less than 3 digits (Exception: detachments enter "D" followed by detachment number.)
- 8-11. Enter numbers and/or letters assigned to identify, within a squadron, each sortie of each aircraft.
- 12-14 Enter last digit of current calendar year in space 12. Enter two digit number of current month in spaces 13-14. Example: August 1972 is coded as 2 08

Preprinted letters under some of the boxes are for data processing purposes and are not of concern to the bathythermograph operator.

Navy submarines will fill out the RADIO MESSAGE INFORMATION section as follows

In the Surface Depth-Temperature group (with 00 preprinted in depth group (Z_oZ_o), enter 999 in temperature group $T_oT_oT_o$ to indicate submarine observations

Table 5
TEMPERATURE CONVERSION, FAHRENHEIT TO CELSIUS

+F	0 0 °C	0 1 °C	0 2 °C	0 3 °C	0 4 °C	0 5 °C	0 6 °C	0 7 °C	0 8 °C	0 9 °C
+21	-6.1	-6 1	-6.0	-5 9	-5 9	-5.8	-5 8	-5 7	-5 7	-5.6
22	-5 6	-5 5	-5 4	-5 4	-5 3	-5 3	-5 2	-5 2	-5 1	-5 1
23	-5 0	-4 9	-4 9	-4 8	-4 8	-4 7	-4 7	-4 6	-4.6	-4 5
24	-4 4	-4 4	-4.3	-4 3	-4 2	-4 2	-4 1	-4 1	-4.0	-3 9
25	-3 9	-3.8	-3 8	-3.7	-3 7	-3.6	-3.6	-3 5	-3 4	-3 4
+26	-3.3	-3 3	-3 2	-3 2	-3 1	-3 1	-3 0	-2 9	-2 9	-2.8
27	-2 8	-2 7	-2 7	-2 6	-2.6	-2.5	-2 4	-2 4	-2.3	-2.3
28	-2 2	-2 2	-2 1	-2 1	-2 0	-1 9	-1 9	-1 8	-1 8	-1 7
29	-1 7	-1 6	-1.6	-1 5	-1 4	-1 4	-1 3	-1.3	-1 2	-1 2
30	-1 1	-1 1	-1.0	-0 9	-0 9	-0.8	-0 8	-0 7	-0 7	-0.6
+31	-0 6	-0.5	-0 4	-0 4	-0 3	-0 3	-0 2	-0 2	-0 1	-0 1
32	0 0	+0 1	+0 1	+0 2	+0 2	+0.3	+0 3	+0 4	+0 4	+0.5
33	+0 6	+0.6	+0 7	+0 7	+0.8	+0 8	+0 9	+0 9	+1 0	+1 1
34	+1 1	+1 2	+1 2	+1.3	+1 3	+1 4	+1 4	+1 5	+1 6	+1.6
35	+1 7	+1.7	+1 8	+1.8	+1 9	+1 9	+2 0	+2 1	+2 1	+2 2
+36	+2 2	+2 3	+2 3	+2 4	+2 4	+2 5	+2 6	+2 6	+2 7	+2.7
37	2 8	2 8	2 9	2 9	3 0	3 1	3 1	3 2	3.3	3.3
38	3 3	3 4	3 4	3 5	3 6	3 6	3 7	3 7	3 8	3.8
39	3 9	3 9	4 0	4 1	4 1	4 2	4 2	4 3	4 3	4 4
40	4 4	4.5	4 6	4 6	4 7	4 7	4 8	4 8	4 9	4 9
+41	+5 0	+5 1	+5 1	+5 2	+5 2	+5 3	+5 3	+5 4	+5 4	+5.5
42	5 6	5 6	5 7	5 7	5 8	5 8	5 9	5 9	6.0	6 1
43	6 1	6 2	6 2	6 3	6 3	6 4	6 4	6.5	6 6	6.6
44	6 7	6 7	6 8	6 8	6 9	6 9	7 0	7 1	7 1	7 2
45	7 2	7 3	7 3	7 4	7 4	7 5	7 6	7 6	7 7	7 7
+46	+7 8	+7 8	+7 9	+7 9	+8 0	+8 1	+8 1	+8 2	+8 2	+8.3
47	8 3	8 4	8 4	8.5	8.6	8 6	8 7	8 7	8.8	8.8
48	8 9	8 9	9 0	9 1	9 1	9 2	9 2	9 3	9 3	9 4
49	9 4	9 5	9.6	9.6	9 7	9 7	9 8	9 8	9 9	9 9
50	10 0	10 1	10 1	10.2	10 2	10 3	10.3	10 4	10 4	10 5
+51	+10 6	+10 6	+10 7	+10 7	+10 8	+10 8	+10 9	+10 9	+11 0	+11.1
52	11 1	11 2	11 2	11.3	11 3	11 4	11 4	11 5	11 6	11 6
53	11 7	11.7	11 8	11 8	11 9	11 9	12 0	12 1	12 1	12 2
54	12 2	12 3	12 3	12 4	12 4	12 5	12.6	12 6	12 7	12 7
55	12.8	12.8	12 9	12 9	13 0	13 1	13 1	13 2	13 2	13 3
+56	+13 3	+13 4	+13 4	+13 5	+13 6	+13 6	+13 7	+13 7	+13.8	+13 8
57	13 9	13 9	14 0	14 1	14 1	14 2	14 2	14.3	14.3	14 4
58	14 4	14.5	14 6	14.6	14 7	14 7	14 8	14 8	14 9	14 9
59	15 0	15 1	15 1	15 2	15 2	15 3	15 3	15 4	15 4	15 5
60	15.6	15.6	15 7	15.7	15.8	15.8	15 9	15 9	16.0	16 1
+61	+16 1	+16.2	+16 2	+16.3	+16.3	+16 4	+16.4	+16.5	+16.6	+16.6
62	16.7	16.7	16.8	16.8	16 9	16.9	17 0	17 1	17 1	17 2
63	17 2	17.3	17.3	17.4	17.4	17.5	17.6	17.6	17.7	17.7
64	17.8	17.8	17.9	17.9	18.0	18.1	18.1	18.2	18.2	18.3
65	18.3	18.4	18.4	18.5	18.6	18.6	18.7	18.7	18.8	18.8

temperature to tenths of a degree Celsius.

5. AIR TEMP —WET-BULB (s_nTTT)—

s_n Air Temperature sign indicator—Enter "0" for positive temperatures and "1" for negative temperatures

TTT Wet-Bulb temperature—Record the wet-bulb temperature to tenths of a degree Celsius

6. SEA TEMP ($T_wT_wT_w$ INSTR)—

$T_wT_wT_w$ Sea surface temperature—Record the temperature to tenths of a degree Celsius (A thermometer, such as an engine room intake, which is read only to the nearest whole degree Celsius should be indicated in the tenths column by a Solidus (/)) To indicate negative temperatures, add 50 0 to the absolute value of the temperature and drop the negative sign For example −1 2°C would be encoded "51 2"

INSTR Enter code number of instrument used to record sea surface temperature from Table 2

Table 2
SEA SURFACE TEMPERATURE
INSTRUMENT CODE

Code	Instrument
1	bucket thermometer
2	thermometer in condenser intake on steam ships, or inlet of engine cooling system on motor ships
3	trailing thermistor
4	hull contact sensor
5	"through hull" sensor
6	radiation thermometer
7	bait tanks thermometer
9	other

7. WAVE ($P_wP_wH_wH_w$)

P_wP_w Wave period—Enter the average wind wave period to the nearest second. Enter "00" for calm, and "99" when the wind wave period cannot be determined because the sea is confused When the wind wave period cannot be determined for any other reason, enter two Solids (//)

H_wH_w Wave height—Use the half-meter code given in Table 3 This code is based on wave heights estimated to the nearest half meter

1 The trace should be read to the nearest tenth of a degree in temperature and to the nearest whole unit of depth. If temperature is in Fahrenheit and/or depth in feet convert to metric units Use Table 5 for temperature conversions and Table 6 for depth conversions.

2 When interpreting and encoding the bathythermograph trace, always include:

a. Water temperature at the sea surface (or the first readable temperature in the upper 10 meters) and at the deepest point of the trace

b Sufficient inflection (flexure) points to describe the temperature structure and significant irregularities in the surface layer. In the upper 500 meters never report more than 20 points. Usually the number of points required to describe the trace in the upper 500 meters will be less than 20

c. The top and bottom of isothermal layers

d Additional intermediate points to support any large temperature depth differences The temperature difference between two consecutive depth/temperature entries should never exceed 3°C All such intermediate points should be read at the nearest whole °C.

3 Do not adjust trace to agree with reference temperature.

4. Do not routinely interpret trace at convenient depth increments (5m, 20m, etc.) unless inflection points actually exist at those depths

5. All values must be recorded accurately (every entry must be rechecked).

6 If the instrument used strikes the sea bottom read temperature depth value and report it in RADIO MESSAGE INFORMATION according to SPECIAL CODING INSTRUCTIONS for the 00000 indicator group.

B. RECORDING THE RADIO MESSAGE INFORMATION

The following procedures should be followed to enter bathythermograph data on "BATHYTHERMOGRAPH LOG"

1 Message Prefix—Preprinted JJXX identifies bathythermograph observations

2 DATE (YYMMJ)

YY Day—Enter the day of month as determined by GMT using numerals 01 through 31.

MM Month—Enter month of year using numerals 01 through 12

J Year—Enter the last digit of year

Examples: for 101m, record 01; for 256m, record 56; for 375m, record 75.

$T_zT_zT_z$ Temperature Group—Enter water temperature at depth ZZ in °C to tenths of degrees. All temperature values of less than 0°C will be coded as $5T_zT_z$ (5 indicates that a negative reading follows)

00000 Indicator Group—Inserted after last $ZZT_zT_zT_z$ group only if last group is an ocean bottom reading

RADIO CALL All messages must terminate with the ship radio call or aircraft squadron designator or the letters ACFT

C. HOW TO ADDRESS MESSAGES FOR RADIO TRANSMISSION

Message addresses should be indicated and forwarded as follows:

FLENUMWEACEN—For Navy aircraft and ships and Navy sponsored observations in accordance with current Navy instructions.

OBS METEO WASHDC—For all platforms other than Navy and under IOC, IGOSS auspices. Use NOAA Form 77-21 BATHY REPORT FOR RADIO TRANSMISSION.

IV. INSTRUCTIONS FOR NAVY USE

BATHY messages will be transmitted with PRIORITY precedence, classified in accordance with the ship's movement The heading on the BATHY radio message is identical to the heading on any Navy message For Example:

P 250015Z DEC 71
FM USS BOSTON
TO RUWJAGD/FLENUMWEACEN MONTEREY
BT
UNCLAS
JJXX etc.

Navy ships, in addition to filling out the REFERENCE and RADIO MESSAGE INFORMATION sections, will fill in the FOR NAVY SHIP USE section in the upper left corner of the log sheet as follows:

3-4 Enter first two letters of ship type in spaces 3 and 4, and remaining letters as appropriate in the next two shaded unnumbered spaces

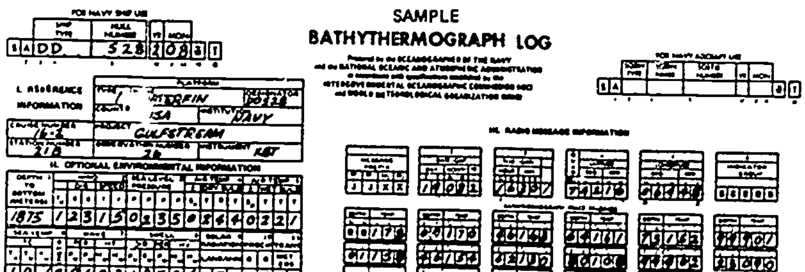
5-7 Enter hull number in spaces 5-7; precede by zeroes if less than 3 digits If hull number is 4 digits, enter the first digit in the shaded unnumbered space

50	10.0	10.1	10.1	10.2	10.2	10.3	10.3	10.4	10.4	10.5
+51	+10.6	+10.6	+10.7	+10.7	+10.8	+10.8	+10.9	+10.9	+11.0	+11.1
52	11.1	11.2	11.2	11.3	11.3	11.4	11.4	11.5	11.6	11.6
53	11.7	11.7	11.8	11.8	11.9	11.9	12.0	12.1	12.1	12.2
54	12.2	12.3	12.3	12.4	12.4	12.5	12.6	12.6	12.7	12.7
55	12.8	12.8	12.9	12.9	13.0	13.1	13.1	13.2	13.2	13.3
+56	+13.3	+13.4	+13.4	+13.5	+13.6	+13.6	+13.7	+13.7	+13.8	+13.8
57	13.9	13.9	14.0	14.1	14.1	14.2	14.2	14.3	14.3	14.4
58	14.4	14.5	14.6	14.6	14.7	14.7	14.8	14.8	14.9	14.9
59	15.0	15.1	15.1	15.2	15.2	15.3	15.3	15.4	15.4	15.5
60	15.6	15.6	15.7	15.7	15.8	15.8	15.9	15.9	16.0	16.1
+61	+16.1	+16.2	+16.2	+16.3	+16.3	+16.4	+16.4	+16.5	+16.6	+16.6
62	16.7	16.7	16.8	16.8	16.9	16.9	17.0	17.1	17.1	17.2
63	17.2	17.3	17.3	17.4	17.4	17.5	17.6	17.6	17.7	17.7
64	17.8	17.8	17.9	17.9	18.0	18.1	18.1	18.2	18.2	18.3
65	18.3	18.4	18.4	18.5	18.6	18.6	18.7	18.7	18.8	18.8
+66	+18.9	+18.9	+19.0	+19.1	+19.1	+19.2	+19.2	+19.3	+19.3	+19.4
67	19.4	19.5	19.6	19.6	19.7	19.7	19.8	19.8	19.9	19.9
68	20.0	20.1	20.1	20.2	20.2	20.3	20.3	20.4	20.4	20.5
69	20.6	20.6	20.7	20.7	20.8	20.8	20.9	20.9	21.0	21.1
70	21.1	21.2	21.2	21.3	21.3	21.4	21.4	21.5	21.6	21.6
+71	+21.7	+21.7	+21.8	+21.8	+21.9	+21.9	+22.0	+22.1	+22.1	+22.2
72	22.2	22.3	22.3	22.4	22.4	22.5	22.6	22.6	22.7	22.7
73	22.8	22.8	22.9	22.9	23.0	23.1	23.1	23.2	23.2	23.3
74	23.3	23.4	23.4	23.5	23.6	23.6	23.7	23.7	23.8	23.8
75	23.9	23.9	24.0	24.1	24.1	24.2	24.2	24.3	24.3	24.4
+76	+24.4	+24.5	+24.6	+24.6	+24.7	+24.7	+24.8	+24.8	+24.9	+24.9
77	25.0	25.1	25.1	25.2	25.2	25.3	25.3	25.4	25.4	25.5
78	25.6	25.6	25.7	25.7	25.8	25.8	25.9	25.9	26.0	26.1
79	26.1	26.2	26.2	26.3	26.3	26.4	26.4	26.5	26.6	26.6
80	26.7	26.7	26.8	26.8	26.9	26.9	27.0	27.1	27.1	27.2
+81	+27.2	+27.3	+27.3	+27.4	+27.4	+27.5	+27.6	+27.6	+27.7	+27.7
82	27.8	27.8	27.9	27.9	28.0	28.1	28.1	28.2	28.2	28.3
83	28.3	28.4	28.4	28.5	28.6	28.6	28.7	28.7	28.8	28.8
84	28.9	28.9	29.0	29.1	29.1	29.2	29.2	29.3	29.3	29.4
85	29.4	29.5	29.6	29.6	29.7	29.7	29.8	29.8	29.9	29.9
+86	+30.0	+30.1	+30.1	+30.2	+30.2	+30.3	+30.3	+30.4	+30.4	+30.5
87	30.6	30.6	30.7	30.7	30.8	30.8	30.9	30.9	31.0	31.1
88	31.1	31.2	31.2	31.3	31.3	31.4	31.4	31.5	31.6	31.6
89	31.7	31.7	31.8	31.8	31.9	31.9	32.0	32.1	32.1	32.2
90	32.2	32.3	32.3	32.4	32.4	32.5	32.6	32.6	32.7	32.7
+91	+32.8	+32.8	+32.9	+32.9	+33.0	+33.1	+33.1	+33.2	+33.2	+33.3
92	33.3	33.4	33.4	33.5	33.6	33.6	33.7	33.7	33.8	33.8
93	33.9	33.9	34.0	34.1	34.1	34.2	34.2	34.3	34.3	34.4
94	34.4	34.5	34.6	34.6	34.7	34.7	34.8	34.8	34.9	34.9
95	35.0	35.1	35.1	35.2	35.2	35.3	35.3	35.4	35.4	35.5
+96	+35.6	+35.6	+35.7	+35.7	+35.8	+35.8	+35.9	+35.9	+36.0	+36.1
97	36.1	36.2	36.2	36.3	36.3	36.4	36.4	36.5	36.6	36.6
98	36.7	36.7	36.8	36.8	36.9	36.9	37.0	37.1	37.1	37.2
99	37.2	37.3	37.3	37.4	37.4	37.5	37.6	37.6	37.7	37.7
100	37.8	37.8	37.9	37.9	38.0	38.1	38.1	38.2	38.2	38.3

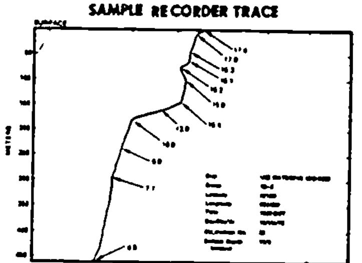
Table 6.
DEPTH CONVERSION, FEET TO METERS

Feet	00	10	20	30	40	50	60	70	80	90
0	0	3	6	9	12	15	18	21	24	27
100	30	34	37	40	43	46	49	52	55	58
200	61	64	67	70	73	76	79	82	85	88
300	91	94	98	101	104	107	110	113	116	119
400	122	125	128	131	134	137	140	143	146	149
500	152	155	158	162	165	168	171	174	177	180
600	183	186	189	192	195	198	201	204	207	210
700	213	216	219	223	226	229	232	235	238	241
800	244	247	250	253	254	259	262	265	268	271
900	274	277	280	283	287	290	293	296	299	302
1000	305	308	311	314	317	320	323	326	329	332
1100	335	338	341	344	347	351	354	357	360	363
1200	366	369	372	375	378	381	384	387	390	393
1300	396	399	402	405	408	412	415	418	421	424
1400	427	430	433	436	439	442	445	448	451	454
Feet	000	100	200	300	400	500	600	700	800	900
1000	305	335	366	396	427	457	488	518	549	579
2000	610	640	671	701	732	762	792	823	853	884
3000	914	945	975	1006	1036	1067	1097	1128	1158	1189
4000	1219	1250	1280	1311	1341	1372	1402	1433	1463	1494
5000	1524	1554	1585	1615	1646	1676	1707	1737	1768	1798

SAMPLE
BATHYTHERMOGRAPH LOG



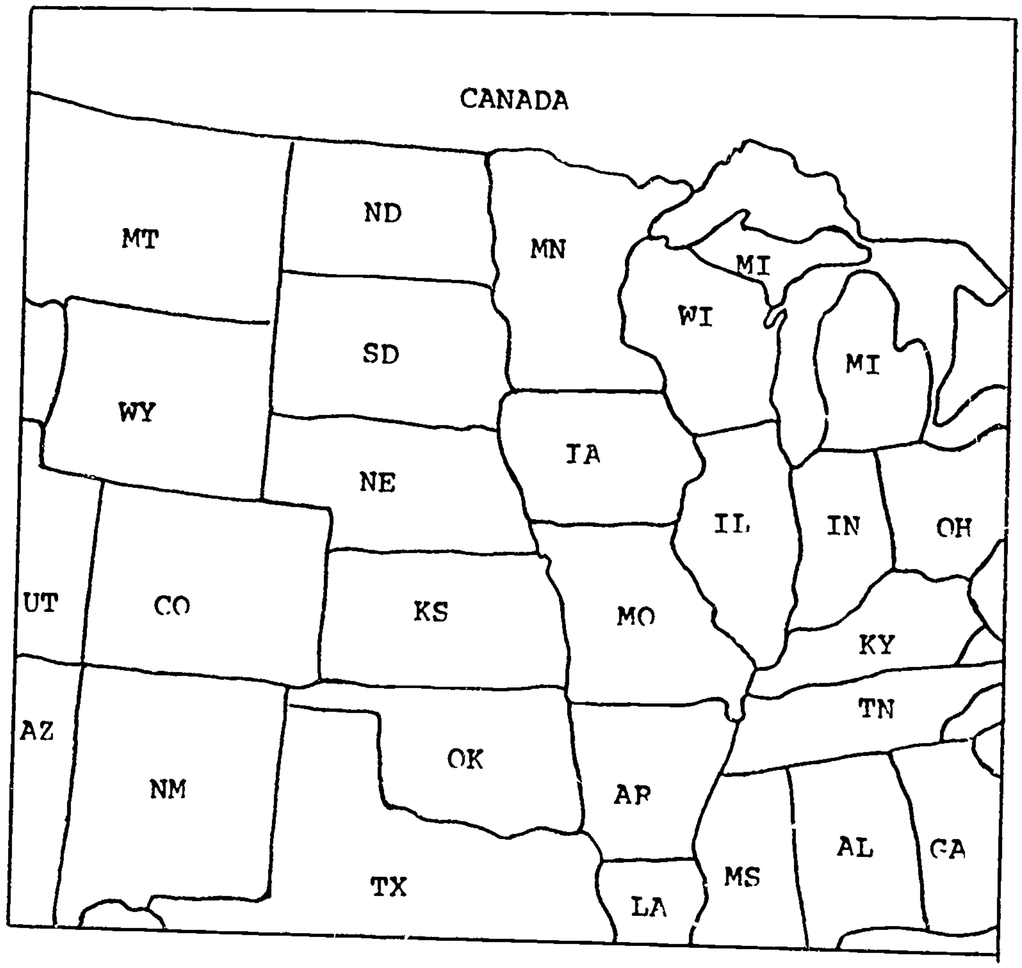
SAMPLE RECORDER TRACE



DEPARTMENT OF THE AIR FORCE
3330 Technical Training Wing (ATC)
Chanute Air Force Base, Illinois 61868

C3ABR25130-2-HO-305a
30 March 1984

AIRWAYS STATE IDENTIFIER



OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 500; DAV - 1

Designed for ATC Course Use. Do Not Use on the Job.

Weather Training Branch
Chanute AFB, Illinois 61868-5000

C3ABR25130 002-SG-305
25 October 1984

ANALYSIS OF THE SKEW T, LOG P DIAGRAM

OBJECTIVES

Given a plotted Skew-T Log P diagram, compute the following data without error in 20 minutes.

1. CCL
2. LCL
3. LFC
4. Freezing level
5. SI

Convective Condensation Level (CCL) To find the CCL, start at the plotted surface dewpoint and draw a line upward parallel to the nearest saturation mixing ratio line until you intersect the plotted temperature curve. The point where this draw line intersects the temperature curve is the CCL.

Lifting Condensation Level (LCL) To find the LCL first determine the CCL. Then start at the surface temperature point and draw a line parallel to the nearest dry adiabat until you intersect the CCL. Where these two lines intersect is the LCL.

Level of Free Convection (LFC). To find the LFC, start at the LCL and draw a line upward, parallel to the nearest saturation adiabat until you intersect the plotted temperature curve. This point of intersection is the LFC.

Snowalter Stability Index (SI). From the 850 mb level dewpoint draw a line upward, parallel to the nearest saturation mixing-ratio line. Then from the 850 mb temperature, draw a line parallel to the nearest dry adiabat until it intersects the line you drew from the dewpoint. This is the 850 mb LCL.

From the 850 mb LCL, draw a line upward parallel to the nearest saturation adiabat until it intersects the 500 mb level.

Read the temperature where this line crosses the 500 mb level, then read the temperature where the temperature curve intersects the 500 mb level. Find the difference between these two temperatures.

If the line you drew falls to the left of the plotted temperature curve prefix this value with a plus (+) sign.

If the line you drew falls to the right of the plotted temperature curve prefix this value with a minus (-) sign.

Supersedes C3ABR25130-2-HO-408A, 16 July 1983.
OPR 3350 TCHTG
DISTRIBUTION X
3350 TCHTG/TTGU-W - 200 DAV - 1

Designed for ATC Course Use. Do Not Use on the Job.

Technical Training

Aerographer's Mate
(C-420-2010-A1)

WEATHER PLOTTING

12 March 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

Designed for ATC Course Use.

Do Not Use on the Job.

WEATHER PLOTTING

OBJECTIVES

5. Map Plotting

a. Given airways reports and plotting guide, plot 40 stations within 20 minutes with no more than five errors in the ten graded stations.

b. Given land synoptic reports and plotting guide, plot 40 stations within 20 minutes with no more than five errors in the ten graded stations.

c. Given shipboard synoptic reports and plotting guide, plot 25 stations within 25 minutes with no more than five errors in the ten graded stations.

d. Given part A of the rawinsonde message and plotting guide, plot constant pressure data. Plot 25 stations within 10 minutes with no more than three errors in the ten graded stations.

e. Given the appropriate rawinsonde message, plot one Skew-T Log P diagram in accordance with a checklist within 20 minutes with no more than four errors.

13. Practice Lab

1. Given environmental warning data, plot a high wind and a high sea warning within 30 minutes with no more than one error.

INSTRUCTIONS

Use this workbook under the direction of your instructor. He will assign the plotting exercises and grade your work against the standards listed above. The exercises are divided as follows.

	SUBJECT	PAGE	EXERCISES
1.	Airways	3	6
2.	Land Synoptic	15	4
3.	Ship Synoptic	20	4
4.	Constant Pressure	28	1
5.	Skew-T	35	5
6.	High Wind/Sea Warning	38	2

OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 100; DAV - 1

EXERCISE 1

SAUM 1 KAWN 281200

DIK SA 1157 E70 BKN 100 OVC 15 070/50/48/1418/978/ 10700 60;
DVL SA 1158 E50 BKN 100 OVC 10 62/59/0000/975/ 213 157/;
FAR SA 1156 25 SCT 130 SCT E300 OVC 20 088/66/56/1308/980/CB SW
MOVG N VIRGA SW/ 710 1362 62;
HIB SA 1155 250 -OVC 15 155/51/45/1204/999/ 103 48;
INL SA 1155 150 SCT E250 OVC 15 128/59/52/1406/992/ 010 1027 55;
JMS SA 1155 130 SCT 250 -BKN 10 082/60/58/0907/980/LINE CB W-NW/
62510 59;

SAUM 6 KAWN 281200

CMX SA 1156 150 -BKN 250 -OVC 20 183/48/44/0706/006/ 209 1037 44;
CWA SA 1155 E40 BKN 60 OVC 12 69/58/0000/001/ 215 157/;
ESC SA 1158 E150 BKN 7 55/49/0000/003/ 213 1070;
GRB SA 1156 E110 OVC 10 157/61/54/0000/999/ 110 107/ 57;
GRR SA 1155 180 SCT E250 BKN 15 178/61/49/1703/006/ 107 1031 54;
HTL SA 1154 100 SCT 250 -SCT 12 189/55/37/1106/009/ 312 1071 50;
IMT SA 1155 35 SCT E150 OVC 5F 56/53/0000/003/ 217 157;
IWD SA 1155 100 SCT 250 -BKN 7 54/49/0000/996/ 010 1071;
LAN SA 1155 60 SCT E110 OVC 8 156/61/54/0605/009/ 214 147/ 55;
LSE SA 1155 60 SCT E110 BKN 250 OVC 7 155/66/58/1206/999;
MBS SA 1155 E60 BKN 250 BKN 10 184/58/52/0409/008/ 212 1502;

SAUM 2 KAWN 281200

EAR SA 1155 50 SCT E100 BKN 250 OVC 15 61/56/0000/994/ 201 1577;
EMP SA 1155 80 SCT E100 OVC 5F 147/66/64/1507/999/ 603 1077;
HUT SA 1153 120 SCT E250 OVC 3F 69/66/2107/996;
LBF SA 1159 33 SCT E70 BKN 330 OVC 4F 129/66/63/1611/994/710 1578 63;
MCK SA 1155 35 SCT E60 BKN 100 BKN 15 58/54/2106/997/ACCAS SW-W/ 212
1580;
OFK SA 1155 E120 BKN 10 122/63/59/1805/992/ 303 1070 59;
OLU SA 1155 100 SCT E250 BKN 7 63/60/1804/995/ 210 1071;
OMA SA 1155 120 SCT 250 -BKN 7 64/60/1705/996/ 211 1071;
RSL SA 1159 60 SCT E200 BKN 15 119/63/60/1609/992/ 607 1078;
SLN SA 1156 E100 OVC 3FH 127/68/63/1408/893/ 270 107/ 63;
SNY SA 1158 250 SCT 15 083/48/43/1803/987/ 500 1001;
TOP SA 1154 E140 OVC 2F 152/63/62/0904/000/ 207 103/ 59;

SAUM 4 KAWN 281200

CMI SA 1155 250 -SCT 15 61/52/1407/008/ 203 1001;
DBQ SA 1155 E80 BKN 7 155/68/59/1904/001/ 210 1070;
JLN SA 1153 100 SCT 44 170/68/63/1807/006/ 103 1070 68;
MCW SA 1155 250 SCT 12 146/63/57/1705/998/ 214 1001 61;
MDH SA 1155 E100 BKN 250 BKN 2F 62/49/0000/007/ 213 1072;
MDW SA 1155 200 -SCT 10 66/51/2004/006;
MKC SA 1155 E120 BKN 6H 59/53/0104/000/ 201 1070;
MLI SA 1155 E120 BKN 6H 156/68/60/1801/001/ 212 1050;

SAUM 4 KAWN 281200 CONT.

MMO SA 1151 120 SCT 200 -BKN 7 64/60/1705/996/ 211 1071;
OTM SA 1155 E100 BKN 250 BKN 9 163/66/59/1708/003/ 314 1071 66;
PIA SA 1155 E150 BKN 280 BKN 12 070/56/55/1805/005/ 307 1059 55;
RFD SA 1155 250 -BKN 15 163/68/55/2008/003/ 305 1003 62;
SGF SA 1156 250 -BKN 3F 172/65/63/1605/007/ 310 1002 63;
SPI SA 1155 100 SCT 12 070/69/58/1909/004/ 310 107/ 67;
STL SA 1158 E100 OVC 10 177/70/56/1805/007/ 310 107/ 67;
SZL SA 1152 100 SCT E150 OVC 7 0000/006;
SUX SA 1157 250 -OVC 15 130/63/61/1308/993/ 305 1001 61;

SAUM 7 KAWN 281200

BKL SA 1158 150 -SCT 15 68/45/2205/011/ /// 1030;
BMG SA 1158 200 -BKN 10 0000/014;
CAK SA 1155 100 SCT E250 BKN 7 201/57/45/1705/013/ 107 1081 54;
CVG SA 1155 250 -SCT 15 204/60/51/1103/015/ 315 1001;
DAY SA 1158 250 -OVC 10 198/62/47/1803/013/ 312 1007 55;
EVV SA 1155 250 -SCT 7 184/57/54/0804/008/ 210 1001;
FDY SA 1155 250 -SCT 20 195/59/47/2004/011/ 213 1001;
FWA SA 1155 250 -BKN 10 195/56/48/2104/011/ 310 1008;
HUF SA 1155 250 -BKN 15 194/58/52/0000/011/ 102 1001;
IND SA 1155 250 -BKN 10 192/55/48/1203/011/ 367 1008;
LAF SA 1155 250 -SCT 10 188/60/52/0805/012/ 217 1001 53;
LEX SA 1155 250 -SCT 20 195/60/52/0805/012/ 217 1001 53;
LOU SA 1150 250 -SCT 7 57/52/3303/013;
LOZ SA 1155 CLR 9 207/57/54/E0000/016/ 217 53;
PAH SA 1155 250 -SCT 1GFH 182/59/57/0000/008/ 210 1008 56;

SAUM 8 KAWN 281200

BNA SA 1152 250 -SCT 5F 192/63/60/0000/011/ 017 1001 50;
CHA SA 1155 250 -SCT 2FH 191/64/62/0000/011/ 314 1001 63;
CSV SA 1155 -X 250 SCT 11/2F 187/64/61/0000/014/F3/ 308 1001;
MKL SA 1155 250 -BKN 7 177/62/59/0000/007/ 215 58;

882

EXERCISE 2

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SAUM 8 KAWN 1612ØØ

BNA SA 1156 E65 OVC 15 165/62/49/Ø5Ø4/ØØ3/ 3Ø3ØØ 1Ø2Ø 61:
CHA SA 1155 M22 OVC 8R- 188/63/54/Ø6Ø4/Ø1Ø/ 314ØØ 1Ø2/ 63;
CSV SA 1156 E1ØØ OVC 12 184/62/5Ø/1ØØ6/Ø12/ 212 1Ø7/ 57;
MEM SA 1157 M4 BKN 1Ø OVC 1R-F 116/64/62/1Ø1Ø/998/ 8Ø769 172/ 64;
MKL RS 1156 E8 BKN 1Ø OVC 2RF 136/59/58/1ØØ8/994/ 2Ø3Ø5 59;
TRI SA 1155 E5Ø BKN 1ØØ BKN 8 215/57/5Ø/Ø9Ø4/Ø19/ 21Ø 153Ø 51;

SAUM 7 KAWN 1612ØØ

BKL SA 1156 25Ø -SCT 4HK 53/42/18Ø2/Ø37;
BMG SA 1155 E1ØØ BKN 15Ø OVC 7 M/M/1Ø15/Ø19;
CAK SA 1155 25Ø -SCT 6H 273/49/38/Ø8Ø6/Ø33/ 21Ø 1ØØ1 41;
CMH SA 115Ø CLR 12 26Ø/51/39/Ø51Ø/Ø3Ø/ 31Ø 49;
CVG SA 1155 12Ø SCT 25Ø -SCT 8 235/55/42/Ø8Ø6/Ø23/ 2Ø7 1Ø51 5Ø;
DAY SA 1155 CLR 7 247/52/42/1ØØ9/Ø27/ 3Ø8 48;
EVV SA 1155 M37 OVC 7 181/57/5Ø/Ø612/ØØ7/ OCNL R-/4ØØØ2 15// 57;
FDY SA 1155 CLR 1Ø 268/48/4Ø/12Ø8/Ø32/ /// 44;
FWA SA 1155 25Ø -SCT 1Ø 259/47/38/Ø8Ø8/Ø29/ 31Ø 1ØØ5 45;
HUF SA 1155 E8Ø BKN 2ØØ BKN 7 213/55/44/ 210 1Ø72 50;
IND SA 1157 11Ø SCT 25Ø -OVC 12 225/53/41/Ø913/Ø2Ø;
LAF SA 1157 14Ø SCT 25Ø SCT 8 232/53/42/Ø7Ø7/Ø22/ 3Ø3 1Ø71 5Ø;
LEX SA 1153 M43 BKN 8Ø OVC 12 215/56/39/1Ø15/Ø17/ 3Ø5 155/ 55;
LNP SA 1152 M4 BKN 7Ø OVC 3R- 149/54/5Ø/Ø61Ø/998/TWR VSBY 4/ 2Ø715
    172/ 54;
LOU SA 1152 E6Ø BKN 1ØØ OVC 1Ø 58/4Ø/Ø812G2Ø/Ø16;
LOZ SA 1155 E9Ø OVC 8 213/57/45/Ø4Ø8/Ø17/ 2Ø5 1Ø7/ 55;
PAH SA 1150 1Ø SCT E34 OVC 4R-F 154/57/53/Ø6Ø5/ØØØ/ 3Ø31Ø 17// 57;
SBN SA 1152 25Ø -SCT 4F 247/5Ø/49/1ØØ6/Ø26/ 3Ø7 1ØØ1 46;
TOL SA 1155 CLR 6F 271/47/44/Ø7Ø4/Ø33/ 31Ø 38;

SAUM 2 KAWN 1612ØØ

MCK SA 1152 4 SCT E1Ø OVC 3RF 48/45/Ø525G3Ø/995/ 2Ø122 17;
MHK SA 115Ø E5 BKN 1Ø OVC 2L-F 55/49/1Ø2Ø/986;
OFK SA 1155 5Ø SCT E1ØØ OVC 1Ø 162/53/41/Ø711/ØØ2/
OLU SA 1154 E15 BKN 5Ø OVC 5R-F 52/48/Ø9Ø5/ØØ3;
OMA SA 1155 E45 BKN 7Ø OVC 6R- 54/44/Ø713/ØØØ;
RSL SA 1158 W3X 2R-F Ø76/5Ø/5Ø/Ø618/976/ 3Ø7
SLN SA 1155 E3 OVC 3L-F Ø77/52/52/Ø818/977/ 61426/ 52;
TOP RS 1148 M1Ø OVC 6F 113/54/1Ø12/987/ 5Ø627 17/ 53;

SAUM 4 KAWN 1612ØØ

MCW SA 115Ø 1ØØ SCT E25Ø OVC 7 22Ø/47/42/Ø91Ø/Ø17/ 5Ø2 1Ø77 46;
MDW SA 115Ø 6Ø SCT 7 52/44/Ø7Ø6/Ø24/PK WND Ø727 ØØØ 1Ø7Ø;
MLI SA 1156 15Ø SCT E25Ø OVC 1Ø 211/51/38/Ø71Ø/Ø16/ 6Ø7 1Ø77 5Ø;
MMO SA 1151 25Ø -BKN 1Ø 243/48/M/Ø7Ø6/Ø25/ 3Ø3 1ØØ1 42;
OTM SA 1158 E80 BKN 250 OVC 12 193/53/39/0817/010/ 808 53;
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SUAM 4 KAWN 161200 CONT.

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PIA SA 1157 E150 BKN 250 OVC 6H 209/51/41/0608/015/ 607 1077 49;
RFD SA 1158 250 -SCT 12 246/46/35/0610/025/ 400 1001 40;
SGF SA 1151 M6 OVC 3L-F 104/54/52/1208/985/ 50052 17//;
SUS SA 1152 E40 BKN 100 OVC 7R- 0913/001;
SUX SA 1157 E55 BKN 120 OVC 10 175/56/41/0914G20/005/ 708 157/ 55;
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SAUM 1 KAWN 161200

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HIB SA 1155 CLR 15 262/38/32/0000/028/ 210 40;
INL SA 1155 CLR 15 255/0413/0000/026/ 210 35;
MKT SA 1155 250 -OVC 10 47/38/1208/ 303 1007;
MSP SA 1155 250 -BKN 20 244/49/37/1105/024;
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SAUM 6 KAWN 161200

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GRB SA 1155 250 SCT 12 271/43/41/0000/031/ 345 1008 37;
GRR SA 1155 CLR 15 271/49/42/1006/033/ 210 40;
HTL SA 1154 CLR 12 283/44/28/0706/035/ 214 1001;
IMT SA 1145 CLR 20 39/37/0000/033;
IWD SA 1155 CLR 10 37/32/0000/025;
JXN SA 1151 CLR 21/2FH 270/46/43/0000/032/ 207 40;
LAN SA 1155 250 -SCT 7 274/49/45/0804/034/ 208 1001 35;
LSE SA 1155 250 -SCT 12 251/41/41/0907/026/ 023 40;
MBS SA 1150 CLR 10 173/44/41/0405/032/ 112 38;
MKG SA 1154 250 -SCT 15 268/45/36/1105/031/ 303 1007;
MKE SA 1155 250 -SCT 10 264/44/39/0405/032/ 112 38;
MNM SA 1154 200 -SCT 10 39/36/0000/033;
MQT SA 1155 CLR 20 276/40/38/0000/031/ 208 32;
MSN SA 1155 250 -BKN 8 261/39/36/0605/028/ 303 1001 33;
PLN SA 1156 CLR 30 282/36/33/0000/035/ 112 30;
RHI SA 1145 CLR 1GF 40/38/0000/026;
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EXERCISE 3

SAUM 1 KAWN 31Ø5ØØ

ABR SA 1456 M38 OVC 1Ø Ø79/57/52/34Ø7/977/ Ø12Ø8 15//;
AXN SA 1458 E6 BKN 2Ø OVC 5R- Ø5Ø/58/57/Ø112/968/ 3Ø5 17//;
BIS SA 1455 25Ø -OVC 12 116/67/45/1ØØ5/988/ 212 1ØØ7;
BJI SA 1445 E8Ø BKN 25Ø OVC 15 61/51/Ø1Ø8/976;
BRD SA 1455 E6 OVC 5R-F 6Ø/6Ø/3615/966;
DIK SA 1459 E25Ø OVC 2Ø 116/63/36/Ø2Ø9/989/ 3Ø3 1ØØ7;
DVL SA 145Ø 25Ø -BKN 1Ø 67/45/ØØØØ/983;
HIB SA 1445 4Ø SCT E8Ø OVC 7RW- Ø53/61/59/34Ø7/969/ 6Ø3 127/;
INL SA 1455 E14Ø BKN 25Ø OVC 15 Ø65/64/47/3611/973/ ØØ3 1Ø77;
ISN SA 1455 8Ø SCT 12Ø SCT 25Ø -BKN 25 126/63/39/3614/991/ 6Ø2 1Ø58;
JMS SA 1455 25Ø -BKN 15 Ø94/64/45/Ø312/982/ 61Ø 1ØØ8;
MHE SA 1457 5 SCT E8Ø OVC 7 61/58/3514/971;
MIB SA 1455 35 SCT 2ØØ -BKN 4FH 72/M/1812G2Ø/99Ø;
MKT SA 1456 25Ø -OVC 2Ø 12Ø/66/4Ø/Ø115/989/ 1Ø3 1ØØ7;
MSP SA 1456 12 SCT M2Ø OVC 1Ø5/63/51/9215/978/ 1Ø7;
PHP SA 1452 E8Ø OVC 1Ø5/63/51/2915/978/ 1Ø7;
PIR SA 1455 E8Ø BKN 12Ø OVC 35 Ø99/6Ø/51/Ø3Ø8/984/ 222 1Ø7/;
RAP SA 1458 5Ø SCT E8Ø OVC 35 124/61/44/3411/993/ 1Ø7 157/;

SAUM 6 KAWN 31Ø5ØØ

CMX SA 1455 WØX 1/8F Ø48/61/61/Ø713/967/ 717;
CWA SA 1445 1Ø SCT E15Ø OVC 15 67/62/21Ø5/961;
GRR SA 1451 M13 OVC 21/2F Ø99/74/68/1912/984/ 2Ø7 17//;
HTL SA 1455 E15 OVC 4H Ø98/71/65/19Ø8/983/ 2Ø3 15//;
IWD SA 1455 E5 BKN 1Ø OVC 2F 6Ø/58/ØØØØ/959;
LAN SA 1455 -X M16 BKN 2H 1Ø2/77/67/2115G2Ø/971/H2 8Ø3 15ØØ;
MQT SA 1457 E7 BKN 7 Ø4Ø/66/62/1312G2Ø/964/ 725 16//;
MSN SA 1456 M5Ø OVC 4RW-F Ø46/69/61/18Ø8/968/ 232ØØ 18//;
RHI SA 1455 12 SCT E3Ø BKN 15Ø OVC 1Ø 69/61/19Ø7/961;

SAUM 2 KAWN 3Ø15ØØ

LNK SA 145Ø 23 SCT 2Ø Ø59/67/58/2815G22/972/ 127ØØ 15ØØ;
MHK SA 1455 CLR 2Ø 7Ø/53/2415G25/986;
OFK SA 1455 E12 BKN 8Ø BKN 15 Ø5Ø/63/57/3114G2Ø/97Ø/ 236ØØ 157Ø;
OLU SA 1457 15 SCT E21 OVC 7 63/56/2716G3Ø/966/ 7Ø3 18ØØ;
RSL SA 1454 CLR 15 121/63/53/2513/993/ 119;
SLN SA 1455 CLR 15 115/67/52/2515/99Ø/ 317;
TOP SA 1454 CLR 15 Ø47/7Ø/61/1712/984/ 5Ø8;

SAUM 4 KAWN 3Ø15ØØ

MCI SA 1455 CLR 2Ø Ø7Ø/71/56/2517/977/ 314;
MCW SA 1457 E1Ø BKN 15 Ø17/68/6Ø/Ø3Ø8/959/ 812 16ØØ;
OTN SA 1455 25 SCT 15 Ø68/72/68/171Ø/975/ 8Ø718 15ØØ;
PIA SA 1458 25Ø SCT 15 Ø37/75/59/222ØG3Ø/966/ 7Ø3 1ØØ3;
SGF SA 1457 5Ø SCT 15 1Ø8/79/66/2412G2Ø/989/ 5ØØ 14ØØ;

SAUM 4 KAWN 3Ø15ØØ CONT.

SPI SA 1458 1ØØ SCT 25Ø SCT 4F Ø8Ø/74/72/1714G22/978/TBØ2E2Ø
RE 45 FEW CU;
SUS SA 1457 9 SCT E12Ø BKN 6H M/M/181Ø/983;

SAUM 7 KAWN 3Ø15ØØ

BKL SA 145Ø E12Ø OVC 6H 8Ø/65/21Ø8/999;
BMG SA 1457 E6Ø BKN 3H M/M/2114/998;
CAK SA 1458 E1ØØ OVC 5H 16Ø/74/62/2113/ØØ3/ ØØØ 1Ø3Ø;
MFD SA 1455 4Ø SCT E1ØØ BKN 5RW-H 15Ø/75/63/1912/999RB50 VRY LGT/
6Ø7ØØ 127Ø;
CVG SA 1455 E1ØØ OVC 3F 164/7Ø/65/1911/ØØ3/ ØØØØ9 1Ø7/;
EVV SA 1451 E80 BKN 4H 143/79/7Ø/2214/998/ 21Ø 1Ø5Ø;
FDY SA 1455 25Ø -SCT 5H 138/75/69/1914/995;
FWA SA 1453 M21 OVC 3H 119/74/65/2316/99Ø/ 6Ø3 15//;
HUF SA 1455 3Ø SCT E9Ø BKN 3F 128/76/69/2213/991;
IND SA 145Ø 37 SCT 5Ø SCT 23Ø -BKN 4H 132/74/68/2111/994/ ØØ2 18Ø1;
LEX SA 1455 E1ØØ BKN 25Ø OVC 5H 168/75/64/2112/ØØ4/ 8Ø2 1Ø77;
LOU SA 1457 12Ø SCT E25Ø BKN 5H 74/67/19Ø9/ØØ1;
LOZ SA 1455 25Ø SCT 5H 193/79/67/ØØØØ/Ø13/ 1Ø7 1ØØ[illegible];
PAH SA 1459 15Ø SCT E2ØØ BKN 5H 144/79/69/2Ø11/997/ 3Ø3 1Ø78;

SAUM 8 KAWN 3Ø15ØØ

BNA SA 1455 E1ØØ BKN 25Ø OVC 6H 175/76/67/19Ø8/ØØ6/ ØØ7 1Ø71;
CHA SA 1457 250 -BKN 3H 194/76/66/21Ø6/Ø12/ 1Ø7 1ØØ6;
CSV SA 1457 3Ø SCT 25Ø SCT 3H 19Ø/76/65/18Ø6/Ø14/HALF 2Ø7;
MEM SA 1453 E12Ø BKN 8 165/81/67/2214/ØØ3/ 1Ø8 1Ø7Ø;

EXERCISE 4

SAUM 1 KAWN 2915ØØ

ABR SA 1455 E7Ø BKN 12Ø OVC 12 Ø7Ø/64/59/36Ø7/975/ 2Ø2 1Ø7/;
BIS SA 1456 E5Ø BKN 8Ø BKN 25Ø OVC 1Ø Ø95/68/64/Ø31Ø/982/ CB 35NE
MOVG NE/ 5ØØ 1378;
BRD SA 1455 25Ø -BKN 2Ø 72/59/27Ø9/978;
DVL SA 1453 9Ø SCT 25Ø -OVC 1Ø 63/5Ø/35Ø4/98Ø;
FAR SA 1455 M4 BKN 12Ø OVC 3F Ø83/61/59/29Ø5/977/ 3Ø7 162/;
HIB SA 1455 25Ø -OVC 15 Ø76/69/62/24Ø9/977/ 8Ø5 1ØØ7;
INL SA 1456 25Ø -OVC 15 Ø57/71/55/29Ø9/971/ ØØ2 1ØØ7;
ISN SA 1455 CLR 25 111/65/44/3612/987/ ØØØ;
JMS SA 1455 15Ø SCT 25Ø -OVC 1Ø Ø87/67/54/Ø215/979/ 6Ø3 1Ø77;
MOT SA 1455 25Ø -SCT 2Ø Ø96/68/66/3313/983/ ØØØ 1ØØ8;
MSP SA 1455 25Ø -BKN 1Ø Ø82/72/6Ø/17Ø9/978/ 3Ø3 1ØØ8;
RAP SA 1455 6Ø SCT 9Ø SCT E22Ø BKN 35 Ø9Ø/66/43/3417/985/ 5Ø3 1378;

SAUM 6 KAWN 2915ØØ

CMX SA 1455 7Ø SCT E9Ø BKN 7 117/59/52/Ø913/985/ 715 1Ø7Ø;
CWA SA 1455 45 SCT E8Ø OVC 7 67/64/161Ø/984;
GRB SA 1455 9 SCT E6Ø OVC 2RW-F 122/65/63/ØØØØ/989/ 1Ø3ØØ 15//;
GRR SA 1445 M38 BKN 1ØØ OVC 8RW- 142/71/64/18Ø4/996/ 8Ø3 157/;
HTL SA 1451 E6Ø OVC 12 149/64/53/12Ø5/997/ 8Ø5 15//;
IMT SA 1458 E1ØØ OVC 4F 59/56/13Ø8/991/ 1Ø6/;
IWD SA 1445 3Ø SCT E6Ø BKN 2ØØ BKN 7 71/62/151Ø/975;
LNR SA 1458 32 SCT E8Ø BKN 25Ø OVC 44 146/74/63/24Ø6/998/ 7Ø8 1578;
MNM SA 1457 -X 15 SCT E5Ø OVC 1RW-F 56/54/ØØØØ/992/F3;
MQT SA 1457 4Ø SCT E1ØØ BKN 15Ø OVC 7R- 119/61/54/2312/987/ 614 157/;
MSN SA 1457 M4 BKN 8 OVC 3H 114/65/6Ø/12Ø4/987/ 8Ø714 17//;
PLN SA 1458 E3Ø BKN 8Ø OVC 12 155/56/49/14Ø4/997/ 1Ø2 157/;
RHI SA 1458 E3Ø BKN 7Ø BKN 5FH 69/61/18Ø8/986;

SAUM 2 KAWN 2915ØØ

LNK SA 1455 E45 BKN 12 Ø82/77/63/1911/98Ø/TCU ENE/ 1Ø2 12ØØ;
MHK SA 1457 CLR 1Ø 82/63/2218/981;
OFK SA 1458 4Ø SCT 8Ø SCT 15 Ø73/74/54/Ø5Ø7/978/CB RWU NW-NE
MOVG NE/ ØØ3 1963;
ONL SA 1451 8Ø SCT 15Ø SCT 7 79/64/ØØØØ/976;
RSL SA 1455 E3Ø BKN 15 Ø65/77/64/1922G28/978/ 1Ø3 12ØØ;
SLN SA 1457 CLR 15 174/77/65/181Ø/978/ 8Ø5;
TOP SA 1458 13Ø SCT 25Ø SCT 7 Ø93/79/69/18Ø9/983/ 8Ø5 1Ø35;

SAUM 4 KAWN 2915ØØ

ALO SA 1457 M9 BKN 6Ø OVC 7TRW- 112/65/63/1513G22/987/TNE-SW MOVG
NE OCNL LTG ICCG PRESFR/ 7Ø335 13//;
CMI SA 1457 2ØØ SCT 7 32/62/25Ø8/994;
DSM SA 1458 5Ø SCT E8Ø BKN 7 Ø87/8Ø/63/2312/981/TCU ACCAS N/ 5Ø3 128Ø;
MCI SA 1458 25Ø -SCT 7 1Ø1/77/68/1913/986/FEW AS W/ 5ØØ 1ØØ1;
MCW SA 1458 3Ø SCT E7Ø BKN 25Ø OVC 3F Ø95/64/61/1614/982/ ØØ2 1277;

SAUM 4 KAWN 2915ØØ CONT.

OTM SA 1458 E6Ø BKN 1ØØ OVC 8 1Ø1/79/68/191Ø/985/ 6Ø5;
PIA SA 1458 CLR 8 124/78/66/18Ø8/991/ 8Ø3;
SGF SA 1457 12Ø SCT E25Ø OVC 6H 135/74/61/1812G19/996/ 3Ø3 1Ø57;
SPI SA 1458 25Ø -BKN 7 122/81/66/19Ø7/991/ 8Ø5 1ØØ1;
SUS SA 1458 12Ø SCT 3ØØ -OVC 6H 1717/995;

SAUM 7 KAWN 2915ØØ
BKL SA 1445 E15Ø OVC 5H 8Ø/59/241Ø/ØØ6;
BMG SA 1457 25Ø -BKN 3H M/M/23Ø5/ØØ4;
CAK SA 1458 E1ØØ BKN 3ØØ OVC 8 176/73/55/18Ø5/ØØ7/ 8Ø3 1Ø51;
OSU SA 1454 E1ØØ BKN 25Ø OVC 7 169/75/57/21Ø7/ØØ4/ 6Ø7 1Ø71;
CMH SA 1457 25Ø -SCT 5H 173/77/58/18Ø7/ØØ6/ ØØ2 1ØØ1:
CVG SA 1458 2Ø5 -SCT 7 176/8Ø/64/23Ø7/ØØ7/ 2Ø7 1ØØ6;
DAY SA 1456 25Ø -SCT 5H 164/79/63/21Ø9/ØØ4/ ØØ5 1ØØ1:
EVV SA 1457 25Ø -BKN 5H 16Ø/79/66/22Ø8/ØØ1/ ØØ3 1ØØ1;
FDY SA 1457 E25Ø OVC 7 147/76/63/21Ø8/ØØ1;
FWA SA 1455 12Ø SCT 25Ø -OVC 7 149/78/63/22Ø8/999/ ØØ2 1Ø37;
HUF SA 1457 25Ø -BKN 5H 151/8Ø/65/21Ø7/999;
IND SA 1457 E15Ø BKN 25Ø BKN 6H 155/78/64/19Ø6/ØØØ/ 8Ø2 1Ø31;
LAF SA 1457 2ØØ SCT 7 137/85/6Ø/24Ø8/995/ 8Ø7 1ØØ8;
LEX SA 1457 25Ø -SCT 7 172/79/64/28Ø9/ØØ6/ 1Ø3 1ØØ1;
LOU SA 1457 25Ø SCT 6H 81/63/21Ø6/ØØ4;

SAUM 8 KAWN 2915ØØ

BNA SA 1457 CLR 3H 176/81/7Ø/19Ø7/ØØØ/ ØØØ;
CHA SA 1457 25Ø -BKN 3H 19Ø/77/67/2ØØ5/Ø11/ ØØ3 1ØØ6;
CSV SA 1457 -X 3Ø SCT 3H 189/77/65/23Ø8/Ø14/H3/ 1Ø5 15ØØ:

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EXERCISE 5

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SAUM 7 KAWN 161800

BKL SA 1755 E2Ø BKN 4Ø OVC 3R 1Ø2/6Ø/58/15Ø6/Ø21/ 8Ø1Ø5 17//;
BMG SA 1755 E25 BKN 8Ø OVC 7 1ØØ/71/63/171Ø/995/ 712 1[illegible]/;
CAK SA 1[illegible]55 8Ø SCT E25Ø BKN 7 121 62/53/14Ø7/Ø12/ 4Ø[illegible] [illegible]Ø78;
CMH SA 1[illegible]55 E8Ø BKN 25Ø OVC 7 13Ø/68/6Ø/12Ø7/Ø36/ 5Ø4 1Ø77;
CVG SA 1755 E6Ø BKN 6R 131/73/7Ø/171Ø/Ø35/ 7Ø2 1Ø2/;
DAY SA 1755 E5Ø BKN 4R- 119/69/66/16Ø8/ Ø287Ø5 1Ø2/;
EVV SA 1755 E25 BKN 8Ø OVC 7 112/75/63/151Ø/ØØ2/ 712 187/;
FWA SA 1755 5 SCT E8 OVC 11/2R Ø6Ø/65/63/2Ø12/983/ 61535 ONE 17//;
HUF SA 1755 E25 BKN 8Ø BKN 25Ø OVC 7 Ø95/72/66/2113/Ø2Ø/ 813 1877;
IND SA 1755 E3Ø BKN 8Ø OVC 7 Ø98/75/69/2Ø1Ø/Ø21/ 81Ø 187/;
LAF SA 1755 E25 BKN 8Ø OVC 7 Ø62/68/66/181Ø/ØØ9/ 84Ø 187/;
LOU SA 1755 8Ø SCT 25Ø SCT 7 115/74/68/161Ø/Ø28;
LOZ SA 1755 CLR 7 136/75/69/1313/Ø32/ 4ØØ;
SBN SA 1755 E25 OVC 6R- Ø49/67/65/22Ø7/961/ 713 1Ø2/;
TOL SA 1755 W5X 1F Ø87/6Ø/59/18Ø2/Ø15/ 2Ø1;

SAUM 8 KAWN 1618ØØ

BNA SA 1755 3Ø SCT 7 148/8Ø/71/1ØØ8/Ø4Ø/ 3Ø3 11ØØ;
CHA SA 1755 3Ø SCT 7 163/83/76/Ø71Ø/Ø49/ 312 11ØØ;
CSV SA 1755 CLR 7 152/81/75/Ø9Ø4/Ø46/ 1Ø2;
LEX SA 1755 8Ø SCT E25Ø BKN 7 12Ø/76/7Ø/1413/Ø29/ 6Ø2 1Ø32;
MEM SA 1755 CLR 7 162/81/74/12Ø8/Ø5Ø/ 5ØØ;
MKL SA 1755 25Ø -SCT 7 158/79/71/14Ø3/Ø47/ 4ØØ 1ØØ1;
TRI SA 1744 CLR 7 145/77/69/Ø9Ø7/Ø43/ 313;

SAUM 1 KAWN 1618ØØ

HIB SA 1755 CLR 1Ø 137/39/21/Ø5Ø6/Ø33/ 4ØØ;
INL SA 1755 CLR 1Ø 142/37/19/Ø8Ø6/Ø41/ 3Ø6;
JMS SA 1755 E35 BKN 5Ø OVC 4R Ø45/54/52/131Ø/961/ 72ØØ7 152;
MKT SA 1755 CLR 5H Ø87/5Ø/42/33Ø5/Ø15/ 32Ø;
MSP SA 1755 -X 4H 119/51/39/Ø5Ø2/Ø2Ø/H1/ 111;

SAUM 6 KAWN 1618ØØ

GRB SA 1755 E3Ø OVC 5R- Ø42/48/46/33Ø7/953/ 1Ø772 17//;
GRR SA 1755 E1Ø OVC 7 Ø39/33/3Ø/161Ø/963/ 7Ø2Ø3 16//;
HTL SA 1755 E25 BKN 6Ø OVC 6R- 045/48/47/0510/960/ 81203 152/;
IMT SA 1755 E30 OVC 1Ø Ø47/51/41/351Ø/961/ 3Ø2Ø5 1Ø7/;
IWD SA 1755 25 SCT 8Ø SCT 7 Ø75/43/3Ø/Ø21Ø/Ø1Ø/ 5Ø6 153Ø;
LAN SA 1755 E35 BKN 5Ø OVC 4R Ø45/54/52/131Ø/961/ 72ØØ7 152/;
LSE SA 1755 25Ø -BKN 1Ø Ø87/5Ø/42/331Ø/Ø15/ 3Ø2 1ØØ1;
MBS SA 1755 E3Ø BKN 1ØØ OVC 7 Ø43/48/43/Ø81Ø/Ø6Ø/ 512 187/;
MKE SA 1755 WØX ØF Ø36/51/49/241Ø/96Ø/ 83Ø16 TWO
MKG SA 1755 M9 OVC 1/2R+ Ø31/5Ø/48/1511/954/ 82Ø87 17//;
MNM SA 1755 E15 OVC 7 Ø29/47/45/351Ø/ 71ØØ5 15//;
MQT SA 1755 E3Ø OVC 7 Ø61/42/3Ø/33Ø8/975/ 315 18//;
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SAUM 6 KAWN 1618ØØ CONT.

MSN SA 1755 M7 OVC 5R-F Ø39/53/52/29Ø6/963/ 7Ø341 17//;
PLN SA 1755 8Ø SCT 7 037/45/32/Ø41Ø/96Ø/ 2Ø2 1Ø3Ø;
RHI SA 1755 2Ø SCT E7Ø BKN 7 Ø65/41/36/Ø31Ø/978/ 312 157Ø;

SAUM 2 KAWN 1618ØØ

LNK SA 1755 CLR 7 153/66/45/Ø2Ø6/Ø45/ 4ØØ;
MHK SA 1755 CLR 1Ø 157/68/59/34Ø4/Ø47/ 4ØØ;
OFK SA 1755 3Ø SCT 1Ø 167/6Ø/53/Ø11Ø/Ø52/ 1Ø5 11ØØ;
OLU SA 1755 25 SCT 1Ø 16Ø/62/48/35Ø5/Ø5Ø/ 1Ø7 11ØØ;
OMA SA 1755 CLR 7 14Ø/64/5Ø/331Ø/Ø4Ø/ 3Ø6;
RSL SA 1755 CLR 2Ø 167/7Ø/59/Ø21Ø/Ø52/ 1Ø1;
SLN SA 1755 CLR 1Ø 168/69/58/36Ø6/Ø52/ ØØØ;

SAUM 4 KAWN 1618ØØ

MCW SA 1755 25Ø SCT 1Ø 1Ø2/58/4Ø/Ø3Ø6/Ø15/ 212;
MDW SA 1755 6 SCT M15 OVC 3R- Ø4Ø/66/65/2215/964/ 73672 17//;
MCI SA 1755 CLR 1Ø 14Ø/71/65/3212/Ø4Ø/ 215;
MLI SA 1755 8Ø SCT 1Ø Ø61/63/5Ø/3ØØ2/973/ 217 1Ø3Ø;
OTM SA 1755 15 SCT E8Ø BKN 7 Ø91/65/6Ø/3415/Ø1Ø/ 23Ø 155Ø;
PIA SA 1755 E15 BKN 4Ø OVC 6R- Ø62/67/64/2312/974/ 81211 172/;
RFD SA 1755 M1Ø OVC 3R Ø62/62/55/241Ø/974/ 81111 17//;
SGF SA 1755 3Ø SCT 1Ø 137/75/72/26Ø8/Ø31/ 3Ø5 12ØØ;
SPI SA 1755 M13 OVC 6R- Ø8Ø/7Ø/63/1912/981/ 8Ø215 17//;
SUS SA 1755 15 SCT E6Ø OVC 7 1Ø2/73/68/24Ø4/Ø19/ 6Ø5 154/;

EXERCISE 6

SAUM 2 KAWN 2712ØØ

AIA SA 1155 25Ø -SCT 2Ø 48/42/Ø9Ø8/974/ 57445;
ANW SA 1155 1 SCT 1/2F 48/47/Ø9Ø5/979/ 211 16ØØ;
BBW SA 1155 W1X 1/8F 49/49/ØØØØ/981/ 1Ø5;
BIE SA 1155 CLR 1Ø 53/51/24Ø5/977/ 46951 2ØØ13;
CDR SA 1155 25Ø SCT 2Ø Ø51/47/43/ØØØØ/972/ 1Ø3 44;
GCK SA 1155 CLR 7 Ø77/5Ø/45/17Ø5/982/ 5ØØ 47 2ØØØ7;
GRI SA 1155 CLR 2GF 48/47/ØØØØ/979/ 1Ø2;
MCK SA 1155 CLR 15 49/47/Ø8Ø4/98Ø/GF ALONG RIVER/ 4ØØ;
MHK SA 1155 -x 1/2F 53/52/2ØØ5/982/F6/ 2Ø5;
MHN sa 1155 CLR 15 46/44/ØØØØ/98Ø/ 5Ø2;
SLN SA 1155 CLR 7 Ø83/5Ø/5Ø/ØØØØ/977/PATCHY GF/ 7Ø3;
STJ SA 1155 6 SCT M22 BKN 7Ø OVC 5F Ø63/63/63/2ØØ7/973/ 3Ø3Ø1 ONE
162 61 2Ø1Ø1;

SAUM 4 KAWN 2712ØØ

BRL SA 1155 6Ø SCT E1ØØ BKN 25Ø BKN 7 62/58/22Ø8/972/REØ2;
CGI SA 1155 E1Ø OVC 5F Ø72/69/67/21Ø6/975/OVC 23/ 214 65 2ØØ42;
CGX SA 1155 WØX 3 57/56/E361Ø/975/ 3Ø5;
CID SA 1155 E35 BKN 8Ø BKN 11Ø OVC 4R-F Ø53/59/57/ØØØØ/97Ø/
PCPN VRY LGHT/ 21ØØ1 59 2ØØØ2;
DBQ SA 1155 W2X 1/4L-F 62/59/17Ø5/971/ ØØØ;
JLN SA 1155 W1X 1/2F Ø8Ø/6Ø/57/29Ø4/978/R13VR1/2/ 21Ø 59 2ØØØ9;
STL SA 1155 6 SCT M22 BKN 7Ø OVC 5F Ø63/63/63/2ØØ7/973/ 3Ø3Ø1 ONE/
162/ 61 2Ø1Ø1;

SAUM 1 KAWN 2712ØØ

ABR SA 1155 M3Ø BKN 7 58/56/ØØØØ/31Ø;
ATY SA 1155 E5 OVC 11/2F Ø87/57/57/Ø5Ø6/979/ 2ØØ 56;
BJI SA 1155 -X 25Ø SCT 1F 51/46/ØØØØ/986;
BRD SA 1155 8Ø SCT E25Ø BKN 7 55/52/Ø3Ø6/98Ø/PTCHS GF/ 214 1Ø72;
DIK SA 1155 E18 OVC 8 Ø72/57/53/2ØØ6/977/ 5ØØ 15//;
GFK SA 1155 -X 11/2F Ø99/55/54/17Ø5/982/F3/ 22Ø 53;
HIB SA 1155 25Ø -SCT 1Ø 1Ø8/53/49/ØØØØ/985/ 3Ø8 1ØØ1;
INL SA 1155 CLR 15 1Ø7/54/51/16Ø3/985/ 114 48 RADAT 211Ø2;
JMS SA 1155 E15 OVC 11/2F 189/57/57/ØØØØ/98Ø/ 3Ø7 16//;
MHE SA 1155 E9 BKN 1/4F 55/55/ØØØØ/975/ 3Ø2 16ØØ;
MKT SA 1155 E5 OVC 1L-F 59/57/Ø3Ø5/975/ 2Ø2 16ØØ;
MOT SA 1155 4Ø SCT 3FH Ø81/55/51/15Ø3/977/VSBY LWR SE/ 2Ø3 55;
PIR SA 1155 18 SCT E34 OVC 1/8F Ø77/58/56/Ø8Ø5/977/BINOVC S-SW
VSBY SW-W6/ 11Ø 58 2ØØØ6;

SAUM 6 KAWN 2712ØØ

AUW SA 1155 W4X 1F Ø91/58/56/Ø7Ø7/981/ 3Ø7 58;
AZO SA 1155 -X E2Ø OVC 11/2F M/M/11Ø6/981/F9/ 604;
CMX SA 1155 E15Ø BKN 25Ø OVC 7 122/56/45/Ø5Ø8/988/ 2Ø2 1Ø47 51;
EAU SA 1155 -X E4 OVC 11/2F Ø85/59/57/Ø7Ø7/978/ 1Ø7 16// 59;

SAUM 6 KAWN 2712ØØ CONT.

DET SA 1155 -X 3Ø SCT 18Ø -BKN 2FH 68/58/Ø9Ø5/987/FH1/ Ø12 11Ø8;
HTL SA 1155 E6 OVC 1F 119/58/57/13Ø5/988/ ØØ3Ø4 16// 2ØØØ4 47155;
IMT SA 1155 15 SCT E3Ø OVC 5F 57/56/ØØØ3/984/DARK W/ 2Ø5 15//;
IWD SA 1155 1ØØ SCT E2ØØ OVC 7 55/51/Ø6Ø4/985/ 11Ø 1Ø77;
JVL SA 1155 WØX ØF M/M/81Ø/973;
LSE SA 1155 E8 OVC 11/4F Ø81/61/61/Ø6Ø5/976/ 1Ø7Ø4 59 2ØØ67/UA/ OV;
MBS SA 1155 -X 3 OVC 1F 112/6Ø/55/Ø6Ø5/986/RØ5VR6Ø+F8/ 4ØØ 54 2ØØØ8;
MKE SA 1155 5Ø SCT E2ØØ OVC 118/54/49/ØØØØ/986/ 3Ø3 15Ø7 46;

SAUM 7 KAWN 2712ØØ

CAK SA 1155 M4 OVC 1F 125/66/63/181Ø/992/RØ1VR6Ø+/ 2Ø8 16// 47962;
CLE SA 1155 E9Ø BKN 25Ø OVC 11/2FH 121/67/62/16Ø8/99Ø/TWR VSBY
21/2/ 3Ø8 1Ø58 63;
DAY SA 1155 E85 BKN 25Ø OVC 3F 1Ø2/65/62/12Ø9/985/ 212 1Ø77;
FDY SA 1155 -X E25Ø BKN 1F 1Ø6/63/63/13Ø5/985/F1/ 1Ø8 6Ø 2ØØØ1;
LAF SA 1155 M22 BKN 45 OVC 11/2TRW-F Ø64/67/65/16Ø4/973/TB46RB43
W MOVG E FQT LTGICCCCG VSBY 11/2W/ 5Ø7Ø3 66 2ØØ86;
LOZ SA 1155 E1ØØ BKN 2ØØ OVC 5FH 12Ø/66/66/ØØØØ/991/ 31Ø 62;
TOL SA 1155 -X 23 SCT E7Ø BKN 2F 1Ø5/61/6Ø/Ø7Ø4/984/F2/ 3Ø3
157Ø 2ØØ2Ø 47356;

SAUM 8 KAWN 2712ØØ

BNA SA 1155 12Ø SCT 6F 1Ø3/7Ø/68/17Ø8/985/ 1Ø3 1Ø3Ø 66
RADAT 72129;
CHA SA 1155 25 SCT 2F 12Ø/68/65/17Ø3/99Ø/MOD CU W/ 314 12ØØ 64 2ØØ2Ø;
CSV SA 1155 15 SCT E3Ø BKN 8Ø OVC 5FH 12Ø/65/64/26Ø5/994/ 312
64 2ØØ46;
DYR SA 1155 E3Ø OVC 15 Ø84/68/65/171Ø/977/ 1Ø3ØØ 68;
TRI SA 1155 -X M2 BKN 3Ø OVC 1F 133/65/63/Ø6Ø3/996/R22VR6Ø+F2/ 312
15// 63 2ØØ7Ø;

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LAND SYNOPTIC

Exercise 1

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SMUS 9 KAWN Ø112Ø RTD
AAXX Ø112Ø
722Ø7 31958 527Ø5 1ØØ63 21Ø21 3Ø169 4Ø187 52ØØ7 7Ø5ØØ 8ØØØ6;
724Ø3 32969 13115 1ØØ37 21Ø44 3Ø172 4Ø178 52Ø12 81Ø7Ø;
7244Ø 32666 814Ø7 1Ø112 2ØØ93 39717 4Ø171 52Ø8Ø 885//;
72544 32974 2Ø814 11Ø21 21Ø57 3ØØ35 4Ø259 53Ø17 82Ø7Ø;
72546 31866 2Ø816 1ØØ1Ø 21Ø34 39861 4Ø218 51ØØ8 82Ø7Ø;
72547 32966 8Ø712 11Ø23 21Ø53 39861 4Ø265 52Ø14 88Ø7/;
72533 31459 8Ø9Ø9 1ØØ25 21Ø1Ø 39696 4Ø184 55ØØ2 71Ø11 846Ø7;
72556 32566 8141Ø 11Ø13 21Ø34 39617 4Ø186 56ØØ7 885//;
72576 32982 83ØØ6 1ØØ14 21Ø81 382Ø3 4ØØ52 56ØØ3 8ØØØ8;
72594 11566 8141Ø 1ØØ73 2ØØ44 3ØØ77 4ØØ99 51ØØ3 6ØØ41 78188 887//;
726Ø5 11458 833Ø5 1ØØ36 2ØØ14 39949 4ØØ78 52Ø1Ø 6ØØ51 76166 8372/;
72618 11216 827Ø7 1ØØ24 2ØØ21 39837 4ØØ9Ø 52Ø14 6ØØ11 76186 887//;
72635 3248Ø 8Ø5Ø5 11Ø23 21Ø44 39986 4Ø291 52Ø2Ø 885//;
72637 32472 8Ø211 11Ø22 21Ø51 39993 4Ø284 52Ø15 885//;
72638 32366 834Ø6 11Ø53 21Ø71 39858 4Ø3ØØ 52Ø19 886//;
7264Ø 32466 8Ø313 11Ø28 21Ø64 3ØØ34 4Ø298 53Ø17 885//;
72641 32466 8Ø613 11Ø24 21Ø63 39963 4Ø287 51Ø14 885//;
72644 31248 8Ø912 11Ø41 21Ø53 39773 4Ø27Ø 53ØØ8 71ØØØ 886//;
72645 3248Ø 8Ø311 11Ø43 21Ø71 3ØØ41 4Ø31Ø 51Ø17 885//;
72648 32969 8Ø114 11Ø32 21Ø48 3ØØ85 4Ø322 52Ø2Ø 88Ø2/;
7265Ø 32974 ØØ813 11Ø3Ø 21Ø53 39734 4Ø234 51ØØ2;
72651 32974 2Ø812 11Ø32 21Ø61 397Ø2 4Ø231 54ØØØ 8ØØØ1;
72652 32966 Ø11Ø5 11Ø22 21Ø44 3965Ø 4Ø192 53ØØ7;
72658 3298Ø 2Ø8Ø8 11Ø59 21Ø91 39963 4Ø282 51ØØ5 8ØØØ1;
72659 32966 7Ø5Ø6 11Ø63 21Ø94 396Ø8 4Ø231 56ØØ8 8ØØØ8;
72662 32974 2181Ø 11Ø24 21Ø58 39Ø2Ø 4Ø149 57Ø12 8ØØØ8;
72677 3298Ø 821Ø6 11Ø43 21Ø77 38838 4ØØ97 56ØØ7 8ØØØ7;
72683 32589 1Ø9Ø2 11Ø38 21Ø54 38659 4Ø1Ø6 52ØØ8 815Ø3;
72694 31/24 915Ø5 1ØØ1Ø 2ØØØØ 3ØØ14 4ØØ88 52ØØ7 71Ø11;
72712 11361 8Ø211 11ØØ9 21Ø21 39915 4Ø154 52ØØ5 699Ø1 75655 887//;
72734 32474 8Ø1Ø7 11Ø49 21Ø83 3ØØ29 4Ø3Ø9 52Ø24 885//;
72741 32566 8Ø5Ø6 11Ø73 211ØØ 39726 4Ø312 52Ø14 885//;
72743 32566 8Ø2Ø6 11Ø63 21Ø83 3Ø774 4Ø32Ø 53Ø17 885//;
72745 32374 81113 11Ø62 21Ø81 39766 4Ø31Ø 53ØØ3 885//;
72747 32974 Ø12Ø5 111Ø2 21123 3985Ø 4Ø3Ø6 5ØØØ5;
72755 32974 Ø16Ø4 11Ø62 21Ø78 39772 4Ø293 52ØØ7;
72772 32974 828Ø5 11ØØ7 21Ø34 38734 4ØØ97 54ØØØ 86Ø77;
72777 32984 319Ø2 11Ø59 21Ø74 39187 4Ø13Ø 5ØØØ3 8ØØØ1;
72779 32674 834Ø5 11Ø11 21Ø22 39Ø54 4Ø11Ø 55ØØØ 885//;
72793 32969 829Ø3 1ØØ43 2ØØ13 39922 4ØØ88 51ØØ3 8ØØØ7;
72797 32961 6ØØØØ 1ØØØØ 21Ø13 3ØØ1Ø 4ØØ85 54ØØØ 8ØØØ6;
72219 32961 43Ø1Ø 1ØØ53 2ØØ29 39736 4Ø1Ø7 52Ø14 82Ø74;
72223 11474 736Ø6 1Ø113 2ØØ94 3ØØ68 4Ø145 52Ø15 699Ø1 7Ø188 835Ø8;
72226 31958 628Ø5 1ØØ74 2ØØ72 3ØØ63 4Ø136 5ØØ1Ø 71Ø11 8ØØØ1;
72228 31956 ØØØØØ 1ØØ43 2ØØ34 39917 4Ø146 51ØØ7 71Ø11;
72231 32461 834Ø7 1Ø143 2Ø131 3Ø144 4Ø154 53Ø14 885//;
72622 11/// 9Ø54Ø 11Ø31 21Ø3Ø 37964 52Ø17 699Ø1 77177;
72506 11328 8Ø413 1ØØ34 2ØØ24 3ØØ49 4ØØ75 53Ø15 6ØØ11 76166 8572/;
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Exercise 2

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SMUS 9 KAWN Ø212ØØ RTD
AAXX Ø212Ø
72513 11432 8Ø5Ø8 11ØØ2 21Ø31 39678 4ØØ25 57Ø25 69981 77177 885//;
72518 3278Ø 4Ø1Ø8 11Ø73 21Ø91 39965 4ØØ76 58Ø1Ø 825Ø1;
72519 32966 8Ø7Ø7 11Ø4Ø 21Ø64 399ØØ 4ØØ52 58Ø12 8ØØØ7;
7252Ø 11/Ø8 9Ø3Ø5 1ØØØ1 21ØØ9 39536 4998Ø 57Ø12 6ØØ51 78588;
72523 32963 8ØØØØ 1ØØ12 21Ø33 39779 4ØØ3Ø 57Ø14 88Ø2/;
72524 11224 8Ø214 1ØØØ3 21Ø11 39717 4ØØ13 56ØØ7 699Ø1 76865 887//;
72532 32569 8Ø112 11Ø14 21Ø42 39844 4ØØ89 52Ø24 885//;
72533 11356 8Ø314 1ØØ73 21Ø22 39725 4ØØ3Ø 53ØØ8 699Ø1 71Ø88 886//;
72535 31356 8Ø2Ø8 1ØØ24 21Ø13 39766 4ØØ5Ø 53Ø14 71Ø11 886//;
72536 11324 8Ø2Ø9 11Ø13 21Ø21 39777 4ØØ34 53ØØ5 699Ø1 71Ø77 885//;
72537 31324 236Ø9 11Ø1Ø 21Ø33 3979Ø 4ØØ36 52ØØ5 71Ø11 826ØØ;
72544 32566 8Ø41Ø 11Ø24 21Ø73 39886 4Ø1Ø7 53Ø2Ø 885//;
72546 32574 7Ø2Ø9 11Ø23 21Ø71 39773 4Ø129 52Ø15 875ØØ;
72547 32566 8Ø6Ø6 11Ø2Ø 21Ø84 397Ø7 4Ø1Ø5 885//;
72552 32974 Ø28Ø5 11Ø98 21124 39485 4Ø176;
72553 32974 Ø34Ø7 11Ø64 21Ø69 39663 4Ø155;
72556 32974 Ø29Ø5 11Ø76 21Ø98 39592 4Ø166;
72576 32982 Ø3ØØ5 11Ø34 21Ø83 38229 4Ø1Ø1;
72594 32966 ØØ4Ø9 1ØØ6Ø 2ØØ13 3Ø115 4Ø137;
726Ø5 3298Ø ØØ3Ø3 11111 21132 39948 4ØØ8Ø;
72613 32989 1323Ø 11167 21213 37871 8ØØØ8;
72617 3298Ø ØØ6Ø5 11113 21128 39968 4ØØ98 56ØØ3;
72637 11356 8Ø317 11Ø14 21Ø21 39765 4ØØ47 53ØØ2 699Ø1 78588 886//;
72638 11466 6Ø2Ø9 11Ø54 21Ø83 39643 4ØØ75 53ØØ2 699Ø1 72688 865ØØ;
7264Ø 32574 73612 11Ø32 21Ø7Ø 39834 4ØØ94 53Ø1Ø 875ØØ;
72641 32966 236Ø8 11Ø64 211Ø1 39787 4Ø111 53Ø1Ø 8205Ø;
72644 32974 Ø341Ø 11Ø84 21117 3998Ø 4Ø135 53ØØ8;
72645 32974 134Ø8 11Ø96 21128 39846 4Ø111 55ØØ3;
7265Ø 32974 Ø29Ø5 11Ø81 211ØØ 39651 4Ø154 51ØØ8;
72651 32966 Ø28Ø4 11Ø84 21Ø93 39633 4Ø165 53ØØ2;
72652 32966 ØØØØØ 11Ø76 21Ø82 39618 4Ø169 53ØØ3;
72654 32974 Ø36Ø5 111Ø8 21129 39692 4Ø174 53ØØ7;
72655 3298Ø Ø33Ø5 11Ø84 21Ø91 39766 4Ø154 53ØØ3;
72658 32969 Ø32Ø4 11Ø71 21112 39833 4Ø147 53ØØ3;
72659 32966 Ø22Ø6 11Ø84 21112 39697 4Ø183 53ØØ7;
72662 32974 ØØØØØ 11Ø64 21113 399Ø3 4Ø13Ø 55ØØ3;
722Ø1 32663 1Ø51Ø 1Ø18Ø 2Ø1Ø4 3Ø183 4Ø19Ø 52Ø14 815ØØ;
722Ø5 32966 8Ø1Ø8 1Ø123 2ØØ41 3Ø166 4Ø2Ø3 51Ø14 87Ø78;
722Ø8 32861 133Ø4 1ØØ52 21Ø2Ø 3Ø166 4Ø186 53Ø17 81Ø7Ø;
72213 32862 4Ø41Ø 1Ø153 2ØØ91 3Ø166 4Ø187 52Ø14 84Ø7Ø;
72225 32866 136Ø8 1Ø178 2ØØ69 3Ø118 4Ø19Ø 51Ø18 81Ø7Ø;
7231Ø 32966 7Ø2Ø6 1Ø181 2Ø1ØØ 3Ø183 4Ø2Ø1 52Ø14 87Ø78;
726Ø7 3298Ø Ø22Ø3 11Ø71 21111 3ØØ52 4ØØ78 56ØØ7;
72712 3298Ø ØØØØØ 11164 21197 398Ø4 4ØØ97 58ØØ7;
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Exercise 3

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SMUS 9 KAWN 031200 RTD
AAXX 03120
72265 32989 72714 10227 21069 39078 40054 53002 81076;
72270 32989 63211 10212 21056 38754 40059 53002 81071;
72274 32989 23011 10220 21062 39221 40102 55003 80008;
72278 32989 12606 10216 21018 39712 40102 55002 80001;
72290 32489 32306 10191 20140 30142 40159 56003 83830;
72363 32989 12514 10165 21052 38782 40010 55000 81030;
72365 32789 22610 10150 21046 38297 40061 53012 81540;
72386 32989 22204 10193 20009 39333 40096 53002 81101;
72389 32689 23012 10136 20065 30058 40176 55003 81501;
72394 32589 13012 10141 20082 30078 40165 55008 81501;
72464 32989 80313 10020 21038 38455 40080 51037 83078;
72465 32889 80114 10000 21035 38794 40087 53034 82578;
72476 11489 81306 10007 21021 38456 40117 51014 60062 72270 885//;
72486 11689 53508 11010 21086 38058 40143 52017 69901 70180 85500;
72488 32789 20509 10012 21099 38674 40186 53005 81501;
72494 32989 03408 10120 21052 30200 40200 52005;
72552 32989 80000 10217 21020 39435 40112 52014 8807/;
72567 32989 22805 11021 21036 39605 40127 52019 82070;
72576 31689 51210 11021 21130 38210 40116 53025 71510 84201;
72578 11364 82512 11043 21045 38609 40182 52027 69901 77170 887//;
72583 32789 10206 10020 21071 38712 40215 52012 81500;
72597 32689 40000 10055 20008 39761 40253 55000 82270;
72650 31548 62506 11020 21060 39607 40102 52024 71010 83405;
72654 31789 31407 11027 21046 39614 40094 53019 70140 83019:
72662 32789 22910 11005 21120 38972 40106 52002 82500;
72677 32689 82709 11011 21133 38840 40110 52019 81577;
72681 11689 63206 10000 21045 39184 40214 52020 69901 78585 86500;
72688 11589 41403 11004 21007 39678 40235 52017 69901 70180 84500;
72698 11489 83405 10062 21132 30240 40254 52040 69902 70260 885//;
72753 32689 60000 11045 21061 39736 40074 53014 85538;
72764 11689 82909 10010 21049 39463 40073 53017 69901 79280 8455/;
72767 11589 73505 11066 21087 39384 40089 52022 69901 70170 86570;
72768 11489 82810 11021 21028 39245 40082 52022 69932 70270 8762/;
72772 31789 83005 11010 21129 38754 40154 53019 71520 86570;
72777 11589 82812 11006 21124 39157 40098 52025 69901 70280 8552/;
72779 31589 82207 11012 21070 39083 40162 52020 71520 885//;
72781 31364 82704 10004 21023 39840 40240 53019 71020 886//;
72793 11489 71006 10040 20005 30075 40243 52012 69901 70280 87800;
72797 32489 20000 10069 20030 30160 40236 53007 82200;
72201 32489 20710 10240 20229 30193 40200 53014 81171;
72202 32489 40711 10248 20221 30204 40208 53008 82830;
72205 32589 20203 10119 21009 30196 40233 53014;
72206 31904 93003 10071 20063 30224 40254 53017 74741;
72207 31906 90000 10064 20030 30240 40258 52010 74740;
72208 32989 00000 10057 20032 30235 40260 52019;
72211 32989 20807 10131 20094 30215 40232 53015 81030;
72214 31904 00000 10015 20008 30114 40241 52010 74440;
72217 31/04 90000 10062 20040 30193 40247 53010 74700;
72218 31980 01703 10020 20011 30132 40248 52014 71040;
```

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72223 31904 01405 10112 20107 30156 40210 55000 74440;
72226 32/04 90804 10079 20064 39997 40227 53007 74710;
72228 32989 01509 10098 20062 30095 40226 52008;
72234 31180 80000 10050 20039 30244 40209 53007 71041 886//;
72304 32989 03204 10097 20087 30081 40248 52020;
72306 32989 02404 10043 20040 30230 40245 53020;
72308 32989 02005 10081 20036 30230 40240 52017;
72311 32989 03505 10059 20041 39944 40240 52010;
72314 31932 00000 10038 20019 39966 40247 52022 71000;
72324 31932 00000 10120 20107 39976 40228 53003 71040;
72327 32989 01510 10066 20049 39969 40191 57010;
72334 32489 71712 10150 20128 30054 40160 56003 87500;
72403 32789 10000 10041 20020 39933 40226 52027 81500;
72407 32989 12307 10054 20042 30105 40210 52024 80001;
72411 32989 03108 10067 20043 30203 40237 52024;
72414 32689 21306 10020 21000 39812 40251 51008 80004;
72421 32989 01411 10019 21007 39890 40207 58003;
72428 32589 32805 10042 20021 39915 40222 53014 83500;
72503 32989 02610 10096 20050 30190 40200 52030;
72507 32989 02513 10097 20008 30242 40166 53027;
72515 32689 32111 10051 21011 39587 40185 52030 83500;
72518 32789 62314 10100 20021 30058 40165 52030 86500;
72520 32589 72108 10049 21023 39780 40227 52022 82531;
72524 32589 72211 10052 20009 39908 40208 53027 87500;
72528 11589 82325 10070 20018 39905 40165 53025 69901 72522 885//;
72605 32989 52508 10100 20023 30003 40130 52030 85030;
72608 12589 22415 10107 20076 30037 40066 53041 60082 70282 81102;
72612 11589 82707 10080 20039 39797 40075 52032 60011 70280 885//;
72619 32789 72220 10086 20001 39824 40071 52041 87700;
72712 11289 82318 10065 20053 39760 49990 51054 60072 78065 885//;
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Exercise 4

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SMUS 9 KAWN Ø412ØØ RDT
AAXX Ø4124
72268 32989 Ø3Ø15 1Ø121 21Ø57 38813 4Ø183 52Ø19;
72274 32989 131Ø3 1Ø187 21Ø62 393Ø9 4Ø196 51Ø1Ø 8ØØØ5;
72278 32989 Ø33Ø4 1Ø17Ø 2ØØØ4 39816 4Ø21Ø 51Ø14;
7229Ø 32489 127Ø5 1Ø178 2Ø119 3Ø196 4Ø2Ø7 51Ø14 815ØØ;
72295 31464 127Ø3 1Ø176 2Ø112 3Ø178 4Ø215 51Ø14 7Ø511 815ØØ;
72374 33989 Ø3217 1Ø139 21ØØ6 39634 4Ø242 52Ø29;
72378 32989 Ø271Ø 1ØØ12 21Ø65 39111 4Ø284 53Ø1Ø;
72384 32989 122Ø5 1Ø119 2ØØ3Ø 3ØØ81 4Ø26Ø 51Ø1Ø 8ØØØ8;
72386 32989 6ØØØØ 1ØØ96 21132 3951Ø 4Ø291 52Ø25 8ØØØ1;
72389 32989 614Ø4 1ØØ83 2ØØ42 3Ø144 4Ø265 52Ø17 81Ø45;
72394 32989 1Ø7Ø5 1Ø147 2ØØ2Ø 3Ø131 4Ø219 51Ø12 8ØØØ1;
72464 32489 117Ø3 1ØØØØ 21Ø25 38598 4Ø246 51Ø12 811ØØ;
72472 32589 324Ø8 1ØØ21 21Ø13 39861 4Ø26Ø 52Ø2Ø 835ØØ;
72476 32989 Ø24Ø3 11Ø38 211Ø7 38615 4Ø321 52Ø2Ø;
72485 32989 818Ø8 1ØØ62 2ØØ4Ø 3ØØ44 4Ø3Ø6 52Ø1Ø 8ØØØ7;
72486 32989 Ø23Ø4 11Ø3Ø 21152 38165 4Ø3Ø9 52Ø14;
72488 32989 726Ø3 1ØØØ1 21Ø9Ø 38765 4Ø32Ø 52Ø17 8ØØØ1;
72494 32989 712Ø8 1Ø139 21Ø12 3Ø251 4Ø257 52Ø19 8ØØØ8;
72499 32989 71212 1Ø1ØØ 21Ø78 38873 4Ø254 52Ø2Ø 87Ø78;
72553 32989 Ø3211 1ØØ29 21Ø21 397Ø3 4Ø194 5ØØ15;
72562 32989 22913 11Ø4Ø 21119 39236 4Ø261 51Ø22 81Ø85;
72567 32589 73Ø13 11Ø15 21Ø66 39787 4Ø248 51Ø15 83531;
72572 32989 Ø25Ø3 11Ø21 21Ø45 39871 4Ø335 52Ø25;
72576 32789 612Ø5 11Ø47 21123 38332 4Ø277 51Ø15 83571;
72578 11489 829Ø5 11Ø6Ø 21Ø9Ø 38744 4Ø351 52Ø2Ø 699Ø1 7Ø27Ø 885//;
72583 32989 2Ø61Ø 11Ø39 21Ø86 3881Ø 4Ø352 52Ø2Ø 8ØØØ1;
72594 32989 713Ø3 1ØØ72 2ØØ1Ø 3Ø228 4Ø25Ø 51ØØ8 87Ø78;
72597 111Ø8 835Ø3 11Ø1Ø 21Ø95 398ØØ 4Ø298 52Ø17 699Ø1 7474Ø 886//;
72654 32489 43Ø13 1ØØ1Ø 21Ø31 39716 4Ø2Ø1 51Ø14 845ØØ;
72662 11589 63422 11Ø28 21Ø68 39Ø96 4Ø355 52Ø15 699Ø1 72611 835Ø1;
72676 32389 82814 11Ø42 21Ø84 3958Ø 4Ø338 51Ø17 8652/;
72677 11489 83311 11Ø4Ø 21117 39Ø12 4Ø296 52Ø34 69931 78585 85577;
72681 32989 213Ø6 11Ø45 21Ø91 393Ø5 4Ø362 51Ø17 81Ø71;
72683 3148Ø 523Ø4 11Ø89 21123 38857 4Ø371 52Ø19 71Ø4Ø 856ØØ;
72688 3298Ø 5ØØØØ 11Ø42 21Ø48 398ØØ 4Ø364 53Ø25 71Ø4Ø 8ØØØ1;
72693 31/16 9Ø4Ø7 1ØØØ7 2ØØØ1 3Ø154 4Ø295 53Ø1Ø 7284Ø;
72698 31559 4Ø2Ø7 1ØØ24 21ØØØ 3Ø3Ø1 4Ø315 53Ø12 71Ø42 826Ø1;
72758 11447 828Ø9 11Ø73 211Ø5 3955Ø 4Ø225 52Ø2Ø 69931 77375 8752/;
72764 11748 83Ø18 11Ø56 21Ø82 39595 4Ø222 51Ø24 69932 7717Ø 885//;
72767 1148Ø 62316 11Ø78 21121 39539 4Ø26Ø 52Ø34 699Ø1 7718Ø 837Ø8;
72768 11548 83216 11Ø97 21123 39449 4Ø318 52Ø34 699Ø2 7717Ø 8452/;
72772 11489 8341Ø 11Ø35 21111 3992Ø 4Ø336 52Ø37 699Ø2 78585 885//;
72773 32689 4ØØØØ 11Ø2Ø 21Ø82 39174 4Ø333 52Ø29 8257Ø;
72777 11489 62912 11Ø87 2114Ø 3938Ø 4Ø356 52Ø36 699Ø1 7228Ø 811Ø8;
72779 32589 225Ø4 11Ø21 21Ø82 39255 4Ø35Ø 52Ø41 8157Ø;
72781 31989 433Ø3 11Ø9Ø 211ØØ 29989 4Ø39Ø 52Ø3Ø 7284Ø 8ØØØ1;
72785 32489 81ØØ6 11Ø29 21Ø82 39484 4Ø366 51Ø27 886//;
72791 32989 7Ø616 1ØØ51 21ØØ9 3Ø29Ø 4Ø298 51ØØ7 8ØØØ1;
72793 3198Ø 7Ø4Ø7 1ØØ1Ø 21ØØØ 3Ø156 4Ø327 52ØØ8 71Ø4Ø 8ØØØ8;
72797 31978 711Ø4 1ØØØ9 21ØØ3 3Ø232 4Ø3Ø9 53Ø1Ø 71Ø4Ø 8ØØØ1;
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SHIP SYNOPTIC

EXERCISE 1

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NNNN

BBXX 150000
AZUE 15004 99540 71450 41498 62125 10211 20204 39810
     40082 57005 72160 84511 22223 00106 20508 307//
     43307;
BYUF 15003 99480 71470 41598 42217 10216 20193 39858
     40130 56002 71580 83152 22235 00112 20606 306//
     43606;
CXWG 15001 99490 71380 42698 32512 10222 20204 39872
     40145 55007 82230 22244 00123 20704 305// 43405;
DLXH 15000 99420 71400 42998 22509 10337 20191 39995
     40180 54000 80003 22216 00146 20203 307// 43606;
EMYI 15004 99360 71450 42998 12408 10233 20200 39926
     40202 53010 80004 22251 00172 20303 206// 43504;
FPZJ 15003 99450 71320 41598 32611 10238 20181 39897
     40172 52007 70180 81546 22273 00186 20304 305//
     43403;
GQAK 15004 99400 71330 42998 03403 10244 20172 39997
     40180 51005 22262 00192 20101 305// 43504;
HRBL 15004 99350 71350 42998 13105 10249 20170 39922
     40196 50002 80005 22284 00244 20302 314// 40404
JSCM 15003 99400 71250 41997 13404 10255 20183 39892
     40165 51005 70540 80008 22200 00265 20403 305//
     43303;
KTDN 15001 99360 71240 42998 03610 10250 20200 39887
     40160 52002 222// 00250 20404 306// 43202;
NPBY 15004 99290 71350 41998 03502 10261 20248 39914
     40190 58002 72580 22213 00252 20000 305// 43601;
TONY 15004 99280 71270 41698 50314 10263 20240 39868
     40141 52003 72160 82128 22234 20403 314// 40202;
CARL 15004 99290 71210 41598 70212 10277 20254 39841
     40115 51005 72060 85272 22254 00257 20503 306//
     40302;
ARNY 15004 99240 71360 41498 80311 10275 20232 39897
     40170 53010 71952 86389 22273 00245 20402 305//
     40403;
NOBY 29064 99315 70750 42998 00903 10282 20214 39848
     40120 56010 22289 00282 20000;
KEYE 29064 99310 70800 42998 11602 10290 20239 39838
     40110 58012 80001 22218 00270 20000;
BREN 29064 99310 70640 41191 88306 10240 20200 39730
     40001 57270 79592 889// 22228 00275 21732 309//
     40926;
CAPE 05180 99435 70675 41392 61006 10122 20063 39993
     40179 56007 77321 84601 22200 00056 20503;
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EXERCISE 1 CONT.

```
NAVY Ø5184 9942Ø 7Ø61Ø 41598 51214 1Ø121 2ØØ9Ø 39997
     4Ø182 57Ø1Ø 7Ø37Ø 8211Ø 22213 ØØØ63 2Ø6Ø4 314//
     418Ø9;
USAF Ø5184 994ØØ 7Ø7ØØ 42498 2Ø619 1Ø132 2Ø111 39872
     4Ø145 58ØØ7 818Ø6 22265 ØØØ67 2Ø7Ø5;
USMC Ø5184 99391 7Ø662 42998 31Ø16 1Ø153 2Ø129 39877
     4Ø149 55Ø1Ø 81Ø25 22224 ØØØ71 2Ø6Ø4;
DIME Ø5184 99339 7Ø739 42998 4Ø824 1Ø166 2Ø154 39853
     4ØØ92 54ØØØ 81Ø33 22233 ØØØ89 2Ø5Ø6 3Ø5// 416Ø7;
SAIL Ø5184 99361 7Ø691 41/9Ø 9Ø916 1Ø142 2Ø134 39845
     4Ø119 55Ø12 74241 22276 ØØØ96 2Ø4Ø4;
LOST Ø5184 99342 7Ø65Ø 41595 81221 1Ø151 2Ø151 39848
     4Ø121 56ØØ5 75111 866Ø2 22245 ØØ121 2Ø7Ø5;
HART Ø5184 99355 7Ø61Ø 41498 71314 1Ø167 2Ø1ØØ 39868
     4Ø14Ø 58Ø15 71311 8514Ø 22284 ØØ142 2Ø9Ø4 3Ø6//
     42ØØ5;
FAST Ø5184 99319 7Ø69Ø 42998 11417 1Ø161 2Ø131 398Ø5
     4ØØ9Ø 57Ø4Ø 81Ø6Ø 222ØØ ØØ161 2Ø3Ø4;
HLLF Ø5184 992Ø9 7Ø791 42998 Ø3524 1Ø17Ø 2Ø124 39814
     4ØØ85 56Ø3Ø 22212 ØØ15Ø 212Ø6;
ONLY Ø5184 99275 7Ø891 41293 53414 1Ø172 2Ø132 39868
     4Ø14Ø 54ØØØ 79111 829Ø4 22263 ØØ163 2Ø3Ø3;
POND Ø5184 99247 7Ø829 41598 33121 1Ø185 2Ø147 39848
     4Ø112 52Ø12 7Ø291 8277Ø 22274 ØØ177 2Ø8Ø5;
SAME Ø5184 99231 7Ø779 41498 72612 1Ø253 2Ø2Ø3 39829
     4Ø1Ø1 5ØØ2Ø 71511 855Ø8 22232 ØØ182 2Ø6Ø4;
COME Ø5184 99189 7Ø8ØØ 42598 62514 1Ø274 2Ø218 39858
     4Ø13Ø 51ØØ6 8249Ø 22221 ØØ195 2Ø5Ø3 314// 43312;
HARD Ø5184 99169 7Ø848 41/91 9261Ø 1Ø266 2Ø26Ø 39885
     4Ø158 53ØØ5 74552 22244 ØØ213 2Ø4Ø2;
SHOT Ø5184 99262 7Ø721 41594 82512 1Ø267 2Ø231 398Ø9
     4ØØ8Ø 54ØØØ 76262 86287 22253 ØØ242 2Ø7Ø4;
SOFT Ø5184 9928Ø 7Ø66Ø 42998 Ø2Ø1Ø 1Ø25Ø 2Ø2Ø4 39843
     4Ø115 5ØØØ2 22272 ØØ237 2Ø6Ø3 3Ø5// 432Ø5;
SLIM Ø5184 99295 7Ø739 41696 4ØØØØ 1Ø243 2Ø2Ø9 39788
     4ØØ6Ø 56Ø1Ø 78Ø22 833Ø9 22284 ØØ223 2ØØØØ;
FAIL Ø5184 99216 7Ø699 41/98 /2417 1Ø285 2Ø222 39858
     4Ø132 56ØØ8 7Ø281 22281 ØØ276 2Ø7Ø4;
LAST Ø5784 99178 7Ø74Ø 42298 Ø2512 1Ø293 2Ø241 39881
     4Ø156 222// ØØ282 2Ø7Ø3 3Ø7// 431Ø4;
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SHIP SYNOPTIC

EXERCISE 2

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NNNN

BBXX 29Ø6ØØ
FNAK 29Ø64 9928Ø 7Ø7ØØ 42698 5331Ø 11ØØ1 21152 3991Ø
     4Ø185 57Ø1Ø 8457Ø 22ØØØ ØØ221 2Ø2Ø8 313// 413Ø3;
JMOG 29Ø64 99275 7Ø775 41598 6222Ø 1Ø192 2Ø161 39912
     4Ø187 58ØØ9 71411 8546Ø 22213 ØØ219 2Ø5Ø7;
URUX 29Ø64 99251 7Ø749 41598 62118 1Ø2Ø3 2Ø17Ø 39912
     4Ø186 5ØØØ8 71522 865ØØ 22224 ØØ218 2Ø4Ø7 314//
     412Ø4;
PFUS 29Ø64 99244 7Ø715 41496 61915 1Ø195 2Ø179 39914
     4Ø19Ø 51ØØ7 78Ø81 862ØØ 22235 ØØ2Ø5 2Ø5Ø5 3Ø5//
     411Ø5;
KPYW 29Ø64 99282 7Ø858 41497 51814 1Ø216 2Ø2ØØ 39912
     4Ø187 52ØØ6 72181 851ØØ 22246 ØØ218 2Ø7Ø4;
DHKE 29Ø64 9925Ø 7Ø8ØØ 41598 41813 1Ø2Ø7 2Ø188 39911
     4Ø185 53ØØ5 72582 831Ø1 22255 ØØ227 2Ø6Ø3 314//
     41ØØ6;
TLWR 29Ø64 99247 7Ø669 41998 31812 1Ø2Ø8 2Ø188 399Ø5
     4Ø179 54ØØØ 72Ø62 8ØØØ1 22264 ØØ236 2Ø6Ø2;
KPZA 29Ø64 992Ø2 7Ø7Ø3 41596 2181Ø 1Ø249 2Ø24Ø 39893
     4Ø167 55ØØ2 71242 821ØØ 22273 ØØ257 2Ø6Ø2;
KHCJ 29Ø64 99151 7Ø792 41899 1161Ø 1Ø21Ø 2Ø164 39913
     4Ø188 56ØØ2 71631 81Ø7Ø 22282 ØØ2Ø6 2Ø5Ø3 313//
     4Ø9Ø5;
WMDZ 29Ø64 992Ø5 7Ø843 41498 41612 1Ø221 2Ø199 3991Ø
     4Ø185 57Ø1Ø 7Ø182 8327Ø 222ØØ ØØ221 2Ø6Ø4;
UGOV 29Ø6Ø 994ØØ 7Ø65Ø 42598 3151Ø 1Ø25Ø 2Ø224 39878
     4Ø15Ø 58ØØ8 833ØØ 22212 ØØ25Ø 2Ø5Ø3;
WLAH 29Ø63 9937Ø 7Ø67Ø 42998 Ø131Ø 1Ø268 21Ø21 39868
     4Ø14Ø 51ØØ6 22223 ØØ369 2Ø5Ø2;
GCCV 29Ø63 9935Ø 7Ø7ØØ 41598 11Ø12 1Ø269 2Ø222 39858
     4Ø132 52ØØ5 71311 811ØØ 22234 ØØ281 2Ø2Ø2;
PHFN 29Ø64 9934Ø 7Ø74Ø 41297 71917 1Ø214 2Ø211 39997
     4Ø18Ø 75151 886// 222// ØØ2Ø7 2Ø5Ø6;
JXRN 29Ø63 9935Ø 7Ø63Ø 41398 818Ø8 1Ø278 2Ø224 39851
     4Ø125 53ØØ3 7Ø331 883// 22245 ØØ276 2Ø5Ø4;
FPLX 29Ø64 9933Ø 7Ø66Ø 41497 716Ø9 1Ø282 2Ø219 39863
     4Ø135 54ØØØ 7Ø582 875ØØ 22256 ØØ29Ø 2Ø8Ø2;
TONY 29Ø64 9932Ø 7Ø71Ø 42598 41216 1Ø264 2Ø211 39865
     4Ø138 55Ø12 842ØØ 22267 ØØ223 21ØØ4;
NOBY 29Ø64 99315 7Ø75Ø 42998 ØØ9Ø3 1Ø282 2Ø214 39848
     4Ø12Ø 56Ø1Ø 22289 ØØ282 2ØØØØ;
CARL 29Ø64 9931Ø 7Ø8ØØ 42998 116Ø2 1Ø29Ø 2Ø239 39838
     4Ø11Ø 58Ø12 8ØØØ1 22218 ØØ27Ø 2ØØØØ;
BREN 29Ø64 9931Ø 7Ø64Ø 41191 883Ø6 1Ø24Ø 2Ø2ØØ 3973Ø
     4ØØØ1 5727Ø 79592 889// 22228 ØØ275 21732 2Ø9//
     4Ø926;
CAPE Ø518Ø 99435 7Ø675 41392 61ØØ6 1Ø122 2ØØ63 39993
     4Ø179 56ØØ7 77322 846Ø1 222ØØ ØØØ56 2Ø5Ø3;
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EXERCISE 2 CONT.

```
NAVY Ø5184 9942Ø 7Ø61Ø 41598 51214 1Ø121 2ØØ9Ø 3997
     4Ø182 57Ø1Ø 7Ø37Ø 8211Ø 22213 ØØØ63 2Ø6Ø4 314//
     418Ø9;
USAF Ø5184 994ØØ 7Ø72Ø 42498 2Ø619 1Ø132 2Ø111 39872
     4Ø145 58ØØ7 818Ø6 22265 ØØØ67 2Ø7Ø5;
USMC Ø5184 99391 7Ø682 42998 31Ø16 1Ø153 2Ø129 39877
     4Ø149 55Ø1Ø 81Ø25 22224 ØØØ71 2Ø6Ø4;
DIME Ø5184 99339 7Ø769 42998 4Ø824 1Ø166 2Ø154 39853
     4ØØ92 54ØØØ 81Ø33 22233 ØØØ89 2Ø5Ø6 3Ø5// 416Ø7;
SAIL Ø5184 99361 7Ø721 41/9Ø 9Ø916 1Ø142 2Ø14Ø 39845
     4Ø119 55Ø12 74241 22276 ØØØ96 2Ø4Ø4;
LOST Ø5184 99342 7Ø64Ø 41595 81221 1Ø15Ø 2Ø15Ø 39848
     4Ø121 56ØØ5 75151 866Ø2 22245 ØØ121 2Ø7Ø5;
HART Ø5184 99355 7Ø61Ø 41498 71314 1Ø167 2Ø1ØØ 39868
     4Ø14Ø 58Ø15 71311 8514Ø 22284 ØØ142 2Ø9Ø4 3Ø6//
     42ØØ5;
FAST Ø5184 993Ø9 7Ø68Ø 42998 11417 1Ø161 2Ø131 398Ø5
     4ØØ9Ø 57Ø4Ø 81Ø6Ø 222ØØ ØØ161 2Ø3Ø4;
HLLF Ø5184 99299 7Ø791 41998 Ø3524 1Ø17Ø 2Ø124 39814
     4ØØ85 56Ø3Ø 72122 22212 ØØ15Ø 212Ø6;
ONLY Ø5184 99275 7Ø891 41293 53414 1Ø172 2Ø132 39868
     4Ø14Ø 54ØØØ 79111 829Ø4 22263 ØØ163 2Ø3Ø3;
POND Ø5184 99247 7Ø829 41598 33121 1Ø185 2Ø147 39848
     4Ø112 52Ø12 7Ø391 8277Ø 22274 ØØ177 2Ø8Ø5;
SAME Ø5184 99231 7Ø779 41498 72612 1Ø253 2Ø2Ø3 39829
     4Ø1Ø1 5ØØ2Ø 71511 855Ø8 22232 ØØ182 2Ø6Ø4;
COME Ø5184 99189 7Ø9ØØ 42598 62514 1Ø274 2Ø218 39858
     4Ø13Ø 51ØØ6 8249Ø 22221 ØØ195 2Ø5Ø3 314// 43312;
HARD Ø5184 99169 7Ø848 41/91 9261Ø 1Ø266 2Ø26Ø 39885
     4Ø158 53ØØ5 74552 22244 ØØ213 2Ø4Ø2;
SHOT Ø5184 99262 7Ø721 41594 82512 1Ø267 2Ø231 398Ø9
     4ØØ8Ø 54ØØØ 76262 86287 22253 ØØ242 2Ø7Ø4;
SOFT Ø5184 9928Ø 7Ø66Ø 42998 Ø2Ø1Ø 1Ø25Ø 2Ø2Ø4 39843
     4Ø115 5ØØØ2 22272 ØØ237 2Ø6Ø3 3Ø5// 432Ø5;
SLIM Ø5184 99295 7Ø739 41696 4ØØØØ 1Ø243 2Ø2Ø9 39788
     4ØØ6Ø 56Ø1Ø 78Ø22 833Ø9 22284 ØØ223 2ØØØØ;
FAIL Ø5184 99216 7Ø699 41/98 /2417 1Ø285 2Ø222 39858
     4Ø132 56ØØ8 7Ø281 22281 ØØ276 2Ø7Ø4;
LAST Ø5184 99178 7Ø74Ø 42298 Ø2512 1Ø293 2Ø241 39881
     4Ø156 222// ØØ282 2Ø7Ø3 3Ø7// 431Ø4;
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SHIP SYNOPTIC

EXERCISE 3

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BBXX 27ØØØØ
AQLM 27ØØ4 9953Ø 7Ø516 41/92 9363Ø 1ØØ62 2ØØ48 39814
     4ØØ85 53Ø14 74522 22255 ØØØ83 21ØØ3 314// 42514;
DEAL 27ØØ3 99441 7Ø611 42498 82526 1Ø255 2Ø163 3979Ø
     4ØØ61 58Ø13 88Ø7/ 22224 ØØ263 2Ø8Ø7 3Ø5// 428Ø7;
DDJY 27ØØ4 99517 7Ø477 42897 12715 1Ø216 2Ø18Ø 398Ø5
     4ØØ78 52Ø3Ø 81Ø3Ø 22255 ØØ2Ø3 2Ø71Ø 311// 435Ø2;
KXFW 27ØØ4 99491 7Ø489 41597 427Ø4 1Ø276 2Ø199 39832
     4Ø1Ø4 52Ø1Ø 71582 842ØØ 22215 ØØ254 2Ø31Ø 3Ø5//
     43Ø1Ø;
NLVR 27ØØ4 9942Ø 7Ø553 41698 72725 1Ø197 2Ø138 3976Ø
     4ØØ31 52ØØ5 78192 8124Ø 22253 ØØ225 2Ø815 312//
     43314;
NNUZ 27ØØ4 99446 7Ø57Ø 42598 63222 1Ø196 2Ø182 39815
     4ØØ88 55ØØ6 8526Ø 22252 ØØ215 2Ø5Ø9 213// 415Ø8;
KQYP 27ØØ4 99281 7Ø663 41396 614Ø7 1Ø2Ø7 2Ø184 399Ø5
     4Ø18Ø 52Ø17 7616Ø 8167Ø 22253 ØØ147 2Ø4Ø8 313//
     431Ø4;
ENPE 27ØØ3 99151 7Ø718 41393 83427 1ØØ46 2ØØ11 39566
     49898 57ØØ3 71242 884// 22225 ØØØ44 2Ø5Ø8 312//
     41312;
KLAT 27ØØ4 99392 7Ø576 41495 1Ø21Ø 1Ø239 2Ø188 39888
     4Ø163 52ØØ8 79511 819ØØ 22225 ØØ257 2Ø2Ø8 3Ø5//
     4Ø2Ø7;
KEHJ 27ØØ4 99324 7Ø625 42998 114Ø9 1ØØ24 2ØØ1Ø 39652
     49838 51Ø17 81Ø7Ø 22265 ØØØ35 2Ø4Ø7 3Ø5// 412Ø7;
FERT 27ØØ3 99379 7Ø662 41597 82838 1ØØ63 2ØØ11 39697
     49968 52Ø17 72Ø52 885// 22262 ØØ114 2Ø5Ø8 3Ø8//
     41612;
WSUO 27ØØ4 993Ø8 7Ø766 41396 825Ø9 1Ø166 2Ø158 39732
     4ØØØ2 55ØØØ 72162 886// 22254 ØØ213 2Ø4Ø4 3Ø5//
     421Ø9;
OGLE 27ØØ4 99359 7Ø619 41598 83624 1ØØ42 2ØØ1Ø 39655
     49924 52Ø17 75Ø51 886// 22246 ØØØ41 2Ø6Ø6 314//
     4252Ø;
HORO 27ØØ4 99241 7Ø68Ø 41997 6Ø51Ø 1Ø234 2Ø167 39934
     4Ø21Ø 56ØØ4 7148Ø 82Ø78 22283 ØØ242 2Ø5Ø4 313//
     4Ø2Ø6;
YTAE 27ØØ4 99344 7Ø719 42398 32Ø23 1Ø325 2Ø279 39822
     4ØØ95 56Ø12 821Ø1 22216 ØØ295 2Ø811 314// 43312;
USLK 27ØØ3 99294 7Ø717 41398 8Ø5Ø4 1Ø164 2Ø141 39941
     4Ø217 53Ø1Ø 71682 882// 22253 ØØ114 2Ø8Ø6 314//
     43Ø15;
UUUM 27ØØ1 99259 7Ø889 42598 41345 1ØØ45 2ØØ33 397Ø1
     49972 57Ø3Ø 841ØØ 22225 ØØØ44 2Ø7Ø6 311// 421Ø5;
```

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EXERCISE 3 CONT.

```
MATX 27004 99154 70753 42597 33204 10134 20077 39707
     49977 53013 72583 82201 22262 00205 20608 305//
     42810;
FAOI 27004 99152 70806 42395 80237 10041 20039 39653
     49921 54000 76052 886// 22222 00061 20507 312//
     40508;
SKCT 27004 99169 70788 42898 60510 10075 20063 39670
     49938 54000 86020 22258 00043 20408 308// 42708;
EIPZ 27004 99169 70818 41396 63424 10164 20079 39653
     49921 53014 71583 86200 22213 00203 20607 312//
     41510;
MWMN 27004 99402 70625 41296 62933 10205 20127 39753
     40025 53002 78281 84732 22213 00206 21012 312//
     41511;
NFXX 27004 99132 70736 41798 60734 10066 20050 39742
     40010 51010 75050 86400 22213 00083 20908 312//
     42604;
ELLS 27004 99378 70712 42498 80512 10043 20032 39836
     40109 56010 885// 22224 00054 20810 312// 42408;
PESI 27004 99273 70750 42598 80915 10254 20219 39902
     40176 58005 81522 22225 00265 20806 312// 41604;
DEAD 27004 99200 70800 41395 80218 10125 20091 39854
     40129 54000 76063 8772/ 22263 00184 20607 313//
     42803;
QYRT 27004 99597 70856 42598 50220 10225 20202 39942
     40217 53019 84820 22265 00225 20306 306// 42410;
QING 27004 99189 70848 42398 80202 10214 20188 39922
     40197 52011 87221 22275 00215 20502 306// 41918;
POEF 27004 99270 70860 41496 81809 10185 20156 39922
     40196 51002 71622 885// 22226 00205 20606 312//
     40516;
SHET 27004 99241 70892 42998 00910 10186 20163 29868
     40142 53002 22264 00195 20308 313// 41509;
WHLM 27004 99270 70922 41498 71112 11016 21053 39924
     40201 52008 72511 87800 22215 01006 20405 308//
     42521;
KTEN 27004 99235 70950 42598 41809 10214 20192 39981
     40258 52005 81262 22215 00210 20607 312// 41505;
DALE 27004 99209 70928 41595 80726 10145 20118 39712
     49983 52002 75153 887// 22262 00145 20610 311//
     41204;
```

SHIP SYNOPTIC

EXERCISE 4

```
NNNN
BBXX Ø212ØØ
UBLX Ø2121 99527 7Ø526 42598 8Ø9Ø8 11Ø15 21Ø38 4Ø186 52ØØ9
     886// 22263 ØØØ1Ø 2Ø4Ø3 321// 41ØØ8;
CGBN Ø2123 99487 7Ø64Ø 41396 829Ø2 11Ø96 2116Ø 4Ø154 53Ø12
     77171 885// 22251 ØØØØ8 2Ø3Ø5 33Ø// 4Ø4Ø4;
FLDE Ø2123 99451 7Ø585 41396 8282Ø 1Ø13Ø 2Ø117 4Ø11Ø 55Ø25
     75422 887// 22252 ØØ142 2Ø7Ø6 322// 4Ø9Ø8;
EJFY Ø2124 99435 7Ø77Ø 41498 62822 1Ø17Ø 2Ø137 4ØØ8Ø 51Ø1Ø
     72162 867ØØ 22263 ØØ22Ø 2Ø3Ø3 329// 4Ø6Ø5;
ONDI Ø2124 99423 7Ø657 42398 73217 11Ø32 211ØØ 4Ø2Ø2 52Ø3Ø
     868// 22214 ØØØ75 2Ø4Ø2 336// 4Ø8Ø3;
LALM Ø2123 9941Ø 7Ø58Ø 41497 82Ø4Ø 1Ø2Ø6 2Ø191 4Ø15Ø 58Ø2Ø
     76462 887// 22263 ØØ192 2Ø6Ø4 317// 4Ø9Ø4;
UBQP Ø2121 9938Ø 7Ø628 42598 7341Ø 1ØØ65 21ØØ6 4Ø2ØØ 52Ø22
     878// 222ØØ ØØ21Ø 2Ø4Ø4 333// 4Ø8Ø6;
FRES Ø2121 99381 7Ø7Ø1 41496 82Ø13 1Ø165 2Ø158 4Ø13Ø 58ØØ5
     78186 8637/ 22242 ØØ15Ø 2Ø6Ø5 32Ø// 4141Ø;
SHIP Ø2123 99379 7Ø748 41496 81924 1Ø17Ø 2Ø148 4Ø248 52ØØ9
     72582 885// 22214 ØØ166 2Ø5Ø5 317// 4Ø7Ø6;
CGDT Ø2124 99355 7Ø664 42698 22ØØ2 1Ø176 2Ø134 4Ø128 51ØØ6
     815Ø1 222ØØ ØØ165 2Ø3Ø4 336// 4Ø4Ø6;
SFAI Ø2123 99326 7Ø635 42498 4172Ø 1Ø198 2Ø17Ø 4Ø23Ø 54ØØØ
     823Ø1 22214 ØØ163 2Ø5Ø4 314// 4Ø8Ø4;
HBFY Ø2123 99326 7Ø7Ø9 41398 73418 1Ø133 2ØØ95 4Ø243 52Ø12
     78Ø22 8532/ 22213 ØØ21Ø 2Ø5Ø3 336// 4Ø8Ø6;
BOMA Ø2124 9934Ø 7Ø76Ø 41297 71825 1Ø21Ø 2Ø185 4Ø133 56Ø1Ø
     76222 87Ø2Ø 22263 ØØ184 2Ø5Ø6 32Ø// 4Ø6Ø6;
4XLZ Ø2123 99311 7Ø8Ø3 42498 73317 1ØØØ5 21Ø25 4Ø22Ø 52Ø2Ø
     875ØØ 22223 ØØ21Ø 2Ø6Ø4 332// 4Ø5Ø3;
HPID Ø2124 99274 7Ø683 42498 4Ø515 1Ø235 2Ø191 4Ø165 58Ø15
     848// ØØ25Ø 2Ø4Ø1 3Ø4// 4Ø3Ø5;
ELJT Ø2123 99271 7Ø758 41298 63218 1Ø13Ø 21Ø16 4Ø162 52Ø32
     72122 85733 22273 ØØ213 2Ø5Ø4 331// 4Ø8Ø8;
ELIS Ø2123 99289 7Ø842 41498 82325 1Ø23Ø 2Ø19Ø 4Ø186 51ØØ9
     7Ø562 886// 22234 ØØ218 2Ø4Ø2 3Ø9// 4Ø7Ø3;
ONND Ø2124 99266 7Ø988 42398 2Ø714 1Ø255 2Ø217 4Ø164 52Ø11
     822ØØ 22233 ØØ244 2Ø8Ø2 31Ø// 4Ø6Ø3;
NHAR Ø2123 99255 7Ø883 42798 7Ø71Ø 1Ø2ØØ 2Ø12Ø 4Ø19Ø 54ØØØ
     863ØØ 22223 2ØØØØ 3Ø1// 4Ø1Ø2;
GOQH Ø2123 99238 7Ø8ØØ 42498 21413 1Ø214 2Ø18Ø 4Ø227 52Ø13
     811Ø5 22213 ØØ21Ø 2Ø4Ø3 313// 4Ø6Ø5;
URDP Ø2121 99232 7Ø731 42498 4Ø9Ø1 1Ø245 2Ø175 4Ø152 54ØØØ
     832Ø1 22223 ØØ25Ø 2Ø1Ø1 4Ø8Ø2;
PFRT Ø2123 99221 7Ø678 42498 2Ø513 1Ø24Ø 2Ø184 4Ø17Ø 51Ø15
     8226Ø 22283 ØØ27Ø 2Ø4Ø2 331// 4Ø7Ø4;
HELP Ø2124 9917Ø 7Ø71Ø 41297 71825 1Ø21Ø 2Ø185 4Ø133 56Ø1Ø
     76222 8721Ø 22263 ØØ184 2Ø5Ø6 32Ø// 4Ø6Ø6;
```

EXERCISE 4 CONT.

```
KNBD Ø2124 99198 7Ø743 42997 13112 1Ø2Ø3 21173 4Ø27Ø 52Ø15
     8ØØØ1 22261 ØØ1Ø7 2Ø2Ø1 333// 4Ø4Ø3;
VPJI Ø2124 9917Ø 7Ø76Ø 42598 2Ø815 1Ø27Ø 2Ø21Ø 4Ø13Ø 52Ø1Ø
     821ØØ 22213 ØØ27Ø 2Ø3Ø3 3Ø7// 4Ø7Ø6;
OOOO Ø2124 99151 7Ø8Ø2 41498 62822 1Ø17Ø 2Ø137 4ØØ8Ø 51Ø1Ø
     72162 867ØØ 22263 ØØ22Ø 2Ø3Ø3 329// 4Ø6Ø5;
ZUSR Ø2123 99194 7Ø797 42598 4Ø321 1Ø254 2Ø225 4Ø147 53ØØ7
     8326Ø 22233 ØØ27Ø 2Ø4Ø3 3Ø5// 4Ø8Ø4;
CZCD Ø2124 99183 7Ø649 42598 2Ø1Ø8 1Ø249 2Ø213 4Ø158 53ØØ8
     8127Ø 22232 ØØ271 2Ø2Ø1 3Ø9// 4Ø3Ø2;
DDLH Ø2123 99215 7Ø861 41497 82Ø4Ø 1Ø2Ø6 2Ø191 4Ø15Ø 58Ø2Ø
     76462 887// 22263 ØØ192 2Ø6Ø4 317// 4Ø9Ø4;
ONAW Ø2124 992Ø2 7Ø93Ø 41398 621Ø9 1Ø226 2Ø199 4Ø189 52Ø18
     71612 83335 22223 ØØ222 2Ø2Ø2 311// 4Ø8Ø6;
```

CONSTANT PRESSURE

USXW9 KAWN 2212ØØ RTDO4

TTAA 72121 72493 99014 11Ø31 26Ø1Ø ØØ12Ø 1ØØ22 26512 85463 11Ø8Ø
27518 7ØØ72 Ø528Ø 28Ø14 5Ø572 1398Ø 26Ø18 4Ø738 2538Ø 26519 3Ø94Ø
413// 29Ø25 25Ø61 513// 28Ø35 2Ø2Ø4 575// 27Ø24 15387 553// 26Ø23
1Ø642 6Ø3// 25Ø21 8819Ø 593// 27Ø3Ø 77999 51515 1Ø164 ØØØ91 1Ø194
28Ø12 28Ø18;

TTAA 72121 72518 99ØØ5 1181Ø 19ØØ4 ØØ125 14Ø16 2Ø5Ø6 85513 15864
32525 7Ø128 Ø4857 34523 5Ø581 11962 32524 4Ø748 2398Ø 33Ø38 3Ø951
4Ø7// 33Ø27 25Ø72 499// 3Ø52Ø 2Ø216 517// 32542 154Ø2 521// 3Ø527
1Ø661 591// 3Ø518 88218 563// 3Ø53Ø 77999 51515 1Ø164 ØØØØ6 1Ø194
29527 34524;

TTAA 72121 7252Ø 99978 1141Ø ØØØØØ ØØ167 ///// ///// 8554Ø 1Ø248
325Ø7 7Ø134 Ø288Ø Ø55Ø9 5Ø579 11568 Ø85Ø8 4Ø746 24946 Ø4ØØ3 3Ø948
417// 1ØØ14 25Ø69 493// 27511 1Ø113 547// 325Ø8 15397 565// 32ØØ8
1Ø65Ø 613// 325Ø8 882Ø7 551// 295Ø8 77999 51515 1Ø164 ØØØØ8 1Ø194
31ØØ5 Ø1ØØ9;

TTAA 72121 72528 99993 13Ø33 22Ø1Ø ØØ155 ///// ///// 85535 12661
33519 7Ø138 Ø3661 Ø1Ø1Ø 5Ø58Ø 12963 34Ø15 4Ø746 2398Ø 34Ø17 3Ø949
415// 35516 25Ø7Ø 5Ø1// ØØ513 2Ø213 567// 34533 15398 555// 32517
1Ø653 6Ø5// 31Ø11 8821Ø 575// ØØ529 77999 51515 1Ø164 ØØØØ7 1Ø194
29Ø19 36Ø17;

TTAA 72121 72532 99995 11Ø23 Ø5ØØ4 ØØ153 ///// ///// 85532 11469
Ø751Ø 7Ø125 Ø388Ø Ø9522 5Ø589 13759 11Ø24 4Ø744 2498Ø 12521 3Ø946
415// Ø9Ø41 25Ø68 497// 1ØØ29 2Ø214 521// Ø9541 15398 561// Ø7526
1Ø653 631// 1ØØØ8 881ØØ 631// 1ØØØ8 77999 51515 1Ø164 ØØØ12 1Ø194
Ø65Ø8 Ø8517;

TTAA 72121 72553 99971 14449 24ØØ4 ØØ141 ///// ///// 85529 11459
11517 7Ø124 Ø348Ø Ø9517 5Ø58Ø 1Ø38Ø Ø6531 4Ø747 2278Ø Ø5Ø39 3Ø951
3998Ø Ø5546 25Ø73 491// Ø4556 2Ø217 577// Ø5Ø45 15399 583// Ø8534
1Ø651 623// 11ØØ6 882ØØ 577// Ø5Ø45 77999 51515 1Ø164 ØØØ1Ø 1Ø194
19Ø11 14Ø15;

TTAA 72121 72562 99919 1165Ø 17ØØ7 ØØ117 ///// ///// 8551Ø 1386Ø
2Ø524 7Ø121 Ø828Ø Ø95Ø8 5Ø581 1Ø767 Ø3513 4Ø75Ø 2218Ø Ø6Ø24 3Ø954
3918Ø 25Ø27 25Ø76 489// Ø5Ø33 2Ø219 595// Ø4526 154ØØ 6Ø3// 1ØØ19
1Ø65Ø 621// 195Ø6 88183 615// Ø5525 77999 51515 1Ø164 ØØØØ7 1Ø194
1952Ø 16513;

TTAA 72121 72572 99865 14458 16ØØ8 ØØØØ8 ///// ///// 85437 21Ø71
1551Ø 7ØØ92 11Ø69 19512 5Ø578 13525 21528 4Ø744 2338Ø 17532 3Ø948
3978Ø 18Ø43 25Ø7Ø 85/// 17Ø44 2Ø213 599// 17545 15392 573// 19Ø43
1Ø649 573// 24Ø23 88189 623// 17546 77999 53535 1Ø164 ØØØ91 1Ø194
1551Ø 17515;

TTAA 72121 72576 99826 13262 22ØØ3 ØØØ18 ///// ///// 85451 /////
///// 7Ø1Ø1 1Ø667 22Ø11 5Ø578 1Ø568 2Ø519 4Ø746 23167 19529 3Ø95Ø
38962 19531 25Ø73 491// 18534 2Ø216 591// 18Ø32 15393 615// 19Ø32
1Ø646 599// 23Ø12 88171 655// 18538 77999 51515 1Ø164 ØØØØ3 1Ø194
///// 215Ø7;

TTAA 72121 72583 99862 11661 16ØØ3 ØØØØ7 ///// ///// 85429 18465
2Ø5Ø5 7ØØ65 Ø7861 21Ø14 5Ø573 14559 17548 4Ø739 24964 19533 3Ø94Ø
419// 18543 25Ø62 5Ø7// 18548 2Ø2Ø4 6Ø3// 17536 15385 579// 24Ø18
1Ø641 573// 21Ø29 88194 613// 16532 77999 51515 1Ø164 ØØØØ2 1Ø194
21ØØ6 2451Ø;

TTAA 72121 72374 99848 11Ø62 11ØØ3 ØØØ36 ///// ///// 85467 /////
///// 7ØØ98 Ø8Ø65 1652Ø 5Ø577 11357 1754Ø 4Ø745 23562 16Ø42 3Ø949
38762 18Ø47 25Ø71 479// /7/8/ ///// //8// //Ø// /5/ 9361/ 8///1
/4/;

TTAA 72121 72393 99ØØ4 1141Ø 33Ø1Ø ØØ133 11Ø1Ø 33Ø1Ø 85483 Ø9645
34525 7ØØ82 Ø4262 31Ø22 5Ø572 14367 32519 4Ø737 25449 33534 3Ø939
4Ø9// 33Ø58 25Ø61 489// 32Ø59 2Ø2Ø6 495// 3Ø527 15391 563// 28Ø29
1Ø645 6Ø9// 25517 88221 535// 31554 77274 32566 4131Ø 51515 1Ø164
ØØØØ5 1Ø194 34Ø17 3352Ø;

TTAA 72121 724Ø2 99Ø19 16413 27ØØ2 ØØ164 16621 2951Ø 85539 1Ø26Ø
3Ø817 7Ø136 Ø5471 31522 5Ø581 1Ø58Ø 29536 4Ø749 2378Ø 26544 3Ø953
3876Ø 27564 25Ø75 491// 28573 2Ø218 583// 28Ø72 15399 559// 28Ø33
1Ø652 621// 3ØØ18 88174 615// 27546 772Ø3 28Ø76 4Ø728 51515 1Ø164
ØØØ12 1Ø194 33Ø15 33Ø16;

TTAA 72121 724Ø3 99ØØ9 128Ø3 ØØØØØ ØØ157 152Ø2 195Ø4 85537 11Ø56
33Ø13 7Ø131 Ø3864 33ØØ9 5Ø58Ø 1218Ø 3Ø523 4Ø747 24363 2953Ø 3Ø95Ø
39761 27571 25Ø72 489// 27579 2Ø216 565// 28558 15398 561// 27528
1Ø652 5Ø3// 3Ø5Ø9 88176 585// 28Ø38 77259 27581 4Ø916 51515 1Ø164
ØØØØ7 1Ø194 31Ø13 33Ø13;

TTAA 72121 72425 9999Ø 12805 11ØØ3 ØØ159 ///// ///// 85536 11257
Ø9Ø11 7Ø131 Ø2Ø6Ø 115Ø7 5Ø579 1Ø98Ø 27Ø17 4Ø747 2278Ø 26524 3Ø951
38958 25Ø52 25Ø74 487// 26Ø48 2Ø217 575// 26554 15398 599// 25Ø18
1Ø651 6Ø5// 315Ø2 88184 617// 25544 77999 51515 1Ø164 ØØØØ9 1Ø194
1ØØØ8 11ØØ7;

TTAA 72121 72429 99984 1442Ø Ø6ØØ4 ØØ159 ///// ///// 8554Ø 11657
Ø8ØØ6 7Ø136 ØØ828 1Ø511 5Ø58Ø 1238Ø 1Ø5Ø3 4Ø746 2398Ø 23ØØ8 3Ø949
4Ø5// 25543 25Ø72 485// 25Ø46 2Ø216 565// 25525 15399 565// 11512
1Ø654 597// Ø35Ø6 882ØØ 565// 25525 77999 51515 1Ø164 ØØØØ7 1Ø194
Ø65Ø4 1ØØØ8;

TTAA 72121 72433 99996 1383Ø Ø5ØØ7 ØØ14Ø ///// ///// 8552Ø 11264
Ø9ØØ9 7Ø112 Ø1656 135Ø7 5Ø576 13363 13515 4Ø743 24761 2ØØ13 3Ø945
4Ø7// 1995Ø 25Ø67 493// 21Ø36 2Ø211 545// 17519 14395 555// 11515
1Ø65Ø 617// Ø95Ø7 88213 543// 2ØØ22 77999 51515 1Ø164 ØØØ1Ø 1Ø194
Ø8511 13ØØ6;

9Ø7

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TTAA 72121 72451 99927 12833 24ØØ6 ØØ133 ///// ///// 85513 /////
///// 7ØØ96 Ø248Ø ///// 5Ø577 1Ø78Ø Ø2Ø33 4Ø745 2438Ø Ø2535 3Ø947
411// Ø4Ø41 25Ø69 497// Ø4Ø52 2Ø212 575// Ø5Ø47 15394 591// Ø4Ø19
1Ø646 623// Ø1ØØ6 88211 573// Ø4547 77999 51515 1Ø164 ØØØ92 1Ø194
///// /////;

TTAA 72121 72456 99986 Ø82Ø6 ØØØØØ ØØ146 ///// ///// 85523 1Ø456
Ø7ØØ9 7Ø1Ø8 ØØ668 Ø7Ø14 5Ø575 1318Ø Ø8525 4Ø741 1598Ø Ø7Ø42 3Ø943
411// Ø5Ø72 25Ø64 487// Ø4567 2Ø2Ø9 543// Ø7Ø55 15394 543// Ø7Ø23
1Ø649 613// Ø55Ø5 88233 727// Ø5Ø7Ø 7724Ø Ø5Ø74 4Ø224 51515 1Ø164
ØØØØ7 1Ø194 Ø5ØØ4 Ø7514;

TTAA 72121 72476 99849 14464 14008 ØØØ3Ø ///// ///// 8545Ø /////
///// 7Ø11Ø 11866 17516 5Ø58Ø 12534 19518 4Ø748 22765 17535 3Ø952
39951 15432 25Ø74 487// 16536 2Ø217 587// 16539 15395 613// 17529
13Ø1Ø 14516;

TTAA 72121 72261 99976 22456 Ø5ØØ6 ØØ999 ///// ///// 855Ø1 14258
1ØØ1Ø 7Ø119 ØØ256 34Ø23 5Ø581 Ø938Ø 31Ø43 4 749 2318Ø 31532 3Ø952
3952Ø 28Ø43 25Ø75 481// 23Ø59 2Ø218 587// 23567 154ØØ 583// 27272
1Ø65Ø 651// 29Ø29 882ØØ 587// 23567 77159 27Ø83 42ØØ1 51515 1Ø164
ØØØØ6 1Ø194 Ø9Ø13 35511;

TTAA 72121 72265 99917 12223 16ØØ3 ØØ122 ///// ///// 85512 13Ø58
Ø9514 7Ø132 Ø846Ø 32Ø18 5Ø582 Ø958Ø 3Ø524 5Ø749 2438Ø 24527 3Ø953
3898Ø 31524 25Ø75 455// 25Ø48 2Ø219 579// 29Ø36 165Ø1 579// 28Ø35
1Ø654 639// 3Ø528 882ØØ 579// 29Ø36 77999 51515 1Ø164 ØØØØ8 1Ø194
125Ø1 Ø2Ø13;

TTAA 72127 72311 99987 17833 Ø7ØØ7 ØØ13Ø ///// ///// 85525 13824
12514 7Ø139 Ø5ØØØ 19527 5Ø58Ø 11931 18525 88999 77999 51515 1Ø164
ØØØØØ 1Ø194 1ØØ19 16518;

TTAA 72121 72317 99987 15ØØØ Ø3ØØ4 ØØ161 ///// ///// 85548 12239
Ø7ØØ1 7Ø152 Ø6469 28Ø16 5Ø582 11368 23519 4Ø751 2Ø363 26Ø27 3Ø957
3735Ø 25553 25Ø8Ø 467// 26552 2Ø224 591// 27573 154Ø1 627// 25536
1Ø653 627// 25ØØ7 88161 665// 26Ø41 772Ø6 27Ø74 41633 51515 1Ø164
ØØØØ4 1Ø194 Ø7ØØ5 36ØØ5;

TTAA 72121 72327 99994 16418 Ø9ØØ3 ØØ13Ø ///// ///// 85522 1386Ø
1Ø511 7Ø126 Ø4662 13512 5Ø579 111ØØ 17519 4Ø747 221Ø7 19Ø29 3Ø952
3773Ø 19547 25Ø75 474// 2Ø561 2Ø219 577// 22Ø62 15399 591// 21Ø14
1Ø652 611// 19ØØ6 8817Ø 6Ø9// 18533 77225 21Ø77 42329 51515 1Ø164
ØØØØ7 1Ø194 1ØØ15 145Ø9;

TTAA 72121 7234Ø 99993 166Ø4 Ø3ØØ5 ØØ11Ø ///// ///// 85483 Ø9647
Ø7Ø18 7ØØ7Ø ØØ6Ø1 11Ø13 5Ø569 1518Ø 15523 4Ø734 2818Ø 14517 3Ø934
435// 13Ø29 25Ø55 471// 15553 2Ø2Ø2 495// 18518 15389 541// 235Ø8
1Ø644 6Ø7// 235Ø2 88271 477// 14529 77999 51515 1Ø164 ØØØØ5 1Ø194
Ø6Ø18 Ø8512;
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TTAA 72121 72349 99964 1341Ø Ø5ØØ5 ØØ131 ///// ///// Ø55Ø8 1Ø622
Ø9515 7Ø1ØØ ØØ6Ø6 1Ø512 5Ø572 1458Ø Ø8Ø13 4Ø738 2578Ø 11Ø19 3Ø939
437// 1Ø428 25Ø58 511// 13Ø19 2Ø2Ø6 5Ø1// Ø8516 15393 533// Ø7517
1Ø549 517// Ø55Ø9 88256 519// 14Ø22 77999 51515 1Ø164 ØØØØ2 1Ø194
Ø8Ø14 Ø9Ø1Ø;

TTAA 72122 72353 99959 14432 35ØØ4 ØØ119 ///// ///// 85494 1Ø843
Ø4517 7ØØ82 ØØ129 Ø3Ø11 5Ø572 1478Ø 36Ø19 4Ø736 28337 35534 3Ø936
437// Ø1555 25Ø57 477// Ø2Ø53 2Ø2Ø3 517// 33Ø17 15389 547// 1Ø645
611// 882ØØ 517// 33Ø17 77999 51515 1Ø164 ØØØØ3 1Ø194 Ø3513 Ø4515;

TTAA 72121 72363 99892 1ØØ21 18ØØ8 ØØ115 ///// ///// 855Ø3 12258
125Ø4 7Ø1Ø4 Ø4442 33526 5Ø579 Ø938Ø 36Ø24 4Ø747 2358Ø 26Ø27 3Ø923
3978Ø ØØ527 25Ø72 491// Ø2526 2Ø216 587// 34Ø18 15395 6Ø3// 34Ø23
1Ø648 6Ø3// 31Ø18 88174 615// 34526 77999 51515 1Ø164 ØØØ11 1Ø194
15ØØ5 Ø2Ø13;

TTAA 22121 7226Ø 99967 14234 26ØØ3 ØØØ13 ///// ///// 85193 11938
36Ø18 7ØØ92 Ø225Ø 36Ø17 5Ø574 1418Ø 34Ø3Ø 4Ø74Ø 2538Ø 32552 3Ø945
3578Ø 28589 25Ø69 455// 276Ø3 2Ø214 543// 29Ø69 15398 573// 29Ø45
1Ø653 617// 3ØØ32 882Ø9 543// 29Ø78 77267 281Ø4 42512 51515 1Ø181
1Ø164 ØØØØ3 1Ø194 34514 ØØ517;

TTAA 72121 7227Ø 9988Ø 17656 24ØØ4 ØØØ59 ///// ///// 85494 17656
13512 7Ø136 Ø9Ø59 19513 5Ø582 11961 23Ø33 40749 2318Ø 24513 3Ø952
4Ø7// 27Ø17 25Ø75 479// 28521 2Ø219 577// 3ØØ2Ø 15399 583// 28Ø23
1Ø652 635// 27Ø23 88185 6Ø7// 29Ø25 77999 51515 1Ø164 ØØØ53 1Ø194
17ØØ9 17Ø15;

TTAA 72124 72274 99921 11465 14ØØ6 ØØØ78 ///// ///// 85474 16265
17ØØ9 7ØØ87 Ø/88Ø 19Ø26 5Ø575 11759 19538 4Ø742 /2/1/ 21542 3Ø945
37963 25Ø68 487// 2Ø211 587// 88999 77999 51515 22/2/ 222// 4////
15Ø11 18522;

TTAA 72121 72486 998Ø5 13263 16ØØ9 ØØØØ2 ///// ///// 8544Ø /////
///// 7ØØ85 Ø8863 13Ø16 5Ø587 13739 15537 4Ø743 24356 15Ø33 3Ø945
427// 16Ø38 25Ø66 5Ø5// 1556Ø 2Ø2Ø8 6Ø1// 15555 1539Ø 561// 21Ø16
1Ø647 585// 23Ø24 882ØØ 6Ø1// 15555 77253 1556Ø 422Ø6 51515 1Ø164
ØØØØØ 1Ø194 ///// 14513;

TTAA 72121 72497 99969 08857 32Ø12 ØØ136 ///// ///// 85473 ØØ857
2751Ø 7Ø21Ø Ø298Ø 23Ø18 5Ø563 16966 22Ø53 4Ø727 28163 21574 3Ø928
4Ø3// 22573 25Ø49 517// 22Ø77 2Ø192 537// 21568 15377 517// 23Ø55
1Ø636 577// 23Ø3Ø 88214 567// 22569 77244 22Ø79 41Ø11 51515 1Ø164
ØØØ16 1Ø181 1Ø194 29Ø1Ø 25Ø16;

TTAA 72121 72768 99924 16665 12ØØ6 ØØ5Ø8 ///// ///// 85425 25Ø8Ø
23Ø11 7ØØ81 1Ø271 25517 5Ø578 Ø898Ø 22Ø25 4Ø746 2298Ø 22532 3Ø951
3918Ø 23542 25Ø73 489// 2355Ø 2Ø216 595// 23549 15395 6Ø1// 23Ø38
1Ø649 597// 23Ø21 88184 617// 23543 77999 51515 1Ø164 ØØØ91 1Ø194
2Ø51Ø 22515;
```

TTAA 72121 78397 99Ø14 28Ø42 ØØØØØ ØØ123 26Ø46 ØØØØØ 85539 18845
1Ø533 7Ø182 1Ø257 17ØØ8 5Ø588 Ø7959 23ØØ9 4Ø759 18764 3Ø523 3Ø967
34159 29Ø31 25Ø91 447// 29Ø37 2Ø237 547// 3ØØ59 15418 645// 3ØØ51
1Ø659 751// 29Ø39 88999 77999;

TTAA 72121 7221Ø 99Ø14 21414 12ØØ7 ØØ135 22817 14Ø12 85545 16431
1952Ø 7Ø175 Ø866Ø 18528 5Ø586 Ø9364 18528 4Ø756 18561 21526 3Ø964
33548 22518 25Ø9Ø 429// 24Ø28 2Ø236 563// 2453Ø 15414 637// 28529
1Ø659 673// 27Ø3Ø 88167 639// 27Ø39 77999 51515 1Ø164 ØØØØØ 1Ø194
18519 18525;

TTAA 72121 72597 99969 Ø8857 32Ø12 ØØ136 ///// ///// 85473 ØØ857
2751Ø 7ØØ1Ø Ø298Ø 23Ø28 5Ø563 16966 22Ø53 4Ø727 28163 21574 3Ø928
4Ø3// 25573 25Ø49 517// 22Ø77 2Ø192 ///// 21568 15377 517// 23Ø55
1Ø636 577// 23Ø3Ø 88214 567// 22Ø68 77244 22Ø79 41Ø12 51515 1Ø164
ØØØ16 1Ø194 29Ø1Ø 25Ø16;

TTAA 72121 726Ø6 99ØØ5 Ø78ØØ ØØØØØ ØØØ81 Ø84ØØ 295Ø4 85468 13862
34Ø24 7ØØ77 22659 3153Ø 5Ø572 1358Ø 32Ø44 4Ø737 26565 3ØØ44 3Ø938
431// 3Ø55Ø 25Ø58 523// 3Ø542 2Ø2Ø1 519// 3Ø545 15387 528// 3Ø538
1Ø643 593// 3Ø524 88221 583// 28538 77999 51515 1Ø164 ØØØØ6 1Ø194
3251Ø 32527;

TTAA 72121 72537 99991 Ø9422 19ØØ5 ØØ158 ///// ///// 85543 13864
345Ø8 7Ø143 Ø368Ø 1ØØØ4 5Ø581 1238Ø Ø45Ø8 4Ø747 26365 Ø6Ø12 3Ø949
413// Ø7Ø18 25Ø71 5Ø3// Ø6522 2Ø214 563// Ø3Ø25 15398 573// Ø4Ø15
1Ø652 615// Ø25Ø3 88193 571// Ø2526 77999 51515 1Ø164 ØØØØ8 1Ø194
31Ø1Ø Ø35Ø6;

TTAA 72121 72545 99993 12811 23ØØ3 ØØ146 ///// ///// 85537 13463
32Ø12 7Ø144 Ø5Ø8Ø 13ØØ4 5Ø581 1296Ø Ø4ØØ3 4Ø747 2536Ø Ø1ØØ6 3Ø95Ø
4Ø16Ø 255Ø1 25Ø72 479// 1ØØ13 2Ø216 469// Ø3513 15399 551// Ø5Ø13
1Ø652 655// ///// 882ØØ 569// Ø3513 77999 51515 1Ø164 ØØØØ7 1Ø194
28513 355Ø7;

TTAA 72121 72654 99968 13249 18Ø11 ØØ111 ///// ///// 855Ø6 15Ø61
2Ø52Ø 7Ø129 Ø9Ø8Ø 1451Ø 5Ø582 1Ø18Ø 3Ø5Ø5 4Ø751 2278Ø Ø1Ø13 3Ø954
39961 35Ø18 25Ø77 489// 36Ø27 2Ø22Ø 581// Ø3513 154Ø1 625// 245Ø7
1Ø651 651// 145Ø5 8815Ø 625// 245Ø7 77999 51515 1Ø164 ØØØØ6 1Ø194
2Ø527 17Ø14;

TTAA 72121 72655 99981 1Ø623 ØØØØØ ØØ146 ///// ///// 85537 1366Ø
21Ø19 7Ø159 8748Ø 145Ø7 5Ø584 12162 Ø1ØØ2 4Ø75Ø 2378Ø 34Ø23 3Ø954
3998Ø 34531 25Ø76 475// 34529 2Ø221 561// 34517 154Ø3 591// 33Ø13
1Ø654 651// 257Ø4 88191 577// 33Ø19 77999 51515 1Ø164 ØØØØ6 10194
21521 19511;

TTAA 72121 72662 999Ø1 13857 19Ø19 ØØØ51 ///// ///// 85469 21471
2Ø528 7Ø113 12Ø8Ø 2Ø511 5Ø583 Ø858Ø 2251Ø 4Ø751 2178Ø 18Ø13 3Ø956
3878Ø 22511 25Ø79 483// 245Ø8 2Ø222 595// 235Ø6 154Ø1 641// 19Ø23
1Ø65Ø 613// 22Ø15 88188 627// 23Ø77 77999 51515 1Ø164 ØØØØ6 1Ø194
2Ø522 2ØØ24;

910

TTAA 72121 72681 999Ø5 1565Ø 16ØØ5 ØØ5Ø3 ///// ///// 85414 21Ø7Ø
Ø1ØØ3 7ØØ52 Ø7262 22512 5Ø571 14527 2Ø546 4Ø737 25556 19592 3Ø939
415// 19Ø58 25Ø6Ø 5Ø3// 19Ø63 2Ø2Ø3 585// 19Ø59 15384 565// 2Ø534
1Ø642 677// 21Ø28 88187 6Ø7// 19Ø5Ø 77257 19Ø65 4Ø7Ø4 51515 1Ø164
ØØØØØ 1Ø194 Ø6ØØ3 3Ø5Ø4;

TTAA 72121 72694 99ØØ8 Ø7814 18ØØ7 ØØ128 Ø823Ø 1851Ø 84353 ØØ9Ø6
24917 7Ø978 1Ø111 24529 5Ø553 1918Ø 21568 4Ø715 3Ø58Ø 2Ø589 3Ø914
441// 21Ø92 25Ø35 493// 2Ø574 2Ø181 499// 2Ø571 1537Ø 491// 21558
1Ø632 529// 22534 8825Ø 493// 2Ø574 7735Ø 2ØØ94 4Ø612 51515 1Ø164
ØØØ13 1Ø194 21517 24Ø26;

TTAA 72121 72712 99981 12833 19ØØ3 ØØØ3Ø ///// ///// 85396 Ø7Ø46
31Ø27 7Ø966 Ø1568 29552 5Ø555 22143 27563 4Ø715 3158Ø 27573 3Ø915
431// 28593 25Ø37 467// 27585 2Ø186 451// 2754Ø 15376 485// 28552
1Ø637 561// 31536 8825Ø 467// 27586 77312 27596 4Ø623 51515 1Ø164
ØØØØ1 1Ø195 29Ø23 3ØØ38;

TTAA 72121 7229Ø 99996 188ØØ 11ØØ5 ØØ1Ø4 ///// ///// 85495 12612
18517 7Ø1Ø2 Ø3ØØØ 19Ø29 5Ø577 1Ø7Ø1 19Ø29 4Ø745 2318Ø 2Ø534 3Ø95Ø
36937 2Ø557 25Ø73 467// 2ØØ76 2Ø218 567// 2ØØ79 15396 625// 22Ø32
1Ø648 613// 29511 88173 635// 21555 77183 2Ø586 4155Ø 51515 1Ø164
ØØØØ2 1Ø194 16Ø17 19Ø24;

TTAA 72121 72232 99Ø11 198Ø8 ØØØØØ ØØØ97 21Ø19 ///// 8549Ø 12822
///// 7Ø1Ø9 Ø7Ø2Ø 27Ø25 5Ø579 Ø918Ø 24537 4Ø748 1958Ø 25Ø36 3Ø956
3518Ø 27Ø38 25Ø8Ø 447// 28572 2Ø226 557// 28Ø61 154Ø5 599// 24551
1Ø656 653// 25526 88171 637// 27Ø43 77242 28576 42814 51515 1Ø164
ØØØØ4 1Ø194 ///// 26518,

TTAA 72121 72235 99ØØØ 2Ø619 21ØØ4 ØØØ91 2Ø619 21ØØ4 85481 116Ø9
23Ø13 7ØØ86 Ø385Ø 22Ø22 5Ø574 1298Ø 19535 4Ø74Ø 2338Ø 2ØØ42 3Ø945
3758Ø 19558 25Ø69 451// 2Ø556 2Ø215 543// 21546 15397 575// 22526
1Ø651 625// 27516 88181 573// 22Ø53 77999 51515 1Ø164 ØØØØ1 1Ø194
21Ø18 22519;

TTAA 72121 7224Ø 99Ø1Ø 2ØØØØ 27ØØ5 ØØØ94 192Ø8 27ØØ8 85482 12856
25518 7ØØ8Ø Ø368Ø 27Ø36 5Ø573 1498Ø 25Ø3Ø 2Ø737 2678Ø 27Ø44 3Ø943
3598Ø 27Ø9Ø 25Ø67 457// 256Ø1 2Ø212 563// 27595 15394 591// 27546
1Ø646 647// 2552Ø 88185 573// 27569 772Ø5 271Ø2 41742 51515 1Ø164
ØØØØ2 1Ø194 26513 25Ø26;

TTAA 72121 72247 99997 127Ø8 Ø3ØØ6 ØØ1ØØ ///// ///// 85473 Ø981Ø
175Ø5 7ØØ6Ø ØØ3Ø3 28ØØ6 5Ø569 14762 32523 4Ø734 2698Ø 3ØØ31 3Ø934
4Ø1// 28Ø47 25Ø58 431// 28Ø7Ø 2Ø2Ø6 513// 26549 15392 54911 25525
1Ø648 627// ///// 883Ø9 417// 28542 77268 27581 43925 51515 1Ø164
ØØØØ2 1Ø194 125Ø6 1ØØØ5;

TTAA 72124 7225Ø 99Ø12 25Ø21 25ØØ7 ØØ11Ø 24417 24ØØ8 85519 16658
17Ø1Ø 7Ø145 Ø56Ø2 31ØØ8 5Ø582 1Ø1Ø6 23Ø22 4Ø751 2Ø922 26529 88999
77999 51515 1Ø15Ø 1Ø151 1Ø164 ØØØØ3 1Ø194 2Ø511 255Ø9;

911

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TTAA  72121 72255 99ØØ9 2Ø833 34ØØ5 ØØ112 21Ø56 355Ø7 8551Ø 138Ø6
23512 7Ø123 Ø4Ø15 28528 5Ø578 1Ø98Ø 31544 4Ø747 2118Ø 29545 3Ø952
36947 25453 25Ø87 475// 25Ø71 2Ø22Ø 539// 25594 154Ø5 577// 2857Ø
1Ø655 679// 28537 88214 547// 24592 77189 25497 43628 51515 1Ø164
ØØØØØ 1Ø194 325Ø8 25518;

TTAA  72121 722Ø1 99Ø15 25423 16ØØ6 ØØ132 25Ø23 16ØØ8 85548 18256
2ØØ1Ø 7Ø184 Ø8462 195Ø8 5Ø588 Ø878Ø 24513 4Ø757 1938Ø 25Ø13 3Ø964
3498Ø 25Ø.8 25Ø9Ø 433// 2852Ø 2Ø236 537// 3ØØ28 15416 629// 3Ø548
1Ø661 7Ø7// 3ØØ2Ø 88999 77999 51515 1Ø164 ØØØØØ 1Ø194 18Ø1Ø 19ØØ9;

TTAA  72125 722Ø8 99Ø17 232Ø5 13ØØ5 ØØ16Ø 22622 125Ø9 85559 15Ø58
Ø75Ø7 7Ø176 Ø6Ø6Ø 22523 5Ø585 Ø918Ø 23Ø23 4Ø754 195Ø8 88999 77999
51515 1Ø141 1Ø164 ØØØØ5 1Ø194 11Ø13 26514;

TTAA  72121 72213 99Ø1Ø 198ØØ 17ØØ6 ØØ128 Ø96Ø1 165Ø9 85531 16Ø58
14Ø22 7Ø154 Ø8219 2ØØ3Ø 5Ø583 Ø918Ø 2Ø53Ø 4Ø753 19556 19532 3Ø96Ø
35131 21Ø43 25Ø85 461// 21Ø47 2Ø229 587// 22547 154Ø5 669// 24Ø29
15Ø18 18Ø21;

TTAA  72121 7222Ø 99Ø11 23223 15Ø15 ØØØ99 23637 15Ø21 855Ø5 16258
19Ø47 7Ø129 Ø5433 2ØØ5Ø 5Ø581 Ø8927 19Ø44 4Ø751 19124 18Ø46 3Ø959
34336 19546 25Ø83 453// 2ØØ47 2Ø228 585// 2Ø546 154Ø5 6Ø3// 24Ø44
1Ø654 675// 26Ø26 8817Ø 671// 22Ø47 77999 51515 1Ø164 ØØØØ4 1Ø194
17Ø42 2ØØ5Ø;

TTAA  721   2747  9997Ø 16Ø6Ø 22ØØ7 ØØØ94 ///// ///// 855Ø3 2Ø273
26517 7Ø136 Ø6464 2451Ø 5Ø579 13563 3ØØ15 4Ø745 2718Ø 3 Ø17 3Ø946
413// 3252Ø 25Ø68 485// 3Ø524 2Ø212 559// 3Ø525 15394 591// 29Ø3Ø
1Ø645 635// 28Ø17 88189 579// 3Ø524 77999 51515 1Ø164 ØØØØ4 1Ø194
25Ø25 23511;

TTAA  72121 72764 99951 1666Ø 16ØØ8 ØØØ6Ø ///// ///// 85481 21265
1852Ø 7Ø124 1Ø267 18519 5Ø582 Ø9962 26Ø16 4Ø75Ø 2356Ø 26Ø16 3Ø954
39558 29826 25Ø76 497// 28529 2Ø219 583// 28526 25399 617// 23529
18519 18521;

TTAA  72121 72775 9988Ø 16662 35ØØ8 ØØ519 ///// ///// 85416 19Ø66
34586 7ØØ58 Ø9263 22Ø3Ø 5Ø574 12926 22Ø29 4Ø741 2378Ø 2ØØ38 3Ø944
39963 2Ø554 25Ø66 493// 21Ø68 2Ø2Ø9 599// 2Ø55Ø 15388 551// 22Ø37
1Ø644 541// 22Ø17 88185 635// 21Ø57 77246 2Ø569 41Ø11 51515 1Ø164
ØØØØ1 1Ø194 335Ø7 25514;

TTAA  72121 72785 99925 12221 22ØØ8 ØØØ44 ///// ///// 8542Ø Ø6ØØ1
25519 7Ø997 ØØ2ØØ 18Ø22 5Ø562 16158 1Ø563 4Ø726 2758Ø 2Ø569 3Ø927
417// 19583 25Ø48 5Ø5// 29588 2Ø191 557// 19572 15375 543// 2ØØ51
1Ø634 355// 21Ø29 8821Ø 575// 19Ø85 77226 19597 4Ø727 51515 1Ø164
ØØØØ6 1Ø194 25Ø15 21Ø16;

TTAA  72121 72797 99ØØ6 Ø99Ø5 13ØØ1 ØØ1Ø3 Ø58Ø6 14ØØ1 85415 Ø21ØØ
22Ø15 7Ø931 12313 19519 5Ø541 2976Ø 19Ø4Ø 4Ø699 3618Ø 2ØØ77 3Ø894
459// 19Ø91 25Ø16 441// 1995Ø 2Ø189 463// 2ØØ48 15356 475// 21549
1Ø622 533// 22Ø52 77999 51515 1Ø164 ØØØØ3 191Ø4 2151Ø 2Ø516;
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SKEW-T

EXERCISE 1

NASHVILLE, TENNESSEE

72327 PPAA NIL/KAWN
PPBB 7Ø12Ø 72327 9ØØ12 34ØØ3 345Ø4 35ØØ6 9Ø346 345Ø6 345Ø5 18ØØ2
9Ø789 21ØØ4 27ØØ4 285Ø6 91246 275Ø9 2751Ø 17515 917// 26Ø17 92Ø25
24Ø32 22549 21562 93Ø45 21Ø76 2Ø587 21Ø84 94Ø9/ 22574 2653Ø 95Ø3/
25524 22524;
TTAA 7Ø121 72327 99992 164Ø8 34ØØ3 ØØ11Ø ///// ///// 85482 Ø82Ø3
345Ø3 7ØØ77 Ø22ØØ 275Ø8 5Ø572 13313 25Ø23 4Ø738 2558Ø 21559 3Ø941
3958Ø 21Ø78 25Ø64 461// 21Ø84 2Ø21Ø 517// 22574 15392 557// 25Ø49
1Ø647 617// 23Ø23 88174 583// 23561 77262 2Ø587 41Ø11;
TTBB 7Ø12/ 72327 ØØ992 164Ø8 11968 17Ø56 2285Ø Ø82Ø3 33827 Ø86ØØ
447ØØ Ø22ØØ 55631 Ø29Ø5 66622 Ø4122 77489 14712 88474 16728 99467
17559 11455 1876Ø 22453 1878Ø 334ØØ 2558Ø 44393 2616Ø 55384 2718Ø
66345 3138Ø 773ØØ 3958Ø 88174 583// 99158 593// 11153 553// 22138
545// 33114 619// 441ØØ 617//;

EXERCISE 2

KEY WEST, FLORIDA

72201 PPAA NIL/KAWN
PPBB 7Ø12Ø 722Ø1 9ØØ12 15ØØ9 15Ø16 15Ø17 9Ø346 15517 15Ø15 185Ø5
9Ø789 215Ø5 245Ø3 29ØØ3 91246 2Ø5Ø3 2153Ø 3ØØØ5 917// 35Ø1Ø 92Ø25
32Ø19 28512 275Ø9 93Ø13 2551Ø 27511 32Ø2Ø 93569 31532 31Ø33 31Ø16
94147 31Ø16 31534 32528 949// 31Ø39 95Ø34 31Ø38 31519 27ØØ9;
TTAA 7Ø121 722Ø1 99Ø13 26823 15ØØ9 ØØ12Ø 26421 15Ø22 85538 17817
155Ø8 7Ø178 Ø966Ø 295Ø2 5Ø589 Ø658Ø 32Ø18 1Ø76Ø 1918Ø 275Ø9 3Ø968
3318Ø 3ØØ14 25Ø94 435// 31Ø32 2Ø24Ø 539// 31Ø15 15419 677// 32527
1Ø661 7Ø5// 27Ø1Ø 88122 719// 31Ø35 77999;
TTBB 7Ø12/ 722Ø1 ØØØ13 26823 11963 238Ø8 22938 23658 33889 2ØØ38
44865 18657 5585Ø 17817 668Ø5 15412 77785 14862 88776 13857 99749
12458 1173Ø 11242 227ØØ Ø966Ø 3369Ø Ø9669 4459Ø Ø1Ø8Ø 5556Ø ØØ88Ø
665ØØ Ø658Ø 77479 Ø9563 88464 1Ø18Ø 99264 3978Ø 1115Ø 667// 22122
719// 33115 689// 441ØØ 7Ø5//;

EXERCISE 3

APALACHICOLA, FLORIDA

7222Ø PPAA NIL/KAWN
PPBB 7Ø12Ø 7222Ø 9ØØ12 2ØØ12 21Ø26 2153Ø 9Ø346 22Ø32 22529 22527
9Ø789 23528 24Ø32 2454Ø 91234 24542 25Ø45 25Ø47 916// 2455Ø 92Ø59
24542 24551 25531 93Ø5/ 25531 25Ø37 94Ø48 24533 2756Ø 25Ø4Ø 95Ø14
26Ø41 2654Ø 24516;
TTAA 7Ø121 7222Ø 99Ø12 25Ø1Ø 2ØØ12 ØØ11Ø 246ØØ 2Ø517 85519 15418
23Ø26 7Ø141 Ø6838 24543 5Ø583 Ø8962 24548 4Ø752 2Ø356 24551 3Ø959
34762 25531 25Ø84 435// 24536 2Ø231 559// 24533 154Ø8 677// 26Ø46
1Ø652 681// 24516 88143 689// 25543 77165 2756Ø 42728;
TTBB 7Ø12/ 7222Ø ØØØ12 25Ø1Ø 11ØØØ 246ØØ 22838 14633 33724 Ø7ØØ7
447ØØ Ø6838 55679 Ø4656 66661 Ø2634 77655 Ø2463 88572 Ø298Ø 99567
Ø198Ø 11551 Ø4162 22537 Ø498Ø 33514 Ø7761 445ØØ Ø8962 55491 Ø918Ø
66425 17361 774Ø9 19166 884ØØ 2Ø356 99368 23562 11273 3916Ø 22173
635// 33143 689// 441ØØ 681//;

EXERCISE 4

BERMUDA

78Ø16 PPAA NIL/KAWN
PPBB 7Ø12Ø 78Ø16 9ØØ12 18ØØ7 18512 2Ø514 9Ø346 24Ø12 26ØØ8 285Ø5
9Ø789 29ØØ8 28ØØ9 2751Ø 91Ø46 27Ø12 27Ø17 27514 92Ø5/ 29Ø13 32529
93Ø58 3353Ø 33Ø52 33Ø22;
TTAA 7Ø122 78Ø16 99Ø19 2Ø458 18ØØ7 ØØ187 18856 18Ø1Ø 85558 Ø8662
28ØØ6 7Ø166 Ø5659 27511 5Ø585 Ø918Ø 29Ø2Ø 4Ø754 1998Ø 33Ø26 3Ø961
3638Ø 34Ø33 25Ø85 463// 33537 2Ø229 589// ///// 154Ø5 678// /////
1Ø649 675// ///// 88999 77999;
TTBB 7Ø12/ 78Ø16 ØØØ19 2Ø458 11ØØØ 18856 22873 Ø9834 3385Ø Ø8662
44843 Ø828Ø 55838 1128Ø 66827 1Ø658 77782 1Ø68Ø 88769 1ØØ69 99745
Ø9662 11735 Ø828Ø 227ØØ Ø5659 4467Ø Ø4866 44662 Ø3264 55644 Ø1456
66635 Ø1267 77631 Ø1Ø63 88618 ØØ28Ø 99574 Ø158Ø 115ØØ Ø918Ø 22485
Ø998Ø 33462 1258Ø 44454 1278Ø 55425 1758Ø 664ØØ 1998Ø 77335 2618Ø
883ØØ 3638Ø 9925Ø 463// 11225 531// 222ØØ 589// 33176 643// 44137
697// 55128 667// 66122 663// 77115 683// 88111 671// 991ØØ 675//
51515 SUPER 75746 4543;

911

EXERCISE 5

PEORIA, ILLINOIS

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72532 PPAA NIL/KAWN
PPBB  7Ø12Ø 72532 9ØØ12 Ø5ØØ4 Ø6Ø11 Ø5512 9Ø346 Ø5Ø1Ø Ø45Ø7 Ø65Ø8
9Ø789 Ø7ØØ9 Ø8ØØ9 Ø8ØØ8 91246 13504 29ØØ5 28ØØ9 917// 29Ø12 92Ø5/
28516 285Ø9 93Ø56 255Ø5 24Ø2Ø 23523 945// 25522 95Ø3/ 23513 23Ø14;
TTAA  7Ø121 72532 99992 12223 Ø5ØØ4 ØØ132 ///// ///// 85492 Ø7421
Ø55Ø7 7ØØ64 Ø2131 Ø95Ø5 5Ø567 1658Ø 29Ø15 4Ø73Ø 3Ø38Ø 285Ø8 3Ø928
456// 25ØØ5 25Ø48 495// 24Ø2Ø 2Ø194 497// 24Ø25 15382 521// 25521
1Ø64Ø 579// 23Ø13 88275 5Ø3// 25Ø14 77999;
TTBB  7Ø12/ 72532 ØØ992 12223 11961 14Ø34 22921 11Ø1Ø 33894 Ø9631
44725 ØØ712 557ØØ Ø2131 66621 1Ø1Ø5 77612 Ø618Ø 885ØØ 1658Ø 99345
3878Ø 11275 5Ø3// 22188 491// 331ØØ 579//;
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HIGH WIND/SEA WARNING
EXERCISE 1

NNNN
1629
WMNT1 KNGU 301200
NAVEASTOCEANCEN NORFOLK VA CURRENT NORTH
ATLANTIC HIGH SEA WARNING AREAS

1. CURRENT HIGH SEA WARNING AREA 12FT OR GREATER FROM 301200Z to 310000Z.

   A. AN AREA OF 25FT SEA, HIGHEST PROBABLE 35FT CENTERED NEAR 40.0N, 65.0W BOUNDED BY A 23FT CONTOUR FROM 42.0N, 60.0W TO 42.0N, 68.0W TO 36.0N, 68.0W TO 37.0N, 61.0W TO 42.0N, 60.0W. AREA STATIONARY. SEA DECREASING TO 12FT BY 310000Z.

2. IN ORDER TO SIMPLIFY DESCRIPTION. THE AREA COVERED BY THIS HIGH SEA WARNING MAY ENCOMPASS SOME SMALL AREAS WHERE THE SEA IS NOT AS HIGH AS INDICATED. SOME CONTOURS MAY CROSS LAND OR ICE FOR SIMPLIFICATION.

3. MY NEXT CURRENT HIGH SEA AREAS WARNING WILL BE ISSUED AT 31000Z.

NNNN
1635
WWNT1 KNGU 301200
NAVEASTOCEANCEN NORFOLK VA CURRENT NORTH
ATLANTIC WIND WARNING

1. CURRENT WIND WARNING FOR WINDS 35KTS OR GREATER VALID FROM 301200Z TO 310000Z.

   A. GALE WARNING.

      1a. WIND OVER WATER 50KTS WITHIN AS AREA BOUNDED BY 45.5N 55.0W SEAWARD TO 42.0N, 55.0W TO 37.5N, 60.5W COASTAL TO 44.0N, 65.0W TO 45.5N, 55.0W.

2. IN ORDER TO SIMPLIFY DESCRIPTION, THE AREA COVERED BY THIS WIND WARNING MAY ENCOMPASS SOME SMALL AREAS WHERE THE WINDS WILL NOT BE AS STRONG AS INDICATED.

3. MY NEXT CURRENT WARNING WILL BE ISSUED AT 310000Z.

EXERCISE 2

NNNN
WMNT1 KNGU 281200
NAVEASTOCEANCEN NORFOLK VA CURRENT NORTH
ATLANTIC HIGH SEA WARNING AREA

1. CURRENT HIGH SEA WARNING 12FT OR GREATER FROM 281200Z TO 29000Z.

   A. AN AREA OF 17FT SEA, HIGHEST PROBABLE 26FT CENTERED NEAR 32.0N, 72.0W, BOUNDED BY A 15FT CONTOUR FROM 34.5, 72.0W TO 32.0N, 74.0W TO 29.0N, 72.0W TO 32.0N, 70.0W TO 34.5, 72.0W. SEAS DECREASING TO LESS THAN 12FT BY 290000Z.

2. IN ORDER TO SIMPLIFY DESCRIPTION, THE AREA COVERED BY THIS HIGH SEA WARNING MAY ENCOMPASS SOME SMALL AREAS WHERE THE SEA IS NOT AS HIGH AS INDICATED. SOME CONTOURS MAY CROSS LAND OR ICE FOR SIMPLIFICATION.

NNNN
1444
WWNT1 KNGU 281200
NAVEASTOCEANCEN NORFOLK VA CURRENT NORTH
ATLANTIC WIND WARNING

1. CURRENT WIND WARNING FOR WINDS 35KTS OR GREATER VALID FROM 281200Z TO 290000Z.

   A. GALE WARNING:

      1a. WINDS OVER WATER TO 35KTS WITHIN AN AREA BOUNDED BY 36.0N, 75.0W TO 29.0N, 64.0W TO 28.0N, 75.0W TO 36.0N TO 75.0W.

2. IN ORDER TO SIMPLIFY DESCRIPTION, THE AREA COVERED BY THIS WIND WARNING MAY ENCOMPASS SOME SMALL AREAS WHERE THE WINDS WILL NOT BE AS STRONG AS INDICATED.

3. MY NEXT CURRENT WARNING WILL BE ISSUED AT 290000Z.

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Weather Observer Branch
Chanute AFB, Illinois

C3ABR25130-SW-305

5 January 1984

WEATHER CAREER FIELD

OBJECTIVE

WITHOUT reference, select facts relating to the duties in the Airman Career field to 75% accuracy.

INTRODUCTION

You are entering training for an Air Force Specialty. In plain terms, a specialty is a job. The most important part to any job, military or civilian, is being provided the chance to add to your knowledge, skills, and chances for stripes and advancement.

INFORMATION

CAREER PROGRESSION

Weather Specialist (AFSC 25150)

Upon successful completion of this mandatory 3-level course for weather specialist, you will be awarded a 25130 AFSC, Apprentice Weather Specialist. When arriving at your first base, you will be put into upgrade training for qualification to the 5-skill level. This upgrade training involves the dual-channel concept of on-the-job training (OJT). The dual-channel concept lets you gain more job knowledge through the completion of a correspondence course, Career Development Course (CDC) 25150, while you are learning job proficiency by actually doing the tasks, required at your base, with a qualified weather specialist to guide you. After spending approximately six months in training to show job proficiency, and completing the CDC 25150, you will be awarded the 25150 AFSC. This allows you to compete for promotion through Staff Sergeant (E-5). Your duties as weather specialist, listed in AFM 39-1 (Airman Classification Manual), will be: observe, record, and disseminate weather element information; plot weather charts and diagrams: maintains weather data files; performs organizational preventive maintenance on weather instruments and electronic weather equipment; operates weather data processors and machines, and supervises subordinate personnel.

Weather Technician (AFSC 25170)

To be eligible for the weather technician course you must be a qualified weather specialist, AFSC 25150. Apply through AWS for this training. When you successfully complete the weather technician course,

Supersedes C3ABR25130-SW-305, 16 December 1982 RGL: 11.0
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGL-W - 600; DAV - 1

Designed for ATC Course Use. Do Not Use on the Job.

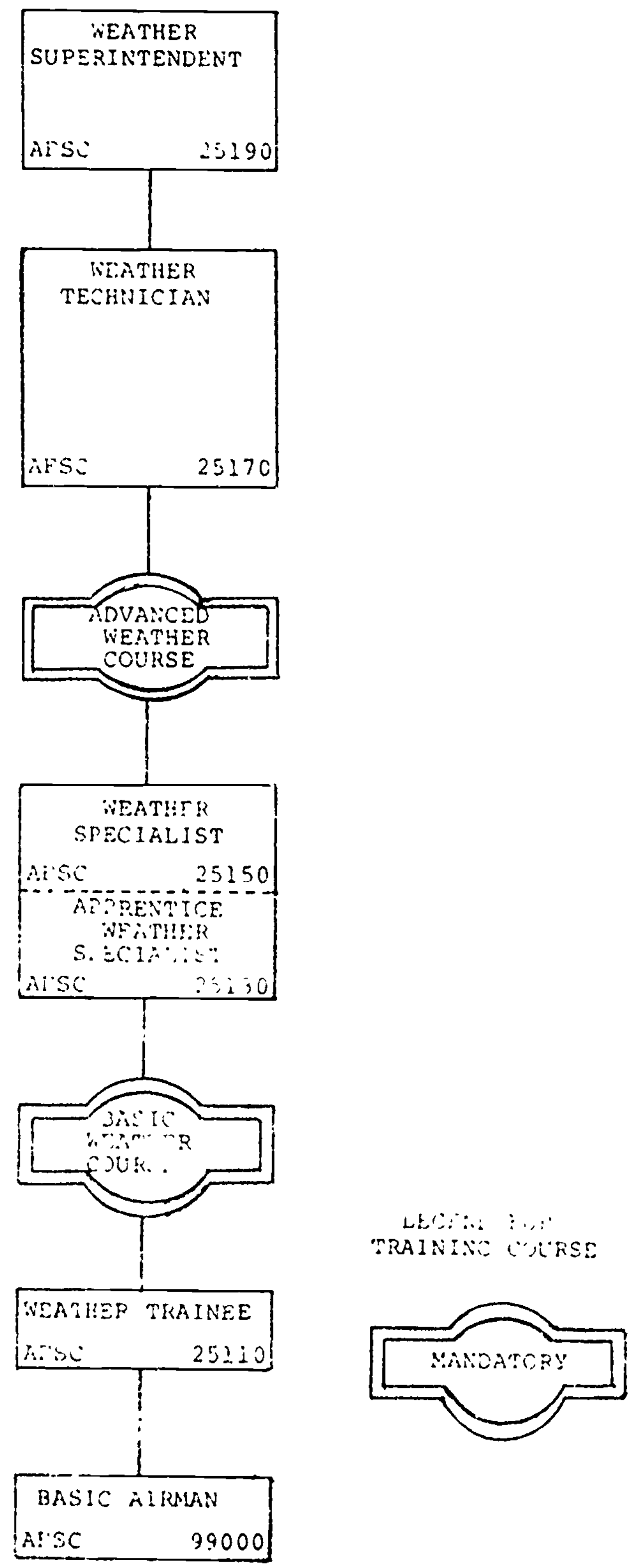


Figure 1. Airman Weather Career Field.

you will still have the 25150 AFSC. To be awarded the 7-level AFSC, you must show job proficiency, complete a management course, and attain the grade of Staff Sergeant. There is no CDC for the 7-level. Successful completion of OJT and award of the 7-level AFSC will allow you to compete for promotion to Technical Sergeant and above. Certain duties and responsibilities of the specialist and technician are the same. They are:

Observe, record and disseminate weather element information

Plot weather charts and diagrams

Supervise subordinate personnel

Perform organizational preventive maintenance

The additional duties and responsibilities required of the technician are: present weather briefings; analyze weather data; perform meteorological watch and prepare forecasts; accomplish supply and administrative functions, and supervise weather data processing.

The final AFSC within the weather career ladder is 25190, Weather Superintendent, who directs weather activities. This position will usually be filled by personnel in the grade of E-7, E-8 or E-9.

QUESTIONS

1. An individual entering the Air Force who wants to be a weather specialist, must first complete the ______________________ course which is a __________________________ requirement.

2. After graduating from the weather specialist course your AFSC will be ______________.

3. When you arrive at your duty station you will be entered into the ___________________________________ training concept. This means that you will be trained to do only those tasks ________________ at your duty station while you reinforce the material you learned in school by completing the _____________________.

4. After spending a specified amount of time on ________________ and satisfactorily completing the __________________ you will be awarded the ______________________ AFSC.

5. In order to attend the weather technician course, you must be a qualified ____.

6. Your AFSC after graduating from the weather technician course will be ______________________.

7. In order to be awarded the 25170 AFSC you must successfully demonstrate __________ ______________, be in the pay grade of ________________ and complete a _______________ course.

8. The ______________ ____________________ has the responsibility of accomplishing supply and ________________ functions.

9. The _____________ ____________________ maintains weather data files.

10. The _____________ __________________ ___ performs a meteorological watch and prepares _____________________.

11. The weather technician _____________ ________ ___ weather personnel.

12. The weather technician _________________ surface and upper air charts plotted by the __________________ __________________.

921

Weather Observer Branch
Chanute AFB, Illinois

C3ABR25130-SW-305A
23 July 1983

PROPERTY RESPONSIBILITY AND ACCOUNTABILITY

OBJECTIVE

Given the facts related to supply responsibility and accountability, select to 75% accuracy those which apply to supply discipline.

INTRODUCTION

Care of property belonging to the Air Force is the duty of each individual, whether that property has been issued to him or his unit. Even though you are not assigned the supply duties at your base, you must know your responsibility toward the government property that is available for your use.

INFORMATION

Pecuniary Liability

This means that you must pay for property lost, damaged, or destroyed from causes other than fair wear and tear because of poor management or negligence in the use, care, custody, or safeguarding of the property. The cost may be shared in a particular case by persons having command, supervisory, or custodial responsibility. If willful, unauthorized issues of property are made and the property is lost, damaged, or destroyed, the person issuing the property and the person receiving the property are held jointly and separately responsible for the value of the property.

Command Responsibility

Commanders at all levels are charged with responsibility for all property used or stored at bases and activities under their control. They are not exempt from pecuniary liability for loss, damage or destruction of government property belonging to their command.

Supervisory Responsibility

Supervisory responsibility applies to any person who exercises supervision over property received, in use, in storage, in transit, or undergoing modification or repair. The supervisor is responsible for selecting qualified persons to perform the duties under his control and for properly directing and training them. The supervisor is also responsible for instructing his men in the principles of supply discipline.

Supersedes C3ABR25130-SW-305A, 16 November 1981. RGL: 10.4
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 610; DAV - 1

Custodial Responsibility

When you possess government property, you assume custodial responsibility for it. You are personally responsible for the property if it is issued for official or personal use, whether you signed a receipt for it or not. You can be held responsible for property under your direct control for storage, use, custody, or safeguarding. If you find government property that has apparently been lost, stolen, or abondoned, protect or care for it until it can be returned to the proper authorities.

EXERCISE

1. You as students, have ________________ level responsibility.

2. When using cleaning equipment you have ________________________ responsibility while the class leader has _________________________.

3. While moving into a new room in the barracks, you find a piece of equipment that seems to belong to one of the courses in Tech School. You should immediately assume ______________________ responsibility for that equipment and return it.

4. The equipment that you will be using in the school is your _____________ responsibility with or without a _____________ ______________.

5. During class, if you lean back on two legs of your chair and they break, you could be charged with ________________ ________________.

6. If the Center Commander orders the Air Force Band of the Midwest to play at a private party and the van carrying the instruments was involved in an accident because of speeding, would anyone have pecuniary liability? ____

____

7. Your supervisor at your next assignment allows you to operate the radar set without supervision before you are certified on its use. While turning the set on you break the magnetron tube (price $1500) because you did not follow the turn-on checklist. Who would be held accountable? ____

____

923

Weather Observer Branch
Chanute AFB, Illinois

C3ABR25130-SW-305B
30 January 1984

AIR WEATHER SERVICE MISSION AN' RGANIZATION

OBJECTIVES

Without reference, select facts relating to the mission of AWS to 75% accuracy.

Without reference, select facts relating to the organization of AWS to 75% accuracy.

INTRODUCTION

As a weather specialist the Air Weather Servic · mission may take you to many areas of the world. Special assignments may include duty with international organizations, such as the North Atlantic Treaty Organization (NATO). Although these special assignments or duty at a weather center or central are available, your career as a weather specialist will probably start at a detachment in the continental US.

INFORMATION

AIR WEATHER SERVICE MISSION

Air Weather Service (AWS), a Military Airlift Command (MAC) component, operates a worldwide network of weather facilities to provide around-the-clock weather support to US Air Force and Army units at all levels of command. In addition to the many weather units manned throughout the world, AWS personnel also are assigned duties at Air Force Global Weather Central (AFGWC) and the Environmental Technical Applications Center (ETAC). The AWS mission can be grouped into four categories.

Air Force Weather Support

This includes local and longline transmission of surface observations and forecasts. AWS also gives weather briefings and radio service to airborne aircraft.

Army Weather Support

This meteorological support permits army commanders to make maximum use of weather conditions to decide when, where, and how to use their forces and to anticipate enemy action under such conditions.

Weather Reconnaissance and Atmospheric Air Sampling

Specially equipped aircraft and trained aircrews take dropsonde observations, track and compile data on tropical storms and gather air samples.

Supersedes C3ABR25130-SW-305B, 13 December 1982
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 550; DAV - 1

RGL: 12.3

Designed for ATC Course Use. Do Not Use on the Job.

Environmental and Scientific Services

Provide climatological studies of rawinsonde observations, surface observations and forecasts. storage and retrieval of environmental data, and staff assistance.

AIR WEATHER SERVICE ORGANIZATION

The organizational structure of AWS consists of wings, squadrons, detachments and operating locations. Each of these organizations provide direct service tailored to the mission of the unit or command supported. In addition to this specialized support, each weather unit contributes to the global network of weather data exchange.

Weather Wings

The Air Force commands, such as SAC, MAC, TAC, that bear the responsibility for the largest share of the total Air Force mission, derive support from the weather wings. For example, the 3d Weather Wing supports the Strategic Air Command. In oversea areas the wings support the area commander as well as the Air Force mission. The 2d Weather Wing serves the commander, US Forces in Europe as well as the Headquarters US Air Force in Europe (USAFE).

Weather Squadrons

Squadrons are the next echelon of command under the weather wing. They support the subordinate numbered Air Force which makes up a major command. For example, the 9th Weather Squadron (subordinate to 3d Weather Wing) supports the 15th Air Force (subordinate to SAC). Each subordinate numbered Air Force within a major command has a weather squadron assigned to support it.

Weather Detachments

Detachments are the next echelon below squadrons. Each detachment of a particular weather squadron provides weather support to the base of a numbered Air Force that the squadron supports. Each detachment is organized and staffed to supply the specific weather information that is required for the base's operations. These detachments provide weather observations, forecasts and climatological information to all base organizations and some off-base government agencies.

Operating Locations (OL's)

Requirements for weather support to specialized units are often requested by various air force and army commands. Operating Locations, that could be attached to Headquarters AWS, a wing, squadron or a detachment, are formed to provide this service. As an example, OL C (Coral Gables, Florida) which is subordinate to Headquarters AWS, provides liaison with other national agencies on both the research and operational requirements of storm tracking and forecasting. They coordinate the aerial reconnaissance of USAF, USN and other weather aircraft in the Atlantic - Caribbean - and Gulf of Mexico area and disseminate the tropical storm information to the military services.

QUESTIONS

1. Air Weather Service is a component of the ______________________.

2. In addition to providing support to Air Force installations AWS also provides meteorological support to the ______________________.

3. Utilizing specially equipped aircraft, AWS personnel ______ ______ and ________ _______ on tropical storms.

4. Although special duty assignments are available, your first assignment will probably be to a ______________ in the continental US.

5. In addition to the support required by each base, each weather unit contributes to the _________ _________ of weather data exchange.

6. The organizational structure of AWS consists of wings, __________, detachments and ___________ ___________.

7. The Air Force _______________ bear the responsibility for the largest share of the Air Force ______________.

8. ________________ ________________ support Air Force commands.

9. Each subordinate _________ _________ Air Force within a major command has a weather _____________________ assigned to support it.

10. _______________________ are the next echelon below a squadron.

11. Each ___________ ________ is organized and staffed to supply ________ ________ information that is required for the ___________ operations.

12. Detachments provide _____________ _____________, _____________ and _______________ information to all ___________ ______________.

3

13. ________________ ________________ are formed to provide weather support to ________________ ________________.

14. Operating Locations could be a surbordinate unit to either ________________, a ________________, ________________ or a ________________.

15. Providing weather support includes ________________ and ________________ transmission of ________________ ________________ and ________________ ________________.

927

PROGRAMMED TEXT

3ABR25130-2-PT-305J

Technical Training

Aerographer's Mate

DECODING RADFO MESSAGES AND PLOTTING RADIOLOGICAL FALLOUT DIAGRAMS

20 April 1981

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

Designed for ATC Course Use.

Do Not Use on the Job.

RGL: 11.5

Supersedes 3ABR25130-2-PT-306, 1 December 1977.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 300; DAV - 1

DECODING RADFO MESSAGES
AND
PLOTTING RADIOLOGICAL FALLOUT DIAGRAMS

INSTRUCTIONS

In this program you will encounter some teaching frames that will require you to make a written response in the program. The correct answer to the frame will be given in the next frame.

Other frames will direct you to work with materials other than this program. Perform the task described in these frames before going to the next frame.

You will be directed by the program at various points to have your work checked by the instructor. At these points he will verify the quality of your work. If you need assistance during the course of this lesson, just notify your instructor.

Now turn to page ii and read the objectives.

DECODING RADFO MESSAGES
AND
PLOTTING RADIOLOGICAL FALLOUT DIAGRAMS

OBJECTIVES

Upon completion of this lesson, the student will:

1. From a given pre-burst prediction message, decode specified elements in allotted time. This program, "Decoding RADFO Messages and Plotting Radiological Fallout Diagrams," may be used as needed. Forty specified elements from one message must be decoded within 15 minutes with no more than 4 errors.

2. From a given pre-burst prediction message, plot a radiological fallout diagram, and delineate areas of high and low yield. This program, "Decoding RADFO Messages and Plotting Radiological Fallout Diagrams," may be used as needed. The completed diagram must be properly labeled and be within 50 nautical miles of the <u>actual</u> forecast plot.

3. State when a fallout warning message would be used and decode the message without error within 15 minutes. This program, "Decoding RADFO Messages and Plotting Radiological Fallout Diagrams," may be used as needed.

DECODING RADFO MESSAGES
AND
PLOTTING RADIOLOGICAL FALLOUT DIAGRAMS

INTRODUCTION

In the event of a nuclear detonation, radiological fallout may be of great significance to the conduct of naval operations. This lesson will provide future Aerographer's Mates with the information necessary to enable them to de- ' ~mine areas which are potentially hazardous because of fallout following a nuclear explosion.

In predicting the fallout area, information must be at hand with respect to location of burst, the yield of the weapon, and the atmospheric wind structure. Except for experimental tests, only the wind structure can be available before the detonation. The procedures explained in this lesson will provide the guidance necessary to prepare a generalized radiological fallout plot which will be available for tactical purposes in reacting to low-yield and high-yield nu :lear expolisions.

1. There are two formats for Navy fallout messages. The first, called a "Pre-Burst Prediction Message" is designed to give the forecaster an idea as to where radiological fallout would go *if* a nuclear weapon is detonated at a given position. The information can be provided for every 5 degrees of latitude and longitude and includes data for both low yield and high yield weapons.

The second type of fallout message called a "Fallout Warning" is for when a nuclear weapon has been detonated. In this case, the exact position of the detonation is known as well as the yield (size) of the weapon. This type of message is an actual warning of nuclear fallout from a weapon that has exploded whereas the pre-burst prediction message is for determining the fallout area just in case a weapon is detonated in the area.

List the two types of radiological fallout messages.

1. ______________________________

2. ______________________________

---

1. pre-burst prediction

2. fallout warning

2. The heading for the pre-burst prediction message is shown below. It begins with the words PRE-BURST PREDICTION which tells you the type of radiological fallout message. Next the heading gives the time span that the forecast is valid for. Finally, the beginning time of the forecast period is given.

```
PRE BURST PREDICTION, 24HR FCST FROM 12Z
05 OCT 75
```

The forecast time period for the pre-burst prediction is given in the message________.

heading	3. The following is the symbolic format of the pre-burst prediction message. $QL_aL_aL_oL_o$ $T_L$ddss DDDDD $T_H$ddss DDDDD Since you will be decoding and plotting pre-burst prediction messages, it will be necessary that you learn the symbolic format and the meaning of all of the elements contained in it. On the next page are explanations of all of the symbolic elements. Study the table carefully; be sure you know the format and the meaning of the symbols in the format before going on to frame 4 on page 4.

Q	Octant of the Globe	Northern Hemisphere 0......0° to 90°W 1.....90°W to 180° 2....180° to 90°E 3.....90°E to 0° Southern Hemisphere 5......0° to 90°W 6.....90°W to 180°W 7....180° to 90°E 8.....90°E to 0°
L_aL_a	Latitude in whole degrees for the point for which fallout forecast is made.	
L_oL_o	Longitude in whole degrees for the point for which fallout forecast is made	The hundreds digit is omitted for longitudes 100 to 180 degrees.
T_L	Designation of applicable template for a low yield weapon	# Template 1 ALFA 2 BRAVO 3 CHARLIE 4 DELTA 5 ECHO 6 FOXTROT
T_H	Designation of applicable template for a high yield weapon	
dd	Direction of effective fallout wind measured in tens degrees clockwise from true north.	The template delineates the shape of the fallout area.
ss	The effective fallout wind speed in knots.	The effective fallout wind (ddss) is an average of the winds that will effect the fallout particles above the forecast point
DDDDD	The distance in nautical miles from the forecast point (surface zero) measured along the fallout axis to the 200 roentgen contour	The 200 roentgen contour represents a total radiation dose of 200 roentgens within 48 hours after detonation. This is sufficient radiation to produce casualties.

4. Below is an example of the pre-burst prediction message and the symbolic format.

Q	L_a	L_a	L_o	L_o	T_L	ddss	DDDDD	T_H	ddss	DDDDD
0	2	8	7	5	1	2836	00017	4	2376	00300

This example is decoded as follows:

$QL_aL_aL_oL_o$
0 2 8 7 5

0 - means that the point for which the forecast is made is located in the Northern Hemisphere between 0° and 90°W.

28 - means that the latitude of the forecast point is 28°N.

75 - means that the longitude of the forecast point is 75°W.

What would the position be if the first group had been encoded 13570?

Latitude ________°

Longitude________°

35°N

170°W

5. The low yield information is contained in these two groups.

$T_L$ddss	DDDDD
1 2836	00017

1 - means that the fallout area for a low yield weapon is in the shape of the pattern of template ALFA.

28 - indicates that the low yield effective fallout wind is from 280°.

36 - this is the low yield effective fallout wind speed in knots.

00017 - this is the greatest distance downwind that would receive 200 roentgens within 48 hours with a low yield weapon. The distance in this case is 17 nautical miles.

Decode the following low yield information.

52122 00013

Template ____________________

Wind direction ______________

Wind speed __________________

Downwind distance____________

ECHO

210°

22 kts

13 NM

6. The high yield information is decoded similarily.

$T_H$ddss	DDDDD
4 2776	00300

4 - means that the fallout area for a high yield weapon is in the shape of the pattern of template DELTA.

27 - indicates that the high yield effective fallout wind is from 270°.

76 - this is the high yield effective fallout wind speed in knots.

00300 - this is the greatest distance downwind that would receive 200 roentgens within 48 hours if the weapon were of high yield. In this case, the distance is 300 nautical miles.

Decode the following high yield information.

23434 00210

Template ________

Wind direction________

Wind speed________

Downwind distance________

BRAVO
340°
34 kts
210 NM

7. The pre-burst prediction message is computed for every 5 degrees latitude and longitude and when transmitted the data for each point is printed out one below the other. The message below is an exact copy of part of an actual message.

```
PRE-BURST PREDICTION 24 HR FCST FROM 12Z 04 JAN 76

FORMAT QLLLL T DDSS DDDD T DDSS DDDDD

04075 22439 00018 52435 00214
04085 22636 00018 32632 00205
14095 43117 00013 23116 00145
14005 22614 00012 22720 00184
04575 22545 00019 52541 00230
```

Using the above message answer the following questions.

A. When does the forecast period begin? ____________

B. What is the latitude and longitude of the first forecast point? ________° ________°

C. What are the low and high templates for 40°N 95°W?

________ ________

D. What is the low and high yield downwind distances for 40°N, 105°W? ________NM ________NM

E. What is the low yield effective fallout wind for 40°N 105°W? ________° ________kts.

F. What is the low and high yield downwind distance for 40°N 85°W? ________NM ________NM

G. Completely decode the last forecast point of the message.

Position ________°N ________°W

Low yield template ____________

Low yield effective fallout wind ______° ______kts.

(Contd.)

7. (Contd.)

Low yield downwind distance ________________NM

High yield template _________________

High yield effective fallout wind _______° _________kts.

High yield downwind distance ____________NM

H. For how many hours is the forecast good? ____________

Answers to Frame 7 will be found on page 9.

8. Now that you know how to break down the pre-burst prediction code, the next step is to construct a radiological diagram. In order to do this you will need:

    1. Plastic overlay (obtain from instructor).
    2. Grease pencils (obtain from instructor).
    3. Proper RADFO template as determined from the message (Figs. 1, 2, and 3).
    4. Nautical mile scale from weather plotting chart (Fig. 4).
    5. The pre-burst prediction message below.

PRE-BURST PREDICTION, 24 HR FCST FROM 12Z 04 JAN 76

FORMAT QLLLL TDDSS DDDDD TDDSS DDDD

04075 13230 00016 12760 00270

NOTE: Figures 1 through 4 are in the back of this program, tear them out now.

(Contd.)

8. (Contd.)

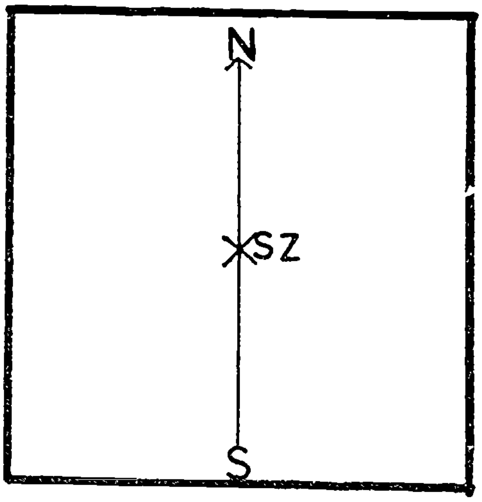
The following 2 steps must be completed before you begin to construct either the high or low yield diagram.

1. With a black grease pencil mark a small x in the center of the plastic overlay and label it SZ (surface zero). (See example below)

2. Draw a straight line through SZ and label the ends N and S to indicate true north and true south on the overlay. To assist further in the orientation, draw a small arrowhead on the north end of the line.

COMPLETE these steps now.

Example:



Answers to Frame 7.

A. 4 JAN 12Z
B. 40°N 75°W
C. DELTA, BRAVO
D. 12NM 184NM
E. 260° 14 kts
F. 18NM 205NM
G. 45°N 75°W

Low BRAVO	High ECHO
250° 45 kts	250° 41 kts
19NM	230NM

H. 24 hrs.

9. Now let's construct the low yield fallout plot. Complete each step before going on to the next step.

★ Step 1. Select the template indicated by the RADFO message for the low-yield trajectory (refer to the message below). Although there are six templates altogether, only three templates are used in this program. They are figures 1, 2 and 3 in the program.

> NOTE: RADFO templates are nothing more than various standard patterns of contoured lines which are used to outline the low-yield and high-yield fallout areas.

PRE-BURST PREDICTION 24HR FCST FROM 12Z 04 JAN 76

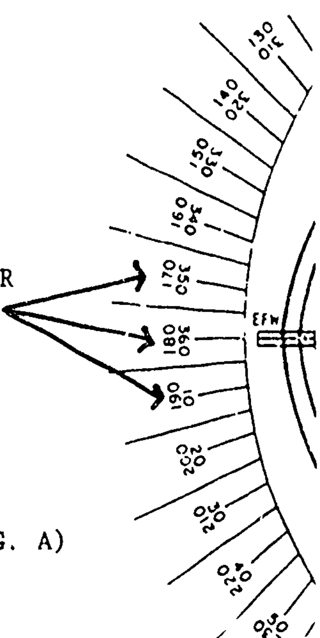
FORMAT QLLLL TDDSS DDDDD TDDSS DDDDD

04075 13230 00016 12760 00270

★ Step 2. Place the plastic overlay on the template with the SZ of the template (ALFA) and the SZ of the plastic overlay coinciding.

★ Step 3. Next rotate the overlay until the N-S line alines with the protracter number (see Fig.A) of the template corresponding to the <u>direction of the low-yield effective fallout wind</u> taken from the preburst prediction message. The rules for this are given on the next page but first, let us tell you what we mean by this.

PROTRACTOR NUMBERS



(FIG. A)

(Contd.)

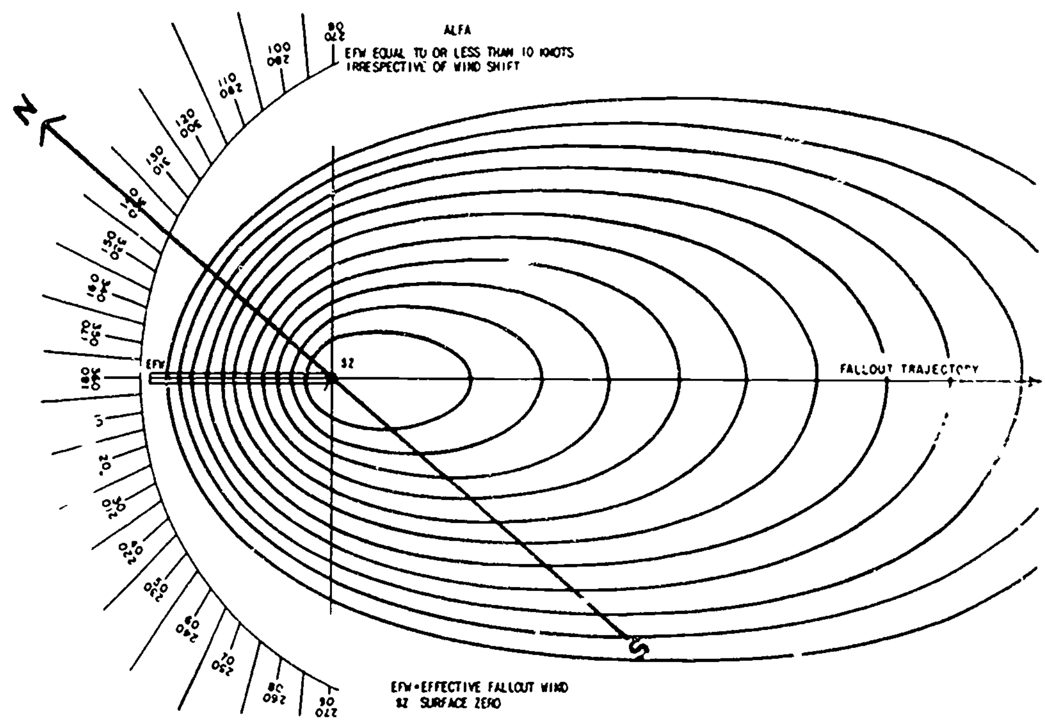
9. (Contd.)

What we're trying to determine here is, once the bomb goes off, where will the winds carry the radioactive fallout? To determine this on the diagram, we must use the wind direction given in the message to determine which end of the N-S line is placed over the appropriate protracter number.

The rules for this are:

a. If the wind direction given in the message falls within the North semicircle (270°-360°-090°), the N end of the N-S line will be placed over the number on the protracter (inside row) corresponding to the wind direction.

Example: Wind from 320°



Look at it this way. If you throw a handfull of sand into the air, where will the wind carry the sand?

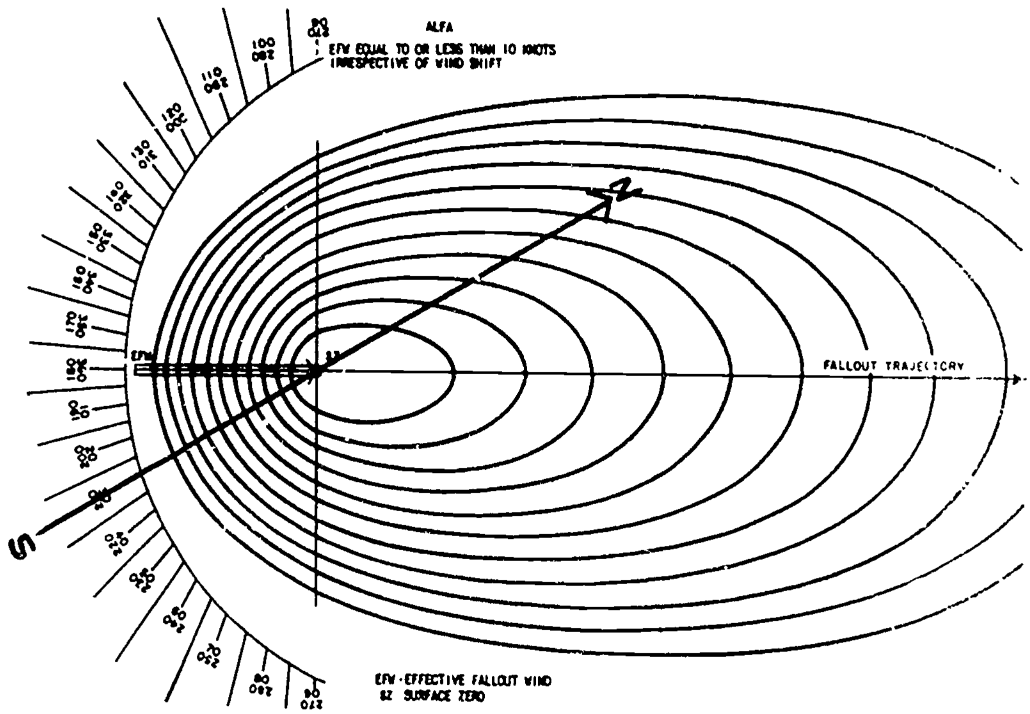
"DOWNWIND"

(Contd.)

9. (Contd.)

b. If the wind direction is within the South semicircle (090°-180°-270°), the S end of the N-S line is placed over the number on the protracter (outside row) corresponding to the wind direction.

Example: Wind from 210°



c. If the wind direction given in the message is from exactly 270°, place the N end of the N-S line over the 270 protracter number (inside row) at the top of the template.

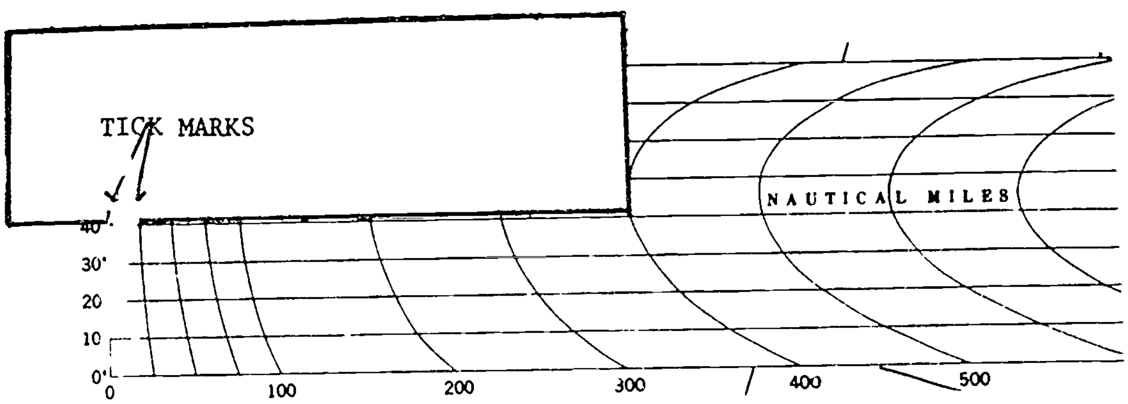
d. If the wind direction given in the message is from exactly 090°, place the S end of the N-S line over the 090 protracter number (outside row) at the top of the template.

Now look at the message we are using (it is reprinted below). As you can see, the low yield effective fallout wind is from 320°. Using this direction, properly align your template and plastic overlay. When you have done this, have your instructor check your alignment.

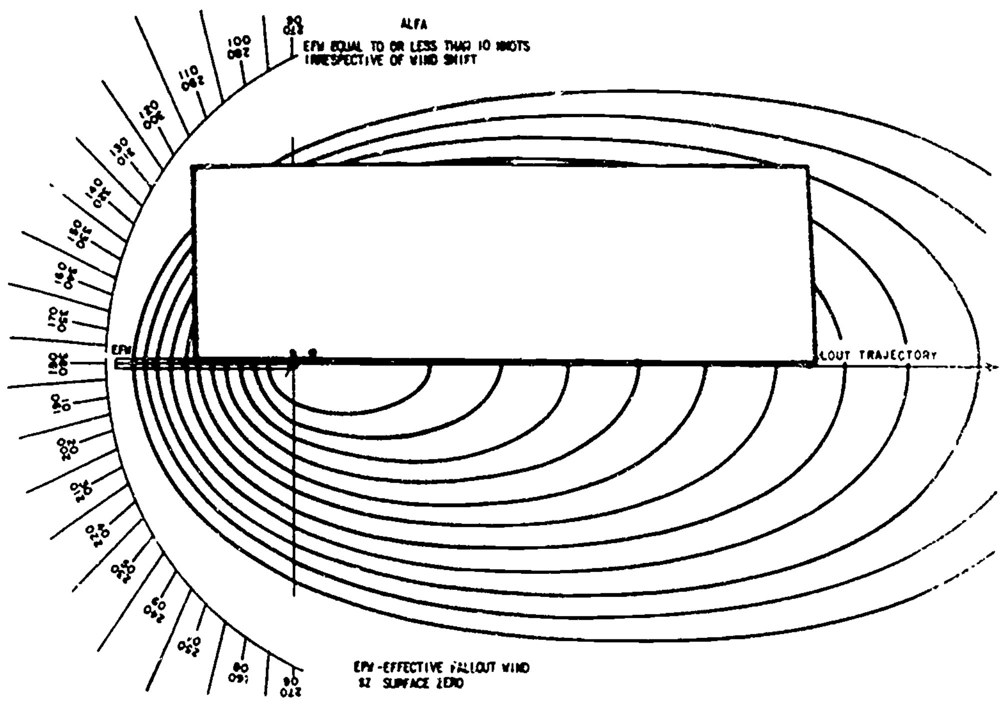
PRE-BURST PREDICTION 24HR FCST FROM 12Z 04 JAN 76
FORMAT QLLLL TDDSS DDDDD TDDSS DDDDD
04075 13230 00016 12760 00270

10. Step 4. ★ Next you must mark off the downwind distance along the fallout trajectory line of the template. The low yield DDDDD group of the message gives the distance in nautical miles, but you must determine the distance for the particular chart you are using. The synoptic plotting chart 1-10-3 will be used here at AG School. A copy of the distance scale for this chart is printed as Fig. 4 of this program.

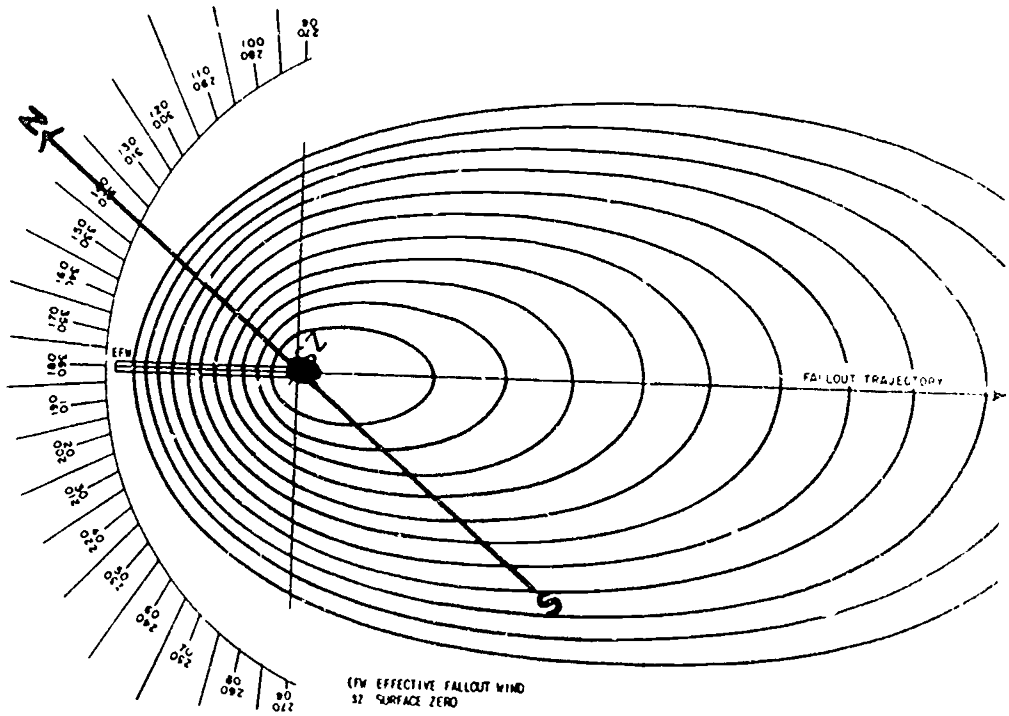
Notice that the scale has latitude printed along the left side and nautical miles printed across the bottom. To figure your downwind distance, aline a piece of blank paper along the line representing the latitude of the RADFO plot (40° in this case). Then, move out along the latitude line until you find the distance that is encoded for the low yield DDDDD. (16 NM) Put small "Tick" marks on the blank piece of paper at 0 miles and 16 miles. The distance between these two marks represents the downwind distance at 40°N. See diagram below.



11. Step 5. Now aline the piece of blank paper along the fallout trajectory line of the template with the left tick mark on the paper at point SZ. Where the second tick mark lines, make a short line with the red grease pencil on the plastic overlay.



12. Step 6. The last step in plotting the low yield section of the RADFO message is to outline the complete low yield fallout area. To do this, start from the point you just made on the overlay that represents the downwind distance, and draw a contour concentric with the contours on the template using a red grease pencil. Your contour should be the same size as the shaded area on the diagram below.

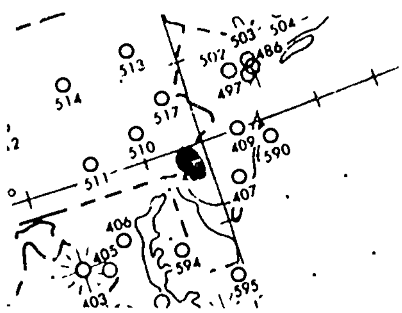


When you have finished outlining the low yield fallout area, have your instructor check your complete low yield plot.

NOTE: You have no doubt noticed that the effective fallout wind speed was not used to construct the plot. The speed can be used to compute the downwind distance and to compute the leading edge of the fallout. You will not need to know how to do these procedures.

Instructor's Signature

13. Now your low yield plot is all prepared. If a low yield nuclear weapon should be set off in the area of 40°N 75°W you would immediately orientate the overlay's N-S line with the meridian (N-S lines) of plotting chart 1-10-3 and put the S-Z point of the overlay exactly over the actual point of detonation. The area covered by the low yield plot should receive enough radiation within 48 hours to produce casualties.



In the example on the left, we had a low yield nuclear weapon set off at station 408, Philadelphia. As you can see Lakehurst would not be in the area. But this plot is for only a relatively small (20 kilotons - 20,000 tons of TNT) weapon. Let's now work up the plot for a high yield weapon.

14. The complete RADFO diagram consists of the low yield <u>and</u> high-yield fallout plots. The procedures for plotting the high-yield are also identical to those used to find the low-yield. Follow the procedures listed below:

Step 1. Refer again to the RADFO message and select the template for the high-yield trajectory. The low and high-yield templates are often different.

PRE-BURST PREDICTION 24HR FCST FROM 12Z 04 JAN 76

```
FORMAT  QLLLL TDDSS DDDDD TDDSS DDDDD
        04075 13230 00016 12760 00270
```

Step 2. Aline the overlay and the template in the same manner as you did with the low-yield. Remember, if the wind direction is 090-180-270, you put the S end of the N-S line over the protractor, and if the wind direction is between 270-360-090, you put the N end of the N-S line over the protractor.

(Contd.)

14. (Contd.)

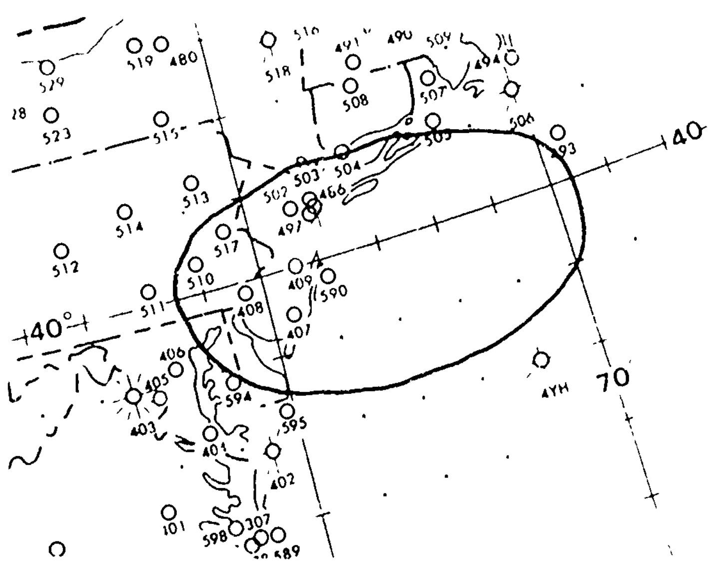
Step 3. Next, using the downwind distance given in the high-yield DDDDD determine the actual distance from plotting chart 1-10-3 from the chart distance scale (Fig. 4). Mark this distance off on a blank piece of paper as you are for the low-yield weapon.

Step 4. Aline the paper along the fallout trajectory as was done for the low-yield. Now mark off the downwind distance for high-yield on the plastic overlay.

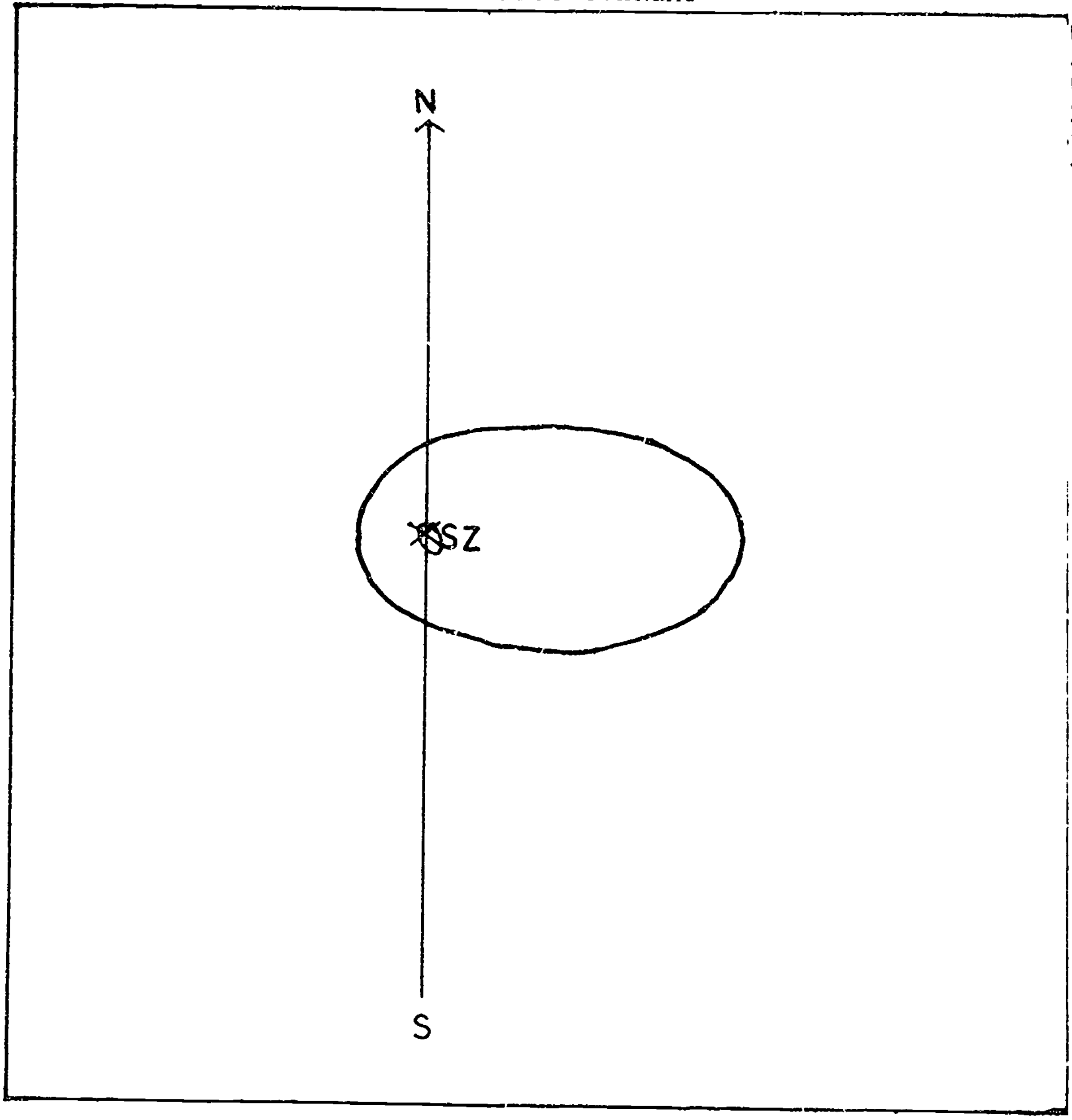
Step 5. Outlining the high-yield fallout area is done in the same manner as with the low-yield except that the contour is drawn with a black grease pencil. Outline your high-yield fall-out area now.

Compare your high and low plots to the ones on page 18. Yours should be very similar.

NOTE: As you can see, the high yield weapon with its higher effective fallout wind speed, covers a much greater area with 200 roetgens of radiation within 48 hours.



PLASTIC RADFO OVERLAY



PRE-BURST PREDICTION, 24HR FCST FROM 12Z 04 JAN 76
FORMAT QLLLL TDDSS DDDD TDDSS DDDDD
04075 13230 00016 12760 00270

15. To complete the RADFO plot, a legend block should be made. This will tell the forecaster the essential information about the plot. This information should be updated for every new plot.

In one corner of the overlay, print the following legend.

Location: ______________________

Beginning Time ______________________

Ending Time ______________________

Map ______________________

Plotter ______________________

For location write in the latitude and longitude of the forecast point.

Beginning time is obtained from the heading of the message.

For ending time you must add the number of hours the forecast is valid for, to the beginning time - usually 24 hours.

The map number from which the distance scale was obtained is written in beside the word MAP. In this case, 1-10-3.

Finally print your name next to the word "Plotter"

This data block must be on every overlay, or the overlay is of no value. The forecaster cannot just guess at the position.

Now, fill in the legend block with the appropriate information! Your data block should appear similar to the one below.

Location 40°N 75°W

Beginning Time 12Z 04 JAN

Ending Time 12Z 05 JAN

Map 1-10-3

Plotter R. Thayer

16. Using the information on the previous 15 frames as a guide, decode and plot the information given in the pre-burst prediction message.

PRE-BURST PREDICTION 24 HR FCST FROM 12Z 02 DEC 74

FORMAT QLLLL TDDSS DDDDD TDDSS DDDDD
03075 41650 00019 42190 00325

Don't forget the l:gend block.

When you have finished the RADFO plot, have your instructor check your work.

____
Instructor's Signature

Go to Frame 17

17. To increase your proficiency in plotting radiological information, decode and plot the information contained in this pre-burst prediction message.

PRE-BURST PREDICTION 24HR FCST FROM 12Z 05 AP 75

FORMAT QLLLL TDDSS DDDDD TDDSS DDDDD
12020 10735 00017 60978 00305

When you have completed this diagram, have your instructor check your work.

____
Instructor's Signature

Go to Frame 18

18. Once again decode and plot the informat on contained in this pre-burst prediction message.

PRE-BURST PREDICTION 24HR FCST FROM 05 AUG 75

FORMAT QLLLL TDDSS DDDDD TDDSS DDDDD
02570 60245 00018 60884 00315

When you have completed the diagram and legend, have your instructor check your work.

Instructor's Signature

☐ Go to Frame 19

☐ Go to Frame 21

19. Practice makes any task easier, therefore plot the following pre-burst prediction message; soon you will find that plotting RADFO diagrams is a simple task. When you have completed the diagram, have your instructor check your work.

PRE-BURST PREDICTION 24HR FCST FROM 12Z 03 SEPT 7.

FORMAT QLLLL TDDSS DDDDD TDDSS DDDDD
13525 13348 00019 43495 00330

Instructor's Signature

☐ Go to Frame 20

☐ Go to Frame 21

20. Complete the RADFO plot from the information contained in this pre-burst prediction message. Have your instructor check your work when you are finished.

PRE-BURST PREDICTION 24HR FCST FROM 12Z 04 OCT 75

FORMAT	QLLLL	TDDSS	DDDDD	TDDSS	DDDDD
	06565	12327	00016	42326	00185

Instructor's Signature

Go to Frame 21.

21. The pre-burst prediction messages that you have been working with are probably the only type of radiological fallout message you will ever see. But remember, back in frame one we said that there were two types of RADFO messages. The second type, called a Fallout Warning, is transmitted only after a nuclear weapon has been detonated.

The format for the fallout warning message is shown below.

$QL_aL_aL_oL_o$ YYGG/ YYYYY Tdd_{ss} DDDDD

As you can see, the format has many elements similar to the pre-burst format.
The $QL_aL_aL_oL_o$ group is the encoded position of the weapon's detonation point.

In this situation you will know the actual point of detonation and the message will not be made up for every 5 degrees latitude and longitude.

YYGG - This is a new group but it is relatively simple to understand.

YY - Is the day of the month and GG is the time in GMT of the detonation of the weapon.

Remember this is not a forecast starting at a given time. The time used for all calculations is the actual time the weapon went off.

(Contd.)

21. (Contd.)

The YYYYY group gives the actual yield of the weapon in kilotons. The group is always encoded as 5 digits.

Once again this message is for an actual blast, you do not have to guess at the weapon's size.

The Tddss group is the same as in the pre-burst prediction message. i.e. fallout template, and effective fallout wind. This is based on actual and forecast winds over the appropriate time period.

The DDDDD group is also the same; it gives the distance in nautical miles from surface zero to the 200 roentegen contour.

State when a FALLOUT WARNING Message would be transmitted.

____

____

only when a nuclear weapon has been detonated

22. Decode the following fallout warning message.

FALLOUT WARNING
03776 1815/ 10000 62185 00430

What is the

A. Time of detonation ________________

B. Location of the burst ________________

C. Yield of the weapon ________________

D. Downwind distance ________________

A. 13Z
B. 37°N 76°W
C. 10,000 kt (or 10MT)
D. 430 Miles

23. Of course a RADFO plot can be construct[illegible] from a fallout warning message just th[illegible] same as from a pre-burst prediction message, but you will only be required t[illegible] decode fallout warning mess[illegible] . Just f[illegible] practice decode the followin[illegible] two messag[illegible]

FALLOUT WARNING

Position A. 13418 2207/ 08000 22978 00[illegible]

FALLOUT WARNING

Position B. 12698 2207/ 02000 12630 00[illegible]

	Point A	Point B
Position	____________	____________
Date	____________	____________
Time	____________	____________
Yield	____________	____________
Template	____________	____________
Effective Fallout Wind	____________	____________
Downwind distance	____________	____________

Answers on next page.

Answers to Frame 23.

Point A.	Point B.
34°N 118°W	26°N 98°W
22nd	22nd
07Z	07Z
8 MT	2 MT
BRAVO	ALFA
290° 78 kts.	260° 30 kts.
380 NM	130 NM

24. This completes this program on RADFO messages. Review the objectives and make sure you can accomplish them. They state <u>exactly</u> what you will be required to do on the test. When you feel sure you can meet them, tell your instructor you are ready to take the performance test.

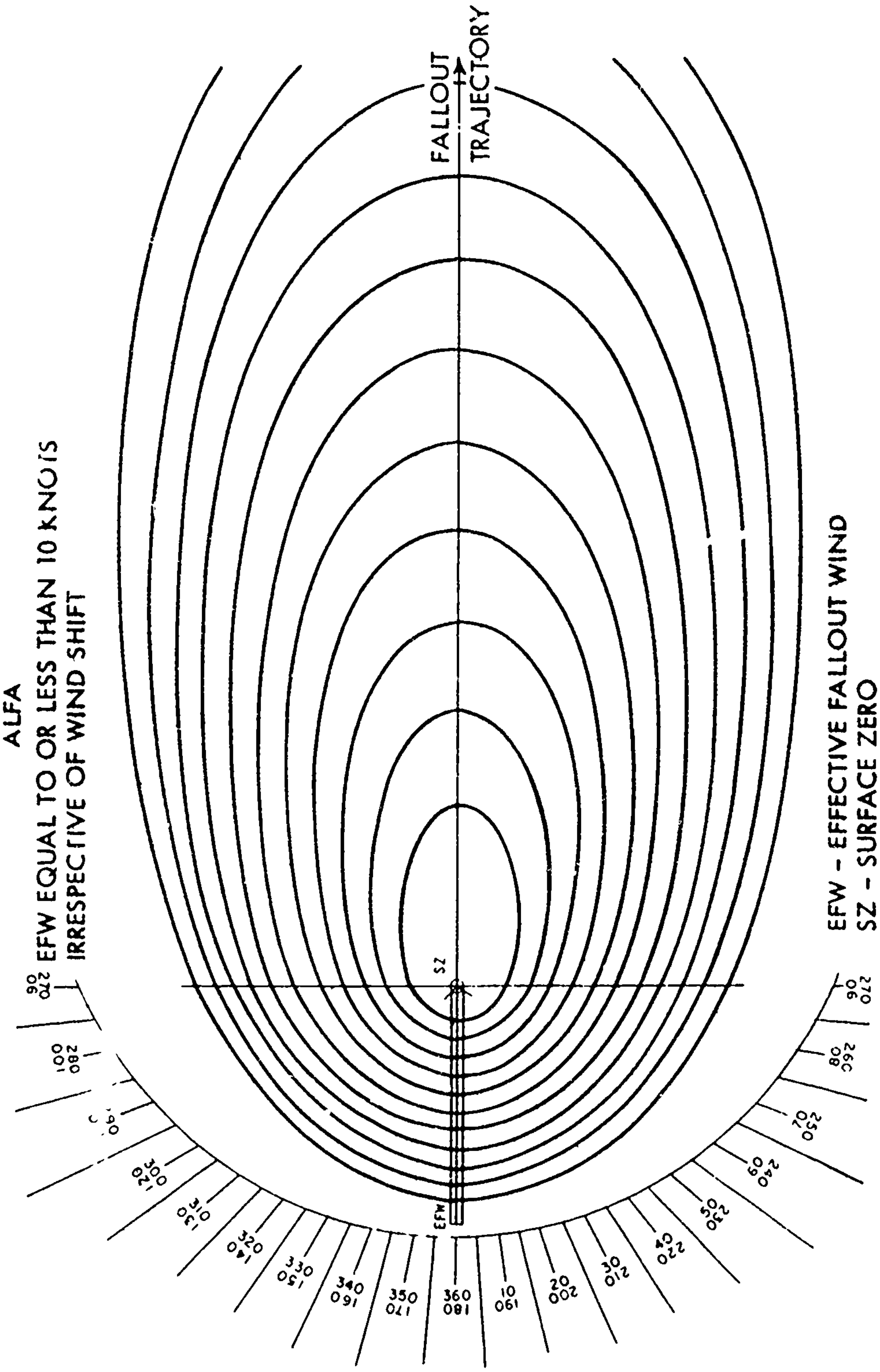

ALFA
EFW EQUAL TO OR LESS THAN 10 KNOTS
IRRESPECTIVE OF WIND SHIFT
FALLOUT
TRAJECTORY
EFW - EFFECTIVE FALLOUT WIND
SZ - SURFACE ZERO
SZ
EFW

Figure 1

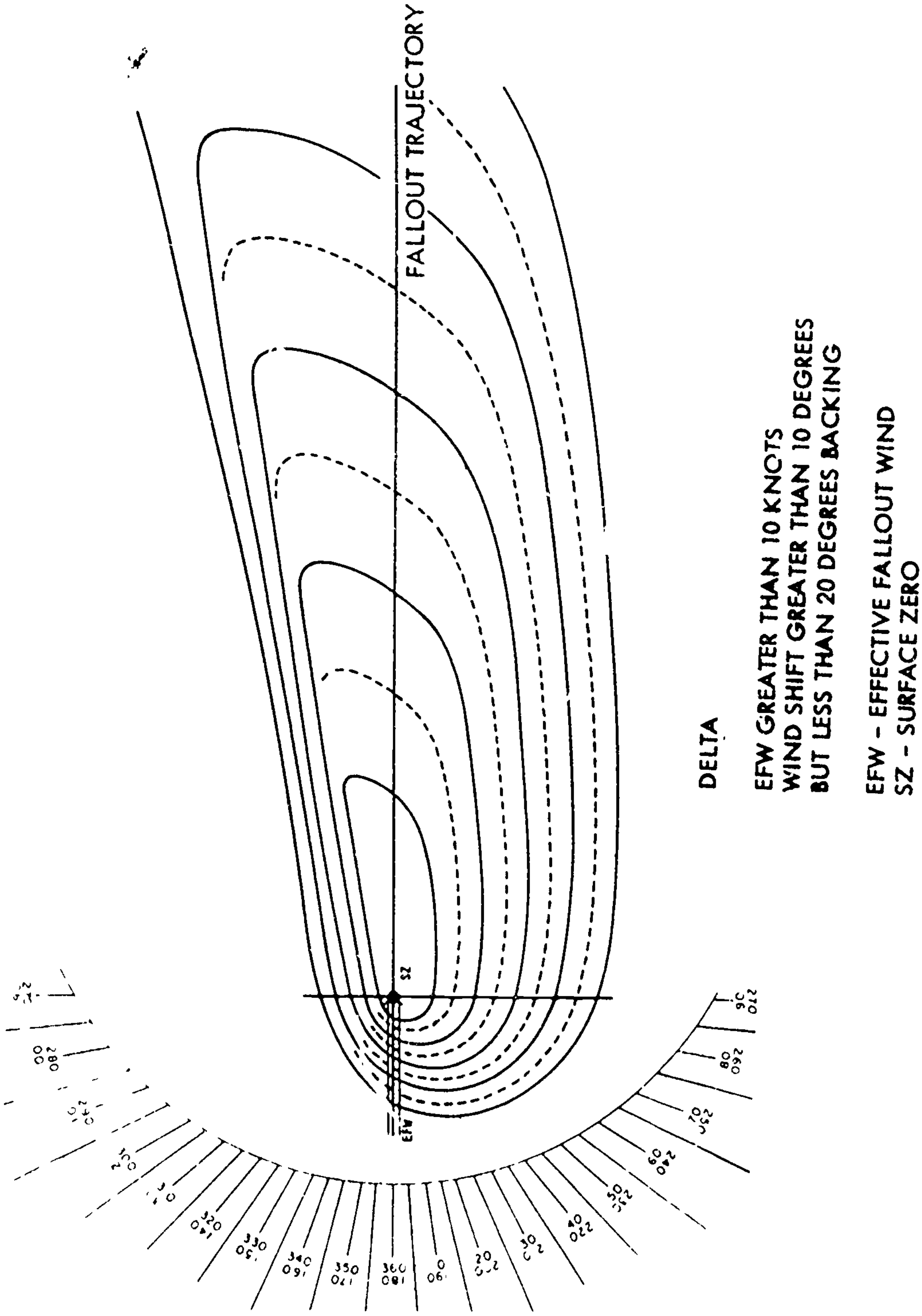

FALLOUT TRAJECTORY
DELTA
EFW GREATER THAN 10 KNOTS
WIND SHIFT GREATER THAN 10 DEGREES
BUT LESS THAN 20 DEGREES BACKING
EFW - EFFECTIVE FALLOUT WIND
SZ - SURFACE ZERO
SZ
EFW

Figure 2

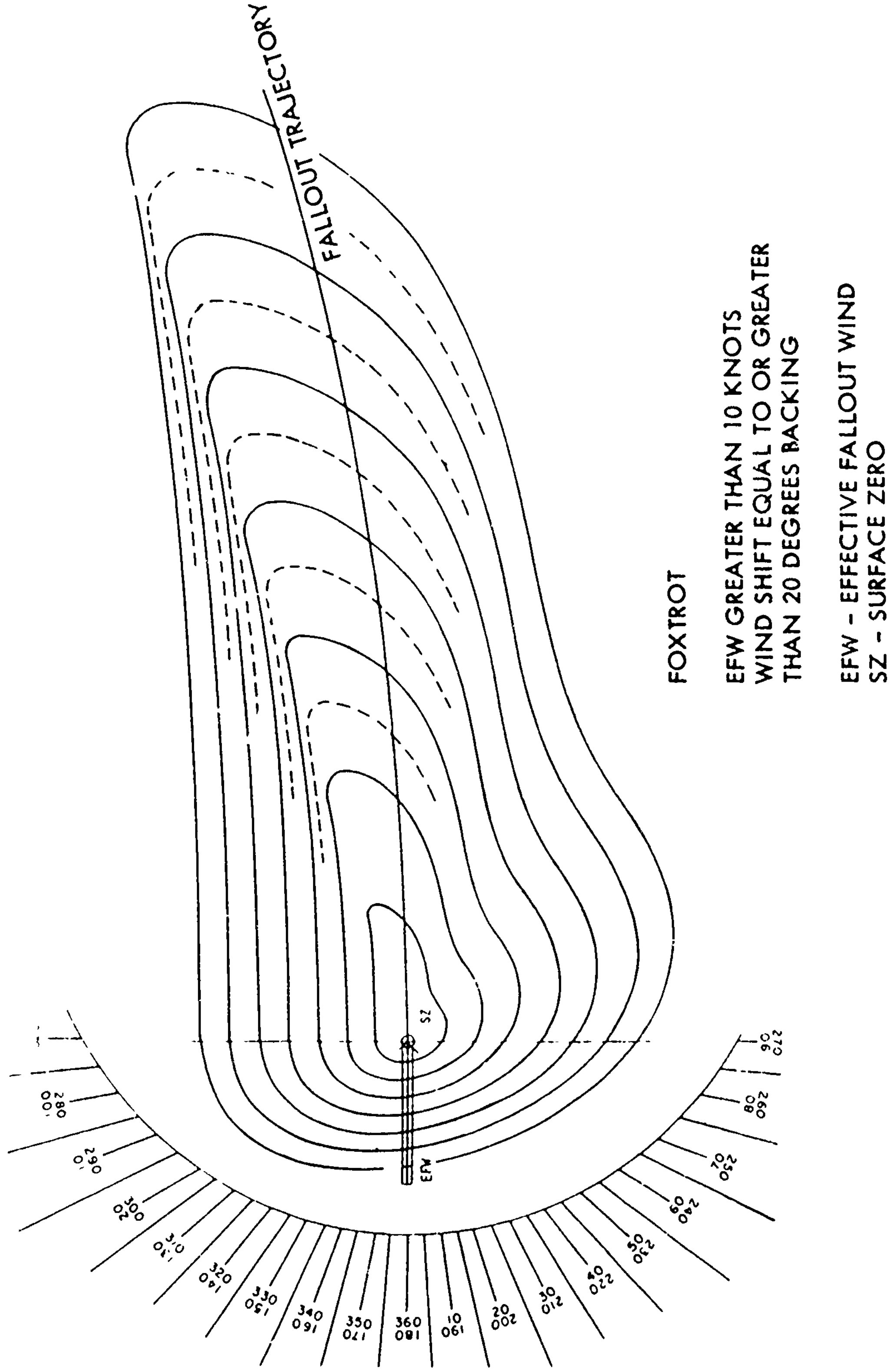
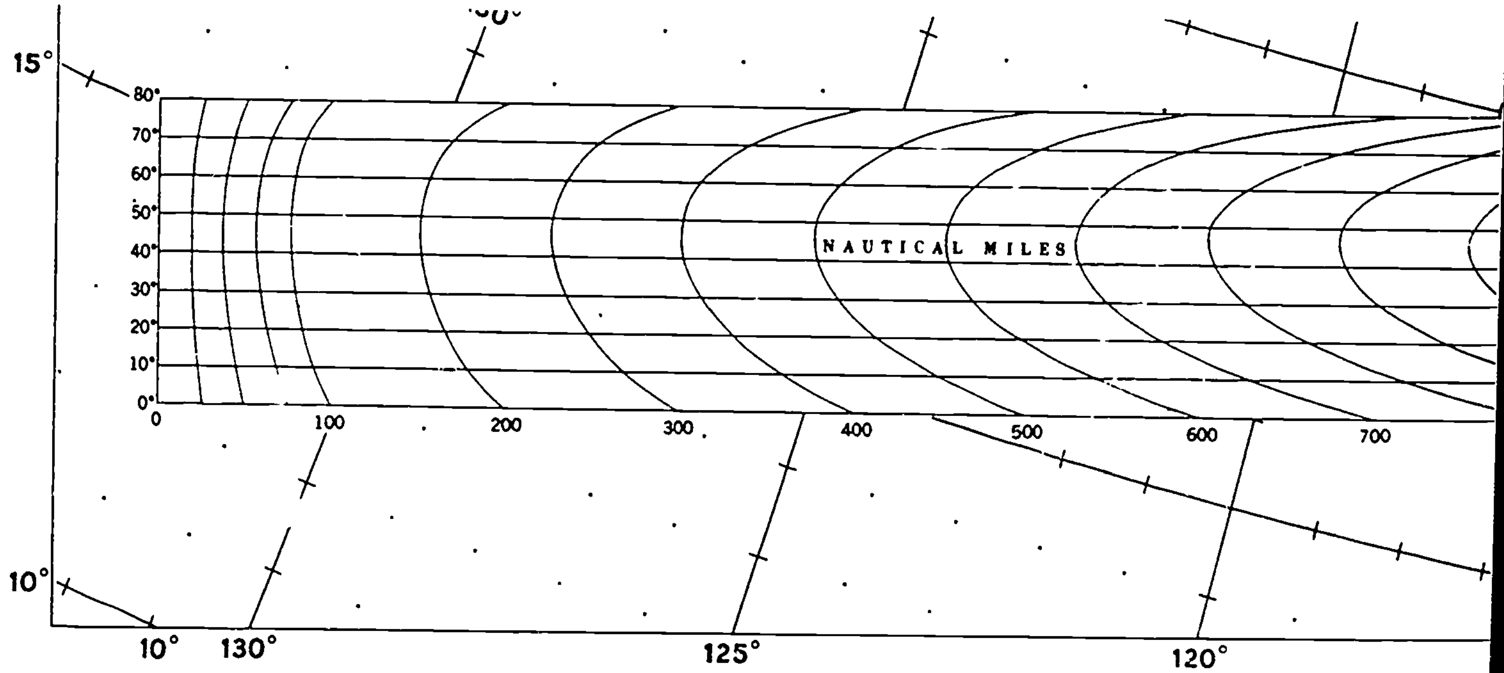

FALLOUT TRAJECTORY
SZ
EFW
FOXTROT
EFW GREATER THAN 10 KNOTS
WIND SHIFT EQUAL TO OR GREATER
THAN 20 DEGREES BACKING
EFW - EFFECTIVE FALLOUT WIND
SZ - SURFACE ZERO

Figure 3

Figure 4



PREPARED AND PUBLISHED BY THE
DEFENSE MAPPING AGENCY AEROSPACE CENTER
ST LOUIS AIR FORCE STATION, MISSOURI 63118

Users can assist in the improvement of DOD Weather Plotting Charts by reporting inaccuracies and omissions to the appropriate WEATHER SERVICE HEADQUARTERS, i.e., Hq Air Weather Service or Director U.S. Naval Weather Service.

Weather Training Branch
Chanute AFB, Illinois

C3ABR25130-SW-306
28 July 1983

OPERATIONS SECURITY (OPSEC)

OBJECTIVE

Given facts related to situations which could be reported at a weather station, select to 75% accuracy responses applicable to OPSEC.

INTRODUCTION

Security of military operations is of vital importance to the effective defense of our nation. Without some type of operations security the enemy would know our every move and would be better able to evaluate our military forces.

INFORMATION

The purpose of OPSEC is to insure the security of military operations during the planning, execution and after-action phases. This can be accomplished by denying the enemy any information which could be used to decrease the effectiveness of an operation or cause it to fail. It may also be accomplished by safeguarding any information about activities, which if revealed, could give the enemy a tactical or strategic advantage.

OPSEC in the Weather Career Field

Weather observations and forecasts by themselves are not classified, however, when they are put together for a specific location they could be valuable information for the enemy. Take, for instance, these four facts: (1) Your station is compiling data on high level winds to Korea; (2) you are sending requests for surface weather data from Korea; (3) your station is giving briefings on weather in Korea; and (4) personnel at your base have been alerted for TDY to Korea. By themselves these would not be important, but with news reports and the base on alert, this information would be very significant.

Unauthorized Contacts

If you are contacted by any unauthorized person(s) concerning military operations, notify your commander or the Air Force Office of Special Investigations as soon as possible. DO NOT, under any circumstances, attempt to investigate by yourself. DO NOT discuss the contact with anyone except the proper authorities.

Supersedes C3ABR25130-SW-306, 4 November 1982. RGL: 12.0
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 610; DAV - 1

Designed for ATC Course Use. Do Not Use on the Job.

EXERCISE

1. The purpose of OPSEC is to insure ______________ of military ______________ during the __________, __________ and __________ phases.

2. OPSEC can be accomplished by ______________ the enemy any information which could be used to __________ __________ of an operation or cause it to __________.

3. Revealing information which could give the enemy a ___ _______ or __________ advantage is a violation of __________.

4. Under certain conditions weather __________ and __________ for a __________ __________ could be valuable information for the enemy.

5. If you are contacted by anyone concerning military operations you should notify your ____________ or the __________ __________ __________ __________ __________ __________ as soon as possible.

6. A contact should not be discussed with anyone except __________ __________, nor should you attempt to __________ by yourself under any circumstances.

WORKBOOK
C3ABR25130-WB-308

Technical Training

Weather Specialist

RADAR THEORY

5 January 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE
DO NOT USE ON THE JOB

RGL: N/A

Weather Observer Branch
Chanute AFB, Illinois

C3ABR25130-WB-308

RADAR THEORY

OBJECTIVE

Without references,select statements relating to the principles of weather radar to 75% accuracy.

DIRECTIONS

Answer the following questions completely.

INTRODUCTION

1. Radar is an acronym which stands for

RA__________ D__________ A__________ R__________

2. Radar data ____________ conventional surface observations by detecting and displaying targets and determining their

a. R______________________

b. A______________________

c. E______________________

d. I______________________

e. M______________________

f. S______________________

PULSE INFORMATION

1. What is a pulse?

2. Where is the magnetron tube located?

3. The pulse travels at the speed of sound, 186,300 mi/sec. True or False?

4. The antenna shapes the pulse into a beam, ______° in width.

5. Define propagation.

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OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 600; DAV - 1

6. What are the four things that can happen to a pulse when it strikes a target?

a.

b.

c.

d.

7. Less than 1% of the power of the pulse returns to the antenna. The returned signal is known as ________________-________________ ________________.

8. The ______________________ acts as both a transmitter and a receiver.

9. Briefly explain the process by which the radar computes the distance from the antenna to the target.

10. How does the radar determine the direction (bearing) of the target?

11.

a. Presents the intensity of the return signal.	_____	PPI
b. Presents a horizontal cross-section of targets displaying azimuth and range.	_____	RHI
c. Presents a vertical cross-section of targets and displays heights.	_____	A/R

PULSE CHARACTERISTICS

1. Define pulse length:

By time:

By distance:

2. Wave length is measured from ________________ to ________________ or from ________________ to ________________.

3. If you were designing a radar set to detect only severe weather and not to detect small clouds, would you want a short or long wavelength?

Why?

4. Discuss the advantages and disadvantages of short vs long wavelengths.

5. Match the following radar set with the correct wavelength:

Type of Radar	Wavelength
TPQ-11	5.40 cm
CPS-9	.86 cm
FPS-77	10.00 cm
WSR-57	3.20 cm

6. Define listening time.

7. Define the term Pulse Repetition Frequency (PRF).

8. The lower the PRF, the ______________ the range.

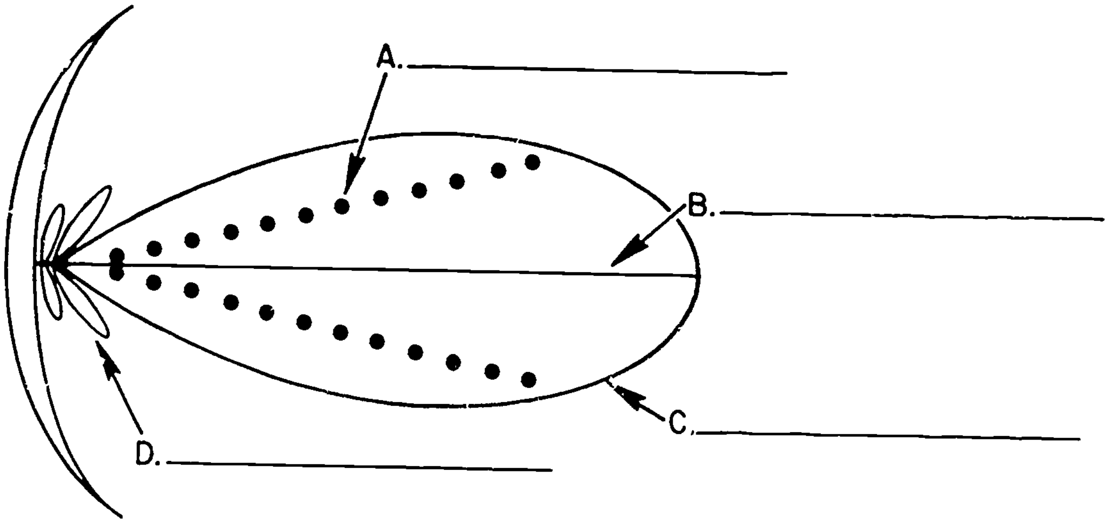
9. The PRF of the FPS-77 is 324/second, and the maximum range is 200NM. A radar with a PRF of 400/second would have a longer/shorter range than the FPS-77.

Why?

BEAM CHARACTERISTICS

1. Define radar beam.

2. Label:



CDR 81—1125
0—14b

3. The center of the beam, where the maximum power is concentrated, is known as the ______ ______ ______.

4. The ______ ______ ______ are the points in the beam where the power is 1/2 the maximum.

5. What is beam width?

6. The two effects of beam widening are ______ and ______.

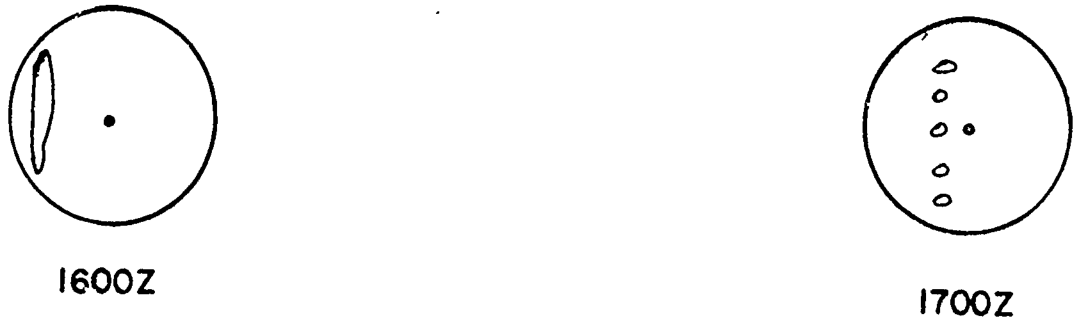
7. Beam distortion causes targets to appear ______.

8. Define resolution.

9. The ability of the radar set to distinguish between two targets at the same range but in different directions is known as ______.

10. In question 9, how far apart would these two targets have to be to appear as two separate echoes?

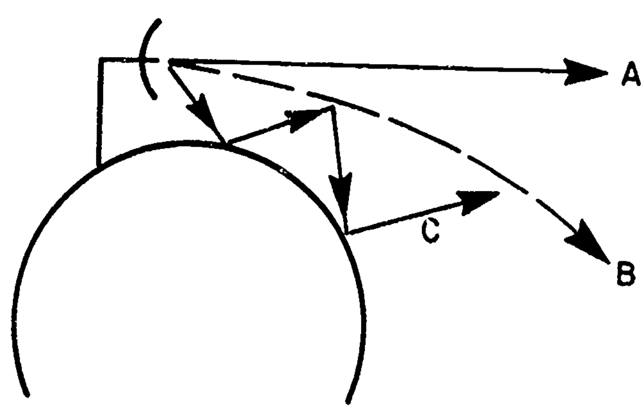
11. At 1600Z, an apparently solid echo, 60NM long and 10NM wide, appears to be moving toward the radar site. At 1700Z, the system now appears as 5 separate cells in a straight line. What has happened and why?



CDR 81-1126
0-14b

12. In order for range resolution to occur, how far apart must the targets be?

13.



CDR 81-1127
0-14b

a. The radar path depicted by A is called ________________.

b. The radar path depicted by B is called ________________.

c. The radar path depicted by C is called ________________.

d. An atmospheric condition in which warm, dry air overlies cool, moist air might cause which radar path? ________________

e. An atmospheric condition in which cool, moist air overlies warm, dry air might cause which radar path? ________________

969

14.

a. Anomalous propagation

b. Standard refraction

c. Sub-refraction

d. Super-refraction

e. Ducting

f. Second trip echoes

g. Attenuation

h. Range attenuation

i. Atmospheric attenuation

j. Precipitation attenuation

k. Inversion

_____A loss of power due to widening of the radar beam.

_____A power loss due to absorption and scattering in the atmosphere.

_____A straightening of the radar beam upward.

_____Any abnormal, unusual or irregular bending of the radar beam.

_____The normal downward bend of the radar beam.

_____A pulse that returns to the antenna during the listening time of another pulse.

_____A reduction of energy in the radar beam.

_____A major cause of ducting and second trip echoes.

_____Recognized by the "v" shaped notches on the far side of the echo.

_____Causes the pulse to travel long distances with little loss of power.

_____An unusual bending of the radar beam downward.

15. If the diameter of the particle increases, the power returned to the antenna will increase/decrease. Diameter is the single most important factor in determining particle reflectivity. True/False

16. What effect does range have on a particle's reflectivity?

17. Arrange the following precipitation types in order of priority, from the highest reflectivity to the lowest.

_____ ice crystals

_____ dry snow

_____ wet hail

_____ rain

_____ cloud droplets

_____ wet snow

18. Water droplets are ________ times more reflective than snow particles of the same size.

19. Define the bright band.

20. On which scope is it observed?

21. In which type of clouds does the bright band appear?

22. Describe the process that causes the bright band to appear on the scope.

23. Where is the freezing level in relation to the bright band?

24. The bright band indicates ______________ conditions and an absence of ______________.

25. The beam must be completely filled to receive an accurate depiction of echoes. Therefore, what will happen to the depiction of an echo as it moves away from the antenna?

Why?

ECHO CHARACTERISTICS

1. A coherent echo is a return from precipitation. True/False

2. What is an extraneous echo?

3. What is noise?

4. Noise appears on the A/R scope as ______________.

5. Man-made objects and natural terrain features close to the antenna may interfere with precipitation detection. These objects are known as ______________-______________.

6. Most ground clutter disappears at ranges beyond ______________.

7. What is one way to eliminate most ground clutter?

8. What is an area of blocking?

9. How does it appear on the PPI scope?

10. Describe the process involved in the appearance of a back-echo.

11. How far away from the antenna does a back echo appear?

12. Aircraft appear as ______________ targets.

13. Interference from another radar appears on the PPI scope as a ______________ ______________.

14. What are angels?

15. Compare the appearance of cumuliform precipitation echoes with that of echoes of stratiform precipitation.

WORKBOOK
C3ABR25130-WB-308A

Technical Training

Weather Specialist

AN/FPS-77 RADAR

13 March 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

RGL: N/A

AN/FPS-77 RADAR

OBJECTIVES

Given an FPS-77 Severe Storm Detection Radar Set, in mormal mode and necessary references, operate its scopes and associated controls IAW checklist with no more than 6 procedural errors.

PROCEDURE

Match the statement on the left with the most correct statement on the right. Some statements may be used more than once, some not at all. Select the best possible answer.

MATCHING

_____ 1. Images will remain indefinitly on this scope until erased.

_____ 2. In this setting video is applied to the scope.

_____ 3. This will adjust the strength of the video signal supplied to the scope.

_____ 4. Range marks on this scope appear as concentric circles.

_____ 5. The FPS-77 radar set has a wave length of __________.

_____ 6. Drizzle has a minimum drop diameter in the range of _____ to _____.

_____ 7. When the PPI is neither writing nor erasing, the Display Mode Selector switch should be left in the ___ _____.

_____ 8. The erase mode affects which scope of the FPS-77 radar set.

_____ 9. This scope has ranges of 30, 60, 120, or 200NM.

_____10. The CRT on the PPI scope is often refered to as the _____ _____.

_____11. You should insure how many minutes have elapsed between erasures.

_____12. What is applied to the CRT of the PPI scope in the erase mode?

A. RHI Scope
B. 4.5CM
C. Video Gain
D. PPI Scope
E. 5.4CM
F. Intensity Control
G. Range Mark Selector Switch
H. Retainer Tube
I. 100-500 Microns
J. Write Mode
K. Standby Mode
L. 50-100 Microns
M. 3-5 Minutes
N. Memory Tube
O. Astigmatism Control
P. 3 Minutes
Q. Focus Control
R. 10 Seconds
S. Heat
T. 5 Seconds

Supersedes C3ABR25130-WB-308A, 21 December 1982.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 550; DAV - 1

_____13. Ground clutter and a horizontal cross-section of targets may be portrayed on this scope.

_____14. What is the maximum amount of time the display mode selector switch can be left in the erase mode?

PROCEDURE

TRUE/FALSE. If the statement is false give a brief reason for your choice.

_____ 1. The FPS-77 radar is designed to detect clouds of all sizes. True/False

_____ 2. The FPS-77 radar consists of 3 major sub assemblies. True/False

_____ 3. Back lighting of green flourescent light makes the images appear as magenta colored images. True/False

_____ 4. The CRT on the PPI is chemically treated to disperse the bombbardment of electrons, to prevent damage to the CRT. True/False

_____ 5. The PPI scope presents a horizontal cross section of suitable targets. True/False

_____ 6. Heat can be applied to the CRT as long as necessary to insure all images are erased. True/False

_____ 7. The intensity control adjusts the amplitude of the video signal applied to the scope. True/False

_____ 8. When the PPI scope is operated in the automatic mode the cursor indicates the antenna position. True/False

_____ 9. The minimum detectable drop diameter is 31 microns at 10NM. True/False

_____10. Range Mark Gain adjusts the brightness and position of Range Marks on the PPI Scope. True/False

_____11. The CRT can be damaged if the images are painted too dark. True/False

_____12. The ranges available on the PPI Scope are 30, 60, or 120 NM. True/False

_____13. The center 1 inch of the PPI Scope is blanked out to block out ground clutter. True/False

_____14. The astigmatism control insures that focusing is uniform throughout the image. True/False

_____15. A visible sweep rotates on the scope when the antenna rotates 4 RPM or faster. True/False

SHORT ANSWER

1. Explain the purpose of the cursor.

2. Explain the function of the azimuth hand wheel in the automatic mode and the manual mode.

3. What are the 3 positions of the Display Mode Selector Switch and briefly explain what happens in each position.

4. What is the purpose of the following controls?

   a. Video Gain

   b. Intensity

   c. Focus

   d. Astigmatism

   e. Range Mark Gain

PROCEDURE

TRUE/FALSE. If the statement is false give a brief reason for your choice.

_____ 1. The Vertical Position Control adjusts the sweep origin up or down to zero height. True/False

_____ 2. The Height Selector Switch on the RHI Scope allows echoes to be displayed on scales of either 0-40,000 or 0-80,000 feet. True/False

_____ 3. The RHI scope displays 15, 30, 60, or 120NM target to antenna slant range depending upon the position of the Range Selector Switch. True/False

_____ 4. The sweep on the RHI scope coincides with the half power points. True/False

_____ 5. The settings available on the Sector Scan Width Selector Switch are -2 to 15°, -2 to 45°, and -2 to 60°. True/False

_____ 6. Ranges available on the RHI Scope are 15, 30, 60, and 120NM. True/False

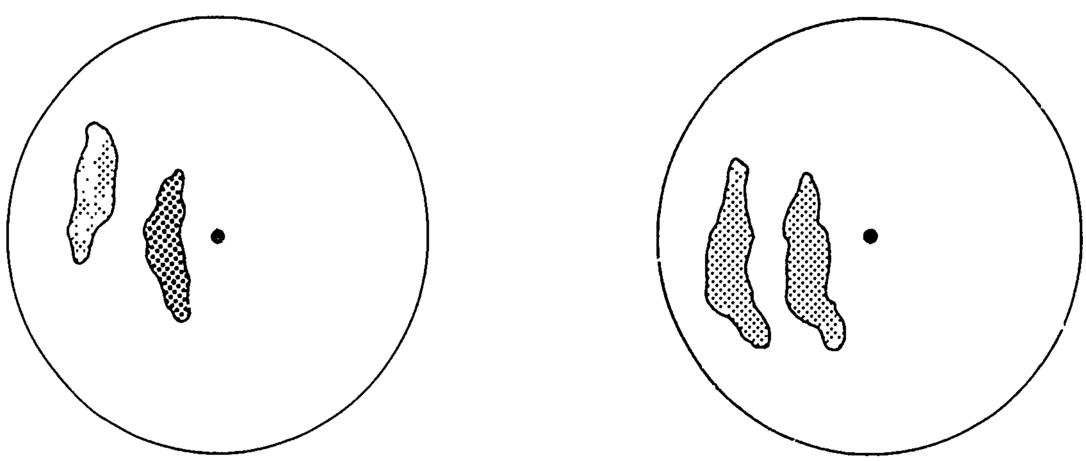
_____ 7. The RHI Scope provides a cross-sectional view of the vertical structure of the target. True/False

_____ 8. When using the Azimuth Handwheel the sweep scans manually from -2 to 60°. True/False

_____ 9. The sweep on the RHI Scope coincides with the axis of propagation. True/False

_____10. The Elevation Handwheel controls the angular distance of the antenna in the manual mode. True/False

11. Which one of the two illustrations below best illustrates that the range normalization is on?



Why?

PROCEDURE

Supply the missing words or phrases for the blanks.

1. The A Scope provides a plot of received ________________ ________________ versus range.

2. Rotation of the ______________ ______________ ______________ changes the location of the 5NM sector.

3. The greater the received signal amplitude, the greater the ________________ of the sweep.

4. Normal returns from meterological targets are ______________, while normal ground clutter returns are ________________.

5. The A/R scope is used for measuring ______________ and determining accurate ________________.

6. Depending upon the position the ______________ switch, ranges of _____, _____, _____, or _____ are available on the A/R Scope.

7. The R-Scope displays a _____ sector of the sweep.

8. The A/R Scope consists of ______ separate displays on a ______ CRT.

9. The _____ Scope displays the echo in greater detail.

10. The Range Strobe consist of a Strobe Position Handwheel and _____________ Counter.

11. The Range Strobe is used to determine accurate ____________ from the ______________ to ________________.

12. The strobe appears as a _______NM____________ in the baseline of the A/R Scope.

13. Exact range is indicated on the Nautical Miles Counter whenever the _____________ edge of the _____________ is on the target.

SHORT ANSWER

1. What is the purpose of the Range Strobe, what scope(s) does it appear, and how does it appear?

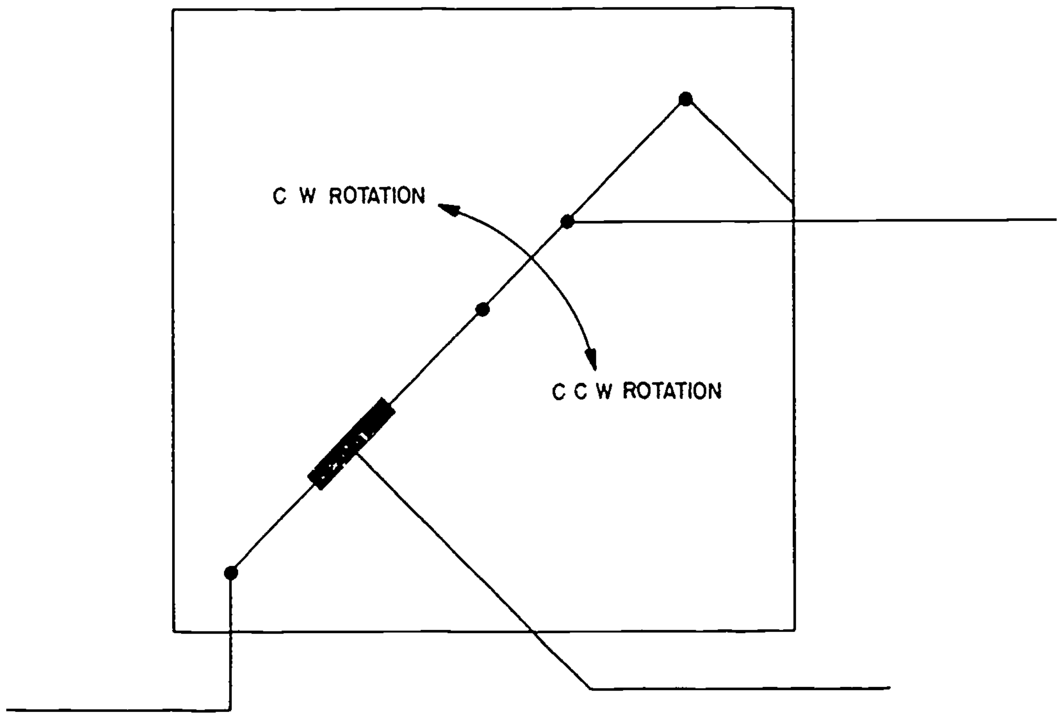
2. Briefly describe the difference between the A scope and the R scope.

3. Briefly describe the procedure for finding the direction and distance of a target. I.e., what scopes are used? What controls are used?

4. How are range marks portrayed on the 3 different scopes?

5. What is the purpose of the Strobe Gain Control?

Label the following parts on the RHI Scope:



PROCEDURE

MATCHING

Match the statement on the left with the most correct statement on the right. Some statements may be used more than once, some not at all. Select the best possible answer.

_____ 1. Adjust the brightness of the sweep and display.

_____ 2. Used to determine accurate distance from antenna to target.

_____ 3. Moves the strobe on the sweep of the A/R and RHI Scopes.

_____ 4. Indicates the range in NM, is the most accurate.

_____ 5. Located on the A/R Scope, but not on the RHI Scope.

_____ 6. Functions same as A Scope, but echo is displayed in greater detail.

_____ 7. Elevates the video signal above the base-line on the CRT.

_____ 8. Located 1/4-inch above baseline on the CRT of A/R Scope.

_____ 9. Controls the depth of the 5NM trench.

_____10. 5NM trench appears on the ___________.

_____11. Bright 5NM section appears on what scope?

_____12. Insures uniform focusing throughout the image.

A. PPI Scope

B. Intensity

C. Azimuth Handwheel

D. Focus

E. Power Reference Line

F. A Scope

G. A/R Scope

H. Strobe Gain

I. RHI Scope

J. R Scope

K. Video Gain

L. Astigmatism

M. Natical Mile Counter

N. Range Strobe

O. Strobe Position Handwheel

P. Range Selector Switch

PROCEDURE

TRUE/FALSE. If the statement is false give a brief reason for your choice.

_____ 1. The IF attenuator control is calibrated in precise decibel steps from 0-99. True/False.

_____ 2. The 4 range normalization settings are OFF, 30, 60, and 120NM. True/False

_____ 3. The IF attenuator dims the PPI and RHI scopes. True/False

_____ 4. The antenna is 8 feet in diameter. True/False

_____ 5. Range Normalization operates on a video cancellation principle. True/False

_____ 6. Iso-Echo may be used to measure echo intensity. True/False

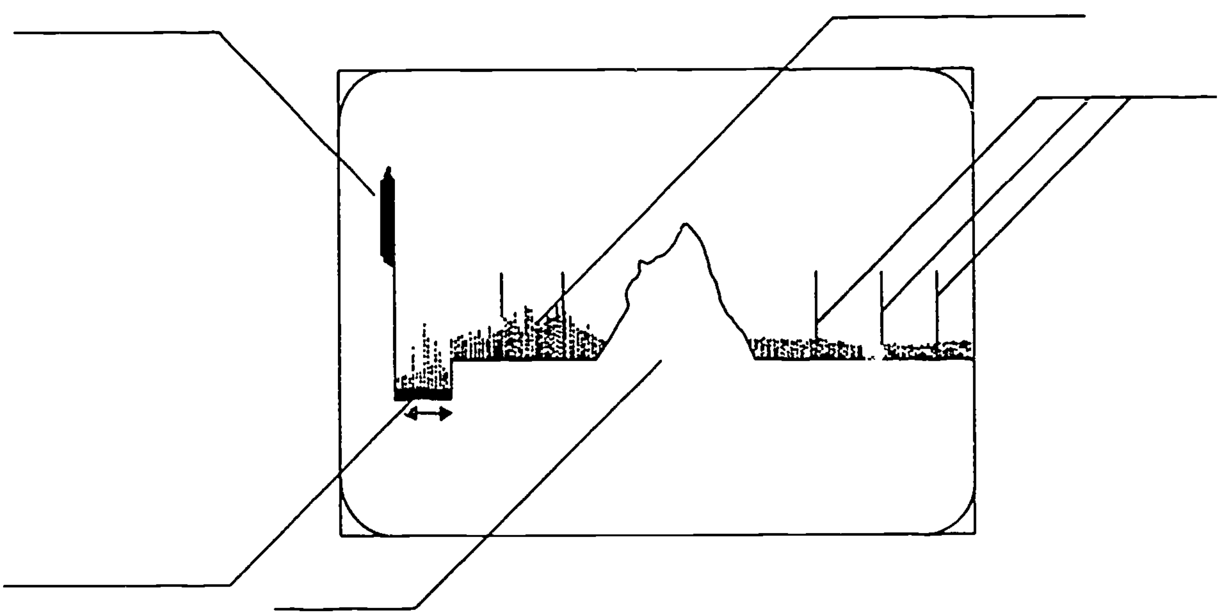
_____ 7. Always use at least 30NM range normalization to eliminate erroneous echoes. True/False

_____ 8. The IF attenuator is primarily used to measure echo intensity. True/False

_____ 9. When the RHI sweep reaches its lowest point, switch the EMA switch to manual. True/False

_____ 10. The range normalization control applies a correction to the amplitude of all echoes. True/False

Label the following parts on the A/R Scope.



PROCEDURE

Supply the missing words or phrases for the blanks.

1. The EMA switch is a ____________ position switch which controls the ___________________.

2. With the EMA switch in manual, the ____________ may be moved in azimuth by the use of the azimuth ______________ or vertically by the use of the ________________.

3. The Iso-Echo operates on a ________________ ________________ principle.

4. Range marks for all scopes are at intervals of 5, ______, ______, or ______.

5. The Gain ______________ _________________ is used to measure echo intensity on the _________ scope by reducing the signal to the _______________ _______________ _______________.

6. By using the ____________ handwheel on the ____________, the antenna may be moved vertically from -2° to ____________ depending on the position of the Sector Scan Width Selector Switch.

7. When switching back to manual wait until the sweep is within ____________ to ____________ degrees of the ____________ before doing so.

8. By using the ____________ ____________ on the PPI scope the antenna may be moved _________ 360°.

MATCHING

Match the statement on the left with the most correct statement on the right. Some statements may be used more than once, some not at all. Select the best possible answer.

_____ 1. Controls the intervals of the range marks.

_____ 2. Indicates the elevation of the antenna.

_____ 3. Used to identify echo signatures.

_____ 4. Makes echo intensity appear as if located at the outer edge of the range.

_____ 5. __________ is a three position switch used for controlling the antenna.

_____ 6. In this mode, the antenna rotates clockwise at 5 to 8 RPM.

_____ 7. If you exceed the angular distance of the Sector Scan Width Selector Switch, the antenna will enter __________________________.

_____ 8. The Iso-Echo level decibel switch is in 10db levels from __________ to __________.

_____ 9. When using Iso-Echo, portions that exceed the set threshold are displayed at ______ ______.

_____10. Causes the A/R return to appear at lower amplitudes.

A. 30-60

B. Range Mark Selector Switch

C. EMA Switch

D. LOG

E. IF Attenuator

F. Zero Amplitude

G. 10 to 90

H. Automatic Elevation

I. 10 to 30

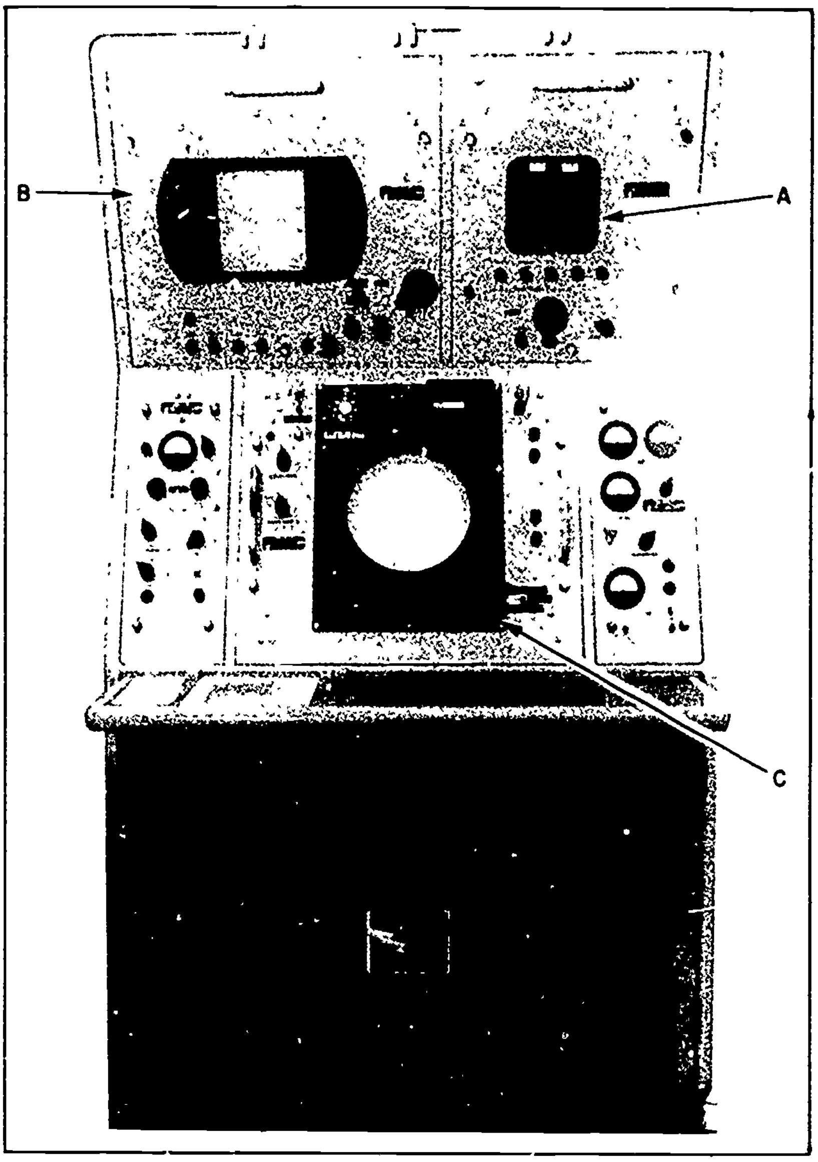
J. Range Normalization

K. Range Strobe

L. Elevation Angle Counter

M. Iso-Echo

N. Azimuth Automatic



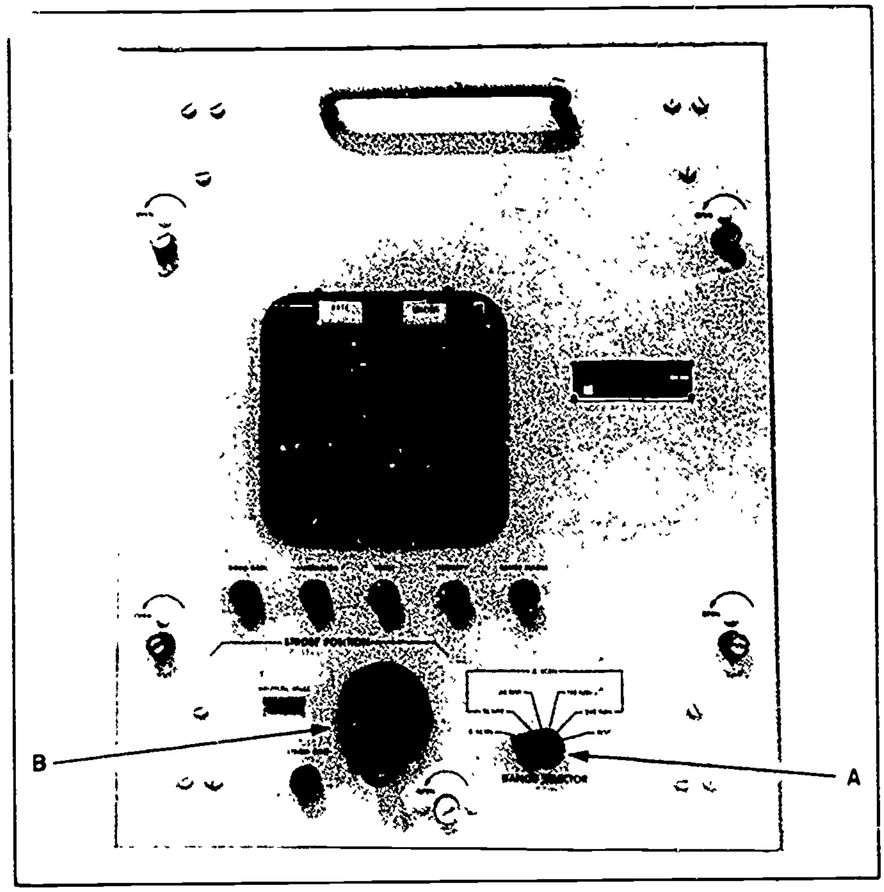
Label the 3 scopes on the FPS-77 Radar.

A. ______________________

B. ______________________

C. ______________________

984



A. Range Selector Switch. Ranges available are:

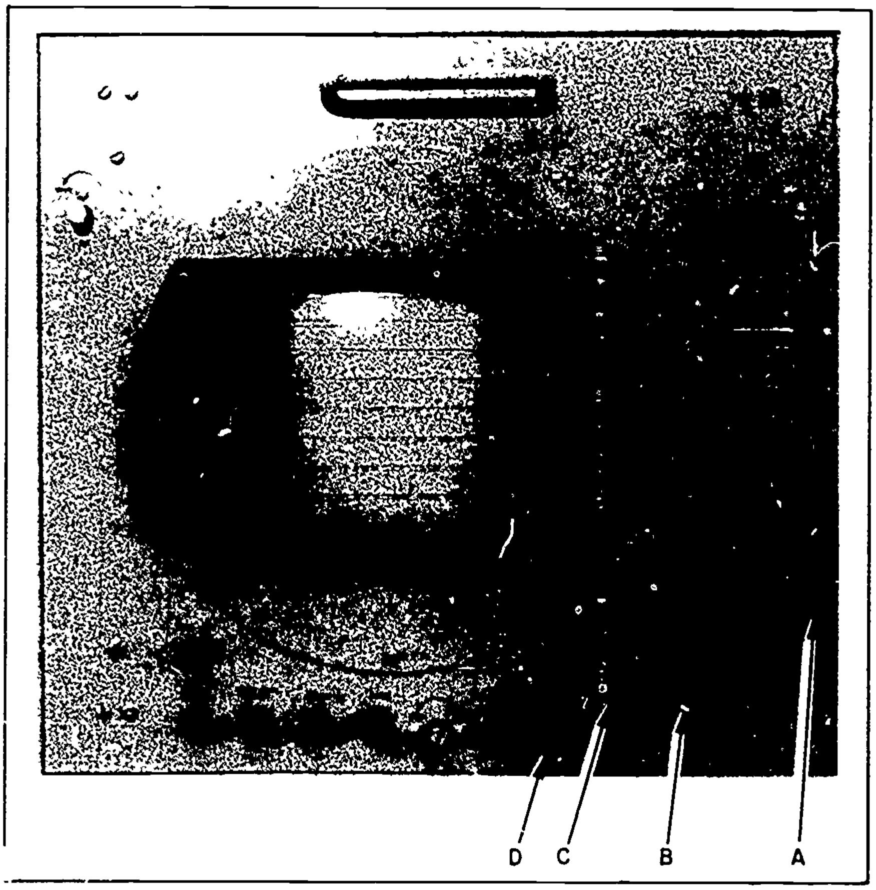
1.

2.

3.

4.

Label part B ____________________________



Label Part A ______________________________

B. Range Selector Switch. Ranges available are:

1.

2.

3.

4.

C. Height Selector Switch. Heights available are:

1.

2.

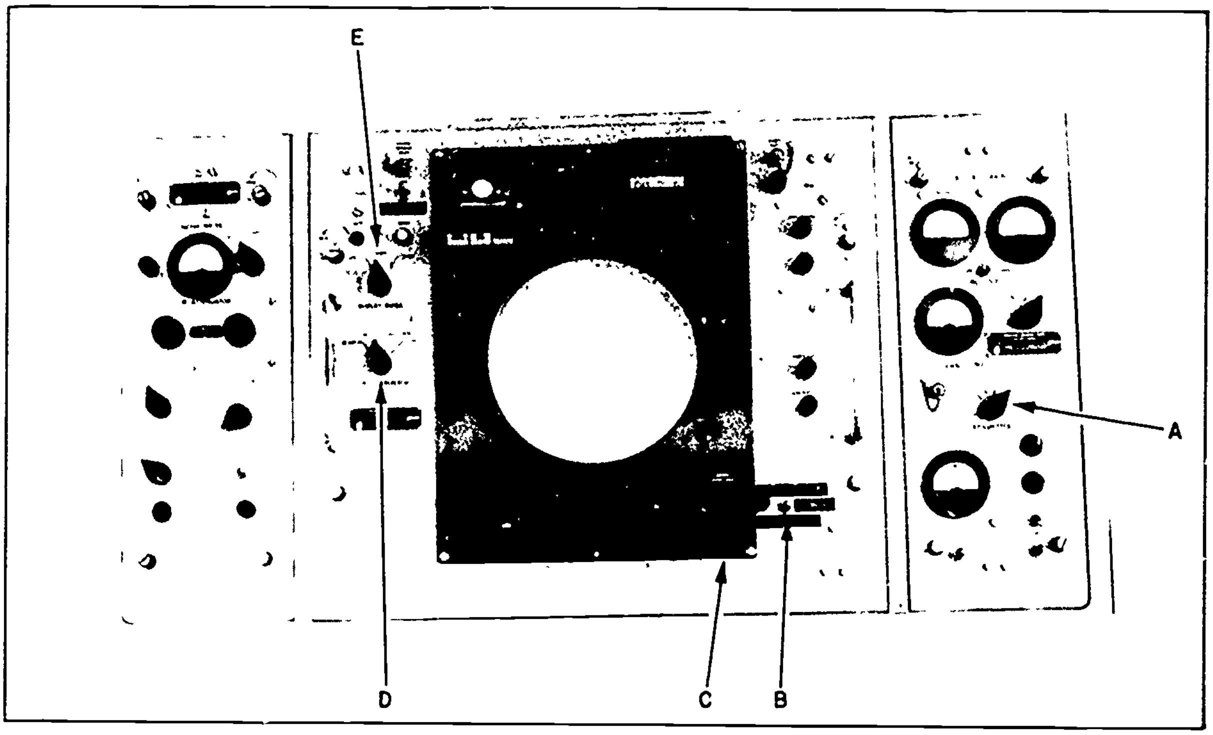
D. Sector Scan Width Selector Switch. Sectors available are:

1.

2.

3.

986



A. Range Mark Selector Switch. Range marks available are:

1. 3.

2. 4.

B. EMA Switch. Positions available are:

1. 3.

2.

Label Part C ______________________________

D. Range Selector Switch. Ranges available are:

1. 3.

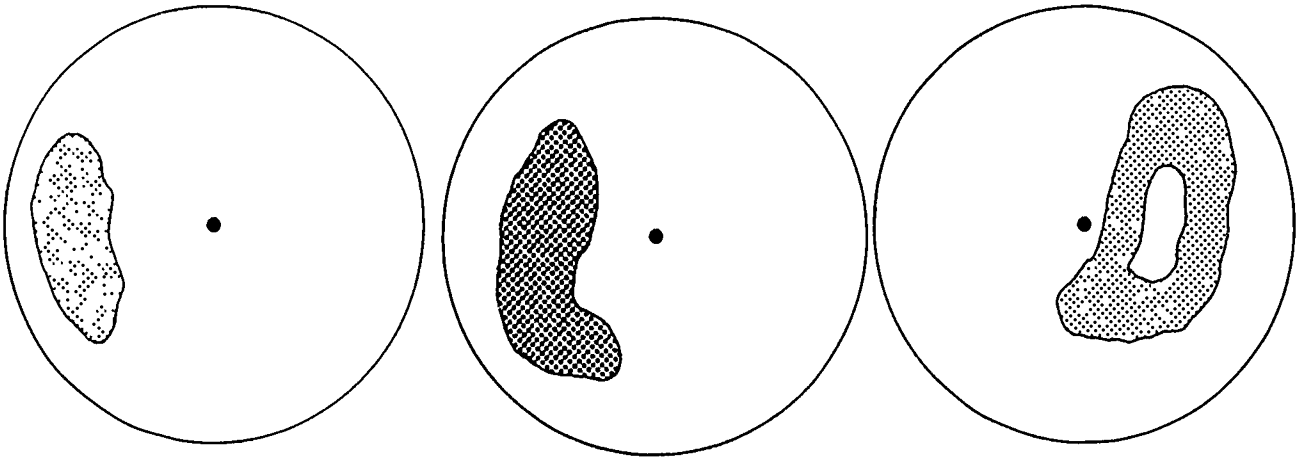
2. 4.

E. Display Mode Selector Switch. Positions available are:

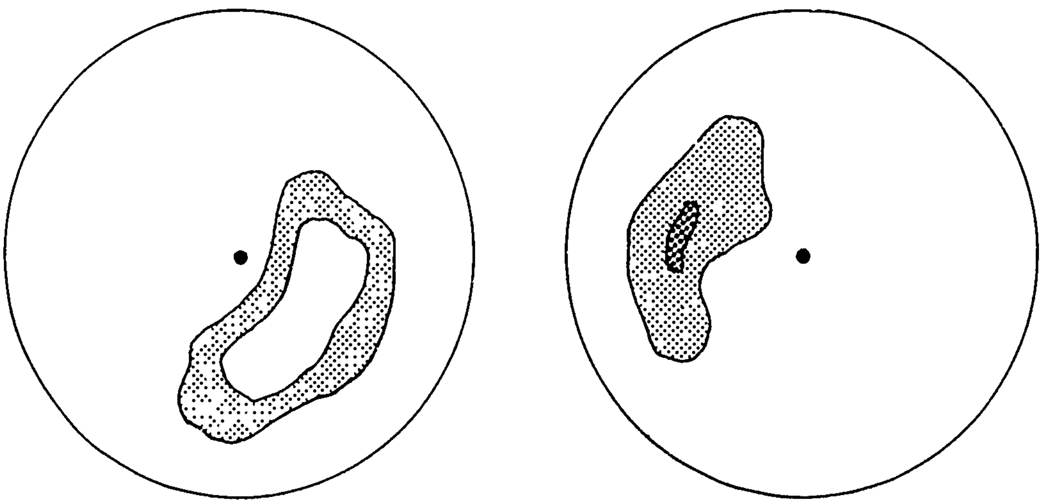
1. 3.

2.

1. Which illustration below best shows Iso-Echo?



2. Which of the illustrations below best shows Iso-Echo of 10db?



988

WEATHER RADAR PERFORMANCE

CHECKLIST

PURPOSE: Radar can provide a great deal of data useful in taking weather observations, particularly in the location and movement of convective weather patterns and vertical distribution of clouds. Continously updated radar information is important if the unit is to perform proper weather support functions. In order to accomplish this, the observer must be able to take rapid and accurate radar observations using the FPS-77 radar. This checklist will help in preparing for the Radar Controls Performance Check.

INSTRUCTIONS: Study this checklist to learn the procedures that will have to be followed when accomplishing operational procedures with the FPS-77 Severe Storm Detection Radar Set in normal operating mode. With an instructor, ensure that NO MAINTENANCE is being performed on the components of the FPS-77. (Main console, RTM and antenna). Accomplish the safety requirements first. Be able to operate the radar IAW this checklist with no more than six procedural errors.

---

(1) Obtain a presentation on the RHI SCOPE by adjusting:

(a) INTENSITY CONTROL - turn clockwise until sweep is visible.

(b) VIDEO GAIN CONTROL - turn clockwise until ground clutter is visible at the base of sweep.

(2) Obtain a presentation on the A/R SCOPE by adjusting:

(a) INTENSITY CONTROL - turn clockwise until baseline is visible.

(b) VIDEO GAIN CONTROL - turn clockwise until "grass" touches the POWER REFERENCE LINE.

(3) Adjust the RANGE MARK INTERVAL at 10NM using the RANGE MARK SELECTOR SWITCH.

(4) Adjust the RANGE NORMALIZATION CONTROL to at least 30NM of RANGE NORMALIZATION.

(5) Set the ISO-ECHO CONTROL to 39Db.

(6) Set range on the PPI SCOPE to 60NM using the RANGE SELECTOR SWITCH. (Set ranges on RHI and A/R scopes to 60NM)

(7) Place the EMA SWITCH in AZIMUTH AUTOMATIC and the DISPLAY MODE SELECTOR SWITCH in WRITE SIMULTANEOUSLY.

(8) Obtain a presentation on the PPI SCOPE by adjusting the:

(a) INTENSITY CONTROL - turn fully clockwise.

(b) VIDEO GAIN CONTROL - turn clockwise, at a minimum, 3/4 of a turn or until sweep is visible.

(c) RANGE MARK GAIN CONTROL - turn clockwise until range marks are visible.

(9) As soon as the PPI SCOPE presentation is dark enough, SIMULTANEOUSLY turn the EMA SWITCH to MANUAL and the DISPLAY MODE SELECTOR SWITCH to STANDBY when the sweep is within 10 to 15 degrees of the CURSOR.

(10) Determine the direction to the target (picked at instructor's discretion) by adjusting the AZIMUTH HANDWHEEL until the cursor is on target.

(11) Using the RANGE MARKS or RANGE STROBE, determine the distance to the target.

(12) Determine Echo Intensity Category:

(a) Stop the ANTENNA on the strongest portion of the target to be measured. (The instructor will determine the target).

(b) Turn the ISO-ECHO CONTROL OFF.

(c) Determine the range to the target using the trench/strobe on the A/R SCOPE. (Ensure that the left side of the trench is set on the target).

(d) Increase the IF ATTENUATOR SETTING until the A/R signal is reduced to the POWER REFERENCE LINE.

(e) Use the NOMOGRAM to determine intensity category. (Ignore Range Normalization setting).

(f) Return the IF ATTENUATOR setting to 00.

(13) Determine Echo Height:

(a) Stop the ANTENNA on the highest part of the target to be measured. (Use the same target as in step (12)(a)).

(b) Insure that the RHI SWEEP ORIGIN is at 0 (zero) degrees by using the VERTICAL POSITION CONTROL to adjust as needed.

(c) Set the SECTOR SCAN WIDTH SELECTOR SWITCH to appropriate setting. (Setting will be at instructor's discretion).

(d) Place EMA SWITCH in ELEVATION AUTOMATIC.

(e) Determine the target's maximum height by averaging the upsweep and downsweep reading on the RHI SCOPE, using the appropriate scale. (Average 2 complete sweeps).

(f) When the ANTENNA is at -2 degrees, on the downswing, place the EMA SWITCH in MANUAL. (The INSTRUCTOR will tell the student when to go back into manual control, at any time during the sweep. The student will go to manual at -2 degrees).

(14) Compute the CORRECTED HEIGHT by using the following:

(a) RHI UNCORRECTED HEIGHT - taken off of the RHI SCOPE, ± 2000 feet. (Use Height in step (13)(e)).

(b) Antenna height at Chanute AFB. (+800 feet).

(c) Correction off of the ECHO TOPS CORRECTION GRAPH - read to the nearest 100 feet.

NOTE: At this point, the instructor may ask you to turn down the controls, turn off the antenna, etc. Your grade will not be determine by these additional procedures. The instructor will guide you or assist you as needed for shutdown procedures.

Technical Training

Weather Specialist

SCOPE INTERPRETATION THEORY

23 March 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE

DO NOT USE ON THE JOB

Weather Training Branch
Chanute AFB, Illinois

C3ABR25130-WB-308B

SCOPE INTERPRETATION THEORY

OBJECTIVE

Given simulated radar scope presentations, Intensity Nomogram, Echo Tops Correction Graph and Weather Radar Manual, Part A, observe, encode and record information on Air Weather Service Form 104 to at least 75% accuracy.

Answer the following questions completely.

1. You must be ____________ to take official radar observations.

2. On what form are radar observations recorded?

3. What is reported in a radar observation?

4. Enter the day of the month on the ____________ line of <u>each observation</u> in Col. 1, in ____________ digits.

5. The ascribed time of a radar report is entered in ____________ digits and is the time of the last data ____________.

6. How recently should all elements of the radar observation have been observed?

7. Which echoes will you report?

Supersedes C3ABR25130-WB-308B, 16 December 1982.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 550; DAV - 1

8. What are the four (4) things that must be described in reporting an echo system?

a.

b.

c.

d.

9. What is the first step in encoding echoes from the PPI scope?

10. In what column will the code of the echo system be reported?

11. Define an AREA.

12. At least what percentage of the total area must be covered to encode a system as an AREA? ______________________

13. How many cells are required to constitute a convective AREA?

____

14. What is the minimum length-to-width ratio of a LINE (LN)?

____

15. A LN must be at least ______________NM long.

16. As a minimum, __________% of the total area must be covered to meet the criteria for a LN.

17. A LN is reported for convective systems only. TRUE/FALSE.

18. Define a CELL.

19. What is a STRATIFIED ELEVATED ECHO (LYR)?

20. What must you report with a LYR?

21. At 2130z you noticed a severe thunderstorm on your radar set to the North, and a light rainshower to the South. Which would you report

first? ______________________________

Why? ______________________________

22. If there were no intensity difference between the two systems in question 21, what would you consider in determining order of entry?

SYSTEM COVERAGE

23. System coverage, except for CELLs, is reported in ______________.

24. How many digits must be used to report system coverage?

25. A LN with no breaks is always reported as ______________ coverage.

PRECIP TYPE

26. What three (3) ways are used to determine precipitation type?

a.

b.

c.

27. If more than one precip type is observed in a convective system, which type would you report?

INTENSITY

28. How is the intensity of a stratiform system reported?

29. Match the following

______ A.	Weak	1.	U
______ B.	Strong	2.	No symbol
______ C.	Intense	3.	X
______ D.	Unknown	4.	XX
______ E.	Moderate	5.	-
______ F.	Very Strong	6.	+
______ G.	Extreme	7.	++

30. What are the two (2) times when echo intensity is reported as unknown (U)?

31. What are the four (4) types of precipitation for which intensity will always be reported?

a.

b.

c.

d.

32. List the five (5) steps involved in determining echo intensity.

a.

b.

c.

d.

e.

INTENSITY TREND

33. What is the period of evaluation for intensity trend of a CELL?

For a LN or AREA?

34. Explain the criteria for reporting a trend of:

a. (+) or (-) -

b. (NC) -

c. (NEW) -

35. At 1430 you reported three (3) CELLs with an intensity of a weak (-). At 1515, the cells had developed into a LN with an intensity of strong (+). What would you report for the intensity trend?

36. If the intensity is unknown or cannot be evaluated, what will you always report for the intensity trend? ____________________

DIMENSIONS, DIRECTIONS AND DISTANCES

37. Echo configurations are evaluated by describing the location, and

________________ ____________________ __________

and dimensions of related groups of echoes.

38. Direction is reported in Cols. 5A - 5E to the nearest __________ degree.

39. Distance is normally reported to the nearest ________________

NM. If severe weather is involved, report to the nearest ________ NM.

40. How is a CELL or circular AREA reported in Cols 5A?

41. Also report the circle's ______________________________.

42. For straight LNs and rectangular AREAs, report the ____________

______________ of the axis, and the average ______________.

43. How do you report a curved LN?

44. In what order will points be reported?

45. How would a LN of varying width be reported?

46. Give the procedures for reporting an irregular AREA.

47. In Col 6, report the average ______________ or ______________ to the nearest ______________ NM, but omit this entry for ____________ AREAs.

MOVEMENT

48. What is the time period for evaluating the movement of CELLs?

What is the time period for evaluating the movement of AREAs?

49. Measure the direction ______________________ which the echoes are moving to the nearest ______________________ degrees.

50. Decode the following movements.

a. A0113

b. L3627

c. C17103

d. A00C0

51. Derive the movement of CELLs and AREAs by considering the successive positions of __________________ or __________________________.

52. Why should you not use the far side of echoes when determining movement?

53. How do you determine the movement of a LN?

54. How is the movement of a LN with portions moving at different speeds, reported?

TOPS

55. When are echo tops not reported?

56. What corrections must be applied to echo tops?

57. How are the uniform tops of a stratiform system reported?

58. What additional information must be reported for a non-uniform system greater than 50 NM in diameter?

59. Other significant tops will be reported in Col ____________________.

REMARKS

60. What four (4) STANDARD REMARKS <u>must</u> include a direction and distance group for identification purposes?

a.

b.

999

c.

d.

61. What is the "MLTLVL," and how is it reported?

62. Match the following

____ a. PPINE	1.	Radar operating below performance standards
____ b. PPIOM	2.	Equipment inoperative or the data derived from the radar is of poor quality
____ c. PPINA	3.	Height data not available
____ d. ROBEPS	4.	Observation not available
____ e. ARNO	5.	No precip echoes observed
____ f. RHINO	6.	The intensity control on the A/R scope is broken

63. What two Operational Status Contractions must include a date/time group?

64. When do you use Plain Language Remarks?

65. On which line or lines of an observation will the observer's initials be placed?

OBSERVATION SCHEDULES AND SPECIALS/INITIALS

66. By what time must hourly radar observations be completed?

67. Take and record an hourly observation every __________ hours unless severe weather is located within __________ NM of your station, in which case an observation will be taken and encoded every __________.

68. What information will be included in "special" radar observation?

1000

69. Where will the contraction "SPL" be encoded in a special observation?

70. List all of the criteria for special observations.

a.

b.

c.

d.

e.

f.

g.

h.

i.

j.

k.

1001

Technical Training

Weather Specialist

SCOPE INTERPRETATION WORKBOOK

25 October 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE
DO NOT USE ON THE JOB

RGL: N/A

Weather Training Branch
Chanute AFB, Illinois 61868-5000

C3ABR25130 000-WB-308C

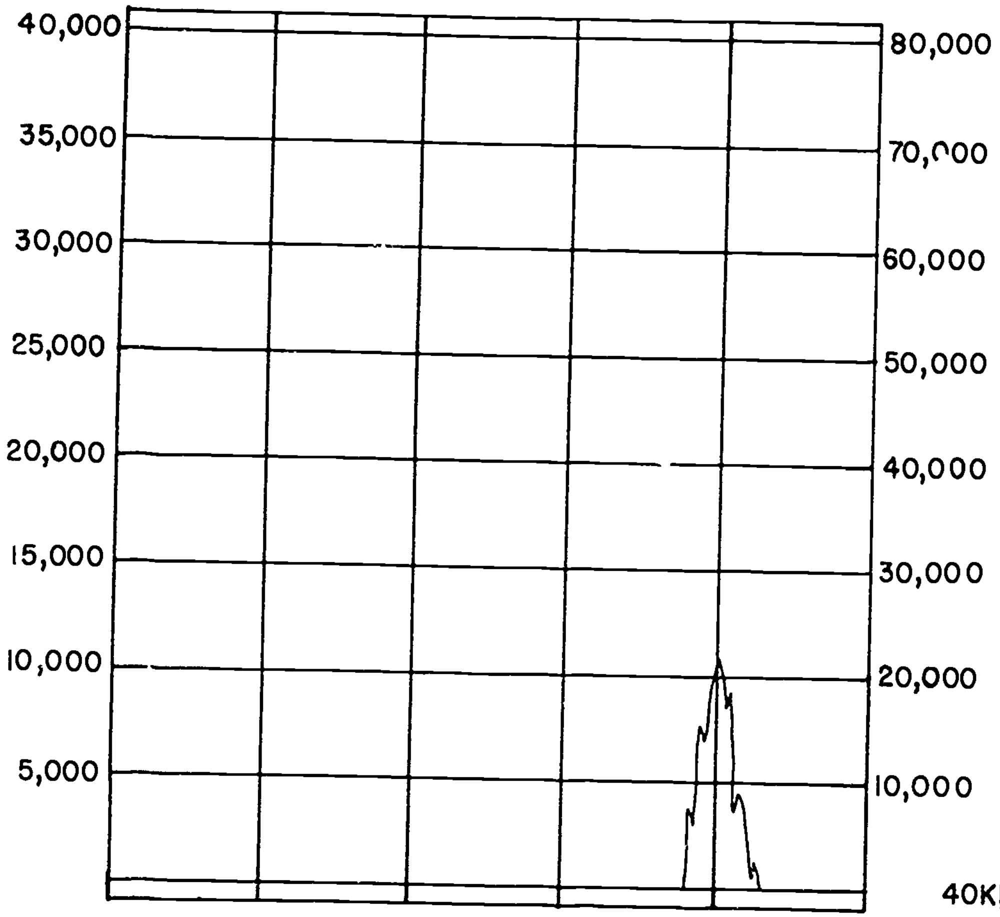
SCOPE INTERPRETATION WORKBOOK

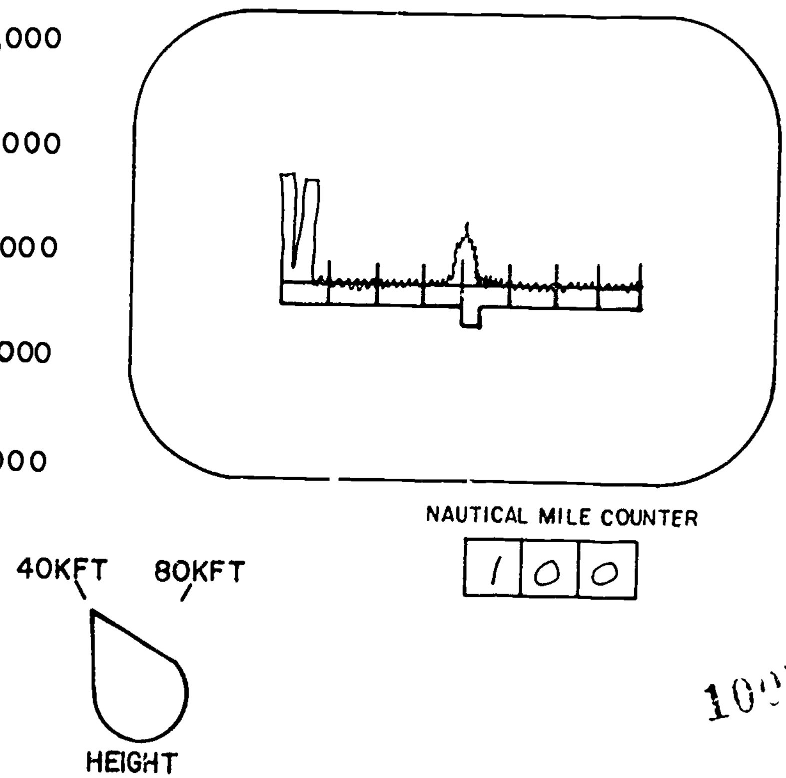
OBJECTIVE

Given simulated radar scope presentations, Intensity Nomogram, Echo Tops Correction Graph and Eather Radar Manual, Part A, observe, encode, and record information on Air Weather Service Form 104 to at least 75% accuracy.

Work each exercise as it is assigned. Make your entries on the observation form (AWSF 104) provided by your instructor. Past position of echoes on the PPI scope is shown by dashed lines. Centers of echoes are indicated by an "X" and past centers are indicated by an "*." Maximum tops are marked by an $\odot$.

Supersedes C3ABR25130-WB-308C, 20 January 1982.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 550; DAV - 1

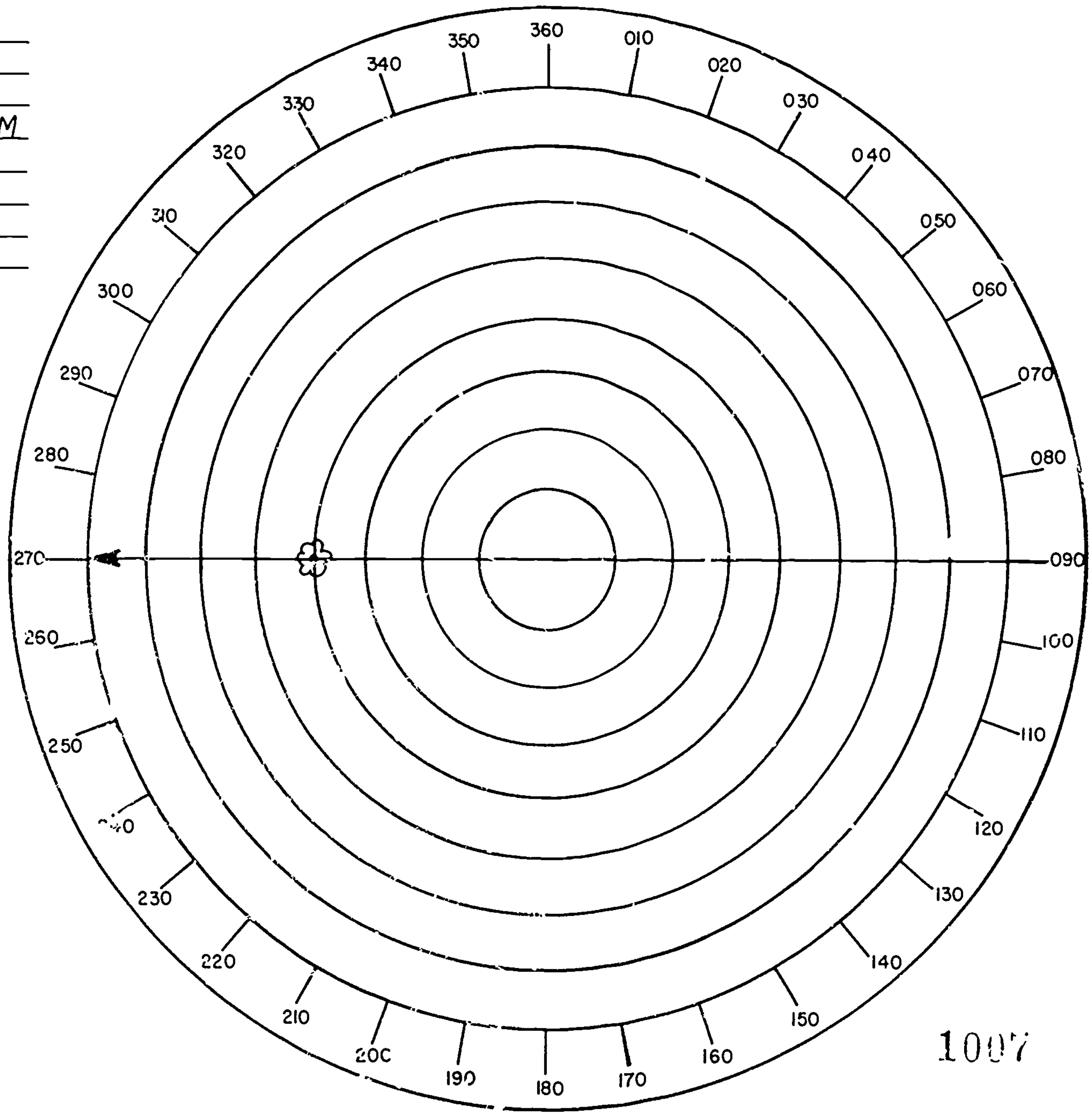

40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000


NAUTICAL MILE COUNTER
100
40KFT
80KFT
HEIGHT

OBSERVATION ENDED 2031
PAST POSITION 1933
RANGE ALL SCOPES 200 NM
RANGE MARKS ALL SCOPES 25 NM
REMARKS Past Radar Observations Reflects PPINE.

I.F.
ATTENUATOR
DB

1	8



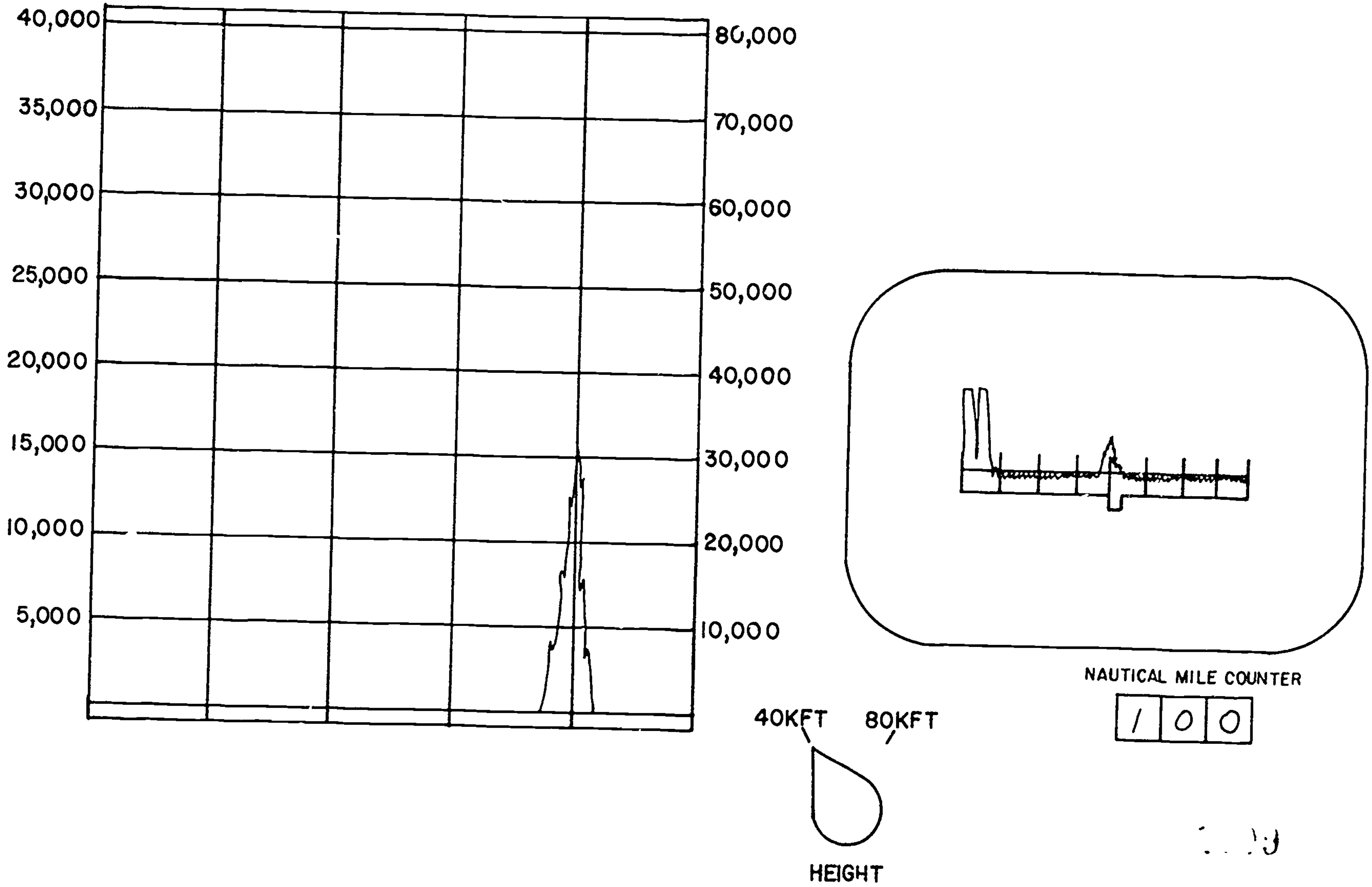
5

1006

1007

EXERCISE 1

EXERCISE 2



1008

OBSERVATION ENDED 2132

PAST POSITION 203L

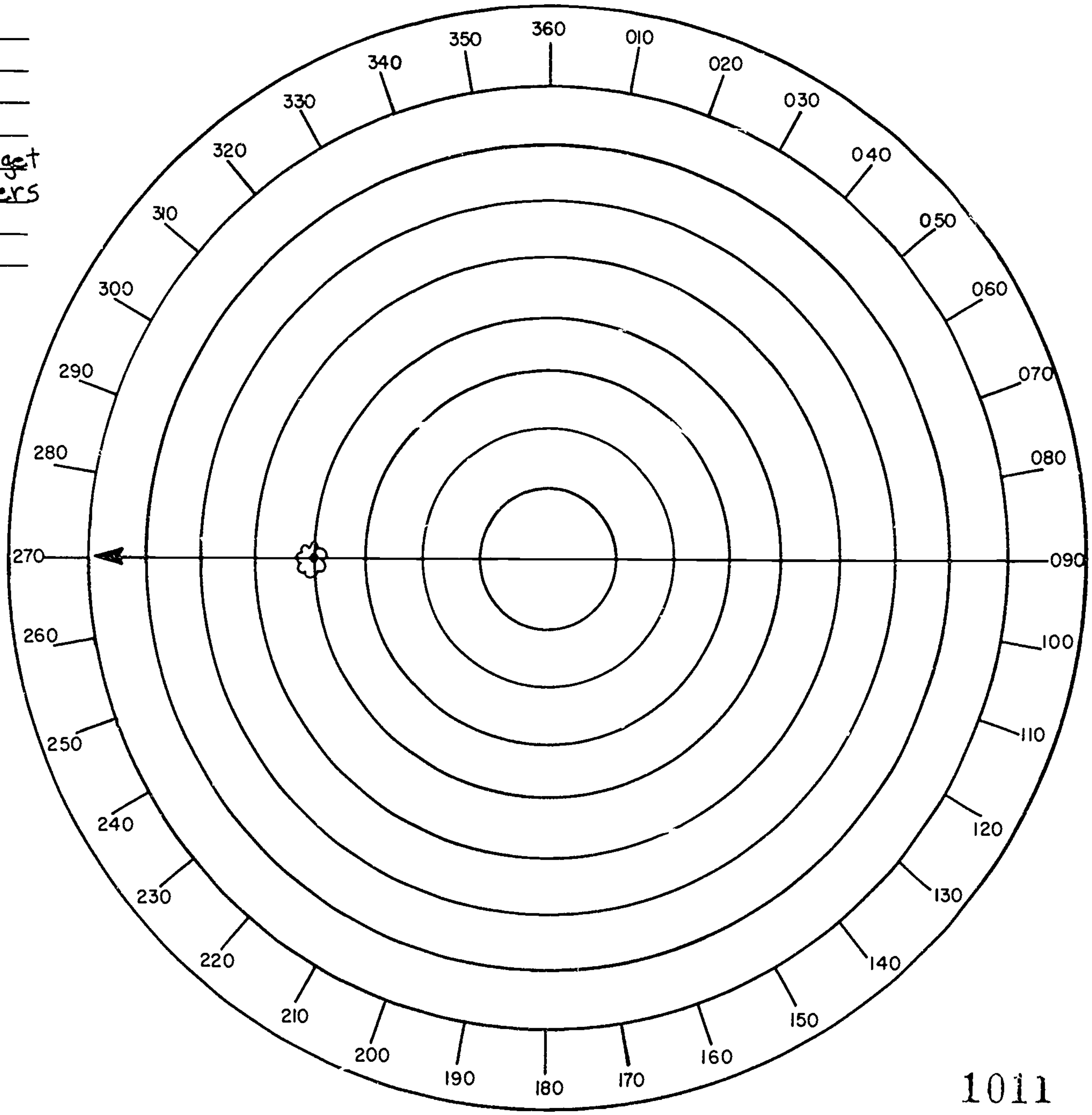
RANGE ALL SCOPES 200NM

RANGE MARKS ALL SCOPES 25NM

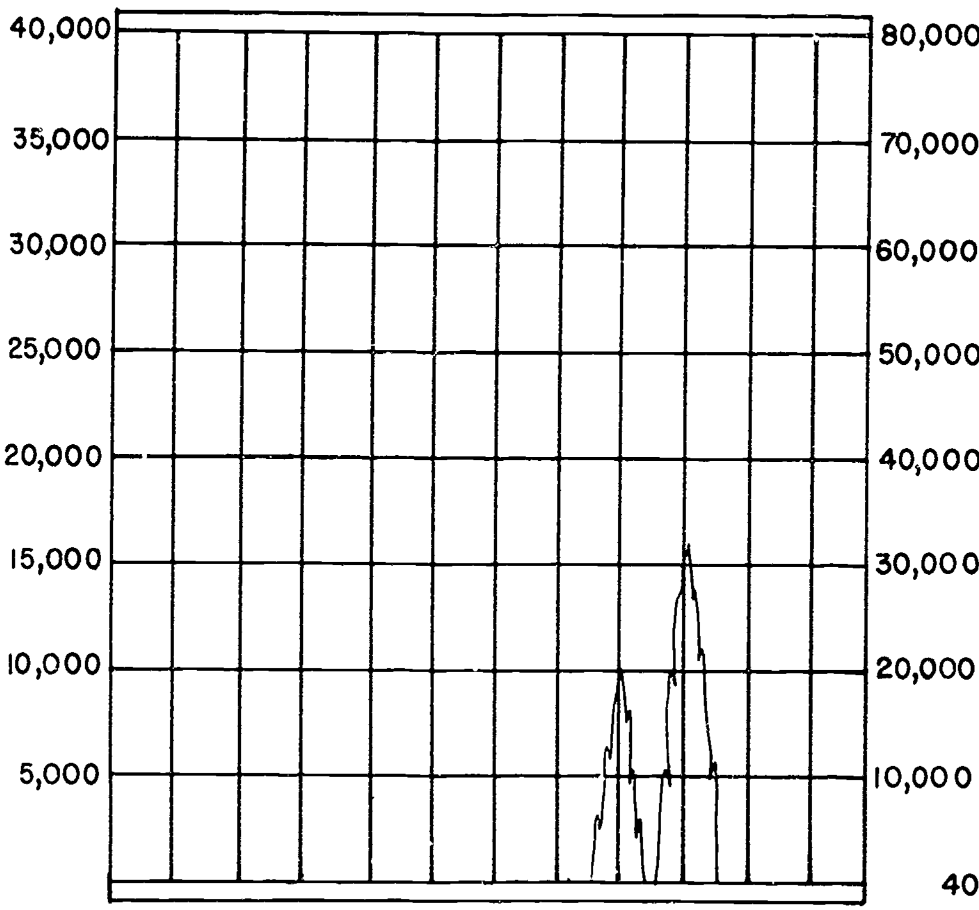
REMARKS PIREPS from target area indicated rainshowers to the west. Intensity at 2016 was weak.

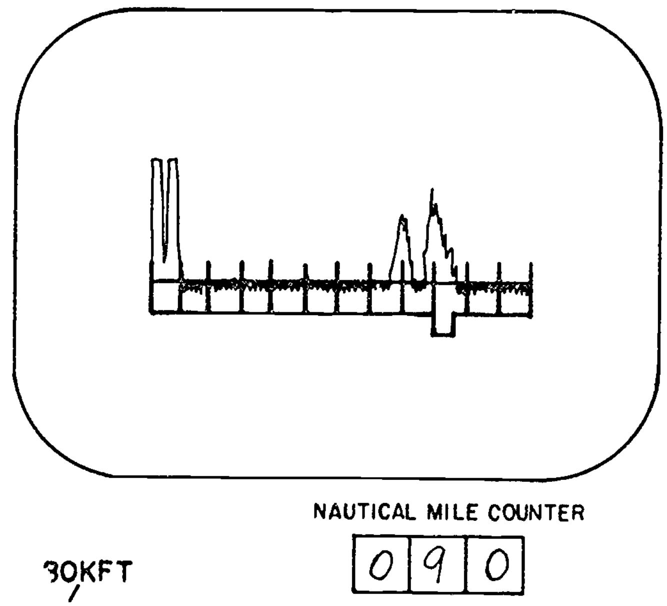
I.F.
ATTENUATOR
DB

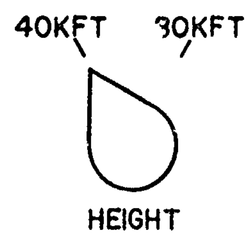
2	4



EXERCISE 2


40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000


NAUTICAL MILE COUNTER
0 9 0


40KFT
30KFT
HEIGHT

1012

1013

OBSERVATION ENDED 2232

PAST POSITION 2132

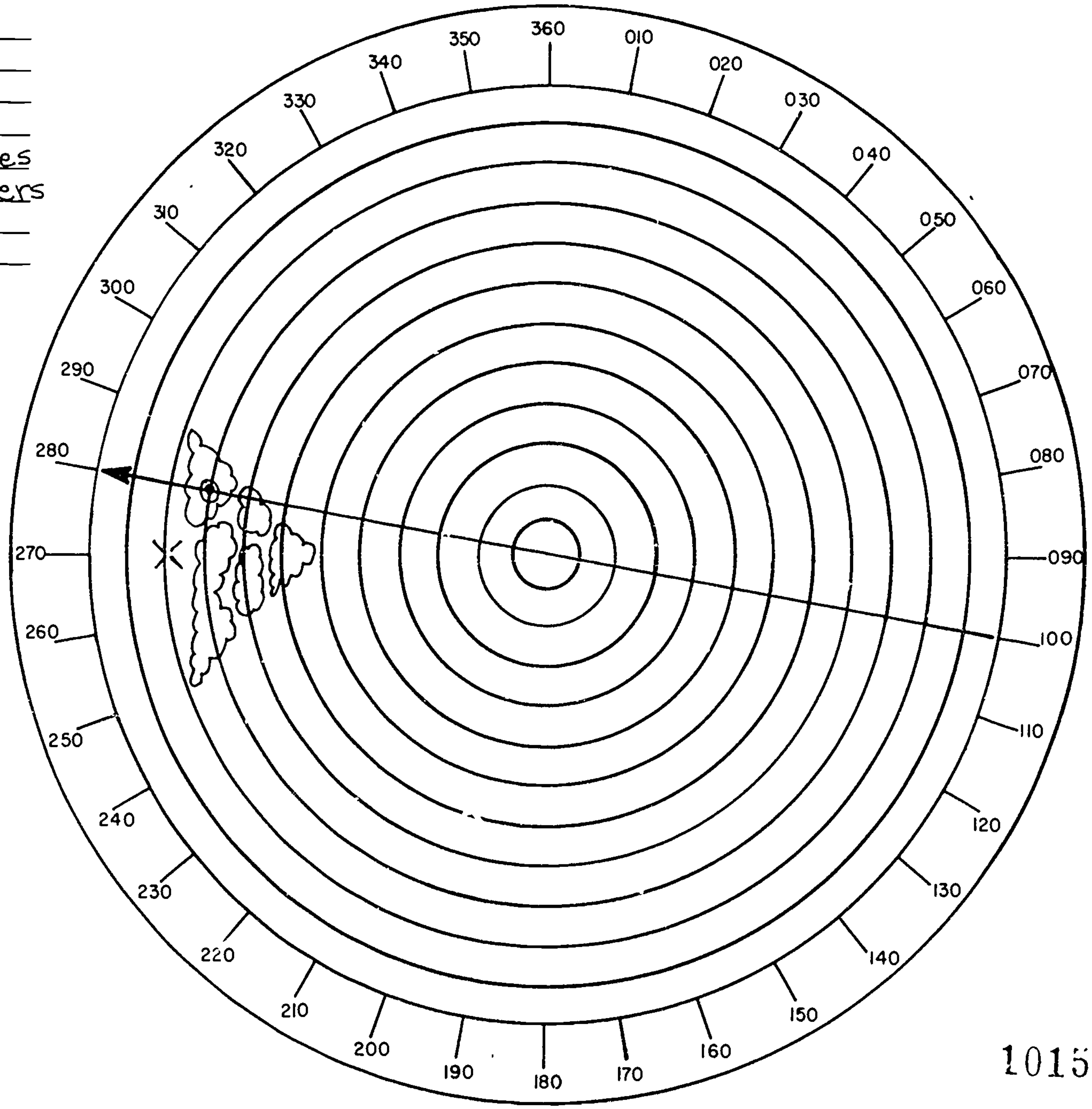
RANGE ALL SCOPES 120NM

RANGE MARKS ALL SCOPES 10NM

REMARKS A station 70 miles west reports rain showers

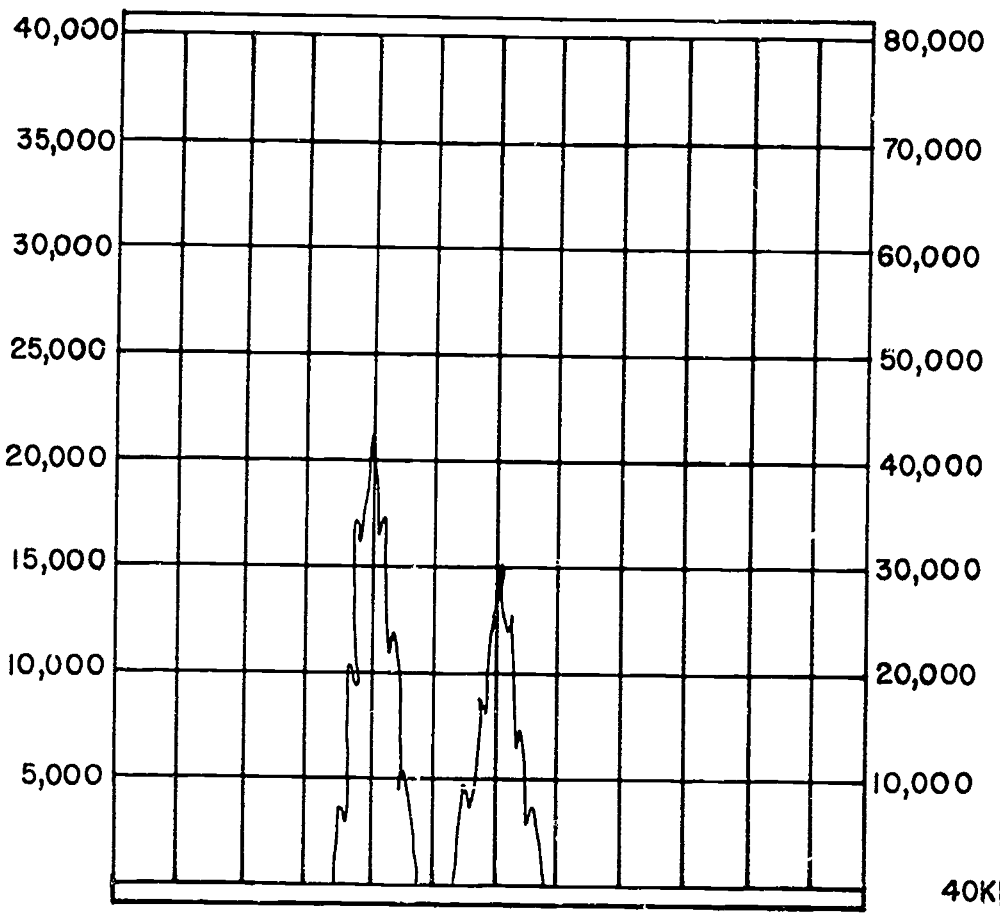
I.F.
ATTENUATOR
DB

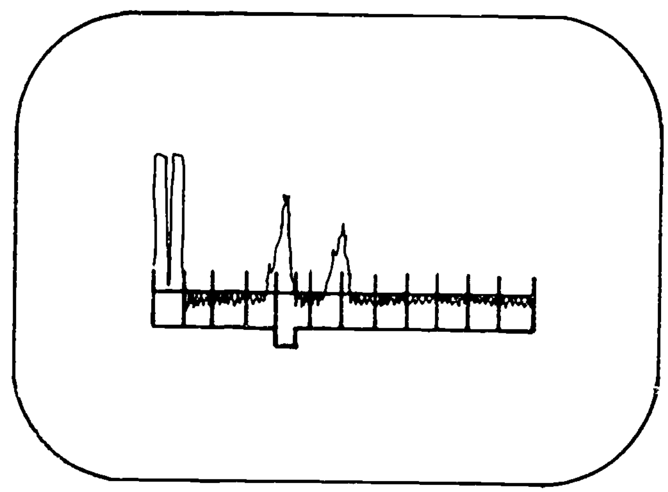
2	7



9

EXERCISE 3





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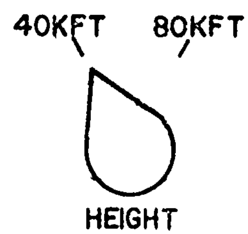


1016

1017

OBSERVATION ENDED 2332

PAST POSITION 2232

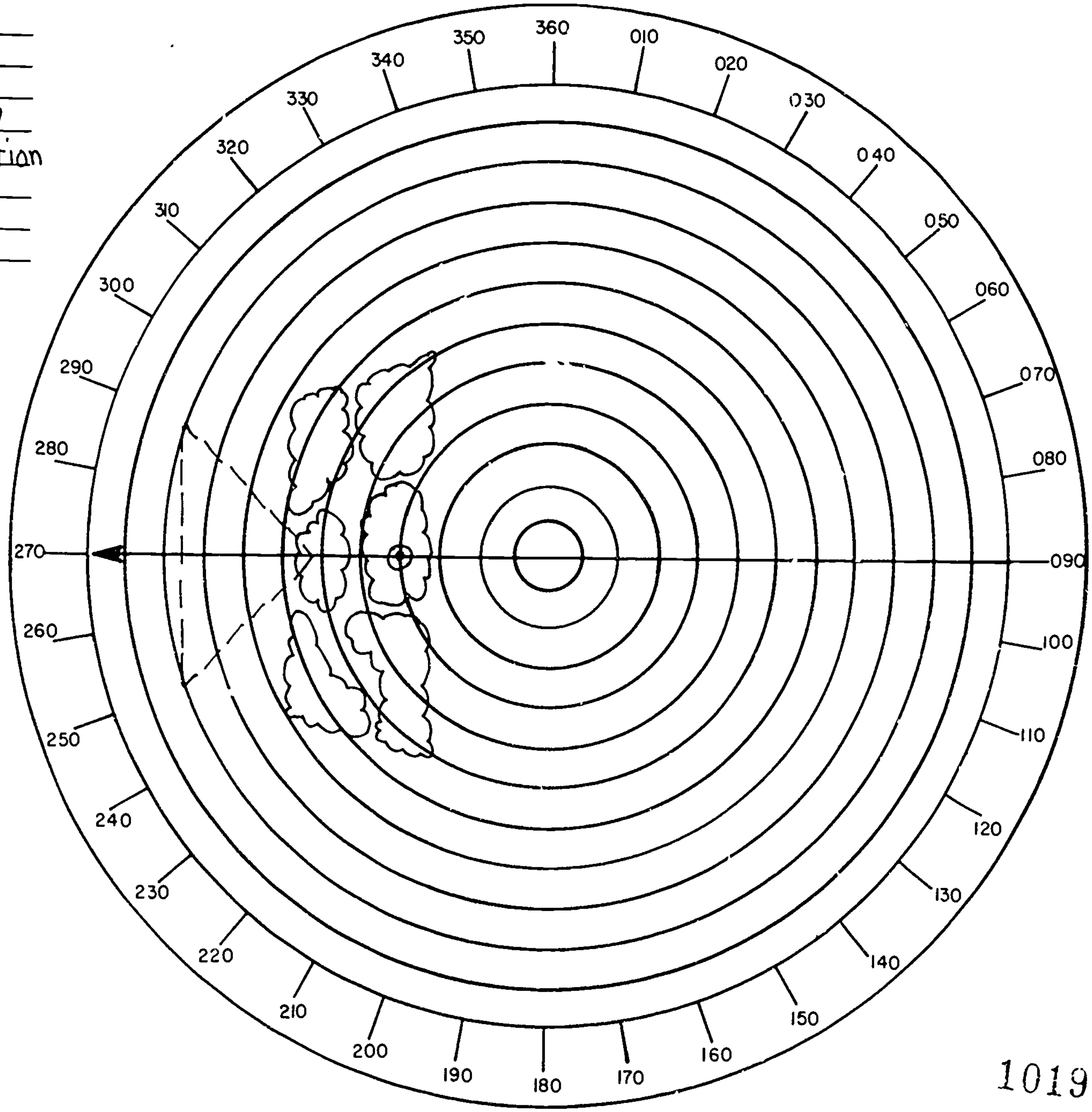
RANGE ALL SCOPES 120 NM

RANGE MARKS ALL SCOPES 10 NM

REMARKS Range Normalization at 60 NM

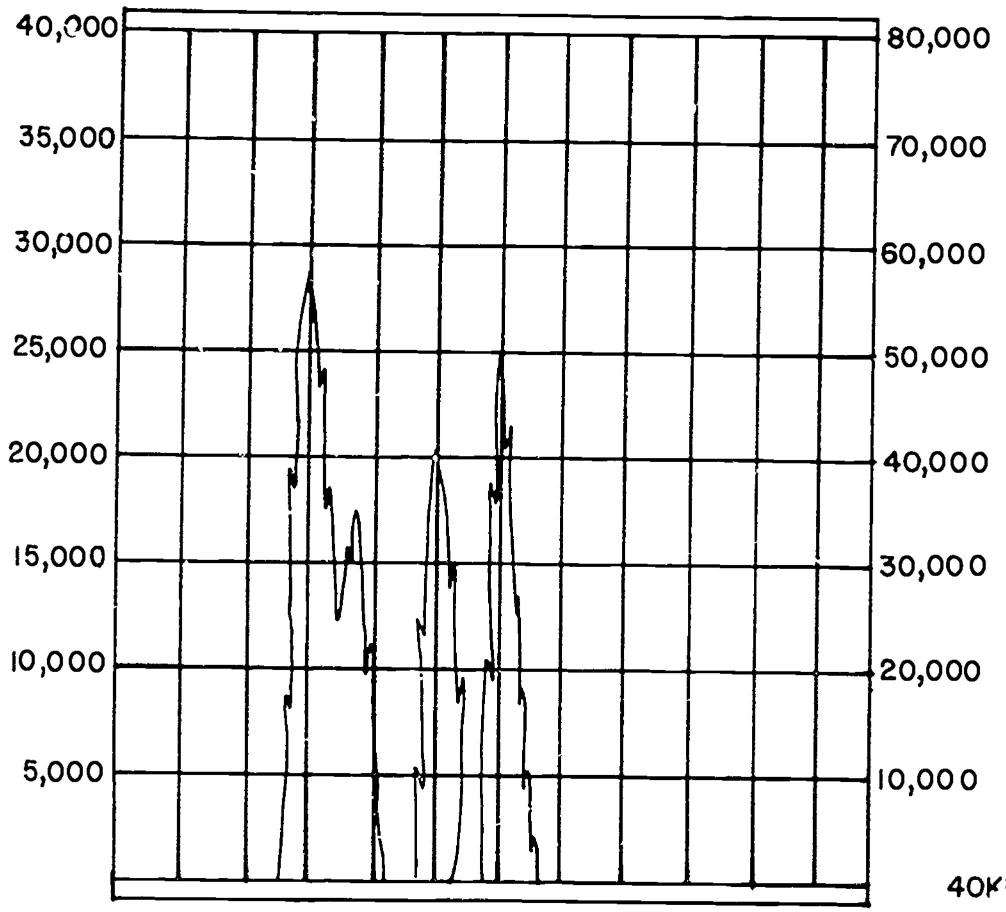
I.F. ATTENUATOR DB

3	6



11

EXERCISE 4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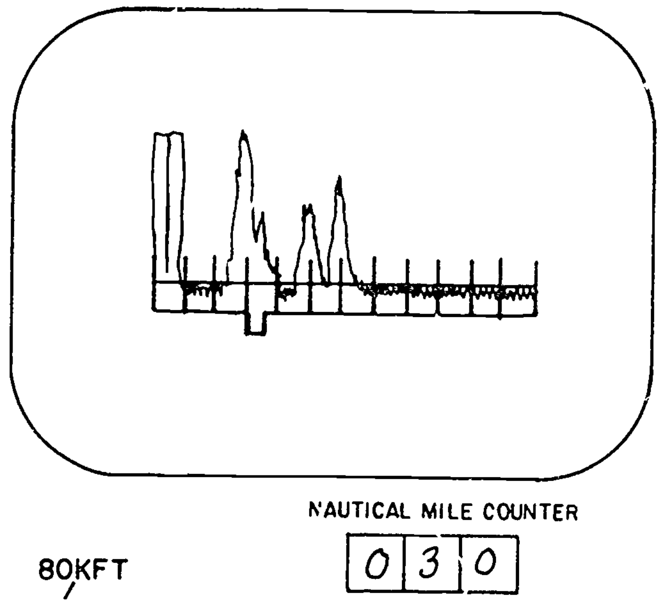
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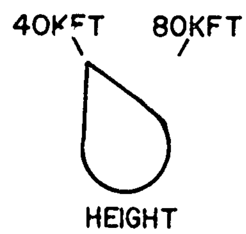

40KFT
80KFT
HEIGHT

1020

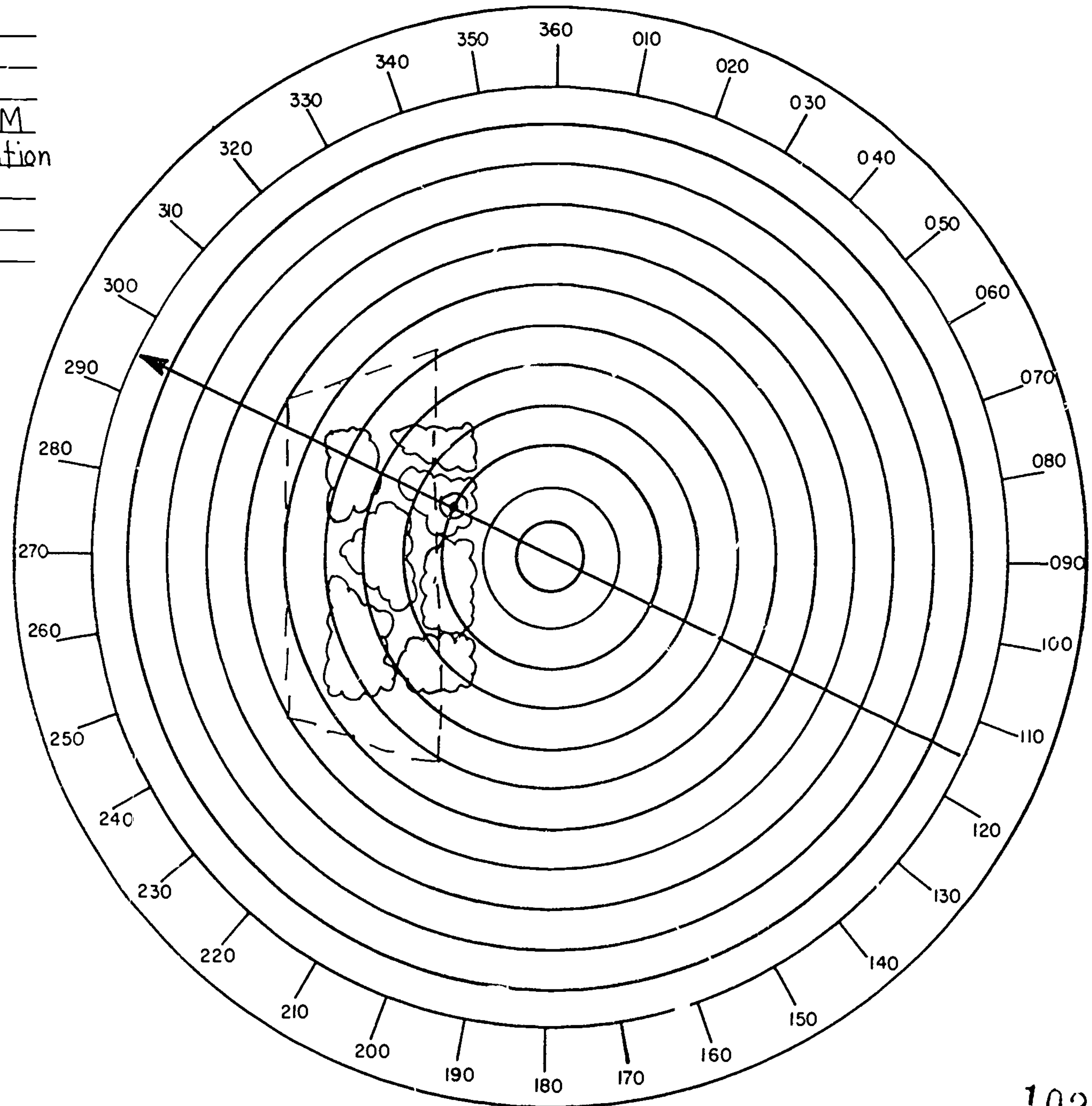
1021

OBSERVATION ENDED 0032
PAST POSITION 2332
RANGE ALL SCOPES 120 NM
RANGE MARKS ALL SCOPES 10 NM
REMARKS Range Normalization set at 60 NM

I.F. ATTENUATOR DB

3	9

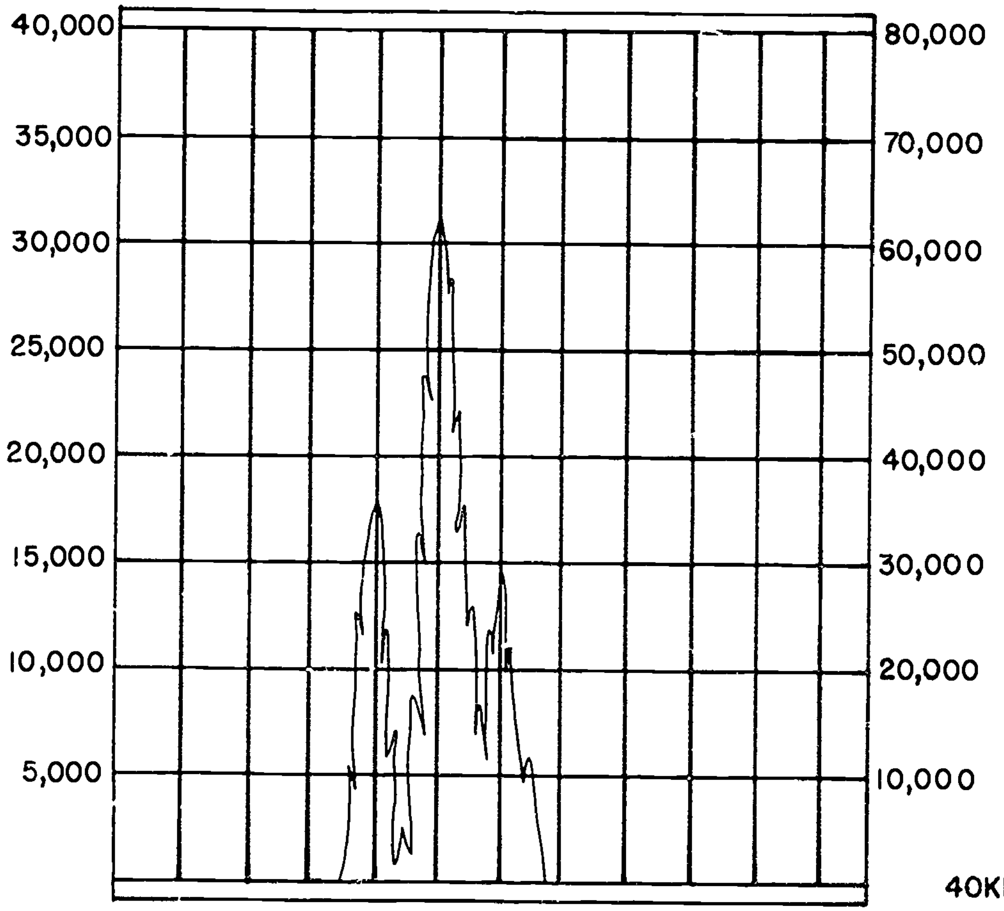
13



1022

EXERCISE 5

1023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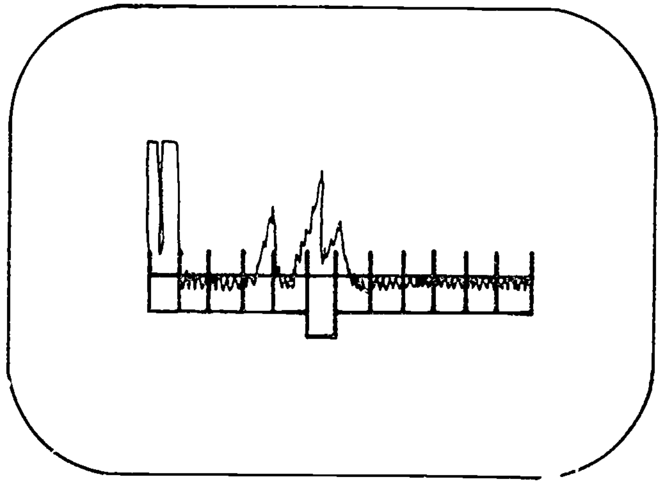

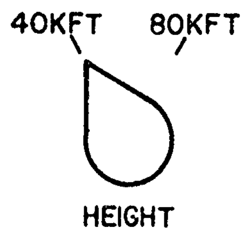
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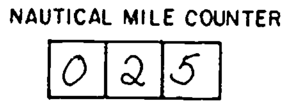
80KFT
HEIGHT


NAUTICAL MILE COUNTER
0 2 5

1024

1025

OBSERVATION ENDED 0132

PAST POSITION 0032

RANGE ALL SCOPES 60NM

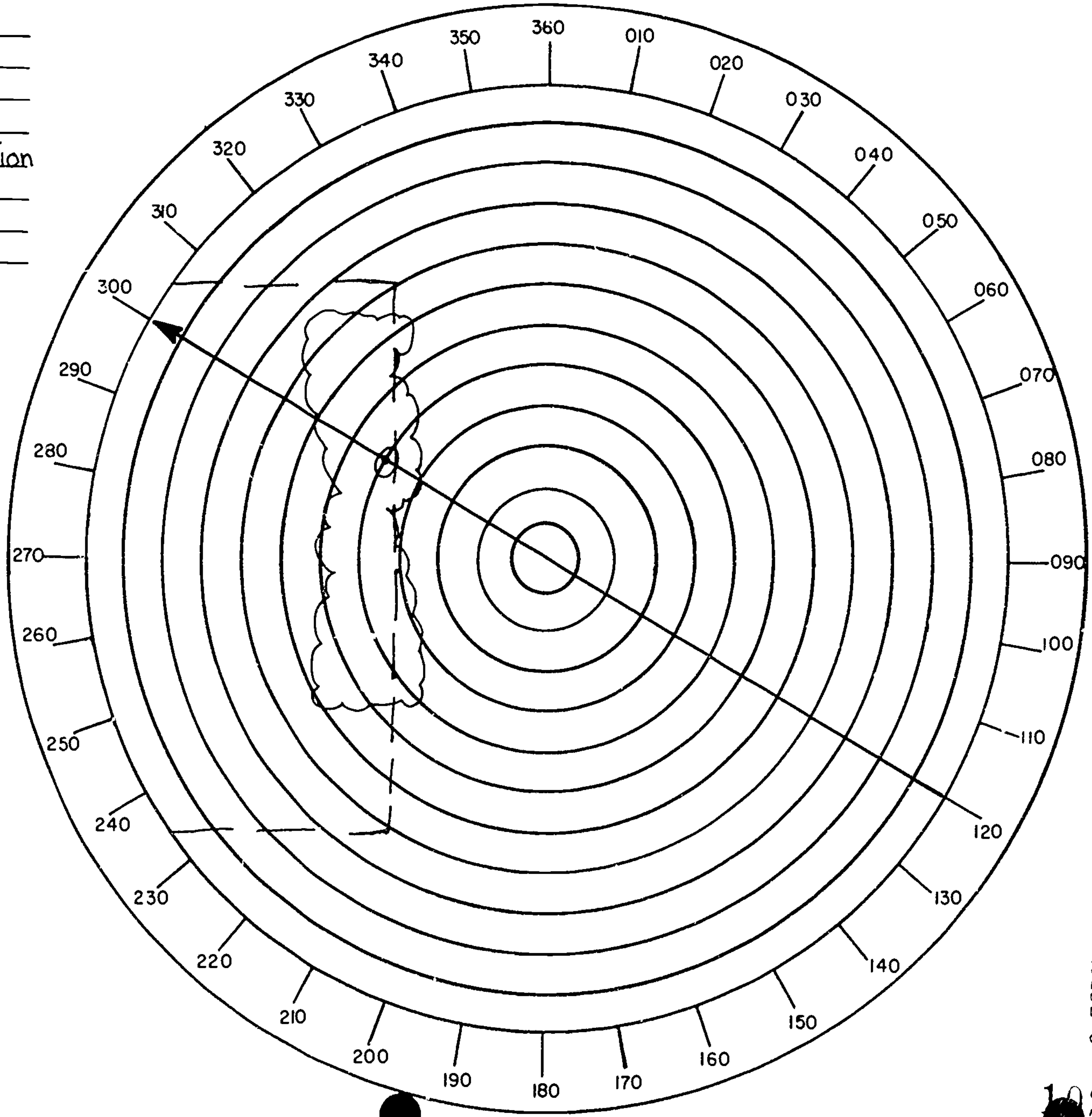
RANGE MARKS ALL SCOPES 5NM

REMARKS Range Normalization set at 60NM

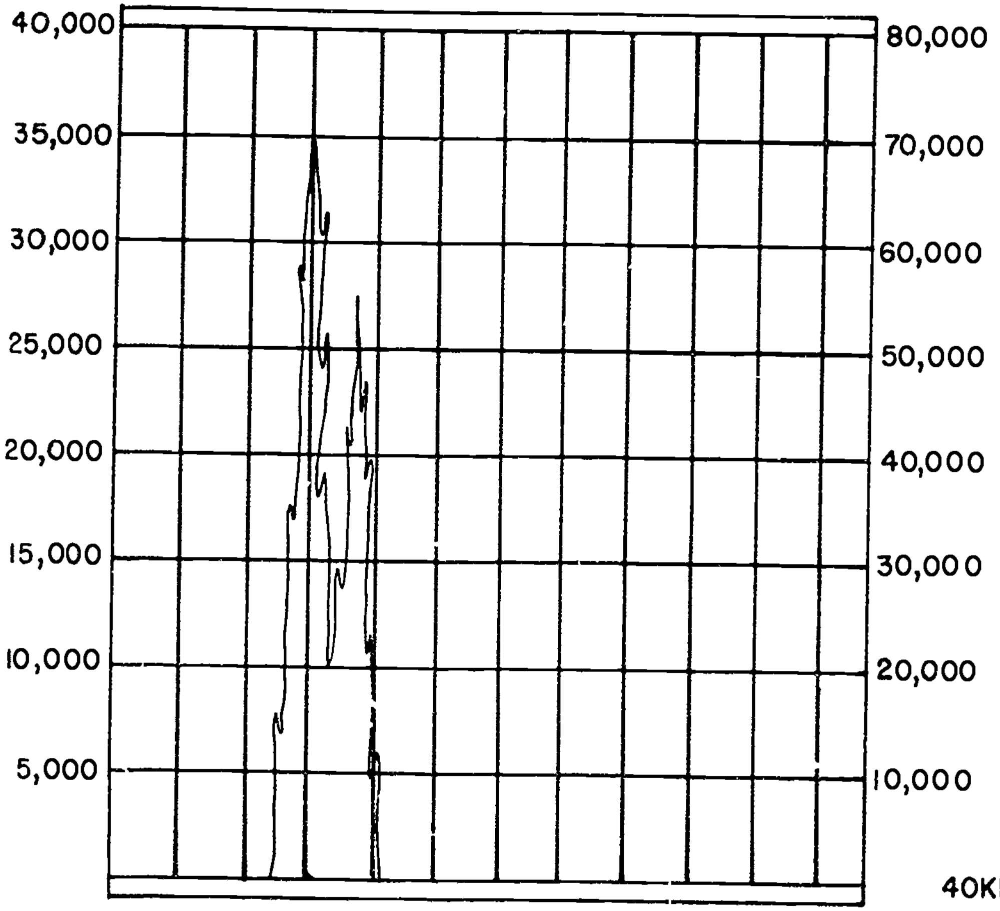
I.F.
ATTENUATOR
DB

3	6

15



EXERCISE 6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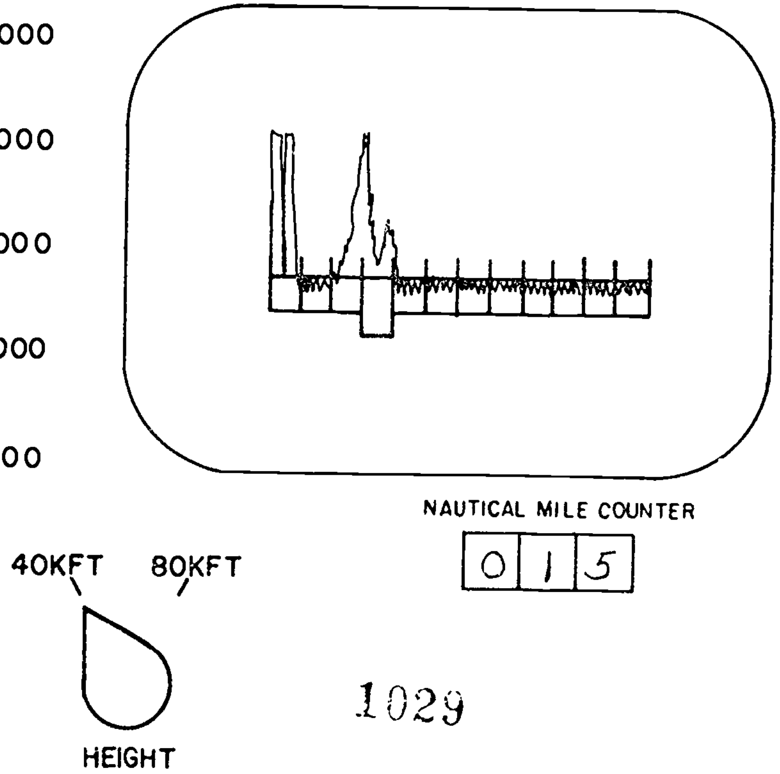

NAUTICAL MILE COUNTER
0 1 5
40KFT
80KFT
HEIGHT

1028

1029

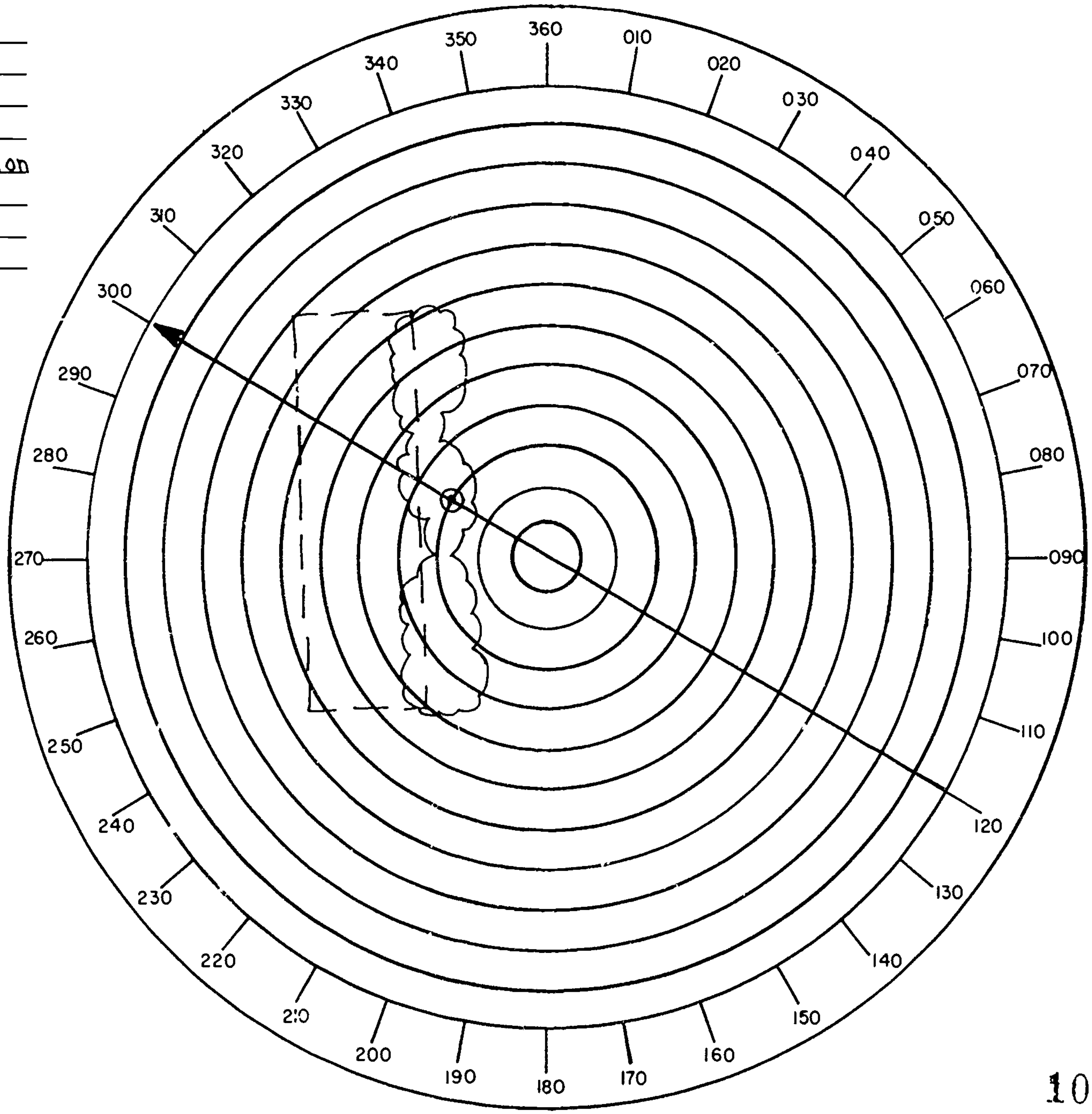
OBSERVATION ENDED 0233

PAST POSITION 0132

RANGE ALL SCOPES 60NM

RANGE MARKS ALL SCOPES 5NM

REMARKS Range Normalization set at 30NM



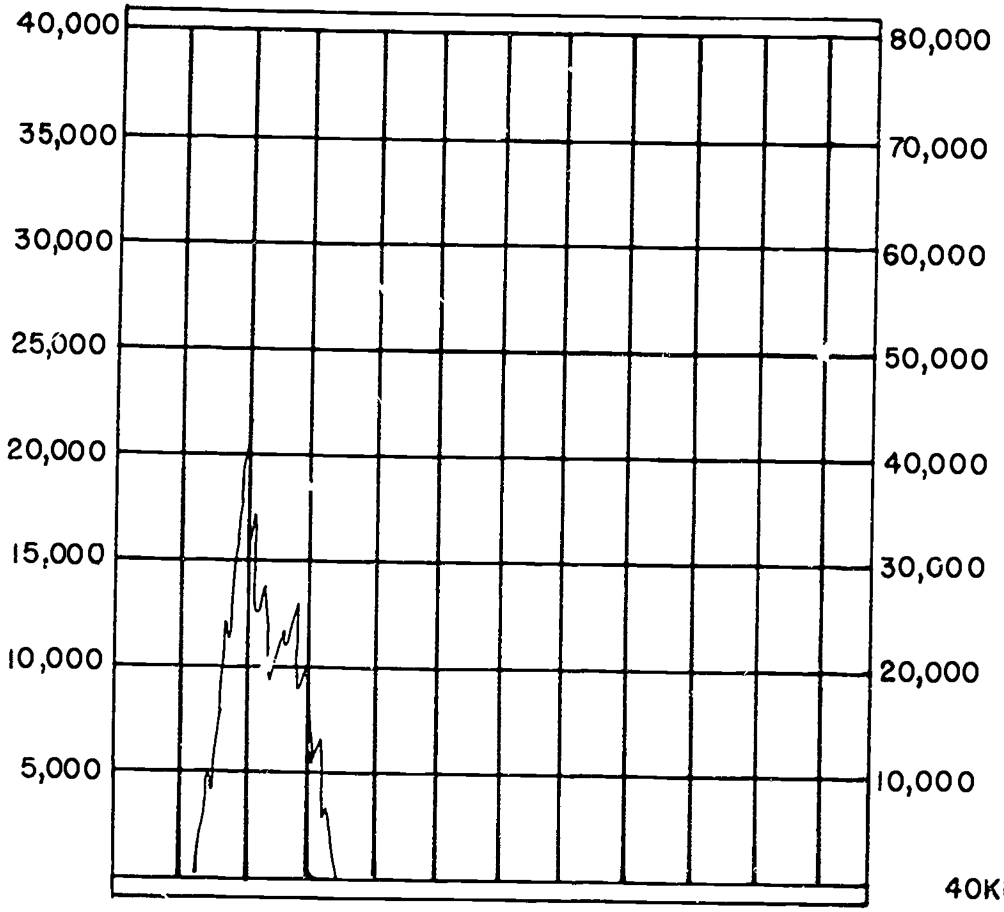
I.F.
ATTENUATOR
DB

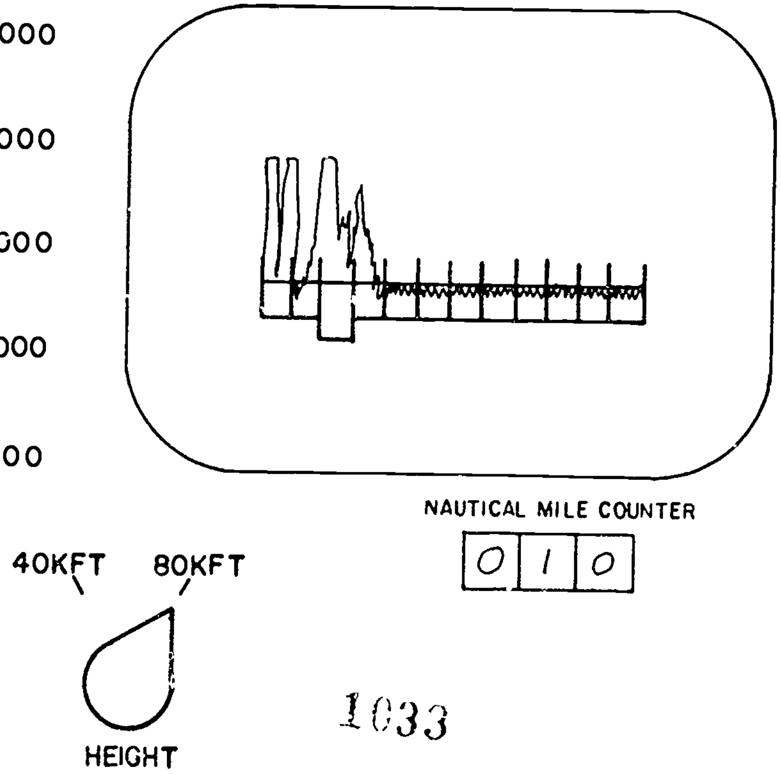
4	8

17

EXERCISE 7

EXERCISE 8





1032

1033

OBSERVATION ENDED 0333

PAST POSITION 0233

RANGE ALL SCOPES 60 NM

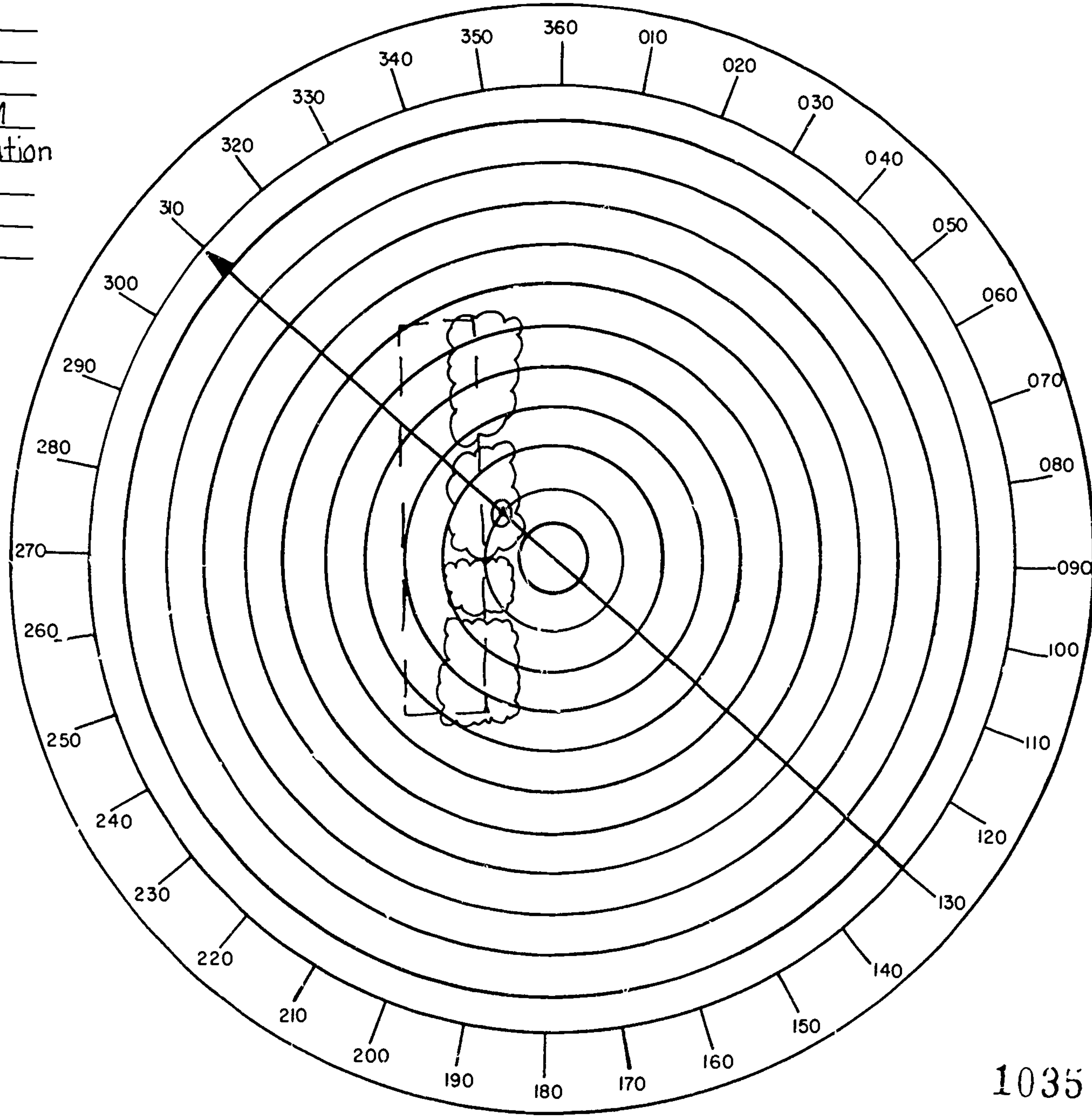
RANGE MARKS ALL SCOPES 5NM

REMARKS Range Normalization set at 30 NM

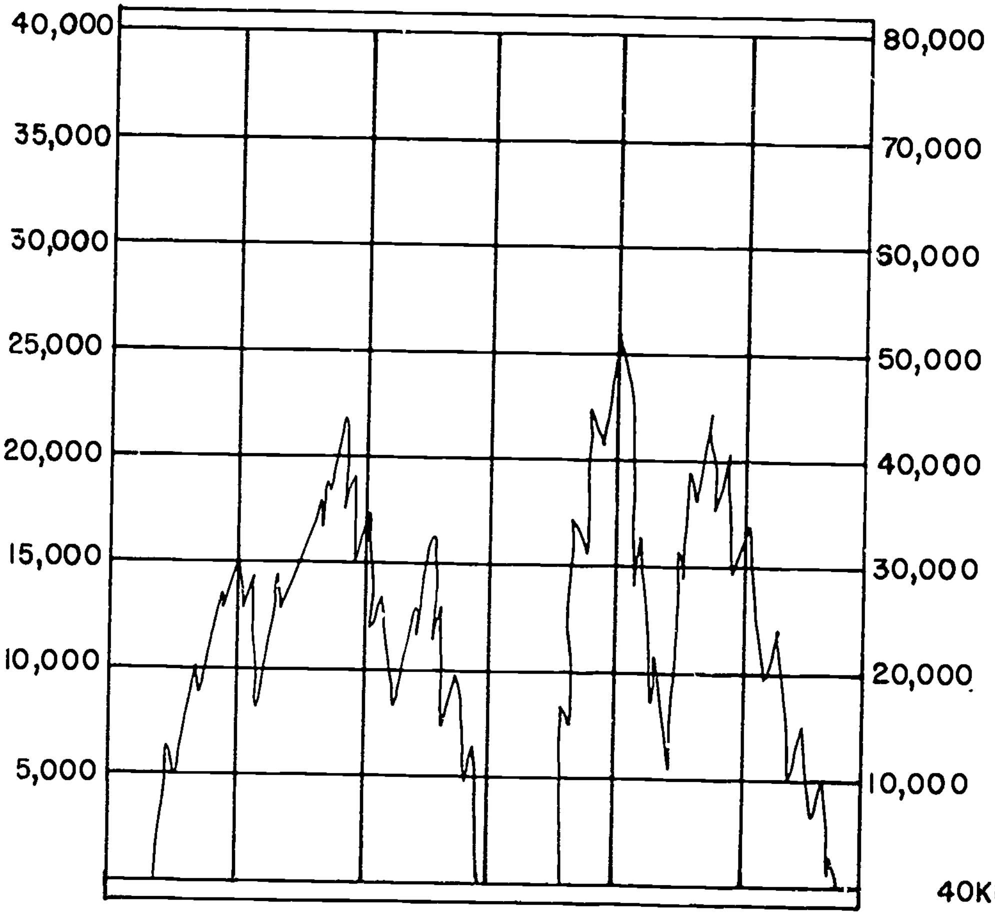
I.F. ATTENUATOR DB

4	8

19



EXERCISE 8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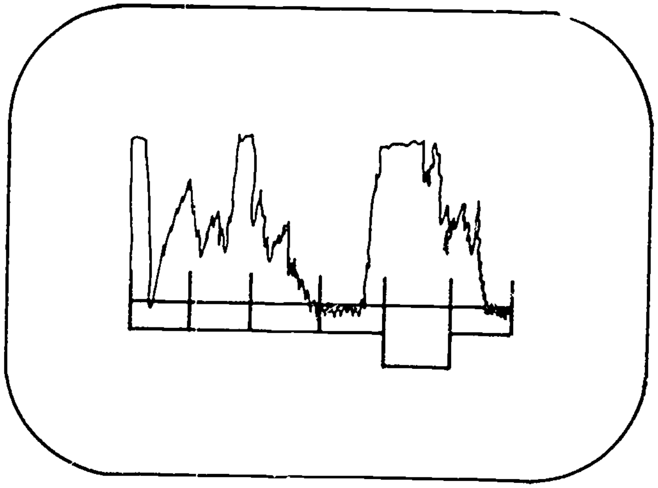

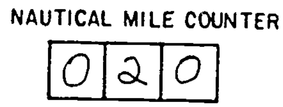
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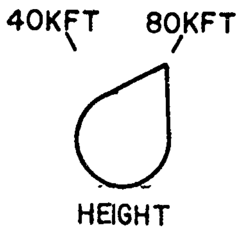

40KFT
80KFT
HEIGHT

1036

1037

OBSERVATION ENDED 0348

PAST POSITION 0333

RANGE ALL SCOPES 30NM

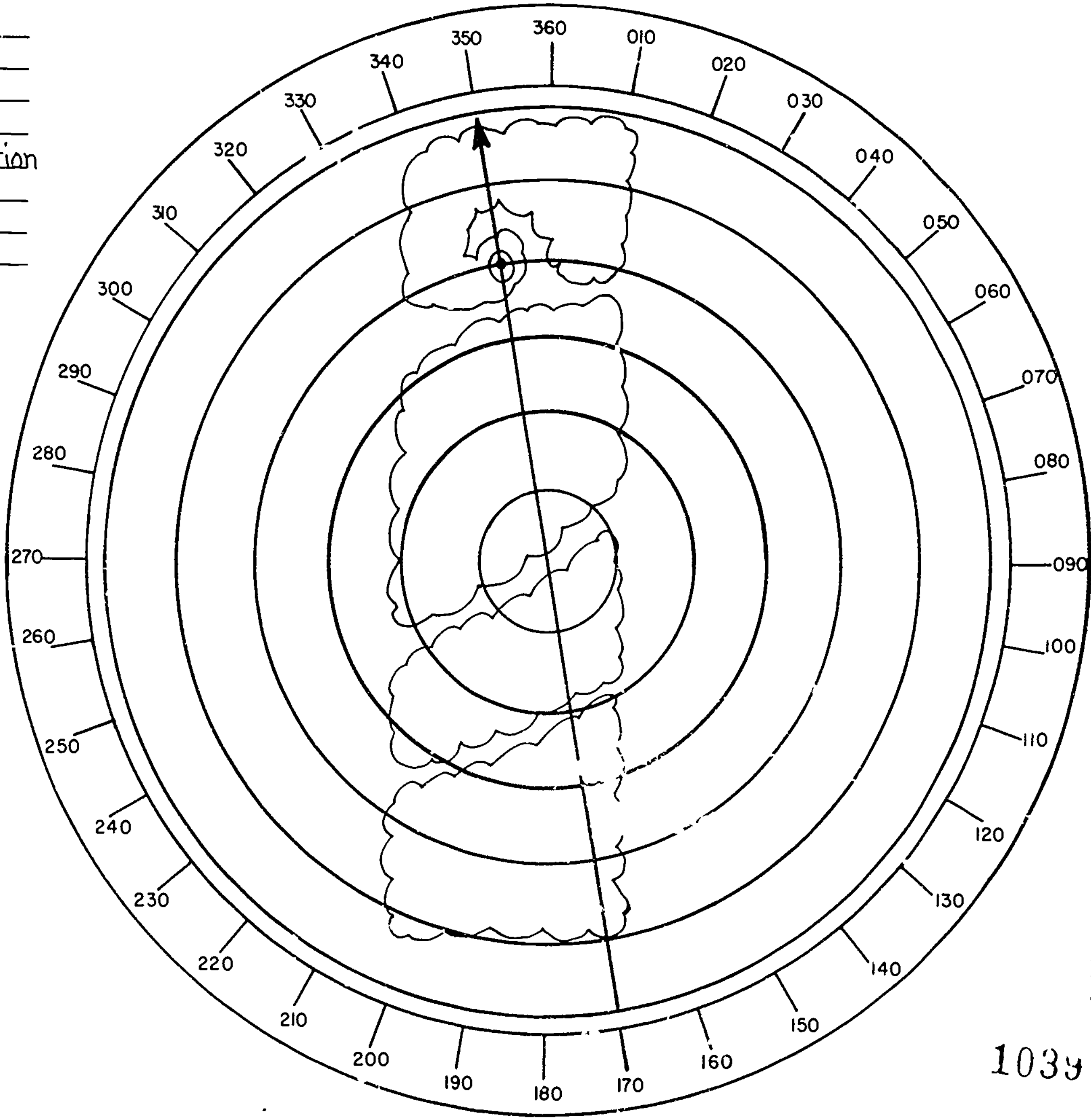
RANGE MARKS ALL SCOPES 5NM

REMARKS Range Normalization set at 30NM

I.F.
ATTENUATOR
DB

5	4

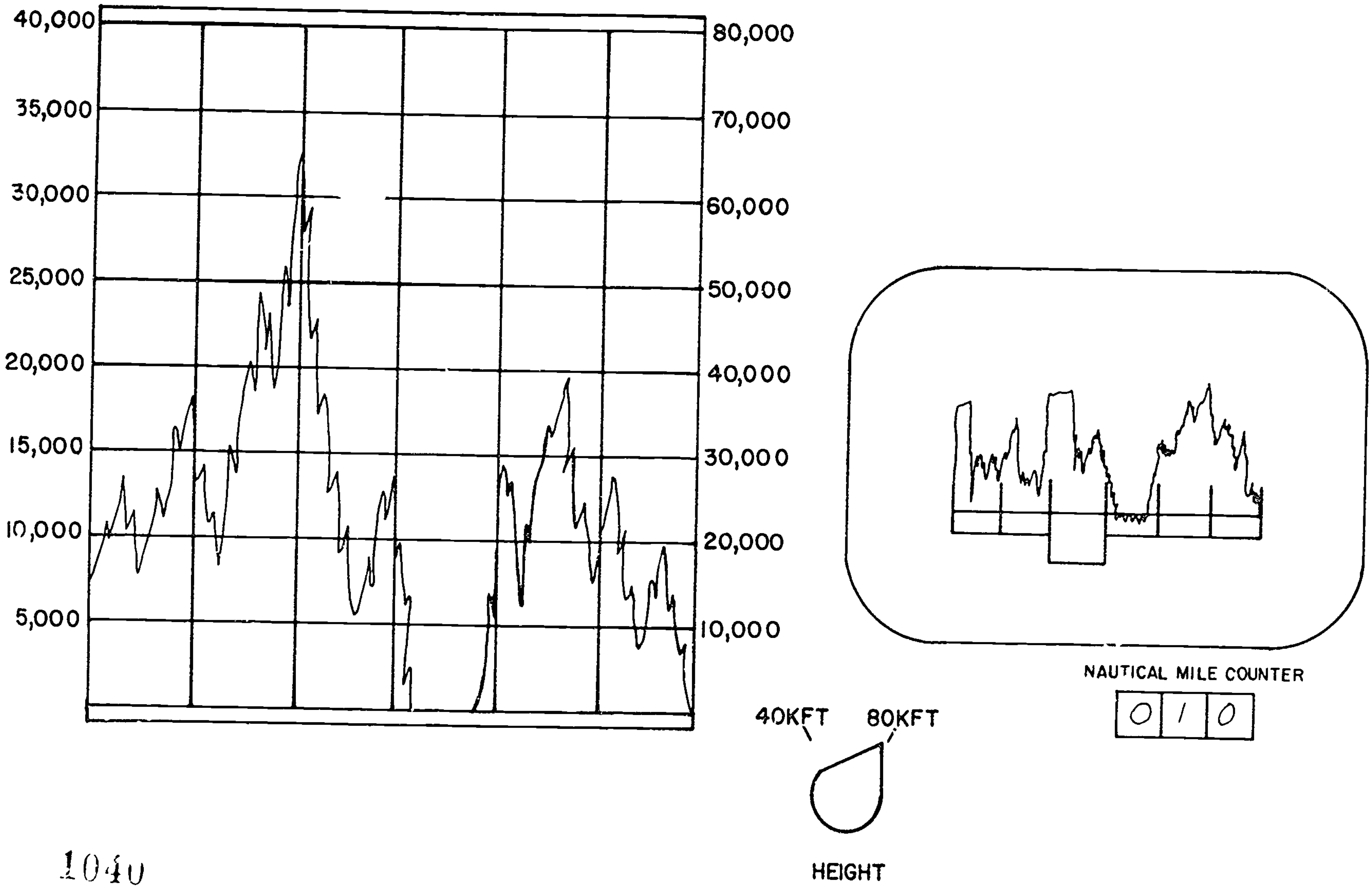
21



ERCISE 9

1038

1039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NAUTICAL MILE COUNTER
0 1 0
40KFT
80KFT
HEIGHT

1040

1041

OBSERVATION ENDED 0409

PAST POSITION —

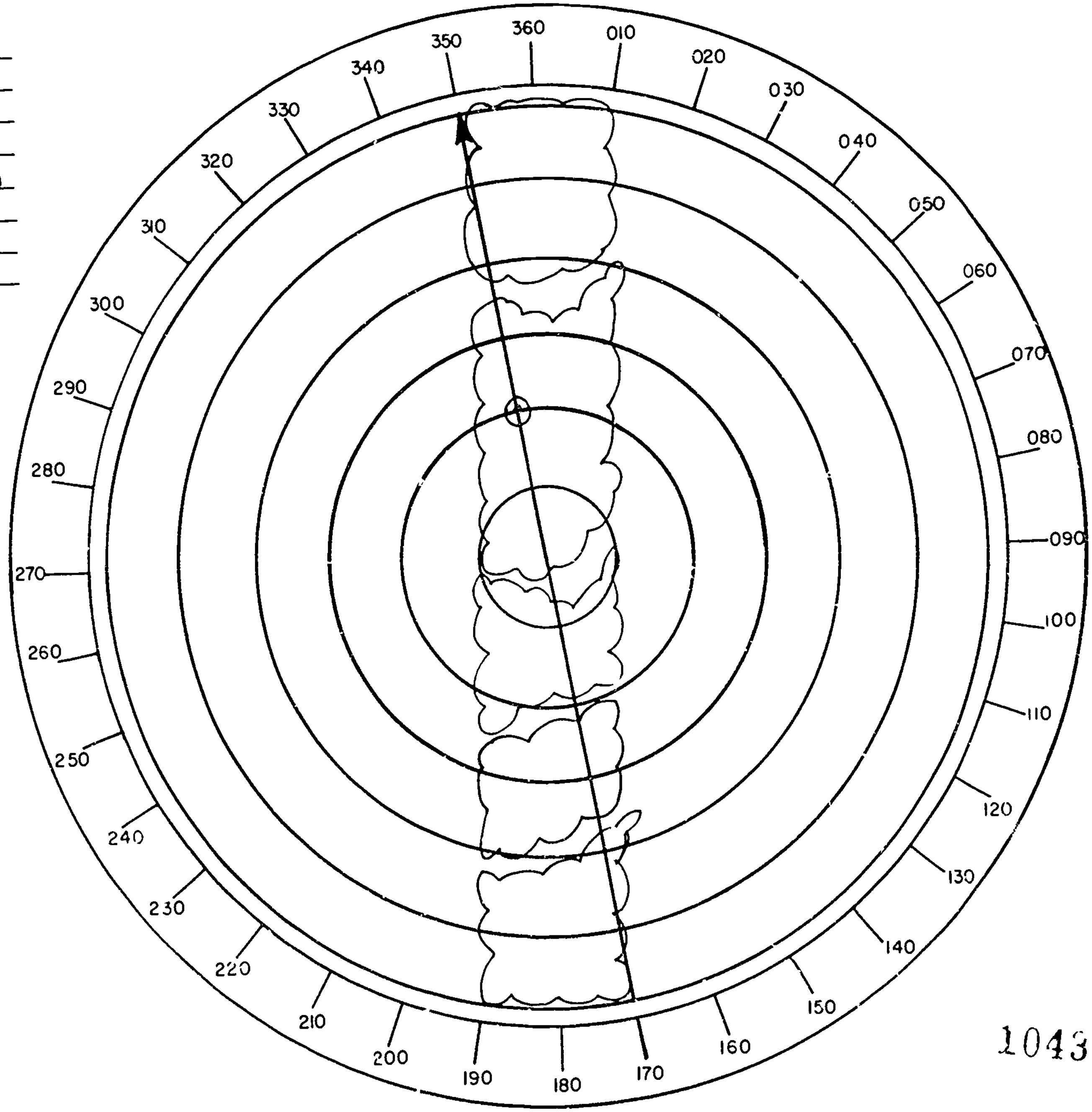
RANGE ALL SCOPES 30 NM

RANGE MARKS ALL SCOPES 5NM

REMARKS Range Normalization at 30NM

I.F.
ATTENUATOR
DB

6	3

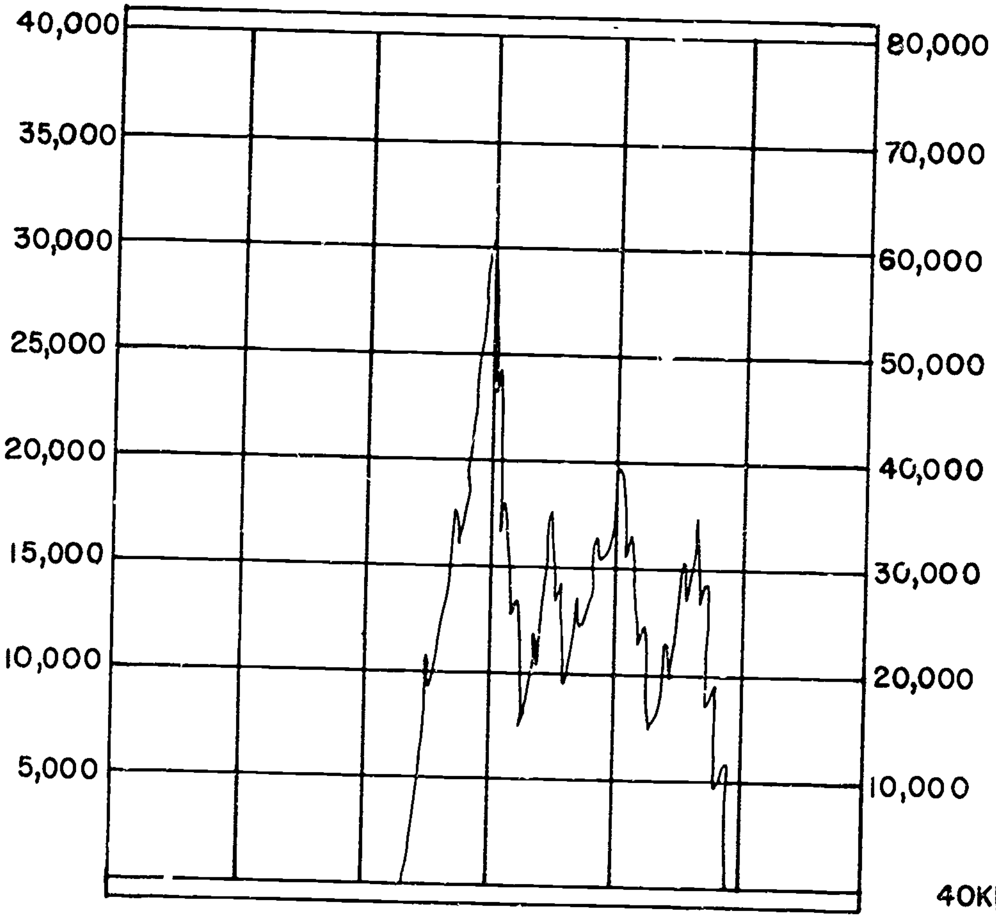


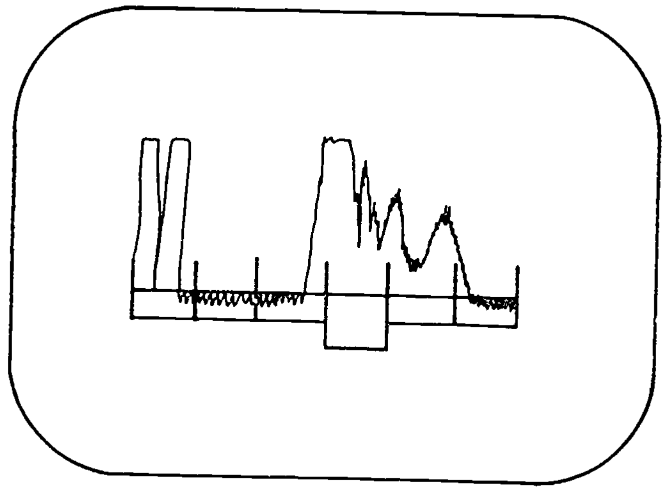
1042

1043

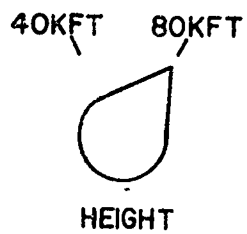
EXERCISE 10

EXERCISE .





NAUTICAL MILE COUNTER



1044

1045

OBSERVATION ENDED 0425

PAST POSITION —

RANGE ALL SCOPES 30 NM

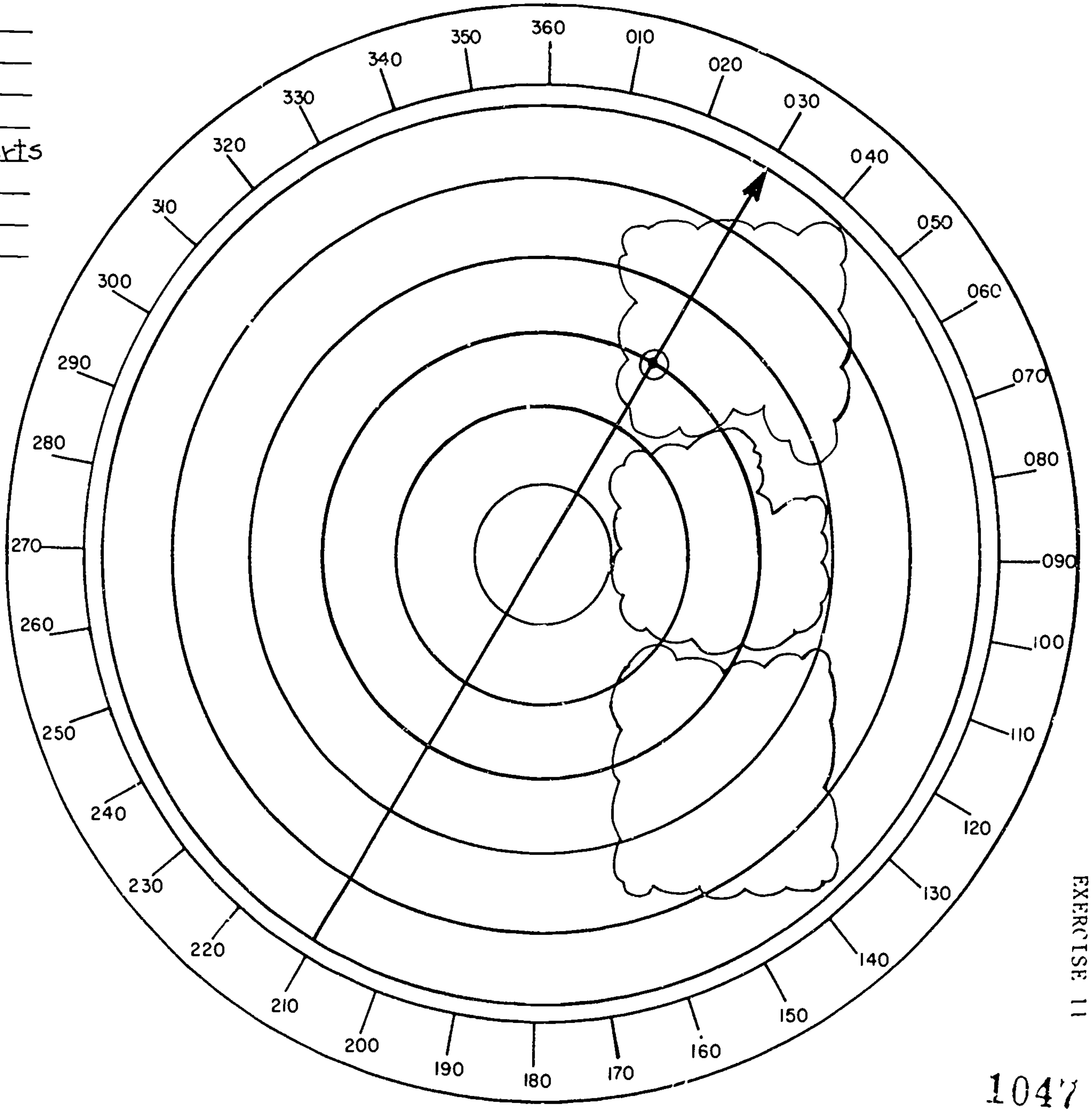
RANGE MARKS ALL SCOPES 5 NM

REMARKS Farmer John reports 70 knot winds 15 miles Northeast. Range Normalization at 30 NM

I.F. ATTENUATOR DB

5	7

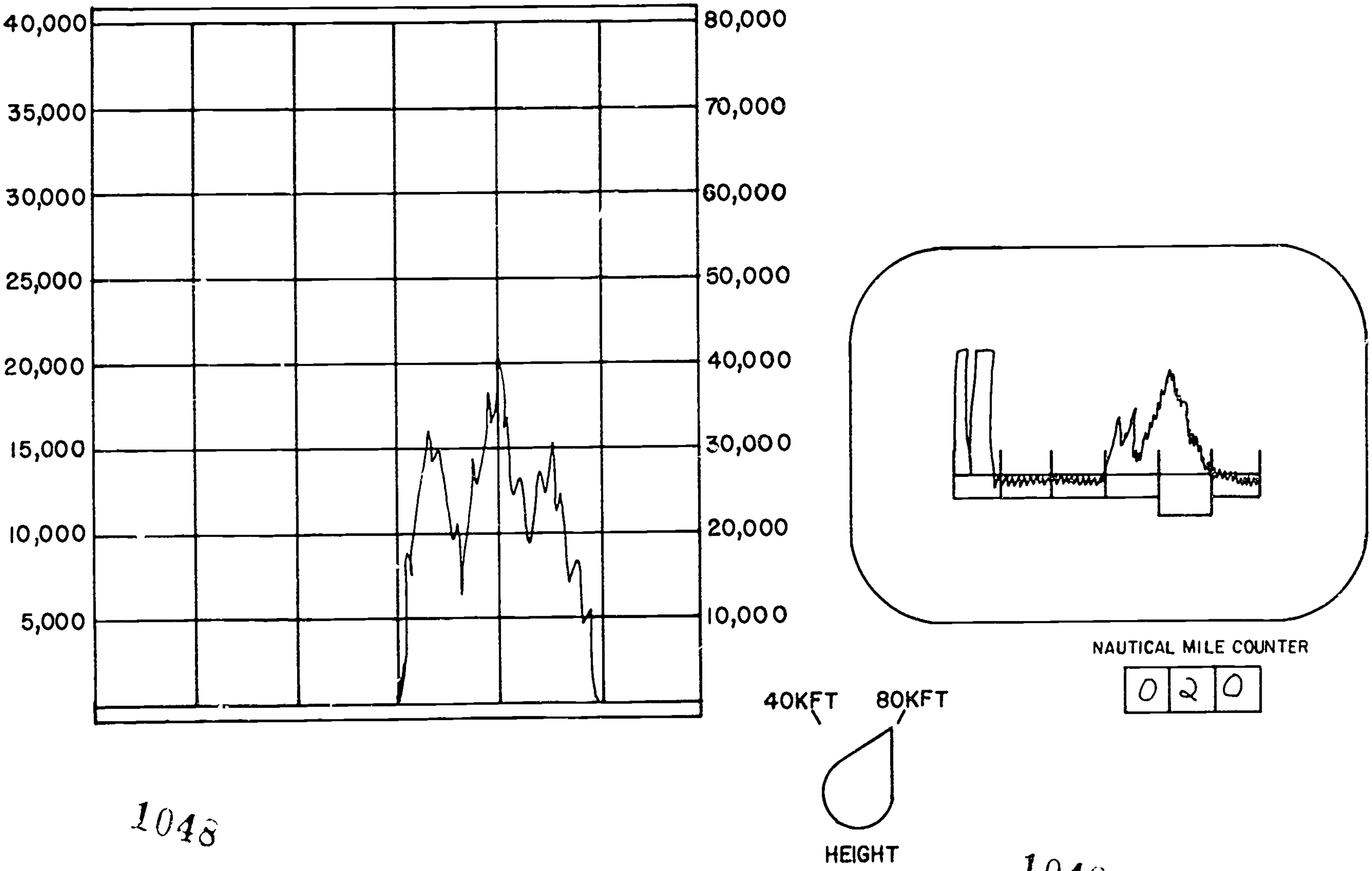
25



EXERCISE 11

1046

EXERCISE 12



1048 1049

OBSERVATION ENDED 0433

PAST POSITION 0333

RANGE ALL SCOPES 30 NM

RANGE MARKS ALL SCOPES 5 NM

REMARKS Range Normalization at 30 NM. Max. top of 30,000 ft. corrected observed to the south.

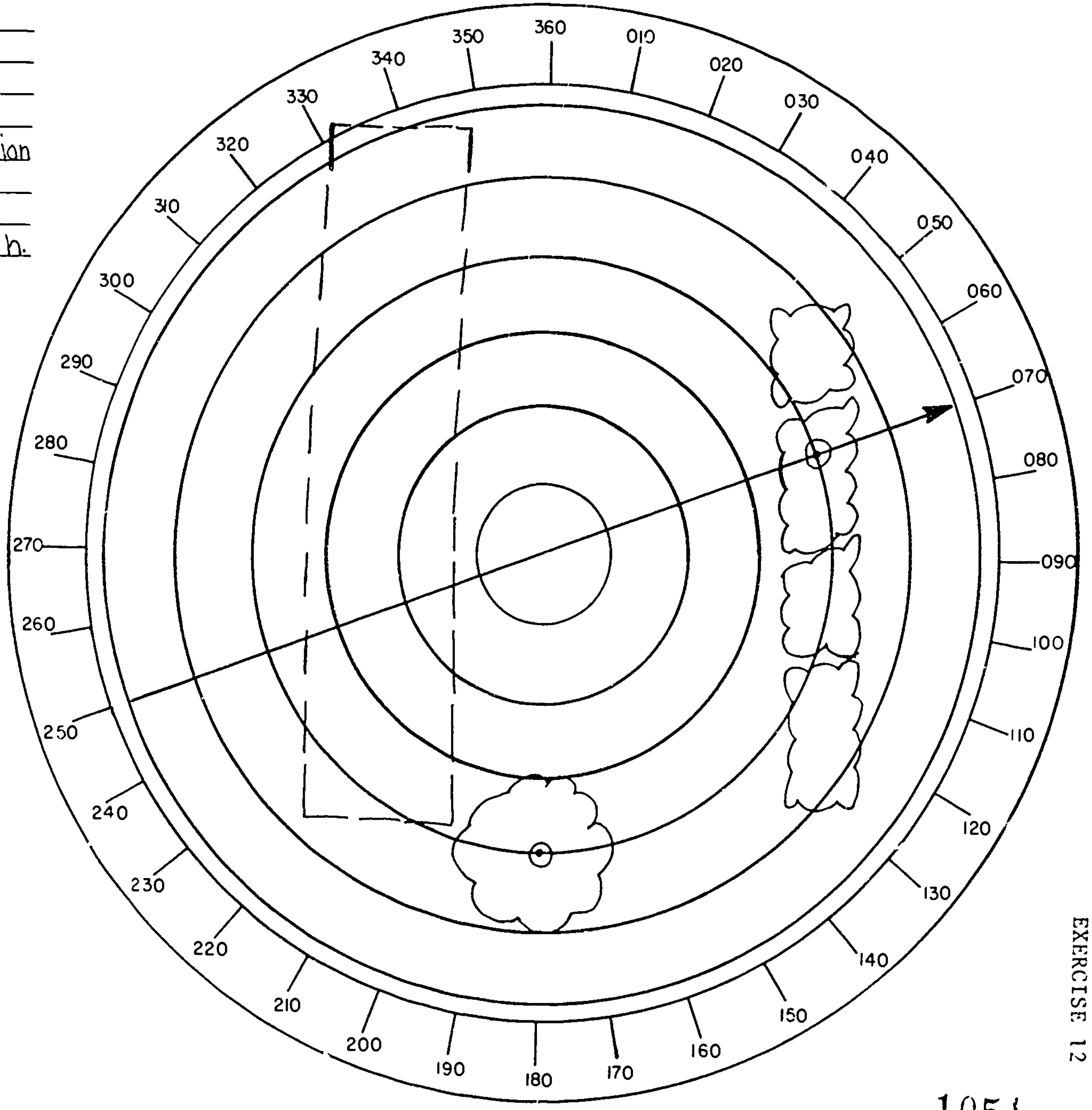
I.F. ATTENUATOR DB

LINE	4	8

DB

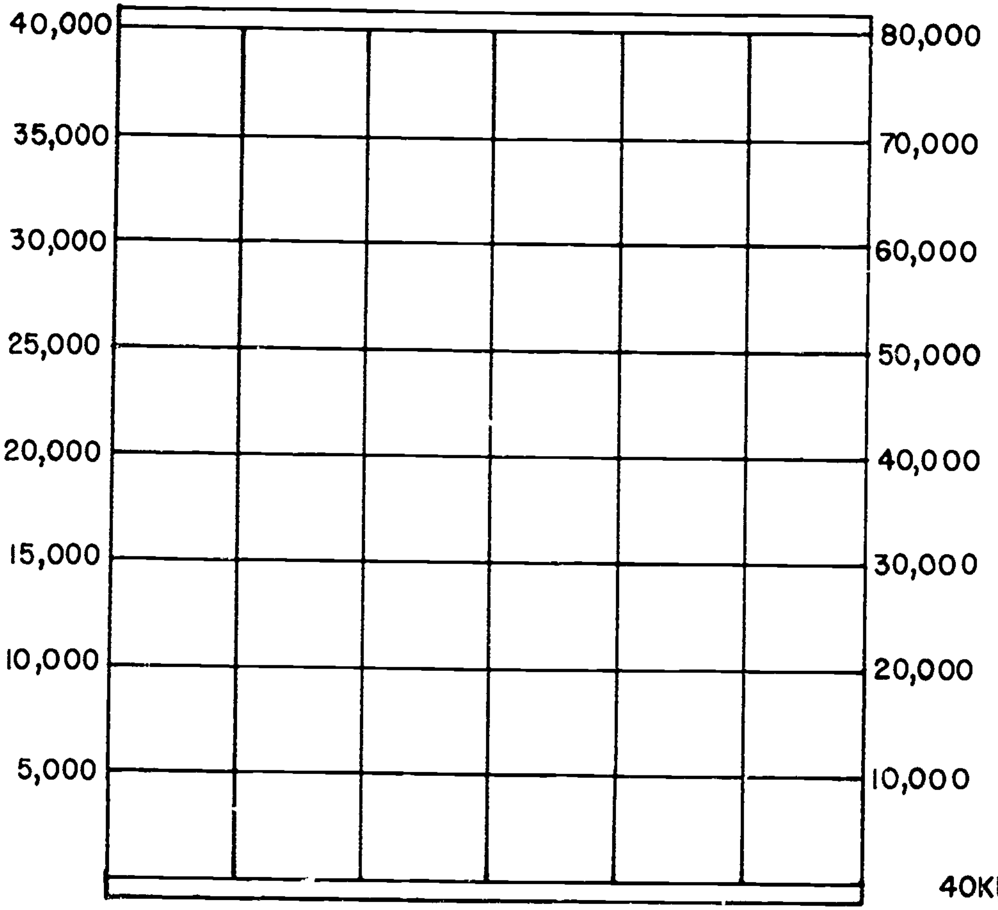
CELL	4	8

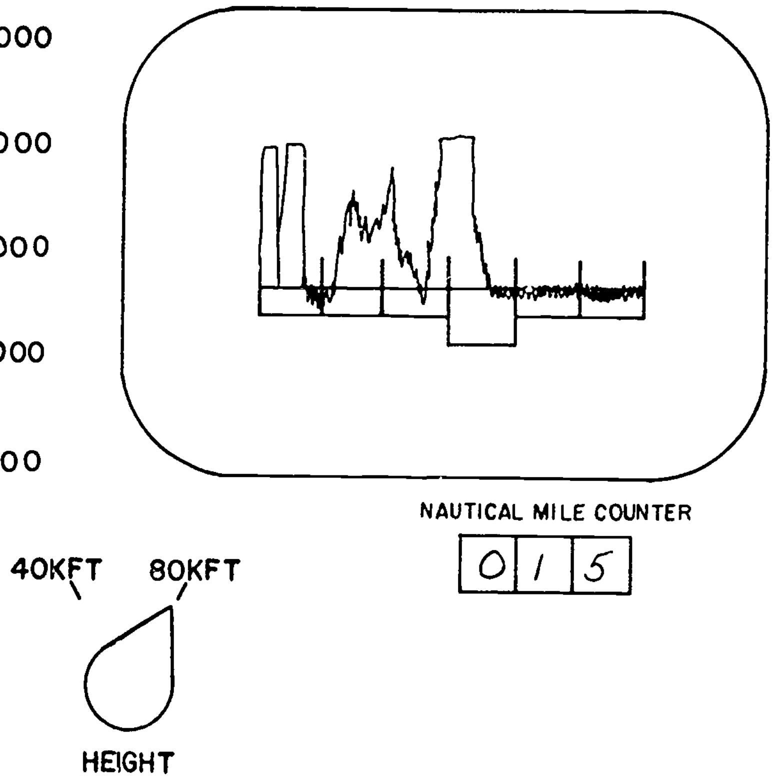
27



EXERCISE 12

EXERCISE 13





1052

1053

OBSERVATION ENDED 0510

PAST POSITION 0433

RANGE ALL SCOPES 30NM

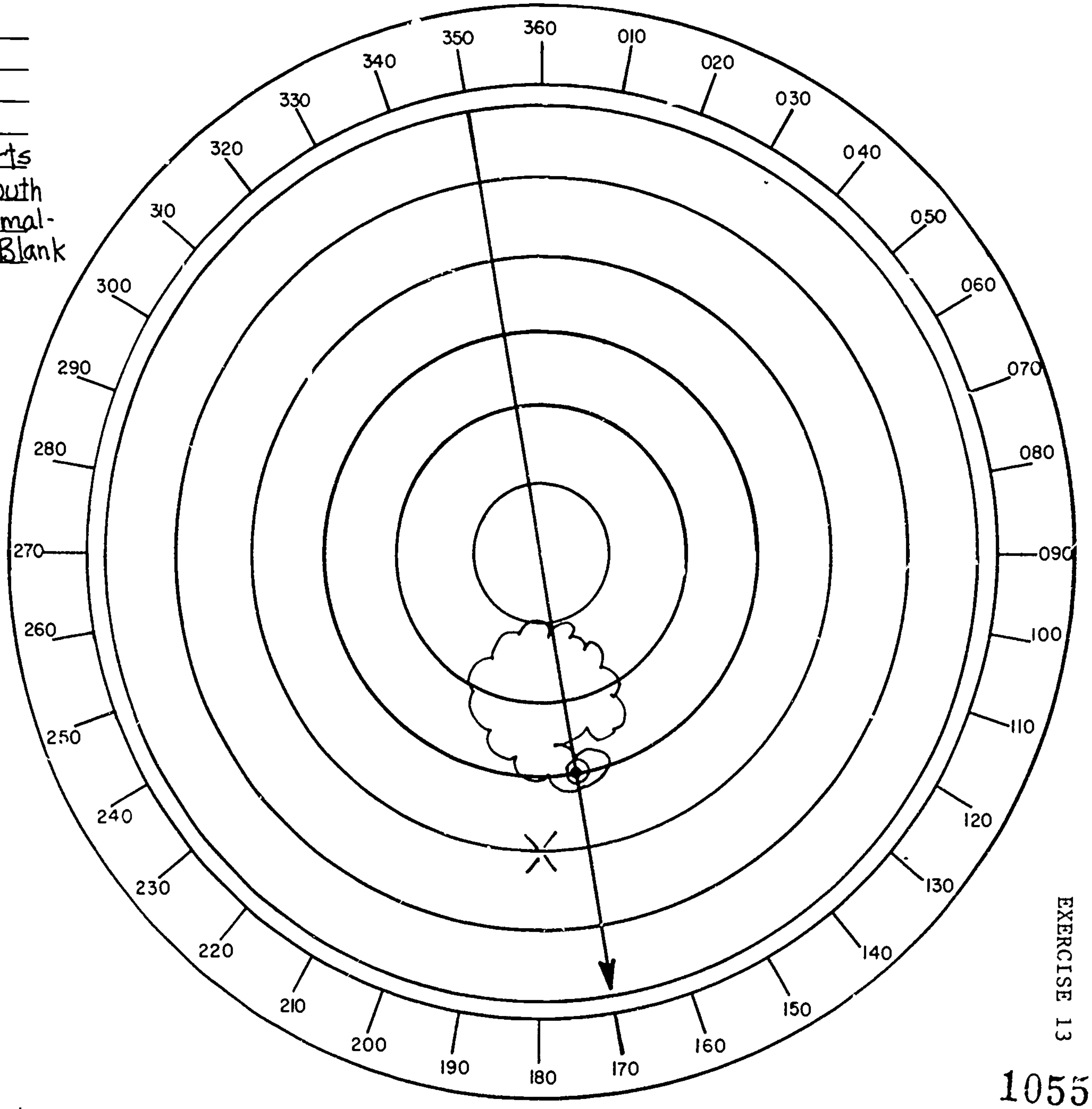
RANGE MARKS ALL SCOPES 5NM

REMARKS Station Chief Roberts reports a funnel cloud south of the station. Range Normalization at 30 N.M. RHI Blank

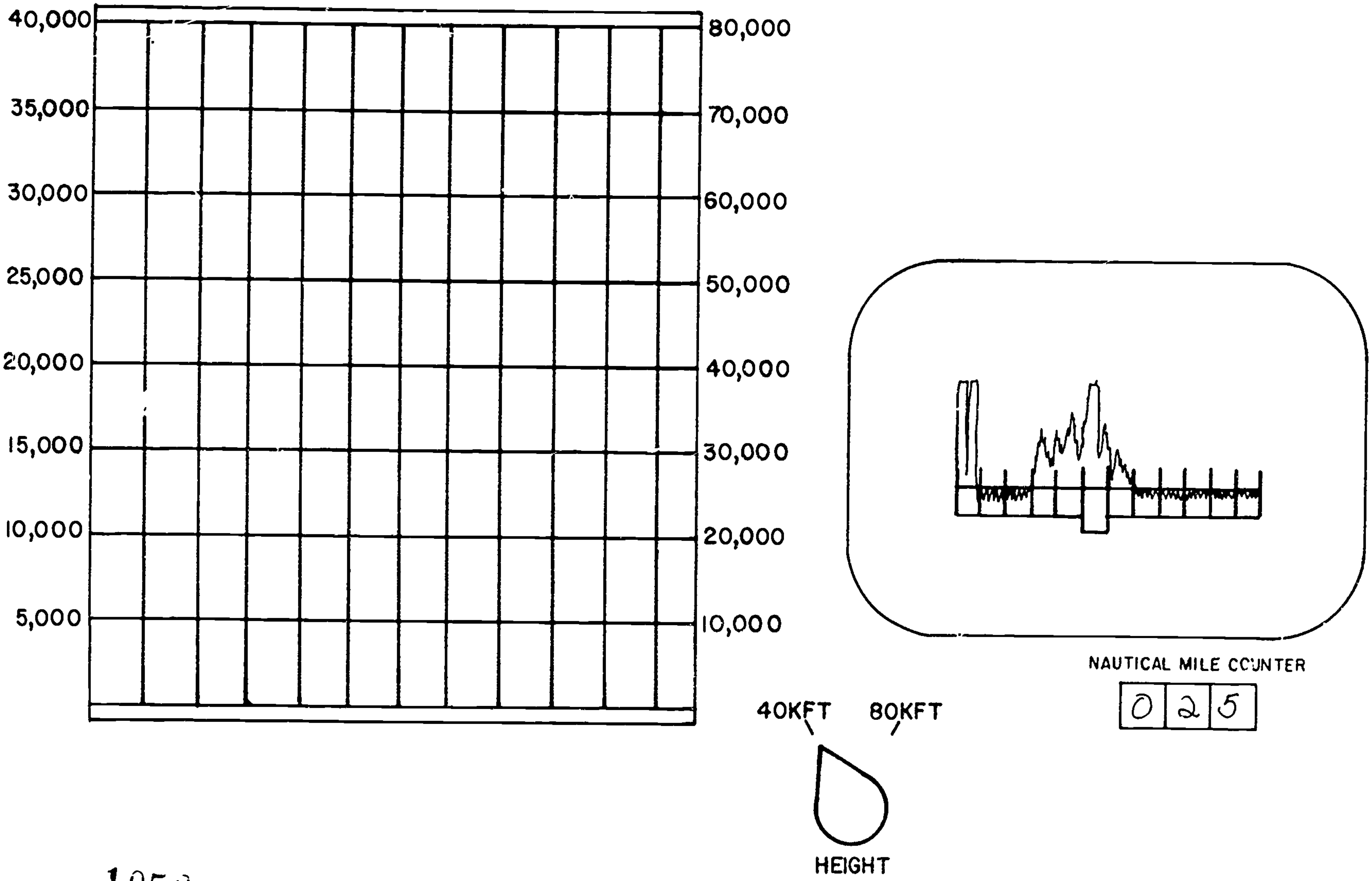
I.F.
ATTENUATOR
DB

6	6

29



EXERCISE 13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NAUTICAL MILE COUNTER
0 2 5
40KFT
80KFT
HEIGHT

1056

1057

OBSERVATION ENDED 0533

PAST POSITION 0510

RANGE ALL SCOPES 60NM

RANGE MARKS ALL SCOPES 5NM

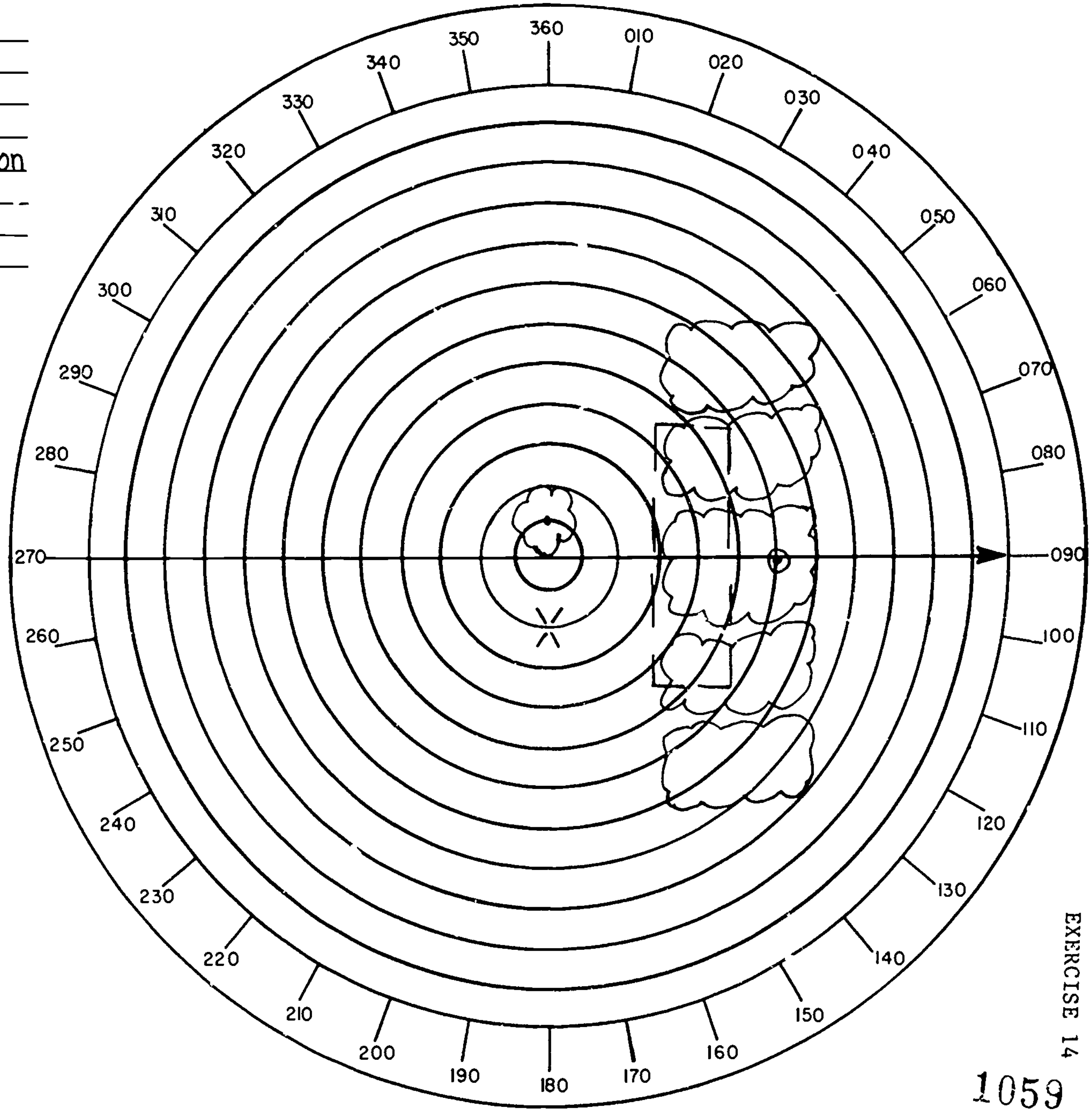
REMARKS Range Normalization at 60 N.M. No heights available due to outage

I.F.
ATTENUATOR
DB

LINE	4	2

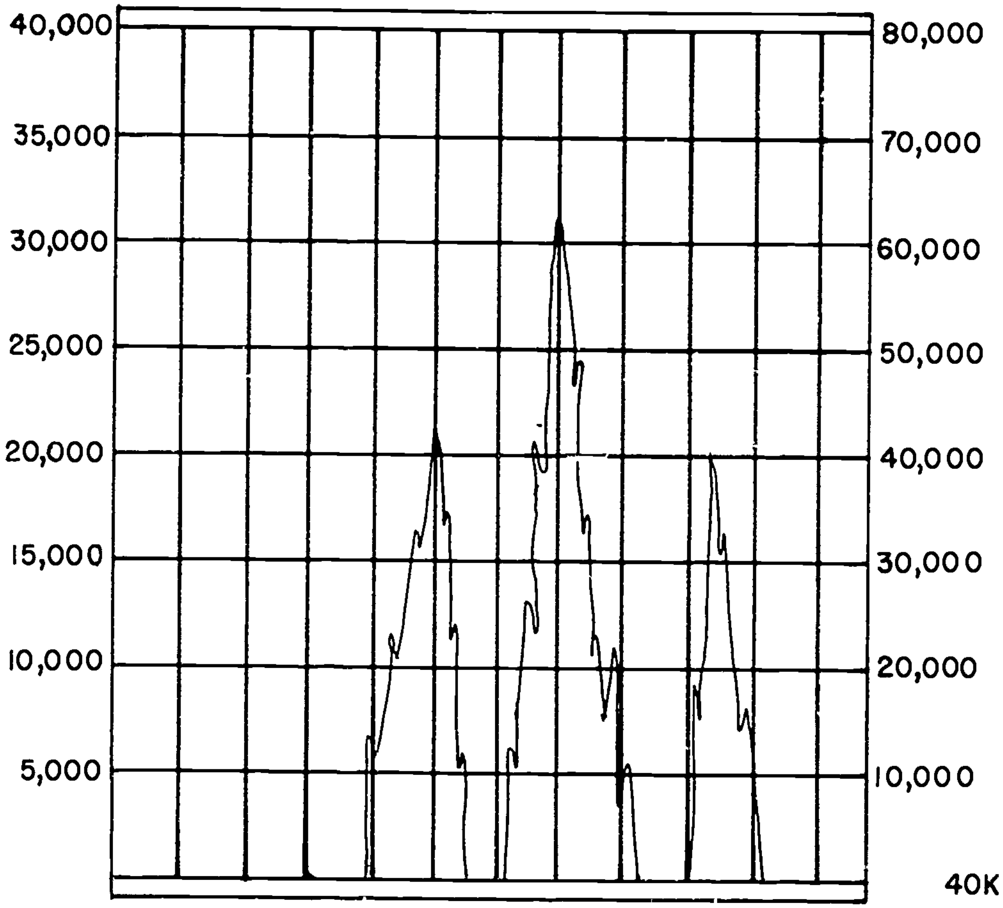
DB

CELL	3	6



31

EXERCISE 14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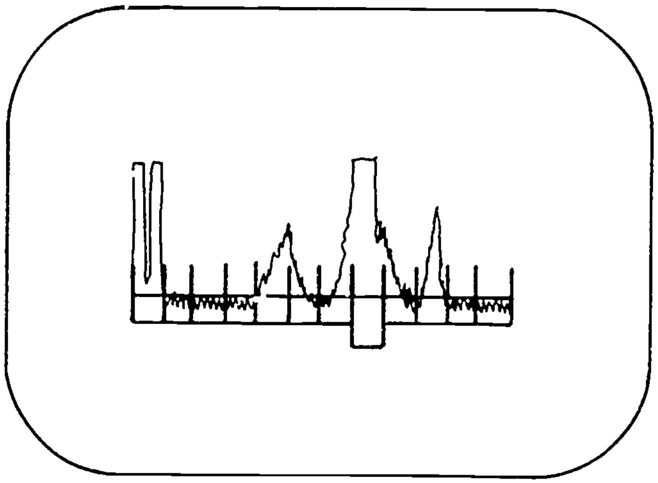

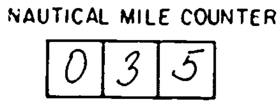
NAUTICAL MILE COUNTER
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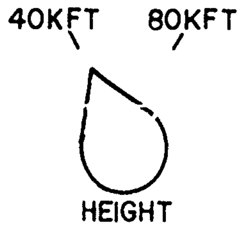

40KFT
80KFT
HEIGHT

1060

1061

OBSERVATION ENDED 0633

PAST POSITION 0533

RANGE ALL SCOPES 60 NM

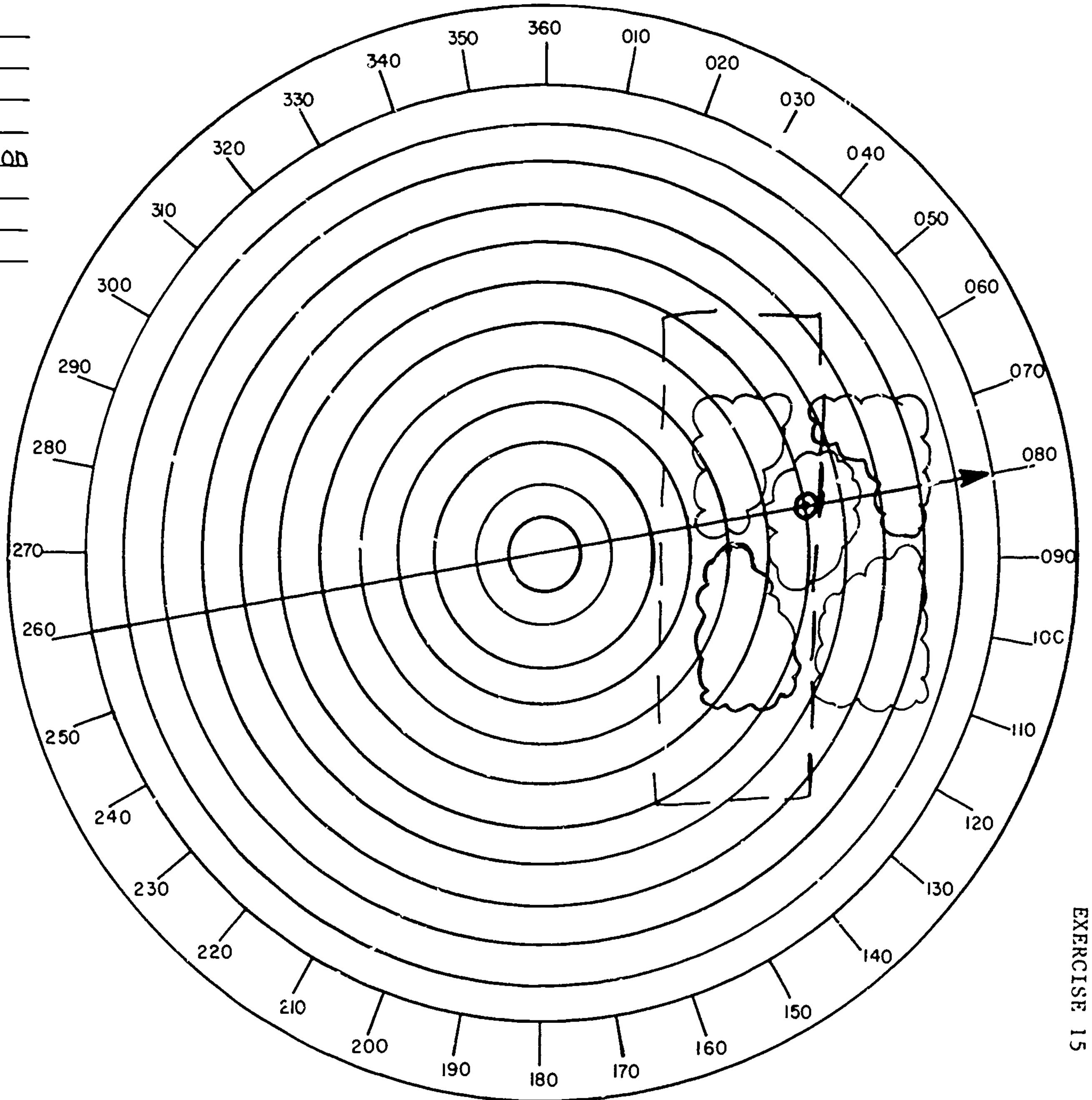
RANGE MARKS ALL SCOPES 5NM

REMARKS Range Normalization at 60NM. Maintenance reports RHI Scope repaired

I.F.
ATTENUATOR
DB

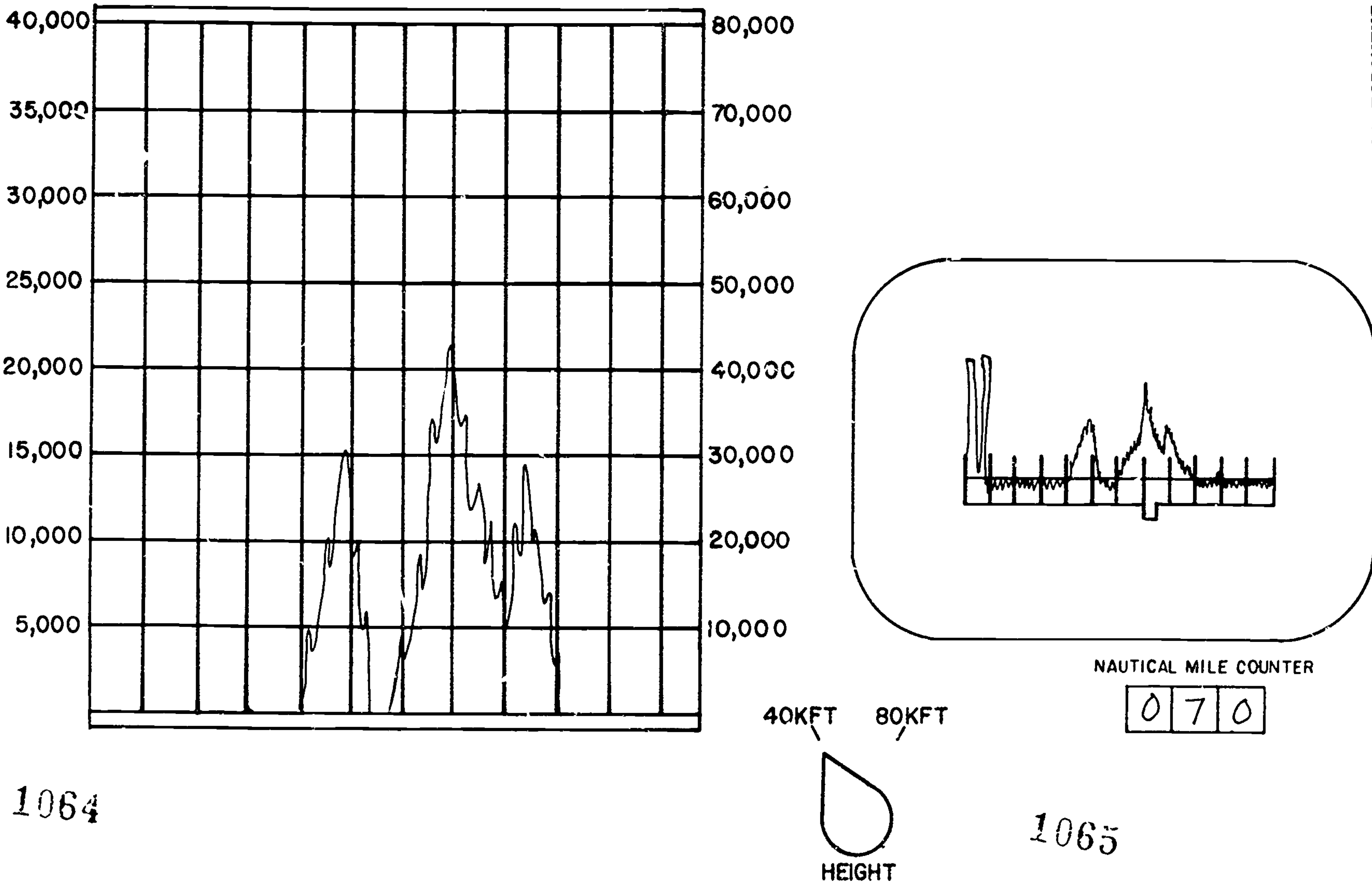
3	9

33



EXERCISE 15

1062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NAUTICAL MILE COUNTER
0 7 0
40KFT
80KFT
HEIGHT

1064

1065

OBSERVATION ENDED 0733

PAST POSITION 0633

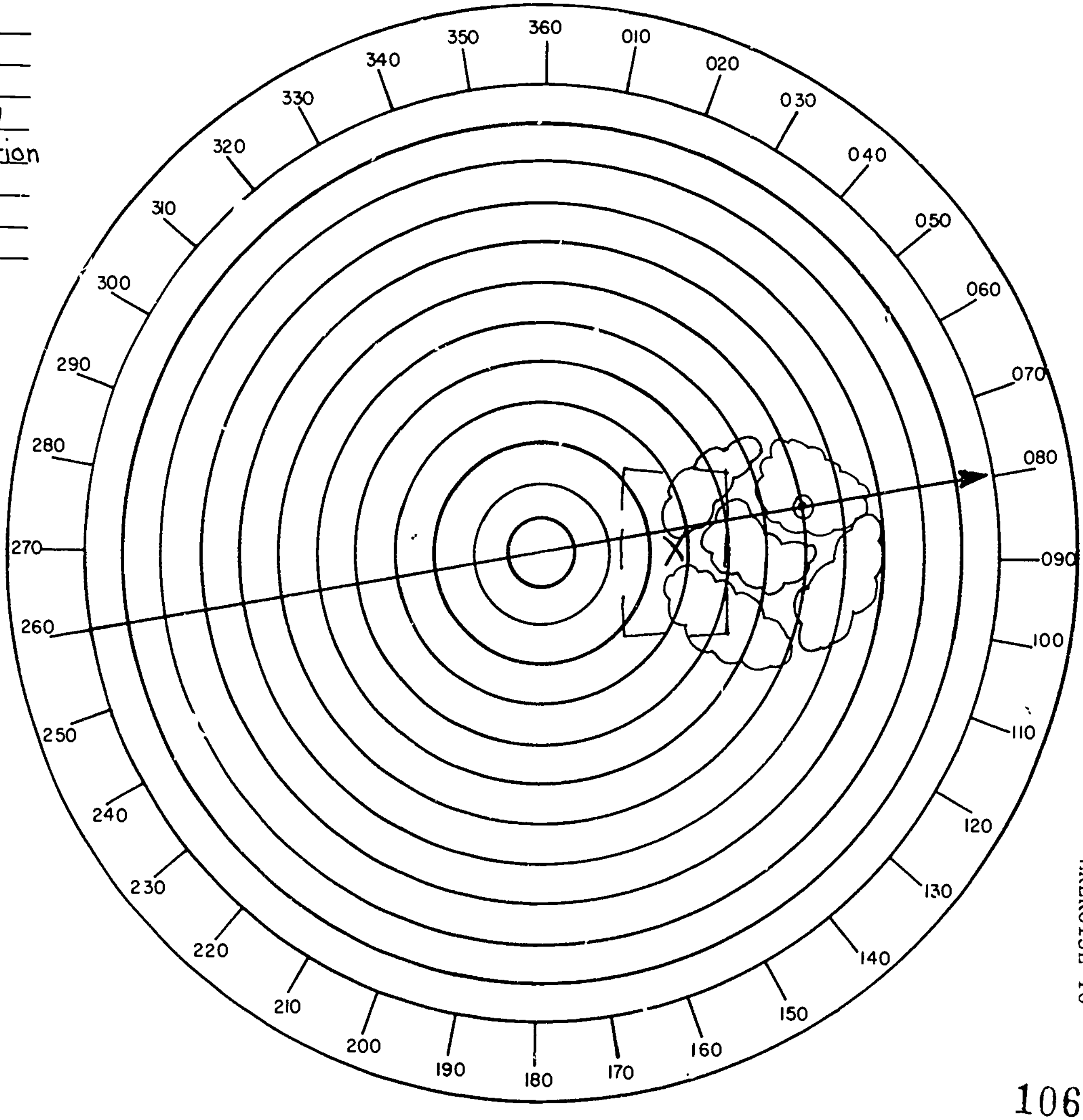
RANGE ALL SCOPES 120 NM

RANGE MARKS ALL SCOPES 10 NM

REMARKS Range Normalization at 120 NM

I.F. ATTENUATOR DB

3	0

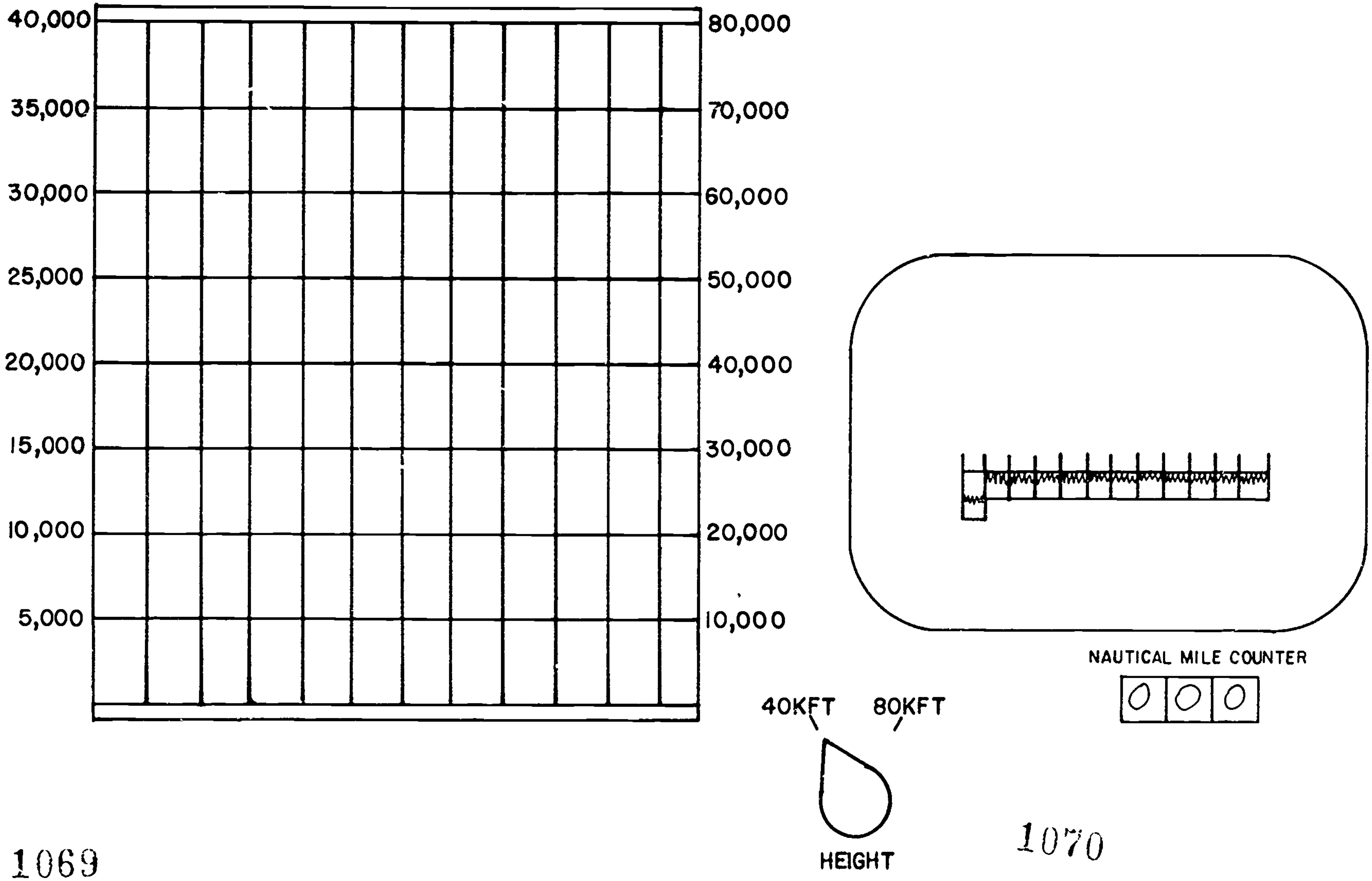


EXERCISE 16

EXERCISE 17

The magnetron tube has just decided that it is not going to emit anymore pulses today. Maintenance has evaluated the situation and informed you that the radar will be down until approximately 0915. However, observations still must be taken.

1068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NAUTICAL MILE COUNTER
0 0 0
40KFT
80KFT
HEIGHT

1069

1070

OBSERVATION ENDED 0934

PAST POSITION None

RANGE ALL SCOPES 120 NM

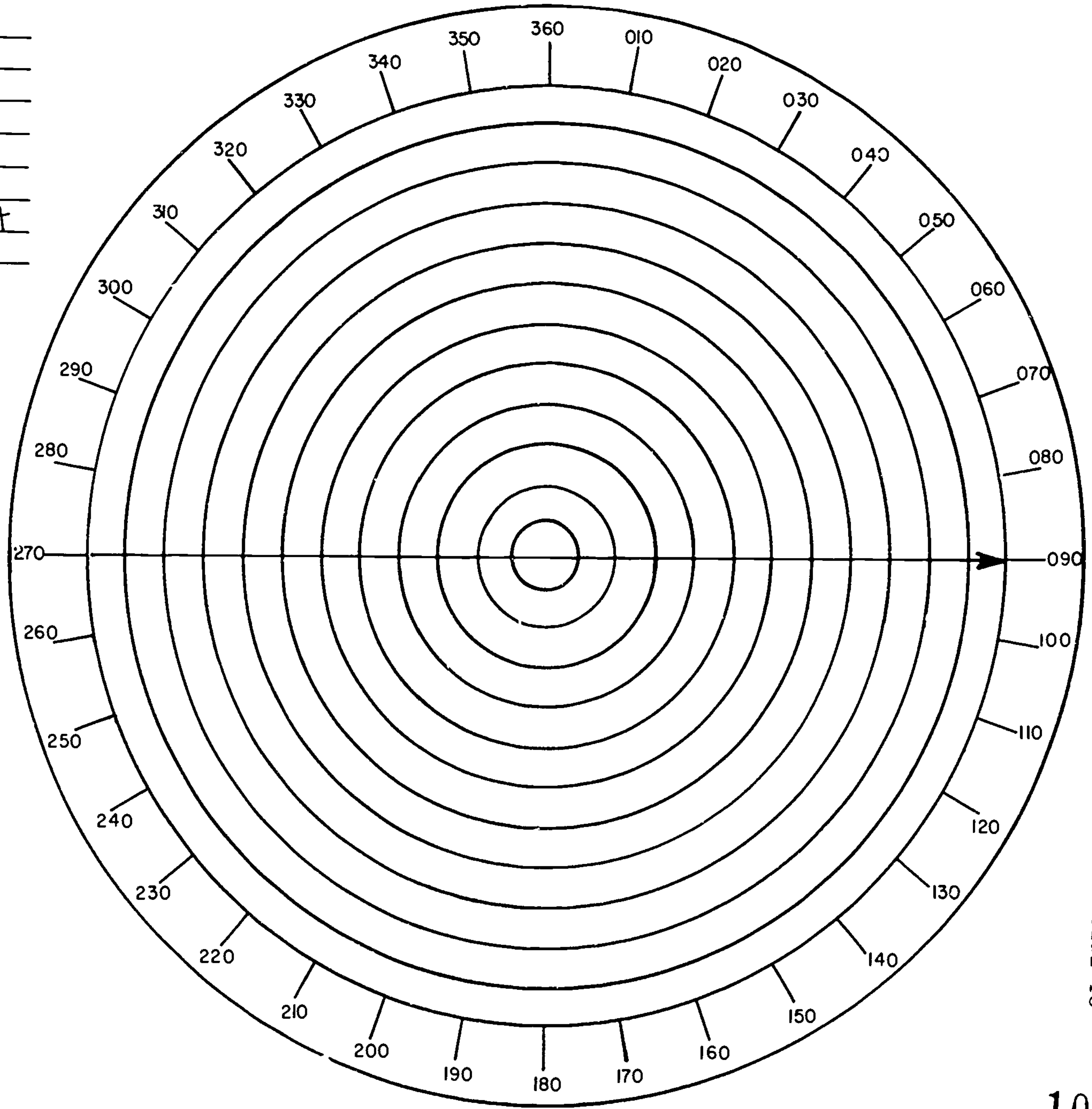
RANGE MARKS ALL SCOPES 10 NM

REMARKS No Precip cchoes observed Radar Operable but not up to standards.

I.F.
ATTENUATOR
DB

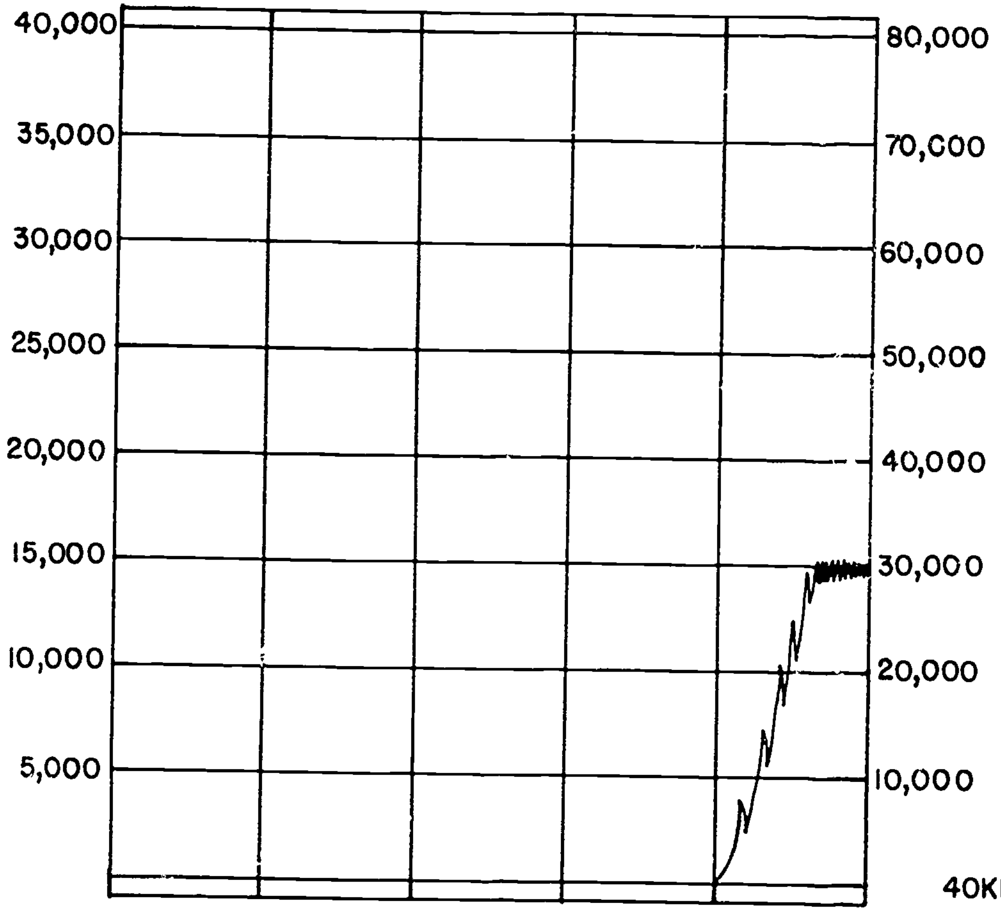
0	0

39



EXERCISE 18

1071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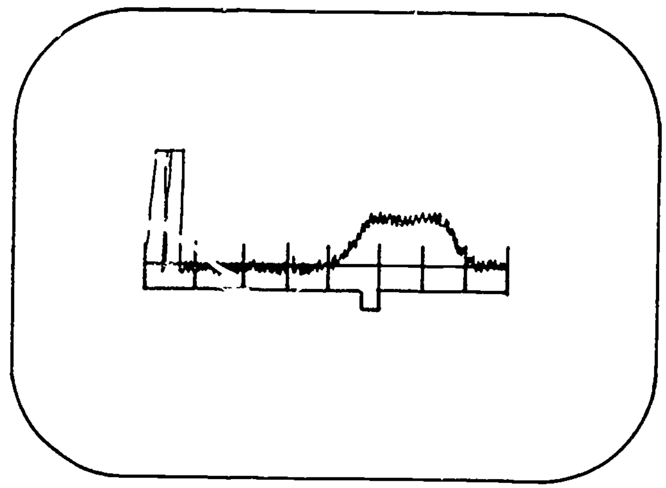

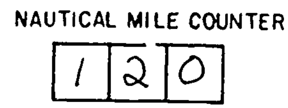
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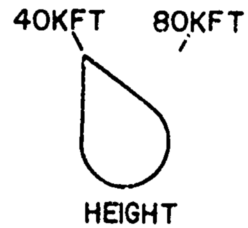

40KFT
80KFT
HEIGHT

1073

1074

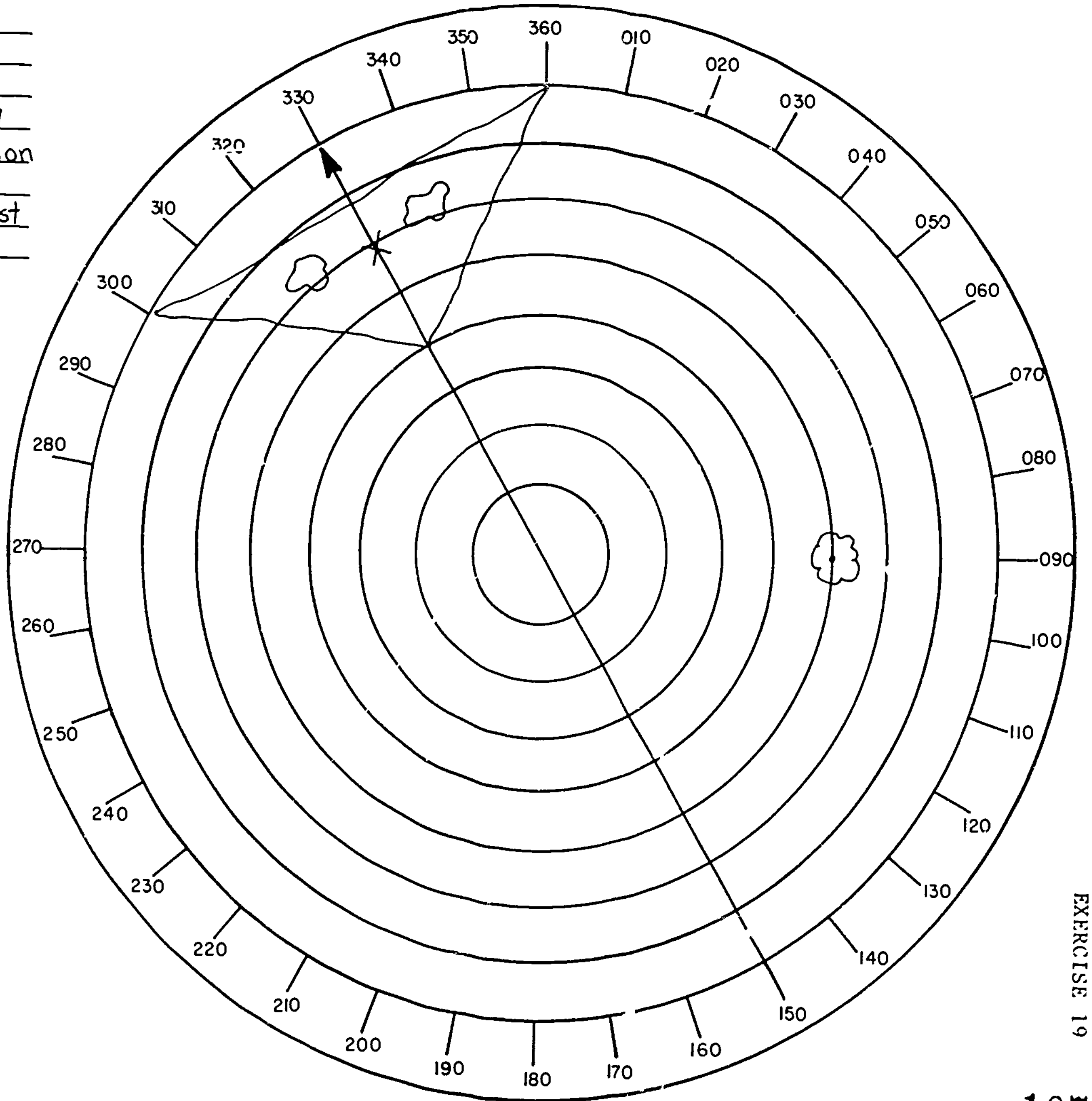
OBSERVATION ENDED 10.33
PAST POSITION 0934
RANGE ALL SCOPES 200NM
RANGE MARKS ALL SCOPES 25NM
REMARKS Range Normalization at 30 NM. Station 150 NM Northwest reports light snow

I.F. ATTENUATOR

	DB	
AREA	1	5

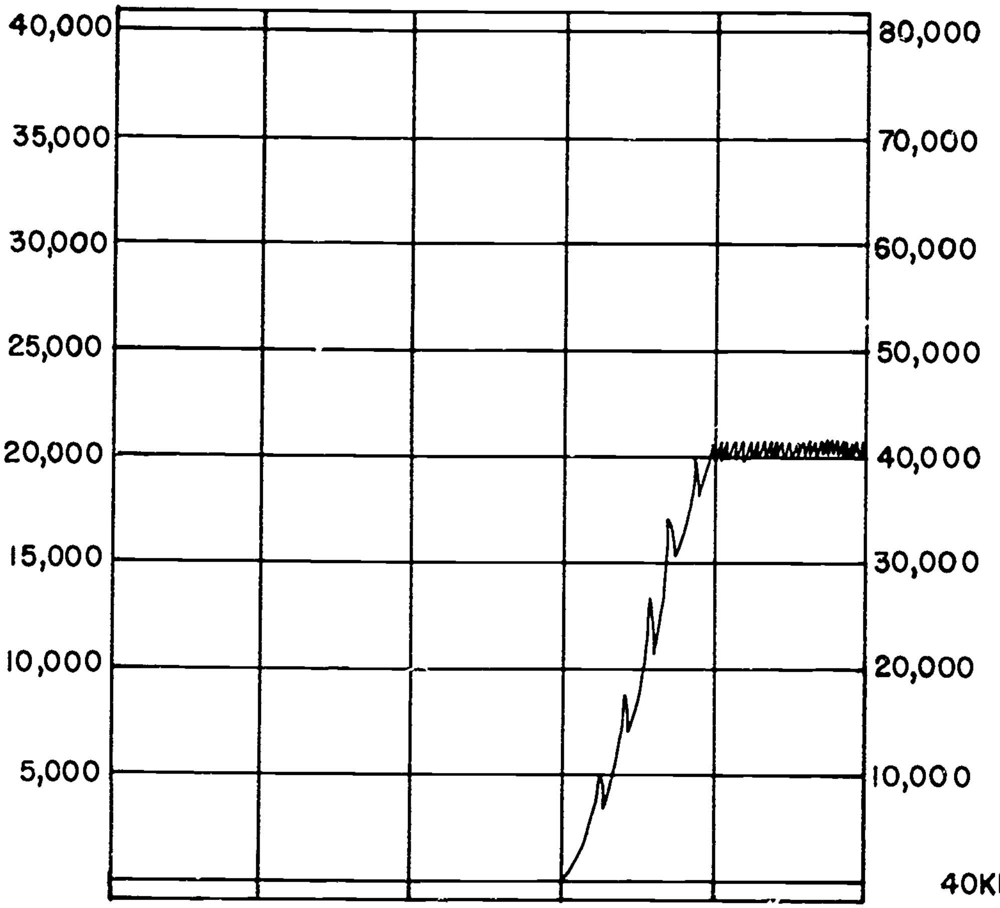
	DB	
CELL	3	0

41

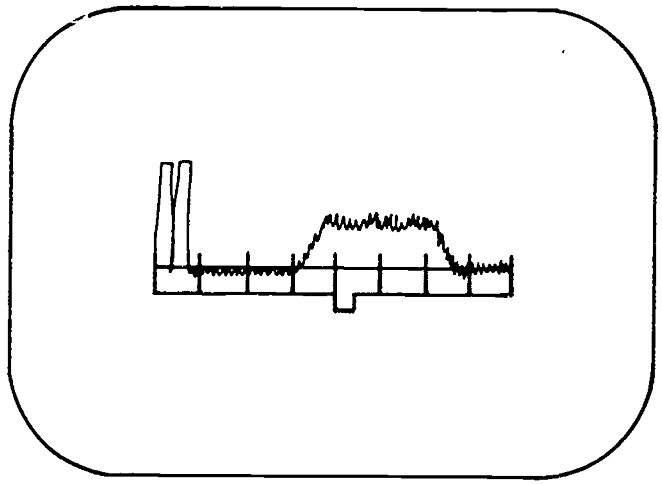


EXERCISE 19

1075

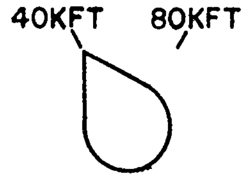


1077



NAUTICAL MILE COUNTER

1 0 0



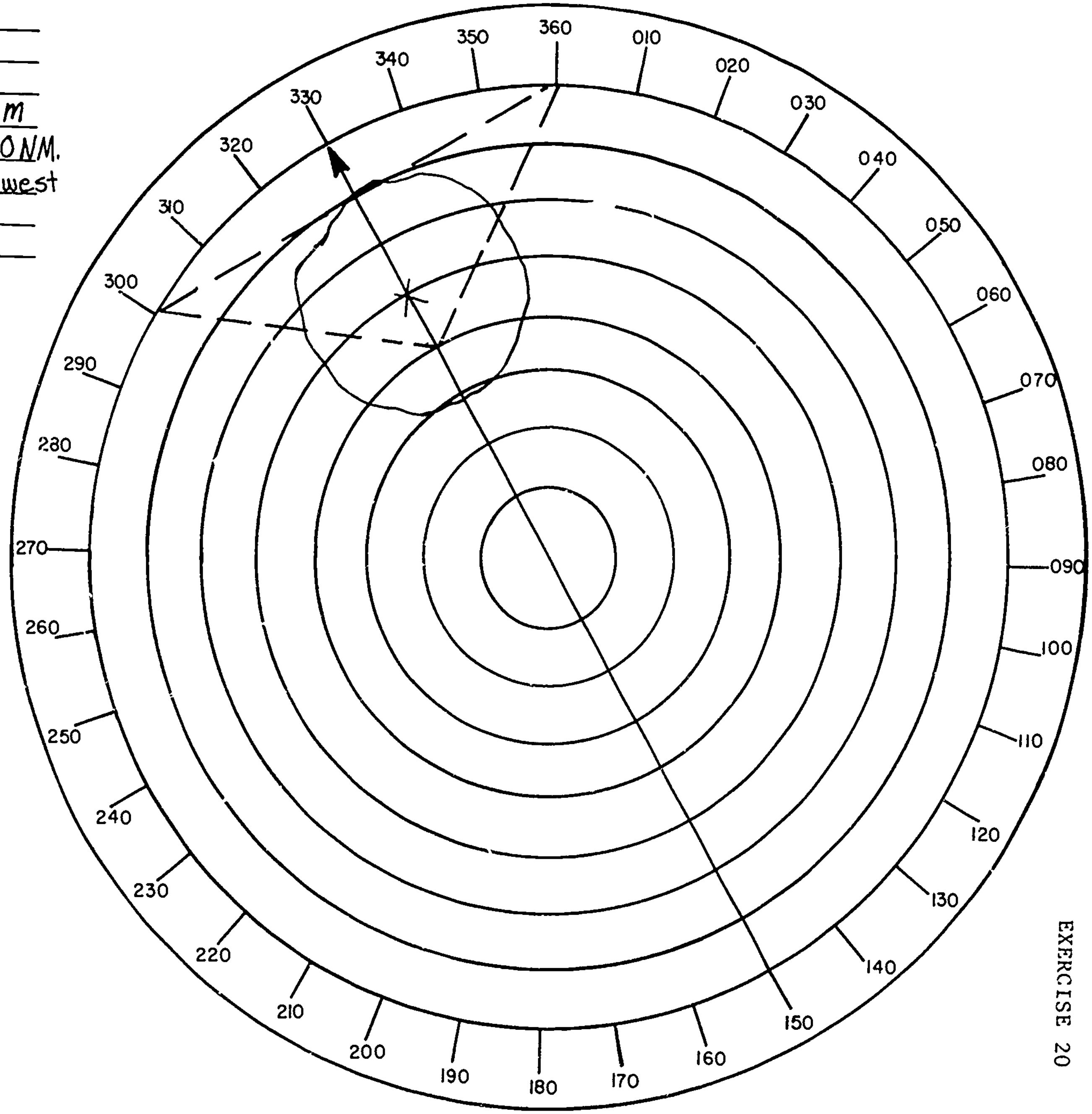
1078

OBSERVATION ENDED 1133
PAST POSITION 1033
RANGE ALL SC[illegible] 200 NM
RANGE MARKS ALL SCOPES 25NM
REMARKS Range Norm at 30NM. Station 120NM Northwest reports light sn[illegible]w

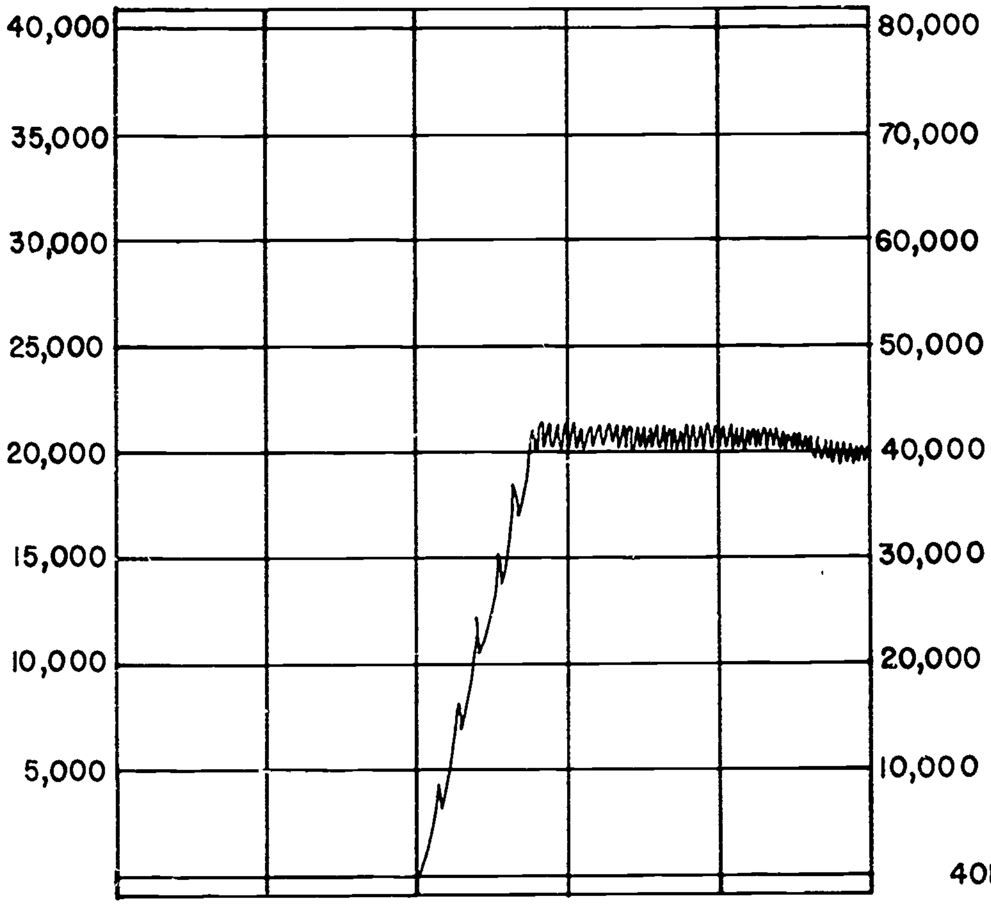
I.F.
ATTENUATOR
DB

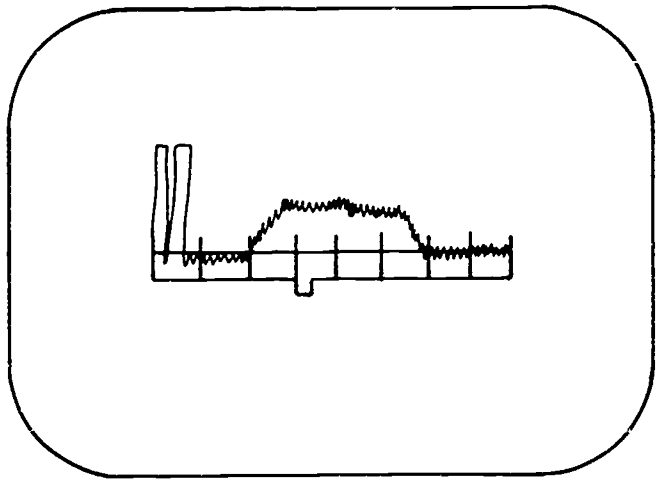
1	5

43

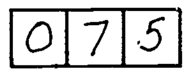


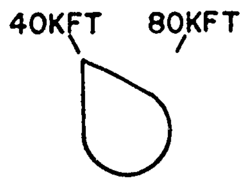
EXERCISE 20





NAUTICAL MILE COUNTER





HEIGHT

1081

1082

OBSERVATION ENDED 1233

PAST POSITION 1133

RANGE ALL SCOPES 200 NM

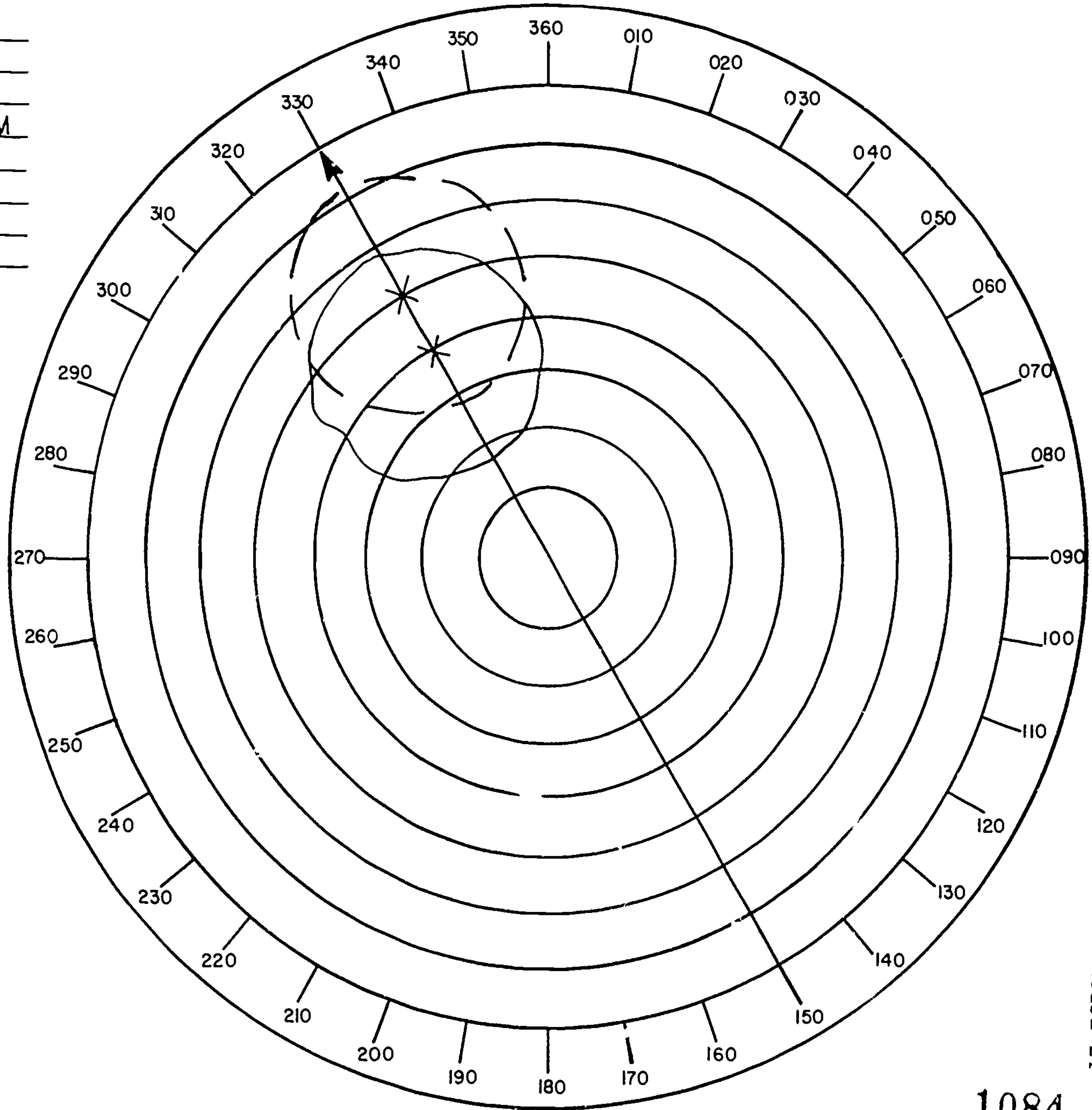
RANGE MARKS ALL SCOPES 25 NM

REMARKS Range Norm. at 30 NM. Station 100 NM North West reports heavy snow.

I.F.
ATTENUATOR
DB

3	3

45



EXERCISE 21

Technical Training

Weather Specialist

SURFACE OBSERVATIONS

16 February 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

RGL: N/A

Weather Observer Branch
Chanute AFB, Illinois

C3ABR25130-WB-310

SURFACE OBSERVATIONS

OBJECTIVES

1. Given all the necessary references and a checklist, compute meteorological and climatological data with WBAN computers for airways observations with no more than 1 error per observation.

2. Given all the necessary references and a checklist, transmit airways observations locally and longline within 5 minutes with no more than 3 errors per observation.

3. Given all the necessary references and a checklist, observe and record all weather elements for airways observations within 12 minutes with no more than 2 errors per observation.

Supersedes C3ABR25130-WB-310, 3 March 1983.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 550; DAV - 1

Assignment 1

1. List and label, in numerical sequence, all the columns on the AWSF 10 in which entries for pressure may be made.

2. Explain the error of parallax.

3. Explain the importance of reading the aneroid barometer correctly.

4. Define the following:

Sea Level Pressure -

Altimeter Setting -

Pressure Altitude -

Pressure Rising/Falling Rapidly -

5. List the step-by-step procedures for determining the following on the pressure wheel:

Altimeter Setting -

Pressure Altitude -

Sea Level Pressure -

6. Define dissemination in terms of local and longline transmission.

7. Observations are disseminated locally over the ____________ system and longline over the ____________ system.

LOCAL DISSEMINATION

8. Which columns are disseminated as recorded on the AWSF 10?

9. List three elements on the AWSF 10 that are not transmitted locally.

10. How are the following weather elements disseminated?

a. A clear sky condition -

b. Wind direction -

c. A wind direction of 270 degrees and speed zero knots -

d. A dewpoint that cannot be determined -

e. Altimeter setting -

11. List two weather elements which appear only on the telewriter and not on the AWSF 10.

12. Explain the local dissemination procedures for runway condition reading.

13. List three characters (numbers or letters) that require special emphasis, for the purpose of legibility, on the telewriter and given an example of each.

14. Explain the procedures for reporting pressure altitude locally.

15. Explain the procedures to be followed by the duty observer when the telewriter is inoperative.

16. When and how are remarks significant to meteorologists placed on the telewriter?

17. What type of observation designator will be used to facilitate the identification of tornadic activity?

18. On all telewriter transmissions what are the last entries made on the report and their significance?

19. Where is runway visual range placed on the telewriter?

20. Explain the disposition of the telewriter file copy.

21. Explain the procedures for making corrections on the telewriter.

22. Circle the items that are NOT entered on the electrowriter: SLP, ALSTG (MET), 904spsp, $1C_LC_MC_M$, peak wind, PV, 6hr precip, WR//, total sky condition, sector visibility, height of drifting snow, F2, 2R24R24R24R24, CB W MOVG NE, App, station pressure and RVR.

LONGLINE DISSEMINATION

23. Which columns of the AWSF 10 may be transmitted over the COMEDS?

24. How are all wind directions disseminated over the COMEDS?

25. List three elements normally given only longline dissemination.

26. For special observations containing reports of tornadic activity, what data type will be transmitted?

27. Explain the difference between local and longline transmission of runway visual range.

28. Explain the procedures for dissemination of longline corrections.

29. How does the duty observer transmit delayed observations?

30. When transmission of an observation is delayed until time for the next SA, RS or SP, send over the COMEDS only the latest observation. Enter "________" in the remarks section of the AWSF 10 for the observation NOT disseminated.

1090

Assignment 2

1. Explain the difference between the BASIC WEATHER WATCH and the CONTINUOUS WEATHER WATCH.

2. ORDER of OBSERVING - Elements having the greatest rate of change are evaluated last. When conditions are relatively unchanging, the observer will evaluate weather elements outdoors first, then the elements indoors, with pressure last. Disregarding observation type, list the AWSF 10 columns associated with the outdoor and indoor elements.

OUTDOOR	INDOOR
SKY CONDITION-	WIND-
VSBY-	PRESSURE-
WX & INSTRUCTIONS	TEMPERATURES-
PRECIP MEASUREMENT-	

3. Define a ceiling.

4. What constitutes a layer for clouds and for an obstruction aloft (i.e., smoke or haze)?

5. List the temperate region cloud ranges (ETAGES):

LOW MIDDLE HIGH

6. Explain the entry of variable sky condition on the AWSF 10.

7. What is the definition of a thin sky condition?

8. Name five clouds that require a mandatory column 13 remark and give an example of each.

9. What is a partial obscuration? A total obscuration? Explain the entry of each on the AWSF 10.

10. Explain the disposal of insignificant figures (rounding) and its use in surface weather observations.

1091

11. List the two times a cloud code group is never reported.

12. Define prevailing visibility.

13. The prevailing visibility (PV) at your station is 10 miles, however, the visibility to the southwest is 2 miles. In this situation, what would the AWSF 10 columns 4 and 13 entries be?

14. The PV has varied from 21/2 to 21/4 to 3 to 23/4 miles within the last 15 minutes. What would the columns 4 and 13 entries be?

15. Circle the values that are not reportable visibility values.

0, 3/16, 3/8, 7/16, 11/16, 1 5/8, 2 1/8, 2 1/4, 2 3/4, 3 1/2, 5, 8, 10, 13, 16, 20, 24, and 30.

16. List the criteria for reporting runway visual range (RVR).

17. How and where is RVR reported on the AWSP 10?

18. List the criteria for tower visibility and explain its entry on the AWSF 10.

19. Define sector visibility and explain its entry on the AWS 10.

20. When are the following atmospheric phenomena reported on the AWSF 10?

a. Tornadic activity -

b. Thunderstorms -

c. Precipitation -

d. Obstructions to vision -

21. When are obstructions to vision NOT carried in column 5 of the AWSF 10?

22. What is the order of entry for column 5?

23. Define fog, ground fog, and shallow ground fog.

24. What is the difference between drifting snow and blowing snow?

25. Define the following precipitation terms:

    Type -

    Character -

    Intensity -

26. List 2 precipitations for which no intensity is determined.

27. Match the following words with their proper definitions:

    a. Prevailing visibility _____
    b. Middle cloud 2 _____
    c. Runway visual range _____
    d. Variable visibility _____
    e. Variable ceiling _____
    f. High cloud 7 _____
    g. High cloud 9 _____
    h. Middle cloud 7 _____
    i. Low cloud 8 _____

    1. L2 and L5 are occurring at different levels.
    2. Prevailing vsby is one mile or less and/or RVR is 6000 ft or less.
    3. AS dense (opaque) or NS extensive and dark associated with precipitation.
    4. CC predominant.
    5. The highest visibility attained throughout half or more of the horizon circle not necessarily continuous.
    6. The height of the ceiling increases and decreases by one or more reportable values and is less than 3000 ft.
    7. AC is single opaque layer, or two layers NPIS, or AC with AS/NS.
    8. CS covers the entire sky.
    9. Visibility increases and decreases by one or more reportable values and is less than 3 miles.

ASSIGNMENT 3

1. List and label, in numerical sequence, all the columns on the AWSF 10 in which entries for wind information may be made.

2. The ________ minute means direction and speed are reported in columns ________ and ________.

3. How are all wind directions reported on the AWSF 10?

4. How are all wind speeds recorded on the AWSF 10?

5. What are the definitions of a gust and a squall? Give examples of each.

6. Explain how an estimated wind is entered on the AWSF 10.

7. Explain the determination of the following wind entries on the AWSF 10 and give an example of each:

Wind variable -

Wind shift -

Peak wind -

8. Using the Beaufort scale, what would be the AWSF 10 entries if the winds are blowing from the north and loose paper is being picked up by the wind?

9. List, in numerical sequence, all columns on the AWSF 10 in which entries for temperature may be made.

10. Define the following temperature terms:

Dry Bulb -

Wet Bulb -

Wet Bulb Depression -

Dewpoint -

11. If the temperature or dewpoint cannot be determined, what is encoded on the AWSF 10?

12. The temperature is minus 4 degrees and the dewpoint is minus 10 degrees. How are these temperatures entered on the AWSF 10?

13. The TMQ-11 Temperature/Humidity set is inoperative. Explain the procedures necessary to determine AWSF 10 temperature entries using the sling Psychrometer (ML24) and psychrometric calculator.

14. How is the measurement of precipitation expressed in Airways Code?

15. The basic U.S. unit of precipitation measurement is the __________.

16. When are precipitation measurements normally taken by the duty observer?

17. 17. List the exact units of measurement for the following precipitation types:

Liquid -

Frozen -

Snow Depth -

18. Describe a "representative area" for the measurement of solid precipitation forms.

19. Describe the procedures for measurement of the following:

Liquid precipitation -

Freezing precipitation -

Frozen precipitation -

Snow depth -

ASSIGNMENT 4

1. Define actual and standard times. Give an example of each.

2. List the five observation types used by Air Weather Service.

3. In numerical sequence, list the columns required to be filled out on the AWSF 10 for every hourly observation.

4. Which two columns will be encoded on an hourly observation <u>ONLY</u> if criteria for entry is met?

5. Name the specific entry in column 13 that is mandatory for every 3 and 6 hourly.

6. Of the following times, underline the 3-hourlies, circle the 6-hourlies, and leave 1-hourlies as they are:

1659, 1957, 1757, 2055, 0856, 2355, 0055, 1055, 2156, 0555, 0258,

1458, 0455, 1159, 0756, 0957, 1856, 0357, 0656

7. Check the following as to when they can be used on

	1-HRLY	3-HRLY	6-HRLY	SPLS
SLP				
RR				
$1C_LC_MC_M$				
STA PRESS				
TOTAL SKY COVER				
App				
904spsp				

8. Identify the following mandatory remarks as either "ATC" or "MET" remarks:

a. K3 SCT ______

b. WND 23V33 ______

c. PK WND 2732/16 ______

d. PRESFR ______

e. TCU W ______

f. K LYR E ______

g. VSBY E1 ______

h. T E MOVG E ______

i. VIRGA SE ______

j. F8 ______

k. SNOINCR 2 ______

l. WSHFT 30 FROPA ______

m. K DRFTG OVR RWY ______

n. INTMT R- ______

9. Define a Record Special observation:

10. Which columns are encoded for a Special observation on the AWSF 10?

11. Which columns are encoded for a Single Element Special observation?

12. Single element specials are authorized for:

a.

b.

c.

13. When is a Special observation designated as being Urgent?

14. Explain how runway condition is determined and reported by the airfield management personnel.

15. Match the examples of encoded runway conditions with their appropriate word descriptions:

a. LSR15 _____

b. IR// _____

c. WR// _____

d. RCRNR _____

e. PSR12 _____

f. SLR08 _____

1. Slush on runway, decelerometer reading 08

2. Packed snow on runway, decelerometer reading 12

3. Ice on runway, decelerometer reading not available

4. Base Operations closed, conditions for reporting RCR are suspected

5. The runway is wet

6. Loose snow on the runway, decelerometer reading 15

16. After initial transmission, include the runway condition remark in each subsequent __________ or __________ __________ observation until report is __________ or __________ by the Base Operations personnel.

17. List the four local observations evaluated and disseminated by Air Weather Service.

18. Local observations are not normally recorded on the AWSF 10. List the two exceptions.

19. List the columns on the AWSF 10 to be encoded for the following observation types:

a. Aircraft Mishap Local -

b. Aircraft Mishap with an intervening special -

c. Aircraft Mishap with an intervening hourly -

d. Runway Change Local -

e. Altimeter Setting Local -

20. Explain the procedures for making corrections on the AWSF 10 in columns 1-13 discovered before dissemination.

21. Explain the procedure for making corrections on the AWSF 10 in columns 1-13 discovered after either local or longline dissemination.

22. List the proper order of entry in column 13 for the following mandatory remarks: F8, WR//, CIG 4V8, PRESFR, WND 25V34, R18VR60, T E MOVG NE, K3 SCT, BRKS W, (ACFT MISHAP), FQT LTGIC SW, VSBY E1W2N1, and PK WND 0937/53.

1100

ASSIGNMENT 5

Each of the following locally transmitted surface observations contains one or more errors. Underline the errors and make the appropriate corrections in the space provided to the right.

HMN SA 1252

25Ø-SCT 4Ø

169 91 62

26Ø8G19

QNH 3Ø.36

STA PRESS 29.31Ø

53/SKP

RAN L 133Ø

ALSTG 3Ø.Ø15

PA+ 69Ø

31/PM

1101

BKF SP 1821

M26 BKN 7RW-

61/54 21Ø/ØØ

ALSTG 2996

PA+ 516Ø

(ACFT MISHAP)

22/TA

GUS SP Ø4Ø2

UNCONFIRMED
TORNADO 1ØSW
MOVG NE Ø4ØØ

Ø3/JB

1102

PSM SA 1656.

-X 5 SCT M16 BKN

3/8V R34VR14

L-F Ø3Ø/Ø5/Ø9

ALSTG 29.815

F2 5BKN V SCT

VSBY 1/4V 1/2

TWR VSBY 5/8

PA+ 56Ø

57/EP

CVS SP Ø45Ø

W6 X 1/2 TRWF

7Ø/69

2615/3Ø

PA+ 5ØØ

STA PRES 29.375

COS S̲P 1623

-X M5 OVC 1/4

RVR3Ø SW-

ØØØ/ØØ

ALS̲TG Ø22

PA+ 315Ø

S̲W3 VS̲BY E3/4

WET RWY

24/SH

1104

OSC SA Ø555

-X M4V BKN 1/2

RW-F 78 70

2610G19

ALSTG 996

R18VR32 F3

VSBY W 3/4

WND 26V34

PA+ 74Ø

PRES FR 1310Ø6

1Ø21

1105

ASSIGNMENT 6

Each of the following longline surface observations contains one or more errors. Underline the error(s).

6-HOURLIES

1. VBG SA 0555 16 SCT 100 SCT E250 BKN 7 8/-2/1904/003 707 1876;

2. TOP SA 2355 CLR 10 231/55/48/1800/022/ 41216;

3. BFF SA 1156 80 SCT 150 BKN 10 62/56/3106/972/ 114 1070;

4. OLU SA 1755 E250 -BKN7 221/58/50/E2902/01 7/ 302 1001;

5. PLA SA 2356 250 -BKN 7 210/66/61/2003/015/WND 17V23/ 505 1008;

6. MDW SA 1157 -X 3/4F 176/67/69/0000/RVR40 F3/605 1600;

7. SPI SA 0555 30 SCT 15 077/85/65/2804/984/20700 1001;

8. OMA SA 1755 W1 X 1/8F 121/62/61/0000/985/R18VR14 SFC VSBY 1/4/ 803 16//;

9. UIN SA 0556 40 SCT 7 218/35/28/3004/018/10005 1500 90401;

3-HOURLIES

10. STL SA 1455 40 SCT 15 202/88/75/1208/16/012/315 1100;

11. RSL SA 2056 CLR 15 236/63/58/1702/022/ 602 1000;

12. RFD SA 0855 250 -BKN 7H 210/66/61/2007/015/ 505 1007;

13. SPS SA 0255 CLR 15 198/52/40/21111/010/ 405;

14. SUX SA 2055 E30 BKN 80 SCT 10 218/59/55/3208/018 400 1570 WR//;

15. DEN SA 0857 M4 BKN 50 OVC 2L-F 244/62/62/3505/996/ 30200 1700;

16. FFO SA 1455 7 BKN E250 OVC 3GFH 189/72/69/1901/007/ 603;

17. RFD SP 0255 -X 21/2GFH 182/70/68/1901/007/ 603;

18. SAL SA 12 SCT 28 SCT 6GF 175/88/87/0104/SCT V BKN/ 102 1500;

SPECIALS AND MISCELLANEOUS

19. DCA SP 0911 -X 3/4F 0000/006/RVR14 F10;

20. BAL SP 1225 M30 OVC 7T 75/73/1716/FQT LTGICCCCG;

21. PIT SP 1717 M18 OVC 5TRW- 2312/003/T MOVG NE;

22. COE 0612 5 SCT E110 OVC 21/2RF 0605G09/008;

23. GRI SP 0929 W1 X 5/8TRW+ 1820/008/WR//;

24. HSI SP 0031 -X M4 OVC 1/16L-F 3507/996 RVRNO F2 VSBY E4;

25. 30I SP 0146 W4X 2L-F 0000/002/RVR60+;

26. BLV 0744 -X M15 OVC 11/2RW+ 2307/007/RW8;

27. DEN SP 1117 M35V BKN 140 OVC 3GFH 0808/013/CIG 34V36;

28. BOS SA 2332 M15 BKN 2RW- 2617G28/892/BRKS ALQDS;

29. AUS SP 1104 W4 X 1R-F 2412/001/RVR60+ PK WND 2733/12;

30. MLI SP 1929 M6V OVC 21/2 FR-0208/001/CIG 4V8 WND 34V05;

31. OFF SP 1057 RTD 250 SCT 20 131/66/50/9012/999;

32. SEM SA COR 0655 -X E50 OVC 1/4 117/63/62/0000/988/RVR18 F10/ 205;

33. NZY SA RTD 1255 W1 X 1/8F 127/63/62/0000/998/RVR18 F10;

34. RND SA RTD 0656 12 SCT 16 172/69/67/0000/005/SCT V BKN;

35. LSF COR 1355 -X 32 SCT 11/4L-F 201/63/63/3509/F1 SCT V BKN;

36. SKF SA RTD 2155 -X E100 BKN 3/4F 182/72/71/0000/007/F8 RVR45;

STUDY GUIDE/WORKBOOK

C3ABR25130-SW-310

Technical Training

Weather Specialist

PREPARATION OF WEATHER CHARTS

9 November 1982

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

Designed for ATC Course Use.

Do Not Use on the Job. RGL: 10.2

Weather Training Branch
Chanute AFB, Illinois

C3ABR25130-SW-310

PREPARATION OF WEATHER CHARTS

OBJECTIVE

Using all required references and charts, post facsimile charts.

INTRODUCTION

One of your jobs as an observer will be to color in various weather charts which you will hang up behind the forecaster's counter. This will include maps drawn locally as well as those made by the Navy, the National Weather Service and Global Weather Central which are received by way of the Air Force Digital Graphics System (AFDIGS). These charts are colored in to make the various features easier to read by both the forecaster and the pilot.

A new weather specialist should be able to color in three basic maps or charts. These charts are the surface analysis, the weather depiction, and the radar charts. These are the ones most frequently used by the forecaster and it is a great deal of help if the various features are highlighted in color. Highlighting these charts is simply a matter of tracing over the features with colored pens. This lesson will provide you with the information necessary to properly color these three charts. These rules may be varied according to local policy.

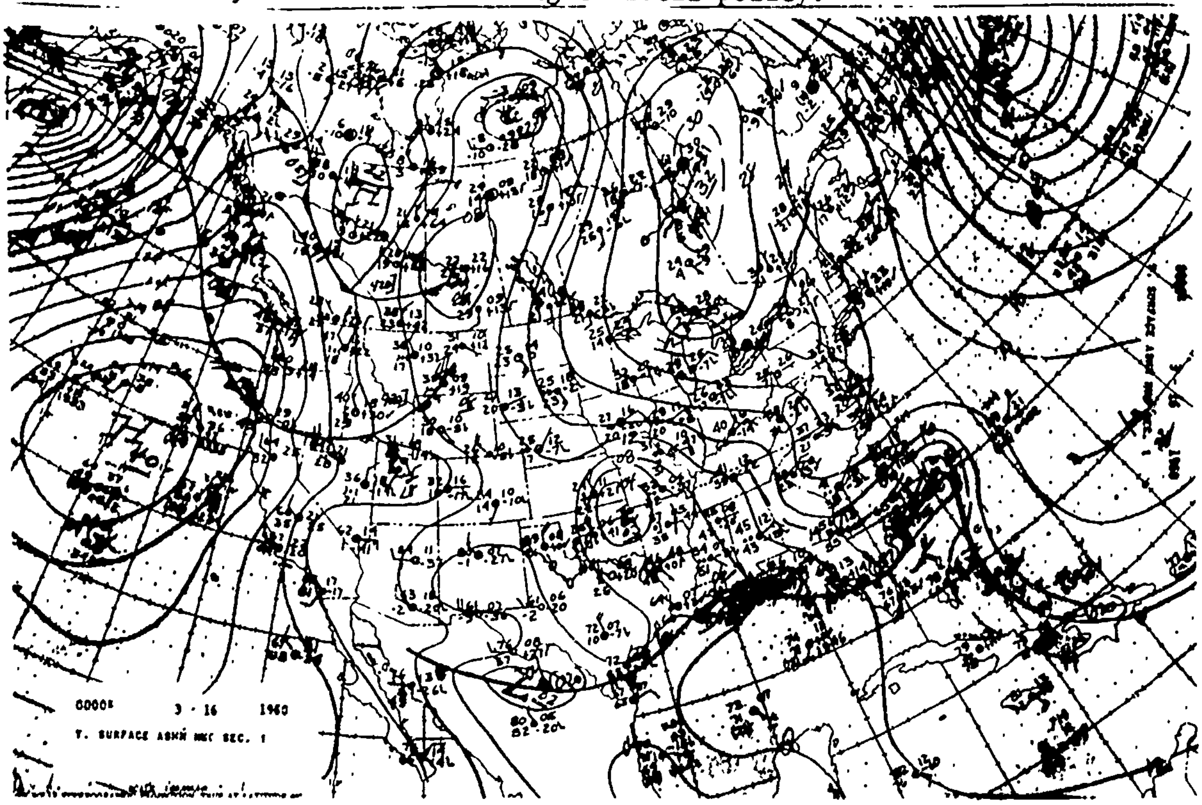


Figure 1. Surface Analysis.

Supersedes 3ABR25130-SW-310, 4 March 1982.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 550; DAV - 1

INFORMATION

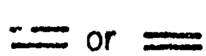
SURFACE ANALYSIS

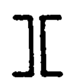
Description

The chart shown in figure 1 is the most commonly used map in the weather station. It gives a picture of the pressure field and the present surface weather across a section of the world. Such features as pressure centers, fronts, troughs, ridges, and areas of bad weather are shown on the map and should be highlighted in the appropriate color.

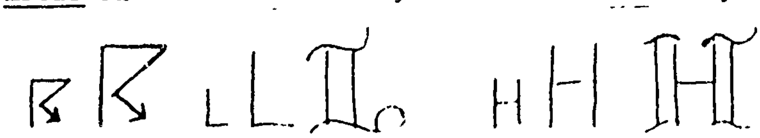
Features to be Colored

The following is a list of the most common features that are colored on the surface analysis chart. Study them carefully!

	WEATHER FEATURE	FACSIMILE CHART SYMBOL	HIGHLIGHTING COLOR
1.	Surface cold front		Blue
2.	Surface warm front		Red
3.	Surface quasi-stationary front		Alternating Red and Blue
4.	Surface occluded front		Purple
5.	Trough line	TROF	Black
	NOTE: Do not confuse trough lines which are relatively short dashed lines, with intermediate isobars, which are rather long dashed lines and numbered at both ends.		
6.	Ridge line		Black
7.	Instability or squall line		Black
8.	Center of tropical cyclone		Red
9.	Center of hurricane		Red
10.	Center of high pressure	H	Blue H
11.	Center of low pressure	L	Red L
12.	Areas of fog		Light yellow shading
13.	Areas of blowing dust or sand		Light brown shading

WEATHER FEATURE	FACSIMILE CHART SYMBOL	HIGHLIGHTING COLOR
14. Significant weather		
a. Thunderstorms		
(1) Present		Red
(2) Past		Red
b. Lightning		Red
c. Hail		Green
d. Freezing rain		Red
e. Freezing drizzle		Red
f. Ice pellets		Green
g. Funnel cloud, tornado, waterspout		Red
h. Rain showers		Green
i. Snow showers		Green
j. Drifting snow		Green
k. Virga		Green
l. Haze		Brown
m. Smoke		Brown

Fronts, troughs, and ridges are just traced in the appropriate color. Other symbols on the surface analysis chart are usually enlarged.

Example: 

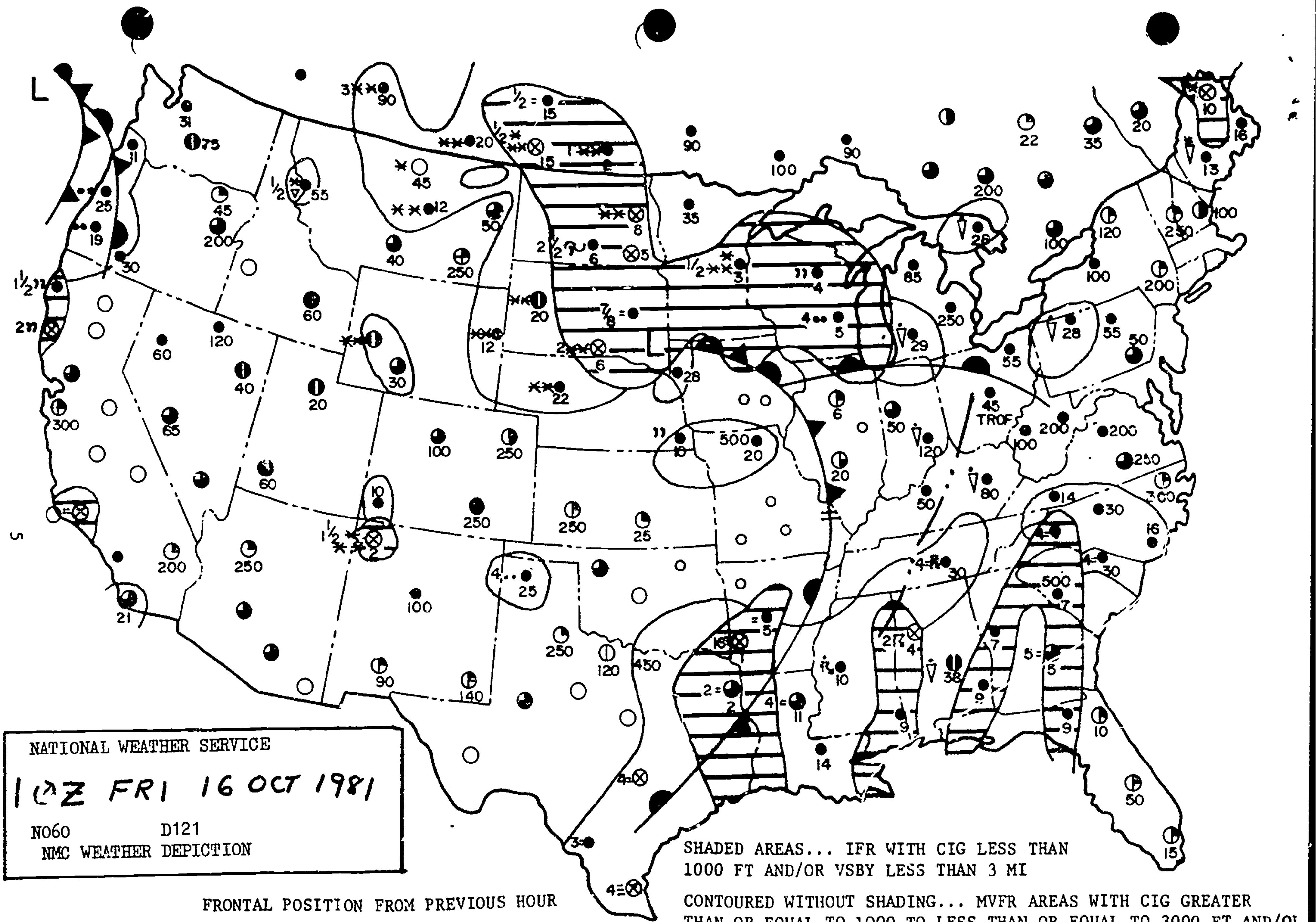
The above list shows only a few of the weather features that are colored on a surface chart. The rest can be found in figure 4 at the end of this study guide/workbook.

Once the map is completely highlighted, outline the state in which you are based (in this case, Illinois) in orange. Also in the lower left-hand corner, print in black the date-time group as follows:

VT $\frac{02}{01} / \frac{0100Z}{1900L}$

"VT" stands for valid time. "02" and "01" represent the day of the month. Remember in the Central Time Zone there is a 6-hour difference between GMT and local time except during daylight savings time when there is only a 5-hour difference.

1111



NATIONAL WEATHER SERVICE

1⁰Z FRI 16 OCT 1981

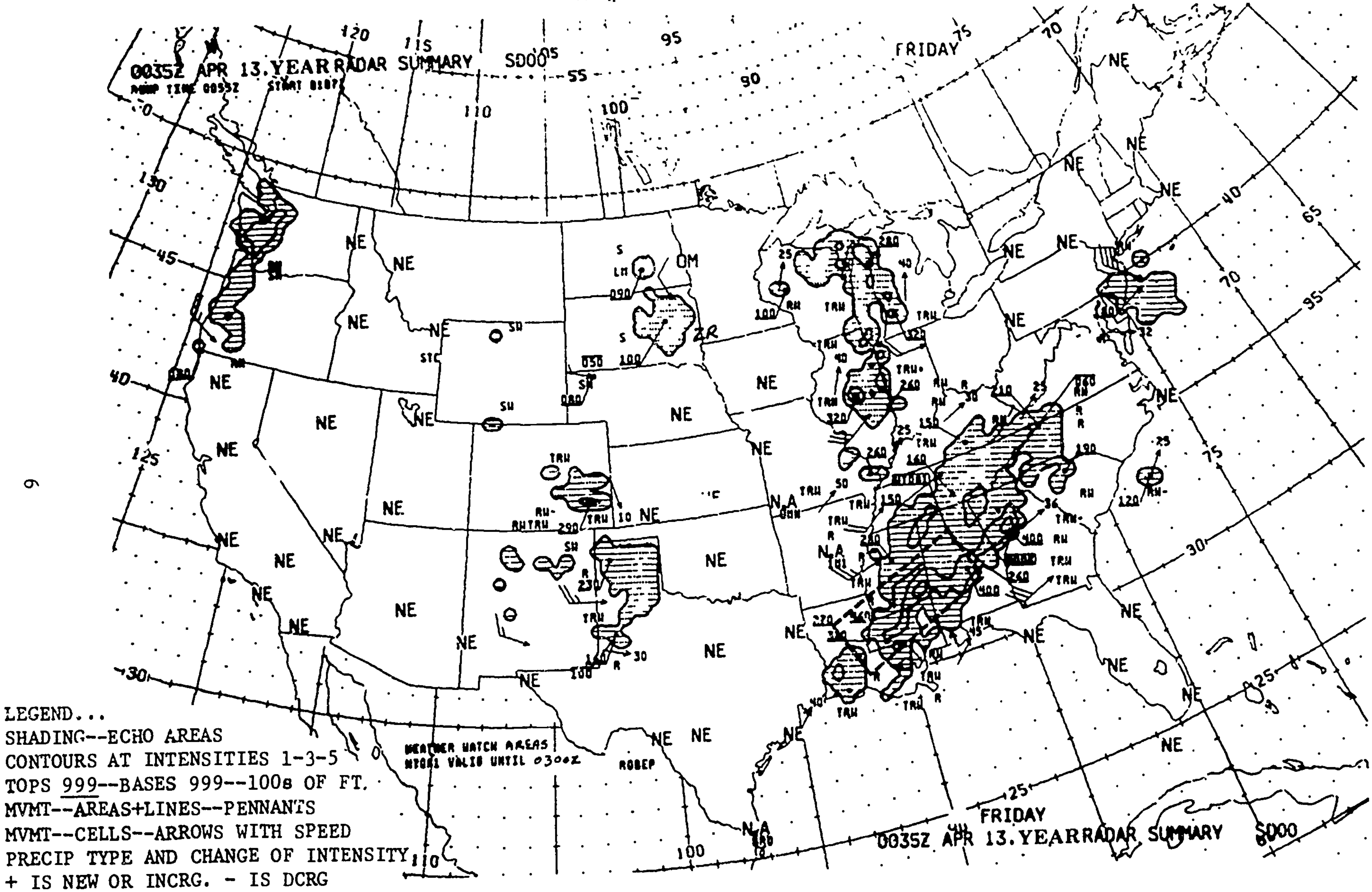
N060 D121
NMC WEATHER DEPICTION

FRONTAL POSITION FROM PREVIOUS HOUR

SHADED AREAS... IFR WITH CIG LESS THAN 1000 FT AND/OR VSBY LESS THAN 3 MI

CONTOURED WITHOUT SHADING... MVFR AREAS WITH CIG GREATER THAN OR EQUAL TO 1000 TO LESS THAN OR EQUAL TO 3000 FT AND/OR VSBY GREATER THAN OR EQUAL TO 3 TO LESS THAN OR EQUAL TO 5 M

NO CONTOURS... VFR AREAS WITH CIG GREATER THAN 3000 FT AND VSBY GREATER THAN 5 MI



1114

Figure 3. Radar.

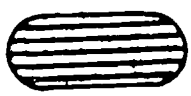
WEATHER DEPICTION

Description

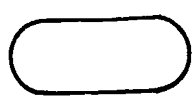
This chart, as seen in figure 2, shows areas of low ceilings and visibilities. It gives the pilot a bird's eye view of areas in which they may need to fly by Instrument Flight Rules (IFR) or Marginal Visual Flight Rules (MVFR).

Features to be Colored

The fronts will not be colored, although they are depicted as on the surface analysis chart. To highlight the areas of low ceilings and/or low visibilities, <u>trace over</u> the <u>outline</u> with the appropriate colored pen as follows:



IRF ceiling less than 1,000 ft RED and/or visibility less than 3 mi



MVFR, ceiling greater than or equal BLUE to 1,000 ft to less than or equal to 3,000 ft and/or visibility greater than or equal to 3 miles to less than or equal to 5 miles

Areas not depicted on the chart are areas of Visual Flight Rules (VFR)

After outlining all of the areas, take red and blue pencils and shade in the corresponding colored areas. Now finish the chart by outlining Illinois. Be sure to place the date-time group in the lower left-hand corner.

RADAR

Description

The chart shown in figure 3 shows a collection of radar reports. It is made by computer and shows precipitation areas and indicates their location, movement, and tops. Remember, radar does not detect clouds and fog. The absence of echoes does not guarantee clear weather to the pilot.

Features to be Colored

Outline the thunderstorms and freezing precipitation echoes in red, and outline all others in green. If a dashed box appears on the chart, trace over it with red pen and lightly shade in red pencil. This box represents a severe weather watch area.

After all of this highlighting is finished, outline Illinois and place the date-time group in the same manner as done on the previous charts.

Now, as a review, draw the symbol, and state the color used to highlight each of the following:

		SYMBOL	COLOR
1.	Occluded front		
2.	Stationary front		
3.	Fog area		
4.	Instability line		
5.	Low pressure		
6.	Freezing drizzle		
7.	High pressure		
8.	Tropical storm		
9.	Ceiling less than 1,000 ft or visibility less than 3 miles.		
10.	Cold front		
11.	Thunderstorm		
12.	Warm front		
13.	Virga		
14.	Squall line		
15.	Trough line		
16.	Rain showers		
17.	Smoke		
18.	Haze		

Finally, get a set of charts and colored pens (red, blue, purple, black, green, yellow, and orange) and pencils (red, blue, green, yellow, and brown) from your instructor. Then color the charts using the instructions in this study guide/workbook.

1117

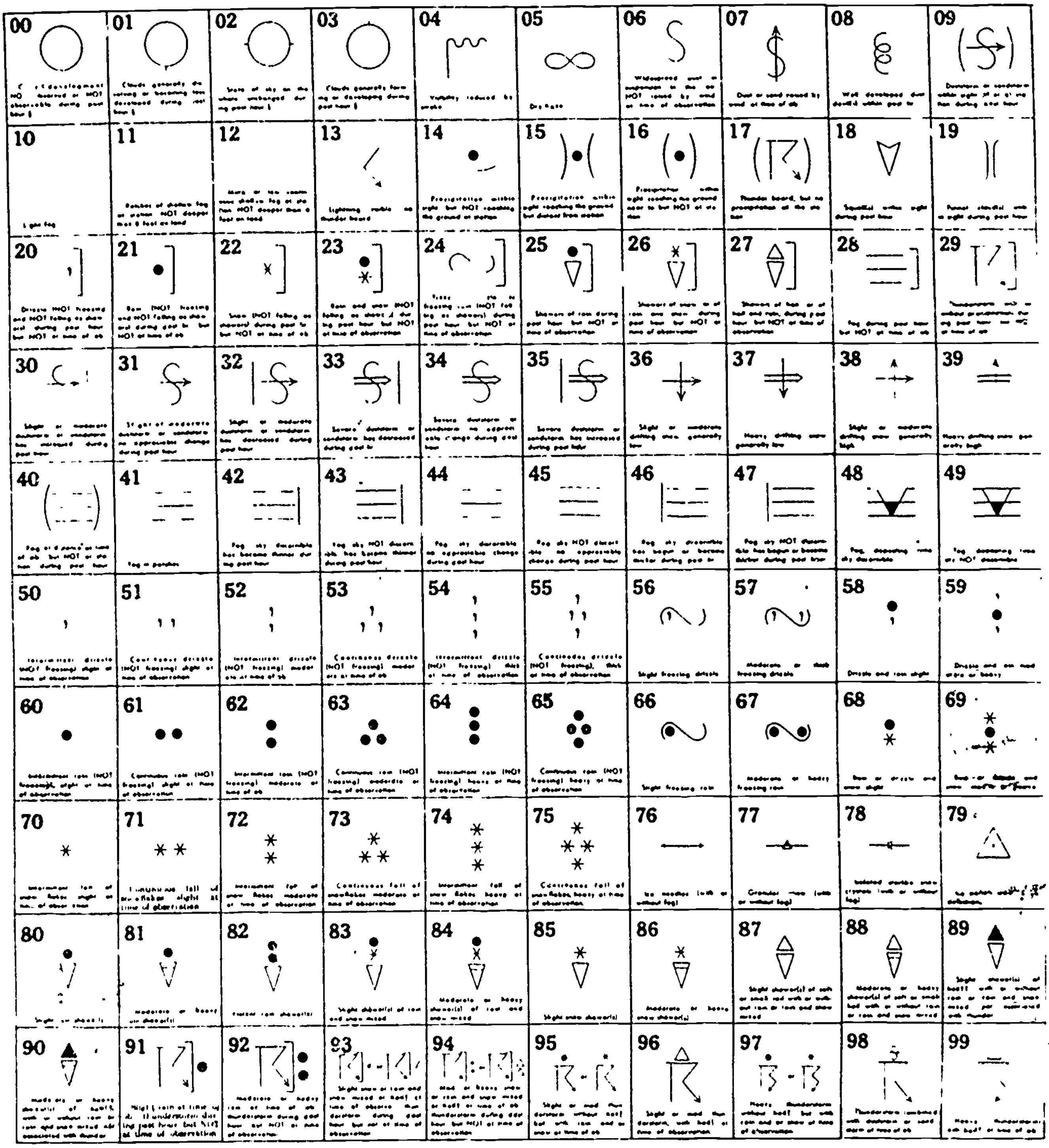
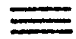
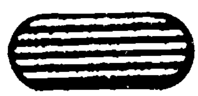


Figure 4. Surface Analysis Symbols.

ANSWERS:

1.		Purple
2.		Red and blue
3.		Yellow
4.		Black
5.		Red
6.		Red
7.		Blue
8.		Red
9.		Red
10.		Blue
11.		Red
12.		Red
13.		Green
14.		Black
15.		Black
16.		Green
17.		Brown
18.		Brown

C3ABR25130-002-PT-313

PROGRAMMED INSTRUCTION

AEROGRAPHER'S

MATE SCHOOL

CLASS A I

DECODING & PLOTTING of the INTERNATIONAL ANALYSIS CODE

CNTT-L186 PAT

Naval Technical Training Command

INSTRUCTIONS

This text is designed to be used in conjunction with Weather Plotting Chart DOD-WPC 1-10-3, the Meteorological Codes and Location Identifiers Pamphlet, and Appendices I and II which can be found at the end of this program. Read each frame carefully and make appropriate entries on the plotting chart. At various places within this program you will be directed to have the instructor check your work. These "check points" are written in so that the instructor can check the accuracy of your work and correct any errors you may be committing. Turn now to the next page and read the objectives carefully.

DECODING AND PLOTTING INTERNATIONAL ANALYSIS CODE

INTRODUCTION

While underway at sea, you may find that because of other duties, time cannot be spared to plot all the ship and land station reports available for analyzing a weather map. On such occasions an analyzed weather map and/or prognosis showing the centers of pressure systems and the location of fronts and isobars, drawn from data given in a coded analysis message, may meet the local requirements. Also, in cases where communications failure precludes the receipt of facsimile transmissions, this coded analysis or prognosis may be the only source upon which the forecaster can base his forecasts. You as an observer will have to decode and plot the analysis/prognosis when the situation arises.

OBJECTIVE

Upon completion of this lesson, the student will:

From a given Surface International Analysis Code, decode and plot data concerning pressure systems, fronts and isobars on a Weather Plotting Chart. Indicate with the proper symbols and colors the central pressure and movement of pressure systems. Connect frontal points using the proper color and connect and label isobars. 90% of all data required must be correctly plotted within 45 minutes.

FRAME 1

Before going any further in this program, turn to Page 5 and 6 in your Meteorological Code and Location Identifiers Booklet. The complete symbolic format for the International Analysis Code Fleet (FM 46D) is found on these pages.

Next, tear out Appendices I and II which are the last pages of this program. Appendix I contains the specification tables for all of the code figures, and Appendix II contains standard weather features.

NOTE: YOU WILL NEED TO REFER TO BOTH OF THESE GUIDES THROUGHOUT THE PROGRAM.

Below is a sample IAC Fleet Message in its encoded format. Each section of this particular message will be explained in the next several frames to aid you in decoding your first IAC map

- -

```
ASNA KWBC 251400
10001 33388 02512
99900
81399 13900 20420 81186 05784 20730 81310 15765 50210 81007
      13818 10000
85218 03074 10000 85018 05154 00730 85322 07065 00930 85333
      17022 21625
85025 14743 20910
99911
66222 15765 16260 16451
66022 16451 16441 15927 15116 14509
66463 12904 13401 13900
66263 13900 13993 04088
66450 04088 04383 04781
66650 04781 05281 05784
66240 04781 04576 04167 04056
99922
44992 05181 05779 06085 05789 05485 05181
44000 04781 05276 05773 06285 15793 05289 05083 04781
44004 13992 14396 14302 13905 13401 13992
44008 14018 13615 13417 13820 14018
44008 13202 13694 04084 04474 04971 05566 06270 06585 16295
      15799 15092 04688 04387 14291 14599 14306 13907 13505
      13202
44012 16163 15870 15365 15761 16163
44012 01871 01983 11993 12301 13098 03686 04177 03870 03759
44012 04255 04365 04670 05166 05863 06470 06685 16399 15803
      14996 14701 14509 14010 13406 13009 13413 14015 14219
      13822 13420 13016 12416 12020
44012 06540 06142 05637
44020 06952 06655 06762 07081 07378
44020 17400 17195 16801 16110 15708 15411 15415 15923 16433
      16644 16552 16755
44020 14859 15654 16143 15630 14921 14727 14431 13628 13032
44028 17321 17212 16815 16317 16726 16933 17230 17321 19191
```

DATA BLOCK INFORMATION

ASNA KWBC 251400 - Message heading

Like all weather messages, the first line of the IAC is the heading. The heading contains data on the type and geographical location of the map, the station originating the message, and the date-time group.

ASNA In the 4-letter group "ASNA", the letters "AS" indicate that the message is a surface weather analysis, and the "NA" indicates it is for North America.

KWBC The international 4-letter location indicator of the station originating the message. (Washington, D.C.)

251400 Transmission time of the message (25th of the month, 1400Z)

10001 33388 02512 Preamble

10001 The first group of the preamble, 10001, indicates that the message is coded in IAC-FLEET (FM46.D) format.

33388 The second group, 33388, indicates that the positions of the pressure systems, the fronts, and the isobars are coded in the form QLaLaLoLo.

02512 The last group of the preamble, 02512, is the date-time group of the data. The first figure is an indicator and is always 0, the second and third figures give the date, and the last two figures the time of observation (GMT) used in the analysis. In this case it is the 25th day of the month at 1200 GMT.

NOTE: These two lines provide the information needed to fill in the data block at the bottom of each weather plotting chart. The plotter always fills in the data block before putting any other information on the chart.

Pick up a weather plotting chart DOD-WPC 1-10-3. Fill in the data block on the bottom of the chart using the information contained in the heading and preamble on the previous page. Consider your instructor to be the forecaster and the station as AG"A1" Class _________. Use the current month and year but obtain the date and time from the actual message heading.

When you have completed the data block, have your instructor check it.

____
Instructor's Signature

PRESSURE-SYSTEMS SECTION

99900
$8P_tP_cPP$ $QL_aL_aL_oL_o$ $md_sd_sf_sf_s$

99900
81399 13900 20420 81186 05784 20730 81310 15765 50210 81007
13818 10000
85218 03074 10000 85018 05154 00730 85322 07065 00930 85333
17022 21625
85025 14743 20910

This section of the message with the prefix 99900 contains data for pressure-system centers to be plotted on the map. Data for pressure systems is given in a series of three 5-figure groups. For example, from our message we have the following series: 81399 13900 20420....81186 05784 20730...

81310 15765 50210....etc.

8	P_t	P_c	PP
8	1	3	99

THIS GROUP GIVES THE TYPE, CHARACTERISTIC AND CENTRAL PRESSURE OF EACH PRESSURE SYSTEM.

8 This first group in each series begins with the figure "8" which is the indicator for pressure systems.

Pt Represents the type of pressure system reported. Using Table I-P_t from Appendix I, you will find that a "1" means the system is a low.

Pc Represents the characteristic of the pressure system From Table II-P_c, code figure "3" means that the low is deepening.

PP The central pressure of the system. PP in this group gives the low's central pressure as 999 millibars. Notice that PP gives the tens and units digits ONLY. For decoding purposes, if PP is between 00 and 49, it is preceeded by 10. If PP is between 51 and 99, it is preceeded by 9.

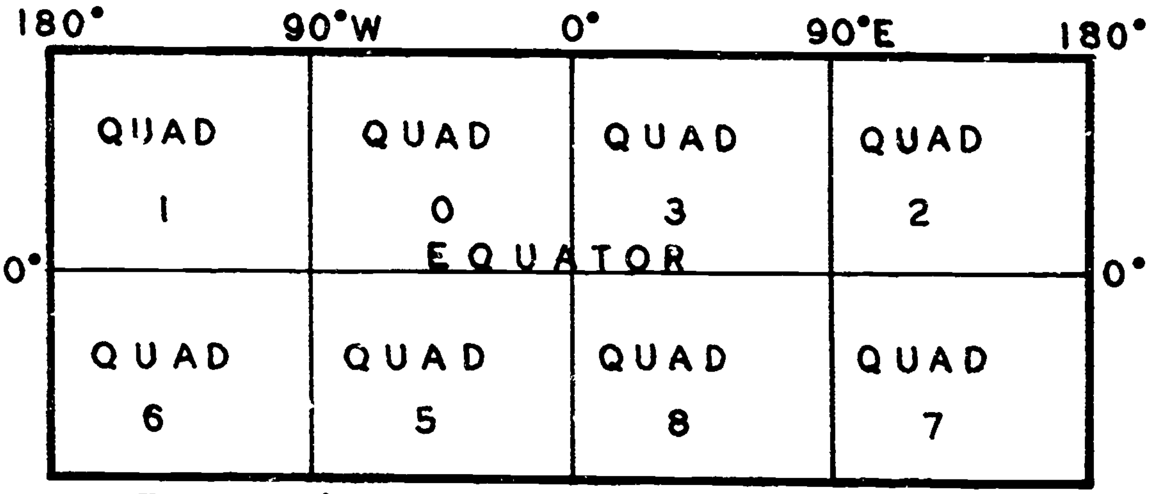
EXAMPLE: PP = 25 . . . Central Pressure = 1025 mb.

PP = 79 . . . Central Pressure = 979 mb.

Q	L_a	L_a	L_o	L_o
1	3	9	0	0

THIS GROUP GIVES THE POSITION OF THE SYSTEM

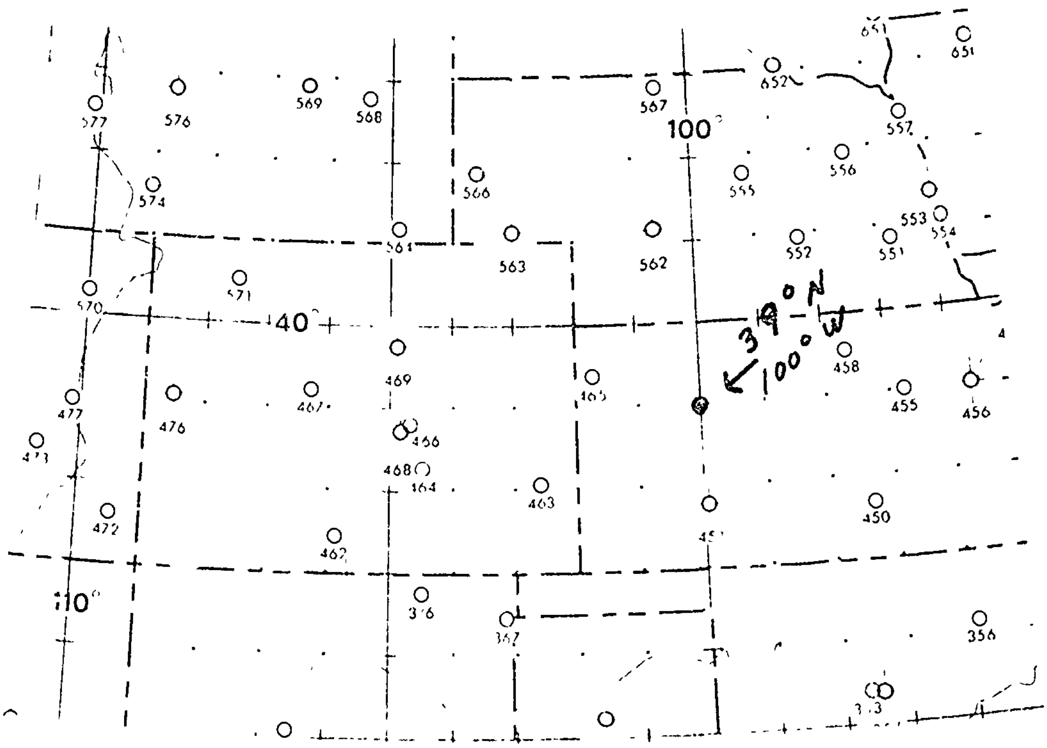
Q The octant of the globe. The figure "1" means the low is between 90 degrees West and 180 degrees West in the Northern Hemisphere. The diagram below shows all the octants. Code Table III - Q in Appendix I also breaks down each code figure.



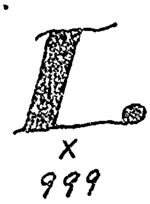
L_aL_a The latitude of the system in tens and units of degrees. 39° North

L_oL_o The longitude of the system in tens and units of degrees. You must check the octant number to determine if a hundreds digit of longitude in needed. In this example, 100° West.

The map below shows where you would find 39° North and 100° West.



Now on your chart, place a small cross (X) in pencil at 39°N, 100°W and enter the low's central pressure 999 mb. (as given in the preceding group) below the "X". Above the "X", mark the center of the pressure system with a large block letter "L". (See example below).



m	d_s	d_s	f_s	f_s
2	0	4	2	0

THE THIRD GROUP OF THE SERIES GIVES THE SYSTEM'S MOVEMENT.

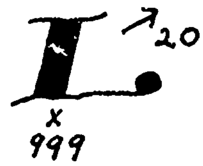
m — Indicates the general movement of the pressure system. Determined from Code Table IV-m in Appendix 1. Code Figure "2" means that the system has shown little change.

d_sd_s — The direction towards which the system is moving to the nearest 10 degrees - in this case 040 degrees.

f_sf_s — The speed of the system in knots, i.e. 20 knots.

Now, on your map, draw a short arrow pointing toward the course of 040 degrees. Beside the block letter "L", also enter the figure "20" (for the speed of movement) immediately underneath the arrow. (See example below.)

EXAMPLE:



> NOTE: In the case of HIGH's use a block letter "H".

> NOTE: 1. If the direction and speed are encoded as 4 zeros, the system is stationary and the letters "STNRY" would be entered.
>
> 2. On this map, North is always parallel to the longitude lines and east is always parallel to the latitude lines.

You have now plotted all the required data for the First pressure center. Data for all of the remaining pressure systems is contained in the message at the beginning of this frame. Remember that data for each pressure system is preceded by an "8" indicator and is given in a series of three groups. Using your Meteorological Codes and Location identifiers Booklet and Appendices I and II, start with the second series . . . . 81186 05784 20730.... and plot all the remaining pressure systems on your chart. If you require assistance raise your hand.

> NOTE: Some pressure systems such as troughs and ridges have more than one position point ($QL_aL_aL_oL_o$). Plot ALL of the positions reported.

When you have plotted the last pressure system, refer to Appendix II. Using Appendix II, highlight all the "L"'s and "H"'s in the appropriate color. When you are finished, raise your hand for instructor evaluation.

Instructor's Signature

FRONTAL SECTION

99911
$66F_tF_iF_c\ QL_aL_aL_oL_o\ QL_aL_aL_oL_o$. . . etc.

99911
66222 15765 16260 16451
66022 16451 16441 15927 15116 14509
66463 12904 13401 13900
66263 13900 13993 04088
66450 04088 04383 04781
66650 04781 05281 05784
66240 04781 04576 04167 04056

This section of the message with the prefix 99911 contains data for the types, intensities, and characteristics of the fronts, as well as the position points needed for drawing the fronts on the chart.

66	F_t	F_i	F_c
66	2	2	2

THIS GROUP GIVES THE TYPE, INTENSITY, AND CHARACTERISTIC OF EACH FRONT.

66 The first group for each front begins with the indicator "66".

F_t Represents the type of front. Refer now to Table V-F_t in Appendix I, and determine what code figure "2" means.... It should show that the front referred to in this group is a warm front.

F_i Represents the intensity of the front. Refer to Table VI-F_i and see what code figure "2" means. It should tell you that the front is weak.

F_c Represents the characteristic of the front. Referring now to Table VII-F_c, code figure "2", you will see that the frontal area is undergoing little change.

Look over the rest of the code figures in each of the tables you've just been referred to, familiarize yourself with their content.

Q	L_a	L_a	L_o	L_o
1	5	7	6	5

THIS GROUP GIVES THE FIRST POSITION POINT OF THE FRONT. IT IS DECODED JUST LIKE A POSITION POINT FOR A PRESSURE SYSTEM.

<u>Q</u> Octant of the globe.

<u>L_aL_a</u> Latitude in tens and units of degrees.

<u>L_oL_o</u> Longitude in tens and units of degrees.

Refer now to the symbolic format of the frontal section at the beginning of this frame. Notice that the position point ($QL_aL_aL_oL_o$) group may be repeated as many times as necessary. You must plot ALL the position point groups reported for each front.

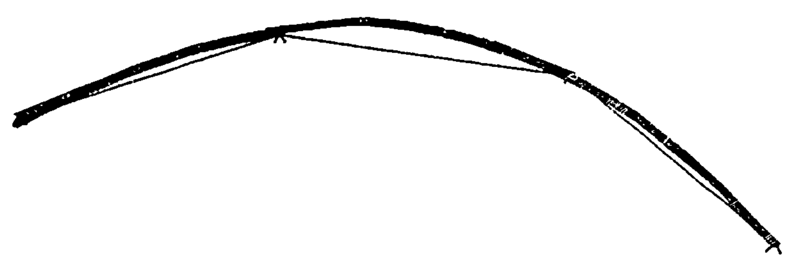
Now refer to the first line of the message. There are three position points reported for the first front. The group 15765 gives the first position point as 57°N and 165°W. On your chart place a small (x) at this location.

The next group, 16260, gives the second position point of the front. Place another small cross at 62°N and 160°W on your map.

For the last group 16451, make a cross at 64°N and 151°W. All the points for this front have now been plotted. Draw a light line <u>in pencil</u> connecting these points. Then with the appropriate colored felt tip or colored pencil, color in the frontal line, <u>smoothing out the kinks</u>. Use Appendix II as necessary for the proper colors and symbols.

> NOTE: When using <u>colors</u> on a map, the fronts are drawn in as simple colored lines, i.e., <u>no half moons or teeth</u>.

EXAMPLE:



All the other fronts are decoded in the same manner as the one on the previous page, except some have more, or less position points. Now, plot the remaining frontal systems on your chart from the message at the beginning of this frame. If you require assistance, raise your hand. When you have plotted and drawn the last frontal system, raise your hand for instructor evaluation. Remember the order: plot the points, sketch the front, then color in the front smoothing out the kinks. Use Appendix II as necessary for the proper symbols and colors.

Instructor's Signature

> NOTE: In some cases a ($md_sd_sf_sf_s$) group is appended to the end of the frontal groups. This group would give the direction and speed of the front.

ISOBARIC SECTION

99922
44PPP $QL_aL_aL_oL_o$ $QL_aL_aL_oL_o$.....etc.

```
99922
44992 05181 05779 06085 05789 05485 05181
44000 04781 05276 05773 06285 15793 05289 05083 04781
44004 13992 14396 14302 13905 13401 13992
44008 14018 13615 13417 13820 14018
44008 13202 13694 04084 04474 04971 05566 06270 06585 16295
      15799 15092 04688 04387 14291 14599 14306 13907 13505
      13202
44012 16163 15870 15365 15761 16163
44012 01871 01983 11993 12301 13098 03686 04177 03870 03759
44012 04255 04365 04670 05166 05863 06470 06685 16399 15803
      14996 14701 14509 14010 13406 13009 13413 14015 14219
      13822 13420 13016 12416 12020
44012 06540 06142 05637
44020 06952 06655 06762 07081 07378
44020 17400 17195 16801 16110 15708 15411 15415 15923 16433
      16644 16552 16755
44020 14859 15[illegible]54 16143 15630 14921 14727 14431 13628 13032
44028 17321 17212 16815 16317 16726 16933 17230 17321
19191
```

The final section of the message with the prefix <u>99922</u> contains the <u>isobars</u>.

44 P P P
44 9 9 2

THIS GROUP GIVES THE PRESSURE VALUE OF <u>EACH</u> ISOBAR.

<u>44</u> The first group for <u>each</u> isobar begins with the indicator "44".

<u>PPP</u> The pressure value of the isobar in hundreds, tens and units of millibars. - 992 millibars.

Q	L_a	L_a	L_o	L_o
0	5	1	8	1

THIS GROUP GIVES THE FIRST POSITION POINT OF THE ISOBAR. IT IS DECODED EXACTLY LIKE OTHER POSITION POINTS YOU HAVE PLOTTED.

<u>Q</u> Octant

<u>L_aL_a</u> Latitude

<u>L_oL_o</u> Longitude

1132

Refer to the isobaric section at the beginning of this frame. Note that there are numerous position groups following each "44" indicator group. All position groups for each isobar must be plotted.

The first position point for the first isobar is at 51°N Latitude and 81°W Longitude. On your map, place a small (x) at this location.

The next group is 05779, so mark another cross at 57°N and 79°W. The group 06085 shows that the third cross should be placed at 60°N and 85°W, the fourth cross at 57°N and 89°W, and the fifth cross at 54°N and 85°W.

Note that in this case the last group 05181 is identical to the first position point group 05181 given for the above mentioned isobar. This shows that the isobar encircles the LOW which is centered at 57°N, 84°W.

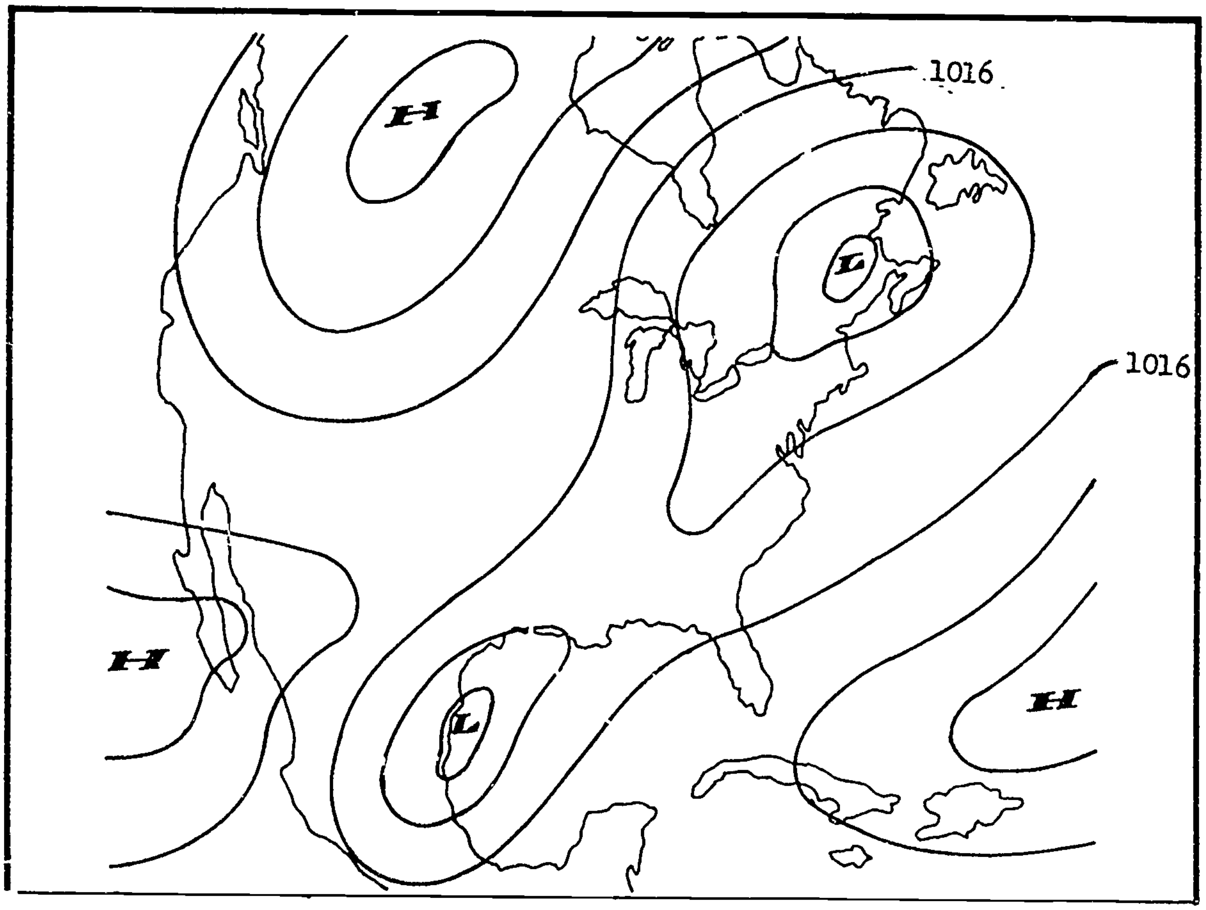
<u>BEFORE DRAWING THE ISOBAR</u> through the position points you have just plotted on your chart, proceed to the next frame, which will discuss isobars and some rules for drawing them.

FRAME 6

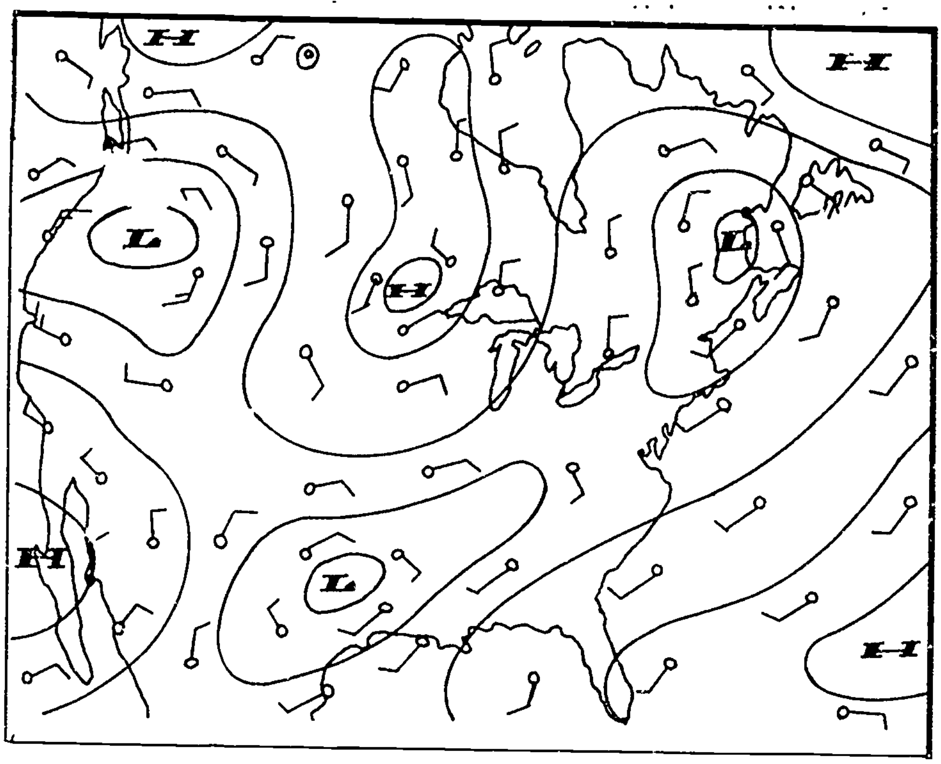
DRAWING ISOBARS

At one time or other, you've seen weather charts (on TV, here at school, etc.) with lines called ISOBARS drawn on them. An isobar is a "LINE CONNECTING POINTS OF EQUAL PRESSURE" on a weather map. This line may cover several dozen miles, several thousand miles, or even extend completely around the globe.

Below is a map with isobars drawn on it. Locate the 1016 isobar and using your finger, trace over the isobar from one end to the other. Note that everywhere along this line the pressure is 1016 millibars.



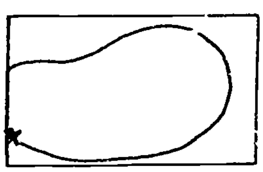
Isobars depict various information on a weather chart. For one, they outline areas of high and low pressure. On the map below, note that at the center of each Cyclonic (counter-clockwise) pressure system there is a "L" for LOW. Also note that at the center of each Anticyclonic (clockwise) pressure system there is a "H" for HIGH.



1. Isobars must always appear as smooth-flowing lines or closed lines. Isobars may begin or end in the following manner:

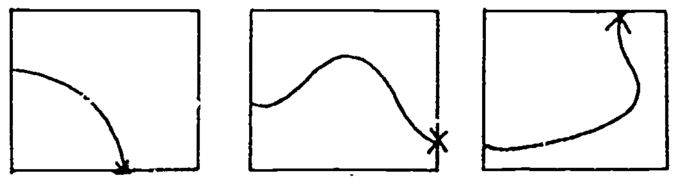
a. ORIGINATE ON ONE EDGE OF THE CHART; TRACE A PATH CONNECTING POINTS OF EQUAL PRESSURE, AND TERMINATE ON THE SAME EDGE.

EXAMPLE:



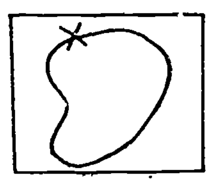
b. ORIGINATE ON ONE EDGE OF THE CHART, TRACE A PATH CONNECTING POINTS OF EQUAL PRESSURE, AND TERMINATE ON ANY OF THE OTHER THREE EDGES.

EXAMPLE:

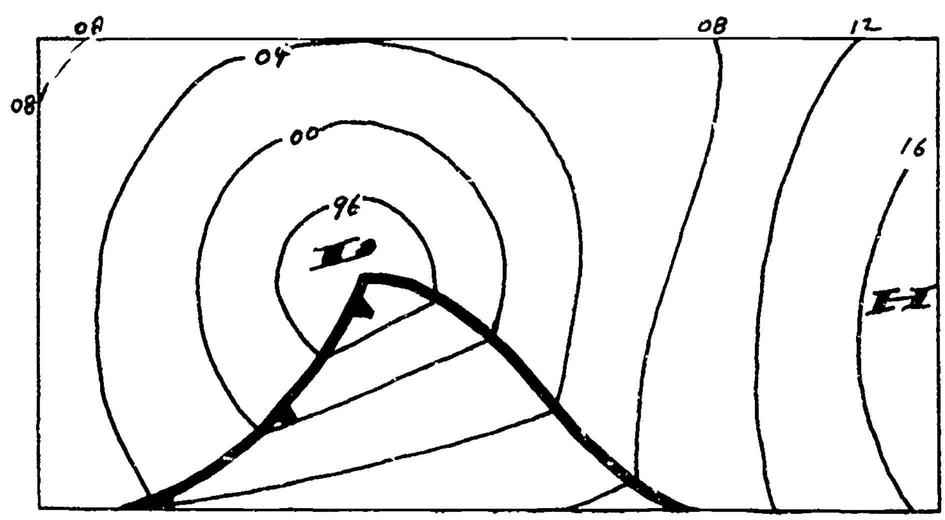


c. ORIGINATE ANYWHERE ON THE CHART, TRACE A PATH CONNECTING POINTS OF EQUAL PRESSURE, AND JOIN ENDS TO FORM A CLOSED CURVE.

EXAMPLE:



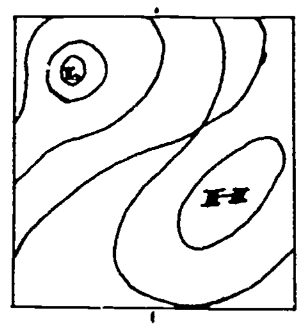
2. There is one exception to the rule that isobars always appear as simple curved lines or closed lines. This exception is when an isobar intersects and/or crosses a front or trough. Isobars near fronts (troughs) should be drawn to bring out the frontal discontinuity. Correctly drawn isobars are kinked at the front, with the kink always pointed toward higher pressure. On the map below note that the isobars are kinked at the fronts and point away from low pressure towards higher pressure.



3. Some of the most common errors in drawing isobars are as follows:

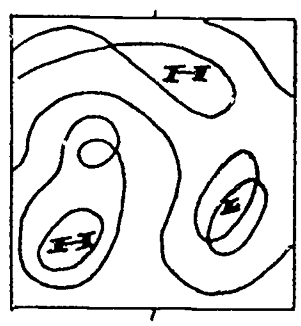
a. Isobars representing <u>different</u> values <u>NEVER</u> touch or cross. Touching or crossing signifies two different pressures at the same time and place which is a physical impossibility.

Example:



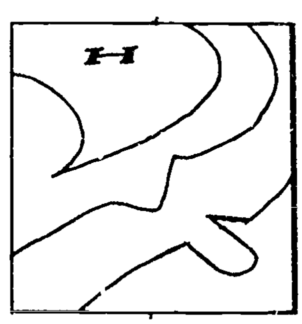
b. Isobars of the <u>same</u> pressure value may touch ends to form a <u>closed curve</u> but <u>NEVER</u> cross. They never form curlicues, figure "8"'s, etc.

Example:



c. Isobars <u>NEVER</u> have sharp corners (except at fronts) nor do they make jagged lines.

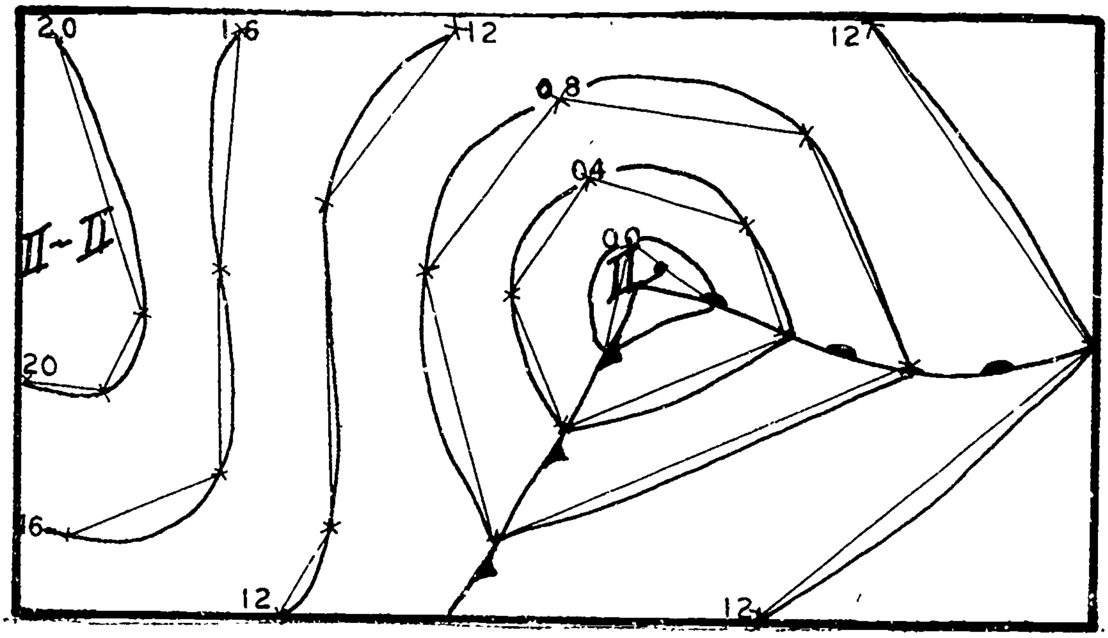
Example:



4. The final step in drawing isobars is to "smooth" and label each isobar. In the example below note how each "smooth" isobar follows the general contour of its adjoining isobar. Isobars that terminate on a chart edge are labeled at both ends. With closed curved isobars, a small break is left near the top of each isobar and it is labeled at this point. When possible, label closed isobars "in-line" with adjoining isobars.

NOTE: Isobars are normally labeled using the last two digits only. Ex: 1008 mb - 08, 996 mb - 96.

EXAMPLE:



5. Now on YOUR MAP use a pencil and LIGHTLY sketch in and label the "92" isobar. Then from the isobaric section at the beginning of Frame 5, plot and connect the position points for the second (1000 mb) isobar and label it "00". Then proceed to the third isobar, the fourth, etc.

When you have completed the last isobar, use either a No. 2 pencil or black felt tip and try your hand at "smoothing" the chart. The most natural flex of the hand and wrist is to draw the isobars TOWARD yourself. Analysts usually turn the chart to various positions, just so they can follow the natural movement of their hand toward themselves.

When you have finished "smoothing" your chart, raise your hand for instructor evaluation.

Instructor's Signature

There may be other sections included in the IAC message as shown on the symbolic form, but for the basic surface analysis, none are needed. The last group in this message, 19191, indicates the end of the analysis message.

Remember, although here at the AG School you will use the IAC for surface analysis only, the code can be used for other maps including constant pressure and prognostic maps. The symbolic form for these maps is similar to the surface analysis form.

Notice that in the analysis message, isobars are not given for every 4-millibar interval. As a rule, where the isobars are close together, some isobars may be encoded in the message for an 8- or 12-millibar interval. In such cases, the isobars for the 4-millibar intervals can be easily sketched in between those with an 8- or 12-millibar interval spacing.

It may be well to mention again that as the position points for each front are marked on the map, you should sketch the line connecting the points to complete the front before entering the position points for the next frontal system given in the message. This same procedure should also be followed in plotting and drawing each isobar. Otherwise, you may sometimes become confused in drawing the fronts or isobars if the points for two fronts or adjacent isobars are close to each other.

With a little practice, you will soon find that much of the data in analysis messages can be decoded without the aid of code tables. Thus, you will be able to plot and draw a weather map showing the pressure systems, the fronts, and the isobars in a minimum amount of time.

NO RESPONSE NECESSARY

1140

FRAME 8

Below is another IAC Surface Analysis. Plot the data at your maximum speed but be accurate. Use Appendices I and II for guides. A map of this size should take you about one (1) hour. When you have completed this map, give it to your instructor for evaluation.

```
ASNA KWBC 080800
10001 33388 00806
99900
81010 16115 00510
85027 06377 20000
85021 14498 01310
81004 12803 20000
85017 14619 00910
81099 15144 00920
85027 13034 20000
81098 04981 00915
85022 02866 01210
99911
66020 04056 04160
66220 04160 04264 04368
66627 04368 04771 04974 05078
66420 04368 04071 03876 03780
66027 03780 03685 03589 13493 13298 13002
66763 03875 03578
66628 16012 15508 14908 14210
66020 14210 13713 13415
66620 15144 15040 14737 14138
66420 14138 13841 13545
99922
44016 07061 06359 05662 05160 04862 05170 05576 05586 15392
      14792 04388 13992 13900 14306 14805 15705 16306 16813
      17312
44024 06170 06084 15993 16095 16295 06485 06679 06770 06468
      06170
44016 13748 14045 14540 14437 14732 15019 15015 14714 14120
      13722 13421 12716 12520 11923
44008 12100 12708 13214 13412 13409 13303 13200 13298 12797
      12496 12100
44008 15438 15547 15053 14749 14740 14737 14936 15438
44000 15146 15245 15142 15146
44024 13244 13637 14230 14325 14124 13726 13426 13023 12726
44016 02068 02475 02977 03273 03467 03563 03560
44008 04264 04071 04473 04678 04785 05186 05380 05072 04768
      04264
44000 04779 04883 05083 05179 05075 04771 04779
19191
```

Instructor's Signature

FRAME 9

The message below should give you the practice you need in drawing IAC maps. This map should take you approximately 45 minutes and is similar to the map you are required to do for the Performance Test. Notify your instructor NOW that you are ready for a timed speed run.

ASNA KWBC 141400
10001 33388 01412
99900
81000 04855 00915
81005 04783 00820
81398 16202 10000
830// 16398 16090 05585
81010 15115 00920
85321 14404 01220
81011 13516 10000
81007 13403 01712
830// 13403 12803
85028 13639 10000
85026 14941 01015
99911
66426 04255 04260 04371
66220 04371 04783
66420 04783 14190 13797
66233 13797 13404
66420 13404 13610
66420 15115 14520 14325 14138
66220 14138 14248 14353
99922
44008 04455 04660 05457 06045 06132
44024 02068 02575 03179 03570 03660
44016 01583 02089 12897 13790 03775 03960
44016 13704 14217 15302 14794 13704
44008 15610 15700 05988 06287 16797 16810 16215 15610
44000 16004 16296 16497 16403 16004
44016 12025 12921 13924 15019 16125 17220 17097 06582 05470
06060 06658 06850
44008 04585 04575 04983 04585
44008 13103 13501 13405 13103
44024 14050 14040 13533 13037 12841
44024 14641 14944 15141 14938 14641
19191

Instructor's Signature

☐ Take performance test

☐ Do Frame 10 for additional practice.

1142

If you are still having some difficulty with the last map or need additional practice, do the IAC map below. This map is somewhat longer than the others and will give you considerable practice at finding position points.

```
ASNA KWBC 140800
10001 33388 01406
99900
81010 06135 00915
85021 07389 01015
81002 05083 01015
85027 14900 01420
81011 14515 20000
81007 13699 01512
89907 12194 93011
81006 12807 10000
81005 13416 20000
85518 14524 20000
830// 14515 13818
81006 13932 20000
81091 15758 30000
99911
66420 07165 06685 16595
66020 16595 16508 17025
66418 05083 15091 15300
66218 04879 05083
66620 04783 04486 14091
66235 03784 03788 13991 14091
66420 14091 13796
66238 13796 13699
66420 13699 13805
66027 04453 04260 03967 03570 03278 03182 03087 13495
66620 15758 15750 15445 15045 14747 14251
```

(Continued)

(Continued)

99922
44024 04554 04660 04861 05060 05255 05245
44016 05638 05745 06260 06975 07273
44016 02071 02779 03376 03780 04573 05569 05968 06175 06080
15490 15093 14395 13906 14609 15015 15417 16611 17301
44024 14403 15006 15505 15900 15695 15299 14697 14403
44008 04387 04779 05277 05480 05088 04387
44008 13498 13796 13701 13400 13498
44008 11994 12192 12294 12196 11994
44008 12305 12803 13210 13413 13717 13015 12710 12305
44016 14324 14627 14921 14720 14324
44016 12325 12921 13725 13432 13837 14338 14936 14548 14353
44008 13831 14030 14132 13933 13831
44008 14755 15147 15544 16245 16746 17040
44000 15063 15255 15749 16455 16560
44992 15659 15856 15859 15659
19191

☐ Take performance test.

Instructor's Signature

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APPENDIX I

	I - P_t Type of pressure system	II - P_c Pressure system characteristic	III - Q Octant of the globe		IIIA - k Position group index figure		
0	Complex low	No specification	0° - 90°W	NORTHERN LATITUDE	$L_aL_aL_oL_o$ as sent	Long. E 0° -99° or Long. W 100°-180°	0
1	Low	Low filling or high weakening	90°-180°		1/2° added to L_aL_a		1
2	Secondary	Little change	180°-90°E		1/2° added to L_oL_o		2
3	Trough	Low deepening or high intensifying	90°-0°		1/2° added to L_aL_a and L_oL_o		3
4	Wave	Complex			Whole degrees		4
5	High	Forming or existence suspected (cyclogenesis or anticyclogenesis)	0°-90°W	SOUTHERN LATITUDE	$L_aL_aL_oL_o$ as sent	Long. W 0° -99° or Long. E 100°-180°	5
6	Area of uniform pressure	Filling or weakening but not disappearing	90°W-180°		1/2° added to L_aL_a		6
7	Ridge	General rise of pressure	180°-90°E		1/2° added to L_oL_o		7
8	Col	General fall of pressure	90°E-0°		1/2° added to L_aL_a and L_oL_o		8
9	Tropical storm	Position doubtful			Whole degrees		9

	IV - m Movement indicator figure	V - F_t Type of front	VI - F_I and T_I Frontal and tropical system intensity	T_I when T_t = 9	VII - F_c Character of front	
0	No specification	quasi-stationary front at surface	no specification	10	no specification	0
1	Stationary	quasi-stationary front above surface	weak, decreasing (frontolysis)	11	frontal activity area, decreasing	1
2	Little change	warm front at surface	weak, little or no change	12	frontal activity area, little change	2
3	Becoming stationary	warm front above surface	weak, increasing (frontogenesis)	12	frontal activity area, increasing	3
4	Retarding	cold front at surface	moderate, decreasing	12	intertropical	4
5	Curving to left	cold front above surface	moderate, little or no change	5	forming or existence suspected	5
6	Recurving	occlusion	moderate, increasing	6	quasi-stationary	6
7	Accelerating	instability line	strong, decreasing	7	with waves	7
8	Curving to right	intertropical front*	strong, little or no change	8	diffuse	8
9	Expected to recurve	convergence line	strong, increasing	9	position doubtful	9

* Preferable to use Tropical section

	VIII - T_t Tropical System Type	IX - T_c Tropical System characteristic	X - W_sW_s Significant Weather	
0	intertropical convergence zone	no specification	area of heavy swell	00
1	shear line	diffuse	area of strong winds (force 6 & 7 Beaufort)	11
2	line or zone of convergence	sharply defined	area of medium cloud	22
3	axis of doldrum belt	quasi-stationary	area of low cloud	33
4	trough in westerlies	existence certain	area of poor visibility	44
5	trough in easterlies	existence uncertain	area of gales (force 8 Beaufort or more)	55
6	LOW area	formation suspected	area of continuous precipitation	66
7	surge line	position certain	area of squally weather	77
8	line or zone of divergence	position uncertain	area of heavy showers	88
9	tropical cyclonic circulation (see Note (x))	movement doubtful	area of thunderstorms	99

International Analysis Code (IAC-FLEET) specification tables.

DECODING AND PLOTTING INTERNATIONAL ANALYST CODE

APPENDIX II

STANDARD WEATHER SYMBOLS

WEATHER FEATURE	SYMBOL	HIGHLIGHTING COLOR
1. Center of low pressure	L	Red L
2. Center of high pressure	H	Blue H
3. Surface cold front		Blue
4. Surface warm front		Red
5. Surface quasi-stationary front		Alternating Red and Blue
6. Surface occluded front		Purple
7. Trough line		Brown
8. Ridge line		Brown
9. Instability line		Purple
10. Center of tropical storm		Red

NOTE: Remember that on a colored chart fronts are drawn as solid colored lines without half moons or teeth.

STUDY GUIDE

C3ABR25130 000-SG-310

Technical Training

Weather Specialist

METAR ENCODING AND DISSEMINATION

22 October 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE.

DO NOT USE ON THE JOB.

RGL: N/A

Weather Specialist Branch
Chanute AFB, Illinois 61868-5000

METAR CODE

OBJECTIVE

Given all the necessary references, encode and record 4 observations in METAR code with no more than 3 errors per observation.

INTRODUCTION

Weather personnel stationed within the continental United States (CONUS) take surface observations in Airways Code. Stations outside the CONUS use an internationally approved weather code for air traffic. This international code is called METAR and is recorded on AWS Form 10a. Since you are familiar with the Airways code format, METAR will be readily understood. Many of the rules that apply to Airways also apply to METAR. This study guide will take you block by block through the AWS Form 10a. A comparison will be made, from time to time, between Airways and the METAR code format to better acquaint you with this international language.

METAR FORMAT

Entries on AWS Form 10a are made according to the following instructions. The column arrangement on AWS Form 10a is somewhat different than the MF1-10. Our discussion follows the order of the columns as found on the AWS Form 10a. You should make the appropriate entries as they are covered on AWS Form 10a.

Columns 1 and 2: Type and Time

1. Columns 1 and 2 entries are the same in METAR as in the Airways code. (SA, RS, SP, L)

2. The time is in GMT. (Add 6 hours for Chanute AFB.)

TYPE (1)	TIME (GMT) (2)
SA	0657
SA	1255

Supersedes C3ABR25130-SG-310, 9 March 1984.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 600; DAV - 1

Column 9: Wind Direction

1. Enter the mean wind direction observed during the 10-minute period prior to the actual time of observation.

2. Enter the wind direction to the nearest 10 degrees in three digits. Enter 000 for calm.

3. Prefix the wind direction with an E whenever any part of the wind is estimated.

4. Enter VRB when the wind direction is varying by 60° or more, and the wind speed is 7 knots or more (include A col 13 remark).

Column 10: Wind Speed

1. Enter the mean wind speed observed during the 10-minute period prior to the actual time of observation.

2. Enter wind speed to the nearest knot using two digits or three digits when the speed is 100 knots or more.

3. Enter 00 when the wind is calm.

Column 11: Maximum Wind Speed

1. Enter the maximum wind speed observed during the 10-minute period prior to the actual time of observation when it exceeds the mean wind speed by 5 knots or more.

2. Enter this data to the nearest knot using two digits or three digits when the speed is 100 knots or more.

Examples of Wind data entries

a. 010° at 7 knots
b. Calm wind
c. 160° at 23 knots, maximum speed at 31 knots
d. 360° at 103 knots, maximum speed at 114 knots
e. 290° at 8 knots, maximum speed estimated at 15 knots
f. Wind direction variable at a speed of 7 knots

	WIND		
	DIRECTION (true) (9)	SPEED (knots) (10)	MAX WIND (knots) (11)
a.	010	07	
b.	000	00	
c.	160	23	31
d.	360	103	114
e.	E 290	08	15
f.	VRB	07	

Column 4A: Prevailing Visibility

1. Enter the prevailing visibility in nautical miles using Table 3-2 for reportable values.

2. Rules for determining prevailing visibility is the same as in the Airways code format.

Column 4B: Prevailing Visibility

1. Enter the prevailing visibility in meters using the four digit reportable values from Table 3-2 corresponding to the reportable values for nautical miles used in Column 4A.

2. When the prevailing visibility in Column 4A is 6 or greater, use 9999.

PREVAILING	
MILES (4A)	METERS (4B)
2.5	4700
6.0	9999
.05	0100

Column 4C: Local RVR

1. RVR is reported whenever visibility is 1 mile or less and/or RVR is 6,000 ft. or less.

2. Local RVR is reported in hundreds of feet, following same procedure as in Airways code.

3. Report RVRNO whenever RVR criteria is met, but RVR is not available.

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Column 4D: Longline RVR

1. Reported using same criteria as local RVR.

2. Convert values into meters using Table 3-3.

3. Reported using the following format.

   a. R - indicator that RVR follows

   b. P - indicates RVR greater than 1830 meters

   c. M - indicates RVR is less than lowest reportable increment (0300 meters)

   d. $V_RV_RV_RV_R$ - 4-digit group reporting RVR value in meters

   e. R//// - is reported whenever RVR criteria is met, but RVR is not available.

RUNWAY VISUAL RANGE	
LOCAL (feet or miles) (4C)	LONG-LINE (meters) (4D)
R22VR36	R1100
R22VR60+	RP1830
R22VR10-	RM0300
RVRNO	R////

Column 5A: Weather and Obstruction to Vision-Local

1. Enter all the weather occurring at the station at the time of observation.

2. Enter obstructions to vision when the prevailing visibility is less than 6 nm or 9999 meters.

3. Use the international code from Table 3-20. Enter the code without parenthesis. Use the order of entry learned in the Airways code format.

Column 5B: Weather and Obstructions to Vision-Longline

1. Enter only one code, which will be the numerically highest code corresponding to the entries in Column 5A.

2. Use Table 3-11 for the numerical-letter code corresponding to the Column 5A entries.

3. There are only three exceptions to the above rules.

   a. 19FC has priority over all codes.

   b. 17TS has priority over codes beginning with 04 through 49.

   c. Codes 20-29 do not have an entry for Column 5A Enter this code for recent weather that has occurred at the station within the past 60 minutes but is not now occurring.

WEATHER AND OBSTRUCTIONS TO VISION	
LOCAL (5A)	LONG-LINE (5B)
TORNADO	19FC
TS+	17TS
DZ-FG	51DZ
HZ-FU	05HZ
	21RERA

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Column 3: Sky Condition

1. Enter each surface-based obscured condition (partly and totally) and each cloud or obscuring phenomena layer aloft as a six-character group ($N_sCCh_sh_sh_s$) in ascending order of height. DO NOT USE THE SUMMATION PRINCIPLE.

2. Use an additional line for more than four layers. Make no entry when the sky is clear.

3. N_s-Enter each individual layer to the nearest eighth.

   a. Enter 9 for a complete obscuration

   b. Enter traces of clouds as 1/8th and overcast with breaks as 7/8

   c. When two or more types of clouds occur at the same level the amount will cover all the clouds at that level; except when one of the types is a cumulonimbus and it does not represent the greater amount. Cumulonimbus clouds will always be entered. If another type of cloud is predominant both that cloud and the CB will be entered.

4. CC-Enter the type of cloud using the appropriate two letter identifier from Table 3-20.

   a. If more than one type of cloud is present at one level, use the most predominant type.

   b. If no one cloud is predominant, use the type for convective over-stratiform.

5. $h_sh_sh_s$- Enter the height of the layer (or vertical visibility into a total obscuration) in three digits.

   a. Use the reportable heights from Table 3-13.

   b. Enter /// for a partly obscured condition.

SKY CONDITION (3)			
1CU015	3AS100	5CI200	
1ST001	9FG005		
3CB020	4SC020		
3FG///	5ST010		

Columns 7 and 8: Temperature and Dewpoint

1. Enter the temperature and dewpoint after converting into centigrade on Table 3-14.

2. Use the reportable values as given in Table 3-14. These values will differ from the reportable values learned in the Airways code format.

3. Negative values will be prefixed with an "M".

TEMP (o C) (7)	DEW-POINT (o C) (8)
14	12
09	08
M00	M04

Column 12: Altimeter Setting

Enter the altimeter setting to the nearest .01 inch H_g in four digits without a decimal point.

ALSTG (inches) (12)
2992
3001
3103

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Column 13: Remarks

1. Use the order of entry given in the heading of Column 13 on the AWS Form 10a and as given on Table 3-17.

2. Enter, as the first remark, the ceiling height.

   a. Use the summation principle, as learned in Airways code, to determine the ceiling height.

   b. For ceiling heights below 3,000 ft use ceiling designators M, E, or W. (i.e. CIGM005)

   c. For ceiling heights at or above 3,000 ft. do not use a ceiling designator. (i.e. CIG100)

3. Enter sector visibility using the reportable values for nautical miles. Use the international contraction for visibility. (i.e. VIS)

4. Enter the CB and Thunderstorm remark using the correct contraction from Table 3-17.

5. See other remarks as given in Table 3-17.

6. Depth of snow ($904S_pS_p$) and 24-hour precipitation ($2R_{24}R_{24}R_{24}R_{24}$) are the only additive data groups used in METAR code.

REMARKS AND SUPPLEMENTAL CODED DATA *(All times GMT. DESIRED ORDER OF ENTRY: Ceiling height, other remarks elaborating preceding data, coded additive data group (if specified) radiosonde data, runway conditions, weather modification.)* (13)
CIGM015 VISN1.9 S2.0 TSW MOVE
CIG100 WND 100V170/ 90403
20010

Column 17: Station Pressure

1. Enter station pressure on only 3 and 6 hourly observations.

2. Enter in 5-digits to the nearest .005 inch H_g. (i.e. 30.005)

Column 21: Total Sky Cover

1. Enter total sky cover in 8ths.

2. Use the summation principle.

3. Enter 8 for overcast and a complete obscuration.

Column 15: Observers' Initials

Enter the accredited observer's initials taking the observation.

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Example of Longline Dissemination

1. Record Observations:

   a. EDAR 2000 VRB07 1300 R1220 61RA 2FG/// 3ST008 8NS012 01/M01 2938INS/CIGM012 CIG010V015 WND 040V100 VIS N2200 PK WND 0531/08 WR//;

   b. RJTY 1900 02010/17 1400 R0730 05HZ 1HZ/// 1ST007 2SC020 6AS070 20/17 3019INS/CIGE020 VIS N3200 RCD SCT045/BKN090;

   c. EDIU 2100 30003 9999 M04/M10 3003INS/ 90402 20001;

2. Special Observations:

   a. EDAR 0731 25003 1700 R1220 10BR 5ST006/CIGM006;

   b. RJTY 1614 02005 0600 R0420 51DZ 2FG/// 1ST006 2ST016/ CIGM016 OCNL CIGNO VIS 0400V0800 TWR VIS 1000 CIG LWR W;

   c. RPMK 0307 R1160;

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Example of Local Dissemination

1. Record Observation:

a. EDAR RS 0756
VRB07 0.7
R09VR40 RA-FG
2FG/// 3ST008
8NS012 CIGM012
01/M01
ALSTG 29.38
CIG010V015
WND 040V100
VIS N1.2 PA+960
57/TG

b. RJTY SA 1053
03010/17 7/8
R36VR24/26
HZ 1HZ///
1ST007 3SC020
CIGE020
6AS070 20/17
ALSTG 30.19
VIS N2
PA+210
59/WW

c. EDIU SA 1157
30003 15
SKC M04/M10
ALSTG 30.03
PA+210
57/WW

2. <u>Special Observations</u>:

a. EDAR SP 0731
25003 0.9
R27VR40 FG
5ST006
CIGM006
ALSTG 30.02
PA+350
32/LC

b. RJTY SP 1614
03005 3/8V
R36VR14/12
DZ-FG 2FG///
1ST006 2ST016
CIGM016
ALSTG 29.31
CIGM016 OCNL
CIGNO VIS
1/4V1/2
TWR VIS 5/8
CIG LWR W
PA+560
15/BW

c. RPMK SP 0307
R02VR38
07/WL

3. <u>Local Observations</u>:

a. EGUA L 0750
0.9 R27VR45
FG 8ST007
CIGM007
ALSTG 30.03
PA+210
51/JS

b. EDIN L 1637
ALSTG 29.80
PA+220
38/AJ

c. EGUN L 1930
5.0 HZ 2CU037
3CS280 CIGNO
ALSTG 29.80
PA+810
31/JK

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Weather Training Branch
Chanute AFB, Illinois

C3ABR25130-SW-310A
24 April 1984

POSTING PUBLICATION CHANGES

OBJECTIVE

Given simulated communications and operations publications post 7 out of 10 correctly.

INTRODUCTION

The Air Force keeps its manuals and regulations up to date with current policy by issuing changes and supplements. It is less expensive and faster to print a few pages of changed information than to reprint an entire manual or regulation. This book will help you to post changes correctly.

INFORMATION

INTERIM MESSAGE CHANGE

Upon receipt, Interim Message Changes(IMC) are reviewed for impact on unit operations. The Interim Message Change is posted without delay and filed until superseded with printed page changes. When an item is being changed, the number of the IMC must be posted in the left margin next to the item being changed. At intervals during the year, the issued IMCs are put into printed page changes. Once you have posted the printed page changes, the Interim Message Changes included in those printed pages can be discarded.

WRITE-IN CHANGES

Deletions to manuals by write-in changes are posted the same way as Interim Message Changes. To make additions of new paragraphs, write in the number of the new paragraph in sequence with the present outline and put (Added) after the new paragraph number.

DELETIONS. If a paragraph or sentence is changed, draw a "Z" through it. For a sentence or word change, a straight line drawn through it is sufficient. Indicate the type of change by writing the word "Deleted" or "Replaced" as appropriate. In the margin write the change number that caused the change.

ADDITIONS. Word or short phrase additions or replacements may be written as close to the proper position as space allows. For entire sentences or paragraphs, legibly write the data in available space.

CHANGES. Replacement of one or more pieces of information with more current information. The old information is deleted and any new information is added by following the directions in the change. After the change has been made, enter the number of the change in the left margin next to the item being changed.

ALL WRITTEN CHANGES MUST BE NEAT AND LEGIBLE.

Supersedes C3ABR25130-SW-310A, 25 June 1983. RGL: 11.7
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W-600; DAV-1
Designed for ATC Course Use. Do Not use on the job.

PAGE CHANGES

Remove old pages and insert new pages. Decimal numbered pages are inserted following the basic pages. e.g. Page 6.1 would be placed after page 6. When old pages are removed, check to see if any of the old pages have any reference to current supplements written on them. If so, post those same references to the new pages. After all change actions have been made, file the cover sheet of the change in the back of the basic publication.

PROCEDURES

The following pages of this study guide/workbook are arranged into projects to provide you with practical application in posting changes.

The first project requires you to post IMC 5 to sample page 2-21 which is simulated from AFGWCP 105-1, vol II.

The second project simulates a pen and ink change to the FMH-1B. Post the change 1 to sample page 7.

EXAMPLES

For the first project - if IMC 5 required you to change "R to read RED," you would merely cross out R, replace it with RED and enter IMC 5 beside the message in the margin.

For the second project - if change 1 required you to go to page 7, reference paragraph 1.2.5.b(1), line 7 (C), and it required you to add "any form" after the word "precipitation," you would change the existing line to read "precipitation, any form."

EVERYTHING INCLUDED IN THE FOLLOWING OUTLINED AREA IS FOR EXAMPLE ONLY.

SUBJECT: INTERIM MESSAGE CHANGE 4 TO AFGWCP 105-1, VOL II

1. WRITE-IN CHANGES:

PG	REFERENCE	LINE	ACTION
2-21	PARA 2-40 a.(2)	1	CHANGE "WIND GUSTS OF 35 KNOTS OR GREATER" TO "WIND GUSTS OF 50 KNOTS OR GREATER"
2-21	PARA 2-40 a.(3)	2	CHANGE "WITH 3/4 INCH OR GREATER DIAMETER" TO "WITH 1/2 INCH OR GREATER DIAMETER"

1160

2-40. WWUS(1) KGWC (CONUS Military Weather Advisory).

a. Description. A time-phased forecast of the weather meeting military weather advisory criteria defined below. Forecast areas depict worst conditions expected during period noted. For tornado and thunderstorm forecast areas, the worst condition implies the expected occurrences of less severe convective activity as well. Forecast areas are delineated by color codes as follows:

(1) R. Tornadoes.

(2) B. Severe thunderstorms (maximum wind gusts ~~35~~ 50 knots
IMC 4 or greater and/or hail, if any, with 3/4 inch or greater diameter).

(3) G. Moderate thunderstorms (maximum wind gusts of 35
IMC 4 knots or greater but less than 50 knots, and/or hail, if any, with ~~3/4~~ 1/2 inch or greater diameter but less than 3/4 inch diameter).

SIMULATED CHANGE 1 TO THE FMH-1B

FMH-1B, 1 January 1980, is changed as follows:

1. Write-in Changes:

PAGE	REFERENCE	LINE	ACTION
6	1.2.5b(1)	5	Change (a) to read: Ceiling 1,500 feet or less.
6	2.1.1b	1	Change "The official time prescribed" to read "The official time ascribed"

SIMULATED PAGE 6 OF THE FMH-1B

C-1 1.2.5b(1) Check weather conditions at intervals not to exceed 20 minutes since the last observation, to determine the need for a local or special observation, when any of the following conditions are observed to be occurring or are forecast to occur within 1 hour:

(a) Ceiling ~~1,000~~ 1,500 feet or less
(b) Visibility 3 miles or less
(c) Precipitation
(d) Fog

C-1 2.1.1b Actual Time of Observation. The official time ~~prescribed~~ ASCRIBED to an observation. It reflects the time, to the nearest minute, that the:

(1) Last element of the observation is observed and evaluated for record observations and for those observations taken for runway changes and aircraft mishaps.

SUBJECT: INTERIM MESSAGE CHANGE 4 TO AFGWCP 105-1, VOL II

1. WRITE-IN CHANGES:

PG	REFERENCE	LINE	ACTION
2-21	PARA 2-40 a.(1)	1	CHANGE "R" TO "RED"
2-21	PARA 2-40 a.(2)	1	CHANGE "B" TO "BLUE" CHANGE "55" TO "50"
		2	AFTER "DIAMETER)" ADD "AND LOCALLY DAMAGING WINDSTORMS."
2-21	PARA 2-40 a.(3)	1	CHANGE "G" TO "GREEN" CHANGE "40" TO "35"
2-21	PARA 2-40 a.(4)	1	CHANGE "O" TO "ORANGE"
		2	CHANGE "5/8" TO "1/2"
2-21	PARA 2-40 a.(5)	1	CHANGE "Bl" TO "BLUE"
		2	CHANGE "ARE NOT FORECAST" TO "ARE FORECAST"
2-21	PARA 2-40 a.(6)	1	CHANGE "P" TO "PURPLE" AFTER "OR MORE" ADD "IN 12 HOURS OR LESS."
2-21	PARA 2-40 a.(7)	1	CHANGE "HP" TO "HATCHED PURPLE" AFTER "OR MORE" ADD "IN 12 HOURS OR LESS."
2-21	PARA 2-40 a.(8)	1	CHANGE "Br" TO "BROWN"
2-21	PARA 2-40 c.	2	DELETE "HAWAII AND COASTAL WATERS OUT TO 200NM OFFSHORE."

1162

2-40. WWUS(i) KGWC (CONUS Military Weather Advisory).

a. Description. A time-phased forecast of the weather meeting military weather advisory criteria defined below. Forecast areas depict worst conditions expectd during period noted. For tornado and thunderstorm forecast areas, the worst condition implies expected occurrences of less severe convective activity as well. Forecast areas are delineated by color codes as follows:

(1) R. Tornadoes.

(2) B. Severe thunderstorms (maximum wind gusts of 55 knots or greater and/or hail, if any, with 3/4 inch or greater diameter)

(3) G. Moderate thunderstorms (maximum wind gusts of 40 knots or greater but less than 50 knots, and/or hail, if any, with 1/2 inch or greater diameter but less than 3/4 inch diameter).

(4) O. Thunderstorms (maximum wind gusts less than 35 knots and/or hail, if any, with less than 5/8 inch diameter).

(5) Bl. Strong surface winds (35 knots or more and not associated with thunderstorms). Gradient winds are not forecast where local surface effects are not known.

(6) P. Rain accumulating 2 inches or more

(7) HP. Snow accumulating 2 inches or more

(8) Br. Freezing precipitation.

b. Format. Manually prepared facsimile chart on a 1:15 million scale polar stereographic projection. Each forecast area will have a letter designator, color code, valid time, and abbreviated desription of individual forecast criteria.

c. Area. CONUS and coastal waters out to 200NM offshore.
HAWAII and coastal waters out to 200NM offshore.

d. Produced. Four times daily.

DESIGNATOR	VALID PERIOD
A	03-15Z
B	09-21Z
C	15-03Z
D	21-09Z

Change 1
FMH-1B
2 May 1980

SURFACE OBSERVATIONS

FMH-1B, 1 January 1980, is changed as follows:

1. <u>Write-in Changes</u>:

PAGE	REFERENCE	LINE	ACTION
7	1.2.5b(1)	7	Change (c) to read: Precipitation (any form).
7 7	2.1.1b(1)	3	Add "For record observations, actual time shall also be within five (5) minutes of standard time of the observation."
7	3.1.3	2	Add new sentence - "To insure legible copies and ample contrast for photographic reproduction, use a black lead pencil such as grade 2 or 2H."
7 7	3.1.5	4	Add new sentence - "Explain briefly the reasons for missing data in Column 90."
7	3.2.13d(2)	4	Add "e.g., 'THN F NW,' 'BRK IN F TO SE,' ect."
7	3.5.2a	2	Insert "Hg" after "inch." Add new sentence - "Prefix station pressure with an 'E' when the data are estimated. Enter 'M' if station pressure is missing."
7	4.3.1e	3	Change "B4-1" to "4-1" and B4-3" to "4-2."
7	6.2.2.c(1)(b)		Add new paragraph after 4.3.1e - "Sharp outlines in relief, with little or no blurring of color, indicate that visibility is much greater than the distance of a reference object. A blurred or indistinct object indicates the presence of an obscuring phenomenon that reduces the visibility to about the same as the distance of the object."

1164

1.2.5b(1) Check weather conditions at intervals not to exceed 20 minutes since the last observation, to determine the need for a Local or Special observation, when any of the following conditions are observed to be occurring or are forecast to occur within 1 hour:

(a) Ceiling 1,500 feet or less
(b) Visibility 3 miles or less
(c) Precipitation
(d) Fog

2.1.1b Actual Time of Observation. The official time ascribed to an observation. It reflects the time, to the nearest minute, that the:

(1) Last element of the observation is observed and evaluated for record observations and for those observations taken for runway changes and aircraft mishaps.

3.1.3 Writing Instrument. The same type writing instrument should be used throughout the form.

3.1.5 Missing Data. Indicate missing data by entering "M" in the appropriate space in all columns except Column 13. Enter a slant to denote missing elements in coded data such as 3- and 6-hourly additive data.

3.2.13d(2) Breaks in An Obscured Sky Condition. Enter a description and the direction of breaks or discontinuity in an obscuration where the sky is obscured overhead and the obscuration hides more than 9/10 but not all the sky.

3.5.2a Station Pressure (Column 17). Enter station pressure to the nearest 0.005 inch on each hourly observation (e.g., 29.995).

4.3.1e Disseminate wind direction locally in degrees magnetic using three digits. Separate direction and speed data as illustrated in figures B4-1 (Airways) and B4-3 (METAR). Disseminate calm winds as "CALM."

HANDOUT
C3ABR25130-HO-310B
C3ABR25130-2-HO-305

Technical Training

Weather Specialist

LOCATION IDENTIFIER

23 November 1982

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE
DO NOT USE ON THE JOB

RGL: N/A

Weather Training Branch
Chanute AFB, Illinois

C3ABR25130-HO-310B
C3ABR25130-2-HO-305

LOCATION IDENTIFIER

The following lists of location identifiers are extracted from DOD Manual 7350.5W Location Identifiers. The list includes all known stations located on Chart, DOD-WPC-1-4-21, current as of April 1981.

Supersedes C3ABR25130-HO-310B, C3ABR25130-2-HO-305, 18 January 1982.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 1000; DAV - 1

1167

Part 1. Station List: SAUM and SAUE

SAUM 9 KAWN (Military Stations)

AREA 04

RCA Ellsworth AFB, SD

AREA 05

ABQ Albuquerque, NM
CVS Cannon AFB, NM
HMN Holloman AFB, NM

AREA 06

DLH Duluth, MN
MIB Minot AFB, ND
RDR Grand Forks AFB, ND
SAW K.I. Sawyer AFB, MI
VOK Camp Douglas, WI

AREA 07

FOE Forbes Field ARPT, KS
FRI Fort Riley, KS
IAB McConnell AFB, KS
NBU Glenview NAS, IL
OFF Offutt AFB, NE

AREA 08

END Vance AFB, OK
FSI Henry Post AAF, OK
FWH Carswell AFB, TX
LTS Altus AFB, OK
NBE Dallas NAS, TX
REE Reese AFB, TX
SPS Wichita Falls, TX
TIK Tinker AFB, OK

AREA 09

DYS Dyess AFB, TX
HLR Fort Hood, TX

AREA 10

BLV Scott AFB, IL
GVW Richards Gebaur AFB,MO
HOP Campbell AAF, KY
NQA Memphis NAS, TN
SZL Whiteman AFB, MO
TBN Forney AAF, MO

AREA 11

AEX England AFB, LA
BAD Barksdale AFB, LA
BYH Blytheville AFB, AR
CBM Columbus AFB, MS
LRF Little Rock AFB, AR
NMM Meridian NAS, MS
POE Fort Polk, LA

AREA 12

FFO Wright-Patterson AFB, OH
FTK Godman AAF, KY
GUS Grissom AFB, IN
LCK Rickenbacker AFB, OH
MTC Selfridge AFB, MI
OSC Wurtsmith AFB, MI

AREA 13

MXF Maxwell AFB, AL
NSE Whiting Field NAS, FL
OZR Cairns AAF, AL
TOI Troy Muni APRT, AL
VPS Eglin AFB, FL

AREA 15

LSF Fort Benning, GA
WRB Warner Robins, GA

AREA 16

MGE Dobbins AFB, GA

SAUM 1 KAWN

ABR Aberdeen, SD
ATY Watertown, SD
AXN Alexandria, MN
BIS Bismarck, ND
BJI Bemidji, MN
BRD Brainerd, MN
CHB Chamberlain, SD
DIK Dickinson, ND
DLH Duluth, MN
DVL Devils Lake, ND
FAR Fargo, ND
FRM Fairmont, MN
FSD Sioux Falls, SD
GFK Grand Forks, ND
HIB Hibbing, MN
HON Huron, SD
INL International Falls, MN
ISN Williston, ND
JMS Jamestown, ND
MHE Mitchell, SD
MKT Mankato, MN
MOT Minot, ND
MSP Minneapolis, MN
OTG Worthington, MN
P11 Devils Lake, ND
PHP Philip, SD
PIR Pierre, SD
RAP Rapid City, SD
REJ Redig, SD
RST Rochester, MN
RWF Redwood Falls, MN
STC Saint Cloud, MN
TVF Thief River Falls, MN
YKN Yankton, SD
Y22 Lemmon, SD
Y26 Morbridge, SD

SAUM 2 KAWN

ADM Ardmore, OK
AIA Alliance, NE
ANW Ainsworth, NE
BBW Broken Bow, NE
BFF Scottsbluff, NE
BIE Beatrice, NE
BVO Bartlesville, OK
CDR Chadron, NE
CNK Concordia, KS
CNU Chanute, KS
CSM Clinton, OK
DDC Dodge City, KS
EAR Kearney, NE
EMP Emporia, KS
GAG Gage, OK
GCK Garden City, KS
GLD Goodland, KS
GRI Grand Island, NE
HBR Hobart, OK
HLC Hill City, KS
HSI Hastings, NE
HUT Hutchinson, KS
ICT Wichita, KS
LBF North Platte, NE
LBL Liberal, KS
LNK Lincoln, NE
MCK McCook, NE
MHK Manhatten, KS
MHN Mullen, NE
MLC McAlester, OK
OFK Norfolk, NE
OJC Olathe, KS
OKC Oklahoma City, OK
OLU Columbus, NE
OMA Omaha, NE
PGO Page, OK
PNC Ponca City, OK
RSL Russell, KS
SLN Salina, KS
SNY Sidney, NE
TOP Topeka, KS
TUL Tulsa, OK
VTN Valentine, NE

SAUM 3 KAWN

ABI Abilene, TX
ACT Waco, TX
AMA Amarillo, TX
CDC Childress, TX
DAL Dallas, TX
DFW Dallas/Forth Worth, TX
DHT Dalhart, TX
ELP El Paso, TX
FTW Fort Worth, TX
GDP Guadalupe Pass, TX
GGG Longview, TX
INK Wink, TX
LBB Lubbock, TX
LFK Lufkin, TX
MAF Midland, TX
MWL Mineral Wells, TX
PVW Plainview, TX
SJT San Angelo, TX
TPL Temple, TX
TYR Tyler, TX

SAUM 4 KAWN

ALO Waterloo, IA
BMI Bloomington, IL
BRL Burlington, IA
CGI Cape Girardeau, MO
CGX Chicago, IL
CID Cedar Rapids, IA
CMI Champaign, IL
COU Columbia, MO
DBQ Dubuque, IA
DEC Decatur, IL
DNV Danville, IL
DPA DuPage Co. ARPT, IL
DSM Des Moines, IA
FOD Fort Dodge, IA
IRK Kirksville, MO
JEF Jefferson City, MO
JLN Joplin, MO
MCI Kansas City, MO
MCW Mason City, IA
MDH Carbondale, IL
MDW Chicago, IL (Midway)
MKC Kansas City, MO
MLI Moline, IL
MWA Marion, IL
ORD Chicago, IL (O'Hare)
OTM Ottumwa, IA
PIA Peoria, IL
RFD Rockford, IL
SGF Springfield, MO
SPI Springfield, IL
STJ St. Joseph, MO
STL St. Louis, MO
SUS St. Louis, MO
SUX Sioux City, IA
UIN Quincy, IL
VIH Vichy, MO
30I Lamoni, IA
3SE Spencer, IA

SAUM 5 KAWN

ELD El Dorado, AR
ESF Alexandria, LA
FSM Fort Smith, AR
FYV Fayetteville, AR
GLH Greenville, MS
GWO Greenville, MS
HEZ Natchez, MS
HOT Hot Springs, AR
HRO Harrison, AR
JAN Jackson, MS
JBR Jonesboro, AR
MCB McComb, MS
MEI Meridian, MS
MLU Monroe, LA
PBF Pine Bluff, AR
SHV Shreveport, LA
TUP Tupelo, MS
TXK Texarkana, AR
UOX Oxford, MS

SAUM 6 KAWN

APN Alpena, MI
AUW Wausau, WI
AZO Kalamazoo, MI
BEH Benton Harbor, MI
BTL Battle Creek, MI
CMX Hancock, MI
CWA Mosinee, WI
DET Detroit, MI
DTW Detroit, MI
EAU Eau Claire, WI
ESC Escanaba, MI
FNT Flint, MI
GRB Green Bay, WI
GRR Grand Rapids, MI
HTL Houghton Lake, MI
IMT Iron Mountain, MI
IWD Ironwood, MI
JVL Janesville, WI
JXN Jackson, MI
LAN Lansing, MI
LNR Lone Rock, WI
LSE La Crosse, WI
MBL Manistee, MI
MBS Saginaw, MI
MKE Milwaukee, WI
MKG Muskegon, MI
MNM Menominee, MI
MQT Marquette, MI
MSN Madison, WI
MWC Milwaukee, WI
OSH Oshkosh, WI
P75 Seul Choix Point, MI
PLN Pellston, MI
PTK Pontiac, MI
RHI Rhinelander, WI
SSM Sault Ste Marie, MI
TVC Traverse City, MI
YIP Detroit, MI

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SAUM 7 KAWN

BKL Cleveland, OH
BMG Bloomington, IN
BWG Bowling Green, KY
CAK Akron, OH
CGF Cleveland, OH
CLE Cleveland, OH
CMH Columbus, OH
CVG Covington, KY
DAY Dayton, OH
EVV Evansville, IN
FDY Findlay, OH
FWA Fort Wayne, IN
HUF Terre Haute, IN
IND Indianapolis, IN
LAF Lafayette, IN
LEX Lexington, KY
LOU Louisville, KY
LOZ London, KY
LUK Cincinnati, OH
MFD Laser, OH
MIE Muncie, IN
OSU Columbus, OH
OWB Owensboro, KY
PAH Paducah, KY
SBN South Bend, IN
SDF Louisville, KY
TOL Toledo, OH
YNG Youngstown, OH
ZZV Zanesville, OH

SAUM 8 KAWN

BNA Nashville, TN
CHA Chattanooga, TN
CSV Crosseville, TN
DYR Dyersburg, TN
MEM Memphis, TN
MKL Jackson, TN
TRI Bristol, TN
TYS Knoxville, TN

SAUE 3 KAWN

HTS Huntington, WV

SAUE 4 KAWN

AND Anderson, SC
AVL Asheville, NC

Part 2. Station List, Alphabetical by Identifier

A

ABE Allentown, PA

ABI Abilene, TX

ABQ Kirtland AFB, NM

ABY Albany, GA

ACT Waco, TX

ACY Atlantic City, NJ

ADM Ardmore, OK

ADS Dallas, TX

ADW Andrews AFB, MD

AEX England AFB, LA

AGC Pittsburg, PA

AGS Augusta, GA

AHN Athens, GA

AIA Alliance, NE

AKO Akron, CO

AKR Akron, OH

ALB Albany, NY

ALI Alice, TX

ALM Alamogordo, NM

ALN Alton, IL

ALO Waterloo, IA

ALS Alamosa, CO

AMA Amarillo, TX

AMG Alma, GA

ANB Anniston, AL

AND Anderson, SC

ANW Ainsworth, NE

AOO Altoona, PA

APE Appleton, OH

AQQ Apalachicola, FL

ARG Walnut Ridge, AR

ASE Aspen, CO

ATL Atlanta, GA

ATW Appleton, WI

ATY Watertown, SD

AUS Austin, TX

AUW Wausau, WI

AVL Asheville, NC

AVO Avon Park, FL

AVP Wilkes-Barre Scranton, PA

AYE Fort Devens, MA

AYS Waycross, GA

AZO Kalamazoo, MI

B

BAD Barksdale AFB, LA

BAF Westfield, MA

BAK Columbus, ID

BAL Baltimore, MD

BBW Broken Bow, NE

BDF Bradford, IL

BDL Windsor Locks, CT

BDR Bridgeport, CT

BEH Benton Harbor, MI

BFD Bradford, PA

BFF Scottsbluff, NE

BFM Mobile, AL

BGD Borger, TX

BGM Binghampton, NY

BGS Webb AFB, TX

BHM Birmingham, AL

BIE Beatrice, NE

BIX Keesler AFB, MS

BKF Buckley ANG, CO

BKL Cleveland, OH

BKT Blackstone, VA

BKW Beckley, WV

BKX Brookings, SD

BLF Bluefield, WV

BLV Scott AFB, IL

BMG Bloomington, IN

BMI Bloomington, IL

BNA Nashville, TN

BOF Bolling AFB, DC

BPA Bethpage, NY

BPI Big Piney, WY

BPT Beaumont, TX

BRL Burlington, IA

BRO Brownsville, TX

BSI Blairsville, PA

BSM Bergstrom AFB, TX

BTL Battle Creek, MI

BTR Baton Rouge, LA

BUF Buffalo, NY

BUB Burwell, NE

BVE Boothville, LA

BVO Bartlesville, OK

BWD Brownwood, TX

BWG Bowling Green, KY

BYH Blytheville, AFB, AR

C

CAE Columbia, SC

CAK [illegible]n, OH

CAO Clayton, NM

CBM Columbus AFB, MS

CDR Chadron, NE

CDS Childress, TX

CEF Westover AFB, MA

CEW Crestview, FL

CEZ Cortez, CO

CGF Cleveland, OH

CGI Cape Girardeau, MO

CGX Chicago, IL

CHA Chattanooga, TN

CHD Williams AFB, AZ

CHO Charlottesville, VA

CHS Charleston AFB, SC

CID Cedar Rapids, IA

CKV Clarksville, TN

CLE Cleveland, OH

CLI Clintonville, WI

CLL College Station, TX

CLT Charlotte, NC

CMH Columbus, OH

CMI Champaign/Urbana, IL

CNK Concordia, KS

CNM Carlsbad, NM

CNU Chanute, KS

CNY Moab, UT

COD Cody, WY

COF Patrick AFB, FL

COS Colorado Springs, CO
Peterson Field

COT Cotulla, TX

COU Columbia, MO

CPR Casper, WY

CRE Myrtle Beach, SC

CRW Charleston, WV

CSG Columbus, GA

CSM Clinton, OK

CSV Crossville, TN

CTY Cross City, FL

CVG Cincinnati, OH

CVN Clovis, NM

CVS Cannon AFB, NM

CWA Mosinee, WI

CWO Mineral Wells, TX
Fort Wolters AHP

CYS Cheyenne, WY

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D

DAA Fort Belvoir (Davison AAF), VA

DAB Daytona Beach, FL

DAL Dallas, TX

DAN Danville, VA

DAY Dayton, OH

DBQ Dubuque, IA

DCA Washington, DC

DCU Decatur, AL

DDC Dodge City, KS

DEC Decatur, IL

DEN Denver, CO

DET Detroit, MI

DHN Dothan, AL

DHT Dalhart, TX

DLF Laughlin AFB, TX

DMA Davis-Monthan AFB, AZ

DMN Demming, NM

DNV Danville, IL

DOV Dover AFB, DE

DRO Durango, CO

DRT Del Rio, TX

DSM Des Moines, IA

DTN Shreveport, LA

DTW Detroit, MI

DUC Duncan, OK

DUJ DuBois, PA

DYR Dyersburg, TN

DYS Dyess AFB, TX

E

EAR Kearney, NE

EAU Eau Claire, WI

ECG Elizabeth City, NC, CGAS

EFD Ellington, TX

EGE Eagle, CO

EHT East Hartford, CT

EKN Elkins, WV

ELD El Dorado, AR

ELM Elmira, NY

ELP El Paso, TX

EMP Emporia, KS

END Vance AFB, OK

ERI Erie, PA

ERV Kerrville, TX

ESF Alexandria, LA

EVV Evansville, IN

EWN New Bern, NC

EWR Newark, NJ

EYW Key West, FL

F

FAF Fort Eustis, VA

FAY Fayetteville, NC

FCL Fort Collins, CO

FCM Minneapolis, MN

FCS Fort Carson (Butts AAF), CO

FDY Findlay, OH

FFO Wright-Patterson AFB, OH

FHU Libby AAF, AZ

FKL Franklin, PA

FLL Fort Lauderdale, FL

FLO Florence, SC

FLP Flippin, AR

FLV Fort Leavenworth (Sherman AAF), KS

FME Tipton AAF, MD

FMH Otis AFB, MA

FMN Farmington, NM

FMY Fort Myers, FL

FNT Flint, MI

FOD Fort Dodge, IA

FOE Forbes AFB, KS

FRG Farmingdale, NY

FRI Fort Riley (Marshall AAF), KS

FRM Fairmont, MN

FSD Sioux Falls, SD

FSI Fort Sill, OK

FSM Fort Smith, AR

FSR Fraser, CO

FTK Fort Knox (Godman AAF), KY

FTW Fort Worth, TX

FTY Atlanta, GA

FWA Fort Wayne, IN

FWH Carswell AFB, TX

FYV Fayetteville, AR

G

GAD Gadsden, AL

GAG Gage, OK

GBD Great Bend, KS

GBG Galesburg, IL

GBN Gila Bend, AZ

CCK Garden City, KS

GDP Guadalupe Pass, TX

GFA Malmstrom AFB, MT

GGG Longview, TX

GJT Grand Junction, CO

GLD Goodland, KS

GLH Greenville, MS

GLS Galveston, TX

GNT Grants, NM

GNV Gainsville, FL

GPT Gulfport, MS

GRB Green Bay, WI

GRD Greenwood, SC

GRI Grand Island, NE

GRK Killeen (Gray AAF), TX

GRR Grand Rapids, MI

GSB Seymour-Johnson AFB, NC

GSO Greensboro, NC

GSP Greer, SC

GSW Fort Worth, TX

GUC Gunnison, CO

GUP Gallup, NM

GUS Grissom AFB, IN

GUY Guymon, OK

GVW Richard-Gebaur AFB, MO

H

HAR Harrisburg, PA

HAT Hatteras, NC

HBG Hattiesburg, MS

HBR Hobart, OK

HDN Hayden, CO

HEZ Natchez, MS

HGR Hagertown, MD

HIF Hill AFB, UT

HKY Hickory, NC

HLC Hill City, KS

HLG Wheeling, WV

HLR Fort Hood AAF, TX

HMN Holloman AFB, NM

HOB Hobbs, NM

HON Huron, SD

HOP Campbell AAF, KY

HOT Hot Springs, AR

HOU Houston, TX

HPN White Plains, NY

HRL Harlingen, TX

HRO Harrison, AR

HRT Valparaiso, FL

HSI Hastings, NE

HSP Hot Springs, VA

HST Homestead AFB, FL

HSV Huntsville, AL

HTL Houghton Lake, MI

HTS Huntington, WV

HUF Terre Haute, IN

HUT Hutchinson, KS

HVN New Haven, CT

HYS Hays, KS

HZL Hazelton, PA

I

IAB McConnell AFB, KS

IAD Washington, DC

IAG Washington, DC

ICT Wichita, KS

ILG Wilmington, DE

ILM Wilmington, NC

IND Indianapolis, IN

INK Wink, TX

INT Winston Salem, NC

IOW Iowa City, IA

INL International Falls, MN

IPT Williamsport, PA

IRK Kirksville, MO

ISO Kinston, NC

ISP Islip, NY

ITH Ithaca, NY

J

JAC Jackson, WY

JAN Jackson, MS

JAX Jacksonville, FL

JBR Jonesboro, AR

JCT Junction, TX

JEF Jefferson City, MO

JFK New York, NY

JHW Jamestown, NY

JLN Joplin, MO

JOT Joliet, IL

JST Johnstown, PA

JXN Jackson, MI

L

LAF Lafayette, IN

LAN Lansing, MI

LAR Laramie, WY

LAW Lawton, OK

LBB Lubbock, TX

LBF North Platte, NE

LBL Liberal, KS

LCH Lake Charles, LA

LCK Lockbourne AFB, OH

LEX Lexington, KY

LFI Langley AFB, VA

LFK Lufkin, TX

LFT Lafayette, LA

LGA New York, NY

LHX La Junta, CO

LIC Limon, CO

LIT Little Rock, AR

LIY Hinesville, GA

LIZ Loring AFB, ME

LMN Lamoni, IA

LND Lander, WY

LNK Lincoln, NE

LNR Lone Rock, WI

LNS Lancaster, PA

LOU Louisville, KY

LOZ London, KY

LRD Laredo AFB, TX

LRF Little Rock AFB, AR

LRU Las Cruces, NM

LSE La Crosse, WI

LSF Ft. Benning, GA

LTL Laredo, TX

LTS Altus AFB, OK

LUF Luke AFB, AZ

LUK Cincinnati, OH

LUL Laurel, MS

LVS Las Vegas, NM

LXV Leadville, CO

LYH Lynchburg, VA

M

MAF Midland, TX

MBL Manistee, MI

MBS Saginaw, MI

MBY Moberly, MO

MCB McComb, MS

MCF MacDill AFB, FL

MCI Kansas City, MC

MCK McCook, NE

MCN Macon, GA

MCO McCoy AFB, FL

MCW Mason City, IA

MDH Carbondale-Murphysboro, IL

MDT Middletown, PA

MDW Chicago, IL

MEI Meridian, MS

MEM Memphis, TN

MFD Mansfield, OH

MFE McAllen, TX

MGE Dobbins AFB, GA

MGL Monteagle, TN

MGM Montgomery, AL

MGR Moultrie, GA

MGW Morgantown, WV

MHE Mitchell, SD

MHK Manhattan, KS

MHN Mullen, NE

MIA Miami, FL

MIB Minot AFB, ND

MIC Minneapolis, MN

MIE Muncie, IN

MIV Millville, NJ

MKC Kansas City, MO

MKE Milwaukee, WI

MKG Muskegon, MI

MKL Jackson, TN

MKO Muskogee, OK

MKT Mankato, MN

MLB Melbourne, FL

MLC McAlester, OK

MLI Moline, IL

MLU Monroe, LA

MMT McEntire ANG, SC

MMU Morristown, NJ

MOB Mobile, AL

MRB Martinsburg, WV

MRF Marfa, TX

MSL Muscle Shoals, AL

MSN Madison, WI

MSP Minneapolis, MN

MSY New Orleans, LA

MTC Selfridge AFB, MI

MTJ Montrose, CO

MTO Mattoon-Charleston, IL

MTU Myton, UT

MTW Manitowoc, WI

MUO Mountain Home AFB, ID

MVN Mt Vernon, IL

MWA Marion, IL

MWC Milwaukee, WI

MWL Mineral Wells, TX

MXF Maxwell AFB, AL

MYR Myrtle Beach AFB, SC

MZZ Marion, IN

N

NAB Albany, NAS, GA

NBC Beaufort, MCAS, SC

NBE Dallas (Hensley Field NAS), TX

NBG New Orleans NAS, LA

NBU Glenview NAS, IL

NCA Jacksonville (New River MCAF), NC

NEA Glynco NAS, GA

NEL Lakehurst NAS, NJ

NEW New Orleans, LA

NFB Mt Clemens NAF, MI

NGP Corpus Christi NAS, TX

NGU Norfolk, NAS, VA

NHK Patuxent River NAS,

NIP Jacksonville NAS, FL

NIR Beeville (Chase Field NAS), TX

NKT Cherry Point MCAS, NC

NMM Meridian NAS, MS

NPA Pensacola NAS, FL

NQA Memphis NAS, TN

NQI Kingsville NAS, TX

NQX Key West NAS, FL

NRB Mayport NS, FL

NSE Milton (Whiting Field NAS), FL

NTU Oceana NAS, VA

NXX Willow Grove NAS, PA

NYC New York, NY

NYG Quantico MCAS, VA

NYL Yuma MCAS, AZ

NZC Jacksonville (Cecil NAS), FL

NZW South Weymouth NAS, MA

O

OCF Ocala, FL

OFF Omaha, (Offutt AFB), NE

OFK Norfolk, NE

OKC Oklahoma City, OK

OKK Kokomo, IN

OLE Olean, NY

OLU Columbus, NE

OMA Omaha, NE

ONA Winona, MN

ONM Socorro, NM

ORD Chicago, IL

ORF Norfolk, VA

ORL Orlando, FL

OSC Wurtsmith AFB, MI

OSH Oshkosh, WI

OTG Worthington, MN

OTM Ottumwa, IA

OWB Owensboro, KY

OZR Cairns AAF, AL

P

PAM Tyndall AFB, FL

PBF Pine Bluff, AR

PBG Plattsburgh AFB, NY

PBI West Palm Beach, GL

PDK Atlanta, GA

PFN Panama City, FL

PGL Pascagoula, MS

PHF Newport News, VA

PHL Philadelphia, PA

PHP Philip, SD

PIA Peoria, IL

PIC Calverton, NY

PIE St. Petersburg, FL

PIR Pierre, SD

PIT Pittsburg, PA

PKB Parkersburg, WV

PMH Portsmouth, OH

PNC Ponca City, OK

PNE Philadelphia, PA

PNS Pensacola, FL

POB Pope AAF, NC

POE Fort Polk (Polk AAF), LA

POU Poughkeepsie, NY

POY Powell, WY

PPF Parsons, KS

PRX Paris, TX

PSB Phillipsburg, PA

PSF Pittsfield, MA

PSM Pease AFB, NH

PSX Palacios, TX

PTK Pontiac, MI

PUB Pueblo, CO

PVW Plainview, TX

R

RAN Chanute AFB, IL

RAP Rapid City, SD

RBD Dallas, TX

RCA Ellsworth AFB, SD

RCT Reed City, MI

RDG Reading, PA

RDU Raleigh, NC

REE Reese AFB, TX

RFD Rockford, IL

RIC Richmond, VA

RIW Riverton, WY

RKS Rock Springs, WY

RME Griffiss AFB, NY

RMG Rome, GA

RMT Rocky Mount, NC

RND Randolph AFB, TX

ROA Roanoke, VA

ROC Rochester, NY

ROW Roswell, NM

RSL Russell, KS

RST Rochester, MN

RTN Raton, NM

RVS Tulsa, OK

RWF Redwood Falls, MN

RWL Rawlins, WY

S

SAF Santa Fe, NM

SAT San Antonio, TX

SAV Savannah, GA

SAW K.I. Sawyer AFB, MI

SBN South Bend, IN

SBY Salisbury, MD

SCH Schenectady, NY

SDF Louisville, KY

SEM Selma (Craig AFB), AL

SGF Springfield, MO

SHD Staunton, VA

SHR Sheridan, WY

SHV Shreveport, LA

SJT San Angelo, TX

SKF Kelly AFB, TX

SLN Salina, KS

SNY Sidney, NE

SOP Southern Pines, NC

SPA Spartanburg, SC

SPI Springfield, IL

SPS Sheppard AFB, TX

SQI Sterling-Rock Falls, IL

SRQ Sarasota, FL

SSC Sumter (Shaw AFB), SC

SSF San Antonio, TX

SSI Brunswick-St. Simons Is., GA

SSU White Sulphur Springs, WV

STE Stevens Point, WI

STJ St. Joseph, MO

STL St. Louis, MO

STP St. Paul, MN

SUX Sioux City, IA

SVC Silver City, NM

SVM Salem, MI

SVN Hunter AAF, GA

SWF Newburg, NY

SWO Stillwater, OK

SYI Shelbyville, TN

SYR Syracuse, NY

SZL Whiteman AFB, MO

T

TAD Trinidad, CO

TBN Fort Leonard Wood (Forney AAF), MO

TCC Tucumcari, NM

TCL Tuscaloosa, AL

TCS Truth or Consequences, NM

TEB Teterboro, NJ

TIK Tinker AFB, OK

TLH Tallahassee, FL

TMB Miami, FL

TOL Toledo, OH

TOP Topeka, KS

TPA Tampa, FL

TPL Temple, TX

TRI Bristol, TN

TTN Trenton, NJ

TUL Tulsa, OK

TUP Tupelo, MS

TVC Traverse City, MI

TXK Texarkana, AR

TYR Tyler, TX

TYS Knoxville, TN

U

UBS Columbus, MS

UCA Utica, NY

UIN Quincy, IL

UOX Oxford, MS

V

VAD Moody AFB, GA

VCT Victoria, TX

VEL Vernal, UT

VHN Van Horn, TX

VIH Vichy, MO

VKS Vicksburg, MS

VLA Vandalia, IL

VLD Valdosta, GA

VOK Camp Douglas (Volk Field), WI

VPS Eglin AFB, FL

VRB Vero Beach, FL

VTN Valentine, NE

W

WAL Chincoteague, VA

WDG Enid, OK

WRB Macon (Robins AFB), GA

WRL Worland, WY

WWD Wildwood, NJ

X

Y

YIP Detroit, MI

YKN Yankton, SD

YNG Youngstown, OH

Z

ZUN Zuni Pueblo, NM

ZZV Zanesville, OH

1185

Part 3. State Abbreviation List, Alphabetical by Identifier

AK Alaska
AL Alabama
AR Arkansas
AZ Arizona
CA California
CO Colorado
CT Connecticut
DE Delaware
FL Florida
GA Georgia
HI Hawaii
IA Iowa
ID Idaho
IL Illinois
IN Indiana
KS Kansas
KY Kentucky
LA Louisiana
MA Massachusetts
MD Maryland
ME Maine
MI Michigan
MN Minnesota
MO Missouri
MS Mississippi
MT Montana
NC North Caroline
ND North Dakota
NE Nebraska
NH New Hampshire
NJ New Jersey
NM New Mexico
NV Nevada
NY New York
OH Ohio
OK Oklahoma
OR Oregon
PA Pennsylvania
RI Rhode Island
SC South Carolina
SD South Dakota
TN Tennessee
TX Texas
UT Utah
VA Virginia
VT Vermont
WA Washington
WI Wisconsin
WV West Virginia
WY Wyoming

Technical Training

Weather Specialist

RADAR REPORTS

23 March 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

 RGL: 10.6

RADAR REPORTS

OBJECTIVE

Given 10 radar reports (RAREPS), a programmed text and a chart, decode and plot the RAREPS with no more than 10 errors.

INSTRUCTIONS

This programmed text is designed so that you will progress through it at your own pace. Nearly every step of the instruction requires you to make a response of some sort. After you write the answer, you may compare the directed response found at the end of the frame following slashes (/////) with your own. If you answered correctly, go on as the directions allow to the next frame or workbook exercise. If you missed some of the questions, recheck your PT before proceeding.

Raise your hand for instructor assistance. At the end of some frames, you are cautioned not to proceed until the instructor directs you. These mandatory check points allow the instructor to monitor your progress.

You may use this programmed text for review purposes. Turn to frame 1 and begin.

Supersedes C3ABR25130-PT-310, 2 March 1983; C3ABR25130-WS-310, 5 August 1983.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 550; DAV - 1

RADAR REPORTS (RAREPS)

RAREPS are storm detection reports depicting areas of precipitation.

FORMAT: iii GGgg (TYPE, COVERAGE, WEATHER, INTENSITY)/ TREND, LOCATION(S), WIDTH OR DIAMETER, MOVEMENT, TOPS, REMARKS

Note: The iii (station call letters) are used as the reference point for all computations.

GGgg: Time expressed in hours and minutes GMT. (Not Plotted)

TYPE (ECHO SYSTEM):

LN - Line
AREA - Area
CELL - Cell
LYR - Stratified Elevated Echo

COVERAGE (SYSTEM COVERAGE):

Indicates the coverage as a numerical figure expressed in tenths. (i.e. 1 = 1/10, 10 = 10/10)

WEATHER (TYPE OF PRECIPITATION):

Weather reported as a contraction. (i.e. Rain - R, Rainshowers - RW)

INTENSITY (strength of radar return):

- light
moderate (no symbol)
+ heavy
++ very heavy
X intense
XX extreme
U unknown

TREND (tendency of the echo):

+ increasing
- decreasing
NC no change
NEW new, no opportunity to check the trend.

LOCATION:

The corner points or the center points are plotted using azimuth and distance from the reporting station.

Azimuth is reported to the nearest whole degree.

Distance is reported to the nearest 5 NM (nearest 1 NM if severe), (60 miles = 1 inch).

WIDTH OR DIAMETER:

Reported to the nearest 1 NM as total width or diameter. (i.e. A line is reported as 25W [25 miles wide], an area will be reported as D25 [diameter of 25 miles].)

MOVEMENT:

The letter A, L or C followed by the direction and speed <u>from which</u> the echo is moving relative to true north.

When 0000 is reported, the area of the echo return is stationary.

TOPS:

Maximum tops of the echo are reported after the contraction MT. Height is given in hundreds of feet (i.e. 300 indicated 30,000 ft). The MT is located away from the iii using azimuth/distance data if the system is extensive. (i.e. MT460 AT 118/13). Additional tops may be reported using the following format in the remarks section "TOP 420 AT 28/36". Uniform maximum tops will be indicated by the letter "U" preceding the height value (i.e. MT U210 for uniform tops at 21,000 ft).

REMARKS:

Standard, Operational Status or Plain Language remarks are remarks which supplement or amplify the encoded observation.

<u>ALL RAREPS ARE PLOTTED IN RED</u>

Using the information presented in this frame, correctly fill in the blanks for the following statements:

1. The contraction for a line of precipitation echoes is ____________.
2. System coverage is reported by a ____________ ____________.
3. After weather the ____________ of the radar return is reported.
4. Increasing trend is indicated by a ____________ sign.
5. The location of a given echo is obtained by using the ____________ and the ____________.
6. Movement shows the ____________ and ____________ from which an echo is moving.
7. All RAREPS are plotted in ____________.

/ /

Answers to Frame 1:

1. LN 2. numerical figure 3. intensity 4. plus
5. azimuth, distance 6. direction, speed 7. red

Frame 2

CIRCULAR AREAS

Plotting Procedures:

1. Locate the reporting station (iii) from 3ABR25130-HO-310, 312, location identifier.

2. Find the center point of the area using your protractor and ruler.

a. Points to remember:

1) Azimuth is reported in whole degrees.
2) Distance is reported in miles (1 inch = 60 miles).
3) Orient your protractor to the latitude and longitude lines.
4) Construction lines drawn too darkly must be erased.

b. Note: To save time, you can locate any MT or TOPS reported with azimuth and distance at this time, mark this point with an ⊙ to identify it from your center point.

3. Set your compass at half the reported value for the diameter. Use your ruler to obtain this increment. (The scale on the compass is not always accurate.)

4. Place the pivot point of the compass on the center point found in step 2. Draw a circle. To check the diameter, measure the completed circle with your ruler.

Labeling Procedures:

1. Use West-East orientation.

2. Arrange the data within the completed circle if possible. If the circle is too small, place the data neatly nearby.

3. Enter the station call letters.

4. Next line enter, as reported, the following elements: TYPE, COVERAGE, WEATHER, INTENSITY, TREND, and DIAMETER.

5. Convert the direction of movement to an arrow (from which the echo is moving). If the direction is reported as 0000 plot "STNRY".

6. Use wind Barb(s) to plot the speed of movement.

7. Underline TOPS reported (i.e. TOPS 280 will be plotted 280).

8. MT (Max Top) placed in brackets, (i.e. MT 280 plotted \280/).

9. Uniform tops are plotted for either MT or TOPS. (i.e. MT U280 plotted as \U280/, TOPS U280 plotted as U280).

10. REMARKS, if reported, will be plotted as received in an appropriate place, generally following or beneath the other plotted data. REMARKS will be plotted the same throughout all RAREPS.

RCA	1635	AREA	4	RW	-	/	-	78/35	D60
iii	GGgg	(TYPE	COVERAGE	WEATHER	INTENSITY)	/	TREND	LOCATION	WIDTH

C 2610	180
MOVEMENT	MAX TOP

RCA 1635 AREA4RW-/-78/35 D60 C2610 MT 180

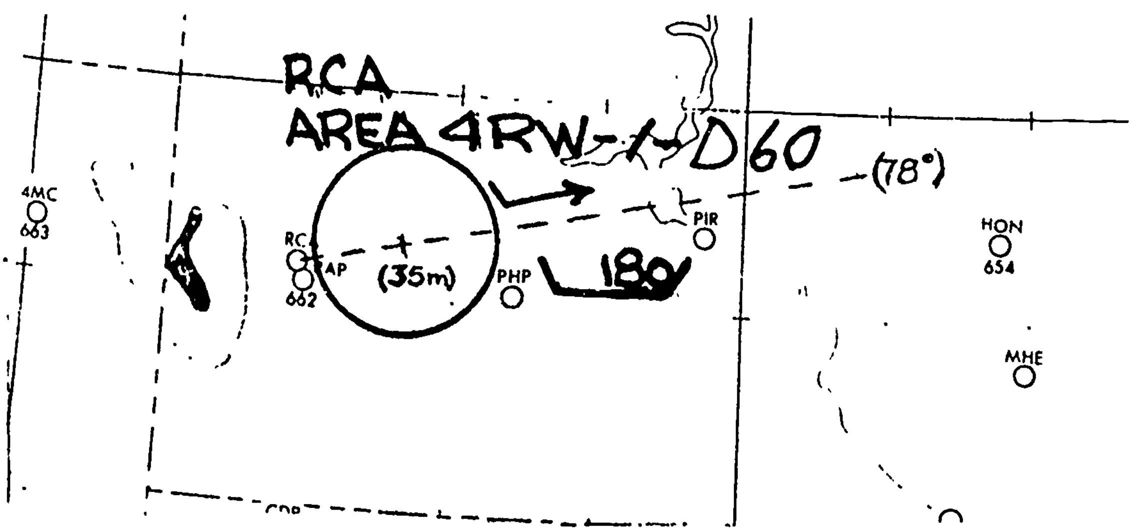

Figure 1. Circular Area

Using the information presented in this frame, correctly fill in the blanks for the following statements.

1. iii is the symbolic form for the ______ ______ and can be found in the location identifier.

2. When measuring the diameter of a circular area, use the scale one inch equals ______ miles.

3. When plotting the circular areas set the compass at ______ ______ the reported value for diameter.

4. The speed of movement is plotted as a ______.

5. TOPS are ______, MT (Max Tops) are placed in ______.

1192

///
Answers to Frame 2:
1. reporting station 2. 60 3. one half 4. barb.
5. underlined, brakets.

Decode and plot the following RAREP on a DOD WPC 1-4-21 map, using instructions given in this frame. Upon completion ask the instructor to check your work.

RAREP

RCA 1133 AREA 8TRW+/+ 132/70 D75 A2515 MT 480

Frame 3

IRREGULAR AREAS

Plotting Procedures:

1. Locate the reporting station (iii) from the location identifier.

2. Find the location (azimuth/distance) of all reported points (at least three), using your protractor and ruler.

3. After all points are located, connect them with a straight, solid, RED line.

4. Erase all construction lines.

Labeling Procedures:

1. Use West-East orientation.

2. Arrange the data within the completed area, if possible. If the area is too small, place the data neatly nearby.

3. Enter the station call letters.

4. Next line enter, as reported, the following elements: TYPE, COVERAGE, WEATHER, INTENSITY, and TREND.

5. Convert the direction of movement to an arrow (from which the echo is moving). If the direction is reported as 0000 plot "STNRY".

6. Use wind barbs to plot the speed of movement.

7. TOPS and MT (Max Tops) will be plotted the same throughout all RAREPS. (See Frame 2)

DDC	1235	AREA	6	R	-	/	NC	60/54	110/102
iii	GGgg	(TYPE	COVERAGE	WEATHER	INTENSITY)	/	TREND	LOCATION	LOCATION

240/132	273/50	A3208	MT 120 AT 85/30
LOCATION	LOCATION	MOVEMENT	MAX TOPS

DDC 1232 AREA 6R-/NC 60/54 110/102 240/132 273/50 A3208 MT 120 AT 85/30

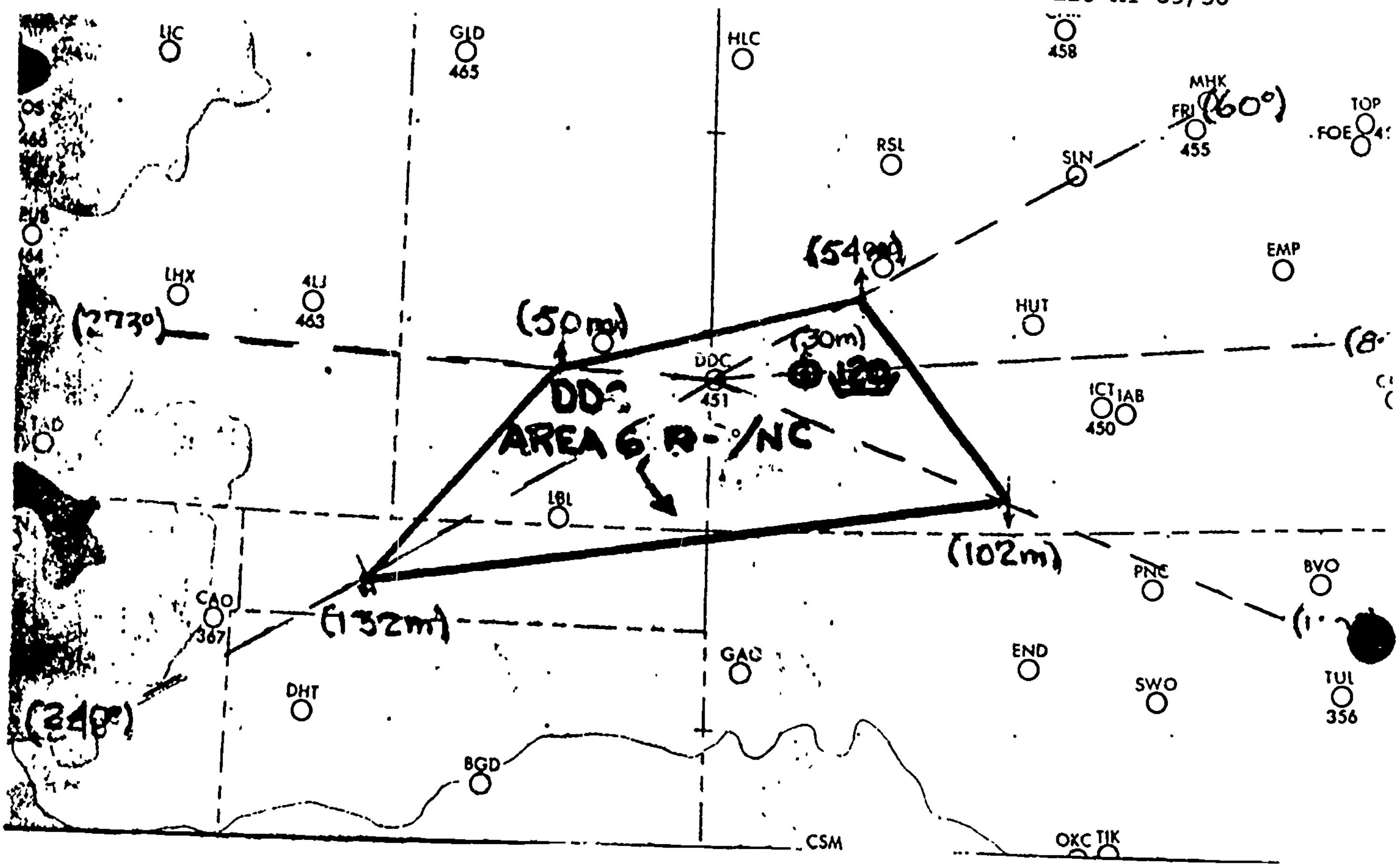

Figure 2. Irregular Area.

Using the information presented in this frame, correctly fill in the blanks for the following statements:

1. An irregular area must have at least __________ location points.
2. Location points are connected by straight, solid, ________ lines.
3. When labeling use a _______-__________ orientation.
4. Direction of movement is converted to an ____________ (from which the echo is moving).

/ /
Answers to Frame 3:

1. three 2. red 3. West-East 4. arrow

Decode and plot the following RAREP on previously used DOD WPC 1-4-21 map using instructions given in this frame. Upon completion, ask the instructor to check your work.

RAREP

DDC 1434 AREA 7RW/+ 55/82 124/67 237/106 282/71 A2909 MT 255/60

Frame 4

LINES

Plotting Procedures:

1. Locate the reporting station (iii) from the location identifier.

2. Using your protractor and ruler find and mark the end points (axis) of the line.

3. Draw a light construction line from end point to end point (axis line).

4. When drawing the end lines measure half the width on either side of the axis line drawing the lines perpendicular to the axis line.

5. For lines which report three location points, follow the same procedures except make only perpendicular lines at the two outside location points. Then draw width lines parallel to the axis lines.

Labeling Procedures:

1. Use West-East orientation.

2. Arrange the data within the rectangle if possible. If the rectangle is too small, place the data neatly nearby.

3. Enter the station call letters.

4. Next line enter, as reported, the following elements: TYPE, COVERAGE, WEATHER, INTENSITY, TREND, and WIDTH.

5. Movement will be plotted the same as areas. (See Frame 3, if necessary)

6. TOPS and MT (Max Tops) will be plotted the same throughout all RAREPS.

FFO 1435 LN 3 TRW - / - 73/150 303/105
iii GGgg (TYPE COVERAGE WEATHER INTENSITY) / TREND LOCATION

40W L2610 MT 250
WIDTH MOVEMENT MAX TOPS

FFO 1432 LN 3TRW-/- 73/150 303/105 40W L2610 MT 250

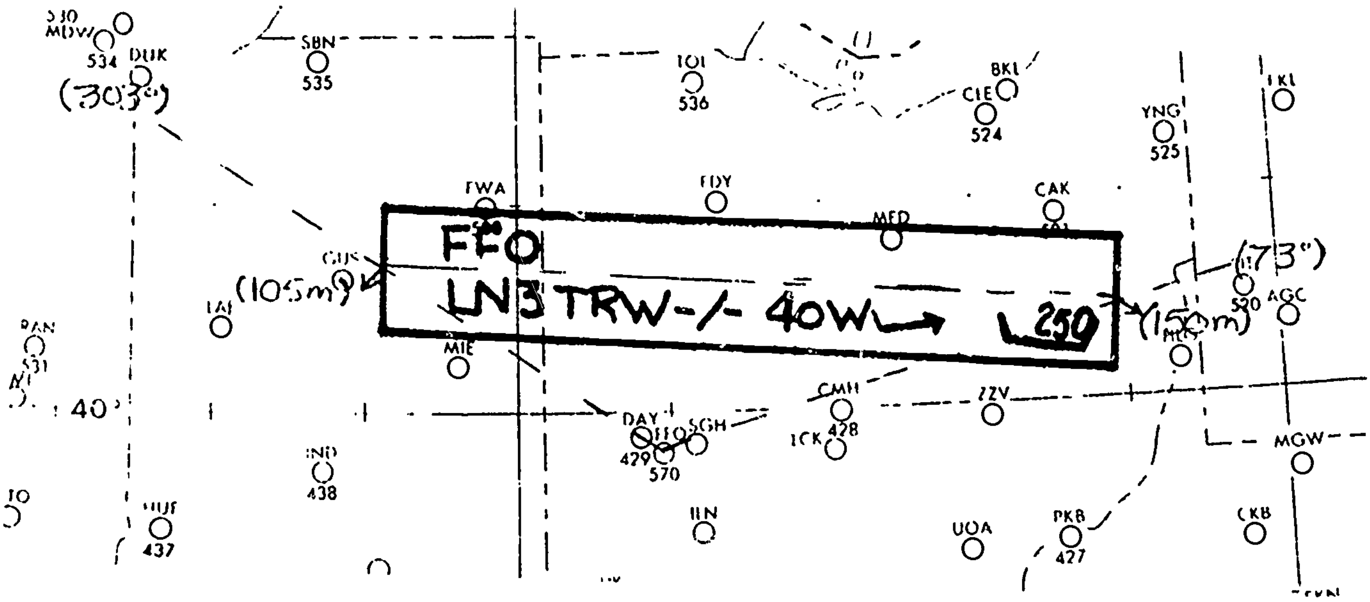

Figure 3. Line.

Using the information presented in this frame, correctly fill in the blanks for the following statements:

1. The _____ __________ are the first plotted elements of a line.

2. The end lines of the LN are plotted ______________ to the axis line.

3. The completed drawing will be a ______________.

/ /
Answers to Frame 4:

1. end points 2. perpendicular 3. rectangle

1196

Decode and plot the following RAREP on previously used DOD WPC 1-4-21 map using instructions given in this frame. Upon completion ask the instructor to check your work.

RAREP

FFO 1734 LN STRW/NC 125/142 281/133 38W L3112 MT 380 AT 133/102

Frame 5

CELL

Plotting Procedures:

1. Locate the reporting station (iii) from the location identifier.
2. Using your protractor and ruler locate the position of the cell.
3. Darken a circle comparable in size with a station circle in the located position.
4. Place a C, for cell (approximately 1/2 inch in height) around the darkened position.

Labeling Procedures:

1. Use West-East orientation.
2. Enter the station call letters.
3. Next line enter, as reported, the following elements: TYPE, WEATHER, INTENSITY, TREND, and DIAMETER.
4. DIAMETER (i.e. 5 mile diameter will be plotted D5).
5. Convert the direction of movement to an arrow (from which the echo is moving). If the direction is reported as 0000, plot "STNRY."
6. Plot speed of movement to the right of the arrowhead.
7. TOPS and MT (Max Tops) will be plotted the same throughout all RAREPS. (See Frame 2, if necessary.)

MKC	1535	CELL	RW	-	/	-	035/145
iii	GGgg	(TYPE	WEATHER	INTENSITY)	/	TREND	LOCATION

D5	C2715	Top 160
DIAMETER	MOVEMENT	TOP

MKC 1533 CELL RWU 035/145 D5 C2715 Tops 160

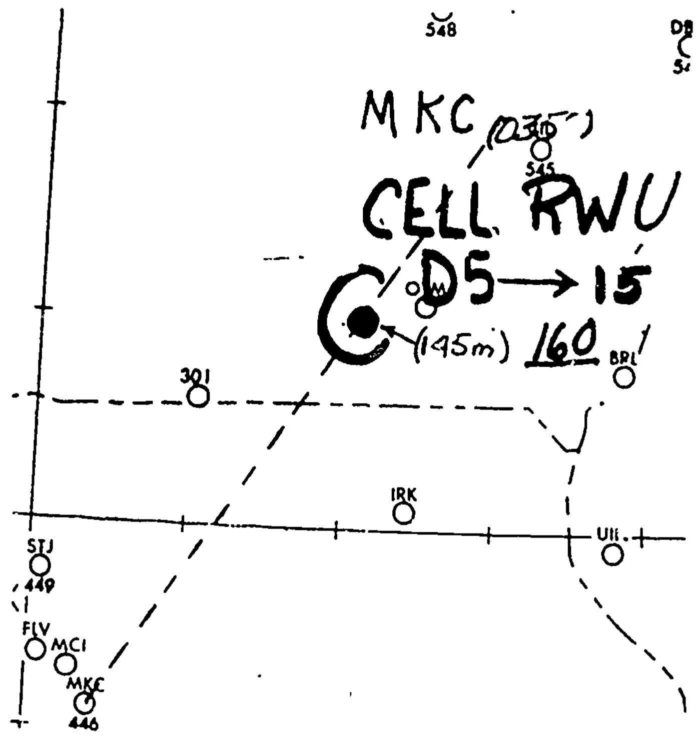

Figure 4. Cell.

Using the information presented in this frame, correctly fill in the blanks for the following statements:

1. After marking the cell position on the map, a __________ about ______ inch in height will be placed around it.

2. When labeling a TOP other than a MAX TOP, the height should be

______________.

/ /

Answers to Frame 5:

1. C, 1/2   2. underlined.

Decode and plot the following RAREP to practice cell plotting.

MKC 0833 CELL TRW++/+ 120/100 D8 C2425 MT 360

1198

1. Begin practice plotting RAREPS.

2. Use the programmed text, location identifiers, an the same DOD WPC 1-4-21 map.

3. The instructor will help you when necessary.

4. Plot your map with as much accuracy and speed as possible.

5. Plot exercise 1 below and have it checked.

6. Plot exercise 2 below and have it checked.

Plot the exercises below using the information in this programmed text on a DOD WPC 1-4-21 chart.

Exercise 1

LAF 0534 LN 4TRW-/- 58/90 266/90 3CW L3410 MT 270 AT 52/60

GLD 0533 AREA 5RW-/NC 122/60 115/180 138/150 A2810 MT 220 AT 129/75

HTL 0533 AREA 3TRW/NC 220/30 D60 A0000 MT 400 AT 260/30

MSL 0534 AREA 10TRW+/+ 28/180 108/120 179/30 330/120 A2715 C2320 RHINO

STL 0533 CELL RW/NC 227/90 D5 C1010 TOP 170

Exercise 2

DAL 1131 AREA 4TRWX/+ 28/90 233/60 270/120 290/90 C0000 MT 380 AT 280/60

AMA 1134 AREA 8TRW/NC OVHD D60 A0510 MT 280 AT 321/15

CEZ 1133 LN 5TRW-/- 68/90 120/90 200/120 30W MT 370 AT 153/75 MOVMT N PTN L2720 S PTN L3310

TOP 1132 AREA 7RW-/- 25/150 30/90 335/75 337/120 A1415 MT 180 AT 349/90

BFF 1134 AREA 6TRW/+ 332/75 60/120 188/60 231/75 275/90 A1915 C2210 MT 410 AT 330/60

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STUDY GUIDE/WORKBOOK

C3ABR25130-SW-310B

Technical Training

Weather Specialist

TERMINAL AERODROME FORECAST CODE - TAF

7 June 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

RGL: 10.0

1200

Weather Training Branch
Chanute AFB, Illinois

C3ABR25130-SW-310B

TERMINAL AERODROME FORECAST CODE - TAF

OBJECTIVES

Given all required references, forms, and weather data, decode weather information and operate the PMSV radio:

1. According to the proper PMSV procedures allowing 3 instructor assists.
2. One surface observation with no more than 1 instructor assist.
3. One Terminal Aerodrome Forecast (TAF) with no more than 2 instructor assists.

INSTRUCTIONS

This study guide/workbook is designed so that you will go through it page-by-page as you would a book. Go through it slowly, work on understanding the different elements of the code.

TAF CODE

The TAF, or TERMINAL AERODROME FORECAST CODE, is a modified Metar code used to disseminate forecasts at Air Force and Army installations. As an observer, you will be required to decode these forecasts for every-day use, as well as for transmission over the PMSV.

The following is an example of a forecast in TAF code. Throughout this study guide/workbook, we will break down the various parts of the code and learn the meaning of the various elements.

BLV 1212 34020/35 9999 5SC030 7AC120 QNH2960INS CIG030

a. BLV - Location identifier of the station for which the forecast is valid. BLV identifies Scott AFB, Illinois.

b. 1212 - This valid time for which the forecast is valid. This forecast is valid from 1200Z today until 1200Z tomorrow.

c. 34020/35 - Wind direction, speed and character group. The first three digits, 340, are the wind direction, the next two, 20, are the speed. The next element, /35, is the peak gust expected for the period. If no gusts are expected this element will be omitted.

d. 9999 - Visibility. A visibility of 9999 means unrestricted, seven miles or greater.

Supersedes C3ABR25130-SW-310B, 17 October 1983.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 600; DAV - 1

e. 5SC030 - Sky condition. As in Metar, we deal in eights of sky cover. We have forecast 5/8 of stratocumulus at 3,000 feet. In transmitting a forecast, you must determine whether the layer is scattered (1-4 eights), broken 5-7 eights), or overcast (8/8). The 7AC120 would translate into 7/8 altocumulus at 12,000 feet.

f. QNH2960INS - Minimum altimeter setting expected during this forecast period. NOTE: When less than 29.50, have pilot read back altimeter.

g. CIG030 - This group tells you that the cloud layer at 3,000 feet will constitute your ceiling.

This forecast would be transmitted over the PMSV in Airways code as follows:

Sky condition, ceiling three thousand broken, one two thousand broken, visibility seven or greater, wind three four zero at two zero, peak gust three five, minimum altimeter two niner six zero, over.

Now, convert the following TAF to Airways:

BLV 1010 17012/25 9999 2SC010 5AC100 QNH3000INS CIG100

1.

Since you did so well on that, we are going to make our TAF a little more complex.

BLV 1212 34020/35 9999 5SC030 QNH2960INS CIG030
GRADU 1617 VRB15/25 4000 95TS 8CB025 QNH2940INS CIG025
WND 130V250

We have already decoded the first line of the TAF so let us look at the second line:

a. GRADU - This indicates that a gradual change will take place in the forecast. This means that the first line of the forecast is no longer valid, it has been replaced by this line of the forecast. Quite often, several GRADU groups will be used in a TAF. Each GRADU group will then supersede the previous line of the forecast.

b. 1617 - Indicates the time that this group will become valid. The 16 is for the forecaster's use only. The 17 indicates the time that this group will become valid. This line will not become valid until 1700Z.

c. VRB15/25 - The wind group. The VRB indicates that the wind will be variable, at a speed of 15 kts, peak gust to 25 kts.

d. 4000 - The visibility. Using your TAF code handout you can see that a visibility of 4000 meters equals 2 1/2 miles.

e. 95TS - The weather and obstructions to vision group. Once again refer to your TAF code handout. 95TS means a thunderstorm with rainshowers.

f. 8CB025 - Sky condition. 8/8 cumulonimbus at 2,500 feet.

g. QNH2940INS - Lowest altimeter setting during this period will be 29.40. Have pilot repeat altimeter since it is lower than 29.50.

h. WND 130V250 - The degrees of variability of the winds.

i. CIG025 - Indicates the first layer that constitutes a ceiling.

Transmitted over the PMSV in airways code, the forecast would be read as follows:

Sky condition, ceiling two thousand five hundred overcast, visibility two and one half in thunderstorms and rainshowers, winds are variable from one three zero to two five zero at one five, peak gust two five. Minimum altimeter two niner four zero, read back altimeter, over.

Now, from the forecast below, put into airways code the forecast that is valid at 1900Z.

BLV 1010 17012/25 9999 2SC010 5AC100 QNH3000INS CIG100
GRADU 1719 VRB10/15 1600 07SA 2CU030 4AC080 QNH3003INS
CIG080 WND 200V270.

2.

You're doing great, so let's move on. We're going to throw in an "intermittent" group.

BLV 1212 34020/35 9999 5SC030 QNH2960INS CIG030
GRADU 1617 VRB15/25 4000 95TS 8CB025 QNH2940INS CIG025
WND 130V250
INTER 1719 27025/40 0600 95TS 9//005 CIG005

Since you know everything in the world about the first two groups, let's figure out this "INTER" group.

a. INTER - Means, more or less, what it sounds like, intermittent. This group does NOT replace the GRADU group, it supplements it. The entire line of the GRADU group is valid for the rest of the forecast period, but the elements listed in this INTER group will occasionally replace some of the elements of the GRADU group.

b. 1719 - Valid time for this intermittent group. This means that intermittently, or on and off during this period, from 1700 to 1900, the following conditions will occur.

c. 27025/40 - The winds.

d. 0600 - The visibility. Look this up on your TAF foldout.

e. 95TS - Weather.

f. 9//005 - The sky condition. The 9// indicates a total obscuration, the 005 indicates the vertical visibility into the obscuration.

g. CIG005 - Indicates the ceiling will be at 500 feet.

IMPORTANT: After 1900, this group will no longer apply.

Over the PMSV, if you were asked for a forecast for 1800, your response would be:

Roger, forecast for Scott, Scott Air Force Base Illinois, valid time one eight zero zero is as follows:

Sky condition, ceiling two thousand five hundred overcast, visibility two and one half in thunderstorms and rainshowers, winds are variable from one three zero to two five zero at one five, peak gust two five. Minimum altimeter two niner four zero, intermittently, sky condition indefinite ceiling five hundred, sky obscured, visibility three eights in thunderstorms and rainshowers, wind from two seven zero at two five, peak gust four zero, read back altimeter, over.

Now, in airways code, write out the forecast for 2100Z.

BLV 1010 17012/25 9999 2SC010 5AC100 QNH3000INS CIG100
GRADU 1719 VRB10/15 1600 07SA 2CU030 4AC080 QNH3003INS
CIG080 WND 200V270
INTER 2022 18020/30 0800 07SA 6CU030 4AC080 CIG030

3.

Let's add again to our original TAF.

BLV 1212 34020/35 9999 5SC030 QNH2960INS CIG030
GRADU 1617 VRB15/25 4000 95TS 8CB025 QNH2940INS CIG025
WND 130V250
INTER 1719 27025/40 0600 95TS 9//005 CIG005
GRADU 2223 00000 9999 WX NIL 6AC100 QNH3000INS CIGNO

a. GRADU - Once again, this indicates a gradual change. It completely replaces the preceding line of the TAF.

b. 2223 - This group will become valid at 2300Z, and will remain in effect until it is either superseded by another GRADU group, or until the end of the entire TAF period (1200Z).

c. 00000 - Winds will be calm.

d. 9999 - Visibility 7 and above.

e. WX NIL - This indicates that the weather or obstruction to vision that had been occurring will no longer be going on. This will only be used to cancel weather or obstructions to vision that were included in the previous line.

f. 6AC100 - Sky condition. 6/8 altocumulus at 10,000 feet.

g. QNH3000INS - Minimum altimeter setting.

h. CIGNO - Indicates that the sky condition will be thin. There will be "NO CEILING" even though there will be enough sky cover to constitute a ceiling, because half or more will be thin.

You now possess nearly all of the knowledge you need for a basic understanding of the TAF code. There are only two other things you will need to know at this point, the icing and turbulence groups. They would appear like this:

MXF 1010 09008 9999 3CU030 <u>650504</u> <u>540208</u> QNH2993INS.

a. 650504 - Is the icing group.

1. 6 - The data designator for the icing group.

2. 5 - Type of icing. Determine this type from your TAF foldout.

3. 050 - Base of the icing layer. The height of this base is reported in the same manner as cloud heights are reported, 050 = 5,000.

4. 4 - Thickness of the icing layer in thousands of feet. This is the distance from the base of the icing to the top of the top of the icing. In a forecast, this group would be given as "Moderate rime icing in cloud, from five thousand to niner thousand."

b. 540208 - Is the turbulence group.

1. 5 - The data designator for the turbulence group.

2. 4 - The type of turbulence - determine this type from the forecast breakdown.

3. 020 - Height of the base of the turbulence layer in thousands of feet. Read the same as cloud heights and icing heights.

4. 8 - This is the thickness of the turbulence layer. In a forecast this group would be given as "Light occasionally moderate turbulence in cloud, from two thousand to one zero thousand."

There are several other possible TAF entries that you will encounter as you progress through the career field. Some of these entries are shown on the following page.

REMARKS:

LLWS - Low level wind shear. A significant change in wind speed and/or direction that could affect arriving or departing aircraft.

VCNTY - In the vicinity. Within a 25 mile radius of the forecast location. Used along with other remarks.

RASH VCNTY - "Rainshowers in the vicinity."

TS VCNTY - "Thunderstorms in the vicinity."

SNSH VCNTY - "Snowshowers in the vicinity."

TS VCNTY 08-12 - Thunderstorms will be in the vicinity from 08Z to 12Z. Only include this remark if it applies to the time that the forecast was requested for.

WND - A remark indicating either a significant change in the winds or variability in the wind direction.

WND 300V060 - "Wind direction variable from three zero zero and zero six zero."

When the wind remark includes the contraction AFT and a time, these winds become the predominant winds from the indicated time till the next forecast period begins.

MXF 1010 14012/20 6000 80RASH 5SC030 8AC080 QNH2960INS CIG030
GRADU 2122 13014/24 9999 WX NIL 5SC025 7AC080 8CI250
QNH2955INS CIG025
INTER 2303 11014/25 4800 95TS 2CB015 8SC025 620208
590308 CIG025
GRADU 0203 VRB10 3200 60RA 10BR 5ST008 8SC015 QNH2948INS
CIG008:

eg. Tinker Metro, Tinker Metro, this is yankee four one, request forecast for Maxwell, Maxwell Air Force Base, Alabama, valid time one eight three zero, over.

ANS. Roger, Yankee four one, forecast for Maxwell, Maxwell Air Force Base, Alabama is as follows, sky condition three thousand broken, eight thousand overcast, visibility four in light rainshowers, wind one four zero at one two, peak gust two zero. Minimum altimeter two niner six zero, over.

Correctly respond to the PMSV contacts below, in airways code.

4. Offutt Metro, Offutt Metro, this is Papa one seven, request forecast for Maxwell, Maxwell Air Force Base, Alabama, valid time two two three zero zulu, over.

5. Loring Metro, Loring Metro, this is echo niner niner, request forecast for Maxwell, Maxwell Air Force Base, Alabama, valid time zero one zero zero zulu, over.

6. Little Rock Metro, Little Rock Metro, this is clipper two two, request forecast for Maxwell, Maxwell Air Force Base, Alabama, valid time zero four three zero zulu, over.

1297

```
LIZ 1109 AMD 34018/30 1200 71SN 38BLSN 9//004 640109 621006
    550005 QNH2927INS CIG004
    GRADU 1213 34018/30 1600 71SN 38BLSN 9//005 620109 621005 550005
    QNH2929INS CIG005
    GRADU 1415 33015/30 3200 71SN 38BLSN 5ST009 8SC020 620209
    550005 QNH2934INS CIG009
    GRADU 1718 33015/30 6000 70SN 38BLSN 2ST009 6SC020 8SC030
    620209 550005 QNH2942INS CIG020
    GRADU 2223 31015/28 9000 38BLSN 4SC025 3SC035 520006 QNH2958INS
    CIG035 AMD 1150;
```

```
RIV 1111 VRB05 9999 3ST010 5SC020 8SC030 620406 621305 520009
    QNH2935INS CIG020
    GRADU 1112 VRB05 9999 3SC010 5SC030 8SC040 620409 621305
    520009 QNH2930INS CIG030
    INTER 1115 14010/15 4800 80RASH 10BR 1ST010 8CU015 CIG015

    GRADU 1415 VRB05 4800 10BR 4ST010 4SC015 4SC040 620409 621305
    QNH2945INS CIG015
    GRADU 2021 28010 9999 WX NIL 2SC015 3SC040 3AC100 2CI250
    QNH2950INS CIG040 RASH OMTNS N-NE
    GRADU 0304 VRB05 9999 2SC025 5AC080 2CI250 QNH2960INS CIG080;
```

```
REE 1111 22012 9999 4SC040 6CS200 520104 QNH2935INS CIGNO
    WND 23014/22 AFT 15
    GRADU 1617 25020/36 4800 07SA 4SC040 4AS080 7CS200 530005
    QNH2930INS CIG040 WND 210V280 SKY-X RASH VCNTY E
    INTER 1824 2400 31SA
    GRADU 0001 26015/25 8000 30SA 3SC040 4AS080 6CS200 520005
    QNH2936INS CIG080 WND 24010/20 AFT 03
    GRADU 0203 24010/18 9999 WX NIL 5SC035 4AS080 8CS200 QNH2942INS
    CIG035 WND 30012/20 AFT 09 RASH VCNTY AFT 10 NEXT 0418 LAST;
```

```
DYS 0909 COR 18012 9999 3SC020 5CU040 5AC100 6CI250 QNH2937INS
    CIG0'0 WND 140V240 TS/RASH VCNTY LLWS VCNTY AFT 14
    INTER 1011 VRB15/28 8000 95TS 2CB020 4CU030 CIG030
    GRADU 1617 23014/24 9999 4CU030 4AC100 4CI250 530009
    QNH2930INS CIG100 WND 170V270 TS/RASH VCNTY LLWS VCNTY TIL 20

    GRADU 2223 23018/28 9999 3CU040 4CI250 530009 QNH2925INS
    CIG250 WND 170V270
    GRADU 0708 32012/24 9999 5ST010 8CS250 530009 QNH2928INS CIG010
    WND 260V010 COR 1233;
```

```
BSM 1212 12010 8000 80RASH 5ST008 5SC015 8AC100 QNH2948INS
    CIG008
    INTER 1214 15010/24 6000 95TS 3CB010 8SC015 CIG015
    GRADU 1415 16010 9000 80RASH 3ST008 5SC015 8AC100 QNH2960INS
    CIG015
    INTER 1619 15010/15 4800 95TS 3ST008 8SC015 CIG015
    GRADU 1819 18015/24 9999 WX NIL 3SC020 5SC030 8AC120 520005
    QNH2940INS CIG030 TS/RASH VCNTY
    INTER 2303 21015/30 4800 95TS 3CB010 8SC015 CIG015
    GRADU 0203 16012/18 9999 3SC020 3AC120 3CI250 510005
    QNH2950INS CIG120
    GRADU 0809 15012 9999 8SC015 QNH2955INS CIG015;

LIZ 1515 02010/18 1200 71SN 38BLSN 9//002 8NS010 640105
    620607 540006 QNH2950INS CIG002 LLWS
    GRADU 1718 36012/22 1600 71SN 38BLSN 6ST006 8NS010 620208
    540006 QNH2940INS CIG006 SKY-X LLWS
    GRADU 2324 34010/15 3200 85SNSH 38BLSN 5SC010 6SC020 8SC040
    620107 QNH2950INS CIG010
    GRADU 0506 32012/20 3200 85SNSH 38BLSN 5SC020 8SC040 620206
    QNH2960INS CIG020;

EDEX 1111 AMD 00000 0100 44FG 3ST002 620001 QNH3054INS CIG002
    SKY-X
    RAPID 12 00000 2800 10BR 3CI200 QNH3053INS CIG200 SKY-X
    GRADU 1112 09005 6000 10BR 5CI200 QNH3053INS CIGNO
    GRADU 1920 00000 1800 10BR SKC QNH3045INS SKY-X
    GRADU 0304 00000 0600 49FZFG 9//002 620001 QNH3047INS CIG002
    GRADU 0910 00000 1500 10BR SKC QNH3047INS SKY-X AMD 1135;

EDAB 1111 09002 6000 05HZ 3AC150 5CI250 QNH3046INS CIG250
    GRADU 1416 11004 6000 05HZ 3SC030 6AC120 5CI250 QNH3042INS
    CIG120 RASH VCNTY
    GRADU 0406 12004 3700 10BR 5SC030 6AC100 4CI250 QNH3038INS
    CIG030 RASH VCNTY
    GRADU 0809 13004 6000 05HZ 4SC030 5AC100 3CI250 QNH3036INS
    CIG100 LAST
```

KEY TO METAR AND TAF CODES

METAR WEATHER REPORT

- **LOCATION IDENTIFIER** — INTERNATIONAL LOCATION IDENTIFIER
- **TYPE REPORT** — TYPE OF REPORT - METAR (HOURLY) OR SPECI (SPECIAL) ON LONG LINE (NORMALLY INCLUDED ONLY ON A LINE PRECEDING THE FIRST REPORT IN A TELETYPE COLLECTIVE) SA RECORD SP SPECIAL OR L-LOCAL FOR LOCAL DISSEMINATION
- **TIME** — TIME OF OBSERVATION (GMT)
- **WIND DATA** — WIND DIRECTION TO NEAREST TEN DEGREES. A VARIABLE DIRECTION IS REPORTED AS VRB. DISSEMINATED WITH RESPECT TO MAGNETIC NORTH LOCALLY AND TRUE NORTH FOR LONGLINE TELETYPEWRITER / WIND SPEED (KNOTS) / MAXIMUM WIND SPEED (KNOTS) WHEN IT EXCEEDS MEAN SPEED BY 5 KNOTS OR MORE
- **PREVAILING VISIBILITY** — PREVAILING VISIBILITY (METERS FOR LONGLINE TELETYPEWRITER, MILES FOR LOCAL DISSEMINATION) 9999 INDICATES 10 KM OR GREATER
- **RUNWAY VISUAL RANGE (RVR) LOCAL** — INDICATOR - (R) / RUNWAY NUMBER / RUNWAY DESIGNATOR (USED TO DISTINGUISH PARALLEL RUNWAYS) / INDICATOR VR FOR RVR VALUE / VISUAL RANGE VALUE (HUNDREDS OF FEET) (OR MILES)
- **RUNWAY VISUAL RANGE (RVR) LONG LINE** — INDICATOR THAT RVR VALUE FOLLOWS / RVR VALUE (METERS)
- **PRESENT WEATHER** — PRESENT WEATHER - SEE TABLE 1
- **SKY CONDITION** — CLOUD AMOUNT (EIGHTHS) / TYPE OF CLOUD - SEE TABLE 2 / CLOUD HEIGHT - SEE TABLE 3 (ALL HEIGHTS ARE IN HUNDREDS OF FEET)
- **CAVOK** — TRANSMITTED IN PLACE OF VIS RVR AND CLOUD DATA WHEN VIS IS 10 KM OR GREATER, NO CLOUD BELOW 5000 FEET, AND NO CB AND NO PRECIP, TS, SHLW FOG, OR LOW DRFTG SNOW
- **TEMP DATA (In hourly reports only)** — AIR TEMPERATURE (DEGREES CELSIUS) / DEW POINT (DEGREES CELSIUS)
- **ALTIMETER SETTING** — ALTIMETER SETTING (INCHES) - THIS ELEMENT IS NOT INCLUDED IN SPECI REPORTS TRANSMITTED LONGLINE
- **CEILING HEIGHT** — CEILING HEIGHT (HUNDREDS OF FEET) - LOCALLY DISSEMINATED AS A PART OF SKY CONDITION
- **REMARKS** — REMARKS EITHER ABBREVIATED OR IN PLAIN LANGUAGE AND SUPPLEMENTARY DATA

LOCATION IDENTIFIER	TYPE REPORT	TIME	WIND DATA	PREVAILING VISIBILITY	RVR LOCAL	RVR LONG LINE	PRESENT WEATHER	SKY CONDITION	CAVOK	TEMP DATA	ALTIMETER SETTING	CEILING HEIGHT	REMARKS	
EDAN	SA	1457	25010 /20	0600	Not transmitted longline	R 10550	44FG	7 ST 005	(Not USAF)	01/M01	2984INS	CIG M005		(longline teletype)
EDAN	SA	1457	25010 /20	0 3	R 22 L VR 18	Not locally disseminated	FG	7 ST 005 CIG M005		01/M01	ALSTG 2984			(local dissemination)

TERMINAL AERODROME FORECAST (TAF) CODE

- **CCCC** — INTERNATIONAL LOCATION IDENTIFIER
- **G_1G_1** — START OF FORECAST PERIOD (GMT)
- **G_2G_2** — END OF FORECAST PERIOD (GMT)
- **ddd** — TRUE WIND DIRECTION VARIABLE DIRECTION REPORTED AS VRB
- **ff** — WIND SPEED IN KNOTS
- **$/f_mf_m$** — MAXIMUM WIND SPEED WHEN IT EXCEEDS THE MEAN SPEED BY 5 KNOTS OR MORE
- **VVVV** — PREVAILING VISIBILITY IN METERS 9999 INDICATES 10 KM OR MORE
- **ww** — FORECAST WEATHER - SEE TABLE 1
- **N_s** — EIGHTHS OF CLOUD
- **CC** — TYPE CLOUD - SEE TABLE 2
- **$h_sh_sh_s$** — HEIGHT OF CLOUD BASE - SEE TABLE 3
- **- - -** — N_s CC $h_sh_sh_s$ IS REPEATED AS NECESSARY
- **CAVOK** — NORMALLY NOT USED BY AWS UNITS (SEE EXPLANATION UNDER METAR BREAKDOWN ABOVE)
- **6** — ICING GROUP INDICATOR
- **I_c** — TYPE AND INTENSITY OF ICING - SEE TABLE 5
- **$h_ih_ih_i$** — HEIGHT ABOVE STATION ELEVATION OF THE BASE OF THE ICING LAYER - SEE TABLE 3
- **t_L** — THICKNESS OF ICING LAYER IN THOUSANDS OF FEET
- **5** — TURBULENCE GROUP INDICATOR
- **B** — TYPE AND INTENSITY OF TURBULENCE - SEE TABLE 4
- **$h_Bh_Bh_B$** — HEIGHT ABOVE STATION ELEVATION OF THE BASE OF THE TURBULENT LAYER - SEE TABLE 3
- **t_L** — THICKNESS OF TURBULENT LAYER IN THOUSANDS OF FEET
- **QNH** — Q CODE SIGNAL FOR ALTIMETER
- **$P_2P_2P_2P_2$** — FORECAST LOWEST ALTIMETER
- **INS** — UNITS INDICATOR - INCHES
- **REMARKS** — REMARKS IN ABBREVIATED PLAIN LANGUAGE. CEILING HEIGHT WILL BE INCLUDED WHENEVER MORE THAN 4/8 TOTAL CLOUD COVER IS FORECAST AND WILL BE LOCALLY DISSEMINATED AS A PART OF SKY CONDITION

EXAMPLE OF TAF FORMAT FOR LONGLINE TELETYPE TRANSMISSIONS

EDAN 1212	23015/25	9999		4CU030	4CI250				QNH2996INS	CIG250
GRADU 1617	23020/30	8000	80RASH	5CU020	4CI250		650504	550208	QNH2993INS	CIG020

EXAMPLE OF MODIFIED TAF FORMAT USED FOR LOCAL DISSEMINATION (Visibility in miles, heights in hundreds of feet, and wind direction in degrees magnetic)

EDAN FORECAST VALID 12Z to 12Z	23015/25	7		4C 030	4CI250 CIG250			QNH29.96INS	
GRADU 16-17Z	23020/30	4.3	RASH	5CU020 CIG020	4CI250	MOD ICING 050-090	MOD TURB 020-100	QNH29.93INS	

AWS VA 105-1 January 1980
OPR: DOOF
Distribution: F

CI 83.1449

0.11p

TABLE 1

w'w' — Significant present and forecast weather

Code		Decode
04	FU	Smoke
05	HZ	Haze
06	HZ	Dust
07	SA	Blowing dust or sand
08	PO	Dust devils
10	BR	Mist (fog)
11	MIFG	Shallow fog or ice fog
12	MIFG	
17	TS	Thunderstorm (no precip)
18	SQ	Squall
19	FC	Tornadic activity
20	REDZ	Recent drizzle
21	RERA	Recent rain
22	RESN	Recent snow
23	RERASN	Recent rain and snow
24	RAFZRA	Recent freezing rain
25	RESH	Recent rainshowers
26	RESNSH	Recent snowshowers
27	REGR	Recent hail*
29	RETS	Recent thunderstorm
30	SA	
31	SA	Duststorm or sandstorm
32	SA	
33	XXSA	Hvy duststorm or sandstorm
34	XXSA	
35	XXSA	
36	DRSN	Drifting snow
37	DRSN	
38	BLSN	Blowing snow
39	BLSN	
40	BCFG	Fog patches
41	BCFG	
42	FG	
43	FG	
44	FG	Fog or ice fog
45	FG	
46	FG	
47	FG	
48	FZFG	Freezing fog
49	FZFG	
50	DZ	Light drizzle
51	DZ	
52	DZ	Moderate drizzle
53	DZ	
54	XXDZ	Heavy drizzle
55	XXDZ	

Code		Decode
56	FZDZ	Light freezing drizzle
57	XXFZDZ	Mod or hvy freezing drizzle
58	RA	Light drizzle and rain
59	RA	Mod or hvy drizzle and rain
60	RA	Light rain
61	RA	
62	RA	Moderate rain
63	RA	
64	XXRA	Heavy rain
65	XXRA	
66	FZRA	Light freezing rain
67	XXFZRA	Mod or heavy freezing rain
68	RASN	Light rain and snow
69	XXRASN	Mod or hvy rain and snow
70	SN	Light snow
71	SN	
72	SN	Moderate snow
73	SN	
74	XXSN	Heavy snow
75	XXSN	
76	IC	Ice crystals
77	SG	Snow grains
79	PE	Ice pellets
80	RASH	Light rainshowers
81	XXSH	Moderate rainshowers
82	XXSH	Heavy rainshowers
83	RASN	Lgt rain and snow showers
84	XXRASN	Mod or hvy rain and snow showers
85	SNSH	Light snowshowers
86	XXSNSH	Mod or hvy snowshowers
87	GR	Lgt ice or snow pellet showers
88	GR	Mod or hvy ice or snow pellet showers
89	GR	Hail
90	XXGR	Hail
91	RA	Rain
92	XXRA	Hvy rain — with recent thunderstorm
93	GR	Hail* — with recent thunderstorm
94	XXGR	Hail* — with recent thunderstorm
95	TS	Thunderstorm with rain/snow
96	TSGR	Thunderstorm with hail*
97	XXTS	Severe thunderstorm with rain/snow
98	TSSA	Thunderstorm with duststorm or sandstorm
99	XXTSGR	Severe thunderstorm with hail*

NOTE. The asterisk (*) refers to snow pellets, ice pellets (type h), and hail

TABLE 2

CC — Cloud Type

Code	Decode	Code	Decode
CI	Cirrus	NS	Nimbostratus
CC	Cirrocumulus	SC	Stratocumulus
CS	Cirrostratus	ST	Stratus
AC	Altocumulus	CU	Cumulus
AS	Altostratus	CB	Cumulonimbus

TABLE 3

$h_Bh_Bh_B - h_fh_fh_f - h_ih_ih_i - h_sh_sh_s - h_th_th_t - h_xh_xh_x$

Code Figure	Meters	Feet	Code Figure	Meters	Feet
000	< 30	100	045	1350	4500
001	30	100	046	1380	4600
002	60	200	047	1410	4700
003	90	300	048	1440	4800
004	120	400	049	1470	4900
005	150	500	050	1500	5000
006	180	600	055	1650	5500
007	210	700	060	1800	6000
008	240	800	065	1950	6500
009	270	900	070	2100	7000
010	300	1000	075	2250	7500
011	330	1100	080	2400	8000
012	360	1200	085	2550	8500
013	390	1300	090	2700	9000
014	420	1400	095	2850	9500
015	450	1500	100	3000	10000
016	480	1600	110	3300	11000
017	510	1700	120	3600	12000
018	540	1800	130	3900	13000
019	570	1900	140	4200	14000
020	600	2000	150	4500	15000
021	630	2100	160	4800	16000
022	660	2200	170	5100	17000
023	690	2300	180	5400	18000
024	720	2400	190	5700	19000
025	750	2500	200	6000	20000
026	780	2600	210	6300	21000
027	810	2700	220	6600	22000
028	840	2800	230	6900	23000
029	870	2900	240	7200	24000
030	900	3000	250	7500	25000
031	930	3100	260	7800	26000
032	960	3200	270	8100	27000
033	990	3300	280	8400	28000
034	1020	3400	290	8700	29000
035	1050	3500	300	9000	30000
036	1080	3600	310	9300	31000
037	1110	3700	320	9600	32000
038	1140	3800	330	9900	33000
039	1170	3900	340	10200	34000
040	1200	4000	350	10500	35000
041	1230	4100	(etc)	(etc)	(etc)
042	1260	4200	990	29700	99000
043	1290	4300	999	30000 or more	100000 or more
044	1320	4400			

TABLE 4

B — Turbulence

CODE	DECODE
0	None
1	Light turbulence
2	Light OCNL moderate turbulence in clear air
3	Moderate turbulence in clear air
4	Light OCNL moderate turbulence in cloud
5	Moderate turbulence in cloud
6	Moderate OCNL severe turbulence in clear air
7	Severe turbulence in clear air
8	Moderate OCNL severe turbulence in cloud
9	Severe turbulence in cloud

NOTES:

1 AWS units will encode extreme turbulence by use of code figure 6, 7, 8 or 9 and adding "EXTRM TURB $h_Bh_Bh_B$ $h_th_th_t$" in Remarks

2 OCNL is defined as occurring less than 1/3 of the time

TABLE 5

Ic — Icing

CODE	DECODE
*0	None or trace
1	Light icing (light mixed)
2	Light icing in cloud (light rime)
3	Light icing in precipitation (light clear)
4	Moderate icing (moderate mixed)
5	Moderate icing in cloud (moderate rime)
6	Moderate icing in precipitation (moderate clear)
7	Severe icing (severe mixed)
8	Severe icing in cloud (severe rime)
9	Severe icing in precipitation (severe clear)

NOTE: WMO code figure 0 is no icing. AWS units will use 0 to indicate a trace of icing

TABLE 6

FORECAST CHANGE GROUPS

The form GRADU GGG_eG_e is used if changes are expected to take place at an approximately constant rate throughout the period beginning at GG and ending at G_eG_e, e.g. "GRADU 0203" indicates a gradual change between 0200 and 0300 GMT. RAPID is used instead of GRADU when changes are expected to take place during a period lasting less than half an hour.

The form INTER GGG_eG_e is used if changes are expected to occur frequently for short periods and fluctuate almost constantly throughout the period beginning at GG and ending at G_eG_e, e.g. "INTER 0913" indicates intermittent changes between 0900 and 1300 GMT. The intermittent condition will *not* cover in the aggregate more than one half of the forecast period or more than 30 minutes of any hour (45 minutes for thunderstorms).

VISIBILITY

Meters	Statute Miles	Meters	Statute Miles	Meters	Statute Miles
0000	0	1200	3/4	3000	1 7/8
0100	1/16	1400	7/8	3200	2
0200	1/8	1600	1	3600	2 1/4
0300	3/16	1800	1 1/8	4000	2 1/2
0400	1/4	2000	1 1/4	4800	3
0500	5/16	2200	1 3/8	6000	4
0600	3/8	2400	1 1/2	8000	5
0800	1/2	2600	1 5/8	9000	6
1000	5/8	2800	1 3/4	9999	7 and above

Technical Training

Weather Specialist

MAP PLOTTING

13 March 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE
DO NOT USE ON THE JOB

RGL. N/A

Weather Training Branch
Chanute AFB, Illinois

C3ABR25130-SW-310C

MAP PLOTTING

OBJECTIVES

1. Given a chart, references and available data, decode and plot one local area work chart (LAWC) in airways code with a minimum of 60 stations within 3 hours with no more than 2 errors on ten graded stations.

2. Given a chart, references and available data, decode and plot one surface chart in synoptic code with a minimum of 60 stations within 3 hours with no more than 3 errors on ten graded stations.

3. Given charts, references and available CONUS teletype data, decode and plot the 850mb, 700mb and 500mb levels with a minimum of 50 stations per level within 3 hours with no more than 3 errors on the 15 graded stations (5 graded on each level).

4. Given diagrams, references and available teletype data, decode and plot two thermodynamic diagrams (Skew-Ts) within 2 hours with no more than 3 errors on the one graded Skew-T.

Do the assignments as directed by the instructor. You are required to turn in the completed assignment to the instructor the following school day.

Supersedes C3ABR25130-000-SW-310C, 25 June 1983.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 550; DAV - 1

ASSIGNMENT 1

PLOTTING THE SKEW-T FOR AIR FORCE BLOCK III

IN BLOCK III YOU WILL BE PLOTTING THE SKEW-T USING THE RAWINSONDE CODE. THE SKEW-T AIDS THE FORECASTER IN HIS OR HER ANALYSIS OF THE ATMOSPHERE. THE SKEW-T IS ESPECIALLY USEFUL IN FORECASTING THUNDERSTORMS AND OTHER POTENTIALLY SEVERE WEATHER. YOUR ABILITY TO GIVE THE FORECASTER A PLOTTED SKEW-T CHART BOTH QUICKLY AND ACCURATELY MAY BE THE DIFFERENCE BETWEEN A GOOD AND A BAD FORECAST.

IN BLOCK III YOU WILL PLOT THE SKEW-T USING THE FOLLOWING GUIDELINES:

1. PLOT THE ØØØØZ SOUNDING IN BLUE AND THE 12ØØZ SOUND IN RED.

2. PLOT THE MANDATORY LEVELS (TTAA) THE SAME AS BLOCK II.

3. PLOT THE MANDATORY MILLIBAR HEIGHTS ON THE LEFT HAND SIDE OF THE CHART. PLOT THE ØØØØZ DATA ON THE LINE AND THE 2ØØZ DATA ABOVE THE ØØØØZ DATA IF THE 12ØØZ DATA IS PLOTTED ON THE SAME CHART.

4. TO INDICATE THE TROP DRAW A LINE ON THE LEFT HAND SIDE AT PROPER MILIBAR LEVEL.

5. PLOT TEMPERATURES AND DEWPOINTS BY A DOT AND CIRCLE AROUND THE DOT. IF THE DEWPOINT DEPRESSION IS ZERO PLOT A DOUBLE CIRCLE AROUND THE TEMPERATURE DOT. CONNECT THE TEMPERATURE DOTS WITH SOLID LINE AND CONNECT THE DEWPOINT DOTS WITH A DASHED LINE.

6. PLOT THE ØØØØZ WINDS ON THE FAR RIGHT SIDE OF THE WIND SCALE. THE 12ØØZ WIND WILL BE PLOTTED ON THE FAR LEFT SIDE OF THE OF THE WIND SCALE. THE CENTER WIND SCALE WILL BE USED FOR PLOTTING OVERLAPPING WINDS.

7. TEMPERATURE OR DEWPOINT DATA THAT IS MISSING IS INDICATED BY PLOTTING THE CONTRACTION MISDA IN PLACE OF THE DATA.

8. FILL IN YOUR NAME, THE STATION NAME AND NUMBER AND THE GMT DATE AND TIME OF THE DATA. IN BLOCK III WE WILL PLOT THE STATIONS 72532 WHICH IS PEORIA, IL (PIA) AND 72433 WHICH IS SALEM, IL (SLO) MOST OFTEN.

NOW ANSWER THE FOLLOWING QUESTIONS ABOUT PLOTTING SKEW-T'S USING THE RAWINSODE DATA BELOW.

PPBB 65ØØØ 72532 9ØØ12 Ø45Ø9 Ø5Ø11 Ø5Ø14 9Ø346 1ØØ1Ø 12Ø11 16Ø18
9Ø789 17523 2ØØ28 22Ø29 91246 23Ø31 ///32 21532 92Ø5/ 25Ø11 26Ø63
935// 27651 94Ø// 32538

TTAA 65ØØ2 72532 9999Ø 22Ø3Ø Ø45Ø9 ØØ127 ///// ///// 85497 16Ø4Ø
12Ø13 7ØØ98 1ØØ5Ø 23Ø3Ø 5Ø/// ///// ///// 4Ø747 2Ø58Ø 24549 3ØØ51
37756 26Ø93 25Ø74 447// 27621 2Ø219 555// 3ØØ76 154Ø1 6Ø1// 1Ø652
737// 8817Ø 521// 34Ø22 77224 27665 4Ø6Ø8 51515 1Ø158 1Ø164 ØØØ1Ø
1Ø194 Ø8512 19527

TTBB 65ØØ/ 72532 ØØ99Ø 22Ø3Ø 1195Ø 2ØØØØ 2291Ø 1861Ø 3375Ø 19Ø65
4465Ø Ø5Ø6Ø 5563Ø Ø3Ø63 666ØØ ØØØ7Ø 7758Ø Ø118Ø 8855Ø Ø4575 9936Ø
31158 11275 3996Ø 2217Ø 521// 3312Ø 669//;

1. WHAT IS THE STATION NUMBER? ---------------------------.

2. WHAT IS THE DAY OF THE MONTH AND TIME OF THE REPORT?

   --.

3. FIND THE HEIGHT OF THE 4ØØMB LEVEL, AND WHAT SIDE OF THE CHART IS IT PLOTTED ON?

4. WHAT ARE THE TEMPERATURES OF THE 85ØMB and 3ØØMB LEVELS AND HOW WOULD EACH BE PLOTTED?

   --.

5. WHAT IS THE DEWPOINT DEPRESSION OF THE 91ØMB LEVEL AND HOW WOULD IT BE PLOTTED?

   --.

6. WHAT IS THE LEVEL, THE TEMPERATURE AND THE WIND AT THE TROPOPAUSE?

   --.

7. WHAT IS THE LEVEL, THE DIRECTION AND THE SPEED OF THE MAX WIND?

   --.

8. WHAT ARE THE WINDS AT 6ØØØ AND AT 2Ø,ØØØ FEET?

   --.

9. WHAT WOULD BE PLOTTED AT THE 500MB LEVEL?

   --.

10. WHAT DOES THE TTAA CODE OF 77999 INDICATE?

   --.

THE FOLLOWING RAWINSONDE OBSERVATATION IS TO BE
PLOTTED ON A SKEW-T CHART VALID TIME 13 AUG 82
SOME DATA MAY BE MISSING

```
72433 PPAA NIL/KAWN
PPBB  63120 72433 90012 12007 12511 14013 90346 14010 22004 28006
90789 27507 27009 28509 91124 29510 29512 29514 9156/ 30013 29515
92025 26513 29515 32021 927// 32536 93025 31561 32074 30569 9415/
30076 29597 95014 32539 33026 33021;
TTAA  63121 72433 99998 16417 12007 00154 ///// ///// 85537 12682
27505 70/// 07050 ///// 50586 08160 26015 40756 18528 32020 30965
31935 32073 25091 419// 31071 20238 549// 30077 15416 659// 30581
10662 643// 33020·88152 685// 30584 77164 29597 41242 51515 10164
00013 10194 17508 28008;
TTBB  6312/ 72433 00998 16417 11977 19259 22882 13656 33854 12212
44850 12662 55821 13480 66819 13660 77812 13666 88796 12461 99786
11015 11756 11263 22741 09257 33662 04239 44613 00657 55610 00880
66557 01780 77472 10956 88464 11326 99263 39550 11152 685// 22145
649// 33100 643//;
```

1219

PLOTTING THE AIRWAYS CODE FOR AIR FORCE BLOCK III

IN BLOCK III YOU WILL BE PLOTTING LOCAL AREA WORK CHARTS (LAWC) USING THE AIRWAYS CODE. THE LAWC IS A CONDENSED VERSION OF THE LOCAL AREA SURFACE CHART (LASC). SOME OF THE ELEMENTS PLOTTED ON THE LASC MAY BE OMITTED ON THE LAWC AS DIRECTED BY THE NEEDS OF THE FORCASTER, THE FORCASTER WILL USE PREPARATION OF HIS OR HER FORECAST. THEREFORE THE LAWC MUST BE PLOTTED BOTH QUICKLY AND ACCURATELY. THE FORECASTER IS DEPENDING ON YOU!

IN BLOCK III YOU WILL PLOT THE AIRWAYS CODE USING THE FOLLOWING GUIDELINES:

1. PLOT THE WIND SHAFT AND BARB FIRST.
   A. PLOT A CIRCLE FOR CALM WINDS.
   B. USE AN X TO INDICATE A PARTIAL WIND. (SEE PLOTTING GUIDE)
   C. DO NOT PLOT ANYTHING FOR MISSING WINDS.

2. THEN PLOT THE SKY CONDITION.
   A. FIRST PLOT THE SKY CONDITION IN LAYERS USING THE SYMBOLS FOR SCT, FOR BROKEN, AND FOR OVC TO THE LOWER RIGHT OF THE STATION CIRCLE.
   B. THEN PLOT THE TOTAL SKY COVER IN SYMBOL FORM IN THE STATION CIRCLE.
   C. PLOT AN X THAT EXTENDS THROUGH THE STATION CIRCLE FOR A MISSING SKY CONDITION.

3. AFTER THE SKY CONDITION PLOT VISIBILITY, WEATHER AND OBSTRUCTIONS TO VISION USING THE SYMBOLS FROM AIRWAYS PLOTTING GUIDE TO THE LEFT OF THE STATION.

4. FOLLOW BY PLOTTING THE SEA LEVEL PRESSURE TO THE UPPER RIGHT OF THE STATION CIRCLE USING THE THREE DIGIT CODE.

5. NOW PLOT THE TEMPERATURE ABOVE AND DEWPOINT BELOW THE VISIBILITY.

6. NEXT PLOT THE APP GROUP TO THE RIGHT OF THE STATION CIRCLE, THE TENDENCY SYMBOL (THE A PART OF APP) WILL PLOTTED TO THE RIGHT OF PRESSURE CHANGE CODE (PP).

7. CONVECTIVE REMARKS WILL BE PLOTTED LAST BELOW ANY SKY CONDITION SYMBOLS. CONVECTIVE REMARKS ARE REMARKS SUCH AS THUNDERSTORM, CB, TCU AND FROPA.

8. FOR GARBLED DATA MAKE EVERY ATTEMPT TO DECODE BY USING THE AIRWAYS PLOTTING GUIDE OR BY ASKING THE FORECASTER.

9. PLOT AN "M" FOR THE FOLLOWING SITUATIONS ONLY:
   A. IF AN "M" IS REPORTED IN PLACE OF THE DATA.
   B. IF A SOLIDUS IS REPORTED IN PLACE OF THE DATA
   C. IF THE DATA IS GARBLED AND THERE IS NO WAY TO DECODE IT.

10. DO NOT PLOT THE FOLLOWING:
   A. AN M IF THE STATION DOES NOT REPORT SLP OR APP. NOT ALL STATIONS REPORT SLP OR APP.
   B. AUTOMATED STATIONS SUCH AS THE AMOS STATION.
   C. RVR, RSC/RCR (SUCH AS WR//), NOTAMS, PIREPS, BEGIN/END OF PRECIPITATION, MAX/MIN TEMPERATURE, 6 OR 24 HOUR PRECIP GROUPS AND RADAT DATA.
   D. THE CLOUD CODE GROUP (THE GROUP THAT BEGINS WITH 1).
   E. STATIONS THAT OVERLAP.

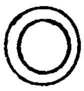
11. PUT YOUR NAME AND GMT DATE/TIME GROUP AT THE BOTTOM OF THE CHART.

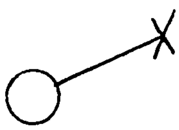
NOW ANSWER THE FOLLOWING QUESTIONS ABOUT PLOTTING THE AIRWAYS CODE

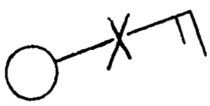
USING THE SKY CONDITION 3 SCT 8 SCT M13 BKN 18 OVC ANSWER QUESTION NUMBER ONE.

1. PLOT THE SKY COVER AND SKY CONDITION FOR THE GIVEN STATION CIRLE.

2. IF THE WIND DIRECTION IS MISSING, BUT THE SPEED IS REPORTED, THE WIND IS PLOTTED AS:

A. 

B. 

C. 

D. 

3. IF HEAVY RAIN IS BEING REPORTED PLOT TO THE LEFT OF THE STATION CIRCLE THE SYMBOL

4. PLOT THE FOLLOWING WIND ON THE STATION CIRCLE 3412G26

5. IF THE APPRR IS REPORTED AS 39975 991Ø7 ONE WHERE AND HOW IS IT PLOTTED ABOUT THE STATION CIRCLE?

6. PLOT THE SLP OF 156 ON THE STATION CIRCLE.

7. HOW WOULD THE SKY CONDITION -X BE PLOTTED?

8. LIST THE SITUATIONS THAT AN M CAN BE PLOTTED IN PLACE OF DATA.

9. WHICH OF THE FOLLOWING REMARKS WOULD BE PLOTTED ON A LAWC? (CIRCLE ONE)

   A. RVR 36

   B. WR//

   C. CB W

THE FOLLOWING 2Ø OBSERVATIONS ARE TO BE PLOTTED
ON AN AIRWAYS CHART VALID TIME 29 APRIL 1982 12ØØZ
SOME OF THE OBSERVATIONS MAY CONTAIN MISSING OR GARBLED DATA

12Ø5
SATIM9 KAWN 2912ØØ
SAUM9

AREA ØZ
OFF SA 1155 2Ø SCT 32BKN 8Ø BKN 3SW- Ø59/29/23/313ØG41/ØØ4
PK WND 3256/39/ 22ØØ2 157Ø 2ØØ12 LSR22;
FRI SA 1157 3Ø SCT 25 Ø82/31/24/3225G31/Ø1Ø 215ØØ 14ØØ 2ØØ15;
FOE RS 1156 E3ØBKN 7Ø BKN 1ØSW- Ø62/31/23/3225/ØØ8/ 22ØØ1 157Ø
2ØØ18 IP2ØP DRY;
IAB SA 1158 CLR 3Ø M/3Ø/23/3Ø12G16/M/Ø12/ 1Ø8 2ØØØ2;

AREA 1Ø
GVW BS 1155 W1 X 1/4SW Ø32/34/26/3 28G35/ØØ1/RVR2Ø SNOINCR 1
/ 32615 9Ø4Ø1 2ØØ58 LSR24;
SZL SA 1156 2Ø SCT M3Ø OVC 1Ø Ø26/39/29/3315G21/ØØØRWU W
/ 32815 15// 2ØØ44 WR//;
TBN RS 1155 -X 15 SCT M2ØBKN 28 OVC 1/4RW+ Ø18/ /36/84Ø2G117/
998/RVR12 R3 VSBY E1/2 CB 3NW-4NE MOVG E T MOVD
WSHFT 47 FROPA/ 312Ø8 ØNE 19// WR//;
BLV SA 1157 -X 32 SCT M4Ø OVC 2TRW ØØ2////6Ø 2Ø2ØØ52/988/T ALQDS
MOVG NE FQT LTGICCCCG WND 14V23/ 82515 19// 2ØØ35 WR//;
FTK SA 2255 -X 3H Ø51/72/61/2417/ØØ6/H2/ 712;
HOP SA 1158 CLR 6H FØ68/78/63/23Ø6/EØØ9/ 71Ø;

AREA 11
BYH SA 2255 3Ø SCT 7 Ø67/79/64/E2412/ØØ2/ 315 12ØØ;
NQA SA 1155 32 SCT 1Ø Ø82/8Ø 64/24Ø9/Ø1Ø/ 7Ø8 11ØØ;

AREA 12
GUS SA 1156 W1 X ØRF ØØ2/54/53/1ØØ2/996/RVR1Ø-/ 8Ø84Ø 2Ø1Ø2 WR//;
FFO SA 2255 W2 X 1F Ø24/55/55/ØØØØ/998/RVR6Ø/ 7Ø73Ø 2ØØ87 WR//'
LCK RS 1158 -X 5 SCT M1Ø OVC 1/2R-L-F Ø41/54/53/ØØØØ/ØØ2
RVR4Ø LF4/ 80525 172/ WR//;

12Ø7
SAUM4 KAWN 2912ØØ
ALO SA 1156 -X 15 SCT ^VC 2R-S-F Ø11/32/3Ø/362ØG28/SF2
/ 3Ø622 152/ 2ØØ6, ,/;
CMI RS 1157 6 SCT M22 BK. 7Ø OVC 7TORNADO 981/65/63/1615G23/ØØ2
CB W-N MOVG NE TORNADO 8NW MOVG NE T MOVD NE FQT LTGICCCCG
WND 12V2Ø / 82847 196/ 2ØØ67 WR//;
IRK SA 1157 2Ø SCT E3ØBKN 5ØBKN 7RW-SW- Ø11/36/3Ø3522G32/ØØ1/ 32617
18ØØ 2ØØ42 WR//;
MLI SA 2256 -X 1Ø SCT M2Ø OVC 3R-F 977/34/31/3618G24/998/RF1
/ 5Ø241 172/ 2ØØ63 WR//;
ORD SA 1156 W4 X 1R-F 979/44/44/Ø715G18/ØØ1/RVR55/ 62832 2ØØØ41 WR//;

ASSIGNMENT 3

PLOTTING THE LAND AND SHIP SYNOPTIC CODE FOR AIR FORCE BLOCK III

IN BLOCK III YOU WILL BE PLOTTING LOCAL AREA SURFACE CHARTS (LASC) USING THE SYNOPTIC CODE. THE LASC IS NEEDED WHEN THE FORECASTER NEEDS TO LOOK AT THE WEATHER IN GREAT DETAIL. FOR STUDY PURPOSES AND DURING TIMES OF FACSIMILE OUTAGES. AT COASTAL STATIONS OR STATIONS NEAR THE GREAT LAKES YOU WILL PLOT SHIPS ON A ROUTINE BASIS FOR BOTH THE LASC AND LAWC. THE KNOWLEDGE OF PLOTTING THE SYNOPTIC CODE IS ESSENTIAL TO THE SUCCESSFUL OPERATION OF ANY WEATHER STATION.

IN BLOCK III YOU WILL PLOT THE SYNOPTIC CODE USING THE FOLLOWING GUIDELINES:

1. FOR BOTH LAND AND SHIP SYNOPTIC OBSERVATIONS YOU WILL PLOT THE CODE GROUPS HVV NDDFF 1SNTTT 2SNTDTDTD 4PPPP 5APPP $7WWW_1W_2$ 8NHCLMCH.

2. FOR LAND STATIONS USE THE IIIII GROUP TO FIND ITS LOCATION. SHIP SYNOTPIC STATIONS WILL BE LOCATED BY THE GROUPS D....D, YYGGIW, 99LALALA AND QCLOLOLOLO.

3. ROUND THE TEMPERATURE AND DEWPOINT TO THE NEAREST WHOLE DEGREE FOR BOTH LAND AND SHIP OBSERVATIONS.

4. PLOT THE VISIBILITY AS REPORTED.

5. PRINT YOUR NAME AND THE DATE AND TIME OF THE DATA AT THE BOTTOM OF THE CHART.

6. DO NOT PLOT THE FOLLOWING:
   - A. PRESENT WEATHER OF 01, 02, OR 03.
   - B. OVERLAPPING STATIONS.
   - C. THE SEA WATER TEMPERATURE, WAVE CONDITIONS ANYTHING ELSE THAT FOLLOWS THE 8 GROUP FOR SHIP OBSERVATIONS.

NOW ANSWER THE FOLLOWING QUESTIONS ABOUT LAND AND SHIP AND SYNOTPIC.

USE THE FOLLOWING LAND SYNOPTIC REPORT TO ANSWER THE FOLLOWING QUESTIONS.

72779 11782 73604 10067 20061 39076 40116 57008 69901 70182 81571

1. What symbol is plotted for present weather?
2. What value is plotted for the height of the low cloud?
3. What is the station number?
4. What symbol is plotted for the pressure tendency?
5. Is the temperature positive or negative?
6. What is the block number?
7. What is the sea level pressure?
8. What symbol is plotted for the past weather?
9. What value is plotted for dew point temperature?
10. What symbol is plotted for the middle cloud?

USE THE FOLLOWING SHIP SYNOPTIC REPORT TO ANSWER THE FOLLOWING QUESTIONS.

MSTX 27004 99152 70756 42395 80237 10041 20039 39653 49921 54000 76052 886// 22222 00061 20507 312// 40508

1. What is the free air temperature?
2. What symbol is plotted for present weather?
3. What symbol is plotted for past weather?
4. What is the sea surface temperature?
5. What is the height of the first swell system?
6. What symbol is plotted for the pressure tendency?
7. What is the time of this report?
8. What is the present location of this ship?
9. Is the dewpoint positive or negative?
10. What is the station pressure?

The following 10 land and 10 ship synoptic stations are to be plotted on a synoptic chart valid on todays date at 1200Z. Some of the data may be missing or garbled.

LAND SYNOPTIC STATIONS

```
72433 32589 82318 1ØØ45 2ØØ2Ø 398Ø2 4Ø1Ø5 52Ø39 885//;
72438 11489 82112 2ØØ16 39846 4ØØ74 52Ø27 669Ø1 7Ø58Ø 8657Ø;
72445 31489 82716 1ØØ44 2ØØØØ 39883 4Ø1Ø3 52Ø37 71Ø42 885//;
72532 31/Ø4 9Ø8Ø4 1ØØ79 2ØØ64 39997 4Ø227 53ØØ7 7471Ø;
72533 11232 831Ø8 1ØØØØ 21ØØ3 39415 49993 52Ø37 7471Ø;
72534 1118Ø 52916 11Ø1Ø 21Ø27 39585 51Ø3Ø 699Ø1 7551Ø 856ØØ;
7254Ø 11689 632Ø6 1ØØØØ 21Ø45 39184 4Ø214 5212Ø 699Ø1 78585 865ØØ;
72547 31589 822Ø7 11Ø12 21Ø7Ø 39Ø83 4Ø162 52Ø2Ø 7152Ø 885//;
72635 32989 23512 1ØØ51 21Ø23 39666 4Ø2Ø9 51Ø15 8ØØØ8;
72643 11ØØ8 829Ø3 1ØØØ8 21ØØ1 39935 4Ø157 58ØØ8 6ØØ32 7717Ø 887//;
```

SHIP SYNOPTIC STATIONS

```
BREN 29Ø64 99155 7Ø8Ø4 41191 883Ø6 1Ø24Ø 212ØØ 3973Ø 4ØØØ1 5727Ø
     79592 889// 22228 ØØ275 21732 3Ø9// 4Ø926;
PHFN 29Ø64 992Ø3 7Ø823 41/97 71917 1Ø214 2Ø211 39997 4Ø18Ø 75151
     222// ØØ2Ø7 2Ø5Ø6;
DHKE 29Ø64 9918Ø 7Ø87Ø 41598 41813 1Ø2Ø7 2Ø188 39911 4Ø185 53ØØ5
     72582 831Ø1 22255 ØØ227 2Ø6Ø3 314Ø9 41ØØ6 5Ø926;
SOFT Ø5184 992Ø2 7Ø918 42998 Ø2Ø1Ø 1Ø25Ø 2Ø2Ø4 39843 53ØØ2 222[illegible]
     ØØ237 2Ø6Ø3 3Ø5// 432Ø5;
JXRN 29Ø63 99256 7Ø956 42598 1Ø5Ø9 1Ø267 2Ø248 39758 4ØØ32 5ØØØØ
     811ØØ 22283 ØØ265 2////;
FAOI 27ØØ4 99173 71Ø41 42395 8Ø237 1ØØ41 2ØØ39 39653 49921 54ØØØ
     76Ø52 886// 22222 ØØØ61 2Ø5Ø7 312// 4Ø5Ø8;
MWMN 27ØØ4 99235 71Ø72 41296 62933 1Ø2Ø5 2Ø127 39753 53ØØ2 78281
     84732 22213 ØØ213 ØØ2Ø6 21Ø12 312// 41511;
ONGI 16ØØ4 99222 71172 42999 ØØØØØ 1Ø26Ø 2Ø211 39876 4Ø15Ø 52Ø1Ø
     22214 ØØ275 2Ø6Ø8;
NEED 16ØØ4 99275 71161 41593 323Ø9 1Ø244 2Ø237 3987Ø 4Ø143 53ØØ5
     71142 8224Ø 22255 ØØ26Ø 2Ø912 314// 43ØØ8;
LAST 28ØØ4 992ØØ 71241 41398 832Ø9 11Ø54 21Ø75 39819 4ØØ91 52Ø1Ø
     7Ø282 887// 22226 ØØØ66 2Ø8Ø8 313Ø5 4242Ø 52313;
```

ASSIGNMENT 4

PLOTTING CONSTANT PRESSURE CHARTS FOR AIR FORCE BLOCK III

IN BLOCK III YOU WILL BE PLOTTING CONSTANT PRESSURE CHARTS USING THE RAWINSONDE CODE. THE UPPER ATMOSPHERE OFTEN HOLDS THE KEY TO MAKING A GOOD FORECAST. THEREFORE, IT IS ESSENTIAL THAT YOU KNOW HOW TO PLOT CONSTANT PRESSURE CHARTS.

IN BLOCK III YOU WILL BE PLOTTING CONSTANT PRESSURE CHARTS USING THE FOLLOWING GUIDELINES:

1. PLOT TEMPERATURES TO UPPER LEFT OF STATION CIRCLE AND DEWPOINT DEPRESSIONS TO THE LOWER LEFT OF THE STATION CIRCLE TO THE NEAREST WHOLE NUMBER ROUNDED AWAY FROM ZERO.
2. NEGATIVE TEMPERATURES ARE INDICATED BY ODD TENTHS VALUES.
3. PLOT THE WINDS AS IN BLOCK II BUT WITHOUT THE DIGIT FOR DIRECTION.
4. THE MILLIBAR HEIGHT OF THE CONSTANT PRESSURE LEVEL WILL BE PLOTTED TO THE UPPER RIGHT OF THE STATION.
5. PLOT "M" FOR MISSING TEMPERATURES, DEWPOINT DEPRESSIONS AND/OR MILLIBAR HEIGHTS.
6. PLOT PARTIAL WINDS WITH AN X FOR THE MISSING DATA.
7. DO NOT PLOT ANYTHING FOR COMPLETELY MISSING WINDS.
8. SHADE IN THE STATION CIRCLE FOR ALL DEWPOINT DEPRESSIONS FIVE DEGREES OR LESS.

NOW ANSWER THE FOLLOWING QUESTIONS ON CONSTANT PRESSURE?

1. Where is the temperature plotted in relation to the station circle?

2. Wind direction is plotted to the nearest ________ degrees and wind speed is plotted to the nearest____knots.

3. A dewpoint depression of 50 is plotted as ______________ and color the _____________________.

4. How is missing data or partially missing data plotted in constant pressure?

5. How is a calm wind plotted in constant pressure?

6. A code figure of 59 for a dewpoint depression must have what done to it before it is plotted?

7. How do you determine if the temperature is positive or negative?

8. Where is the height plotted in relation to the station circle?

9. The tens digit is plotted at the end of the wind barb. T/F

CONSTANT PRESSURE

PLOT THE 850MB LEVEL FOR THE FOLLOWING STATIONS

TTAA 53121 72712 99969 Ø3514 34Ø22 ØØ565 ///// ///// 85219 Ø29Ø5
Ø3Ø6Ø 7Ø742 Ø97Ø8 Ø2Ø56 5Ø531 19717 Ø8515 4Ø694 3Ø732 15Ø15 3Ø891
481// 16Ø21 25ØØ9 575// 18524 2Ø15Ø 525// 23521 15336 513// 24539
88234 6Ø7// 19521 77999;

TTAA 53121 726Ø6 99992 Ø2456 33Ø24 ØØ524 ///// ///// 85257 ØØØ33
35557 7Ø786 Ø8916 35552 5Ø532 2392Ø 33Ø3Ø 4Ø693 31929 Ø9Ø1Ø 3Ø889
481// 14Ø2Ø 25ØØ8 519// 2251Ø 2Ø154 493// 28518 15343 5Ø1// 27Ø41
1Ø6Ø7 523// 27Ø29 88255 525// 21Ø1Ø 77999;

TTAA 53121 72518 99998 Ø3258 29Ø18 ØØØ68 ///// ///// 85358 Ø73Ø6
34536 7Ø869 1Ø165 34551 5Ø538 27963 33555 4Ø695 35563 34575 3Ø891
467// 3356Ø 25Ø11 483// 32558 2Ø157 499// 31Ø51 15346 483// 29542
1Ø6Ø9 529// 27531 88274 493// 32Ø56 774ØØ 34575 4Ø913 77174 31Ø74
42434;

TTAA 53121 72734 99988 Ø3317 Ø9ØØ5 ØØ126 ///// ///// 85422 ØØ25Ø
///// 7Ø958 Ø91Ø5 27Ø36 5Ø55Ø 24134 3ØØ5Ø 4Ø7Ø8 36541 3ØØ56 3Ø9Ø2
519// 29571 25Ø17 6Ø3// 3ØØ74 2Ø157 573// 29569 15341 547// 29Ø43
1Ø6ØØ 559// 29Ø43 88226 637// 3ØØ64 77266 3ØØ76 4Ø711 51515 1Ø164
ØØØØ9 1Ø194 12ØØ6 27532;

TTAA 53121 72645 99986 ØØ7Ø6 Ø5ØØ7 ØØØ97 ///// ///// 8543Ø Ø8464
25Ø32 7ØØØØ Ø4716 27526 5Ø557 21739 27537 4Ø717 3535Ø 28Ø4Ø 3Ø911
493// 28Ø45 25Ø28 579// 28557 2Ø168 579// 28551 1535Ø 535// 28Ø43
1Ø6Ø8 569// 29Ø3Ø 88219 621// 29566 7723Ø 29Ø69 4182Ø 51515 1Ø164
ØØØØ5 1Ø194 19523 27Ø3Ø;

TTAA 53121 72747 99964 Ø1Ø18 12Ø11 ØØØ63 ///// ///// 85374 Ø18Ø3
15Ø11 7Ø933 Ø3356 24524 5Ø55Ø 22341 25523 4Ø71Ø 3455Ø 26526 3Ø9Ø4
511// 26538 25Ø2Ø 6Ø9// 27Ø42 2Ø159 587// 27558 15343 563// 27548
1Ø6Ø2 557// 29543 8825Ø 6Ø9// 27Ø42 77999 51515 1Ø164 ØØØØ6 1Ø194

TTAA 53121 72655 99967 Ø1ØØ7 1ØØØ9 ØØØ38 ///// ///// 85386 11257
25516 7Ø973 Ø1357 24522 5Ø556 1898Ø 28548 4Ø718 3298Ø 28Ø62 3Ø913
497// 27578 25Ø3Ø 595// 27577 2Ø169 619// 28556 15351 557// 26545
1Ø61Ø 579// 28Ø39 88223 621// 27Ø77 77284 27581 415Ø3 51515 1Ø164
ØØØØØ 1Ø194 21Ø18 2452Ø;

TTAA 53121 72654 99998 Ø3258 29Ø18 ØØØ68 ///// ///// 85369 15368
2352Ø 7Ø869 1Ø165 34551 5Ø538 27963 33555 4Ø695 35563 34575 3Ø891
467// 3356Ø 25Ø11 483// 32558 2Ø157 499// 31Ø51 15346 483// 29542
1Ø6Ø9 529// 27531 88274 493// 32Ø56 774ØØ 34575 4Ø913 77174 31Ø74
42434 51515 1Ø164 ØØØ12 1Ø194 32Ø31 34549;

TTAA 53121 72764 99945 Ø1639 Ø6ØØ3 ØØØ4Ø ///// ///// 85362 Ø645Ø
32ØØ7 7Ø937 Ø1763 28522 5Ø553 2Ø361 26Ø4Ø 4Ø714 33162 26Ø49 3Ø9Ø9
5Ø1// 25Ø66 25Ø66 25Ø25 599// 25574 2Ø165 571// 26Ø63 15349 533//
1Ø6Ø8 565// 26525 88244 6Ø5// 25577 77233 25Ø81 42224 51515 1Ø164
ØØØØ9 1Ø194 Ø2ØØ6 29Ø18;

TTAA 53121 7[illegible]2 99891 Ø3257 31ØØ4 ØØ5Ø8 ///// ///// 85329 Ø8Ø58
24518 7Ø954 ØØ16Ø 2Ø522 5Ø555 19539 22526 4Ø717 31756 24Ø38 3Ø913
493// 24Ø48 25Ø3Ø 589// 23552 2Ø167 675// 24Ø51 15349 561// 2453Ø
1Ø6Ø8 567// 26524 882ØØ 569// 24Ø29 77999 51515 1Ø164 ØØØØ2 1Ø194
18511 23518;

TTAA 53121 72775 99873 Ø3317 14ØØ2 ØØØ2Ø ///// ///// 85329 Ø645Ø
19Ø13 7Ø9Ø1 Ø2957 24Ø17 5Ø547 21763 23Ø2Ø 4Ø7Ø7 36338 22521 3Ø899
533// 23523 25Ø15 581// 23Ø39 2Ø156 567// 2354Ø 15342 537// 2353Ø
1Ø6Ø2 535// 23531 88279 569// 24Ø29 77999 51515 1Ø164 ØØØØ2 1Ø194
ØØØØ3 1Ø194 12Ø23 16Ø19;

TTAA 53121 72681 99896 Ø9458 1ØØ12 ØØ564 ///// ///// 853Ø6 Ø8Ø58
12526 7Ø876 Ø4134 16517 5Ø545 2Ø959 19Ø24 4Ø7Ø5 34347 2Ø535 3Ø899
521// 21Ø59 25Ø15 617// 22554 2Ø155 551// 21535 15341 52541 23Ø35
1Ø6Ø1 541// 23525 8825Ø 617// 22554 77261 22Ø61 41427 51515 1Ø164
ØØØØ3 1Ø194 12Ø94 12Ø23 16Ø19;

TTAA 53121 72785 99913 Ø44ØØ Ø2ØØ5 ØØ538 ///// ///// 853Ø3 Ø6Ø46
17Ø16 7Ø866 Ø51Ø5 19Ø15 5Ø542 22761 21Ø23 4Ø7Ø2 36758 21Ø29 3Ø893
543// 2Ø537 25ØØ8 591// 21527 2Ø149 549// 22Ø33 15334 543// 22523
1Ø595 541// 23Ø3Ø 88265 613// 21Ø36 77999 51515 1Ø164 ØØØØ3 1Ø194
28ØØ7 18515;

TTAA 53121 72694 99986 14457 Ø55Ø3 ØØ559 ///// ///// 85297 Ø6458
2Ø514 7Ø854 Ø5713 17515 5Ø541 23338 18Ø3Ø 4Ø7Ø1 3576Ø 18Ø4Ø 3Ø893
531// 18542 25ØØ9 583// 19Ø34 2Ø152 511// 2Ø52Ø 15339 5Ø7// 23Ø2Ø
1Ø6Ø4 513// 23Ø18 88258 591// 18536 77999 51515 1Ø164 ØØØØ3 1Ø194
28ØØ7 18515;

TTAA 53ØØ1 72797 99987 Ø5412 Ø7ØØ3 ØØ55Ø ///// ///// 85287 Ø3833
23ØØ6 7Ø833 Ø79Ø2 2151Ø 5Ø537 25131 19528 4Ø695 3855Ø 19535 3Ø885
559// 19547 25ØØØ 559// 2Ø533 2Ø14[illegible] 531// 22Ø24 1533Ø 513// 24512
1Ø592 517// 24511 88265 597// 18541 77999 51515 1Ø164 ØØØØ2 1Ø194
14ØØ3 16ØØ8;

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CONSTANT PRESSURE

PLOT THE 700MB LEVEL FOR THE FOLLOWING STATIONS

TTAA 53121 72304 99Ø13 Ø9457 32ØØ6 ØØ113 12668 32513 85453 1Ø76Ø
33Ø26 7ØØØ9 ØØ48Ø 3Ø532 5Ø561 1898Ø 3ØØ29 4Ø723 3338Ø 3Ø542 3Ø918
481// 31Ø47 25Ø36 565// 3ØØ56 2Ø177 499// 2856Ø 15368 511// 27555
1Ø626 615// 27Ø45 8825Ø 565// 3ØØ56 77168 28567 4Ø5Ø7 51515 1Ø164
ØØØØ4 1Ø194 33Ø22 32Ø22;

TTAA 53121 724Ø2 99Ø12 Ø6456 28512 ØØ1Ø5 Ø6Ø57 29521 85427 Ø1261
33543 7Ø964 Ø7568 3255Ø 5Ø554 2Ø765 32Ø71 4Ø715 35162 3Ø574 3Ø9Ø8
521// 32Ø84 25Ø25 561// 3ØØ86 2Ø17Ø 477// 28545 15358 529// 29552
1Ø616 583// 27Ø46 88244 569// 3Ø587 77245 3Ø588 41832 51515 1Ø164
ØØØ13 1Ø194 32Ø37 33Ø43;

TTAA 53121 72317 99983 Ø7458 24ØØ4 ØØ135 ///// ///// 85485 04456
34528 7ØØ51 ØØ58Ø 32Ø25 5Ø564 2Ø763 3Ø536 4Ø726 3318Ø 32Ø36 3Ø921
477// 32Ø53 25Ø39 581// 31565 2Ø18Ø 523// 29559 15365 517// 27568
1Ø62Ø 623// 27544 88239 599// 31566 77217 3Ø57Ø 41417 51515 1Ø164
ØØØØ7 1Ø194 31Ø18 33528;
TTAA 53121 72425 99986 Ø3238 2ØØØ2 ØØ126 ///// ///// 85477 Ø6Ø61
32Ø16 7ØØ42 Ø395Ø 33529 5Ø562 19966 3ØØ36 4Ø742 3218Ø 29Ø38 3Ø92Ø
483// 3ØØ52 25Ø38 567// 3Ø571 2Ø178 591// 29562 15361 543// 28554
1Ø618 6Ø5// ///// 88226 6Ø9// 3Ø582 77226 3Ø583 41421 51515 1Ø164
ØØØØ8 1Ø194 29Ø12 32523;

TTAA 53121 72429 99979 Ø2881 ØØØØØ ØØ12Ø ///// ///// 85474 Ø787Ø
29515 7ØØ43 Ø2956 3ØØ27 5Ø562 2Ø758 29539 4Ø724 31763 29Ø42 3Ø92Ø
487// 28551 25Ø38 565// 3ØØ65 2Ø177 6Ø3// 28556 15359 553// 27Ø4Ø
1Ø617 587// 28Ø45 88213 621// 29569 77232 3ØØ83 42332 51515 1Ø164
ØØØØ9 1Ø194 2951Ø 3Ø521;

TTAA 53121 72327 99994 Ø6419 11ØØ3 ØØ127 ///// ///// 85497 11Ø72
28ØØ7 7ØØ9Ø Ø1667 3Ø519 5Ø572 16161 3ØØ47 4Ø736 28364 29545 3Ø935
453// 3ØØ68 25Ø54 543// 29Ø76 2Ø194 655// 29Ø69 15374 567// 27563
1Ø629 633// 28Ø41 882ØØ 655// 29Ø69 77233 29Ø81 41Ø11 51515 1Ø164
ØØØ11 1Ø194 2ØØØ7 29Ø12 29Ø12;

TTAA 53121 72433 99991 1ØØ38 14ØØ6 ØØ1ØØ ///// ///// 85473 12Ø66
22Ø17 7ØØ68 Ø1459 28Ø21 5Ø568 16763 29Ø44 4Ø732 29565 28542 3Ø93Ø
461// 28559 25Ø49 559// 2858Ø 2Ø187 659// 28Ø65 15366 575// 27561
1Ø623 6Ø5// 27539 8819Ø 679// 28Ø61 77239 29Ø81 41117 51515 1Ø164
ØØØØ7 1Ø194 19517 25517;

TTAA 53121 72349 99958 12828 17ØØ8 ØØØ71 ///// ///// 85462 17Ø8Ø
23Ø29 7ØØ77 Ø4471 2ØØ12 5Ø571 16161 24526 4Ø735 29526 24537 3Ø933
467// 24542 25Ø51 561// 24Ø53 2Ø19Ø 657// 24Ø46 15368 589// 26Ø45
1Ø622 599// 26Ø39 88191 671// 24544 77999 51515 1Ø164 ØØØ91 1Ø194
21529 22Ø2Ø;

1232

TTAA 53121 72456 99974 14456 24ØØ4 ØØØ4Ø ///// ///// 85428 16466
23Ø29 7ØØ43 Ø3667 24Ø26 5Ø567 1718Ø 23532 4Ø73Ø 3Ø131 24Ø32 3Ø928
463// 24Ø46 25Ø46 561// 25Ø42 2Ø185 669// 24552 15363 577// 27Ø35
1Ø619 6Ø5// 26Ø34 882ØØ 669// 24552 77999 51515 1Ø164 ØØØØ1 1Ø194
2253Ø 24Ø23;

TTAA 53121 72451 99913 12248 17ØØ4 ØØØØ3 ///// ///// 85398 17666
2Ø536 7ØØ22 Ø5671 19Ø19 5Ø567 16758 17529 4Ø729 31141 19Ø36 3Ø927
473// 2ØØ4Ø 25Ø45 567// 2Ø536 2Ø183 631// 21Ø47 15364 561// 24535
1Ø62Ø 577// 26Ø21 882Ø6 641// 2Ø551 77999 51515 1Ø164 ØØØØØ 1Ø194
2ØØ27 2ØØ27;

TTAA 53121 72562 999Ø4 Ø2216 15ØØ3 ØØ5Ø6 ///// ///// 85366 15267
15Ø16 7Ø981 Ø4266 22518 5Ø561 16965 23Ø36 4Ø723 31956 21/49 3Ø92Ø
477// 23Ø38 25Ø38 573// 23542 2Ø176 661// 22558 15356 559// 24Ø45
1Ø614 587// 27Ø19 88293 882Ø3 669// 22Ø61 772Ø6 22Ø64 51515 1Ø164
ØØØØ3 1Ø194 15Ø13 19516;

TTAA 53121 72469 99826 Ø3261 3ØØØ4 ØØ521 ///// ///// 85369 /////
///// 7Ø558 1938Ø 19528 5Ø458 1978Ø 19Ø29 4Ø72Ø 3Ø756 19531 3Ø918
467// 2Ø5Ø9 25Ø36 577// 2ØØ13 2Ø174 659// 22Ø39 15356 539// 23Ø26
1Ø615 565// 24Ø22 882ØØ 659// 22Ø39 77999 51515 1Ø181 1Ø164 ØØØØ5
1Ø194 ///// 295Ø8;

TTAA 53121 72476 99839 Ø446Ø 12Ø12 ØØ5Ø9 ///// ///// 85359 /////
///// 7Ø943 ØØ464 18Ø16 5Ø554 18564 19535 4Ø717 3154Ø 2ØØ33 3Ø914
467// 19Ø36 25Ø33 575// 21525 2Ø17Ø 661// 19Ø45 15353 539// 21526
1Ø612 543// 24521 882ØØ 661// 19Ø45 77999 51515 1Ø164 ØØØØ5 1Ø194'
11511 14512;

TTAA 53121 72572 99855 Ø5Ø39 14ØØ5 ØØ533 ///// ///// 85333 Ø6Ø58
13ØØ4 7Ø913 Ø1556 17Ø24 5Ø55Ø 19343 19Ø24 4Ø712 31557 19Ø34 3Ø9Ø9
487// 2ØØ52 25Ø26 591// 21541 2Ø165 595// 2ØØ4Ø 1525Ø 5Ø7// 22524
1Ø611 553// 22525 8823Ø 633// 21Ø4Ø 77999 51515 1Ø164 ØØØØ4 1Ø194
11ØØ3 14512;

TTAA 53121 72486 9979Ø Ø1ØØ9 Ø4ØØ7 ØØ542 ///// ///// 8531Ø /////
///// 7Ø878 Ø31Ø5 15Ø26 5Ø547 2Ø116 16Ø3Ø 4Ø7Ø9 31356 1754Ø 3Ø9Ø5
497// 18544 25Ø21 6Ø3// 1956Ø 2Ø161 545// 18536 15347 533// 23Ø27
1Ø6Ø9 545// 21519 8825Ø 6Ø3// 1956Ø 77999 51515 1Ø164 ØØØØ1 1Ø194
///// 13517;

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CONSTANT PRESSURE

PLOT THE 500MB LEVEL FOR THE FOLLOWING STATIONS

```
TTAA  53121 722Ø3 99Ø15 Ø6634 Ø2ØØ4 ØØ14Ø 16468 Ø35Ø8 85499 Ø6861
3ØØØ7 7ØØ67 ØØØ69 31Ø29 5Ø568 17767 31Ø36 4Ø731 3Ø38Ø 31545 3Ø929
453// 32548 25Ø49 543// 32Ø51 2Ø192 525// 29Ø84 15378 545// 28Ø9Ø
1Ø63Ø 679// 28Ø53 88238 567// 3Ø555 77167 28Ø9Ø 4Ø8Ø3 51515 1Ø164
ØØØ1Ø 1Ø194 Ø2ØØ8 3Ø518;

TTAA  53121 7221Ø 99Ø17 11ØØ3 12ØØ4 ØØ158 15ØØØ 22ØØ9 85528 1Ø658
35ØØ9 7Ø124 Ø448Ø 32Ø22 5Ø578 1218Ø 3Ø538 4Ø745 2578Ø 3Ø542 3Ø946
421// 3ØØ62 25Ø67 5Ø1// 29Ø82 2Ø215 493// 271Ø2 154ØØ 597// 26595
1Ø647 693// 26568 8825Ø 5Ø1// 29Ø82 77224 27616 44919 51515 1Ø164
ØØØØ8 1Ø194 31512 33516;

TTAA  53121 72213 99Ø1Ø Ø8813 21ØØ3 ØØ128 14422 26ØØ5 855Ø1 Ø9Ø57
32Ø14 7ØØ9Ø Ø2Ø57 31Ø23 5Ø573 14965 31549 4Ø737 27763 31Ø6Ø 3Ø937
443// 3Ø569 25Ø57 525// 3Ø582 2Ø2Ø1 547// 286ØØ 15385 573// 27118
1Ø637 679// 28Ø44 8825Ø 525// 3Ø582 77157 27122 42Ø25 51515 1Ø164
ØØØØ7 1Ø194 3351Ø 32Ø2Ø;

TTAA  53121 7222Ø 99Ø17 14ØØØ 277Ø2 ØØ147 164Ø2 ///// 85527 13267
245Ø5 7Ø138 Ø3868 27ØØ3 5Ø578 1258Ø 26Ø16 4Ø744 26964 88999 77999
51515 1Ø155 1Ø164 ØØØ1Ø 1Ø194 ///// 25ØØ5;

TTAA  53121 72232 99Ø15 128Ø3 16ØØ5 ØØ126 ///// ///// 85515 14672
16Ø1Ø 7Ø125 Ø628Ø 225Ø6 5Ø579 1278Ø 23515 4Ø745 2758Ø 1533Ø 3Ø945
443// 25548 25Ø65 535// 26Ø65 2Ø2Ø6 553// 2558Ø 15389 593// 25583
1Ø637 683// 27Ø43 88225 593// 26Ø68 77153 25584 4Ø316 51515 1Ø164
ØØØ1Ø 1Ø194 18513 14ØØ8;

TTAA  53121 72235 99ØØ3 116Ø5 13ØØ6 ØØ114 138Ø5 14ØØ7 855Ø4 15Ø66
25Ø1Ø 7Ø114 Ø5471 235Ø7 5Ø577 14564 27515 4Ø741 27961 25531 3Ø941
445// 26Ø48 25Ø6Ø 543// 26554 2Ø2ØØ 631// 26Ø73 15382 573// 25572
1Ø633 659// 26547 882Ø4 639// 26Ø72 77175 26Ø81 4Ø81Ø 51515 1Ø164
ØØØØ5 1Ø194 2251Ø 245Ø6;

TTAA  53121 7224Ø 99Ø11 16ØØØ 13ØØ8 ØØ1Ø1 164Ø5 14Ø14 8549Ø 1628Ø
17Ø26 7Ø116 Ø628Ø 22Ø19 5Ø578 1358Ø 19Ø3Ø 4Ø743 2718Ø 21Ø33 3Ø944
427// 23Ø47 25Ø65 533// 23549 2Ø2Ø6 577// 24583 15389 551// 25587
1Ø642 635// 26Ø47 8822Ø 589// 23Ø69 77164 25Ø95 42415 51515 1Ø164
ØØØØ5 1Ø194 2251Ø 245Ø6;
```

1234

```
TTAA 53121 72247 99997 13800 18007 00095 ///// ///// 85476 17080
18528 70093 05080 19521 50574 15780 20031 40738 28963 20533 30938
441// 22546 25057 551// 23546 20196 653// 23063 15377 565// 25566
10632 603// 25552 88200 653// 23063 77171 24575 41912 51515 10164
00091 10194 18529 19024;

TTAA 53121 72255 99003 18205 12010 00059 18404 12512 85443 16080
17054 70073 09280 19545 50574 14349 22037 40740 26960 22035 30940
431// 23532 25060 543// 23045 20202 555// 24571 15387 563// 25089
10640 619// 26543 26543 88222 571// 24060 77161 25090 41213 51515
10164 00091 10194 16049 18555;

TTAA 53121 72250 99005 20612 16013 00047 19407 16018 85443 18671
17556 70095 10880 23025 50578 13356 24540 40743 26365 24051 30944
423// 24072 25066 471// 24574 20213 511// 27072 15397 563// 25095
10646 691// 25554 88999 77140 25104 42426 51515 10163 00005 10194
16550 20539;

TTAA 53121 72261 99966 17603 11010 00017 ///// ///// 85410 13803
18522 70029 06280 21532 50568 13980 21037 40733 27962 20042 30934
437// 22545 25054 517// 23042 23042 20198 543// 24572 15385 513//
10639 621// 26058 88225 549// 549// 24044 77171 25082 40916 51515
00054 10194 16021 22529;

TTAA 53121 72265 99902 17027 17015 00528 ///// ///// 85379 13404
18531 70994 06868 20514 50565 15964 21034 40728 30362 20036 30926
455// 21535 25045 555// 23030 20186 543// 23559 15372 543// 25557
10628 609// 25563 88219 611// 23534 77105 25568 40811 51515 10164
00055 10194 18026 20522;

TTAA 53121 72270 99869 12062 26004 00521 ///// ///// 85383 12861
2600/ 70983 01656 20037 50560 17506 21045 40724 28957 20031 30922
465// 19540 25040 573// 20040 21083 5[illegible]3// 24044 15368 531// 26060
10627 591// 25050 88243 583// 20540 77163 25070 42610 51515 10164
00001 10194 26007 21426;

TTAA 53121 72365 99825 05060 35006 00526 ///// ///// 85364 /////
///// 70962 01661 19019 50557 16764 18536 40720 31312 18528 30918
461// 20024 25046 569// 20020 20175 599// 19543 15360 533// 25532
10618 587// 24538 88224 621// 19021 77999 51515 10164 00006 10194
///// 15511;

TTAA 53121 72274 99911 12058 19015 00514 ///// ///// 85364 07450
17526 70932 02304 19534 50552 20541 21043 40712 34380 21046 30907
479// 22045 25027 479// ///// 20174 479// ///// 15363 515// /////
10622 591// 26053 88312 477// 21545 77341 21560 41716 51515 10164
00003 10194 18022 19029;
```

1235

EXTRA PLOTTING EXERCISES

THE FOLLOWING RAWINSONDE OBSERVATION IS TO BE
PLOTTED ON A SKEW-T CHART VALID TIME 15 JUN 82
SOME DATA MAY BE MISSING

PPBB 65000 72532 90012 04509 05011 05014 90346 10010 12011 16018
90789 17523 20028 22029 91246 23031 ///32 21532 9205/ 25011 26063
935// 27651 940// 32538;

TTAA 65002 72532 99990 22030 04509 00127 ///// ///// 85497 16040
12013 70098 10050 23030 50/// ///// ///// 40747 20580 24549 30951
37756 26093 25074 447// 27621 20219 555// 30076 15401 601// 10652
737// 88170 521// 34022 77224 27665 40608 51515 10158 10164 00010
10194 08512 19527;

TTBB 6500/ 72532 00990 22030 11950 20000 22910 18610 33750 19065
44650 05060 55630 03063 66600 00070 77580 00180 88550 04575 99360
31158 11275 39960 22170 521// 33120 669//;

1236

THE FOLLOWING RAWINSONDE OBSERVATIONS ARE TO BE
PLOTTED ON A CONSTANT PRESSURE CHART VALID TIME
10 AUG 82 SOME DATA MAY BE MISSING

TTAA 60121 71896 99936 00437 12003 00143 ///// ///// 85468 05661
23509 70016 07950 29008 50558 21157 34032 40718 33733 35039 30914
483// 35550 25032 569// 35058 20172 583// 35053 15355 543// 34534
10614 533// 35518 88220 605// 35061 77220 35061 4////;

TTAA 60121 71119 99926 01856 27004 00139 ///// ///// 85465 04062
31009 70003 09943 02511 50552 25963 31513 40710 37361 33514 30904
497// 09526 25021 549// 34523 20165 535// 30516 15350 531// 31016
10613 513// 27014 88243 555// 34520 77999;

TTAA 60121 71867 99985 02713 01006 00152 ///// ///// 85450 04756
35008 70978 06768 24009 50554 21359 24029 40714 34156 24039 30909
501// 23557 25026 563// 23578 20166 601// 24056 15349 535// 24527
10612 527// 25023 88235 599// 23577 77243 23579 4////;

TTAA 60121 71836 09029 00513 09005 00237 02911 10513 85533 00963
02507 70053 08363 29504 50561 21560 31533 40722 32960 32553 30918
479// 31554 25036 569// 31071 20176 577// 31042 15360 535// 29021
10621 527// 26509 88237 589// 31068 77248 31071 4////;

TTAA 60121 71826 99964 01733 03013 00246 ///// ///// 85/// 09907
03514 70031 10766 01018 50556 25166 01014 40715 34564 21532 30911
479// 20562 25029 549// 21057 20172 543// 22029 15358 523// 22516
10620 529// 25504 88233 563// 21047 77276 20562 4////;

TTAA 60121 72797 99012 07219 00000 00153 27441 33501 85475 038//
04008 70022 06966 06509 50557 21780 01547 40718 32580 02068 30915
477// 01078 25033 553// 00579 20175 549// 36061 15360 553// 01045
10618 555// 00520 88250 553// 00579 77272 01086 40808 51515 10164
00011 10194 34005 05508;

TTAA 60121 72785 99929 05059 05008 00100 ///// ///// 85443 02658
///12 70981 09350 01021 50551 25907 04015 40709 37756 10511 30901
529// 09514 25019 515// 04517 20164 509// 23514 15351 515// 01511
10613 523// 34004 88202 541// 08512 77999 51515 10164 00005 12194
05513 03013;

TTAA 60121 72775 99887 00027 36006 00141 ///// ///// 85455 02301
03011 70975 09902 04017 50552 23180 22517 40712 35561 22020 30905
527// 17525 25020 559// 17023 20163 535// 19023 15348 535// 18511
10610 517// 20010 88258 593// 16523 77999 51515 10164 00010 10194
02009 02515;

TTAA 60121 72768 99930 02823 03010 00105 ///// ///// 85421 01101
00507 70964 03303 18006 50555 20339 19015 40717 33180 19522 30911
499// 19553 25029 559// 19065 20170 555// 20527 15354 555// 21019
10615 513// 22020 88226 601// 19547 77268 18573 43022 51515 10164
00011 10194 02511 06508;

TTAA 60121 72747 99964 07803 16012 00051 ///// ///// 85388 07406
15519 70971 00716 20524 50559 15923 19022 40724 27556 20030 30924
443// 20541 25043 541// 23047 20183 663// 25054 15360 587// 26019
10619 547// 26015 88195 667// 25048 77210 25066 42341 51515 10164
00004 10194 14518 19023;

The following 20 observations are to be plootted on an AIRWAYS chart valid time 12 August 1982 at 1500Z. Some of the observations may contain missing or garbled data.

15Ø3
SAUM9 KAWN 1215ØØ

FOE SA 1345 1Ø SCT 7Ø SCT 12 75/69/16Ø6/994;
FRI SA 1455 12ØSCT 25Ø SCT 1Ø 126/8Ø/7Ø/1ØØ3/993/ 3Ø2 1Ø71;
IAB SA RTD 1455 25Ø -OVC 7 117/83/71/1412/992/ 8Ø2 1ØØ7;
OFF SA 1455 M4 OVC 1Ø 163/67/Ø9Ø5/ØØ2/ 114 16//;

AREA 1Ø
BLV SA 1455 12Ø SCT E1ØØ BKN 2ØØ OVC 5H 189/66/61/Ø6Ø2/ØØ9/ 11Ø 1577 WR//;
GVW SA 1455 M4 BKN 7 147/72/66/Ø9Ø5/999/ 3Ø7 16// WR//;
HOP SA 1455 12Ø SCT E25Ø OVC 7 188/69/58/ØØØØ/ØØ9/ 11Ø 1Ø77;
NQA RS 1455 M25 BKN 4Ø BKN 12Ø OVC 3H 173/77/68/11Ø6/ØØ5/ ØØ3 157/;
SZL SA 1455 M4 BKN 32 BKN 13Ø OVC 5F 15Ø/66/Ø6Ø7/999/4 BKN V SCT CIG RGD;
TBN SA 1455 M6 BKN 2Ø OVC 4H E152/65/61/15Ø8/ØØ1/ 8Ø2 18// WR//;

AREA 11
BYH SA 1455 M28 BKN 1ØØ OVC 23/4FH 176/72/71/13Ø4/ØØ5;

AREA 12
FFO SA 1455 25Ø SCT 12 211/69/53/Ø7Ø3/Ø17/ 5Ø5 1ØØ1;
FTK SA 1455 12Ø SCT E3ØØ BKN 7 199/68/54/Ø6Ø4/Ø12/ 3Ø2 1Ø38;
GUS SA 1455 12Ø -SCT 25Ø -SCT 1Ø 2Ø3/72/56/12Ø2/Ø14/ 8Ø3 1Ø31;
LCK SA 1457 25Ø -BKN 15 214/67/52/Ø4Ø4/Ø15/ 8Ø5 1ØØ1;

15Ø7
SAUM4 KAWN 1215ØØ
ALO SA 1451 M2: BKN 33OVC 7 18Ø/69/58/14Ø8/ØØ7;
CMI SA 1455 12Ø SCT 25Ø -BKN 1Ø 212/74/57/27Ø5/Ø17/ 1Ø8 1031;
IRK SA 1456 12Ø SCT E9Ø BKN 2ØØ BKN 4H 188/65/6Ø/1ØØ7/Ø1Ø/ 112 1577;
MLI SA 1449 M38 OVC 7 188/66/57/12Ø7/ØØ9;
ORD SA 1450 22Ø -SCT 9 2Ø2/67/56/ØØØØ/Ø13;

1239

THE FOLLOWING 30 OBSERVATIONS ARE TO BE PLOTTED ON A SYNOPTIC CHART VALID TIME 7 APRIL 1982 1200Z. SOME OF THE OBSERVATIONS MAY CONTAIN MISSING OR GARBLED DATA.

0712007
72747 32674 12507 10006 21039 39621 40054 53007 81500 333 10188
 20000;
72745 32674 12808 10011 21056 39567 40085 53012 81500 333 10122
 21206 70003;
72741 32566 82706 10050 20000 39523 40081 57003 8653/;
72734 11574 82503 10072 20050 39824 40088 52014 69901 70162 885//
 333 10217 20056 70018 90540;
72638 32566 83108 10089 20061 39678 40097 51017 885// 333 10261
 20089 70003;
71631 31958 81805 10/// 20109 39624 40106 52006 705//. 88070 333
 10270 20154 555 01095;
71628 32663 81204 10140 20073 39985 40121 53001 81181 333 10212
 20105;
72661 43/// /2202 10044 21006 40125;
72654 32966 833// 10044 21067 39650 40117 54000 86078 333 12206
 20028;
72658 32982 03006 10055 21020 39806 40113 52019 333 10119 20047
 70046;
72645 32974 72106 10067 20056 39837 40094 56003 82078 333 12206
 20056 70036;
72635 11463 82710 10106 20083 39822 40110 52008 69921 70282 885//
 333 10289 22106 70015 90521;
72528 32966 81706 10194 20078 39873 40126 53005 80007 333 10283
 20178;
72552 32974 12507 10044 20011 39465 40127 57005 81270 333 10189
 20039;
72546 32981 00000 10072 20039 39781 40131 53007 333 10133 20067
 70185;
72533 11240 82111 10172 20156 39804 40097 58007 68851 76162 885//
 333 10300 20172 70005 90525;
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 20133;

72344 32674 33006 10072 20056 30007 40175 53017 81501 333 10222
22067 70043;
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333 10233 20106 70262 90512;
72334 11263 83211 10178 20161 30026 40127 52014 60131 76182 887//
333 10272 20178 70160 90542;
72324 32661 82303 10165 20109 39919 40162 56002 81577 333 10284
20143;
72248 11461 23008 10128 20111 30061 40153 53003 69901 70286 84500
333 10250 20128 70234 90544;

1241

Technical Training

Aerographer's Mate (C-420-2010-A1)

OCEANIC CIRCULATION

14 September 1977

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3360 Technical Training Group
Chanute Air Force Base, Illinois

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PROGRAMMED INSTRUCTION

OCEANIC CIRCULATION

Naval Air Technical Training Command

CNATT–L129 PAT

FOR U.S. NAVY TRAINING PURPOSES ONLY

OCEANIC CIRCULATION

INSTRUCTIONS

This booklet contains a programmed lesson on the oceanic circulation and was designed and developed to allow you to progress through the subject matter at your own speed. It is written in a linear format; that is, you will work through the program from "frame" to succeeding "frame."

Be sure you read the program objectives on page ii very carefully before beginning to work, and keep them in mind as you work through the program. Complete each frame in the program. Use your answer cover sheet to keep the desired responses (to the left of succeeding frame) covered until you have made your response to a particular frame. As you make the required responses in each frame, check them to be sure they are correct. If you make an error, feel free to turn back into the program and review until the point is clarified. If you become confused, or if there is some material which you do not understand, ask the instructor for assistance.

After you have read the objectives on page ii and the introduction on page iii, turn to frame 1 on page 1 and begin the program. Follow all directions explicitly, and read and work at your own pace, but steadily and diligently.

SUGGESTED READING TIME 43 MINUTES

NAME ______________________ CLASS ______________________

OCEANIC CIRCULATION

OBJECTIVES

Upon completion of this program, the student will be able to:

1. State where all sea water acquires its basic characteristics.
2. Match the terms WATER TYPE and WATER MASS with their definitions.
3. Match the four different water masses found vertically in the ocean with the thermal layer with which each is generally associated.
4. Match the three important water masses found horizontally in the ocean with their source regions.
5. Draw and label a diagram to illustrate:

   a. Surface convergence and its resulting vertical motion.

   b. Surface divergence and its resulting vertical motion.

   Each diagram must be labeled with the correct term for the vertical motion illustrated.
6. Identify a statement that explains the basic circulation pattern of the deep ocean.
7. Write the definition of an ocean current.
8. Match the terms SET and DRIFT with their definitions.
9. Identify true statements containing surface-current characteristics.
10. List the most important current system in the North Atlantic and North Pacific Oceans.

OCEANIC CIRCULATION

INTRODUCTION

One of the most important concepts ever contributed to the science of meteorology was Bjerknes' "air-mass theory." By classifying large masses of air in the atmosphere as to temperature, humidity, and source region, and by following the migration of these masses and noting the resulting modification to them, it is possible to determine the type of weather that each will produce.

In recent years, oceanographers have found it desirable to classify masses of water, by a similar system, and track them. Using this concept, it is possible to determine the changes that will occur in the properties of the water mass.

With this knowledge, the type of water that will be in a particular area, the thermal structure of the water mass, and, therefore, the degree of favorability of the water mass for antisubmarine warfare operations may be determined.

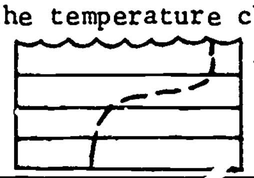
In this programmed lesson, you will be introduced to some of the basic aspects of oceanic circulation.

	1. To aid you in understanding the formation and circulation of water types and masses, one important fact must be kept in mind: ALL SEA WATERS RECEIVE THEIR BASIC CHARACTERISTICS WHEN THEY ARE AT THE SURFACE AND IN CONTACT WITH THE ATMOSPHERE. Stated another way, the density characteristics (stability condition based on temperature and salinity) of a particular water type or mass are determined by the characteristics of the ________ in the region in which the water type or mass is formed.
atmosphere (air)	2. Oceanic water under a cold air mass experiences continued evaporation which results in a water mass of high salinity. In regions of copious precipitation, the water mass will be less saline as a result of dilution by the pure precipitation. The basic characteristics, and changes thereto, of a given mass of sea water are determined when the water is at the ________ and in contact with the ________.
surface atmosphere	3. Complete the statement below: All sea waters receive their basic characteristics when ________________________.

at the surface and in contact with the atmosphere.	4. Using your own words, write a statement that describes where all sea water acquires its basic characteristics. ____ ____ (For answer, see frame 1.)
	5. The terms "WATER TYPE" and "WATER MASS," mentioned earlier, can now be defined. In regions where the atmospheric conditions are constant, or nearly so, <u>WATER TYPES</u> are formed. A water type is a volume of water having a single value of temperature and a single value of salinity associated with it. A water type has __________ value for temperature and __________ value for salinity.
one one	6. A volume of water with a single value of temperature and a single value of salinity is termed a water ______________.
type	7. There are a few distinct water types that do persist, such as Mediterranean Water and Antarctic Bottom Water, both of which have unique and singular values of temperature and salinity associated with them. However, nearly all water types exist for only short periods of time after they are formed, since mixing begins almost immediately. It is is mixing of several water types that produces a <u>WATER MASS</u>. NO RESPONSE.

	8. A water mass has a <u>range</u> of temperature and salinity values, the range of values for each being dependent upon the values of the individual water types mixed together to form the water mass. A water mass differs from a water type in that a water mass has a ______________ of temperature and salinity values, whereas a water type has ____________ value for temperature and ____________ value for salinity.
range one one	9. A large volume of water with a range of temperature and salinity values would be termed a water ____________________.
mass	10. Match the terms below with their definitions. _____ Water type _____ Water mass a. Has one value for temperature and a wide range of values for salinity. b. Has a range of values for temperature and salinity. c. Has a wide temperature range but only one value for salinity. d. Has one value for temperature and one value for salinity.

d Wáter type b Water mass	11. There are four important water masses found vertically in the ocean. These water masses closely correspond with the different thermal layers which you learned previously. The upper water mass is found closest to the surface and, for the most part, comprises the mixed layer. Just below the upper water mass is found the intermediate water mass. This water mass has a much larger range of temperature and salinity values than the upper water mass, because temperature decreases rapidly through this water mass. From this, we know that the intermediate water mass corresponds closely with the __________ ____________________ layer.
main thermocline	12. The remaining two water masses found vertically in the ocean are the deep water mass and the bottom water mass. These two water masses correspond with the deep layer of the ocean where temperatures are very cold, and the water is quite dense. The bottom water mass is actually a part of the deep water layer and is present in the deeper areas of the oceans. On the vertical cross section of the ocean below, label the four different water masses. The dashed line represents the temperature characteristics of each layer.



a. ____________
b. ____________
c. ____________
d. ____________

a. Upper

b. Interme-diate

c. Deep

d. Bottom

13. Match the four different water masses in column A below with the thermal layer in column B with which each is generally associated.

A	B
_____ Upper water	a. Main thermocline layer
_____ Intermediate water	b. Deep layer
_____ Deep water	c. Mixed layer
_____ Bottom water	

c Upper

a Interme-diate

b Deep

14. In addition to the four important water masses found vertically in the ocean, there are three important water masses found horizontally in the ocean with which you must be familiar. The first of these three is the North Atlantic Deep and Bottom Water mass. This water mass is formed in the Labrador Sea, in the region between Iceland and the southern part of Greenland. Surface waters in this area are cooled, and their density is increased until the water sinks to become the North Atlantic ____________ and ____________ Water mass.

Deep

Bottom

15. A major source region for North Atlantic Deep and Bottom Water is the ________________ Sea.

Labrador	16. Another important water mass which can be identified in the sea is the <u>Central Water</u> mass. Central Water is formed in the North and the South Atlantic and the North and the South Pacific in the areas of the corresponding semipermanent high-pressure areas. Atmospheric conditions in the regions of these high-pressure areas are quite stable, thus allowing central water to form. Central Water masses form in the regions of the semipermanent high-/low-pressure systems. (Circle one.)
high	17. The third important water mass is the Antarctic Deep and Bottom Water mass. This water mass is formed in the Antarctic Ocean, completely surrounding the Antarctic Continent. A special area of interest for formation of this water mass is the Weddell Sea. In this Antarctic region, surface water is cooled to very low temperatures, and ice formation increases salinity. These two factors result in a very dense, heavy water which sinks to the ocean floor as ________________ Deep and Bottom Water.
Antarctic	18. An important source region for North Atlantic Deep and Bottom Water is in the ____________ Sea; an important source region for Antarctic Deep and Bottom Water is in the ________________ Sea.

Labrador

Weddell

19. Match the three important water masses listed in column A below with their source regions in column B.

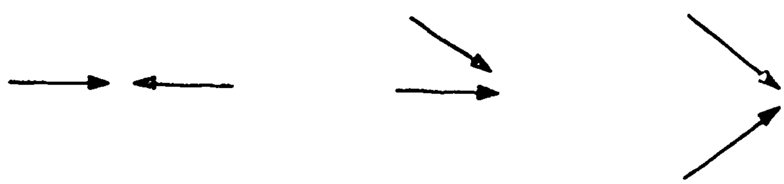
A	B
___North Atlantic Deep and Bottom Water	a. Formed in the Weddell Sea over the continental shelf.
___Central Water	b. Formed in the Labrador Sea and in the region between Iceland and Greenland.
___Antarctic Deep and Bottom Water	c. Formed in the Gulf of Mexico and transported into the Atlantic by the Gulf Stream Current.
	d. Formed in the North and South Atlantic and the North and South Pacific in the areas of the corresponding high-pressure areas.

b

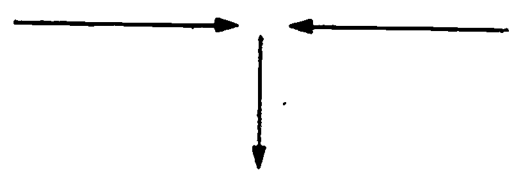
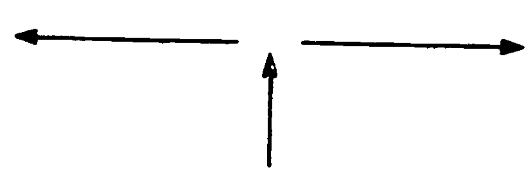
d

a

20. In addition to those water masses formed as a result of sinking because of density differentials, there are other water masses formed by mixing resulting from mechanical means. Tides, currents, and winds all cause water masses to mix, move together, or move apart. CONVERGENCE occurs in a region where two or more water volumes tend to move together. The flows need not be directly opposed in order for convergence to occur. Examine the arrows below.



Each of these diagrams indicates a net inflow, and in each case, ______________ is occurring.

convergence	21. Convergence results in a "piling up" of water and, as a result, sets in motion downward vertical water currents called SINKING. This motion is illustrated below.  In the diagram above: a. The horizontal arrows illustrate ____________. b. The vertical arrow illustrates ____________.
a. convergence b. sinking	22. In a region where two or more water volumes tend to move together, ____________ is occurring. This moving together will create downward vertical motion which is termed ______________.
convergence sinking	23. When two water volumes tend to move apart, an area of DIVERGENCE is formed. Since this separation requires a volume replacement, replacement is provided from below. This rising water motion is called UPWELLING and occurs whenever there is divergence occurring. Examine the diagram below.  In the diagram above: a. The horizontal arrows illustrate ____________. b. The vertical arrow illustrates ____________.

a. divergence

b. upwelling

24. Match the terms convergence and divergence with the vertical motion with which each is associated.

_____ Convergence   a. Upwelling

_____ Divergence   b. Convection

c. Sinking

d. Advection

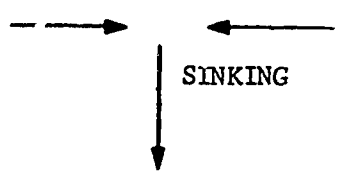
c Convergence

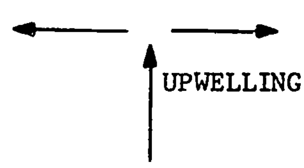
a Divergence

25. In space A below, draw and label a diagram to illustrate surface convergence in the ocean and its resulting vertical water motion; in space B below, draw and label a diagram to illustrate surface divergence and its resulting vertical water motion. <u>In each case, use the correct term when labelling the vertical motion.</u>

A	B

Answer to frame 25.





	26. In addition to those localized areas where water masses or currents flow together or apart, there is a distinct circulation pattern in the deep ocean. All oceans show a general circulation pattern of <u>deep water flowing toward the equator</u> and <u>surface water flowing toward the poles</u>. This circulation pattern is a factor in transporting heat to high latitudes. Surface water, warmed near the equator, migrates poleward where it gives up its heat to the atmosphere, then sinks and migrates equatorward along the ocean bottom. In general, all oceans show a circulation pattern of deep water flowing ______________ and surface water flowing ________________.
equatorward poleward	27. Match the terms <u>deep water</u> and <u>surface water</u> with their respective direction of flow in the general circulation pattern of the oceans. _____ Deep water _____ Surface water a. Flows poleward. b. Flows equatorward. c. Flows eastward. d. Flows westward.
b Deep water a Surface water	28. Write a statement on the lines below that explains the basic circulation pattern of the deep oceans. ____________________________________ ____________________________________ (For answer, see frame 26.)

29. Place an "X" beside the statement below that best describes the general circulation pattern of the deep oceans.

_________ a. In general, surface water flows toward the equator, and deep water flows toward the poles.

_________ b. In general, surface water flows from north to south, while deep water flows from south to north.

_________ c. In general, surface water flows poleward, and deep water flows equatorward.

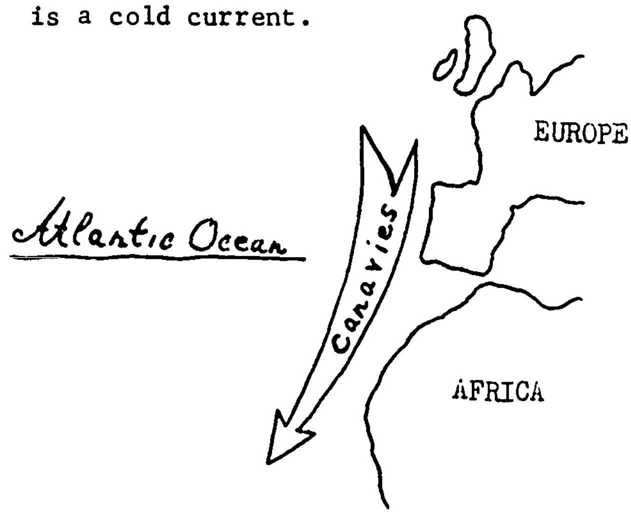
_X_ c.	30. Maury once wrote: "There is a river in the ocean. In the severest droughts, it never fails, and in the mightiest floods, it never overflows. It flows more rapidly than the Mississippi or the Amazon, and its volume is more than a thousand times greater." Maury was referring, of course, to the Gulf Stream Current System. Research since Maury's day has proven that he could have safely written: There are numerous rivers in the oceans. These rivers are the many different currents found throughout the world oceans. An ocean current is an organized belt of water in horizontal motion. The primary factor in defining an ocean current is that this belt or band of water in motion, regardless of velocity, must show _____________________.
organization	31. An organized belt of water in horizontal motion is the definition of an ocean ____________________.
current	32. An ocean current has not only length and width dimensions but also extends to some depth vertically in the ocean. An ocean current is an ____________ belt of water in horizontal ________________.
organized motion	33. On the lines below, write the definition of an ocean current. ____ ____ (For answer, see frame 30.)

	34. The speed of ocean currents is usually measured in knots and is referred to as current DRIFT. A current moving at 3 knots has a ____________ of 3 knots.
drift	35. The direction of an ocean current is the direction <u>toward</u> which it is flowing and is referred to as current SET. A current flowing toward the west ______________ westward.
sets	36. If a current off the California coast is flowing from the north at a speed of 2 knots, we can say that this current sets ________________ at a ________________ of 2 knots.
southward drift	37. Match the terms below with their definitions. _____ Set _____ Drift a. The speed of flow of a current. b. The relative absence of motion beneath the sea surface. c. The speed and direction of current flow. d. The direction toward which a current is flowing.

__d__ Set	38. Ocean currents are the manifestations of prevailing wind systems -- that is, currents generally follow the direction of the semipermanent wind systems. Winds about the subtropical high-pressure system over the Atlantic Ocean blow clockwise with a current system that generally flows clockwise. In this system of the North Atlantic Ocean, warm currents set northward along the east coast of the United States, while cold currents set southward along the west coasts of Europe and North Africa. An example of an Atlantic Ocean warm current is the well-known GULF STREAM Current.
__a__ Drift	

The warm Gulf Stream Current System sets

______________________.

northward	39. The CANARIES Current in the eastern Atlantic Ocean is a cold current.  The cold Canaries Current sets ______________.
southward	40. The Pacific Ocean is very similar to the Atlantic in that the currents also generally flow clockwise--warm currents set northward, and cold currents set southward. The Pacific Ocean counterpart of the Gulf Stream is the KUROSHIO Current. The Kuroshio Current is a warm current that flows off the coast of Japan. Since it is a warm current, we know that it must set ______________________.
northward	41. An example of a Pacific Ocean cold current is the CALIFORNIA Current found off the west coast of the United States. Since the California is a cold current, we know that it must set ______________.

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southward	42. As a result of the change in wind-flow patterns in the Southern Hemisphere, Southern-Hemisphere directions of flow are the reverse of Northern-Hemisphere flows. We can generalize, though, by saying that, in both hemispheres, warm currents set ____________, and cold currents set ____________.
poleward equatorward	43. We can summarize the material presented in the last several frames by completing the statements below. a. Surface-current systems generally follow the direction of the semipermanent ________ systems. b. As a general rule, at middle and low latitudes, warm currents set ____________, and cold currents set ____________. c. In middle and low latitudes, warm currents are usually found near the __________ coast of continents, while cold currents are usually found near the ________ coast of continents. d. As a result of the Bermuda (North Atlantic) semi-permanent high-pressure cell, the current system of the North Atlantic Ocean flows generally in a ____________ direction.

a. wind b. poleward equatorward c. east west d. clockwise	44. There are numerous small-scale deviations from the general circulation pattern; some of the local currents that do not follow the major currents are quite important. These minor currents deviate considerably from the general atmospheric flow patterns and depend upon various oceanic characteristics for their existence. An example of such a current is a tidal current which is set in motion by the interaction of tidal movement and bottom topography. NO RESPONSE.
	45. One of the major current systems that changes set with seasonal variations is the Indian Ocean System where changing seasonal monsoon winds cause seasonal changes in the set of this current system. During the northeast monsoon, prolonged northeasterly winds over the Indian Ocean cause the current system to set ____________________.
southwesterly	46. With the coming of the southwest monsoon season, prolonged southwesterly flow causes the current system to set ________________________.
northeasterly	47. Seasonal monsoon winds result in variations in the set of the current system in the _________________ Ocean.

Indian	48. Place an "X" on the line beside each statement below which contains a true surface-current characteristic.

_____a. Surface-current systems generally follow the direction of the semipermanent wind systems.

_____b. As a result of the Bermuda high, the current system of the North Atlantic Ocean flows generally counterclockwise.

_____c. As a general rule, at middle and low latitudes, warm currents set poleward, and cold currents set equatorward.

_____d. In middle and low latitudes, warm currents are usually found near the west coast of continents, while cold currents are usually found near the east coast of continents.

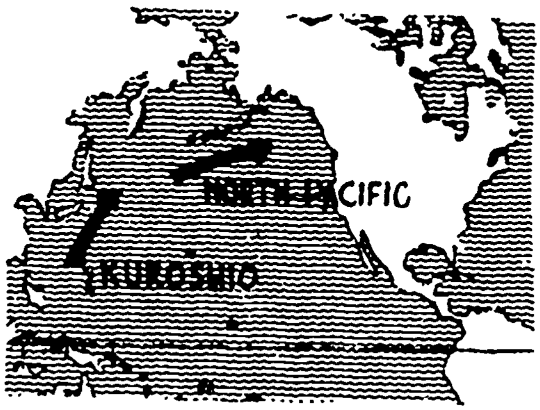
_____e. There are numerous minor currents in the oceans that deviate considerably from the general atmospheric flow patterns and depend upon various oceanic characteristics for their existence.

_____f. Variations in the current system in the Indian Ocean are a result of the seasonal monsoon winds.

X	a.
___	b.
X	c.
___	d.
X	e.
X	f.

49. There are two major current systems in the Northern Hemisphere with which you should be familiar. These current systems are each comprised of several individual ocean currents. In the North Atlantic Ocean, the most important current system is the GULF STREAM SYSTEM. This system is made up of three different currents: the Florida Current, the Gulf Stream Current, and the North Atlantic Current. These three currents are located on the diagram below. Examine it carefully.

The three individual currents in the diagram make up the most important current system in the North Atlantic Ocean, which is the ________ ________ System.

Gulf Stream	50. The other important current system is located in the North Pacific Ocean and is labeled the <u>KUROSHIO</u> System. This system is comprised of two individual currents: the Kuroshio Current and the North Pacific Current. These currents are shown on the diagram below. Examine it carefully.  The two individual currents in the diagram above make up the most important current system in the North Pacific Ocean, which is the ______________ System.
Kuroshio	51. Complete the statements below. a. The most important current system in the North Atlantic Ocean is the ____________ ____________ ________ System. b. The most important current system in the North Pacific Ocean is the ______________ System.

Gulf Stream

Kuroshio

This completes this program on oceanic circulation. Before taking the self-test, reread the program objectives and be sure you can accomplish each one. Review unclear areas in the program. When you are certain that you have mastered each objective, attempt the self-test.

OCEANIC CIRCULATION

SELF-TEST

1. On the lines below, and using your own words, write a statement that describes where all sea water acquires its basic characteristics. (frame 1)

____

____

2. Match the terms below with their definitions. (frame 5)

_______ Water type

_______ Water mass

a. Has one value for temperature and a wide range of values for salinity.

b. Has a range of values for temperature and salinity.

c. Has a wide temperature range but only one value for salinity.

d. Has one value for temperature and one value for salinity.

3. Match the four different water masses in column A below with the thermal layer in column B with which each is generally associated. (frame 11)

A	B
______ Upper water	a. Main thermocline layer
______ Intermediate water	b. Deep layer
______ Deep water	c. Mixed layer
______ Bottom water	

4. Match the three important water masses listed in column A below with their source regions in column B.
(frame 14)

A	B
_____ North Atlantic Deep and Bottom Water	a. Formed in the Weddell Sea area and around the South Pole.
_____ Central Water	b. Formed in the Labrador Sea and in the extreme North Atlantic.
_____ Antarctic Deep and Bottom Water	c. Formed in the North and South Atlantic and the North and South Pacific in the areas of the corresponding high-pressure areas.
	d. Formed only in the central Atlantic Ocean.

5. In space A below, draw and label a diagram to illustrate surface convergence in the ocean and its resulting vertical water motion; in space B below, draw and label a diagram to illustrate surface divergence and its resulting vertical water motion. <u>In each case, use the correct term when labelling the vertical motion.</u>
(frame 20)

A	B

6. Place an "X" beside the statement below that best describes the general circulation pattern of the deep oceans.
(frame 26)

_____ a. In general, surface water flows from north to south, while deep water flows from south to north.

_____ b. In general, surface water flows poleward, and deep water flows equatorward.

_____ c. In general, surface water flows toward the equator, and deep water flows toward the poles.

7. On the lines below, write the definition of an ocean current.
(frame 30)

____

____

8. Match the terms below with their definitions.
(frame 34)

_____ Set	a. The speed of flow of a current.
_____ Drift	b. The relative absence of motion beneath the sea surface.
	c. The speed and direction of current flow.
	d. The direction of flow of a current.

9. Place an "X" on the line beside each statement below which contains a true surface-current characteristic.
(frame 38)

_____ a. Surface-current systems generally follow the direction of the semipermanent wind systems.

_____ b. As a result of the Bermuda high, the current system of the North Atlantic Ocean flows generally counterclockwise.

_____ c. As a general rule, at middle and low latitudes, warm currents flow poleward, and cold currents flow equatorward.

_____ d. In middle and low latitudes, warm currents are usually found near the west coast of continents, while cold currents are usually found near the east coast of continents.

_____ e. There are numerous minor currents in the oceans that deviate considerably from the general atmospheric flow patterns and depend upon various oceanic characteristics for their existence.

_____ f. Variations in the current system in the Indian Ocean are a result of the seasonal monsoon winds.

10. Complete the statements below.
(frame 49)

a. The most important current system in the North Atlantic Ocean is the ______________ ____________________ System.

b. The most important current system in the North Pacific Ocean is the ____________________ System.

OCEANIC CIRCULATION

ANSWERS TO SELF-TEST

1. All sea water acquires its basic characteristics when at the surface and in contact with the atmosphere. (Reasonable facsimile.)

2. d Water type

   b Water mass

3. c Upper water

   a Intermediate water

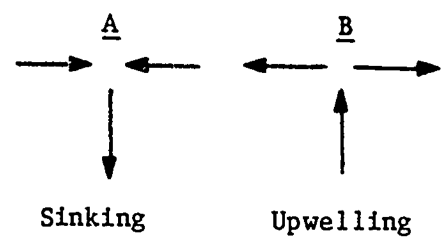
   b Deep water

   b Bottom water

4. b North Atlantic Deep and Bottom Water

   c Central Water

   a Antarctic Deep and Bottom Water

5. 

6. X b.

7. An ocean current is an organized belt of water in horizontal motion.

8. d Set

   a Drift

9. X a.

   X c.

   X e.

   X f.

10. a. Gulf Stream

    b. Kuroshio

WORKBOOK

C3ABR25130-WB-104
C3ABR25130-1-WB-104
C3ABR25130-2-WB-104

Technical Training

Weather Specialist
Aerographer's Mate
Meteorological Observations

SKY CONDITION

10 February 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE
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Weather Training Branch
Chanute AFB, Illinois

C3ABR25130-WB-104
C3ABR25130-1-WB-104
C3ABR25130-2-WB-104

SKY CONDITION

4. Sky Condition

a. Without reference, select those facts which relate to sky condition and clouds to a minimum of 75% accuracy.

b. Given the FMH-1B, weather scenarios, and handout, encode the required sky condition entries on an AWS Form 10 to a minimum of 80% accuracy.

Supersedes C3ABR25130-WB-104, C3ABR25130-1-WB-104, C3ABR25130-2-WB-104, 23 July 1983.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 900; DAV - 1

Exercise 1

Complete the following definitions by placing the correct word or phrase in the space provided.

1. ______________ is defined as the appearance of the sky in reference to sky cover by clouds and obscuring phenomena.

2. ______________ is defined as clouds and/or obscuring phenomena with bases at approximately the same level.

3. The amount of sky covered at and below a given level is the ______________.

4. A layer aloft that is more than one-half opaque is considered to be an ______________.

5. A layer aloft that is one-half or less opaque is considered to be a ______________.

6. The height, in feet, of the base of a layer above the surface, to include vertical visibility, is known as the ______________.

7. ______________ is a term used to reflect the degree of cloudiness or sky coverage in sky condition evaluations.

8. Using the sky coverage described, enter the correct sky cover contraction for each of the following:

   ______________ The absence of layers of clouds or other obscuring phenomena.

   ______________ A layer amount of a trace through 5/10.

   ______________ A layer amount of 6/10 through less than 10/10.

   ______________ A layer amount of 10/10 coverage.

   ______________ A condition in which surface based obscuring phenomena is hiding 10/10 of the sky.

   ______________ A condition in which surface based obscuring phenomena is hiding at least 1/10, but less than 10/10 of the sky.

9. A sky condition that has varied between reportable classifications during the period of observation is known as a ______________.

10. The height ascribed to the lowest broken or overcast layer aloft which is predominantly opaque or the vertical visibility into a surface based obscuration best describes the _______________.

11. A designation of the ceiling layer to indicate the relative degree of accuracy of the reported height is called _______ ________.

12. A ceiling height for a layer aloft that was determined by a ceiling light and clinometer, a ceilometer or the known height of a fixed object within 1½ nautical miles of the airfield is classified as _______________. (M)

13. A ceiling height for a layer aloft that was determined by any method not specified as measured is classified as _______________. (E)

14. A ceiling height that is identified as the vertical visibility into a surface based obscuration is classified as _______________. (W)

15. A _______________ is a condition when the ceiling height is rapidly increasing and decreasing by one or more reportable values during the period of observation.

1277

Exercise 2

Convert the following heights to reportable values and the encoded values that would be entered in column 3 of the Form 10.

	REPORTABLE VALUE	ENCODED VALUE
1. 75		
2. 275		
3. 850		
4. 2,750		
5. 9,500		
6. 23,250		
7. 38,000		
8. 100		
9. 5,250		
10. 44,500		
11. 750		
12. 3,625		
13. 425		
14. 18,600		
15. 6,500		
16. 9,750		
17. 47		
18. 860		
19. 7,750		
20. 23,450		
21. 41,000		
22. 3,975		

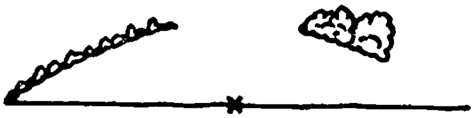
Exercise 3

Determine the reportable height and sky cover contractions for the following problems.

PROBLEM 1

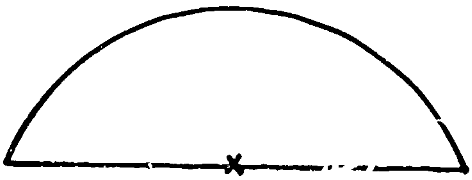
3/10 SC at 4,600'.

2/10 CU at 4,600'.



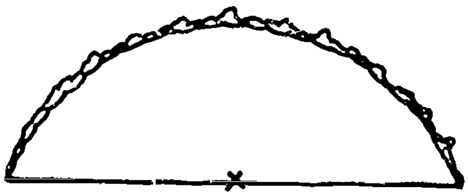
PROBLEM 2

10/10 ST at 5,200'.



PROBLEM 3

10/10 SC at 4,950'.

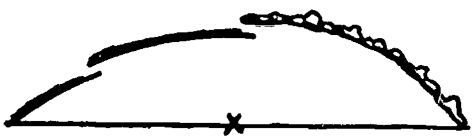


PROBLEM 4

2/10 ST at 1,175'.

3/10 NS at 1,210'.

5/10 SC at 1,250'.



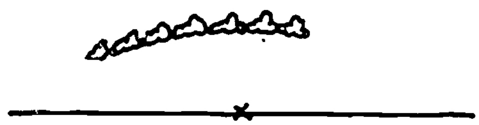
1279

PROBLEM 5

No clouds or obscuring phenomena are present.

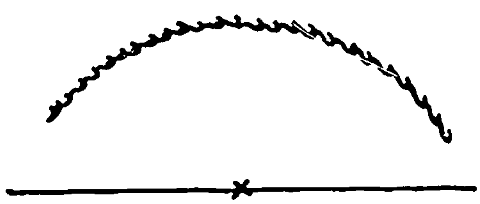
PROBLEM 6

4/10 CUFRA at 6,250'.



PROBLEM 7

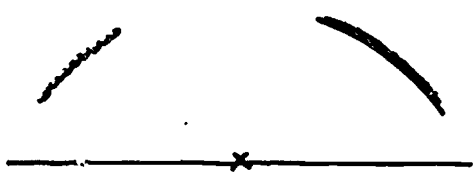
8/10 CC at 34,450'.



PROBLEM 8

1/10 CI at 26,600'

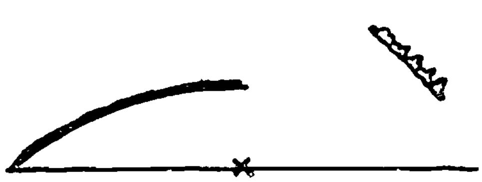
2/10 CS at 27,250'.



PROBLEM 9

5/10 AS at 8,350'.

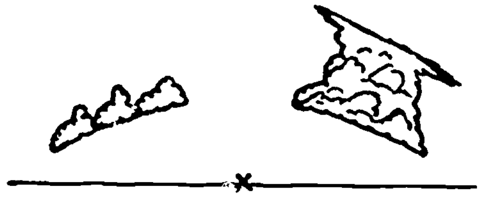
2/10 AC at 8,600'.



PROBLEM 10

3/10 CU at 2,960'.

3/10 CB at 2,970'.

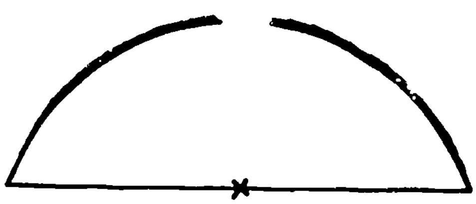


PROBLEM 11

The sky is clear.

PROBLEM 12

10/10 CS at 27,500'.
There is a small break in the layer north of the station.



1281

Exercise 4

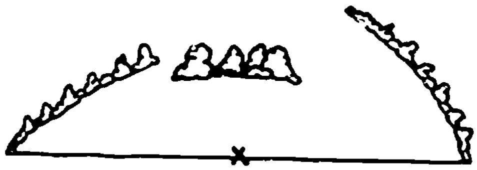
For the following problems, determine the reportable heights and sky cover contractions for each layer (column 3), and the total amount of sky cover (column 21).

PROBLEM 1

2/10 CU at 1,560'.

4/10 SC at 2,540'.

4/10 AC at 8,750'.



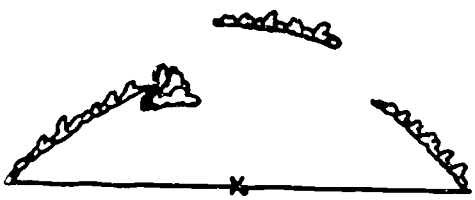
PROBLEM 2

1/10 CU at 1,000'.

3/10 SC at 3,600'.

2/10 AC at 8,900'.

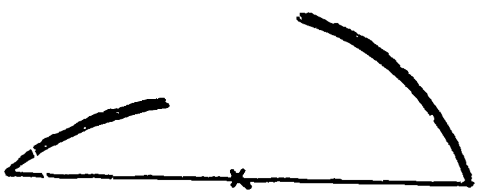
2/10 CS at 27,200'.



PROBLEM 3

3/10 ST at 900'.

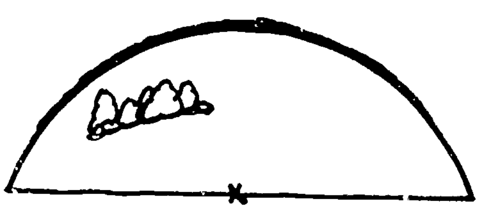
4/10 CS at 29,000'.



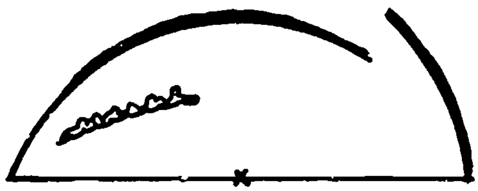
PROBLEM 4

3/10 CU at 1,500'.

10/10 AS at 8,700'.



PROBLEM 5

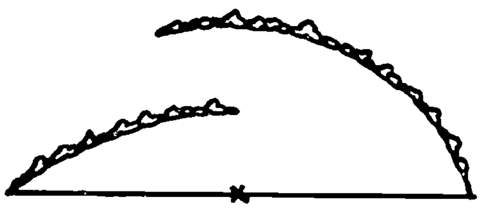


3/10 SC at 2,700'.

7/10 AS at 9,300'.

3/10 CS at 21,000'.

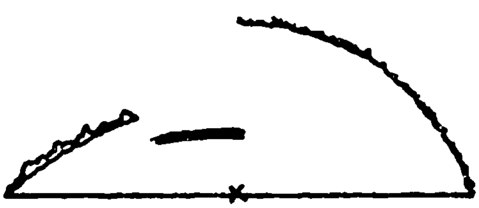
PROBLEM 6



5/10 SC at 1,950'.

7/10 AC at 8,950'.

PROBLEM 7



2/10 ST at 1,200'.

3/10 SC at 4,300'.

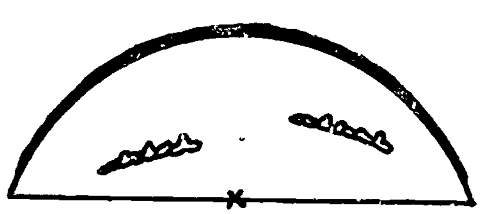
5/10 CI at 24,000'.

PROBLEM 8

a TRACE of CU at 900'.

2/10 CI at 28,000'.

PROBLEM 9



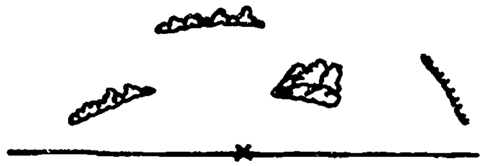
2/10 SC at 1,500'.

2/10 AC at 8,500'.

10/10 CS at 21,500'.

1283

PROBLEM 10



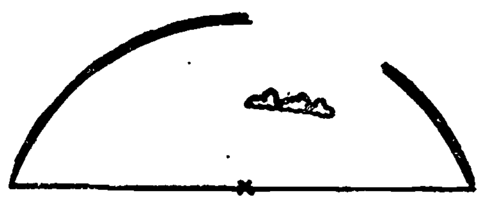
2/10 CU at 1,700'.

2/10 SC at 4,700'.

2/10 AC at 9,700'.

2/10 CI at 27,000'.

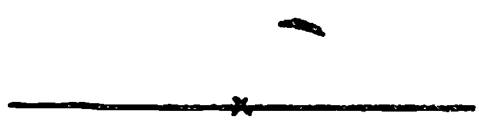
PROBLEM 11



1/10 CUFRA at 700'.

9/10 NS at 1,700'.

PROBLEM 12



a TRACE of SMOKE at 1,100'.

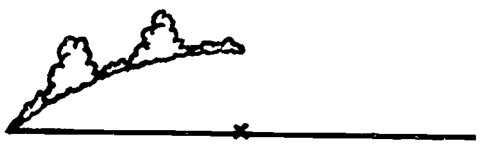
Exercise 5

For the following problems determine the reportable height and sky cover contractions for each layer (column 3) and the total amount of sky cover (column 21). All clouds are considered to be opaque unless stated otherwise.

PROBLEM 1

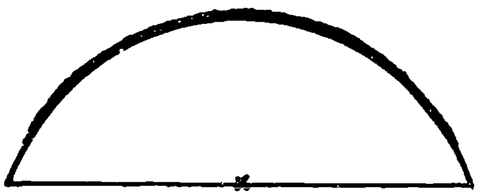
3/10 SC at 4,575'.

2/10 CU at 4,575'.



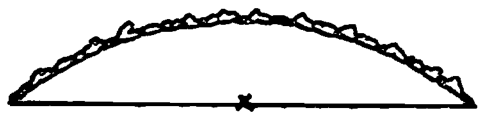
PROBLEM 2

10/10 ST (4/10 opaque) at 5,240'.



PROBLEM 3

10/10 SC (4/10 thin) at 4,950'.



PROBLEM 4

6/10 ST (2/10 thin) at 1,175'.

3/10 SC (1/10 thin) at 3,990'.

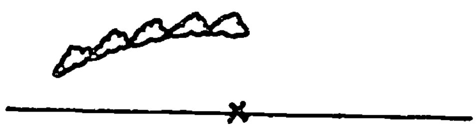
1285

PROBLEM 5

No clouds are present.

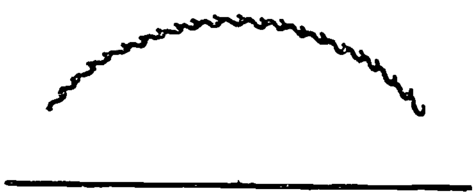
PROBLEM 6

4/10 CUFRA at 6,250'.



PROBLEM 7

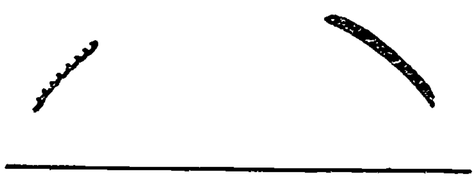
7/10 CC at 34,450'.



PROBLEM 8

1/10 CI (all opaque) at 26,600'.

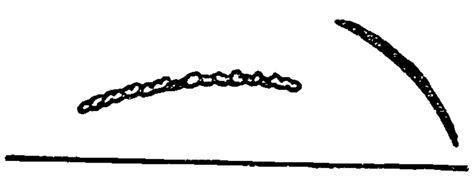
2/10 CS (all thin) at 27,250'.



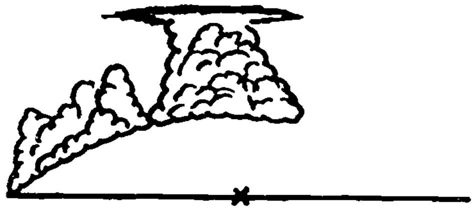
PROBLEM 9

6/10 AC (2/10 thin) at 8,350'.

3/10 CS (3/10 thin) at 19,975'.



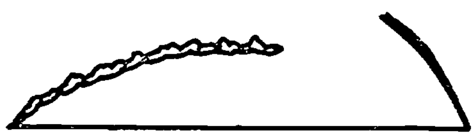
PROBLEM 10



3/10 CU at 2,960'.

3/10 CB at 3,020'.

PROBLEM 11



6/10 AC (2/10 thin) at 8,350'.

3/10 AS (3/10 thin) at 9,275'.

PROBLEM 12

8/10 AS (5/10 thin) at 7,925'.

PROBLEM 13

2/10 AS (1/10 thin) at 8,350'.

2/10 AC (2/10 opaque) at 8,680'.

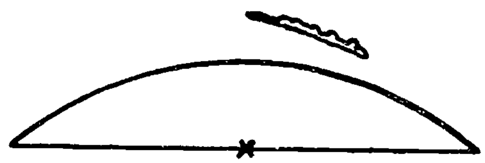
PROBLEM 14

2/10 CU at 1,950'.

4/10 SC at 3,765'.

1287

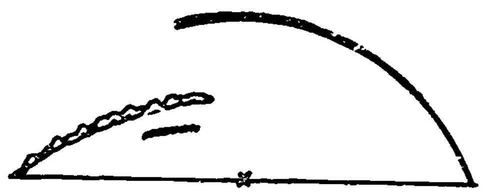
PROBLEM 15



10/10 ST (all thin) at 975'.

2/10 SC at 3,000'.

PROBLEM 16

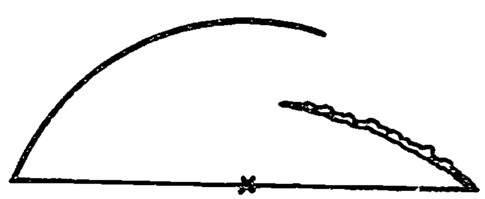


1/10 STFRA at 375'.

4/10 SC (all thin) at 3,980'.

6/10 AS (1/10 thin) at 8,325'.

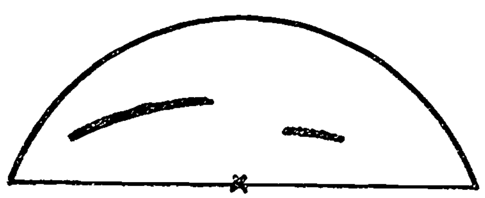
PROBLEM 17



4/10 AC at 7,300'.

6/10 AS at 13,575'.

PROBLEM 18



1/10 ST at 1,470'.

3/10 AS at 10,505'.

10/10 CS (4/10 thin) at 30,720'.

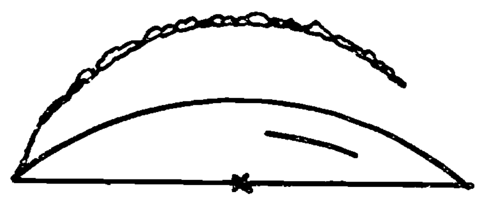
PROBLEM 19

2/10 CU at 3,578'.

10/10 AS (all thin) at 9,275'.

2/10 CS (all thin) at 26,508'.

PROBLEM 20



2/10 ST (1/10 th..n) at 2,275'.

10/10 AS (all thin) at 8,192'.

8/10 AC (all opaque) at 11,800'.

Exercise 6

Determine the height of layers aloft and the vertical visibility into total obscurations, using the data provided.

10 Gram Balloon

TYPE	FADE TIME	DISAPPEAR TIME	REPORTABLE HEIGHT
1. Layer aloft	1:09	1:23	______
2. Layer aloft	2:17	3:04	______
3. Total obscuration	0:18	0:53	______
4. Total obscuration	0:40	1:07	______

30 Gram Balloon

TYPE	FADE TIME	DISAPPEAR TIME	REPORTABLE HEIGHT
1 Layer aloft	1:19	2:01	______
2. Layer aloft	2:37	3:19	______
3. Total obscuration	0:18	0:27	______
4. Total obscuration	0:40	1:10	______

Exercise 7

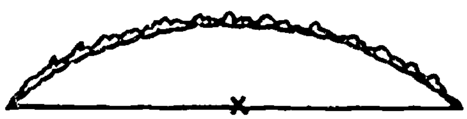
Each of the following problems has three consecutive angular readings from the clinometer (800' baseline). Convert the angles to reportable height values for each problem.

1. 77, 79, 76	6. 80, 78, 80
2. 31, 28, 29	7. 63, 62, 65
3. 56, 56, 54	8. 45, 48, 47
4. 19, 21, 20	9. 13, 11, 14
5. 16, 17, 17	10. 28, 30, 29

Exercise 8

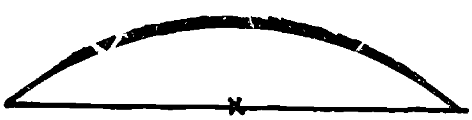
For the following problems, determine the correct entries for columns 3 and 21 of the Form 10. All clouds are opaque unless stated otherwise.

PROBLEM 1



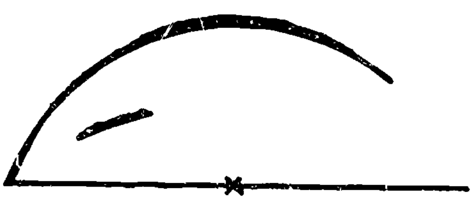
10/10 SC. Angular readings on the clinometer were 77, 79, and 76 degrees.

PROBLEM 2



10/10 ST. The following consecutive readings were taken on the clinometer, 31, 28, and 29 degrees.

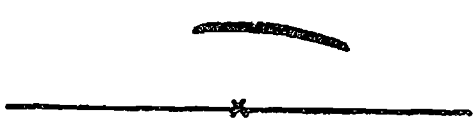
PROBLEM 3



1/10 STFRA (all thin) at 185'.

8/10 ST (2/10 thin). The clinometer readings are 56, 54, and 56 degrees.

PROBLEM 4

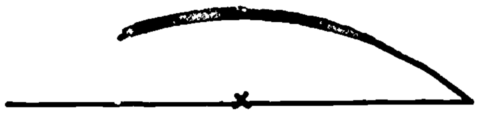


3/10 ST (2/10 thin). The ceiling light projector indicated angles of 19, 21, and 20 degrees.

1291

PROBLEM 5

8/10 ST (4/10 thin). The angles on the clinometer were 17, 16, and 19 degrees.



PROBLEM 6

2/10 ST (all thin) at 975'.

2/10 CU at 2,040'.

10/10 NS. The following angles were determined by using the ceiling light projector and clinometer: 79, 78, and 80 degrees.

PROBLEM 7

3/10 CB. Clinometer readings were 63, 62, and 65 degrees.

PROBLEM 8

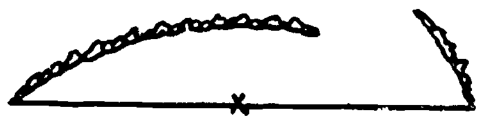
10/10 ST (6/10 opaque) at clinometer readings of 13, 11, and 14 degrees.

1232

PROBLEM 9

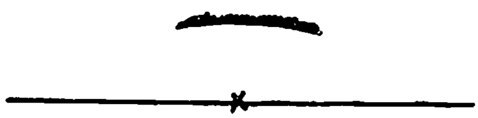
7/10 SC (3/10 thin). The clinometer readings were 45, 48, and 47 degrees.

2/10 AC at 12,250'.



PROBLEM 10

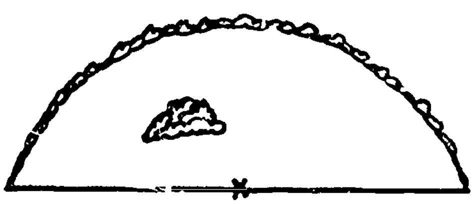
3/10 SMOKE. Ceiling light projector and clinometer readings were 28, 30, and 29 degrees.



PROBLEM 11

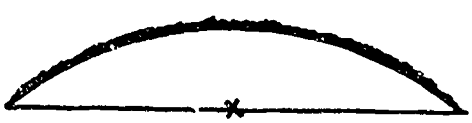
1/10 CU at 1,500'.

10/10 SC. At angles on the clinometer of 70, 75, and 69 degrees.



PROBLEM 12

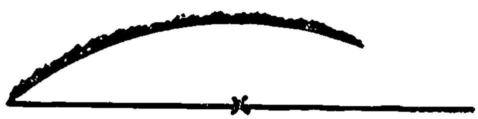
10/10 NS. The readings from the clinometer are 36, 47 and 41 degrees.



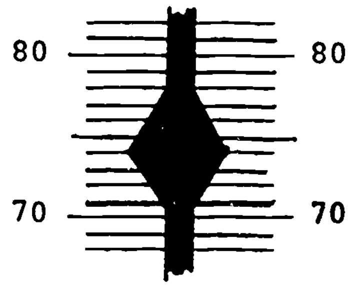
Exercise 9

For the following problems, make the correct entries on a Form 10 for columns 3 and 21. All clouds are opaque unless stated otherwise.

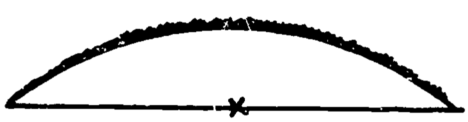
PROBLEM 1



7/10 ST. Determine the height from the RBC.

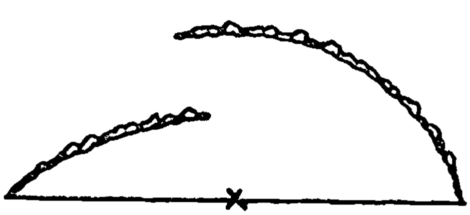


PROBLEM 2



10/10 ST (5/10 thin). The RBC indicates an angle of 56 degrees.

PROBLEM 3

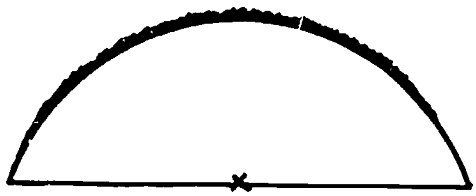


4/10 SC at a height indicated on the RBC at 77 Degrees.

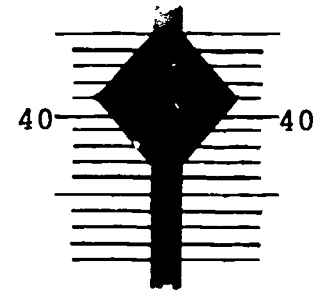
6/10 SC with consecutive readings on the clinometer of 76, 79 and 77 degrees.

1294

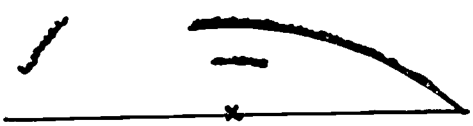
PROBLEM 4



10/10 NS at a height indicated by the RBC below:



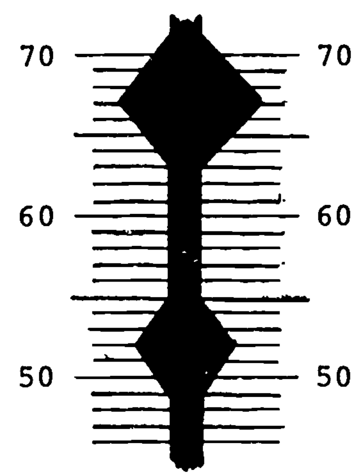
PROBLEM 5



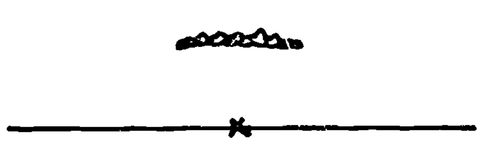
1/10 STFRA. The height can be obtained from the RBC below.

6/10 NS (2/10 thin) at a height indicated on the RBC below.

1/10 CI at 22,750'.



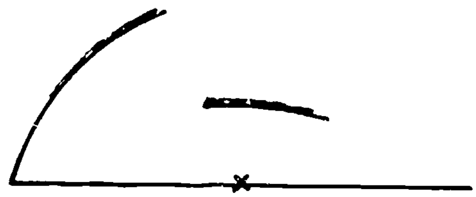
PROBLEM 6



2/10 SC, the RBC reads 81 degrees.

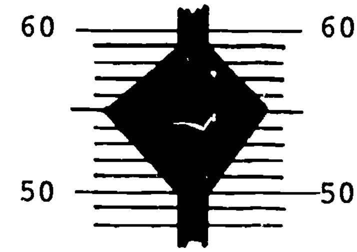
1295

PROBLEM 7

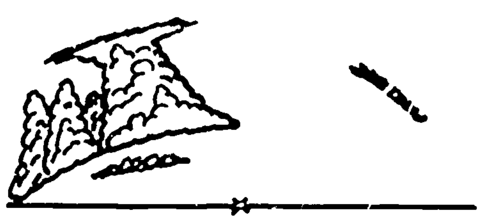


2/10 ST (all thin), use the RBC below for the height.

4/10 CI (all thin) at 32,400'.



PROBLEM 8

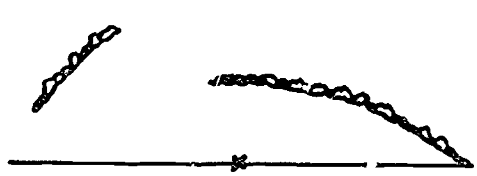


2/10 SC at an angle of 60 degrees on the RBC.

5/10 TCU and CB, the clinometer readings were 55, 53 and 54 degrees.

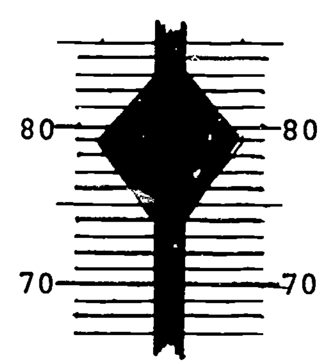
2/10 CI at 35,500'.

PROBLEM 9



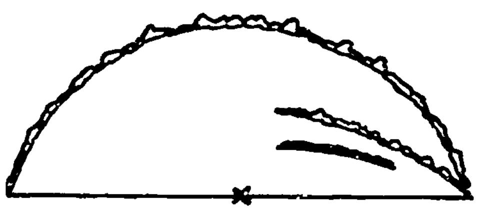
6/10 SC at a height indicated on the RBC below.

2/10 AC at 9,770'.



1296

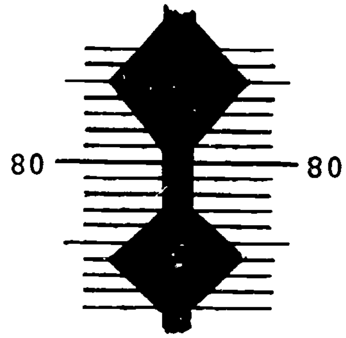
PROBLEM 10



3/10 ST at 900'.

4/10 SC, height indicated on the RBC below.

10/10 SC, height indicated on the RBC below.

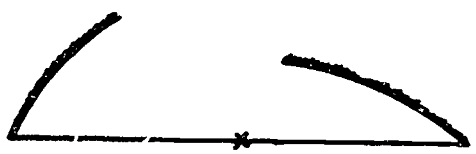


1297

Exercise 10

For the following problems make the correct entries on a Form 10 for columns 3 and 21. All clouds are opaque unless stated otherwise. When only one height or angle is given from the ceiling light projector and clinometer, it will be the average of three or more consecutive readings.

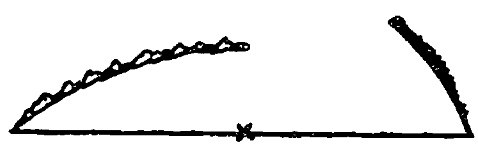
PROBLEM 1



4/10 ST at a height measured by the RBC at 78 degrees.

3/10 AS reported by a pilot at 18,600' MSL.

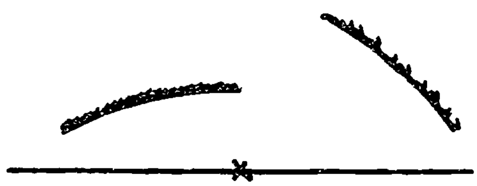
PROBLEM 2



5/10 AC at a height of 7,600' measured by the clinometer.

3/10 AS at 14,000'.

PROBLEM 3



3/10 AS at 10,260'.

3/10 CI (all thin) at 22,300' determined from a pilot report.

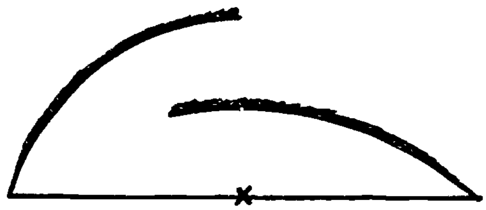
PROBLEM 4

5/10 CU at an RBC angle of 81 degrees.

10/10 CS (all thin) at 25,000'.

1298

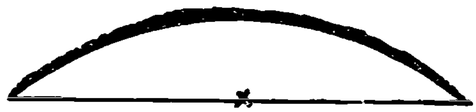
PROBLEM 5



7/10 ST (4/10 opaque) is touching the top of a radio tower 1 mile to the east. The tower is 325 feet tall.

5/10 NS reported by a pilot on take off to be at 2,040' MSL.

PROBLEM 6

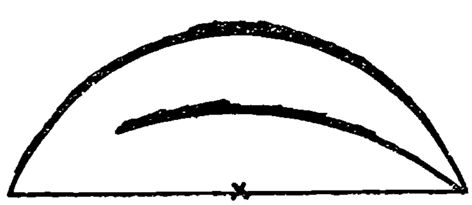


10/10 ST (5/10 thin). The base of the stratus layer is just touching the top of a building which is 450' high. The building is 3/4 mile from the observation site.

PROBLEM 7

5/10 ST. The base of the layer is at the top of an 80' water tower 2 miles to the north.

PROBLEM 8

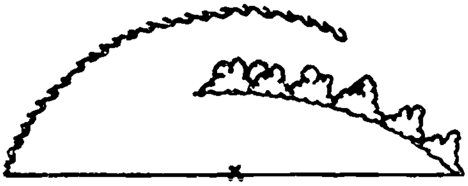


8/10 NS at an angle of 44 degrees on the clinometer.

10/10 AS (2/10 visible) was reported by a pilot at a height of 8,600' MSL.

1299

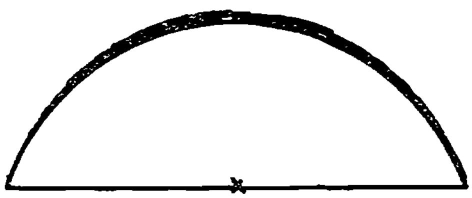
PROBLEM 9



6/10 CU has just formed over the station and airfield. The temperature is 55 degrees fahrenheit and the dew point is 44 degrees fahrenheit.

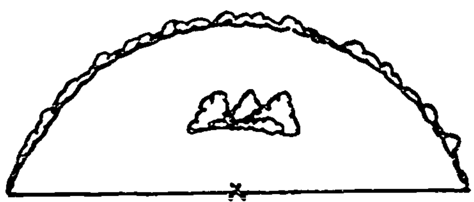
7/10 CI (all thin) at 29,500' determined from a pilot report.

PROBLEM 10



10/10 NS. A 10 gram ceiling balloon began to fade into the layer at 1 min, 19 sec, and disappeared at 2 min, 02 sec.

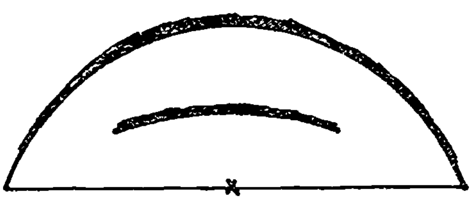
PROBLEM 11



3/10 CU has formed over the airfield.
Temperature = 75 deg.
Dew Point = 62 deg.

10/10 SC at an angle of 85 degrees on the RBC.

PROBLEM 12



6/10 ST. A 30 gram ceiling balloon first began to fade at 0 min, 47 sec, and disappeared at 1 min, 13 sec.

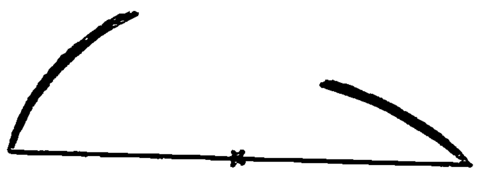
10/10 NS at 2,800' measured by the ceilometer.

130

Exercise 11

Determine the columns 3 and 21 entries for the following problems. All clouds are opaque unless stated otherwise. Angles determined with the clinometer are the average of three consecutive readings.

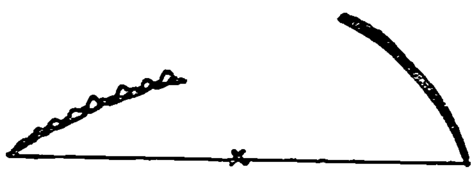
PROBLEM 1



3/10 ST at 1,860' measured with the RBC.

3/10 AS at 18,600', estimated.

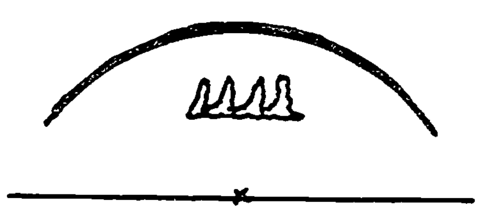
PROBLEM 2



4/10 AC at 9,400', estimated. The layer is semitransparent.

4/10 AS at 13,800' MSL The layer is semitransparent.

PROBLEM 3

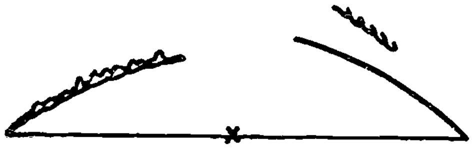


2/10 ACCAS at 8,200', measured with the clinometer.

7/10 AS (4/10 thin) at 12,600'. The height was obtained from a Skew-T/ rawin balloon.

1301

PROBLEM 4

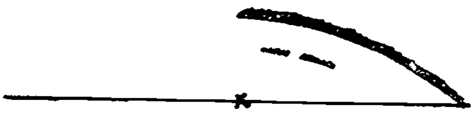


3/10 AC at 7,300', estimated.

3/10 AS (all thin) at 12,000' MSL. Height reported by a pilot.

1/10 CI at 21,000', estimated.

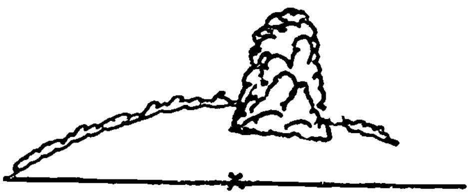
PROBLEM 5



1/10 STFRA (all thin) at 750', measured by the RBC.

5/10 ST at 1,375', measured by the RBC.

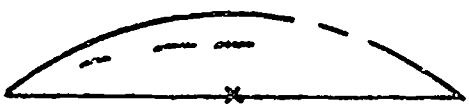
PROBLEM 6



3/10 TCU at 900', estimated.

6/10 SC at an angle of 75 degrees on the RBC.

PROBLEM 7

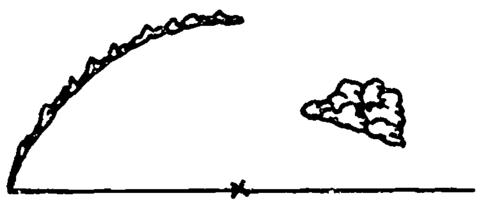


3/10 STFRA (2/10 thin) at 850' measured by the RBC.

10/10 NS at an angle of 56 degrees on the clinometer. There are some small breaks in the layer to the northeast.

13?2

PROBLEM 8



2/10 CU has formed over the airfield. Temp. = 75
D.P. = 66

5/10 SC at an angle of 85 degrees on the RBC.

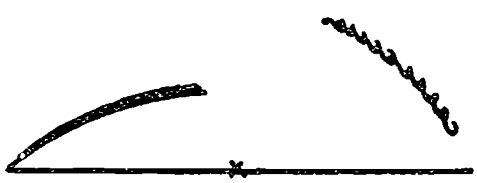
PROBLEM 9

3/10 CB at 1,750', measured by the RBC. The cloud is moving toward the north.

2/10 ACSL at 17,500' MSL reported by a pilot.

2/10 CS at 39,000'.

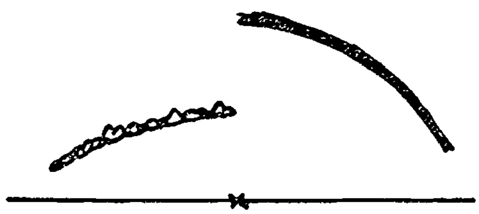
PROBLEM 10



4/10 AS at 10,260', estimated.

3/10 CI (all thin) at 23,300' MSL reported by a pilot.

PROBLEM 11

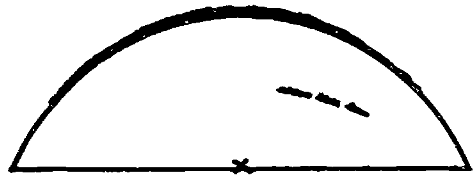


4/10 SC at 3,305' measured by the clinometer.

4/10 AS at an angle of 85 degrees on the clinometer.

1303

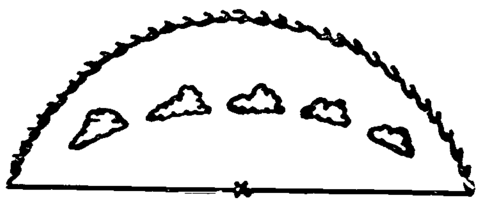
PROBLEM 12



2/10 STFRA (all thin) at 875'.

10/10 NS at an angle of 74 degrees on the RBC.

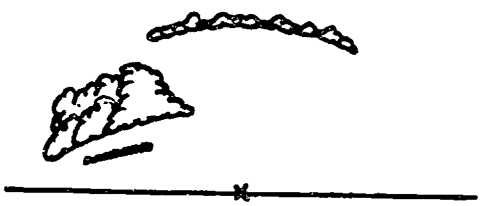
PROBLEM 13



5/10 CU at 2,800'.

10/10 cirrus (all thin) at 25,500' MSL. Only 5/10 of these clouds can be seen.

PROBLEM 14

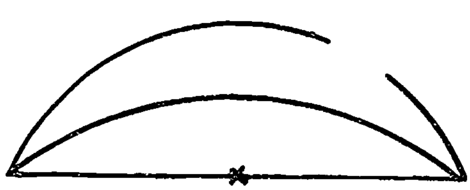


1/10 STFRA (all thin) at 560'.

2/10 CU at 3,300'.

3/10 SC at an angle of 86 degrees on the RBC.

PROBLEM 15

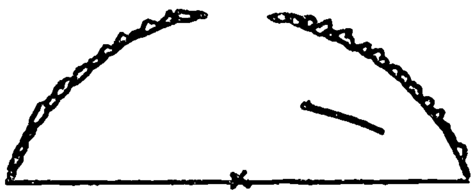


10/10 ST (all thin) at an angle of 68 degrees on the Rotating Beam Ceilometer.

9/10 NS at 5,700' MSL.

13:4

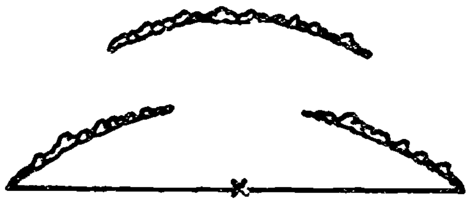
PROBLEM 16



2/10 ST at 900'.

10/10 SC at an angle of 85 degrees on the RBC. The layer has a small break to the south of the station.

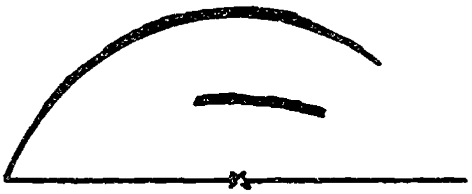
PROBLEM 17



6/10 SC at an angle of 76 degrees on the clinometer.

4/10 AC at an angle of 83 degrees on the clinometer.

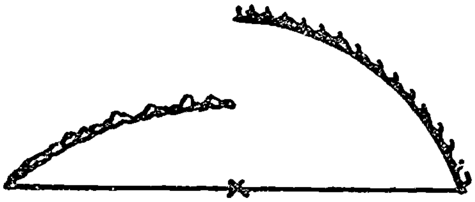
PROBLEM 18



3/10 ST at 1,200'. This layer is all thin.

7/10 AS at 12,000' MSL.

PROBLEM 19

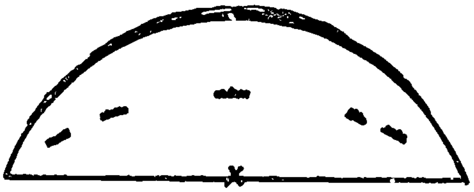


5/10 SC at 2,350' MSL, determined by a pilot report.

5/10 CI (all thin) at an estimated height of 25,000'.

1305

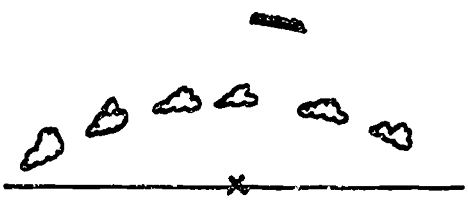
PROBLEM 20



3/10 STFRA at 500', estimated. Fragments of these clouds are in all quadrants of the sky.

10/10 NS. A ceiling balloon (30 gram) began to fade into the layer at 1 min; 30 sec. and completely disappeared at 2 min; 08 sec.

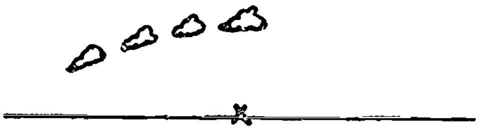
PROBLEM 21



8/10 CU has formed over the airfield: Temp. = 65
D. P. = 54

A TRACE of SMOKE has drifted over the airfield at 7,000'.

PROBLEM 22



2/10 CU has formed over the airfield. The surface temperature is 32.5 and the dew point is 25.

13?6

Exercise 12

Make the correct entries in columns 3, 13 and 21 on a Form 10 for each of the problems. The following information is provided to assist in determining the correct entries.

1. All clouds are opaque unless stated otherwise.

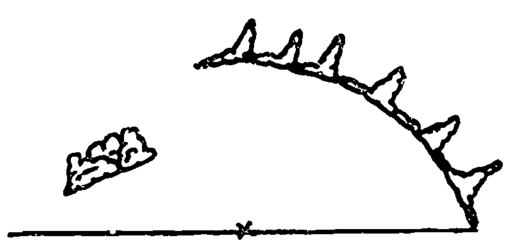
2. All cloud heights stated as measured were determined by the ceilometer (RBC) or clinometer during the period of observation, unless stated otherwise.

3. Cloud heights given from the clinometer are the average of three or more consecutive readings.

4. Cumulus clouds that have great or strong vertical development are towering cumulus; moderate vertical development is not towering cumulus.

5. Use the FMH-1B cloud descriptions to determine cloud types and the appropriate remarks.

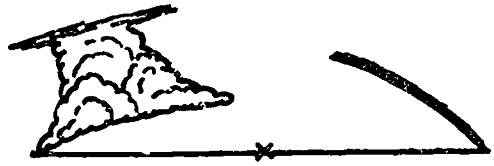
PROBLEM 1



2/10 CU with little vertical development at 1,500'.

6/10 AC with sproutings in the form of small towers or battlements at 9,300' MSL reported by a pilot.

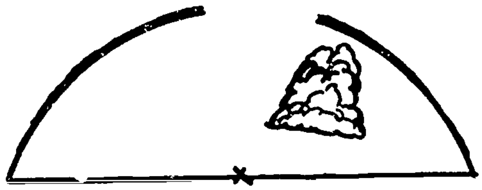
PROBLEM 2



4/10 CB at a measured height of 1,650' moving toward the northeast.

3/10 CS at an estimated height of 20,750'.

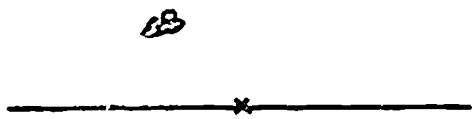
PROBLEM 3



2/10 CU with strong vertical development at 1,500'. The cloud is east of the station moving toward the southeast.

8/10 CS (4/10 thin) at 37,000' determined from the observer's experience and judgement.

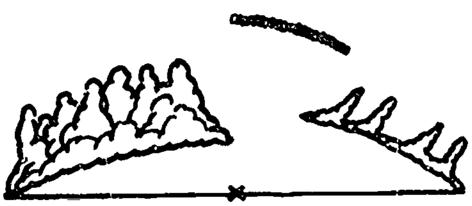
PROBLEM 4



A TRACE of CU with little vertical development at a height of 2,000'.

There are no other clouds present.

PROBLEM 5

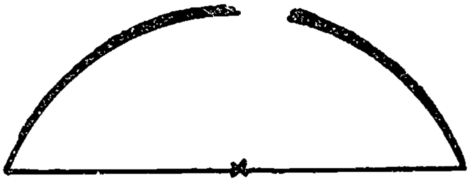


5/10 CU with strong vertical development at an angle of 80 degrees on the RBC.

4/10 AC with sproutings in the form of towers or battlements at 11,000', estimated.

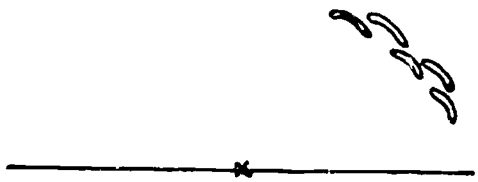
1/10 CC at a height of 24,200' MSL reported by a pilot.

PROBLEM 6



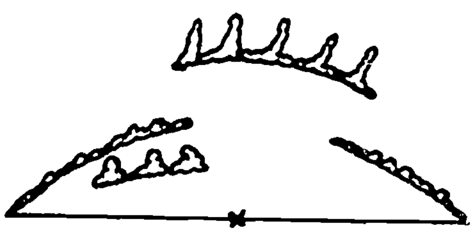
10/10 NS at an angle of 39 degrees on the RBC. There is a small break in the layer overhead.

PROBLEM 7



3/10 AC in the shape of almonds, with no movement, at 9,000'.

PROBLEM 8

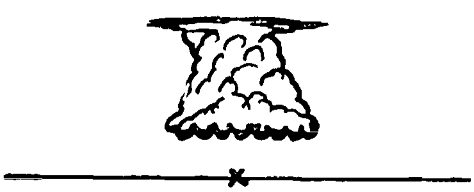


3/10 CU at 1,800', is west of the station.

7/10 SC at 3,249' measured with the clinometer.

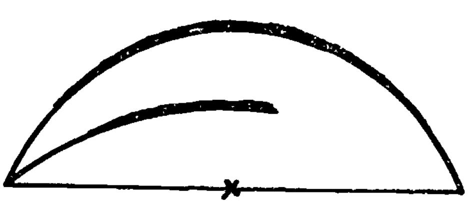
3/10 AC with sproutings in the form of towers is directly overhead at a height reported by a pilot of 13,000' MSL.

PROBLEM 9



4/10 CB with pouches hanging from the base is overhead. The base of the cloud is at 1,900' determined by the RBC and it is moving toward the north.

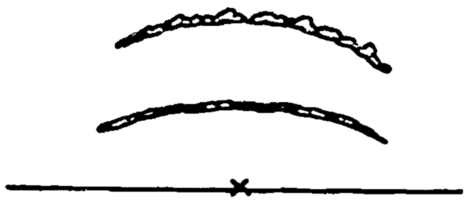
PROBLEM 10



6/10 ST (4/10 thin) at 700' determined by the RBC.

10/10 AS at 8,350' measured with the clinometer.

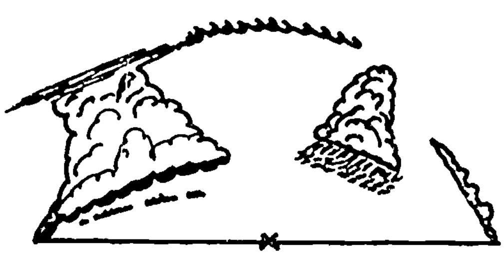
PROBLEM 11



7/10 SC (all transparent) at 2,500'. The height was determined with the RBC.

4/10 SC at 3,500' determined with the RBC 20 minutes ago.

PROBLEM 12



2/10 STFRA at a measured height of 150'.

4/10 CBMAM west of the station moving towards the southeast, at an aircraft reported height of 2,500' above mean sea level.

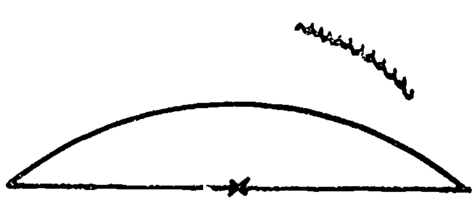
2/10 CU with great vertical development at 3,150' MSL reported by an aircraft.

2/10 AC at 19,000', estimated.

2/10 CI at 42,500' MSL.

Precipitation is falling from the towering cumulus to the east, but does not reach the surface.

PROBLEM 13



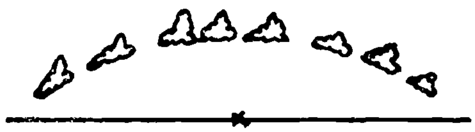
10/10 AS (all thin) at an estimated height of 8,700'.

3/10 CI at an estimated height of 25,000'.

1310

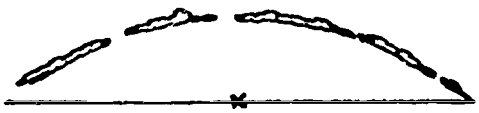
PROBLEM 14

8/10 CU has formed over the airfield. The temperature is 70 degrees and the dew point is 51 degrees. There are small breaks in all quadrants of the sky.



PROBLEM 15

9/10 SC, a 30 gram balloon took 2 minutes to begin to fade and 3 minutes to completely disappear.



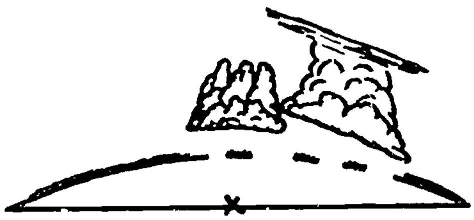
PROBLEM 16

6/10 ST and STFRA at 600' measured by the RBC.

2/10 TCU at 1,162' measured by the RBC, is overhead.

3/10 CB at 1,231' measured by the RBC, is east of the station moving toward the north.

NOTE: There are breaks in the ST and STFRA overhead and to the east of the station.



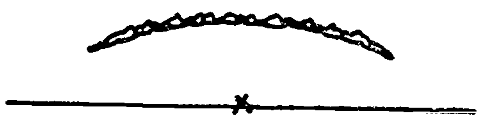
1311

Exercise 13

Make the correct entries in columns 3, 13 and 21 on a Form 10 for the following problems. The clouds are all opaque except where stated otherwise.

PROBLEM 1

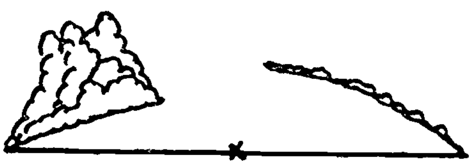
8/10 SC with heights on the RBC changing during the period of observation from 1,400' to 1,600' to 1,800' and to 1,500'.



PROBLEM 2

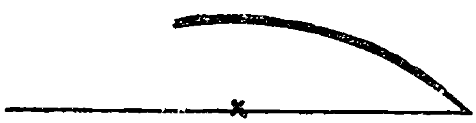
3/10 CU of great vertical development at 1,200'.

4/10 SC with RBC readings varying from 2,200' to 2,500' to 2,100' to 2,600' during the past 15 minutes.



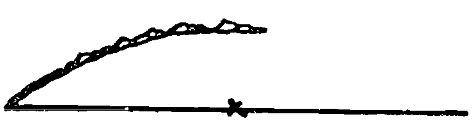
PROBLEM 3

7/10 NS with heights indicated on the RBC varying from 2,900' to 3,100' to 3,000' and to 3,200' during the period of observation.

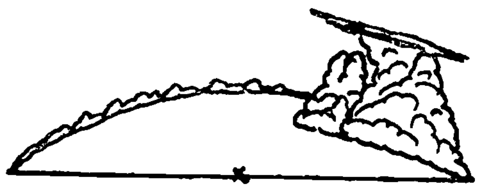


PROBLEM 4

6/10 SC. The base has varied on the RBC during the past 15 minutes as follows: 2,100' to 2,300' to 1,900' to 2,500'.



PROBLEM 5



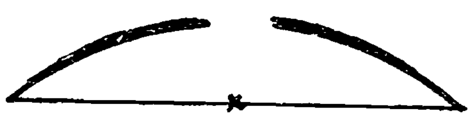
1/10 TCU at 1,200' is northeast of the station.

2/10 CB at 1,200' is east of the station.

7/10 CU and SC with bases varying on the RBC from 2,800' to 3,200' to 3,100' to 3,200'.

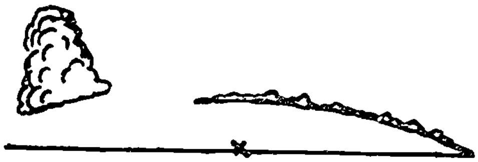
All clouds are moving toward the northeast.

PROBLEM 6



9/10 ST, the RBC indicates heights varying from 500' to 900' to 700' to 800' and to 1,000'.

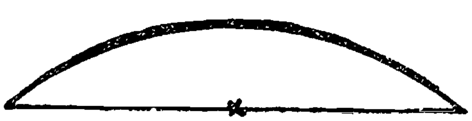
PROBLEM 7



6/10 SC at an angle on the RBC of 65 degrees.

1/10 TCU at an estimated height of 1,800'.

PROBLEM 8



10/10 NS. The base of the clouds have varied between the following reportable values during the period of observation: 300' to 0' to 200' to 100'.

NOTE: The heights were determined by the RBC.

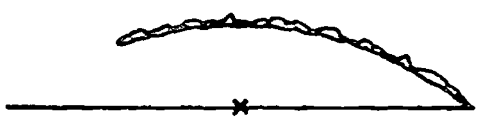
1313

PROBLEM 9

7/10 ST (2/10 thin) at RBC heights varying from 300' to 600' to 400' to 500'. There are small breaks in the layer northeast of the station.

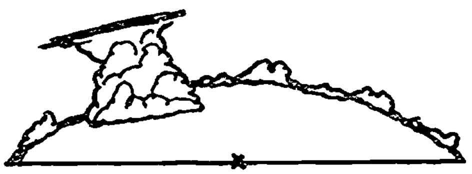
3/10 AS (all thin) at 7,000', estimated.

PROBLEM 10



8/10 SC, the base has varied between the following reportable height values during the period of observation: 2,800' to 3,100' to 2,900' to 3,000', as measured by the RBC.

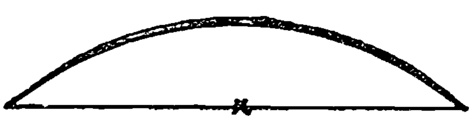
PROBLEM 11



2/10 CB at 1,200' is southwest of the station moving toward the east.

8/10 CU and SC, the RBC has indicated heights of 1,800' to 2,100' to 1,900' to 2,200' during the past 15 minutes.

PROBLEM 12

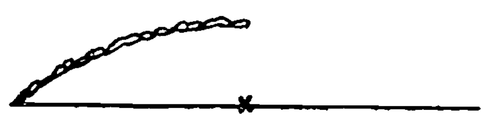


10/10 NS, the RBC has indicated angles of 21, 28, 24 and 32 degrees during the past 15 minutes.

Exercise 14

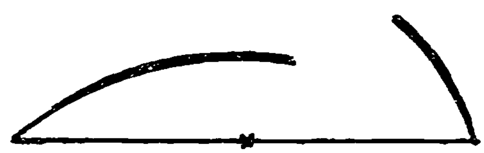
Make the correct entries in columns 3, 13, and 21 on a Form 10 for the following problems. The clouds are all opaque exeept where stated otherwise.

PROBLEM 1



5/10 SC at 2,500', estimated. The amount has varied to 6/10 during the period of observation.

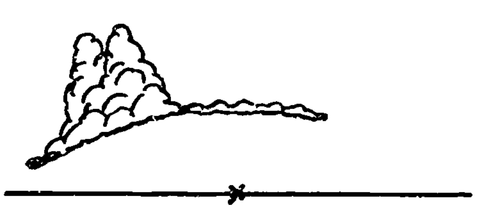
PROBLEM 2



6/10 ST at 250', determined from the height of a radio tower 1/2 mile to the south. The layer has varied from 6/10 to 5/10 during the past 15 minutes.

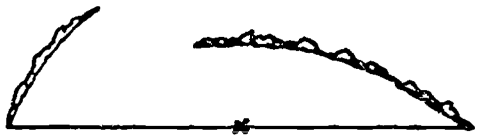
3/10 AS (all thin) at an estimated height of 7,000'.

PROBLEM 3



6/10 SC and CU at an angle of 80 degrees on the RBC. The CU has strong vertical development.
The amount has varied to 7/10 during the period of observation.

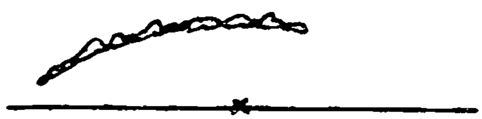
PROBLEM 4



6/10 SC (3/10 thin) at an angle of 75 degrees on the RBC. The layer has varied from 3/10 thin to 4/10 thin during the period of observation.

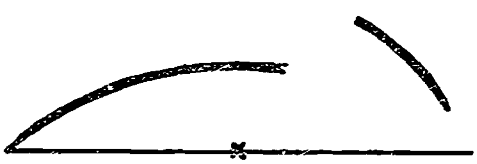
3/10 AC at 15,000', estimated.

PROBLEM 5



6/10 SC (2/10 thin) at 1,100', measured with the RBC. The layer has varied from 2/10 to 3/10 thin during the period of observation.

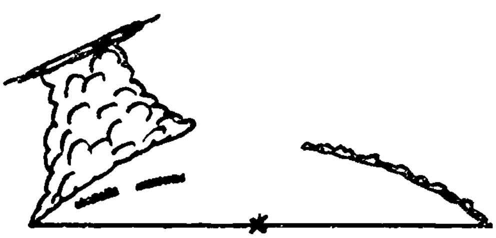
PROBLEM 6



6/10 ST (3/10 thin) at 900', measured by the RBC. The stratus varied to 2/10 thin during the period of observation.

2/10 AS (1/10 thin) reported by an aircraft at 9,500' MSL.

PROBLEM 7



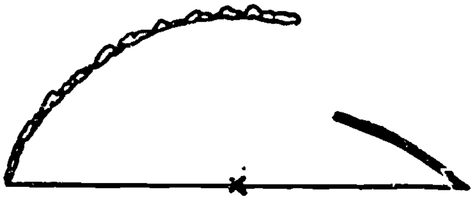
2/10 CUFRA (1/10 thin) at 650', estimated. The layer has varied to all thin during the past 15 minutes.

4/10 SC reported by a pilot at 2,275' MSL.

3/10 CB at 3,500' is west of the station moving north.

1316

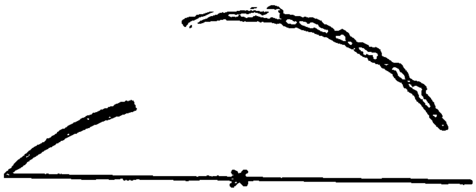
PROBLEM 8



3/10 ST at 800', measured by the RBC. The amount has varied to 4/10 during the period of observation.

6/10 SC at 1,900', estimated.

PROBLEM 9



2/10 ST at an angle of 32 degrees on the clinometer. The stratus has varied to 1/10 thin during the past 15 minutes.

4/10 SC at 2,000', measured with the clinometer.

PROBLEM 10

5/10 CU at 1,500', estimated. The amount has varied to 6/10 during the past 15 minutes.

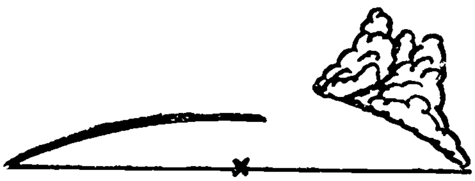
PROBLEM 11

2/10 ST at 1,100', estimated. The layer has varied to 1/10 thin during the period of observation.

2/10 SC at a balloon height of 2,650'.

1317

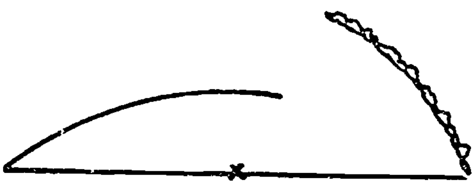
PROBLEM 12



6/10 ST (2/10 thin) at heights varying on the RBC from 400' to 700' to 500' to 800' during the period of observation.

3/10 TCU at 1,400', estimated. The amount of coverage has varied to 4/10 during the past 15 minutes.

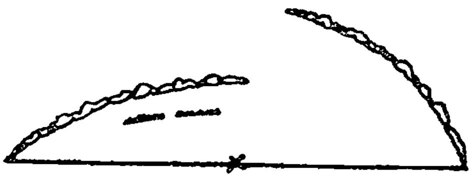
PROBLEM 13



6/10 ST (3/10 thin) at 900' measured by the RBC.
The amount has varied to 5/10 (3/10 thin) during the period of observation.

4/10 SC at 2,500' measured by the RBC.

PROBLEM 14



1/10 STFRA at 600'.

5/10 SC at 1,200'.
The amount has varied to 6/10 during the past 15 minutes.

4/10 SC at 3,000'.

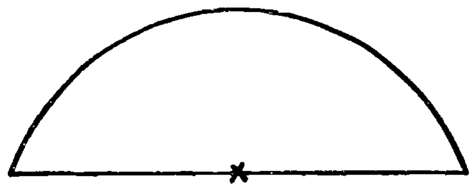
All cloud heights were measured by the RBC.

1318

Exercise 15

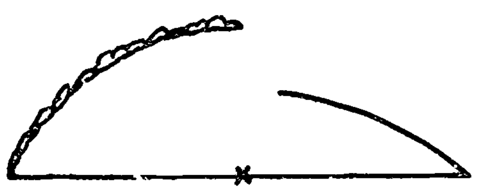
Make the appropriate entries in columns 3, 13 and 21 on a Form 10 for the following problems. All obscuring phenomena and clouds are opaque unless stated otherwise.

PROBLEM 1



10/10 HAZE (all thin) at 4,600' MSL reported by a pilot over the base.

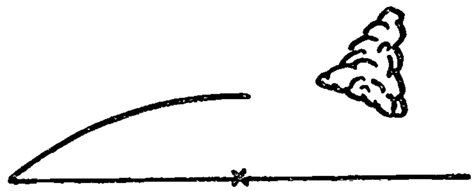
PROBLEM 2



4/10 HAZE (all thin) at 2,640' determined by the ceilometer.

5/10 AC at 8,600' as determined from rawinsonde data.

PROBLEM 3

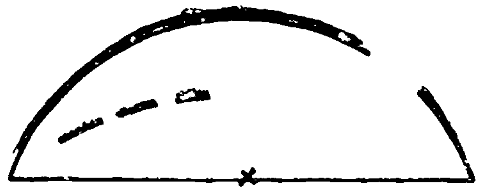


5/10 SMOKE (3/10 thin) at an angle of 68 degrees on the RBC.

1/10 CU of great vertical development east of the station moving toward the east; height 2,600', estimated.

1319

PROBLEM 4



3/10 STFRA at a measured height of 1,950' on the Rotating Beam Ceilometer.

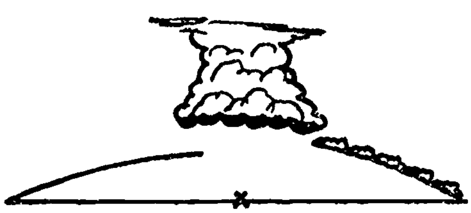
9/10 NS at 7,000' measured with the clinometer.

PROBLEM 5

2/10 SMOKE at 650' on the RBC.

10/10 CS (all thin) at a height of 29,000' determined by weather radar.

PROBLEM 6



3/10 DUST (all thin) at 500'.

3/10 CUFRA at a measured height of 1,200' on the RBC.

4/10 CBMAM is overhead moving north. The height was determined from the RBC at an angle of 71 deg.

PROBLEM 7

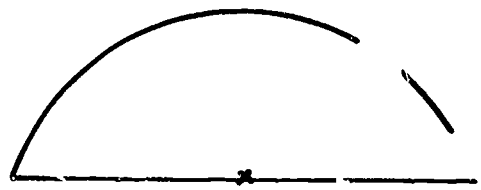
3/10 CU of strong vertical extent southeast of the station at an estimated height of 4,000'.

3/10 SMOKE (all thin) at 15,000', estimated.

2/10 CS at 23,000' MSL.

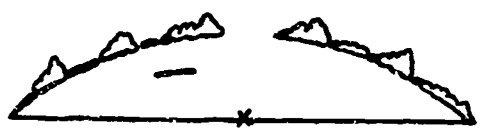
1320

PROBLEM 8



8/10 SMOKE at 900' on the Rotating Beam Ceilometer. There are breaks in the layer northeast and east of the station.

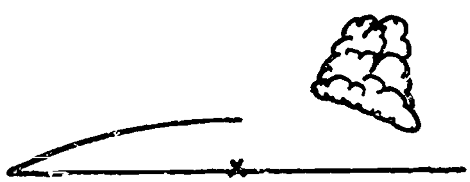
PROBLEM 9



A TRACE of SMOKE at 400'.

10/10 CU and SC at 2,600', determined from weather radar. There is a small break in the layer overhead.

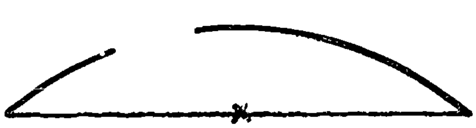
PROBLEM 10



5/10 SMOKE (all thin) at an angle of 28 degrees on the ceilometer.

2/10 TCU at 2,000', estimated.

PROBLEM 11

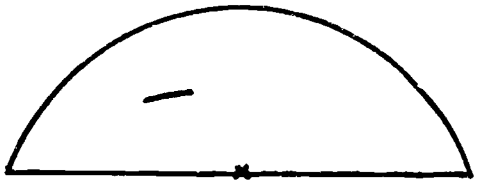


6/10 SMOKE (3/10 thin) at a height of 270', determined from the RBC.

2/10 ST at an angle of 40 degrees on the RBC.

1321

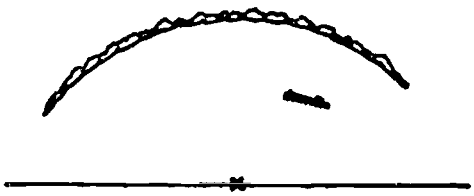
PROBLEM 12



A TRACE of SMOKE (all thin) at an angle of 38 degrees on the ceilometer.

10/10 ST at an angle of 49 degrees on the ceilometer.

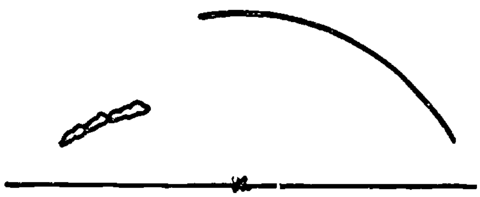
PROBLEM 13



A TRACE of STFRA at 400'.

7/10 AC at 9,700', measured with the clinometer.

PROBLEM 14



2/10 CUFRA at 1,500' measured on the RBC.

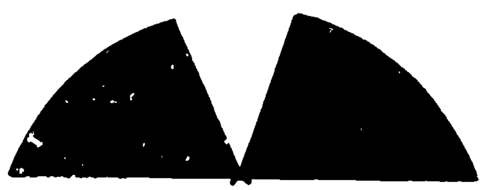
4/10 DUST at 27,500' MSL reported by the pilot of a KC-135 aircraft.

Exercise 16

Make the appropriate entries in columns 3, 13 and 21 on a Form 10 for the following problems. NOTE: Surface based obscuring phenomena is classified as a layer only when it hides 1/10 or more of the sky. Obscuring phenomena aloft must cover (but not necessarily hide) 1/10 or more of the sky to be classified as a layer.

PROBLEM 1

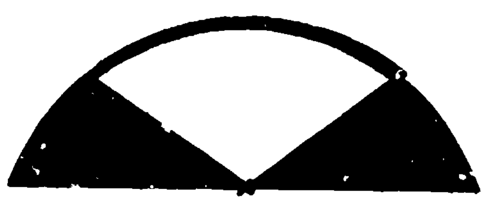
8/10 of the sky is hidden by blowing snow.



PROBLEM 2

4/10 of the sky is hidden by snow.

6/10 NS is visible and the base is measured at 2,350' by the RBC.



PROBLEM 3

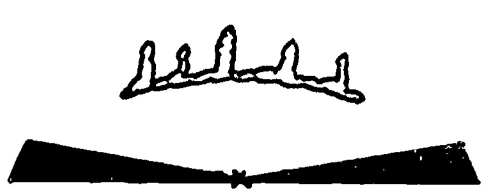
3/10 of the sky is hidden by smoke.

4/10 CS reported by an aircraft at 22,300' MSL.

PROBLEM 4

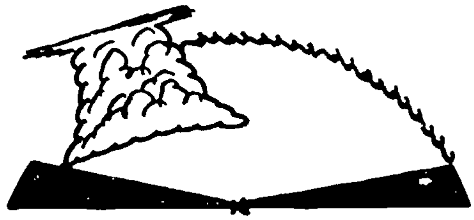
10/10 haze hides 1/10 of the sky.

5/10 ACCAS at an estimated height of 14,000'.



1323

PROBLEM 5



2/10 of the sky is hidden by blowing dust.

4/10 CB is west of the station moving towards the north. The height of the CB is estimated to be 3,300'.

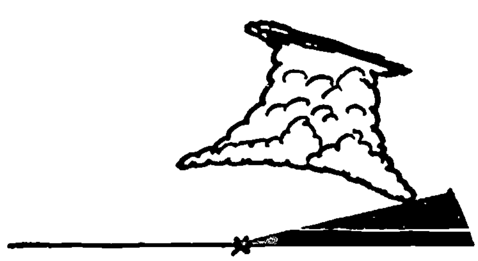
4/10 CI (all thin) at 29,000' MSL.

PROBLEM 6

10/10 fog is hiding 3/10 of the sky.

10/10 NS at an angle of 28 degrees on the RBC.

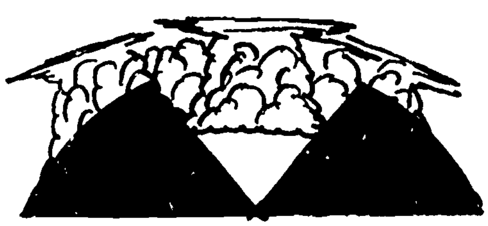
PROBLEM 7



1/10 of the sky is hidden by ice pellet showers.

6/10 CB is visible at an angle of 75 degrees on the ceilometer. The cloud is moving northeast.

PROBLEM 8



7/10 of the sky is hidden by heavy rainshowers,

3/10 CB is visible at 3,550' overhead, moving toward the southeast. The height was estimated by the observer.

PROBLEM 9

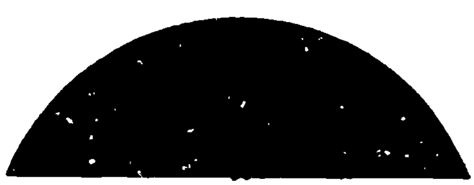
10/10 fog is hiding the sky completely. The vertical visibility was determined by a 30 gram ceiling balloon:

Fade time = 1 min.; 4 sec.
Disappear time = 1 min.;15 sec.

PROBLEM 10

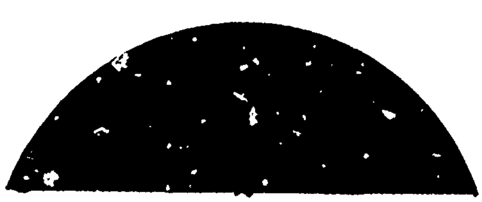
10/10 fog and drizzle are hiding the sky completely. The RBC indicated consecutive readings of 45, 51, 48 and 54 degrees.

PROBLEM 11



The sky is hidden completely by 10/10 fog. An aircraft on takeoff reported the vertical visibility to be 1,400' MSL.

PROBLEM 12

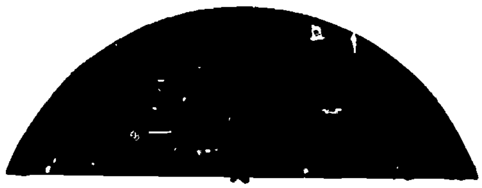


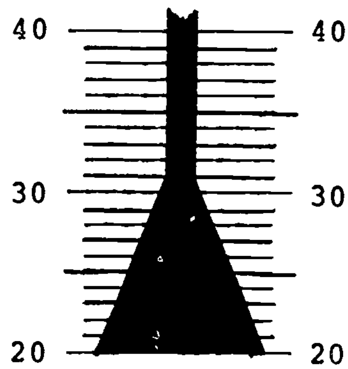
10/10 of the sky is hidden by blowing snow. The observer can see up into the phenomena an estimated 300'.

1325

PROBLEM 13

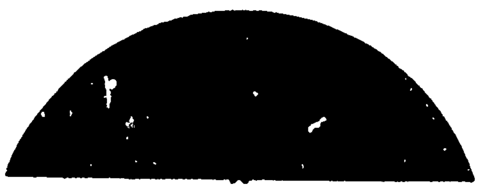
10/10 fog and drizzle hides the sky completely. The vertical visibility can be determined from the RBC diagram below. (This reading is to be considered as the average of four consecutive readings.)





PROBLEM 14

10/10 snow hides the sky completely. The RBC has indicated four consecutive readings of 48, 43, 39 and 46 degrees.



PROBLEM 15

10/10 snow and blowing snow has the sky hidden completely. The vertical visibility is 980' MSL reported by a pilot.

PROBLEM 16

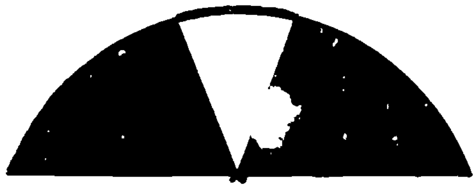
10/10 fog is hiding 5/10 of the sky.

3/10 SMOKE (all thin) at 700' determined by the RBC.

PROBLEM 17

8/10 of the sky is hidden by blowing snow.

2/10 HAZE at 30,000' MSL.



PROBLEM 18

10/10 haze and smoke hides 2/10 of the sky.

4/10 ST at 1,500', estimated.

4/10 DUST at 27,000' MSL.

PROBLEM 19

10/10 fog is hiding the sky completely. A 30 gram balloon first started to fade at 30 seconds and disappeared at 1 minute 10 seconds.

PROBLEM 20

10/10 fog hides the sky. The vertical visibility is 2,275' MSL reported by a pilot.

1327

Exercise 17

Make the appropriate entries in columns 3, 13 and 21 of a Form 10 for each problem. The following information is provided to assist in determining the correct entries.

1. All clouds and obscuring phenomena aloft are opaque, except when the problem states otherwise.

2. All layer heights stated as measured were determined by the ceilometer (RBC) or clinometer during the period of observation, unless stated otherwise.

3. Layer heights determined with the clinometer are the average of three or more consecutive readings.

4. Vertical visibility values determined with the ceilometer (RBC) are the average of four consecutive readings.

5. When only one ascension time is given for a ceiling balloon, it will be the correct entry time for determining that particular height.

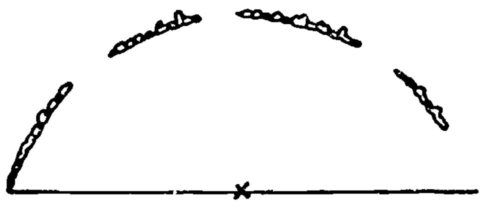
6. Each diagram depicts the condition at the time of observation. When a condition is said to be varying, it is assumed to have varied during the period of observation, except when the problem states otherwise.

7. Use the FMH-1B cloud descriptions to determine cloud types and the appropriate remarks.

8. Cumulus clouds that have great or strong vertical development are towering cumulus; moderate vertical development is not towering cumulus.

PROBLEM 1

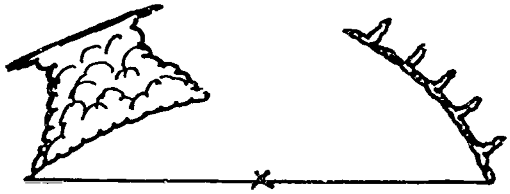
6/10 AC at a height of 7,800' MSL reported by a pilot.



PROBLEM 2

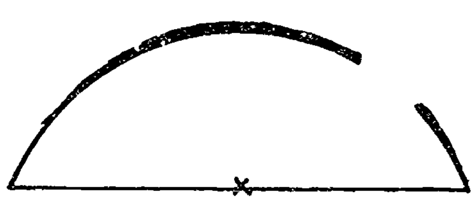
4/10 CB at a measured height of 1,650'. The cloud is west of the station moving toward the northeast.

3/10 ACCAS at a height of 20,750' MSL determined from a pilot report.



PROBLEM 3

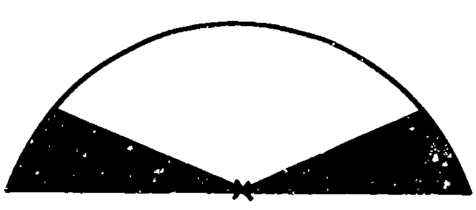
9/10 CS (5/10 thin) at an estimated height of 28,000'.



PROBLEM 4

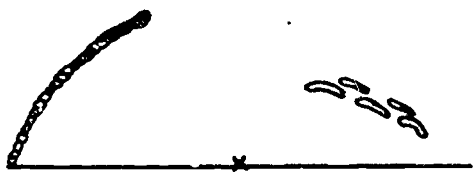
4/10 of the sky is hidden by snow.

6/10 NS is visible and the base is at an angle of 80 degrees on the RBC.



1329

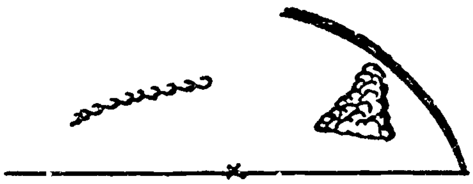
PROBLEM 5



3/10 ACSL to the east at an aircraft height of 12,000' MSL.

4/10 CC at 36,750' MSL reported by the pilot of a B-52.

PROBLEM 6

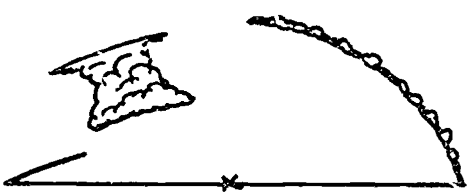


1/10 TCU at 3,500', estimated.

2/10 CI at 21,500' MSL.

4/10 CS at 28,000', estimated.

PROBLEM 7

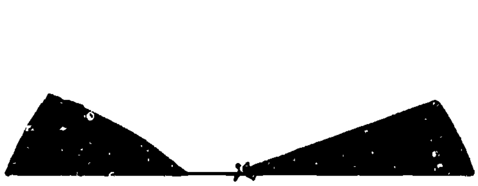


1/10 SMOKE (all thin) at 200', estimated.

2/10 CB at 1,900', estimated, moving toward the northeast.

5/10 AC at 9,800' MSL reported by an F-4 pilot.

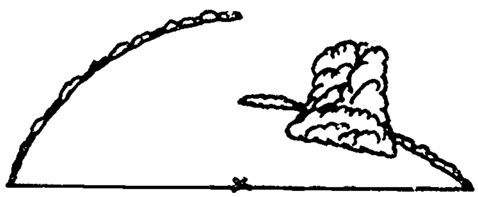
PROBLEM 8



1/10 of the sky is hidden by a fog bank west of the station.

1/10 of the sky is hidden by smoke to the east of the station.

PROBLEM 9

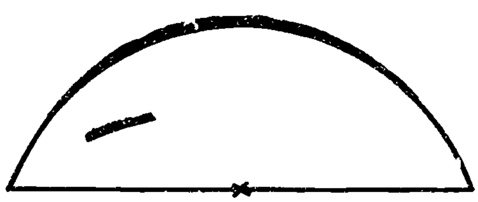


2/10 CU at 1,100', estimated. This cumulus has strong vertical development.

3/10 SC at 2,500', estimated.

5/10 SC at 4,000', estimated.

PROBLEM 10



1/10 STFRA at 200', estimated.

10/10 ST (4/10 thin). Heights on the RBC have varied from 1,500' to 1,600' to 1,400' to 1,700'.

PROBLEM 11

2/10 of the sky is hidden by a ground fog bank east of the station.

1/10 of the sky is hidden by a rainshower to the west.

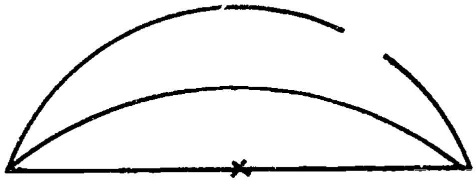
2/10 CB is visible to the west of the station at an estimated height of 2,200'.

PROBLEM 12

5/10 of the sky is hidden by blowing snow. The amount of sky hidden has varied from 5/10 to 6/10 during the past 15 minutes.

1/10 CU of moderate vertical development at 1,500' measured on the RBC.

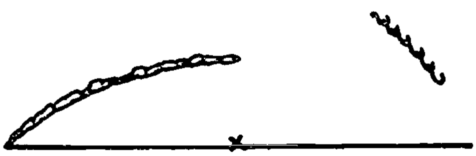
PROBLEM 13



10/10 HAZE (all thin) at 10,000' MSL reported by the pilot of an F-16.

10/10 AS at 20,000', determined by weather radar. There is a small break in this layer to the northeast.

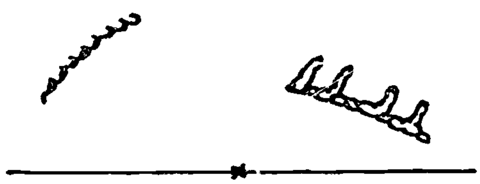
PROBLEM 14



5/10 AC (2/10 thin) at 6,600', estimated.

1/10 CI at an aircraft height of 25,000' MSL.

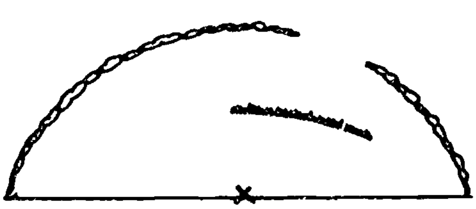
PROBLEM 15



3/10 AC with sproutings in the shape of small towers, at 11,000', estimated.

2/10 CI (all thin) at 30,000'. The amount of this layer has varied to 3/10 during the past 15 minutes.

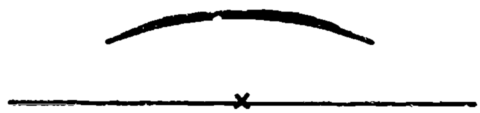
PROBLEM 16



3/10 STFRA at 900'.

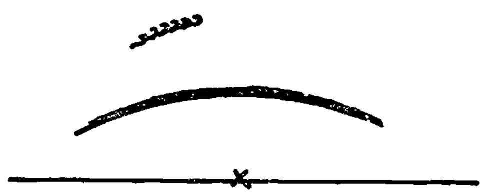
9/10 SC at 2,300' MSL reported by a pilot on takeoff.

PROBLEM 17



6/10 SMOKE (2/10 thin), determined with a 10 gram ceiling balloon:
Fade time = 2 min; 30 sec.
Disappear time = 3 min; 30 sec.

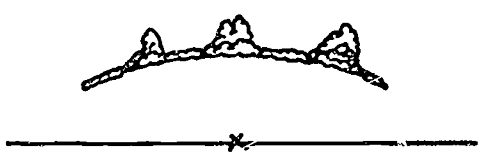
PROBLEM 18



7/10 AC at an estimated height of 9,000'.

A pilot report indicates 1/10 of CI at 20,000' MSL.

PROBLEM 19



7/10 CU and SC at the same level. The height was determined by a 30 gram ceiling balloon, which began to fade into the SC after 0 min; 54 sec. and disappeared after 1 min; 46 sec.

PROBLEM 20

5/10 of the sky is hidden by blowing snow. The amount of sky hidden has varied from 5/10 to 4/10.

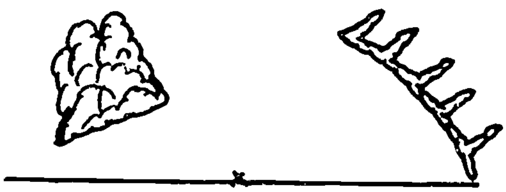
1/10 CU at 1,500', estimated.

1333

PROBLEM 21

10/10 heavy rain is hiding the clouds completely. The vertical visibility reported by a pilot on take-of is 1,740' MSL.

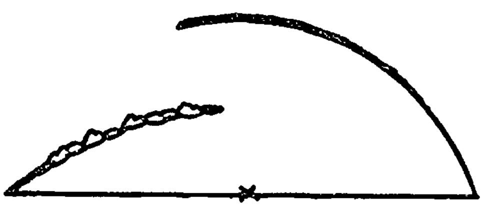
PROBLEM 22



2/10 TCU at 3,000', estimated.

3/10 AC with sproutings in the form of battlements and towers. The height was measured with the clinometer at 8,000'.

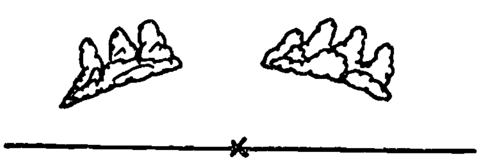
PROBLEM 23



4/10 SC at 5,500', estimated.

6/10 CS (4/10 thin) at 32,500' MSL reported by a pilot.

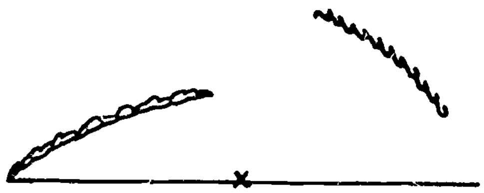
PROBLEM 24



6/10 CU of moderate vertical development determined with the convective cloud height diagram:
Temp. = 76 degrees
D.P. = 60 degrees.

1334

PROBLEM 25



4/10 AC, semitransparent, at 18,500' determined by weather radar.

3/10 CI (all thin) at 28,000' determined by weather radar.

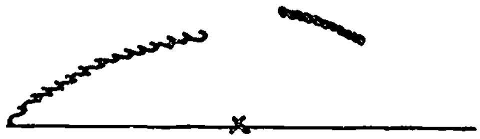
PROBLEM 26

3/10 of the sky is hidden by haze.

2/10 CU at 4,250', measured with the RBC.

1/10 CS at 44,000' determined from the Skew-T.

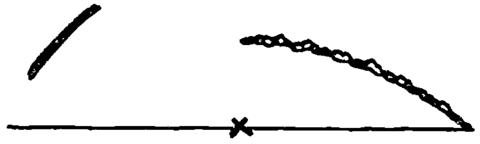
PROBLEM 27



4/10 CI at 28,000', estimated.

2/10 CC at 29,200' MSL, obtained from a pilot report.

PROBLEM 28

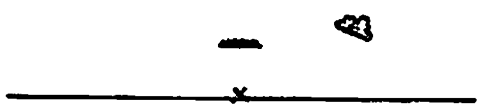


5/10 SC at an angular reading of 70 degrees, using the ceiling light and clinometer.

1/10 SMOKE (all thin) at 13,700 MSL reported by an aircraft.

1335

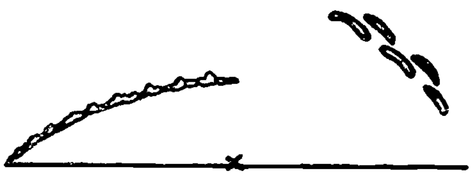
PROBLEM 29



A trace of SMOKE (all thin) has drifted over the station at a height of 300'.

A trace of CU is east of the station at 1,500'.

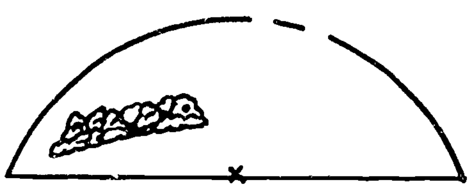
PROBLEM 30



5/10 SC at 6,500', estimated. The amount has varied to 6/10 during the past 15 minutes.

3/10 AC in the shape of almonds is northeast and not moving. The height of these clouds is estimated to be 19,000'.

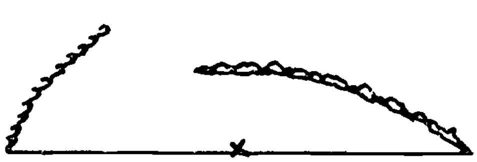
PROBLEM 31



3/10 CU at 5,100', measured with the clinometer.

10/10 AS (3/10 thin) at an estimated height of 14,000'. There are some small breaks in this layer to the north.

PROBLEM 32

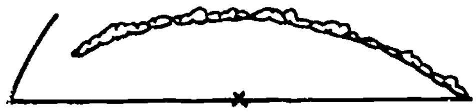


6/10 SC at 5300', determined by a ceiling balloon.

3/10 CI at 33,000' MSL reported by the pilot of a KC-135.

1336

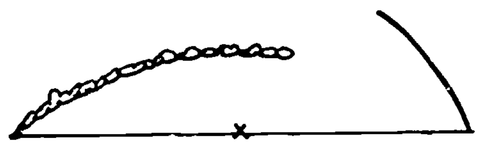
PROBLEM 33



9/10 AC at an angle of 84 degrees on the clinometer.

1/10 AS (all thin) at 15,000', estimated.

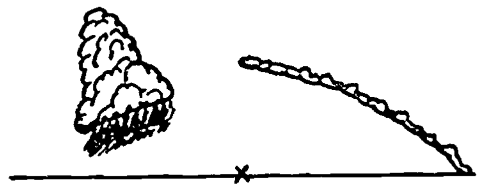
PROBLEM 34



6/10 AC at a height of 14,500' MSL reported by a pilot.

3/10 CS at 35,800' MSL.

PROBLEM 35

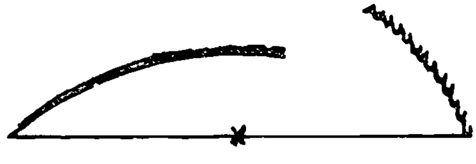


1/10 TCU at 3,300'.

5/10 SC at 5,700'.

There are vertical trails of precipitation that do not reach the surface, extending from the TCU to the west.

PROBLEM 36

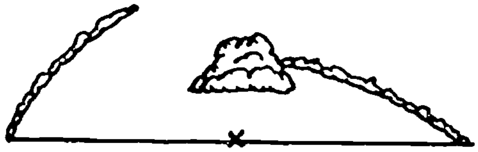


6/10 AS at 10,600' MSL obtained from a pilot report.

3/10 CI at a height of 34,900, estimated.

1337

PROBLEM 37

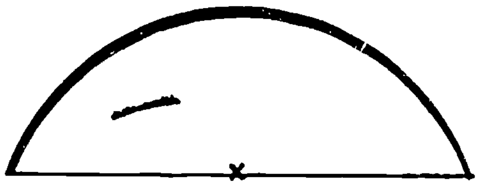


2/10 CU at 4,150'.

4/10 SC at 5,300', estimated.

4/10 AC at a height of 9,500' MSL reported by a pilot.

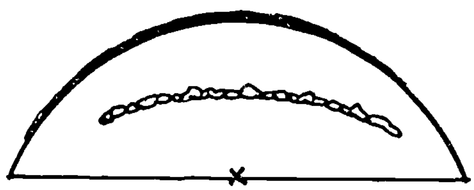
PROBLEM 38



1/10 STFRA (all thin) at 1,000'.

10/10 ST at an angle of 75 degrees on the RBC.

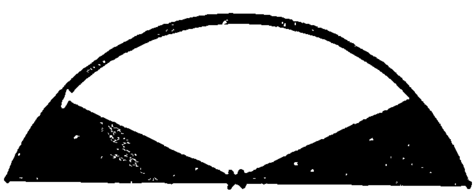
PROBLEM 39



8/10 SC at a height obtained with a 10 gram balloon:
Fade time = 2 min; 40 sec.
Disappear time =
3 min; 22 sec.

10/10 CS at 26,400' MSL reported by the pilot of an F-14.

PROBLEM 40



3/10 of the sky is hidden by smoke.

10/10 DUST at 22,300' MSL reported by the crew of a B-52 aircraft.

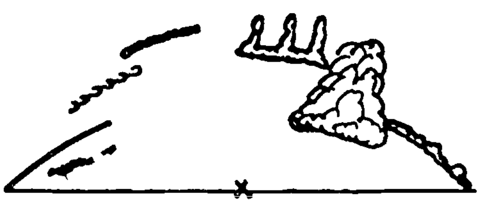
1338

PROBLEM 41

1/10 of the sky is hidden by haze.

5/10 AC (3/10 thin) at an angle on the clinometer of 87 degrees (height 14,000').

PROBLEM 42



1/10 CUFRA at 500'.

1/10 TCU at 1,400' east of the station.

2/10 AC at 7,500, estimated, is east of the station.

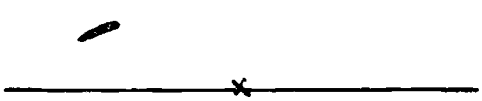
2/10 AS at 9,500', estimated, is west of the station.

2/10 ACCAS at 13,000', estimated. These clouds are overhead through east of the station.

1/10 CI at 22,000' MSL reported by a pilot.

1/10 CC at 22,000', estimated.

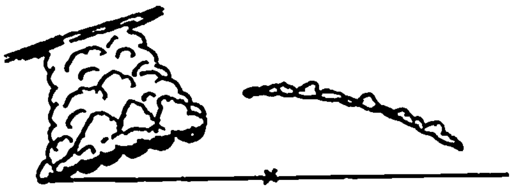
PROBLEM 43



A trace of SMOKE at 900' MSL reported by a pilot over the approach end of the runway.

1339

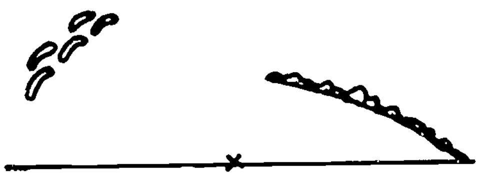
PROBLEM 44



3/10 CB with pouches hanging from the base, is west moving east. The base is at 1,800'.

5/10 SC at an angular reading of 82 degrees on the RBC.

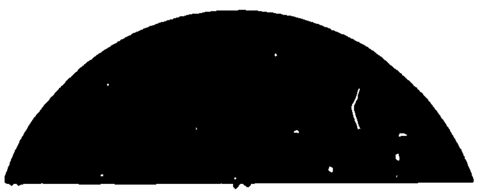
PROBLEM 45



4/10 SC (2/10 thin) at 2,350', estimated. The amount of transparency has varied from 2/10 to 1/10 thin.

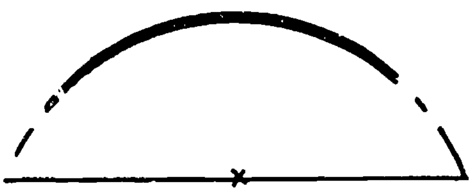
2/10 ACSL at 14,000'.

PROBLEM 46



10/10 blowing snow hides the sky completely. The average of four consecutive readings on the RBC is 22 degrees.

PROBLEM 47



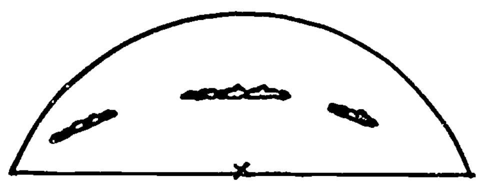
10/10 CS (6/10 thin) at an estimated 37,000'. There are small breaks to the east and west.

1340

PROBLEM 48

9/10 CU of little vertical development has formed over the station.
Temp. = 80 degrees
D. P. = 76 degrees
There are small breaks in all quadrants.

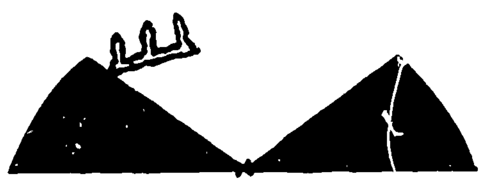
PROBLEM 49



6/10 AC at 13,400' MSL reported by an aircraft.

10/10 CS (all thin) at 46,500 MSL reported by a pilot.

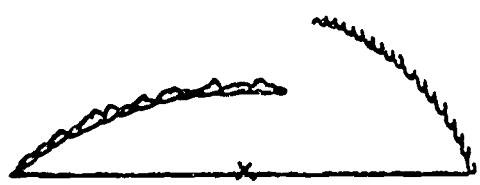
PROBLEM 50



10/10 haze hides 5/10 of the sky.

1/10 ACCAS at 20,000', estimated.

PROBLEM 51

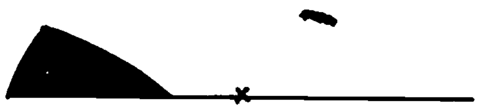


6/10 AC (2/10 thin) at 16,500' determined from rawinsonde data.

4/10 CI (all thin) at 34,000' measured with weather radar.

1341

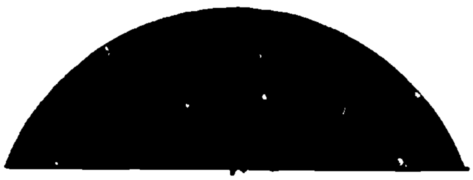
PROBLEM 52



1/10 of the sky is hidden by a ground fog bank west of the station.

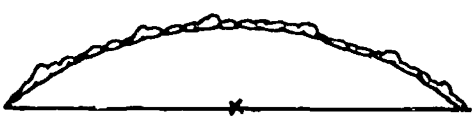
A trace of SMOKE at 1,900'.

PROBLEM 53



10/10 drizzle and fog hides the sky completely. Four consecutive sweeps on the RBC indicated angles of 44, 53, 48 and 57 degrees.

PROBLEM 54



10/10 SC at an angle of 82 degrees on the RBC. A pilot on takeoff from the airfield reports bases of an overcast layer at 3,600' MSL.

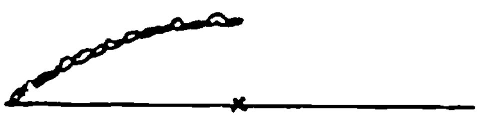
PROBLEM 55

10/10 haze hides 7/10 of the sky.

2/10 SMOKE (all thin) at an angle of 82 degrees on the RBC.

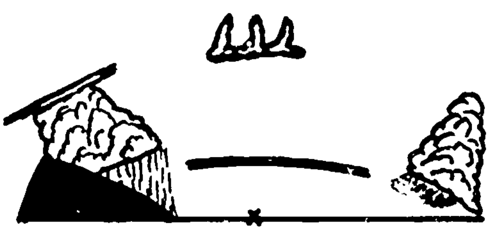
1342

PROBLEM 56



5/10 SC (2/10 thin) at 2,800', measured with the RBC.
The layer has varied to 6/10 (3/10 thin) during the period of observation.

PROBLEM 57



1/10 of the sky is hidden by rainshowers to the west.

7/10 SMOKE (5/10 thin) at 700' measured with the RBC.

1/10 CB at 1,565' is visible to the west moving toward the north.

1/10 TCU at 1,650' is visible to the east moving toward the northeast.

2/10 ACCAS at 8,800' MSL, reported by a pilot, is visible overhead.

The precipitation that is falling from the towering cumulus to the east does not reach the surface.

PROBLEM 58

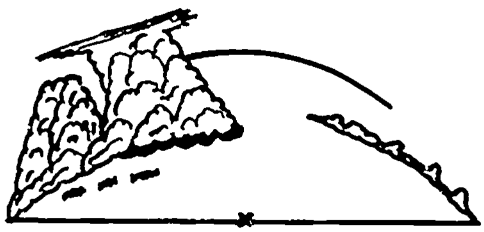
1/10 CU of moderate vertical development is east of the station. The height is 600'.

6/10 ST at heights varying from 700' to 900' to 800' to 1,000' on the RBC.

10/10 CS (only 3/10 is visible) at 35,000' MSL.

1343

PROBLEM 59



1/10 STFRA at 370', measured with the RBC.

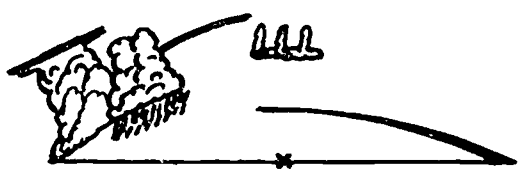
2/10 CU of strong vertical development at 1,500'.

3/10 CBMAM at 1,500' is overhead through west moving northeast.

3/10 SC (all thin) at 4,300' measured with the RBC.

3/10 CS (all thin) at 43,400' MSL reported by a pilot.

PROBLEM 60



6/10 ST (3/10 thin) heights on the RBC have varied from 400' to 700' to 500' to 600' during the period of observation.

1/10 TCU at 1,700', estimated.

2/10 CB at 1,733', measured with the RBC.

1/10 ACCAS is visible overhead at an estimated height of 8,500'.

1/10 SMOKE at 27,500' MSL reported by a pilot.

NOTE: All the clouds are moving toward the north and the precipitation falling from the TCU does not reach the surface.

1344

Exercise 18

Convert the following heights intc reportable values and encoded values (column 3 entries) as directed by the instructor.

		REPORTABLE VALUE	ENCODED VALUE
1.	20,200		
2.	6,200		
3.	21,300		
4.	1,205		
5.	8,450		
6.	3,225		
7.	10,200		
8.	475		
9.	9,900		
10.	300		
11.	34,500		
12.	7,300		
13.	5,050		
14.	6,750		
15.	40,800		
16.	1,125		
17.	19,100		
18.	20,750		
19.	50		
20.	8,250		
21.	4,900		
22.	6,100		

1345

Exercise 19

From the following temperatures and dew points, compute the height of clouds using the convective cloud height diagram. Make your answers in reportable height values.

	TEMP	DP	REPORTABLE HEIGHT
1.	42	38	______
2.	50	40	______
3.	80	58	______
4.	62	40	______
5.	20	19	______
6.	49	18	______
7.	34	30	______
8.	20	18	______
9.	77	68	______
10.	45	41	______
11.	73	72	______
12.	80	76	______
13.	47	36	______
14.	68	64	______
15.	-10	-14	______
16.	70	48	______
17	60	38	______
18.	70	20	______
19.	75	66	______
20.	-05	-09	______

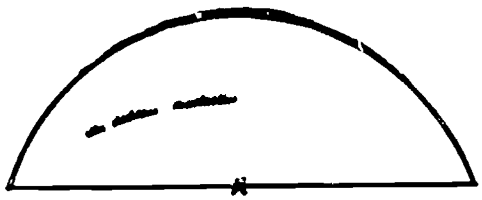
1346

Exercise 20

Variable Ceiling Heights

Complete the following problems as directed by the instructor.

PROBLEM 1



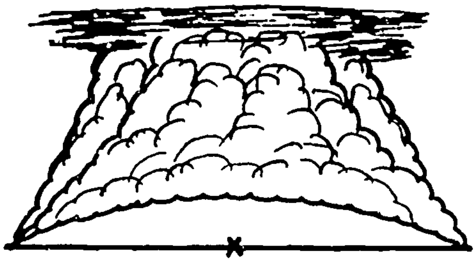
2/10 STFRA at 500', estimated.

10/10 NS, heights varying on the RBC from 1,500' to 1,200' to 1,400' to 1,300' during the period of observation.

PROBLEM 2

8/10 ST (4/10 thin) at heights varying on the RBC from 600' to 400' to 500' to 700' during the past 15 minutes.

PROBLEM 3



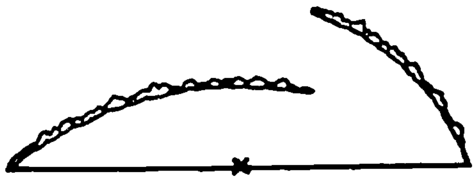
10/10 CB is in all quadrants. Consecutive readings on the RBC indicated angles of 83, 82, 81 and 80 degrees.

1347

PROBLEM

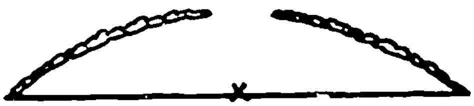
7/10 SC is at an average height of 2,000'. This height has varied, on the RBC, between 1,800' and 2,200' during the period of observation.

4/10 AC is at an estimated height of 11,000'.



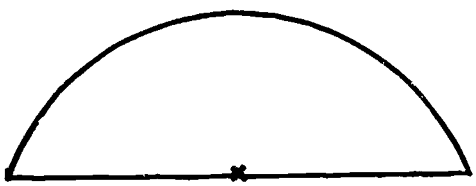
PROBLEM 5

9/10 SC at varying heights on the RBC of 2,800', 3,100', 2,900', and 3,100'.



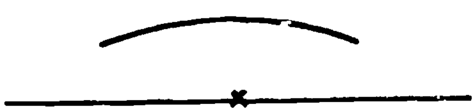
PROBLEM 6

10/10 AS at 7,500'. Consecutive readings on the clinometer were 84, 83, and 84 degrees.



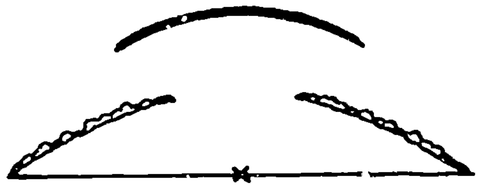
PROBLEM 7

5/10 ST has varied from 1,200' to 1,800' to 1,500' to 1,700' during the past 15 minutes. These heights were determined by the RBC.



1348

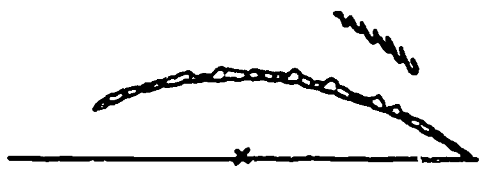
PROBLEM 8



6/10 SC has varied from angles of 76, 74, 77 and 74 degrees on the Rotating Beam Ceilometer.

4/10 AS (all thin) was reported by a pilot at a height of 11,500' MSL.

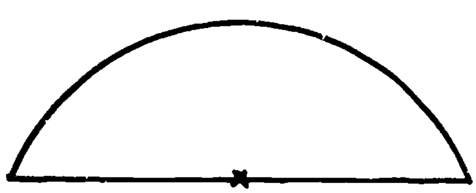
PROBLEM 9



9/10 SC at measured heights on the RBC of 2,500', 2,800', 2,700' and 2,600'.

A pilot reports 1/10 of CI at 34,000' MSL.

PROBLEM 10



10/10 NS, readings on the RBC have varied from 69 to 71 to 67 to 70 degrees during the period of observation.

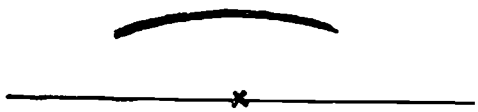
1349

Exercise 21

Variable Sky Condition

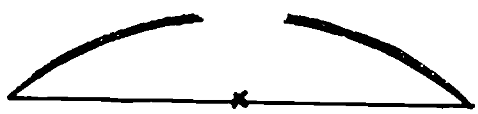
PROBLEM 1

5/10 ST at 600' measured with the RBC. The amount has varied to 7/10 during the period of observation.



PROBLEM 2

9/10 ST (4/10 thin) at 900', estimated. During the past 15 minutes the coverage has varied to 10/10 (5/10 thin).



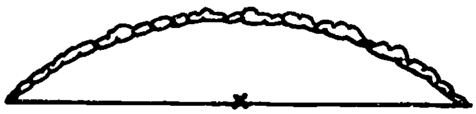
PROBLEM 3

4/10 ST (all opaque) is measured at 400' by the ceilometer. It has varied to 6/10 coverage during the period of observation.

4/10 SC at 3,000', estimated.

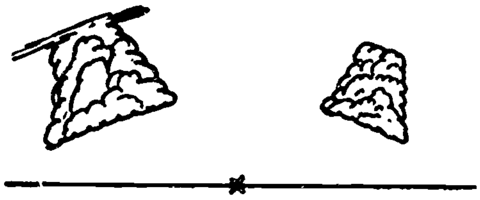
1350

PROBLEM 4



10/10 SC (4/10 thin) at 2,850' measured with the clinometer. The layer has varied to 10/10 coverage (5/10 thin) during the period of observation.

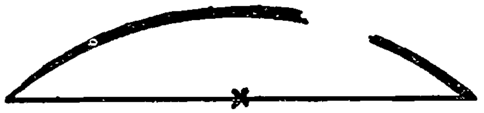
PROBLEM 5



3/10 CB at 2,500', estimated. The cloud is west of the station moving toward the northeast. The amount has varied to 4/10 coverage during the past 15 minutes.

2/10 TCU at an aircraft reported height of 3,300' MSL is also moving toward the northeast.

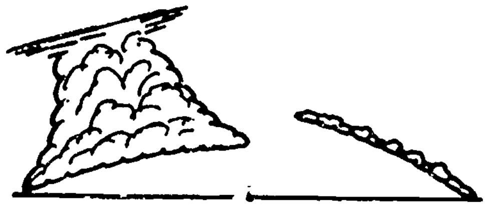
PROBLEM 6



9/10 ST (all thin) is touching the top of a water tower 1/2 mile north of the station. The tower is 112' high. The coverage has varied to 10/10 during the period of observation.

1351

PROBLEM 7



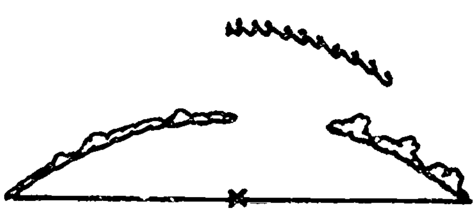
5/10 CB at 2,900', measured by the RBC. The amount has varied to 6/10 coverage during the period of observation.

4/10 SC is estimated at a height of 3,500',

PROBLEM 8

10/10 ST (5/10 thin) is reported by the pilot of an F-4 to be at a height of 1,800' MSL. The layer has varied to 10/10 coverage (4/10 thin) during the past 15 minutes.

PROBLEM 9



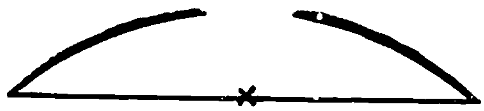
5/10 SC is at an angle on the RBC of 79 degrees. The amount has varied to 6/10 coverage during the period of observation.

3/10 CU of little vertical development is east of the station. The height was measured with the RBC 20 minutes ago at 2,100'.

2/10 CI at 16,500' MSL, reported by the crew of a KC-135 tanker.

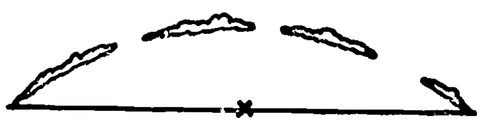
1352

PROBLEM 10



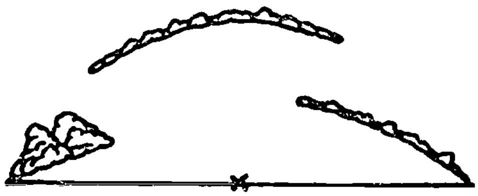
8/10 ST (3/10 thin) at 500', estimated. It has varied to 8/10 coverage (4/10 thin) during the past 15 minutes.

PROBLEM 11



8/10 SC (3/10 thin) at 2,500', measured by the RBC. During the past 15 minutes the layer has varied to 10/10 coverage (5/10 thin).

PROBLEM 12



2/10 CU at 1,600', estimated. The amount has varied to 3/10 during the period of observation.

3/10 SC at 2,700', measured by the RBC.

4/10 SC at 4,200', measured by the RBC.

1353

Exercise 22

Obscuring Phenomena Aloft and Surface Based

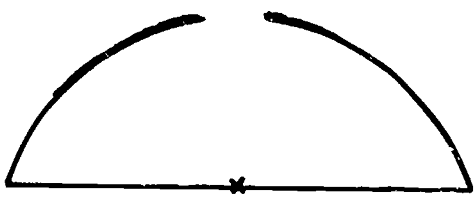
PROBLEM 1

2/10 of the sky is hidden by haze.

8/10 ST (6/10 visible) at a measured height of 900'.

2/10 SMOKE (all thin) at 4,500' MSL reported by a pilot.

PROBLEM 2



10/10 haze hides 0/10 of the sky.

9/10 HAZE (all opaque) at an angle of 51 degrees on the clinometer. There is a small break in the layer overhead.

PROBLEM 3

2/10 of the sky is hidden by rainshowers.

1/10 of the sky is hidden by a fog bank west of the station.

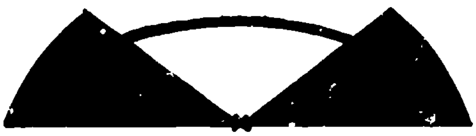
4/10 CBMAM is visible. The RBC is indicating an angle of 82 degrees. This cloud was overhead through west 20 minutes ago. It is now overhead through east of the station and still moving.

1354

PROBLEM 4

6/10 of the sky is hidden by blowing dust.

4/10 of a DUST layer is visible. A pilot reported the height at 4,150' MSL.



PROBLEM 5

1/10 of the sky is hidden by snowshowers.

2/10 CU of strong vertical extent is west of the station at 1,500'.

5/10 SMOKE is at an estimated height of 8,200'.

PROBLEM 6

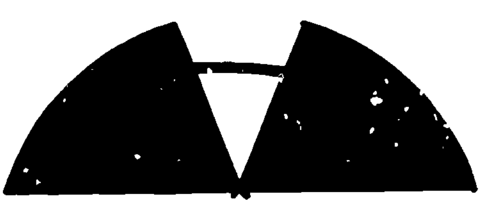
4/10 of the sky is hidden by fog.

5/10 SMOKE has drifted over the radar tower at the station. The tower is 157' high.

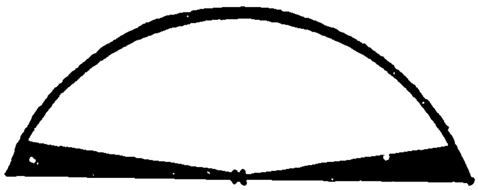
PROBLEM 7

9/10 of the sky is hidden by blowing sand.

A layer of SAND is visible overhead. The height is estimated at 1,200'.



PROBLEM 8



1/10 of the sky is hidden by smoke and haze. The smoke is predominant.

9/10 HAZE (4/10 thin) the heights on the RBC have varied from 2,800' to 3,000' to 2,900' to 2,700' during the past 15 minutes. The layer has varied to 9/10 coverage (5/10 thin) during the period of observation.

PROBLEM 9

2/10 haze hides the sky.

2/10 HAZE (1/10 thin) is reported by a helicopter pilot at 895' MSL.

2/10 AC, stationary and in the shape of almonds, at 9,500', estimated.

10/10 CS (all thin) at a height of 30,000'.

PROBLEM 10

10/10 drizzle hides 2/10 of the sky.

3/10 SMOKE (all thin) has drifted over the station at 400' determined with the Rotating Beam Ceilometer.

9/10 ST at 900', measured by the RBC. The height has varied between 800' and 1,000' during the period of observation.

Exercise 23

Complete the following exercise by correctly answering the questions or completeing the statements as assigned by the instructor.

1. What is the maximum ceiling height that can be designated as measured when using the Rotating Beam Ceilometer?

2. What are the only three methods of obtaining a measured ceiling height?

3. When using the ceiling light projector and clinometer, ceiling heights must be less than ____________________ to be designated as measured.

4. The lowest opaque layer aloft that is broken or overcast would be designated as the ____________________.

5. State the criteria for reporting a variable ceiling height.

6. State the criteria for reporting a variable sky condition.

7. State the criteria for reporting breaks (BRKS) in a layer.

1357

8. Name four cloud types that require a remark in Column 13 of the Form 10.

9. What is the definition of VIRGA?

10. For each of the following, if the statement is true, indicate TRUE; if the statement is false, indicate FALSE.

   a. _____ A thin layer can never be a ceiling.

   b. _____ Surface based obscuring phenomena must cover, but not necessarily hide, at least 1/10 of the sky to be considered as a layer.

   c. _____ Partial obscurations that cover 6/10 to less than 10/10 of the sky are considered to be ceiling layers.

   d. _____ The time that a ceiling balloon disappears into a total obscuration is used to determine the ceiling height.

   e. _____ When the condition observed is obscuring phenomena aloft, a remark must be entered to include the type, height and sky cover contraction.

   f. _____ A scattered layer can never be a ceiling.

   g. _____ Obscuring phenomena aloft must hide at least 1/10 of the sky to be considered as a layer.

   h. _____ A smoke layer aloft would be entered in Column 3 in the same manner as a Cumulonimbus cloud.

   i. _____ All ceiling heights must be prefixed with estimated (E) or measured (M).

j. _____ The remark in Column 13 for a surface based total obscuration would include the type and amount (example: F10).

k. _____ A trace (less than 1/10) of smoke at 1,500' is NOT considered as sky cover.

l. _____ 6/10 SC (all opaque) at 1,900' (height reported by a pilot) would be entered in Column 3 as follows: E19 BKN.

m. _____ Partial obscurations must hide 1/10 to less than 10/10 of the sky.

n. _____ A trace (less than 1/10) of CU at 1,200' would be entered on the Form 10 as follows: (Column 3) 12 SCT (Column 21) 1.

11. Which of the following would be a valid entry in Columns 3 and 13 for sky condition and remarks?

a.	15 -SCT M29 BKN 95 OVC	OVC V BKN TCU N
b.	15 -SCT 29 -BKN E95 OVC	29-BKN V BKN TCU N
c.	15 -SCT 29 -BKN M95 OVC	-BKN V BKN TCU N
d.	15 -SCT M29V BKN 95 OVC	CIG 27V32 TCU N

12. Use the following diagram to select the correct answer for questions a and b.

2/10 of the sky is hidden by fog.

4/10 ST (3/10 thin) at heights varying on the RBC from 400' to 700' to 300' to 600' during the period of observation.

2/10 SC (1/10 thin) at a height of 1,500' on the RBC. This layer has varied to all thin during the past 15 minutes.

2/10 SMOKE at 9,000', estimated.

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a. Which of the following entries correctly describes the sky condition (Column 3)?

(1) -X 5V -BKN M15 BKN 90 OVC
(2) -X 5 -BKN 15 -BKN E90 OVC
(3) -X M5V BKN 15 -BKN 90 OVC
(4) -X 5 -BKN 15V -BKN E90 OVC

b. Which of the following entries correctly describes the remarks (Column 13)?

(1) F2 BRKS E K90 OVC
(2) F2 BRKS E CIG 3V7 K90 OVC
(3) F2 BRKS E OVC V -OVC K90 OVC
(4) F2 BRKS E 90OVC V -OVC K90 OVC

TABLE 1

Height Values for 400' Baseline (RBC)

ANGLE	REPORT VALUE	ACTUAL VALUE
5		35
6	0	42
7		49
8		56
9		63
10		71
11		78
12		85
13	100	92
14		100
15		107
16		115
17		122
18		130
19		138
20		146
21		154
22		162
23		170
24		178
25		187
26	200	195
27		204
28		213
29		222
30		231
31		240
32		250

ANGLE	REPORT VALUE	ACTUAL VALUE
33		260
34		270
35		280
36	300	291
37		301
38		313
39		324
40		336
41		348
42		360
43		373
44		386
45	400	400
46		414
47		429
48		444
49		460
50		477
51	500	494
52		512
53		531
54		551
55	600	571
56		593
57		616
58		640
59		666
60	700	693
61		722

ANGLE	REPORT VALUE	ACTUAL VALUE
62		752
63	800	785
64		820
65		858
66	900	898
67		942
68	1000	990
69		1042
70	1100	1099
71	1200	1162
72		1231
73	1300	1308
74	1400	1395
75	1500	1493
76	1600	1604
77	1700	1733
78	1900	1882
79	2100	2058
80	2300	2269
81	2500	2526
82	2800	2846
83	3300	3258
84	3800	3806
85	4600	4572
86	5500	5720

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TABLE 2

Height Values for 800' Baseline (Clinometer)

ANGLE	REPORT VALUE	ACTUAL VALUE
4		56
5		70
6		84
7	100	98
8		112
9		127
10		141
11		156
12		170
13		185
14	200	199
15		214
16		229
17		245
18		260
19		275
20	300	291
21		307
22		323
23		340
24		356
25		373
26	400	390
27		408
28		425
29		443
30		462
31	500	481

ANGLE	REPORT VALUE	ACTUAL VALUE
32		500
33	500	520
34		540
35		560
36		581
37	600	603
38		625
39		648
40		671
41		695
42	700	720
43		746
44		772
45	800	800
46		828
47		858
48	900	888
49		920
50		953
51	1000	988
52		1024
53		1062
54	1100	1101
55		1142
56	1200	1186
57		1232
58	1300	1280
59		1331

ANGLE	REPORT VALUE	ACTUAL VALUE
60	1400	1386
61		1443
62	1500	1505
63	1600	1570
64		1640
65	1700	1716
66	1800	1797
67	1900	1885
68	2000	1980
69	2100	2084
70	2200	2198
71	2300	2323
72	2500	2462
73	2600	2617
74	2800	2790
75	3000	2986
76	3200	3209
77	3500	3465
78	3800	3764
79	4100	4116
80	4500	4537
81	5000	5051
82	5500	5692
83	6500	6515
84	7500	7612
85	9000	9144
86	11,000	11,440

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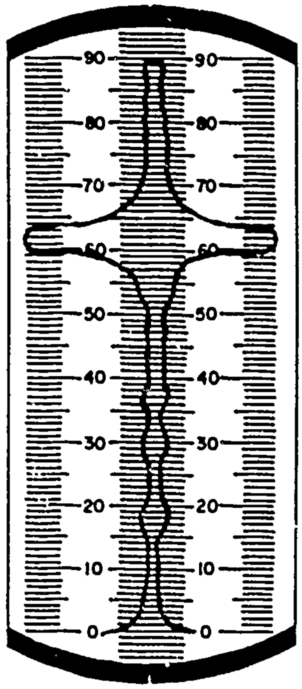
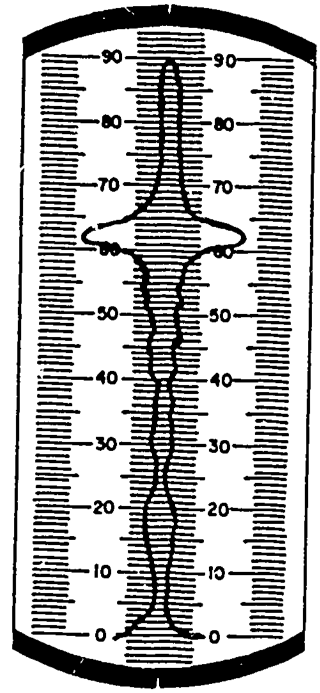
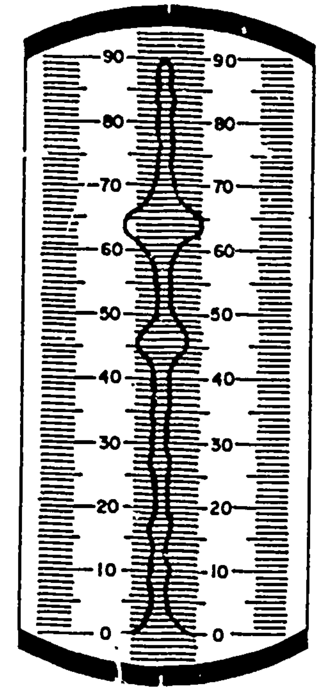


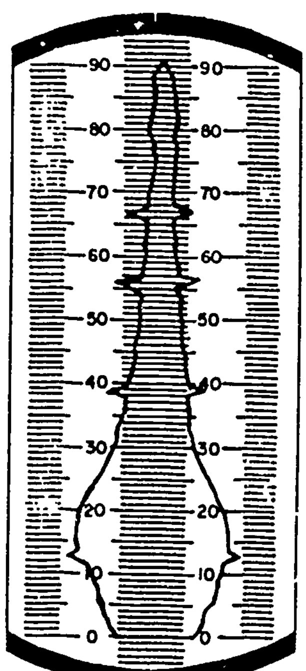
A. SINGLE CLOUD



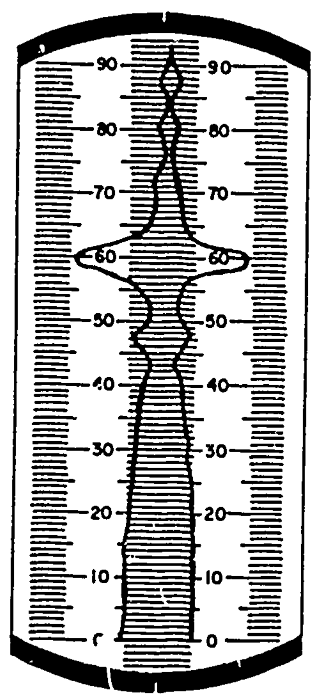
B. SINGLE CLOUD



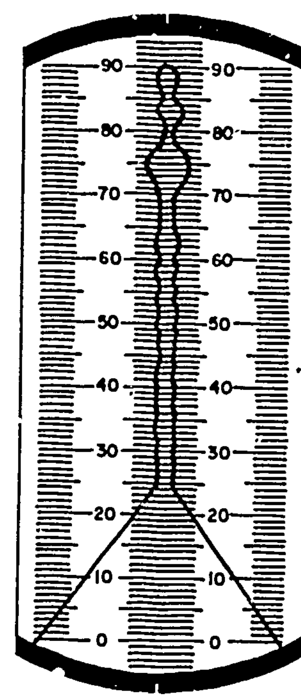
C. MULTIPLE CLOUD



D. LOW CEILING



E. SNOW TAPER WITH CLOUD SIGNAL



F. SURFACE BASED OBSCURING PHENOMENA (FOG)

Typical cloud height indications on the Rotating Beam Ceilometer

1363

82-67205

Weather Training Branch
Chanute AFB, Illinois

C3ABR25130-000-HO-104A
C3ABR25130-002-HO-104A
19 April 1984

STUDENT CHECKLIST

Course: Weather Specialist/Aerographer's Mate

Subject: Sky Conditions

Objective: Given the FMH-1B, weather scenarios, and handout, encode the required sky condition entries on an AWS Form 10 to a minimum of 80% accuracy.

Notes: Upon completion of this unit of instruction, you will be required to make entries on the AWS Form 10 for the following items:

1. Sky Condition

2. Remarks

3. Total Sky Cover

All items are valued at one (1) point each. There are 15 problems that total 100 points possible on the progress check. The time limit will be one hour (60 minutes). Minimum passing score is 80%.

Supersedes ST C3ABR25130-000-HO-104A, C3ABR25130-002-HO-104A, 10 November 1983.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 200; DAV - 1

Designed for ATC Course Use. Do Not Use on the Job.

WORKBOOK

C3ABR25130 000-WB-104b
C3ABR25130 002-WB-104b

Technical Training

Weather Specialist
Meteorological Observations
Aerographer's Mate

CLOUD FORMS

4 October 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE
DO NOT USE ON THE JOB

CLOUD FORMS

OBJECTIVE

Without reference, select those facts which relate to sky condition and clouds to a minimum of 75% accuracy.

PROCEDURE

Follow the instructions given for each exercise. Use the FMH-1B for reference.

Supersedes C3ABR25130-WB-104b, C3ABR25130-1-WB-104b, C3ABR25130-2-WB-104b, 8 February 1983.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 800; DAV - 1

EXERCISE 1

INSTRUCTIONS FOR EXERCISE 1.

Complete the blanks for the following problems.

1. The approximate height ranges of clouds are:

Low clouds from __________ to __________ feet.

Middle clouds from __________ to __________ feet.

High clouds from __________ to __________ feet.

2. The ten basic types of clouds are:

Low clouds: __________, __________, __________, and __________.

Middle clouds: __________, __________, and __________.

High clouds: __________, __________, and __________.

3. What is meant by the term "bad weather"? __________________________

____

4. List the abbreviations for each of the 27 states of sky:

Low Clouds	Middle Clouds	High Clouds
L1_____ or _____	M1_____	H1_____
L2_____ or _____	M2_____ or _____	H2_____
L3_____	M3_____	H3_____
L4_____	M4_____ or _____	H4_____
L5_____	M5_____	H5_____
L6_____ or _____	M6_____	H6_____
L7_____ or _____	M7_____	H7_____
L8_____	M8_____ or _____	H8_____
L9_____ or _____	M9_____	H9_____

INSTRUCTIONS FOR EXERCISES 2 THROUGH 8.

Use the cloud names and descriptions to determine the proper classification number and abbreviation.

EXERCISE 2

	No.	Abbr.	
1.	_____	_____	Cumulus; seemingly flattened with very little vertical extent.
2.	_____	_____	Stratocumulus; formed by the spreading out of cumulus.
3.	_____	_____	Stratus; a continuous, uniform layer with light snow grains occurring.
4.	_____	_____	Cumulus; a cloud with strong to great vertical extent. Tops well defined; shaped in towers and domes.
5.	_____	_____	Cumulonimbus; the summits of which lack sharp outlines, but are neither clearly fibrous nor anvil-shaped.
6.	_____	_____	Stratocumulus; formed by some other means than by the spreading out of cumulus at 5,000 feet and cumulus of moderate vertical development at 3,000 feet.
7.	_____	_____	Cumulus fractus; ragged shreds of other than bad weather cumulus.
8.	_____	_____	Stratus fractus; ragged shreds of stratus, not of bad weather.
9.	_____	_____	Cumulonimbus; of great vertical development of cumulus, but not yet having reached the anvil or cirriform state.
10.	_____	_____	Stratocumulus; a layer resulting from the spreading out of cumulus.
11.	_____	_____	Cumulus fractus; formed beneath a cumulonimbus due to bad weather conditions.
12.	_____	_____	Cumulus; great vertical development; tops in the form of domes and towers.
13.	_____	_____	Cumulonimbus; the top of which is clearly cirriform, often in the form of an anvil.
14.	_____	_____	Stratus; a more or less continuous sheet or layer.
15.	_____	_____	Stratocumulus; a continuous layer not formed from the spreading out of cumulus.

16. _____ _____ Cumulonimbus mamma; the underside of the anvil or the base evidenced by pouch-like proturberances.

17. _____ _____ Stratocumulus; a layer not formed from the spreading out of cumulus with cumulus forming beneath it.

18. _____ _____ Cumulus; small, seemingly flattened clouds with little vertical development.

19. _____ _____ Cumulonimbus; lacking the cirriform or anvil-shaped top.

20. _____ _____ Stratocumulus; not resulting from the spreading of cumulus.

EXERCISE 3

No. Abbr.

1. _____ _____ Top of this cloud is clearly fibrous, often in the form of an anvil. The base of the cloud is at 2,500 feet.

2. _____ _____ Cumuliform cloud of great vertical extent whose base has pouches hanging from it.

3. _____ _____ Cumulonimbus cloud whose top is not clearly fibrous.

4. _____ _____ Stratocumulus clouds formed from the spreading out of cumulus.

5. _____ _____ A layer of stratocumulus, not formed from cumulus, is present at 4,000 feet. There are also some cumulus clouds of little vertical extent present at 4,200 feet.

6 _____ _____ Cumulus clouds of moderate vertical development.

7. _____ _____ Cumuliform clouds of strong vertical extent, tops well defined and in the form of domes.

8. _____ _____ Cumulus clouds of little vertical extent with flattened bases.

9. _____ _____ Ragged shreds of cumulus of good weather.

10. _____ _____ Stratocumulus clouds, not formed by the spreading out of cumulus clouds.

11. _____ _____ A predominantly continuous layer from which light drizzle is falling.

12. _____ _____ Ragged shreds of stratus clouds associated with good weather.

13. _____ _____ Ragged shreds of stratus clouds. Precipitation has just now ended.

14. ____ ____ Ragged shreds of cumulus clouds, not associated with good weather.

EXERCISE 4

No.	Abbr.	
1. ____	____	Cumulus; of strong vertical extent, with tops in the form of domes or towers, base of the cloud at 2,000 feet.
2. ____	____	Altocumulus; a layer formed by the spreading out of cumulus clouds.
3. ____	____	Stratocumulus; a layer formed as a result of the spreading out of cumulus clouds.
4. ____	____	Altostratus; a relatively uniform layer, dense enough to hide the sun or moon.
5. ____	____	Altocumulus; semitransparent, and progressively invading the sky.
6. ____	____	Altocumulus; semitransparent, and not changing in appearance.
7. ____	____	Altocumulus; a patch of stationary clouds, lenticular in shape and the greater part of which is semitransparent.
8. ____	____	Stratus; a more or less continuous sheet, from which continuous drizzle is falling.
9. ____	____	Altostratus; predominantly semitransparent.
10. ____	____	Nimbostratus; a relatively dark and extensive layer from which rain has been falling for several hours.
11. ____	____	Altocumulus; a semitransparent layer of clouds at one level, not progressively invading the sky.
12. ____	____	Altocumulus castellanus; cumuliform tufts on a common base with sproutings in the form of battlements.
13. ____	____	Altocumulus; in one or more continuous layers, progressively invading the sky.
14. ____	____	Altostratus; an extensive, dark layer that obscures the sun from view.
15. ____	____	Altocumulus; of a chaotic sky, generally at several different levels.
16. ____	____	A continuous layer consisting partly of dense altostratus, but mostly opaque altocumulus.

17. _____ _____ Altostratus; a thin, semitransparent layer, through which the moon is weakly visible.

18. _____ _____ Cumulonimbus; a cloud with which thunder, lightning and showers are associated, the top having an anvil or cirriform appearance.

19. _____ _____ Altocumulus; a layer showing a regular arrangement of well defined elements, semitransparent, not changing or progressively invading the sky.

20. _____ _____ Stratocumulus; an extensive, continuous layer not resulting from the spreading out of cumulus.

EXERCISE 5

No. Abbr.

1. _____ _____ Altocumulus of a chaotic sky, generally at several different layers.

2. _____ _____ Altocumulus having the appearance of cumuliform tufts.

3. _____ _____ Altocumulus which has sproutings in the form of battlements or towers.

4. _____ _____ Altocumulus together with altostratus or nimbostratus.

5. _____ _____ Only middle cloud formed by the spreading out of cumulus clouds.

6. _____ _____ Semitransparent altocumulus in bands progressively invading the sky.

7. _____ _____ Altocumulus with elements that are continually changing; elements are often in the form of almonds or fishes.

8. _____ _____ Altocumulus in the form of fishes and almonds. The cloud is stationary.

9. _____ _____ A single opaque layer of altocumulus is present, not progressively invading the sky.

10. _____ _____ Semitransparent altocumulus at a single level with slowly changing elements.

11. _____ _____ Altostratus which is dense enough to hide the sun or moon.

12. _____ _____ A dense, dark cloud in the middle cloud range whose base has a wet, diffuse look and from which continuous precipitation is falling.

13. _____ _____ Semitransparent altostratus which does not hide the sun or moon.

EXERCISE 6

	No.	Abbr.	
1.	_____	_____	Cirrus; in the form of filaments and hooks, progressively invading the sky.
2.	_____	_____	Cirrus; dense patches not increasing and sometimes has the appearance of the remains of an anvil.
3.	_____	_____	Cirrus; in the form of hooks and strands, usually transparent, and not invading.
4.	_____	_____	Altocumulus; a layer formed as a result of the spreading of cumulus.
5.	_____	_____	Cumulonimbus; top lacks sharp outlines, but is neither clearly fibrous nor anvil-shaped.
6.	_____	_____	Cirrus; an anvil-shaped mass of cloud being the result of the dissipation of a cumulonimbus.
7.	_____	_____	Stratus; a low, uniform layer. Light snow grains are occurring at the station.
8.	_____	_____	Altostratus; a dense, gray, sheet-like layer that hides the sun or moon.
9.	_____	_____	Cirrus; in the form of hooks or filaments invading the sky.
10.	_____	_____	Stratocumulus; not formed from the spreading out of cumulus.
11.	_____	_____	Cirrostratus; a relatively uniform veil not covering the whole sky and not progressively invading the sky.
12.	_____	_____	Cirrocumulus; a layer of very small, regularly arranged, globular masses.
13.	_____	_____	Cirrostratus; a layer advancing over the sky with the leading edge more than 45 degrees above the horizon, but not covering the whole sky.
14.	_____	_____	Altocumulus; progressively invading the sky and generally thickening as a whole.
15.	_____	_____	Cirrostratus; a very thin uniform layer, hardly visible, covering the celestial dome.
16.	_____	_____	Cirrostratus; a sheet of thin clouds advancing from the horizon, but the leading edge not yet extending above an angle of 45 degrees.

17. _____ _____ Cirrostratus; a very thin, white layer more than 45 degrees above the horizon from which it is advancing, and filaments of cirrus progressively invading the sky.

18. _____ _____ Cirrus; thick, opaque patches with sproutings in the form of turrets or battlements.

19. _____ _____ Cirrostratus; a nebulous veil covering the entire celestial dome.

20. _____ _____ Cirrus; scattered, wispy appearing strands, not invading the sky.

EXERCISE 7

No. Abbr.

1. _____ _____ Small cumuliform elements with an apparent width of less than one degree in the high cloud range.

2. _____ _____ Cirrocumulus along with cirrus or cirrostratus, but the cirrocumulus is predominant.

3. _____ _____ Cirrostratus covering the entire celestial dome.

4. _____ _____ Cirrostratus which is not invading and which does not cover the entire celestial dome.

5. _____ _____ Cirrostratus progressively invading, becoming denser and extending more than 45 degrees above the horizon.

6. _____ _____ Cirrostratus progressively invading but covering less than 45 degrees above the horizon.

7. _____ _____ Cirrus which is in the form of hooks and filaments and is invading the sky.

8. _____ _____ Cirrus, dense and in the form of an anvil; the cloud is the remains of a CB.

9. _____ _____ Dense cirrus which appears to be the remains of a cumulonimbus but isn't.

10. _____ _____ Cirrus in the form of hooks and filaments, not invading the sky.

EXERCISE 8

No. Abbr.

1. _____ _____ A thin, veil-like continuous layer, very white and diffuse, at 27,000 feet, covering the entire sky.

2. _____ _____ An extensive layer of clouds in one or more continuous layers at 8,500 feet, invading the sky.

3. ______ ______ Thin, wispy, hook-like tufts of clouds with bases at 25,000 feet that are invading the sky.

4. ______ ______ A heavy, dense cloud of great vertical development with its base at 3,000 feet and the upper portion spread out in the shape of an anvil.

5. ______ ______ A continuous, uniform layer of clouds at 10,000 feet, and altocumulus of a chaotic sky at 18,000 feet.

6. ______ ______ Small, ripple-shaped masses forming a continuous layer at 35,000 feet.

7. ______ ______ A low, dark, extensive layer from which steady rain is falling.

8. ______ ______ Small, individual puffs of clouds, whose horizontal bases are at 4,000 feet.

9. ______ ______ A layer of clouds at 5,200 feet, formed by the spreading out of cumulus.

10. ______ ______ The sky is overcast at 1,500 feet by a gray sheet-like layer from which light intermittent drizzle is falling.

11. ______ ______ A continuous layer at 4,700 feet, not formed as the result of cumulus spreading out.

12. ______ ______ A semitransparent, sheet-like layer whose base is at 9,500 feet, and through which the sun is dimly visible.

13. ______ ______ A strongly vertically developed cloud from which thunder can be heard, whose base is at 2,000 feet, and a cirriform top extending to 55,000 feet.

14. ______ ______ A very thin, practically invisible veil of clouds at 28,000 feet, not invading the sky, and not covering the celestial dome.

15. ______ ______ Evenly distributed cumuliform elements occurring at 12,000 feet, semitransparent and not invading the sky.

16. ______ ______ A more or less continuous sheet at 700 feet.

17. ______ ______ Wispy appearing cloud filaments in the form of hooks and filaments at 38,000 feet, not invading the sky.

18. ______ ______ A continuous layer whose base is occurring at 3,200 feet, not formed by cumulus. and a layer of cumuliform puffs at 3,000 feet.

19. ______ ______ Small, individual clouds with a common horizontal base at 5,000 feet.

20. _____ _____ A fairly uniform, very dark layer of clouds whose base looks extremely wet and has been gradually lowered.

EXERCISE 9

INSTRUCTIONS

Use the cloud names and description to determine the classification number, abbreviation and necessary Column 13 remarks.

1. A layer of stratocumulus not formed from cumulus is at 3,700 feet and scattered cumuliform clouds of little vertical extent are at 2,000 feet. An opaque layer of altocumulus not progressively invading the sky exists above. No other clouds are present.

2. Broken-up fragments of clouds at 600 feet (precipitation has been falling), lies below an overcast stratiform layer at 2,700 feet from which precipitation has been falling for six hours. No other clouds are observable.

3. Cumuliform cloud of great vertical development, with an anvil-shaped top sits west of the station moving from the west. Cumuliform cloud at 8,000 feet formed as the result of the spreading out of a previously present CB. Dense patches of clouds are at 35,000, this being the remains of a CB.

4. Cumuliform cloud of little vertical development, at 3,000 feet lies beneath a stratiform layer at 30,000 feet that does not cover the entire sky and is not progressively invading the sky. No other clouds are present.

5. Stratocumulus not from cumulus form the lower laver. An opaque cumuliform laver at 12,000 feet is progressively invading the sky. Cumuliform clouds with an apparent width of less than one degree at a height of 24,000 feet.

6. Stratocumulus formed as a result of the spreading out of previously present cumulus. Above this, layers of opaque non-invading altocumulus and dense cirrus in patches are present.

7. A thin, whitish veil-like cloud covers the entire sky at 27,000 feet.

8. An overcast layer appears as a uniform sheet at 500 feet. No other clouds are observable.

9. Scattered, ragged cumuliform clouds (not of bad weather) dot the sky. Stationary altocumulus of almond-shaped appearance can be seen northwest of the station. Wispy, hook-shaped cirrus that is not invading the sky is also present.

10. A layer of altostratus (opaque) at 12,000 feet lies below a layer of opaque altocumulus not invading the sky at 14,000 feet. Thin, filament-shaped cirrus is progressively invading the sky.

11. A cumuliform cloud with very great vertical development and a fibrous top appears south of the station and is moving south. The underside of the cloud appears to have hanging pouches. No other clouds are present.

12. A cumuliform cloud of strong vertical development east of station moving east has its base at 3,500 feet and top well defined. Altocumulus with tiny sproutings in the form of battlements lies to the west. Cirrostratus is progressively invading the sky and extend to about 30 degrees above the horizon.

13. Stratocumulus has formed by some other means than the spreading out of cumulus. An opaque statiform layer is at 12,000 feet. No other clouds are present.

14. A cumulonimbus is northeast of the station moving southeast. Its top lacks clear outlines but is not fibrous or anvil-shaped. You can see a single semitransparent altocumulus layer that is not invading. A layer of cirrostratus is invading the sky and extends to about 65 degrees above the horizon.

15. Cumuliform cloud of little vertical development rises north of the station. Northeast of the station a cumuliform cloud shows moderate vertical development. A cumuliform cloud of great vertical extent is to the west of the station, its top definitely anvil-shaped. All bases are at 3,000 feet. Clouds are moving east. No other clouds are present.

16. An opaque, overcast, straciform layer exists at 200 feet. No other clouds are observable.

17. Cumulus of little vertical development at 2,100 feet lies below stratocumulus formed from cumulus at 2,900 feet. To the southeast altocumulus with sproutings in the form of towers moves northeast. Dense cirrus in sheaves is also seen not progressively invading the sky.

18. A cumuliform cloud of strong vertical extent (top clearly defined) is directly overhead. Its base is at 4,500 feet and the cloud is moving northeast. A stratiform layer, predominantly semitransparent, is at 7,500 feet. An opaque stratiform layer at 30,000 feet is not invading or covering the entire sky.

19. There is cumulus with little vertical development at 3,500 feet and stratocumulus not from cumulus at 4,700 feet. Stationary altocumulus (almond-shaped) lies at 10,000 feet to the north. Strand-shaped cirrus at 22,000 feet is not invading the sky.

20. Stratocumulus has formed by a method other than the flattening of cumulus. An opaque cumuliform layer stretches in bands at 8,000 feet and is invading the sky. A layer of cumuliform clouds is at 26,000 feet.

21. An opaque cumuliform layer is invading the sky at 13,000 feet. An overcast, opaque layer of altocumulus at 16,000 feet is not invading the sky.

22. Ragged shreds of cloud are drifting below an extensive, gray layer with a wet, diffuse base at 400 feet which is producing continuous light rain. No other clouds are observable.

23. A cumuliform cloud west of the station has a base at 3,500 feet and top at 47,000 feet. The top is fibrous. Pouches are hanging from the base. At 13,000 feet there is an altocumulus layer formed by the spreading out of a previously present cumulonimbus cloud. All clouds are moving from the west. No other clouds are present.

24. You can observe a single layer of semitransparent altocumulus that is not invading and an invading cirrostratus layer that extends to 75 degrees above the horizon.

25. Southeast of the station the sky has a greatly developed cumuliform cloud with base at 2,500 feet. The top lacks sharp outline and is neither fibrous nor anvil-shaped. Cirrus in the shape of hooks is invading the sky.

26. Scattered cumuliform clouds with little vertical development are drifting across the sky at 3,700 feet. A semitransparent veil-like cloud covers the celestial dome at 25,000 feet.

27. You can see the sun dimly through a stratiform layer. The layer is at 11,000 feet and no other clouds are present.

28. A stratiform layer at 29,000 feet invades the sky and extends to about 40 degrees above the horizon.

29. A single, uniform sheet-like layer of clouds stretches at 3,000 feet. No other clouds are observable.

30. A moderately developed cumuliform cloud is based at 4,000 feet northwest of the station. To the south you can see altocumulus with sproutings in the form of battlements. All clouds are moving east. No other clouds are present.

31. A cumuliform cloud of strong vertical development whose base appears at 2,000 feet and top is clearly outlined lies northeast of the station. It is moving northeast. No other clouds are present.

EXERCISE 10

INSTRUCTIONS

Use the cloud names and descriptions to determine the classification number, abbreviation and necessary Column 13 remarks.

1. A moderately developed cumuliform cloud sits south of the station at 2,000 feet. Stratocumulus not from cumulus is to the east at 3,500 feet. A stratiform layer at 35,000 feet completely covers the celestial dome. All clouds are moving north.

2. Drizzle is falling from a continuous layer of stratiform clouds at 500 feet. No other clouds are observable.

3. A cumuliform cloud, top not well-defined but not clearly fibrous, has its base at 3,000 feet and top at 25,000 feet west of the station. To the east another cumuliform cloud with anvil top rises to 50,000 feet from the same base, 3,000 feet. A layer is spreading out from the cumulus at 10,000 feet. A large patch of cirriform cloud drifts at 40,000 feet; it is the upper remains of a CB. Visible drops of moisture are falling from clouds to the east, but are evaporating before reaching the surface. All clouds are moving from west to the east.

4. At 7,000 feet is a dense stratiform cloud. An opaque layer of altocumulus is present at 8,500 feet and is not invading the sky. Cirrostratus extends to 25 degrees from the horizon and is progressively invading the sky.

5. Almond shaped patches are seen at 15,000 feet to the south of the station. No other clouds are present.

6. A cumuliform layer at 7,000 feet whose top forms domes and towers stretches east of the station. Dense patches of cirrus can be observed. They appear cumuliform. No other clouds are visible.

7. You observe a cumuliform cloud with strong vertical development whose top has a sharp, clear-cut appearance. Its base is at 2,500 feet. Stratocumulus (from cumulus) at 3,500 feet is also observed. All clouds are east of the station moving west. No other clouds are present.

8. Ragged shreds of clouds are observed under an overcast, stratiform layer which is producing continuous rain. The base of the upper layer is at 400 feet. No other clouds are observable.

9. A cumuliform cloud west of the station is at 3,000 feet, tops well defined and in shape of domes and towers, with strong vertical development. A stratiform layer is at 10,000, semitransparent and completely covers the sky. No other clouds are observable.

10. Clouds with base at 12,000 feet, and top in the form of towers, is west of station. Cirrostratus which is not covering the entire celestial dome is also present, but not invading. No other clouds are present.

11. Stratocumulus from cumulus and other cumuliform clouds of little vertical development are present at 3,000 feet. A layer of altocumulus, the greater part of which is semitransparent, is at 8,000 feet. Cumuliform puffs at 30,000 feet are also present.

12. A cumuliform layer is east of station at 7,500 feet. Its elements are rapidly changing and take on the appearance of almonds. The cloud is stationary. A stratiform layer is at 30,000 feet, not invading the sky, and not covering the celestial dome. No other clouds are present.

13. Stratiform clouds of a flat, dense blanket type are at 8,000 feet. Also a noninvading opaque cumuliform layer of clouds is at 10,000 feet. No other clouds present.

14. A cumuliform cloud of strong vertical development is northwest of station at 3,000 feet, its top dome-shaped. A cumuliform cloud is at 7,500 feet, progressively invading. Cirrostratus is moving in from the west, the leading edge of which is 50 degrees above the horizon and progressively invading.

15. Stratocumulus from cumulus, altocumulus from cumulus, and cirrus from cumulonimbus are present.

16. Cumuliform cloud of strong vertical development appears west of station moving east, tops well defined, base at 4,000 feet. No other clouds are present.

17. An opaque dark stratiform layer exists at 12,000 feet. No other clouds are observable.

18. A cumuliform cloud of little vertical development appears at 3,000 feet. Thin, wispy clouds, in strands and filaments, at 20,000 feet, are not invading.

19. A layer of stationary clouds to the north of the station at 30,000 feet presents a "mackerel sky" appearance. No other clouds are present.

WORKBOOK

C3ABR25130-WB-106
C3ABR25130-2-WB-106

Technical Training

Weather Specialist
Aerographer's Mate

VISIBILITY AND PRESENT WEATHER

26 March 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

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Weather Training Branch
Chanute AFB, Illinois

3ABR25130-WB-106
C3ABR25130-2-WB-106

VISIBILITY AND PRESENT WEATHER

OBJECTIVES

Without reference, select those facts which relate to visibility to a minimum of 75% accuracy.

Without reference, select those facts which relate to present weather to a minimum of 75% accuracy.

Given the FMH-1B, weather scenarios, and handout, encode the required visibility, RVR, and present weather entries on an AWS Form 10 to a minimum of 80% accuracy.

PROCEDURE

Using the FMH-1B and the information given in each exercise, make the appropriate entries on an AWS Form 10 as directed by your instructor.

Supersedes 3ABR25130-WB-106, 2 November 1983.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 900; DAV - 1

PREVAILING VISIBILITY

1. The greatest distance at which selected objects can be seen and identified is a definition of what?

2. Name two observing aids for visibility.

3. Name three items that visibility markers show.

4. Give a definition of daytime visibility markers.

5. Give a definition of night visibility markers.

6. What visibility value is reported when the visibility is halfway between reportable values?

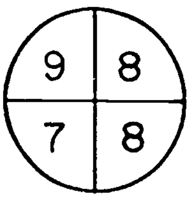
7. Give a definition of prevailing visibility and a brief explanation of what it is.

8. What must you always be aware of before entering visibility in Column 4 of the AWS Form 10?

9. What must you do before taking a visibility observation at night?

Use the following data to make the proper entries in Column 4 for visibility.

1.



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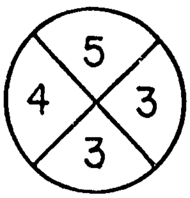

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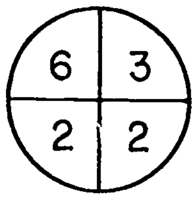

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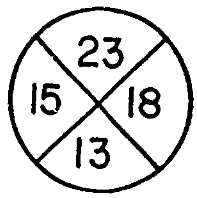

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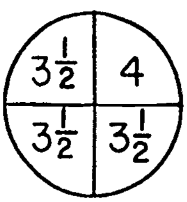

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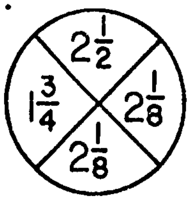

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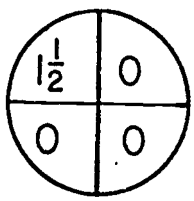

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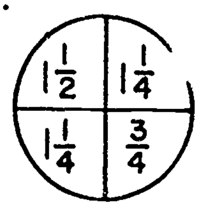

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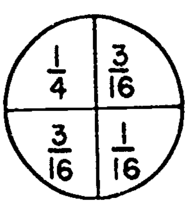

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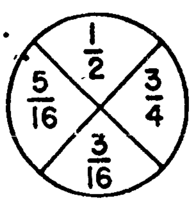

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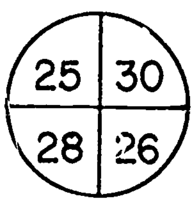

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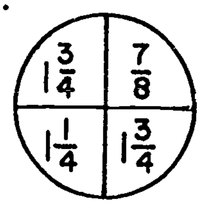

VARIABLE VISIBILITY

1. What is variable visibility?

2. When is variable visibility entered on the Form 10?

3. What entries are made in column 4?

4. What entries are made in column 13?

5. What value must you have for prevailing visibility before you can enter variable visibility in columns 4 and 13?

6. What does the letter "V" stand for when entered in columns 4 and 13?

Use the following information to make the correct entries in columns 4 and 13 of the Form 10.

1. The visibility varies from 3/4 to 1-1/4 to 1 to 1-3/4 during the period of observation.

2. The visibility varies from 1/16 to 1/4 to 1/2 to 1/8 during the period of observation.

3. The visibility varies from 1 to 4 to 2 to 8 to 3 during the period of observation.

4. The visibility varies from 4 to 1 to 3 to 1 during the period of observation.

5. The visibility changed from 1/4 to 1/2 to 3/4 to 1 during the period of observation.

6. The visibility varied from 1/4 to 2-1/4 to 1/2 during the period of observation.

7. The visibility is varying from 1 to 4 to 2-1/2 to 5 to 1/2 to 3 miles during the period of observation.

8. The visibility has varied from 7 to 1 to 3 to 4 to 2 miles in the past hour. For the last 20 minutes it has been steady at 2 miles.

9. The visibility North is 1-1/2, South 3/4, East 1 and West 1-1/16.

10. The visibility has varied from 1/4 to 1 to 1/16 to 7/8 to 0 during the period of observation.

SECTOR VISIBILITY

Use notes you took in class and/or the FMH-1 to answer the following questions.

1. What is visibility in a specified portion of the horizon circle called?

2. In what direction will you move when reporting the direction of each sector around the horizon circle?

3. What is the criteria for reporting sector visibility?

Use the following data to make the proper entries in columns 4 and 13 of the Form 10.

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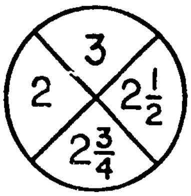

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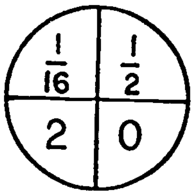

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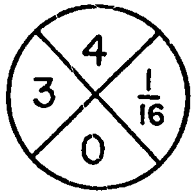

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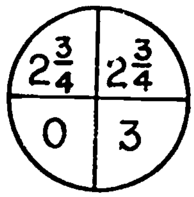

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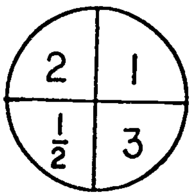

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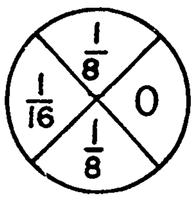

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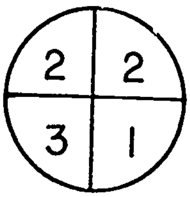

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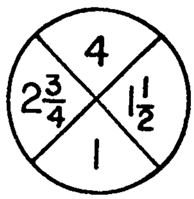

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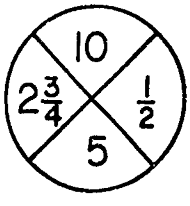

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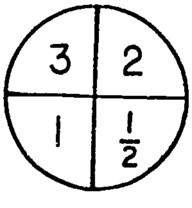

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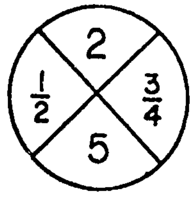

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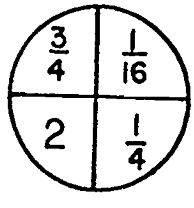

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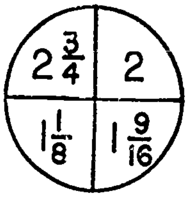

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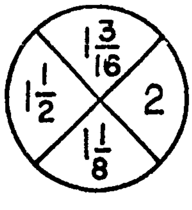

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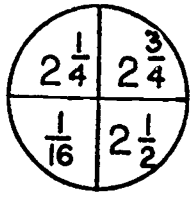

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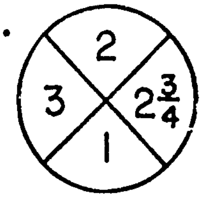


17. $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, 1

18. 2, 2, 1, 1

19. 2, 1, 2, 1

20. $\frac{3}{4}$, $\frac{7}{8}$, $\frac{5}{8}$, $\frac{1}{16}$

21. $\frac{7}{8}$, $\frac{1}{16}$, $\frac{5}{16}$, $\frac{3}{8}$

22. $\frac{1}{2}$, $\frac{1}{16}$, $\frac{3}{8}$, $\frac{5}{8}$

23. $\frac{7}{8}$, $\frac{1}{16}$, $1\frac{1}{4}$, $\frac{3}{4}$

24. $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{16}$, $\frac{5}{16}$

25. 0, $\frac{5}{16}$, $\frac{1}{8}$, $\frac{1}{16}$

26. 0, 0, 3, 0

27. 4, 2, $\frac{1}{2}$, $2\frac{3}{4}$

28. 3, $\frac{1}{16}$, $\frac{1}{4}$, 1

29. 0, 2, 1, 4

30. $\frac{1}{16}$, $\frac{1}{8}$, $\frac{3}{4}$, $\frac{1}{4}$

31. 20, 15, 5, 2

32. 10, 3, $2\frac{3}{4}$, 5

33. 18, $\frac{1}{4}$, 17, 0

34. $\frac{1}{2}$, $\frac{3}{4}$, $\frac{7}{8}$, $\frac{1}{4}$

35. $2\frac{1}{2}$, $2\frac{3}{4}$, $2\frac{3}{4}$, $2\frac{1}{2}$

36. 2, 1, 1, 0

37. $\frac{1}{16}$, $\frac{1}{4}$, $\frac{3}{16}$, 0

38. 0, $\frac{1}{16}$, 0, $\frac{1}{16}$

39. 2, $\frac{3}{4}$, $1\frac{1}{2}$, $\frac{7}{8}$

40. 3, 3, 1, 2

TOWER VISIBILITY

1. Give the definition of tower visibility.

2. What are the criteria for reporting tower visibility?

Use the following data to make the proper entries in columns 4 and 13 on the Form 10.

1. The visibility is 2 miles at the surface and the control tower reports visibility as 3 miles.

2. You, the observer, can see 5 miles, but tower reports a visibility of only 3 miles.

3. Surface visibility is 4 miles and tower visibility is 7 miles.

4. Tower visibility is 1-1/4 miles and surface visibility is 2-3/4 miles.

5. Surface visibility is 3 miles and tower reports a visibility of 3-1/4 miles.

6. Surface visibility is 2 miles and tower visibility is 1 mile.

7. Visibility at the surface is 4 miles. Tower reports a visibility of 3-1/2 miles.

8. Visibility at the tower is 2-3/4 miles. Visibility at the surface is 1/2 mile.

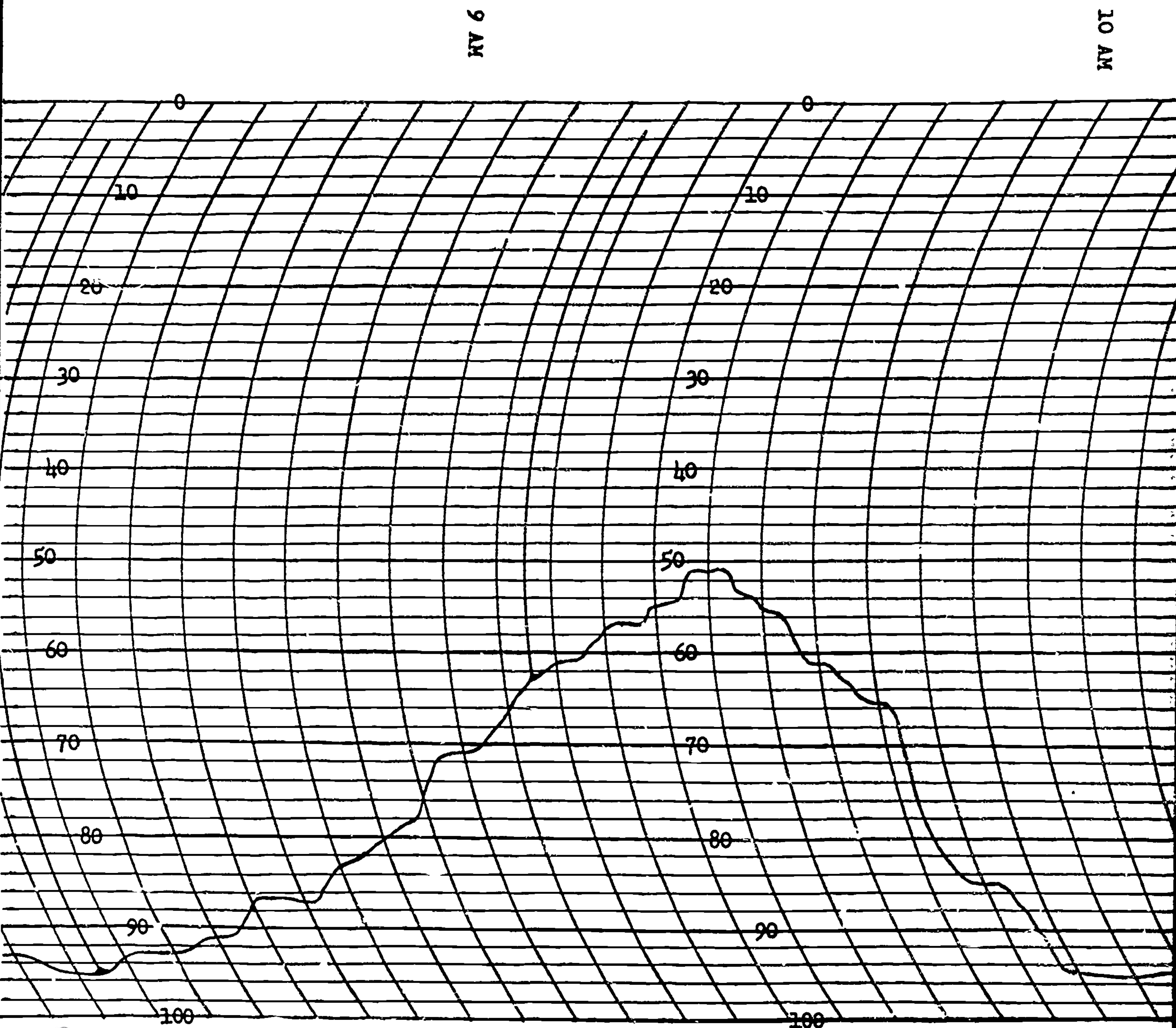
9. Surface visibility is N1, E5/8, S5/8 and W1/2. Tower reports the visibility to be 3-1/2 miles.

10. Visibility at the surface is 0. Tower also reports visibility as 0.

11. Visibility at the surface is 3 miles and tower reports a visibility of 4 miles.

12. At the surface the visibility is varying from 1 to 3 to 1-1/2 to 4 and back to 1-1/2 miles. Tower reports a visibility of 1-1/2 miles.

13. At the surface the prevailing visibility is varying from 5 to 2 to 3 to 1-1/4 to 3/4 miles. Tower visibility is reported as 5 miles.


9 AM
10 AM
0
10
20
30
40
50
60
70
80
90
100

TRANSMISSOMETER CHART

1. When is the transmissometer chart used?

2. How often is an automatic background check given on the transmissometer chart?

3. How many minutes does each time line on the chart represent?

4. What is the lowest numerical value that can be reported during the day? (500' Baseline)

5. What does the transmissivity background check measure?

Use the example of a transmissometer chart on page 8 to make the entries as indicated for the corrected transmissometer value and the Runway Visual Range (RVR) value.

	TIME	CORRECTED VALUE	RVR VALUE
1.	0835	________	_____
2.	0840	________	_____
3.	0845	________	_____
4.	0850	________	_____
5	0855	________	_____
6.	0900	________	_____
7.	0905	________	_____
8.	0910	________	_____
9.	0915	________	_____
10.	0930	________	_____
11.	0940	________	_____
12.	0945	________	_____
13.	0950	________	_____
14.	0955	________	_____
15.	1000	________	_____

RUNWAY VISUAL RANGE (RVR)

1. What is the purpose of RVR?

2. What is the purpose of the FMN-1 Runway Visual Range Computer?

3. What is the format for reporting RVR?

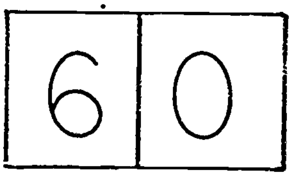
4. What is the lowest numerical value that can be used for reporting RVR and what is the only symbol that can be used in conjunction with that value?

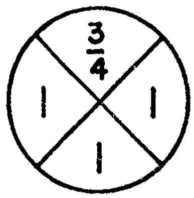
5. What is the highest numerical value that can be reported for RVR and what is the only symbol that can be used with that value?

6. What are the criteria for reporting RVR?

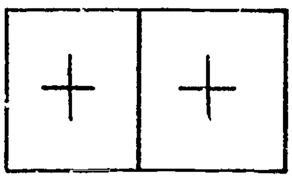
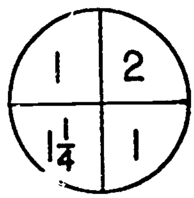
Use the following data to make the proper entries in columns 4 and 13 of the Form 10 for visibility and Runway Visual Range (RVR).

1. The corrected transmissometer chart reading is 78%.
   The RVR on runway 27 is:
   Tower reports visibility of 1-1/2.

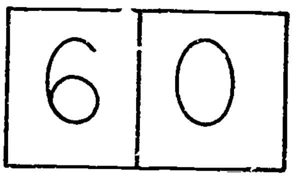


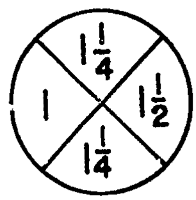


2. Tower reports visibility of 1/2.
   The corrected transmissometer chart reading is 75%.
   The RVR on runway 01 is:

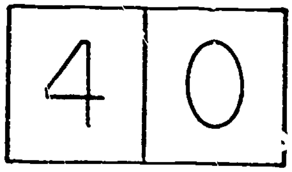



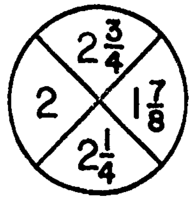
3. Tower reports visibility to be 1 mile.
   The corrected transmissometer chart reading is 79%.
   The RVR on runway 18 is:



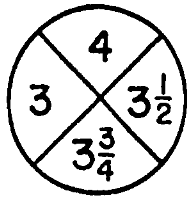


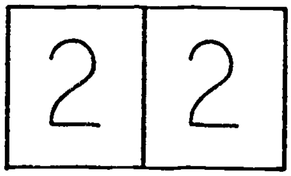
4. Control tower reports the visibility as 1 mile.
The corrected transmissometer chart is 68%.
The RVR for runway 21 is:



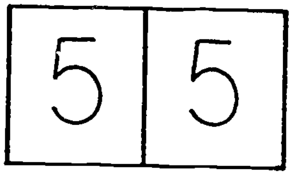


5. Tower reports visibility to be 3 miles.
The corrected transmissometer chart is 47%.
The RVR for runway 36 is:

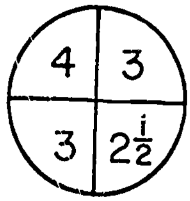


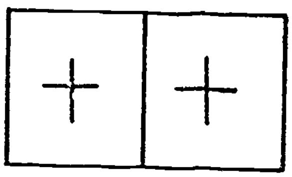


6. During the period of observation the prevailing visibility was observed to vary from 1-1/2 to 3 to 2 and back to 2-1/2 miles.
Control tower reports visibility as 3 miles.
Corrected transmissometer chart is 72%.
RVR reading for runway 18 is:



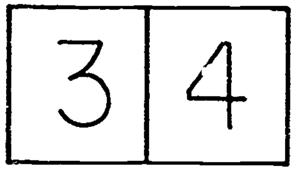
7. Tower visibility is 3 miles.
The corrected transmissometer chart is 86%.
RVR reading for runway 36 is:

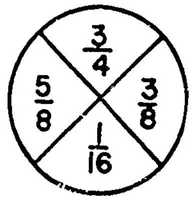




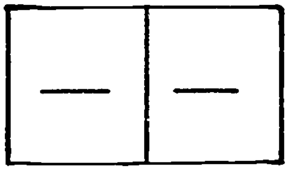
1330

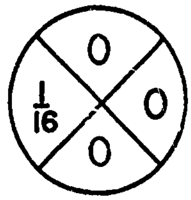
8. Tower reports a visibility of 7 miles.
The corrected transmissometer chart is 62%.
RVR reading for runway 19 is:



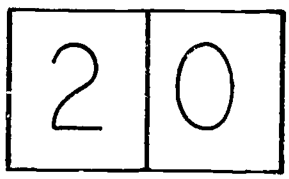


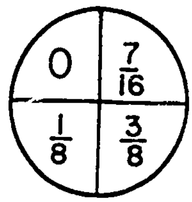
9. Tower reports a visibility of 1/16 of a mile.
The corrected transmissometer chart is 5%.
RVR on runway 18 is:



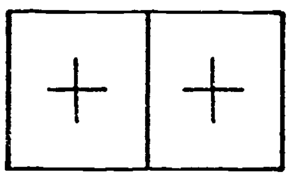


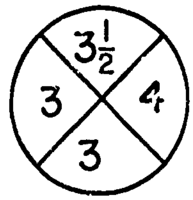
10. Tower visibility is reported as 3/8 mile.
The corrected transmissometer chart is 40%.
RVR on runway 24 is:



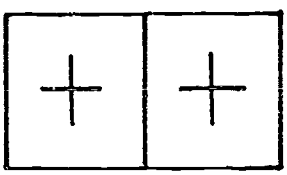


11. Control tower reports 4 miles.
The corrected transmissometer chart reads 93%.
The RVR on runway 27 is:





12. During the period of observation the prevailing visibility was observed to vary from 2 to 4 and back to 3 miles.
Tower visibility is reported as 3 miles.
The corrected transmissometer chart is 87%.
RVR on runway 10 is:



TORNADIC ACTIVITY

1. What is the identifying feature of a tornado, waterspout, or funnel cloud?

2. What is the difference between a tornado and funnel cloud?

3. Give an example of a column 5 entry for a tornado observed at your station.

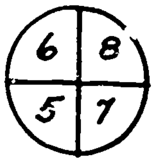
4. Give an example of a column 5 entry for a waterspout reported by the public within the past hour.

5. What items are entered in column 13 for a funnel cloud reported by the public within the past hour?

Use the following data to make the proper entries in columns 4, 5 and 13 of the Form 10. Assume that you are the observer and the station is Chanute AFB.

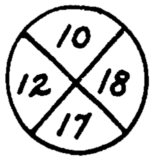
1. A tornado is visible one mile north of the station. The Cumulonimbus Mammatus cloud from which the phenomena is occurring can be seen moving toward the northeast.

TOWER 10



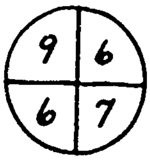
2. A traveling salesman called the observer at 1450L to report seeing a tornado 32 miles east of Chanute AFB. He observed the storm was moving toward the north at 1430L.

TOWER 21



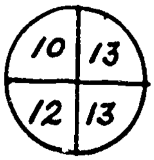
3. A funnel shaped appendage is visible from the weather station. The appendage is south of the station and does not touch the surface. The CBMAM is also visible. The entire storm and cloud system is moving toward the north.

TOWER 13



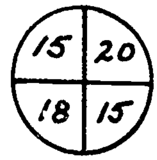
4. Corporal Smith, a state policeman, called the weather station at 0948L to report seeing a tornado at 0845L. The tornado was 11 miles east of Rantoul, IL moving toward the east.

TOWER 15



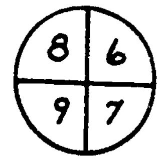
5. The observer received a report of a tornado 15 miles west of Chanute AFB at 1545L. The caller stated he saw the phenomena at 1530L. No additional information was available.

TOWER 24



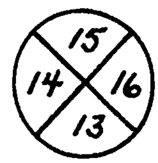
6. The observer can see a funnel cloud to the west of the station. It is moving to the northeast. The cloud, a CBMAM, is also visible and is moving toward the northeast.

TOWER 8



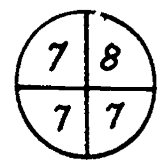
7. A tornado is visible hanging from a CBMAM, which is observed northeast of the station. The cloud is moving toward the northeast.

TOWER 18



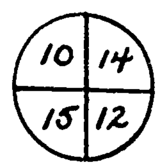
8. The observer can see a waterspout 3 miles east of the station. The CBMAM can be seen moving toward the northeast.

TOWER 9



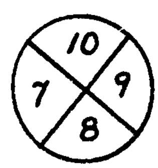
9. A farmer reported seeing a tornado 55 miles northeast of Scott AFB (BLV) at 1130L. He called the Chanute Base Weather station at 1145L to give the information to the observer. The farmer stated the tornado was moving very rapidly toward the northeast.

TOWER 17



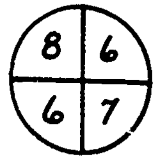
10. You, the observer, sight a CBMAM and a tornado southeast of the station moving toward the northeast.

TOWER 15



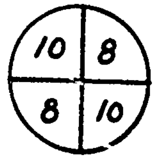
11. A funnel shaped appendage is observed west of the station. The observer can see that the CB cloud and the appendage are moving toward the east. The appendage is not touching the ground.

TOWER 8



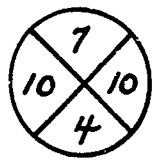
12. You observe, while taking your observation, a CBMAM and a tornado west of the station moving southeast.

TOWER 10



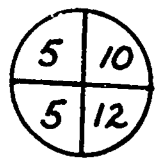
13. You can see a waterspout approaching the station from the south. A CBMAM is visible south moving north and a CB is north of the station moving north.

TOWER 10



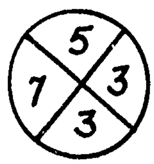
14. A funnel cloud is visible west of the station. You also observe a CBMAM in all quadrants of the sky that is moving toward the east.

TOWER 13



15. Cumulonimbus clouds can be seen to the north and northeast of the station. A CBMAM, producing a funnel cloud, is visible to the southwest. All of the clouds are moving toward the northeast.

TOWER 7



THUNDERSTORM ACTIVITY

1. What types of phenomena are associated with a thunderstorm?

2. When is a thunderstorm considered to have begun at the station?

3. What criteria do we use to determine when a thunderstorm has ended?

4. What is the criteria for determining the intensity of a thunderstorm?

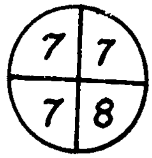
5. What information must be entered in column 13 if a thunderstorm is carried in column 5?

6. What are the four types of lightning?

Use the following data to make the appropriate entires in columns 4, 5 and 13 on the Form 10. Assume that you are the observer and the station is Chanute AFB.

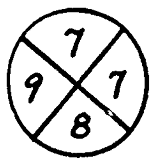
1. Loud peals of thunder are heard and occasional flashes of lightning are seen within a cumulonimbus cloud and from the cloud to air west of the station. The cloud is moving toward the southeast.

TOWER 7



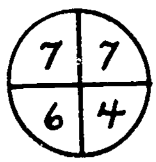
2. Thunder was last heard 10 minutes ago from a cumulonimbus north of the station moving toward the east.

TOWER 7



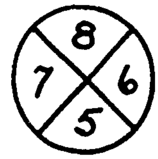
3. Loud peals of thunder are occurring from a cumulonimbus cloud overhead with frequent flashes of lightning from cloud to ground and within the cloud. Occasional flashes of lightning from cloud to air is seen, but no thunder is heard, from a cumulonimbus northeast of the station.

TOWER 4



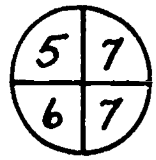
4. Thunder was last heard 13 minutes ago to the southwest. Occasional flashes of lightning within the cloud and from cloud to cloud can be seen to the southwest.

TOWER 5



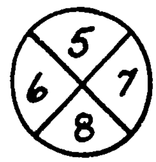
5. Almost continuous thunder and lightning within the cloud and from cloud to cloud is occurring to the west. Surface wind is gusting to 55 knots. The storm is moving toward the northeast. The CB is visible.

TOWER 5



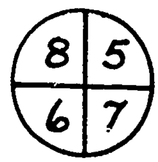
6. A tornado is observed coming from a CBMAM to the north. The cloud is moving toward the east. Thunder was last heard from the cloud to the north about 5 minutes ago. Frequent lightning from cloud to ground is visible to the north. Surface wind is in excess of 50 knots.

TOWER 10



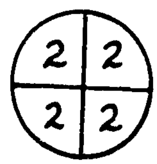
7. A cumulonimbus is visible to the northeast and occasional lightning is occurring within the cloud. Thunder was last heard 15 minutes ago to the northeast. All clouds are moving east.

TOWER 9



8. A CBMAM is visible in all quadrants with a funnel cloud to the east of the station. The storm and clouds are moving east. Thunder is heard to the east and frequent lightning within the cloud, from cloud to ground and from cloud to cloud is seen from the north through the east quadrants.

TOWER 2



PRECIPITATION

1. Name the three characters of precipitation.

2. What is the difference between intermittent and showery precipitation?

3. What cloud form is associated with showery precipitation?

4. What cloud form is associated with intermittent precipitation?

5. What are the three intensities for precipitation?

6. What are the three states or forms of precipitation?

7. Which types of precipitation do not have intensities?

8. What does the "W" stand for when suffixed to a type of precipitation?

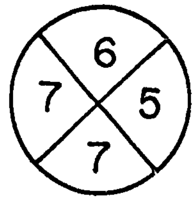
9. What character of precipitation can never be reported as intermittent in column 13?

10. How do you measure amounts of precipitation that exceed two inches?

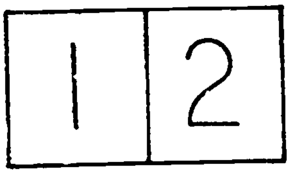
Use the following data to make the proper entries in columns 4, 5 and 13 on the Form 10. Assume that the conditions are occurring at your station, unless otherwise stated. Your station is Chanute AFB.

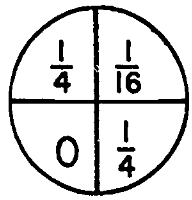
1. Drizzle is falling and freezing on contact with objects on the surface. It has stopped and started again several times in the past hour. The prevailing visibility has varied during the past 15 minutes. The observed values were: 1/2 to 3/4 to 1/16 to 5/8. The tower reports visibility of 1 1/2 miles. The FMN-1 computer on runway 27 LEFT reads + +.

2. Snowshowers of unknown intensity are occurring to the south of the station. The control tower reports visibility as 5 miles.

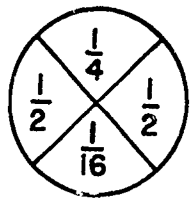


3. Light ice pellets and moderate snow are falling. The tower visibility is reported as 5/16 mile. The corrected transmissometer chart is reading 18%. RVR on runway 09 is:

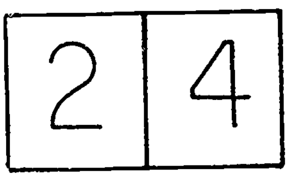


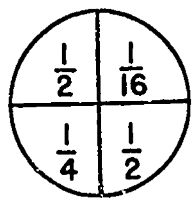


4. Light drizzle and moderate snow grains are falling. Tower reports visibility to be 1/4 mile. The corrected transmissometer chart reads 62%. RVR on runway 32 is 2600 feet.

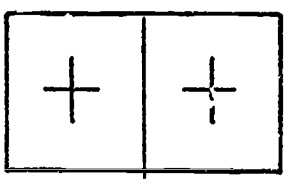


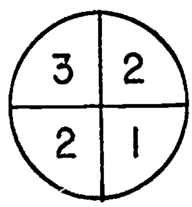
5. Drizzle is falling in a liquid state. Tower reports its visibility to be the same as prevailing. Transmissometer chart reads 60%. The FMN-1 computer on runway 18 reads:



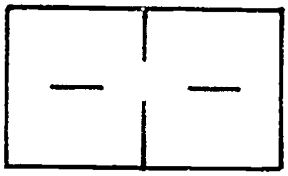


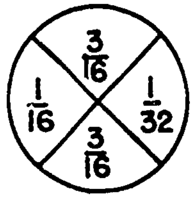
6. Snow is falling at the station. Tower visibility is 7 miles. The transmissometer chart reads 87%. RVR on runway 30 is:



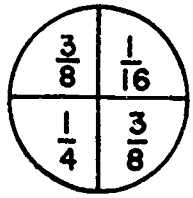


7. Drizzle is occurring at the station. Tower reports its visibility to be 1/32 mile. The transmissometer chart reads 10%. RVR on runway 17 is:

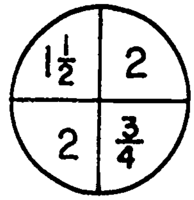




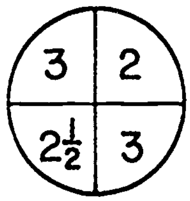
8. Snow is occurring at the station. Tower visibility is the same as the surface. Transmissometer chart on runway 20 reads 46%. FMN-1 computer is inoperative.



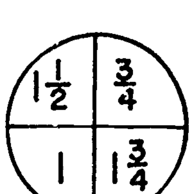
9. Rain is occurring at the station. A total of .09 inch has fallen in the past hour. During the period of observation the rain has stopped and started again. Control tower reports visibility as 4 miles. The transmissometer chart for runway 21 is 88%.



10. Rain is occurring at the station. A total of .06 inch has accumulated within the past hour. Tower visibility is reported as 7 miles. The transmissometer chart is reading 86%. The active runway is runway 31.



11. Moderate rainshowers are occurring at the station. They have stopped and started several times within the past hour. The RVR reading for runway 27 is 6000 feet. The transmissometer chart is indicating 78%. Tower reports its visibility to be 4 miles.



OBSTRUCTIONS TO VISION

1. What is the definition of fog?

2. What is the definition of ground fog?

3. What must the prevailing visibility be before you may carry an obstruction to vision in column 5?

4. What is the difference between dust and blowing dust?

5. In what order will obstructions to vision be entered in column 5 if more than one type is present at the same time?

6. List 5 hydrometeors.

7. List 5 lithometeors.

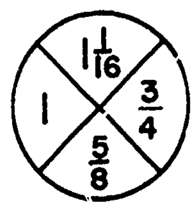
8. What is the abbreviation for blowing sand?

9. If smoke and haze are both restricting the visibility at your station to less than 7 miles and smoke is predominant, which one would be entered first in column 5?

Use the following observational data to make appropriate Form 10 entries for weather, obstructions to vision and visibility.

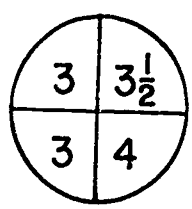
1. Fog is present and extends to a height of 40 feet. The RVR on runway 35 is 3000 feet. The transmissometer chart is reading 65%.

Tower 5

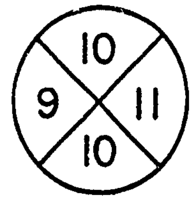


2. Light rain is occurring at the station. Light ice pellets began and ended once within the past 15 minutes. Fog, with the top reaching a height of 18 feet above the surface, is present.

Tower 3

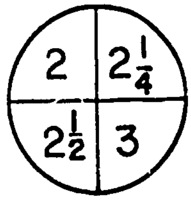


3. Scattered drops of rain which would not wet the surface regardless of duration, are occurring at the station. Fog depth 3 feet. The rain has stopped and restarted in the past 20 minutes.



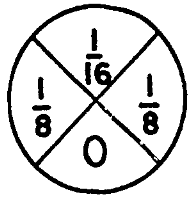
4. Snow is being picked up from the surface to a height of 8 feet by gusty winds. Prevailing visibility is 5 miles. Tower reports the visibility to be 3-1/2.

5. Fog, whose depth is 100 feet, and haze is restricting horizontal visibility, also, light freezing drizzle and light snow grains are falling. Control tower visibility is 2-3/4. The transmissometer chart is reading 91%.



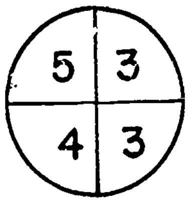
6. Light ice pellets and heavy snow are falling. The FMN-1 reads - - on runway 09. The transmissometer chart is indicating 9%.

Tower 1/4



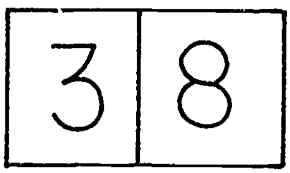
7. Fog at the surface is 17 feet thick. Also, light rainshowers are occurring.

Tower 4

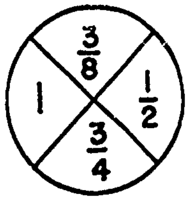


8. A tornado is observed southwest of the station, moving toward the north. Dust is being picked up by gusty surface winds and blown about. Rain began very abruptly and rapidly increased in intensity. It is now moderate. Visibility has varied from 2 to 1/2 to 1 to 1-1/2 miles. Tower reports their visibility to be 1 mile. Transmissometer chart indicates 81%. The FMN-1 indicates + + on runway 14.

9. Drizzle is occurring at the rate of approximately .01 inch per hour. Fog hides 3/10 of the sky and is 113 feet in depth. The transmissometer chart indicates 71%. The RVR value for runway 35 is:

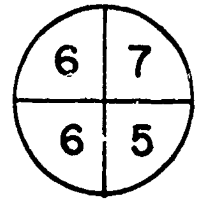


Tower 3/4

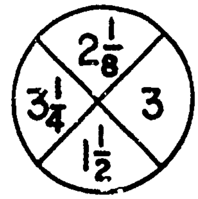


10. The state police reported sighting a tornado 9 miles southeast of Chanute AFB (RAN) at 1215L, and called the base weather station at 1237L. The storm was moving toward the northeast. Dust is present at the station.

Tower 5

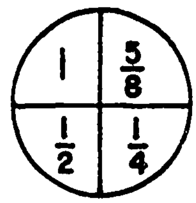


11. Fog and haze, maximum depth of fog is 300 feet, with fog predominant. The control tower reports visibility as 4 miles. The transmissometer chart reads 89%.

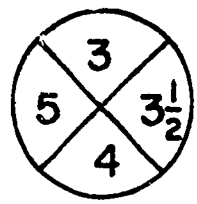


12. Light rain is falling and freezing upon contact with objects on the ground, and moderate ice pellets are occurring. The RVR on runway 12 is 5500 feet. The transmissometer chart indicates 65%.

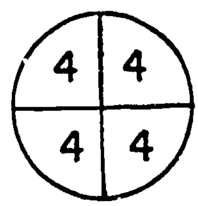
Tower 1/2



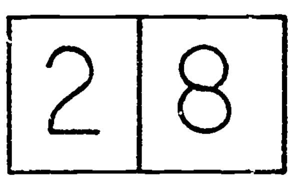
13. Smoke and haze, with haze predominant, is reducing prevailing visibility; also, light drizzle is falling. Tower visibility is reported as 2-1/2 miles.



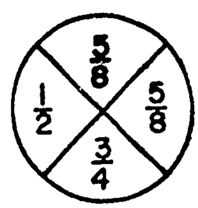
14. Dust is being picked up by high, gusty surface winds enough to restrict visibility. The control tower reports visibility to be 5 miles.



15. Drizzle is falling at the station. The transmissometer chart reads 54%. RVR for runway 17 is:



Tower 1/2



16. A few peals of thunder are heard, occasional flashes of in-cloud lightning are seen, and rainshowers are observed from a cumulonimbus northeast of the station. The cloud is moving toward the east.

8	7
6	9

17. Fog with a depth greater than 20 feet is present during the observation. Tower visibility is 2-1/2 miles.

$2\frac{3}{4}$	3
3	4

18. During the period of observation the prevailing visibility was observed to vary from 3 to 2 and back to 4 miles. Sand is being raised by gusty surface winds to height of 15 feet. Control tower reports visibility to be 5 miles.

19. Fog and smoke are present. Fog is predominant. The depth of the fog is 15 feet.

7	5
5	5

20. Smoke and haze are present. Smoke is predominant.

$2\frac{1}{2}$	10
7	8

21. Moderate snow and light freezing rain are occurring at the station. Fog, depth 150 feet, is present and reducing visibility. Transmissometer chart reads 32%. RVR value for runway 22 is:

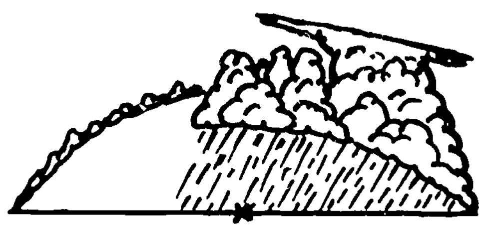
0	$\frac{1}{16}$
$\frac{1}{32}$	0

1	4

Use the following observational data to make entries on the Form 10 for Sky Condition (Col 3), Visibility (Col 4), Weather and Obstructions to vision (Col 5), Remarks (Col 13), and Total Sky Cover (Col 21).

PROBLEM 1

Sky Condition



3/10 TCU at 1,493', measured by the RBC.

3/10 CB at 1,500', estimated.

4/10 SC at 3,500', measured by the clinometer.

All clouds are moving toward the north.

Visibility

The visibility was observed to vary from 2 to 3 and back to 2 1/2 miles during the period of observation.

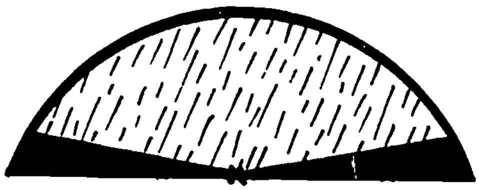
The control tower reports their visibility to be 4 miles.

Weather and Obstructions to vision

Occasional thunder has been heard within the past 15 minutes from a CB to the east of the station. A few flashes of cloud to ground lightning are also observed to the east. Moderate rainshowers are occurring at the station; intensity has varied to light several times during the period of observation.

PROBLEM 2

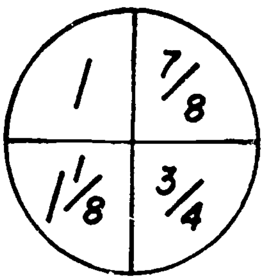
Sky Condition



1/10 of the sky is hidden by fog.

10/10 NS at 800', measured by the RBC.

Visibility



The control tower reports visibility as 2 miles.

The transmissometer chart indicates 81%.

RVR value for runway 27 is:

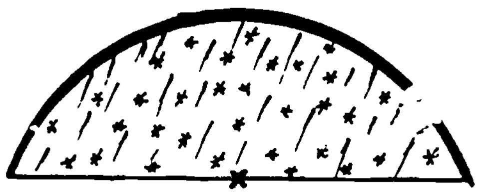
Weather and Obstruction to vision

Light rain is occurring at the station. The rain has stopped and started once during the last 15 minutes. Fog, extending from the surface to a height of 200 feet, is present.

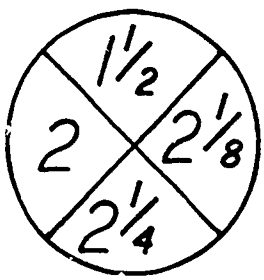
PROBLEM 3

Sky Condition

10/10 NS at 4,000', measured by the RBC 12 minutes ago.



Visibility



The transmissometer chart for runway 20 reads 87%.

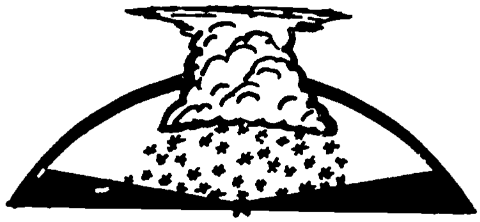
The control tower reports visibility to be 1 mile.

Weather and Obstructions to vision

Light snow, light rain and light ice pellets are occurring at the station.

PROBLEM 4

Sky Condition



1/10 of the sky is hidden by snow.

4/10 CB at 2,500', measured by the RBC, is moving toward the northeast.

6/10 AS at 14,000' MSL, determined by an aircraft.

Visibility

The prevailing visibility was observed to vary from 1/2 to 7/8 and back to 1/2 mile, during the period of observation.

The control tower reports visibility as 3/4 mile.

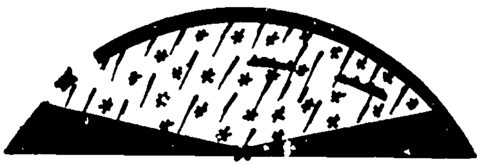
The transmissometer chart indicates 62%. Runway 36 RVR is 3,000 feet.

Weather and Obstructions to vision

Snowshowers are occurring at the station.

PROBLEM 5

Sky Condition

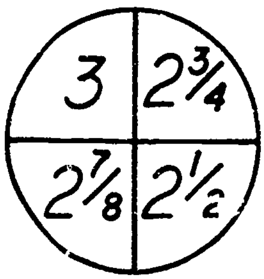


2/10 of the sky is hidden by fog.

2/10 STFRA (all thin) at 500'.

10/10 NS at 1,500' MSL, reported by a pilot. There are small breaks to the west.

Visibility



The control tower reports visibility of 3-1/2 miles.

The FMN-1 on runway 21 Right indicates:

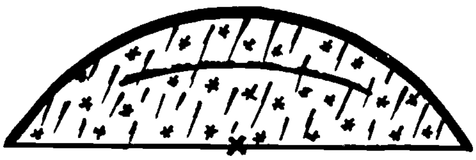
4	0

Weather and Obstructions to vision

Light snow, moderate snow grains, light freezing rain and fog are occurring at the station.

PROBLEM 6

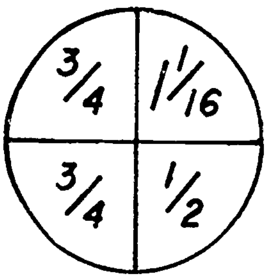
Sky Condition



6/10 ST at 400', determined by the ceilometer.

10/10 NS at 1,800', estimated.

Visibility



The RVR value for runway 09 is 3,600 feet.

The transmissometer chart is reading 67%.

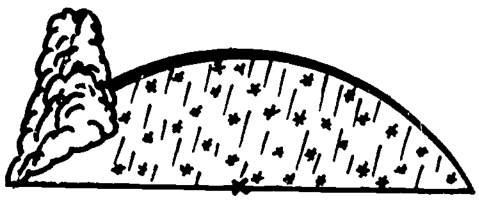
The control tower reports visibility of 3/4 mile.

Weather and Obstructions to vision

Light freezing drizzle and light snow grains are occurring. Fog, depth 50 feet, is present at the station.

PROBLEM 7

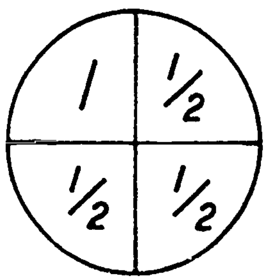
Sky Condition



2/10 TCU at 1,200' MSL, west of the station.

8/10 AS at 14,000' MSL, determined by the pilot of a KC-135 aircraft.

Visibility



The transmissometer chart indicates 80%.

The RVR value on runway 35 is:

6 0

Weather and Obstructions to vision

Light freezing rain, light snow and moderate ice pellets are falling.

PROBLEM 8

Sky Condition

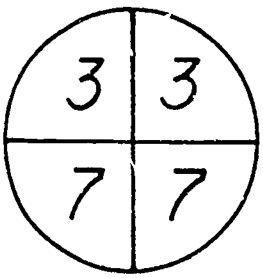
3/10 CB at 1,500' determined by the RBC, is observed west of the station.

3/10 CBMAM at 1,500', measured by the RBC 20 minutes ago, is observed north of the station.

4/10 CS at 40,000' MSL, is visible.

All clouds are moving toward the north.

Visibility



The control tower reports visibility of 7 miles.

Weather and Obstructions to vision

A tornado is observed north of the station. The cloud from which it is occurring is moving toward the north. Loud thunder and frequent flashes of lightning are heard and seen within the cloud and from cloud to ground to the north. Haze is present at the station.

PROBLEM 9

Sky Condition

5/10 CU at 2,500', has moderate development and is moving toward the northeast.

4/10 SC at 4,500', measured by the clinometer.

Visibility

Visibility is varying and the following values are observed during the period of observation: 2 to 1/4 to 1-1/2 and back to 3/4.

The tower reports the visibility to be 1-1/2 miles.

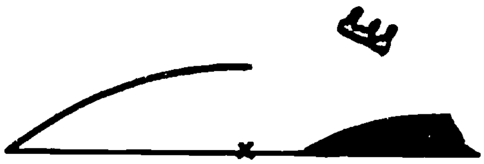
The transmissometer chart reads 82% and the FMN-1 reads + +. (The active runway is 18)

Weather and Obstructions to vision

Light snowshowers and light snow pellets are falling.

PROBLEM 10

Sky Condition



1/10 of the sky is hidden by a fog bank east of the station.

5/10 SMOKE (3/10 Thin) at 900', estimated height.

1/10 AC at 9,500' MSL, reported by the crew of an F-16 aircraft.

Visibility

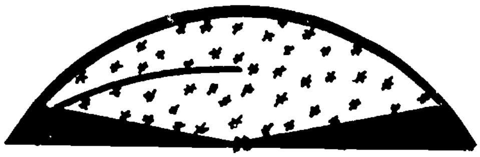
The prevailing visibility is 4 miles. The control tower reports the visibility as 5 miles.

Weather and Obstructions to vision

Haze and smoke are present. Haze is predominant. There is a fog bank east of the station.

PROBLEM 11

Sky Condition

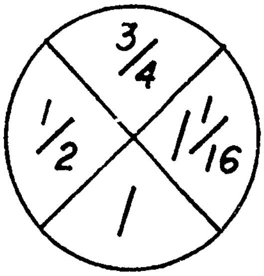


2/10 of the sky is hidden by snow and blowing snow.

4/10 ST at 700' (all thin), determined by the Rotating Beam Ceilometer.

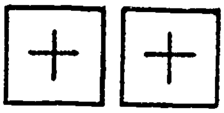
10/10 NS at 2,200', determined by the clinometer.

Visibility



The transmissometer chart indicates 85%.

The FMN-1 computer for runway 21 reads:

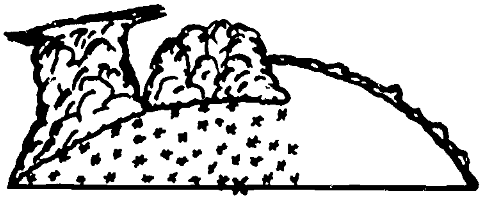


Weather and Obstructions to vision

Light snow is occurring at the station. Surface winds are picking up snow and lifting it to a height of more than 6 feet above the surface.

PROBLEM 12

Sky Condition



3/10 CB at 1,200', estimated, is observed west of the station moving toward the northeast.

3/10 TCU at 1,162', measured by the RBC.

4/10 SC at 4,000', estimated.

Visibility

The prevailing visibility is restricted to 5 miles.

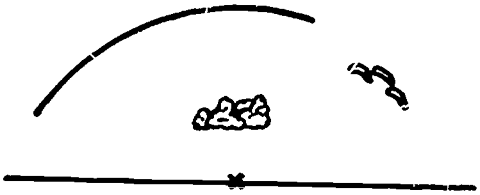
The control tower reports visibility of 3 miles.

Weather and Obstructions to vision

The snow, which is occurring now, began very abruptly. The intensity has varied to moderate several times during the past 15 minutes.

PROBLEM 13

Sky Condition

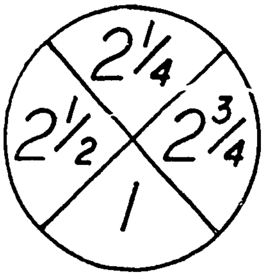


2/10 CU has just formed over the airfield. The current temperature and dew point are:
Temp 65°F
D.P. 52°F

2/10 AC at 11,000' MSL, in the shape of almonds.

4/10 CS (All Thin) at 26,000' MSL, reported by a pilot.

Visibility



The control tower reports the visibility as being 2 miles.

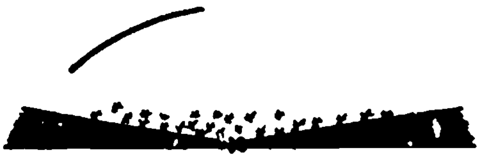
Weather and Obstructions to vision

A rainshower of moderate intensity started and stopped in the past 15 minutes. Fog is present with a maximum depth of 30 feet.

1416

PROBLEM 14

Sky Condition



2/10 of the sky is hidden by snow.

2/10 SMOKE (1/10 Thin) at 7,000' MSL.

Visibility

The prevailing visibility rapidly varied from 3 to 2 and back to 3 miles during the period of observation. The control tower reports their visibility to be 3 miles.

Weather and Obstructions to vision

Snow is being picked up from the surface and blown about so as to restrict the visibility.

PROBLEM 15

Sky Condition

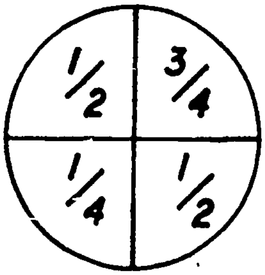
2/10 of the sky is hidden by rainshowers.

A trace of CUFRA at 500'.

4/10 CB at 1,800', measured by the RBC.

6/10 SC (4/10 visible) at 4,500', estimated.

Visibility



The transmissometer chart indicates 75%.

The RVR on runway 19 reads 5,000'.

The control tower visibility is 1 mile.

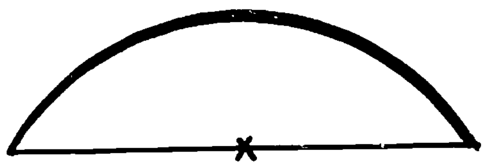
Weather and Obstructions to vision

Frequent thunder and lightning are occurring from a Cumulonimbus which is overhead. The cloud is moving to the northeast. A heavy rainshower and 1/2 inch hail are occurring at the station. The lightning is occurring in the cloud overhead.

PROBLEM 16

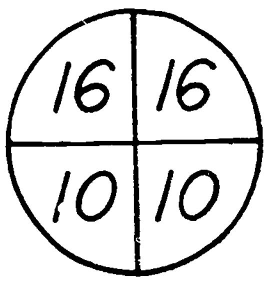
Sky Condition

10/10 CS at 45,000', reported by a pilot.



Visibility

The control tower reports visibility of 18 miles.

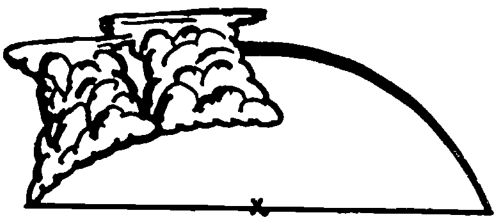


Weather and Obstructions to vision

The state police reported sighting a funnel cloud which was not touching the surface 20 miles south of Rantoul moving south at 1500L. They called the report in at 1615L. Fog is present at the station, depth of 5 feet.

PROBLEM 17

Sky Condition

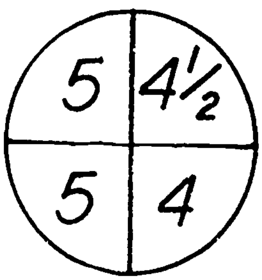


3/10 CB at 2,000', estimated, west of the station moving northeast.

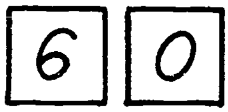
3/10 CB at 2,000', estimated, north of the station moving northeast.

4/10 CS at 46,000', MSL, reported by the pilot of a B-52 aircraft.

Visibility



The FMN-1 on the center runway 36 indicates:

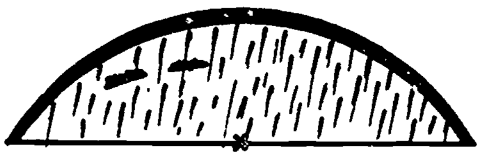


Weather and Obstructions to vision

A few peals of thunder are heard, occasional flashes of cloud to cloud lightning are observed to the north. Rainshowers of unknown intensity are observed to the north. Dust is being raised by gusty surface winds enough to restrict the visibility.

PROBLEM 18

Sky Condition



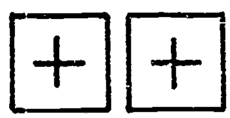
2/10 STFRA (All Thin), at 300', determined by the RBC.

10/10 NS at 1,200', determined by the RBC.

Visibility

Surface visibility is 3 miles and the control tower reports visibility as 3 miles.

The FMN-1 computer on runway 14 reads:

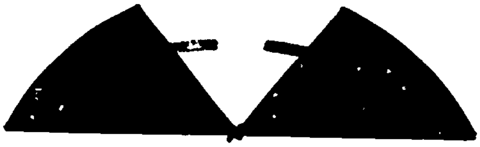


Weather and Obstructions to vision

Rain is falling at the rate of .10 inch per hour. Fog, depth 15 feet is also present at the station.

PROBLEM 19

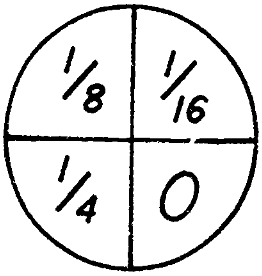
Sky Condition



6/10 of the sky is hidden by fog.

3/10 ST, measured by a 10 gr. balloon:
Fade time 1:03
Disappear time 1:47

Visibility



Control tower reports visibility of 1/4 mile.

The transmissometer chart reads 5% for runway 35.

The FMN-1 computer is inoperative.

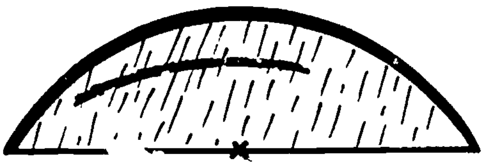
Weather and Obstructions to vision

Fog, extending from the surface to a height of 200 feet, is present.

1422

PROBLEM 20

Sky Condition



5/10 STFRA, (all thin), determined by the RBC at 200 feet.

10/10 ST, at 1,200 feet, measured by a ceiling balloon.

Visibility

The visibility is 2-1/4 miles in all quadrants. The control tower visibility is the same as the prevailing.

The transmissometer equipment is inoperative.

Weather and Obstructions to vision

Drizzle is falling at the time of observation. It has stopped twice during the hour.

PROBLEM 21

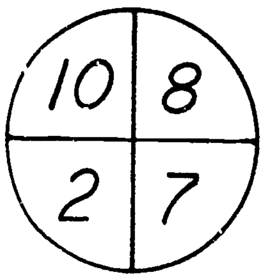
Sky Condition

1/10 CUFRA, at 500', estimated.

5/10 TCU, at 1,800', determined by the RBC, extends from the southwest through the north of the station. These clouds are all moving toward the northeast.

5/10 SC, bases at 3,500' MSL was reported by the pilot of a CH-47 on takeoff.

Visibility



The control tower visibility is 5 miles.

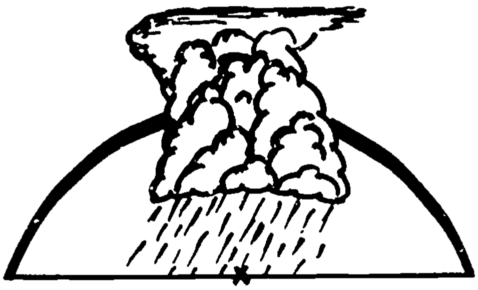
The FMN-1 computer is inoperative.

Weather and Obstructions to vision

Snowshowers of unknown intensity are occurring to the southwest of the station. Some fog, with a depth of 4 feet, is visible at the station.

PROBLEM 22

Sky Condition



2/10 TCU, 1,500', estimated.

4/10 CBMAM, 1,500', north of the station.

10/10 AS, 9,000' MSL.

Visibility

The visibility is 4 miles. The control tower reports the visibility as 7 miles.

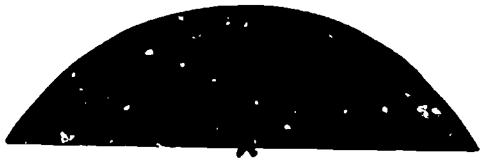
Weather and Obstructions to vision

Thunder was last heard 8 minutes ago to the north. Light rain is falling at the station with its intensity varying to moderate throughout the period of observation. A few flashes of lightning can be seen from cloud to cloud and within the cloud to the north. The clouds are moving toward the northwest.

1425

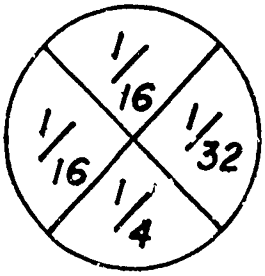
PROBLEM 23

Sky Condition



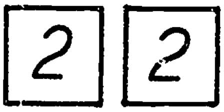
10/10 of the sky is hidden by snow. The vertical visibility was determined to be 200' by the RBC 10 minutes ago.

Visibility



The tower visibility is reported as 5/16 mile.

The FMN-1 computer on runway 35 reads:



Weather and Obstructions to vision

Light ice pellets and heavy snow are falling.

1426

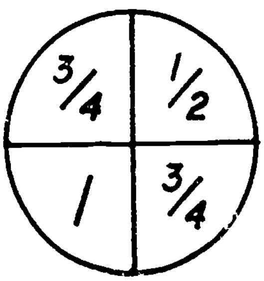
PROBLEM 24

Sky Condition

2/10 of the sky is hidden by rain and fog.

10/10 (8/10 visible) NS, heights as indicated by the RBC have varied: 300' to 100' to 400' and back to 200' during the past 15 minutes.

Visibility



The tower visibility is reported to be 3/8 mile.

The FMN-1 computer for runway 13 is not operating. The corrected transmissometer chart reading is 78%.

Weather and Obstructions to vision

Moderate rain is falling and freezing immediately upon contact with objects on the ground. Fog is also present.

PROBLEM 25

Sky Condition

5/10 CU, 1,300', estimated. (The amount has varied to 6/10 during the period of observation.)

4/10 SC, 2,500', by the RBC.

Visibility

The prevailing visibility is 8 miles.

Weather and Obstructions to vision

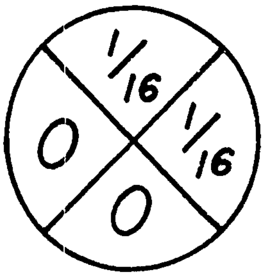
Scattered snow flakes are falling. They will not cover an exposed surface regardless of duration.

PROBLEM 26

Sky Condition

10/10 of the sky is obscured by snow and rain. The vertical visibility is 700'.

Visibility



The control tower reports visibility of 0.

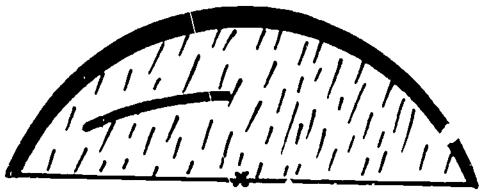
The FMN-1 computer on runway 02 reads:

Weather and Obstructions to vision

Heavy snow and light rain are falling.

PROBLEM 27

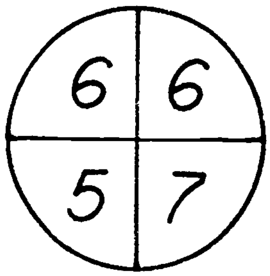
Sky Condition



3/10 Smoke, 1,200', estimated.

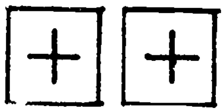
10/10 AS, reported by a pilot at 9,300'.

Visibility



The control tower visibility is 7 miles.

The FMN-1 on runway 23 Right reads:

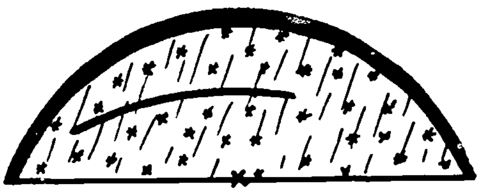


Weather and Obstructions to vision

Rain is falling at the rate of .05 inch in one hour.

PROBLEM 28

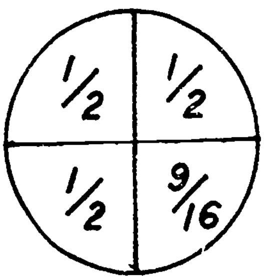
Sky Condition



5/10 ST at 700', measured by the RBC.

10/10 NS at 1,400', measured by the RBC.

Visibility



The transmissometer chart on runway 32 reads 52%.

The FMN-1 for Runway 32 reads:

2	6

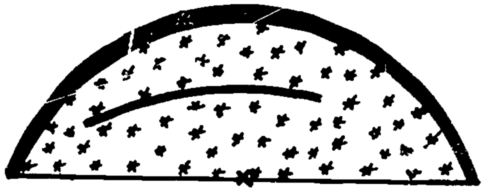
Weather and Obstructions to vision

Light drizzle and moderate snow grains are falling.

1431

PROBLEM 29

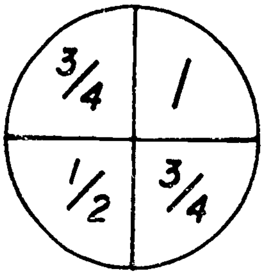
Sky Condition



6/10 ST at 500', measured by the RBC. (The amount has varied to 5/10 during the past 15 minutes.)

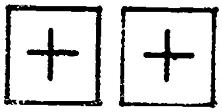
10/10 NS at 1,800', measured by the RBC.

Visibility



Tower visibility is 1 mile.

The FMN-1 on Runway 27 Center reads:

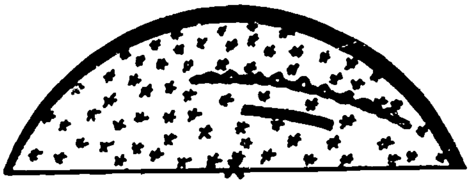


Weather and Obstructions to vision

Snow has been falling for the past several hours. The intensity has not changed and the snow stopped and started twice during the past hour. It is still snowing at the time of observation.

PROBLEM 30

Sky Condition

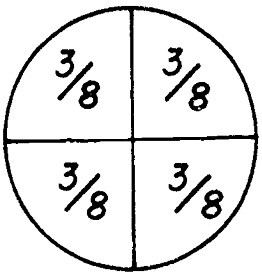


2/10 ST at 300', estimated.

4/10 SC at 2,000', measured by the RBC.

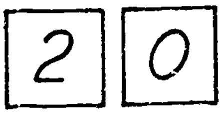
10/10 AS at 11,000' MSL, reported by the pilot of an F-111 during takeoff.

Visibility



The tower visibility is 1/2 mile.

The FMN-1 on Runway 10 Left reads:

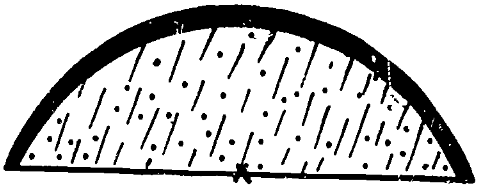


Weather and Obstructions to vision

Moderate snow and light ice pellets are falling at the station. Fog is also present. A pilot reported the top of the fog to be 1,100 feet MSL.

PROBLEM 31

Sky Condition



10 NS at 4,000', determined by the ceilometer (RBC).

Visibility

The prevailing visibility is varying and the following values are observed during the period of observation: 1/2 to 1-3/4 to 3/4 mile.

The FMN-1 computer indicates the RVR on Runway 18 is:

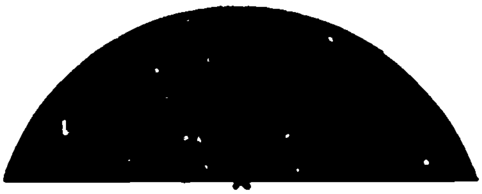
3	0

Weather and Obstructions to vision

Moderate rain and light ice pellets are falling.

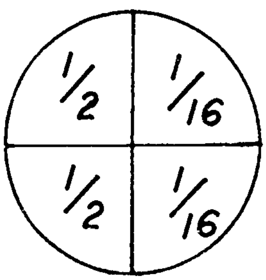
PROBLEM 32

Sky Condition



10/10 of the sky is obscured by drizzle and fog. Fog is predominant. The vertical visibility is 300' determined by the RBC.

Visibility



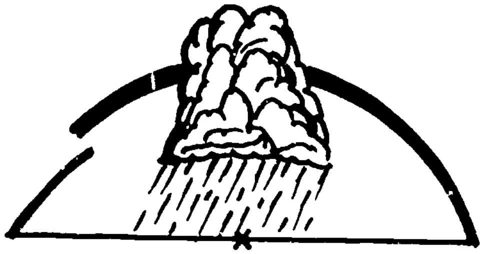
The RVR on Runway 15 is 2,800 feet. The control tower reports visibility of 1 mile.

Weather and Obstructions to vision

Light drizzle is falling and fog is present at the station.

PROBLEM 33

Sky Condition



4/10 TCU at 1,400', overhead moving toward the north.

2/10 SMOKE (all thin) at 7,000', west of the station.

4/10 CS (all thin) at 27,000' MSL.

Visibility

The prevailing visibility is 1/4 mile. The control tower reports visibility of 1 mile. The FMN-1 computer on Runway 27 reads 6,000 feet.

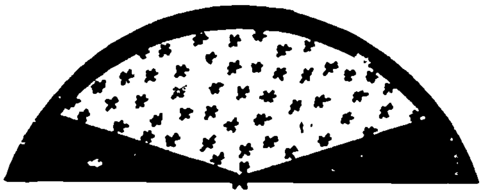
Weather and Obstructions to vision

Moderate rainshowers are occurring at the station. The intensity has varied to heavy during the last 15 minutes.

1436

PROBLEM 34

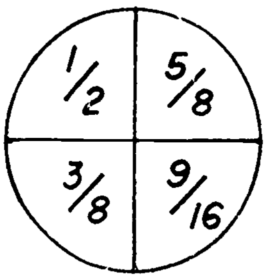
Sky Condition



2/10 of the sky is hidden by snow.

10/10 AS at 7,000', estimated.

Visibility



The control tower reports visibility of 1 mile.

The FMN-1 on Runway 09 indicates:

2	5

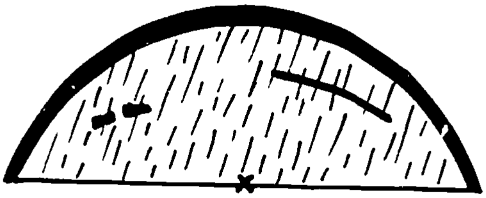
Weather and Obstructions to vision

Snow is occurring at the station. Determine the intensity in terms of effects on the visibility.

1437

PROBLEM 35

Sky Condition

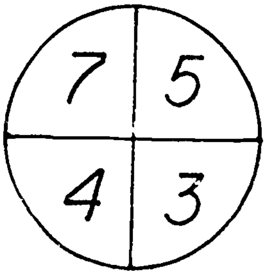


1/10 STFRA at 100', estimated.

3/10 ST at 600', measured.

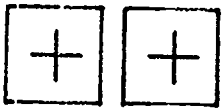
10/10 NS at 4,000' MSL.

Visibility



Control tower visibility is 4 miles.

The FMN-1 computer on Runway 31 reads:

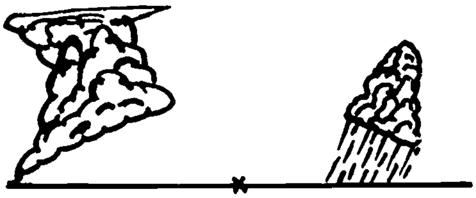


Weather and Obstructions to vision

Rain is occurring at the station with .09 inch accumulated in the past hour. During the past 15 minutes the rain stopped and then started again.

PROBLEM 36

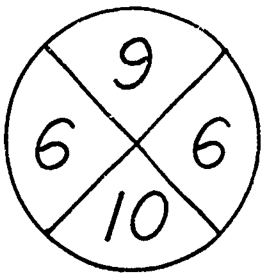
Sky Condition



3/10 CB at 1,800', southwest of the station moving toward the north.

1/10 TCU at 1,800', east of the station moving toward the north.

Visibility



The control tower reports visibility of 15 miles.

The transmissometer equipment is not operating.

Weather and Obstructions to vision

Thunder was last heard 13 minutes ago to the southwest. Light rainshowers started 14 minutes ago, but are not occurring now. Occasional flashes of lightning are occurring within the cloud and from the cloud to ground to the southwest. Rainshowers of unknown intensity are observed to the east of the station.

1439

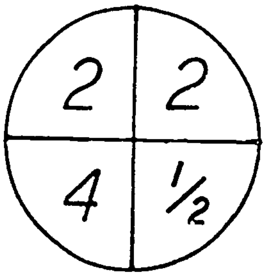
PROBLEM 37

Sky Condition

6/10 of the sky is hidden by rainshowers.

4/10 CB is at 1,100', measured by the RBC is visible overhead through the east.

Visibility



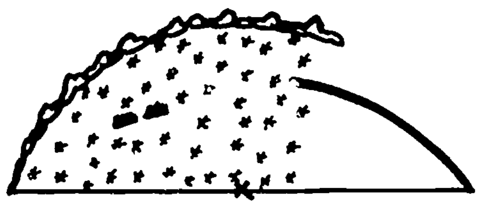
The control tower reports their visibility to be 5 miles with the visibility lower to the east and south.

Weather and Obstructions to vision

Heavy rainshowers and 3/4 inch hail are occurring at the station. Almost continuous thunder and lightning are occurring within the cloud, from cloud to ground and from cloud to air to the east. The storm is moving to the east. The rainshowers have varied to moderate intensity several times during the period of observation.

PROBLEM 38

Sky Condition

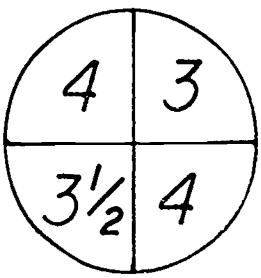


1/10 STFRA (all thin) at 400'.

4/10 ST (2/10 thin) at 900' determined by the RBC. (The amount of transparency has varied to 1/10 thin during the past 15 minutes.)

6/10 SC at 3,500', determined by the RBC.

Visibility



The control tower reports their visibility to be 3-1/2 miles.

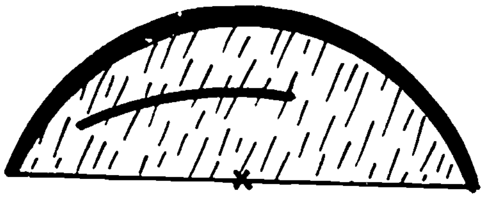
Weather and Obstructions to vision

Snow is occurring at the station. It has stopped and restarted once in the past hour.

1441

PROBLEM 39

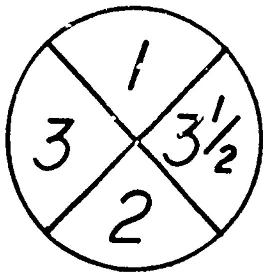
Sky Condition



4/10 ST (2/10 thin) at 500'.

10/10 NS at 1,900' MSL reported by the pilot of a B-52.

Visibility



Tower visibility is 1 mile.

The FMN-1 on Runway 06 reads:

2	0

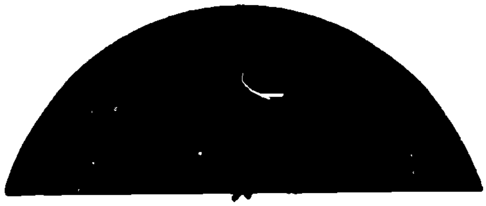
Weather and Obstructions to vision

Drizzle started and stopped within the past 15 minutes and is now occurring. Fog is also present. The top of the fog is 475 feet.

 1442

PROBLEM 40

Sky Condition



10/10 fog hides the sky. The vertical visibility was reported by a pilot on takeoff as 900' MSL.

Visibility

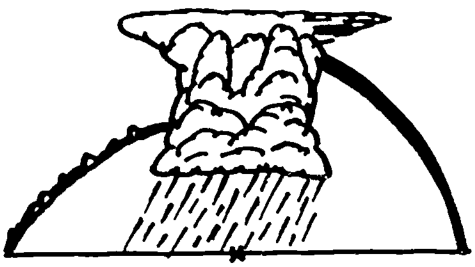
The prevailing visibility has varied from 1/16 to 3/4 to 3/16 and back to 1 mile during the past 15 minutes. The RVR on Runway 18 is 1,000 feet.

Weather and Obstructions to vision

Light drizzle and heavy, dense fog are occurring at the station. The pilot of an F-4 on takeoff reported the top of the fog layer at 2,700 feet MSL.

PROBLEM 41

Sky Condition

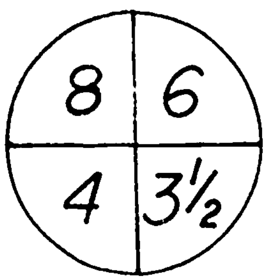


5/10 CB at 2,500', determined by the RBC, is north of the station and moving toward the north.

3/10 AC at 9,300', measured by radar.

2/10 CS at 39,000' MSL, reported by a pilot.

Visibility



Weather and Obstructions to vision

Thunder was last heard 15 minutes ago from a Cumulonimbus to the north of the station moving north. Light rain is occurring at the station. The rain has stopped and started abruptly within the past 15 minutes. Occasional lightning within the cloud is observed to the north.

1444

PROBLEM 42

Sky Condition

7/10 of the sky is hidden by heavy rainshowers.

3/10 CB is visible at an estimated 3,[illegible]00'.

Visibility

The prevailing visibility is varying and the following values are observed during the period of observation: 1/2 to 1/4 to 3/4 to 1/2 mile.

The control tower visibility is 3/4 mile.

The transmissometer equipment is not operational.

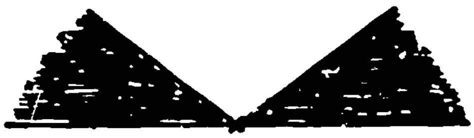
Weather and Obstructions to vision

Severe thunderstorms with 1-1/4 inch hail and heavy rainshowers are occurring at the station. Thunder can be heard in all quadrants. Frequent lightning from cloud to ground and within the cloud is occurring overhead and to the north. Occasional lightning within the cloud can be seen to the east. The clouds are moving toward the southeast.

1445

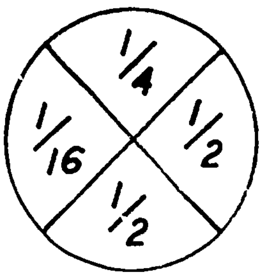
PROBLEM 43

Sky Condition



5/10 of the sky is hidden by blowing snow.

Visibility



The control tower reports their visibility as 15 miles.

The FMN-1 computer on Runway 31 reads:

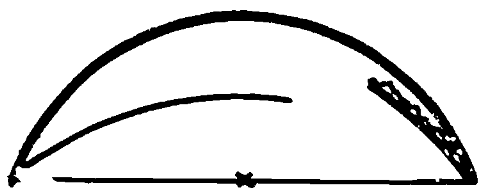
3	0

Weather and Obstructions to vision

Snow is being picked up by high, gusty surface wind and blown about enough to restrict the visibility. The snow is causing considerable drifting on the runways.

PROBLEM 44

Sky Condition

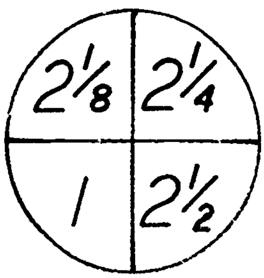


6/10 ST at 600', determined by the Rotating Beam Ceilometer.

2/10 SC at 2,000', estimated.

10/10 NS at 5,000', estimated.

Visibility



Tower visibility is 3-1/2 miles.

The RVR on runway 24 is:

6 0

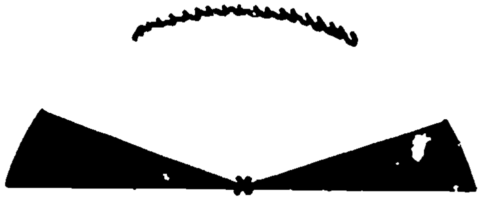
Weather and Obstructions to vision

Light drizzle is falling and fog is present. The control tower reports the fog depth as 50 feet.

1447

PROBLEM 45

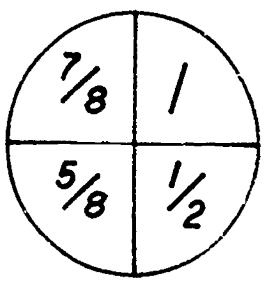
Sky Condition



3/10 of the sky is hidden by fog.

3/10 CI (all thin) at 23,000'.

Visibility



The transmissometer chart is indicating 59%.

The FMN-1 on runway 32 is reading:

2 8

Weather and Obstructions to vision

Fog, depth of 250 feet, is restricting the horizontal visibility.

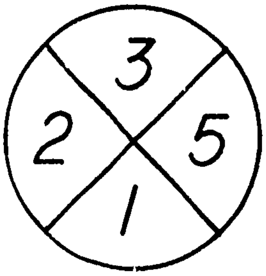
PROBLEM 46

Sky Condition

5/10 SC at 2,700', estimated.

3/10 CI (all thin), at 24,000' MSL.

Visibility



Tower visibility: 5 miles.

RVR on runway 13 reads 6,000 feet.

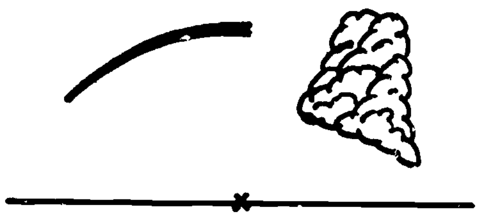
Weather and Obstructions to vision

Blowing snow and light ice pellets are occurring.

1449

PROBLEM 47

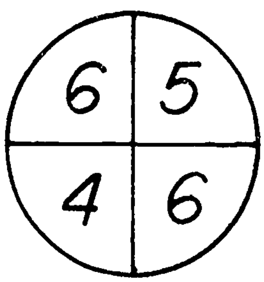
Sky Condition



3/10 TCU at 2,500', determined by the RBC 30 minutes ago.

4/10 DUST (2/10 thin) at 14,000', reported by a pilot.

Visibility



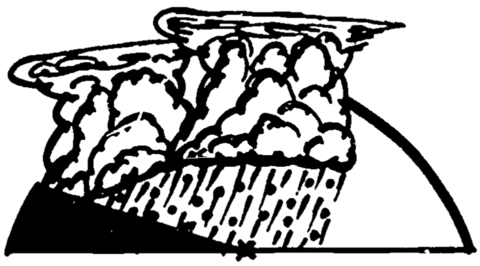
Tower reports the visibility to be 3 miles.

Weather and Obstructions to vision

Haze and smoke are present. Smoke is predominant.

PROBLEM 48

Sky Condition



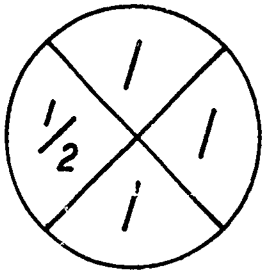
2/10 of the sky is hidden by rainshowers west of the station.

4/10 CB (2/10 visible) at 1,600', estimated, west of the station is moving north.

4/10 CB at 1,600', measured by the RBC, extends from overhead to north of the station and is moving north.

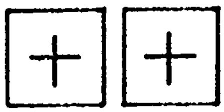
2/10 CS at 28,000', estimated.

Visibility



Control tower visibility: 3 miles.

The FMN-1 on runway 09 reads:

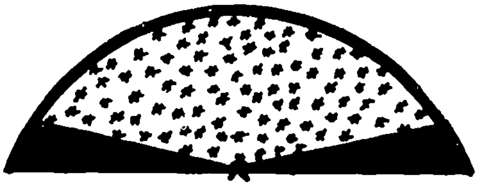


Weather and Obstructions to vision

Almost continuous thunder and lightning within the cloud and from cloud to cloud is occurring to the west. Heavy rainshowers and hail (largest stone 1-1/2 inch) are occurring at the station. The intensity of the rainshowers has varied to moderate several times during the period of observation.

PROBLEM 49

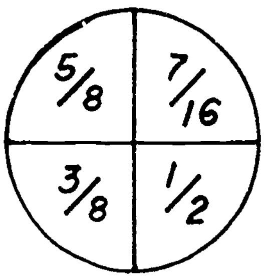
Sky Condition



2/10 of the sky is hidden by snow.

10/10 NS at 2,900', measured by the RBC.

Visibility



The control tower reports visibility of 5/8 mile.

The FMN-1 for runway 22 reads:

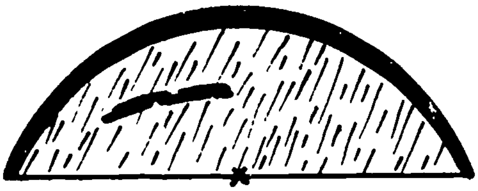
2	4

Weather and Obstructions to vision

Snow is occurring at the station and has stopped and started once in the last 15 minutes.

PROBLEM 50

Sky Condition



2/10 STFRA at 300', RBC.

10/10 NS, a 10 gram balloon began to fade at 1 minute, 27 seconds and completely disappeared at 2 minutes, 39 seconds.

Visibility

The prevailing visibility has varied from 4 to 5 to 3 and back to 4 miles during the period of observation.

Weather and Obstructions to vision

Rain, occurring now, has accumulated .11 inch since it started an hour ago.

1453

PROBLEM 51

Sky Condition

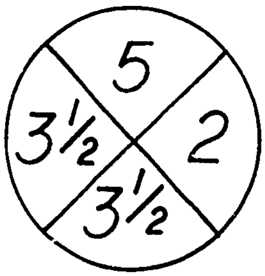
2/10 CUFRA at 800', estimated.

4/10 CBMAM at 1,300', RBC.

3/10 SC at 1,300', estimated.

3/10 AC at 8,925' MSL.

Visibility



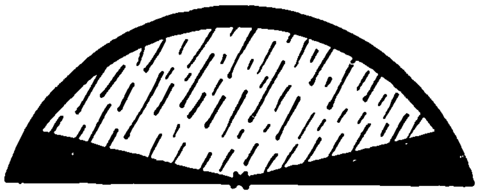
Tower reports visibility of 2 miles.

Weather and Obstructions to vision

A funnel-shaped appendage, not touching the ground, is observed hanging from the base of a Cumulonimbus Mammatus to the north. The cloud is moving to the northeast. Thunder was last heard 5 minutes ago to the north. Occasional flashes of lightning from cloud to ground are visible to the north. Light rainshowers which have varied to moderate several times during the past 15 minutes are occurring at the station.

PROBLEM 52

Sky Condition

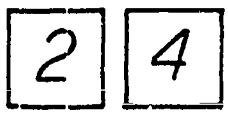


2/10 of the sky is hidden by rain and fog.

10/10 NS at 600', measured by the RBC.

Visibility

The prevailing visibility has varied from 1/2 to 3/4 to 1 and back to 3/4 mile. Visibility at the tower level is 7/8 mile. The FMN-1 computer on runway 15 reads:

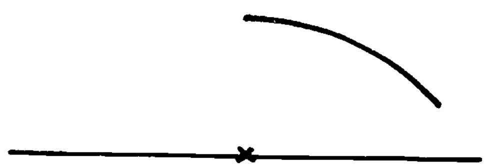


Weather and Obstructions to vision

Rain, occurring at the station, has accumulated an amount of .04 inch in the last hour. The rain has varied to moderate during the period of observation. Fog is also present.

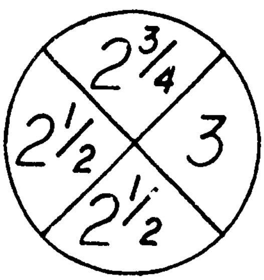
PROBLEM 53

Sky Condition



4/10 SMOKE at 15,000' MSL was reported by the pilot of a C-141 aircraft and is visible from the station.

Visibility



Tower visibility: 7 miles.

Weather and Obstructions to vision

A rainshower moved through the station area during the past hour. It is no longer visible from the station. Fog, reaching a height of 15 feet, is restricting the horizontal visibility.

1456

PROBLEM 54

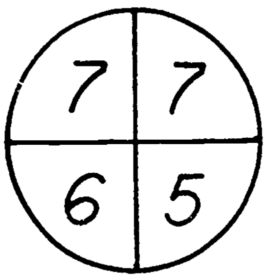
Sky Condition

6/10 ST (all opaque) at 800', height estimated.

7/10 SC at 1,200', measured by the RBC.

10/10 NS at 8,000' MSL, reported by a pilot.

Visibility



Control tower visibility: 7 miles.

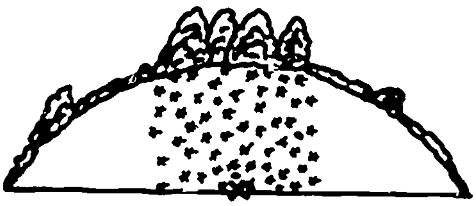
The FMN-1 computer is inoperative. The transmissometer chart indicates 89%.

Weather and Obstructions to vision

Rain began slowly and gradually increased in intensity; .02 inch has accumulated in the past hour. Fog is present.

PROBLEM 55

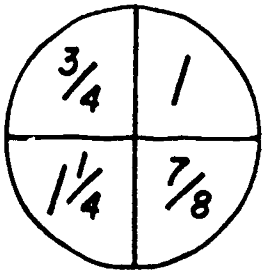
Sky Condition



4/10 CU at 1,500', RBC.

6/10 SC at 1,500', RBC.

Visibility



The control tower visibility is 1-1/2 miles.

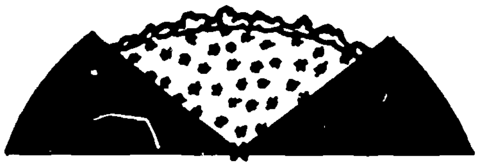
The transmissometer equipment is inoperative due to projector malfunction. The active runway is 17.

Weather and Obstructions to vision

Light snowshowers are occurring at the station. They have varied from light to moderate several times during the past 15 minutes. Snow is being picked up from the surface by gusty wind and raised to a height of 4 feet. There are snow drifts on the runway.

PROBLEM 56

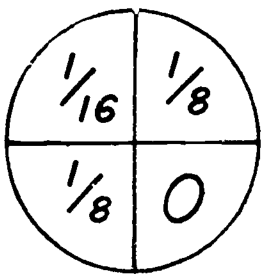
Sky Condition



6/10 of the sky is hidden by smoke and dust.

10/10 SC at 4,000', measured by the RBC.

Visibility



The control tower reports visibility is 0 at that level.

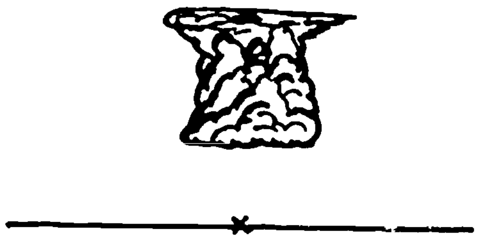
The transmissometer equipment is inoperative.

Weather and Obstructions to vision

Light ice pellets are occurring at the time of observation. Dust and smoke are present with the smoke being predominant.

PROBLEM 57

Sky Condition



2/10 CB at 2,500', estimated, north of the station.

Visibility

The prevailing visibility is 35 miles.

Weather and Obstructions to vision

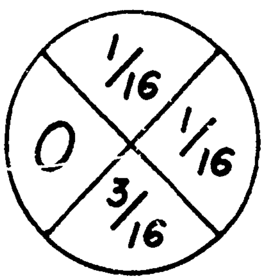
Thunder was heard from a Cumulonimbus north of the station 16 minutes ago. The cloud is moving north.

PROBLEM 58

Sky Condition

10/10 of the sky is observed by a mixture of snow and rain. The vertical visibility is 400'.

Visibility



Control tower visibility is 1 mile.

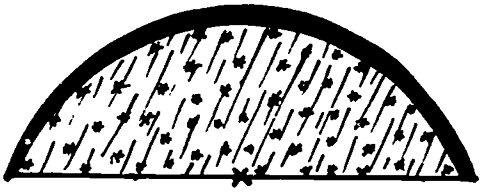
The FMN-1 computer on runway 25 is reading:

Weather and Obstructions to vision

Continuous heavy snow and moderate freezing rain are falling at the station.

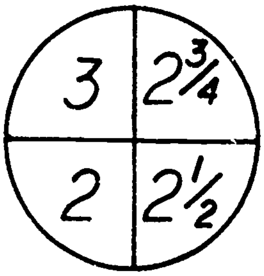
PROBLEM 59

Sky Condition



10/10 NS at 5,692', measured by the Clinometer.

Visibility



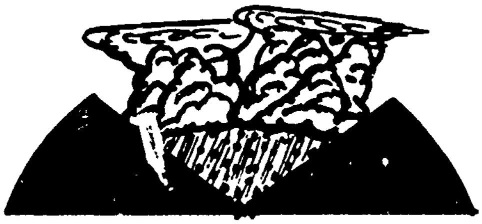
The control tower reports visibility as 3 miles.

Weather and Obstructions to vision

Light ice pellets, moderate rain and light snow are falling at the station.

PROBLEM 60

Sky Condition

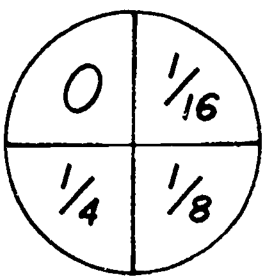


5/10 of the sky is hidden by rainshowers.

2/10 CB at 1,200', is visible from the northwest through north of the station.

3/10 CBMAM at 1,200', (RBC), is visible from overhead through east of the station.

Visibility



The FMN-1 computer is inoperative. The transmissometer for runway 27 is indicating: 4%

Weather and Obstructions to vision

Heavy rainshowers and hail (largest stone 3/4 inch) are occurring at the station. Almost continuous thunder and lightning within the cloud are occurring overhead. All clouds are moving toward the north. Frequent bolts of lightning from cloud to ground are also observed north of the station.

Use the following observational data to make entries on the Form 10 for Sky Condition (Col 3), Prevailing Visibility (Col 4), Remarks (Col 13), and Total Sky Cover (Col 21).

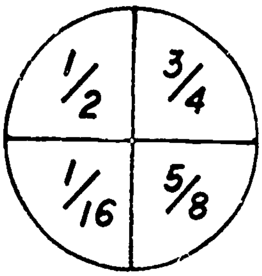
PROBLEM 1

Sky Condition

4/10 of the sky is hidden by fog.

3/10 SMOKE at 900', measured by a ceiling balloon.

Visibility



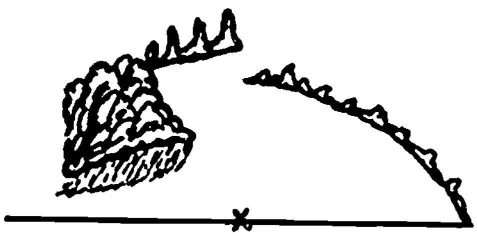
Tower visibility: 2 miles.

The FMN-1 on Runway 21 reads:

2 0

PROBLEM 2

Sky Condition

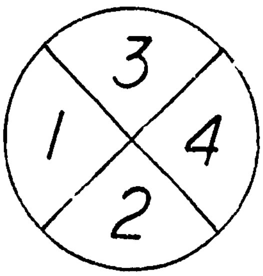


3/10 TCU at 3,000', west of the station. NOTE: The precipitation falling from the TCU does not reach the ground.

5/10 SC at 5,000', estimated.

1/10 ACCAS at 13,000' MSL.

Visibility



Tower visibility: 4 miles.

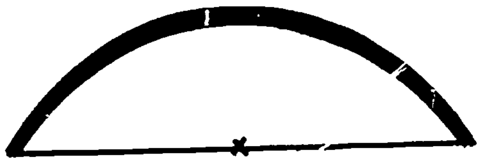
FMN-1 on runway 18 indicates:

6 0

1464

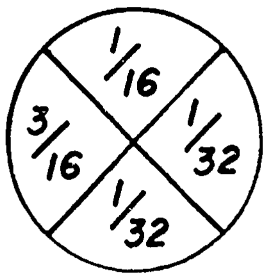
PROBLEM 3

Sky Condition



10/10 NS, the RBC heights have varied from 1,500' to 1,800' to 1,600' and back to 1,400' during the past 15 minutes.

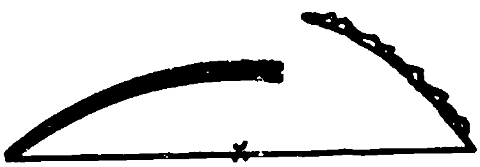
Visibility



Control tower visibility is 1/2 mile. The FMN-1 computer is inoperative. The transmissometer chart for runway 36 is reading 8%.

PROBLEM 4

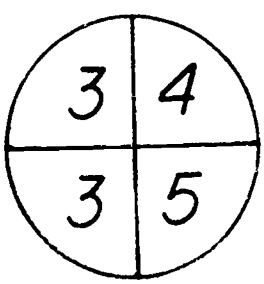
Sky Condition



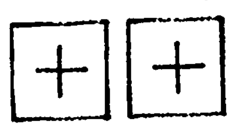
6/10 ST at 800', measured by the RBC. (The amount has varied to 5/10 during the past 15 minutes.)

4/10 SC at 2,500', measured by the RBC.

Visibility

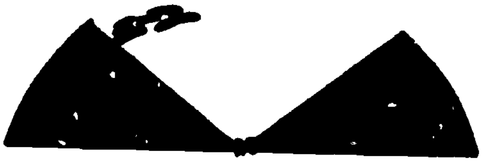


The visibility at the control tower level is 3 miles.
The transmissometer chart reads 89%.
The FMN-1 computer on runway 17 reads:



PROBLEM 5

Sky Condition



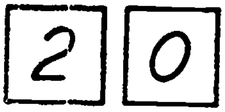
4/10 of the sky is hidden by ground fog.

2/10 ACSL at 12,000', estimated.

Visibility

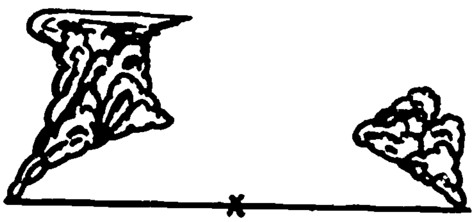
The prevailing visibility varied from 3/16 to 1/2 to 1/16 and back to 5/8 during the past 15 minutes.

The control tower reports visibility of 4 miles. The FMN-1 computer on runway 32 reads:



PROBLEM 6

Sky Condition

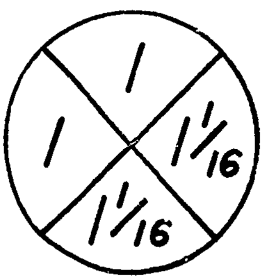


4/10 CB at 1,570', measured by the RBC, is visible northwest of the station.

2/10 TCU at 1,600', estimated, is visible southeast of the station.

NOTE: All clouds are moving toward the northwest.

Visibility



The control tower visibility is 1 mile. The FMN-1 computer on runway 09 reads:

PROBLEM 7

Sky Condition

10/10 of the sky is hidden by snowshowers.
The vertical visibility into the obscuration is 200'.

Visibility

The prevailing visibility has varied from 0 to 7/8 to 1/16 to 1/2 and back to 3/16 during the period of observation.

The control tower reports visibility of 1/2 mile. The FMN-1 computer on runway 08 reads:

PROBLEM 8

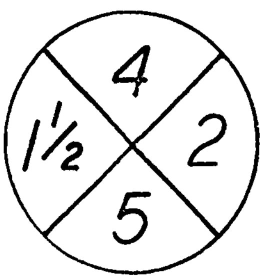
Sky Condition

2/10 of the sky is hidden by blowing dust.

3/10 ST (2/10 thin) at 1,000', estimated.

3/10 ST (2/10 thin) at 2,000', measured by the RBC.

Visibility



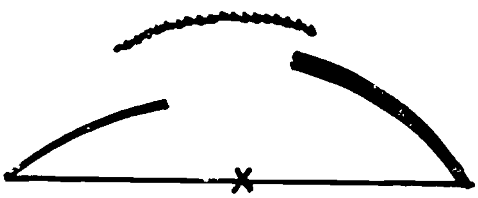
The visibility at the control tower level is 3 miles.

The transmissometer equipment is inoperative.

1467

PROBLEM 9

Sky Condition

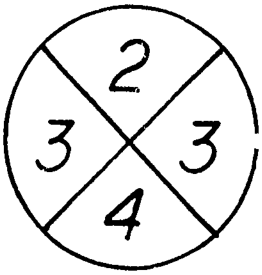


2/10 ST (1/10 thin), at 500', estimated.

4/10 AS (1/10 thin) at 12,000', measured with the ceiling light and clinometer.

4/10 CI (all thin) at 31,000' MSL, determined from an aircraft report.

Visibility

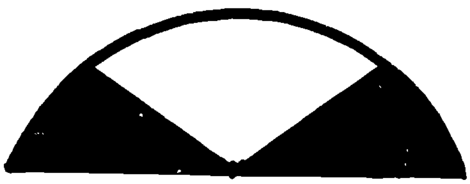


Control tower visibility: 4 miles. The FMN-1 computer on runway 22 reads:

$\boxed{6}\ \boxed{0}$

Problem 10

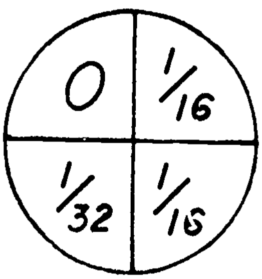
Sky Condition



4/10 of the sky is hidden by snow.

10/10 NS at 4,000', measured by the RBC.

Visibility

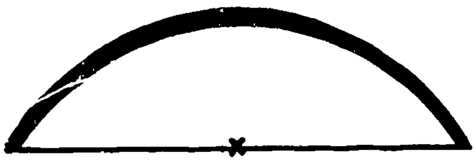


Tower visibility: 3/16 mile.
The FMN-1 computer on runway 20 reads:

$\boxed{-}\ \boxed{-}$

PROBLEM 11

Sky Condition



10/10 ST at heights indicated by the RBC as varying from 800' to 1,100' to 900' and back to 1,100' during the period of observation.

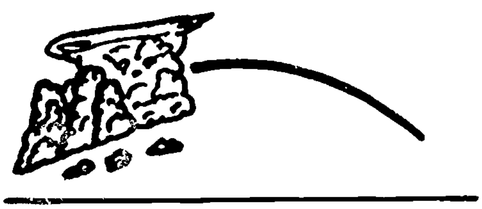
Visibility

The prevailing visibility is varying from 1/2 to 3/4 to 1/4 and back to 7/8 mile during the past 15 minutes.

The control tower reports visibility of 3/4 mile. The transmissometer chart for runway 16 is indicating 52%. The FMN-1 computer is inoperative.

PROBLEM 12

Sky Condition



2/10 CUFRA at 1,200'.

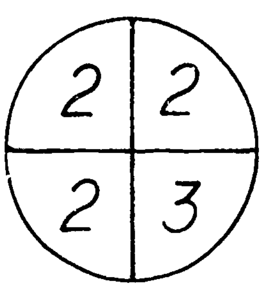
2/10 TCU at 2,800', RBC.

2/10 CB at 2,800', RBC.

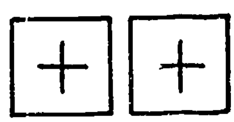
4/10 CS at 30,000', estimated.

NOTE: All clouds are moving toward the east.

Visibility



The control tower visibility is 3 miles. The FMN-1 computer on runway 32 reads:

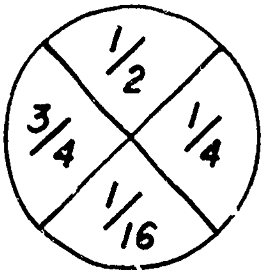


PROBLEM 13

Sky Condition

9/10 ST (4/10 thin) at 800', measured by the RBC. (The amount has varied to 10/10 with 5/10 thin during the period of observation.)

Visibility



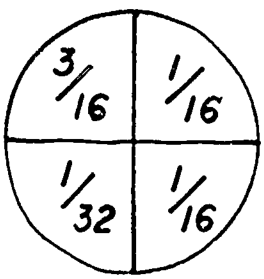
Tower visibility: 3/8 mile.
The RVR on runway 15 is:

PROBLEM 14

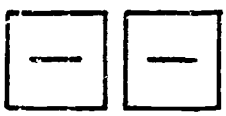
Sky Condition

10/10 fog hides the sky. The vertical visibility is 300' measured by the RBC.

Visibility



The tower visibility is 1/16 mile.
The FMN-1 on runway 27 reads:

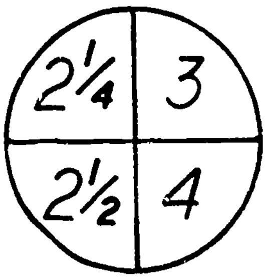


PROBLEM 15

Sky Condition

6/10 CU is just forming over the airfield. The temperature is 45°F and the dew point is 42°F. There are breaks in all quadrants.

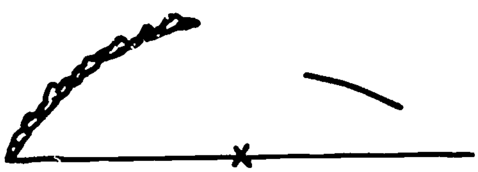
Visibility



The control tower visibility is 5 miles.
The transmissometer equipment is inoperative.

PROBLEM 16

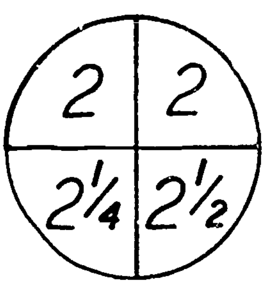
Sky Condition



2/10 SMOKE (all thin) at 500' determined by the RBC.

4/10 AC at 14,000' MSL.

Visibility



The control tower visibility is 2 miles.
The FMN-1 on runway 18 indicates:

6 0

Use the following observational data to make entries on a Form 10 for Sky Condition (Col 3), Prevailing Visibility (Col 4), Atmospheric Phenomena (Col 5), and Remarks (Col 13). Also complete Total Sky Cover (Col 21).

PROBLEM 1

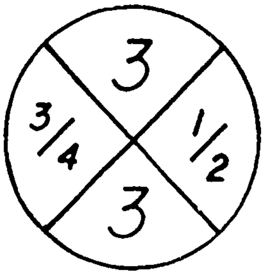
Sky Condition

2/10 of the sky is hidden by a rainshower to the west.

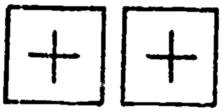
2/10 of the sky is hidden by blowing dust to the east.

3/10 CB is visible at 2,000', estimated, and is moving toward the northeast.

Visibility



The control tower visibility is 4 miles.
The FMN-1 on runway 07 indicates:

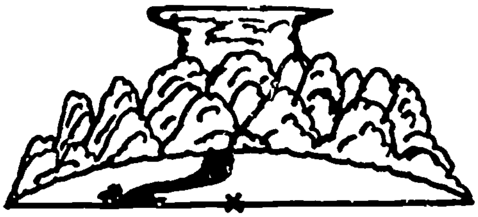


Atmospheric Phenomena

Thunder is heard to the west. Occasional flashes of lightning within the cloud and from cloud to ground is seen to the west. A pig farmer, who is known to be an amateur weather observer, reported that he saw a tornado on his farm 30 miles north of Chanute AFB at 1710 LST. He called the report in at 1730 LST and said the storm was moving toward the southeast.

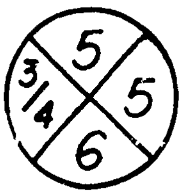
PROBLEM 2

Sky Condition



10/10 TCU and CBMAM at 1600', measured by the RBC. The clouds are visible in all quadrants and are moving toward the east.

Visibility



The control tower visibility is 6 miles.

Atmospheric Phenomena

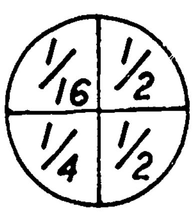
A tornado is visible to the west of the station. Thunder is heard in all quadrants of the sky and frequent lightning within the clouds and from clouds to ground is occurring in all directions.

PROBLEM 3

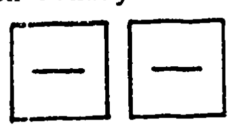
Sky Condition

10/10 of the sky is hidden by rain. The vertical visibility is 400'.

Visibility



Control tower visibility: 1/4 mile.
The FMN-1 on runway 16 indicates:

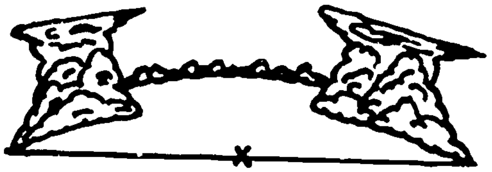


Atmospheric Phenomena

Thunder is heard overhead. Occasional lightning in the cloud is seen overhead. Hail (3/4 inch diameter) is falling. The storm is moving toward the northeast.

PROBLEM 4

Sky Condition

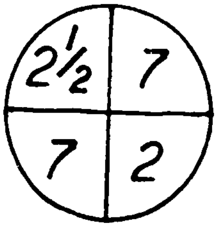


2/10 CB at 1,500', west of the station moving northeast.

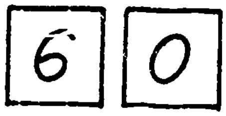
3/10 CB at 1,500', east of the station moving northeast.

5/10 SC at 3,000', measured by the RBC.

Visibility



Control tower visibility: 5 miles.
FMN-1 on runway 25 indicates:

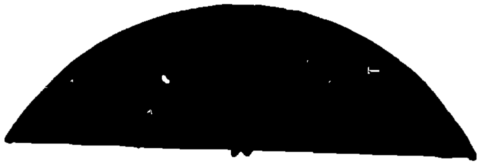


Atmospheric Phenomena

Thunder is heard to the east. Occasional lightning within the cloud is observed to the east. Occasional lightning from cloud to ground is seen to the west.

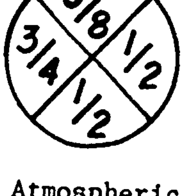
PROBLEM 5

Sky Condition

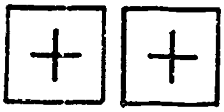


10/10 of the sky is hidden by rain. The vertical visibility is 200'.

Visibility



Tower reports visibility of 3/4 mile.
The FMN-1 on runway 02 indicates:



Atmospheric Phenomena

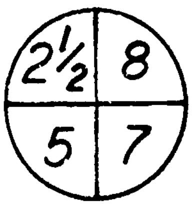
Thunder is heard overhead and frequent lightning from cloud to ground is seen overhead.

PROBLEM 6

Sky Condition

4/10 CB at 2,000', measured by the RBC, is northwest. The cloud is moving toward the southeast.

Visibility



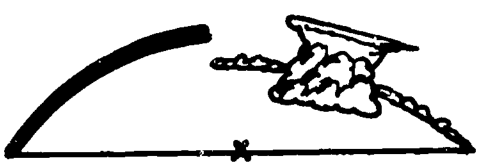
Tower visibility: 7 miles.
The FMN-1 is inoperative.

Atmospheric Phenomena

Loud peals of thunder along with occasional flashes of lightning within the Cumulonimbus and from the cloud to air are observed to the northwest.

PROBLEM 7

Sky Condition

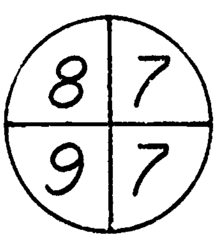


3/10 CB at 1,000', northeast of the station is moving toward the east.

3/10 SC at 3,500', estimated.

4/10 CS at 32,000' MSL.

Visibility



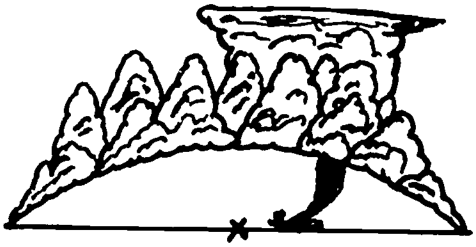
Control tower visibility is 6 miles.

Atmospheric Phenomena

Thunder was last heard 16 minutes ago to the north. Occasional lightning is seen from cloud to ground to the northeast.

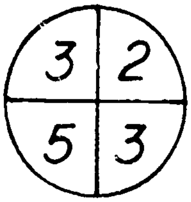
PROBLEM 8

Sky Condition



10/10 CBMAM and TCU at 1,200', measured by the RBC, is in all quadrants. The clouds are moving toward the northeast.

Visibility



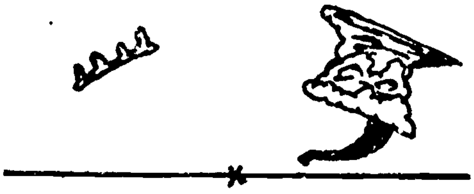
Tower visibility is 5 miles.

Atmospheric Phenomena

A tornado is observed two miles northeast of the station. Frequent lightning within the clouds, from the clouds to ground, from clouds to clouds, and from the clouds to air is observed in all quadrants of the sky.

PROBLEM 9

Sky Condition



3/10 CBMAM at 1,500' is southeast of the station, moving toward the northeast.

2/10 ACCAS at 9,700' MSL.

Visibility

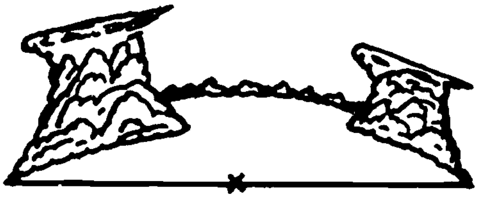
The prevailing visibility is 6 miles.

Atmospheric Phenomena

A funnel cloud is visible to the southeast of the station. Thunder is heard to the southeast and occasional lightning within the cloud and from cloud to ground is observed, also to the southeast.

PROBLEM 10

Sky Condition

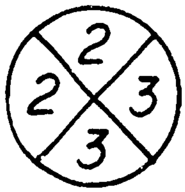


4/10 CB at 1,500', measured, moving toward the northeast.

2/10 CB at 2,000', measured, moving toward the northeast.

4/10 SC at 4,000', measured.

Visibility



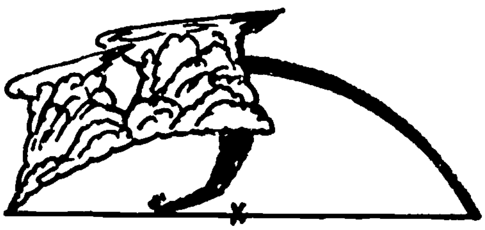
The control tower visibility is 2-1/2 miles. The FMN-1 for runway 21 reads 6,000.

Atmospheric Phenomena

Thunder is heard to the west. Occasional flashes of lightning are occurring from cloud to ground and within the cloud to the west. Occasional flashes of lighting are observed from cloud to cloud in the northeast. A state policeman called at 1710 LST to report seeing a tornado 35 miles northwest of Champaign IL (CMI) at 1650 LST. The storm system was moving toward the east.

PROBLEM 11

Sky Condition



2/10 CB at 2,200', measured.

4/10 CBMAM at 2,200', measured by the RBC.

4/10 CS at 34,000' MSL.

NOTE: All clouds are moving toward the east.

Visibility

The prevailing visibility is 3 miles. The control tower visibility is 4 miles.

Atmospheric Phenomena

Thunder is heard overhead. Frequent flashes of lightning are occurring in the cloud overhead. A tornado is seen north of the station moving toward the east.

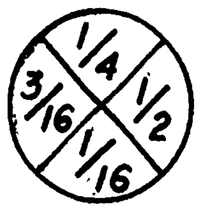
PROBLEM 12

Sky Condition

9/10 of the sky is hidden by rain.

1/10 CBMAM is visible at heights indicated by the RBC to have varied from 1,200' to 1,500' to 1,300' and back to 1,600' during the past 15 minutes.

Visibility



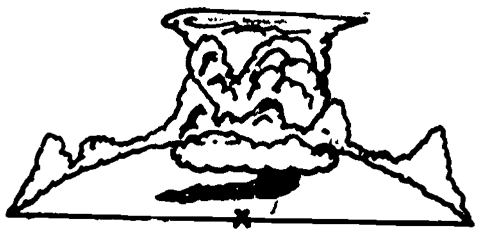
The control tower visibility is 3/4 mile. The transmissometer equipment is out for maintenance.

Atmospheric Phenomena

Thunder is heard in all directions. Frequent lightning is occurring within clouds and from clouds to ground in all quadrants. The weather maintenance personnel, working on the transmissometer equipment on runway 18, reported a tornado 2 miles south of the base moving toward the northeast. The tornado was observed at 1815 LST.

PROBLEM 13

Sky Condition



2/10 CBMAM at 1,500', measured, north of the station moving north.

8/10 CU and SC at 4,000', measured by the RBC.

Visibility

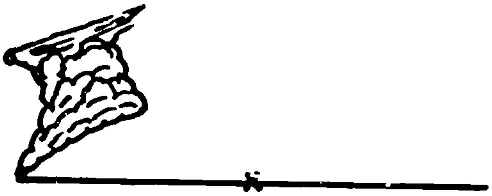
The prevailing visibility is 7 miles.

Atmospheric Phenomena

Thunder is heard north of the station. Frequent lightning from cloud to ground and within the cloud is seen to the north. A funnel cloud is observed extending from the base of the CBMAM to the north.

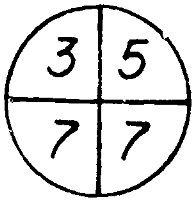
PROBLEM 14

Sky Condition



3/10 CB at 2,500', extends from west through northwest of the station, moving east.

Visibility



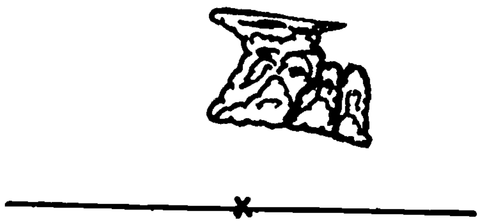
Tower visibility is 7 miles.

Atmospheric Phenomena

Occasional lightning within the cloud and from cloud to ground and from cloud to air is occurring to the west. A very reliable truck driver called at 1505 LST to report that he saw a funnel cloud at 1400 LST, 20 miles west of Chanute AFB. He said the clouds were moving very fast toward the east.

PROBLEM 15

Sky Condition



2/10 CB at 2,000', estimated, north of the station.

2/10 TCU at 2,000', estimated, northeast of the station.

NOTE: All clouds are moving toward the north.

Visibility

The prevailing visibility is 7 miles.

Atmospheric Phenomena

Thunder was last heard 16 minutes ago to the north. Occasional flashes of cloud to cloud lightning are occurring to the north.

DEPARTMENT OF THE AIR FORCE
3330 Technical Training Wing (ATC)
Chanute Air Force Base, Illinois 61868

C3ABR25130-000-HO-106A
C3ABR25130-002-HO-106A
10 November 1983

STUDENT CHECKLIST

Course: Weather Specialist/Aerographer's Mate

Subject: Visibility and Present Weather

Objective: Given the FMH-1B, weather scenarios and handout, encode the required visibility, RVR and present weather entries on an AWS Form 10 to a minimum of 80% accuracy.

Notes: Upon completion of this unit of instruction, you will be required to make entries on the AWS Form 10 for the following items:

1. Sky Condition
2. Prevailing Visibility
3. Weather and Obstructions to Vision
4. Remarks
5. Total Sky Cover

All items taught during this unit of instruction are valued at two (2) points each. All previously learned items are valued at one (1) point each. There are 6 problems that total 110 points possible on the progress check. The time limit will be 1¼ hours (75 minutes). Minimum passing score is 80%.

WORKBOOK

C3ABR25130-WB-108
C3ABR25130-2-WB-108

Technical Training

Weather Specialist
Aerographer's Mate

TEMPERATURE, WIND AND PRESSURE

15 March 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE

DO NOT USE ON THE JOB

1481

8. TEMPERATURE, WIND AND PRESSURE

OBJECTIVES

a. Without reference, select those facts which relate to atmospheric temperatures to a minimum of 75% accuracy.

b. Without reference, select those facts which relate to wind to a minimum of 75% accuracy.

c. Without reference, select those facts which relate to pressure to a minimum of 75% accuracy.

d. Given the FMH-1B, weather scenarios, psychrometric calculator, pressure conversion table, and handout, encode the required temperature, wind and pressure entries on an AWS Form 10 to a minimum of 80% accuracy.

PROCEDURE

Using the FMH-1B and the information given in each exercise, make the appropriate entries on an AWS Form 10 as directed by the instructor.

Supersedes C3ABR25130-WB-108, C3ABR25130-2-WB-108, 6 April 1983.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 900; DAV - 1

1482

EXERCISE 1

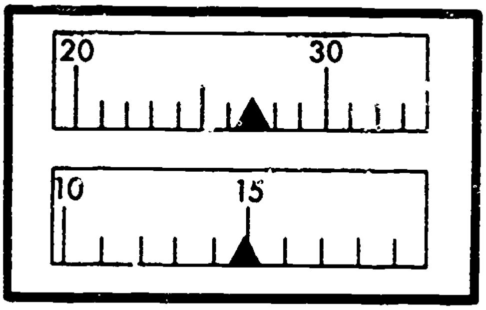
Evaluate the following GMQ-29 readouts for temperature and dew point for the proper column 7 and column 8 entries.

	TEMPERATURE	DEW POINT
1	76.1	73.2
	______	______
2	57.2	46.8
	______	______
3	27.5	19.6
	______	______
4	47.2	46.8
	______	______
5	-21.3	-26.6
	______	______
6	37.8	33.4
	______	______
7	102.3	89.7
	______	______
8	64.3	59.6
	______	______
9	94.1	76.2
	______	______
10	- 0.2	- 3.2
	______	______

<u>EXERCISE 2</u>

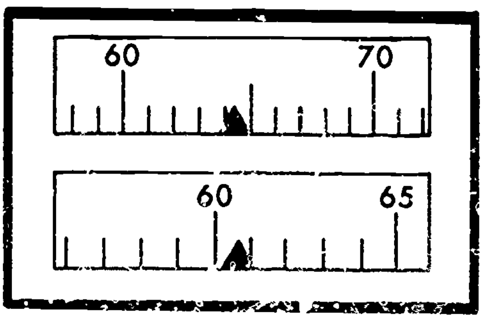
Evaluate the following AN/TMQ-11 temperature and dew point scales for the proper column 7 and 8 entries.

1.



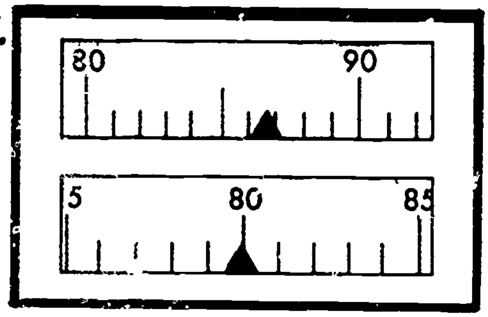
Col 7 ______ Col 8 ______

2.



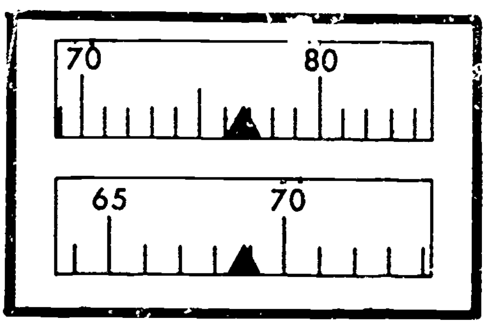
Col 7 ______ Col 8 ______

3.



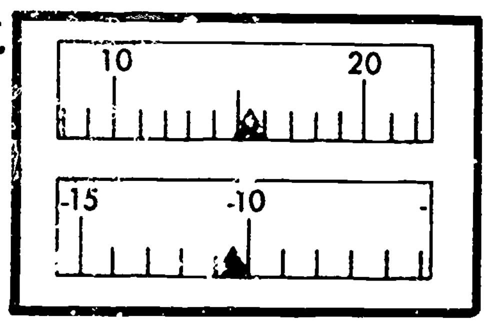
Col 7 ______ Col 8 ______

4.



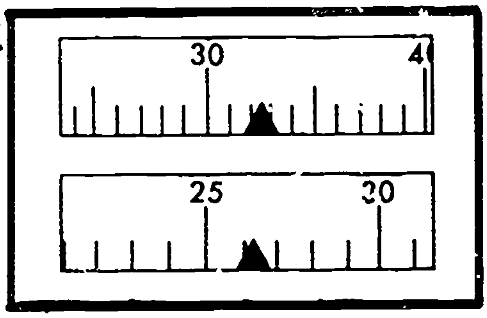
Col 7 ______ Col 8 ______

5.

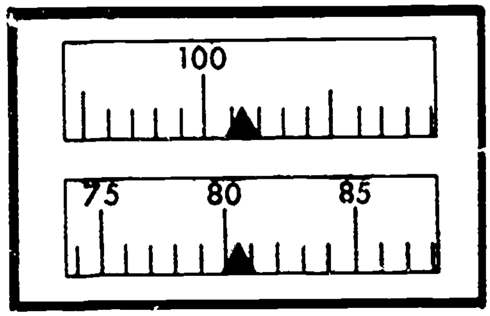


Col 7 ______ Col 8 ______

6.



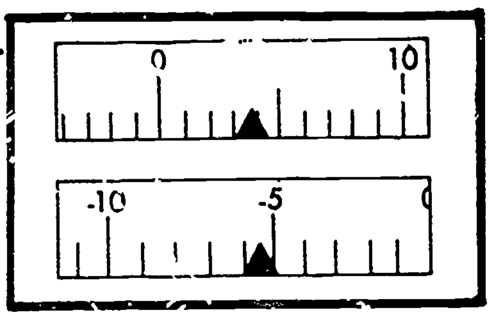
7.



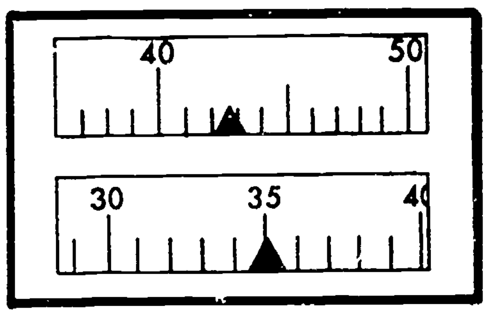
Col 7 Col 8

Col 7 Col 8

8.



9.

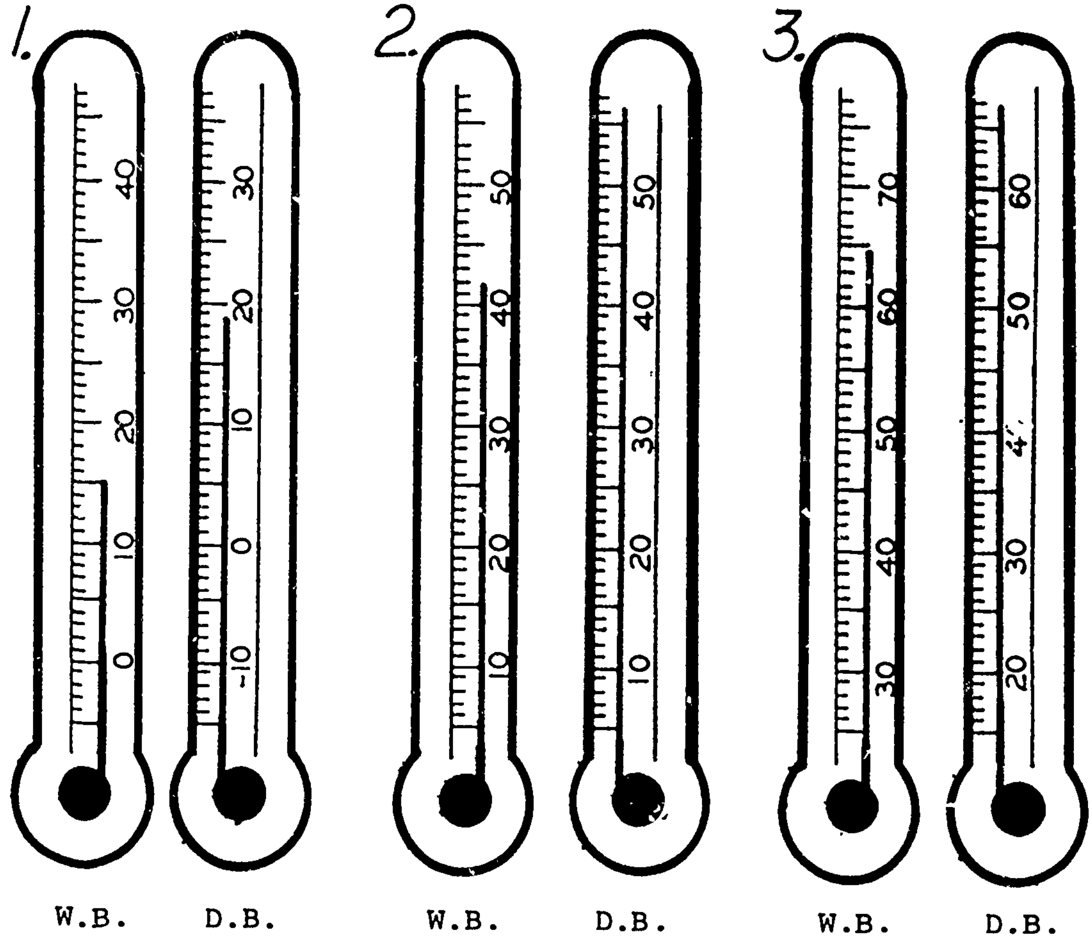


Col 7 Col 8

Col 7 Col 8

EXERCISE 3

Determine the dry bulb and wet bulb temperatures, wet bulb depression, and dew point for the figures below.



D.B. _____	D.B. _____	D.B. _____
W.B. _____	W.B. _____	W.B. _____
W.B.D. _____	W.B.D. _____	W.B.D. _____
D.P. _____	D.P. _____	D.P. _____

EXERCISE 4

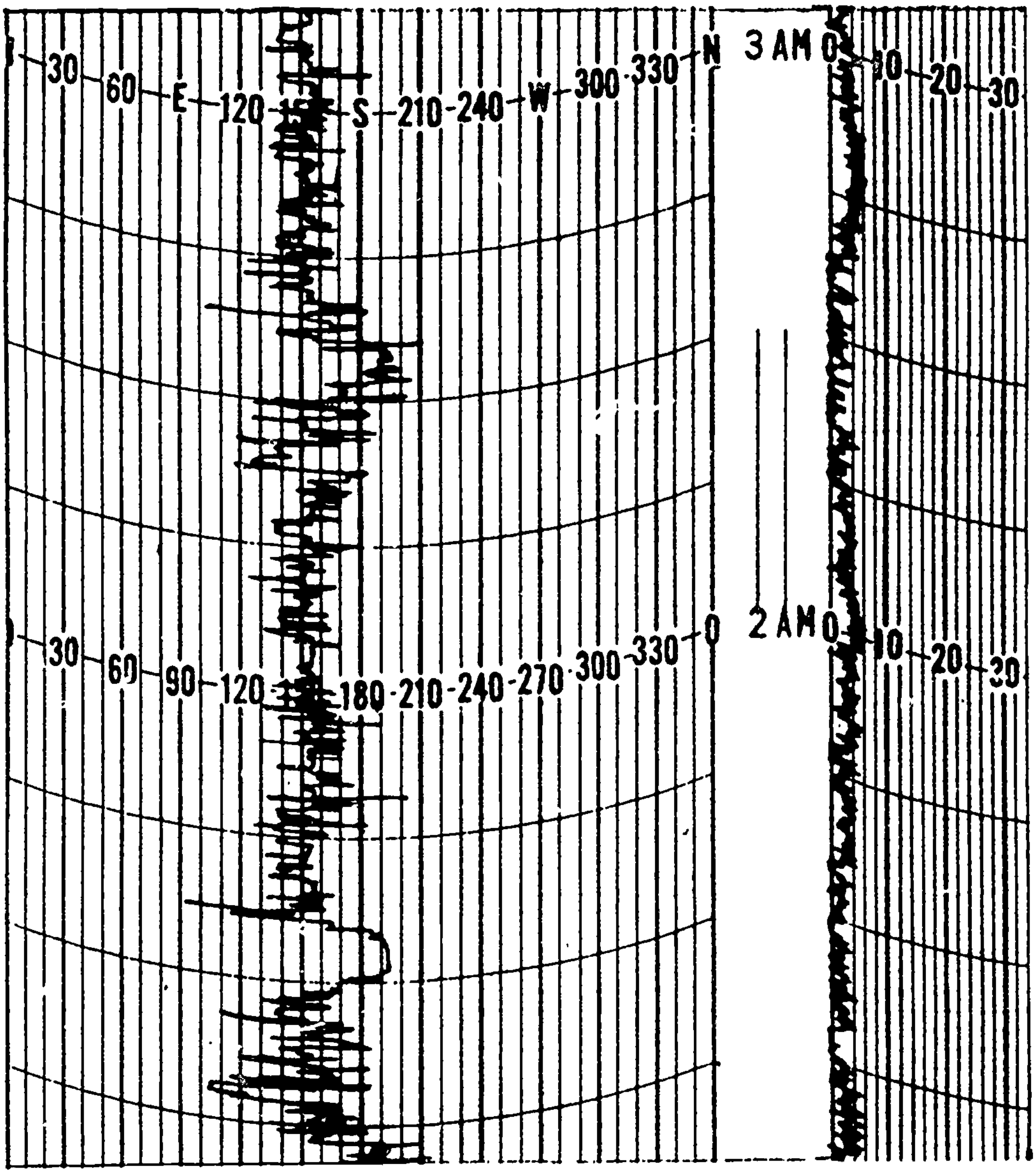
Use the following dry bulb and wet bulb temperatures to determine the proper column 7 and 8 entries.

1.	DB	56.4	2.	73.6	3.	78.8	4.	22.4	5.	18.8
	WB	53.0		67.7		76.5		18.2		16.3
	WBD									
	DP									
6.	DB	36.9	7.	42.6	8.	79.2	9.	15.2	10.	65.2
	WB	29.5		38.7		78.7		10.7		61.9
	WBD									
	DP									
11.	DB	7.0	12.	66.4	13.	75.3	14.	6.2	15.	25.4
	WB	7.0		62.1		75.0		4.0		18.2
	WBD									
	DP									
16.	DB	-0.8	17.	68.7	18.	70.6	19.	39.4	20.	80.4
	WB	-1.5		68.7		45.3		28.2		76.0
	WBD									
	DP									
21.	DB	76.3	22.	54.8	23.	41.1	24.	14.8	25.	66.6
	WB	59.7		54.6		32.0		11.9		63.3
	WBD									
	DP									

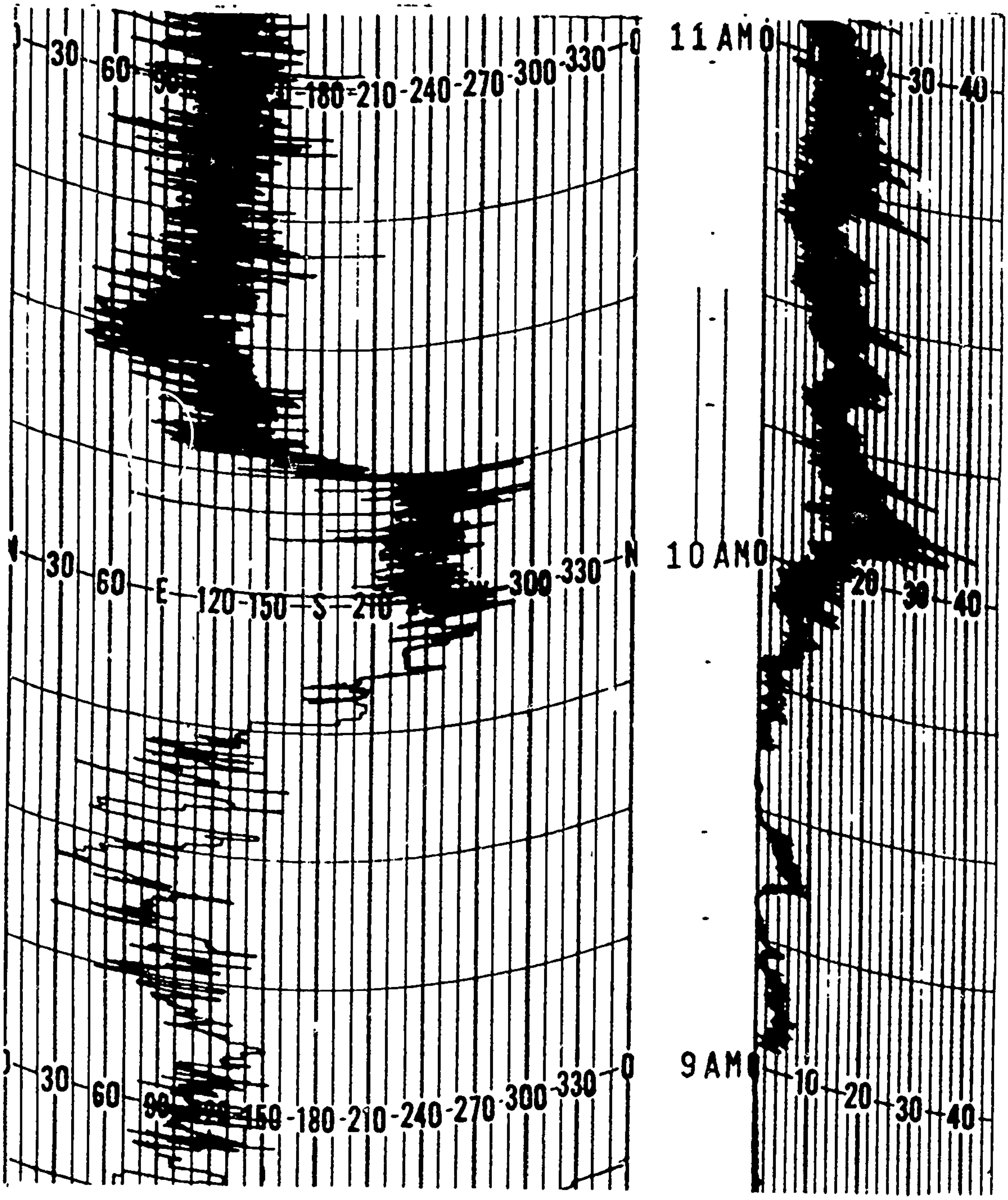
26.	DB	-6.9	27.	27.7	28.	64.7	29.	67.3	30.	11.6
	WB	-7.8		21.2		63.1		53.2		10.5
	WBD	____		____		____		____		____
	DP	____		____		____		____		____
31.	DB	80.7	32.	57.4	33.	33.9	34.	-1.5	35.	18.7
	WB	71.9		57.3		30.5		-2.8		13.8
	WBD	____		____		____		____		____
	DP	____		____		____		____		____
36.	DB	45.3	37.	-2.3	38.	7.4	39.	23.6	40.	38.9
	WB	40.2		-3.0		6.3		20.9		34.8
	WBD	____		____		____		____		____
	DP	____		____		____		____		____
41.	DB	40.6	42.	83.6	43.	80.0	44.	1.0	45.	23.1
	WB	35.2		78.2		68.7		-0.7		18.2
	WBD	____		____		____		____		____
	DP	____		____		____		____		____
46.	DB	37.4	47.	42.6	48.	50.7	49.	85.3	50.	79.4
	WB	27.6		39.3		42.9		80.1		59.1
	WBD	____		____		____		____		____
	DP	____		____		____		____		____
51.	DB	11.9	52.	75.9	53.	-6.4	54.	61.5	55.	1.3
	WB	10.9		53.2		-7.1		51.3		-0.2
	WBD	____		____		____		____		____
	DP	____		____		____		____		____

EXERCISE 5

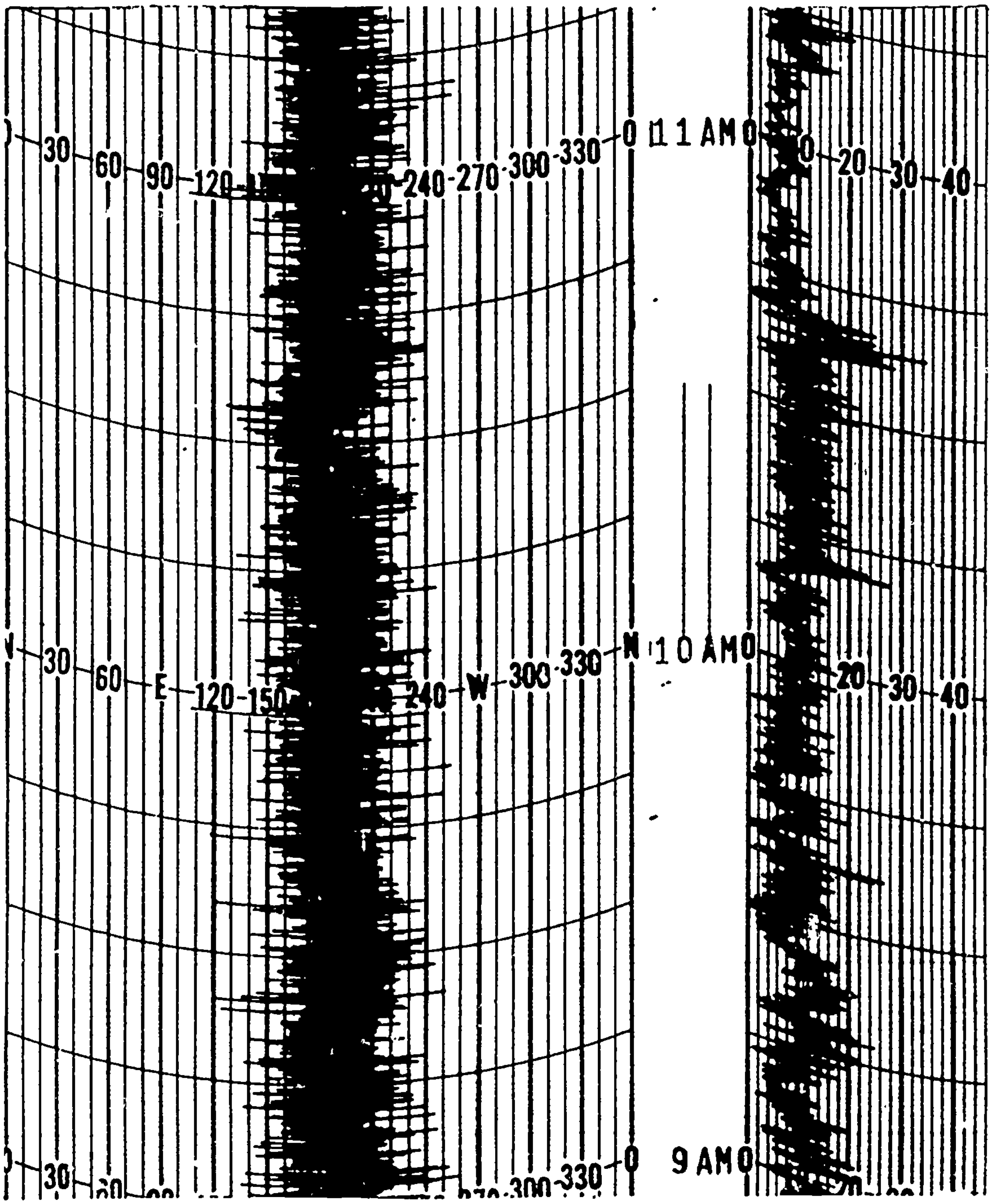
Evaluate the illustrated RO-362, wind recorder chart, to determine the wind direction and speed at the indicated times. Make the appropriate entries for columns 9, 10, 11 and 13.



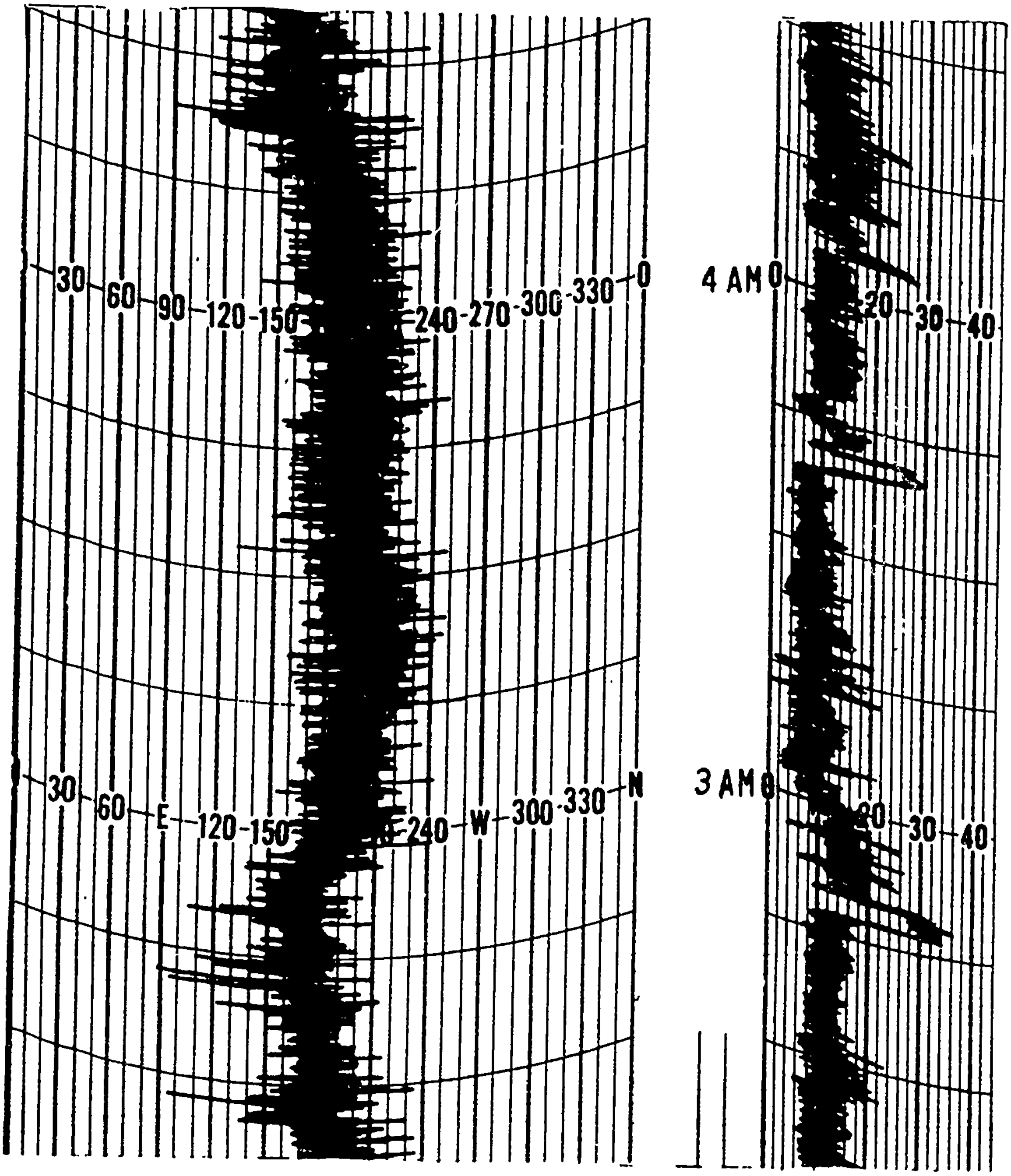
	9	10	11	13		9	10	11	13
0115					0205				
0130					0245				
0147					0258				



	9	10	11	13		9	10	11	13
0900					1015				
0925					1020				
1000					1045				



	9	10	11	13		9	10	11	13
0920					1030				
0945					1045				
1015					1055				



9 10 11 13

0230 ______________________

0256 ______________________

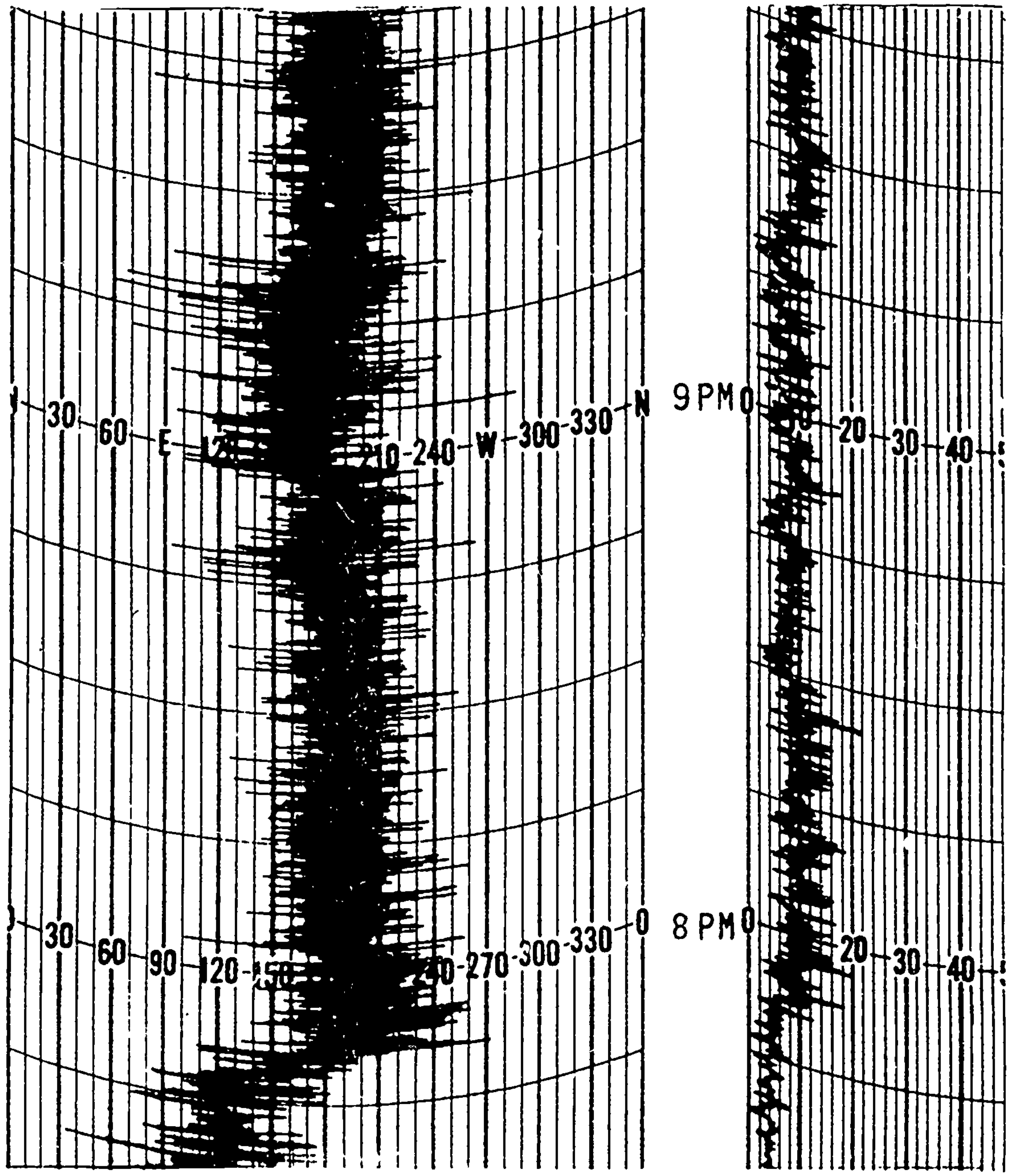
0315 ______________________

9 10 11 13

0345 ______________________

0415 ______________________

0430 ______________________

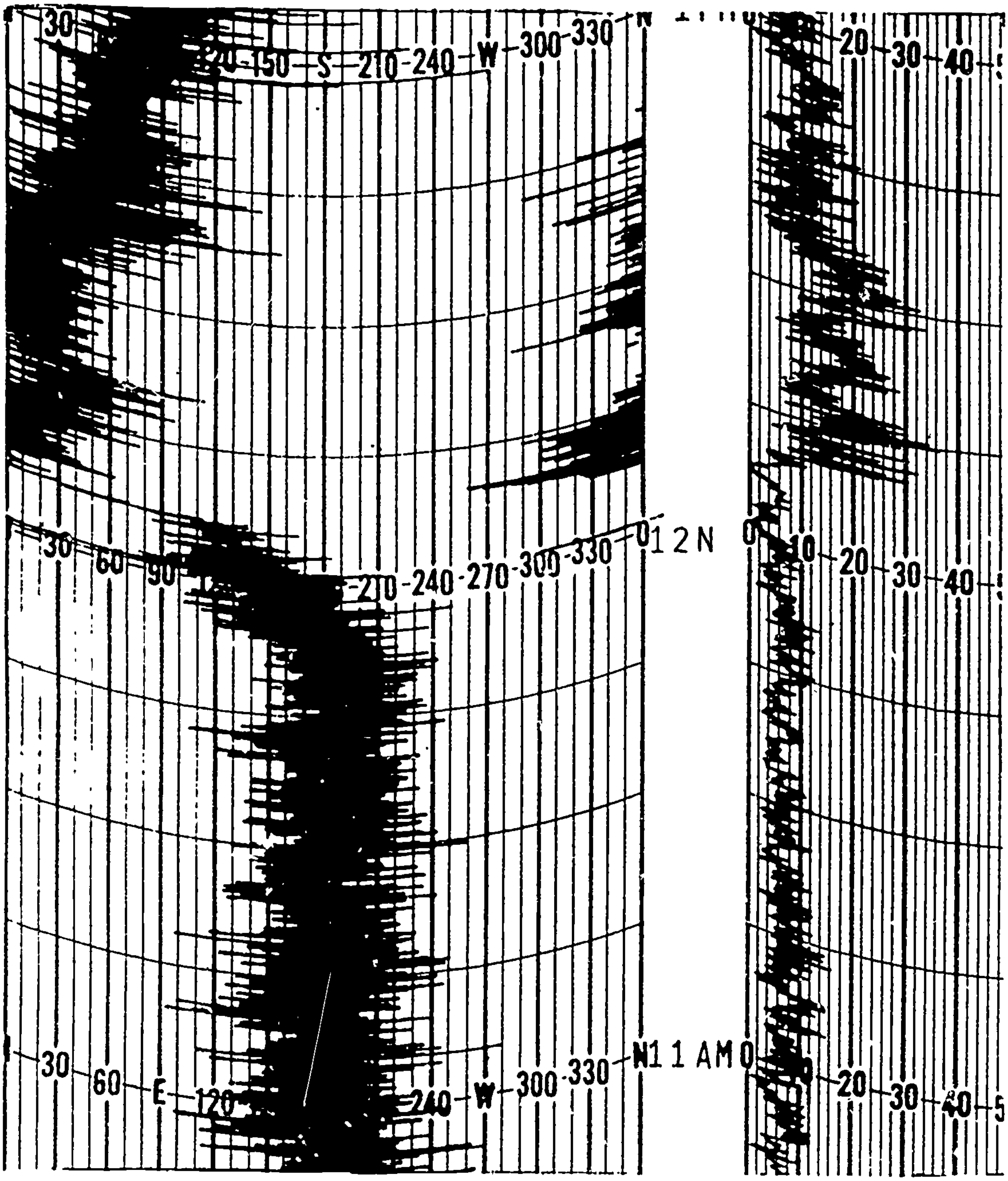


9 10 11 13 9 10 11 13

1945 ______________________ 2030 ______________________

2000 ______________________ 2100 ______________________

13



	9	10	11	13		9	10	11	13
1128					1200				
1145					1230				

EXERCISE 6

From the information given in each problem, make the appropriate entries for columns 9, 10, 11 and 13 on an AWS Form 10.

1. Wind direction is 206 degrees at 17 knots.
2. The wind at 1859Z was calm.
3. The average 1-minute wind direction and speed observed at 0655Z was 299 degrees at 13 knots.
4. The average 1-minute wind direction and speed observed at 0055Z was 123 degrees at 8 knots.
5. Wind direction is 135 degrees with an average speed of 6 knots.
6. The average 1-minute wind direction and speed observed at 1256Z was 276 degrees at 0 knots.
7. Wind direction is from 5 degrees at 2 knots.
8. Wind is 355 degrees at an estimated 5 knots.
9. Wind direction is from 3 degrees at 17 knots.
10. The wind direction is observed to be 35 degrees with an average speed of 100 knots.
11. Wind direction is an estimated 20 degrees at 5 knots.
12. The wind recorder chart indicates the wind direction as 235 degrees and the wind speed as 0 knots.
13. Estimated direction is 240 degrees at 12 knots.
14. Wind direction is 1 degree at 12 knots.
15. Wind direction is 250 degrees at 103 knots.
16. Wind direction is 95 degrees at 11 knots.
17. Wind directi is 125 degrees at an estimated 10 knots.
18. The recorder chart indicates a direction of 270 degrees with a speed of 0 knots.

19. Wind direction is from 2 degrees at 116 knots.

20. The average 1-minute wind direction and speed observed at 0054Z was 321 degrees at 9 knots with lulls of 5 knots and peaks of 15 knots that have occurred during the past 8 minutes.

21. Wind direction is from 83 degrees at an average speed of 7 knots. Squalls of 23 knots have occurred during the past 10 minutes.

22. Wind direction is 155 degrees with an average speed of 7 knots. A lull of 3 knots occurred 5 minutes ago with a peak of 16 knots.

23. The average wind direction and speed observed at 1557Z was 320 degrees at an estimated 7 knots. In the past 10 minutes, the wind speed suddenly increased from a lull of 5 knots to a peak of 9 knots.

24. The average one minute wind direction and speed observed at 0055Z was 198 degrees at 11 knots. At 0049Z, the wind speed suddenly increased from a lull of 8 knots to a peak of 31 knots. This sudden increase lasted for only a few seconds.

25. The average 1-minute wind direction and speed observed at 0657Z was 297 degrees at 12 knots. At 0648Z, the wind speed suddenly increased from a lull of 10 knots to a peak of 25 knots. This increase lasted for 2 minutes.

26. The wind direction is currently 65 degrees at 19 knots. Ten minutes ago, a peak speed of 34 knots occurred and lasted for 1 minute.

27. The average 1-minute wind direction and speed observed at 1853Z was 273 degrees at 4 knots. At 1849Z, the wind speed suddenly increased to 19 knots and remained at that speed for 1 minute.

28. The average one minute wind direction and speed observed at 0655Z was 221 degrees at 14 knots. At 0647Z, the wind speed suddenly increased from a lull of 12 knots to a peak of 18 knots. This sudden increase lasted for almost 10 seconds.

29. Wind direction is at 45 degrees with an average speed of 8 knots. Peak speed of 16 knots with lulls of 2 knots occurred 7 minutes ago.

30. The average one minute wind direction and speed observed at 1856Z was 324 degrees at 13 knots. At 1848Z, the wind speed suddenly increased to 33 knots and remained at that speed for nearly two minutes.

31. The average 1-minute wind direction and speed observed at 1857Z was 25 degrees at 14 knots. At 1846Z, the wind increased from a lull of 5 knots to a peak of 22 knots. This increase lasted for 20 seconds.

32. The average 1-minute wind direction and speed observed at 1257Z was 337 degrees at 14 knots. At 1251Z, the wind speed suddenly increased to 33 knots and remained at that speed for one minute.

33. The average one minute wind direction and speed observed at 0356Z was 73 degrees at 16 knots. At 0352Z, the wind speed suddenly increased to 30 knots and remained there for nearly two minutes.

34. Wind direction is from 9 degrees at an average speed of 14 knots. A peak of 32 knots occurred 7 minutes ago and was sustained for 65 seconds. A lull of 8 knots occurred 5 minutes ago.

35. Wind direction is 43 degrees with an average wind speed of 13 knots. Two minutes ago, the peak wind speed was 27 knots. It lasted slightly over 1 minute.

36. The wind direction is varying from 265 degrees to 325 degrees at 8 knots.

37. Wind is varying in direction from 105 degrees to 175 degrees with an average speed of 6 knots.

38. The wind is varying in direction from 355 degrees to 55 degrees with a speed of 15 knots.

39. The wind has been fluctuating from 70 degrees to 120 degrees during the period of observation. The average speed is 7 knots.

40. The average one minute wind direction at 2154Z was fluctuating from 67 degrees to 149 degrees at a speed of 8 knots. In the past 10 minutes, the wind speed increased from lulls of 4 knots to peaks of 15 knots.

41. Wind direction has been varying from 323 degrees to 42 degrees during the period of observation. The wind speed is also fluctuating from a lull of 4 knots to a peak of 11 knots.

42. The wind direction has varied from 80 to 140 degrees in the past 10 minutes. The average speed is 13 knots.

43. The average 1-minute wind direction and speed observed at 1252Z was 330 degrees at 7 knots. The wind varied from 300 to 360 degrees during the period of observation.

44. The wind direction is rapidly fluctuating between 185 and 240 degrees. The speed has also varied with lulls of 11 knots and peaks of 24 knots for the previous 10 minutes. For the past 60 seconds, the speed has averaged 19 knots.

45. At 0535Z, the wind shifted direction from 135 degrees at 14 knots to 185 degrees at 16 knots gusting to 24 knots.

46. In the last eight minutes, the wind has changed direction from 270 degrees to 350 degrees with a speed of 15 knots. The change was associated with a cold front passage. The wind began to shift at 0946Z.

47. At 1411L, the wind direction was 75 degrees at 9 knots; the direction changed to 115 degrees at 1425L with a speed of 12 knots.

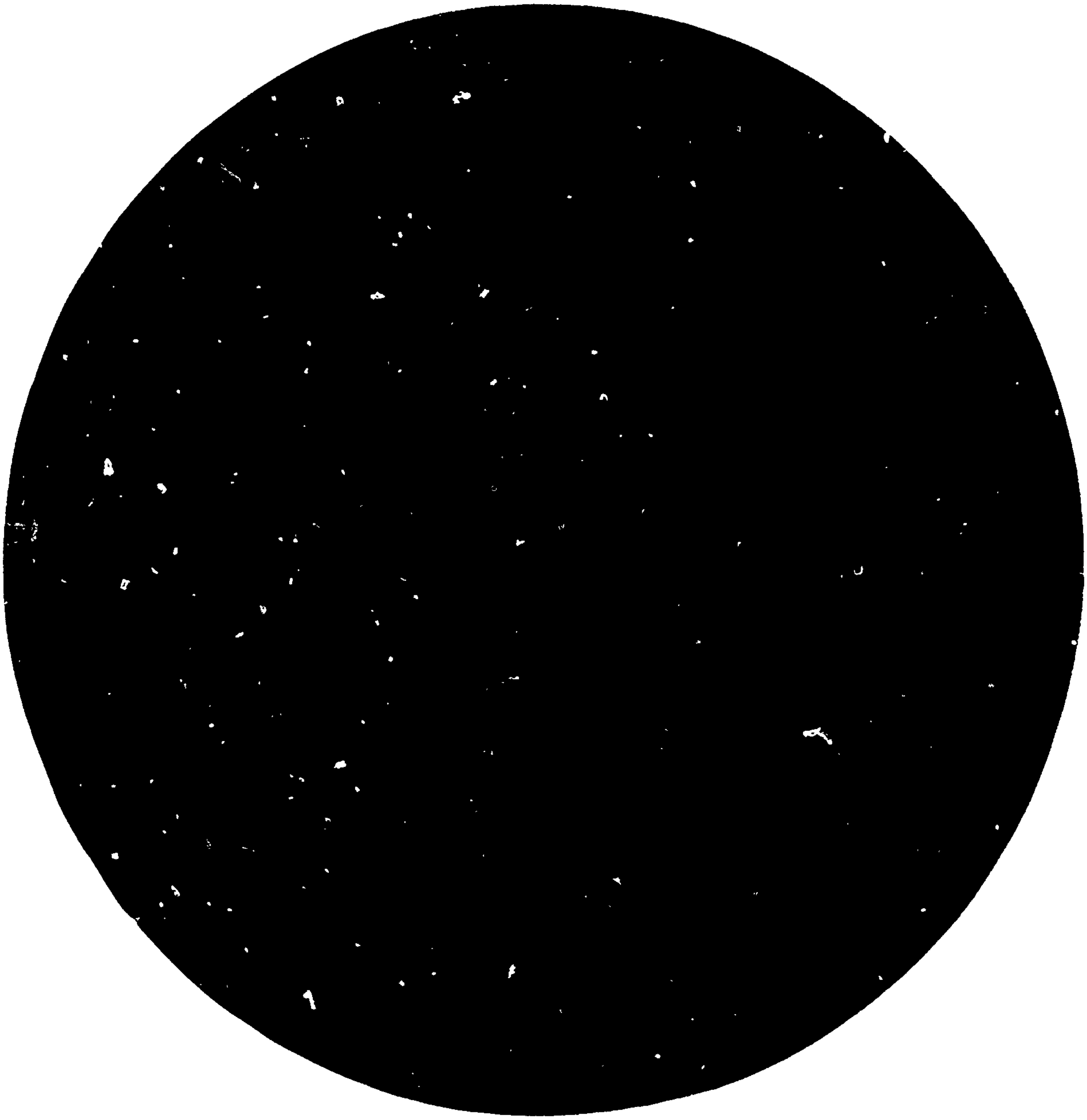
48. The average 1-minute wind direction and speed observed at 1256Z was 323 degrees at 21 knots. At 1238Z, the wind direction began to shift from 247 degrees and by 1249Z, the direction was from 330 degrees. This change in the wind direction was due to a cold frontal passage.

49. Wind direction changed from 347 degrees to 15 degrees with the passage of a front. The speed is now averaging 133 knots.

50. The average 1-minute wind direction and speed observed at 0955Z was 302 degrees at 17 knots. At 0942Z, the wind direction began to shift from 206 degrees and by 0946Z, the direction was from 302 degrees. The wind direction shifted because of a cold frontal passage. At 0947Z, the wind speed suddenly increased from a lull of 13 knots to a peak of 35 knots. This sudden increase lasted for about 15 seconds.

EXERCISE 7

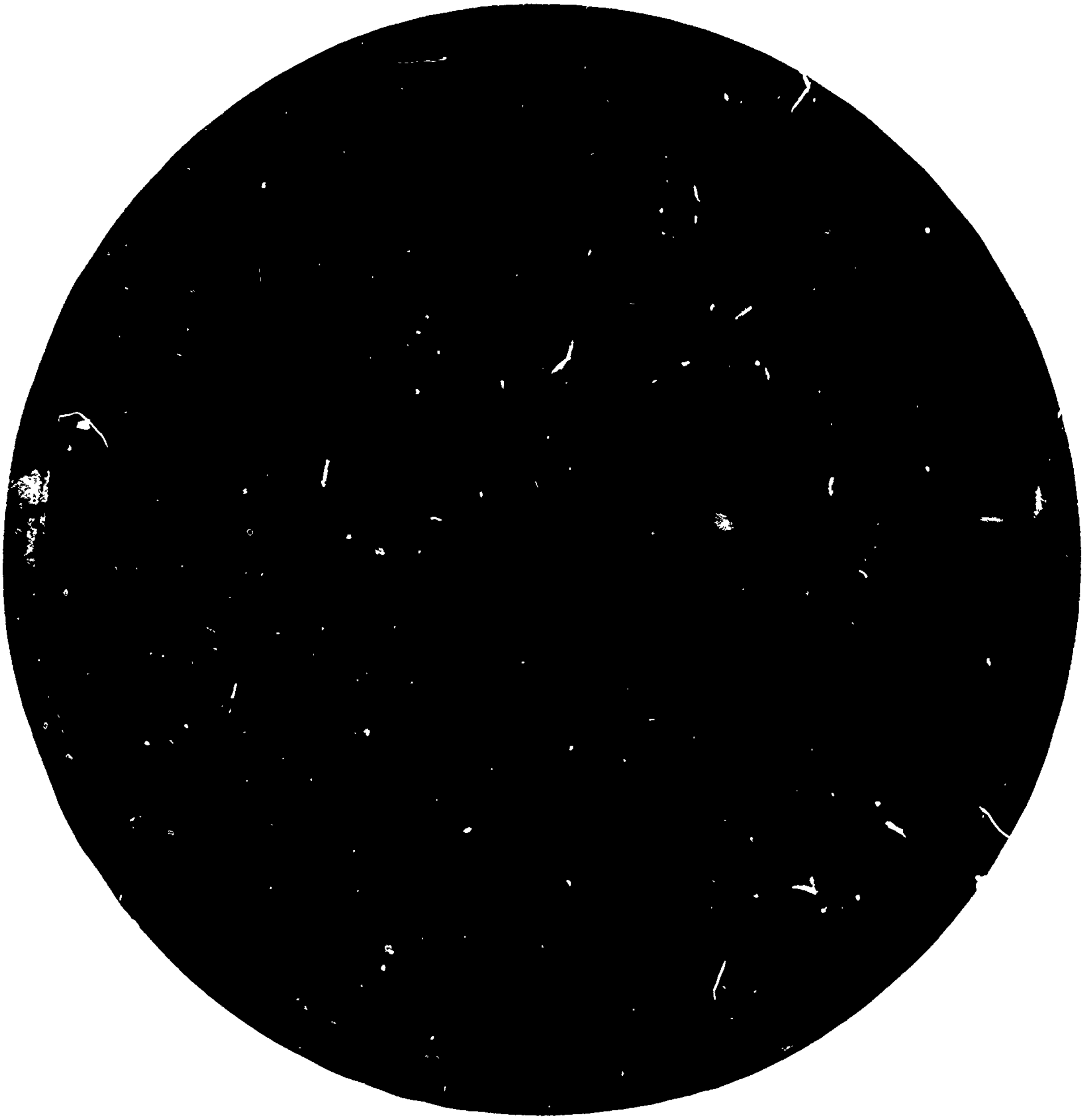
Determine the station pressure from the following pictures of aneroid barometers. Corrections for the readings are indicated with each aneroid.



Correction: +.015

Correction: -.005

1500



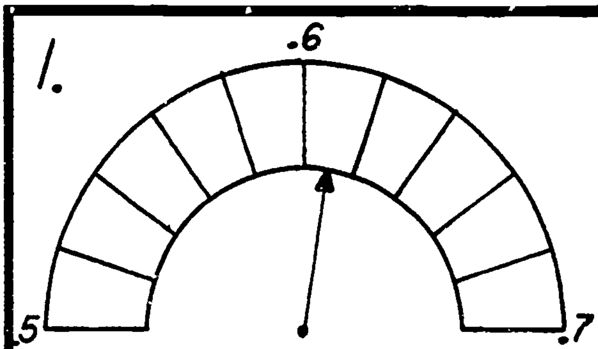
Correction: Zero

Correction: +.020

EXERCISE 8

Determine the appropriate pressure entries from the illustrated aneroid barometers below. Include entries for temperatures when required.

1.

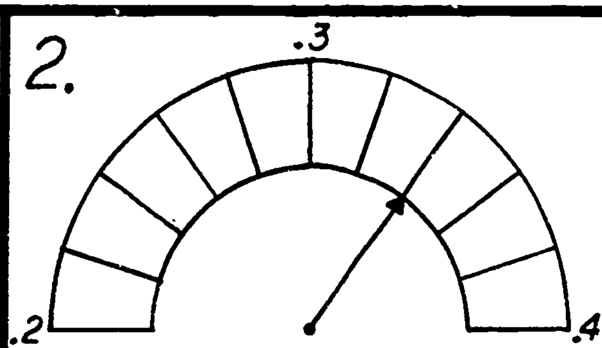


Observed 29.____

Correction .000

Station Pressure ______

2.

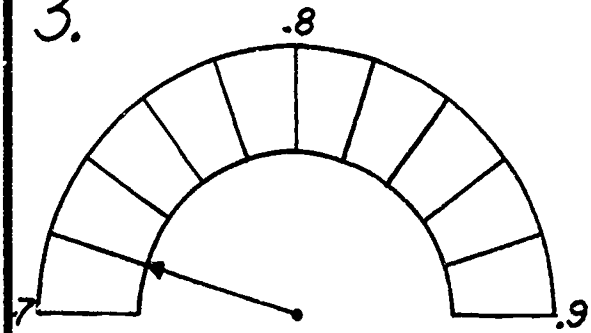


Observed 29.____

Correction -.005

Station Pressure ______

3.

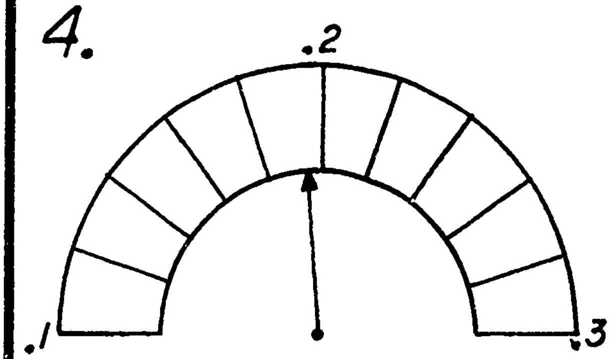


Observed 28.____

Correction +.005

Station Pressure ______

4.

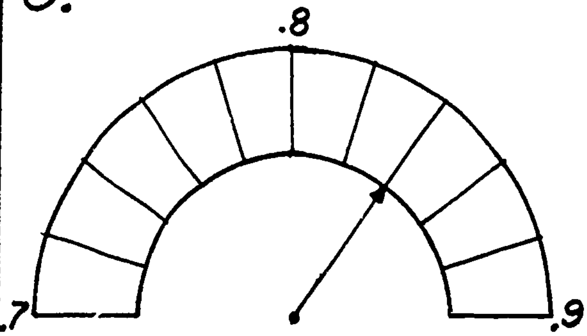


Observed 29.____

Correction -.005

Station Pressure ______

5.



Observed 29.____

Correction -.005

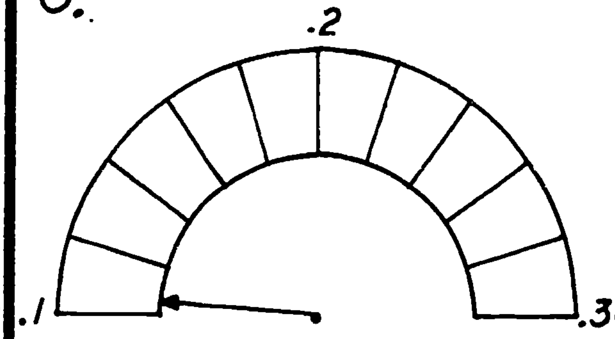
Station Pressure ________

D.B. 39.8 SLP ________

W.B. 35.1 ALSTG ________

D.P. ________

6.



Observed 29.____

Correction -.010

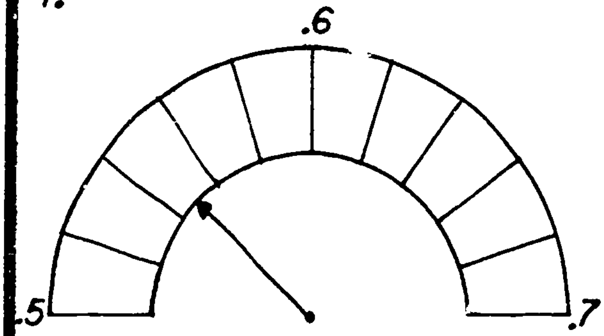
Station Pressure ________

D.B. 58.2 SLP ________

W.B. 53.7 ALSTG ________

D.P. ________

7.



Observed 28.____

Correction +.005

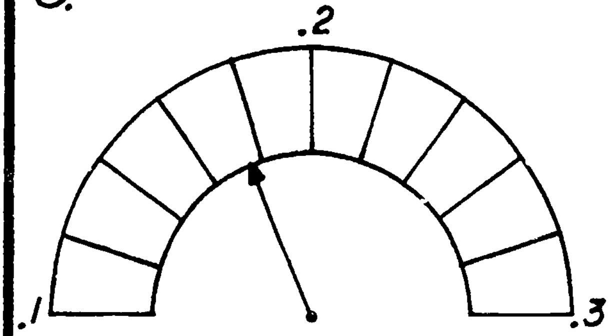
Station Pressure ________

D.B. 71.2 SLP ________

W.B. 66.7 ALSTG ________

D.P. ________

8.



Observed 29.____

Correction -.005

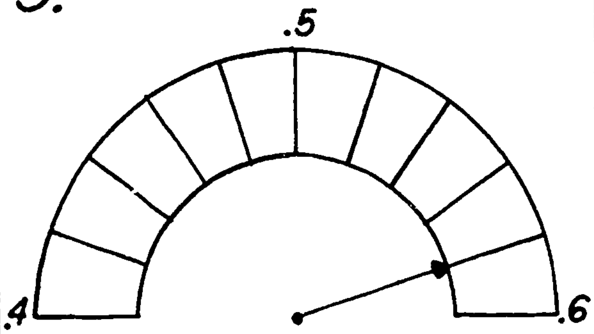
Station Pressure ________

D.B. 19.7 SLP ________

W.B. 15.4 ALSTG ________

D.P. ________

9.



Observed 29.____

Correction -.005

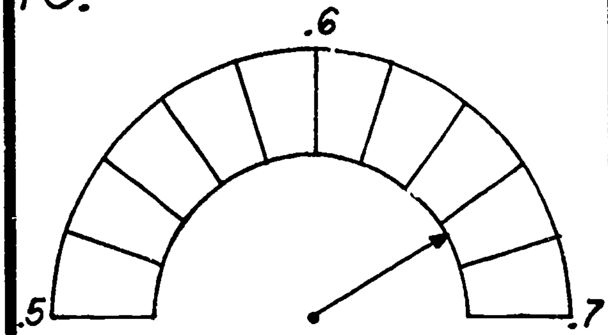
Station
Pressure ________

D.B. 66.6 SLP __________

W.B 65.4 ALSTG ________

D.P. ________

10.



Observed 29.____

Correction -.010

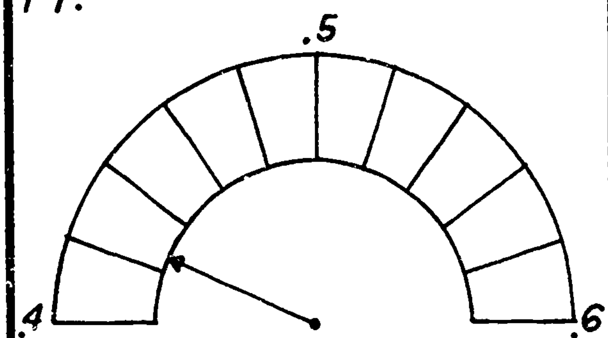
Station
Pressure ________

D.B. 46.8 SLP __________

W.B. 44.7 ALSTG ________

D.P. ________

11.



Observed 29.____

Correction +.005

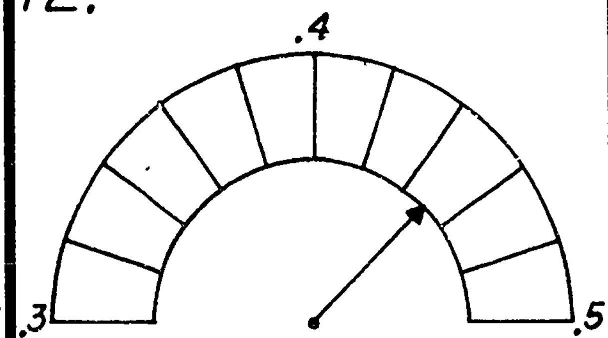
Station
Pressure ________

D.B. 67.3 SLP __________

W.B. 66.7 ALSTG ________

D.P. ________

12.



Observed 29.____

Correction .000

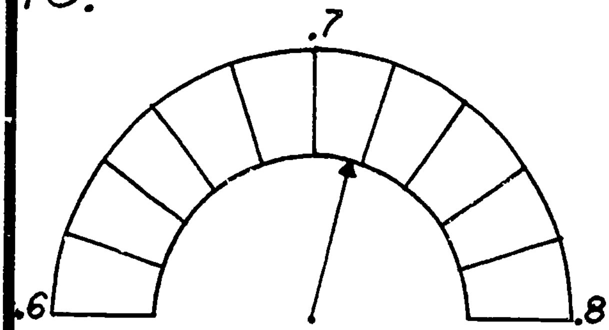
Station
Pressure ________

D.B. 85.6 SLP __________

W.B. 81.4 ALSTG ________

D.P. ________

13.



Observed 28.____

Correction +.005

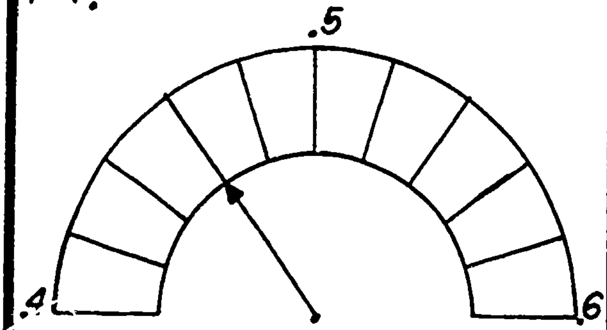
Station Pressure ______

D.B. 30.8 SLP ________

W.B. 30.8 ALSTG ______

D.P. ______

14.



Observed 29.____

Correction .000

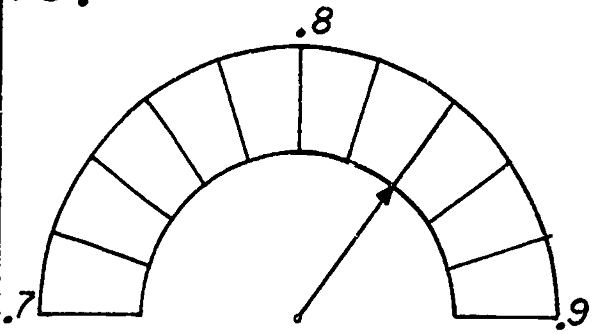
Station Pressure ______

D.B. 25.4 SLP ________

W.B. 22.3 ALSTG ______

D.P. ______

15.



Observed 29.____

Correction -.005

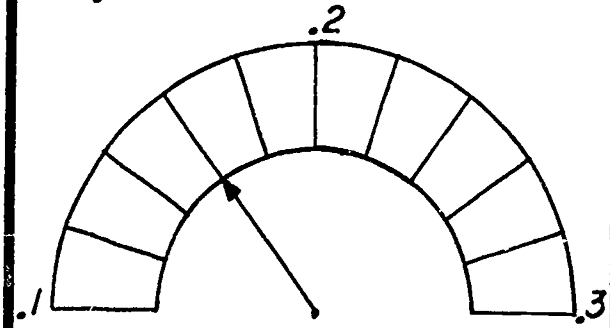
Station Pressure ______

D.B. 5.2 SLP ________

W.B. 4.9 ALSTG ______

D.P. ______

16.



Observed 29.____

Correction +.005

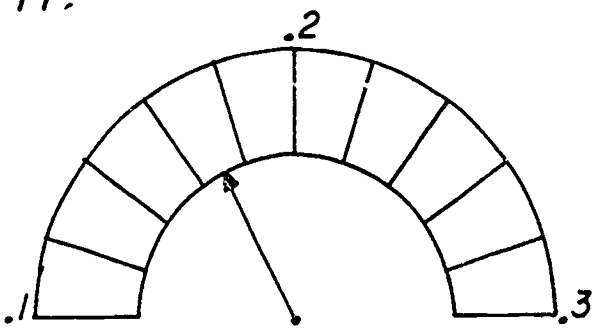
Station Pressure ______

D.B. 27.1 SLP ________

W.B. 26.4 ALSTG ______

D.P. ______

17.



Observed 29.____

Correction -.005

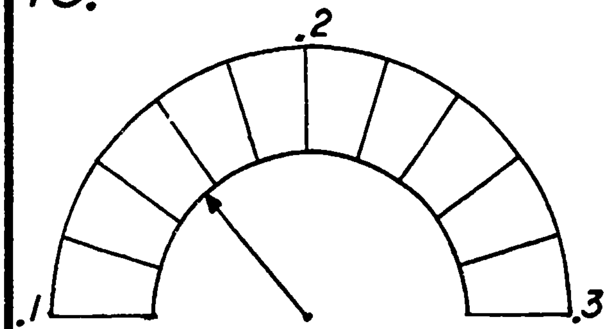
Station Pressure ______

D.B. 41.6 SLP ______

W.B. 41.5 ALSTG ______

D.P. ______

18.



Observed 29.____

Correction +.005

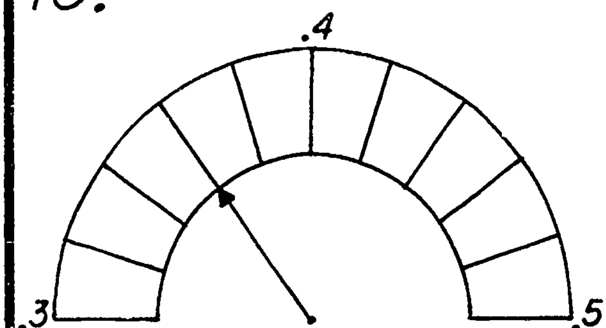
Station Pressure ______

D.B. 69.3 SLP ______

W.B. 66.4 ALSTG ______

D.P. ______

19.



Observed 29.____

Correction -.005

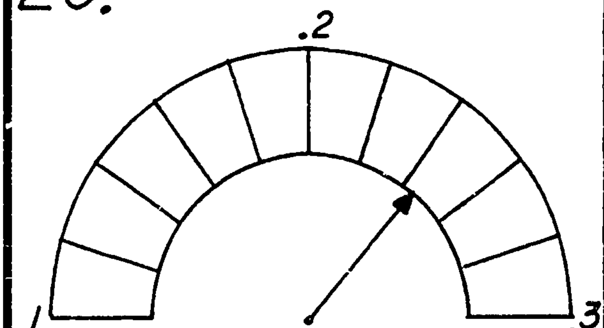
Station Pressure ______

D.B. 16.0 SLP ______

W.B. 13.5 ALSTG ______

D.P. ______

20.



Observed 29.____

Correction -.005

Station Pressure ______

D.B. 68.2 SLP ______

W.B. 64.4 ALSTG ______

D.P. ______

EXERCISE 9

Using the FMH-1B, psychrometric calculator, pressure conversion table and the following information, make the correct entries in columns 6 through 13 and 17 of an AWS Form 10.

1. TEMPERATURE

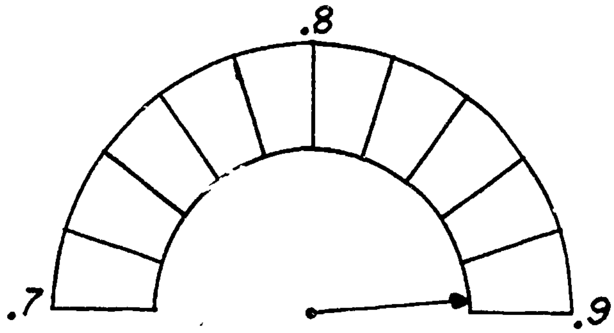
Dry Bulb: 63.4
Wet Bulb: 63.2

WIND

The direction of the wind is 345 degrees with an average speed of 20 knots and gusts to 33 knots. At 1248L, the wind direction was 325 degrees with an average speed of 20 knots gusting to 34 knots. The time is now 1257L.

PRESSURE

Observed 28.____
Correction +.005



2. TEMPERATURE

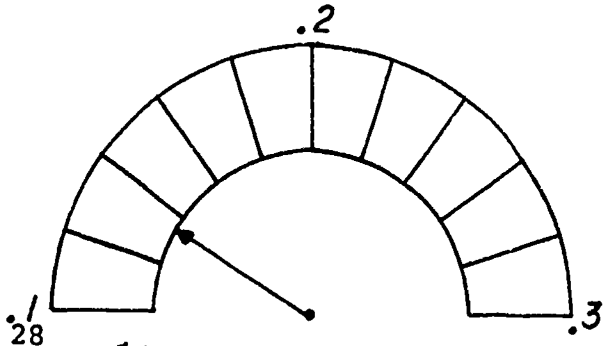
Dry Bulb: 27.4
Wet Bulb: 25.1

WIND

There is no apparent motion of the air.

PRESSURE

Observed 30.____
Correction .000



1508

3. TEMPERATURE

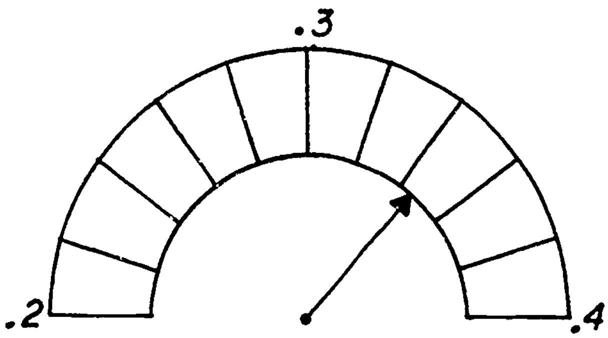
Dry Bulb: 1.7
Wet Bulb: -1.2

WIND

The winds are 185 degrees at 115 knots.

PRESSURE

Observed 29.____
Correction -.010



4. TEMPERATURE

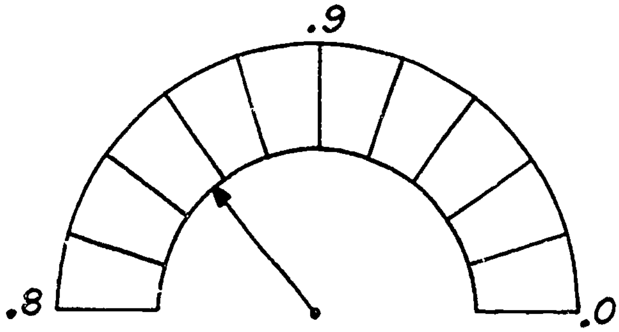
Dry Bulb: 66.6
Wet Bulb: 65.4

WIND

At 0831L, the winds were 225 degrees at 30 knots gusting to 44 knots. They changed to 310 degrees at 38 knots gusting to 50 knots during a frontal passage. The change in direction stopped at 0845L.

PRESSURE

Observed 28.____
Correction +.005



5. TEMPERATURE

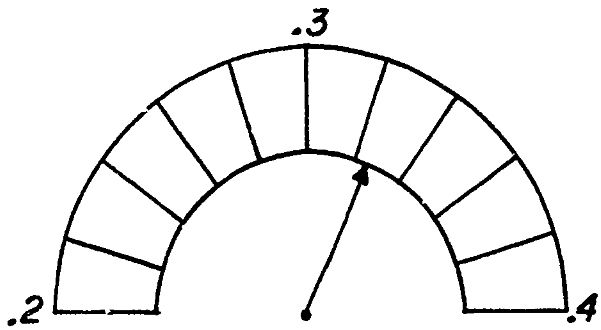
Dry Bulb: 73.0
Wet Bulb: 71.1

WIND

Wind direction is varying from 270 degrees to 340 degrees at an average speed of 6 knots.

PRESSURE

Observed 29.____
Correction -.005



6. TEMPERATURE

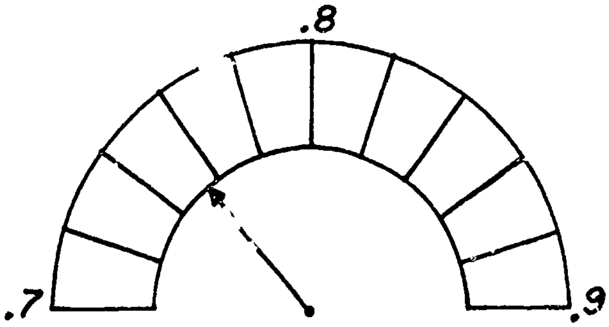
Dry Bulb: 52.0
Wet Bulb: 44.9

WIND

Wind direction is 20 degrees at an average speed of 25 knots, with a peak of 37 knots during the occurrence of a gust. There was a peak speed of 39 knots 12 minutes ago with a direction of 40 degrees.

PRESSURE

Observed 29.____
Correction +.005



7. TEMPERATURE

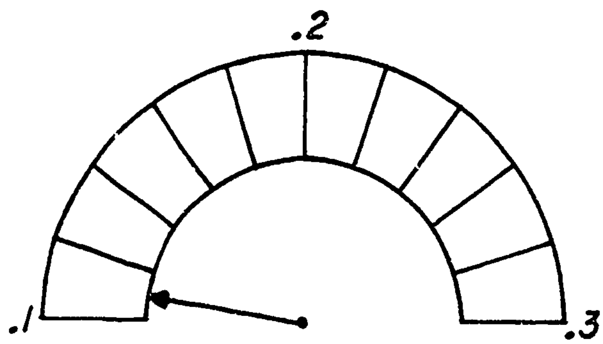
Dry Bulb: 84.3
Wet Bulb: 79.8

WIND

Wind direction is 20 degrees with rapid increases and decreases in the wind speed. The highest speed observed in the past 10 minutes was 26 knots with lulls of 13 knots. (Time interval between peaks and lulls was 10 to 15 seconds.) The average speed was 18 knots.

PRESSURE

Observed 29.____
Correction +.010



8. TEMPERATURE

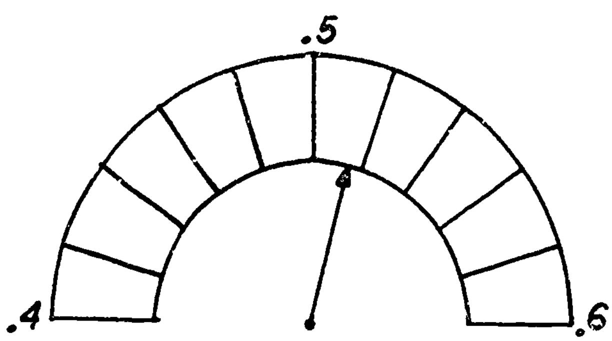
Dry Bulb: 18.1
Wet Bulb: 17.6

WIND

Wind direction is 45 degrees at an average speed of 22 knots with a peak speed of 38 knots during the occurrence of a squall.

PRESSURE

Observed 29.____
Correction -.005



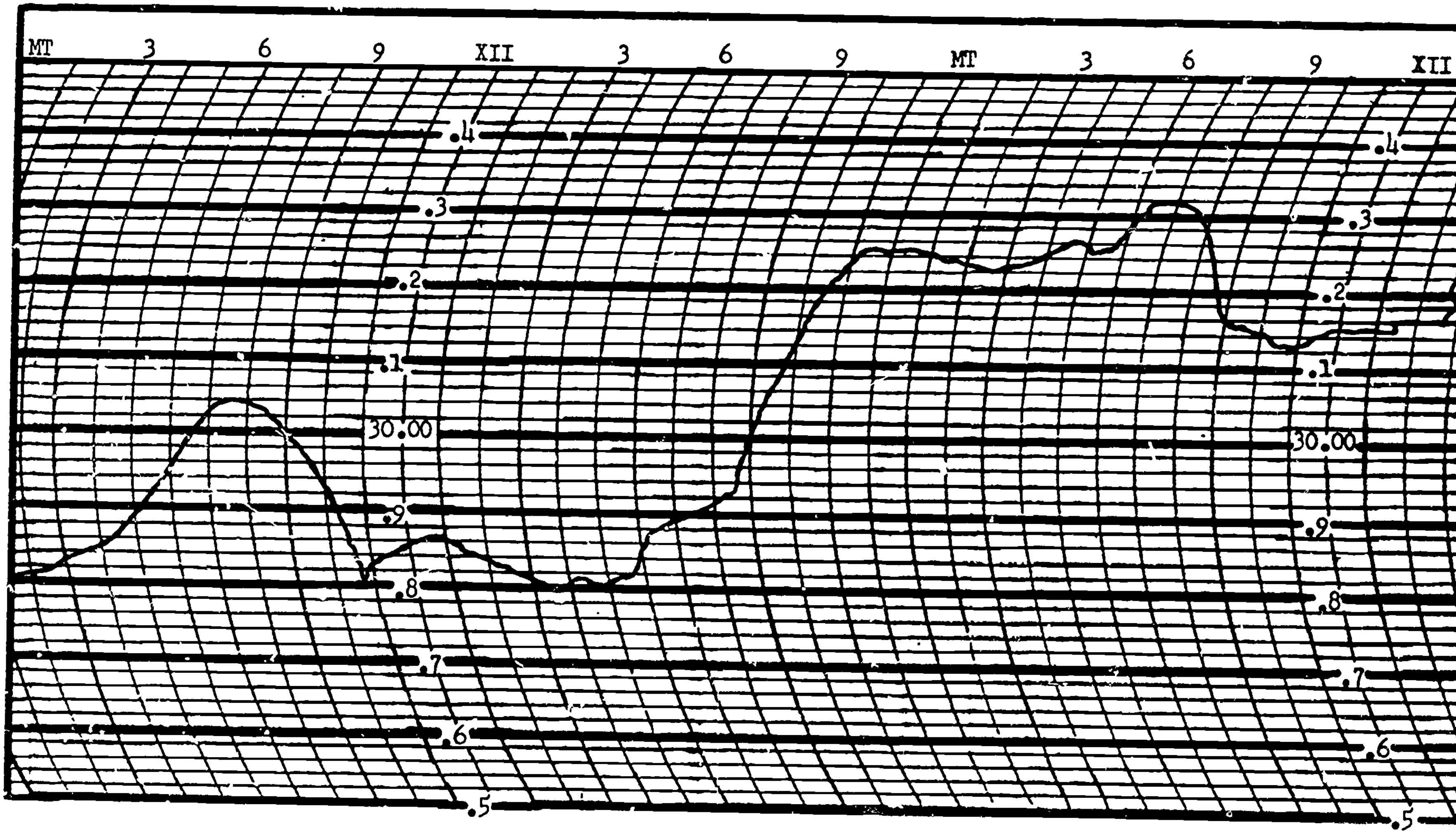
1511

EXERCISE 10

Read the barograph on page 33 to the nearest .005 inch at the times indicated below.

0300Z	______	2215Z	______
0400Z	______	0020Z	______
0530Z	______	0115Z	______
0915Z	______	0245Z	______
1030Z	______	0310Z	______
1200Z	______	0425Z	______
1420Z	______	0600Z	______
1710Z	______	0720Z	______
1850Z	______	0935Z	______
2045Z	______	1110Z	______

Evaluate the chart on page 33 for any cases of PRESRR or PRESFR. Note the time periods and the amounts of pressure changes when these remarks would apply.



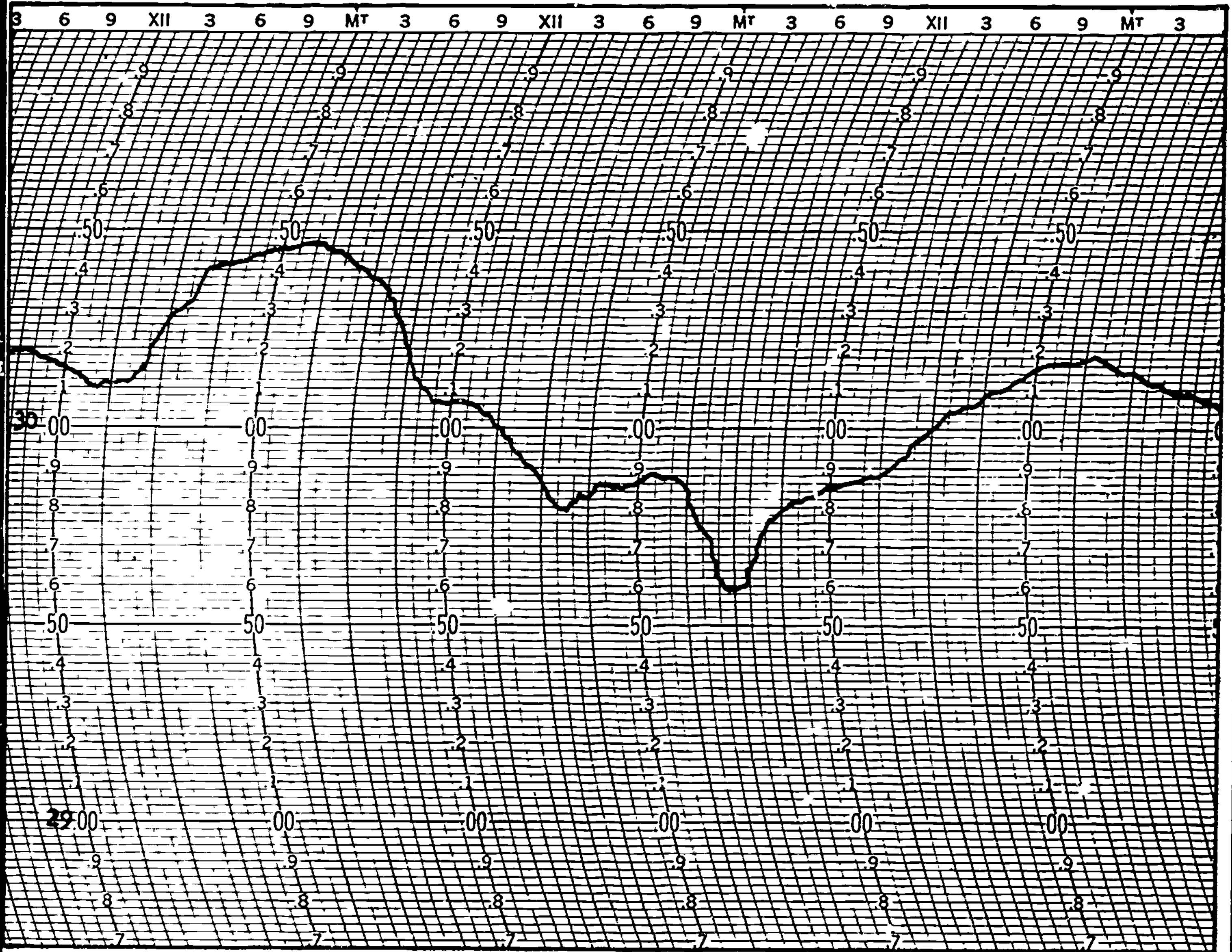
1513

1514

Read the barograph on page 35 to the nearest .005 inch at the times indicated below.

1300Z	______	1230Z	______
1430Z	______	1515Z	______
1645Z	______	1820Z	______
1800Z	______	2120Z	______
2020Z	______	0010Z	______
2330Z	______	0450Z	______
0215Z	______	0800Z	______
0450Z	______	1210Z	______
0715Z	______	1705Z	______
0900Z	______	2355Z	______

Evaluate the chart on page 35 for any cases of PRESRR or PRESFR. Note the time periods and the amounts of pressure changes when these remarks would apply.


3 6 9 XII 3 6 9 MT 3 6 9 XII 3 6 9 MT 3 6 9 XII 3 6 9 MT 3
30.00
.50
29.00

EXERCISE 11

For the following problems, make the appropriate entries for columns 3 through 13, 15, 17, and 21. Include all appropriate remarks in column 13.

Use Table 1, page 71 to convert RBC angles to layer heights.

Use Table 2, page 72 to convert ceiling light projector and clinometer angles to layer heights.

SKY CONDITION

6/10 CU. The height is determined using the convective cloud base height diagram.

VISIBILITY

The prevailing and tower visibilities are both 10 miles. The FMN-1 computer on runway 22 Left reads:

ATMOSPHERIC PHENOMENA

None

TEMPERATURE

Dry Bulb: 83.6
Wet Bulb: 71.2

WIND

During the period of observation, the wind direction has been fluctuating from 150 to 210 degrees. The average wind speed for the last minute has been 6 knots.

PRESSURE

Observed Barometer: 29.615
Correction: -.005

This observation was completed at 0056Z.

SKY CONDITION

3/10 FOG is hiding the sky.

2/10 ST is at a measured height of 1,580'.

10/10 AS is at 8,300', estimated.

VISIBILITY

The prevailing visibility is 2 miles. The tower reports a visibility o[illegible] miles. The FMN-1 computer on runway 32 reads:

$\boxed{6}$ $\boxed{0}$

ATMOSPHERIC PHENOMENA

Fog, 18 feet deep, is present at the station.

TEMPERATURE

Dry Bulb: 42.7
Wet Bulb: 41.3

WIND

The average one-minute wind direction and speed is 120 degrees at 4 knots.

PRESSURE

Observed Barometer: 29.835
Correction: +.010

This observation was completed at 1258Z.

SKY CONDITION

3/10 SMOKE (2/10 opaque) is at an estimated 400'.

2/10 AC is at an estimated 12,000'.

6/10 CS (5/10 opaque) is at an estimated 24,000'.

VISIBILITY

The tower and prevailing visibilities are 10 miles.

ATMOSPHERIC PHENOMENA

Haze is present in all quadrants.

TEMPERATURE

Temperature: 76
Dew Point: 55

WIND

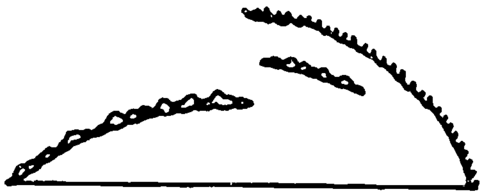
The average one minute wind direction and speed is 268 degrees at 12 knots. Seven minutes ago, the wind suddenly increased to 27 knots and sustained that speed for more than one minute.

PRESSURE

Observed Barometer: 29.130
Correction: -.005

This observation was completed at 1756Z.

SKY CONDITION



5/10 SC is determined by the ceiling light projector at angles of 62, 60, and 64 degrees.

2/10 AC is at 6,800', estimated.

5/10 CI is at 28,000', estimated.

VISIBILITY

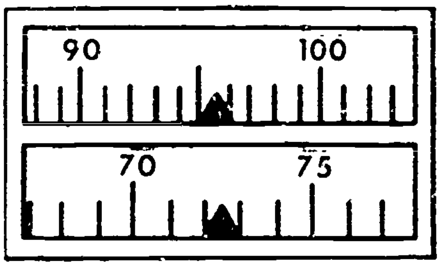
The visibility has been rapidly fluctuating between 1/2, 1, and 3/4 miles during the period of observation. The tower reports 1 1/2 miles.

ATMOSPHERIC PHENOMENA

Blowing dust and haze are present. The dust is predominate.

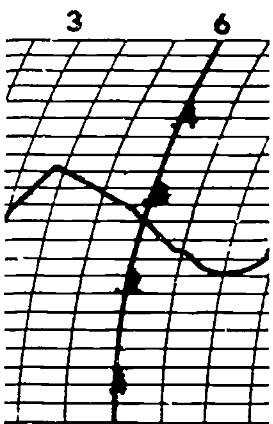
TEMPERATURE

Read the TMQ-11 below for the temperature and dew point.



WIND

The average one-minute wind was observed to be 25 degrees at 22 knots with lulls of 12 knots and peaks of 37 knots.

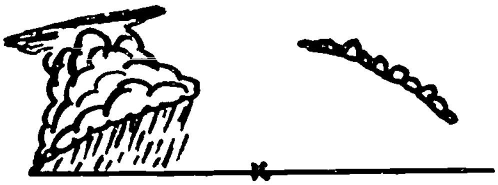


PRESSURE

Read the barograph trace at 0400Z for the station pressure.

This observation was completed at 0400Z.

SKY CONDITION

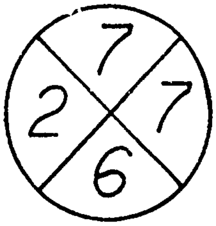


4/10 CB is west of the station at a measured 1,450'.

3/10 AC is at an estimated height of 12,000'.

All clouds are moving east.

VISIBILITY



The tower visibility is 7 miles.

ATMOSPHERIC PHENOMENA

Rainshowers of unknown intensity are west of the station.

TEMPERATURE

Temperature: 64
Dew Point: 52

WIND

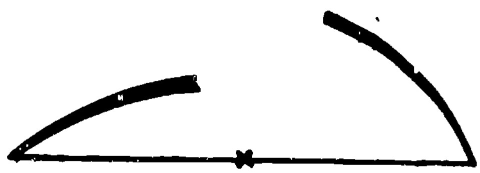
The wind direction has varied from 290 degrees to 70 degrees in the past eight minutes. The wind speed has been 17 knots with gusts to 29 knots.

PRESSURE

Observed Barometer: 29.460
Correction: -.005

This observation was completed at 1356Z.

SKY CONDITION



4/10 ST is measured with the RBC at an angle of 44 degrees.

3/10 AS is at an estimated 7,700'.

VISIBILITY

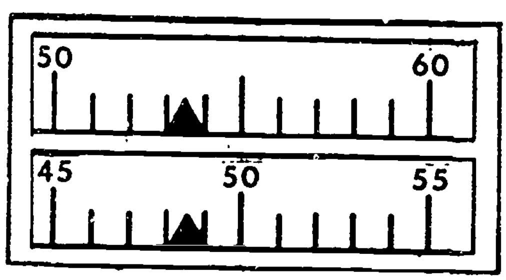
The prevailing visibility is 10 miles. The control tower reports 15 miles.

ATMOSPHERIC PHENOMENA

None

TEMPERATURE

Use the TMQ-11 below to determine the temperature and dew point.



WIND

The average one-minute wind direction and speed are 317 degrees at 14 knots. In the past 10 minutes, the wind speed had peaks of 27 knots and lulls of 7 knots.

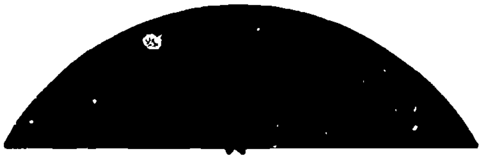
PRESSURE

Observed Barometer: 29.545
Correction: +.010

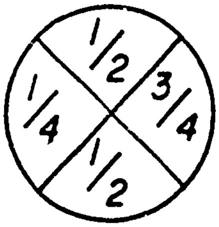
This observation was completed at 0758Z.

SKY CONDITION

10/10 FOG hides the sky. A 30 gram balloon began to fade in 1 minute, 5 seconds and completely disappeared in 1 minute, 20 seconds.



VISIBILITY



The tower reports 1/2 miles visibility. The FMN-1 on runway 18 now reads:

ATMOSPHERIC PHENOMENA

The fog, which has been present for hours, has become thicker and is now 1300 feet deep.

TEMPERATURE

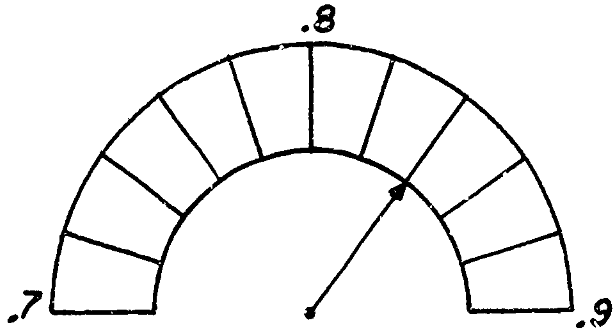
Dry Bulb: 51.4
Wet Bulb: 51.0

WIND

The wind recorder reads a direction of 135 degrees with a speed of 0 knots.

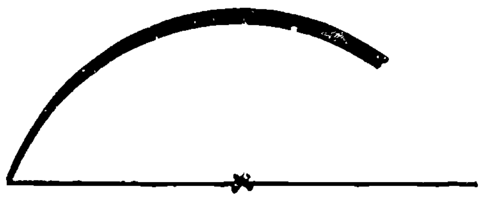
PRESSURE

Observed Barometer: 29.____
Correction: +.015



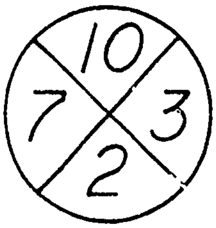
This observation was completed at 1359Z.

SKY CONDITION



7/10 ST (4/10 opaque) is at an estimated height of 600'. This layer has varied to 7/10 (4/10 thin) during the period of observation.

VISIBILITY



The tower visibility is 8 miles.

ATMOSPHERIC PHENOMENA

Haze is present at the station.

TEMPERATURE

Temperature: 63
Dew Point: 55

WIND

The average one-minute wind speed and direction is 225 degrees at 7 knots. Six minutes ago, the wind suddenly increased to 21 knots and was sustained for one minute.

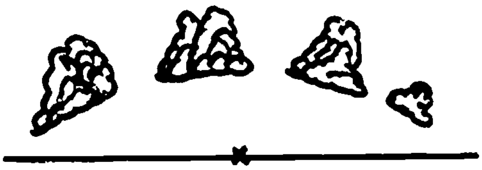
PRESSURE

Observed Baromete : 30.060
Correction: -.010

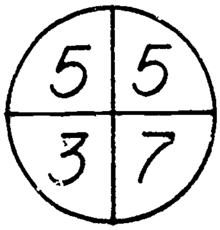
This observation was completed at 1158Z.

SKY CONDITION

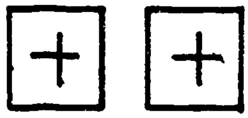
8/10 CU is at 2,500', measured.



VISIBILITY



The tower visibility is 7 miles. The FMN-1 on runway 31 reads:



ATMOSPHERIC PHENOMENA

Snow is being blown about the station enough so as it restricts the visibility.

TEMPERATURE

Dry Bulb: 27.7
Wet Bulb: 25.1

WIND

The average one-minute wind direction and speed is 85 degrees at 23 knots. Four minutes ago, the speed suddenly increased to 38 knots and remained there for 1 1/2 minutes.

PRESSURE

To obtain pressure data, use the aneroid barometer that is pictured on page 46.

This observation was completed at 1858Z.

Correction -.010

SKY CONDITION

2/10 STFRA is at 150'.

5/10 CB is overhead through west at heights determined by the RBC of 1,500', 1,400', 1,800', and 1,600'.

2/10 CU of moderate vertical extent is east of the station at 3,150' MSL.

2/10 AC is at 12,000' MSL.

All clouds are moving southeast.

VISIBILITY

The sector visibilities are north 3/4, east 1 1/2, south 3/4 and west 1/2. The tower reports 3/8 mile. The runway visual range for runway 27 is determined by means of the Transmissometer chart on page 48 at 1750Z.

ATMOSPHERIC PHENOMENA

Moderate rain, thunder and hail, 3/4 inch in diameter, are occurring at the station.

TEMPERATURE

Dry Bulb: 81.3
Wet Bulb: 79.7

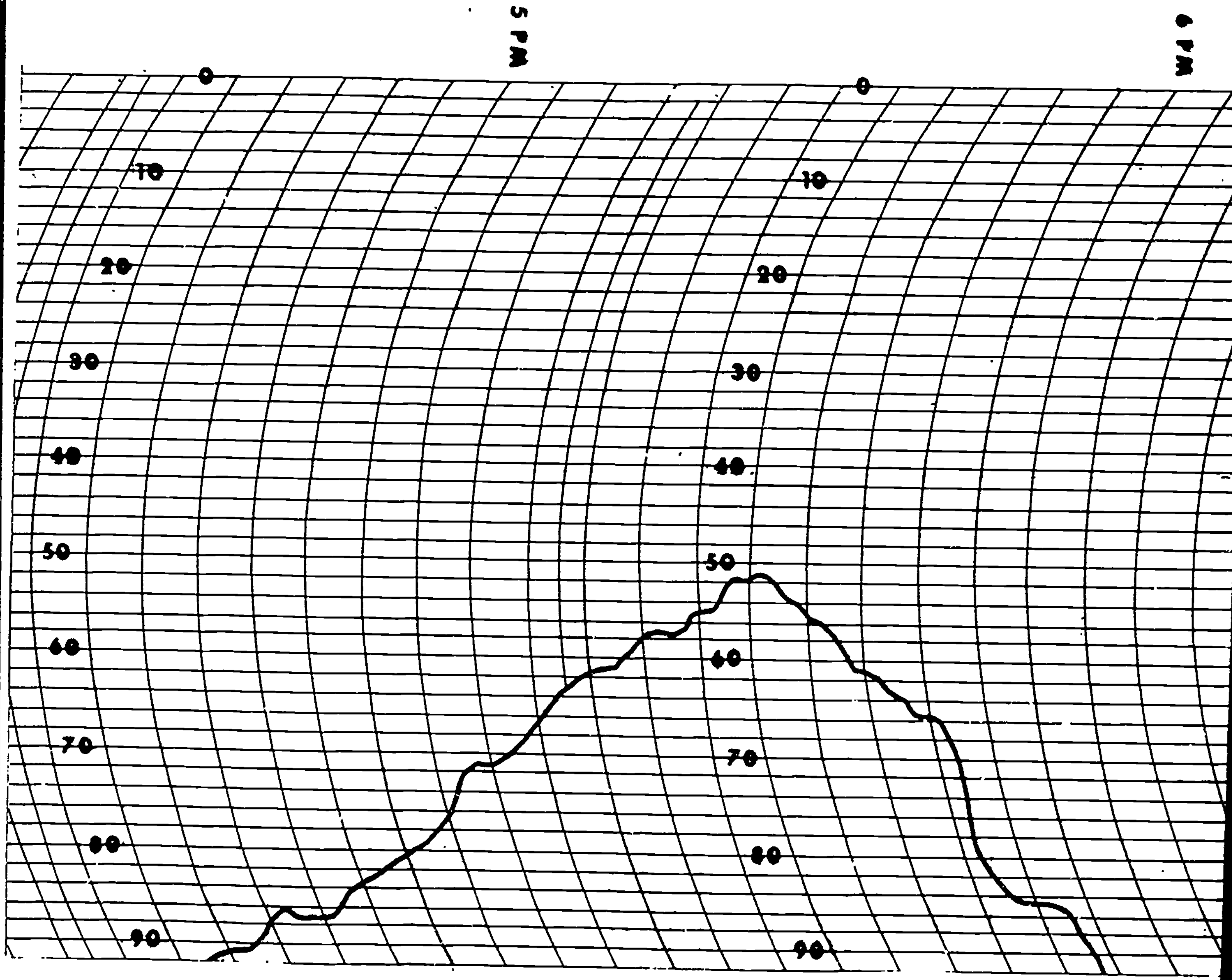
WIND

180 degrees at 20 knots with squalls to 38 knots.

PRESSURE

Observed Barometer: 29.150
Correction: -.010

This observation was completed at 1755Z.


5 PM
6 PM
0
10
20
30
40
50
60
70
80
90

SKY CONDITION

The sky is void of clouds.

VISIBILITY

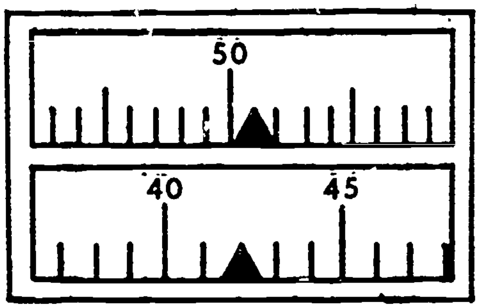
The prevailing and tower visibilities are both 10 miles.

ATMOSPHERIC PHENOMENA

None

TEMPERATURE

Read the TMQ-11 below for the temperature and dew point.



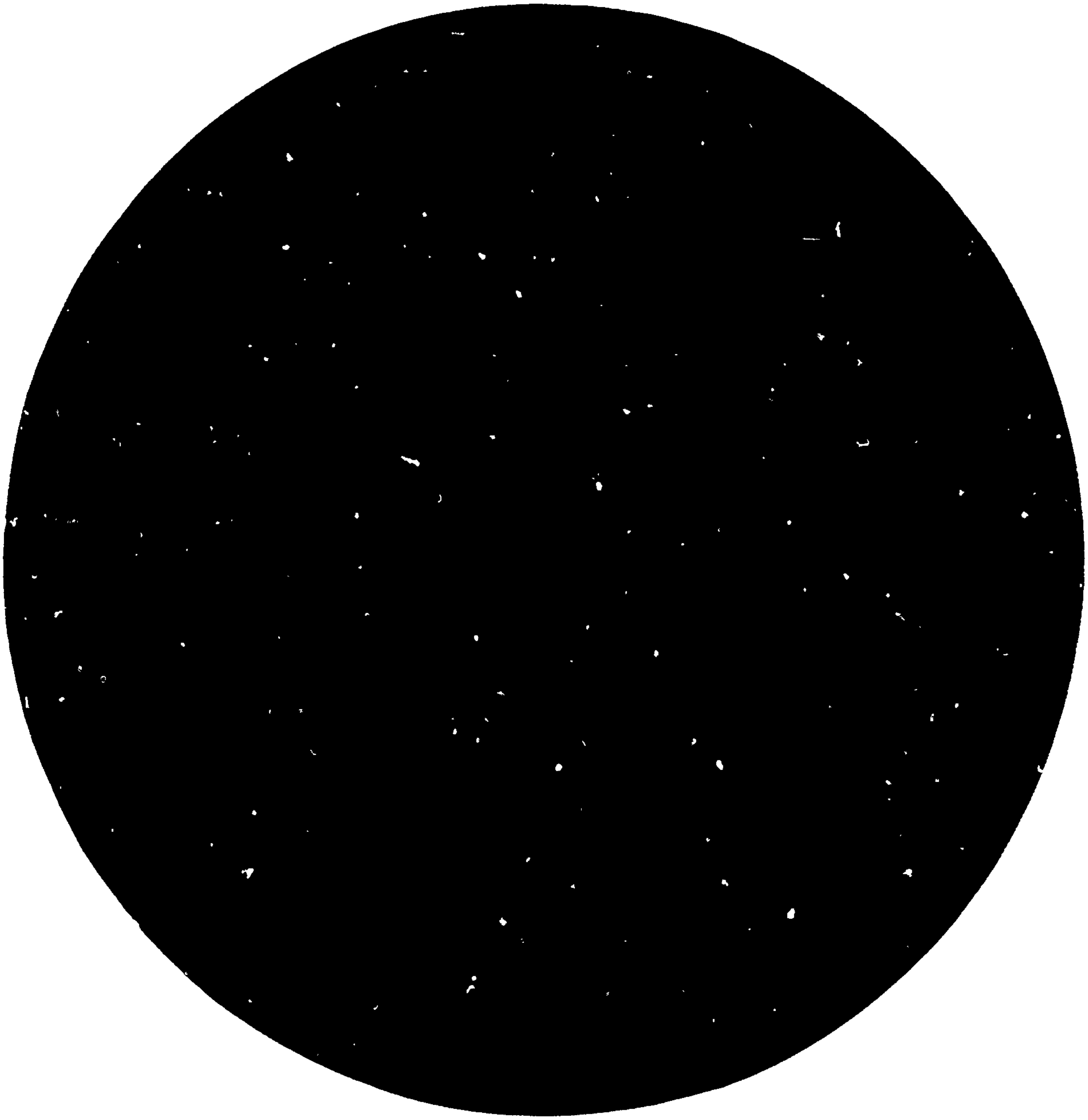
WIND

The average one-minute wind direction and speed are 1 degree at 5 knots.

PRESSURE

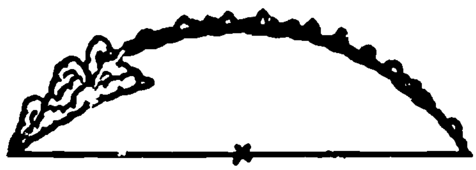
To obtain pressure data, use the aneroid barometer that is pictured on page 50.

This observation was completed at 1855Z.



Correction +.005

SKY CONDITION



3/10 CU is estimated at 2,000'.

7/10 AC is determined by the ceiling light projector to be at 8,000'.

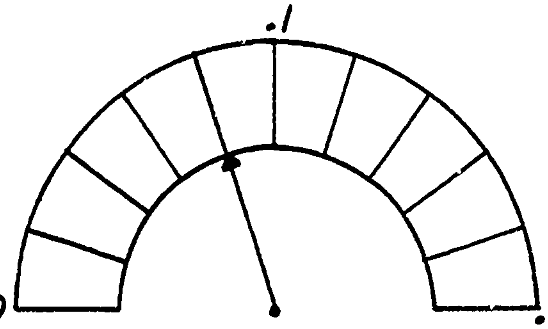
VISIBILITY
The visibility is 7 miles in the tower and on the surface.

ATMOSPHERIC PHENOMENA
Haze and smoke are present at the station.

TEMPERATURE
Dry Bulb: 70.2
Wet Bulb: 63.7

WIND
Calm

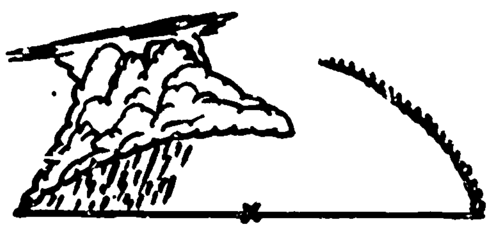
PRESSURE
Observed Barometer: 29.____
Correction: -.010



This observation was completed at 1857Z.

1532

SKY CONDITION

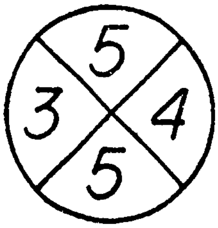


6/10 CB is west through overhead at 63 degrees determined by the RBC.

4/10 CI is at 28,000', estimated.

All clouds are moving east.

VISIBILITY



The tower reports 4 miles. The FMN-1 on runway 08 Right now reads:

ATMOSPHERIC PHENOMENA

Haze is present at the station. Rainshowers are falling to the west of the station. Thunder is heard west of the station with frequent flashes of lightning from the cloud to the ground and from the cloud to the air observed.

TEMPERATURE

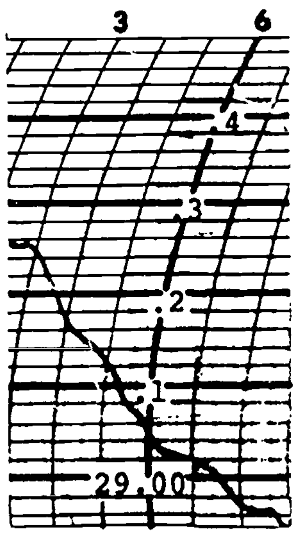
Dry Bulb: 53.7
Wet Bulb: 51.3

WIND

220 degrees at 15 knots.
A peak of 29 knots occurred 5 minutes ago and remained there for more than a minute.

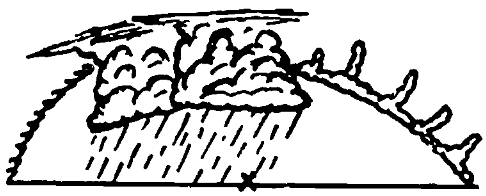
PRESSURE

Read the barograph trace at 0356Z for the station pressure.



This observation was completed at 0356Z.

SKY CONDITION



5/10 CB are overhead and west at clinometer heights of 50, 52, and 53 degrees.

4/10 AC with sproutings in the form of battlements is estimated to be at 10,600'.

1/10 CI is visible at 24,500', estimated.

All clouds are moving northwest.

VISIBILITY

The sector visibilities are north 2 1/2, east 3, south 2, and west 1. The tower reports 3 miles.

ATMOSPHERIC PHENOMENA

Thunder is heard only overhead. Frequent lightning within the cloud is observed overhead while occasional lightning is observed from cloud to cloud and from cloud to ground to the west. Light rain is falling at the station.

TEMPERATURE

Temperature: 43
Dew Point: 38

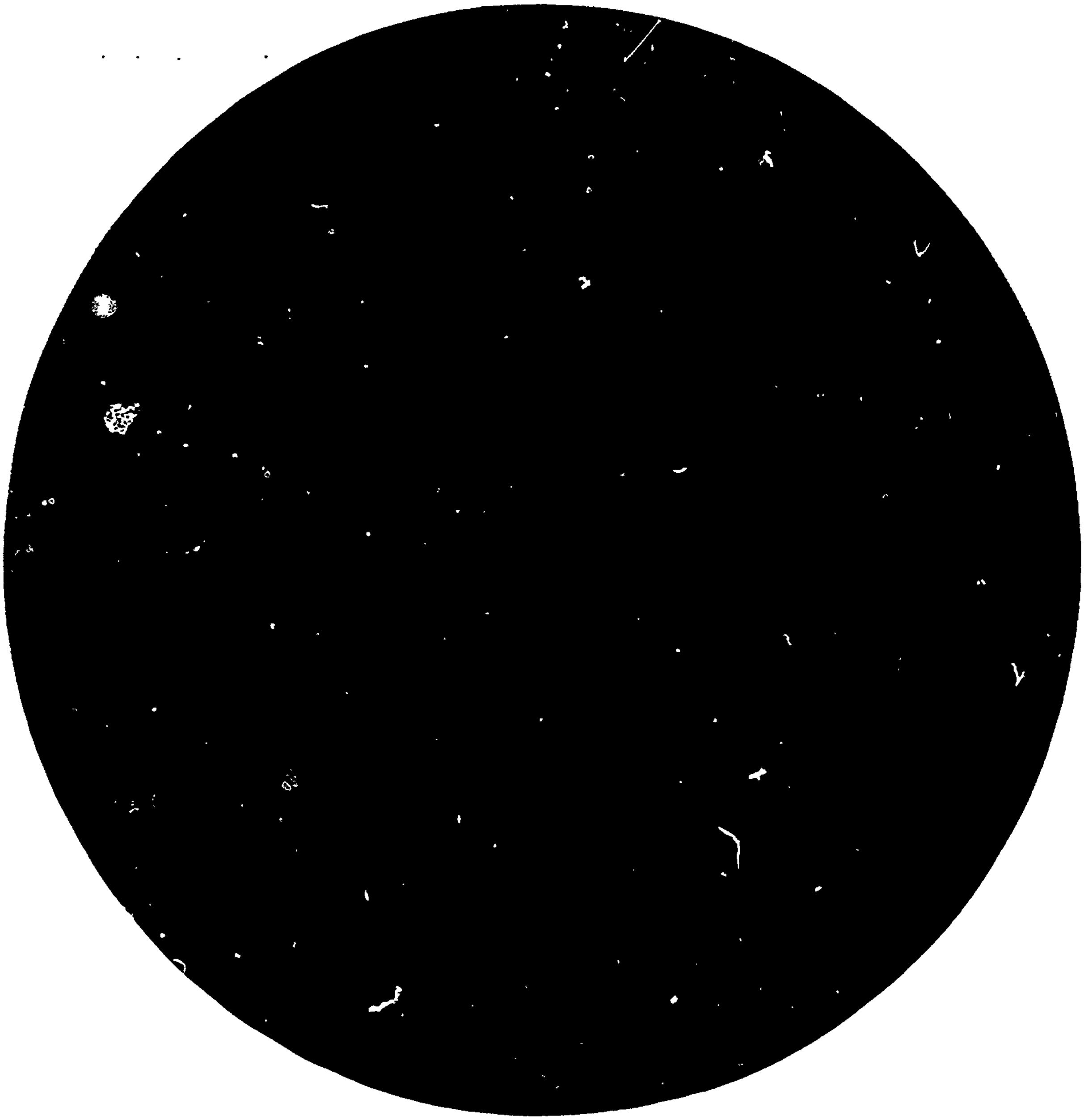
WIND

217 degrees at 19 knots. Eight minutes ago, a peak of 35 knots was observed for a fifty second period.

PRESSURE

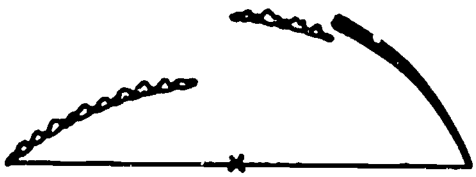
To obtain pressure data, use the aneroid barometer that is pictured on page 54.

This observation was completed at 0956Z.



Correction -.005

SKY CONDITION



4/10 SC (2/10 opaque) is at an estimated 2,000'.

1/10 AC is at a measured 7,350'.

4/10 AS (3/10 opaque) is at 7,700', measured by the ceiling light projector and clinometer.

VISIBILITY

The visibilities in the sectors are north 7, east 6, south 6, and west 5.

ATMOSPHERIC PHENOMENA

Haze and smoke are present with the smoke predominant.

TEMPERATURE

Read the GMQ-29 below for temperature and dew point.

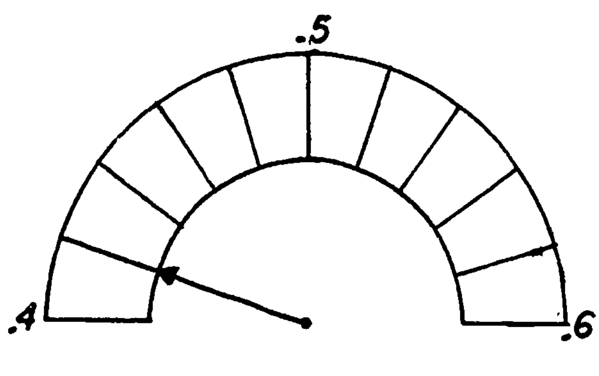
71.6	42.9

WIND

The wind has varied from 120 degrees to 175 degrees at 10 knots. In the past 10 minutes, there have been peaks of 16 knots and lulls of 7 knots.

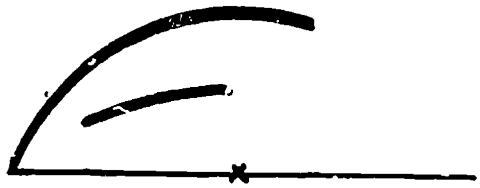
PRESSURE

Observed Barometer: 29.____
Correction: -.015



This observation was completed at 1157Z.

SKY CONDITION



3/10 SMOKE (all thin) is at 1,540', estimated.

6/10 AS is at 13,300' MSL.

VISIBILITY

The prevailing visibility is 12 miles.

ATMOSPHERIC PHENOMENA

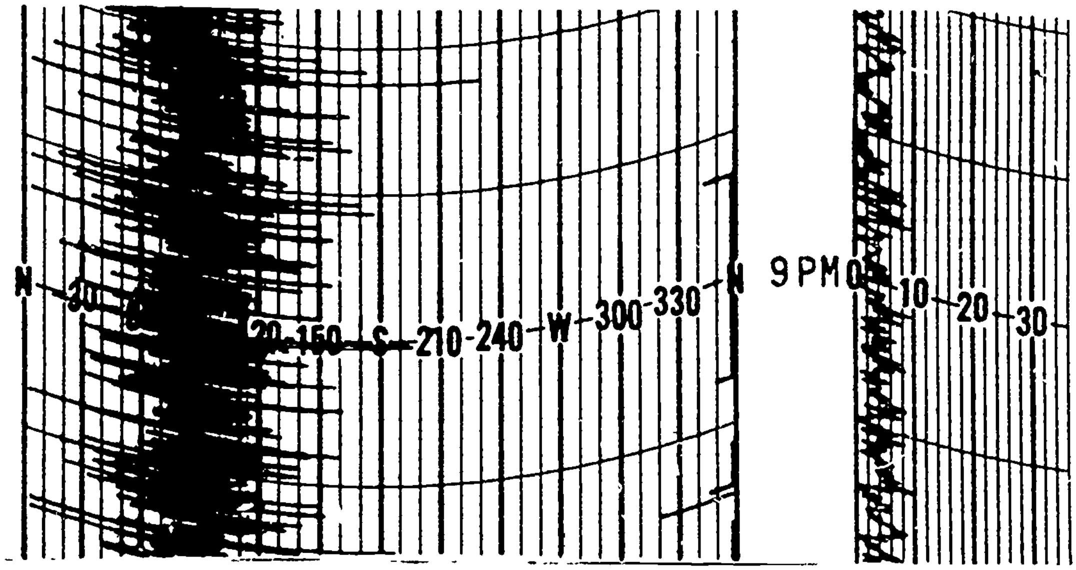
None

TEMPERATURE

Dry Bulb: 42.8
Wet Bulb: 36.5

WIND

Read the RO-362 below for the correct wind entries.



PRESSURE

Observed Barometer: 29.425
Correction: -.005

This observation was completed at 2056Z.

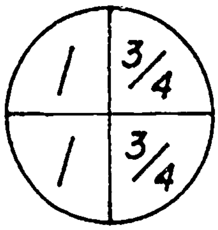
1537

SKY CONDITION

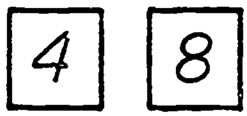
3/10 of the sky is hidden by blowing sand.

2/10 ACSL is at 9,700', estimated.

VISIBILITY



The tower reports 2 miles. The FMN-1 on runway 17 Right reads:

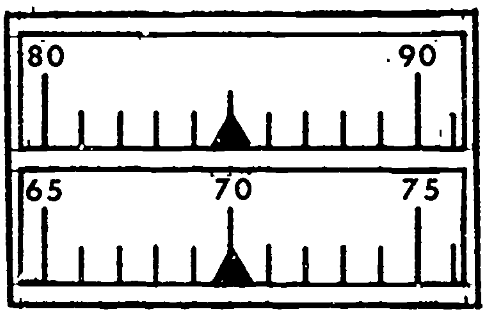


ATMOSPHERIC PHENOMENA

Sand is being raised by gusty surface winds to a height of 15 feet.

TEMPERATURE

Read the TMQ-11 below for temperature and dew point.



WIND

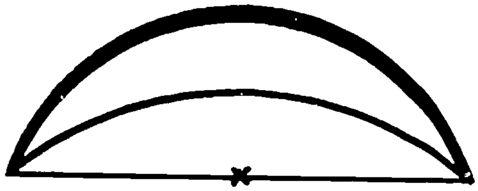
The wind direction and speed was observed to be 179 degrees at 24 knots. There have been rapid fluctuations in the wind speed in the last 7 minutes. Peaks of 38 knots with lulls of 17 knots were observed.

PRESSURE

Observed Barometer: 29.765
Correction: +.010

This observation was completed at 2356Z.

SKY CONDITION



10/10 AS (all thin) is at 14,200', estimated.

10/10 CS is at 24,000', estimated.

VISIBILITY

The prevailing visibility is 8 miles. The tower reports only 7 miles.

ATMOSPHERIC PHENOMENA

None

TEMPERATURE

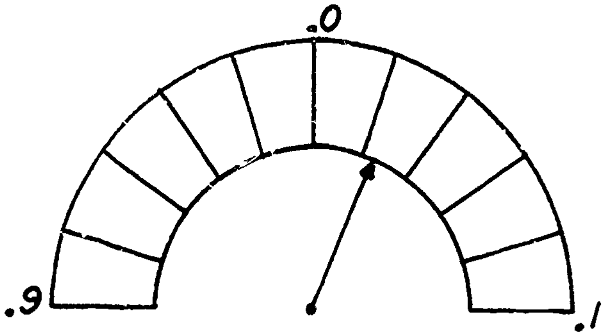
Temperature: 55
Dew Point: 53

WIND

The average one-minute wind direction and speed is 90 degrees at 8 knots. Seven minutes ago, the speed increased from a lull of 5 knots to a peak of 14 knots.

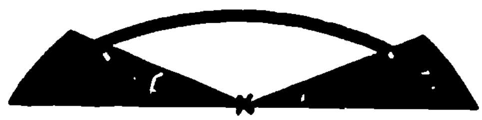
PRESSURE

Observed Barometer: 30.____
Correction: -.005



This observation was completed at 1855Z.

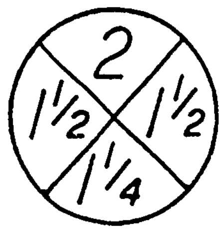
SKY CONDITION



4/10 FOG hides the sky.

6/10 ST (1/10 opaque) is visible at an estimated 1,200'. This layer has varied to 2/10 opaque during the period of observation.

VISIBILITY



The runway visual range for runway 16 Left is determined by means of the Transmissometer chart on page 60 at 1255Z.

ATMOSPHERIC PHENOMENA

Fog that is 19 feet deep is present at the station.

TEMPERATURE

Dry Bulb: 63.6
Wet Bulb: 61.9

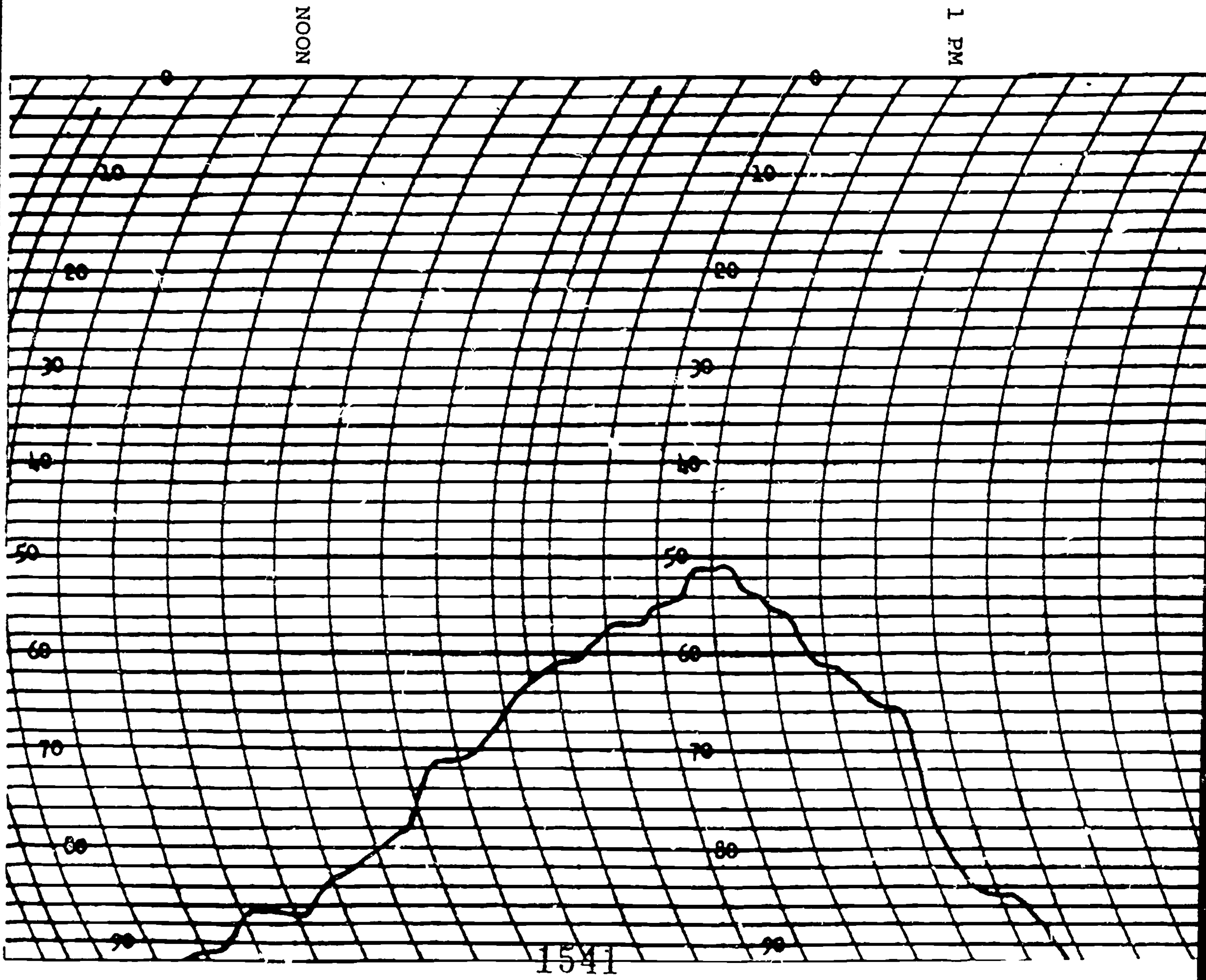
WIND

The average one-minute wind direction and speed is 10 degrees at 4 knots.

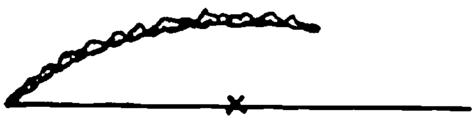
PRESSURE

Observed Barometer: 29.450
Correction: -.015 (estimated).

This observation was completed at 1300Z.


NOON
1 PM
0
10
20
30
40
50
60
70
80
90

SKY CONDITION



7/10 SC. A 30 gram ceiling balloon began to fade in 2 minutes and completely disappeared in 2 minutes, 30 seconds.

VISIBILITY

The prevailing visibility is 12 miles and the tower visibility is reported as 11 miles. The FMN-1 on runway 22 now reads:

ATMOSPHERIC PHENOMENA

Haze is present in all quadrants.

TEMPERATURE

Dry Bulb: 35.6
Wet Bulb: 29.8

WIND

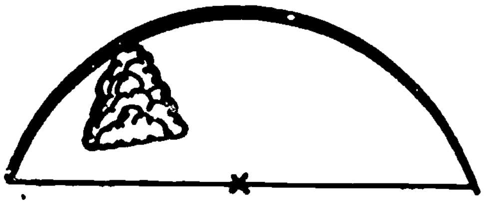
The average one minute wind direction and speed is 292 degrees at 10 knots. Nine minutes ago, the wind suddenly increased to a peak of 25 knots and sustained this speed for one minute. Six minutes ago, the wind speed increased to 28 knots and sustained this peak for one minute also.

PRESSURE

Observed Barometer: 29.750
Correction: -.020

This observation was completed at 1359Z.

SKY CONDITION



2/10 TCU is at 1,700', estimated.

10/10 CS (5/10 thin) is at an estimated 25,000'.

VISIBILITY

The prevailing visibility is 4 miles.

ATMOSPHERIC PHENOMENA

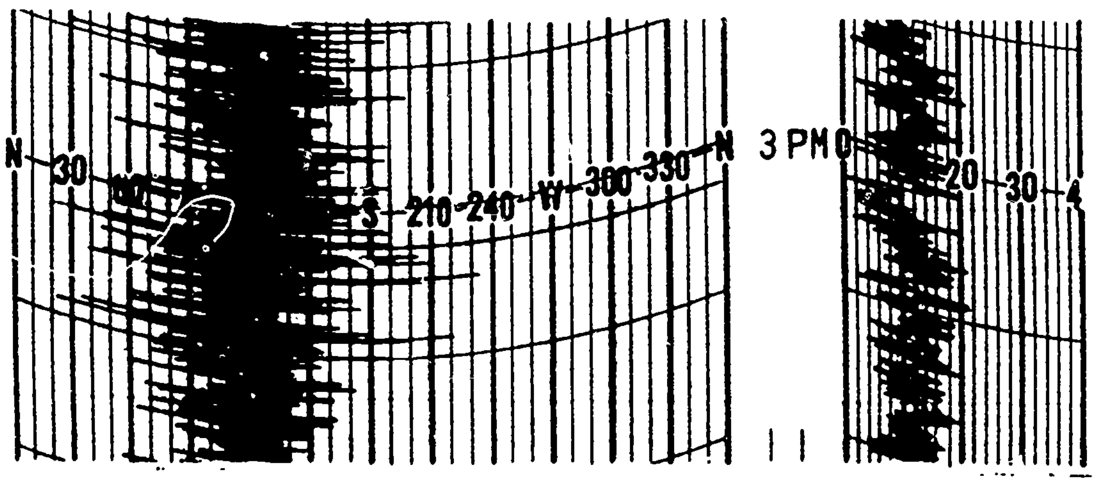
Haze is present at the station

TEMPERATURE

Dry Bulb: 52.1
Wet Bulb: 47.3

WIND

Read the RO-362 below for the wind direction and speed at 1459Z.



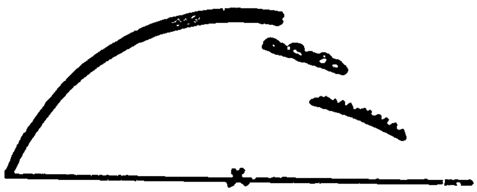
PRESSURE

Observed Barometer: 30.000
Correction: Zero

This observation was completed at 1459Z.

1543

SKY CONDITION

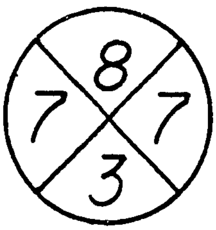


2/10 SMOKE (all thin) is at an estimated 1,500'.

1/10 AC is at an estimated 8,300'.

6/10 CS (2/10 thin) is at an estimated 23,000'.

VISIBILITY



ATMOSPHERIC PHENOMENA

Haze is present in all quadrants.

TEMPERATURE

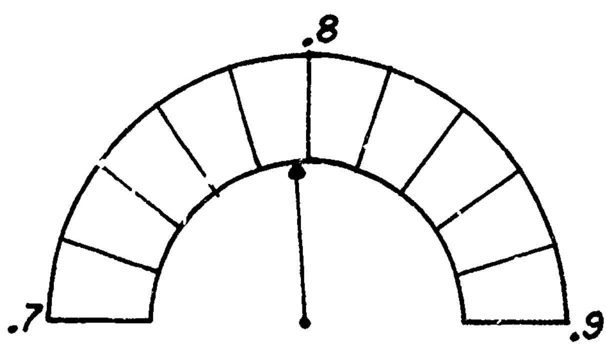
Dry Bulb: 83.6
Dew Point: 75.3

WIND

174 degrees at 12 knots with gusts to 20 knots.

PRESSURE

Observed Barometer: 29.____
Correction: -.005



This observation was completed at 1255Z.

Correction -.005

SKY CONDITION

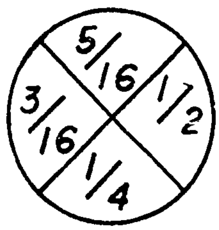
4/10 FOG hides the sky.

1/10 ST is at 750', estimated.

3/10 CB is west of the station at 3,200', estimated.

All clouds are moving north.

VISIBILITY



The tower visibility is 2 miles.

ATMOSPHERIC PHENOMENA

Loud peals of thunder are heard to the west of the station. Frequent lightning is observed to the west of the station within the clouds, from cloud to ground, and from cloud to air. Heavy rainshowers are falling at the station and fog is also present.

TEMPERATURE

Dry Bulb: 52.1
Wet Bulb: 51.3

WIND

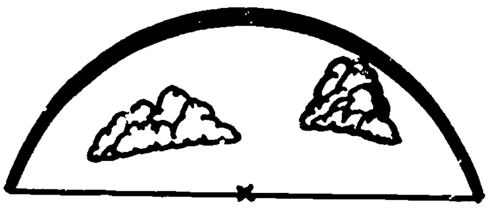
87 degrees at 12 knots with gusts to 28 knots. The wind speed and direction was from 32 degrees at 5 knots 12 minutes ago, but shifted with the approach of the CB.

PRESSURE

Read the aneroid barometer that is pictured on page 64 for pressure data.

This observation was completed at 1657Z.

SKY CONDITION



3/10 CU is at 3,200'.

2/10 TCU is east of the station at a measured 3,775'.

10/10 CS is at an estimated 28,000'.

VISIBILITY

The visibility in all quadrants is 16 miles.

ATMOSPHERIC PHENOMENA

None

TEMPERATURE

Dry Bulb: 76.5
Wet Bulb: 72.4

WIND

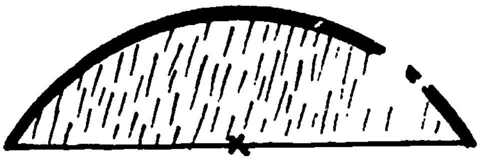
Twelve minutes ago, the wind shifted from 307 degrees to 350 degrees. The wind speed was observed to be 11 knots with peaks of 18 knots and lulls of 7 knots.

PRESSURE

Observed Barometer: 28.975
Correction: -.010

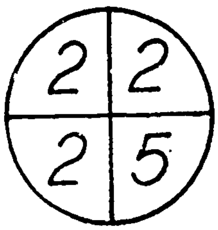
This observation was completed at 0756Z.

SKY CONDITION

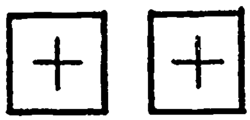


10/10 ST is at a height reported by a pilot of 1,500' MSL. There are breaks in this layer to the east.

VISIBILITY



The control tower reports a visibility of 2 1/8 miles. The FMN-1 on runway 18 Left is now reading:

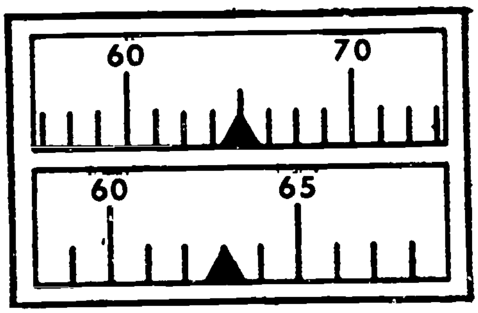


ATMOSPHERIC PHENOMENA

Drizzle that began last hour is still falling. It has stopped and restarted once in the past hour.

TEMPERATURE

Read the TMQ-11 below for the temperature and dew point.



WIND

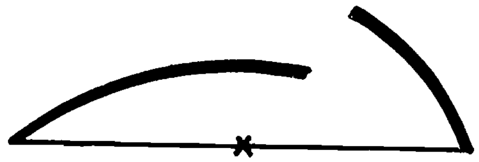
The wind is calm.

PRESSURE

Observed Barometer: 29.175
Correction· -.025 (Estimated)

This observation was completed at 1558Z.

SKY CONDITION



7/10 NS is determined by the ceilometer to be at heights that are rapidly fluctuating from 66 to 72 to 64 to 70 degrees.

3/10 AS is at 7,200', estimated. This layer has varied to 2/10 during the period of observation.

VISIBILITY

The prevailing and tower visibilities are both 7 miles. The GMQ-10 on runway 34 indicates 96%.

ATMOSPHERIC PHENOMENA

None

TEMPERATURE

Temperature: 53
Dew Point: 49

WIND

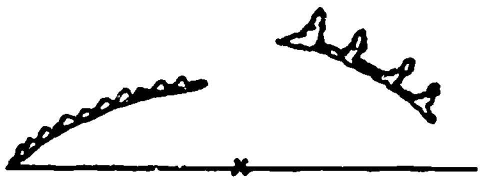
The average one minute wind direction has varied during the period of observation from 292 degrees to 14 degrees. The average speed is 7 knots. Four minutes ago, the speed increased from a lull of 3 knots to a peak of 12 knots and sustained that peak for one minute.

PRESSURE

Observed Barometer: 29.645
Correction: Zero

This observation was completed at 1655Z.

SKY CONDITION



4/10 SC is reported by a pilot to be at 1,700' MSL.

4/10 AC in the form of towers and battlements is at 9,800', as determined by radar.

VISIBILITY

The prevailing visibility is 16 miles.

ATMOSPHERIC PHENOMENA

None

TEMPERATURE

Read the GMQ-29 for the temperature and dew point.

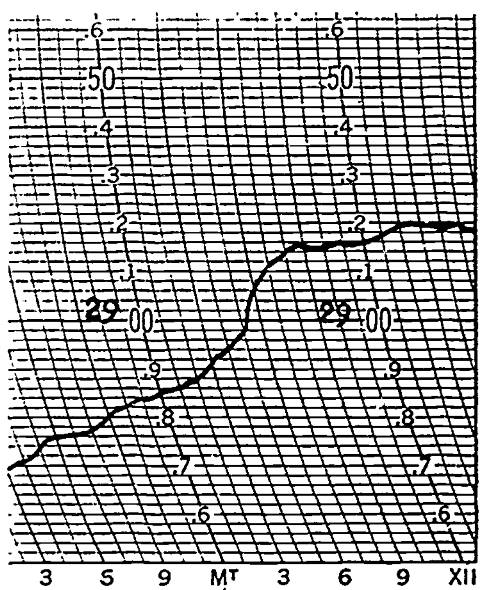
79.8	72.4

WIND

The wind recorder is inoperative. However, smoke is observed to be rising vertically from the power plant that is 2 miles to the south.

PRESSURE

Read the barograph to the right at 1756Z.



This observation was completed at 1756Z.

SKY CONDITION

The sky is completely hidden by snow. The vertical visibility was determined to 325' from the RBC 20 minutes ago.

VISIBILITY

The visibility has been observed to be varying from 1/4 to 0 to 1/8 to 5/16 to 1/2 to 3/8 during the period of observation. The tower reports a visibility of 1/16. The FMN-1 on runway 02 Center reads less than 1,000'.

ATMOSPHERIC PHENOMENA

Snow is falling at the station.

TEMPERATURE

Temperature: 29.4
Dew Point: 29.2

WIND

302 degrees at 16 knots. During the last 8 minutes, the speed has been frequently reaching peaks of 30 knots which are sustained for only a few seconds. Lulls of 7 knots are also observed.

PRESSURE

Observed Barometer: 28.810 (Estimated)
Correction: -.005

This observation was completed at 1856Z.

TABLE 1

Height Values for 400' Baseline (RBC)

ANGLE	REPORT VALUE	ACTUAL VALUE
5		35
6	0	42
7		49
8		56
9		63
10		71
11		78
12		85
13	100	92
14		100
15		107
16		115
17		122
18		130
19		138
20		146
21		154
22		162
23		170
24		178
25		187
26	200	195
27		204
28		213
29		222
30		231
31		240
32		250
33		260
34		270
35		280
36	300	291
37		301
38		313
39		324
40		336
41		348
42		360
43		373
44		386
45	400	400
46		414
47		429
48		444
49		460
50		477
51	500	494
52		512
53		531
54		551
55	600	571
56		593
57		616
58		640
59		666
60	700	693
61		722
62		752
63	800	785
64		820
65		858
66	900	898
67		942
68	1000	990
69		1042
70	1100	1099
71	1200	1162
72		1231
73	1300	1308
74	1400	1395
75	1500	1493
76	1600	1604
77	1700	1733
78	1900	1882
79	2100	2058
80	2300	2269
81	2500	2526
82	2800	2846
83	3300	3258
84	3800	3806
85	4600	4572
86	5500	5720

TABLE 2

Height Values for 800' Baseline (Clinometer)

ANGLE	REPORT VALUE	ACTUAL VALUE
4		56
5		70
6		84
7	100	98
8		112
9		127
10		141
11		156
12		170
13		185
14	200	199
15		214
16		229
17		245
18		260
19		275
20	300	291
21		307
22		323
23		340
24		356
25		373
26	400	390
27		408
28		425
29		443
30		462
31	500	481
32		500
33	500	520
34		540
35		560
36		581
37	600	603
38		625
39		648
40		671
41		695
42	700	720
43		746
44		772
45	800	800
46		828
47		858
48	900	888
49		920
50		953
51	1000	988
52		1024
53		1062
54	1100	1101
55		1142
56	1200	1186
57		1232
58	1300	1280
59		1331
60	1400	1386
61		1443
62	1500	1505
63	1600	1570
64		1640
65	1700	1716
66	1800	1797
67	1900	1885
68	2000	1980
69	2100	2084
70	2200	2198
71	2300	2323
72	2500	2462
73	2600	2617
74	2800	2790
75	3000	2986
76	3200	3209
77	3500	3465
78	3800	3764
79	4100	4116
80	4500	4537
81	5000	5051
82	5500	5692
83	6500	6515
84	7500	7612
85	9000	9144
86	11000	11440

EXERCISE 12

Answer the following questions as directed by your instructor.

AN/TMQ-11, Temperature Humidity Measuring Set

1. How is the temperature scale graduated, numbered, and read?

2. How is the dew point scale graduated, numbered, and read?

3. Which scale is on the top?

ML-24, Sling Psychrometer

4. What does the sling psychrometer furnish?

5. How is it graduated, numbered, and read?

6. Which temperature is read first?

GMQ-29, Automatic Weather Station

7. How are the temperatures and dew points indicated?

8. How are both of these read?

ML-429/UM, Psychrometric Calculator

9. When is the high side used?

10. When is the low side used?

11. When computing dew points, the 0 Index is set opposite of what value?

12. What value is the hairline of the cursor set on when computing dew points?

13. The dew point is then read under the hairline of which scale on the high side? low side?

Form 10 Entries

14. What column is the temperature entered in?

15. What column is the dew point entered in?

16. How many digits are entered for the temperature and dew point?

RO-362, Wind Measuring Set - Direction

17. The _______ side of the recorder chart displays direction.

18. How are the vertical lines graduated, numbered, and read?

19. How are the horizontal lines graduated, numbered, and read?

20. Wind direction is determined by obtaining what?

RO-362, Wind Measuring Set - Speed

21. The _______ side of the recorder chart displays speed.

22. How are the vertical lines graduated, numbered, and read?

23. How are the horizontal lines graduated, numbered, and read?

24. Wind speed is determined by obtaining what?

Form 10 Entries

25. Which columns are used to enter wind direction, speed, and character?

26. How many digits can be used in each of these columns?

27. If the speed is 100 knots or more, how is the entry made for column 9? column 10?

28. If any part of the winds are estimated, how is this entered on the form? which column?

29. Define a gust.

30. Define a squall.

31. What are the time limits for determining gusts and squalls?

32. Which column is used to record variable winds and wind shifts?

33. State the criteria for variable winds.

34. Give an example of how variable winds are entered on the form.

35. State the criteria for wind shifts.

36. Give an example of how wind shifts are entered on the form.

ML-102, Aneroid Barometer

37. The aneroid barometer can be read in what 2 ways?

38. How is it graduated, numbered, and read for each scale?

39. What must be done to the observed barometer reading in order to obtain the station pressure?

ML-563, Barograph

40. What three purposes does the barograph serve?

41. How is the barograph chart graduated, numbered, and read for time and pressure?

42. The barograph is set in reference to what time?

Form 10 Entries

43. Which columns are used to enter sea level pressure, altimeter setting, and station pressure?

44. How many digits can be used for each of the above entries?

45. How is station pressure entered?

46. How is sea level pressure entered?

47. How is altimeter setting entered?

48. Which columns are used to indicate estimated pressure readings?

49. State the criteria for pressure rising rapidly.

50. State the criteria for pressure falling rapidly.

DEPARTMENT OF THE AIR FORCE
3330 Technical Training Wing (ATC)
Chanute Air Force Base, Illinois 61868

C3ABR25130-000-HO-108A
C3ABR25130-002-HO-108A
10 November 1983

STUDENT CHECKLIST

Course: Weather Specialist/Aerographer's Mate

Subject: Temperature, Wind and Pressure

Objective: Given the FMH-1B, weather scenarios, psychrometric calculator, pressure conversion table and handout, encode the required temperature, wind and pressure entries on an AWS Form 10 to a minimum of 80% accuracy.

Notes: Upon completion of this unit of instruction, you will be required to make entries on the AWS Form 10 for the following items:

1. Sky Condition
2. Prevailing Visibility
3. Weather and Obstructions to Vision
4. Sea Level Pressure
5. Temperature
6. Dew Point
7. Wind Direction
8. Wind Speed
9. Wind Character
10. Altimeter Setting
11. Remarks
12. Station Pressure
13. Total Sky Cover

All items taught during this unit of instruction are valued at two (2) points each. All previously learned items are valued at one (1) point each. There are 4 problems that total 100 points possible on the progress check. The time limit will be one hour (60 minutes). Minimum passing score is 80%.

Designed for ATC Course Use. Do Not Use on the Job.

Technical Training

Weather Specialist
Aerographer's Mate

ADDITIVE DATA

8 February 1983

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

RGL: N/A

Weather Observer Branch
Chanute AFB, Illinois

C3ABR25130-WB-110
C3ABR25130-2-WB-110

ADDITIVE DATA

OBJECTIVES

Without reference, select the step-by-step procedure for determining 3-hourly additive data to a minimum of 70% accuracy.

Without reference, select the step-by-step procedure for determining 6-hourly addit. re data to a minimum of 70% accuracy.

PROCEDURE

Using the FMH-1B and the information given in each exercise, make the appropriate entries on an AWS Form 10 as directed by the instructor.

Supersedes 3ABR25130-WB-110, 9 September 1980.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 900; DAV - 1

EXERCISE 1

From the following word descriptions, determine an app and a 99ppp group as appropriate.

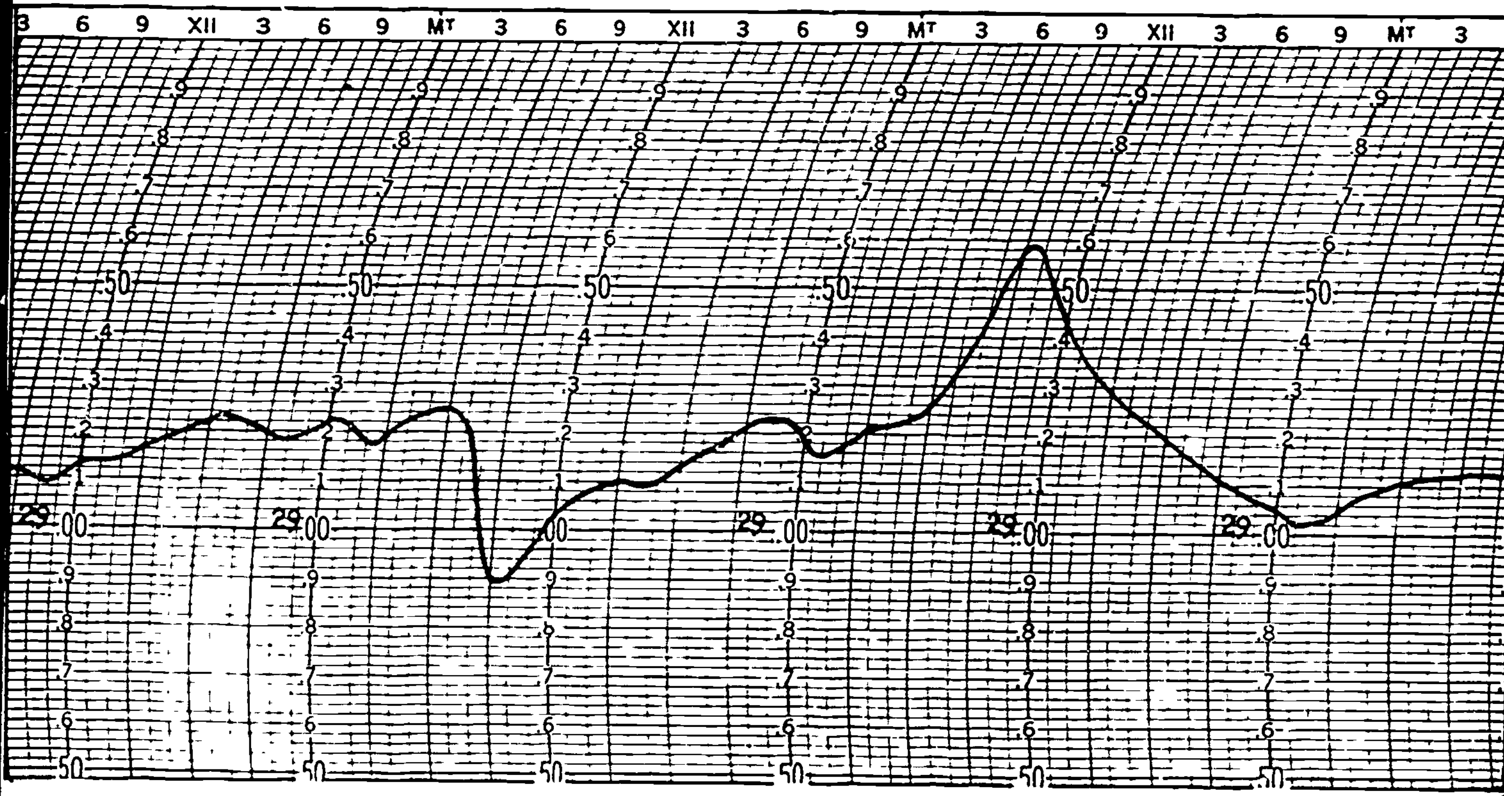
1.	SP now: 29.270 SP 3 hrs. ago: 29.270	The pressure was decreasing, then increasing.
2.	SP now: 29.750 SP 3 hrs. ago: 29.700	The pressure has been increasing steadily.
3.	SP now: 29.720 SP 3 hrs. ago: 29.800	The pressure has been decreasing unsteadily.
4.	SP now: 29.980 SP 3 hrs. ago: 30.000	The pressure has been decreasing, then increasing.
5.	SP now: 28.995 SP 3 hrs. ago: 28.975	The pressure has been increasing, then decreasing.
6.	SP now: 28.985 SP 3 hrs. ago: 28.985	The pressure has been increasing, then decreasing.
7.	SP now: 29.150 SP 3 hrs. ago: 29.555	The pressure has been decreasing, then decreasing more rapidly.
8.	SP now: 29.715 SP 3 hrs. ago: 29.700	The pressure has been increasing unsteadily.
9.	SP now: 29.720 SP 3 hrs. ago: 29.390	The pressure was steady, then increasing.
10.	SP now: 29.265 SP 3 hrs. ago: 29.275	The pressure was decreasing, then steady.
11.	SP now: 29.700 SP 3 hrs. ago: 29.700	The pressure has been steady.

12.	SP now: 29.990 SP 3 hrs. ago: 30.050	The pressure has been decreasing, then decreasing more slowly.
13.	SP now: 30.020 SP 3 hrs. ago: 29.990	The pressure has been increasing, then increasing more slowly.
14.	SP now: 28.990 SP 3 hrs. ago: 28.995	The pressure was increasing, then decreasing.
15.	SP now: 30.015 SP 3 hrs. ago: 29.720	The pressure was increasing, then steady.
16.	SP now: 29.840 SP 3 hrs. ago: 29.770	The pressure was increasing, then increasing more rapidly.
17.	SP now: 30.010 SP 3 hrs. ago: 29.985	The pressure was decreasing, then increasing.
18.	SP now: 30.020 SP 3 hrs. ago: 30.065	The pressure was steady, then decreasing.
19.	SP now: 29.580 SP 3 hrs. ago: 30.105	The pressure was decreasing steadily.
20.	SP now: 30.075 SP 3 hrs. ago: 30.075	The pressure was steady.

EXERCISE 2

Using the barograph on page 6 and the following station pressures, determine the app and 99ppp as appropriate for every three hours.

	TIME	SP	app 99ppp
	0900	29.115	
1.	XII 1200	29.130	1. ______
2.	1500	29.165	2. ______
3.	1800	29.220	3. ______
4.	2100	29.200	4. ______
5.	MT 0000	29.225	5. ______
6.	0300	29.195	6. ______
7.	0600	29.245	7. ______
8.	0900	28.900	8. ______
9.	XII 1200	29.035	9. ______
10.	1500	29.100	10. ______
11.	1800	29.135	11. ______
12.	2100	29.210	12. ______
13.	MT 0000	29.180	13. ______
14.	0300	29.210	14. ______
15.	0600	29.260	15. ______
16.	0900	29.580	16. ______
17.	XII 1200	29.440	17. ______
18.	1500	29.290	18. ______
19.	1800	29.195	19. ______
20.	2100	29.110	20. ______
21.	MT 0000	29.050	21. ______
22.	0300	29.050	22. ______


3 6 9 XII 3 6 9 MT 3 6 9 XII 3 6 9 MT 3 6 9 XII 3 6 9 MT 3
29.00

EXERCISE 3

Encode the proper cloud code groups for the following sky conditions.

1. _________ Scattered cumuliform clouds of little vertical extent are at 2,000 feet and a layer of stratocumulus, not formed from cumulus, is at 3,700 feet. One opaque layer of altocumulus, not progressively invading the sky, exists above. No other clouds are present.

2. _________ Ragged shreds of clouds at 600 feet lie below an overcast stratiform layer at 2,700 feet from which rain has been falling for six hours. No other clouds are observable.

3. _________ Cumuliform clouds of great vertical development, with anvil-shaped tops, are west of the station. Cumuliform clouds at 8,000 feet were formed as the result of the spreading out of a previous CB. Dense patches of cirrus, the remains of a CB, are at 35,000 feet.

4. _________ Cumuliform clouds of little vertical development are at 3,000 feet. A stratiform layer at 30,000 feet does not cover the entire sky and is not progressively invading the sky. No other clouds are present.

5. _________ Stratocumulus, not from cumulus, forms the lower layer. A semitransparent cumuliform layer at 12,000 feet is progressively invading the sky. Cumuliform clouds are at 24,000 feet.

6. _________ Stratocumulus, formed as a result of the spreading out of cumulus, is at 4,500 feet. Above this, two layers of opaque altocumulus and dense cirrus in patches, not from a CB, are present.

7. _________ A thin, stratiform cloud covers the entire sky at 27,000 feet.

8. _________ A continuous, overcast layer, producing snow grains, is at 500 feet. No other clouds are observable.

9. _________ Scattered, ragged cumuliform clouds (of good weather) are present. Stationary altocumulus, almond-shaped in appearance, can be seen northwest of the station. Wispy, hook-shaped cirrus that is not invading the sky, is also present.

10. _________ A layer of opaque altostratus at 12,000 feet lies below a layer of opaque altocumulus, not invading the sky, at 14,000 feet. Thin, filament-shaped cirrus is progressively invading the sky.

11. _________ A cumuliform cloud with very great vertical development and a fibrous top appears to the south of the station. Pouches appear to be hanging from the underside of this cloud. No other clouds are present.

12. _________ A cumuliform cloud of moderate vertical development is east of the station at 3,500 feet with its top in the form of domes and towers. Altocumulus with sproutings in the form of battlements lies to the west. Cirrostratus is progressively invading the sky and extends to 30 degrees above the horizon.

13. _________ Stratocumulus has formed by some other means than the spreading out of cumulus. An opaque stratiform layer is at 12,000 feet. No other clouds are observable.

14. _________ A cumulonimbus is northeast of the station moving southeast. Its top lacks a clear outline, is not fibrous, nor is it anvil-shaped. A single semitransparent altocumulus layer, composed of individual globular masses, is not progressively invading the sky. A layer of cirrostratus is invading the sky and extends to 65 degrees above the horizon.

15. _________ No clouds are present in any of the three height ranges.

16. _________ Cumuliform clouds of little vertical development are north of the station. Northeast of the station, a cumuliform cloud shows moderate vertical development. A cumuliform cloud of great vertical extent, its top anvil-shaped, is west of the station. All bases are at 3,000 feet. No other clouds are present.

17. _________ An opaque, overcast, stratiform layer exists at 200 feet. No precipitation is occurring and no other clouds are observable.

18. _________ Cumulus of little vertical development at 2,100 feet lies below stratocumulus, formed from cumulus, at 2,900 feet. To the southeast, altocumulus, with sproutings in the form of towers, moves northeast. Dense cirrus in patches, not progressively invading the sky, not from a CB, is overhead.

19. _________ A cumuliform cloud of strong vertical extent (top in the form of towers) is directly overhead. Its base is at 4,500 feet and the cloud is moving northeast. A stratiform layer, predominantly semitransparent, is at 7,500 feet. An opaque stratiform layer at 30,000 feet is not progressively invading the sky and not covering the entire sky.

20. _________ There is cumulus observed with little vertical development at 3,500 feet and stratocumulus (not from cumulus) at 4,700 feet. Stationary altocumulus (fish-shaped) lies at 10,000 feet to the north. Hook-shaped cirrus at 22,000 feet is not invading the sky.

21. _________ Stationary stratocumulus has formed by a method other than the spreading out of cumulus. An opaque cumuliform layer stretches in bands at 8,000 feet and is invading the sky. A cirriform layer at 26,000 feet appears as cumuliform tufts.

22. _________ A semitransparent, cumuliform layer is invading the sky at 13,000 feet. An opaque layer of altocumulus, at 16,000 feet, is not invading the sky. No other clouds are present.

23. _________ Ragged shreds of cloud are drifting below an extensive, gray layer at 400 feet which is producing continuous light rain. No other clouds are observable.

24. _________ A cumuliform cloud west of the station has a base at 3,500 feet and top at 47,000 feet. The top is fibrous and pouches are hanging from the underside of the cloud. At 13,000 feet, there are altocumulus clouds that were formed by the spreading out of a previous CB. No other clouds are observable.

25. _________ You observe a semitransparent, cumuliform layer at 12,000 feet that is not invading the sky. An invading cirrostratus layer, extending to 75 degrees above the horizon, is also observed.

26. _________ A cumuliform cloud with a base at 2,500 feet is to the south. The top lacks a sharp outline and is neither fibrous nor anvil-shaped. Cirrus in the shape of hooks is invading the sky.

27. _________ Scattered cumuliform clouds with little vertical extent are drifting across the sky at 3,700 feet. A transparent veil-like cloud covers the whole sky at 25,000 feet.

28. _________ The sun is dimly visible through a stratiform layer at 11,000 feet. No other clouds are observable.

29. _________ A stratiform layer at 29,000 feet invades the sky and extends to about 40 degrees above the horizon.

30. _________ A single, uniform blanket-like layer of clouds stretches across the sky at 300 feet. No other clouds are observable.

31. _________ Moderately developed cumuliform clouds are based at 4,000 feet northwest of the station. To the south, altocumulus, with sproutings in the form of battlements, is visible. No other clouds are present.

32. _________ Scattered, ragged cumulus was observed 20 minutes ago, but by the time of observation, it had dissipated. No clouds are present.

33. _________ A cumuliform cloud of great vertical development, whose base appears at 2,000 feet and top is dome-shaped, lies northeast of the station. No other clouds are present.

34. _________ Drizzle has started to fall from a continuous layer of stratiform clouds at 500 feet. No other clouds are observable.

35. _________ A cumuliform cloud of strong vertical extent, has its base at 3,000 feet and top at 25,000 feet west of the station. To the east, another cumuliform cloud with an anvil top rises to 50,000 feet from the same base. A layer is spreading out from the cumulus at 10,000 feet. A large patch of cirriform cloud drifts past at 40,000 feet; it is the upper remains of a CB.

36. _________ The sky is totally obscured by fog.

37. _________ At 7,000 feet, there is a dense stratiform cloud. An opaque layer of altocumulus is present at 8,500 feet and is not invading the sky. Cirrostratus extends to 25 degrees above the horizon.

38. _________ An almond-shaped cumuliform cloud appears at 9,000 feet to the west of the station moving east. No other clouds are present.

39. _________ A cumuliform layer at 7,000 feet with the top in the form of towers and battlements is east of the station. Dense patches of cirrus can be observed. They appear as cumuliform tufts.

40. ________ You observe a cumuliform cloud with strong vertical development whose top has a sharp, clear-cut appearance. Its base is at 2,500 feet. Stratocumulus, from cumulus, at 3,500 feet is also observed. No other clouds are present.

41. ________ Ragged shreds of clouds are observed under a stratiform layer which is producing continuous rain. No other clouds are observable.

42. ________ A cumuliform cloud of great vertical development is west of the station at 3,000 feet with tops dome-shaped. A semitransparent stratiform layer is at 10,000 feet. No other clouds are observable.

43. ________ Clouds with bases at 12,000 feet and tops in the form of towers are west of the station. Cirrostratus, not covering the entire sky and not progressively invading, is also present. No other clouds are present.

44. ________ Stratocumulus from cumulus and other cumuliform clouds of little vertical development are present at 3,000 feet. A layer of altocumulus, the greater part of which is semitransparent, is at 8,000 feet. Cumuliform puffs at 30,000 feet are also present.

45. ________ A cumuliform layer is at 7,500 feet. Its elements are rapidly changing and take on the appearance of almonds. A cumuliform cloud at 25,000 feet is covering 1/10 of the sky. A stratiform layer at 30,000 feet, not progressively invading, covers 4/10 of the sky. No other clouds are present.

46. ________ Stratiform clouds are at 8,000 feet. An opaque, cumuliform layer of clouds, not progressively invading the sky, is at 10,000 feet. No other clouds are present.

47. ________ A cumuliform cloud of strong vertical development is at 3,000 feet. A cumuliform cloud at 25,000 feet extends to 50 degrees and is invading the sky.

48. ________ An opaque stratiform layer exists at 12,000 feet. No other clouds are observable.

49. ________ A cumuliform cloud of little vertical development appears at 3,000 feet. Thin, wispy clouds, in hooks and filaments, at 20,000 feet, are not invading the sky.

50. ________ A layer of cumuliform clouds are at 30,000 feet. No other clouds are present.

EXERCISE 4

For the following problems, encode the appropriate additive data for these 6-hourly observations. Encoded groups for pressure and clouds are given.

1. At 0600Z, 6 hour precipitation: .01
   24 hour precipitation: .10
   Snow depth: Trace

Max Temps		Min Temps			
Past 12:	33	Past 12:	20	app:	400
Past 24:	35	Past 24:	18	Clouds:	18//

/____.

2. At 1200Z, 6 hour precipitation: Trace
   24 hour precipitation: .17
   Snow depth: 2.0

Max Temps		Min Temps			
Past 12:	11	Past 12:	-10	app:	312
Past 24:	15	Past 24:	-11	Clouds:	1070

/____.

3. At 1800Z, 6 hour precipitation: .09
   24 hour precipitation: .20
   Snow depth: None

Max Temps		Min Temps			
Past 12:	56	Past 12:	21	app:	500
Past 24:	65	Past 24:	20	Clouds:	1578

/____.

4. At 0000Z, 6 hour precipitation: 2.24
   24 hour precipitation: 3.08
   Snow depth: 15.0

Max Temps		Min Temps			
Past 12:	22	Past 12:	-12	app:	202
Past 24:	30	Past 24:	-15	Clouds:	None

/____.

5. At 0600Z, 6 hour precipitation: 3.01
24 hour precipitation: 3.20
Snow depth: None

Max Temps		Min Temps			
Past 12:	102	Past 12:	84	app:	799 99103
Past 24:	107	Past 24:	82	Clouds:	1963

/________________________________.

6. At 0000Z, 6 hour precipitation: .01
24 hour precipitation: .03
Snow depth: 5.5

Max Temps		Min Temps			
Past 12:	27	Past 12:	12	app:	400
Past 24:	28	Past 24:	5	Clouds:	None

/________________________________.

7. At 1800Z, 6 hour precipitation: .004
24 hour precipitation: .31
Snow depth: 100.2

Max Temps		Min Temps			
Past 12:	-1	Past 12:	-6	app:	502
Past 24:	2	Past 24:	-8	Clouds:	1007

/________________________________.

8. At 1200Z, 6 hour precipitation: .10
24 hour precipitation: .25
Snow depth: 212.1

Max Temps		Min Temps			
Past 12:	-25	Past 12:	-30	app:	000
Past 24:	-18	Past 24:	-32	Clouds:	1009

/________________________________.

9. At 1800Z, 6 hour precipitation: .22
24 hour precipitation: .47
Snow depth: 1.5

Max Temps		Min Temps			
Past 12:	35	Past 12:	20	app:	007
Past 24:	36	Past 24:	18	Clouds:	172/

/______________________________.

10. At 0600Z, 6 hour precipitation: Trace
24 hour precipitation: .05
Snow depth: 2.3

Max Temps		Min Temps			
Past 12:	11	Past 12:	-15	app:	605
Past 24:	13	Past 24:	-20	Clouds:	1231

/______________________________.

11. At 1200Z, 6 hour precipitation: None
24 hour precipitation: Trace
Snow depth: Trace

Max Temps		Min Temps			
Past 12:	2	Past 12:	-7	app:	808
Past 24:	5	Past 24:	-9	Clouds:	None

/______________________________.

12. At 0000Z, 6 hour precipitation: .01
24 hour precipitation: .05
Snow depth: None

Max Temps		Min Temps			
Past 12:	85	Past 12:	77	app:	299 99110
Past 24:	88	Past 24:	75	Clouds:	109/

/______________________________.

13. At 1800Z, 6 hour precipitation: Trace
24 hour precipitation: Trace
Snow depth: None

Max Temps		Min Temps			
Past 12:	84	Past 12:	62	app:	108
Past 24:	100	Past 24:	65	Clouds:	1080

/____.

14. At 0600Z, 6 hour precipitation: 1.30
24 hour precipitation: 2.55
Snow depth: 2.2

Max Temps		Min Temps			
Past 12:	22	Past 12:	1	app:	225
Past 24:	25	Past 24:	0	Clouds:	15//

/____.

15. At 1200Z, 6 hour precipitation: Unknown
24 hour precipitation: .004
Snow depth: Trace

Max Temps		Min Temps			
Past 12:	94	Past 12:	78	app:	310
Past 24:	101	Past 24:	75	Clouds:	16//

/____.

16. At 0600Z, 6 hour precipitation: .45
24 hour precipitation: 1.07
Snow depth: None

Max Temps		Min Temps			
Past 12:	80	Past 12:	72	app:	400
Past 24:	90	Past 24:	70	Clouds:	1900

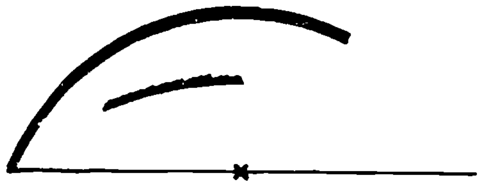
/____.

EXERCISE 5

For the following 15 problems, make the appropriate entries on an AWS Form 10 to include required additive data.

Using the FMH-1B and either the provided barograph trace or the given Column 12 or 17 entries, enter the pressure tendency in the additive data.

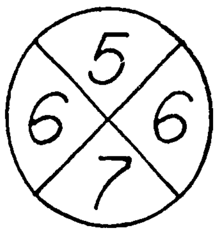
SKY CONDITION



3/10 Smoke (1/10 thin) is at an estimated 1,400 feet.

7/10 CS (4/10 transparent) is progressively invading the sky at 25,500' MSL.

VISIBILITY



The control tower reports a visibility of 5 1/2 miles.

ATMOSPHERIC PHENOMENA

Smoke and haze are present at the station.

TEMPERATURE

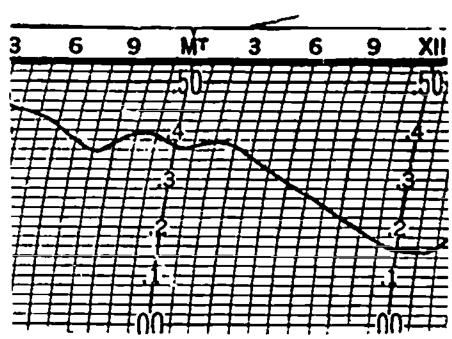
Dry Bulb: 39.8
Dew Point: 38.1

WIND

Calm

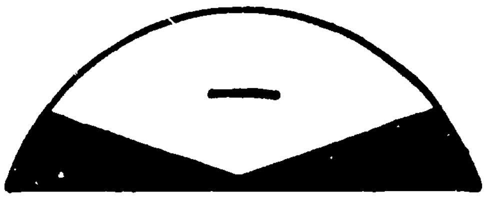
PRESSURE

Observed pressure: 29.220
Correction: +.005
SP 3 hours ago: 29.295



This observation was completed at 0258L.

SKY CONDITION

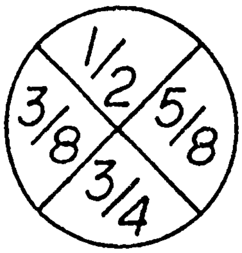


Rain hides 2/10 of the sky.

2/10 STFRA (all thin) is at a measured 1150 feet.

8/10 NS is visible at a measured 5100 feet.

VISIBILITY



The control tower reports 3/4 mile visibility.

The FMN-1 on Runway 09 Right indicates 4,000 feet.

ATMOSPHERIC PHENOMENA

Rain is occurring and accumulating at the rate of .30 inch per hour. Fog, 7 feet deep, contributes to the low visibility.

TEMPERATURE

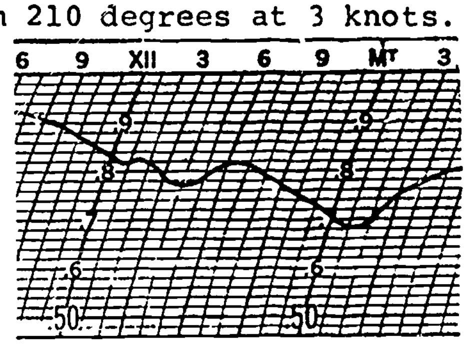
Dry Bulb: 32.3
Dew Point: 31.4

WIND

The wind is estimated to be from 210 degrees at 3 knots.

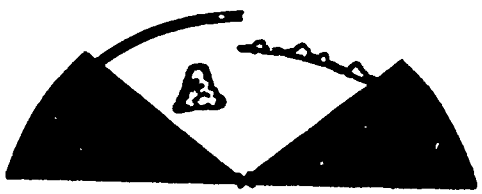
PRESSURE

Observed pressure: 28.750
Correction: +.005
SP 3 hours ago: 28.710



This observation was completed at 2058L.

SKY CONDITION



6/10 Blowing dust hides the sky.

1/10 Cumulus with moderate vertical development is at an estimated 2,300 feet.

2/10 Altocumulus is observed at 19,000' MSL.

2/10 Cirrostratus, all thin, not invading the sky, is at 34,000'.

VISIBILITY

The prevailing visibility has varied from 7/8 to 1 to 3/4 to 1 1/8 to 7/8. The FMN-1 on runway 18 reads 4,000 feet. The control tower reports 4 miles as their visibility.

ATMOSPHERIC PHENOMENA

Blowing dust is restricting the visibility.

TEMPERATURE

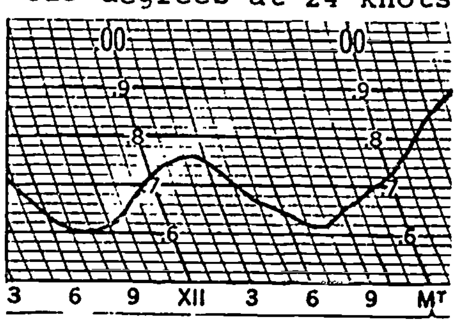
Dry Bulb: 86.4
Dew Point: 66.6

WIND

The wind is estimated to be from 325 degrees at 24 knots.

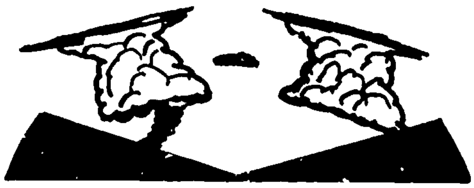
PRESSURE

Observed pressure: 28.640
Correction: +.010
SP 3 hours ago: 28.645



This observation was completed at 1457L.

SKY CONDITION



2/10 Blowing sand hides the sky.

3/10 CB is east of the station at 2,240', estimated.

2/10 CBMAM is west of the station at 2,240', measured.

1/10 AC, from CU, is at an estimated 18,000'.

All clouds are moving east.

VISIBILITY

The prevailing visibility is varying from 1/2 to 1 to 7/8 to 1 1/4. The FMN-1 on runway 27 reads 1,600'.

ATMOSPHERIC PHENOMENA

Blowing sand is present. Thunder was heard 5 minutes ago from the CBMAM. Occasional lightning from cloud to cloud and within the cloud was observed to the west and from the cloud to the ground to the east. A tornado is visible to the west of the station.

TEMPERATURE

Dry Bulb: 96.4
Dew Point: 80.5

WIND

313 degrees at 17 knots with a squall of 34 knots.

PRESSURE

Observed pressure: 29.710
Correction: -.005
SP 3 hours ago: 29.710

PREVIOUS COL. 17

At 1200L, 29.710
At 1300L, 29.715
At 1400L, 29.720

This observation was completed at 1458L.

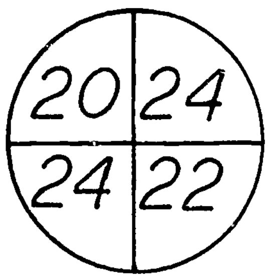
SKY CONDITION

4/10 Smoke (2/10 opaque) is at a measured 450'.

1/10 ACSL is at an estimated 10,000' east of the station.

6/10 CS (5/10 opaque) is not progressively invading the sky at 33,400' MSL.

VISIBILITY



ATMOSPHERIC PHENOMENA
None

TEMPERATURE
Dry Bulb: 77.7
Dew Point: 70.2

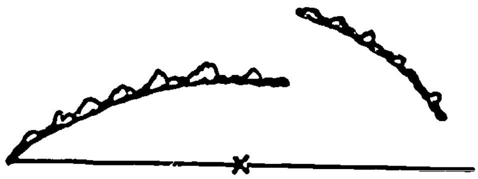
WIND
The wind is from 200 degrees at 4 knots.

PRESSURE
Observed pressure: 29.745
Correction: Zero
SP 3 hours ago: 29.825

PREVIOUS COL. 17
At 0600L, 29.825
At 0700L, 29.780
At 0800L, 29.750

This observation was completed at 0857L.

SKY CONDITION

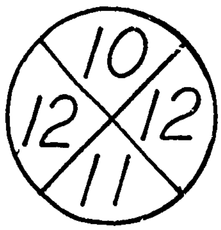


6/10 SC, formed by the spreading out of cumulus, is observed by the ceilometer at heights of 2,800, 2,300, 2,700 and 2,400'.

3/10 AC, formed by the spreading out of cumulus, is at an estimated 13,000'.

VISIBILITY

The tower reports 15 miles.



ATMOSPHERIC PHENOMENA

None

TEMPERATURE

Dry Bulb: 23.8
Dew Point: 4.4

WIND

205 degrees at an average speed of 8 knots.

PRESSURE

Observed pressure: 29.220
Correction: Zero
SP 3 hours ago: 29.225

PREVIOUS COL. 12

At 1800L, 30.04
At 1900L, 30.04
At 2000L, 30.05

This observation was completed at 2057L.

SKY CONDITION

10/10 Rain hides the sky. Vertical visibility is 370' as determined by the ceilometer.

VISIBILITY

The prevailing visibility is varying from 1/8 to 3/8 to 0 to 1/2 mile. The FMN-1 on runway 36 indicates 3,000'. The control tower reports 3/8 mile visibility.

ATMOSPHERIC PHENOMENA

Continuous heavy rain is falling. It is freezing on contact with the surface.

TEMPERATURE

Dry Bulb: 32.3
Dew Point: 27.7

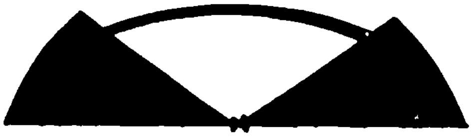
WIND

320 degrees at 15 knots.

PRESSURE	PREVIOUS COL. 17
Observed pressure: 29.605	At 0000L, 29.595
Correction: +.005	At 0100L, 29.700
SP 3 hours ago: 29.595	At 0200L, 29.640

This observation was completed at 0257L.

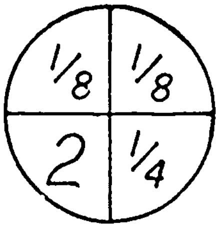
SKY CONDITION



Fog hides 4/10 of the sky.

6/10 ST is visible at 600', determined by a ceiling balloon.

VISIBILITY



The control tower reports 1/2 mile.

The FMN-1 on runway 36 reads 1,400'.

ATMOSPHERIC PHENOMENA

Fog at the station is 200 feet deep.

TEMPERATURE

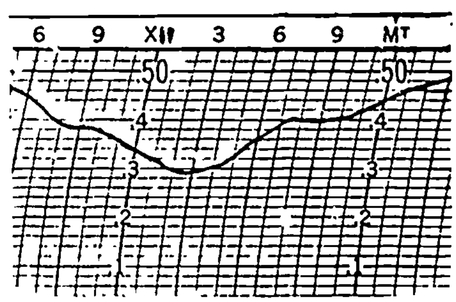
Dry Bulb: 52.7
Dew Point: 52.2

WIND

The wind direction and speed is 175 degrees at 13 knots.

PRESSURE

Observed pressure: 29.395
Correction: +.005
SP 3 hours ago: 29.360



This observation was completed at 1457L.

SKY CONDITION

Rainshowers hide 6/10 of the sky.

4/10 CB, with an anvil top, is at a measured 2,800'. This cloud is moving northwest.

VISIBILITY

The following values were observed during the period of observation: 3, 3/4, and 2 1/4.

ATMOSPHERIC PHENOMENA

Moderate rainshowers are at the station. Occasional flashes of lightning cloud to cloud are causing thunder overhead.

TEMPERATURE

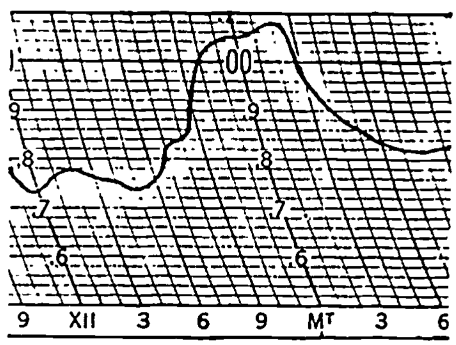
Dry Bulb: 82.3
Dew Point: 82.1

WIND

Direction is 265 degrees at 15 knots with gusts to 27 knots.

PRESSURE

Observed pressure: 28.975
Correction: Zero
SP 3 hours ago: 29.050



This observation was completed at 2057L.

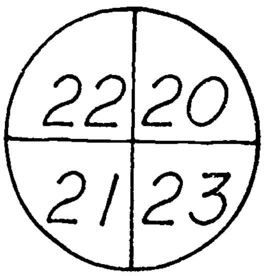
SKY CONDITION

2/10 CU, with little vertical extent, is at an estimated 4,000 feet.

9/10 CS (all thin) is not progressively invading the sky at 27,000', estimated.

1/10 CC is at 30,000 feet, estimated.

VISIBILITY



ATMOSPHERIC PHENOMENA

None

TEMPERATURE

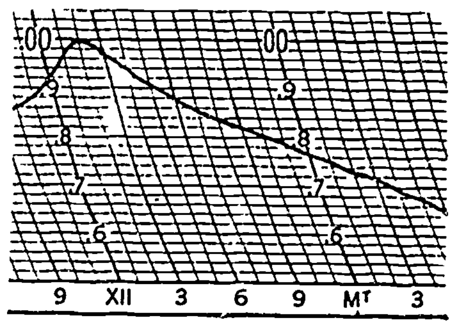
Dry Bulb: 11.4
Dew Point: 2.1

WIND

Direction is 83 degrees at 17 knots with gusts to 33 knots.

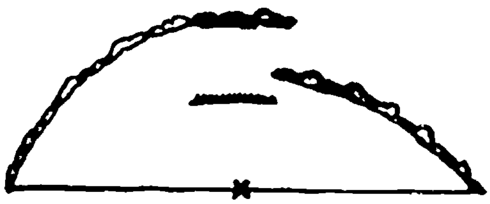
PRESSURE

Observed pressure: 28.970
Correction: Zero
SP 3 hours ago: 28.915



This observation was completed at 0856L.

SKY CONDITION

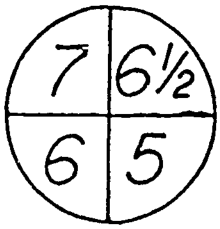


2/10 Haze (all thin) is at an estimated 2,000'.

4/10 SC, not formed from CU, is at 5,200' MSL.

6/10 AC, semitransparent and progressively invading the sky, is at an estimated 10,000'.

VISIBILITY



The control tower reports 5 miles.

ATMOSPHERIC PHENOMENA

Haze is present at the station.

TEMPERATURE

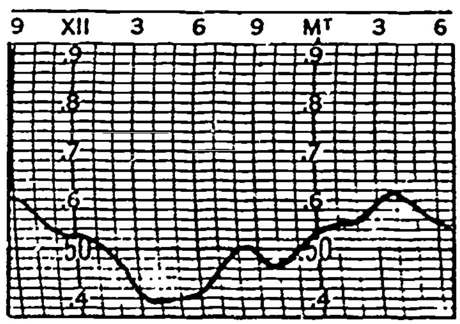
Dry Bulb: 78.9
Dew Point: 67.5

WIND

Direction is 347 degrees at 12 knots.

PRESSURE

Observed pressure: 29.485
Correction: -.005
SP 3 hours ago: 29.415

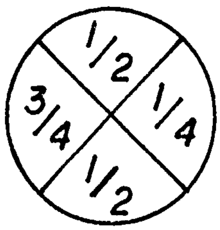


This observation was completed at 1458L.

SKY CONDITION

10/10 Snow hides the sky. A 30 gram balloon is used to determine the vertical visibility. Fade time: 65 seconds. Disappear time: 80 seconds.

VISIBILITY



The tower reports 1/8 mile. The FMN-1 on Runway 09 reads 1,000'.

ATMOSPHERIC PHENOMENA

Continuous snow is falling.

TEMPERATURE

Dry Bulb: 25.5
Dew Point: 21.7

WIND

Direction is 325 degrees at 10 knots.

PRESSURE

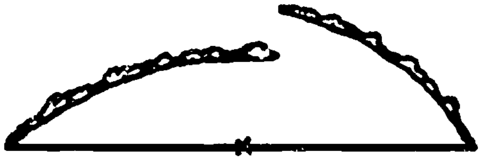
Observed pressure: 29.725
Correction: +.005
SP 3 hours ago: 29.755

PREVIOUS COL. 17

At 0600L, 29.755
At 0700L, 29.715
At 0800L, 29.700

This observation was completed at 0858L.

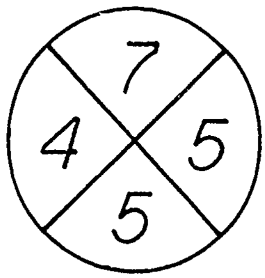
SKY CONDITION



6/10 SC, not formed from CU, is reported by a pilot to be at 1,700' MSL.

4/10 AC, opaque and not progressively invading the sky, has bases at 7,300' MSL.

VISIBILITY



ATMOSPHERIC PHENOMENA

Haze is present at the station.

TEMPERATURE

Dry Bulb: 68.9
Dew Point: 55.7

WIND

Presently, the wind is from 335 degrees at 17 knots. It shifted from 285 degrees at 1449L.

PRESSURE

Observed pressure: 29.275
Correction: +.010
SP 3 hours ago: 29.255

PREVIOUS COL. 12

At 1200L, 30.07
At 1300L, 30.12
At 1400L, 30.11

This observation was completed at 1456L.

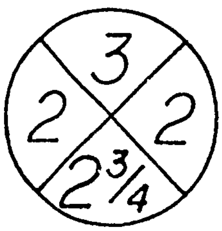
SKY CONDITION

1/10 of the sky is hidden by smoke.

6/10 Smoke (3/10 transparent) is at 3,700', estimated.

2/10 CI (all thin) is in the form of hooks and filaments, not progressively invading the sky, at 23,000' as reported by an aircraft.

VISIBILITY



The tower reported 3 miles visibility 10 minutes ago.

ATMOSPHERIC PHENOMENA

Smoke is at the station.

TEMPERATURE

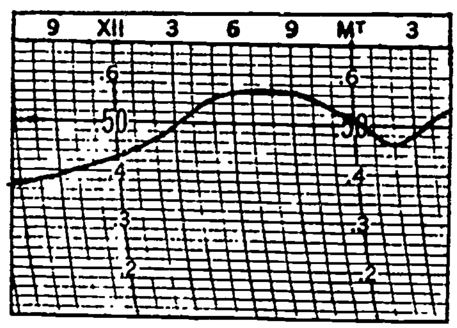
Dry Bulb: 31.2
Dew Point: 26.8

WIND

The direction is 107 degrees at 12 knots. There have been peaks of 18 knots and lulls of 5 knots in the past 8 minutes.

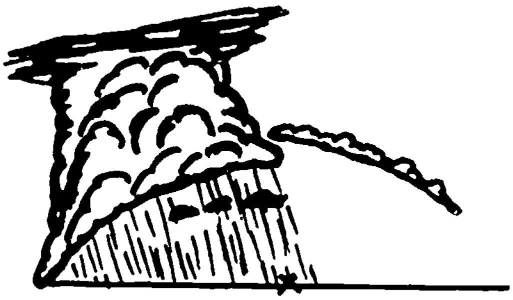
PRESSURE

Observed pressure: 29.480
Correction: +.005
SP 3 hours ago: 29.515



This observation was completed at 2057L.

SKY CONDITION

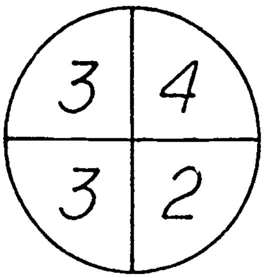


2/10 CUFRA (1/10 thin) is at 925', estimated.

5/10 CB, with an anvil top, is at 2,300', measured. This CB is northwest of the station and is moving to the southeast.

3/10 AC, semitransparent and progressively invading the sky, is at an estimated 7,200'.

VISIBILITY



ATMOSPHERIC PHENOMENA

Light rain is falling at the station. Frequent flashes of lightning from cloud to cloud and within the clouds are producing thunder from the CB to the northwest.

TEMPERATURE

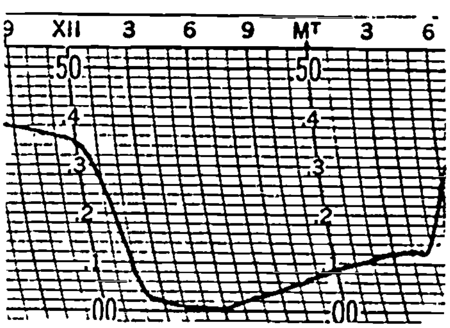
Dry Bulb: 69.0
Dew Point: 68.4

WIND

Direction is 130 degrees at 14 knots with gusts to 22 knots.

PRESSURE

Observed pressure: 29.015
Correction: Zero
SP 3 hours ago: 29.345



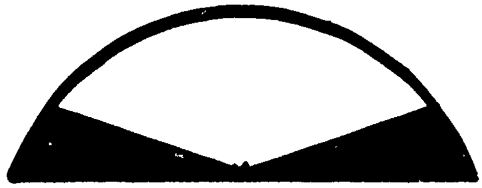
This observation was completed at 0356L.

EXERCISE 6

The following 30 problems consist of hourly, 3-hourly, and 6-hourly observations. Make the appropriate entries on an AWS Form 10 to include the required additive data.

Using the FMH-1B and either the provided barograph trace or the given Column 12 or 17 entries, enter the pressure tendency in the additive data.

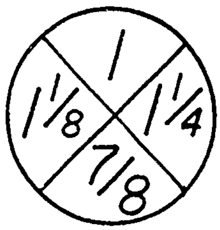
SKY CONDITION



2/10 of the sky is hidden by snow.

10/10 NS, 8/10 visible, is at an aircraft reported height of 1,400' MSL.

VISIBILITY



The tower reports 1/2 mile.

ATMOSPHERIC PHENOMENA

Snow is falling at the station.

TEMPERATURE		MAX TEMPS		MIN TEMPS	
Dry Bulb:	16.6	Past 12:	22	Past 12:	-2
Dew Point:	10.5	Past 24:	29	Past 24:	-4

WIND

The wind is 205 degrees at 2 knots.

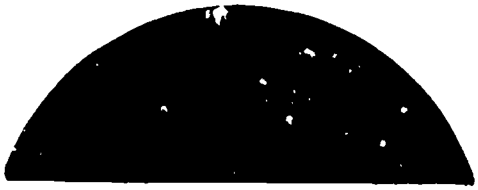
PRESSURE	PREVIOUS COL. 17
Observed pressure: 28.745	At 0300L, 28.705
Correction: +.010	At 0400L, 28.720
SP 3 hours ago: 28.705	At 0500L, 28.740

PRECIPITATION

6 hour precipitation: .31
24 hour precipitation: 1.06
Snow depth: 11.7

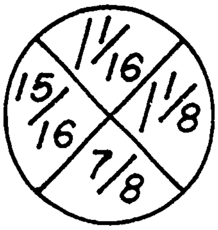
This observation was completed at 0557L.

SKY CONDITION



10/10 of the sky is hidden by fog. Vertical Visibility is 1,460' MSL.

VISIBILITY



The tower reports 1 mile. The FMN-1 for runway 36 indicates 3,600'.

ATMOSPHERIC PHENOMENA

Fog, 2,500' in depth as reported by a pilot, is present.

TEMPERATURE

Dry Bulb: 36.6
Dew Point: 36.3

MAX TEMPS
Past 12: 40
Past 24: 42

MIN TEMPS
Past 12: 37
Past 24: 32

WIND

Calm

PRESSURE

Observed pressure: 29.725
Correction: -.005
SP 3 hours ago: 29.795

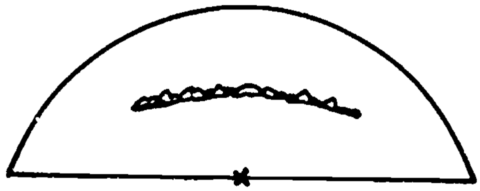
PREVIOUS COL. 17
At 2100L, 29.795
At 2200L, 29.820
At 2300L, 29.765

PRECIPITATION

6 hour precipitation: Trace
24 hour precipitation: .07
Snow depth: .4

This observation was completed at 2357L.

SKY CONDITION



6/10 SC, from CU, is at an estimated 3,500'.

10/10 CS (all thin) is present. A pilot reported the bases at 35,000' MSL.

VISIBILITY

The prevailing visibility is 7 miles.

ATMOSPHERIC PHENOMENA

Smoke and haze are present at the station.

TEMPERATURE

Dry Bulb: 81.0
Dew Point: 74.5

MAX TEMPS
Past 12: 84
Past 24: 88

MIN TEMPS
Past 12: 65
Past 24: 57

WIND

Calm

PRESSURE

Observed pressure: 29.345
Correction: -.010
SP 3 hours ago: 29.400

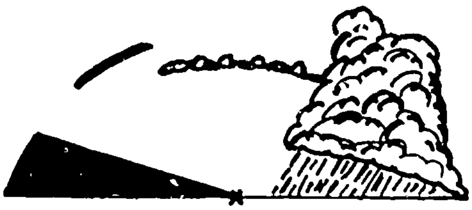
PREVIOUS COL. 12
At 1500L, 30.21
At 1600L, 30.24
At 1700L, 30.23

PRECIPITATION

6 hour precipitation: Trace
24 hour precipitation: Trace
Snow depth: None

This observation was completed at 1758L.

SKY CONDITION



Haze hides 1/10 of the sky.

3/10 CB, top not cirriform, is at an estimated 1,200'.

3/10 AC, opaque, is at 7,500', estimated.

1/10 CS, thin, is at 25,000'.

All clouds are moving east.

VISIBILITY

The prevailing visibility is 9 miles.

ATMOSPHERIC PHENOMENA

There is a rainshower of unknown intensity east of the station. Thunder was last heard at 1742L and then moved east. Haze is also present.

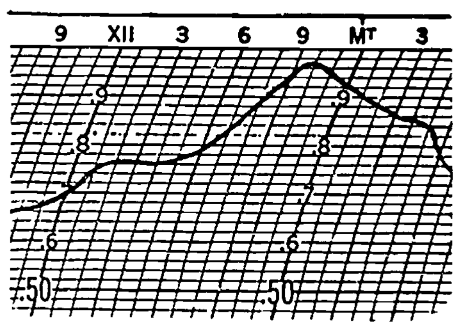
TEMPERATURE		MAX TEMPS		MIN TEMPS	
Dry Bulb:	42.5	Past 12:	54	Past 12:	40
Dew Point:	35.6	Past 24:	67	Past 24:	38

WIND

45 degrees at 8 knots with gusts to 16 knots.

PRESSURE

Observed pressure: 29.935
Correction: -.010
SP 3 hours ago: 29.940



PRECIPITATION

6 hour precipitation: .63
24 hour precipitation: .74
Snow depth: 4.2

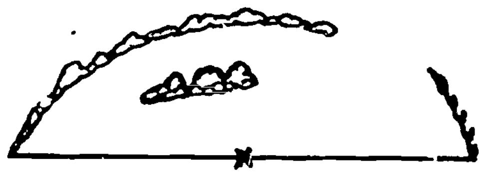
This observation was completed at 1758L.

SKY CONDITION

3/10 CU at an estimated 4,500'.

7/10 AC, semitransparent, is progressively invading the sky at 9,300', estimated.

1/10 CI, in hooks and filaments and not progressively invading the sky, is at 25,000' MSL.



VISIBILITY

Visibility to the north and south is 5 miles and to the east and west is 4 miles. Tower reports 7 miles.

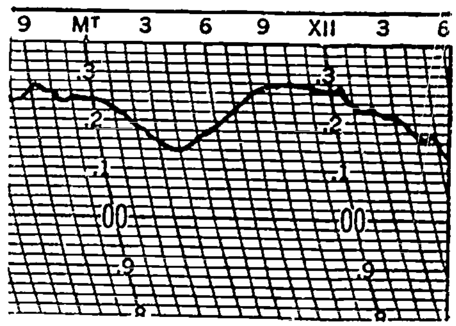
ATMOSPHERIC PHENOMENA

Haze is present at the station.

TEMPERATURE		MAX TEMPS		MIN TEMPS	
Dry Bulb:	73.4	Past 12:	78	Past 12:	73
Dew Point:	62.7	Past 24:	82	Past 24:	69

WIND

220 degrees at 18 knots with gusts to 25 knots.



PRESSURE

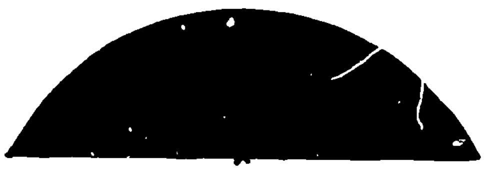
Observed pressure: 29.185
Correction: +.005
SP 3 hours ago: 29.160

PRECIPITATION

6 hour precipitation: .002
24 hour precipitation: .004
Snow depth: None

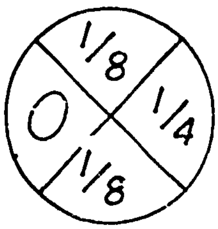
This observation was completed at 2357L.

SKY CONDITION



10/10 Rainshowers hides the sky. Vertical visibility is estimated at 470' by use of a balloon.

VISIBILITY



The FMN-1 on runway 18 reads 2,600'. The control tower reports 1/2 mile.

ATMOSPHERIC PHENOMENA

Rainshowers are occurring at the station and have accumulated .68 inch in the last hour. Continuous thunder is heard to the northwest. Frequent flashes of lightning from cloud to ground are to the northwest.

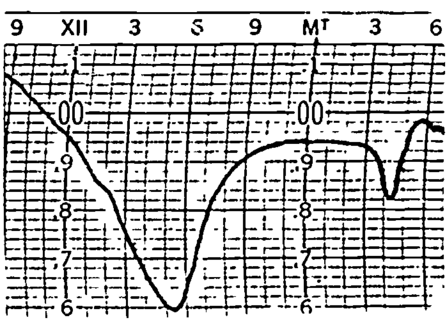
TEMPERATURE		MAX TEMPS		MIN TEMPS	
Dry Bulb:	54.5	Past 12:	48	Past 12:	40
Dew Point:	52.7	Past 24:	64	Past 24:	38

WIND

75 degrees at 37 knots with a peak of 48 knots that lasted for 15 seconds.

PRESSURE

Observed pressure: 29.640
Correction: -.010
SP 3 hours ago: 29.760



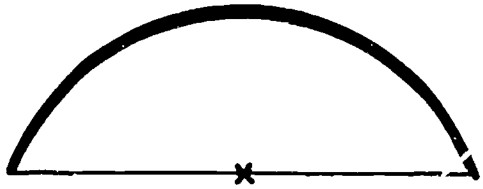
PRECIPITATION

6 hour precipitation: 1.08
24 hour precipitation: 2.16
Snow depth: None

This observation was completed at 1157L.

SKY CONDITION

10/10 CS at 37,400' MSL.



VISIBILITY

The prevailing visibility is 17 miles.

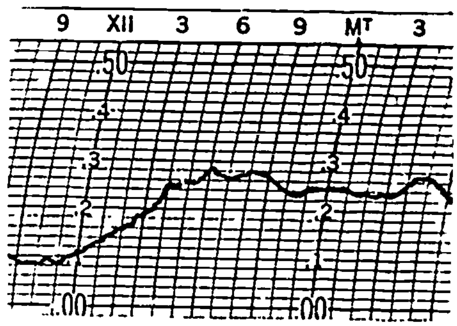
ATMOSPHERIC PHENOMENA

None

TEMPERATURE		MAX TEMPS		MIN TEMPS	
Dry Bulb:	40.4	Past 12:	40	Past 12:	21
Dew Point:	31.3	Past 24:	42	Past 24:	18

WIND

143 degrees at 14 knots.



PRESSURE

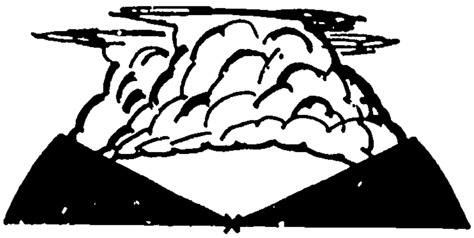
Observed pressure: 29.190
Correction: Zero
SP 3 hours ago: 29.110

PRECIPITATION

6 hour precipitation: .005
24 hour precipitation: .10
Snow depth: 2'.0

This observation was completed at 0857L.

SKY CONDITION



Blowing sand hides 4/10 of the sky.

6/10 CB, with an anvil top, is visible at 2,500', estimated. The CBs are in all quadrants and are moving east.

VISIBILITY

The visibility is varying from 1/2 to 1 to 7/8 to 3/4. The FMN-1 on runway 17 left is reading 5,000' and the tower reports 1 1/2 miles in all quadrants.

ATMOSPHERIC PHENOMENA

Sand is being picked up from the surface and blown about enough to restrict visibility.

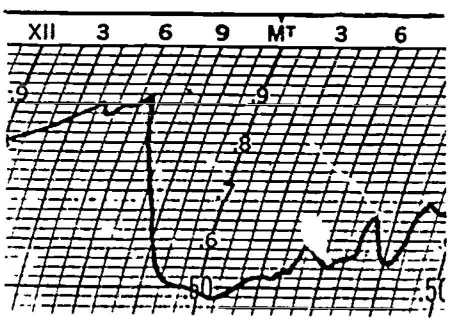
TEMPERATURE		MAX TEMPS		MIN TEMPS	
Dry Bulb:	66.6	Past 12:	100	Past 12:	67
Dew Point:	57.4	Past 24:	102	Past 24:	65

WIND

The wind was from 225 degrees at 10 knots at 1448L. It then shifted to 315 degrees at 17 knots with gusts of 34 knots at the time of observation.

PRESSURE

Observed pressure: 29.590
Correction: -.005
SP 3 hours ago: 29.880

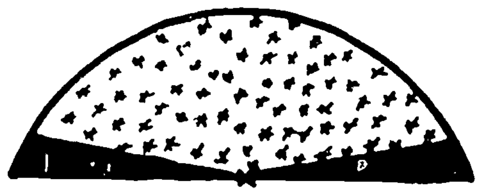


PRECIPITATION

6 hour precipitation: 1.12
24 hour precipitation: 1.12
Snow depth: None

This observation was completed at 1458L.

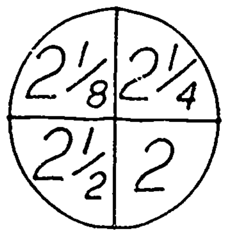
SKY CONDITION



Snow hides 1/10 of the sky.

9/10 NS is visible at 6,700', determined by the ceilometer.

VISIBILITY



The tower reports 1 mile. The FMN-1 on runway 22 is inoperative.

ATMOSPHERIC PHENOMENA

Continuous snow is falling at the station.

TEMPERATURE

Dry Bulb: 17.4
Dew Point: 12.8

MAX TEMPS

Past 12: 17
Past 24: 20

MIN TEMPS

Past 12: 0
Past 24: -6

WIND

Direction is 169 degrees at 9 knots.

PRESSURE

Observed pressure: 29.455
Correction: Zero
SP 3 hours ago: 29.455

PREVIOUS COL. 12

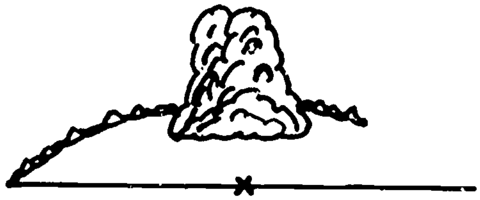
At 0900L, 30.27
At 1000L, 30.24
At 1100L, 30.25

PRECIPITATION

6 hour precipitation: .13
24 hour precipitation: .40
Snow depth: 6.4

This observation was completed at 1156L.

SKY CONDITION



3/10 CU of great vertical development is at 3,700'.

5/10 SC, not from CU, is at 5,400', estimated.

VISIBILITY

The prevailing visibility is 7 miles.

ATMOSPHERIC PHENOMENA

Smoke is present at the station.

TEMPERATURE	MAX TEMPS	MIN TEMPS
Dry Bulb: 68.2	Past 12: 68	Past 12: 43
Dew Point: 61.4	Past 24: 74	Past 24: 42

WIND

204 degrees at 13 knots.

PRESSURE	PREVIOUS COL. 17
Observed pressure: 29.170	At 0300L, 29.170
Correction: -.005	At 0400L, 29.190
SP 3 hours ago: 29.170	At 0500L, 29.170

PRECIPITATION

6 hour precipitation: .37
24 hour precipitation: .37
Snow depth: None

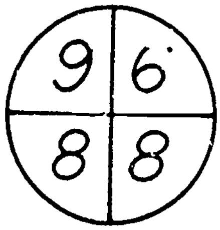
This observation was completed at 0558L.

SKY CONDITION

The sky is void of clouds.

VISIBILITY

The tower reports 7 miles.



ATMOSPHERIC PHENOMENA

Haze and smoke are present at the station, with the haze being predominant.

TEMPERATURE

Dry Bulb: 15.0
Dew Point: 7.2

MAX TEMPS		MIN TEMPS	
Past 12:	15	Past 12:	-3
Past 24:	19	Past 24:	-5

WIND

The wind recorder indicates a direction of 247 degrees and a speed of 0 knots.

PRESSURE

Observed pressure: 29.740
Correction: -.005
SP 3 hours ago: 29.750

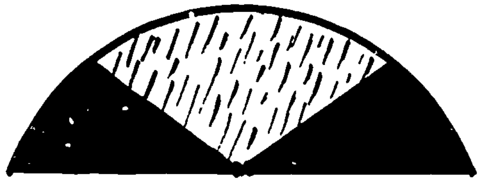
PREVIOUS COL. 17
At 0300L, 29.750
At 0400L, 29.755
At 0500L, 29.760

PRECIPITATION

6 hour precipitation: .012
24 hour precipitation: .022
Snow depth: 1.6

This observation was completed at 0557L.

SKY CONDITION



Fog hides 4/10 of the sky.

6/10 ST, 4/10 thin, was observed at heights of 2,800, 2,300, 2,600, and 2,400 feet during the period of observation on the RBC.

VISIBILITY

The prevailing visibility is 1 1/2 miles with 2 miles observed to the north. The tower reports 2 miles. The FMN-1 on runway 02 reads greater than 6,000 feet.

ATMOSPHERIC PHENOMENA

Fog, 30 feet in depth, is at the station. Drizzle is also occurring at the station and accumulating at the rate of .01 inch per hour. It is freezing on contact with the surface.

TEMPERATURE		MAX TEMPS		MIN TEMPS	
Dry Bulb:	32.3	Past 12:	34	Past 12:	32
Dew Point:	32.0	Past 24:	39	Past 24:	31

WIND

The wind is from 5 degrees at 7 knots.

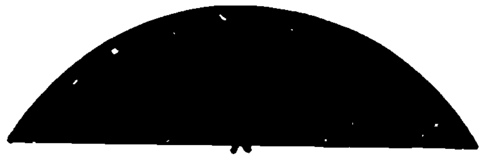
PRESSURE	PREVIOUS COL. 12
Observed pressure: 29.105	At 2100L, 29.96
Correction: +.005	At 2200L, 29.95
SP 3 hours ago: 29.155	At 2300L, 29.92

PRECIPITATION

6 hour precipitation: .075
24 hour precipitation: .14
Snow depth: 3.1

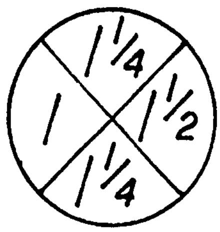
This observation was completed at 2356L.

SKY CONDITION



10/10 Fog hides the sky. Vertical visibility as reported by a pilot is 1,400' MSL.

VISIBILITY



The tower reports 1 5/8 miles visibility.

ATMOSPHERIC PHENOMENA

Fog, depth unknown, is at the station.

TEMPERATURE		MAX TEMPS		MIN TEMPS	
Dry Bulb:	30.8	Past 12:	38	Past 12:	26
Dew Point:	30.8	Past 24:	42	Past 24:	19

WIND

Direction and speed is 322 degrees at 4 knots.

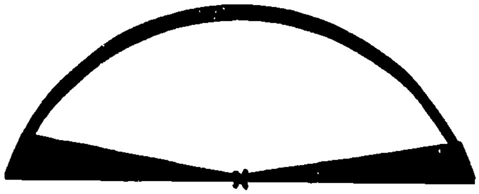
PRESSURE		PREVIOUS COL. 17
Observed pressure:	28.715	At 1500L, 28.680
Correction:	+.005	At 1600L, 28.670
SP 3 hours ago:	28.680	At 1700L, 28.695

PRECIPITATION

6 hour precipitation: .007
24 hour precipitation: .021
Snow depth: 3.3

This observation was completed at 1755L.

SKY CONDITION



Snow is being blown enough to hide 1/10 of the sky.

9/10 NS is reported by a pilot to be at 4,700' MSL.

VISIBILITY

The following values were observed during the period of observation: 3, 2, 2 1/4, and 1 3/4. The tower reports 2 1/4 miles.

ATMOSPHERIC PHENOMENA

Snow is being raised by the wind to a height of 12 feet and is restricting visibility.

TEMPERATURE		MAX TEMPS		MIN TEMPS	
Dry Bulb:	27.1	Past 12:	34	Past 12:	21
Dew Point:	24.4	Past 24:	36	Past 24:	18

WIND

40 degrees at 20 knots.

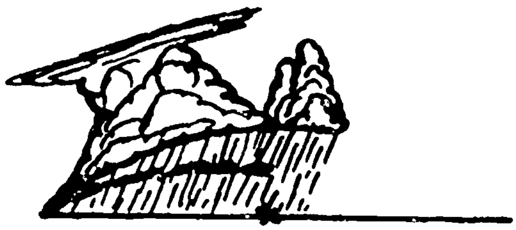
PRESSURE		PREVIOUS COL. 17
Observed pressure:	29.155	At 1500L, 29.225
Correction:	+.005	At 1600L, 29.200
SP 3 hours ago:	29.225	At 1700L, 29.185

PRECIPITATION

6 hour precipitation: .004
24 hour precipitation: .004
Snow depth: 11.1

This observation was completed at 1756L.

SKY CONDITION



5/10 CUFRA (3/10 thin) is at an estimated 1,500'.

2/10 TCU and 5/10 CB with tops anvil-shaped are at 3,800' MSL.

VISIBILITY

The prevailing visibility is 4 miles and the tower reports 5 miles.

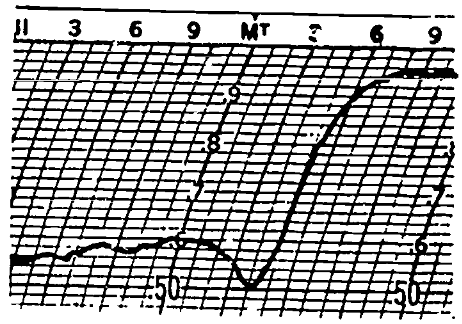
ATMOSPHERIC PHENOMENA

Light rainshowers are falling. Thunder is heard overhead through west and frequent lightning from cloud to cloud and cloud to ground are observed west of the station.

TEMPERATURE		MAX TEMPS		MIN TEMPS	
Dry Bulb:	83.4	Past 12:	90	Past 12:	83
Dew Point:	83.2	Past 24:	103	Past 24:	79

WIND

345 degrees at 20 knots with gusts to 33 knots. At 2349L, the wind direction was 335 degrees at 20 knots with gusts to 34 knots.



PRESSURE

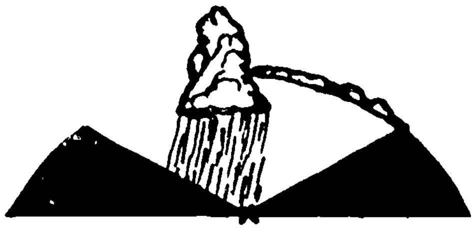
Observed pressure: 28.895
Correction: +.005
SP 3 hours ago: 28.545

PRECIPITATION

6 hour precipitation: 1.00
24 hour precipitation: 2.12
Snow depth: None

This observation was completed at 2358L.

SKY CONDITION



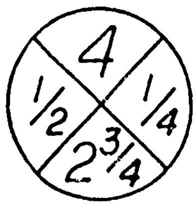
Fog hides 3/10 of the sky.

2/10 CU of strong vertical extent is at 1,500', estimated.

3/10 AC, semitransparent, is at 7,300', estimated.

All clouds are moving east.

VISIBILITY



The tower reports 4 miles. The FMN-1 on runway 24 indicates 4,500 feet.

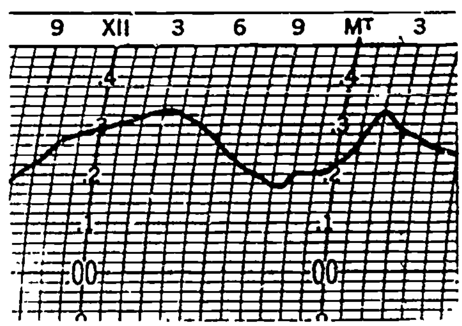
ATMOSPHERIC PHENOMENA

Moderate rain is falling. Fog is present and is 19 feet deep.

TEMPERATURE		MAX TEMPS		MIN TEMPS	
Dry Bulb:	47.0	Past 12:	52	Past 12:	45
Dew Point:	41.7	Past 24:	54	Past 24:	44

WIND

Estimated at 355 degrees at 5 knots.



PRESSURE

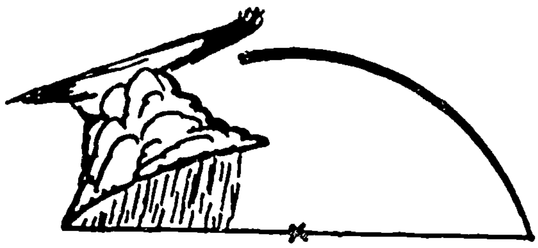
Observed pressure: 29.305
Correction: -.010
SP 3 hours ago: 29.225

PRECIPITATION

6 hour precipitation: .27
24 hour precipitation: .53
Snow depth: None

This observation was completed at 0556L.

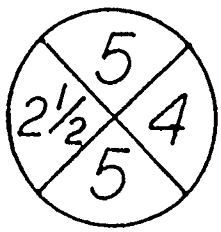
SKY CONDITION



4/10 CB with a cirriform top is reported by a pilot to be at 2,500' MSL.

6/10 CI, the remains of other CBs, is observed at 40,000'.

VISIBILITY



The tower reports 4 miles. The FMN-1 on runway 24 indicates 5,500'.

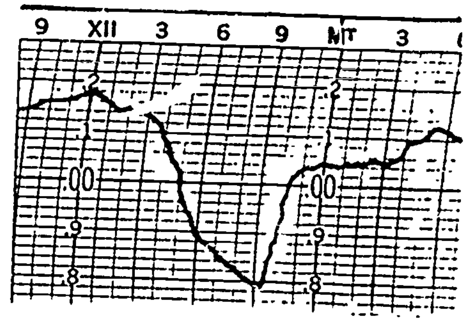
ATMOSPHERIC PHENOMENA

Haze is present at the station. Rainshowers of unknown intensity are to the west of the station. Thunder is heard west of the station, with frequent lightning from cloud to ground observed.

TEMPERATURE		MAX TEMPS		MIN TEMPS	
Dry Bulb:	53.7	Past 12:	54	Past 12:	44
Dew Point:	51.3	Past 24:	59	Past 24:	41

WIND

240 degrees at 17 knots gusting to 35 knots.



PRESSURE

Observed pressure: 29.845
Correction: +.005
SP 3 hours ago: 30.135

PRECIPITATION

6 hour precipitation: 1.00
24 hour precipitation: 1.06
Snow depth: None

This observation was completed at 1156L.

SKY CONDITION

4/10 Smoke, all thin, is at 800', estimated. This layer has varied to 5/10 during the period of observation.

1/10 CU, little vertical extent, is at 1,500', estimated.

10/10 CS is at 26,700' MSL.

VISIBILITY

The tower reports 17 miles while prevailing is only 16 miles.

ATMOSPHERIC PHENOMENA

None

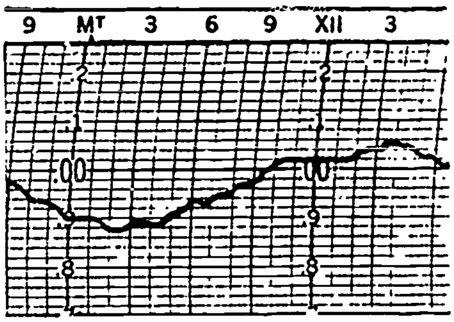
TEMPERATURE		MAX TEMPS		MIN TEMPS	
Dry Bulb:	18.5	Past 12:	19	Past 12:	-1
Dew Point:	5.9	Past 24:	22	Past 24:	-5

WIND

The winds are from 166 degrees at 16 knots.

PRESSURE

Observed pressure: 29.010
Correction: +.010
SP 3 hours ago: 28.975



PRECIPITATION

6 hour precipitation: .000
24 hour precipitation: .02
Snow depth: 2.1

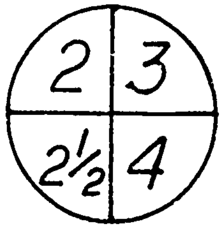
This observation was completed at 0556L.

SKY CONDITION

2/10 Haze is estimated to be at 2,100'.

VISIBILITY

The tower reports 1 5/8 miles.



ATMOSPHERIC PHENOMENA

Snow is being raised to a height of 12 feet and is restricting the visibility.

TEMPERATURE		MAX TEMPS		MIN TEMPS	
Dry Bulb:	25.1	Past 12:	28	Past 12:	25
Dew Point:	12.3	Past 24:	30	Past 24:	17

WIND

The winds are from 270 degrees at 15 knots with gusts to 22 knots.

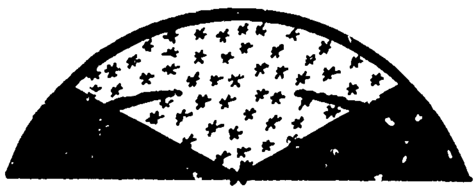
PRESSURE		PREVIOUS COL. 17
Observed pressure:	29.790	At 1800L, 29.720
Correction:	-.005	At 1900L, 29.685
SP 3 hours ago:	29.720	At 2000L, 29.735

PRECIPITATION

6 hour precipitation: Unknown
24 hour precipitatic "nknown
Snow depth: 7.4

This observation was completed at 2057L.

SKY CONDITION

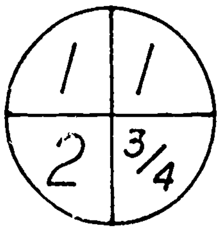


Snow hides 4/10 of the sky.

2/10 STFRA, all thin, is at a height determined by a 10 gram ceiling balloon. Fade time: 2:12 minutes. Disappear time: 2:44 minutes.

6/10 NS is at 5,800', estimated.

VISIBILITY



The control tower reports 3/4 mile.

ATMOSPHERIC PHENOMENA

Continuous snow is falling at the station.

TEMPERATURE		MAX TEMPS		MIN TEMPS	
Dry Bulb:	21.6	Past 12:	22	Past 12:	12
Dew Point:	21.1	Past 24:	24	Past 24:	10

WIND

Calm

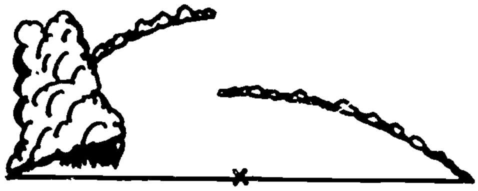
PRESSURE		PREVIOUS COL. 12
Observed pressure:	29.440	At 0800L, 30.25
Correction:	-.005	At 0900L, 30.25
SP 3 hours ago:	29.435	At 1000L, 30.25

PRECIPITATION

6 hour precipitation: .72
24 hour precipitation: 1.43
Snow depth: 129.2

This observation was completed at 1056L.

SKY CONDITION



2/10 CU of strong vertical development is at 2,850', estimated.

6/10 SC from CU is at 4,560', determined by a balloon.

2/10 AC, opaque, is at 7,800', estimated.

All clouds are moving east.

VISIBILITY

The visibility to the north and south is 7 miles, but is only 6 miles to the east and west.

ATMOSPHERIC PHENOMENA

Rainshowers are occurring west of the station, but are evaporating before reaching the surface. Haze is also present.

TEMPERATURE		MAX TEMPS		MIN TEMPS	
Dry Bulb:	73.0	Past 12:	63	Past 12:	55
Dew Point:	71.1	Past 24:	69	Past 24:	47

WIND

330 degrees at 12 knots with gusts to 18 knots.

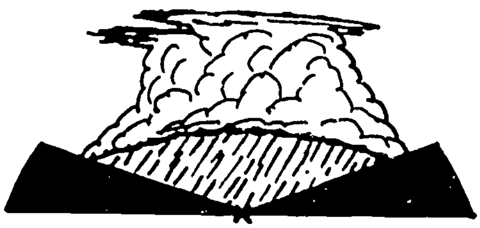
PRESSURE		PREVIOUS COL. 17
Observed pressure:	29.325	At 1200L, 29.320
Correction:	-.005	At 1300L, 29.320
SP 3 hours ago:	29.320	At 1400L, 29.320

PRECIPITATION

6 hour precipitation: None
24 hour precipitation: None
Snow depth: None

This observation was completed at 1455L.

SKY CONDITION



Rainshowers hide 3/10 of the sky.

7/10 CB is visible in all quadrants at a measured 3,300'. These clouds are moving east.

VISIBILITY

The prevailing visibility is varying from 1/2 to 1 1/2 to 3/4 miles. The tower reports 3/4 miles. The FMN-1 is inoperative.

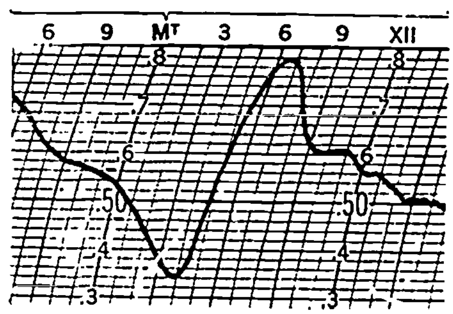
ATMOSPHERIC PHENOMENA

Thunder is heard in all quadrants. Moderate rainshowers are falling and frequent lightning from cloud to air and within the cloud is observed in all quadrants.

TEMPERATURE		MAX TEMPS		MIN TEMPS	
Dry Bulb:	52.0	Past 12:	72	Past 12:	52
Dew Point:	44.9	Past 24:	74	Past 24:	50

WIND

20 degrees at 25 knots. A peak of 37 knots occurred 3 minutes ago, but lasted only for 10 seconds.



PRESSURE

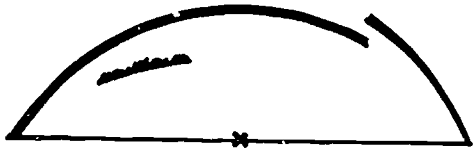
Observed pressure: 28.765
Correction: +.010
SP 3 hours ago: 28.375

PRECIPITATION

6 hour precipitation: 1.11
24 hour precipitation: Unknown
Snow depth: None

This observation was completed at 2357L.

SKY CONDITION

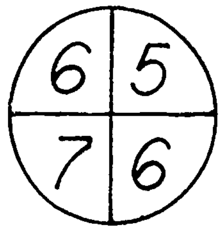


2/10 STFRA, all thin, is at an estimated 965 feet.

8/10 AS is at 8,000', estimated.

2/10 CS is at 23,700', MSL.

VISIBILITY



The tower reports 8 miles visibility.

ATMOSPHERIC PHENOMENA

Haze and smoke are at the station.

TEMPERATURE	MAX TEMPS	MIN TEMPS
Dry Bulb: 36.1	Past 12: 36	Past 12: 30
Dew Point: 33.4	Past 24: 42	Past 24: 28

WIND

The wind is from 111 degrees at 13 knots.

PRESSURE	PREVIOUS COL. 17
Observed pressure: 29.165	At 0600L, 29.200
Correction: -.005	At 0700L, 29.180
SP 3 hours ago: 29.200	At 0800L, 29.160

PRECIPITATION

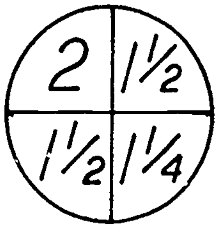
6 hour precipitation: .004
24 hour precipitation: .04
Snow depth: None

This observation was completed at 0856L.

SKY CONDITION

Blowing snow hides 8/10 of the sky.

VISIBILITY



The tower reports 1/4 mile. The FMN-1 on runway 22 indicates greater than 6,000'.

ATMOSPHERIC PHENOMENA

Ice crystals are present along with the blowing snow.

TEMPERATURE		MAX TEMPS		MIN TEMPS	
Dry Bulb:	-8.1	Past 12:	-4	Past 12:	-15
Dew Point:	-9.5	Past 24:	-2	Past 24:	-18

WIND

45 degrees at 22 knots with a peak of 38 knots that lasted for 65 seconds.

PRESSURE

Observed pressure: 29.515
Correction: -.005
SP 3 hours ago: 29.420

PREVIOUS COL. 12

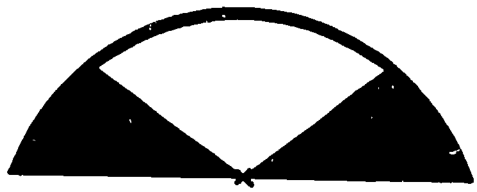
At 2100L, 30.24
At 2200L, 30.30
At 2300L, 30.33

PRECIPITATION

6 hour precipitation: .004
24 hour precipitation: .006
Snow depth: 207.3

This observation was completed at 2357L.

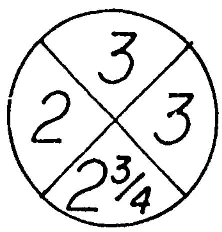
SKY CONDITION



Fog hides 5/10 of the sky.

5/10 AS, 4/10 transparent, is reported by a pilot to have bases at 13,800'.

VISIBILITY



The tower visibility is 1 1/2 miles. The FMN-1 on runway 07 is inoperative.

ATMOSPHERIC PHENOMENA

Fog, 65 feet in deptn, is at the station.

TEMPERATURE

Dry Bulb: 66.6
Dew Point: 66.1

MAX TEMPS

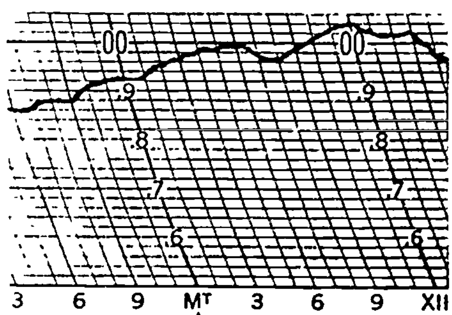
Past 12: 73
Past 24: 75

MIN TEMPS

Past 12: 67
Past 24: 65

WIND

The winds are estimated to be from 240 degrees at 4 knots.



PRESSURE

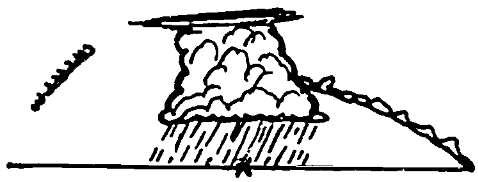
Observed pressure: 29.990
Correction: Zero
SP 3 hours ago: 29.995

PRECIPITATION

6 hour precipitation: None
24 hour precipitation: None
Snow depth: None

This observation was completed at 0258L.

SKY CONDITION



4/10 CB with an anvil is at 3,460', determined by the ceilometer.

3/10 AC from CU is at 9,200' MSL reported by a pilot.

1/10 CI from the CB is at 41,400' MSL.

All clouds are moving east.

VISIBILITY

The prevailing visibility is 8 miles.

ATMOSPHERIC PHENOMENA

Light rain is falling at the station. Thunder is heard overhead and occasional lightning is observed from the cloud to the air overhead.

TEMPERATURE		MAX TEMPS		MIN TEMPS	
Dry Bulb:	84.3	Past 12:	100	Past 12:	84
Dew Point:	79.8	Past 24:	104	Past 24:	82

WIND

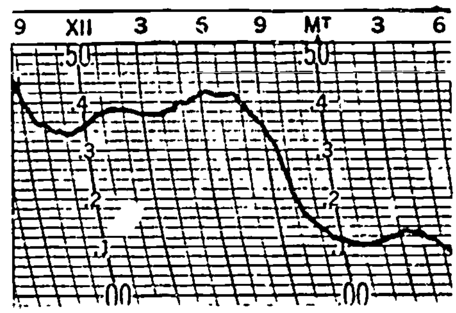
20 degrees at 19 knots with gusts to 26 knots.

PRESSURE

Observed pressure: 29.105

Correction: +.005

SP 3 hours ago: 29.355



PRECIPITATION

6 hour precipitation: .15

24 hour precipitation: .25

Snow depth: None

This observation was completed at 1758L.

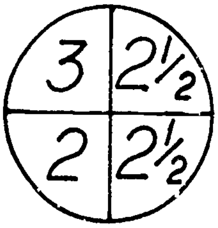
SKY CONDITION

Haze hides 2/10 of the sky.

3/10 CU of little vertical development is at 4,300'.

2/10 CI, 1/10 thin, in the form of hooks and filaments, is at an estimated 27,500'.

VISIBILITY



The tower reports 2 miles in all quadrants.

ATMOSPHERIC PHENOMENA

Haze is present at the station and is 120 feet deep.

TEMPERATURE

Dry Bulb: 96.7
Dew Point: 75.2

MAX TEMPS		MIN TEMPS	
Past 12:	102	Past 12:	84
Past 24:	111	Past 24:	82

WIND

The winds are from 214 degrees at 6 knots.

PRESSURE

Observed pressure: 29.470
Correction: +.010
SP 3 hours ago: 29.500

PREVIOUS COL. 17
At 2100L, 29.500
At 2200L, 29.490
At 2300L, 29.480

PRECIPITATION

6 hour precipitation: Unknown
24 hour precipitation: Unknown
Snow depth: None

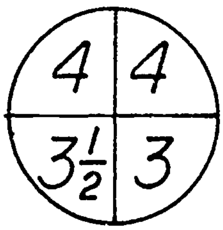
This observation was completed at 2357L.

SKY CONDITION

10/10 ST is at 1,370', determined by a ceiling balloon.

VISIBILITY

The tower reports 4 1/2 miles.



ATMOSPHERIC PHENOMENA

Light drizzle is occurring. It has stopped and restarted twice in the past hour.

TEMPERATURE

Dry Bulb: 41.3
Dew Point: 39.8

MAX TEMPS

Past 12: 42
Past 24: 47

MIN TEMPS

Past 12: 38
Past 24: 35

WIND

The wind direction is varying from 12 degrees to 81 degrees at an average speed that is estimated to be 8 knots.

PRESSURE

Observed pressure: 29.555
Correction: -.005
SP 3 hours ago: 29.600

PREVIOUS CCL. 12

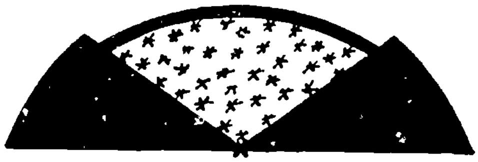
At 0300L, 30.42
At 0400L, 30.49
At 0500L, 30.42

PRECIPITATION

6 hour precipitation: .05
24 hour precipitation: .12
Snow depth: Trace

This observation was completed at 0558L.

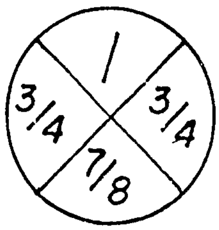
SKY CONDITION



4/10 of the sky is hidden by snow.

6/10 NS is at 2,000' as determined by the RBC 20 minutes ago.

VISIBILITY



The tower reports 1 mile. The FMN-1 on runway 11 center reads 6,000'.

ATMOSPHERIC PHENOMENA

Continuous snow is falling at the station.

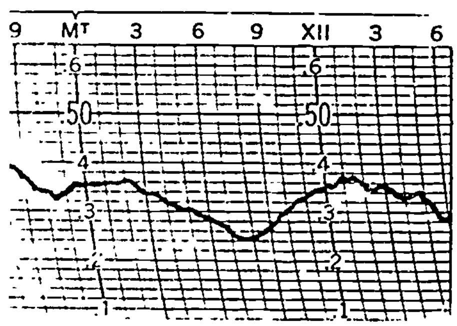
TEMPERATURE		MAX TEMPS		MIN TEMPS	
Dry Bulb:	28.3	Past 12:	31	Past 12:	0
Dew Point:	27.3	Past 24:	32	Past 24:	-1

WIND

The current wind direction and speed is from 247 degrees at 14 knots. At 0248L, the winds shifted from 312 degrees at 8 knots. This was due to a frontal passage.

PRESSURE

Observed pressure: 29.265
Correction: +.005
SP 3 hours ago: 29.285

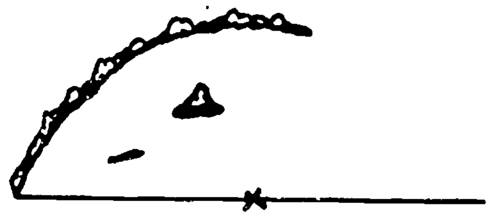


PRECIPITATION

6 hour precipitation: .015
24 hour precipitation: 2.05
Snow depth: 25.2

This observation was completed at 0256L.

SKY CONDITION

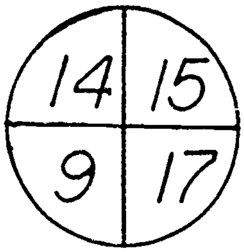


Trace of smoke is at 420'.

Trace of CU is at an estimated 3,500'.

6/10 AC, semitransparent, is at an estimated 12,000'.

VISIBILITY



ATMOSPHERIC PHENOMENA

None

TEMPERATURE

Dry Bulb: 16.0
Dew Point: 3.5

MAX TEMPS

Past 12: 20
Past 24: 28

MIN TEMPS

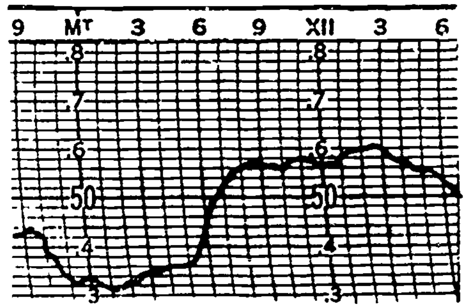
Past 12: 7
Past 24: 4

WIND

115 degrees at 5 knots.

PRESSURE

Observed pressure: 29.445
Correction: -.005
SP 3 hours ago: 29.350



PRECIPITATION

6 hour precipitation: .02
24 hour precipitation: 1.06
Snow depth: 6.7

This observation was completed at 2358L.

DEPARTMENT OF THE AIR FORCE
3330 Technical Training Wing (ATC)
Chanute Air Force Base, Illinois 61868

C3ABR25130-000-HO-110A
C3ABR25130-002-HO-110A
10 November 1983

STUDENT CHECKLIST

Course: Weather Specialist/Aerographer's Mate

Subject: Additive Data

Objective: Given the FMH-1B, weather scenarios, pressure conversion table and handout, encode the required additive data entries on an AWS Form 10 to a minimum of 80% accuracy.

Notes: Upon completion of this unit of instruction, you will be required to make entries on the AWS Form 10 for the following items:

1. Time
2. Sky Condition
3. Prevailing Visibility
4. Weather and Obstructions to Vision
5. Sea Level Pressure
6. Temperature
7. Dew Point
8. Wind Direction
9. Wind Speed
10. Wind Character
11. Altimeter Setting
12. Remarks
13. Station Pressure
14. Total Sky Cover

All items taught during this unit of instruction are valued at two (2) points each. All previously learned items are valued at one (1) point each. There are 4 problems that total 135 points possible on the progress check. The time limit will be one hour (60 minutes). Minimum passing score is 80%.

STUDY GUIDE

C3ABR25130-SG-112
C3ABR25130-2-SG-112

Technical Training

Weather Specialist
Aerographer's Mate

TYPES OF OBSERVATION

5 January 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE RGL: N/A

DO NOT USE ON THE JOB

Weather Observer Branch
Chanute AFB, Illinois

C3ABR25130-SG-112
C3ABR25130-2-SG-112

12. TYPES of OBSERVATION

OBJECTIVE

c. Given the study guide and necessary information, encode 2 pilot reports in PIREP Code on an AWS Form 12 to a minimum of 80% accuracy.

d. Given the study guide, decode 2 pilot reports from the PIREP Code into plain language on an AWS Form 12 to a minimum of 80% accuracy.

PROCEDURE

Use this study guide for reference during the PIREPS performance test, as an aid in completing the PIREPS workbook and as directed by the instructor.

Supersedes C3ABR25130-SG-112, C3ABR25130-2-SG-112, 15 February 1983
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTMV - 600; DAV - 1

PIREP CODE

Symbolic Format

Each element of the pirep message is introduced by a two-letter symbol. These two-letter symbols let you quickly indentify the elements contained in the pirep. The message type, position, time, altitude, and aircraft type are required entries for all pireps. In addition to this information, at least one other element is required to complete the pirep. The symbolic format for pireps is as follows:

iii UA(UUA) /OV /TP /SK /TA /WV /TB /IC /RM

Location Identifiers - iii

The symbol "iii" represents the three-letter location identifier of the station which transmits the pilot report longline over the teletype. These location identifiers are not entered on the pirep form, but instead, they are assigned to each individual weather station and are then entered on the teletype at the time of transmission. An abbreviated list of identifiers that you will need to know can be found in the pirep workbook that has been issued to you.

Message Type - UA(UUA)

The indicator "UA" is used for regular pireps, while the indicator "UUA" is used for those pireps that are classified as severe. Pireps will be classified as severe when they contain any of the following hazardous phenomena:

1. Tornadic Activity
2. Severe or extreme turbulence
3. Hail
4. Severe icing

Position, Time, Altitude - /OV

The symbol "/OV" indicates that the position, time, and altitude is next. This element of the pirep can be further defined as follows:

Position: The location of every type of aircraft that gives a pirep is reported using a three-letter location identifier and, if necessary, a space and a six-digit group of numbers (the first three digits indicating the magnetic bearing from the location identifier and the last three digits indicating the nautical mile distance from the location identifier). Two or more locations may be grouped together by connecting each location with a hyphen. (See examples below).

Encoded Position:	Actual Location:
BLV	Over Scott AFB, IL
BLV-STL	Between Scott AFB, IL and St. Louis, MO
BLV 090045	45 miles east of Scott AFB, IL
BLV 180038-STL 315050	Between 38 miles south of Scott AFB, IL and 50 miles northwest of St. Louis, MO

The table below can be used to convert the magnetic bearing to a direction with respect to 16 compass points.

Direction	Bearing	Direction	Bearing
North	350-010	South	170-190
North/Northeast	020-030	South/Southwest	200-210
Northeast	040-050	Southwest	220-230
East/Northeast	060-070	West/Southwest	240-250
East	080-100	West	260-280
East/Southeast	110-120	West/Northwest	290-300
Southeast	130-140	Northwest	310-320
South/Southeast	150-160	North/Northwest	330-340

Time: The time that the elements were observed by the pilot follow the position. This time is reported in exactly the same fashion as observations; to the nearest minute in Greenwich Mean Time (GMT) in four digits.

Altitude: The flight altitude, or level, of the aircraft is the final element that follows the symbol "/OV". This element is encoded using the contraction "FL", a space, and the altitude of the aircraft to the nearest 100 feet above MSL, in three digits. When the altitude is unknown, it will be encoded as "FL UNK". (See examples).

Encoded Altitude:	Actual Height (MSL):
FL 005	500 feet
FL 027	2,700 feet
FL 240	24,000 feet
FL UNK	Unknown

Aircraft Type - /TP

The type of aircraft is necessary on all pireps so the forecaster will be able to identify the extent of the reported phenomena. A report of moderate turbulence from a light aircraft may have only minor affects on a large cargo airplane. This entry is encoded after the indicator "/TP". If the aircraft is unknown, "UNK" is reported.

Sky Condition - /SK

This entry is for the sky condition or cloud layers that aircraft observe at their flight level. The format is (1) encode the height of the base (if known), (2) the sky cover contraction (if known), and (3) the height of the top (if known). The height of the bases and the tops are reported in hundreds of feet above MSL, using three digits. Authorized contractions for sky cover are CLR, SCT, BKN, OVC, and UNK. A space is required to clarify between the height of the bases, the layer's contraction, and the height of the tops. If two or more layers are reported, each layer is separated by a solidus. If the pilot is in the clouds, "OVC" is reported. Note the examples below:

Encoded Sky Condition:	Actual Sky Condition:
/SK 085 UNK 100	Bases - 8,500', Sky Cover - unknown, Tops - 10,000'
/SK BKN 095/120 OVC 150	(1st layer) Bases - unknown, Sky Cover - Broken, Tops - 9,500'(2nd layer) Bases - 12,000', Sky Cover - Overcast, Tops - 15,000'.

Air Temperature - /TA

The temperature will be reported in whole degrees Celsius using two digits. Negative temperatures will be prefixed with a minus sign (-). Examples:

Encoded Temperature:	Actual Air Temperature:
/TA 05	5 degrees Celsius
/TA 23	23 degrees Celsius
/TA -08	Minus (-) 8 degrees Celsius

Wind Direction and Speed - /WV

The wind's direction and speed are encoded as a six digit group. The first three digits represent the direction from which the wind is blowing to the nearest whole degree. The last three digits are the speed of the wind in knots. Examples:

Encoded Wind:	Actual Wind:
/WV 270042	From 270 degrees at 42 knots
/WV 315125	From 315 degrees at 125 knots

Turbulence - /TB

Turbulence is reported by it's intensity, type and altitude.

The only intensities that may be reported are NEG, LGT, MDT, SVR, and EXTRM. Varying intensities are reported with a hyphen inserted between the two intensities; e.g. MDT-SVR. Negative turbulence (NEG) is reported when an aircraft is flying in an area of forecast turbulence, but none is experienced.

The type of turbulence is included only if clear air turbulence is reported. Clear air turbulence is encoded as "CAT".

Finally, the altitude is encoded immediately following the intensity or type, if known. Occasionally, the altitude is omitted if the turbulence reported is at the aircraft's currently reported flight level. When aircraft are descending or ascending through turbulence layers, a hyphen will be used to combine these reported altitudes, i.e., "060-090". Undefined lower or upper limits of turbulence will be reported as "BLO" for below or "ABV" for above. The undefined values are to be treated as an altitude, e.g., BLO-130 or 270-ABV. A solidus will be used to separate two or more layers of turbulence. All heights of turbulence altitudes are reported in hundreds of feet above MSL. Examples:

Encoded Turbulence:	Actual Turbulence:
/TB NEG	Negative turbulence; altitude same as flight level
/TB MDT-SVR 060-090	Moderate to severe turbulence between 6,000' and 9,000'
/TB EXTRM CAT BLO-180	Extreme clear air turbulence 18,000' and below
/TB SVR 070-100/LGT-MDT CAT 270-ABV	Severe turbulence between 7,000' and 10,000' then light to moderate turbulence 27,000' and above

Icing - /IC

Icing, like turbulence, is reported by it's intensity, type, and altitude. The procedures for encoding information for icing follow those used in encoding turbulence.

The intensities used to report icing are NEG, TRACE, LGT, MDT, and SVR. Varying intensities are reported with a hyphen inserted between the two intensities. Negative icing (NEG) is reported when an aircraft is flying in an area of forecast icing, but none is experienced.

The type of icing encoded will be one of the following: CLR (clear), which is formed by large water droplets and is relatively smooth, RIME, which is formed by very minute water droplets and has a rough, milky, opaque appearance, and MXD (mixed), which is a combination of clear and rime icing.

Finally, the altitude of icing layers is encoded in the same manner as turbulence, utilizing a hyphen, solidus, "BLO" and "ABV" as appropriate. See the examples of these entries on the next page.

Encoded Icing:	Actual Icing:
/IC LGT CLR 090-110	Light clear icing between 9,000' and 11,000'
/IC MDT-SVR RIME	Moderate to severe rime icing; altitude same as flight level
/IC SVR MXD BLO-090/ NEG 150-ABV	Severe mixed icing, 9,000' and below, then negative icing 15,000' and above
/IC TRACE RIME 085	Trace of rime icing at 8,500'

Remarks - /RM

The remarks section will contain reports of weather conditions not described elsewhere in the report and can also be used for clarifying previously reported elements. Weather elements such as tornadoes, hail, thunderstorms, precipitation, obstructions to vision, etc. will be reported in the remarks section. The most hazardous phenomena will be listed first. Examples of various types of remarks are given below.

Encoded Remark:	Actual Phenomena:
/RM K LYR 035-050	Smoke layer with the base at 3,500' and the top at 5,000'
/RM DISCHARGE	Electrical discharge experienced by the aircraft
/RM LN TSTMS N-S OCNL LTGCCCG	Line of thunderstorms orientated north to south with occasional cloud-to-cloud and cloud-to-ground lightning observed
/RM TORNADO S MOVG NE	Tornado south moving towards the northeast
/RM CONTRAILS	Condensation trails
/RM DURGC	Report was made during climb
/RM DURGD	Report was made during descent

Because of the great number of possible remarks which may be used in the pirep code, for training purposes in this course, you need only to be concerned with the phenomena listed in the examples above.

Summary

The pilot report is a vital link in our continuing process of observing the various elements of our atmosphere. A report of low ceilings, low visibilities, precipitation, or hazardous phenomena will enable the duty observer to report these changing elements rapidly and they can provide the forecaster with valuable information throughout sparsely populated areas of our country.

Reports of turbulence and icing are needed to alert other aircraft of impending hazards along any flight path.

Therefore, a uniform code that is readily understood by all is essential so that we may successfully perform all the aspects of our various duties.

WORKBOOK
C3ABR25130-WB-112a
C3ABR25130-2-WB-112a

Technical Training

Weather Specialist
Aerographer's Mate

TYPES OF OBSERVATIONS

8 February 1983

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE
DO NOT USE ON THE JOB

RGL: N/A

1630

TYPES OF OBSERVATIONS

OBJECTIVE

Given the FMH-1B, AWS Form 10, simulated weather conditions, simulated equipment readouts, psychrometric calculator and pressure conversion table, record 8 consecutive observations in Airways Code with a minimum of 80% accuracy.

PROCEDURE

Using the FMH-1B and the information given in each exercise, make the appropriate entries as directed by the instructor.

OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-M - 800; DAV - 1

Directions for Exercises 1-7:

Each of the following exercises will give you a series of changes in ceiling, sky condition, visibility, weather, or runway visual range. Starting with the first observation in each exercise, study each change in the elements given. Determine what type of observation to enter in Column 1, Special, Record Special, Record, or Local. If the changes are not critical enough to require an observation, leave Column 1 blank. Take each change in turn until the exercise is completed. Do each exercise as directed by your instructor.

Exercise 1

TYPE (1)	TIME (GMT) (2)	SKY CONDITION (3)
SA	1158	120 SCT
	1210	E120 BKN
	1220	E49 BKN 120 BKN
	1229	20 SCT E50 OVC
	1245	M19 BKN 50 OVC
	1256	M15 BKN 50 OVC
	1330	8 SCT M15 BKN 50 OVC
	1357	8 SCT M15 BKN 50 OVC
	1414	E6 BKN 12 OVC
	1423	M4 BKN 9 OVC
	1440	4 -BKN M8 OVC
	1458	M4 BKN 8 OVC
	1508	-X M5 OVC
	1520	W3 X
	1533	W1 X
	1538	W0 X
	1558	W2 X
	1615	-X M4 OVC
	1625	W4 X
	1639	-X M5 OVC
	1657	-X M7 BKN 17 OVC
	1729	-X 7 SCT M16 OVC
	1756	M16 BKN 46 BKN
	1313	E20 BKN 47 BKN
	1355	20 SCT E48 BKN
	1927	20 SCT 48 -BKN
	1955	48 SCT 100 SCT
	2020	48 SCT E100 BKN

Exercise 2

TYPE (1)	TIME (GMT) (2)	SKY CONDITION (3)	PVLG VSBY (miles) (4)
RS	0058	W10 X	1/4
	0110	W6 X	1/4
	0131	-X M19 OVC	3/4
	0144	-X M16V OVC	1/2
	0156	-X M16 BKN 370 OVC	3
	0205	M19 BKN 75 BKN 370 OVC	6
	0217	6 SCT M16 BKN 75 OVC	6
	0232	E75 BKN 370 OVC	7
	0256	75 SCT E350 OVC	7
	0330	75 SCT E350 OVC	8
	0358	E55 BKN 350 OVC	10
	0440	E48 BKN 350 OVC	8
	0457	E46 BKN 240 OVC	10
	0530	46 SCT E240 OVC	6
	0555	43 SCT E80 BKN 240 OVC	15
	0655	80 SCT E240 OVC	15
	0757	6 -SCT 80 SCT 240 -OVC	15
	0856	E250 OVC	15
	0955	75 SCT 250 -OVC	15
	1010	75 SCT E230 OVC	20
	1057	21 SCT 75 SCT E230 OVC	20
	1115	M19 BKN 75 OVC	15
	1129	M14 OVC	6
	1140	M14 OVC	4
	1155	M12 OVC	2
	1210	-X 9 SCT M14 OVC	3/4
	1230	-X M9 BKN 14 OVC	1/2
	1245	W6 X	1/8

TYPE (1)	TIME (GMT) (2)	SKY CONDITION (3)	PVLG VSBY (miles) (4)
SA	0655	M20 OVC	7
	0705	M16 OVC	7
	0716	16 SCT E80 OVC	6
	0725	-X E80 OVC	3
	0731	-X E80 OVC	1
	0745	W6 X	1/4
	0755	W0 X	0
	0805	W1 X	1/8
	0820	W5 X	1
	0831	W9 X	3
	0840	-X E80 OVC	4
	0345	12 SCT E80 BKN	6
	0856	M12 BKN 80 BKN	4
	0901	M9 BKN 80 OVC	3
	0919	M7 OVC	1
	0934	-X M6 OVC	3/4
	0946	W5 X	5/8
	0955	W4 X	1/2
	1000	W3 X	3/4
	1010	W0 X	0
	1023	W2 X	5/8
	1030	W1 X	3/4
	1036	W3 X	11/8
	1041	W4 X	7/8
	1045	W5 X	11/4
	1058	-X M6 OVC	11/2
	1157	-X M7 OVC	13/4
	1255	-X M6 OVC	11/8

Exercise 4

TYPE (1)	TIME (GMT) (2)	SKY CONDITION (3)	PVLG VSBY (miles) (4)	WEATHER AND OBSTRUCTIONS TO VISION (5)
RS	1058	M40 OVC	7	
	1105	M35 OVC	7	R-
	1115	M30 OVC	6	R-
	1127	M30 OVC	7	R-
	1145	M26 OVC	7	ZR-
	1155	M23 OVC	6	ZR-
	1204	E21 OVC	4	ZR
	1213	E19 BKN	7	ZR-
	1220	M18 OVC	5	ZR-IP-
	1232	M17 OVC	4	ZR-IP-
	1240	M16 OVC	4	ZR-IP-
	1256	M14 OVC	4	IP-
	1313	M15 OVC	3	IP-S-
	1326	M16 OVC	2	IP-S-
	1340	-X M15 OVC	1	IPS-
	1355	-X M15 OVC	1/2	IP+S-
	1410	-X M14 OVC	1/2	SIP-
	1415	-X M15 OVC	5/8	S-
	1426	-X M15 OVC	3/4	R-S-
	1439	E16 OVC	2	R-S-
	1458	E16 OVC	4	R-
	1505	E16 OVC	7	R-
	1515	E18 OVC	4	R-SG-
	1530	M20 OVC	3	SG-S-
	1537	M20 OVC	7	S-
	1540	M19 OVC	7	ZL-S-
	1546	M19 OVC	5	ZL-
	1555	M19 OVC	7	ZL-

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Exercise 5

TYPE (1)	TIME (GMT) (2)	SKY CONDITION (3)	PVLG VSBY (miles) (4)	WEATHER AND OBSTRUCTIONS TO VISION (5)
SA	1157	75 -SCT E300 OVC	6	H
	1202	8 SCT 75 -BKN E300 OVC	5	GF
	1220	8 -SCT E300 OVC	4	GF
	1232	M8 OVC	4	GF
	1258	7 -OVC	11/2	ZL-F
	1310	E7 OVC	3/4V	ZL-F
	1322	E5 BKN 16 OVC	7/8V	F
	1345	E5 BKN 16 OVC	11/2	S-F
	1356	M4 BKN 16 OVC	2	IP-F
	1430	5 -BKN M16 OVC	11/8	F
	1455	6 -BKN M15 OVC	15/8	ZR-F
	1510	6 -SCT M17 OVC	13/4	R-F
	1517	7 SCT M16 OVC	11/2	F
	1531	8 SCT M15 OVC	21/2	IP-F
	1543	8 -SCT E16 OVC	4	IP-S-F
	1558	E17 OVC	21/4	IP-S-F
	1618	E14 OVC	2	S-F
	1630	M14 OVC	1	IP-S-F
	1638	M13 OVC	4	IP-F
	1657	M20 BKN 150 OVC	4	R-IP-F
	1705	M21 OVC	5	R-GF
	1740	M21 BKN 150 OVC	4	R-GF
	1755	M29 BKN 150 OVC	5	R-GF
	1809	35 -OVC E150 OVC	3	R-GF
	1815	M35 BKN 150 OVC	4	R-GF
	1829	M45 BKN 150 OVC	5	H
	1344	45 -BKN E150 OVC	6	H
	1858	45 SCT 150 -OVC	7	

Exercise 6

TYPE (1)	TIME (GMT) (2)	SKY CONDITION (3)	PVLG VSBY (miles) (4)	WEATHER AND OBSTRUCTIONS TO VISION (5)
RS	0057	W0 X	0	F
	0105	W3 X	1/16	IP-F
	0120	W2 X	5/16	IP-F
	0132	W3 X	3/8	SIP-F
	0140	W4 X	1/4	S+F
	0158	W5 X	5/16	SF
	0205	W3 X	1/4	S-F
	0215	-X M4V OVC	3/16	R-S-F
	0225	-X M6V OVC	3/8	IP-F
	0239	-X M7V OVC	1/4	IP-F
	0250	M5 OVC	3/8	ZR-F
	0255	M7 OVC	1/2	RF
	0312	M6 OVC	1/2	RF
	0321	E5 OVC	1/2	R-F
	0330	E6 BKN 12 OVC	1/2	GF
	0340	6 SCT M12 OVC	3/4	GF
	0349	5 -SCT M10 OVC	7/8	RW-GF
	0355	8 SCT M13 OVC	1	TRW
	0400	8 -BKN M14 OVC	2	TRW-
	0412	8 -BKN M11 OVC	11/8	TRW+
	0428	7 SCT M12 OVC	7/8	TRWA
	0440	7 SCT M13 OVC	3/4	TRW+
	0456	8 SCT M15 BKN 49 OVC	3	TRW-
	0515	M15 BKN 45 OVC	5	RW-
	0522	15 SCT E45 BKN	6	RW-
	0538	15 SCT 45 -BKN	7	RW-
	0549	15 SCT E50 BKN	7	
	0555	15 SCT 50 SCT	7	

TYPE (1)	TIME (GMT) (2)	SKY CONDITION (3)	PVLG VSBY (miles) (4)	WEATHER AND OBSTRUCTIONS TO VISION (5)	SEA LEVEL PRES (mb) (6)	TEMP (°F) (7)	DEW-POINT (°F) (8)	WIND DRCTN (true) (9)	WIND SPEED (knots) (10)	WIND CHARACTER (knots) (11)	ALSTG (inches) (12)	(All times GMT preceding code) RVR
SA	0956	40 SCT	15					18	08			
	1010	E43 BKN	15					20	11			
	1025	M41 OVC	12	TRW-				22	12	G19		
	1029	M41 OVC	7	TRW-				23	12	G21		
	1058	M38 OVC	4	TRW				22	10	G18		
	1107	-X M34 OVC	2	TRW+				22	14	G22		R18VR60
	1126	-X M31 OVC	2	T+RW+				33	17	G51		R18VR60
	1145	W14 X	1	T+RW+				34	35	G50		R18VR55
	1157	W16 X	1	T+RW+A				34	21	Q55		R18VR50
	1215	W13 X	3/4	T+RW+A				34	45	G55		R36VR22
	1225	-X M32 OVC	1	T+RW+A				30	14	G22		R36VR40
	1257	-X M33 OVC	3	T+RWA				28	11	G19		R36VR60
	1330	-X M34 OVC	4	T+RWA				27	10	G17		
	1358	M37 BKN	6	RW-				24	08			
	1416	37 SCT	7	RW-				22	07			
	1420	38 SCT	7					22	08			
	1436	E35 BKN	8	T				21	06			
	1457	35 SCT	8	T				20	07			
	1555	35 SCT 270 -BKN	9	T				21	04			
	1614	35 SCT 270 -BKN	10					00	00			
	1633	E35 BKN 270 BKN	10					00	00			
	1659	E29 BKN 270 BKN	6	F				20	01			
	1708	E29 BKN 270 BKN	6	F				20	03			
	1736	E29 BKN 270 BKN	4	F				00	00			
	1745	E29 BKN	2	F				00	00			R18VR60
	1755	E29 OVC	3/4	F				00	00			R18VR30

6

Exercise 7

BEST COPY AVAILABLE

Exercise 8

Directions:

1. Each page of data represents a change from the previous observation. This exercise represents a 24 hour period.

2. All layers of sky condition are considered to be opaque unless otherwise stated.

3. All clouds are moving towards the east.

4. Use Table 1, page 71 to convert RBC angles to layer heights.

5. Use Table 2, page 72 to convert ceiling light projector and clinometer angles to layer heights.

6. The correction to all observed barometers, aneroid barometers, and barographs are $\pm.000$.

7. Use Table 3, page 73 (Barograph chart) for the following:

   a.) Station pressure when indicated.
   b.) Appropriate additive data.
   c.) Appropriate Column 13 remarks.

8. Use Table 4, page 74 as a list of all local criteria at Chanute.

9. Use the following Column 7 temperatures as an aid in determining appropriate additive data.

GMT	TEMPERATURE	GMT	TEMPERATURE
0600	48	1800	58
0700	48	1900	57
0800	49	2000	57
0900	50	2100	56
1000	50	2200	55
1100	51	2300	54
1200	51	0000	53
1300	52	0100	51
1400	53	0200	50
1500	55	0300	50
1600	56	0400	49
1700	57	0500	48

SKY CONDITION

5/10 CI in the form of hooks and filaments is at an estimated 25,000'.

VISIBILITY

The visibility is 7 miles in all quadrants.

ATMOSPHERIC PHENOMENA

There are patches of fog, 5 feet in depth, at the station.

TEMPERATURE

Temperature: 45
Dew Point: 40

WIND

The wind is from 160 degrees at 5 knots.

PRECIPITATION

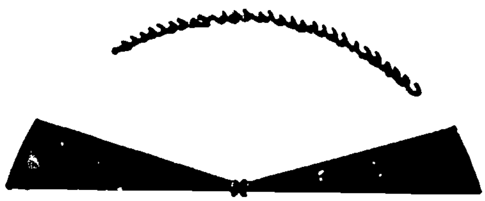
6 hour total: None
24 hour total: .01
Snow depth: None

PRESSURE

Station pressure: 29.290

This observation was completed at 0555Z.

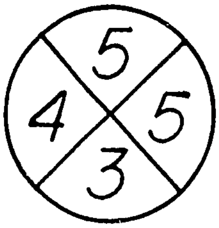
SKY CONDITION



2/10 of the sky is hidden by fog.

5/10 CI in the form of hooks and filaments is at an estimated 25,000'.

VISIBILITY



The control tower reports a visibility of 7 miles.

ATMOSPHERIC PHENOMENA

Fog, 12 feet in depth, is restricting the horizontal visibility at the station.

TEMPERATURE

Temperature: 44
Dew Point: 41

WIND

The wind is from 153 degrees at 4 knots.

PRECIPITATION

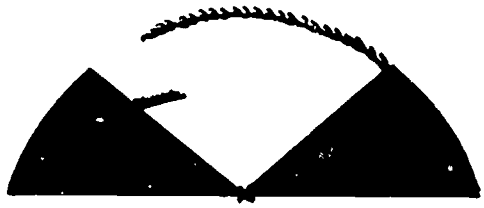
6 hour total: None
24 hour total: .01
Snow depth: None

PRESSURE

Station pressure: 29.310

This observation was completed at 0656Z.

SKY CONDITION

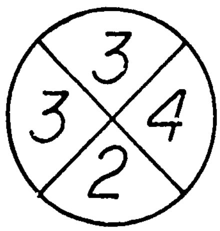


4/10 of the sky is hidden by fog.

1/10 STFRA (all thin) is at a measured 1,500'.

5/10 CI in the form of hooks and filaments is at an estimated 25,000'.

VISIBILITY



The control tower reports a visibility of 4 miles.

ATMOSPHERIC PHENOMENA

Fog, 20 feet in depth, is at the station.

TEMPERATURE

Temperature: 43
Dew Point: 41

WIND

The wind is varying from 100 degrees to 180 degrees at a speed of 3 knots.

PRECIPITATION

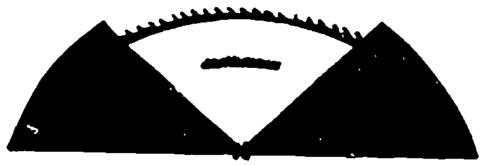
6 hour total: None
24 hour total: .01
Snow depth: None

PRESSURE

Station pressure: 29.320

This observation was completed at 0755Z.

SKY CONDITION

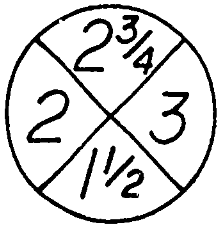


5/10 of the sky is hidden by fog.

2/10 STFRA (all thin) is at 1,500' determined by a weather balloon.

5/10 CI is at 25,000', estimated.

VISIBILITY



The control tower reports a visibility of 3 1/2 miles.

ATMOSPHERIC PHENOMENA

Fog, 35 feet in depth, is present.

TEMPERATURE

Temperature: 43
Dew Point: 41

WIND

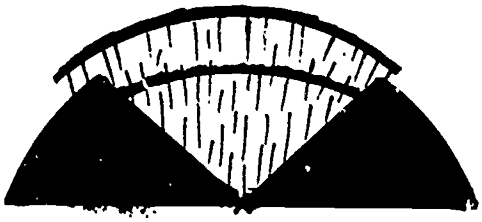
The wind is varying from 95 degrees to 167 degrees at a speed of 2 knots.

PRESSURE

The observed barometer is 29.320.

This observation was completed at 0805Z.

SKY CONDITION

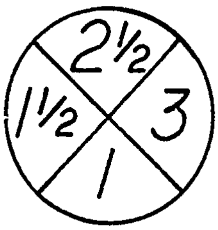


5/10 of the sky is hidden by fog.

5/10 STFRA (5/10 opaque) is at an angle of 75 degrees on the RBC.

6/10 ST is reported by a pilot to be above the STFRA.

VISIBILITY



The control tower reports a visibility of 3 1/4 miles.

ATMOSPHERIC PHENOMENA

Light drizzle began to fall at 0815Z. Fog, 60 feet deep, is also present.

TEMPERATURE

Temperature: 43
Dew Point: 41

WIND

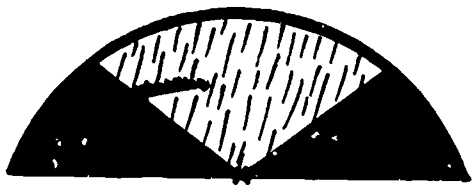
The wind is from 122 degrees at 0 knots.

PRESSURE

The observed barometer is 29.320.

This observation was completed at 0817Z.

SKY CONDITION

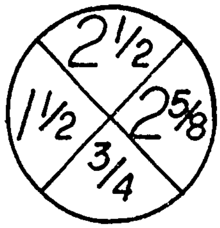


4/10 of the sky is hidden by fog.

1/10 STFRA is observed at 0831Z to be at 800', estimated.

10/10 ST (6/10 opaque) is at an angle of 75 degrees on the RBC.

VISIBILITY



The control tower reports a visibility of 2 7/8 miles.

ATMOSPHERIC PHENOMENA

Drizzle and fog, 100 feet deep, are at the station.

TEMPERATURE

Temperature: 43
Dew Point: 42

WIND

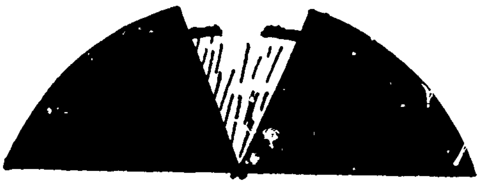
Calm

PRESSURE

The aneroid barometer is reading 29.325.

This observation was completed at 0835Z.

SKY CONDITION



8/10 of the sky is hidden by fog.

1/10 ST is visible with breaks overhead. The RBC indicates its height to be varying from 700' to 900' to 1,000' to 800'.

VISIBILITY

The prevailing visibility has varied in the past 15 minutes from 1 to 3 to 2 1/2 to 1 1/2 miles. The control tower reports their visibility as 2 1/2 miles.

ATMOSPHERIC PHENOMENA

Fog, 140 feet deep, and drizzle are occurring at the station.

TEMPERATURE

Temperature: 42.7
Dew Point: 42.3

WIND

Calm

PRECIPITATION

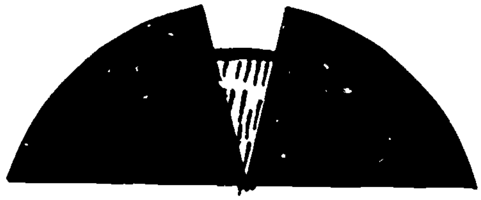
6 hour total: Trace
24 hour total: .01
Snow depth: None

PRESSURE

Station pressure: 29.325

This observation was completed at 0855Z.

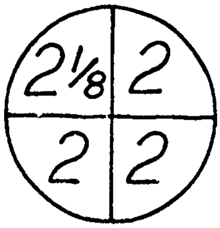
SKY CONDITION



9/10 of the sky is hidden by fog.

1/10 ST is visible overhead at a measured 700'.

VISIBILITY



The control tower reports a visibility of 1 1/2 miles. At 0914Z, the FMN-1 on Runway 18 is observed to read 6,000 feet.

ATMOSPHERIC PHENOMENA

Light drizzle and fog, 250 feet deep, are restricting the visibility.

TEMPERATURE

Temperature: 43
Dew Point: 42

WIND

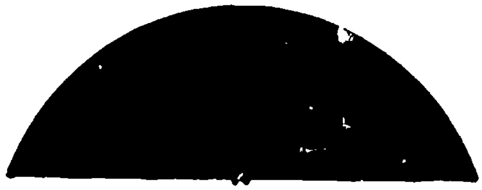
Calm

PRESSURE

Station pressure: 29.330

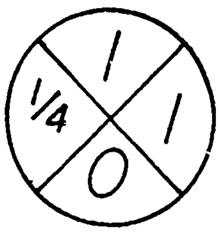
This observation was completed at 0916Z.

SKY CONDITION



10/10 of the sky is hidden by fog. Vertical visibility is determined to be 600'.

VISIBILITY



The control tower reports their visibility as 1 1/2 miles. The FMN-1 on Runway 18 is inoperative.

ATMOSPHERIC PHENOMENA

The drizzle that was falling stopped at 0929Z. Fog continues to be predominant at the station.

TEMPERATURE

Temperature: 43
Dew Point: 42

WIND

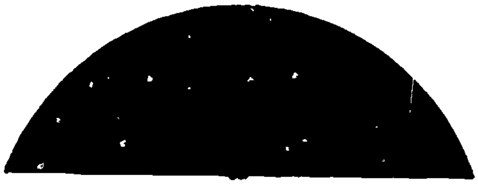
Calm

PRESSURE

The observed pressure is 29.320.

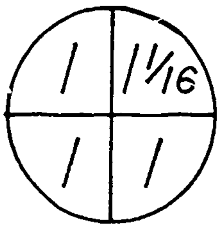
This observation was completed at 0933Z.

SKY CONDITION



The sky is totally obscured by fog. Vertical visibility is determined by observer experience to be 400'.

VISIBILITY



The control tower reports their visibility to be 3/4 mile. The FMN-1 on Runway 18 is now operating and reads 5,000 feet.

ATMOSPHERIC PHENOMENA

The drizzle has restarted at 0944Z. Fog is still restricting visibility.

TEMPERATURE

Temperature: 42.8
Dew Point: 42.7

WIND

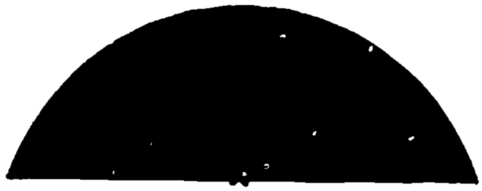
The wind direction is 83 degrees at a speed of 0 knots.

PRESSURE

The observed aneroid is 29.310.

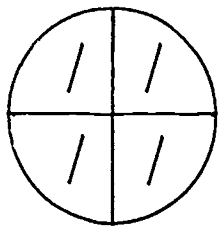
This observation was completed at 0948Z.

SKY CONDITION



10/10 Fog hides the sky. Vertical visibility was determined from the RBC with consecutive readings of 36, 47, 43, and 51 degrees.

VISIBILITY



The tower visibility is 1/2 mile. The FMN-1 on Runway 18 reads 5,000 feet.

ATMOSPHERIC PHENOMENA

Light drizzle and fog are present.

TEMPERATURE

Temperature: 43
Dew Point: 43

WIND

The wind direction is from 92 degrees at 5 knots.

PRECIPITATION

6 hour total: .01
24 hour total: .02
Snow depth: None

PRESSURE

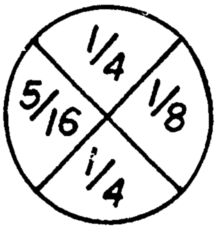
The station pressure has decreased to 29.305.

This observation was completed at 0955Z.

SKY CONDITION

The sky is totally obscured by fog. A pilot reported the vertical visibility during take-off to be 800' MSL.

VISIBILITY



The tower visibility is 1/2 mile. The FMN-1 on Runway 18 was seen to decrease at 1010Z to read 2,200 feet.

ATMOSPHERIC PHENOMENA

Fog and light drizzle are present.

TEMPERATURE

Temperature: 43
Dew Point: 43

WIND

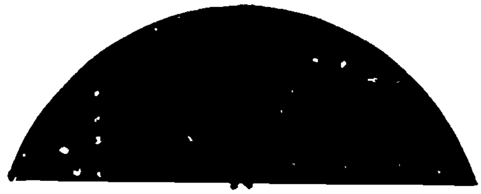
The wind direction is now 111 degrees at 3 knots.

PRESSURE

The station pressure is 29.305.

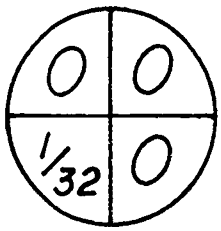
This observation was completed at 1015Z.

SKY CONDITION



10/10 of the sky is hidden by drizzle and fog. Vertical visibility is 35'.

VISIBILITY



The tower visibility is 3/32 mile. The Runway Visual Range on Runway 18 is determined from the transmissometer reading of 18%. The correction for the transmissometer is -1%.

ATMOSPHERIC PHENOMENA

Light drizzle and fog are restricting the visibility.

TEMPERATURE

Temperature: 43
Dew Point: 43

WIND

The wind direction has shifted to 162 degrees at 4 knots.

PRESSURE

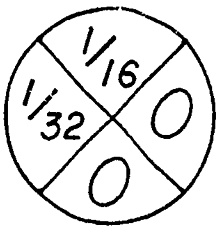
The observed barometer is 29.300.

This observation was completed at 1022Z.

SKY CONDITION

The sky is totally obscured. Ceiling is 100', estimated.

VISIBILITY



The tower visibility is 1/16 mile. The FMN-1 on Runway 18 reads less than 1,000 feet.

ATMOSPHERIC PHENOMENA

Light drizzle is falling at the station. Fog is also present.

TEMPERATURE

Temperature: 43.5
Dew Point: 43.5

WIND

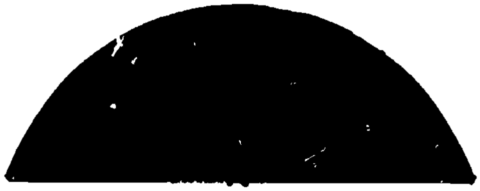
The wind recorder is reading calm winds.

PRESSURE

Station pressure: 29.290.

This observation was completed at 1031Z.

SKY CONDITION



10/10 Fog hides the sky. Vertical visibility as determined by the clinometer is 375'.

VISIBILITY

The prevailing visibility has varied during the period of observation from 0 to 1/2 to 3/16 to 3/8 miles. The control tower reports a visibility of 1/2 mile. The FMN-1 on Runway 18 reads 1,600 feet.

ATMOSPHERIC PHENOMENA

Drizzle that has accumulated .01 inch in the last hour and fog are present at the station. The drizzle has varied to moderate several times in the past 15 minutes.

TEMPERATURE

Temperature: 44
Dew Point: 43

WIND

Calm

PRECIPITATION

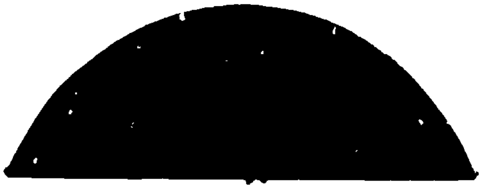
6 hour total: .02
24 hour total: .03
Snow depth: None

PRESSURE

The station pressure is obtained from the barograph.

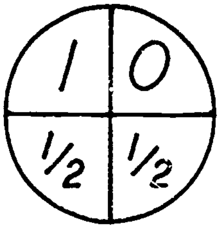
This observation was completed at 1055Z.

SKY CONDITION



10/10 Fog hides the sky. A 30 gram balloon was used to determine the ceiling. The balloon faded at 45 seconds and completely disappeared at 1 minute.

VISIBILITY



The tower visibility is 1 mile. The FMN-1 on Runway 18 was observed to change at 1110Z to read 2.600 feet.

ATMOSPHERIC PHENOMENA

Very light drizzle is falling and fog is also present.

TEMPERATURE

Temperature: 44.2
Dew Point: 43.5

WIND

The wind is calm.

PRESSURE

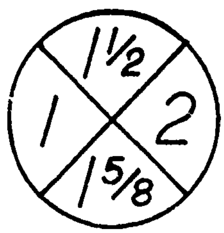
Station pressure: 29.280.

This observation was completed at 1112Z.

SKY CONDITION

Fog hides 10/10 of the sky. Vertical visibility was determined by a radio tower 1 1/2 miles away to be 970'.

VISIBILITY



The tower visibility is 2 miles. The FMN-1 on Runway 18 reads 4,500 feet.

ATMOSPHERIC PHENOMENA

Drizzle that was occurring at the station stopped at 1122Z. Fog is present; its depth is unknown.

TEMPERATURE

Temperature: 44.4
Dew Point: 43.4

WIND

The wind direction is 175 degrees at 0 knots.

PRESSURE

Station pressure: 29.270.

This observation was completed at 1125Z.

SKY CONDITION

7/10 fog hides the sky.

At 1142Z, 3/10 ST becomes visible. Its height, determined by the RBC, has varied from 800' to 1,100' to 900' to 700' during the period of observation.

VISIBILITY

The prevailing visibility is 3 miles and the tower reports 4 miles.

ATMOSPHERIC PHENOMENA

Fog is present at the station.

TEMPERATURE

Temperature: 44.6
Dew Point: 43.3

WIND

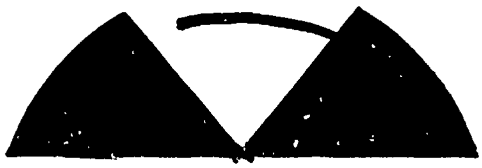
The wind is blowing from 177 degrees at 3 knots.

PRESSURE

The observed aneroid reads 29.260.

This observation was completed at 1145Z.

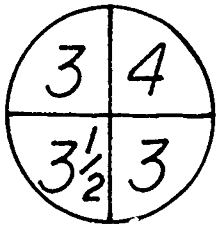
SKY CONDITION



10/10 fog hides 5/10 of the sky.

4/10 ST is at angles of 45, 48, and 42 degrees determined by the clinometer.

VISIBILITY



The control tower reports a visibility of 3 1/2 miles. The FMN-1 on Runway 18 reads greater than 6,000 feet.

ATMOSPHERIC PHENOMENA

Fog at the station is reported by a pilot to be 810 feet thick.

TEMPERATURE

Temperature: 45
Dew Point: 43

WIND

The wind direction is estimated to be from 185 degrees at 4 knots.

PRECIPITATION

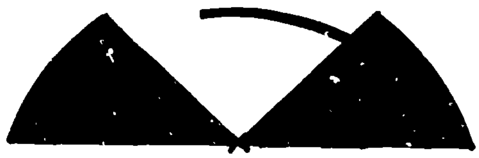
6 hour total: .02
24 hour total: .03
Snow depth: None

PRESSURE

Station pressure: 29.240.

This observation was completed at 1155Z.

SKY CONDITION



10/10 Fog hides 4/10 of the sky.

4/10 ST is observed to change to 900' at 1222Z. The height was determined by the clinometer.

VISIBILITY

The prevailing visibility and the lower visibility are both 4 miles.

ATMOSPHERIC PHENOMENA

Fog, 32 feet in depth, is starting to dissipate at the station.

TEMPERATURE

Temperature: 45
Dew Point: 43

WIND

The wind is from 202 degrees at 5 knots.

PRESSURE

The observed aneroid is 29.220 and falling.

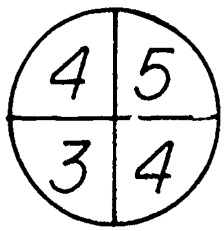
This observation was completed at 1227Z.

SKY CONDITION

10/10 fog hides 3/10 of the sky.

5/10 ST is measured at 1,475' at 1252Z.

VISIBILITY



The control tower reports a visibility of 4 miles.

ATMOSPHERIC PHENOMENA

The fog at the station has thinned to a depth of 18 feet.

TEMPERATURE

Temperature: 45.7
Dew Point: 42.7

WIND

The wind has varied from 187 degrees to 235 degrees at an average speed of 7 knots.

PRESSURE

The observed barometer has decreased to 29.205.

This observation was completed at 1253Z.

SKY CONDITION

TRACE of SMOKE is at 800'.

3/10 ST (1/10 thin) is at an estimated 1,025'. There are breaks in this layer to the west.

4/10 SC, not from CU, is at a measured 2,300'.

VISIBILITY

The prevailing visibility is 5 miles in all quadrants.

ATMOSPHERIC PHENOMENA

The fog at the station has thinned to a depth of 10 feet.

TEMPERATURE

Temperature: 46
Dew Point: 43

WIND

The wind direction is from 217 degrees at 10 knots. There are lulls of 6 knots and peaks of 15 knots.

PRECIPITATION

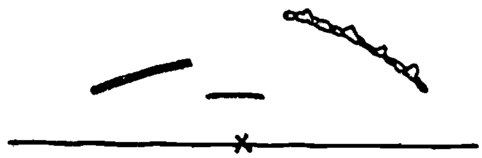
6 hour total: None
24 hour total: None
Snow depth: None

PRESSURE

Station pressure: 29.190

This observation was completed at 1257Z.

SKY CONDITION



1/10 SMOKE is at 800'.

2/10 ST is at 1,175'.

3/10 SC, not from CU, (all thin) is estimated at 2,425'.

VISIBILITY

The prevailing visibility is 6 miles.

ATMOSPHERIC PHENOMENA

Fog, 8 feet deep, is at the station.

TEMPERATURE

Temperature: 47.9
Dew Point: 43.2

WIND

220 degrees at 11 knots.

PRESSURE

The station pressure is 29.185.

This observation was completed at 1314Z.

SKY CONDITION

2/10 ST is at 1,200'.

3/10 CU of little vertical development is at a measured 2,500'.

VISIBILITY

The prevailing visibility is 7 miles.

ATMOSPHERIC PHENOMENA

None

TEMPERATURE

Temperature: 50
Dew Point: 42

WIND

The wind has varied from 178 degrees to 253 degrees at a speed of 12 knots.

PRECIPITATION

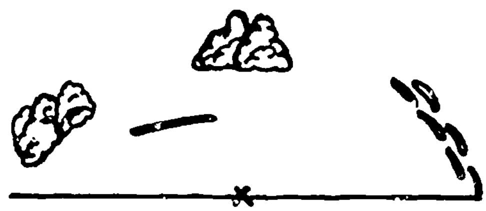
6 hour total: None
24 hour total: None
Snow depth: None

PRESSURE

The station pressure has decreased to 29.150.

This observation was completed at 1358Z.

SKY CONDITION



1/10 ST is at 1,200'.

4/10 CU of moderate vertical development has bases at 2,800' and tops at 9,000', determined by radar.

2/10 ACSL at an estimated 12,000' is east of the station.

VISIBILITY

The prevailing visibility is 7 miles.

ATMOSPHERIC PHENOMENA

Haze is present.

TEMPERATURE

Temperature: 53
Dew Point: 41

WIND

The average direction and speed is 225 degrees at 15 knots.

PRECIPITATION

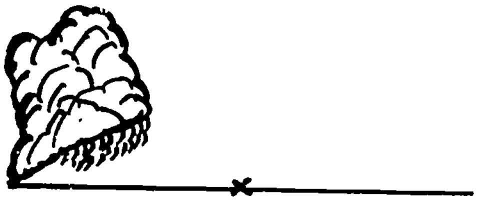
6 hour total: None
24 hour total: None
Snow depth: None

PRESSURE

The station pressure is obtained from the barograph.

This observation was completed at 1456Z.

SKY CONDITION



3/10 CU of strong vertical development is estimated at 2,800' west of the station.

Precipitation falling from this cloud is evaporating before reaching the surface.

VISIBILITY

The prevailing visibility is 10 miles.

ATMOSPHERIC PHENOMENA

Haze is present.

TEMPERATURE

Temperature: 57.3
Dew Point: 40.4

WIND

The direction and speed are 217 degrees at 15 knots. There are lulls of 8 knots and peaks of 21 knots in the past 10 minutes.

PRECIPITATION

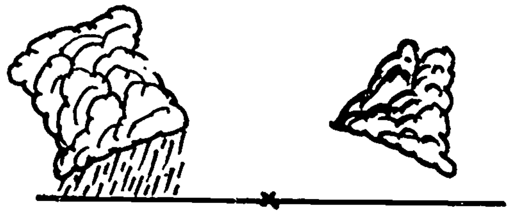
6 hour total: None
24 hour total: None
Snow depth: None

PRESSURE

The barometer reads 29.070.

This observation was completed at 1555Z.

SKY CONDITION



3/10 TCU is at 2,500', estimated, east of the station.

2/10 CB without fibrous tops are at 3,300' reported by a pilot west of the station. This cloud has varied to 3/10 during the period of observation.

VISIBILITY

The prevailing visibility is 15 miles.

ATMOSPHERIC PHENOMENA

A rainshower of unknown intensity is occurring from the CB west of the station.

TEMPERATURE

Temperature: 58
Dew Point: 40

WIND

The average direction and speed is 240 degrees at 15 knots with gusts to 22 knots.

PRECIPITATION

6 hour total: None
24 hour total: None
Snow depth: None

PRESSURE

Station pressure: 29.035.

This observation was completed at 1657Z.

SKY CONDITION

2/10 CB and 4/10 TCU. The CB without an anvil is west of the station and the TCU, in all quadrants, are estimated at 1717Z to be at 2,500'.

2/10 AC, from CU, is at 8,800' MSL.

VISIBILITY

The prevailing visibility is 17 miles with 5 miles observed to the west.

ATMOSPHERIC PHENOMENA

A rainshower of unknown intensity is west of the station. Haze is also present.

TEMPERATURE

Temperature: 58
Dew Point: 40

WIND

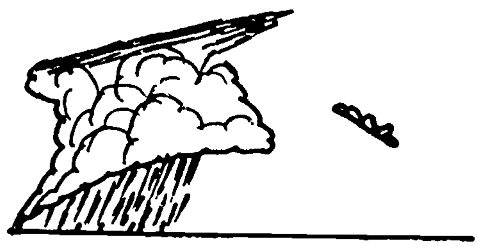
240 degrees at 16 knots. A peak of 25 knots was observed 7 minutes ago during the occurrance of a gust.

PRESSURE

Station pressure: 29.035.

This observation was completed at 1720Z.

SKY CONDITION



6/10 CB with an anvil is west of the station. Height was determined by the RBC at 1730Z to be 83 degrees.

1/10 AC, from CU, is estimated at 8,775'.

VISIBILITY

The prevailing visibility is 16 miles with 3 1/2 miles reported to the west.

ATMOSPHERIC PHENOMENA

Occasional lightning is observed west of the station from the CB to the ground. A rainshower is falling from the CB.

TEMPERATURE

Temperature: 58
Dew Point: 40

WIND

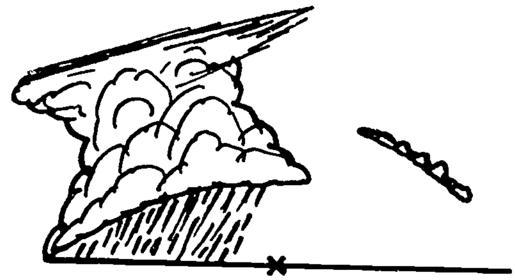
The average direction and speed is 247 degrees at 14 knots. At 1721Z, a peak was observed to 27 knots from 252 degrees during a gust. At 1727Z, a gust to 25 knots was observed.

PRESSURE

The station pressure is 29.030.

This observation was completed at 1733Z.

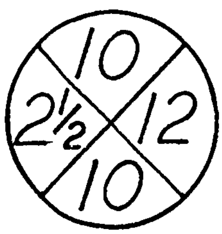
SKY CONDITION



6/10 CB with an anvil is west of the station. Height was last obtained from the RBC at 1730Z to be 3,200'.

2/10 AC, from CU, is estimated at 8,500'.

VISIBILITY



The control tower reports a visibility of 3 miles.

ATMOSPHERIC PHENOMENA

Thunder is heard at 1746Z from the CB west of the station. Occasional lightning is observed to the west in the cloud and from the cloud to the ground. A rain-shower is still falling from the CB.

TEMPERATURE

Temperature: 58.2
Dew Point: 41.1

WIND

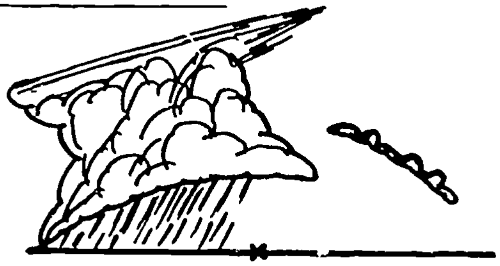
250 degrees at 10 knots with gusts to 23 knots.

PRESSURE

The barometer has fallen to 29.000.

This observation was completed at 1748Z.

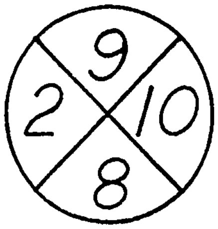
SKY CONDITION



7/10 CB is overhead through west of the station at 3,000', estimated.

2/10 AC, from CU, is at 8,000', estimated.

VISIBILITY



The tower visibility is 2 miles.

ATMOSPHERIC PHENOMENA

Thunder from the CB continues. Occasional lightning is observed in the cloud and from the cloud to the ground to the west of the station. A rainshower is also visible to the west.

TEMPERATURE

Temperature: 58
Dew Point: 42

WIND

250 degrees at 10 knots gusting to 18 knots.

PRECIPITATION

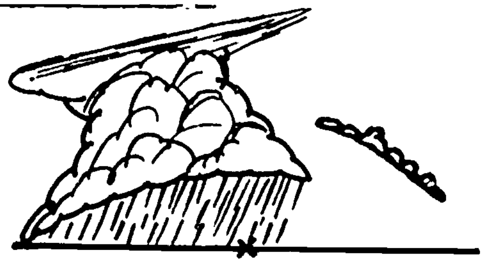
6 hour total: None
24 hour total: None
Snow depth: None

PRESSURE

The pressure has fallen to 28.960.

This observation was completed at 1758Z.

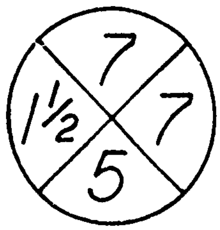
SKY CONDITION



7/10 CB is overhead through west of the station at an estimated 3,000'.

2/10 AC, from CU, is at 8,000', estimated.

VISIBILITY



The tower visibility is 2 miles.

ATMOSPHERIC PHENOMENA

Light rain has begun to fall at the station at 1810Z. The thunder continues overhead through the west accompanied by occasional lightning in the cloud and from the cloud to the ground.

TEMPERATURE

Temperature: 58
Dew Point: 42

WIND

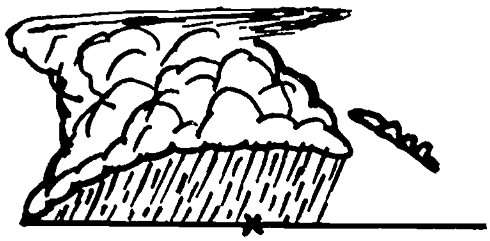
The winds have decreased to 5 knots from 270 degrees.

PRESSURE

The barometer indicates 28.900 and falling rapidly.

This observation was completed at 1812Z.

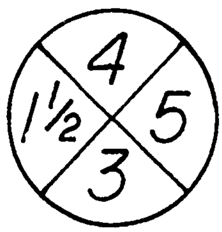
SKY CONDITION



8/10 CB is overhead through west at 3,000', estimated.

1/10 AC, from CU, is at 8,000', estimated.

VISIBILITY



The FMN-1 on Runway 18 reads greater than 6,000 feet.

ATMOSPHERIC PHENOMENA

.02 inches of rain has fallen in the past 6 minutes. Frequent lightning in-cloud, cloud-to-cloud, and cloud-to-ground, from the CB, is producing thunder at the station.

TEMPERATURE

Temperature: 58
Dew Point: 44

WIND

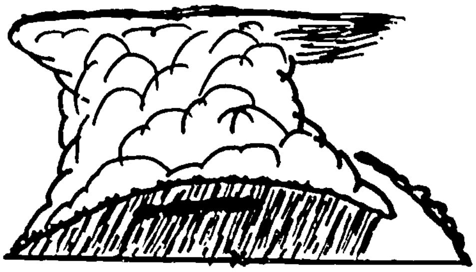
Calm

PRESSURE

The barometer reads 28.905.

This observation was completed at 1833Z.

SKY CONDITION

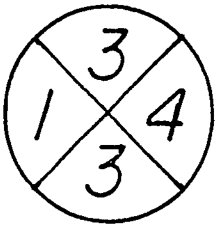


2/10 STFRA is below a CB at a measured 1,500'.

9/10 CB is overhead at 3,000', estimated.

1/10 AC, from CU, is still visible at 8,000', estimated.

VISIBILITY



The FMN-1 is inoperative.

ATMOSPHERIC PHENOMENA

The rain on the roof resembles a distant roar as frequent lightning in-cloud, cloud-to-cloud, and cloud-to-ground produces thunder overhead.

TEMPERATURE

Temperature: 53.2
Dew Point: 45.4

WIND

The wind began to shift at 1840Z from 230 degrees to 320 degrees by 1845Z. Speed has increased to 28 knots with squalls to 40 knots. Frontal passage has occurred.

PRESSURE

The barometer rapidly rose to a reading of 28.980.

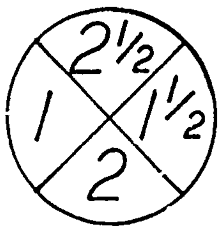
This observation was completed at 1847Z.

SKY CONDITION

5/10 STFRA is at 1,500', estimated. This layer has varied to 6/10 in the past 5 minutes.

10/10 CB with pouches are in all quadrants at 3,000', estimated.

VISIBILITY



The FMN-1 is inoperative.

ATMOSPHERIC PHENOMENA

Thunder is heard overhead and heavy rainshowers are at the station. Frequent lightning in-cloud and cloud-to-ground are seen overhead and occasional lightning in-cloud and cloud-to-cloud are northwest of the station.

TEMPERATURE

Temperature: 52
Dew Point: 46

WIND

330 degrees at 25 knots with squalls to 47 knots.

PRECIPITATION

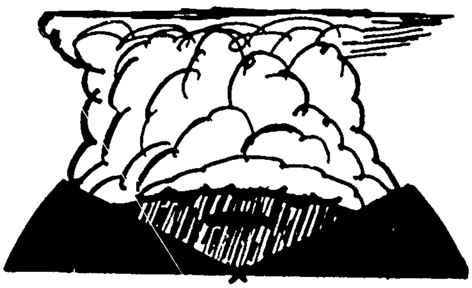
6 hour total: .18
24 hour total: .18
Snow depth: None

PRESSURE

Station pressure: 29.055.

This observation was completed at 1855Z.

SKY CONDITION

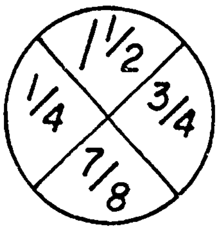


4/10 of the sky is hidden by rainshowers.

2/10 STFRA is visible at a measured 1,500'. This layer is varying to 1/10.

10/10 CB with pouches are in all quadrants at 3,000', estimated.

VISIBILITY



The FMN-1 on Runway 36 reads 6,000 feet.

ATMOSPHERIC PHENOMENA

At 1845Z, a tornado was reported to occur 10 miles north of Champaign (CMI) by an unknown source. This report was recieved at 1927Z. Heavy rain has varied to moderate at the station during the past 15 minutes. Frequent lightning in-cloud and cloud-to-ground overhead still produces thunder overhead.

TEMPERATURE

Temperature: 50
Dew Point: 45

WIND

340 degrees at 30 knots. A peak of 52 knots occurred during a squall at 1927Z.

PRESSURE

Station pressure: 29.015.

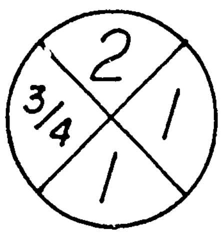
This observation was completed at 1930Z.

SKY CONDITION

6/10 rainshowers hides the sky.

10/10 CBMAM is in all quadrants at 1,500', estimated.

VISIBILITY



At 1956Z, the FMN-1 on Runway 36 decreased to 4,500 feet.

ATMOSPHERIC PHENOMENA

Frequent lightning in-cloud, cloud-to-cloud, cloud-to-air, and cloud-to-ground is causing thunder in all quadrants. Heavy rain is falling at the station.

TEMPERATURE

Temperature: 47
Dew Point: 45

WIND

340 degrees at 26 knots. A peak of 43 knots was sustained for 1 1/2 minutes at 1953Z.

PRECIPITATION

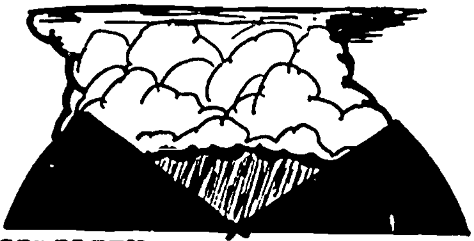
6 hour total: .77
24 hour total: .77
Snow depth: None

PRESSURE

The observed aneroid is 29.075.

This observation was completed at 1958Z.

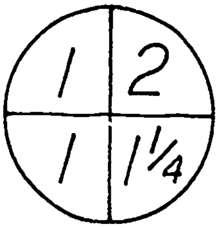
SKY CONDITION



6/10 rainshowers hides the sky.

4/10 CBMAM is visible overhead at a height of 76 degrees on the RBC.

VISIBILITY



The FMN-1 on Runway 36 is reading 4,500 feet.

ATMOSPHERIC PHENOMENA

Loud peals of thunder are heard in all quadrants. Almost continuous lightning is seen overhead from cloud-to-cloud, cloud-to-ground, cloud-to-air, and within the cloud. The rain changed to a moderate intensity at 2036Z.

TEMPERATURE

Temperature: 47
Dew Point: 45

WIND

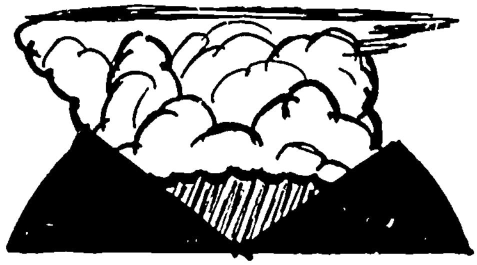
350 degrees at 35 knots with gusts to 46 knots.

PRESSURE

The corrected aneroid reading is 29.075.

This observation was completed at 2037Z.

SKY CONDITION

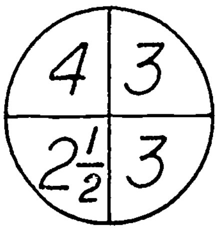


6/10 rain hides the sky.

2/10 CUFRA is at a measured height of 1,600'.

4/10 CBMAM is visible overhead at a height of 2,500'.

VISIBILITY



The FMN-1 on Runway 36 is reading greater than 6,000 feet.

ATMOSPHERIC PHENOMENA

Thunder continues to be heard in all quadrants. Frequent lightning is seen within the cloud, cloud-to-cloud and cloud-to-ground in all quadrants. Hail began to fall at 2045Z. The largest stone observed is 1 inch. Moderate rain is falling at the station.

TEMPERATURE

Temperature: 45
Dew Point: 43

WIND

The winds are from 340 degrees at 20 knots with gusts to 36 knots.

PRESSURE

The pressure is obtained from the barograph.

This observation was completed at 2046Z.

SKY CONDITION

2/10 rain hides the sky.

2/10 CUFRA is at 1,650'.

5/10 CBMAM is visible overhead through east at 2,500', estimated.

VISIBILITY

The prevailing visibility has increased to 4 miles.

ATMOSPHERIC PHENOMENA

Thunder is heard overhead through east. Occasional lightning is seen within the cloud, cloud-to-cloud, and cloud-to-ground in the east. Hail ended at 2056Z. The largest stone observed was 1 inch. Moderate rain is falling at the station.

TEMPERATURE

Temperature: 43
Dew Point: 42

WIND

350 degrees at 20 knots gusting to 31 knots.

PRECIPITATION

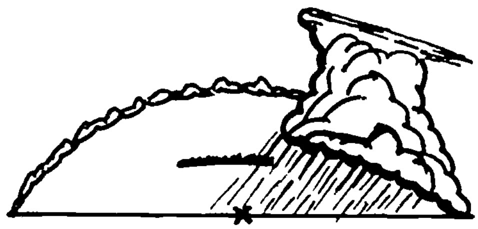
6 hour total: 1.14
24 hour total: 1.14
Snow depth: 1.0

PRESSURE

The pressure is obtained from the barograph.

This observation was completed at 2057Z.

SKY CONDITION



2/10 CUFRA is estimated to be at 1,600'.

4/10 CBMAM is east of the station at 81 degrees on the RBC.

6/10 AC, from CU, is at an estimated 10,000'.

VISIBILITY

The prevailing visibility is 7 miles and the tower visibility is 10 miles.

ATMOSPHERIC PHENOMENA

Thunder was last heard at 2104Z, 15 minutes ago. Occasional lightning is seen from the cloud to the ground in the east. Light rainshowers are falling at the station.

TEMPERATURE

Temperature: 42
Dew Point: 40

WIND

360 degrees at 17 knots. There have been lulls of 14 knots and peaks of 23 knots in the past 10 minutes.

PRESSURE

The station pressure is 29.090.

This observation was completed at 2121Z.

SKY CONDITION

5/10 ST is at an estimated 1,240'. This layer has varied to 6/10 during the period of observation.

5/10 SC, formed by the spreading out of CU, is at a measured 2,700'.

VISIBILITY

The prevailing visibility is 8 miles.

ATMOSPHERIC PHENOMENA

Lightning is no longer visible to the east. The rain stopped at 2132Z.

TEMPERATURE

Temperature: 42
Dew Point: 38

WIND

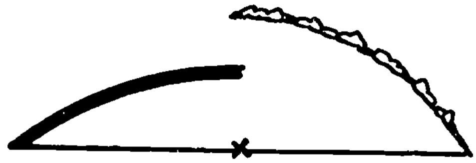
355 degrees at 15 knots.

PRESSURE

The station pressure remains at 29.090.

This observation was completed at 2134Z.

SKY CONDITION



5/10 ST is at 1,200'.

5/10 SC, from CU, is at a measured 2,600'.

VISIBILITY

The prevailing visibility is 7 miles.

ATMOSPHERIC PHENOMENA

None

TEMPERATURE

Temperature: 40
Dew Point: 38

WIND

360 degrees at 15 knots.

PRECIPITATION

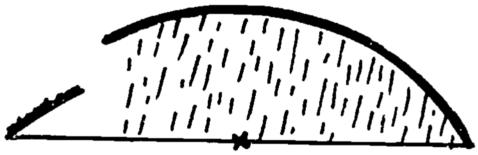
6 hour total: 1.18
24 hour total: 1.18
Snow depth: .7

PRESSURE

The observed aneroid reads 29.140.

This observation was completed at 2155Z.

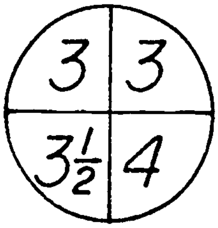
SKY CONDITION



1/10 STFRA became visible at 2240Z. It is at a height of 700'.

8/10 ST is measured at 1,200'. This layer has varied to 9/10 coverage during the period of observation.

VISIBILITY



ATMOSPHERIC PHENOMENA

Drizzle has begun at the station.

TEMPERATURE

Temperature: 38.8
Dew Point: 38.4

WIND

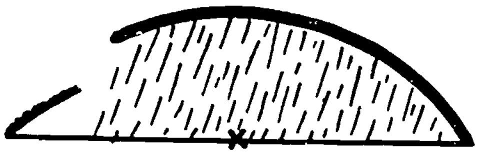
2 degrees at 12 knots.

PRESSURE

Station pressure: 29.155.

This observation was completed at 2243Z.

SKY CONDITION



1/10 STFRA is at 700'.

8/10 ST is also visible. Its height, determined by the RBC, has varied from 1,000' to 1,400' to 1,100' to 1,500' in the past 9 minutes.

VISIBILITY

The prevailing visibility has varied during the period of observation from 2 to 1 1/2 to 4 to 2 1/2 miles.

ATMOSPHERIC PHENOMENA

Drizzle is still falling at the station. It has stopped and restarted twice during the period of observation.

TEMPERATURE

Temperature: 37
Dew Point: 37

WIND

The wind direction has fluctuated from 320 degrees to 60 degrees during the past 10 minutes. The average wind speed is 12 knots.

PRECIPITATION

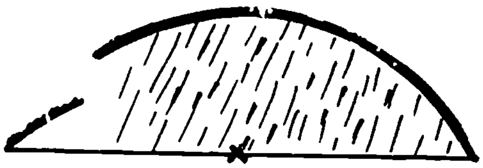
6 hour total: 1.19
24 hour total: 1.19
Snow depth: .5

PRESSURE

Station pressure: 29.175.

This observation was completed t 2258Z.

SKY CONDITION



1/10 STFRA is at 700'.

8/10 NS is at a measured height on the RBC at angles of 68, 74, 70, and 75 degrees.

VISIBILITY

The prevailing visibility is 2 miles. The tower reports a visibility of 2 1/8 miles.

ATMOSPHERIC PHENOMENA

Light drizzle is still falling at the station. Light ice pellets began to fall at 2316Z. Fog is at the station; its depth is unknown.

TEMPERATURE

Temperature: 35
Dew Point: 34

WIND

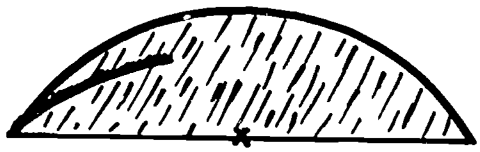
9 degrees at 10 knots.

PRESSURE

The barometer reads 29.185.

This observation was completed at 2320Z.

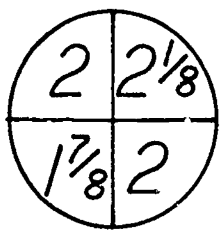
SKY CONDITION



3/10 STFRA is estimated to be at a height of 500'.

10/10 NS, 7/10 visible, is measured by the RBC at a height of 1,175'.

VISIBILITY



The tower reports a visibility of 3 miles. The FMN-1 on Runway 36 reads 6,000 feet.

ATMOSPHERIC PHENOMENA

Light drizzle and light ice pellets are falling at the station. Fog is also present.

TEMPERATURE

Temperature: 33.6
Dew Point: 33.4

WIND

15 degrees at 10 knots.

PRECIPITATION

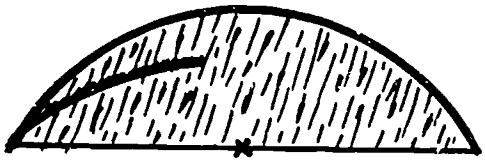
6 hour total: 1.22
24 hour total: 1.22
Snow depth: .8

PRESSURE

Station pressure: 29.210

This observation was completed at 2357Z.

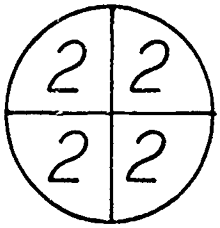
SKY CONDITION



4/10 STFRA is estimated to be at a height of 500'.

10/10 NS, 6/10 visible, is measured by the RBC at a height of 1,125'.

VISIBILITY



The tower visibility is 2 3/4 miles. The FMN-1 on Runway 36 reads 5,500 feet at 0012Z.

ATMOSPHERIC PHENOMENA

Light ice pellets and drizzle and fog are present at the station.

TEMPERATURE

Temperature: 33.4
Dew Point: 33.2

WIND

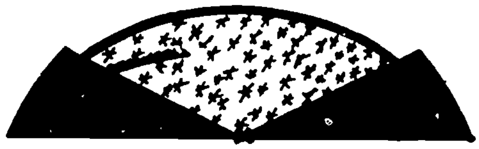
The average wind direction and speed is 27 degrees at 9 knots.

PRESSURE

The station pressure has remained steady at 29.210.

This observation was completed at 0015Z.

SKY CONDITION

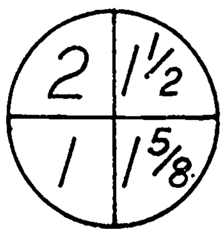


4/10 snow and fog hides the sky.

1/10 STFRA is visible at an estimated 500'. This layer has varied to 2/10 visible in the past 12 minutes.

10/10 NS is at a measured 1,100', determined by the RBC 14 minutes ago.

VISIBILITY



The FMN-1 on Runway 36 registers a reading of 5,000 feet. The control tower reports that their visibility is 2 1/4 miles.

ATMOSPHERIC PHENOMENA

At 0030Z, the ice pellets have become moderate. The drizzle has changed to light snow and fog is still present.

TEMPERATURE

Temperature: 33
Dew Point: 31

WIND

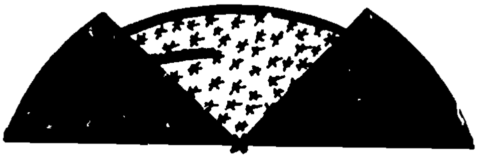
The wind direction has been varying from 7 degrees to 51 degrees in the past 10 minutes. The average speed is 8 knots.

PRESSURE

The station pressure has increased to 29.230.

This observation was completed at 0033Z.

SKY CONDITION

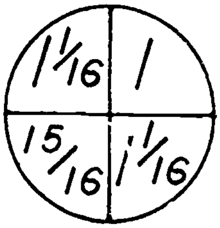


6/10 fog and snow hides the sky.

1/10 STFRA is at 600', measured.

10/10 NS is at a measured 1,100'.

VISIBILITY



The FMN-1 on Runway 36 reads 4,500 feet. The tower visibility is not available.

ATMOSPHERIC PHENOMENA

Light snow and moderate ice pellets and fog are present at the station. The snow has stopped and restarted several times in the past 15 minutes.

TEMPERATURE

Temperature: 32
Dew Point: 31

WIND

45 degrees at 8 knots.

PRECIPITATION

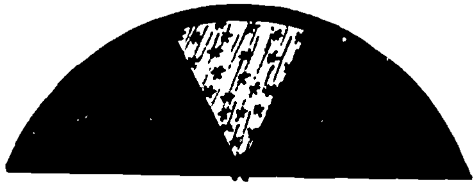
6 hour total: .07
24 hour total: 1.29
Snow depth: 1.2

PRESSURE

The barometer has risen to read 29.250.

This observation was completed at 0057Z.

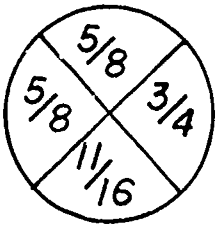
SKY CONDITION



8/10 of the sky is hidden by fog and snow.

10/10 NS is at a measured 500'.

VISIBILITY



The FMN-1 on Runway 36 is 4,000 feet.

ATMOSPHERIC PHENOMENA

Moderate ice pellets and light snow are occurring at the time of observation. Fog is also present. Light drizzle has restarted at 0110Z and is freezing upon contact with objects on the surface. The snow is being blown about by the wind to a height of 3 feet.

TEMPERATURE

Temperature: 31.8
Dew Point: 31.4

WIND

43 degrees at an average speed of 6 knots.

PRESSURE

Station pressure: 29.260.

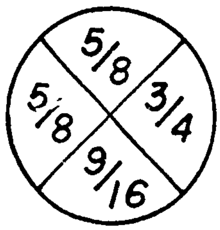
This observation was completed at 0115Z.

SKY CONDITION

9/10 of the sky is hidden by snow and fog.

10/10 NS is at a measured 600'.

VISIBILITY



The runway visual range on Runway 36 is 3,800 feet.

ATMOSPHERIC PHENOMENA

Light freezing drizzle, moderate ice pellets, light snow and fog are at the station.

TEMPERATURE

Temperature: 31.3
Dew Point: 30.6

WIND

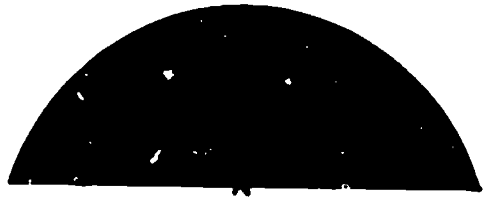
58 degrees at 10 knots.

PRESSURE

The observed aneroid is 29.280.

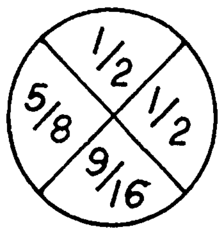
This observation was completed at 0142Z.

SKY CONDITION



At 0157Z, the sky became totally obscured. The vertical visibility as determined by the RBC is 36 degrees.

VISIBILITY



The FMN-1 on Runway 36 is reading 2,400 feet.

ATMOSPHERIC PHENOMENA

Moderate ice pellets, light freezing drizzle, light snow and fog are all present at the station. The drizzle has varied to moderate several times in the past 5 minutes.

TEMPERATURE

Temperature: 30
Dew Point: 30

WIND

The wind speed and direction are 12 knots from 57 degrees.

PRECIPITATION

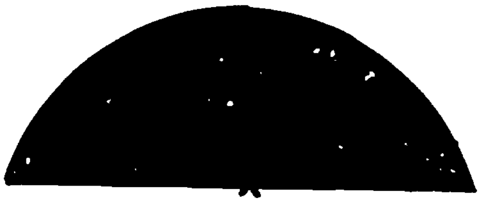
6 hour total: .31
24 hour total: 1.53
Snow depth: 3.5

PRESSURE

Station pressure: 29.285.

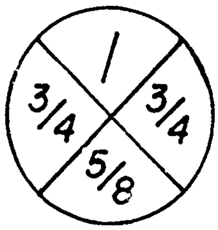
This observation was completed at 0158Z.

SKY CONDITION



10/10 of the sky is hidden by snow. Vertical visibility is determined to be 475', based on the observer's experience.

VISIBILITY



The FMN-1 on Runway 36 is 2,800 feet.

ATMOSPHERIC PHENOMENA

Light snow and light ice pellets are at the station. The freezing drizzle stopped at 0214Z.

TEMPERATURE

Temperature: 30
Dew Point: 29

WIND

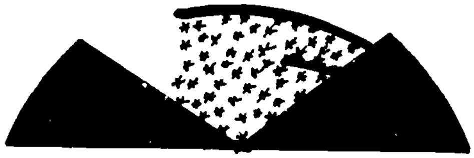
50 degrees at 8 knots.

PRESSURE

The station pressure has increased to read 29.300.

This observation was completed at 0217Z.

SKY CONDITION

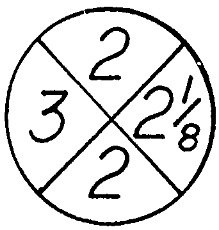


10/10 snow hides 4/10 of the sky.

1/10 STFRA is at 500', estimated.

4/10 NS is reported by a pilot to be at 2,800' MSL.

VISIBILITY



The FMN-1 on Runway 36 reads 6,000 feet.
The tower reports a visibility of 3 miles.

ATMOSPHERIC PHENOMENA

The ice pellets have stopped at 0232Z. The light snow has stopped and restarted in the past 7 minutes.

TEMPERATURE

Temperature: 29
Dew Point: 28

WIND

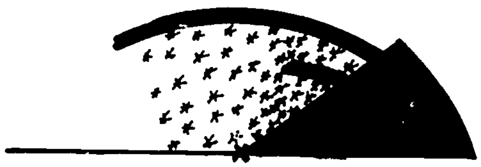
43 degrees at 7 knots.

PRESSURE

Station pressure: 29.310.

This observation was completed at 0235Z.

SKY CONDITION

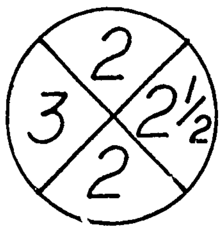


2/10 snow hides the sky.

1/10 STFRA is at 500', estimated.

5/10 NS is at 2,200', determined by the RBC 20 minutes ago.

VISIBILITY



The FMN-1 on Runway 36 reads greater than 6,000 feet. The tower reports 4 miles visibility.

ATMOSPHERIC PHENOMENA

Very light snow is at the station.

TEMPERATURE

Temperature: 28
Dew Point: 28

WIND

40 degrees at 5 knots.

PRECIPITATION

6 hour total: .39
24 hour total: 1.61
Snow depth: 4.3

PRESSURE

The observed aneroid is 29.310.

This observation was completed at 0255Z.

SKY CONDITION

2/10 snow hides the sky.

4/10 NS is at a measured height of 2,300'. This layer has varied to 3/10 in the past 10 minutes.

VISIBILITY

The prevailing visibility is 3 miles, but 2 1/2 miles is observed to the east.

ATMOSPHERIC PHENOMENA

The snow stopped at 0335Z, but fog, 8 feet deep, has now formed.

TEMPERATURE

Temperature: 27
Dew Point: 26

WIND

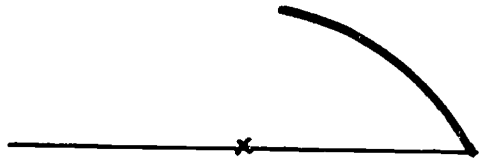
17 degrees at an average speed of 4 knots.

PRESSURE

The barometer has risen to read 29.330.

This observation was completed at 0340Z.

SKY CONDITION



4/10 NS is at a measured height of 2,000'. This layer has varied to 6/10 during the period of observation.

VISIBILITY

The prevailing visibility is 7 miles.

ATMOSPHERIC PHENOMENA

The fog has thinned to a depth of 4 feet.

TEMPERATURE

Temperature: 27
Dew Point: 26

WIND

27 degrees at 6 knots.

PRECIPITATION

6 hour total: .43
24 hour total: 1.65
Snow depth: 4.7

PRESSURE

The station pressure is obtained from the barograph.

This observation was completed at 0356Z.

SKY CONDITION

The sky is clear.

VISIBILITY

The prevailing visibility is 7 miles.

ATMOSPHERIC PHENOMENA

The fog at the station is now 5 feet in depth.

TEMPERATURE

Temperature: 23
Dew Point: 20

WIND

The wind is varying from 20 degrees to 55 degrees at an average speed of 8 knots.

PRECIPITATION

6 hour total: .43
24 hour total: 1.65
Snow depth: 4.5

PRESSURE

Station pressure: 29.360.

This observation was completed at 0455Z.

SKY CONDITION

No clouds are observed.

VISIBILITY

The prevailing visibility has decreased to 3 miles at 0550Z.

ATMOSPHERIC PHENOMENA

The fog at the station has thickened to a depth of 25'.

TEMPERATURE

Temperature: 22
Dew Point: 20

WIND

65 degrees at 3 knots.

PRESSURE

The station pressure has increased to 29.370.

This observation was completed at 0552Z.

TABLE 1

HEIGHT VALUES FOR 400' BASELINE (RBC)

ANGLE	REPORT VALUE	ACTUAL VALUE
5		35
6	0	42
7		49
8		56
9		63
10		71
11		78
12		85
13		92
14	100	100
15		107
16		115
17		122
18		130
19		138
20		146
21		154
22		162
23		170
24		178
25		187
26	200	195
27		204
28		213
29		222
30		231
31		240
32		250
33		260
34		270
35		280
36		291
37	300	301
38		313
39		324
40		336
41		348
42		360
43		373
44		386
45	400	400
46		414
47		429
48		444
49		460
50		477
51	500	494
52		512
53		531
54		551
55		571
56	600	593
57		616
58		640
59		666
60	700	694
61		722
62		752
63	800	785
64		820
65		858
66	900	898
67		942
68	1000	990
69		1042
70	1100	1099
71	1200	1162
72		1231
73	1300	1308
74	1400	1395
75	1500	1493
76	1600	1604
77	1700	1733
78	1900	1882
79	2100	2058
80	2300	2[illegible]69
81	2500	2526
82	2800	2846
83	3300	3258
84	3800	3806
85	4600	4572
86	5500	5720

TABLE 2

HEIGHT VALUES FOR 800' BASELINE (CLINOMETER)

ANGLE	REPORT VALUE	ACTUAL VALUE
4		56
5		70
6		84
7	100	98
8		112
9		127
10		141
11		156
12		170
13		185
14	200	199
15		214
16		229
17		245
18		260
19		275
20	300	291
21		307
22		323
23		340
24		356
25		373
26	400	390
27		408
28		425
29		443
30		462
31		481
32	500	500
33		520
34		540
35		560
36		581
37	600	603
38		625
39		648
40		671
41		695
42	700	720
43		746
44		772
45	800	800
46		828
47		858
48	900	888
49		920
50		953
51	1000	988
52		1024
53		1062
54	1100	1101
55		1142
56	1200	1186
57		1232
58	1300	1280
59		1331
60	1400	1386
61		1443
62	1500	1505
63	1600	1570
64		1640
65	1700	1716
66	1800	1797
67	1900	1885
68	2000	1980
69	2100	2084
70	2200	2198
71	2300	2323
72	2500	2462
73	2600	2617
74	2800	2790
75	3000	2986
76	3200	3209
77	3500	3465
78	3800	3764
79	4100	4116
80	4500	4537
81	5000	5051
82	5500	5692
83	6500	6515
84	7500	7612
85	9000	9144
86	11000	11440

Table 3

BAROGRAPH

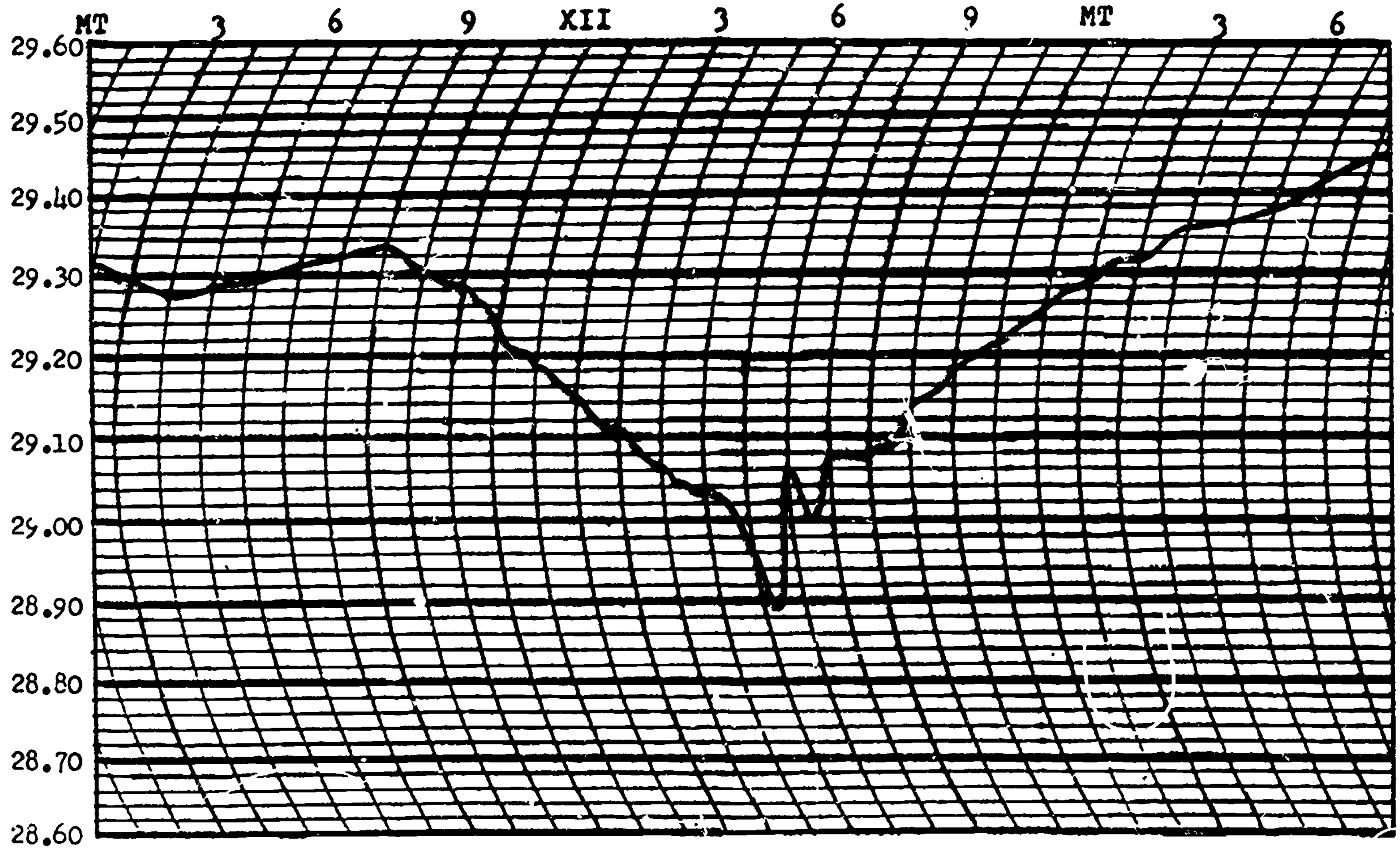


TABLE 4

LOCAL REQUIREMENTS AT CHANUTE

1. Ceiling decreases to less than 2,000 feet, or is less than 2,000 feet and changes by one or more reportable values, or if below, increases to equal or exceed 2,000 feet.

2. Visibility decreases to less than 4 miles or is less than 4 miles and changes by one or more reportable values, or if below, increases to equal or exceed 4 miles.

3. Precipitation changes intensity.

4. When conditions for reporting Runway Visual Range (RVR) are first observed and when the conditions are observed to no longer exist.

   a. First lowers to 6,000 feet.

   b. Decreases to less than, or if below, increases to equal or exceed:

      1. 2,000 feet.

      2. 1,600 feet.

Entries are made in the following columns for the following types of observations:

TYPE	COLUMNS
SA	1-13, 15, 17, 21
RS	1-13, 15, 17, 21
SP	1-5, 9-13, 15
L	1-5, 12, 13, 15

WORKBOOK

C3ABR25130-0-WB-112b
C3ABR25130-2-WB-112b

Technical Training

Weather Specialist
Aerographer's Mate

METAR

7 March 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE

DO NOT USE ON THE JOB

RGL: N/A

Weather Observer Branch
Chanute AFB, Illinois

C3ABR25130-0-WB-112b
C3ABR25130-2-WB-112b

METAR

OBJECTIVE

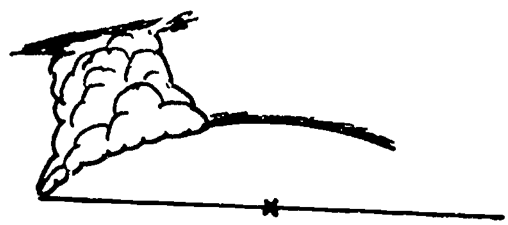
Given the FMH-1B and weather scenarios, encode 2 one-hourly observations in Metar Code on an AWS Form 10a to a minimum of 80% accuracy.

PROCEDURE

Using the FMH-1B and the information given in each problem, make the appropriate entries as directed by the instructor.

Supersedes C3ABR25130-0-WB-112b, C3ABR25130-2-WB-112b, 22 February 1983.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 900; DAV - 1

SKY CONDITION



3/8 CB is at a measured 3,200'.

1/8 ST is at an estimated 3,200'.

All clouds are moving to the southeast.

VISIBILITY

The prevailing visibility is .7 miles. The FMN-1 on Runway 27 reads 4,500 feet.

ATMOSPHERIC PHENOMENA

The wind is picking up sand and has been blowing it to a height of 12 feet in the past hour.

TEMPERATURE

Temperature: 83.7 degrees F.
Dew Point: 69.6 degrees F.

WIND

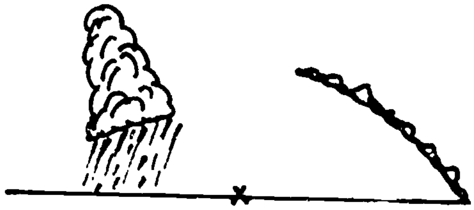
75 degrees at 30 knots with a peak speed of 38 knots.

PRESSURE

Observed pressure: 28.885
Correction: +.005

This observation was completed at 0656Z.

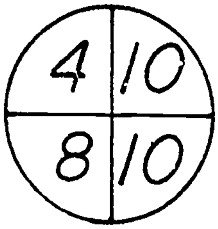
SKY CONDITION



2/8 TCU is at a measured 1,5 0'.

3/8 SC is at a measured 2,70(. This layer has varied to 2/8 during the period of observation.

VISIBILITY



ATMOSPHERIC PHENOMENA

Rainshowers of unknown intensity are falling to the west of the station. Haze is also present.

TEMPERATURE

Temperature: 50.0 degrees F.
Dew Point: 46.7 degrees F.

WIND

The wind direction is varying from 100 to 160 degrees during the period of observation. The 10-minute average wind speed is 10 knots with peaks of 14 knots.

PRESSURE

Observed pressure: 30.005
Correction: -.010

This observation was completed at 0758Z.

SKY CONDITION

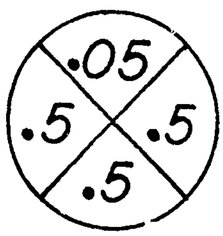
2/8 FOG hides the sky.

1/8 STFRA is measured at 300'.

2/8 ST is at a measured 2,800'. This layer has varied to 1/8 during the period of observation.

2/8 ACCAS, 1/8 visible, is a 8,600' as reported by a pilc .

VISIBILITY



The tower reports .05 miles visibility. The FMN-1 on Runway 35 Left reads 3,400'.

ATMOSPHERIC PHENOMENA

Fog is present at the station and is becoming thicker.

TEMPERATURE

Temperature: 46.1 degrees F.
Dew Point: 44.4 degrees F.

WIND

4 degrees at 3 knots.

PRESSURE

Observed pressure: 29.01(
Correction: -.005

This observation was completed at 0458Z.

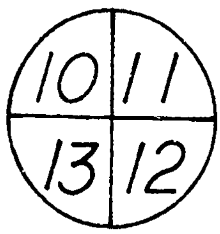
SKY CONDITION

1/8 CU is at 4,000'.

4/8 CS (3/8 thin) is at 27,000', estimated.

3/8 CC is at 30,000', estimated.

VISIBILITY



ATMOSPHERIC PHENOMENA
None

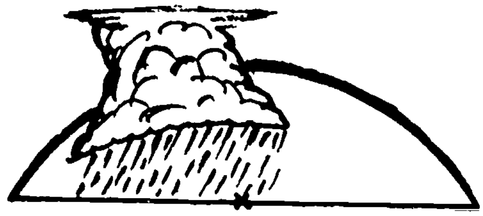
TEMPERATURE
Temperature: 9.2 degrees F.
Dew Point: 5.8 degrees F.

WIND
85 degrees at 17 knots with gusts to 23 knots.

PRESSURE
Observed pressure: 29.995
Correction: Zero

This observation was completed at 0857Z.

SKY CONDITION

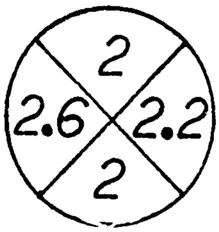


4/8 CB is at 4,500', measured.

4/8 AS is at 7,500', measured.

All clouds are moving towards the southwest.

VISIBILITY



ATMOSPHERIC PHENOMENA

Thunder is heard to the west of the station. Rainshowers of moderate intensity are occurring with 1/2 inch hail.

TEMPERATURE

Temperature: 82.3 degrees F.
Dew Point: 80.0 degrees F.

WIND

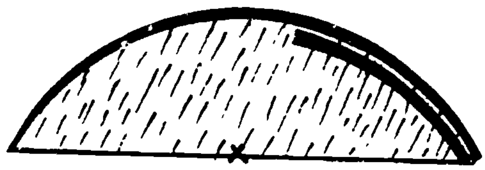
315 degrees at 16 knots gusting to 26 knots.

PRESSURE

Observed pressure: 29.560
Correction: +.005

This observation was completed at 0655Z.

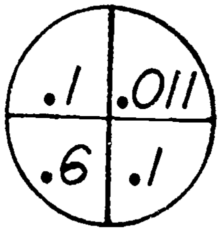
SKY CONDITION



3/8 STFRA is at 875', estimated.

5/8 NS is at 920', estimated.

VISIBILITY



The FMN-1 on Runway 22 is inoperative.

ATMOSPHERIC PHENOMENA

Drizzle is falling from the Nimbostratus.

TEMPERATURE

Temperature: 52.1 degrees F.
Dew Point: 50.1 degrees F.

WIND

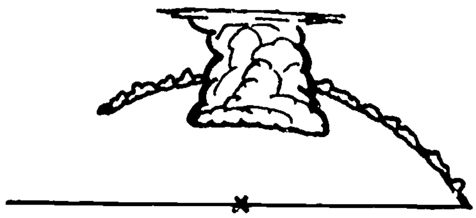
270 degrees at 10 knots.

PRESSURE

Observed Aneriod: 29.660
Correction: +.010

This observation was completed at 0257Z.

SKY CONDITION

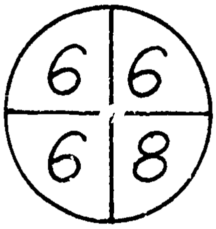


2/8 CB is at an estimated 3,000'.

4/8 AC is at an estimated 8,300'.

All clouds are moving towards the southeast.

VISIBILITY



ATMOSPHERIC PHENOMENA

Rainshowers occurred 2 minutes ago, but are not occurring at the time of observation. Haze is also present.

TEMPERATURE

Temperature: 84.9 degrees F.
Dew Point: 69.9 degrees F.

WIND

The 10-minute average wind direction and speed is 315 degrees at 14 knots.

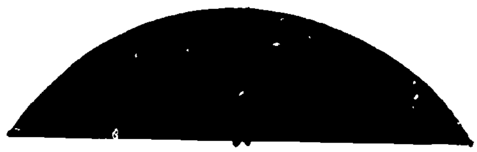
PRESSURE

Observed pressure: 29.210
Correction: -.010

This observation was completed at 1856Z.

SKY CONDITION

8/8 FOG hides the sky. The vertical visibility is 200'.



VISIBILITY

The prevailing visibility has varied from .25 to .5 to .3 to .1 miles. The FMN-1 on Runway 02 reads 1,400'.

ATMOSPHERIC PHENOMENA

Fog is present and is becoming thicker.

TEMPERATURE

Temperature: 36.8 degrees F.
Dew Point: 34.1 degrees F.

WIND

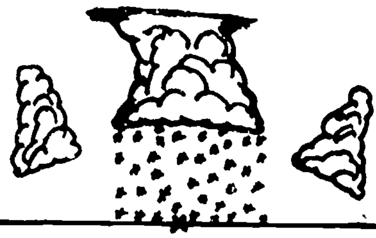
7 degrees at 3 knots.

PRESSURE

The station pressure is estimated 29.120.

This observation was completed at 2358Z.

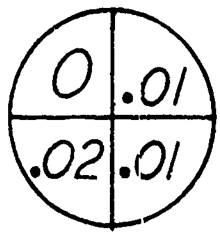
SKY CONDITION



3/8 TCU are to the west and the east of the station at 4,000', estimated.

3/8 CB is overhead at a measured 5,000'.

VISIBILITY



The FM -1 on Runway 22 reads less than 1,000'

ATMOSPHERIC PHENOMENA

Snow is falling at the station.

TEMPERATURE

Temperature: 34.2 degrees F.
Dew Point: 29.9 degrees F.

WIND

The wind direction and speed is 210 degrees at 15 knots with gusts to 24 knots.

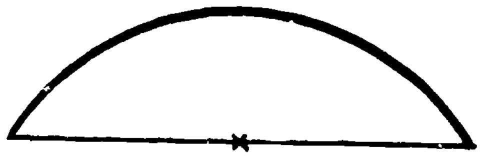
PRESSURE

Observed pressure: 30.005
Correction: -.010

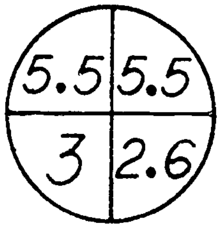
This observation was completed at 0456Z.

SKY CONDITION

8/8 AS (6/8 thin) is at an estimated 8,400'.



VISIBILITY



ATMOSPHERIC PHENOMENA

Patches of fog, more than 6 feet in depth, are present.

TEMPERATURE

Temperature: 51.2 degrees F.
Dew Point: 50.5 degrees F.

WIND

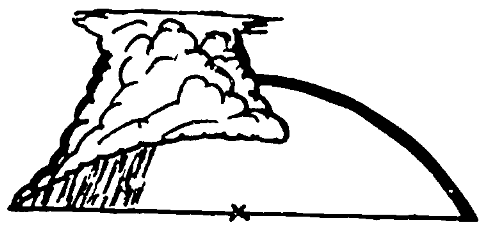
Calm

PRESSURE

Observed pressure: 29.265
Correction: -.005

This observation was completed at 1256Z.

SKY CONDITION

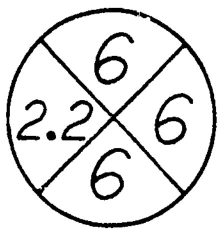


5/8 CB is at 3,100', measured.

3/8 AS is at 9,700', estimated.

All clouds are moving towards the northeast.

VISIBILITY



ATMOSPHERIC PHENOMENA

Thunder was last heard to the west of the station 10 minutes ago. Frequent lightning in the cloud and from the cloud to clouds is observed to the west. Heavy rainshowers were falling 6 minutes ago, but have stopped. Rainshowers of unknown intensity are now observed to the southwest.

TEMPERATURE

Temperature: 72.1 degrees F.
Dew Point: 69.6 degrees F.

WIND

240 degrees at 13 knots with gusts to 24 knots.

PRESSURE

Observed pressure: 28.995
Correction: -.010

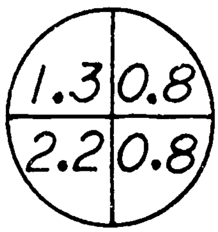
This observation was completed at 1957Z.

SKY CONDITION

2/8 FOG hides the sky.

5/8 ST is visible in all quadrants. Heights have been varying from 400' to 600' to 200' to 300'. There is a break in this layer to the east. (RBC).

VISIBILITY



The FMN-1 on Runway 08 reads 6,000'.

ATMOSPHERIC PHENOMENA

Fog, which has shown no change, is present. Drizzle is falling and freezing on contact with the ground. The drizzle has also been varying to moderate during the period of observation.

TEMPERATURE

Temperature: 33.1 degrees F.
Dew Point: 32.6 degrees F.

WIND

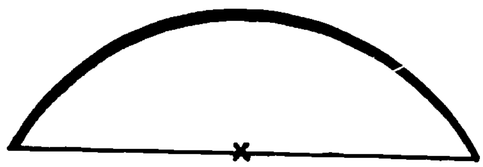
345 degrees at 6 knots.

PRESSURE

Observed pressure: 28.775
Correction: -.005

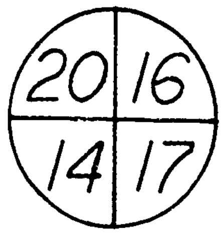
This observation was completed at 0458Z.

SKY CONDITION



8/8 CS is at 32,000', estimated. This layer has varied to 7/8 coverage during the period of observation.

VISIBILITY



ATMOSPHERIC PHENOMENA

Smoke is present.

TEMPERATURE

Temperature: -15.3 degrees F.
Dew Point: -25.3 degrees F.

WIND

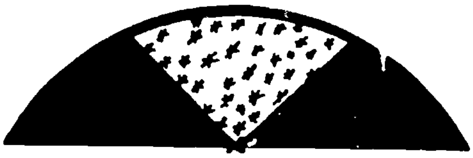
The winds are from 255 decrees at an average speed of 16 knots, estimated.

PRESSURE

Observed pressure: 29.345
Correction: +.005

This observation was completed at 0355Z.

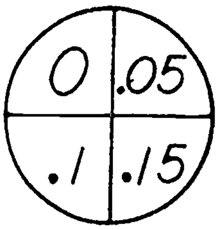
SKY CONDITION



SNOW hides 5/8 of the sky.

3/8 ST is visil   at 2,500', measured.

VISIBILITY



This station does not have the capability of determining Runway Visual Range.

ATMOSPHERIC PHENOMENA

Snow is occurring at the station. It has stopped and restarted twice within the last hour.

TEMPERATURE

Temperature: 30.6 degrees F.
Dew Point: 28.7 degrees F.

WIND

175 degrees at 6 knots.

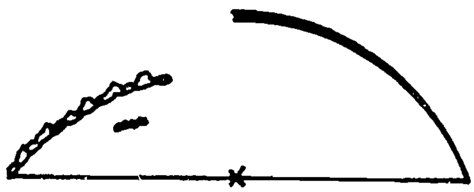
PRESSURE

The station pressure is 29.135.

This observation was completed at 0158Z.

1721

SKY CONDITION

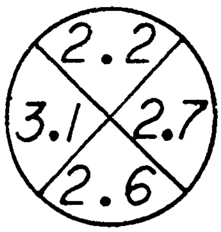


A Trace of CUFRA is at 700'.

3/8 AC is estimated to be at 7,700'.

4/8 CS is estimated to be at 22,000'.

VISIBILITY



ATMOSPHERIC PHENOMENA

Haze and smoke are present with the haze being predominant.

TEMPERATURE

Temperature: 41.8 degrees F.
Dew Point: 34.6 degrees F.

WIND

340 degrees at 11 knots with maximum peaks of 27 knots

PRESSURE

Observed pressure: 28.'75
Correction: Zero

This observation was completed at 2255Z.

Weather Observer Branch
Chanute AFB, Illinois 61868-5000

C3ABR25130 000-WB-112c/d
C3ABR25130 002-WB-112c/d
8 November 1984

PIREP CODE

OBJECTIVES

Given the study guide and necessary information, encode 2 pilot reports in PIREP Code on an AWS Form 12 to a minimum of 80% accuracy.

Given the study guide, decode 2 pilot reports from the PIREP Code into plain language on an AWS Form 12 to a minimum of 80% accuracy.

PROCEDURE

Using the study guide, complete exercises 1 through 3. After you have completed these exercises, have your instructor check your work.

Supersedes C3ABR25130 000-WB-112c/d, undated.
OPR. 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 600; DAV - 1

Designed for ATC Course Use. Do Not Use on the Job.

Exercise 1

1. In the pirep code, iii represents the three-letter ____________ of the station which transmits the pilot report by longline.

2. The indicator _____ is used for regular pireps and the indicator UUA is used for those pireps classified as __________.

3. In the pirep code, /OV indicates that the __________, __________ and __________ will follow.

4. Pireps classified as severe will contain any of the following hazardous phenomena:

   a. ____________________.
   b. ____________________.
   c. ____________________.
   d. ____________________.

5. In the pirep code, /TP indicates the _____ _____ _______ _____ will follow.

6. In the pirep code, /TA indicates that the _____ ________ _____ will follow.

7. The heights of the bases and tops of cloud layers are reported in __________ above MSL, in three digits.

8. When UNK is reported, the sky cover is __________.

9. Temperature will be reported in __________ __________ Celsius.

10. The /SK in the pirep indicates information for cloud __________, __________ and __________.

11. The term "CAT" is encoded in the pirep for _____ _____ __________.

12. The /WV is the indicator for wind __________ and __________.

13. The intensities which may be reported for turbulence are __________, __________, __________, __________ and _____ _____.

14. The altitude of a turbulence layer with an undefined lower limit will be reported as __________.

15. The last three digits of the wind group are for the wind ________.

16. All height values of the turbulence altitude are reported in ________ _____ ________ above MSL.

17. /IC is the indicator for the icing ________, ________ and ________.

18. The three types of icing which may be reported are ________, ________ and ________.

19. The term "CONTRAILS" will be reported for ________ ________.

20. Altitude for icing will be reported in accordance with the instructions for reporting the altitude of ________ ________.

21. Remarks will follow the indicator _____.

22. The intensities which may be used to report icing are ________, ________, ________, ________ and ________.

Exercise 2

Using the study guide and the location identifier (Table 1), decode the following pireps. Make appropriate entries on the AWS Form 12.

1. CMI UA /OV RAN 090020 1625 FL 080/TP F-4/SK 030 OVC 080/ TA 03/TB MDT-SVR 060-070/RM H LYR 100

2. NUQ UA /OV NUW-NUQ 1835 FL UNK/TP P-3/SK 120 SCT 140/TA -03/RM DURGD

3. FWH UA /OV RNO 020045-FWH 180015 1745 FL 095/TP UNK/SK 010 OVC 035/050 OVC 075/TA 07/RM LN TSTMS N-E

4. LCK UA /OV FFO 2030 FL 100/TP KC-135/TA 04/WV 350080/TB MDT 040-100

5. NZJ UA /OV NUQ-NZJ 2145 FL 025/TP UH-1/SK OVC/TA -03/WV 350020/IC NEG

6. TUL UA /OV FWH 180075 2233 FL 200/TP C-5A/SK 090 OVC 150/ TA -2[illegible]/WV 290090/TB MDT 100-160/IC MDT RIME 100-150

Exercise 3

Using the study guide and the location identifier (Table 1), encode the following information in pirep code. Make appropriate entries on the AWS Form 12.

1. Location of Aircraft - Over Little Rock AFB, Arkansas
   Time of Observation - 1830Z
   Flight Altitude - 18,000' MSL
   Type of Aircraft - KC-135
   Sky Condition - Overcast layer, bases at 10,000' and tops at 14,000'
   Air Temperature - Minus (-) 4 degrees Celsius

2. Location of Aircraft - 45 miles north of NAS Pensacola, Florida
   Time of Observation - 2032Z
   Flight Altitude - 15,000' MSL
   Type of Aircraft - C-130
   Sky Condition - Broken layer, bases at 7,000' and tops at 9,500'; Overcast layer, bases at 12,000' and tops at 14,000'

3. Location of Aircraft - Over Carswell AFB, Texas
   Time of Observation - 0540Z
   Flight Altitude - 10,000' MSL
   Type of Aircraft - B-52
   Sky Condition - Clear
   Air Temperature - Minus (-) 12 degrees Celsius
   Wind at Flight Level - West/Northwest at 125 knots
   Remarks - Phenomena observed during climb

4. Location of Aircraft - Between Wright-Patterson AFB, Ohio and Offutt AFB, Nebraska
   Time of Observation - 0830Z
   Flight Altitude - 21,000' MSL
   Type of Aircraft - F-4
   Sky Condition - Overcast layer, bases at 13,000' and tops at 18,000'
   Turbulence - Moderate from 15,000' to 18,000'

5. Location of Aircraft - Over MCAS Cherry Point, North Carolina
   Time of Observation - 1450Z
   Flight Altitude - 27,000' MSL
   Type of Aircraft - AV-8A
   Sky Condition - Overcast layer, bases at 8,000' and tops at 15,000'
   Air Temperature - Minus (-) 32 degrees Celsius
   Icing - Light rime between 12,000' and 15,000'

6. Location of Aircraft - Over McChord AFB, Washington
Time of Observation - 1545Z
Flight Altitude - 21,000' MSL
Type of Aircraft - KC-135
Sky Condition - Overcast layer, bases at 4,000' and tops at 9,000'; Overcast layer, bases at 11,000' and tops at 14,000'
Air Temperature - Minus (-) 18 degrees Celsius
Wind at Flight Level - North/Northwest at 85 knots
Turbulence - Moderate from 18,000' to 20,000'
Icing - Light to Moderate rime from 10,000' to 11,000'

Table 1

Location Identifiers

CMI - Champaign, Illinois

FFO - Wright-Patterson AFB, Ohio

FWH - Carswell AFB, Texas

LCK - Rickenbacker AFB, Ohio

LRF - Little Rock AFB, Arkansas

NKT - MCAS Cherry Point, North Carolina

NPA - NAS Pensacola, Florida

NUQ - Moffett Field, California

NUW - Whidbey Island, Washington

NZJ - MCAS El Toro, California

OFF - Offutt AFB, Nebraska

RAN - Chanute AFB, Illinois

RNO - Reno, Nevada

TCM - McChord AFB, Washington

TUL - Tulsa, Oklahoma

WORKBOOK
C3ABR25130-WB-201

Technical Training

Weather Specialist

WEATHER CODES

31 January 1983

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE
DO NOT USE ON THE JOB

RGL: N/A

1728

1. Surface Charts

a. Using Airways reports, Airways Code Plotting Guide, and the appropriate plotting chart, plot 40 stations within 30 minutes with no more than five errors in the ten stations graded. STS: 11a(1), 11b(1) CTS: 3c(1), 3d(1) Meas: P

(1) Hourly sequence

(2) Three hourly sequence

(3) Six hourly sequence

b. Using land synoptic reports, land synoptic plotting guide, and the appropriate plotting chart, plot 30 stations within 20 minutes with no more than five errors in the ten stations graded. STS: 11a(2), 11b(2) CTS: 3c(2), 3d(2) Meas: P

c. Using shipboard synoptic reports, shipboard synoptic plotting guide, and the appropriate plotting chart, plot 25 stations within 30 minutes with no more than five errors in the ten stations graded. STS: 11a(2), 11b(2) CTS: 3c(4), 3d(3) Meas: P

2. Upper Atmospheric Charts and Diagrams

a. Using Parts A and B of the Rawinsonde message and Part B of the Upper Winds message, plot one DOD-WPC-9-16, Skew-T Log P diagram to include height values for mandatory levels, temperature curve, dew point temperature curve and wind data for all levels up to and including the 100 millibar level within 20 minutes and no more than 5 errors. STS: 11a(6), 11b(5) CTS: 3c(8), 3c(5) Meas: P

b. Using Part A of the Rawinsonde message and the appropriate plotting chart, plot constant pressure data to include height, temperature, dew point depression, and wind data. A minimum of 25 stations must be plotted within 10 minutes with no more than 5 errors in the ten stations graded. STS: 11a(6), 11b(3) CTS: 3c(8), 3d(4) Meas: P

OPR: 3350 TCHTC
DISTRIBUTION: X
3350 TCHTC/TTGU-W - 400; DAV - 1 1729

AIRWAYS REPORTS

Exercise 1

SAUM 9 KAWN 1311ØØ

AREA Ø8
END SA 1Ø55 M22 BKN 32 BKN 1ØØ BKN 25Ø OVC 1Ø Ø56/66/55/Ø7Ø8/
973;
FWH SA 1Ø55 15 SCT 7Ø SCT 12 Ø83/7Ø/63/19Ø5/98Ø;
LTS SA 1Ø55 CLR 7 Ø38/64/58/12Ø2/969;
SPS SA 1Ø52 CLR 1Ø Ø39/71/64/1918/969;
TIK SA 1Ø55 2Ø SCT 25Ø SCT 1Ø Ø45/66/62/181Ø/97Ø;

AREA Ø9
DYS SA 1Ø55 CLR 12 Ø6Ø/67/6Ø/2116G24/977/WND 16V25;

AREA 11
AEX SA 1Ø56 CLR 3F 154/58/54/ØØØØ/988;
BAD SA 1Ø55 11 SCT 25Ø SCT 7 133/6Ø/59/15Ø2/992;
BYH SA 1Ø55 12Ø SCT 25Ø -BKN 7 151/6Ø/5Ø/15Ø6/998;
CBM SA 1Ø55 CLR 7 182/53/44/ØØØØ/ØØ7;
LRF SA 1Ø55 5Ø SCT E2ØØ OVC 6F 131/63/59/15Ø4/993;
NMM SA 1Ø55 CLR 7 176/47/43/ØØØØ/ØØ9;

AREA 13
MXF SA 1Ø55 CLR 7 188/53/47/Ø7Ø4/ØØ9;
OZR SA 1Ø55 CLR 7 184/57/52/ØØØØ/ØØ8;

SAUS 6 KAWN 1311ØØ
CMI SA 1Ø49 E35 OVC 3H 51/47/Ø8Ø8/ØØ3;
MLI SA 1Ø58 M31 OVC 8 161/49/41/Ø811/ØØ1;
PIA SA 1Ø59 25 SCT M44 BKN 25Ø OVC 8 162/5Ø/45/Ø91Ø/ØØ1;

SAUS 7 KAWN 1311ØØ
ACT SA 1Ø57 M16 OVC 1Ø 1Ø7/71/64/1914/986/BINOVC;
LFK SA 1Ø5Ø 1Ø SCT 3F 135/63/6Ø/17Ø5/994;
PRX SA 1Ø48 E9 OVC 7 61/M/1812/985;
TYR SA 1Ø49 M9 OVC 7 7Ø/M/2Ø15/988;

SAUS 8 KAWN 1311ØØ
BMG SA 1Ø47 1ØØ SCT 2F M/M/11Ø6/ØØ9/VSBY S1;
CAK SA 1Ø55 E12Ø BKN 25Ø BKN 1Ø 185/47/37/22Ø6/ØØ7;
CHA SA 1Ø51 CLR 6GF 191/46/43/ØØØØ/Ø1Ø/FEW CI;
FDY SA 1Ø55 E5Ø BKN 1ØØ BKN 1Ø 188/44/38/28Ø6/ØØ8;
LOZ RS 1Ø52 -X 25Ø -BKN 3F 2ØØ/42/39/ØØØØ/Ø11/F2;
MEM SA 1Ø55 25Ø -OVC 15 156/61/5Ø/15Ø6/ØØØ;

SAUS 9 KAWN 1311ØØ
FSM RS 1Ø52 M28 OVC 15 1Ø6/65/58/Ø2Ø9/986;
GLH SA 1Ø46 2ØØ SCT 7 59/52/18Ø5/ØØ4;
MCB SA 1Ø54 CLR 1/2F 174/54/53/ØØØØ/ØØ5;

Exercise 2

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SAUM 9 KAWN 2615ØØ

AREA Ø6
VOK SA 1455 6 SCT E12 OVC 1Ø 139/63/57/32Ø7/993/ 1Ø7;

AREA Ø7
FRI SA 1455 25 -SCT 7 125/67/6Ø/ØØØØ/991/ ØØ2 11ØØ;
IAB SA 1455 15 SCT 7 117/69/58/ØØØØ/99Ø/ 1Ø5 15ØØ;
NBU SA 1456 12Ø SCT 2ØØ -BKN 12 134/67/54/1ØØ6/992/ 3Ø5 1Ø32;
OFF SA 1455 CLR 12 13Ø/66/54/Ø2Ø6G1Ø/993/ 1Ø3;

AREA 1Ø
BLV SA 1455 2Ø SCT E4Ø BKN 8Ø OVC 6R-F 125/65/62/Ø2Ø4/991/
    ØØ3 152/ WR//;
GVW SA 1457 25Ø SCT 1Ø 124/73/61/34Ø1/992/ 1Ø5 1ØØ1;
HOP SA 1455 E4Ø BKN 8Ø OVC 5H 1Ø9/72/66/16Ø4/986/ 6Ø2 157/;
TBN SA 1455 8Ø SCT E12Ø OVC 7 E114/66/58/Ø6Ø5/987/ 8Ø3 1Ø7/;

AREA 12
FFO SA 1455 3Ø SCT E1ØØ OVC 5H 147/67/59/19Ø3/998/WND LGT AND
    VRBL/ 3Ø5 157/;
FTK SA 1455 3Ø SCT E2ØØ OVC 7 E13Ø/69/66/11Ø5/993/ 8Ø2 12Ø7;
GUS SA 1455 45 SCT E6Ø BKN 9Ø OVC 7 135/7Ø/59/16Ø4/994/CIG
    RGD/ 3Ø2 158Ø;
LCK SA 1455 4Ø SCT E75 OVC 7 154/67/6Ø/12Ø2/998/ 1Ø8 157/;
MTC SA 1455 8Ø SCT E15Ø BKN 25Ø BKN 15 126/72/58/26Ø4/991/
    1Ø2 1Ø78;

SAUS 5 KAWN 2615ØØ
ATY SA 1457 E6 OVC 7 146/55/52/35Ø6/995/ 1Ø3;
FRM SA 1448 E2Ø OVC 7 59/52/ØØØØ/993/CIG RGD;
GRR SA 1455 4Ø SCT E25Ø BKN 15 132/67/53/33Ø7/993/ 1Ø7 15Ø8;
MBL SA 1445 15 SCT E35 OVC 15 59/52/24Ø5/992/BINOVC;
MHE SA 1455 15 SCT E25 OVC 15 6Ø/54/32Ø5/996;
MSP RS 1454 M9V OVC 4F 137/58/53/34Ø3/993/CIG 6V12 WND DRCTN
    VRBL/ 1Ø7ØØ 15//;

SAUS 6 KAWN 2615ØØ
ALO SA 1454 M65 BKN 12 13Ø/65/55/Ø3Ø4/992/ 6Ø3 1Ø7Ø;
BBW SA 1447 E1ØØ OVC 15 129/58/52/Ø9Ø8/995/ 3Ø3 1Ø7/;
COU SA 1451 6Ø SCT E25Ø OVC 15 12Ø/71/6Ø/Ø5Ø3/99Ø/ ØØØ 14Ø7;
DDC SA 1455 M75 BKN 1Ø 118/68/62/2ØØ6/994/ 3Ø5ØØ 1Ø7Ø;
DSM SA 1449 CLR 15 124/68/56/361Ø/991/FEW AC NE/ 1Ø7 1Ø7Ø;
HSI SA 1452 E8Ø BKN 25Ø BKN 12 142/64/54/Ø71Ø/977/FEW CU W/
    1Ø7 1278;
IRK SA 1445 1ØØ SCT 7 123/71/62/3ØØ6/989/ 4ØØ;
JLN SA 145Ø 25Ø -SCT 12 121/68/6Ø/Ø3Ø7/99Ø/ 1Ø5;
RSL SA 145Ø 15Ø -SCT 15 123/71/62/23Ø5/994/LN AC NW-N FEW SC
    N-NE/ 2Ø8;
SUX SA 1453 M21 OVC 3Ø 145/59/5Ø/34Ø8/996/ 3Ø7 15//;
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1731

Exercise 3

SAUM 9 KAWN 1512ØØ

AREA Ø6
VOK SA 115Ø 12Ø SCT E25Ø BKN 7 126/47/33/31Ø6/989/ 21Ø 1Ø78
43 2ØØØ9;

AREA Ø7
FRI SA 1155 25Ø -SCT 1Ø 157/43/41/ØØØØ/Ø6Ø/ 5ØØ 1ØØ1;
IAB SA 1155 25Ø -SCT 1Ø 155/51/39/17Ø4/999/ 1Ø5 1ØØ4;
NBU SA 1155 E6Ø BKN 2ØØ BKN 5F 127/48/44/28Ø7/989/ 31ØØ2 15Ø8
45 2ØØ6Ø;
OFF SA 1155 18Ø SCT 25Ø -SCT 15 15Ø/47/39/ØØØØ/998/PTCHY GF
E-SE AND NW-N/ 3Ø2 1ØØ8;

AREA Ø8
END SA 1155 2ØØ SCT 1Ø 149/52/4Ø/13Ø5/999/ 8Ø2 1ØØ8;
LTS SA 1155 4Ø SCT E8Ø BKN 25 154/57/45/14Ø4/ØØ1/ 5ØØ 157Ø;
TIK SA RTD 1155 1ØØ SCT 25Ø SCT 7 166/52/45/18Ø8/ØØ3/ ØØ7
1Ø71;

AREA 1Ø
BLV SA 1155 4Ø SCT 25Ø SCT 7 159/44/38/23Ø2/999/ 212 11Ø2
2ØØØ8;
GVW SA 1148 CLR 7 52/45/3ØØ3/ØØ1/ 51;
HOP SA 1155 M15 OVC 7 131/51/45/32Ø7/991/CIG RGD/ 314ØØ 15//
2ØØØ2 WR//;
TBN SA COR 1155 CLR 7 169/42/39/24Ø2/ØØ3/ 3Ø5 FIRST;

AREA 11
BYH SA 1155 4Ø SCT 7 162/5Ø/42/35Ø8/ØØ1/ 214 15ØØ;
LRF SA 1155 CLR 7 183/47/44/ØØØØ/ØØ7/ 314;

AREA 12
FFO SA 1155 7 SCT M9 OVC 3F Ø64/51/44/22Ø8/972/ 212Ø1 15//
2Ø141 WR//;
FTK SA 1155 E9 BKN 11 OVC 1Ø 1Ø9/49/44/29Ø8/985/WND 25V31
CIG RGD/ 22Ø// 15//;
GUS RS 1155 M15 OVC 6R-F 1Ø1/45/42/341Ø/982/CIG RGD PCPN VRY
LGT/ 322Ø6 15// 2ØØ6Ø WR//;
LCK SA 1155 M8 BKN 2Ø OVC 7R- Ø71/52/47/21Ø8/972/ 312Ø1 17//
2ØØ86 WR//;
MTC RS 1155 5 SCT M15 OVC 13/4R-F Ø73/46/44/35Ø9/975/ 3Ø712
18// 2ØØ41 WR//;

SAUS 5 KAWN 1512ØØ
ATY SA 1155 15Ø SCT 25Ø SCT 1Ø 136/44/27/ØØØØ/993/ 5ØØ 4Ø;
FRM SA 1156 CLR 12 143/46/32/28Ø7/994/FEW AC NE/ 3Ø7 1Ø31
39;
GRR SA 1155 M5Ø OVC 15 Ø99/5Ø/39/35Ø9/982/ 3Ø8 15// 46 2ØØ1Ø;
MBL SA 1158 3Ø SCT E8Ø BKN 15Ø OVC 15 119/45/34/Ø9Ø5/987/ 214
41;
MHE SA 1158 CLR 1Ø 48/39/12Ø4/993;

SAUS 5 KAWN 1512ØØ
MSP SA 1153 CLR 2Ø 144/44/37/ØØØØ/995/ 3Ø7 39;

SAUS 6 KAWN 1512ØØ
ALO SA 1151 CLR 15 155/45/36/3ØØ5/998/ 31Ø 43;
BBW SA 1142 8Ø SCT 1Ø 5Ø/38/1716/989;
CMI SA 115Ø E9Ø BKN 15Ø BKN 7 47/43/3318/991;
COU SA 115Ø CLR 15 165/4Ø/29/21Ø5/ØØ1/ 3Ø3 39 2ØØ34;
DDC SA 1155 1ØØ SCT 25Ø -BKN 2Ø 112/49/42/1614/99Ø/ 619 1Ø71
48 RADAT 6Ø123;
DSM SA 1154 CLR 8 151/46/42/ØØØØ/998/ 1Ø7 43;
HSI SA 1148 25Ø -SCT 1Ø 47/39/15Ø7/993;
IRK RS 1154 CLR 7 159/45/4Ø/25Ø9/ØØØ/ 3Ø3 41 2Ø158;
JLN SA 1156 CLR 7 167/46/4Ø/2ØØ3/ØØ3/ 3Ø3 45;
MLI SA 1153 CLR 7 145/42/4Ø/25Ø4/995/ 215 39 2ØØ44;
PIA SA 1159 2ØØ -SCT 1Ø 147/48/43/29Ø9/996/ 312 1ØØ1 43 2ØØ66
RADAT 65Ø64;
RSL SA 1158 CLR 15 135/51/41/1614/995/ 71Ø 49;
SUX SA 1155 CLR 15 146/45/33/12Ø5/996/ 4ØØ 42;

SAUS 8 KAWN 1512ØØ
BMG SA 1145 8 SCT E15 OVC 6L-F M/M/351Ø/985;
CAK SA 1155 1Ø SCT E3Ø OVC 3RW-F Ø85/57/5Ø/2Ø11/971/RB4Ø PCPN
VRY LGT/ 2Ø7ØØ 15// 54 2ØØ44;
CHA SA 1151 3Ø SCT M41 BKN 15 114/55/42/3Ø12/988/ 314 15ØØ 54
2ØØ22;
FDY SA 1155 E4 OVC 11/2F Ø63/47/47/Ø2Ø8/971/RB46/ 21Ø18 47
2ØØ71;
LOZ SA 1155 E9 BKN 15 OVC 7 1Ø3/5Ø/45/21Ø8/984/ 317 5Ø 2ØØ48;
MEM SA 1155 CLR 15 167/51/45/361Ø/ØØ3/ 312 5Ø 2ØØØ3;

SAUS 9 KAWN 1512ØØ
FSM SA 1154 CLR 4F 19Ø/44/42/ØØØØ/ØØ9/ 317 43;

Exercise 4

SAUM 9 KAWN 1412ØØ

AREA Ø7
FRI SA 1155 28 SCT 25Ø SCT 1Ø 156/47/4Ø/32Ø2/999/ 2Ø8 1Ø51
2ØØ2Ø;
IAB SA 1155 5Ø SCT 7 159/49/36/341Ø/999/ 1Ø7 15ØØ;
OFF SA COR 1155 25Ø SCT 1Ø 15Ø/5Ø/41/ØØØØ/997/ 4ØØ 1ØØ1
2ØØ18;

AREA Ø8
END SA 1155 CLR 2Ø 175/47/38/3ØØ7/ØØ5/ 3Ø7;
FWH SA 1155 5Ø SCT 28Ø SCT 1Ø 177/54/48/3412/ØØ8/ 112 14Ø8;
LTS SA COR 1155 4Ø SCT 1ØØ SCT 15 191/49/4Ø/31Ø4/Ø11/CB DSIPTD
TCU E VIRGA SE/ 2Ø8 147Ø;
SPS SA 1156 3Ø SCT 8Ø SCT 1Ø 192/47/44/32Ø9/Ø11/TCU NE-S
RBØ7E19/ 214ØØ 127Ø 4Ø;
TIK SA 1155 3Ø SCT 7 179/48/41/33Ø8/ØØ6/TCU S/ 112 12ØØ;

AREA Ø9
DYS SA 1155 8Ø SCT 15 19Ø/49/42/Ø1Ø6/Ø12/ 31Ø 1Ø7Ø;

AREA 1Ø
BLV SA 1155 3 SCT M1Ø BKN 23 OVC 7 Ø4Ø/59/56/221ØG16/965/
61ØØ3 15// 2ØØ35 WR//;
GVW SA 1149 12 SCT E1ØØ BKN 4F 54/47/3315/987/ ///88 ONE
2Ø258 54;
HOP SA 1155 E3Ø BKN 4Ø BKN 8Ø OVC 4F Ø68/62/59/2ØØ2/972/
227Ø4 152/ 2ØØØ4 WR//;
TBN SA 1155 M6 OVC 7 Ø58/51/47/2612G2Ø/97Ø/CIG RGD WND 22V29/
714// 15// 2Ø143 FIRST:

AREA 11
AEX SA RTD 1159 M11 BKN 5Ø OVC 7 133/63/58/25Ø2/992/ 31435
15// 2ØØ35 RCRNR;
BAD SA 1155 M23 BKN 1Ø 138/59/55/31Ø7/994/PRESRR/ 327Ø2 15ØØ
2ØØ64;
BYH SA 1155 5 SCT M1Ø BKN 24 OVC 5L-F Ø73/63/59/2511/975/
3Ø234 15// 2Ø112 WR//;
CBM SA 1155 M25 BKN 55 BKN 9Ø OVC 7 1Ø1/64/57/15Ø5/984/ 822Ø9
152/ 64 2ØØØ9 WR//;
LRF SA 1155 15 SCT M28 BKN 7 1Ø9/6Ø/53/2813G24/986/BKN V SCT/
217ØØ 15ØØ 2ØØ65;
NMM RS 1158 25 SCT E4Ø OVC 3R-F 133/63/6Ø/15Ø3/997/ 2Ø8Ø3
15// 63 2ØØØ2 CAWW TIL 123Ø;

AREA 12
FFO SA 1155 E45 BKN 8Ø OVC 5RW-F Ø9Ø/52/45/Ø9Ø8/98Ø/CIG RGD/
83616 15// WR//;
FTK SA 1155 3Ø SCT E6Ø BKN 1ØØ BKN 2ØØ OVC 12 Ø56/61/52/151Ø/
971/ 829// 1277 2ØØØ1 WR//;

Exercise 4 (Cont)

SAUM 9 KAWN 1412ØØ

AREA 12
GUS RS 1155 M7 OVC 3R-F Ø76/5Ø/49/Ø81Ø/975/TWR VSBY 3/4/
    63252 18// 2ØØ81 WR//;
LCK SA 1155 E4Ø BKN 8Ø BKN 7 113/56/44/Ø71Ø/985/ 117ØØ 157Ø;

AREA 13
MXF SA 1155 11Ø SCT E25Ø OVC 6F 156/58/53/ØØØØ/999/ 215 1Ø77;
OZR SA 1155 25Ø -OVC 6F 165/6Ø/57/ØØØØ/ØØ3/ 32Ø 1ØØ7;

SAUS 6 KAWN 1412ØØ
CMI SA 1147 -X M3 OVC 3/4L-F 55/55/1212/966/F7;
COU RS 1151 M7 OVC 4L-F Ø4Ø/49/47/3515/965/RB1ØE4Ø LB4Ø/
    5ØØ26 17// 49 2ØØ39;
DDC SA 1155 CLR 12 2Ø4/4Ø/39/3212/Ø12/ 2Ø7 39 RADAT 55Ø72;
DSM SA 1154 48 SCT 1ØØ OVC 4F 129/48/43/31Ø9/991/ 8Ø3Ø9
    122/ 48 2ØØ41;
HSI SA 1156 CLR 1Ø 44/35/321Ø/ØØ7;
IRK SA 1157 E45 OVC 3RW-F 12Ø/46/43/Ø116/989/ 3Ø327 46 2ØØ53;
JLN SA 1153 E15 OVC 6F 126/5Ø/45/2911/991/BINOVC/ 3Ø7 5Ø
    2Ø186;
PIA RS 1155 M5 OVC 1RF Ø55/48/46/Ø615G22/969/R3ØVR6Ø+ CIG RGD/
    71755 17// 48 2ØØ91 RADAT 79Ø97;
RSL SA 1155 CLR 15 188/41/38/3Ø1Ø/ØØ8/ 4ØØ 41 2ØØØ6 RADAT
    93ØØØ;

SAUS 7 KAWN 1412ØØ
ACT SA 1155 CLR 12 164/55/48/3613/ØØ3/ 314 55 2ØØØ7;
LFK SA 1147 M15 BKN 35 58/57/33Ø8/998/ /// 2ØØ12;
PRX RS 115Ø E11 BKN 25 OVC 7TRW- 135/7Ø/69/Ø2Ø6/993/T SW MOVG
    SE BINOVC N-NE RWU S/ 71922 68 2ØØ22;
TYR SA 115Ø 3Ø SCT 1Ø 179/53/47/321Ø/ØØ7/ 217 15ØØ 52;

SAUS 8 KAWN 1412ØØ
BMG SA 1146 E5Ø BKN 8Ø OVC 3R-F M/M/13Ø7/972;
CHA SA 1151 M75 BKN 25Ø BKN 15 132/55/5Ø/27Ø3/993/FEW CU W/
    1Ø3 1256 49;
LOZ SA 1153 E35 BKN 25Ø OVC 15 1Ø5/62/5Ø/18Ø4/986/ 612 54;
MEM SA 1155 M7 OVC 1ØRW- Ø86/65/61/21Ø8/979/RB3Ø/ 5ØØ53 17//
    65 2ØØ7Ø;

SAUS 9 KAWN 1412ØØ
FSM SA 1152 E2Ø OVC 15 143/53/45/271Ø/996/ 3Ø5 15// 53 2ØØØ9;
GLH SA 1154 E14 BKN 2Ø OVC 7 64/6Ø/211Ø/991;
MCB SA 1156 E3Ø OVC 5R-F 128/63/61/16Ø6/992/TE15 MOVD E/
    8Ø442 61 2ØØ42;

Exercise 5

SAUM 9 KAWN 2618ØØ

AREA Ø6
VOK SA 1756 E2Ø BKN 4Ø OVC 7 E138/67/56/32Ø4/994/ 1Ø3 15ØØ;

AREA Ø7
FRI SA 1755 35 SCT 12Ø SCT 25Ø SCT 1Ø 117/76/63/Ø2Ø3/989/ 7Ø7
    1138;
IAB SA 1755 25 SCT 25Ø SCT 1? 112/78/57/ØØØØ/989/ 7Ø3 11Ø1;
NBU SA 1757 5Ø SCT 12Ø SCT 2ØØ -BKN 15 134/7Ø/54/12Ø6/992/
    ØØØ 1132 62;
OFF SA 1756 4Ø SCT 25Ø SCT 15 127/71/55/Ø21Ø/992/WND 34VØ7/
    8Ø3 11Ø8;

AREA Ø8
END SA 1755 8Ø SCT 25Ø SCT 2Ø 1Ø8/83/57/Ø7Ø6/988/ 7Ø5 1Ø71;
FWH SA 1755 3Ø SCT 1ØØ SCT 25Ø SCT 8 Ø94/86/7Ø/13Ø6/984/ 8Ø8
    1178;
LTS SA 1757 25Ø SCT 2Ø Ø86/86/61/1Ø1Ø/983/ 712 1ØØ8;

SPS SA 1754 CLR 1Ø Ø87/87/66/Ø914/983/FEW CI/ 71Ø 1ØØ1 63;
TIK SA 1755 2Ø SCT 7 11Ø/8Ø/63/Ø6Ø3/989/ 8Ø3 11ØØ;

AREA Ø9
DYS SA 1755 25Ø -SCT 15 Ø68/9Ø/64/19Ø6/98Ø/ 8Ø8 1ØØ1;

AREA 1Ø
BLV SA 1755 2Ø SCT E45 BKN 8Ø OVC 7R- 117/68/6Ø/Ø6Ø2/988/
    7Ø812 152/ WR//;
GVW SA 1756 3Ø SCT 25Ø SCT 1Ø 123/78/57/33Ø2/992/ 8Ø2 11Ø1;
HOP SA 1755 9 SCT E17 BKN 25 OVC 212RW-F 1Ø1/68/64/15Ø9/984/
    8Ø7Ø9 15// WR//;
TBN SA 1755 5Ø SCT 12Ø SCT E25Ø OVC 7 E1Ø9/72/58/Ø4Ø9/986/
    8Ø5ØØ 1117;

AREA 11
AEX SA 1755 25 SCT 27Ø SCT 7 1Ø5/8Ø/64/33Ø4/984/ 8Ø5 11Ø1;
BAD RS 1755 E3Ø BKN 12 116/77/71/32Ø6/987/CIG RGD/ ØØ2 15ØØ;
BYH SA 1755 M18 BKN 28 BKN 25Ø OVC 6RW- Ø64/73/65/17Ø7/972/
    7Ø811 18Ø2;
CBM SA 1755 M13 BKN 2Ø OVC 7 Ø86/72/65/13Ø8/979/ 812 12//;
LRF SA 1755 7 SCT E2Ø BKN 5Ø OVC 7 Ø95/68/66/28Ø7/982/ ØØ319
    15// WR//;
NMM SA 1755 E25 BKN 7 Ø79/79/68/1ØØ2/981/TCU N-NE/ 71ØØØ 12ØØ
    66;

AREA 12
FFO SA 1755 3Ø SCT E5Ø BKN 1ØØ BKN 25Ø BKN 1Ø 138/74/61/24Ø5/
    996/WND LGT AND VRBL/ 7Ø8ØØ 1299;

Exercise 5 (Cont)

SAUM 9 KAWN 2618ØØ

AREA 12
FTK SA 1755 3Ø SCT E8Ø BKN 12Ø OVC 7 E124/71/68/Ø7Ø8/99Ø/
8Ø7Ø2 127/;
GUS SA 1756 E3Ø BKN 5Ø OVC 4RW-F 15Ø/68/63/2ØØ9/997/ 314//
14// WR//;
LCK SA 1755 4Ø SCT E9Ø OVC 15 146/74/62/15Ø4/995/ 8Ø8 157/;
MTC SA 1755 3Ø SCT E8Ø BKN 2ØØ BKN 15 122/76/58/25Ø3/99Ø/
TCU ALQDS/ 6Ø3 1278;

AREA 13
MXF SA 1755 1Ø SCT M16 OVC 7 EØ94/69/63/Ø7Ø4/981/ 62971 ONE
15// WR//;
OZR RS 1755 12 SCT M24 BKN 25Ø BKN 7 115/68/68/17Ø9/988/
61Ø57 ONE 15Ø8;

SAUS 5 KAWN 2618ØØ
ATY SA 1756 E1Ø OVC 12 149/59/52/Ø4Ø4/996/CIG RGD/ 2Ø2 52;
FRM SA 1746 1Ø SCT E2Ø OVC 7 63/54/ØØØØ/992;
GRR SA 1755 M38 BKN 25Ø BKN 2Ø 132/72/54/25Ø7/993/ 5ØØ 11Ø8
54;
MBL SA 1745 3Ø SCT 2ØØ -SCT 15 64/53/27Ø6/993;
MHE SA 175Ø E15 OVC 15 63/53/35Ø3/997;
MSP SA 1753 M12 OVC 4F 137/61/54/14Ø4/993/ 4ØØØØ 15// 55;

SAUS 6 KAWN 2618ØØ
ALO SA 1754 27 SCT E7Ø BKN 12 132/68/56/Ø2Ø7/993/ ØØ2 117Ø
52;
BBW SA 1742 E8Ø BKN 1Ø 7Ø/54/Ø91Ø/995;
CMI SA 1745 8Ø SCT E12Ø OVC 15 7Ø/58/171Ø/993;
COU SA 175Ø 4Ø SCT 25Ø -BKN 15 115/75/62/Ø4Ø6/989/ 8Ø3 11Ø1
58;
DDC SA 1755 M75 BKN 15 115/8Ø/57/16Ø8/993/ 6Ø2ØØ 1Ø7Ø 6Ø;
DSM SA 1755 25 SCT 15 121/76/56/3ØØ7/99Ø/ 6Ø2 11ØØ 55;
HSI SA 175Ø E1ØØ BKN 1Ø 71/59/Ø9Ø8/992;
IRK SA 1745 E3Ø BKN 1Ø 117/77/62/24Ø5/989/ 4ØØ 59;
JLN SA 1753 3Ø SCT 25Ø SCT 2Ø 117/77/59/Ø4Ø7/989/ 8Ø2 54;
MLI SA 1759 M46 BKN 25Ø BKN 2Ø 113/78/59/151Ø/987/TCU ALQDS/
8Ø8 12Ø1 53;
PIA SA 1759 E7Ø BKN 25Ø OVC 12 128/73/63/16Ø8/992/BLDG CU N/
ØØØ 127/ 62;
RSL SA 1755 3Ø SCT E1ØØ BKN 25Ø OVC 15 115/77/65/Ø6Ø6/992/
TCU SW-N/ 8Ø7 58;
SUX SA 1754 M23 OVC 3Ø 141/65/52/Ø31Ø/995/BINOVC/ 8Ø3 15//
49;

SAUS 7 KAWN 2618ØØ
ACT SA 1755 12Ø SCT 25Ø -SCT 12 Ø92/9Ø/72/17Ø7/982/ 81Ø 1171
65;
LFK SA 1755 E25 BKN 7 1Ø9/86/69/25Ø4/986/ 7Ø7 64;

Exercise 5 (Cont)

SAUS 7 KAWN 2618ØØ
PRX SA 1749 CLR 15 112/84/74/211Ø/986/ 8Ø5 69;
TYR SA 1748 4Ø SCT 1Ø 86/64/33Ø6/985;

SAUS 8 KAWN 2618ØØ
BMG SA 1758 E5 BKN 3R-F M/M/Ø213/995;
CAK SA 1755 E8Ø OVC 1Ø 156/69/55/1811/ØØ1/ 1Ø3 1Ø7/ 56;
CHA SA 1753 M17 BKN 41 BKN 9Ø OVC 5R-H 127/69/63/18Ø8/992/
814ØØ 152/ 63;
FDY SA 1755 6Ø SCT E1ØØ OVC 1Ø 136/76/58/18Ø5/994/ 6Ø3 63;
LOZ SA 1755 5Ø SCT E1ØØ OVC 1Ø 128/79/6Ø/2ØØ6/994/ 8Ø8 61;
MEM SA 1755 M23 BKN 35 BKN 25Ø BKN 15 Ø69/77/65/2311/974/
8Ø717 18Ø2 68;

SAUS 9 KAWN 2618ØØ
FSM SA 1755 2Ø SCT 25Ø SCT 25 114/77/65/27Ø8/988/ ØØØ 11Ø8
6Ø;
GLH SA 1745 3Ø SCT E15Ø OVC 15R- 73/65/241Ø/982/RB1Ø;
MCB SA 1753 E25 BKN 1Ø 1Ø2/81/64/29Ø7/984/ 8Ø2 65;

1738

Exercise 6

SAUM 9 KAWN 1312ØØ

AREA Ø6
VOK SA 1157 CLR 15 185/46/44/Ø1Ø5/ØØ6/ 6Ø3ØØ 41 2ØØØ2;

AREA Ø7
FRI SA 1157 5Ø SCT E8Ø OVC 5F 56/47/Ø4Ø8/991;
IAB SA 1155 2Ø SCT 4Ø SCT E25Ø OVC 15 1Ø3/61/54/Ø5Ø4/988/ 33ØØ9 13Ø7 61 2ØØØ9;
NBU SA 1156 E9Ø BKN 25Ø OVC 15 179/48/37/Ø4Ø5/ØØ5/ 5ØØ 1Ø77 46;
OFF RS 1159 M7 OVC 2F 47/43/35Ø8/997/ 47 2ØØØ5 RADAT 61Ø93;

AREA Ø8
END SA 1158 E4Ø BKN 1ØØ OVC 1Ø Ø62/61/56/Ø914/974/ 3Ø319 ONE 61 2Ø119;
FWH SA 1155 M23 BKN 8Ø OVC 15 Ø82/7Ø/62/2Ø16G23/979/ 6Ø5 157/ 69;
LTS SA 1155 25Ø SCT 1Ø Ø42/69/62/2ØØ8/969/ 5Ø2 1ØØ8;
SPS SA 1151 M2Ø OVC 1Ø 7Ø/64/1712/975/CIG RGD/ /// 69;
TIK SA 1157 1Ø SCT 2ØØ SCT 7 Ø4Ø/67/61/1814/969/ 5ØØ 16Ø8 65 RADAT 32128;

AREA Ø9
DYS SA 1155 CLR 15 Ø63/69/63/1819G27/979/FEW ST E/ 3Ø3 16ØØ 69;

AREA 1Ø
BLV SA 1159 E5Ø BKN 12Ø OVC 7 148/58/54/15Ø9/997/ 3Ø3 152/ 57;
GVW SA 1155 33 SCT E8Ø BKN 25Ø OVC 4F 115/53/51/11Ø5/988/ 22Ø 1577 2ØØØ8 53;
HOP SA 1156 -X 7Ø SCT E1ØØ BKN 1F 19Ø/44/44/ØØØØ/ØØ8/ 5ØØ 41;
TBN SA 1156 3Ø SCT E6Ø OVC 1Ø 122/6Ø/49/18Ø8/991/ ØØØ 6Ø;

AEX RS 1156 CLR 11/2GF 154/54/54/ØØØØ/999/ 53;
BAD RS 1152 7 SCT 4FHK 132/61/6Ø/14Ø7/993/ 3Ø3 16ØØ 61;
BYH SA 1158 25Ø -BKN 8 169/54/5Ø/14Ø4/ØØ4/ 31Ø 51;
CBM SA 1158 CLR 1Ø 53/49/ØØØØ/ØØ5;
LRF SA 1155 E15 BKN 2ØØ OVC 5H 13Ø/63/58/19Ø8/993/ 11Ø 17Ø2;
NMM SA 1155 CLR 7 Ø76/5Ø/46/ØØØØ/ØØ6/ 21Ø 47;

AREA 12
FFO SA 1155 9 SCT 7 19Ø/48/45/25Ø4/ØØ9/ 1Ø7 1Ø7Ø 41 RADAT 35Ø89;
FTK SA 1155 E8Ø BKN 12Ø BKN 25Ø OVC 8 185/51/46/13Ø5/ØØ8/ 3Ø7ØØ 1Ø78 49;
GUS SA 1157 E5Ø BKN 15 182/46/34/ØØØØ/ØØ6;
LCK SA 1155 12Ø SCT 2F 192/48/47/15Ø3/Ø1Ø/ 1Ø5 1Ø3Ø 46;
MTC SA 1156 8Ø SCT 2ØØ -BKN 12 177/43/38/28Ø4/ØØ5/ 2Ø8 1Ø78 35;

SAUM 9 KAWN 1312ØØ

AREA 13
MXF SA 1155 CLR 6H E192/48/42/ØØØØ/ØØ9/DA -3ØØ/ 31Ø FIRST;
OZR SA 1155 CLR 5FH 176/57/53/Ø2Ø2/ØØ5/ 3Ø7 56;

SAUS 5 KAWN 1312ØØ
ATY SA 1153 CLR 15 214/32/26/25Ø4/Ø14/ 21Ø 1ØØ1 28;
FRM SA 1156 7Ø SCT 4F 181/41/39/Ø1Ø8/ØØ8/ 5ØØØØ 1Ø7Ø 38
2ØØØ5;
GRR SA 1152 E65 BKN 1Ø 179/44/42/27Ø4/ØØ5/ 1Ø2 1Ø7Ø 36;
MBL SA 1158 25Ø -BKN 15 179/42/29/24Ø8/ØØ4/ 714 33;
MHE SA 1153 25Ø -OVC 1Ø 21Ø/38/37/26Ø5/Ø12/ 3Ø7 1Ø77 35
2ØØØ2;
MSP SA 1156 25Ø -SCT 5F 2Ø1/43/42/33Ø5/Ø1Ø/ 1Ø7 42 2ØØØ6;

SAUS 6 KAWN 1312ØØ
ALO SA 1155 E25 OVC 1Ø 171/45/41/Ø51Ø/ØØ1/ 51Ø32 44 2ØØ44;
BBW RS 115Ø M18 BKN 55 OVC 15 17Ø/44/41/Ø21Ø/ØØ4/ 1Ø3Ø6 15//
43 2ØØØ6 RADAT 83Ø73;
CMI SA 1155 E8Ø BKN 15Ø OVC 7 156/51/47/1412/999/ 5Ø3ØØ 48;
COU SA 1145 3Ø SCT E5Ø OVC 1ØR- 58/53/12Ø5/988;
DDC SA 1156 E12 BKN 5Ø OVC 2Ø 133/47/46/Ø12ØG3Ø/996/ 2321Ø
44 2ØØ16;
DSM SA 1159 1ØØ SCT 12Ø SCT E25Ø OVC 6F 15Ø/46/44/Ø61Ø/997/
31Ø 45 2ØØØ1;
HSI SA 1152 M8 BKN 13 OVC 7 169/45/42/Ø2Ø9/ØØ3/ 314 15// 45;
IRK SA 1152 8Ø SCT E15Ø OVC 3F 139/51/49/Ø8Ø7/994/SCT V BKN/
11Ø 51;
JLN SA 1156 45 SCT M75 OVC 3TRW+ 135/58/53/16Ø5/995/T OVHD
MOVG ESE OCNL LTGIC ALQDS/ Ø1721 196/ 58 2ØØ21;
MLI SA 1156 15Ø SCT E25Ø OVC 7 5Ø/45/Ø91Ø/996;
PIA SA 1148 E2Ø OVC 9 1314/ØØ2;
RSL RS 1147 E15 BKN 2Ø OVC 11/2R-F 129/57/51/341Ø/993/PRESRR/
33713 54 2ØØ13;
SUX SA 1151 M4 OVC 3F 175/44/42/Ø212G2Ø/ØØ3/ 314ØØ 16// 44
2ØØØ9;

SAUS 7 KAWN 1312ØØ
ACT SA 1152 7 SCT M18 OVC 6R-F Ø84/61/61/11Ø8/979/PCPN VRY
LGT/ 6Ø7Ø1 172/ 61 2ØØØ1;
LFK RS 1155 M28 BKN 12Ø BKN 138/7Ø/66/16Ø7/994/ 3Ø3 157Ø 69;
PRX SA 1151 E12 OVC 5F Ø79/69/66/1815/979/ 1Ø7 69;
TYR SA 1147 M8 OVC 4F 68/67/1812/99Ø/ /// 66;

SAUS 8 KAWN 1312ØØ
BMG SA 1156 E8Ø BKN 25Ø OVC 1Ø 183/5Ø/45/12Ø5/ØØ7/ 47;
CAK SA 115Ø 1ØØ SCT 25Ø SCT 1Ø 183/46/38/2ØØ6/ØØ6/ 1Ø8 1Ø35
42;
CHA SA 115Ø CLR 1Ø 187/45/45/1ØØ4/Ø1Ø/ 2Ø7 37;
FDY SA 1155 1ØØ SCT E25Ø BKN 1Ø 187/43/36/25Ø4/ØØ7/ 21Ø 1Ø71
39;

Exercise 6 (Cont)

SAUS 8 KAWN 1312ØØ
LOZ SA 1155 W3 X 1/8F 211/43/41/Ø4Ø5/Ø16/R22VRØ6/ 1Ø5 42;
MEM SA 1156 1ØØ SCT E25Ø OVC 7 164/58/48/1ØØ2/ØØ2/ 2Ø8 1Ø72
    56;

SAUS 9 KAWN 1312ØØ
FSM SA 1155 E3Ø OVC 5TRW- 118/57/55/18Ø5/991/T NE MOVG NE
    OCNL LTGIC N-E/ 23218 ONE 57 2Ø118;
GLH SA 1153 CLR 15 173/58/53/14Ø4/ØØ4/ 314 56;
MCB SA 115Ø CLR 1F 173/57/57/Ø7Ø3/ØØ4/ 314 56;

Exercise 7 (Speedrun)

SAUM 9 KAWN 2612ØØ

AREA Ø6
VOK RS 1156 E3 BKN 25 BKN 3F 132/57/57/ØØØØ/991/ 3Ø7ØØ 55;

AREA Ø7
FRI RS 1155 -X 1/16F 55/51/ØØØØ/992/F9;
IAB SA 1155 25Ø -SCT 4F 115/6Ø/55/Ø9Ø5/99Ø/FEW AC/ ØØ3Ø8
    1Ø71 59 2ØØ1Ø;
NBU SA 1157 1ØØ SCT 25Ø SCT 15 126/61/58/32Ø3/991/ 1Ø7 1Ø31
    58 2ØØØ1;
OFF SA 1158 CLR 7 54/5Ø/35Ø4/992/FEW AC S/ 53 RADAT 641Ø4;

AREA Ø8
END SA 1155 25Ø SCT 4GF 1Ø7/57/53/EØ4Ø3/987/ 1Ø3 56;
FWH SA 1158 5 SCT 4F Ø94/67/63/21Ø2/983/ 1Ø2 11ØØ 75;
LTS SA 1155 5Ø SCT 1ØØ SCT 2ØØ SCT 7 1Ø4/64/57/ØØØØ/986/
    PTCHY GF/ 3Ø8 1578;
SPS SA 1153 W2 X 1/2F 66/65/26Ø4/986/ /// 64;
TIK SA 1156 WØ X 1/16F 111/61/59/2ØØ4/989/TWR VSBY 1/8/
    21Ø 6Ø RADAT 77112Ø;

AREA Ø9
DYS SA 1157 12Ø SCT 25Ø -BKN 3Ø Ø76/68/62/14Ø7/983/ 1Ø2
    1Ø76 67 SEP RADAT 78125;

AREA 1Ø
BLV SA 1155 5Ø SCT E8Ø OVC 5RW- 129/64/62/21[illegible]/992/ 11ØØ5
    127/ 64;
GVW SA 1158 25Ø -SCT 7 12Ø/58/56/27Ø5/99Ø/ACCAS N/ 4ØØ 1Ø81
    57 2ØØ7Ø;
HOP SA 1155 -X E35 BKN 8Ø BKN 21/2F 126/64/64/ØØØØ/99Ø/F3
    4ØØ 62;
TBN SA 1158 1Ø SCT 5Ø SCT E12Ø OVC 4F 1Ø4/57/57/32Ø9/985/
    6Ø3Ø5 57 2ØØ46;

AREA 11
AEX RS 1156 W1 X 1/4F Ø94/68/68/24Ø6/981/ 67 2Ø37Ø;
BAD SA 1158 M5 OVC 7 Ø95/66/63/28Ø6/98Ø/ 3Ø3 65 2ØØ62;
BYH SA 1158 E9 BKN 25 OVC 3RF Ø96/65/63/1811/982/ 5Ø316 68
    2ØØ74;
CBM SA 1155 E8 OVC 3R 67/67/191Ø/978;
LRF SA 1156 3 SCT E8 BKN 2ØØ OVC 4FH 61/6Ø/24Ø3/981;
NMM SA 1153 M7 OVC 7 1ØØ/69/66/18Ø6/984/ 3Ø518 ONE 15// 68
    2Ø165;

AREA 12
FFO SA 1155 5Ø SCT E8Ø BKN 25Ø OVC 1Ø 144/59/57/21Ø4/997/
    3Ø8 1538 58 RADAT 661Ø6;
FTK SA 1156 E1ØØ BKN 25Ø OVC 1Ø 131/65/62/11Ø4/993/ 4ØØ 1Ø77
    65 2ØØØ7;

SAUM 9 KAWN 2612ØØ

AREA 12

GUS SA 1155 6Ø SCT E25Ø BKN 1Ø 133/62/57/ØØØØ/993/ 2Ø7 15Ø8 6Ø;

LCK SA 1159 E8Ø BKN 12Ø OVC 7 146/63/55/15Ø4/998/ ØØ2 1Ø7/ 57;

MTC SA 1156 E1ØØ BKN 15 121/64/57/2Ø1Ø/99Ø/ 2Ø7 1Ø7Ø 6Ø;

AREA 13

MXF SA 1155 2Ø SCT E35 BKN 8Ø OVC 2R-F E132/68/67/Ø5Ø2/993/ DA -135Ø/ 1Ø5// 162/ 2ØØØ8 E72HR WR// FIRST;

OZR RS 1155 M5 BKN 2Ø OVC 3RW-F Ø99/7Ø/69/1912/982/ 51Ø38 ONE 17// 7Ø 2Ø138 WR//;

SAUS 5 KAWN 2612ØØ

ATY SA 1155 E8 BKN 13 OVC 5F 143/52/51/33Ø8/994/ 3Ø7 52;

FRM RS 1156 E1Ø OVC 7 139/58/57/3ØØ8/993/CIG RGD/ 3Ø7 57;

GRR SA 1154 2ØØ -OVC 5F 127/6Ø/6Ø/29Ø4/991/ 31ØØ1 1ØØ7 56 2ØØ82;

MBL RS 1155 7 SCT E12 OVC 7 119/56/49/25Ø6/988/ 212 52;

MHE SA 1155 12 SCT M23 OVC 7 139/55/54/ØØØØ/994/ 1Ø3 15// 55 RADAT 4711Ø;

MSP SA 1155 M22 OVC 4F 129/53/53/3ØØ7/99Ø/ 1Ø3 15// 49 2ØØØ2;

SAUS 6 KAWN 2612ØØ

ALO SA 1155 E4Ø OVC 6GF 135/54/54/ØØØØ/992/ 21Ø 51;

BBW SA 1149 28 SCT E9Ø BKN 25Ø BKN 15 122/51/49/1ØØ7/994/ 4ØØ 1578 5Ø RADAT 94115;

CMI SA 115Ø E9Ø BKN 25Ø OVC 15 121/62/57/ØØØØ/99Ø/ ØØØ 6Ø;

COU SA 1145 8Ø SCT E2ØØ OVC 1Ø 58/55/ØØØØ/988;

DDC RS 115Ø E3 OVC 21/2F Ø97/6Ø/59/1415/991/ 4ØØ 58;

DSM SA 1158 15Ø SCT 25Ø -SCT 7 124/61/57/21Ø7/991/TCU SE/ 1Ø7 57;

IRK SA 1156 E1ØØ BKN 25Ø BKN 15 117/63/6Ø/31Ø5/989/ 4ØØ 6Ø;

JLN SA 1156 9Ø SCT 25Ø -OVC 1Ø 11Ø/58/57/Ø2Ø3/988/ 5ØØ 1Ø38 58 UMN RADAT 64121;

MLI RS 1149 8Ø SCT 3F 62/61/Ø4Ø5/991/ RADAT 48552;

PIA SA 1156 E8Ø BKN 2ØØ OVC 1Ø 122/64/62/ØØØØ/99Ø/PTCHY GF ON FLD/ 5Ø218 1Ø77 62 2ØØ26 RADAT 911Ø5;

RSL SA 115Ø CLR 7 115/57/54/ØØØØ/99Ø/ 2Ø7 57;

SUX SA 1155 CLR 1F 133/49/47/32Ø3/994/ 4ØØ 157Ø 47;

SAUS 7 KAWN 2612ØØ

ACT SA 1146 CLR 6F 69/66/ØØØØ/984;

LFK SA 1155 CLR 6F 1Ø8/69/68/2ØØ4/985/ 3Ø8 69;

PRX SA 1152 WØ X ØF 1Ø9/6Ø/6Ø/ØØØØ/987/ 2Ø7 55 2ØØØ4;

TYR SA COR 1147 WØ X 1/16F 63/63/ØØØØ/984/ /// 63 2ØØ69;

1743

Exercise 7 (Cont)

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SAUS 8 KAWN 2612ØØ
BMG SA 1155 6Ø SCT E1ØØ BKN 2ØØ OVC 6FH 132/64/6Ø/12Ø4/993/
    63;
CAK SA 1155 12Ø SCT 7 152/63/51/18Ø5/ØØØ/ 21Ø 1Ø3Ø 56;
CHA SA 1155 3Ø SCT E6Ø BKN 25Ø BKN 12 131/64/57/21Ø4/993/
    1Ø7 1Ø71 61 2ØØØ2;
FDY SA 1155 1ØØ SCT E14Ø BKN 25Ø BKN 7 146/62/62/ØØØØ/999/
    1Ø7 6Ø 2ØØ67;
LOZ RS 1156 E25Ø OVC 3F 163/6Ø/58/ØØØØ/ØØ5/ 2Ø3 1ØØ7 58;
MEM RS 115Ø 2 SCT E1Ø BKN 5Ø OVC 3R-F Ø85/66/65/15Ø9/979/
    5Ø36Ø 66 2ØØ81;

SAUS 9 KAWN 2612ØØ
FSM SA 1155 6 SCT E1ØØ BKN 25Ø BKN 7 1Ø7/59/59/ØØØØ/986/F
    LOW AREAS/ 5ØØ 59 2ØØ37;
GLH SA 1156 E1Ø BKN 4Ø OVC 15 Ø95/66/65/17Ø5/981/ 2Ø758 65
    2Ø348;
MCB RS 1155 15 SCT 2F 1Ø5/7Ø/7Ø/24Ø6/984/ 31ØØØ 15ØØ 69
    2ØØ57;
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Exercise 8 (Speedrun)

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SAUM 9 KAWN 261200

AREA 06
VOK RS 1156 E3 BKN 25 BKN 3F 132/57/57/0000/991/ 30700 55;

AREA 07
FRI SA 1155 70 SCT 23/4F 125/54/53/0000/991/ 310 1070 20040;
IAB SA 1155 80 SCT 250 SCT 6F 112/59/53/0802/989/ 108 1061;
NBU SA 1155 120 SCT 200 SCT 15 126/64/57/3204/991/ 302 1081;
OFF SA 1155 80 SCT 12 127/59/50/0000/992/ 307 1070;

AREA 08
END SA 1155 -X E30 BKN 3/4F 109/64/56/1002/988/RVR60+ F4/ 305
    1100;
FWH RS COR 1155 -X 8 -SCT 120 SCT 2F 103/67/67/0000/986/F1/
    308 1630;
LTS SA 1155 80 SCT E250 BKN 7 099/67/61/0404/987/ 310 1058;
SPS SA 1153 120 SCT 2F 100/63/62/0605/986/ 214 1070 63;
TIK SA 1155 W2 X 1/4F 109/62/60/2103/988/RVR10-/ 207;

AREA 09
DYS SA 1155 100 SCT 250 SCT 15 070/66/57/0000/982/ 303 1078;

AREA 10
BLV SA 1155 15 SCT E35 BKN 80 OVC 6RW- 122/64/61/3305/990/
    10317 152/ 20017 WR//;
GVW SA 1155 M46 BKN 7 124/54/52/2104/990/ 308 1500 50;
HOP SA 1155 E45 BKN 100 OVC 21/2F 111/64/64/1303/986/ 302
    157/;
TBN SA 1155 E80 BKN 120 OVC 7 E118/60/57/0000/988/ 20300
    107/ WR// FIRST;

AREA 11
AEX RS COR 1158 -X M2 BKN 1/2FH 095/67/61/3102/981/RVR10- F7/
    307 1400 20120;
BAD SA 1155 M8 OVC 5F 099/65/65/3003/982/ 302 15// 20078;
BYH SA 1155 4 SCT E7 BKN 17 OVC 3R-F 077/68/60/1008/976/ 00031
    172/ 20121 WR//;
CBM SA 1155 M8 BKN 15 OVC 6F 094/68/64/1602/982/ 50771 12//
    20083 68 WR//;
LRF RS 1155 6 SCT E8 BKN 50 BKN 5R- 085/65/64/2504/979/ 30704
    1620 20384 WR//;
NMM SA 1157 6 SCT 25 SCT E70 BKN 200 OVC 5F 091/66/63/1503/984/
    50712 ONE 1877 66 20125;

AREA 12
FFO RS 1155 50 SCT E80 BKN 200 OVC 7R- 143/63/55/1804/997/
    30500 1577;
FTK SA 1155 90 SCT 110 SCT E200 OVC 7 E132/64/62/0904/993/
    802// 1077 20056;
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SAUM 9 AKWN 2612ØØ

AREA 12
GUS SA 1155 E1ØØ BKN 25Ø BKN 7 133/64/59/17Ø5/993/ACCAS E AND W/ 1Ø7 1Ø89;
LCK SA 1155 E75 OVC 7R- 146/62/55/Ø3Ø2/995/ 4ØØ 1Ø7/;
MTC SA 1155 12Ø SCT 25Ø -BKN 2Ø 123/67/57/22Ø3/991/ 31Ø 1Ø78;

AREA 13
MXF SA 1155 2Ø SCT E6Ø OVC 4R- 132/68/61/15Ø3/993/ 1Ø71Ø 172/ WR//;
OZR SA 1155 4Ø SCT E8Ø OVC 5R-F 131/68/68/13Ø4/993/ 5ØØØ4 157/ 2ØØØ4;

SAUS 5 KAWN 2612ØØ
ATY SA 1155 E8 BKN 13 OVC 5F 143/52/51/33Ø8/994/ 3Ø7 52;
FRM SA 1155 M22 OVC 4F 129/53/53/3ØØ7/99Ø/ 1Ø3 15// 49 2ØØØ2;
GRR SA 1152 3ØØ -SCT 9 125/6Ø/55/3ØØ4/991/ 31Ø 1ØØ1 54 2ØØ13;
MBL RS 1155 7 SCT E12 OVC 7 119/56/49/25Ø6/988/ 212 52;
MHE SA 115Ø E15 BKN 35 OVC 7 55/52/ØØØØ/995/BINOVC;
MSP RS 1156 M9 OVC 15 13Ø/57/52/23Ø5/991/ 3Ø8 15// 55;

SAUS 6 KAWN 2612ØØ
ALO SA 1155 M65 BKN 7 131/56/53/ØØØØ/993/ 31ØØØ 1Ø7Ø 52;
BBW SA 1142 E5Ø BKN 8 53/49/ØØØØ/997/ RADAT 48Ø5Ø;
CMI SA 1148 E9Ø BKN 15Ø -OVC 15 64/58/ØØØØ/99Ø;
COU SA 1151 1ØØ SCT E25Ø OVC 15 121/59/56/ØØØØ/99Ø/ 3Ø3 1Ø77 58;
DDC SA 1155 M3 OVC 6F 1ØØ/63/61/15Ø7/992/ 3Ø2 16// 6Ø RADAT 65122;
DSM SA 1151 55 SCT 8 116/57/52/32Ø5/989/ 3Ø7 15ØØ 55;
HSI RS 115Ø CLR 5GF 54/52/ØØØØ/993/ RADAT 47954;
IRK RS 1147 E5Ø BKN 7Ø BKN 5F 117/61/59/25Ø4/989/ ØØØ 2ØØ16 59;
JLN SA 1155 E25Ø OVC 6GF 114/55/51/ØØØØ/988/ 4ØØ 54;
MLI SA 1157 9Ø SCT 7 124/58/54/ØØØØ/99Ø/ ØØ2 1Ø7Ø 53;
PIA SA 1156 E9Ø BKN 2ØØ OVC 1Ø 122/64/61/ØØØØ/99Ø/PTCHY GF ON FLD/ 5ØØ19 1Ø77 2ØØ26 62 RADAT 911Ø5;
RSL SA 1159 25Ø SCT 15 113/58/56/21Ø7/991/ 6Ø2Ø3 58 2ØØØ3;
SUX SA 1156 28 SCT 7 136/53/48/ØØØØ/994/ 4ØØ 15ØØ 49;

SAUS 7 KAWN 2612ØØ
ACT SA 1158 CLR 4F Ø96/66/66/1ØØ4/983/ 3Ø7 65;
LFK RS 1155 WØ X 1/4F 1Ø1/65/63/ØØØØ/984/ 3Ø3 64 2ØØ24;
PRX SA 1155 1Ø SCT 7 112/74/73/23Ø7/986/ 3Ø8 68;
TYR SA 1148 CLR 3/4F 62/58/ØØØØ/983;

SAUS 8 KAWN 2612ØØ
BMG SA 1145 E8Ø BKN 15Ø OVC 4F M/M/ØØØØ/996;
CAK SA 1155 12Ø SCT 7 152/63/51/18Ø5/ØØØ/ 21Ø 1Ø3Ø 56;
CHA SA 1153 M55 BKN 12Ø OVC 4F 136/65/62/ØØØØ/995/ 2Ø7 157/ 63 2ØØ26;

Exercise 8 (Cont)

SAUS 8 KAWN 2612ØØ
FDY SA 1155 25Ø -SCT 12 14Ø/61/55/18Ø5/995/ 2Ø7 59;
LOZ SA 1155 -X E5Ø BKN 7Ø BKN 25Ø OVC 5F 147/63/61/ØØØØ/999/
F2 BINOVC/ 3Ø3 2ØØ11 61;
MEM SA COR 1155 M4 BKN 21 OVC 1RF Ø76/69/66/161Ø/977/R36LVR6Ø+/
1Ø269 172/ 68 2Ø269;

SAUS 9 KAWN 2612ØØ
FSM RS 1152 E25Ø BKN 4F 1Ø1/6Ø/58/26Ø7/984/ 5ØØ 1ØØ8 6Ø 2ØØ31;
GLH SA 1146 E2Ø BKN 1Ø 71/67/21Ø6/98Ø;
MCB RS 1156 E1Ø BKN 3F Ø97/68/68/24Ø5/983/ 3Ø7 65 2Ø14Ø;

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Exercise 9 (Speedrun)

SAUM 9 KAWN 2618ØØ

AREA Ø6
VOK SA 1755 E12 BKN 33 OVC 15 144/67/55/34Ø4/994/ 3Ø3ØØ 55;

AREA Ø7
FRI SA 1756 18Ø SCT 15 79/64/36Ø4/991/FEW CU;
IAB SA 1759 CLR 1Ø 117/77/58/ØØØØ/991/FEW CU AC/ 8Ø3 117Ø
59;
NBU SA 1755 1ØØ SCT E25Ø BKN 15 126/74/56/11Ø8/991/ 8Ø3
1Ø71 58;
OFF SA 1755 CLR 7 72/51/33Ø5/992/ 53;

AREA Ø8
END SA 1757 3Ø SCT 15 112/79/6Ø/ØØØØ/988/ 8Ø7 56;
FWH SA 1755 35 SCT 1ØØ SCT 25Ø SCT 12 Ø96/88/69/11Ø2/983/
ØØØ 1178 67;
LTS SA 1755 12Ø -SCT 25Ø -SCT 2Ø Ø97/84/58/11Ø8/985/ 71Ø
1Ø78;
SPS SA 1759 25 SCT 15 79/68/1ØØ5/987/ /// 64;
TIK SA 1755 CLR 2Ø 114/82/62/11Ø7/99Ø/ 8Ø5 11ØØ 6Ø;

AREA Ø9
DYS SA 1755 3ØØ SCT 3Ø Ø82/92/61/1913/982/ 7Ø8 1ØØ8 67;

AREA 1Ø
BLV SA 1759 8Ø SCT E2ØØ OVC 7 119/71/65/11Ø7/989/ 614Ø9
1Ø77 64;
GVW SA 1755 CLR 2Ø 117/76/58/27Ø3/99Ø/FEW CU AND CI/ 4ØØ
11Ø1 57;
HOP SA 1756 E4Ø BKN 1ØØ OVC 7 114/7Ø/66/1211/987/ 7Ø7ØØ 62;
TBN SA 1755 9Ø SCT E2ØØ OVC 1Ø 1Ø9/72/56/Ø51Ø/988/ 8Ø3 62;

AREA 11
AEX SA 1755 E3Ø BKN 7 1Ø4/81/69/32Ø8/984/ 6Ø3 67;
BAD SA 1759 25 SCT 1Ø 1Ø5/8Ø/69/34Ø5/985/ 8Ø3 11ØØ 66;
BYH SA 1755 E12 BKN 3Ø BKN 5Ø OVC Ø74/74/67/1613/976/
812Ø7 63;
CBM SA 1756 E2Ø BKN 4Ø BKN 7 73/65/1815/976;
LRF SA 1758 E2Ø OVC 25 72/64/331Ø/984;
NMM SA 1758 M15 BKN 7 Ø9Ø/79/7Ø/23Ø6/988/ 71Ø23 15ØØ 68;

AREA 12
FFO SA 1755 E7Ø BKN 25Ø OVC 5H 135/74/64/21Ø7/995/ 8Ø8 1Ø77
58;
FTK SA 1758 M28 BKN 5Ø OVC 7R-H 121/74/65/ØØØØ/99Ø/ 6Ø5Ø1
14// 65;
GUS SA 1756 E1ØØ OVC 1Ø 139/73/61/22Ø8/995/ 5ØØ 1Ø2/ 6Ø;
LCK SA 1757 35 SCT E8Ø BKN 25Ø BKN 7 146/75/63/17Ø9/998/
8Ø7ØØ 1138 57;

Exercise 9 (Cont)

SAUM 9 KAWN 2618ØØ

AREA 12
MTC SA 1747 M35 BKN 25Ø OVC 15 119/75/62/27Ø8/989/ 8Ø2 15Ø7
6Ø;

AREA 13
MXF SA 1755 6 SCT E12 BKN 25 BKN 7 E1Ø5/77/67/18Ø7G14/984/
DA +2Ø1Ø/ 6Ø738 ONE 18ØØ WR//;
OZR RS E2Ø BKN 25Ø BKN 7 Ø91/8Ø/69/29Ø8/98Ø/CB NE MOVG NE
TCU ALQDS/ 7141Ø 19Ø3 7Ø;

SAUS 5 KAWN 2618ØØ
ATY SA 1753 M14 OVC 15 15Ø/62/57/Ø6Ø5/997/CIG RGD/ ØØØØØ
15// 54;
FRM SA 1755 E15 OVC 1Ø 142/64/6Ø/34Ø6/994/CIG RGD/ 8Ø3 57;
GRR SA 175Ø E3Ø BKN 25Ø BKN 8 132/72/6Ø/27Ø8/993/ 5ØØ 11Ø2
56;
MBL SA 175Ø E24 BKN 15 134/66/52/Ø21Ø/992/ 4ØØ 52;
MHE SA 1756 M15 BKN 23 OVC 7 142/65/53/33Ø7/995/ 5Ø3 15//
54;
MSP SA 1757 18 SCT M26 OVC 1Ø 134/63/54/Ø8Ø4/992/ ØØØØØ
15// 49;

SAUS 6 KAWN 2618ØØ
ALO SA 1755 2Ø SCT E4Ø BKN 1Ø 139/65/59/32Ø9/993/ 1Ø3 51;
BBW SA 1748 M75 OVC 15 128/62/56/1Ø1Ø/994/RWU E/ 8Ø3ØØ 1Ø7/
5Ø;
CMI SA 1759 9Ø SCT E12Ø OVC 1Ø 124/69/58/1611/991/ 8Ø3 6Ø;
COU SA 1745 35 SCT E2ØØ BKN 15 75/58/Ø8Ø6/987;
DDC SA 1755 E12Ø BKN 25Ø BKN 15 1ØØ/81/59/1515/991/ 71ØØØ 58;
DSM SA 1755 E4Ø BKN 18Ø BKN 1Ø 113/78/57/25Ø6/988/TCU ALQDS/
8Ø7 57;
HSI SA 1751 E1ØØ BKN 25Ø OVC 1Ø 129/69/57/Ø9Ø8/993/ 712 1Ø78
5Ø;
IRK SA 1751 4Ø SCT E9Ø BKN 25Ø OVC 15 122/73/63/ØØØØ/99Ø/
LN OF BLDG CU E-S/ 8Ø5 6Ø;
JLN SA 1755 2Ø SCT 25Ø -BKN 15 11Ø/77/6Ø/3111/989/ 4ØØ;
MLI SA 1745 3Ø SCT 12Ø SCT E2ØØ OVC 15 1813/993;
PIA SA 1748 E3Ø BKN 25Ø BKN 1Ø 76/65/17Ø7/987;
RSL SA 1756 2ØØ SCT 15 116/78/61/1ØØ8/99ØFEW CU/ ØØØØØ 57;
SUX SA 1751 25Ø -SCT 15 129/7Ø/5Ø/Ø311/993/ACCAS SW AND NW/
7Ø8 1Ø88 47;

SAUS 7 KAWN 2618ØØ
ACT SA 1754 4Ø SCT 25Ø -SCT 12 9Ø/72/21Ø6/985;
LFK SA 1755 CLR 15 1Ø9/87/68/27Ø7/986/FEW CU/ 7Ø7 11ØØ 68;
PRX SA 1755 25 SCT 1Ø 112/78/65/Ø3Ø6/989/ 8Ø3 55;
TYR SA 1747 27 SCT 2Ø 8Ø/71/36Ø5/986/ /// 63;

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Exercise 9 (Cont)

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SAUS 8 KAWN 2618ØØ
BMG SA 1756 6 SCT E14 BKN 3Ø OVC 5R-F 69/64/35Ø8/991/PRESFR/
    63;
CAK SA 175Ø E12Ø OVC 12 159/72/54/23Ø8/ØØ1/ 4ØØ 1Ø7/ 55;
CHA SA 1755 1Ø SCT E3Ø BKN 5Ø OVC 5R-F 127/66/61/15Ø8/995/
    RB4Ø/ 612Ø2 6Ø;
FDY SA 1752 9Ø SCT E25Ø BKN 1Ø 126/77/6Ø/24Ø8/991/FEW CU SE/
    8Ø7 1131 61;
LOZ SA 1756 4Ø SCT E1ØØ BKN 25Ø OVC 7 143/8Ø 57/22Ø8/ØØØ/ 717
    1577 58;
MEM SA 1756 E15 BKN 7Ø BKN 25Ø BKN 7 Ø74/76/63/2Ø1Ø/975/TCU
    SW/ 8Ø312 1572 66 WR//;

SAUS 9 KAWN 2618ØØ
FSM RS 175Ø E23 BKN 25Ø BKN 15 111/73/59/36Ø9/989/ ØØØ 11Ø8
    6Ø;
GLH SA 1754 E25 BKN 15Ø OVC 15R- Ø85/73/68/23Ø7/978/RB29/
    8Ø7Ø7 65;
MCB SA 1757 35 SCT 7 1Ø8/83/71/291Ø/985/ 8Ø3 11ØØ 69;
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Exercise 1Ø (Speedrun)

SAUM 9 KAWN 2Ø18ØØ

AREA Ø6
VOK SA 1755 2ØØ SCT 2Ø 14Ø/5Ø/43/Ø7Ø8/Ø11/ ØØØ 36;

AREA Ø7
FRI SA 1755 55 SCT E1ØØ OVC 15 Ø82/6Ø/37/12Ø5/995/ 38;
IAB SA 1755 M17 BKN 15 Ø56/58/53/Ø9Ø7/988/ 3Ø2 14ØØ;
NBU SA 1755 E4Ø BKN 8Ø OVC 1Ø 12Ø/52/48/1ØØ7/ØØØ/ 6Ø2 157/;
OFF SA 1755 1ØØ SCT 15Ø SCT 7 11Ø/58/55/Ø9Ø5/997/ 3Ø3 1Ø3Ø
66;

AREA Ø8
END SA 1755 5 -SCT M1Ø BKN 3R Ø21/61/6Ø/Ø222/981/ 3Ø3// 17ØØ;
FWH RS 1756 E25 BKN 2ØØ BKN 1Ø Ø39/73/65/ØØØØ/985/CB DSIPTD
VIRGA ALQDS/ 5Ø31Ø 14Ø3;
LTS RS 1755 -X 1Ø SCT E25 OVC 2RW-F Ø37/63/61/Ø312/981/F2 T
MOVD NE/ 11845 18// 51;
SPS SA 1746 M2Ø OVC 1/4L Ø25/66/43/3ØØ9/975/CIG RGD/ 1Ø1ØØ
16// 53;
TIK SA 175Ø W3 X 1R-F Ø15/63/63/ØØØØ/975/ 5ØØ24 5Ø;

AREA Ø9
DYS SA 1757 E25 BKN 25Ø OVC 1Ø Ø46/67/41/3413/98Ø/ 212 11Ø7
49;

AREA 1Ø
BLV RS 1758 M2 OVC 7 Ø15/59/58/3217/987/ 1Ø5 16//;
GVW SA 1757 E55 BKN 1ØØ OVC 6H Ø91/59/41/1111/997/ 8Ø7 157/
46;
HOP SA 1755 1ØØ SCT E25Ø BKN 15 113/83/69/16Ø2/99Ø/ 6Ø3 1Ø78;
TBN SA 1755 E1ØØ BKN 25Ø OVC 1Ø Ø84/58/49/3Ø14/987/ 31Ø 1Ø78
56;

AREA 11
AEX SA 1755 3ØØ -OVC 12 Ø92/8Ø/64/19Ø5/997/FEW CU/ 814 11Ø7
51;
BAD SA 1752 E55 BKN 15Ø OVC 1Ø Ø79/77/59/171Ø/996/LN CB TOPS
DSNT W/ 8Ø7 56;
BYH SA 1756 E4Ø OVC 6TRW-F 099/84/82/3517/999/T OVHD MOVG E
OCNL LTGICCCCG/ 7Ø815 13// 48;
CBM SA 1755 25Ø -OVC 1Ø E112/87/48/21Ø7/Ø12/ 81Ø 1ØØ7;
LRF SA 1757 M3Ø OVC 2VTRW-F Ø79/72/68/27Ø8/987/CIG RGD VSBY
13/4V21/4 T NW MOVG E OCNL LTGIC/ 3Ø2Ø3 19//;
NMM SA 175Ø 1ØØ SCT E25Ø OVC 7 83/64/18Ø8/ØØ1;

AREA 12
FFO SA 1755 6Ø SCT 8Ø SCT 15 128/7Ø/68/22Ø6/986/ 5Ø3 1Ø3Ø;
FTK SA 1756 4Ø SCT 7 123/72/69/14Ø2/985/ 312 49;
GUS SA 1758 M8 BKN 32 OVC Ø17/74/7Ø/17Ø9/987/ 3Ø325 172/
41;

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SAUM 9 KAWN 2Ø18ØØ

AREA 12
LCK SA 1755 CLR 15 135/72/6Ø/26Ø3/994/ 5ØØ 61;
MTC SA 1755 25Ø SCT 7 146/53/41/15Ø2/ØØ5/ 2Ø3 1ØØ1;

AREA 13
MXF SA 1755 8Ø SCT 2ØØ SCT 7 187/88/48/141Ø/ØØ7/ 714 1Ø51 46;
OZR SA 1755 8Ø -SCT 7 131/8Ø/75/EØØØØ/ØØ8/F BANK SE AND NW-N/ ØØ7 1Ø7Ø 4Ø;

SAUS 5 KAWN 2Ø18ØØ
ATY SA 1755 2ØØ SCT 6KF 151/46/45/Ø91Ø/ØØ6/K ALF/ 2Ø7 1ØØ2;
FRM SA 1749 CLR 2Ø 49/4Ø/ØØØØ/ØØ1;
GRR SA 1759 4Ø SCT 35 139/56/34/1211/ØØ7/ 8Ø7 42;
MBL SA 1755 CLR 15 149/48/39/14Ø1/999/ 1Ø9;
MHE SA 1754 25Ø -SCT 1Ø 14Ø/52/3Ø/Ø7Ø3/ØØ5/ 4ØØ 1ØØ1;
MSP SA 1756 CLR 2Ø 153/48/4Ø/Ø8Ø4/ØØ2/ 1Ø7;

SAUS 6 KAWN 2Ø18ØØ
ALO SA 1757 25Ø SCT 1Ø 131/52/35/Ø8Ø3/ØØ2/ 21Ø 1ØØ2;
BBW SA 1752 CLR 7 57/2Ø/Ø4Ø6/Ø1Ø;
CMI RS 1759 M6 BKN 15 OVC 1ØL- Ø96/76/74/2313/972/INTMTL L-/ 32ØØØ 17// 55;
COU SA 1756 E55 BKN 15Ø OVC 7 1ØØ/59/46/35Ø8/985/BKN V OVC/ 81ØØØ 62;
DDC SA 1757 15 SCT M28 OVC 6F Ø71/6Ø/57/Ø517/992/ 2Ø4 16//;
HSI SA 1755 1ØØ -BKN 1Ø 1Ø9/59/35/ØØØØ/ØØ7/ 4ØØ 1Ø1Ø;
IRK SA 1756 12Ø SCT 25Ø -BKN 7 11Ø/52/18/Ø41ØG15/ØØØ/WND 35VØ6/ 8Ø8 1Ø71 59;
JLN SA 1758 12 SCT M2Ø BKN 5L-F Ø65/57/57/ØØØØ/987/ 2Ø6 172/;
MLI SA 1747 2Ø SCT E12Ø OVC 8 48/38/Ø712/ØØ4/ 4ØØ;
PIA SA 1755 M7 OVC 1/2R- Ø12/53/53/Ø313/983/CIG RGD/ 31Ø24 17// 57;
RSL SA 1755 2Ø SCT 7 6Ø/52/Ø5Ø2/993;
SUX SA 1755 25Ø -BKN 12 123/55/17Ø4/ØØ3/ 81Ø 42;

SAUS 7 KAWN 2Ø18ØØ
ACT SA 1755 E3Ø BKN 1ØØ OVC 7 EØ62/78/65/26Ø6/992/ 6Ø723 TWO 157/;
LFK SA 1755 1ØØ SCT 25Ø SCT 12 Ø76/82/66/21Ø4/998/ 1Ø5ØØ 1Ø31;
PRX SA 1757 2Ø SCT E3Ø BKN 8Ø OVC 4RW-H Ø7Ø/79/7Ø/16Ø6/994/ CB S-W-N MOVG SLOLY NE/ 6Ø8 19// 132/ WR//;
TYR RS 1759 15 SCT M22 OVC 7TORNADO Ø75/86/84/2523Q42/995/ TORNADO 3NW MOVG ENE/ 6Ø8 19// 95;

SAUS 8 KAWN 2Ø18ØØ
BMG SA 1756 M32 BKN 12Ø BKN 25Ø OVC 12 116/74/64/2ØØ8/ØØ2/ 124 1578;
CAK SA 1754 12Ø SCT 15 135/6Ø/45/Ø2Ø3/ØØ9/ 3Ø6 1Ø3Ø;
CHA SA 1755 CLR 2Ø 9Ø/53/16Ø1/Ø1Ø;

Exercise 1Ø (Cont)

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SAUS 8 KAWN 2Ø18ØØ
FDY SA 1758 1ØØ SCT 7 132/59/41/12Ø6/ØØ4/ 2Ø4 1Ø3Ø;
LOZ SA 1757 CLR 2Ø 139/84/7Ø/2ØØ5/Ø13/ 7Ø8;
MEM SA 1756 3Ø SCT E12Ø BKN 25Ø OVC 2RW- Ø96/85/82/22Ø9/996/
    TCU ALQDS/ 5ØØ18 1277 51;

SAUS 9 KAWN 2Ø18ØØ
FSM SA 1755 M15 OVC 4F Ø59/7Ø/68/24Ø9/991/ 2Ø2 1Ø2/;
GLH SA 1755 2ØØ -OVC 12 Ø85/8Ø/M/2305/992/FEW CU/ 814 11Ø7
    51;
MCB SA 1755 CLR 2Ø 1Ø5/83/64/13Ø7/Ø1Ø/ 817 5Ø;
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LAND SYNOPTIC REPORTS

Exercise 1

AAXX 27004

72201	32989	20115	10250	20220	30171	40183
72202	32689	60707	10260	20220	30184	40188
72205	32989	23204	10190	20080	30169	40207
72206	32989	02703	10130	20100	30196	40207
72207	32989	02404	10140	20060	30190	40208
72214	32989	00000	10100	20080	30175	40199
72226	32989	00000	10150	20070	30115	40188
72234	32989	00000	10110	20090	30070	40184
72304	11989	02611	10190	20160	30148	40152
72306	32989	02605	10130	20020	39995	40154
72308	11989	02613	10190	20100	30125	40135
72311	32989	02407	10110	20040	39891	40184
72314	32989	02108	10120	20020	39892	40167
72324	32989	01905	10120	20050	39932	40182
72327	32989	02105	10110	21010	39956	40176
72403	11989	02005	10100	20070	39992	40109
72407	11689	22613	10110	20070	30053	40078
72414	32789	42515	10130	20010	39782	40134
72421	32589	62917	10070	20010	39804	40164
72428	32589	22414	10080	20040	39820	40120
72503	11289	61711	10160	20150	30020	40031
72507	11364	81520	10170	20150	30027	40051
72515	11489	82509	10080	20080	39468	40050
72518	11340	82514	10160	20160	39898	40005
72524	32789	62415	10070	20010	39796	40089
72528	32589	82429	10100	20040	39773	40028
72605	11432	81316	10170	21080	39901	40028
72608	11489	80908	10110	20110	30152	40183
72612	11208	80909	10140	20130	39831	40070
72712	11364	81112	10070	20070	39905	40141

Exercise 2

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AAXX 27ØØ4
72231 32989 Ø2ØØ7 1Ø185 2Ø141 3Ø168 4Ø178 53Ø14
72243 32989 Ø1812 1Ø187 2Ø119 3Ø108 4Ø147 55ØØØ
72248 32989 214Ø3 1Ø142 2Ø046 3ØØ41 4Ø134 55ØØØ 8ØØØ1
7225Ø 32989 Ø1614 1Ø21Ø 2Ø153 3Ø132 4Ø139 56ØØ3
72251 32989 Ø1413 1Ø214 2Ø155 3Ø115 4Ø132 58ØØ7
72256 32989 118Ø8 1Ø17Ø 2ØØ5Ø 39926 4Ø1Ø7 56ØØ7 8ØØØ1
72261 32989 Ø131Ø 1Ø226 21ØØ5 39726 4ØØ88 55Ø16
72334 32989 Ø15Ø5 1Ø114 2ØØ12 3ØØ63 4Ø165 53ØØ8 8ØØØ1
72344 32989 6Ø8Ø9 1Ø1Ø9 2ØØØØ 39949 4Ø119 56ØØ7 8ØØØ5
72348 32989 ØØØØØ 1ØØ66 21Ø21 39773 4Ø14Ø 5ØØØ8
72351 32989 61812 1Ø153 2ØØØ4 39691 4ØØ59 56ØØ7 8ØØØ8
72353 32989 81512 1Ø118 21Ø23 396ØØ 4ØØ68 58Ø1Ø 8ØØØ7
72432 32589 221Ø8 1ØØ65 2ØØ19 3ØØ12 4Ø155 52Ø24 815Ø7
72434 32989 125Ø7 1ØØ8Ø 2ØØ3Ø 39935 4Ø142 52Ø27 8ØØØ7
72446 32989 713Ø4 1ØØ63 21Ø31 39743 4Ø117 5ØØØ5 83Ø57
7245Ø 32989 214Ø7 1ØØ46 21Ø27 396Ø2 4ØØ87 53ØØ2 81Ø71
72451 32989 5Ø81Ø 1ØØ51 21Ø19 39128 4ØØ5Ø 53Ø1Ø 8ØØØ6
72533 32589 82318 1ØØ45 2ØØ2Ø 398Ø2 4Ø1Ø5 52Ø39 885//
72534 11489 82112 1ØØ61 2ØØ16 39846 4ØØ74 52Ø27 699Ø1 7Ø58Ø 8657Ø
72544 31489 82716 1ØØ44 2ØØØØ 39883 4Ø1Ø3 52Ø37 71Ø42 885//
72546 32789 429Ø7 1ØØ41 21Ø18 39753 4Ø1Ø8 51Ø25 81571
72635 11689 8232Ø 1ØØ7Ø 2ØØ45 39745 4ØØ35 52Ø36 699Ø1 7Ø28Ø 8257Ø
72638 11489 82615 1ØØ27 2ØØ2Ø 39556 49974 52Ø47 6993Ø 78Ø8Ø 887//
72641 1148Ø 82414 1ØØ52 2ØØØ6 39732 4ØØ51 53Ø32 699Ø1 7Ø56Ø 886//
72644 1118Ø 52916 11Ø1Ø 21Ø27 39585 4ØØ75 51Ø3Ø 699Ø1 7551Ø 856ØØ
72645 11489 82614 1ØØ39 2ØØ2Ø 39749 4ØØ1Ø 51Ø41 699Ø1 7Ø26Ø 885//
72734 1148Ø 82515 1ØØ42 2ØØ34 39624 4989Ø 52Ø24 6ØØ72 76165 887//
72741 11489 8261Ø 1ØØ1Ø 2ØØØØ 39455 4ØØ14 52Ø29 699Ø1 77Ø7Ø 885//
72743 11232 831Ø8 1ØØØØ 21ØØ3 39415 49993 52Ø37 6ØØ32 7717Ø 887//
72745 11389 83Ø1Ø 1ØØØ5 21Ø23 39499 4ØØ18 53Ø15 69931 7Ø27Ø 886//
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Exercise 3

AAXX 27ØØ4

72265	32989	72714	1Ø227	21Ø69	39Ø78	4ØØ54	53ØØ2	81Ø76			
7227Ø	32989	63211	1Ø212	21Ø56	38754	4ØØ59	56ØØ2	81Ø71			
72274	32989	23Ø11	1Ø22Ø	21Ø62	39221	4Ø1Ø2	55ØØ3	8ØØØ8			
72278	32989	126Ø6	1Ø216	21Ø18	39712	4Ø1Ø2	55ØØ2	8ØØØ1			
7229Ø	32489	323Ø6	1Ø191	2Ø14Ø	3Ø142	4Ø159	56ØØ3	8383Ø			
72363	32989	12514	1Ø165	21Ø52	38782	4ØØ1Ø	55ØØØ	81Ø3Ø			
72365	32789	2261Ø	1Ø15Ø	21Ø46	38297	4ØØ61	53Ø12	154Ø			
72386	32989	222Ø4	1Ø193	2ØØØ9	39333	4ØØ96	53ØØ2	811Ø1			
72389	32689	23Ø12	1Ø136	2ØØ65	3ØØ58	4Ø176	55ØØ3	815Ø1			
72394	32589	13Ø12	1Ø141	2ØØ82	3ØØ78	4Ø165	55ØØ8	815Ø1			
72464	32989	8Ø313	1ØØ2Ø	21Ø38	38455	4ØØ8Ø	51Ø37	83Ø78			
72465	32889	8Ø114	1ØØØØ	21Ø35	38794	4ØØ87	53Ø34	82578			
72476	11489	813Ø6	1ØØØ7	21Ø21	38456	4Ø117	51Ø14	6ØØ62	7227Ø	885//	
72486	11689	535Ø8	11Ø1Ø	21Ø86	38Ø58	4Ø143	52Ø17	699Ø1	7Ø18Ø	855ØØ	
72488	32789	2Ø5Ø9	1ØØ12	21Ø99	38674	4Ø186	53ØØ5	815Ø1			
72494	32989	Ø34Ø8	1Ø12Ø	21Ø52	3Ø2ØØ	4Ø2ØØ	52ØØ5				
72552	32989	8ØØØØ	1Ø217	21Ø2Ø	39435	4Ø112	52Ø14	88Ø7/			
72567	32989	228Ø5	11Ø21	21Ø36	396Ø5	4Ø127	52Ø19	82Ø7Ø			
72576	31689	5121Ø	11Ø21	2113Ø	3321Ø	4Ø116	53Ø25	7151Ø	842Ø1		
72578	11364	82512	11Ø43	21Ø45	386Ø9	4Ø182	52Ø27	699Ø1	7717Ø	887//	
72583	32789	1Ø2Ø6	1ØØ2Ø	21Ø71	38712	4Ø215	52Ø12	815ØØ			
72597	32689	4ØØØØ	1ØØ55	2ØØØ8	39761	4Ø253	55ØØØ	8227Ø			
7265Ø	31548	625Ø6	11Ø2Ø	21Ø6Ø	396Ø7	4Ø1Ø2	52Ø24	71Ø1Ø	834Ø5		
72654	31789	314Ø7	11Ø27	21Ø46	39614	4ØØ94	53Ø19	7Ø14Ø	83Ø19		
72662	32789	2291Ø	11ØØ5	2112Ø	38972	4Ø1Ø6	52ØØ2	825ØØ			
72677	32689	827Ø9	11Ø11	21133	3884Ø	4Ø11Ø	52Ø19	81577			
72681	11689	632Ø6	1ØØØØ	21Ø45	39184	4Ø214	52Ø2Ø	699Ø1	78585	865ØØ	
72688	11589	414Ø3	11ØØ4	21ØØ7	39678	4Ø235	52Ø17	699Ø1	7Ø18Ø	845ØØ	
72698	11489	834Ø5	1ØØ62	21132	3Ø24Ø	4Ø254	52Ø4Ø	699Ø2	7Ø26Ø	885//	
72753	32689	6ØØØØ	11Ø45	21Ø61	39736	4ØØ74	53Ø14	85538			
72764	11689	829Ø9	1ØØ1Ø	21Ø49	39463	4ØØ73	53Ø17	699Ø1	7Ø28Ø	8455/	
72767	11589	735Ø5	11Ø66	21Ø87	39384	4ØØ89	52Ø22	699Ø1	7Ø17Ø	8657Ø	
72768	11489	8281Ø	11Ø21	21Ø28	39245	4ØØ82	52Ø22	69932	7Ø27Ø	8762/	
72772	31789	83ØØ5	11Ø1Ø	21129	38754	4Ø154	53Ø19	7152Ø	8657Ø		
72777	11589	82812	11ØØ6	21124	39157	4ØØ98	52Ø25	699Ø1	7Ø28Ø	8552/	
72779	31589	822Ø7	11Ø12	21Ø7Ø	39Ø83	4Ø162	52Ø2Ø	7152Ø	885//		
72781	31364	827Ø4	1ØØØ4	21Ø23	3984Ø	4Ø24Ø	53Ø19	71Ø2Ø	886//		
72785	32289	62412	11Ø52	21Ø78	39346	4Ø216	52Ø2Ø	866ØØ			
72793	11489	71ØØ6	1ØØ4Ø	2ØØØ5	3ØØ75	4Ø243	52Ø12	699Ø1	7Ø28Ø	878ØØ	
72797	32489	2ØØØØ	1ØØ69	2ØØ3Ø	3Ø16Ø	4Ø236	53ØØ7	822ØØ			

Exercise 4

AAXX 271[illegible]4

72201	32489	20710	10240	20229	30193	40200	53014	81171			
72202	32489	40711	10248	20221	30204	40208	53008	82830			
72205	32589	20203	10119	21009	30196	40233	53014				
72206	31904	93003	10071	20003	30224	40254	53017	74741			
72207	31906	90000	10064	20030	30240	40258	52010	74740			
72208	32989	00000	10057	20032	30235	40260	52019				
72211	32989	20807	10131	20094	30215	40232	53015	81030			
72214	31904	00000	10015	20008	30114	40241	52010	74440			
72217	31/04	90000	10062	20040	30193	40247	53010	74700			
72218	31980	01703	10020	20011	30132	40248	52014	71040			
72223	31904	01405	10112	20107	30156	40210	55000	74440			
72226	31/04	90804	10079	20064	39997	40227	53007	74710			
72228	32989	01509	10098	20062	30095	40226	52008				
72234	31190	80000	10050	20039	30244	40209	53007	71014	886//		
72304	32989	03204	10097	20087	30081	40248	52020				
72306	32989	02404	10043	20040	30230	40245	53020				
72308	32989	02005	10081	20036	30230	40240	52017				
72311	32989	03505	10059	20041	39944	40240	52010				
72314	31932	00000	10038	20019	39966	40247	52022	71000			
72324	31932	00000	10120	20107	39976	40228	53003	71040			
72327	32989	01510	10066	20049	39969	40191	57010				
72334	32489	71712	10150	20128	30054	40160	56003	87500			
72403	32789	10000	10041	20020	39933	40226	52027	81500			
72407	32989	02307	10054	20042	30105	40210	52024	80001			
72411	32989	03108	10067	20043	30203	40237	52024				
72414	32689	21306	10020	21000	39812	40251	51008				
72421	32989	01411	10019	21007	39890	40207	58003				
72428	32589	32805	10042	20021	39915	40222	53014	83500			
72503	32989	02610	10096	20050	30190	40200	52030				
72507	32989	02513	10097	20008	30142	40166	53027				
72515	32689	32111	10051	21011	39587	40185	52030	83500			
72518	32789	62314	10100	20021	30058	40165	52030	86500			
72520	32589	72108	10049	21023	39780	40227	52022	82531			
72524	32589	72211	1005[illegible]	20009	39908	40208	53027	87500			
72528	11589	82325	10070	20018	39905	40165	53025	69901	72520	885//	
72605	32989	52508	10100	20023	30003	40130	52030	85030			
72608	12589	22415	10107	20076	30037	40066	53041	60082	81102		
72612	11589	82707	10080	20039	39797	40075	52032	60011	70280	885//	
72618	32789	72220	10086	20001	39824	40071	52041	87700			
72712	11289	82318	10065	20053	39760	49990	51054	60072	78065	885//	

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Exercise 5

AAXX 27124
72231 32589 21615 1Ø257 2Ø17Ø 3Ø18Ø 4Ø19Ø 58Ø1Ø 821ØØ
7224Ø 32589 21912 1Ø246 2Ø181 3Ø162 4Ø178 5ØØØØ 813ØØ
72243 32689 62115 1Ø263 2Ø179 3Ø124 4Ø162 5ØØØØ 861ØØ
72248 32589 62414 1Ø225 2Ø148 3ØØ51 4Ø143 56ØØ3 865ØØ
7225Ø 32589 31823 1Ø27Ø 2Ø19Ø 3Ø14Ø 4Ø147 58ØØ3 831ØØ
72251 32589 21718 1Ø281 2Ø195 3Ø122 4Ø139 58Ø1Ø 825ØØ
72253 31489 719Ø7 1Ø152 2Ø136 39871 4Ø153 5ØØØØ 7Ø14Ø 875ØØ
72256 32589 125Ø9 1Ø22Ø 2Ø13Ø 39965 4Ø145 5ØØ14 811ØØ
72259 32989 23Ø14 1Ø171 2ØØ15 39942 4Ø156 51Ø27 8ØØØ8
72261 32989 Ø31Ø3 1Ø217 2ØØ83 39789 4Ø149 5ØØØ5
72263 32989 122Ø5 1Ø1Ø8 21Ø1Ø 39441 4Ø1Ø4 52Ø2Ø 8ØØØ1
72265 32989 Ø3516 1Ø129 21Ø18 3919Ø 4Ø178 52Ø22 8ØØØ1
72267 32989 12615 1ØØ9Ø 21Ø32 3ØØ83 4Ø21Ø 51Ø3Ø 8ØØØ1
7227Ø 32989 Ø2815 1Ø156 21Ø38 3885Ø 4Ø17Ø 52Ø16
7234Ø 31232 82Ø18 1Ø115 2Ø112 39933 4Ø127 55ØØØ 71ØØ4 885//
72344 32689 73Ø15 1Ø177 2ØØ8Ø 39953 4Ø121 52ØØ7 875ØØ
72348 11589 81914 1Ø17Ø 2Ø1Ø8 39751 4Ø114 56ØØ7 699Ø2 7551Ø 885//
72349 11489 33414 1ØØ87 2ØØ2Ø 39617 4Ø135 53Ø3Ø 699Ø1 7515Ø 8162Ø
72351 32989 13523 1Ø142 2ØØØ7 3982Ø 4Ø189 52Ø34 8ØØØ1
72353 32589 73522 1Ø1Ø5 2ØØØ6 3Ø822 4Ø19Ø 52Ø42 875ØØ
72356 32989 1Ø116 1Ø12Ø 2ØØ2Ø 39926 4Ø17Ø 52Ø41 81Ø7Ø
72363 32589 43616 1ØØ48 21Ø35 38961 4Ø226 51Ø41 845ØØ
72365 32789 1332Ø 1ØØ61 21122 38422 4Ø211 52Ø24 815ØØ
72432 11489 82215 1Ø167 2Ø131 39985 4Ø127 57Ø17 699Ø1 7515Ø 885//
72434 11389 83Ø1Ø 1ØØ92 2ØØ6Ø 399Ø6 4Ø114 5ØØØØ 69952 76165 84727
72446 11489 834Ø7 1ØØ36 2ØØ13 398Ø6 4Ø185 51Ø19 69931 7Ø25Ø 887//
7245Ø 11489 83517 1ØØ57 2ØØ1Ø 39713 4Ø2Ø4 51Ø27 699Ø1 7Ø265 887//
72451 32989 63517 1ØØ4Ø 21ØØ9 39294 4Ø225 51Ø19 8ØØØ8
72458 32989 23512 1ØØ51 21Ø23 39666 4Ø2Ø9 51Ø15 8ØØØ8
72465 32989 Ø3316 1ØØØØ 21Ø86 3893Ø 4Ø244 51Ø24
72531 1137Ø 821Ø9 1ØØ18 2ØØØØ 39881 4Ø13Ø 5ØØ1Ø 69932 77Ø7Ø 88Ø2/
72533 11489 8111Ø 1ØØ56 2ØØ3Ø 39836 4Ø141 57Ø56 69931 76Ø5Ø 8152/
72534 11332 8Ø6Ø5 1ØØ17 2ØØØ7 39922 4Ø154 58Ø17 69982 77Ø7Ø 88Ø2/
7254Ø 31789 732Ø6 1ØØ2Ø 21Ø11 39793 4Ø167 57ØØ3 7Ø265 82571
72544 11ØØ8 828Ø3 1ØØØ8 21ØØ1 39935 4Ø157 58ØØ8 69Ø32 7717Ø 887//
72546 32489 73214 1ØØ46 21Ø12 3981Ø 4Ø166 58ØØ3 82571
72552 32989 Ø3313 1ØØ13 21Ø46 39543 4Ø226 51Ø2Ø
72635 11489 823Ø6 1ØØ4Ø 2ØØ18 39865 4Ø163 58Ø1Ø 699Ø1 7616Ø 885//
72638 31989 7241Ø 1ØØ36 21Ø25 397Ø9 4Ø136 5ØØØØ 8ØØØ6
72641 39689 823Ø8 1ØØ21 21Ø3Ø 39827 4Ø148 58Ø14 7Ø52Ø 815Ø7
72644 32489 2291Ø 1ØØØ6 21Ø33 39661 4Ø152 5ØØØØ 815Ø1
72645 31989 8231Ø 11Ø1Ø 21Ø16 39878 4Ø142 58ØØ7 7Ø51Ø 81Ø37
7265Ø 32989 13Ø1Ø 1ØØØ7 21Ø21 3968Ø 4Ø177 51ØØ8 81Ø5Ø
72655 11448 829Ø6 11Ø26 21Ø39 39777 4Ø164 51Ø14 699Ø1 78585 887//
72734 11589 82712 1ØØ23 21ØØ6 39827 4ØØ97 51Ø1Ø 699Ø1 7268Ø 885//
72741 32589 52513 11ØØ9 21Ø2Ø 39567 4Ø135 5ØØØ3 852ØØ
72743 32389 8281Ø 11Ø1Ø 21Ø36 3956Ø 4ØØ97 5ØØØ3 885//
72745 11489 83Ø13 11Ø21 21Ø67 395Ø1 4Ø129 51ØØ3 699Ø1 7262Ø 885//
72747 11489 834Ø9 11Ø56 21Ø75 3955Ø 4Ø122 52Ø2Ø 699Ø1 7Ø17Ø 885//
72753 32489 23112 11Ø32 21Ø76 39835 4Ø175 51Ø14 8273Ø

Exercise 6

AAXX 27124

72268	32989	Ø3Ø15	1Ø121	21Ø57	38813	4Ø183	52Ø19			
72274	32989	131Ø3	1Ø187	21Ø62	393Ø9	4Ø196	51Ø1Ø	8ØØØ5		
72278	32989	Ø33Ø4	1Ø17Ø	2ØØØ4	39816	4Ø21Ø	51Ø14			
7229Ø	32489	127Ø5	1Ø178	2Ø119	3Ø196	4Ø2Ø7	51Ø14	815ØØ		
72295	31464	127Ø3	1Ø176	2Ø112	3Ø178	4Ø215	51Ø14	7Ø51Ø	815ØØ	
72374	32989	Ø3217	1Ø139	21ØØ6	39634	4Ø242	52Ø29			
72378	32989	Ø271Ø	1ØØ12	21Ø65	39111	4Ø284	53Ø1Ø			
72384	32989	122Ø5	1Ø119	2ØØ3Ø	3ØØ81	4Ø26Ø	51Ø1Ø	8ØØØ8		
72386	32989	6ØØØØ	1ØØ96	21132	3951Ø	4Ø291	52Ø25	8ØØØ1		
72389	32989	614Ø4	1ØØ83	2ØØ42	3Ø144	4Ø265	52Ø17	81Ø45		
72394	32989	1Ø7Ø5	1Ø147	2ØØ2Ø	3Ø131	4Ø219	51Ø12	8ØØØ1		
72464	32489	117Ø3	1ØØØØ	21Ø25	38598	4Ø246	51Ø12	811ØØ		
72472	32589	324Ø8	1ØØ21	21Ø13	39861	4Ø26Ø	52Ø2Ø	835ØØ		
72476	32989	Ø24Ø3	11Ø38	211Ø7	38615	4Ø321	52Ø2Ø			
72485	32989	818Ø8	1ØØ62	2ØØ4Ø	3ØØ44	4Ø3Ø6	52Ø1Ø	8ØØØ7		
72486	32989	Ø23Ø4	11Ø3Ø	21152	38165	4Ø3Ø9	52Ø14			
72488	32989	726Ø3	1ØØØ1	21Ø9Ø	38765	4Ø32Ø	52Ø17	8ØØØ1		
72494	32989	712Ø8	1Ø139	21Ø12	3Ø251	4Ø257	52Ø19			
72499	32989	71212	1Ø1ØØ	21Ø78	38873	4Ø254	52Ø2Ø	87Ø78		
72553	32989	Ø3211	1ØØ29	21Ø21	397Ø3	4Ø194	5ØØ15			
72562	32989	22913	11Ø4Ø	21119	39236	4Ø261	51Ø22	81Ø85		
72567	32589	73Ø13	11Ø15	21Ø66	39787	4Ø248	51Ø15	83531		
72572	32989	Ø25Ø3	11Ø21	21Ø45	39871	4Ø335	52Ø25			
72576	32789	612Ø5	11Ø47	21123	38332	4Ø277	51Ø15	83571		
72578	11489	829Ø5	11Ø6Ø	21Ø9Ø	38744	4Ø351	52Ø2Ø	699Ø1	7Ø27Ø	885//
72583	32989	2Ø61Ø	11Ø39	21Ø86	3881Ø	4Ø352	52Ø2Ø	8ØØØ1		
72594	32989	713Ø3	1ØØ72	2ØØ1Ø	3Ø229	4Ø25Ø	51ØØ8	87Ø78		
72597	111Ø8	835Ø3	11ØØ5	21Ø1Ø	398Ø9	4Ø298	52Ø17	699Ø1	7474Ø	886//
72654	32489	43Ø13	1ØØ1Ø	21Ø31	39716	4Ø2Ø1	51Ø14	845ØØ		
72662	11589	63422	11Ø28	21Ø68	39Ø96	4Ø355	52Ø15	699Ø1	7261Ø	835Ø1
72676	32389	82814	11Ø42	21Ø84	3958Ø	4Ø338	51Ø17	8652/		
72677	11489	83311	11Ø4Ø	21117	39Ø12	4Ø296	52Ø34	69931	78585	85577
72681	32989	213Ø6	11Ø45	21Ø91	393Ø5	4Ø362	51Ø17	81Ø71		
72683	3148Ø	523Ø4	11Ø89	21123	38857	4Ø371	52Ø19	71Ø4Ø	856ØØ	
72688	3198Ø	5ØØØØ	11Ø42	21Ø48	398ØØ	4Ø364	53Ø25	71Ø4Ø	8ØØØ1	
72693	31/16	9Ø4Ø7	1ØØØ7	2ØØØ1	3Ø154	4Ø295	53Ø1Ø	7284Ø		
72698	31559	4Ø2Ø7	1ØØ24	21ØØØ	3Ø3Ø1	4Ø315	53Ø12	71Ø24	826Ø1	
72758	11447	828Ø9	11Ø73	211Ø5	3955Ø	4Ø225	52Ø2Ø	69931	77375	8752/
72764	11748	83Ø18	11Ø56	21Ø82	39595	4Ø222	51Ø24	69932	7717Ø	885//
72767	1148Ø	63216	11Ø78	21121	39539	4Ø26Ø	52Ø34	699Ø1	7718Ø	83708
72768	11548	83216	11Ø97	21123	39449	4Ø318	52Ø34	699Ø2	7717Ø	8452/
72772	11489	8341Ø	11Ø35	21111	3992Ø	4Ø336	52Ø37	699Ø2	78585	885//
72773	32689	4ØØØØ	11Ø2Ø	21Ø82	39174	4Ø344	52Ø29	8257Ø		
72777	11489	62912	11Ø87	2114Ø	3938Ø	4Ø356	52Ø36	699Ø1	7228Ø	811Ø8
72779	32589	225Ø4	11Ø21	21Ø82	39255	4Ø35Ø	52Ø41	8157Ø		
72781	31989	433Ø3	11Ø9Ø	211ØØ	39989	4Ø39Ø	52Ø3Ø	7284Ø	8ØØØ1	
72785	32489	81ØØ6	11Ø29	21Ø82	39484	4Ø366	51Ø27	886//		
72791	32989	7Ø616	1ØØ51	21ØØ9	3Ø29Ø	4Ø298	51ØØ7	8ØØØ1		
72793	3198Ø	7Ø4Ø7	1ØØ1Ø	21ØØØ	3Ø156	4Ø327	52ØØ8	71Ø4Ø	8ØØØ8	
72797	31978	711Ø4	1ØØØ9	21ØØ3	3Ø232	4Ø3Ø9	53Ø1Ø	71Ø4Ø	8ØØØ1	

Exercise 7 (Speedrun)

AAXX 13124
722Ø1 32466 136Ø9 1Ø231 2Ø187 3Ø156 4Ø163 52Ø1Ø 811ØØ
722Ø2 3154Ø 134Ø7 1Ø183 2Ø134 3Ø161 4Ø165 52Ø15 7Ø4Ø1 819ØØ
722Ø5 31958 ØØ4Ø6 1Ø18Ø 2Ø159 3Ø135 4Ø173 52Ø1Ø 7Ø5ØØ
722Ø6 31956 ØØØØØ 1Ø162 2Ø136 3Ø179 4Ø19Ø 52Ø17 71ØØØ
722Ø8 3196Ø Ø36Ø6 1Ø157 2Ø141 3Ø174 4Ø193 52Ø19 71ØØØ
72214 31956 ØØØØØ 1Ø121 2Ø12Ø 3Ø158 4Ø182 53Ø14 71Ø1Ø
72223 31958 ØØ7Ø3 1Ø135 2Ø124 3ØØ98 4Ø176 53Ø1Ø 7Ø59Ø
72226 31958 ØØ5Ø4 1Ø132 2Ø1Ø9 3Ø115 4Ø188 51Ø14 71ØØØ
72231 31948 ØØØØØ 1Ø14Ø 2Ø116 3Ø16Ø 4Ø17Ø 53Ø17 71Ø2Ø
72235 32961 Ø13Ø5 1Ø125 2Ø117 3ØØ54 4Ø173 53Ø1Ø
72248 31356 314Ø7 1Ø163 2Ø16Ø 3ØØ41 4Ø132 53ØØ3 71ØØØ 836ØØ
723Ø4 31959 ØØ513 1Ø154 2ØØ85 3Ø195 4Ø199 51Ø29 7Ø512
723Ø6 32966 Ø36Ø5 1ØØ69 2ØØ66 3ØØ51 4Ø211 52Ø17
72315 319Ø4 3ØØØØ 1ØØ61 2ØØ61 39441 4Ø2Ø9 53Ø12 7444Ø
72324 31959 1ØØØØ 1ØØ84 2ØØ55 39942 4Ø191 51ØØ7 71Ø42 8ØØØ1
72327 31958 7ØØØØ 1ØØ72 2ØØ67 39973 4Ø192 53ØØ7 71Ø1Ø
72329 31/Ø1 9Ø8Ø4 1ØØ81 2ØØ72 39834 4Ø186 5ØØØØ 74712 82Ø31
72334 32974 815Ø6 1Ø164 2ØØ99 3ØØ54 4Ø156 53ØØ7 8ØØØ7
7234Ø 32961 82ØØ5 1Ø165 2Ø129 39939 4Ø131 53ØØ3 88ØØ7
724Ø1 31958 218Ø4 1Ø1ØØ 2ØØ73 3Ø142 4Ø2Ø7 52Ø14 7Ø5Ø1 8ØØØ1
724Ø5 31963 221Ø7 1Ø132 2ØØ67 3Ø179 4Ø2Ø3 51Ø17 7Ø52Ø 8ØØØ1
72411 32982 625Ø3 1ØØ7Ø 2ØØ45 3979Ø 4Ø214 51Ø14 84Ø31
72421 1194Ø 411Ø3 1ØØ93 2ØØ84 39875 4Ø194 51ØØ7 699Ø1 71Ø65 84Ø7Ø
72425 31959 814Ø6 1ØØ78 2ØØ76 39888 4Ø193 5ØØØ2 71Ø2Ø 8ØØØ7
72428 31932 215Ø3 1ØØ9Ø 2ØØ82 39889 4Ø192 51ØØ5 71Ø1Ø 82Ø3Ø
72439 11761 813Ø7 1Ø121 2ØØ87 39923 4Ø146 53ØØ5 699Ø1 76152 8657Ø
7244Ø 11648 816Ø5 1Ø136 2Ø119 39685 4Ø135 5ØØ17 7959Ø 8396Ø
72445 11919 814Ø7 1Ø125 1Ø114 398Ø6 4Ø126 52ØØ7 699Ø1 76121 88Ø5/
725Ø3 3297Ø 22514 1Ø11Ø 2ØØ51 3Ø159 4Ø169 52Ø2Ø 8ØØØ1
725Ø7 32974 12915 1Ø1Ø9 2ØØ32 3ØØ99 4Ø122 52Ø24 81Ø31
72511 31658 626Ø8 1Ø1Ø1 2ØØ64 3Ø181 4Ø181 52Ø17 7Ø5Ø5 815Ø8
72519 3258Ø 22516 1ØØ87 2ØØ15 3ØØØØ 4Ø151 51Ø1Ø 825ØØ
7252Ø 31959 624Ø6 1ØØ72 2ØØ54 39745 4Ø188 52ØØ8 71Ø4Ø 86Ø5Ø
72524 3298Ø 723Ø7 1ØØ65 2ØØ21 39893 4Ø189 53ØØ7 86Ø78
72533 11774 6ØØØØ 1ØØ78 2ØØØ9 39878 4Ø182 5ØØØØ 865ØØ
72544 11563 8Ø811 1ØØ91 2ØØ45 39944 4Ø161 53ØØ5 699Ø1 7Ø28Ø 885//
72546 31456 8Ø711 1ØØ9Ø 2ØØ49 39797 4Ø146 53Ø1Ø 7Ø512 885//
726Ø5 1158Ø 7291Ø 1ØØ99 2ØØ21 3997Ø 4ØØ96 52Ø17 69931 7Ø28Ø 885//
726Ø8 11512 811Ø9 1Ø122 2Ø115 3ØØ88 4Ø116 57Ø2Ø 6ØØ51 78Ø61 885//
72612 1158Ø 8ØØØØ 1ØØ64 2ØØ61 398Ø7 4ØØ87 52ØØ8 6Ø213 78Ø8Ø 8857/
72622 11/Ø1 914Ø2 1ØØ33 2ØØ27 37977 4//// 53ØØ2 6Ø1Ø2 74395
72638 32966 7281Ø 1ØØ57 21Ø1Ø 39746 4Ø169 52ØØ8 82Ø72
72641 11661 7ØØØØ 1ØØ69 2ØØ55 39861 4Ø179 5ØØØØ 69931 72165 8257Ø
72644 11856 2Ø1Ø8 1ØØ54 2ØØ45 39699 4Ø181 55ØØØ 699Ø1 71Ø61 82Ø7Ø
72648 32969 234Ø6 1ØØ56 2ØØØØ 39956 4Ø183 54ØØØ 8ØØØ2
72655 32966 1ØØØØ 1ØØ1Ø 21Ø16 39824 4Ø2Ø3 52Ø1Ø 8ØØØ1
72712 11261 81ØØ8 1Ø146 2Ø144 39836 4ØØ65 56Ø19 6Ø192 71661 887//
72734 11756 83111 1ØØ5Ø 2ØØ3Ø 39887 4Ø156 53ØØ7 69931 78Ø8Ø 885//
72741 32966 ØØ4Ø3 1ØØ29 21Ø63 39638 4Ø196 52ØØ5
72755 32974 3Ø3ØØ 1ØØØ7 21Ø3Ø 39695 4Ø2Ø4 52ØØ7

Exercise 8 (Speedrun)

```
AAXX 13124
72243 31558 716Ø7 1Ø2Ø5 2Ø191 3Ø1ØØ 4Ø138 53ØØ3 7Ø412 8657Ø
7225Ø 32466 81512 1Ø25Ø 2Ø215 3Ø112 4Ø119 53ØØ7 888//
72255 31459 815Ø6 1Ø219 2Ø214 3ØØ88 4Ø13Ø 53ØØ5 71Ø2Ø 885//
72259 32566 81918 1Ø2Ø6 2Ø172 39873 4ØØ81 56ØØ7 885//
72261 32466 8121Ø 1Ø213 2Ø177 39739 4ØØ94 53ØØ8 885//
72265 31958 12ØØ8 1Ø171 2Ø155 391Ø9 4ØØ68 53ØØ7 712ØØ 8ØØ4Ø
72266 32474 11819 1Ø2Ø9 2Ø166 39453 4ØØ63 53ØØ3 816ØØ
7227Ø 32989 231Ø8 1Ø213 2ØØ46 388Ø2 4ØØ87 52Ø15 81Ø72
72274 32984 Ø12Ø8 1Ø168 2ØØ22 39246 4Ø1Ø9 53ØØ5
72295 32566 811Ø8 1Ø173 2ØØ85 3Ø113 4Ø15Ø 54ØØØ 885//
72344 32574 8Ø3Ø9 1Ø184 2Ø137 39942 4Ø1Ø6 53ØØ7 885//
72356 1136Ø 811Ø8 1Ø163 2Ø155 39844 4ØØ84 56ØØ7 69931 76Ø9Ø 8172/
72363 3258Ø 6362Ø 1Ø152 2ØØ79 38865 4ØØ67 52Ø51 866ØØ
72365 32987 12811 1Ø163 21Ø42 38354 4ØØ75 52Ø12 81Ø71
72386 32974 ØØ512 1Ø2ØØ 21Ø43 39357 4Ø1Ø4 52Ø25
72389 32974 Ø28Ø6 1Ø139 2ØØ76 3ØØØØ 4Ø115 53ØØ3
72446 31556 811Ø5 1Ø121 2Ø1Ø9 39749 4Ø115 52Ø2Ø 71Ø2Ø 82577
7245Ø 11574 8Ø5Ø4 1Ø156 2Ø117 39631 4Ø1Ø3 53Ø3Ø 72991 833Ø7
72451 32972 Ø3212 1ØØ39 2ØØ35 39282 4Ø2Ø4 52ØØ7
72464 32989 2Ø5Ø5 1ØØ36 2ØØ21 38595 4Ø197 58ØØ3 81Ø71
72465 32961 Ø26Ø7 1ØØ1Ø 21ØØ6 38921 4Ø213 55ØØØ
72469 3298Ø 22ØØ9 1ØØ58 2ØØ1Ø 3838Ø 4Ø169 56ØØ5 8ØØØ1
72476 32963 6121Ø 1Ø1Ø7 2ØØ32 3ØØØ8 4Ø158 53Ø12
72488 32769 223Ø8 1Ø123 2ØØ39 386Ø6 4ØØ72 58ØØ7 8117Ø
72494 32969 Ø22Ø4 1Ø1ØØ 2ØØØØ 3Ø132 4Ø139 54ØØØ
725 2 32966 Ø29Ø6 1ØØØØ 21Ø13 39254 4Ø21Ø 55ØØØ
72566 11248 8Ø212 1ØØ72 2ØØ59 39612 4Ø175 53Ø14 699Ø1 71Ø51 886//
72567 11458 8Ø411 1ØØ77 2ØØ51 39775 4Ø179 53Ø14 699Ø1 71Ø52 885//
72569 32987 3Ø2Ø4 1ØØØ3 21Ø2Ø 38368 4Ø155 57Ø12 6//// 7888Ø 81Ø48
72572 31983 816Ø7 1ØØ86 2ØØ31 38666 4ØØ9Ø 56Ø14 7142Ø 87Ø87
72578 32987 8ØØØØ 1ØØ4Ø 2ØØØ9 38592 4Ø115 58Ø14 81Ø77
72583 32987 4Ø511 1ØØ42 21Ø65 387ØØ 4Ø172 5ØØØØ 8ØØØ1
72594 11716 83612 1Ø151 2ØØ85 3Ø148 4Ø17Ø 55ØØØ 6ØØ11 76151 887//
72595 32966 112Ø3 1ØØ72 2ØØ44 39685 4Ø161 51ØØ3 8105Ø
72651 32966 1ØØØØ 1ØØ14 21Ø18 39653 4Ø173 54ØØØ 81Ø7Ø
72662 32985 111Ø3 1ØØ31 21ØØ7 39Ø74 4Ø193 57Ø1Ø 8ØØØ1
72677 32984 519Ø5 1ØØ27 21Ø1Ø 38894 4Ø136 54Ø1Ø 82Ø76
72681 3288Ø 814Ø4 1Ø12Ø 2ØØ29 39Ø89 4ØØ77 55ØØ5 8651/
72683 11574 83ØØ2 1ØØ72 2ØØ65 38676 4ØØ93 57Ø2Ø 6ØØ41 76165 88Ø2/
7269Ø 11669 822Ø8 1ØØ62 2ØØØ6 3ØØ12 4Ø146 5ØØØØ 699Ø1 7Ø26Ø 885//
72694 32574 825Ø3 1Ø12Ø 2ØØ83 3ØØ68 4Ø141 51ØØ3 885//
72764 32969 1ØØØØ 11Ø1Ø 21Ø39 39585 4Ø191 54ØØØ 8ØØØ4
72676 32982 6ØØØØ 1ØØ6Ø 2ØØ2Ø 39484 4Ø17Ø 57ØØ8 82Ø36
72768 1198Ø 811Ø9 1ØØ67 2ØØ11 39325 4Ø144 57Ø12 699Ø1 7251Ø 86Ø72
72772 32987 828Ø5 1ØØ51 2ØØ18 38778 4Ø125 57Ø1Ø 86Ø77
72777 32984 214Ø1 1ØØ43 2ØØ31 392ØØ 4Ø121 57ØØ7 82Ø31
72779 11782 736Ø4 1ØØ7Ø 2ØØ56 39Ø76 4Ø116 57ØØ8 699Ø1 7Ø18Ø 81571
72785 32784 4Ø4Ø5 1ØØ62 2ØØ37 39272 4Ø1Ø5 56Ø1Ø 1ØØ57 2ØØ4Ø 8257Ø
72793 12274 818Ø5 1Ø1Ø7 2ØØ85 39959 4Ø122 56ØØ7 699Ø1 887//
72797 11548 83ØØ4 1Ø1Ø1 2ØØ91 3ØØ55 4Ø131 56ØØ3 6ØØ22 76182 8846/
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Exercise 9 (Speedrun)

AAXX 14124
72202 31561 23607 10221 20179 30144 40148 52008 70290 81902
72205 31924 00603 10189 20155 30125 40163 53003 70400
72206 31904 52703 10137 20135 30156 40166 53003 74240
72207 31948 13203 10163 20134 30151 40169 52008 71000 80001
72217 31959 61805 10169 20140 30030 40159 53007 70500 80098
72223 31558 71203 10181 20156 30078 40155 52014 71040 83206
72228 31958 62010 10186 20137 39914 40135 50000 70500 86022
72231 11/24 92810 10200 20173 30151 40160 53020 60052 79510
72234 11648 81807 10179 20155 30028 40140 50003 69961 76180 8357/
72242 11461 83111 10210 20191 30117 40137 53014 60062 72990 8557/
72248 11474 63212 10146 20112 30051 40143 53027 69901 70190 86500
72250 31456 31405 10246 20229 30097 40104 53005 70520 83501
72251 31559 61405 10235 20232 30105 40122 51005 71020 86500
72256 32969 03613 10131 20090 39985 40164 53014
72304 31659 51605 10214 20162 30171 40175 55002 70510 85100
72310 31958 00000 10142 20127 30088 40169 51010 71040
72312 32969 02105 10140 20109 39816 40160 53007
72317 32974 12105 10131 20096 39851 40166 52010 81070
72324 32574 72703 10130 20099 39887 40132 51003 81256
72327 11561 81809 10155 20137 39868 40093 58014 69901 72160 8452/
72334 11366 82108 10176 20160 39985 40086 55000 60142 78090 884//
72340 32761 63210 10140 20092 39915 40107 52014 86500
72349 31558 83112 10085 20081 39604 40112 54000 71020 885//
72402 31958 12110 10163 20137 30172 40176 51002 710// 80070
72403 32966 82005 10160 20134 30039 40156 53008 85071
72410 32974 12006 10154 20109 39824 40158 51007 81030
72422 11766 81712 10161 20084 39736 40085 55010 69901 78020 885//
72425 32966 21407 10133 20116 39810 40108 56010 71010 82070
72429 11656 81015 1//// 20099 39725 40085 57039 60041 71065 8657/
72432 11761 82204 10156 20140 39905 40044 56017 60122 72580 885//
72434 11561 82515 10141 20134 30042 40042 55007 60011 72060 8612/
72446 11458 63510 10100 20078 39749 40120 52010 60112 71060 85501
72518 32066 11609 10103 20071 30053 40161 53007 81970
72521 32966 80410 10107 20020 39699 40045 50000 8802/
72532 11216 80615 10090 20078 39865 40055 57017 60142 76360 887//
72535 11556 80711 10092 20074 3//// 40099 58014 60021 76160 885//
72546 11656 83106 10086 20060 39780 40129 58003 60021 71060 8222/
72547 11561 80408 10075 20019 39736 40128 52003 69931 780// 885//
72553 32969 03407 10088 20037 39674 40157 54000
72608 32566 73211 10101 20074 30098 40125 53007 87500
72613 31/00 92709 11045 21045 37988 4//// 53006 74940
72638 32961 80404 10036 20031 39739 40163 51003 82078
72640 11466 80413 10072 20019 39885 40140 54000 69901 72580 885//
72644 32974 53507 10040 21005 39672 40148 51003 80008
72648 32969 32106 10057 20032 39946 40173 54000 80002
72655 32980 40000 10035 20023 39793 40167 55000 84070
72712 32474 82114 10082 20039 39853 40086 55000 884//
72734 32974 22806 10056 20005 39892 40161 53007 81078
72741 32966 20705 10039 21020 39617 40176 52003 80004
72747 32974 60000 10061 20017 39731 40164 53003 83071

Exercise 10 (Speedrun)

```
AAXX 14124
72253 11680 80213 10196 20131 39865 40140 53024 69901 70260 885//
72261 32561 60909 10203 20125 39775 40128 53024 86570
72265 32774 80516 10116 20054 39194 40169 52014 86508
72266 32874 33600 10100 20073 39563 40188 52010 83070
72267 32774 70607 10093 20036 39075 40183 53007 87500
72270 32980 00000 10138 20062 38820 40115 53008
72274 32984 01208 10162 20007 39225 40084 58003
72278 32985 00903 10233 20036 39701 40080 55000
72290 32966 83006 10180 20131 30119 40129 57010 885//
72295 11561 82307 10170 20109 30098 40135 55005 69901 70251 885//
72351 32566 43209 10075 20072 39824 40192 52014 69901 72501 83270
72353 32680 13112 10081 20054 39716 40183 52010 81300
72363 32984 83307 10088 20032 38957 40194 52010 8807/
72365 32987 10915 10110 21010 38387 40125 54000 81071
72386 32974 01504 10209 21050 39310 40055 56003
72389 32974 13206 10137 20073 39993 40109 56003 80001
72450 32966 03311 10071 20019 39683 40168 52007
72451 32972 03212 10044 20035 39282 40204 52007
72465 32961 02607 10012 21007 39821 40213 55000
72469 32980 22009 10056 20014 38380 40169 56005
72476 32984 61210 10090 21038 38515 40131 56002 80008
72486 32974 32311 10085 21047 38039 40049 57008 83040
72488 32769 22308 10123 20035 38606 40072 58007 81170
72494 32961 13504 10132 20080 30144 40158 51010 80001
72562 32966 02906 10000 21007 39254 40210 55000
72564 32284 22303 10023 20012 38134 40181 57012 82600
72569 31987 30204 10000 21018 38368 40155 57012 78886 81048
72572 31983 81607 10086 20034 38666 40090 56014 71420 87087
72576 32989 71605 10034 21021 38278 40141 56005 81078
72578 32987 80000 10038 20012 38592 40115 58014 81077
72594 11416 83612 10101 20087 30148 40170 55000 60011 76152 887//
72597 32866 83007 10109 20071 39663 40135 53007 3807/
72652 32974 00000 10074 20025 39638 40172 57002
72659 32974 12704 10031 21062 39702 40173 54000 81070
72662 32985 11103 10020 21010 39074 40193 56010 80001
72677 32984 51905 10027 21011 38894 40136 57010 82076
72681 11880 81404 10115 20033 39089 40077 55005 60123 70028 8651/
72683 11574 83002 10074 20071 38676 40093 57020 60040 76162 8802/
72693 11489 82208 10110 20078 30012 40146 50000 69901 70265 885//
72753 32980 61704 10068 21036 39831 40159 54000 82071
72764 32969 10000 11014 21039 39585 40191 54000 80004
72767 32982 60000 10056 20022 39484 40170 57008 82036
72768 11980 81109 10073 20006 39325 40144 56012 69900 72512 86072
72772 32987 82805 10045 20023 38778 40125 57010 86077
72773 32374 81003 10113 20046 39005 40110 56007 885//
72777 32984 21401 10044 20035 39200 40121 57007 82031
72779 11782 73604 10067 20061 39076 40116 57008 69901 70182 81571
72785 32784 40405 10056 20043 39272 40105 56010 82570
72793 12274 81805 10111 20089 39959 40122 56007 887//
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SHIPBOARD SYNOPTIC PLOTTING

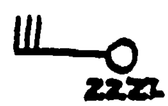
Using shipboard synoptic reports and the appropriate plotting chart, plot 25 reports within 30 minutes with no more than 5 errors in the ten graded stations.

Exercise 1

Instructions: Using the partial reports provided below and a DOD WPC 1-10-3 plotting chart

1) Determine the position of each ship
2) Draw a cicle centered over this position. The circle size will be approximately this size O
3) Plot the wind direction and speed for each ship
4) Label each plotted report with the ship's call letters
5) Have your instructor evaluate your completed work

Example: ZZZZ 23Ø61 992ØØ 7Ø8Ø5 42/98 /2715 would be plotted at 20.0 degrees North latitude and 80.5 degrees West longitude as



AAAA 23Ø64 9925Ø 7Ø7ØØ 42/98 /271Ø

BBBB 23Ø63 9935Ø 7Ø75Ø 42/98 /271Ø

CCCC 23Ø63 994ØØ 7Ø6ØØ 42/98 /21Ø5

DDDD 23Ø64 995ØØ 7Ø5ØØ 42/97 /271Ø

EEEE 23Ø64 9925Ø 7Ø9ØØ 42/98 /2812

FFFF 23Ø64 992ØØ 7Ø95Ø 42/96 /2312

GGGG 23Ø61 99336 7Ø662 42/98 /241Ø

HHHH 23Ø64 99277 7Ø691 42/97 /2615

IIII 23Ø64 99324 7Ø748 42/97 /2734

JJJJ 23Ø6Ø 99553 7Ø554 42/98 /2812

Exercise 2

```
BBXX 29Ø6ØØ
TONY 29Ø61 993ØØ 7Ø8ØØ 42598 129Ø5 1Ø27Ø 2Ø232 39843
     4ØØ19 57Ø16 812ØØ 22273 ØØ29Ø 2Ø2Ø1;
NOBY 29Ø64 99255 7Ø786 41498 81111 1Ø25Ø 2Ø241 39878
     4Ø15Ø 57Ø1Ø 7929Ø 8396/ 22223 ØØ262 2Ø3Ø4 312//
     4Ø8Ø5;
ARNY 29Ø63 99227 7Ø763 42498 8Ø9Ø6 1Ø244 2Ø2ØØ 39688
     4Ø139 57Ø14 8215Ø 22253 ØØ24Ø 2ØØØØ 318// 41214;
CARL 29Ø63 99195 7Ø742 41498 2Ø3Ø4 1Ø284 2Ø24Ø 39949
     4Ø228 57Ø2Ø 78Ø2Ø 823ØØ 22274 ØØ13Ø 2Ø2Ø1 311//
     414Ø3;
BREN 29Ø63 99169 7Ø718 41497 8Ø925 1Ø25Ø 2Ø242 39865
     4Ø138 58Ø1Ø 76Ø6Ø 8581/ 22214 ØØ23Ø 2Ø4Ø4 3Ø6//
     41314;
ARCH 29Ø63 99135 7Ø725 42398 3Ø718 1Ø267 2Ø243 39846
     4Ø119 57Ø12 832Ø7 22274 ØØ278 2Ø5Ø3 3Ø4// 4Ø5Ø4;
ROBY 29Ø63 99155 7Ø766 42598 4Ø415 1Ø281 2Ø244 3981Ø
     4ØØ82 52Ø12 841ØØ 22212 ØØ29Ø 2Ø5Ø3 3Ø4// 4Ø5Ø4;
MEEK 29Ø63 99155 7Ø8Ø4 41598 6Ø413 1Ø283 2Ø25Ø 398Ø8
     4ØØ8Ø 57ØØ2 7Ø44Ø 861ØØ 22212 ØØ29Ø 2ØØØØ 3Ø4//
     4Ø514;
CORB 29Ø63 9918Ø 7Ø87Ø 42398 21Ø15 1Ø287 2Ø254 39837
     4Ø11Ø 56Ø15 821ØØ 22243 ØØ289 2ØØØØ;
FRAZ 29Ø61 992Ø3 7Ø823 41492 2Ø725 1Ø275 2Ø241 39811
     4ØØ81 58Ø18 7959Ø 829ØØ 22233 ØØ278 2Ø6Ø6;
CUUN 29Ø63 99254 7Ø857 41596 8Ø515 1Ø244 2Ø232 39829
     4Ø1ØØ 7616Ø 851ØØ 222// ØØ282 2Ø2Ø2 315// 41216;
MIKE 29Ø64 992Ø2 7Ø918 41596 8Ø812 1Ø253 2Ø2ØØ 39897
     4Ø17Ø 57Ø2Ø 7818Ø 854ØØ 22273 ØØ264 2Ø5Ø5 323//
     4Ø516;
JIMS 29Ø63 99256 7Ø956 42498 42Ø2Ø 1Ø194 2Ø173 39931
     4Ø2Ø7 56Ø1Ø 842ØØ 22234 ØØ19Ø 21111 334// 4Ø612;
DUST 29Ø61 99173 71Ø41 41498 81ØØ5 1Ø2Ø4 2Ø2ØØ 39878
     4ØØ15 57Ø11 75Ø5Ø 886// 22254 ØØ2Ø3 2Ø1Ø1 3Ø1//
     411Ø5;
WLAH 29Ø63 99222 71172 42498 73427 1Ø214 2Ø184 39834
     4Ø1Ø8 54ØØØ 864ØØ 22264 ØØ175 21Ø1Ø 327// 4Ø7Ø8;
GOGO 29Ø64 99235 71Ø72 42/98 52512 1Ø19Ø 2Ø16Ø 39932
     4Ø2Ø8 8//// 222// ØØ17Ø 225Ø7 329// 4Ø5Ø9;
PHEN 29Ø61 99213 71156 41598 8Ø7Ø3 1Ø168 2Ø122 39957
     4Ø235 55Ø11 7Ø16Ø 885// 22285 ØØ175 2Ø4Ø2 313//
     413Ø5;
JXRN 29Ø61 99275 71161 42498 5Ø5Ø6 1Ø267 2Ø254 3289Ø
     4Ø163 52Ø15 85261 22214 ØØ265 2ØØØØ 313// 41Ø1Ø;
FPLX 29Ø64 9925Ø 712ØØ 41996 Ø36Ø4 1Ø181 2Ø18Ø 39973
     4Ø25Ø 7454Ø 222// ØØ17Ø 2Ø9Ø1 312// 4Ø6Ø4;
KPZA 29Ø63 992ØØ 71241 42498 2Ø725 1Ø275 2Ø252 39881
     4ØØ81 58Ø17 821ØØ 22233 ØØ278 2Ø6Ø6;
LAST 29Ø63 99262 71261 41797 8Ø812 1Ø211 2Ø127 39892
     4Ø166 57Ø2Ø 7814Ø 887// 22264 ØØ244 2Ø3Ø3 3Ø8//
     4Ø5Ø5;
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Exercise 3

```
BBXX 15ØØØØ
AZUE 15ØØ4 9954Ø 7145Ø 41498 62125 1Ø211 2Ø2Ø4 3981Ø
     4ØØ82 57ØØ5 7216Ø 84511 22223 ØØ1Ø6 2Ø5Ø8 3Ø7//
     433Ø7;
BYUF 15ØØ3 9948Ø 7147Ø 41598 42217 1Ø216 2Ø193 39858
     4Ø13Ø 56ØØ2 7158Ø 83152 22235 ØØ112 2Ø6Ø6 3Ø6//
     436Ø6;
CXWG 15ØØ1 9949Ø 7138Ø 42698 32512 1Ø222 2Ø2Ø4 39872
     4Ø145 55ØØ7 8223Ø 22244 ØØ123 2Ø7Ø4 3Ø5// 434Ø5;
DLXH 15ØØØ 9942Ø 714ØØ 42998 225Ø9 1Ø227 2Ø191 39995
     4Ø18Ø 54ØØØ 8ØØØ3 22216 ØØ146 2Ø2Ø3 3Ø7// 436Ø6;
EMYI 15ØØ4 9936Ø 7145Ø 42998 124Ø8 1Ø233 2Ø2ØØ 39926
     4Ø2Ø2 53Ø1Ø 8ØØØ4 22251 ØØ172 2Ø3Ø3 3Ø6// 435Ø4;
FPZJ 15ØØ3 9945Ø 7132Ø 41598 32611 1Ø238 2Ø181 39897
     4Ø172 52ØØ7 7Ø18Ø 81546 22273 ØØ186 2Ø3Ø4 3Ø5//
     434Ø3;
GQAK 15ØØ4 994ØØ 7133Ø 42998 Ø34Ø3 1Ø244 2Ø172 39997
     4Ø18Ø 51ØØ5 22262 ØØ192 2Ø1Ø1 3Ø5// 435Ø4;
HRBL 15ØØ4 9935Ø 7135Ø 42998 131Ø5 1Ø249 2Ø17Ø 39922
     4Ø196 5ØØØ2 8ØØØ5 22284 ØØ244 2Ø3Ø2 314// 434Ø4;
JSCM 15ØØ3 994ØØ 7125Ø 41997 134Ø4 1Ø255 2Ø183 39892
     4Ø165 51ØØ5 7Ø54Ø 8ØØØ8 222ØØ ØØ265 2Ø4Ø3 3Ø5//
     433Ø3;
KTDN 15ØØ1 9936Ø 7124Ø 41998 Ø361Ø 1Ø25Ø 2Ø2ØØ 39887
     4Ø16Ø 52ØØ2 78Ø11 222// ØØ25Ø 2Ø4Ø4 3Ø6// 432Ø2;
NPBY 15ØØ4 9929Ø 7135Ø 41998 Ø35Ø2 1Ø261 2Ø248 39914
     4Ø19Ø 58ØØ2 7258Ø 22213 ØØ252 2ØØØØ 3Ø5// 436Ø1;
TONY 15ØØ4 9928Ø 7127Ø 41698 5Ø314 1Ø263 2Ø24Ø 39868
     4Ø141 52ØØ3 7216Ø 82127 22234 2Ø4Ø3 314// 4Ø2Ø2;
CARL 15ØØ4 9929Ø 7121Ø 41598 7Ø212 1Ø277 2Ø254 39841
     4Ø115 51ØØ5 72Ø6Ø 85272 22254 ØØ257 2Ø5Ø3 3Ø6//
     4Ø3Ø2;
ARNY 15ØØ4 9924Ø 7136Ø 41498 8Ø311 1Ø275 2Ø232 39897
     4Ø17Ø 53Ø1Ø 71952 86389 22273 ØØ245 2Ø4Ø2 3Ø5//
     4Ø4Ø3;
BREN 15ØØ4 9924Ø 7123Ø 41798 7Ø316 1Ø286 2Ø241 39834
     4Ø1Ø7 54ØØØ 78181 8349Ø 222[illegible]2 ØØ266 2Ø3Ø4 314//
     4Ø5Ø2;
ARCH 15ØØ4 992ØØ 7125Ø 41/98 6Ø317 1Ø284 2Ø26Ø 39831
     4Ø1Ø2 7171Ø 8//// 222// ØØ274 2Ø6Ø4 3Ø5// 4Ø6Ø1;
RICH 15ØØ4 9919Ø 713ØØ 41598 4Ø215 1Ø292 2Ø25Ø 39837
     4Ø11Ø 55ØØØ 7166Ø 83861 22241 ØØ292 2Ø2Ø3 3Ø6//
     4Ø7Ø1;
NAVY 15ØØ4 9915Ø 7134Ø 41398 6Ø315 1Ø29Ø 2Ø24Ø 39837
     4Ø11Ø 71561 863ØØ 222// ØØ285 2Ø4Ø4 3Ø7// 4Ø8Ø2;
USMC 15ØØ4 9912Ø 713ØØ 41798 8Ø312 1Ø3Ø9 2Ø251 3981Ø
     4ØØ81 57ØØ5 71462 873// 22254 ØØ294 2Ø2Ø3 3Ø5//
     4Ø9Ø2;
USAF 15ØØ4 9914Ø 7125Ø 41998 8Ø3Ø7 1Ø3Ø4 2Ø244 39799
     4ØØ7Ø 56ØØ2 7139Ø 894// 22263 ØØ284 2Ø5Ø4 3Ø7//
     4Ø8Ø2;
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GUAM 15ØØ1 99282 71171 41998 7Ø5Ø4 1Ø28Ø 2Ø25Ø 39833
     4Ø1Ø5 5ØØØØ 7ØØ4Ø 8ØØØ1 222ØØ ØØ28Ø 2//Ø2;
ROME 15ØØ1 99269 71111 42998 612Ø3 1Ø271 2Ø239 39821
     4ØØ91 55ØØØ 8ØØØ2 222ØØ ØØ272 2Ø5Ø3;
REGG 15ØØØ 99239 71182 42998 4Ø6Ø5 1Ø292 2Ø253 39819
     4ØØ9Ø 54ØØØ 8ØØØ2 222ØØ ØØ259 2Ø4Ø2;
IEJA 15ØØØ 9924Ø 71128 42998 5Ø7Ø5 1Ø3Ø1 2Ø228 39814
     4ØØ86 5ØØØØ 8ØØØ1 222ØØ ØØ281 2Ø6Ø2;
CKSC 15ØØ1 99231 71Ø8Ø 41497 811Ø3 1Ø275 2Ø262 39987
     4ØØ79 54ØØØ 7Ø541 8662Ø 222ØØ ØØ279 2Ø5Ø1;
NOBY 15ØØØ 99161 71148 41/96 /Ø6Ø1 1Ø284 3998Ø 4ØØ72
     55ØØØ 78Ø91 8//// 222ØØ ØØ268 2ØØØØ;
YAKS 15ØØØ 99181 711ØØ 41/95 812Ø1 1Ø273 2Ø262 39797
     4ØØ69 78182 8//// 22212 ØØ272 2ØØØØ;
SWAN 15ØØ1 99192 71Ø6Ø 41494 812Ø1 1Ø262 2Ø262 39799
     4ØØ7Ø 79162 889// 222// ØØ259 2ØØØØ;
WINO 15ØØ4 9925Ø 7Ø95Ø 41593 8151Ø 1Ø269 39819 4ØØ9Ø
     5ØØØØ 7925Ø 885// 222ØØ ØØ261 2Ø4Ø2 313// 4Ø9Ø2;
LAST 15ØØ4 99221 7Ø919 41592 814Ø8 1Ø266 2Ø259 39819
     4ØØ92 55ØØØ 78281 883// 222ØØ ØØ272 2Ø5Ø3 314//
     4Ø8Ø4;
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Exercise 4

```
BBXX 29Ø6ØØ
FNAK 29Ø64 9928Ø 7Ø7ØØ 42698 5331Ø 11ØØ1 21152 3991Ø
     4Ø185 57Ø1Ø 8457Ø 222ØØ ØØ221 2Ø2Ø8 313// 413Ø3;
JMQG 29Ø64 99275 7Ø775 41598 6222Ø 1Ø192 2Ø161 39912
     4Ø187 58ØØ9 7141Ø 8546Ø 22213 ØØ219 2Ø5Ø7;
URUX 29Ø64 99251 7Ø749 41598 62118 1Ø2Ø3 2Ø17Ø 39912
     4Ø186 5ØØØ8 7152Ø 865ØØ 22224 ØØ218 2Ø4Ø7 314//
     412Ø4;
PFUS 29Ø64 99244 7Ø715 41496 61915 1Ø195 2Ø179 39914
     4Ø19Ø 51ØØ7 78Ø81 862ØØ 22235 ØØ2Ø5 2Ø5Ø5 3Ø5//
     411Ø5;
KPYW 29Ø64 99282 7Ø858 41497 51814 1Ø216 2Ø2ØØ 39912
     4Ø187 52ØØ6 72181 851ØØ 22246 ØØ218 2Ø7Ø4;
DHKE 29Ø64 9925Ø 7Ø8ØØ 41598 41813 1Ø2Ø7 2Ø188 39911
     4Ø185 53ØØ5 72582 831Ø1 22255 ØØ227 2Ø6Ø3 314//
     41ØØ6;
TLWR 29Ø64 99247 7Ø669 41998 31812 1Ø2Ø8 2Ø188 399Ø5
     4Ø179 54ØØØ 72Ø62 8ØØØ1 22264 ØØ236 2Ø6Ø2;
KPZA 29Ø64 992Ø2 7Ø7Ø3 41596 2181Ø 1Ø249 2Ø24Ø 39893
     4Ø167 55ØØ2 71242 821ØØ 22273 ØØ257 2Ø6Ø2;
KHCJ 29Ø64 99191 7Ø792 41899 1161Ø 1Ø21Ø 2Ø164 39913
     4Ø188 56ØØ2 71631 81Ø7Ø 22282 ØØ2Ø6 2Ø5Ø3 313//
     4Ø9Ø5;
WMDZ 29Ø64 992Ø5 7Ø843 41498 41612 1Ø221 2Ø199 3991Ø
     4Ø185 57Ø1Ø 7Ø182 8327Ø 222ØØ ØØ221 2Ø6Ø4;
UGOV 29Ø6Ø 994ØØ 7Ø65Ø 42598 3151Ø 1Ø25Ø 2Ø224 39878
     4Ø15Ø 58ØØ8 7Ø11Ø 833ØØ 22212 ØØ25Ø 2Ø5Ø3;
WLAH 29Ø63 9937Ø 7Ø67Ø 42998 Ø131Ø 1Ø268 21Ø21 39868
     4Ø14Ø 51ØØ6 22223 ØØ269 2Ø5Ø2;
GCCV 29Ø63 9935Ø 7Ø7ØØ 41598 11Ø12 1Ø269 2Ø222 39858
     4Ø132 52ØØ5 71312 811ØØ 22234 ØØ281 2Ø2Ø2;
PHFN 29Ø64 9934Ø 7Ø74Ø 41/97 71917 1Ø214 2Ø211 39997
     4Ø18Ø 75151 8//// 222// ØØ2Ø7 2Ø5Ø6;
JXRN 29Ø63 9935Ø 7Ø63Ø 41398 818Ø8 1Ø278 2Ø224 39851
     4Ø125 53ØØ3 7Ø331 883// 22245 ØØ276 2Ø5Ø4;
FPLX 29Ø64 9933Ø 7Ø66Ø 41497 716Ø9 1Ø282 2Ø219 39863
     4Ø135 54ØØØ 7Ø582 875ØØ 22256 ØØ29Ø 2Ø8Ø2;
TONY 29Ø64 9932Ø 7Ø71Ø 42598 41216 1Ø264 2Ø211 39865
     4Ø138 55Ø12 842ØØ 22267 ØØ223 21ØØ4;
NOBY 29Ø64 99315 7Ø75Ø 42998 ØØ9Ø3 1Ø282 2Ø214 39848
     4Ø12Ø 56Ø1Ø 22289 ØØ282 2ØØØØ;
CARL 29Ø64 9931Ø 7Ø8ØØ 42998 116Ø2 1Ø29Ø 2Ø239 39838
     4Ø11Ø 58Ø12 8ØØØ1 22218 ØØ27Ø 2ØØØØ;
BREN 29Ø64 9931Ø 7Ø64Ø 41191 883Ø6 1Ø24Ø 212ØØ 3973Ø
     4ØØØ1 5727Ø 79592 889// 22228 ØØ275 21732 3Ø9//
     4Ø926;
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Exercise 5

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RRXX Ø518ØØ

NAVY Ø5184 9942Ø 7Ø61Ø 41598 51214 1Ø121 2ØØ9Ø 39997
     4Ø182 57Ø1Ø 7Ø37Ø 8211Ø 22213 ØØØ63 2Ø6Ø4 314//
     418Ø9;
USAF Ø5184 994ØØ 7Ø72Ø 42498 2Ø619 1Ø132 2Ø111 39872
     4Ø145 58ØØ7 818Ø6 22265 ØØØ67 2Ø7Ø5;
USMC Ø5184 99391 7Ø662 42998 31Ø16 1Ø153 2Ø129 39877
     4Ø149 55Ø1Ø 81Ø25 22224 ØØØ71 2Ø6Ø4;
DIME Ø5184 99339 7Ø739 42998 4Ø824 1Ø166 2Ø154 39853
     4ØØ92 54ØØØ 81Ø33 22233 ØØØ89 2Ø5Ø6 3Ø5// 416Ø7
SAIL Ø5184 99361 7Ø691 41/9Ø 9Ø916 1Ø144 2Ø142 39845
     4Ø119 55Ø12 74241 89/// 22276 ØØØ96 2Ø4Ø4;
LOST Ø5184 99342 7Ø65Ø 41595 81221 1Ø151 2Ø15Ø 39848
     4Ø121 56ØØ5 751Ø1 866Ø2 22245 ØØ121 2Ø7Ø5;
HART Ø5184 99355 7Ø61Ø 41498 71314 1Ø167 2Ø1ØØ 39868
     4Ø14Ø 58Ø15 7131Ø 8514Ø 22284 ØØ142 2Ø9Ø4 3Ø6//
     42ØØ5;
FAST Ø5184 99319 7Ø69Ø 42998 11417 1Ø161 2Ø131 398Ø5
     4ØØ9Ø 57Ø4Ø 81Ø6Ø 222ØØ ØØ161 2Ø3Ø4;
HLLF Ø5184 993Ø9 7Ø791 41998 Ø3524 1Ø17Ø 2Ø124 39814
     4ØØ85 56Ø3Ø 72121 8ØØØØ 22212 ØØ15Ø 212Ø6;
ONLY Ø5184 99275 7Ø891 41293 53414 1Ø172 2Ø132 39868
     4Ø14Ø 54ØØØ 7911Ø 829Ø4 22263 ØØ163 2Ø3Ø3;
POND Ø5184 99247 7Ø829 41598 33121 1Ø185 2Ø147 39848
     4Ø112 52Ø12 7Ø391 8277Ø 22274 ØØ177 2Ø8Ø5;
SAME Ø5184 99231 7Ø779 41498 72612 1Ø253 2Ø2Ø3 39829
     4Ø1Ø1 5ØØ2Ø 715Ø1 855Ø7 22232 ØØ182 2Ø6Ø4;
COME Ø5184 99189 7Ø8ØØ 42598 62514 1Ø274 2Ø218 39858
     4Ø13Ø 51ØØ6 7Ø221 8249Ø 22221 ØØ195 2Ø5Ø3 314//
     43312;
HARD Ø5184 99169 7Ø848 41/91 9261Ø 1Ø266 2Ø26Ø 39885
     4Ø158 53ØØ5 74552 8//// 22244 ØØ213 2Ø4Ø2;
SHOT Ø5184 99262 7Ø721 41594 82512 1Ø267 2Ø231 398Ø9
     4ØØ8Ø 54ØØØ 76262 86288 22253 ØØ242 2Ø7Ø4;
SOFT Ø5184 9928Ø 7Ø66Ø 42998 Ø2Ø1Ø 1Ø25Ø 2Ø2Ø4 39843
     4Ø115 5ØØØ2 22272 ØØ237 2Ø6Ø3 3Ø5// 432Ø5;
SLIM Ø5184 99295 7Ø739 41696 4ØØØØ 1Ø243 2Ø2Ø9 39788
     4ØØ6Ø 56Ø1Ø 78Ø21 833Ø9 22284 ØØ223 2ØØØØ;
FAIL Ø5184 99216 7Ø699 41/98 /2417 1Ø285 2Ø222 39858
     4Ø132 56ØØ8 7Ø281 8//// 22281 ØØ276 2Ø7Ø4;
LAST Ø5184 99178 7Ø74Ø 42298 Ø2512 1Ø293 2Ø241 39881
     4Ø156 222// ØØ282 2Ø7Ø3 3Ø7// 431Ø4;
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Exercise 6

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BBXX 29Ø6ØØ
FNAK 29Ø63 99299 7Ø8Ø1 42598 129Ø5 1Ø27Ø 2Ø228 39847
     4Ø119 57Ø16 812ØØ 22233 ØØ29Ø 2Ø2Ø1;
JMQG 29Ø61 99255 7Ø786 41491 811Ø5 1Ø25Ø 2Ø241 39878
     4Ø15Ø 56Ø2Ø 79291 8396/ 22223 Ø1Ø22 2Ø3Ø4 3Ø8//
     412Ø5;
URUX 29Ø63 99227 7Ø763 41498 8Ø9Ø9 1Ø244 2Ø2ØØ 39865
     4Ø139 55Ø14 71562 8215/ 22253 ØØ24Ø 2Ø4Ø3 312//
     4Ø9Ø6;
PFUS 29Ø64 99195 7Ø742 42498 2Ø3Ø4 1Ø284 2Ø237 39829
     4Ø1Ø2 58ØØ5 823ØØ 22274 ØØ3ØØ 2Ø2Ø1 314// 411Ø3;
KPYW 29Ø64 99169 7Ø718 41497 8Ø923 1Ø25Ø 2Ø243 39865
     4Ø138 58Ø1Ø 76Ø62 8581/ 22214 ØØ233 2Ø4Ø4 313//
     4Ø614;
NAVY 29Ø64 99135 7Ø725 42398 3Ø718 1Ø264 2Ø244 39844
     4Ø119 57Ø1Ø 832Ø7 22274 ØØ278 2Ø5Ø3 3Ø5// 4Ø4Ø4;
DHLE 29Ø63 99155 7Ø766 42598 4Ø415 1Ø281 2Ø236 39989
     4ØØ82 52Ø12 841ØØ 22212 ØØ29Ø 2Ø6Ø6 313// 4Ø3Ø5;
USAF 29Ø64 99155 7Ø8Ø4 42597 6Ø413 1Ø283 2Ø254 39989
     4ØØ3Ø 57ØØ2 7Ø452 84136 22212 ØØ29Ø 2Ø5Ø2 3Ø5//
     4Ø4Ø2;
TLWR 29Ø64 9918Ø 7Ø87Ø 42598 21Ø15 1Ø278 2Ø26Ø 39837
     4Ø11Ø 51ØØ7 8117Ø 22243 ØØ289 2Ø4Ø3;
USMC 29Ø64 992Ø3 7Ø823 41392 5Ø725 1Ø275 2Ø237 39988
     4ØØ81 52Ø1Ø 79592 83944 22235 ØØ278 2Ø6Ø6;
WIND 29Ø64 992Ø2 7Ø918 4158Ø 8Ø812 1Ø253 2Ø199 39895
     4Ø17Ø 57Ø2Ø 78181 8622/ 22273 ØØ268 2Ø2Ø5;
WMDZ 29Ø64 99256 7Ø956 41698 72Ø2Ø 1Ø194 2Ø172 39931
     4Ø2Ø7 54ØØØ 72121 83481 22234 ØØ19Ø 2112Ø 3Ø6//
     43412;
UGOV 29Ø64 99173 71Ø41 41998 Ø1ØØ5 1Ø2ØØ 2Ø197 39837
     4Ø11Ø 53ØØ6 7Ø242 22243 ØØ2ØØ 2Ø1Ø1 311// 4Ø1Ø5;
WLAH 29Ø64 99222 71172 41/93 93427 1Ø214 2Ø183 39834
     4Ø1Ø8 5ØØØ2 74542 8//// 22264 ØØ175 2Ø6Ø5 3Ø5//
     428Ø4;
GCCV 29Ø64 99235 71Ø72 42/98 12512 1Ø19Ø 2Ø161 39932
     4Ø2Ø8 222// ØØ17Ø 2Ø7Ø3 3Ø5// 4Ø4Ø4;
PHFN 29Ø64 99213 71156 41898 2Ø915 1Ø168 2Ø119 39958
     4Ø235 5ØØØ6 75Ø41 81Ø98 22285 ØØ175 2Ø4Ø2;
JXRN 29Ø63 99275 71161 42598 1Ø5Ø9 1Ø267 2Ø248 39758
     4ØØ32 5ØØØØ 811ØØ 22283 ØØ265 2////;
SHIP 29Ø64 992ØØ 71241 42998 8Ø725 1Ø275 2Ø246 39988
     4ØØ81 55Ø1Ø 8ØØØ2 22234 ØØ278 2Ø6Ø6;
FPLX 29Ø64 9925Ø 712Ø5 42998 736Ø2 1Ø18Ø 2Ø159 39973
     4Ø25Ø 56ØØ6 8ØØØ3 22245 ØØ17Ø 2Ø9Ø1 3Ø6// 412Ø4;
LAST 29Ø64 99262 71261 42998 6Ø812 1Ø217 2Ø21Ø 39893
     4Ø166 57ØØ4 8ØØØ9 22254 ØØ244 2Ø2Ø3 3Ø5// 4Ø8Ø5;
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Exercise 7 (Speedrun)

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BBXX 27ØØØØ
AQLM 27ØØ4 9953Ø 7Ø516 41/92 9363Ø 1ØØ62 2ØØ48 39814
     4ØØ85 53Ø14 7452Ø 8//// 22255 ØØØ83 21ØØ3 314//
     42514;
DEAL 27ØØ3 99441 7Ø611 42498 82526 1Ø255 2Ø163 3979Ø
     4ØØ61 58Ø13 88Ø7/ 22224 ØØ263 2Ø8Ø7 3Ø5// 428Ø7;
DDJY 27ØØ4 99517 7Ø477 42897 12715 1Ø216 2Ø18Ø 398Ø5
     4ØØ78 52Ø3Ø 81Ø3Ø 22255 ØØ2Ø3 2Ø71Ø 311// 435Ø2;
KXFW 27ØØ4 99491 7Ø489 41597 427Ø4 1Ø276 2Ø199 39832
     4Ø1Ø4 52Ø1Ø 71582 842ØØ 22215 ØØ254 2Ø31Ø 3Ø5//
     43Ø1Ø;
NLVR 27ØØ4 9942Ø 7Ø553 41698 72725 1Ø197 2Ø138 3976Ø
     4ØØ31 52ØØ5 78192 8124Ø 22253 ØØ225 2Ø815 312//
     43314;
NNUZ 27ØØ4 99446 7Ø57Ø 42598 63222 1Ø2Ø6 2Ø182 39815
     4ØØ88 55ØØ6 8526Ø 22252 ØØ215 2Ø5Ø9 312// 415Ø8;
KQYP 27ØØ4 99281 7Ø663 41396 614Ø7 1Ø2Ø7 2Ø184 399Ø5
     4Ø18Ø 52Ø17 7616Ø 8167Ø 22253 ØØ147 2Ø4Ø8 313//
     431Ø4;
ENPE 27ØØ3 99251 7Ø718 41393 83427 1ØØ46 2ØØ11 39566
     49898 57ØØ3 71242 884// 22225 ØØØ44 2Ø5Ø8 312//
     41312;
KLAT 27ØØ4 99392 7Ø576 41495 1Ø21Ø 1Ø239 2Ø188 39888
     4Ø163 52ØØ8 7951Ø 819ØØ 22225 ØØ257 2Ø2Ø8 3Ø5//
     4Ø2Ø7;
KEHJ 27ØØ4 99324 7Ø625 42998 114Ø9 1ØØ24 2ØØ1Ø 39652
     49838 51Ø17 81Ø7Ø 22265 ØØØ35 2Ø4Ø7 3Ø5// 412Ø7;
FFRT 27ØØ3 99379 7Ø662 41597 82838 1ØØ63 2ØØ11 39697
     49968 52Ø17 72Ø52 885// 22262 ØØ114 2Ø5Ø8 3Ø8//
     41612;
WSUO 27ØØ4 993Ø8 7Ø766 41396 825Ø9 1Ø166 2Ø158 39732
     4ØØØ2 55ØØØ 72162 886// 22254 ØØ213 2Ø4Ø4 3Ø5//
     421Ø9;
OGLE 27ØØ4 99359 7Ø619 41598 83624 1ØØ42 2ØØ1Ø 39655
     49924 52Ø17 75Ø51 886// 22246 ØØØ41 2Ø6Ø6 314//
     4252Ø;
HORO 27ØØ4 99241 7Ø68Ø 41997 6Ø51Ø 1Ø234 2Ø167 39934
     4Ø21Ø 56ØØ4 7146Ø 82Ø78 22283 ØØ242 2Ø5Ø4 313//
     4Ø2Ø6;
YTAE 27ØØ4 99344 7Ø719 42398 32Ø23 1Ø325 2Ø279 39822
     4ØØ95 56Ø12 821Ø1 22216 ØØ295 2Ø811 314// 43312;
USLK 27ØØ3 99294 7Ø717 41368 8Ø5Ø4 1Ø164 2Ø141 39941
     4Ø217 53Ø1Ø 71682 882// 22253 ØØ114 2Ø8Ø6 314//
     43Ø15;
UUUM 27ØØ1 99299 7Ø639 42598 41345 1ØØ45 2ØØ33 397Ø2
     49972 57Ø3Ø 841ØØ 22225 ØØØ44 2Ø7Ø6 311// 421Ø5;
MATX 27ØØ4 99154 7Ø7Ø3 42597 332Ø4 1Ø134 2ØØ77 397Ø7
     49977 53Ø13 72583 822Ø1 22262 ØØ2Ø5 2Ø6Ø8 3Ø5//
     4281Ø;
FAOI 27ØØ4 99152 7Ø756 42395 8Ø237 1ØØ41 2ØØ39 39653
     49921 54ØØØ 76Ø52 886// 22222 ØØØ61 2Ø5Ø7 312//
     4Ø5Ø8;
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Exercise 7 (Cont)

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SKCT 27ØØ4 99159 7Ø788 42898 6Ø51Ø 1ØØ75 2ØØ63 3967Ø
     49938 54ØØØ 86Ø2Ø 22258 ØØØ43 2Ø4Ø8 3Ø8// 427Ø8;
EIPZ 27ØØ4 99169 7Ø818 41396 63424 1Ø164 2ØØ79 39653
     49921 53Ø14 71583 862ØØ 22213 ØØ2Ø3 2Ø6Ø7 312//
     4151Ø;
MWMN 27ØØ4 994Ø2 7Ø625 41296 62933 1Ø2Ø5 2Ø127 39753
     4ØØ25 53ØØ2 78281 84732 22213 ØØ2Ø6 21Ø12 312//
     41511;
NFXX 27ØØ4 99132 7Ø736 41798 6Ø734 1ØØ66 2ØØ5Ø 39742
     4ØØ1Ø 51Ø1Ø 75Ø5Ø 864ØØ 22213 ØØØ83 2Ø9Ø8 312//
     426Ø4;
ELLS 27ØØ4 99378 7Ø712 42498 8Ø512 1ØØ43 2ØØ32 39836
     4Ø1Ø9 56Ø1Ø 885// 22224 ØØØ54 2Ø81Ø 312// 424Ø8;
PESI 27ØØ4 99273 7Ø75Ø 42598 8Ø915 1Ø254 2Ø219 399Ø2
     4Ø176 58ØØ5 81422 22225 ØØ265 2Ø8Ø6 312// 416Ø4;
DEAD 27ØØ4 992ØØ 7Ø8ØØ 41395 8Ø218 1Ø125 2ØØ91 39854
     4Ø129 54ØØØ 76Ø63 8772/ 22263 ØØ184 2Ø6Ø7 313//
     428Ø3;
QYRT 27ØØ4 99597 7Ø856 42598 5Ø22Ø 1Ø225 2Ø2Ø2 39942
     4Ø217 53Ø19 8482Ø 22265 ØØ225 2Ø3Ø6 3Ø6// 4241Ø;
QING 27ØØ4 99189 7Ø848 42398 8Ø2Ø2 1Ø214 2Ø188 39922
     4Ø197 52Ø11 87221 22275 ØØ215 2Ø5Ø2 3Ø6// 41918;
ROEF 27ØØ4 9927Ø 7Ø86Ø 41496 818Ø9 1Ø185 2Ø156 39922
     4Ø196 51ØØ2 7162Ø 885// 22226 ØØ2Ø5 2Ø6Ø6 312//
     4Ø516;
SHET 27ØØ4 99241 7Ø892 42998 ØØ91Ø 1Ø186 2Ø163 39868
     4Ø142 53ØØ2 22264 ØØ195 2Ø3Ø8 313// 415Ø9;
WHLM 27ØØ4 9927Ø 7Ø922 41498 71112 11Ø16 21Ø53 39924
     4Ø2Ø1 52ØØ8 7251Ø 878ØØ 22215 Ø1ØØ6 2Ø4Ø5 3Ø8//
     42521;
KTEN 27ØØ4 99235 7Ø95Ø 42598 418Ø9 1Ø214 2Ø192 39981
     4Ø258 52ØØ5 81262 22215 ØØ21Ø 2Ø6Ø7 312// 415Ø5;
DALE 27ØØ4 992Ø9 7Ø928 41595 8Ø726 1Ø145 2Ø118 39712
     49983 53ØØ2 75153 887// 22262 ØØ145 2Ø61Ø 311//
     412Ø4;
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Exercise 8 (Speedrun)

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BBXX 16ØØØØ
EDAM 16ØØ4 9931Ø 71347 41398 8323Ø 1ØØ64 2ØØ39 399Ø5
     4Ø213 54ØØØ 71682 887// 22224 ØØ154 2Ø5Ø8;
JYAK 16ØØ4 99365 71278 41/92 93218 1ØØ56 2ØØ51 39844
     4Ø118 55ØØØ 74541 8//// 22214 ØØ1Ø5 2Ø6Ø4;
HOOL 16ØØ4 99252 71191 41598 52518 1ØØ34 2ØØ11 39718
     49988 51ØØ5 78282 8236Ø 222ØØ ØØØ64 2Ø5Ø8 31Ø//
     42ØØ8;
WWHK 16ØØ4 99432 71352 42499 82323 1Ø173 2ØØ9Ø 39871
     4Ø146 52Ø2Ø 84417 22268 ØØ174 2Ø6Ø8;
NNEU 16ØØ4 99487 71442 41493 8292Ø 1ØØ86 2ØØ49 39799
     4ØØ71 56ØØ5 7656Ø 887// 22225 ØØ123 2Ø5Ø9;
8HH3 16ØØØ 99532 71557 42498 4Ø911 1Ø245 2Ø156 39946
     4Ø222 56Ø18 8216Ø 22256 ØØ234 2Ø5Ø7;
ICES 16ØØ4 99236 71375 42596 4Ø713 1Ø255 2Ø217 39898
     4Ø196 57Ø1Ø 8386Ø 22266 ØØ254 2Ø4Ø7 3Ø5// 4Ø8Ø8;
KOHD 16ØØ4 99162 71332 41497 82718 1Ø185 39832 4Ø1Ø4
     57Ø17 7Ø252 87561 22286 ØØ214 2Ø4Ø6;
XCGC 16ØØ4 99461 71394 41498 83618 1Ø137 2ØØ44 3987Ø
     4Ø144 54ØØØ 7Ø361 85422 22285 ØØ2Ø6 2Ø4Ø6;
FPXU 16ØØ4 99285 71377 42498 832Ø5 1Ø193 2Ø155 39883
     4Ø157 58ØØ8 885// 22273 ØØØ74 2Ø3Ø2;
XQUR 16ØØ4 99332 71313 42697 83618 1Ø196 2Ø133 39934
     4Ø21Ø 53ØØ8 886// 22249 ØØ235 2Ø5Ø7 3Ø6// 4Ø712;
YPEA 16ØØ4 99218 71193 41597 32ØØ9 1Ø21Ø 2Ø178 39958
     4Ø232 52Ø13 7Ø52Ø 8256Ø 22215 ØØ21Ø 2Ø4Ø7;
GBRD 16ØØ4 99173 713Ø5 42498 111Ø1 1Ø244 2Ø195 39922
     4Ø198 523Ø2 811ØØ 22215 ØØ236 2Ø812;
FNAH 16ØØ4 992Ø7 7123Ø 41495 63619 1Ø214 2Ø1ØØ 39851
     4Ø124 54ØØØ 72162 8267Ø 22226 ØØ264 2Ø4Ø8;
GBET 16ØØ4 99239 712Ø7 41497 73215 1Ø2Ø8 2Ø2ØØ 39892
     4Ø166 5ØØØ8 76Ø61 877ØØ 22264 ØØ226 2Ø3Ø6;
HBHY 16ØØ3 99227 7116Ø 41496 73215 1Ø2Ø7 2Ø199 39893
     4Ø166 5ØØØ8 76Ø62 877ØØ 22264 ØØ227 2Ø712 314//
     4121Ø;
KOXH 16ØØ4 99231 71125 41498 82752 1Ø216 2Ø2ØØ 3969Ø
     4996Ø 57Ø32 71682 887// 22216 ØØ256 2Ø6Ø8;
ICEB 16ØØ4 99258 71156 41398 418Ø9 1Ø144 2Ø124 39692
     49962 57Ø1Ø 771Ø2 849ØØ 22225 ØØ154 2Ø5Ø7 313//
     429Ø6;
KURW 16ØØ4 99189 7135Ø 42698 5Ø22Ø 1Ø234 2Ø194 39934
     4Ø217 53Ø19 8487Ø 22264 ØØ265 2Ø4Ø8;
EOEK 16ØØ4 99328 71272 41598 418Ø9 1Ø225 2ØØ93 39875
     4Ø148 52ØØ5 78Ø82 81261 22215 ØØ215 2Ø3Ø8;
KEWL 16ØØ4 99324 71382 41398 83539 1ØØ64 2ØØ11 3ØØ42
     4Ø321 54ØØØ 71591 887// 22224 ØØ1Ø4 2Ø6Ø9 3Ø5//
     4Ø3Ø7;
KIYP 16ØØ4 99351 71352 41/92 Ø3218 1ØØ53 2ØØ5Ø 39844
     4Ø118 55ØØØ 74542 8//// 22214 ØØ11Ø 2Ø4Ø6;
KOOJ 16ØØ4 99356 71413 42698 22Ø11 1Ø246 2Ø164 39846
     4Ø12Ø 54ØØØ 821// 22214 ØØ253 2Ø2Ø7;
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BOOF 16ØØ4 99379 71321 41395 83625 1Ø23Ø 2Ø211 397Ø2
     49973 55ØØØ 78Ø82 887// 22212 ØØ295 2Ø4Ø6;
BELF 16ØØ4 99388 71372 41598 727Ø2 1Ø186 2Ø162 39812
     4ØØ83 53Ø2Ø 71582 82218 22264 ØØ174 2Ø2Ø7;
KUKS 16ØØ4 99389 71425 41496 6Ø21Ø 1Ø246 2Ø194 399ØØ
     4Ø174 58ØØ8 716Ø1 862ØØ 22245 ØØ254 2Ø4Ø6 314//
     42Ø1Ø;
IMEO 16ØØ4 99418 71398 42997 ØØ915 1Ø244 2Ø178 39954
     4Ø23Ø 58Ø12 22264 ØØ216 2Ø5Ø7;
ELMO 16ØØ1 99421 71429 41798 73616 1Ø21Ø 2Ø184 3ØØ85
     4Ø365 51Ø39 71482 87Ø7Ø 22264 ØØ245 2Ø6Ø7;
PIKE 16ØØ3 99478 71524 42598 63218 1Ø255 2Ø18Ø 39985
     4Ø233 5ØØØ8 83125 22265 ØØ274 2Ø4Ø8;
DAYY 16ØØ4 99552 7144Ø 41293 3Ø2Ø9 1Ø18Ø 2Ø151 39985
     4Ø233 58Ø2Ø 71142 838ØØ 22245 ØØ215 2Ø2Ø7;
ONGI 16ØØ4 99521 71395 42999 ØØØØØ 1Ø26Ø 2Ø211 39876
     4Ø15Ø 52Ø1Ø 22214 ØØ275 2Ø6Ø8;
SUMO 16ØØ4 99489 71348 41492 62916 1Ø13Ø 2ØØ55 39958
     4Ø234 52ØØ7 75552 866ØØ 22236 ØØ16Ø 2Ø61Ø;
PUCI 16ØØ4 99458 713Ø9 42499 7ØØØØ 1Ø22Ø 2Ø166 39836
     4Ø1Ø9 54ØØØ 8598Ø 22244 ØØ255 2Ø5Ø6;
GUIP 16ØØ4 99417 71295 41497 6ØØØØ 1Ø245 2Ø224 39866
     4Ø139 57Ø1Ø 72161 8434Ø 22275 ØØ26Ø 2Ø4Ø7;
NJFK 16ØØ4 99525 71349 42598 51115 1Ø236 2Ø197 39912
     4Ø186 52ØØ3 83731 22265 ØØ274 2Ø6Ø7;
NEED 16ØØ4 99576 71368 41593 323Ø9 1Ø244 2Ø237 3987Ø
     4Ø143 53ØØ5 71142 8224Ø 22255 ØØ26Ø 2Ø912 314//
     43ØØ8;
NEOI 16ØØ4 99496 71582 41497 72ØØ2 1Ø22Ø 2Ø199 39819
     4ØØ91 57ØØ7 742Ø2 878ØØ 22276 ØØ245 2Ø6Ø8;
NCEP 16ØØ4 99553 71355 41/93 92925 1ØØ7Ø 2ØØ5Ø 39853
     4Ø126 54ØØØ 74541 8//// 22215 ØØ15Ø 2Ø411;
NJLF 16ØØ4 99222 7Ø89Ø 41394 83222 1ØØ71 2ØØ7Ø 39843
     4Ø116 52Ø27 74452 887// 22264 ØØ165 2Ø2Ø7;
NDCI 16ØØ4 99312 71213 42598 82513 1Ø176 2ØØ99 39958
     4Ø234 51Ø4Ø 87241 22226 ØØ2Ø2 2Ø1Ø6;
NCJO 16ØØ4 99158 71153 42597 6292Ø 1Ø126 2ØØ84 39951
     4Ø226 54ØØØ 845Ø2 22228 ØØ2Ø4 2Ø4Ø8;
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Exercise 9 (Speedrun)

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BBXX 27ØØØØ
FAOI 27ØØ4 99132 7Ø736 42498 13222 1Ø198 2Ø118 39687
     49955 51ØØ4 812ØØ 22285 ØØ2Ø3 21ØØ5;
SKCT 27ØØ4 99378 7Ø712 41495 82918 1ØØ31 2ØØØØ 396ØØ
     49816 52Ø15 78681 889// 22234 ØØØ55 2Ø9Ø7;
EPIZ 27ØØ4 99273 7Ø75Ø 42596 825Ø9 1ØØ6Ø 399ØØ 4Ø174
     52Ø1Ø 885// 22215 ØØØ9Ø 2Ø6Ø4;
AORT 27ØØ1 99189 7Ø848 41498 63626 1ØØ74 2ØØ31 39834
     4Ø1Ø6 54ØØØ 71862 869ØØ 22225 ØØ1Ø5 2Ø8Ø7;
KUKT 27ØØ4 99 'Ø 7Ø86Ø 41395 8Ø524 1Ø152 2Ø134 39555
     49774 53ØØ5 7156Ø 887// 22265 ØØ165 21ØØ5;
ZFRT 27ØØ4 99241 7Ø892 41498 53294 1ØØ71 2ØØ42 39798
     4ØØ69 51Ø26 7Ø282 854ØØ 22266 ØØ1Ø5 2Ø7Ø8 3Ø5//
     42414;
OYRT 27ØØ4 9927Ø 7Ø922 42597 4ØØØØ 1Ø115 2ØØ33 39837
     4Ø11Ø 52ØØ5 8428Ø 22254 ØØ142 2Ø8Ø4 314// 41511;
ELMO 27ØØ4 9953Ø 7Ø516 41698 8Ø7Ø7 11Ø48 21Ø99 39963
     4Ø241 58ØØ4 7Ø242 882// 222ØØ ØØ225 2//ØØ 312//
     428Ø8;
PIKE 27ØØ3 99441 7Ø611 42298 6Ø516 1Ø11Ø 2ØØ7Ø 39897
     4Ø172 5ØØØØ 868ØØ 222ØØ ØØØ75 2Ø8Ø3;
PUCI 27ØØ3 99491 7Ø489 42598 32511 1Ø22Ø 2Ø2Ø2 399Ø2
     4Ø176 52ØØ6 8223Ø 22275 ØØ23Ø 2Ø7Ø3;
QUIP 27ØØ4 9942Ø 7Ø553 41492 4Ø9Ø5 1Ø259 2Ø194 39931
     4Ø2Ø7 57Ø21 712Ø2 841ØØ 22287 ØØ271 2Ø6Ø1;
NJFK 27ØØ4 99281 7Ø663 41498 236Ø5 1Ø163 2ØØ88 39951
     4Ø227 5ØØØ3 7Ø282 825ØØ 22265 ØØ154 2Ø6Ø2 314//
     43418;
NFDR 27ØØ4 99392 7Ø576 41492 8274Ø 1Ø116 2ØØ67 398Ø5
     4ØØ78 5?Ø27 7422Ø 886// 222ØØ ØØ145 28Ø12;
NEOL 27ØØ4 9925? 7Ø718 42598 5Ø225 1Ø12Ø 21Ø22 39843
     4Ø116 58Ø2Ø 851ØØ 22284 ØØØ58 2ØØØØ 3Ø6// 431Ø9;
NELP 27ØØ4 99324 7Ø675 42898 5Ø717 1ØØ37 21Ø54 39953
     4Ø228 57Ø1Ø 85Ø8Ø 22277 ØØØ11 2Ø9Ø5;
NJLF 27ØØ4 99379 7Ø662 41/96 82533 1ØØ81 2ØØ62 39717
     49997 76281 8//// 222// ØØ265 2Ø6//;
BOOF 27ØØ4 993Ø8 7Ø766 41/92 93215 1Ø2Ø5 2ØØ78 39768
     4ØØØ4 51ØØ3 74542 8//// 22213 ØØ175 2Ø6Ø9 311//
     42513;
KOOJ 27ØØ4 99359 7Ø619 42398 5Ø533 1Ø171 2ØØ79 39795
     4ØØ68 8422Ø 222// ØØ187 2Ø8Ø8 3Ø7// 41812;
AYDT 27ØØ3 99241 7Ø68Ø 42498 82937 1ØØ99 2ØØ87 39871
     4Ø146 52Ø31 887// 22252 ØØØ55 2ØØØØ 3Ø8// 419Ø9;
CATZ 27ØØ4 99344 7Ø719 41892 827Ø4 1Ø1ØØ 2ØØ93 398Ø2
     4ØØ74 5ØØ71 74741 88Ø2/ 22272 ØØØ84 2Ø3Ø1 31Ø//
     43ØØ8;
QING 27ØØ4 99235 7Ø95Ø 41495 63(26 1ØØ73 2ØØ33 39832
     4Ø1Ø6 54ØØØ 7168Ø 879ØØ 22223 ØØØ88 21ØØ6;
```

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Exercise 9 (Cont)

```
BBXX 28ØØØØ
XQWR 28ØØ4 99332 71313 41494 82335 1ØØ47 2ØØØØ 39697
     49968 52Ø1Ø 7892Ø 889// 22264 ØØ117 2Ø8Ø7 313//
     41214;
YPEA 28ØØ4 99218 71193 41496 5Ø54Ø 1Ø161 2Ø129 39837
     4Ø11Ø 53ØØ8 7Ø241 852ØØ 22212 ØØØ44 2Ø9Ø8 313//
     415Ø7;
GRBD 28ØØ4 99173 71315 41594 6Ø327 1ØØ88 2ØØ8Ø 398Ø4
     4ØØ75 53ØØ1 76Ø1Ø 863ØØ 22233 ØØ14Ø 21ØØ5 3Ø7//
     413Ø6;
KRHE 28ØØ4 992Ø9 7Ø928 41498 4Ø527 1Ø221 2Ø173 39835
     4Ø1Ø5 52Ø14 74212 84232 22264 ØØ161 2111Ø 311//
     436Ø6;
FNAH 28ØØ4 992Ø7 7123Ø 41395 7Ø73Ø 1Ø164 2Ø144 39865
     4Ø139 54ØØØ 72562 85392 22223 ØØ185 211Ø9 312//
     43312;
GBET 28ØØ4 99239 71227 41897 8162Ø 1ØØ65 2ØØ53 39846
     4Ø12Ø 58Ø18 7Ø242 885// 22266 ØØØ34 21ØØ9 312//
     43414;
HBHY 28ØØ4 99227 7116Ø 41996 41115 1ØØ36 2ØØ33 399Ø3
     4Ø178 5ØØØØ 7Ø541 8ØØØ9 22225 ØØØ57 2Ø7Ø6 313//
     4251Ø;
KOXH 28ØØ1 99232 71125 41498 6Ø9Ø5 1ØØ65 2ØØ22 39948
     4Ø224 54ØØØ 7Ø262 866ØØ 22257 ØØØ28 2Ø9Ø4 3Ø5//
     42313;
ICEB 28ØØ4 99258 71156 41398 832Ø9 1ØØ75 2ØØ54 39819
     4ØØ91 52Ø1Ø 7Ø282 887// 22226 ØØØ66 2Ø8Ø8 313//
     4242Ø;
GDMN 28ØØ4 99285 71187 42496 81845 1Ø173 2ØØ1Ø 39819
     4ØØ91 57ØØ8 888// 22226 ØØ144 2Ø8Ø4 312// 415Ø7;
EPEK 28ØØØ 99328 71272 41496 81815 1Ø141 2Ø131 39783
     4ØØ56 54ØØØ 71821 885// 22227 ØØ111 2Ø7Ø5 312//
     42ØØ7;
KIYP 28ØØ4 99351 71352 42496 81845 1Ø17Ø 2Ø12Ø 39798
     4ØØ71 56Ø14 888// 22288 ØØ13Ø 2Ø5Ø3 3Ø5// 41515;
BOOF 28ØØØ 99379 71321 42498 5Ø7Ø2 1Ø215 2Ø178 39924
     4Ø2ØØ 52ØØ3 8185Ø 22236 ØØ199 2Ø6Ø3 3Ø7// 413Ø6;
BELF 28ØØ4 99388 71372 42496 71835 1ØØ87 2ØØ66 399Ø5
     4Ø179 52Ø22 8772Ø 22272 ØØ37Ø 2Ø7Ø7 3Ø7// 42Ø2Ø;
FULS 28ØØ4 99389 71429 42598 61814 1Ø1Ø5 2ØØ21 39866
     4Ø14Ø 54ØØØ 8235Ø 22265 ØØ143 21ØØ6 3Ø7// 413Ø9;
IMEO 28ØØ4 99418 71398 41397 82736 1Ø111 2ØØ83 39892
     4Ø166 53Ø14 71782 8789/ 22245 ØØØ99 2131Ø 3Ø5//
     41422;
ELMO 28ØØ4 99421 71449 41/92 92527 1Ø138 2ØØ73 399Ø7
     4Ø183 53Ø27 745Ø2 89/// 22275 ØØ1Ø7 2Ø8Ø8 311//
     423Ø5;
PIKE 28ØØ4 99478 71524 41395 83218 1Ø198 2Ø174 39881
     4Ø156 53ØØ2 7258Ø 8222/ 22276 ØØ151 2Ø5Ø6 3Ø9//
     43611;
```

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Exercise 10 (Speedrun)

BBXX 28ØØØØ
ROEF 28ØØ4 9931Ø 71347 41395 8Ø524 1Ø16Ø 2Ø131 399ØØ
4Ø174 53ØØ5 71562 887// 22265 ØØ18Ø 2Ø5Ø7 312//
42713;
SHET 28ØØØ 99365 71278 41596 4Ø913 1Ø177 2ØØ94 39875
4Ø148 52ØØ2 7Ø51Ø 848ØØ 22224 ØØ152 215Ø8 3Ø5//
42323;
WHML 28ØØ3 99252 71192 41395 8294Ø 1ØØ38 2ØØØ1 3979Ø
4ØØ62 52Ø1Ø 71821 886// 22212 ØØ24Ø 2Ø814 3Ø7//
41534;
KTEN 28ØØ4 99191 71262 41598 2Ø2Ø6 1Ø112 2ØØ63 39971
4Ø247 54ØØØ 711Ø1 821Ø1 22263 ØØ262 2//ØØ 311//
429Ø6;
EDAN 28ØØ4 99453 71479 42398 73412 1Ø3Ø6 2Ø144 39856
4Ø13Ø 53Ø1Ø 8733Ø 22216 ØØØ85 21ØØ8 3Ø7// 4Ø523;
JYAK 28ØØ3 99158 71153 42397 8142Ø 1Ø252 2Ø189 39831
4Ø1Ø3 52ØØ4 875Ø7 22214 ØØ267 2Ø5Ø5 31Ø// 4Ø661;
HOOL 28ØØ4 9916Ø 71Ø9Ø 42398 52515 1Ø243 2Ø221 39888
4Ø162 52Ø2Ø 8317Ø 22255 ØØ272 2Ø5Ø4 312// 41115;
WNEK 28ØØ4 99432 71352 42796 2Ø237 1Ø151 2Ø127 39832
4Ø1Ø6 52Ø26 822Ø1 22256 ØØ134 2Ø711 3Ø7// 436Ø7;
NNEU 28ØØ4 99487 71442 42996 1Ø916 1Ø176 2Ø155 399Ø7
4Ø183 56ØØ5 8ØØØ3 22223 ØØ156 2Ø8Ø2 3Ø6// 4Ø512;
8HH3 28ØØØ 99532 71557 42998 1Ø916 1Ø192 2Ø1Ø9 399Ø5
4Ø1Ø8 55ØØ6 8ØØØ2 22223 ØØ181 2Ø5Ø4 3Ø5// 4Ø615;
ILES 28ØØ4 99236 71375 41595 5Ø54Ø 1Ø14Ø 2ØØ81 39732
4ØØØ3 54ØØØ 7Ø52Ø 8434Ø 222ØØ ØØ154 2Ø5Ø5 3Ø7//
436Ø8;
KOHD 28ØØ4 99162 71332 42498 6Ø715 1Ø143 2Ø117 39919
4Ø193 5ØØ9Ø 864ØØ 22271 ØØ117 21ØØ5 31Ø// 4Ø219;
XCGG 28ØØ4 99512 71493 41497 5Ø7Ø9 1Ø141 2Ø1Ø9 39974
4Ø249 58ØØ5 7Ø342 8215Ø 22214 ØØØ12 21Ø14 3Ø5//
4Ø322;
GUYG 28ØØ4 99461 71394 42298 7Ø516 1ØØ94 2ØØ44 399Ø9
4Ø184 57Ø1Ø 8433Ø 22225 ØØ132 2Ø7Ø8 3Ø5// 4Ø1Ø2;
FPXU 28ØØ4 99285 71397 41394 8Ø54Ø 1Ø142 2Ø121 398Ø9
4ØØ8Ø 52Ø15 76252 8722/ 22213 ØØØ63 2Ø7Ø5 3Ø5//
43313;

BBXX 27ØØØØ

DEAL 27ØØ4 9953Ø 7Ø46Ø 41498 8Ø7Ø7 1ØØ25 2ØØ1Ø 39963
4Ø241 58ØØ4 79241 882// 222ØØ ØØØ62 2Ø4Ø2;
PDJY 27ØØ4 9942Ø 7Ø553 414Ø3 7Ø318 1Ø2Ø2 2ØØ34 39577
4968Ø 53Ø16 74252 82412 22216 ØØ247 2//ØØ 312//
427Ø6;
GBFM 27ØØ4 99446 7Ø57Ø 42398 8Ø216 1Ø236 2Ø178 39922
4Ø196 52Ø1Ø 889// 22227 ØØ1Ø5 2Ø8Ø5 3Ø7// 42417;
CQNY 27ØØ4 99281 7Ø663 42398 72932 1Ø15Ø 2ØØ52 39915
4Ø19Ø 52Ø24 876ØØ 22282 ØØØ9Ø 2Ø7Ø8;

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Exercise 10 (Cont)

```
KXFW 27ØØ4 99392 7Ø576 41598 42311 1Ø24Ø 2Ø199 399Ø2
     4Ø176 52ØØ5 71681 83339 22275 ØØ255 2Ø4Ø3 311//
     429Ø8;
NLUR 27ØØ4 99251 7Ø718 41492 4Ø9Ø6 1Ø214 2Ø21Ø 39932
     4Ø2Ø7 54ØØØ 74441 841ØØ 22244 ØØ172 2ØØØØ 313//
     4321Ø;
NVZF 27ØØ4 99324 7Ø675 41496 6Ø9Ø8 1Ø281 2Ø2ØØ 39892
     4Ø165 52ØØ8 78182 8326Ø 22275 ØØ274 2Ø5Ø2;
KYQP 27ØØ4 99379 7Ø662 41497 63612 1Ø169 2Ø132 39951
     4Ø227 52ØØ4 7Ø54Ø 865ØØ 22265 ØØ141 2Ø6Ø7;
KCAT 27ØØ3 993Ø8 7Ø766 41/92 93215 1Ø22Ø 2ØØ25 39734
     4ØØØ4 51ØØ3 745Ø2 8//// 22216 ØØ2ØØ 2Ø8Ø8;
FNPE 27ØØ4 99359 7Ø619 41398 8Ø533 1Ø179 2ØØ88 39797
     4ØØ68 52Ø34 78882 8492/ 22265 ØØ139 21Ø1Ø;
KEHJ 27ØØ4 99241 7Ø68Ø 41498 8Ø327 1Ø1ØØ 2ØØ67 39871
     4Ø146 52Ø31 76261 887// 22224 ØØ158 2Ø6Ø8 313//
     43314;
FERT 27ØØ4 99344 7Ø719 42598 73233 1ØØØ4 21Ø44 39968
     4Ø245 511Ø6 8682Ø 22283 ØØØ52 2ØØØØ 3Ø5// 43Ø12;
OGLE 27ØØ3 99244 7Ø747 41497 5Ø518 1ØØ84 2ØØ8Ø 39861
     4Ø134 52ØØ5 78Ø82 81398 22255 ØØØ8Ø 21ØØ5;
HORD 27ØØ4 99299 7Ø649 41295 7Ø715 1Ø254 2Ø2Ø2 39881
     4Ø156 52Ø1Ø 7646Ø 85531 22226 ØØ272 2Ø3Ø2 312//
     4Ø9Ø6;
YTHE 27ØØ4 99154 7Ø723 42698 611Ø9 1Ø256 2Ø195 39912
     4Ø187 52Ø1Ø 8222Ø 22256 ØØ225 2Ø7Ø3;
KIYT 27ØØØ 99152 7Ø756 41497 63616 1Ø129 2ØØ67 39948
     4Ø224 52ØØ7 79292 863ØØ 22285 ØØØ61 2Ø8Ø8;
VUUM 27ØØ4 99169 7Ø818 42596 6Ø51Ø 1Ø32Ø 2Ø211 39583
     49847 52Ø92 82128 22214 ØØ299 2Ø7Ø2;
MATX 27ØØ4 994Ø2 7Ø625 41593 636Ø9 1Ø331 2Ø313 3967Ø
     49938 55ØØØ 7878Ø 84131 22224 ØØ295 2ØØØØ 312//
     433Ø8;
```

RAWINSONDE CODE

Exercise 1

1. Decode the following Identification - Position groups for the item requested.

a.	TTAA 55121 72532	a.	Date ______________
b.	TTAA 71ØØ5 72493	b.	Station Number ______________
c.	TTAA 57121 72441	c.	Time ______________
d.	TTAA 72127 72127	d.	Date ______________
e.	TTAA 6ØØØ1 72225	e.	Station Number ______________
f.	TTAA 72122 72628	f.	Time ______________

2. Fill in the blanks for the following:

   a. In the U.S., 50 is added to the date because the wind speed is measured in ______________.

   b. The first two digits of the surface level data are ______________.

   c. If the T_{ao} is an odd number, the temperature is ______________.

   d. Given a surface wind of 25Ø1Ø, the direction is decoded as ______________ degrees, and the speed is ______________ knots.

   e. Given a dewpoint depression doded value of 56 or greater, you must subtract ______________ to obtain the true depression.

   f. If the T_{ao} is an even number, the temperature is ______________.

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3. Decode the following surface data group:

99988 15272 Ø75Ø5

a. Pressure ____________

b. Temperature ____________

c. Dewpoint Depression ____________

d. Dewpoint ____________

e. Wind Direction ____________

f. Wind Speed ____________

4. Decode the following surface data group:

99Ø42 1Ø5ØØ 1ØØ15

a. Pressure ____________

b. Temperature ____________

c. Dewpoint Depression ____________

d. Dewpoint ____________

e. Wind Direction ____________

f. Wind Speed ____________

5. Decode the following TTT_aDD groups:

		TEMPERATURE	DEPRESSION
a.	25415	______	______
b.	ØØØØØ	______	______
c.	17678	______	______
d.	555//	______	______
e.	24357	______	______
f.	11Ø8Ø	______	______
g.	15772	______	______

6. Decode the following ddfff groups:

	DIRECTION	SPEED
a. 12Ø45		
b. ØØ515		
c. 27546		
d. 2512Ø		
e. 111ØØ		
f. 356Ø5		

7. Determine the temperature, dewpoint depression, and dewpoint for the following TTT_aDD groups:

	TEMPERATURE	DEWPOINT DEPRESSION	DEWPOINT
a. Ø9661			
b. Ø6463			
c. 18435			
d. 397ØØ			
e. 1Ø961			
f. 15678			
g. 12Ø6Ø			
h. 641//			
i. 281Ø3			
j. Ø5Ø5Ø			
k. 3ØØ8Ø			
l. 13728			

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8. Decode the millibar level, temperature, dewpoint depression, and wind direction and speed for the following:

a. 85542 17238 355Ø8

b. 4Ø755 2Ø366 29Ø33

c. 2Ø234 551// 356Ø3

d. 3Ø957 38956 13525

e. ØØ149 ///// /////

f. 1Ø658 655// Ø5ØØ3

g. 7Ø281 Ø7859 Ø45Ø8

h. 25Ø88 455// 27Ø39

i. 154Ø6 615// 32131

j. 5Ø582 1398Ø Ø6519

	MB LEVEL	TEMPERATURE	DEWPOINT DEPRESSION	WIND DIRECTION	WIND SPEED
a.					
b.					
c.					
d.					
e.					
f.					
g.					
h.					
i.					
j.					

9. Decode the following tropopause and maximum wind data:

a. 88116 791// Ø3567
77227 Ø4611 4Ø7Ø3

b. 88159 637// 19544
77197 2Ø571 41414

c. 88187 547// 2Ø519
77999

d. 88225 521// 1ØØ73
772Ø3 Ø91ØØ 41ØØ8

e. 8815Ø 669// 22625
77174 23142 4Ø813

f. 88999
77126 Ø36Ø1 4Ø9Ø4

TROPOPAUSE

	PRESSURE	TEMPERATURE	WIND DIRECTION	WIND SPEED
a.				
b.				
c.				
d.				
e.				
f.				

MAXIMUM WIND

	PRESSURE	WIND DIRECTION	WIND SPEED
a.			
b.			
c.			
d.			
e.			
f.			

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10. Decode the following significant groups:

TTBB 6512/ 72493 ØØØ3Ø Ø5Ø45 1193Ø Ø6Ø4Ø 2277Ø Ø292Ø 3365Ø 1Ø1ØØ 446ØØ 1474Ø 55435 29769 66358 371//;

	PRESSURE	TEMPERATURE	DEWPOINT DEPRESSION	DEWPOINT
Surface Level				
1st sig Level				
2nd sig Level				
3rd sig Level				
4th sig Level				
5th sig Level				
6th sig Level				

11. Give the height values in meters for the following mandatory levels:

a. ØØ111 ________
b. 8554Ø ________
c. 7ØØ1Ø ________
d. 5Ø557 ________
e. 4Ø718 ________
f. 3Ø916 ________
g. 25Ø3Ø ________
h. 2Ø179 ________
i. 15363 ________
j. 1Ø16Ø ________

RAWINSONDE CODE

Exercise 2

Decode the following PPBB paragraph for height, direction, and speed of wind:

PPBB 78000 72532 90012 09015 09004 09010 90346 09511 09012

08515 90789 09016 09020 09525 91246 09030 09030 09537 9205/

09050 09061 9305/ 09096 08602 940// 09107 950// 09616

	HEIGHT	DIRECTION	SPEED
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			

SKEW T, LOG P DIAGRAM

Exercise 3

Station: RANTOUL, IL.

Note: This message has been arranged so that one level appears on each line. The indicators have also been underlined. This has been done to help you decode you first Rawinsonde message.

```
72351 PPAA NIL/KAWN
PPBB 78ØØØ 72531
9ØØ12 Ø9Ø15 Ø9ØØ4 Ø9Ø1Ø
9Ø346 Ø9511 Ø9Ø12 Ø8515
9Ø789 Ø9Ø16 Ø9Ø2Ø Ø9525
91246 Ø9Ø3Ø Ø9Ø3Ø Ø9537
92Ø5/ Ø9Ø5Ø Ø9Ø61
93Ø5/ Ø9Ø96 Ø86Ø2
94Ø// Ø91Ø7
95Ø// Ø9616

TTAA 78ØØ1 72531
99Ø3Ø Ø5Ø5Ø Ø9Ø15
ØØ111 Ø6Ø6Ø Ø9ØØ5
8545Ø ØØ646 Ø7Ø16
7ØØ1Ø Ø69ØØ Ø8528
5Ø557 22764 Ø9Ø47
4Ø718 33372 Ø9Ø45
3Ø916 459// Ø9Ø71
25Ø3Ø 543// Ø9Ø96
2Ø179 581// Ø9Ø99
15363 595// Ø9615
1Ø61Ø 575// Ø91ØØ
88225 589// Ø9Ø98
77132 Ø9628 4Ø5Ø8

TTBB 78ØØ/ 72531
ØØØ3Ø Ø5Ø5Ø
1193Ø Ø6Ø4Ø
2277Ø Ø292Ø
3365Ø 1Ø3ØØ
446ØØ 1474Ø
55435 29769
66358 37171
77225 589//
8822Ø 587//
```

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SKEW T LOG P DIAGRAM

Exercise 4

STATION: HUNTINGTON, WV

Note: This message has been arranged as it would appear if received from a teletype. The indicators have once again been underlined to help you locate each level.

72425 PPAA NIL/KAWN
PPBB 78ØØØ 72425 9ØØ23 34ØØ4 28ØØ6 275Ø7 9Ø467 285Ø6 3Ø5Ø7
33ØØ8 9Ø89/ 34Ø1Ø 35Ø1Ø 91246 Ø3Ø14 Ø2514 Ø4Ø19 92Ø5/ Ø3Ø19
Ø3524 93Ø5/ Ø4533 Ø5538 943// Ø4Ø41 95Ø// 36Ø17

TTAA 78ØØ1 72425 99991 27865 34ØØ4 ØØ162 ///// ///// 85577
16661 3ØØØ8 7Ø196 Ø446Ø Ø2Ø11 5Ø587 Ø9966 Ø3513 4Ø755 22166
Ø3523 3Ø96Ø 37964 Ø4535 25Ø83 481// Ø5537 2Ø227 589// Ø454Ø
154Ø4 663// Ø2Ø21 1Ø654 621// Ø1Ø14 8815Ø 663// Ø2Ø21 77999

TTBB 78ØØ/ 72425 ØØ991 27865 11779 1ØØ59 22673 Ø2465 33579
Ø2567 444ØØ 22166 55288 4Ø163 66224 541// 7715Ø 663// 88121
611//

Exercise 5

STATION: MIAMI, FL

72202 PPAA NIL/KAWN
PPBB 78ØØØ 722Ø2 9ØØ12 34ØØ4 125Ø8 1551Ø 9Ø346 16Ø11 16Ø13
15Ø15 9Ø789 14Ø17 13Ø11 14ØØ6 91246 21ØØ3 25ØØ5 28Ø11 92Ø5/
26523 25Ø34 93Ø58 23Ø64 23Ø67 24567
TTAA 78ØØ1 722Ø2 99Ø1Ø 22815 34ØØ4 ØØ1Ø5 23221 Ø4ØØ4 85517
17856 16Ø16 7Ø156 Ø8857 14ØØ6 5Ø585 Ø9964 2652Ø 4Ø754 2Ø563
25Ø35 3Ø961 34956 23568 25Ø86 457// 23568 2Ø232 527// 25559
15414 613// 26Ø47 1Ø661 671// 26Ø29 88115 679// 26Ø42 77282
23569 426Ø1
TTBB 78ØØ/ 722Ø2 ØØØ1Ø 22815 11961 21412 22908 22Ø31 33885
19256 44676 Ø7Ø57 55624 Ø145Ø 666Ø5 ØØ871 77587 ØØ672 8848[illegible]
1Ø966 99423 16965 11372 2516Ø 22352 26356 33317 31937 44276
4Ø159 5524Ø 479// 66146 625// 77115 679// 881ØØ 671//

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Exercise 6

STATION: ATHENS GA

72311 PPAA NIL/KAWN
PPBB 78ØØØ 72311 9ØØ23 Ø7ØØ3 Ø55Ø4 Ø5ØØ6 9Ø467 Ø5ØØ4 Ø5Ø13
Ø4517 9Ø89/ Ø5Ø18 Ø5Ø22 91246 Ø5Ø16 Ø5Ø17 Ø3514 92Ø5/ Ø4512
Ø4521 93Ø35 Ø4518 Ø3527 Ø4Ø27 94148 Ø2Ø25 Ø3Ø14 27ØØ8 95Ø//
29ØØ8;
TTAA 78ØØ1 72311 9998Ø 24Ø62 Ø7ØØ3 ØØ159 ///// ///// 85563
1386Ø Ø6ØØ5 7Ø169 Ø3871 Ø4519 5Ø583 1Ø974 Ø5Ø12 4Ø75Ø 24567
Ø4519 3Ø953 39966 Ø4519 25Ø75 481// Ø4Ø27 2Ø219 577// Ø2525
15399 613// 345Ø7 1Ø65Ø 655// 35Ø11 88169 625// Ø1514 77999;
TTBB 78ØØ/ 72311 ØØ98Ø 24Ø62 11825 1356Ø 22756 Ø7668 33718
Ø5271 44684 Ø3Ø67 55595 Ø2577 66479 13174 7745Ø 16168 884ØØ
24567 99221 535// 11169 625// 22159 [illegible]// 33146 623//;

Exercise 7

STATION: NEW YORK NY

74486 PPAA NIL/KAWN
PPBB 78ØØØ 74486 9ØØ12 25Ø2Ø 25531 26535 9Ø346 27536 29Ø37
31534 9Ø789 33Ø42 34Ø44 34Ø42 91246 34Ø42 34535 35Ø32 92Ø5/
35535 36Ø33 93Ø14 Ø4Ø24 Ø5Ø22 Ø3Ø62 935// Ø3Ø6Ø 95Ø// 33Ø29;
TTAA 78ØØ1 74486 99Ø21 26Ø65 25Ø2Ø ØØ1Ø3 25666 25Ø26 855Ø8
15457 3Ø533 7Ø129 Ø4465 34541 5Ø58Ø 117// 35Ø31 4Ø747 2397Ø
35533 3Ø95Ø 4Ø1// Ø4Ø23 25Ø72 5Ø5// Ø3Ø62 2Ø214 593// Ø3Ø67
15391 623// 35Ø49 1Ø644 599// 33Ø28 88168 669// 36Ø34 77212
Ø3Ø91 43141;
TTBB 78ØØ/ 74486 ØØØ21 26Ø65 1185Ø 15457 2282Ø 12848 33786
1123Ø 4476Ø 1Ø258 55725 Ø6848 6664Ø ØØØ73 77565 Ø3958 883ØØ
4Ø1// 99262 477// 11231 541// 22216 565// 33168 669// 44131
599// 55126 575// 661Ø4 6Ø5// 51515 1Ø168 Ø564Ø;

Exercise 8

STATION: PITTSBURGH PA

7252Ø PPAA NIL/KAWN
PPBB 78ØØØ 7252Ø 9ØØ23 24ØØ6 26Ø19 27519 9Ø467 2[illegible]519 31Ø2Ø
32518 9Ø89/ 33Ø23 34Ø23 91246 35Ø15 ØØ515 36Ø16 93Ø5/ Ø1523
36Ø23 93Ø5/ Ø1Ø33 Ø1541 94Ø// Ø2Ø5Ø 95Ø// 36Ø21;
TTAA 78ØØ1 7252Ø 9998Ø 14258 24ØØ6 ØØ185 ///// ///// 85567
12649 2951Ø 7Ø169 Ø3Ø19 33525 5Ø582 13363 36Ø25 4Ø749 23969
ØØ518 3Ø952 4Ø5// ØØ535 25Ø74 495// Ø154Ø 2Ø217 583// Ø2Ø54
15396 623// ØØ533 1Ø648 613// 35Ø12 88173 621// Ø1552 77999;
TTBB 78ØØ/ 7252Ø ØØ98Ø 14258 1196Ø 19467 22917 17462 33888
14847 4483Ø 114// 55799 Ø94// 66771 Ø76// 77546 Ø8542 88481
15371 99465 15371 114ØØ 23969 22218 561// 33173 621// 44138
639// 55129 611// 66124 579// 771ØØ 613// 51515 1Ø168 Ø857Ø;

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Exercise 9

STATION: CHARLESTON SC

72208 PPAA NIL/KAWN
PPBB 63ØØØ 722Ø8 9ØØ12 14ØØ6 215Ø3 3Ø5Ø8 9Ø345 28511 29Ø1Ø
29529 9Ø678 29Ø31 29Ø35 28536 9Ø9// 29Ø36 91246 28Ø46 28Ø51
27556 918// 27Ø62 92Ø25 26Ø92 261ØØ 26112 929// 2713Ø 93Ø5/
27131 26137 9415/ 26642 27Ø99 95Ø2/ 266Ø3 27Ø88;
TTAA 63ØØ1 722Ø8 99Ø19 Ø7259 14ØØ6 ØØ17Ø Ø6858 18ØØ4 8549Ø
Ø148Ø 3ØØ28 7ØØ4Ø Ø3[illegible] 28539 5Ø563 17935 27Ø67 4Ø729 245ØØ
261Ø8 3Ø932 3955Ø 2[illegible]2 25Ø54 499// 26136 2Ø199 5Ø7// 26641
15382 6Ø5// 271ØØ 1Ø627 695// 27Ø87 88234 533// 2614Ø 77193
26642 4Ø626;
TTBB 63ØØ/ 722Ø8 ØØØ19 Ø7259 11985 Ø6Ø57 22963 Ø6461 33887
Ø1262 44827 Ø228Ø 5556Ø 1238Ø 6653Ø 15161 775Ø7 1774Ø 88499
18146 99491 187Ø3 11475 179ØØ 224ØØ 245ØØ 333ØØ 3955Ø 44234
533// 55214 489// 66117 695//;

Exercise 10

STATION: PONTIAC MI

72637 PPAA NIL/KAWN
PPBB 63ØØØ 72637 9ØØ12 22ØØ6 225Ø8 25Ø16 9Ø346 26Ø18 26Ø18
26Ø15 9Ø789 26512 26513 27Ø14 91246 28Ø2Ø 28Ø24 29Ø28 92Ø5/
29533 3ØØ45 93Ø14 29555 29Ø52 28Ø72 935// 28Ø74 944// 27594
95Ø// 27Ø79;
TTAA 63ØØ1 72637 99992 Ø3928 22ØØ6 ØØ169 ///// ///// 85433
133ØØ 26Ø18 7Ø899 1678Ø 27Ø14 5Ø536 32164 28529 4Ø69Ø 435//
29543 3Ø878 547// 29551 25994 553// 28561 2Ø137 521// 28Ø81
15323 535// 27593 1Ø581 557// 27583 8827Ø 563// 29Ø53 77144
27594 4Ø916;
TTBB 63ØØ/ 72637 ØØ992 Ø3928 11973 Ø41[illegible] 2285Ø 133ØØ 33798
169Ø4 44776 1576Ø 55684 1718Ø 66561 25966 77451 37763 88335
515// 9927Ø 563// 112ØØ 521// 22113 575// 331ØØ 557//;

Exercise 11

STATION: NASHVILLE TN

72327 PPAA NIL/KAWN
PPBB 63ØØØ 72327 9ØØ12 36ØØ7 36ØØ8 34ØØ7 9Ø345 295Ø6 28511
29515 9Ø678 3Ø524 3Ø526 3ØØ26 9Ø9// 3ØØ28 91246 3Ø524 2955Ø
29553 919// 29Ø56 92Ø59 28562 27Ø93 2661Ø 93Ø25 26622 26153
26171 937// 26637 9416/ 26651 26615 95Ø2/ 26621 266Ø2;
TTAA 63ØØ1 72327 99ØØ3 Ø1959 36ØØ7 ØØ2Ø3 Ø1161 36ØØ7 85478
Ø6767 3ØØ17 7Ø998 Ø698Ø 3ØØ32 5Ø556 2298Ø 29Ø55 4Ø716 3338Ø
27584 3Ø913 451// 26621 25Ø34 5Ø7// 25669 2Ø179 481// 26144
15365 575// 27124 1Ø615 641// 266ØØ 88231 549// 26165 7724Ø
26171 41834;
TTBB 63ØØ/ 72327 ØØØØ3 Ø1959 11ØØØ Ø1161 2293Ø Ø6557 33894
Ø795Ø 44871 Ø6962 55829 Ø518Ø 66648 Ø818Ø 774ØØ 3338Ø 88344
39364 993ØØ 451// 11281 449// 22231 549// 33222 553// 44219
5Ø7// 552ØØ 481// 661Ø9 659// 771ØØ 641//;

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Exercise 12

STATION: TUCSON AZ

72274 PPAA NIL/KAWN
PPBB 7112Ø 72274 9ØØ34 15ØØ7 175Ø8 2Ø51Ø 9Ø678 25Ø11 24515
23Ø22 9Ø9// 23Ø24 91Ø23 22524 24Ø22 24524 9146/ 24Ø25 24Ø27
92Ø57 23Ø45 23Ø53 23559 93Ø23 22579 23Ø8Ø 231Ø6 9359/ 23585
24Ø6Ø 945// 25Ø57 95Ø2/ 24533 25Ø24;
TTAA 71121 72274 99924 12257 15ØØ7 ØØ111 ///// ///// 85492
1Ø856 235Ø9 7ØØ75 Ø194Ø 22524 5Ø567 18165 23537 4Ø731 2978Ø
2355Ø 3Ø931 3738Ø 22583 25Ø56 415// 23Ø84 2Ø2Ø5 491// 24558
15392 567// 24555 1Ø643 659// 26ØØ8 88999 77279 221Ø6 43422;
TTBB 7112/ 72274 ØØ924 12257 119Ø8 15Ø59 22749 Ø2ØØ8 3373Ø
Ø1247 44686 Ø2942 55663 Ø511Ø 66637 Ø61Ø8 776Ø4 Ø9317 8859Ø
1Ø38Ø 99531 1418Ø 11441 2558Ø 2235Ø 3638Ø 33314 3878Ø 443Ø9
3718Ø 55271 3938Ø 661ØØ 659//;

Exercise 13

STATION: JOPLIN MO

72349 PPAA NIL/KAWN
PPBB 7112Ø 72349 9ØØ23 17ØØ6 21527 22Ø32 9Ø467 23Ø34 22532
23Ø3Ø 9Ø89/ 23Ø28 23Ø27 91246 23527 23531 23532 92Ø25 23539
24537 26Ø54 93Ø58 26Ø75 271Ø5 27622 94147 26599 27591 26Ø51
95Ø13 26Ø5Ø 26Ø5Ø 26538;
TTAA 71121 72349 99964 Ø7814 17ØØ6 ØØ131 ///// ///// 85487
Ø4468 23Ø33 7ØØ81 Ø4Ø8Ø 22527 5Ø573 13161 24Ø37 4Ø74Ø 22536
26Ø53 3Ø945 3855Ø 26Ø81 25Ø67 471// 271Ø5 2Ø213 541// 271ØØ
15394 599// 27563 1Ø644 647// 26523 88128 631// 26Ø48 77218
27622 42137;
TTBB 7112/ 72349 ØØ964 Ø7814 11944 128ØØ 22874 Ø96ØØ 33858
Ø8238 4485Ø Ø4468 55838 Ø868Ø 66743 Ø688Ø 77653 Ø128Ø 88598
Ø438Ø 99567 Ø8162 11519 1178Ø 22511 11365 33464 17734 444ØØ
22536 553ØØ 3855Ø 66265 457// 77159 6Ø3// 881ØØ 647//;

Exercise 14

STATION: REDWOOD FALLS MN

72655 PPAA NIL/KAWN
PPBB 7112Ø 72655 9ØØ23 15ØØ4 19522 2Ø528 9Ø467 2Ø529 22Ø33
22Ø34 9Ø89/ 22Ø33 22Ø32 91245 23Ø3Ø 24Ø28 24528 9168/ 24529
23Ø24 92Ø35 23525 22533 23538 93Ø15 22Ø47 22Ø46 24Ø53 94Ø5/
26Ø59 29Ø4Ø 95Ø2/ 29Ø35 29Ø32;
TTAA 71121 72655 99974 ØØ621 15ØØ4 ØØØ98 ///// ///// 85421
Ø8267 21Ø29 7ØØØ2 ØØØ7Ø 22532 5Ø56Ø 1996Ø 23Ø24 4Ø721 33518
22535 3Ø916 5Ø1// 22Ø47 25Ø33 533// 23547 2Ø179 491// 26Ø55
15366 515// 29Ø4Ø 1Ø526 585// 29Ø34 88263 569// 23Ø45 77999;
TTBB 7112/ 72655 ØØ974 ØØ621 11943 ØØ313 229Ø5 Ø545Ø 33873
Ø8461 4479Ø Ø6Ø7Ø 55594 Ø958Ø 66511 18766 77473 24119 88354
4Ø113 99263 569// 11235 499// 22156 5Ø1// 331ØØ 585//;

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CONSTANT PRESSURE
Exercises 1 (500 mb), 2 (700 mb) and 3 (850 mb-Speed Run)

TTAA 62121 722Ø1 99Ø12 2ØØØ7 Ø4ØØ3 ØØ112 1982Ø Ø55Ø5 855Ø5
1565Ø Ø5ØØ5 7Ø132 Ø546Ø 14ØØ9 5Ø58Ø 11941 2251Ø 4Ø747 2318Ø
22Ø3Ø 3Ø952 38356 22563 25Ø75 475// 22581 2Ø219 591// 22584
15395 651// 23532 1Ø641 673// 22Ø12 88179 639// 23Ø66 772Ø5
22585 4Ø723;

TTAA 62121 7221Ø 99ØØ8 27439 11Ø11 ØØØ77 27235 11Ø11 85495
17442 1351Ø 7Ø132 Ø9666 17ØØ6 5Ø585 ØØ569 23ØØ4 4Ø755 18762
25513 3Ø964 3356Ø 27527 25Ø89 437// 27527 2Ø235 555// 23523
15413 693// 25539 1Ø648 739// 25513 88117 785// 25526 77999;

TTAA 62121 72213 99Ø13 2181Ø Ø9ØØ4 ØØ113 24249 1ØØØ7 85513
15Ø8Ø 1ØØØ9 7Ø131 Ø4865 Ø4ØØ6 5Ø578 1398Ø Ø8516 4Ø743 26565
1Ø5Ø8 3Ø945 421// 165Ø9 25Ø65 527// 145Ø8 2Ø2Ø9 557// 11ØØ9
1539Ø 6Ø5// Ø1ØØ5 1Ø638 683// 24ØØ8 881ØØ 683// 24ØØ8 77999;

TTAA 62121 72225 99ØØ3 178Ø5 15ØØ1 ØØ113 176Ø8 155Ø2 855Ø4
1323Ø 235Ø9 7Ø117 Ø6669 26Ø13 5Ø578 1278Ø 19ØØ2 4Ø744 24965
Ø8Ø14 3Ø946 411// ///// 25Ø68 513// Ø9Ø37 2Ø21Ø 573// Ø2Ø16
15391 611// 35ØØ5 1Ø638 681// 245Ø8 88114 671// 32ØØ6 77999;

TTAA 62121 72235 99Ø12 17812 1ØØØ5 ØØ1Ø5 2Ø816 12ØØ6 855Ø7
1848Ø 225Ø8 7Ø133 Ø5858 265Ø3 5Ø578 1198Ø 1ØØØ9 4Ø744 2898Ø
Ø9Ø12 3Ø946 421// Ø6Ø18 25Ø67 489// Ø452Ø 2Ø212 541// 355Ø6
15395 6Ø1// Ø1ØØ9 1Ø642 683// 32ØØ4 881Ø4 693// 345Ø7 77999;

TTAA 62121 7224Ø 99997 2ØØØ8 21ØØ6 ØØØ99 ///// ///// 85497
15Ø26 23ØØ8 7Ø114 Ø528Ø 27Ø18 5Ø578 1198Ø Ø35Ø9 4Ø745 2448Ø
Ø3Ø21 3Ø948 4Ø1// Ø6526 25Ø7Ø 513// Ø7525 2Ø212 549// Ø2Ø28
15394 615// Ø251Ø 1Ø639 689// 31513 8822Ø 577// Ø3Ø3Ø 77999;

TTAA 62121 72250 99ØØ9 21Ø17 ØØØØØ ØØØ86 25Ø31 17ØØ5 85495
19273 13Ø14 7Ø128 Ø6669 Ø7Ø11 5Ø578 13363 355Ø7 4Ø745 2458Ø
31515 3Ø948 3758Ø 28Ø53 25Ø71 475// 28545 2Ø216 547// 29533
15398 621// 32Ø29 1Ø643 681// 3351Ø 88117 689// 33518 77284
28Ø62 42519;

TTAA 62121 72255 99ØØ7 19ØØ3 Ø4ØØ3 ØØØ9Ø 2Ø814 Ø7ØØ4 85496
19Ø8Ø 19Ø13 7Ø128 Ø6868 155Ø9 5Ø579 1218Ø Ø55Ø7 4Ø745 2458Ø
Ø6515 3Ø948 4Ø5// Ø2Ø13 25Ø79 477// Ø2Ø17 2Ø216 523// Ø1Ø22
154ØØ 595// ØØ525 1Ø647 683// 3551Ø 88114 681// ØØ519 77999;

TTAA 62121 7226Ø 99963 1842Ø 18ØØ6 ØØØ69 ///// ///// 8548Ø
2Ø465 21Ø13 7Ø115 Ø728Ø 24ØØ8 5Ø58Ø 1Ø38Ø Ø45Ø8 4Ø748 22166
Ø1521 3Ø952 399// Ø2519 25Ø74 499// Ø3522 2Ø217 553// 35531
15399 617// 35Ø29 1Ø643 7Ø7// 33Ø16 88122 695// 3552Ø 77999;

TTAA 62121 72265 99973 2ØØØ7 12Ø1Ø ØØØ71 ///// ///// 8548Ø
19466 17Ø13 7Ø122 Ø8Ø65 21ØØ4 5Ø579 1138Ø Ø5Ø11 4Ø746 2358Ø
Ø5536 3Ø949 3998Ø Ø6Ø46 25Ø72 451// Ø4Ø37 2Ø218 527// 36Ø38
154ØØ 611// 33528 1Ø643 713// 36Ø17 8811Ø 733// 35518 77999;

TTAA 62121 7227Ø 99911 13216 19ØØ6 ØØØ56 ///// ///// 85471
21668 2Ø514 7Ø119 Ø8669 35ØØ6 5Ø582 Ø8168 Ø75Ø9 4Ø751 21167
Ø1Ø15 3Ø956 39362 Ø3514 25Ø78 491// Ø1Ø2Ø 2Ø223 529// 34529
154Ø4 631// 34Ø35 1Ø648 697// 34Ø25 88124 697// 3553Ø 77999;

TTAA 62121 72274 99921 17868 15ØØ8 ØØØ62 ///// ///// 85489
2288Ø 3551Ø 7Ø138 Ø9469 Ø65Ø4 5Ø584 Ø778Ø 1Ø511 4Ø753 2138Ø
Ø5Ø19 3Ø958 3798Ø 34Ø12 25Ø82 441// 33Ø45 2Ø228 547// 32563
154Ø8 633// 31Ø44 1Ø65Ø 713// 31521 88117 723// 33Ø25 77224
3257Ø 4361Ø;

TTAA 62121 7229Ø 99996 16ØØ2 21ØØ3 ØØØ87 ///// ///// 855Ø3
22Ø8Ø Ø95Ø7 7Ø148 1Ø68Ø Ø45Ø9 5Ø587 Ø638Ø Ø9912 4Ø756 2138Ø
Ø4ØØ7 3Ø963 34764 29551 25Ø87 435// 3ØØ63 2Ø234 549// 3ØØ76
15413 659// 28548 1Ø653 721// 3Ø519 881Ø7 739// 3ØØ17 77216
3ØØ79 41611;

TTAA 62121 723Ø4 99Ø16 17ØØØ Ø2ØØ7 ØØ143 19256 Ø251Ø 8552Ø
11463 345Ø9 7Ø125 Ø4665 27521 5Ø579 1118Ø 26525 4Ø747 2298Ø
25Ø46 3Ø952 36563 23559 25Ø76 467// 23Ø72 2Ø22Ø 559// 21586
154Ø1 621// 22554 1Ø649 639// 24Ø2Ø 88133 655// 21548 77213
22Ø91 42515;

TTAA 62121 72311 99988 1Ø6Ø5 Ø2ØØ6 ØØ141 ///// ///// 85523
13357 28ØØ8 7Ø126 Ø2864 31ØØ2 5Ø578 11568 28Ø11 4Ø746 2338Ø
285Ø6 3Ø95Ø 3938Ø Ø6514 25Ø72 5Ø1// Ø45Ø9 2Ø215 575// 22521
15395 619// 26Ø14 1Ø642 653// 21523 881Ø6 675// 21Ø24 77999;

TTAA 62121 7234Ø 99986 Ø72Ø8 24ØØ5 ØØ152 ///// ///// 85525
11656 3ØØ18 7Ø12Ø ØØ856 275Ø8 5Ø577 1238Ø 25524 4Ø744 2238Ø
29521 3Ø948 3978Ø 33Ø22 25Ø7Ø 5Ø7// 28519 2Ø213 569// 23534
15394 595// 25Ø25 1Ø642 627// 24522 88131 649// 23Ø22 77999;

TTAA 62121 72349 99993 16Ø22 18ØØ5 ØØ119 ///// ///// 855Ø5
12Ø34 24523 7Ø1Ø1 Ø1662 25Ø14 5Ø575 12561 27Ø24 4Ø742 2358Ø
29Ø19 3Ø945 4Ø7// 26516 25Ø66 515// 3ØØ14 2Ø2Ø8 577// 3ØØ19
15388 623// 2451Ø 1Ø635 671// 24Ø21 882Ø4 593// 3ØØ2Ø 77999;

TTAA 62121 72353 99958 182Ø8 22ØØ8 ØØØ67 ///// ///// 85473
18461 26Ø25 7Ø1Ø4 Ø7Ø65 28Ø17 5Ø577 11559 28Ø24 4Ø745 22962
28Ø27 3Ø949 3956Ø 27Ø27 25Ø71 493// 27525 2Ø215 543// 28527
15295 631// 31Ø35 1Ø64Ø 679// 26522 8811Ø 695// 28522 77999;

TTAA 62121 72363 99885 12256 22Ø1Ø ØØØ28 ///// ///// 85445
22272 22533 7ØØ98 1Ø28Ø 24Ø1Ø 5Ø58Ø 1Ø163 3ØØ19 4Ø747 24161
3ØØ24 3Ø95Ø 4Ø5// 29Ø41 25Ø72 491// 31Ø34 2Ø217 537// 32Ø34
15397 637// 31533 1Ø641 721// 3353Ø 881ØØ 721// 3353Ø 77999;

TTAA 62121 72365 99851 Ø8864 25ØØ3 ØØØ83 ///// ///// 855ØØ
12666 255Ø3 7Ø143 1ØØ66 34515 5Ø585 Ø7968 36Ø14 4Ø754 21965
33524 3Ø958 4Ø163 34Ø26 25Ø81 467// 31529 2Ø226 551// 31527
154Ø6 643// 32Ø23 1Ø648 717// 33Ø25 8811Ø 729// 31525 77999;

TTAA 62121 72374 99ØØ1 13ØØØ 2ØØØ1 ØØ1Ø7 128ØØ 2Ø5Ø1 85519
2168Ø Ø65Ø9 7Ø164 Ø948Ø Ø9Ø14 5Ø588 Ø778Ø 11511 4Ø757 2178Ø
27512 3Ø963 3598Ø 27527 25Ø88 429// 28Ø58 2Ø233 555// 27566
15413 657// 2853Ø 1Ø655 697// 28Ø22 88126 713// 29528 77217
27Ø73 41719;

TTAA 62121 72381 99Ø17 1Ø4Ø5 36ØØØ ØØ149 16214 255Ø5 85518
1Ø463 29Ø16 7Ø111 Ø1863 26523 5Ø575 1358Ø 28Ø38 4Ø741 2458Ø
26533 3Ø944 3958Ø 26544 25Ø67 467// 23562 2Ø212 551// 23564
15395 599// Ø4Ø// 1Ø644 619// 23532 881Ø6 675// 23538 77217
23572 41117;

TTAA 62121 724Ø2 99ØØ6 1Ø2Ø2 19ØØ2 ØØ131 Ø9813 195Ø5 85498
11256 28524 7ØØ91 ØØ22Ø 26Ø27 5Ø572 14964 26Ø37 4Ø737 23765
27544 3Ø941 3998Ø 29549 25Ø63 487// 27Ø44 2Ø2Ø7 5Ø3// 25Ø51
15391 585// 24Ø47 1Ø642 647// 24Ø31 88227 545// 26Ø46 77999;

TTAA 62121 724Ø3 99984 16Ø58 21ØØ6 ØØ1Ø8 ///// ///// 85495
12424 26537 7ØØ92 Ø2662.26515 5Ø573 1238Ø 27Ø38 4Ø74Ø 2258Ø
2854Ø 3Ø944 3998Ø 29Ø41 25Ø65 4Ø7// 3ØØ39 2Ø2Ø8 557// 27Ø46
1539Ø 595// 25Ø3Ø 1Ø639 655// 23Ø28 882Ø9 589// 28Ø43 77999;

TTAA 62121 72425 99916 11658 1651Ø ØØØ28 ///// ///// 85458
Ø2673 24Ø32 7ØØ93 1Ø48Ø 25524 5Ø578 1Ø78Ø 27525 4Ø746 23763
29531 3Ø949 39959 31Ø31 25Ø7Ø 513// 32Ø26 2Ø214 555// 3ØØ41
15394 615// 3ØØ39 1Ø639 685// 3Ø525 88121 691// 3Ø54Ø 77999;

TTAA 62121 72429 99976 Ø941Ø Ø8ØØ2 ØØØ6Ø ///// ///// 85445
14865 14ØØ7 7ØØ69 Ø7Ø67 26532 5Ø572 14731 26542 4Ø739 23563
28Ø48 3Ø943 3958Ø 28542 25Ø65 5Ø9// 28Ø41 2Ø2Ø7 577// 29558
15386 627// 28557 1Ø642 697// 29Ø27 88212 597// 29548 77192
3ØØ6Ø 41814;

TTAA 62121 72433 99834 17271 19Ø23 ØØØØ5 ///// ///// 85442
///// ///// 7ØØ77 Ø7257 3ØØ27 5Ø576 Ø998Ø 33Ø36 4Ø743 24357
3Ø541 3Ø947 4Ø3// 3ØØ45 25Ø68 5Ø9// 28537 2Ø2// 573// 3Ø571
15391 625// 1Ø164 1Ø636 713// 29531 88999 772Ø1 3Ø571 417Ø7;

TTAA 62121 72455 99852 Ø5662 13ØØ5 ØØØ94 ///// ///// 85493
12864 ///// 7Ø115 Ø6Ø62 32511 5Ø58Ø Ø9568 32Ø25 4Ø748 23762
31Ø26 3Ø951 4Ø7// 32Ø39 25Ø73 497// 31514 2Ø218 519// 3Ø546
154ØØ 617// 31Ø47 1Ø643 713// 31542 88122 7Ø5// 3Ø542 77999;

TTAA 62121 72469 99814 Ø2Ø59 2ØØØ9 ØØ142 ///// ///// 85541
///// ///// 7Ø158 Ø5461 35Ø19 5Ø585 Ø9367 32Ø2Ø 4Ø753 2337Ø
3153Ø 3Ø956 4Ø7// 3Ø54Ø 24Ø78 487// 31538 2Ø223 539// 3ØØ44
15413 643// 31Ø41 1Ø645 711// 31535 88111 725// 29536 77999;

TTAA 62121 72476 99Ø13 15456 ØØØØØ ØØ113 2Ø663 Ø9512 85521
18668 Ø4ØØ8 7Ø168 Ø168Ø Ø4Ø13 5Ø588 Ø858Ø Ø55Ø8 4Ø756 23364
145Ø3 3Ø96Ø 4Ø163 145Ø8 25Ø83 451// 2753Ø 2Ø229 549// 27Ø38
15418 665// 28531 1Ø65Ø 7Ø1// 29518 88129 7Ø1// 28522 77124
27Ø55 4Ø515;

TTAA 62121 72473 99ØØ6 11833 16ØØ6 ØØ139 12Ø33 165Ø9 85488
Ø5812 2Ø543 7ØØ65 ØØ58Ø 22527 5Ø567 18756 22551 4Ø73Ø 3Ø374
23Ø58 3Ø929 415// 26Ø49 25Ø51 469// 24Ø61 2Ø198 5Ø5// 24566
15383 549// 25551 1Ø637 633// 24533 881ØØ 633// 24533 77212
24574 41123;

TTAA 62121 72486 9997Ø 13Ø13 2151Ø ØØØ95 ///// ///// 85464
Ø88ØØ 25539 7ØØ54 Ø2Ø62 27Ø31 5Ø568 17514 26547 4Ø733 26114
28Ø57 3Ø935 415// 29Ø7Ø 25Ø55 523// 29Ø73 2Ø199 529// 25554
15383 6Ø3// 25Ø45 1Ø633 613// 23528 88226 545// 27557 77266
29Ø75 4Ø516;

TTAA 62121 72494 99983 12839 2ØØ13 ØØØ69 ///// ///// 85433
Ø7414 21538 7ØØ11 Ø1663 26Ø47 5Ø563 1718Ø 2555Ø 4Ø727 28759
25556 3Ø926 431// 27Ø59 25Ø48 477// 27Ø72 21Ø94 485// 25566
15382 557// 24547 1Ø635 583// 2353Ø 88269 475// 26577 77192
26574 41219;

TTAA 62121 72518 9998Ø 1384Ø 15ØØ5 ØØØ58 ///// ///// 85426
Ø8Ø45 15ØØ9 7Ø1Ø3 Ø2257 16Ø11 5Ø572 16372 16512 4Ø813 2658Ø
1552Ø 3Ø945 411// 17534 25Ø56 489// 16532 2Ø2Ø3 5Ø3// 17Ø35
15374 611// 17Ø32 1Ø623 589// 16Ø23 8815Ø 611// 17Ø32 77999;

TTAA 62121 72528 99976 12434 19ØØ4 ØØØ55 ///// ///// 85424
Ø7226 18ØØ8 7Ø11Ø Ø1259 1851Ø 5Ø568 15776 19Ø12 4Ø8Ø3 2558Ø
18Ø13 3Ø956 432// 17Ø21 25Ø68 5Ø1// 17528 2Ø2Ø5 573// 18Ø34
15383 621// 18Ø35 1Ø645 6Ø1// 17Ø23 88145 635// 1753Ø 77999;

TTAA 62121 72532 9993Ø 1Ø463 13ØØ2 ØØØ67 ///// ///// 85432
Ø5664 125Ø5 7ØØ32 Ø2259 14ØØ9 5Ø572 133// 13Ø13 4Ø824 24576
13519 3Ø967 3898Ø 13Ø26 25Ø78 455// 14534 2Ø222 533// 13Ø38
1539Ø 599// 12534 1Ø658 587// 13Ø31 88168 613// 13Ø36 77999;

TTAA 62121 72553 99913 Ø666Ø Ø9ØØ4 ØØØ88 ///// ///// 85441
Ø3661 1352Ø 7ØØ38 Ø3658 26Ø42 5Ø558 12366 28562 4Ø735 24565
28571 3Ø939 38761 28574 25Ø61 5Ø1// 28585 2Ø2Ø3 597// 29Ø81
15383 613// 28Ø78 1Ø631 649// 28536 88212 593// 29Ø82 77254
28588 41514;

TTAA 62121 72562 99874 Ø8243 17ØØ8 ØØ13Ø ///// ///// 85526
14Ø6Ø 27511 7Ø132 Ø4463 31521 5Ø579 Ø9965 3ØØ41 4Ø747 23363
3Ø548 3Ø951 3996Ø 3Ø543 25Ø73 499// 3ØØ36 2Ø216 553// 31Ø57
15397 639// 3ØØ56 1Ø641 717// 31547 88114 7Ø5// 3Ø549 77191
3Ø563 4Ø714;

TTAA 62121 72572 99829 Ø6861 13ØØ9 ØØØ75 ///// ///// 8548Ø
///// ///// 7ØØ76 Ø1258 325Ø3 5Ø572 12165 3Ø579 4Ø738 25365
29581 3Ø941 39961 3Ø6Ø5 25Ø63 493// 2Ø1Ø7 2Ø2Ø5 589// 3Ø111
15387 6Ø9// 29Ø68 1Ø635 669// 29Ø63 88999 77999;

TTAA 62121 72597 99977 Ø6617 35ØØ3 ØØ2Ø2 ///// ///// 8557Ø
14865 Ø3ØØ6 7Ø19Ø Ø6267 ØØ518 5Ø588 Ø9769 31Ø24 4Ø755 2296Ø
29Ø29 3Ø959 4Ø3// 29538 25Ø81 485// 29Ø37 2Ø225 549// 29Ø38
154Ø6 635// 3ØØ42 1Ø651 693// 31Ø33 88117 697// 29Ø34 77999;

TTAA 62121 726Ø6 99Ø18 Ø6615 195Ø4 ØØ164 Ø96ØØ 195Ø7 85496
Ø548Ø 2Ø523 7ØØ67 Ø198Ø 21525 5Ø567 1778Ø 23Ø38 4Ø73Ø 3Ø58Ø
22549 4Ø927 477// 22Ø5Ø 25Ø48 531// 23Ø79 2Ø195 553// 24575
15379 583// 24Ø54 1Ø631 6Ø2// 24535 883ØØ 477// 22Ø5Ø 77215
23581 4Ø917;

TTAA 62121 72637 99977 14432 22Ø12 ØØØ4Ø ///// ///// 854ØØ
264Ø9 26Ø29 7Ø968 Ø2565 26Ø44 5Ø558 1678Ø 26Ø48 4Ø722 28758
27Ø67 3Ø923 417// 27Ø72 25Ø43 513// 26Ø73 2Ø188 537// 26548
15373 565// 24546 1Ø629 6Ø1// 25Ø36 8823Ø 535// 26575 7733Ø
27Ø8Ø 41414;

TTAA 62121 72645 99979 Ø5Ø22 25ØØ7 ØØØ31 ///// ///// 85374
Ø4262 28Ø26 7Ø918 Ø7169 27536 5Ø546 22167 28568 4Ø7Ø7 31157
271ØØ 3Ø9Ø6 437// 27Ø97 25Ø27 5Ø9// 256Ø1 2Ø172 489// 27Ø75
15361 5Ø9// 25Ø51 1Ø619 593// ///// 88237 517// 25Ø98 77249
256Ø2 42816;

TTAA 62121 72655 99963 Ø7258 28ØØ8 ØØØ74 ///// ///// 85425
Ø5259 31515 7Ø973 Ø81Ø5 29525 5Ø552 2Ø733 28581 4Ø715 31126
25577 3Ø911 455// 276Ø6 25Ø31 511// 28624 2Ø177 5Ø3// 27595
15363 523// 28Ø75 1Ø623 571// 28Ø39 8825Ø 511// 28624 7726Ø
2813Ø 42529;

TTAA 62121 72662 99969 Ø3826 23ØØ4 ØØØ52 ///// ///// 85386
Ø1859 3Ø538 7Ø924 Ø7769 29544 5Ø545 25563 29Ø8Ø 4Ø7Ø4 35357
27121 3Ø898 467// 27122 25Ø18 5Ø5// 271Ø1 2Ø165 486// 27587
15354 475// 26559 1Ø615 569// 27Ø36 88262 5Ø5// 27614 77378
26628 431Ø4;

TTAA 62121 72681 999Ø5 Ø6Ø32 35Ø16 ØØ122 ///// ///// 85475
Ø2623 33522 7ØØ22 Ø5314 29543 5Ø56Ø 19315 26561 4Ø721 31358
28593 3Ø921 431// 28622 25Ø42 491// 29634 2Ø186 545// 29599
1537Ø 565// 2859Ø 1Ø626 595// 27539 88219 545// 29618 77242
29636 42136;

TTAA 62121 72694 99922 Ø4457 12ØØ5 ØØ18Ø ///// ///// 85543
Ø8667 32523 7Ø131 Ø2865 31Ø46 5Ø579 11565 32Ø46 4Ø746 24156
3Ø552 3Ø949 4Ø16Ø 3ØØ64 28Ø71 499// 29Ø57 2Ø215 557// 3ØØ67
15395 631// 29575 1Ø639 663// 3Ø56Ø 88188 7Ø3// 3Ø565 77181
3Ø579 41612;

TTAA 62121 727Ø1 99Ø2Ø Ø824Ø 33ØØ6 ØØ227 Ø8826 36Ø13 85572
Ø928Ø 35519 7Ø169 Ø4263 31536 5Ø583 1138Ø 3Ø543 4Ø75Ø 2438Ø
29538 3Ø952 415// 29551 25Ø73 497// 3Ø552 2Ø217 561// 29552
15398 629// 29Ø51 1Ø643 677// 3ØØ39 88128 681// 3ØØ49 77999;

TTAA 62121 72712 99995 Ø56ØØ 14ØØ9 ØØ149 ///// ///// 85477
Ø5265 21Ø17 7ØØ48 Ø136Ø 21Ø17 5Ø565 17767 22523 4Ø728 3Ø761
22529 3Ø926 457// 23553 25Ø45 545// 23548 2Ø189 525// 25Ø53
15373 571// 25Ø4Ø 1Ø628 587// 25Ø31 8825Ø 545// 23548 77236
24561 425Ø9;

Weather Observer Branch
Chanute AFB, Illinois

C3ABR25130-HO-201A
C3ABR25130-2-HO-201A
21 June 1984

LOCATION IDENTIFIER

SAUM 9 KAWN

AREA 06
VOK Camp Douglas, WI

AREA 07
FRI Fort Riley, KS
IAB McConnell AFB, KS
NBU NAS Glenview, IL
OFF Offutt AFB, NE

AREA 08
END Vance AFB, OK
FWH Carswell AFB, TX
LTS Altus AFB, OK
SPS Wichita Falls, TX
TIK Tinker AFB, OK

AREA 09
DYS Dyess AFB, TX

AREA 10
BLV Scott AFB, IL
GVW Richards Gebaur AFB, MO
HOP Campbell AAF, KY
TBN Forney AAF, MO

AREA 11
AEX England AFB, LA
BAD Barksdale AFB, LA
BYH Blytheville AFB, AR
CBM Columbus AFB, MS
LRF Little Rock AFB, AR
NMM NAS Meridian, MS

AREA 12
FFO Wright-Patterson AFB, OH
FTK Godman AAF, KY
GUS Grissom AFB, IN
LCK Rickenbacker AFB, OH
MTC Selfridge ANGB, MI

AREA 13
MXF Maxwell AFB, AL
OZR Cairns AAF, AL

SAUS 5 KAWN

ATY Watertown, SD
FRM Fairmont, MN
GRR Grand Rapids, MI
MBL Manistee, MI
MHE Mitchell, SD
MSP Minneapolis, MN

SAUS 6 KAWN

ALO Waterloo, IA
BBW Broken Bow, NE
CMI Champaign, IL
COU Columbia, MO
DDC Dodge City, KS
DSM Des Moines, IA
HSI Hastings, NE
IRK Kirksville, MO
JLN Joplin, MO
MLI Moline, IL
PIA Peoria, IL
RSL Russell, KS
SUX Sious City, IA

SAUS 7 KAWN

ACT Waco, TX
LFK Lufkin, TX
PRX Paris, TX
TYR Tyler, TX

SAUS 8 KAWN

BMG Bloomington, IN
CAK Akron, OH
CHA Chattanooga, TN
FDY Findlay, OH
LOZ London, KY
MEM Memphis, TN

SAUS 9 KAWN

FSM Fort Smith, AR
GLH Greenville, MS
MCB McComb, MS

Supersedes 3ABR25130-HO-201A, 7 January 1982
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 900; DAV - 1

RCL: N/A

Designed for ATC Course Use. Do Not Use on the Job

Weather Observer Branch
Chanute AFB, Illinois

C3ABR25130-HO-203a
C3ABR25130-2-HO-203a
17 February 1984

ADDITIONAL INFORMATION ON COMEDS

OBJECTIVES

a. Given information, correct message preparation formats and procedures, and the COMEDS Model 40 machine, prepare appropriate messages as listed below for transmission. All messages prepared will be corrected to 100% accuracy.

(1) Airways

(2) TAF

(3) RAREPS

(4) PIREPS

(5) NOTAMS

b. Given information, correct message preparation formats and procedures, and the COMEDS Model 40 machine, prepare ARQ messages. All messages prepared will be corrected to 100% accuracy with instructor assistance.

INTRODUCTION

ROP - Receive only printer

KEYBOARD - used to type messages

KEYBOARD DISPLAY UNIT - allows you to see what you're typing

Capabilities -

a. Receive data and give a visual display of data being typed.

b. 3 electronic pages

c. Each line consists of 80 spaces but the Carswell computer will accept only 69 spaces of data.

Supersedes C3ABR25130-HO-204, 15 November 1983.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 500; DAV - 1

Designed for ATC Course Use. Do Not Use on the Job.

INFORMATION

KEYBOARD FUNCTIONS

Operational Mode Control Keys - (Located above the keyboard).

a. SEND - The SEND mode is used to transmit messages to the ADWS Computer.

b. REC - The RECEIVE key (if lamp is not on) may be depressed to receive traffic on the display screen of the keyboard.

c. LOCAL - The LOCAL mode of operation is used to prepare messages off-line for subsequent transmission.

d. HIGHLIGHT - This key may be used to highlight characters entered from the keyboard. This function is not used.

e. FORM ENTER - When this key is depressed, the lamp will light and any subsequent characters which are entered will be protected and displayed at half intensity. Such protected characters cannot be overtyped, moved or cleared until FORM ENTER key is re-depressed.

f. TAB SET - This key is used to set tabs at the mandatory 69 characters per line limit and below the cursor.

g. TAB CLEAR - Erases TAB SET functions under the cursor.

h. CLEAR - It clears all unprotected to the right and below the cursor.

Cursor Controls - (Located on the left hand side of the keyboard).

a. HOME - Causes the cursor to move to the first space on the first line on the first page.

b. CURSR RETRN - Returns the Cursor to the beginning of the line of entry.

c. ARROW KEY - Move the cursor in the direction of the arrow.

d. SCROL CONTROLS - (UP/DOWN) Moves the data in either direction.

e. SEGMENT ADVANCE - May be used to move the segment to the next segment.

f. CURSR TAB - Moves cursor to the tab.

Editing Controls - (Located on right hand side of the keyboard).

a. LINE INSERT/DELETE - Adds or subtracts a line

b. CHAR INSERT/DELETE - Adds or subtracts a character or space

Additional Controls or Keys

a. NEW LINE - Will be used at the end of each line. It tells the computer to go to a new line.

b. SPACE BAR - Moves the cursor one space to the right.

c. CAPSLOCK - Will always be depressed when COMEDS is in use. When depressed, all letters will be capitalized.

FORMATS

AIRWAYS

```
RAN SA (MOD)* 1755 30 SCT E80 BKN 5F 039/73/60/3605/989/CB W MOVG E/ 317
    1579;(NL)
    etx
```

FORECASTS

```
RAN TAF 0808 (MOD)* 22006 9999 7CS200 QNH2997INS CIG200(NL)
     GRADU 0911 4800 10BR 05HZ 2AC100 7CS200 QNH2995INS CIG200(NL)
     GRADU 1214 32010 9999 WX NIL 1CU030 4AC100 7CS200 QNH2994INS(NL)
          CIG100;(NL)
etx
```

*MOD = COR-correction, RTD-routine transmission delay, AMD-amendment

PIREPS

```
RAN MOD UA /OV BLV 1310 FL 053/TP C141/SK 040 SCT 053/260 OVC/IC LGT(NL)
    035-053/RM CLR ABV;(NL)
etx
```

RAREPS

```
RAN MOD SD 0138 AREA 3TRW+/+ 35/145 350/80 40W A3020 C3115 MT 500(NL)
    AT 21/96;(NL)
etx
```

NOTAM

```
NOTAM(NL)
KRAN(NL)
R060201 CHANUTE AFB IL(NL)
RAN VOR RWY 33 UNUSBLE 010-04´ (NL)
etx
```

NOTAM number consists of - N, , R, Day of month, month, NOTAM for that day.

NOTE: N-new, C-cancelled, R-revised

ARQ

```
*1 ARQ(NL)            *2 ARQ(NL)              *3 ARQ(NL)
   SA LTS FWH(NL)        SAUS 22 KAWN(NL)         UJ 72210 72221 72235(NL)
   TW CMI DCA(NL)        etx                      UJ 72250 72251 72260(NL)
   etx                                            etx
```

Number of stations requested cannot exceed 9 per line with no more than 5 lines.

ARQP - when you want an answer on the printer.

Technical Training

Weather Specialist

OBSERVATION WORKBOOK

31 January 1983

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

RGL: N/A

Weather Training Branch
Chanute AFB, Illinois

OBSERVATIONAL INSTRUCTIONS

OBJECTIVE

Using all required references and necessary equipment, perform the following operations. Observe current weather conditions visually and/or instrumentally for: sky condition and cloud forms, visibility and runway visual range, weather and obstructions to vision, wind, pressure, temperature and dewpoint and precipitation measurement.

PROCEDURE

1. All layers are to be considered to be opaque unless stated otherwise.

2. All heights are to be considered to be estimated unless otherwise stated.

3. Use RBC chart to obtain angular height values.

4. Use standard tables to compute sea level pressure and altimeter setting.

5. The correction for all pressure values is -.005.

6. Beyond 1200Z, use the 0055Z-1155Z column 7 entries to obtain "R" values.

7. Use a combination of cloud diagrams, word descriptions, and common sense to get your column 3 entries.

8. Make entries in all appropriate columns for Record and Special observations.

9. The station elevation is 780'.

10. Fill out columns 41-46 on six hourly observations. Only columns 1-4 will be used.

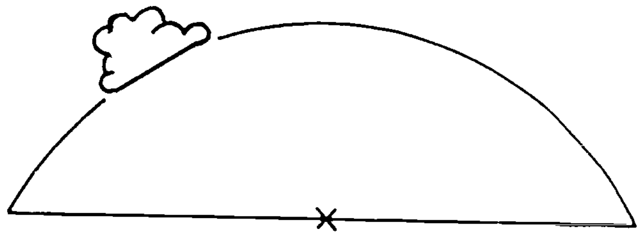
11. Fill out summary of the day columns after completing the last observation in this workbook.

12. Add 10° to wind direction for the magnetic to true correction.

13. The numbers in parentheses after the sky coverage are to be used by those encoding these observations in METAR on AWS Form 10a.

Supersedes C3ABR25130-WB-300, 13 December 1982.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-W - 550; DAV - 1

OBSERVATIONS

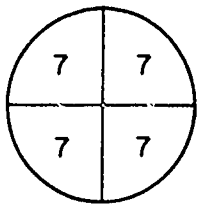


1. Sky Condition:

   1/10 (1/8) Smoke at 1000'

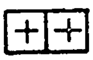
   1/10 (1/8) Cumulus at 1300'

   8/10 (8/8) Cirrostratus at 28,000'



2. Visibility:

   TWR reports 10 miles

   RVR  *Rwy #18*

3. Atmospheric phenomena: Shallow ground fog is present at a height of 3 feet.

4. Temperature: Temp
   dry bulb 75.0

   Dew Point 70.0

5. Wind: Calm

6. Observed pressure: 29.410

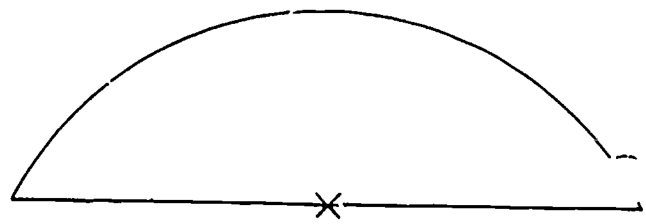
7. $T_{12} = 54$

Observation completed 0055Z

1. Sky Condition:

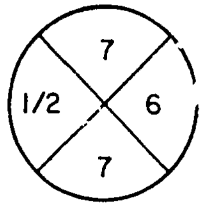
   10/10 (8/8) Cirrostratus,
   6/10 (6/8) thin.

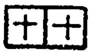
   Height 28,000'



2. Visibility:

   TWR reports 10 miles



   RVR  Rwy #18

3. Atmospheric Phenomena: Fog is present at a depth of 5 feet

4. Temperature: Temp
   dry bulb 75.3

   Dew Point 71.8

5. Wind: 180° 01 knots (magnetic)

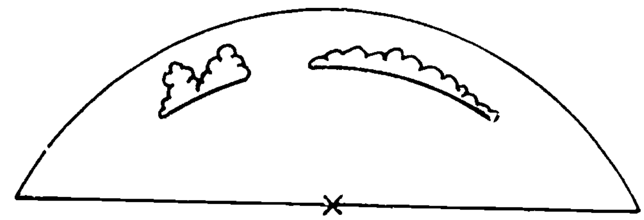
6. Observed pressure: 29.415

7. $T_{12} = 44$

Observation completed 0155Z

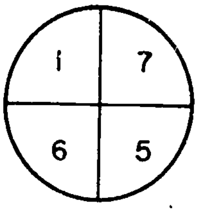
Sky Condition:

1. 4/10 (4/8) Altocumulus, with sproutings in the form of small towers. (Height 10,000 MSL)
10/10 (8/8) Cirrostratus, all thin.
(28,000 MSL)



2. Visibility: Twr reports 10 miles

RVR
Rwy # 18 



3. Atmospheric phenomena: Fog is present 12 feet in depth.

4. Temperature: Temp
dry bulb 74.2

dewpoint 71.1

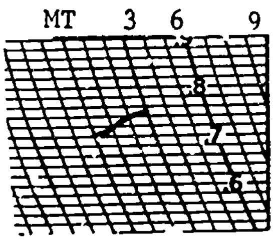
5. Wind: Calm

6. Observed Pressure 29.425

Station Press 3 hrs Ago 29.400

Use Barograph for pressure tendency

7. $T_{12} = 45$



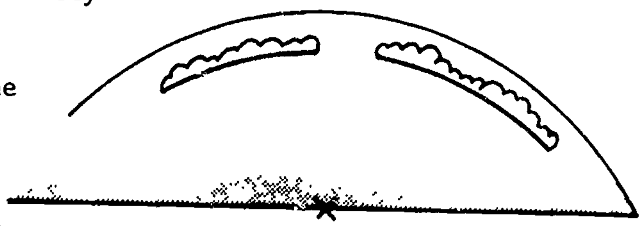
Observation completed 0255Z

1. Sky Condition:

   4/10 (4/8) Altocumulus, which is predominantly opaque (9,250')

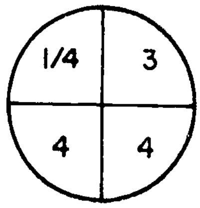
   9/10 (7/8) Cirrostratus, not covering the entire sky (27,000')

   nor increasing.



2. Visibility: Twr reports 10 miles

   RVR
   Rwy #18 $\boxed{6}\boxed{0}$



3. Atmospheric phenomena: Fog is now 20 feet in depth

4. Temperature: Temp
   dry bulb 72.9

   dew point 71.0

5. Wind: Calm

6. Observed pressure 29.400

7. $T_{12} = 52$

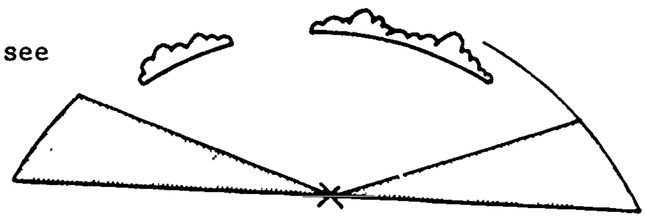
Observation completed 0355Z

1. Sky Condition:

   Fog is hiding 3/10 (3/8) of the sky, at a depth of 95 feet

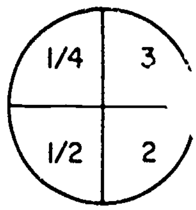
   3/10 (3/8) Altocumulus at 9,850

   1/10 (1/8) Cirrostratus is visible at 28,795 MSL



2. Visibility: Twr reports that they can see

   4 miles. The RVR for runway # 18 is



$\boxed{40}$

3. Atmospheric phenomena: Fog is present

4. Temperature: Temp
   dry bulb 72.6

   dew point 71.5

5. Wind: Calm

6. Observed pressure 29.390

7. $T_{12} = 46$

Observation completed 0455Z

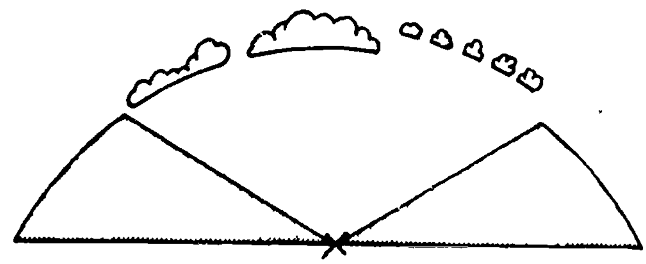
1. Sky condition:

   Fog hides 6/10 (5/8) of the sky

   1/10 (1/8) Altocumulus, all opaque, at 9,850'

   1/10 (1/8) Altocumulus, all opaque, at 11,325'

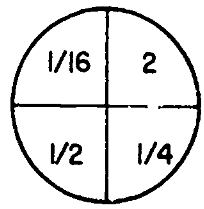
   1/10 (1/8) Cirrocumulus 31,000', all opaque



2. Visibility: Twr personnel can only see 2 1/2 miles.

   RVR for runway #18 is

2	2



3. Atmospheric phenomena: Fog is present

4. Temperature: Temp
   dry bulb 72.6

   dew point 71.5

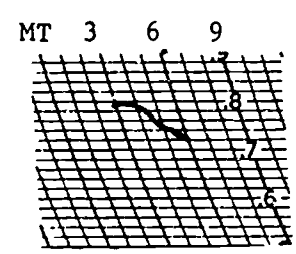
5. Wind: Calm

6. Observed pressure 29.380

7. T_{12} = 45

8. 6 hour water equivalent- none

use the barograph chart below for the pressure tendency



Observation completed at 0555Z

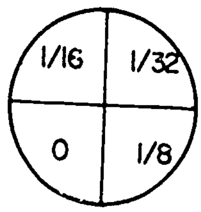
1. Sky Condition:

Fog is hiding 10/10 (8/8) of the sky. The vertical visibility is 70 degrees on the RBC.

2. Visibility: The Twr reports a visibility of 1/2 mile

RVR on RWY # 18 is

1 0



3. Atmospheric phenomena: Fog is present.

4. Temperature: Temp 72.6

dew point 71.5

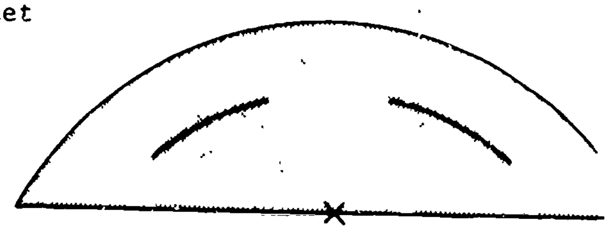
5. Wind: Calm

6. Observed pressure 29.380

7. Observation time 0610Z

1. Sky Condition:

   3/10 (2/8) Stratus Fractus, height, 375 feet
   10/10 (8/8) fog hides the sky, vertical
   visibility values of 52°, 56°, 50°, 54°
   were obtained from the RBC.



2. Visibility: Tower reports a visibility of 1/2 mile. The RVR on Runway # 18 is $\boxed{-\mid-}$

   The visibility has varied from 1/8 to 0 to 1/4 to 1/16 in the last 10 minutes.

3. Atmospheric phenomena: Fog is present, the top of which is 5,800 feet according to a pilot who just passed over the station.

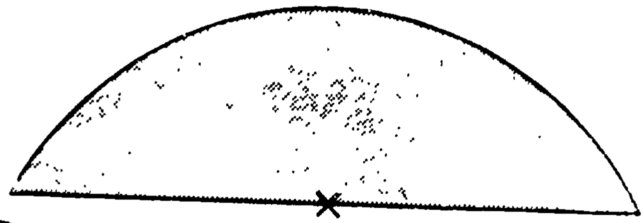
4. Wind: Calm

5. Observed pressure 29.380

6. Observation time 0617Z

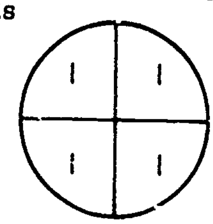
1. Sky Condition:

Fog hides 10/10 (8/8) of the sky, the vertical visibility as reported by a pilot is 780'.



2. Visibility: The tower reports that they can see 0 miles. The active runway is # 18 and the FMN-1 computer reads

$\boxed{4}\boxed{0}$



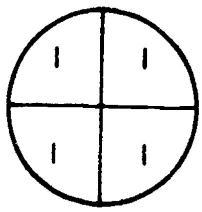
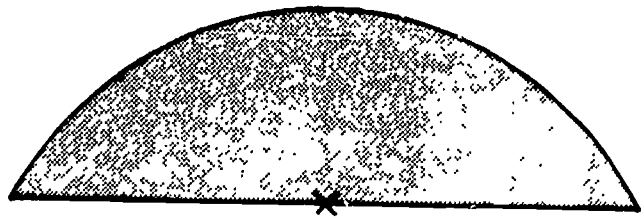
3. Winds: The [illegible]0-362 indicates 170° at 01 knots

4. Observed pressure: 29.375

5. Observation time 0631Z

1. Sky Condition:

   Fog is hiding 10/10 (8/8) of the sky, the vertical visibility is 47 feet.

2. Visibility:  

   Tower reports same visibility as last observation.

   The RVR for runway # 18 is $\boxed{4}\boxed{5}$

3. Winds: The RO-362 indicates 170° at 03 knots.

4. Temperature: Temp 72.5

   dew point 72.1

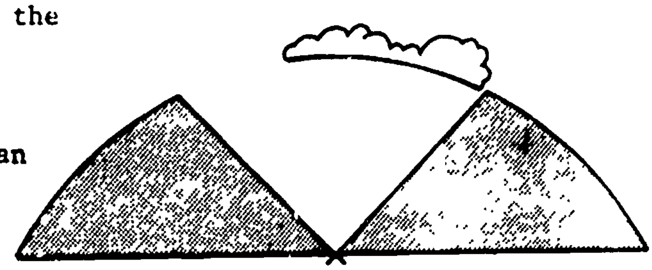
5. Observed pressure 29.370

6. Observation completed 0655Z

7. $T_{12} = 46$

1. Sky Condition:

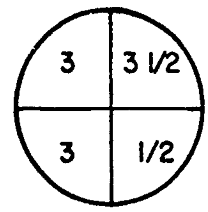
Fog hides 8/10 (6/8) of the sky
1/10 (1/8) Stratocumulus determined by the
RBC at 900'



2. Visibility: Tower reports that they can now see 7 miles.

FMN-1 computer indicates
active runway is # 18 $\boxed{6}\boxed{0}$

Prevailing:



3. Winds: The RO-362 now indicates 170° at 13 knots.

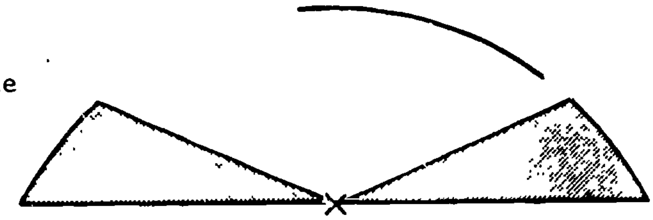
4. Observed pressure 29.365

5. Observation time 0731Z

1. Sky Condition:

Fog is now hiding 2/10 (2/8) of the sky

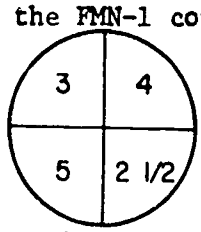
4/10 (3/8) Stratus at 1300' (from the RBC) (the St is 3/10 (3/8) thin and it varies to 2/10 (2/8) thin during the period of obs.)



2. Visibility: The tower reports that their visibility is 6 miles.

The RVR as indicated from the FMN-1 computer is ++ for Rwy #18.

Prevailing visibility:



3. Winds: The 1 minute average is 12 knots with a peak gust of 19 knots during the last ten minutes. The winds are coming from 170 degrees.

4. Observed pressure 29.365

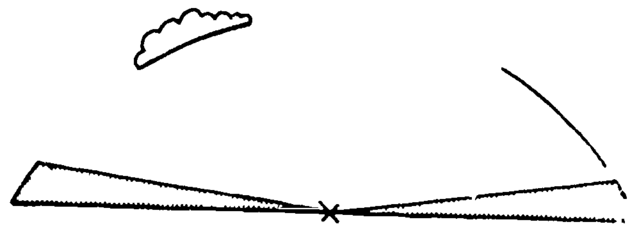
5. Observation time 0746Z

1. Sky Condition:

   1/10 (1/8) of the sky is still hidden by fog

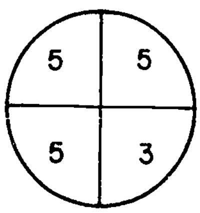
   2/10 (1/8) Stratus at 1300' (varies to 3/10 (3/8) coverage during the period of observation)

   2/10 (2/8) Cumulus determined by the convective cloud height diagram to be 2000'



2. Visibility: Tower reports a visibility of 7 miles.

   The FMN-1 computer indicates 

   prevailing visibility is 

3. Temperature: Temp 73.1

   dew point 68.1

4. Wind: Direction of 180°, speed of 13 knots gusting to 23 knots.

5. Observed pressure 29.365

6. Observation completed 0755Z

7. $T_{12} = 42$

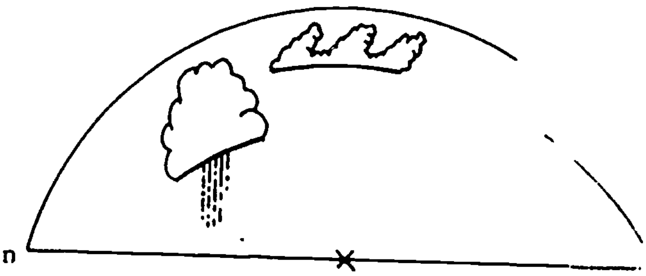
1. Sky Condition:

   2/10 (2/8) Stratus, height 1300'
   (1/10 (1/8) thin)

   2/10 (2/8) Cumulus of strong vertical development height 2000'

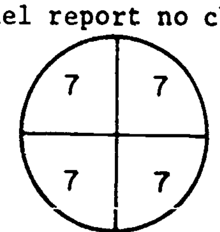
   2/10 (2/8) Altocumulus with sproutings in the form of towers or battlements at a height of 8,750'

   7/10 (6/8) Cirrostratus, all tnin, height reported by an FB-111 to be 31,000'

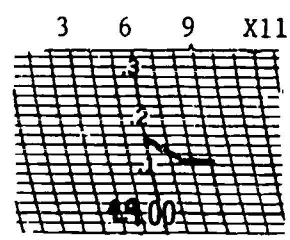


2. Visibility: Tower personnel report no change in their visibility.

   prevailing visibility:



3. Atmospheric phenomena: A lithometeor that gives the sun a peculiar silvery tinge is present at your station. Rain is falling from the cumuliform cloud to the west of your station but is evaporating before reaching the surface.



4. Temperature: Temp 73.1

   dew point 68.5

5. Observed pressure 29.360 (use this barograph chart for the pressure tendency)

6. $T_{12} = 43$

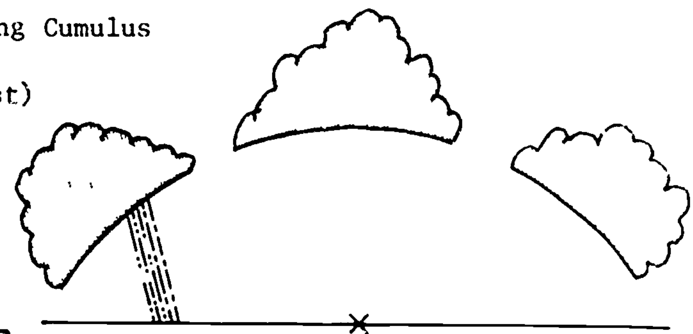
7. Wind: 180 degrees, speed 10 knots, gusting to 23 knots.

8. Observation completed 0855Z

1815

1. Sky Condition:

6/10 (5/8) Cumulonimbus and Towering Cumulus (CB - west) and TCU's-(ovhd and east) are all moving northeast.) 3,500'



3. Visibility: TWR VSBY 7

FMN-1 computer $\boxed{+}\boxed{+}$

Prevailing visibility has been varying from 5 to 7 to 6 and back up to 9 miles because of the light haze that is present at your station.

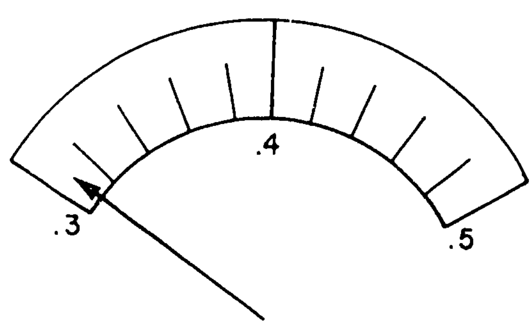
3. Atmospheric phenomena: Haze is present and a rainshower is occurring to the west of your station.

4. Temperature: Temp
dry bulb 76.0

dew point 66.0

5. Pressure: obtain reading from the sample Aneroid barometer.

29.________



6. $T_{12} = 43$

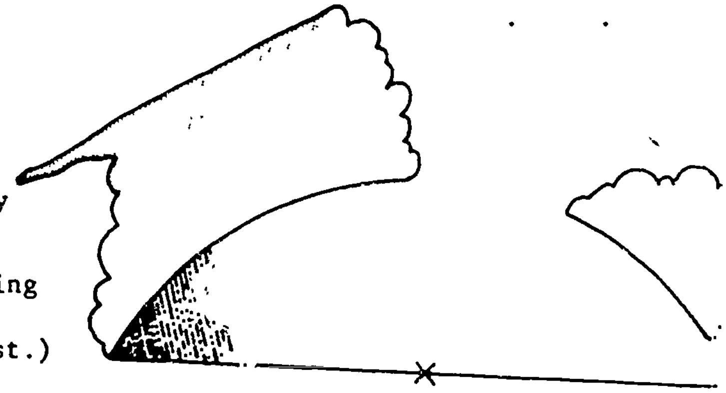
7. Wind: The 1 minute average is 10 knots, a peak gust of 18 knots occurred 4 minutes ago, from a direction of 210°.

8. Observation completed 0955Z

1. Sky Condition:

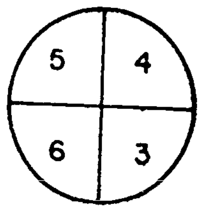
1/10 (1/8) of the sky is hidden by rain.

8/10 (6/8) Cumulonimbus and Towering Cumulus at 3,500' from the RBC. (Clouds are moving to the northeast.)



2. Visibility: Tower reports 3 miles visibility

Prevailing

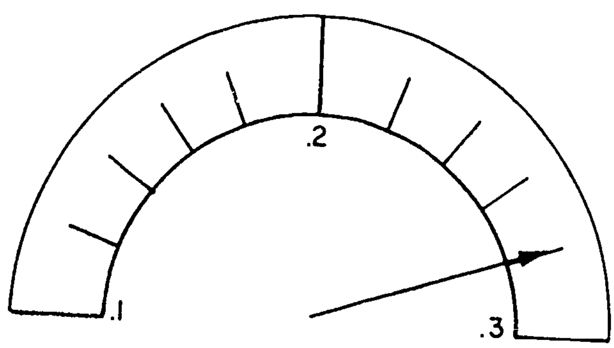


3. Atmospheric phenomena: Haze is present and a wall of rain is blocking 1/10 (1/8) of the sky to the west.

4. Temperature: Temp 73.4

dew point 68.3

5. Pressure: 29.________

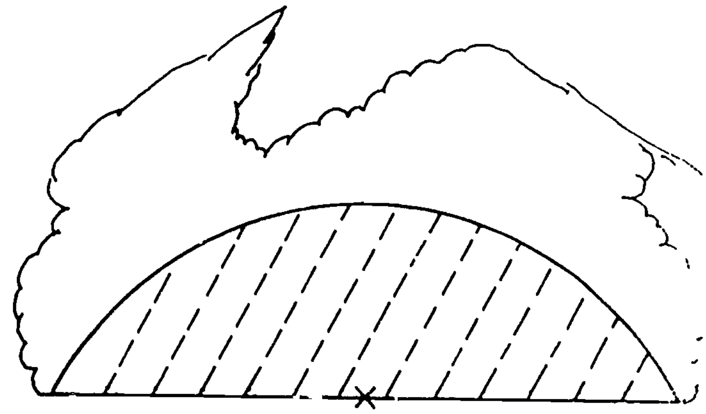


6. $T_{12} = 41$

7. The wind is from 220° at 15 knots with gusts to 24 knots.

8. Observation completed 1055Z

1817



1. Sky Condition:

   10/10 (8/8) Cumulonimbus, height obtained from the RBC, at 3,500' (cloud moving to the northeast) (the amount of coverage varies at 9/10)

2. The prevailing visibility has been varying between 3 miles and 1 mile, during the period of observation. Tower reports 1/2 mile visibility. The RVR for runway #18 is: $\boxed{6|0}$

3. Atmospheric phenomena: Light rain is falling and has been varying to moderate during the period of observation. Haze is present also.

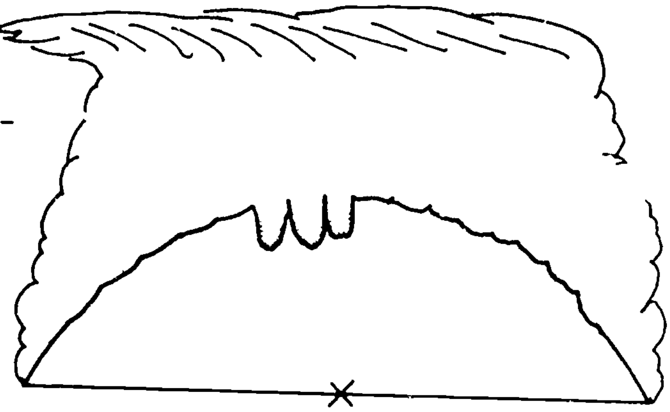
4. Wind: The winds are from 220^{o} at 16 knots gusting to 28 knots.

5. Observed pressure 29.255

6. Observation time 1114Z

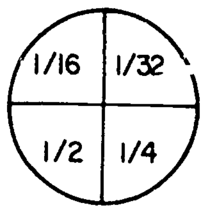
1. Sky Condition:

10/10 (8/8) Cumulonimbus, when determining the height you observed the RBC values to be varying from 69° to 71° to 68° to 73°.



2. Visibility: The FMN-1 computer indicates  for Rwy #18

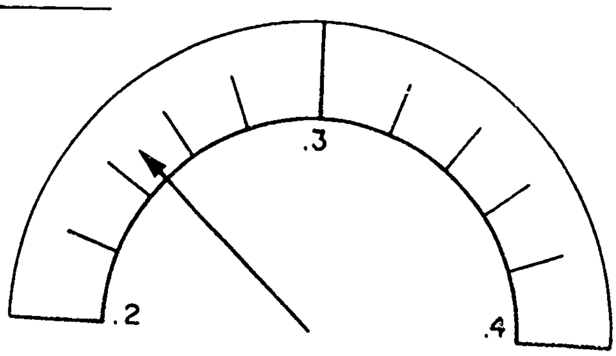
prevailing



3. Atmospheric phenomena: Thunder was just heard (time now 1119Z) to the west of your station. Rain is falling and has accumulated .09 inches in the last 6 minutes. A farmer called the forecaster at 1118Z to report sighting a Tornado 11 miles southwest of your station (RAN). The farmer stated that the Tornado was moving to the northeast and that he sighted it at 1100Z.

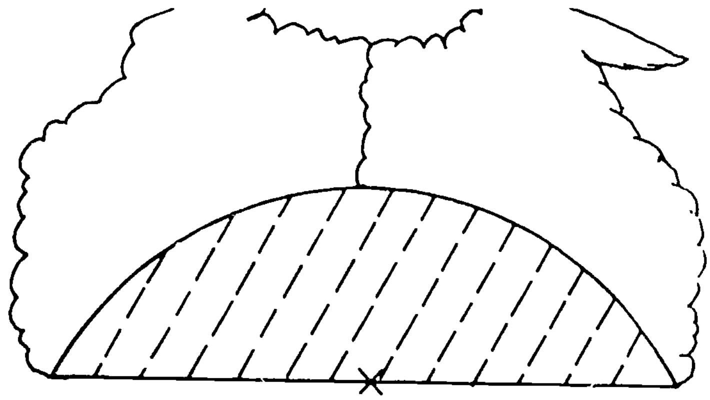
4. Wind: Currently from 230° at 20 knots gusting to 36 knots.

5. Pressure: 29.________

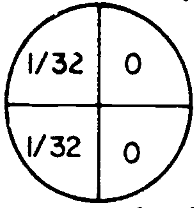


1819

1. 10/10 (8/8) Cumulonimbus at an RBC height of 63°, clouds are moving northeast.



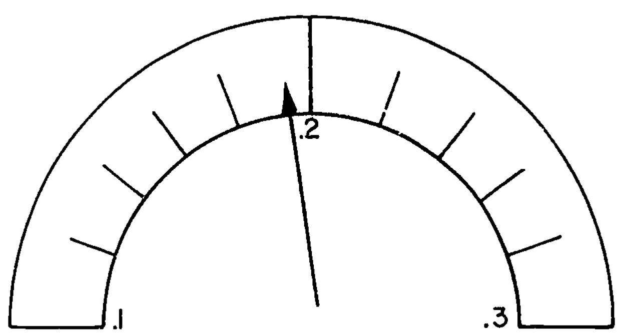
3. Visibility: RVR for Rwy #18



3. Atmospheric phenomena: Thunder is occurring in all quadrants with frequent lightning in cloud and cloud to ground to the west. Hail just started to fall (1131Z), the largest stone is 1/2 inch. Rain is still falling and has accumulated .06 inches in the last six minutes. During the period of observation the rain has varied to moderate.

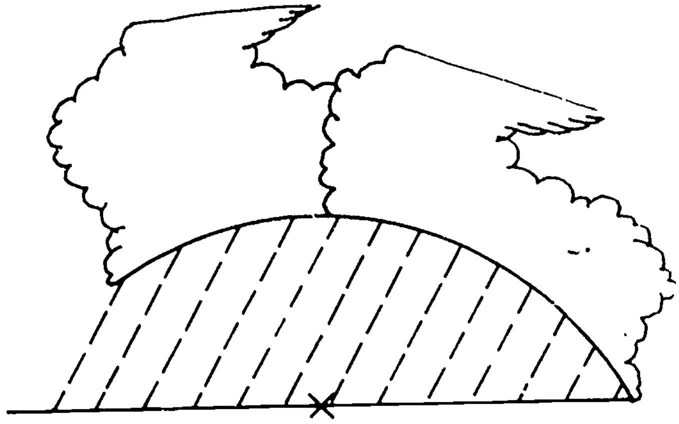
4. Wind: 340° speed 36 knots, gusting to 58 knots. The forecaster indicated that the wind shift was due to a cold frontal passage. (The shift began 25 mins past the hour)

5. Pressure: 29.________



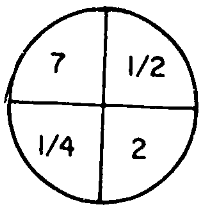
1. Sky Condition:

   8/10 (6/8) Cumulonimbus at an RBC height of 77°, clouds are moving northeast.



2. Visibility: RVR on Rwy #18 is $\boxed{2\,|\,0}$

   prevailing:



3. Atmospheric phenomena: Thunder is occurring primarily to the east, along with continuous lightning cloud to ground and in cloud also in the east. The hail has stopped but the largest stone of one (1) inch in diameter occurred a minute ago. The rain has decreased to moderate intensity.

4. Wind: 330° at 25 knots gusting to 41 knots.

5. Pressure: 29.180

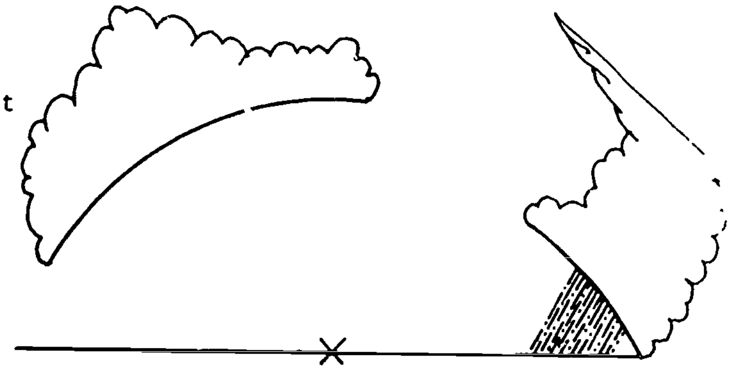
6. Observation time 1142Z

1821

1. Sky Condition:

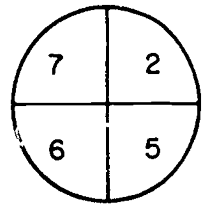
4/10 (3/8) Cumulonimbus, at a height of 77° from the RBC (moving northeast)

4/10 (3/8) Altocumulus, formed by the spreading out of cumulus, at a height of 8,000'



height of 8,000'

2. Visibility: Tower reports 2 miles visibility prevailing:



3. Atmospheric phenomena: The rain has moved to the east. Thunder was last heard at 1139Z. Occasional lightning is still visible within the CB to the east. Some patches of ground fog are reducing visibility around the station.

4. Temperature: Temp 63.2

   dew point 61.2

5. 6 hour rainfall .38"

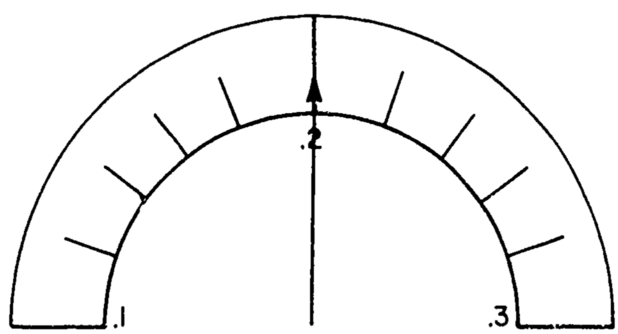
   24 hour rainfall .91"

6. Wind: 330° at 20 knots gusting to 28 knots

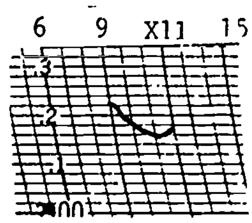
7. Pressure 29.______

8. $T_{12} = 55$

9. Observation completed 1155Z



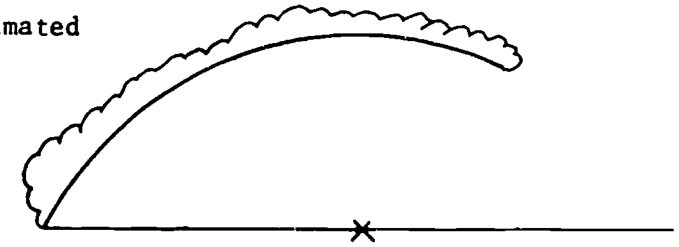
Use sample barograph chart for pressure tendency.



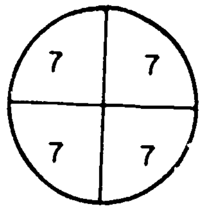
1822

1. Sky Condition:

6/10 (5/8) Altocumulus at an estimated height of 8,000'



2. Visibility:



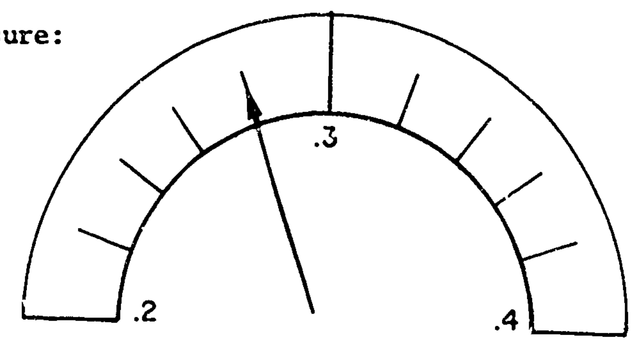
3. Atmospheric phenomena: None

4. Wind: 320° at 20 knots gusting to 25 knots

5. Temperature: Temp 55.0

dew point 50.0

6. Pressure:



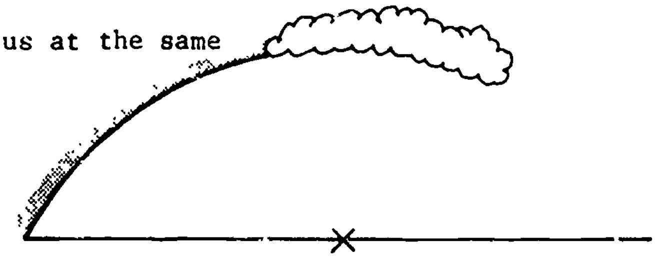
*The pressure is rising at the rate of .08" per hour and has risen .08" in the last hour.

7. Observation completed 1255Z

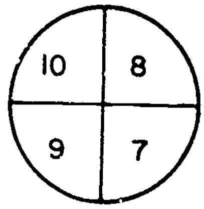
1823

1. Sky Condition:

8/10 (6/8) Altocumulus/Altostratus at the same level 8,000'



2. Visibility:



3. Atmospheric phenomena: Smoke is drifting from a tower to the north of your station.

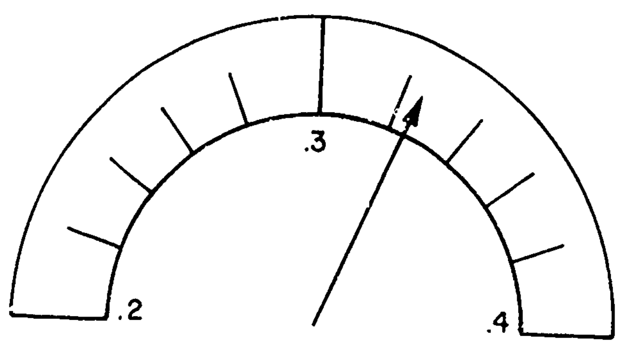
4. Temperature: Temp 51.0

dew point 42.0

5. Wind: 320° speed 10 knots with gusts to 18 knots.

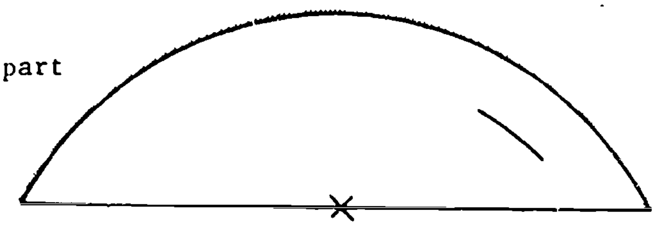
6. Pressure: 29.______

7. Observation completed 1355Z

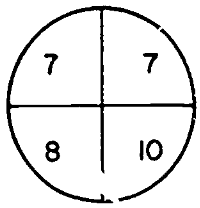


1. Sky Condition:

1/10 (1/8) Smoke at 1,000'
10/10 (8/8) Altostratus, the greater part is dense enough to hide the sun or moon. Height 8,200' obtained from a pilot.



2. Visibility: prevailing



3. Atmospheric phenomena: None

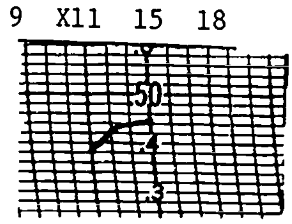
4. Temperature: Temp 45.3

dew point 40.7

5. Wind: 330° 08 knots, gusts to 16 knots

6. Pressure: 29.375 obtain pressure tendency from sample barograph chart

7. Observation completed 1455Z



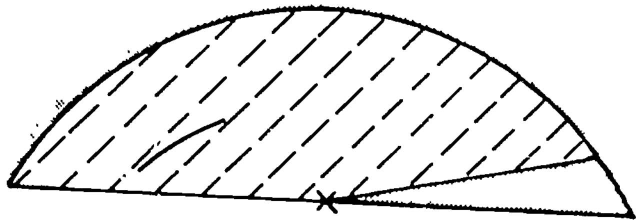
1825

1. Sky Condition:

   1/10 (1/8) of the sky is hidden by dust

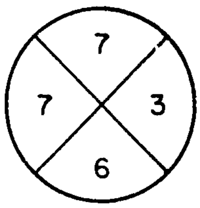
   1/10 (1/8) Smoke at 1,000'

   10/10 (8/8) Nimbostratus at an RBC angle of 83°



3. Visibility: Tower reports a visibility of 5 miles

   prevailing



3. Atmospheric phenomena: Light rain is falling, during the last hour it has stopped and restarted at least once.

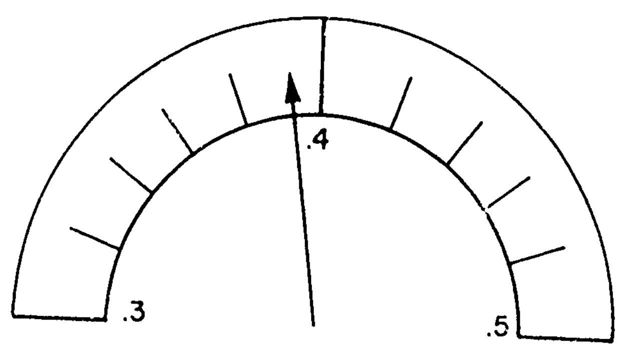
4. Temperature: 37.8-Temp

   34.6-dew point

5. Wind: 320° speed 12 knots

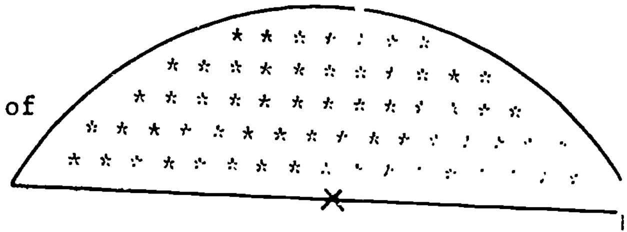
6. Pressure: 29.________

7. Observation completed 1555Z



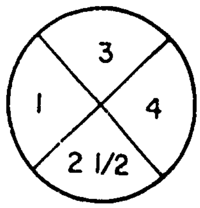
1. Sky Condition:

   10/10 (8/8) Nimbostratus at an RBC height of 72°



2. Visibility: Tower reports a visibility of 2 miles.

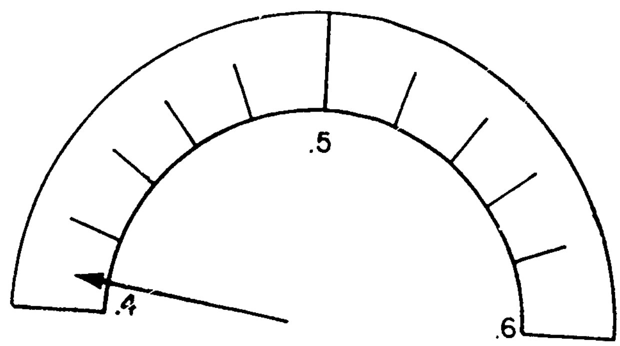
   prevailing:



3. Atmospheric phenomena: Rain has now changed to wet snow.

4. Wind: 330° at 08 knots

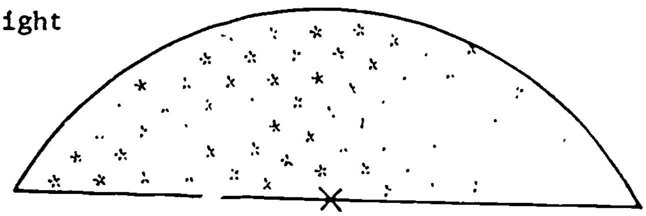
5. Pressure: 29.________



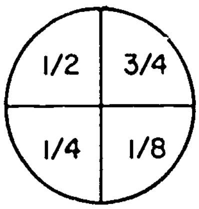
6. Observation time 1621Z

1. Sky Condition:

10/10 (8/8) Nimbostratus at an RBC height of 31°, (measurement was taken 20 minutes ago)



2. Visibility: Tower 3/4



Rwy # 36 4 5

3. Atmospheric phenomena: The snows intensity appears to have increased. The depth of the snow is 3/4 inch. Some snow is being blown about by the wind to a height of 4 feet.

4. Temperature: Temp 33.4

dew point 32.1

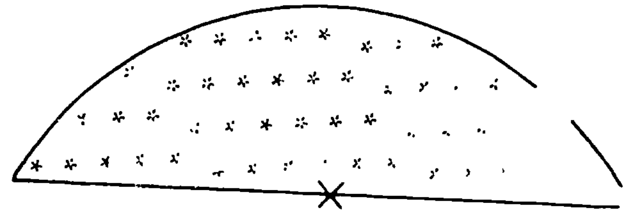
5. Wind: 330° 08 knots, with gusts to 15 knots

6. Pressure: 29.410

7. Observation completed 1656Z

1. Sky Condition:

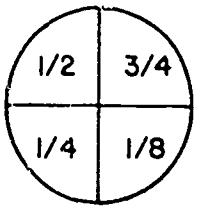
10/10 (8/8) Nimbostratus at a RBC angle of 41°



2. Visibility: Tower 3/4

Rwy # 36

| 5 | 0 |



3. Atmospheric phenomena: Light snow is still falling, the wind is blowing snow about to great heights.

4. Temperature: Temp 31.0

dew point 30.7

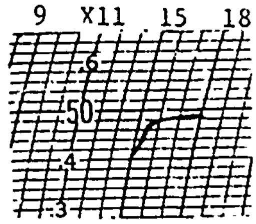
5. 6 hour water equivalent .21

snow depth 3.7"

6. Wind: 330° 08 knots, gusting to 19 knots.

7. Pressure: 29.410

(use sample barograph chart for pressure tendency)



8. Observation completed 1755Z

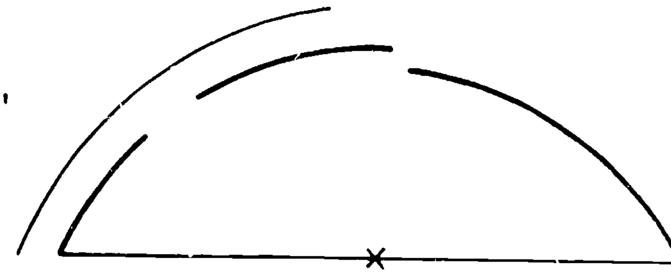
1829

1. Sky Condition:

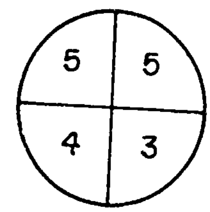
5/10 (4/8) Nimbostratus, height 300'

3/10 (2/8) Altostratus at 10,000' MSL

2/10 (1/8) Cirrostratus is visible at an estimated height of 20,000'



2. Visibility: Tower 7 Rwy #36

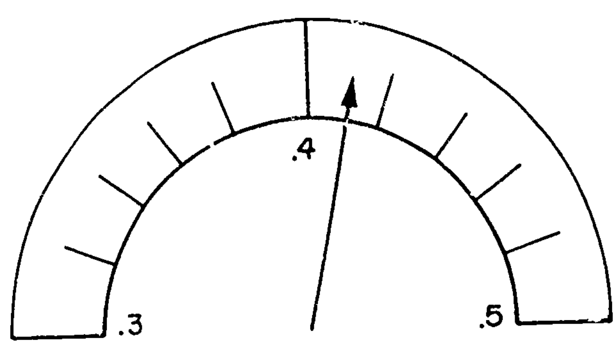


3. Atmospheric phenomena: The snow has stopped, but the winds are still picking up the snow to a height of approximately 25 feet.

4. Winds: 340° 07 knots, gusts to 15 knots.

5. Pressure: 29.______

6. Observation time 1829Z

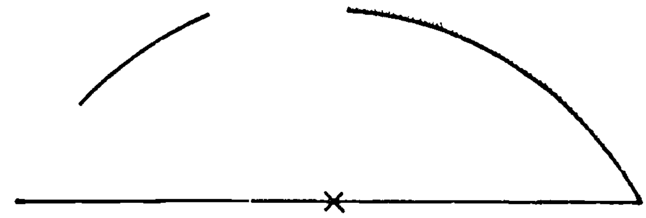


1830

1. Sky Condition:

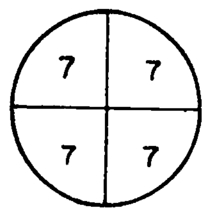
5/10 (4/8) Altostratus at an estimated height of 9,000'

3/10 (2/8) Cirrostratus at an est.mated height of 20,000'



2. Visibility: Tower 7

prevailing:



3. Atmospheric phenomena: The winds have died some but the snow is still being blown about to a height of 5 feet.

4. Temperature: Temp 30.1

dew point 28.1

5. Wind: 340° speed 06 knots

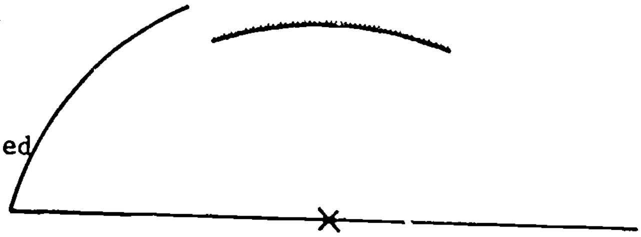
6. Pressure: 29.410

7. Observation time 1855Z

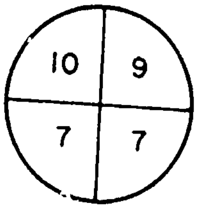
1831

1. Sky Condition:

4/10 (3/8) Altostratus at an estimated height of 9300' (amount varied to 6/10 (5/8) during observation)
3/10 (2/8) Cirrostratus, height estimated to be 20,000'



2. Visibility:



3. Atmospheric phenomena: None

4. Temperature: Temp 30.0

dew point 26.2

5. Wind: 340° speed 06 knots

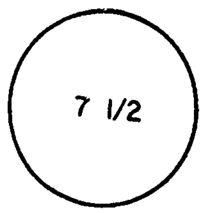
6. Pressure: 29,410

7. Observation completed 1955Z

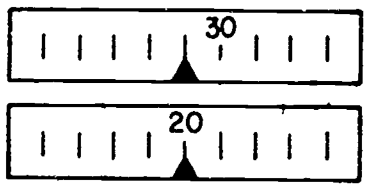
1. Sky Condition:

   Clear skies

2. Visibility:



3. Temperature:



4. Wind: 330° at 02 knots

5. Pressure 29.410

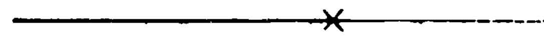
   * The Barograph trace indicates a horizontal line (no pressure change) for the past 3 hours.

6. Observation completed 2055Z

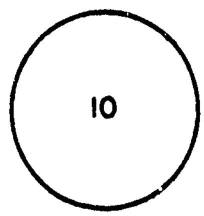
1833

1. Sky Condition:

3/10 (2/8) Cirrus, hooks strands and filaments, height 25,000'



2. Visibility:



3. Atmospheric phenomena: None

4. Temperature: 28 degrees
   Dew Point: 20 degrees

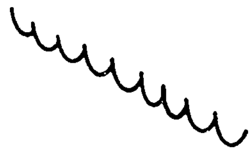
5. Wind: 330° at 01 knots

6. Pressure: 29,400

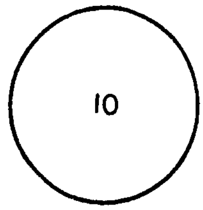
7. Observation completed 2155Z

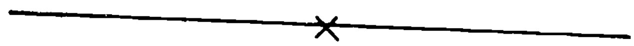
1. Sky Condition:

3/10 (2/8) Cirrus, height 25,000'



2. Visibility:





3. Atmospheric phenomena: None

4. Temperature: 28 degrees

Dew Point: 19 degrees

5. Wind: Calm

6. Pressure: 29.395

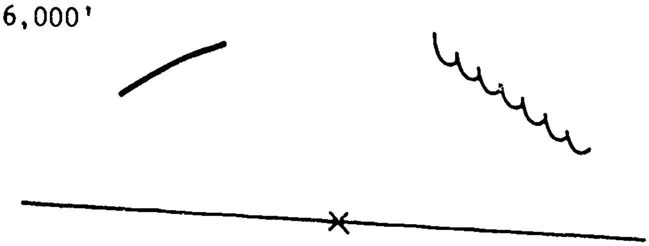
7. Observation completed 2255Z

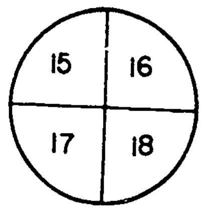
1835

1. Sky condition:

3/10 (2/8) Cirrus, height 25,000' (hooks, strands and filaments)

1/10 (1/8) Cirrostratus at an aircraft height of (not invading the sky) 26,000'



2. Visibility: 

3. Atmospheric phenomena: None

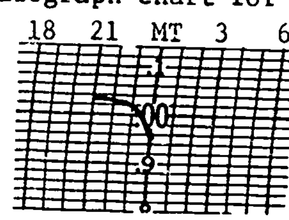
4. Temperature: 28 degrees

Dew Point 19 degrees

5. Wind: Calm

6. Pressure: 29.345

*Use sample Barograph chart for pressure tendency



7. Observation completed 2358Z

SPECIAL CRITERIA

CEILING:

The ceiling is observed to form or dissipate below, decrease to less than or, if below, increase to equal or exceed:

1. 3,000 feet
2. 1,500 feet
3. 1,000 feet
4. 500 feet

Sky Condition:

A layer of clouds or obscuring phenomena aloft is observed below:

1,000 feet and no layer aloft was reported below 1,000 feet in the preceding Record or Special observation.

Visibility:

Prevailing visibility (in statue miles) is observed to decrease to less than or, if below, increases to equal or exceed:

1. 3 miles
2. 2 miles
3. 1 1/2 miles
4. 1 mile

Runway Visual Range:

The RVR applicable to touchdown for the active runway is observed to decrease to less than or, if below, increases to equal or exceed:

1. 6,000 feet
2. 4,000 feet
3. 2,400 feet

Tornado, Waterspout, or Funnel Cloud:

1. is observed
2. disappears from sight
3. occurred within the past hour according to an outside source and was not reported by another station.

Thunderstorm:

A thunderstorm:

1. begins

2. increases in intensity (T to T+)

   decreases in intensity (T+

3. Ends. (15 minutes after the last occurrence of criteria for a thunderstorm)

Precipitation:

1. hail begins or ends.
2. freezing precipitation begins, ends, or changes intensity.
3. ice pellets begin end or change intensity.
4. any other type of precipitation begins or ends.

Wind and Wind Shifts:

1. The 1 minute average wind speed suddenly doubles and exceeds 25 knots.

2. Any wind direction change of 45 degrees or more in less than 15 mins. which is associated with a frontal passage, or the result of other situation which may be considered operationally significant.

ROTATING BEAM CEILOMETER (RBC) HEIGHT VALUES FOR A 400" BASELINE

ANGLE	REPORT VALUE	ACTUAL VALUE
5		35
6	0	42
7		49
8		56
9		63
10		71
11		78
12		85
13	100	92
14		100
15		107
16		115
17		122
18		130
19		138
20		146
21		154
22		162
23		170
24		178
25		187
26	200	195
27		204
28		213
29		222
30		231
31		240
32		250

ANGLE	REPORT VALUE	ACTUAL VALUE
33		260
34		270
35		280
36	300	291
37		301
38		313
39		324
40		336
41		348
42		360
43		373
44		386
45	400	400
46		414
47		429
48		444
49		460
50		477
51	500	494
52		512
53		531
54		551
55	600	571
56		593
57		616
58		640
59		666
60	700	693
61		722

ANGLE	REPORT VALUE	ACTUAL VALUE
62		752
63	800	785
64		820
65		858
66	900	898
67		942
68	1000	990
69		1042
70	1100	1099
71	1200	1162
72		1231
73	1300	1308
74	1400	1395
75	1500	1493
76	1600	1604
77	1700	1733
78	1900	1882
79	2100	2058
80	2300	2269
81	2500	2526
82	2800	2846
83	3300	3258
84	3800	3806
85	4600	4572
86	5500	5720