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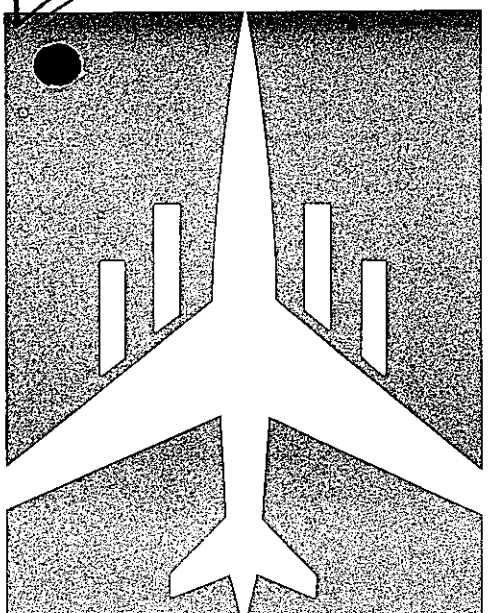
AC 61-18B



AIRLINE TRANSPORT PILOT

(airplane)

WRITTEN TEST GUIDE

Department of Transportation
FEDERAL AVIATION ADMINISTRATION

airline transport pilot (airplane)

written test guide

Revised

1968

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

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AIRLINE TRANSPORT PILOT (AIRPLANE) WRITTEN TEST GUIDE

INTRODUCTION

In a continuing effort to provide guidance and assistance, the Federal Aviation Administration offers this test guide to applicants who are preparing for the Airline Transport Pilot (Airplane) Written Test. It supersedes (AC 61–18A) issued in 1966, and is issued as Advisory Circular 61–18B.

The guide describes the type and scope of aeronautical knowledge covered by the written test, includes study material, lists appropriate references for study, and presents sample test questions. As a further convenience to the applicant, those portions of the present Federal Aviation Regulations concerning general eligibility and aeronautical experience requirements for the certificate have been included. Applicants should be aware, however, that regulations are subject to amendment. Any question regarding the currency of these quoted regulation excerpts may be checked with the appropriate FAA office.

The written test for the Airline Transport Pilot (Airplane) Certificate places major emphasis on the specific requirements and duties of an airline transport pilot, in accordance with the requirements stipulated in Federal Aviation Regulations, Part 61. This test guide outlines the aeronautical knowledge needed to obtain an Airline Transport Pilot Certificate and stresses requirements relating specifically to airline operations. Pilots wishing to acquire this certificate only for its advantage to them in their line of aviation activity must expect to be examined on the same basis as an applicant seeking the certificate for use in an airline pilot's job.

ELIGIBILITY REQUIREMENTS FOR CERTIFICATE

The following excerpts from the Federal Aviation Regulations Part 61, pertaining to eligibility, are given for the convenience of the applicant.

§ 61.141 Eligibility requirements: general.

To be eligible for an airline transport pilot certificate, a person must—

(a) Be at least 23 years of age;

(b) Be of good moral character;

(c) Be able to read, write, and understand the English language and speak it without accent or impediment of speech that would interfere with two-way radio conversation;

(d) Be a high school graduate, or its equivalent in the Administrator's opinion, based on the applicant's general experience and aeronautical experience, knowledge, and skill;

(e) Have a first-class medical certificate issued under Part 67 of this chapter within the 6 months before the date he applies; and

(f) Comply with the sections of this Part that apply to the rating he seeks.

§ 61.143 Airplane rating: aeronautical knowledge.

An applicant for an airline transport pilot certificate with an airplane rating must, after meeting the requirements of § 61.141 (except paragraph (a) thereof) and § 61.145, pass a written test on—

(a) The sections of this Part relating to airline transport pilots and Part 121, subpart C of Part 65, and § 91.1 through § 91.9 and subpart B of Part 91 of this chapter, and so much of Parts 21 and 25 of this chapter as relate to the operations of air carrier aircraft;

(b) The fundamentals of air navigation and use of formulas, instruments, and other navigational aids, both in aircraft and on the ground, that are necessary for navigating aircraft by instruments;

(c) The general system of weather collection and dissemination;

(d) Weather maps, weather forecasting, and weather sequence abbreviations, symbols, and nomenclature;

(e) Elementary meteorology, including knowledge of cyclones as associated with fronts;

(f) Cloud forms;

(g) Department of Commerce Weather Bureau Circular N, "Manual of Surface Observations", as amended;

(h) Weather conditions, including icing conditions and upper-air winds, that affect aeronautical activities;

(i) Air navigation facilities used on Federal airways, including rotating beacons, course lights, radio ranges, and radio marker beacons;

(j) Information from airplane weather observations and meteorological data reported from observations made by pilots on air carrier flights;

(k) The influence of terrain on meteorological conditions and developments, and their relation to air carrier flight operations;

(l) Radio communication procedure in aircraft operations; and

(m) Basic principles of loading and weight distribution and their effect on flight characteristics.

§ 61.145 Airplane rating: aeronautical experience.

(a) An applicant for an airline transport pilot certificate with an airplane rating must hold a commercial pilot certificate or a foreign airline transport pilot or commercial pilot license without limitations, issued by a member state of ICAO, or he must be a pilot in an Armed Force of the United States whose military experience qualifies him for a commercial pilot certificate under § 61.31 of this Part.

(b) An applicant must have had

(1) At least 250 hours of flight time as pilot-in-command, or as copilot performing the duties and functions of a pilot-in-command under the supervision of a pilot-in-command, or any combination thereof, at least 100 hours of which were cross-country time and 25 hours of which were night flight time; and

(2) At least 1200 hours of flight time as a pilot within the 8 years before the date he applies, including at least—

(i) 5 hours within the 60 days before the date he applies;

(ii) 500 hours of cross-country flight time;

(iii) 100 hours of night flight time; and

(iv) 75 hours of actual or simulated instrument time, at least 50 hours of which were in actual flight.

Flight time used to meet the requirements of subparagraph (1) of this paragraph may also be used to meet the requirements of subparagraph (2) of this paragraph.

(c) If an applicant with less than 250 hours of pilot-in-command time otherwise meets the requirements of paragraph (b)(1) of this section, his certificate will be endorsed "Holder does not meet the pilot-in-command flight experience requirements of ICAO," as prescribed by article 39 of the "Convention on International Civil Aviation." Whenever he presents satisfactory written evidence that he has accumulated the 250 hours of pilot-in-command time, he is entitled to a new certificate without the endorsement.

TYPE OF TEST

The Airline Transport Pilot (Airplane) Written Test is an integrated, single-section type which takes a practical, operational approach to the problems that arise in planning and conducting air transport operations. Test items present a progression of problems from flight planning to arrival at destination.

When the applicant takes the test, appropriate planning materials are issued to him in a supplementary booklet. Similar materials are included in this test guide for illustrative purposes.

Test Items and Scoring

Test items are of the multiple-choice type, similar to those shown in the sample test in this guide.

The applicant marks his answers on a special sheet. He should read the directions very carefully before beginning the test. Incomplete or erroneous personal information entered on the scoring sheet delays the scoring process.

The passing grade is 70%. All answer sheets are graded by a computer which is programmed to indicate the areas missed. It prints the subject matter codes on the test result form, so that the applicant can determine the areas in which he had difficulty. A subject matter outline is mailed with the test result form. An applicant must present this form (AC Form 8060–37) for a flight test or for retesting if he fails the written test.

Taking the Test

The written test may be taken at FAA Flight Standards District Offices and other designated places. After completing the test, the applicant must surrender the answer sheet (together with the supplementary booklet and any papers used for computations or notations) to the proctor before leaving the test room.

When taking the test, the applicant should keep in mind these points:

1. Each question or problem should be read carefully before looking at the possible answers. The applicant should clearly understand the problem before attempting to solve it.

2. After formulating his own answer, the applicant should then determine which of the alternatives most

nearly corresponds with his answer. The answer chosen should completely resolve the problem.

3. From the answers given, it may appear that there is more than one possible answer; however, there is only one answer that is correct and complete. The other answers either are incomplete or are derived from popular misconceptions.

4. If a particular test item proves difficult, it is best to proceed to another question. After the less difficult questions have been answered, the others should then be reconsidered.

5. Do not make any marks in the test booklet or the supplementary booklet of information.

REFERENCE MATERIALS

The following list of publications and materials is provided for the benefit of people who wish to prepare for the written test. Except for charts, all of these items may be obtained from the Superintendent of Documents, U.S. Government Printing Office. Textbooks and other reference materials are also available from many commercial publishers. It is the responsibility of each applicant to obtain study materials appropriate to his needs. References listed were available at the time this publication went to press.

Federal Aviation Regulations (FAR):

Part 1—Definitions and Abbreviations	$0.35
Part 25—Airworthiness Standards: Transport Category Airplanes	2.25
Part 61—Certification: Pilots and Flight Instructors	.70
Part 71—Designation of Federal Airways, Controlled Airspace, and Reporting Points	.20
Part 75—Establishment of Jet Routes	.20
Part 91—General Operating and Flight Rules	.70
Part 97—Standard Instrument Approach Procedures	.20
Part 121—Certification and Operations: Air Carriers and Commercial Operators of Large Aircraft	1.50

Airman's Information Manual (AIM)

Part 1. Basic Flight Manual and ATC Procedures; issued quarterly, annual subscription—$2.00.

Aerodynamics for Naval Aviators, NAVAIR 00-80T-80 ($3.50). This publication presents elements of aerodynamics of interest to all pilots.

Aviation Weather AC 00-6 ($2.25). This comprehensive handbook explains basic meteorology from the viewpoint of the pilot's needs.

Enroute High Altitude Charts (35 cents each). These charts provide necessary aeronautical information for enroute instrument navigation in the established airway structure.

Instrument Approach Procedure Charts (10 cents each). Individual charts give detailed information on procedure for each type of approach at the airport.

How to Obtain Reference Materials:

The study materials listed, except the charts, may be obtained by sending a check or money order to:

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

Charts may be obtained at your local airport or by sending a check or money order to:

Distribution Division C-44
Coast and Geodetic Survey
Rockville, Maryland 20852

AERONAUTICAL KNOWLEDGE COVERED BY THE WRITTEN TEST

I. Federal Aviation Regulations

A. Parts 1 and 61:

1. General definitions (1.1).
2. Abbreviations and symbols (1.2).
3. Pilot logbooks: Airline Transport Pilots (61.41).
4. Medical certificates: duration (61.43).
5. Recent flight experience: Airline Transport (61.47c and e).

B. Parts 91 and 97:

1. General Operating and Flight Rules (91.1 through 91.9).
2. Compliance with ATC clearances and instructions (91.75).
3. ATC light signals (91.77).
4. Operating on or in the vicinity of an airport (91.85 through 91.89).
5. Positive control and Jet advisory areas (91.97 and 91.99).
6. Visual Flight Rules (91.105 through (91.109).
7. Instrument Flight Rules (91.115 through 91.1129).
8. Standard Instrument Approach Procedures (97.1 through 97.5).

C. Parts 25 and 121. Airplane Performance and Equipment Requirements: Transport Category Airplanes:

1. Performance: reciprocating engine powered airplanes (121.171 through 121.187).
2. Performance: turbine engine powered airplanes (121.189 through 121.197).
3. Fire protection (25.851 through 25.857).
4. Carriage of cargo in passenger compartments (121.285).
5. Instrument and Equipment Requirements (121.301 through 121.310; 121.313 through 121.325).
6. Supplemental oxygen: reciprocating engine powered airplanes (121.327 through 121.331).
7. Supplemental oxygen: turbine engine powered airplanes (121.329 and 121.333).
8. Equipment for overwater operations (121.339 and 121.340).
9. Equipment for operations in icing conditions (121.341).
10. Flight and Voice recorders (121.343 and 121.359).
11. Radio equipment (121.345 through 121.351).
12. Airborne weather radar equipment (121.357).

D. Part 121. Airman and Crewmember requirements; qualification; duty time limitations:

1. Airman and crewmember requirements (121.381 through 121.391).
2. Emergency and evacuation duties (121.397).
3. Initial flight assignments on a particular type of airplane (121.425).
4. Flight crewmember qualifications (121.433, 121.437 through 121.447).
5. Flight time limitations (121.471, 121.481, 121.503, and 121.505).

E. Part 121. Flight Operations:

1. Responsibility for operational control (121.533 through 121.537).
2. Operation; flight deck duty, etc. (121.543 through 121.549; 121.587).
3. Compliance with approved routes and limitations (121.555).
4. Emergencies: domestic and flag air carriers (121.557).

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5. Engine inoperative: landing; reporting (121.565).
6. Briefing of passengers (121.571 and 121.573).
7. Minimum altitudes for use of automatic pilot (121.579).
8. Closing and locking of flight crew compartment door (121.587).

F. Part 121. Dispatching and Flight Release Rules:
1. Dispatching and flight release authority (121.591 through 121.597).
2. Familiarity with weather conditions (121.599).
3. Equipment, facilities and service (121.603 through 121.609).
4. Dispatch and flight release (121.611 through 121.615).
5. Alternate airport for departure (121.617) and for destination (121.619 through 121.623).
6. Alternate airport weather minimums (121.625).
7. Flight in unsafe conditions (121.627 and 121.629).
8. Dispatch rules: original, redispatch or amendment (121.631 through 121.635).
9. Takeoffs from unlisted and alternate airports (121.637).
10. Fuel supply (121.639 through 121.645).
11. Takeoff and landing minimums (121.649 through 121.655).
12. Flight altitude rules (121.657 through 121.661).
13. Responsibility for dispatch release, load manifest, and flight plan (121.663 through 121.667).

G. Part 121. Records and Reports:
1. Dispatch release (121.687, 121.689, and 121.691).
2. Disposition of load manifest, dispatch release, and flight plans (121.695 and 121.697).
3. Crewmember Certificate: International (121.723).

II. Airman's Information Manual

A. Basic Flight Manual:
1. Glossary of Aeronautical Terms.
2. Air Navigation Radio Aids.
3. Airport, Air Navigation, and Lighting and Marking Aids.
4. Altimetry.
5. Medical Facts for Pilots.
6. Radar.
7. Safety of Flight.
8. Weather.

B. Air Traffic Control Procedures:
1. Preflight.
2. Departure.
3. Enroute.
4. Arrival.
5. Landing.
6. General.
7. Emergency Procedures.

III. Flight Planning and Air Navigation

A. Aviation Weather:
1. Elementary meteorology.
2. Air masses and fronts.
3. Thunderstorms.
4. Icing hazards and operating procedures.
5. Common "IFR" producers.
6. Aviation weather reports.
7. Weather charts—Surface and Significant weather.
8. Weather charts—Upper Air and Constant pressure.
9. Weather charts—Depiction and Radar Summary.

10. Aviation weather forecasts.
11. High altitude weather features.
12. Pressure, density, and true altitude details.

B. Computations:

1. Flight time enroute.
2. Required fuel—enroute, reserve, extra.
3. Actual and allowable payload determination.
4. Weight and balance—structural limitations.
5. Weight and balance—location of center of gravity (CG).
6. Weight and balance—shifting, adding, or removing weight.
7. Performance charts (graphs)—Reciprocating engine powered airplanes.
8. Performance charts (graphs)—Turbine engine powered airplanes.
9. Off-course and return to course computations.
10. Computing wind experienced enroute—direction and velocity.
11. Wind components—head, tail, cross-wind.
12. Estimated time of arrival.
13. Airspeed adjustments to maintain schedule or arrival at a fix.
14. Climb requirements—time and rate.
15. Computing true airspeed using compressibility and temperature corrections.
16. Computing true airspeed from a given Mach number or Mach number from a given true airspeed.
17. Range performance—specific range.

IV. Miscellaneous Areas

A. Coast and Geodetic Survey Charts:

1. Interpretation fo data on entroute charts.
2. Interpretation of data on instrument approach charts.

B. High Speed Aerodynamics:

1. Effect of compressibility on airspeed instrument indications.
2. Effect of compressibility and heat of friction on temperature instrument indications.
3. Definition of Mach number and Critical Mach number.
4. Effect of sweepback—advantages and disadvantages.
5. Subsonic, transonic, and supersonic flight regimes.

SAMPLE TEST

The following sample test is similar in format to the official FAA written test. It is important to remember, however, that these test items do not direct attention to all of the topics on which you will be tested in the official test. It is for this reason that you should concentrate on the section titled "Aeronautical Knowledge Covered By The Written Test." A knowledge of all of the topics presented, not just the ability to answer these few sample test items, should be your goal as you prepare for the written test.

The increased performance of present day transport category aircraft requires greater emphasis on high-altitude meteorology, high-speed aerodynamics, and turbine equipment. Applicants should, therefore, expect to encounter test items dealing with these areas in the written test.

Answers to the sample test items are given at the end of the test in a separate section, which includes an analysis of each test item.

NOTE.—The reader should be aware that the sample test items are based on regulations and procedures in effect at the time of preparation of this guide. Similar test items in the official FAA written tests should always be answered in terms of current regulations and procedures.

Situation

You are an airline captain, employed by Lunar Airlines, whose home base is Denver, Colorado. The company is a certificated air carrier, authorized to operate in scheduled air transportation under the provisions of Part 121 of the Federal Aviation Regulations.

The crew scheduling office assigns you to Flight 45, which operates between Denver, Colorado, and Minneapolis, Minnesota. As pilot-in-command, you are expected to make judgments based upon compliance with pertinent regulations, good operating procedures, and information supplied with this test.

1. As pilot-in-command of this flight, your recent experience (within the preceding 90 days), must include at least—

1—6 hours of flight duty in a similar type aircraft.

2—3 takeoffs and 3 landings in any type of aircraft.

3—5 takeoffs and 5 landings to a full stop in a similar type aircraft.

4—3 takeoffs and 3 landings in the same type of aircraft.

2. The pilot who is to serve as second-in-command of Flight 45 must hold—

1—An airline transport pilot certificate.

2—A commercial pilot certificate only.

3—At least a commercial pilot certificate and instrument rating.

4—An airline transport pilot certificate and appropriate ratings.

3. The date of your last proficiency check is December 20. Your next scheduled proficiency check may be given as early as—

1—June 1.

2—June 20.

3—May 1.

4—May 20.

4. Choose the correct statements from the list below regarding emergency equipment.

A. Protective breathing equipment, or smoke masks, must be provided for each flight crewmember on duty.

B. Flight crewmembers need only be aware of the location of emergency equipment in the immediate flight deck area.

C. Each crewmember must have readily available a flashlight in good working order.

D. A hand fire extinguisher must be provided on the flight deck for use by the flight crew.

E. A crash ax is not required in this operation.

F. All passenger emergency exit markings must be capable of illumination by the main lighting system for night operations only.

1—A, C, D.

2—A, D, F.

3—B, E, F.

4—B, C, E.

5. Which cargo compartment requires a built-in fire extinguishing system?

1—Class A.

2—Class B.
3—Class C.
4—Class D.

6. The duty aircraft dispatcher briefs you on the weather affecting this flight by directing your attention to the surface weather map. Choose the correct statements from the list below. (See Appendix, Figure 7)

A. The barometric pressure at Denver (40°N.; 105°W.) has fallen 7 millibars in the past 3 hours.

B. A stationary front is just east of Omaha. (41°N.; 95°W.)

C. Barometric pressure at Minneapolis (45°N.; 93°W.) is 1012.7 millibars.

D. Sky is obscured at North Platte. (41°N.; 100°W.)

1—A and D
2—B and C
3—B and D
4—A and C

7. Which of the following terms describes the flow of air in a low-pressure system?

1—Converging and descending.
2—Diverging and descending.
3—Converging and ascending.
4—Diverging and ascending.

8. An aircraft is maintaining a constant pressure altitude of 18,000 feet between 35°N.; 120°W. and 40°N.; 75°W. The true altitude of the aircraft will (see Appendix, Figure 8)—

1—decrease.
2—increase, then decrease.
3—increase.
4—decrease, then increase.

9. With respect to temperatures at the level of the polar tropopause, temperatures at the tropical tropopause level are—

1—colder.
2—warmer.
3—the same.
4—colder in the winter.

10. Refer to the area forecast (FA DEN) in the Appendix, page 31). Which of the following statements is correct?

1—A polar cold front will become stationary in southern Minnesota.
2—Local freezing drizzle is forecast for northwestern Kansas.
3—Northern portions of Minnesota are forecast to have occasional ceiling 1500 overcast with light snow showers.
4—The outlook is for not much change in ceilings north of the Pacific front.

11. Referring to the terminal forecasts (FT–1, Appendix, page 31), which statement is correct?

1—The Denver (DEN) visibility is forecast to be occasionally restricted by light fog.
2—The surface wind at Minneapolis (MSP) is forecast to be from 340° at 12 knots after 1400Z.
3—The ceiling at Sioux Falls (FSD) is forecast to be 8,000 feet for the entire forecast period.
4—The visibility is given in nautical miles, but omitted if over 8 miles.

12. Select the statement which correctly interprets certain elements of the surface weather observation at 1500Z. (See Appendix, page 32).

1—The ceiling at MSP is estimated to be 3,500 feet.
2—The surface wind at OMA is reported to be 4 knots from 60°.
3—The barometric pressure at FSD is 996.0 millibars.
4—The drizzle at DEN began at 1435Z.

13. For this IFR operation, regulations specify that the weather conditions at the destination airport must be at or above authorized minimums—

1—prior to departure.
2—at the estimated time of arrival.
3—during the entire flight.
4—during the period 2 hours prior to 2 hours after, the estimated time of arrival.

* * * * *

Flight 45 is scheduled to depart Denver at 1530 Greenwich Mean Time on Friday, January 26. With your crew, you report to the dispatch office at 1430 GMT.

Flight planning data for this flight is outlined below:

Altitude _____ Flight Level 190.
Route _____ J60 OMA, J21 MSP.
Alternate Airport _____ Not required.

You are to complete the flight plan from Denver to Minneapolis. Compute the time from takeoff to the Minneapolis-St. Paul International Airport, rounding off the leg times to the nearest minute. Appropriate chart segments for this routing are in the Appendix, Figures 3 and 4. Airplane flight planning data is in the Appendix, page 25. Use 97,000 pounds for the estimated TOGW; interpolate to arrive at the correct rate of climb and cruise airspeeds.

NOTE.—There are a wide variety of flight plan and/or flight log forms in current use. The flight time analysis

form used in Figure 22 is not intended to be an operational form. It is used here for an orderly presentation of flight planning data. Similar forms are made available to applicants when they take the official written test. Applicants may use these forms or any other flight planning form of their selection.

* * * * *

14. The computed flight time from takeoff at Denver to the Minneapolis-St. Paul International Airport is—
    1—2 hours, 42 minutes.
    2—2 hours, 22 minutes.
    3—2 hours, 10 minutes.
    4—2 hours, 50 minutes.

15. The weight of the fuel required for this flight is—
    1—6,175 pounds.
    2—7,750 pounds.
    3—7,150 pounds.
    4—5,575 pounds.

16. In view of the fuel calculations previously made and assuming no operating limitations, what is the maximum allowable gross weight for this flight? (See Appendix, Aircraft Particulars, for aircraft weights.)
    1— 97,000 pounds.
    2— 98,535 pounds.
    3—100,240 pounds.
    4— 97,865 pounds.

17. Based on the previous fuel load calculations, what is the maximum allowable payload for Flight 45?
    1—31,700 pounds.
    2—26,700 pounds.
    3—30,925 pounds.
    4—29,925 pounds.

18. The actual payload for Flight 45 consists of the following:

Passengers	14,450 pounds.
Baggage and cargo	8,500 pounds.

What is the actual takeoff gross weight?
    1—89,915 pounds.
    2—93,665 pounds.
    3—91,360 pounds.
    4—95,240 pounds.

19. Assume that you desire to carry more fuel, what is the maximum additional fuel that can be loaded?
    1—8,750 pounds.
    2—5,000 pounds.
    3—3,425 pounds.
    4—7,175 pounds.

20. You review the weight and balance manifest and note that the center of gravity for the actual takeoff gross weight is located 436 inches aft of the datum line. What is the equivalent location in terms of percent of the mean aerodynamic chord? (See Appendix, Aircraft Particulars.)
    1—20% MAC.
    2—25% MAC.
    3—27% MAC.
    4—33% MAC.

21. Assume a takeoff weight of 100,000 pounds with the C.G. located at 25% MAC. Five hundred pounds of cargo is shifted from the aft cargo compartment to the forward cargo compartment. The new C.G. location is—
    1—21.5% MAC.
    2—22.1% MAC.
    3—23.5% MAC.
    4—27.5% MAC.

22. In the event of engine failure at the V_1 speed, the aircraft must be capable of attaining a height of 50 feet before passing the end of the runway and, thereafter, to clear all obstacles by—
    1—50 feet vertically and 300 feet horizontally.
    2—50 feet vertically without banking.
    3—At least 50 feet vertically and 300 feet horizontally within the airport boundaries.
    4—At least 50 feet vertically or 200 feet horizontally within the airport boundaries.

23. The maximum permissible crosswind component for takeoff and landing applicable to this aircraft is 25 knots. Assuming a runway heading of 045° (Variation 10°E), which of the following tower reported winds would cause this limitation to be exceeded?
    1—010°/35 knots.
    2—090°/40 knots.
    3—100°/25 knots.
    4—020°/50 knots.

24. The maintenance department releases the Flight 45 aircraft to the operations department. Which procedure is applicable?
    1—A separate release form must be prepared.
    2—An appropriate entry must be made in the aircraft log.
    3—An appropriate entry may be made in the aircraft log or a separate release form may be issued.
    4—The release may be made verbally.

25. Which statement is correct with regard to operations within positive control areas?
    1—Aircraft are operated under IFR at a specific flight level assigned by ATC.
    2—Radio equipment must be capable of providing direct pilot/controller communication.

3—Aircraft must be equipped with a coded radar beacon transponder.
4—All of the above.

26. You are anticipating moderate icing in clouds and precipitation over the eastern sector of the route. Which statement is correct?
1—Frost can form in flight when a warm aircraft climbs from a zone of above freezing temperatures to a zone of subzero temperatures.
2—Glaze ice is the most serious form of ice as it is very difficult to remove.
3—Carburetor icing cannot occur in cloudless skies.
4—Rime ice is transparent and has a glassy surface.

27. Assume that you shut down No. 1 engine due to low oil pressure. Which of the following courses of action are you, as pilot-in-command of this flight, expected to adopt in conformance with regulations?
1—Proceed to the nearest suitable airport in point of time.
2—Return to departure point.
3—Proceed to destination.
4—Proceed to an airport of your selection if, upon consideration of certain factors, you believe such action to be safe.

28. Determine the average wind experienced between Hayes Center (HCT) and Omaha (OMA) using the data below: (See Appendix, Figure 4.)

Time between HCT and OMA	50 minutes.
Average TAS	258 knots.
Average MC	070°.
Average MH to maintain course	069°.
Average variation	10°E.

The average wind is approximately
1—250°/25 knots.
2—270°/30 knots.
3—240°/35 knots.
4—060°/30 knots.

29. On the basis of the wind computed in the previous test item with no change in TAS, the average compass heading to stay on course leaving OMA is (variation 8°E.; deviation 3°W.)—
1—022°.
2—027°.
3—012°.
4—004°.

30. Assume a pressure altitude of 19,000 feet. At what temperature value will the density altitude be the same as the pressure altitude?
1— −26°C.
2— −19°C.
3— −30°C.
4— −23°C.

31. As you pass OMA, ATC requests that you reduce speed so as to cross the 294 Radial of Fort Dodge (FOD) in 25 minutes. Compute the IAS which must be maintained to comply with this request using the data below:

Distance to FOD 294 Radial	108 miles.
Pressure altitude	19,000 feet.
Airspeed position and instrument correction	+5 knots.
Indicated Outside Air Temperature	−14°C.
Temperature rise	6°C.
Compressibility correction	−1 knot.
Tailwind component	30 knots.

The required IAS is—
1—171 knots.
2—165 knots.
3—162 knots.
4—175 knots.

32. Assume that a flight departs on the 060 radial of the Sioux Falls VORTAC. How many nautical miles to the right of the centerline of Airway J30 is the flight after flying a distance of 48 nautical miles?
1— 7.
2—12.
3—21.
4—10.

* * * * *

Test Items 33 through 42 pertain to certain features of high altitude and ocean operations.

* * * * *

33. The speed of sound in the atmosphere is a function of—
1—Air temperature.
2—Pressure altitude.
3—Density altitude.
4—True altitude.

34. Mach number is the relationship of the speed of sound to—
1—EAS.
2—TAS.
3—CAS.
4—IAS.

35. An aircraft is cruising at 35,000 feet at TAS 485 knots. The speed of sound at this altitude is 576.6 knots. What is the Mach number?
1—Mach 1.0
2—Mach 0.92

3—Mach 0.88
4—Mach 0.84

36. An aircraft establishes .82 Mach cruise at pressure altitude 33,000 feet. Ambient temperature is −60°C. What is the TAS?
1—466 knots.
2—445 knots.
3—462 knots.
4—471 knots.

37. Determine the specific range of an airplane using the following data:

Flight level	250
Outside air temperature	−20°C.
Cruise speed	Mach .84
Fuel flow	9,800 lbs./hr.

1—51 Nautical Air Miles/1,000 lbs. fuel.
2—53 Nautical Air Miles/1,000 lbs. fuel.
3—62 Nautical Air Miles/1,000 lbs. fuel.
4—58 Nautical Air Miles/1,000 lbs. fuel.

38. Which of the following phrases correctly describes "critical Mach number"?
1—Boundary between transonic and supersonic flow.
2—Limiting level flight cruise speed.
3—Boundary between subsonic and transonic flow.
4—Maximum design dive speed.

39. What effect does the use of a swept wing have on "critical Mach number" when compared to a straight wing?
1—Decreases critical Mach number.
2—Critical Mach number remains constant—no effect.
3—Decreases critical Mach number as altitude increases.
4—Increases critical Mach number.

40. Significant weather charts are drawn to show the weather between the surface and 400 millibar level, and between the 400 millibar and 150 millibar levels. (See Appendix, Figures 10 and 11). Which statement regarding an ocean flight on the great circle route between JFK and LPPT is correct?
1—Freezing level is below 5,000 feet over the entire route.
2—Flight below the 400 millibar level will avoid all areas of clear air turbulence.
3—Flight above the 400 millibar level will be free of clouds except for isolated cb's near 40°W.
4—Layered clouds will be encountered above the 400 millibar level in the vicinity of 40°W.

41. Wind direction and speed at the 300 millibar level at 37°N.; 55°W. is approximately (see Appendix, Figure 12)
1—230°/80 knots.
2—210°/100 knots.
3—250°/80 knots.
4—230°/100 knots.

42. Refer to the Tropopause-Vertical Wind Shear Chart (see Appendix, Figure 13). The tropopause at 45°N.; 45°W. is shown to be at
1—250 millibars.
2—275 millibars.
3—300 millibars.
4—325 millibars.

* * * * *

The following test items are based on the performance charts in the Appendix. These charts have been excerpted from FAA-Approved Airplane Flight Manuals for turbojet transport type aircraft. Sample problems are included in the Appendix material.

Charts such as these portray the performance characteristics of the particular airplane as they are influenced by operating variables. These include runway slope or gradient, wind, field elevation, and temperature. In turbojet aircraft the effect of anti-icing system operation is also considered.

It should be noted that individual airlines and operators use these charts to develop other charts and tables of varying format to fit the needs of their service.

* * * * *

Use the following data as needed for test items 43 through 45: (See Appendix, Figure 15)

Pressure altitude	3000 feet
Outside Air Temperature	−5°C
Flaps	15°

43. What is the EPR setting for number 2 engine with anti-ice ON?
1—2.07.
2—2.04.
3—2.10.
4—2.05.

44. What is the V_1 speed at 150,000 pounds with C.G. at 14%?
1—133 knots.
2—1139 knots.
3—127 knots.
4—118 knots.

45. What is the V_2 speed at 155,000 pounds?
1—145 knots.
2—150 knots.

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3—140 knots.
4—148 knots.

46. Determine the maximum permissible gross weight at brake release using the following data: (See Appendix, Figure 16.)

Anti-skid—ON, Nose Brakes—ON, C.G.—Aft 14%, Flaps—15°.

Runway length available	8,500 feet.
Wind	20 kts. headwind.
Runway slope	1% UP.
Average takeoff EPR	1.90.
Airport pressure altitude	2,000 feet.
Outside air temperature	+80°F.

1—158,000 pounds.
2—153,500 pounds.
3—156,500 pounds.
4—151,000 pounds.

47. Which of the following is the correct relation of temperature to International Standard Atmosphere (ISA) at 20,000 feet? (See Appendix, Figure 14.)

1—+05°C.=ISA +34°C.
2—−05°C.=ISA +15°C.
3—−30°C.=ISA −05°C.
4—+10°C.=ISA +30°C.

48. Compute the trip time and fuel required using the following data: (See Appendix, Figure 17.)

Trip distance	1,400 nautical ground miles.
Landing gross weight	130,000 pounds.
Average wind	30 knots headwind.
Altitude	FL 290.
Outside air temperature	−30°C.

1—3:00 and 28,400 pounds.
2—2:45 and 24,800 pounds.
3—3:25 and 32,800 pounds.
4—3:10 and 31,000 pounds.

49. Determine the airplane gross weight at the start of cruise altitude. (See Appendix, Figures 18 and 20)

Field elevation	Sea level.
Cruise altitude	FL 350.
Temperature deviation from ISA	+5°C.
Gross weight at brake release	150,847 pounds.

1—145,426 pounds.
2—144,509 pounds.
3—143,619 pounds.
4—146,920 pounds.

50. At 1605 GMT, the airplane gross weight is 150,000 pounds at 30,000 feet in Mach .82 cruise. Compute the gross weight at 1800 GMT using the data below (See Appendix, Figure 21):

Outside air temperature	−40°C.
Wind component (tailwind)	+20 knots.

The gross weight at 1800 GMT is—

1—135,000 pounds.
2—130,000 pounds.
3—132,980 pounds.
4—131,460 pounds.

ANALYSES OF ANSWERS TO SAMPLE TEST ITEMS

Item Answer *Reference*

1—(4)

The reference is FAR 121.439.

2—(3)

The reference is FAR 121.437.

3—(3)

The reference is FAR 121.433(c).

The proficiency check may be administered at any time during the month preceding or following the month in which it becomes due. Earliest date is, therefore, May 1.

4—(1)

The following comments pertain to the lettered statements:

A. Correct; the reference is FAR 121.337.

B. Incorrect; flight crewmembers must be aware of the location of all emergency equipment used in ditching and evacuation. Reference is FAR 121.416.

C. Correct as stated; the reference is FAR 121.549.

D. Correct as stated; the reference is FAR 121.309 (c) (2).

E. Incorrect; a crash ax must be carried. The reference is FAR 121.309(e).

F. Incorrect; the lighting source must be independent of the main lighting system. The reference is FAR 121.310(c).

5—(3)

The reference is FAR 121.221(d) (2).

6—(2)

The following comments pertain to the lettered statements:

A. Incorrect; the barometric pressure has fallen .7 millibars in the past 3 hours.

B. Correct; the front is a stationary front.

C. Correct; the last 3 digits only of the barometric pressure (excluding the decimal point) are listed on the chart.

D. Incorrect; the sky coverage is four-tenths.

7—(3)

The net flow of air about a low center is inward, toward low pressure. This convergence can only be accompanied by a resultant ascending flow.

Item Answer *Reference*

8—(3)

The height contour at 35°N.; 120°W. is 18,100 feet increasing to 18,600 feet at 40°N.; 75°W.

9—(1)

The tropical tropopause is higher than the polar tropopause. In view of the normal decrease in temperature with altitude in the troposphere, the temperature is, therefore, colder at the tropical tropopause.

10—(3)

The following comments pertain to the numbered statements:

1. Incorrect; the Polar cold front in southern Minnesota will overtake the Pacific cold front and become stationary from east central Iowa to the border of northern Kansas.

2. Incorrect; ZL– –means very light freezing drizzle.

3. Correct; northern portion of Minnesota is forecast to have occasional ceiling 1,500 feet, overcast, with light snow showers.

4. Incorrect; the outlook is for not much change *south* of the Pacific front.

11—(2)

The following comments pertain to the numbered statements:

1. *Incorrect; the Denver visibility* is forecast to be occasionally restricted by very light snow and moderate fog.

2. Correct; the Minneapolis surface wind 3412 is decoded to read 340°/12 knots.

3. Incorrect; the ceiling at Sioux Falls is forecast to be occasionally 1,500 feet broken clouds.

4. *Incorrect; the visibility* is given in statute miles and fractions.

12—(4)

The following comments pertain to the numbered statements:

1. Incorrect; the ceiling at MSP is estimated to be 10,000 feet.

2. Incorrect; the surface wind at OMA is 40°/6 knots.

Item Answer *Reference*

3. Incorrect; the barometric pressure at FSD is 1016.4 millibars.

4. Correct: LB35 means that the drizzle began 35 minutes past the hour preceding the observation.

13—(2)

The reference is FAR 121.613.

Item Answer *Reference*

14—(1)

Stapleton International Airport is 5,330 feet, which leaves 13,670 feet to climb to cruising Flight Level. The rate of climb at a gross weight of 97,000 pounds is 630 feet/minute (average). Time is (rounded off) 22 minutes. Average wind and temperature in climb is 2335–10. The pertinent section of the flight time analysis form is reproduced below:

True Course	Airspeed (*kts.*)		Winds Aloft Direction Velocity Temperature	Ground Speed	Distance N.M.	Time		Fuel Consumption (*lbs.*)		Misc. TOGW
	EAS or Mach. No.	TAS				Leg	Total	Leg	Total	
----	---	195	+20 kts.	215	79	0 :22	----	1,375	----	97,000 95,625
079°	193	262	2440/−20	299	101	0 :20	0 :42	700	2,075	94,925
080°	194	263	2440/−20	300	240	0 :48	1 :30	1,680	3,755	93,245
023°	196	266	2447/−20	302	260	0 :52	2 :22	1,820	5,575	91,425
----	---	---	--------	---	---	0 :20	2 :42	600	6,175	90,825

15—(2)

The time and fuel summary is reproduced below:

Enroute	2:42/6,175 lbs.
Reserve	0:45/1,575 lbs.
Total	3:27/7,750 lbs.

16—(2)

The maximum allowable takeoff gross weight should not exceed the sum of the enroute fuel weight and the maximum allowable landing gross weight.

Maximum Allowable LGW	92,360 lbs.
Enroute fuel burn	6,175 lbs.
Maximum TOGW	98,535 lbs.

17—(2)

The maximum allowable payload is the difference between the maximum allowable Zero Fuel Weight and the Basic Operating Weight.

Maximum Allowable ZFW	87,360 lbs.
Basic Operating Weight	60,660 lbs.
Maximum Allowable Payload	26,700 lbs.

18—(3)

Basic operating weight	60,660 lbs.
Payload	22,950 lbs.
ZFW	83,610 lbs.
Fuel load	7,750 lbs.
TOGW	91,360 lbs.

19—(4)

The reserve fuel will still be aboard at destination, so the reserve fuel weight added to the ZFW for this flight will make a LGW of 85,185 pounds.

Maximum Allowable LGW	92,360 lbs.
Actual LGW	85,185 lbs.
Additional fuel	7,175 lbs.

20—(2)

Since the LEMAC is known, we can determine the relative position of the C.G. on the MAC, in this case, 41 inches aft of the LEMAC. Dividing this value by the MAC (164 inches) and multiplying by 100 yields the C.G. location in terms of percent of MAC.

21—(3)

The problem can be solved on the slide rule side of your computer by using the following ratio:

$$\frac{\text{Weight moved}}{\text{Gross weight}} :: \frac{\text{C.G. movement}}{\text{Distance moved}}$$

The C.G. moves a distance of 2.5 inches in this case, resulting in a new location of 23.5% MAC.

22—(4)

The reference is FAR 121.177.

23—(2)

Note that runway headings and tower reported winds are in terms of magnetic direction.

24—(3)

The reference is FAR 121.709.

25—(4)

The reference is FAR 91.97.

Item Answer Reference

26—(2)

The reference is Aviation Weather, AC 00–6, Chapter 12.

27—(4)

The reference is FAR 121.565.

28—(2)

The time interval between HCT and OMA is 50 minutes for the distance of 240 n.m. Groundspeed, is, therefore, 288 knots. Application of variation to magnetic course and magnetic heading precedes the solution outlined below:

True Heading	079°
True Course	080°
Groundspeed	288 knots
TAS	258 knots

Using the wind side of the computer, the resultant wind is 270°/30 knots.

29—(3)

The magnetic course leaving OMA on J21 is 015°. After converting to true direction, the following facts are known:

True Course	023°
TAS	258 knots
W/V	270°/30 knots

Resultant solution yields:

True Heading	017°
Groundspeed	269 knots

Application of variation and deviation to the true heading yields compass heading 012°.

30—(4)

When existing temperature is the same as standard at a particular pressure altitude, density and pressure altitude are equal. In this case the temperature is −23°C.

31—(2)

The distance of 108 nautical miles must be covered in 25 minutes. Groundspeed is, therefore, 259 knots. The tailwind component of 30 knots requires a TAS of 229 knots. Computer solution yields EAS 169 knots. Application of compressibility and position corrections with reversed signs yields IAS 165 knots.

32—(4)

The angle change between the course radial 048 and the 060 radial is 12°. Set up on the computer using the square grid; the resultant answer is 10 nautical miles. The problem can be worked more accurately using the sine law to solve the right triangle; some computer instruction booklets present problems illustrating the use of the sine function.

Item Answer Reference

33—(1)

The speed of sound is the rate at which small pressure disturbances are propagated through the air and this propagation speed is solely a function of temperature.

34—(2)

The relationship is expressed as the ratio between the TAS and the speed of sound.

35—(4)

Mach 0.84 results from dividing TAS (485 knots) by speed of sound (576.6 knots).

36—(1)

The speed of sound is a function of temperature, so most computers have a Mach Index arrow marked on the computer. For this problem, set −60°C. over the Mach Index arrow; over 82 on the time scale, read 466 knots on the distance scale.

37—(2)

Convert Mach .84 to TAS (520 knots). Air miles flown in 1 hour is 520 nautical miles. Dividing by .98 (thousands of pounds) yields 53 NAM/1,000 pounds.

38—(3)

The Mach number which produces first evidence of local sonic flow is the critical Mach number. It is, therefore, described as the boundary between subsonic and transonic flow.

39—(4)

The velocity component of the free air stream perpendicular to the leading edge of the swept wing is reduced as a result of the sweep angle of the wings. One of the effects of this sweep angle is to increase the critical Mach number.

40—(3)

The chart reference for abbreviations and symbols used on prognostic weather charts is Appendix III, Aviation Weather, AC 00–6.

1. Incorrect; the freezing level starts at 5,000 feet and increases to almost 10,000 feet.
2. Incorrect; clear air turbulence will be encountered from 18°W. to 16°W.
3. Correct as indicated on chart in Figure 11.
4. Incorrect; Cumulonimbus clouds are indicated at 40°W.

41—(3)

Wind flows approximately parallel to the solid contour lines; wind speed is shown by the dashed lines referred to as isotachs, i.e., lines of equal wind speed.

Item Answer *Reference*

42—(3)

The Tropopause-Vertical Wind Shear Chart, when used in conjunction with the 300 millibar chart, provides wind and temperature information—vertically and horizontally—within the layer from 300 millibars to 150 millibars at intervals of 2 knots/1,000 feet, this chart:

a. Intersections of the tropopause in 50 millibar intervals from 300 to 150. Standard heights of the pressure surfaces are given in the inset box at the bottom of the chart.

b. Mean vertical wind shear for the layer from 300 to 150 millibars at intervals of 2 knots/1,000 feet, shown by dashed lines. The mean vertical wind shear is an arithmetic mean of the forecast values of the shear below and above the layer of maximum wind. It is not drawn for values less than 2 knots.

c. Tropopause and 150-millibar level temperatures are enclosed in rectangles and circles, respectively.

43—(2)

Enter EPR table in Figure 15. For pressure altitude 3,000 feet and temperature −05°C., the EPR is 2.07. The "anti-ice ON" correction of .03 from the inset table at upper right reduces the EPR to 2.04. Note that the uncorrected EPR value of 2.07 at −5°C. is also limiting between sea level and 10,000 feet. Also observe that at a given pressure altitude the EPR may be further limited as shown at the bottom of the table opposite the entry "MAX EPR FOR COLDER TEMP AT PRESS ALT." For example, at P.A. 3,000 feet and −20°C., the uncorrected EPR is 2.15. The "MAX EPR" for this colder temperature is limited, however, to 2.10, as shown at the bottom of the table.

44—(3)

Temperature value of −5°C. is found in the first column opposite the pressure altitude "3 to 5" bracket. Drop vertically down to the 15° FLAPS bracket and read V_1 127 knots opposite the gross weight value of 150,000 pounds. Since the C.G. is at 14% and the gross weight is less than 160,000 pounds, the correction referred to at the bottom of the table is not applicable.

45—(1)

Interpolate between 150,000 and 160,000 pounds to determine the proper V_2 speed.

46—(2)

Refer to the explanation associated with Figure 16 for a description of RUNWAY and CLIMB limitations on gross weight. In this situation, the RUNWAY

Item Answer *Reference*

LIMIT establishes the maximum permissible gross weight at brake release under the stated conditions. Note that when the REF (reference) line lies within a range of values, entry is always made first *to the REF line*. For instance, in the plotted example, had the temperature been given as +40°F.—rather than +88°F.—the dashed guide line would have sloped upward to the left from the REF line to intersect the +40°F. line. This would result in a gross weight at brake release of 136,500 pounds, rather than 132,000 pounds.

47—(3)

This chart relates actual Outside Air Temperature (OAT) at a given pressure altitude to the value in the International Standard Atmosphere (ISA). In this example, at 20,000 feet pressure altitude, an OAT of −30°C. is ISA −05°C., meaning 5°C. less than—or colder than—the standard value. On some performance charts this value is listed as ISA DEV.

48—(4)

Use the plotted example to determine the trip time and trip fuel based on the given data. Note that the final entry for trip time involves relating the OAT of −30°C. at 29,000 feet pressure altitude to ISA. From Figure 14, the ISA Dev is +12°C.

49—(2)

Fuel burn from brake release to climb speed at sea level is found in Figure 18 (847 pounds). Start climb weight is, therefore, 150,000 pounds. Fuel burn to 35,000 feet from Figure 20 is 5,491 pounds. Gross weight at start of cruise is 144,509 pounds.

50—(3)

Refer to Figure 21 in the Appendix for the first gross weight bracket between 150,000 pounds and 145,000 pounds at −40°C., the starting total fuel flow is at the rate of 9,126 pounds per hour. Solution is outlined in the following table:

Gross Weight	*Fuel Burn*	*Total Fuel Flow*	*Time Interval*	*Clock Time (1605)*
150,000				
	5,000	9,126	33′	1638
145,000				
	5,000	8,943	34′	1712
140,000				
	5,000	8,769	34′	1746
135,000				
	2,010	8,604	14′	1800
132,990				

APPENDIX

This section contains supplementary data necessary for use with the sample test. Additional material of value to the applicant for the Airline Transport Pilot (Airplane) Written Test is also included.

PHYSIOLOGICAL TRAINING

The following articles concerning Hypoxia and Hyperventilation are excerpted from the Physiological Training Manual of the Civil Aeromedical Institute (CAMI). If further information is desired, write the Chief, Physiological Operations and Training Section, Civil Aeromedical Institute, FAA Aeronautical Center, P.O. Box 25082, Oklahoma City, Oklahoma 73125.

Hypoxia

Hypoxia is probably our most important physiological problem. It can be the most dangerous physical flying problem due to its insidious onset. Hypoxia, therefore, is one of the basic and most vital problems to the aviator. He must completely understand its causes, effects, prevention, and treatment.

Hypoxia can be defined as a lack of sufficient oxygen available to the body cells. The degree of hypoxia depends upon the reduction of the partial pressure of oxygen in the air sacs. This reduction of oxygen pressure becomes apparent in the Physiological Deficient Zone which extends from about 12,000 feet to 50,000 feet. Interference with the supply of oxygen to the cells of the body affects normal processes. The amount of oxygen in the cells may become inadequate due to various conditions.

The most important single characteristic of hypoxia at altitude is that if the aircrew member is engrossed in his duties, he may not notice the effect that hypoxia is having on his body. Each person will experience his individual symptoms of hypoxia; therefore, in order to detect hypoxia, you must know your reactions. Some of the common symptoms to look for are:

1. An increased breathing rate.
2. Light-headed or dizzy sensations.
3. Tingling or warm sensations.
4. Sweating.
5. Loss of vision or reduced vision; sleepiness.
6. Cyanosis. (Blue coloring of skin, fingernails, and lips)
7. Behavior changes.

Time of Useful Consciousness (T.U.C.) is the time from the onset of hypoxia until deterioration of the individual's effective performance. At altitudes below 30,000 feet this time may differ from the time of total consciousness (the time it takes to "pass-out") considerably. Above 35,000 feet the times become closer and eventually coincide for all practical purposes. Various factors will determine T.U.C., some of which are:

1. Altitude. T.U.C. decreases with increasing altitude.
2. Rate of Ascent. In general, the faster the rate, the shorter the T.U.C.
3. Physical Activity. Exercise decreases T.U.C. considerably.
4. Day-to-Day Factors. Physical fitness or ability to tolerate hypoxia will change from day to day; therefore, changing your T.U.C.

The following T.U.C.'s given for various altitudes represent *average* times without supplemental oxygen:

15–18,000 feet	30 minutes or more.
22,000 feet	5 to 10 minutes.
25,000 feet	3 to 5 minutes.
28,000 feet	2½ to 3 minutes.
30,000 feet	1 to 2 minutes.
35,000 feet	30 to 60 seconds.

An immediate realization of your hypoxic symptoms and the obtaining of a proper amount of supplemental oxygen by emergency oxygen equipment procedures are necessary to combat hypoxia.

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If oxygen is administered within a matter of three to five minutes to a person who is unconscious from hypoxia, recovery is usually rapid and complete. However, a hypoxic reaction may be followed by a state of shock during which there is a weak pulse, sweating, low blood pressure, and pooling of blood in dilated capillaries. This condition will require the usual treatment for shock.

Hyperventilation

The respiratory center of the brain reacts to the amount of carbon dioxide found in the blood stream. When you are in a physically relaxed state, the amount of carbon dioxide in your blood stimulates the respiratory center and your breathing rate is stabilized at about 12 to 16 breaths a minute. When physical activity occurs, the body cells use more oxygen and more carbon dioxide is produced. Excessive carbon dioxide enters the blood and consequently the respiratory center responds to this excess. Breathing increases in depth and rate to remove the excess carbon dioxide. When the excess is removed, the respiratory center changes the breathing back to normal.

The same process is involved when a maximum effort is made to hold the breath. While the breath is being held, the body cells continue to manufacture carbon dioxide which enters the blood. The amount in the blood finally becomes so great that in spite of conscious efforts, the respiratory center overrides it and breathing is resumed.

Hyperventilation, or overbreathing, is a disturbance of respiration that may occur in individuals as a result of physical exertion, emotional tension, or anxiety. It is a condition in which the respiratory rate and depth are abnormally increased. This results in an excessive loss of carbon dioxide from the lungs, lowering the normal carbon dioxide tension of 40 mm Hg. The most common symptoms are dizziness, hot and cold sensations, tingling of the hands, legs, and feet, tetany, nausea, sleepiness, and, finally, unconsciousness. After becoming unconscious, the breathing rate will be exceedingly low until enough carbon dioxide is produced to stimulate the respiratory center. Hyperventilation is a normal response to hypoxia. However, the excessive breathing does little good. Hyperventilation combined with hypoxia is very serious.

Should symptoms occur which you cannot definitely identify as either hypoxia or hyperventilation, the following steps should be taken:

Check your oxygen equipment immediately and put the regulator on 100% oxygen.

After three or four deep breaths of oxygen, the symptoms should improve markedly, if the condition experienced was hypoxia. (Recovery from hypoxia is extremely rapid.)

If the symptoms persist, you should consciously slow your breathing rate to an abnormally slow rate for 30 to 45 seconds, and then resume your breathing at a normal rate.

FIRE PROTECTION

Types of fires:

Class A fires—Fires in ordinary combustible materials where the quenching and cooling effects of quantities of water, or solutions containing large percentages of water, are of first importance.

Class B fires—Fires in flammable liquids, greases, etc., where a blanketing effect is essential.

Class C fires—Fires in electrical equipment, where the use of a nonconducting extinguishing agent is of first importance.

Airworthiness Standards: Transport Category Airplanes

Airplanes certificated as Transport Category Airplanes must comply with the following requirements for hand fire extinguishers:

Flight deck—at least 1.

Passenger compartment—determined by passenger capacity.

Passenger capacity	*Minimum number extinguishers*
7 through 30	1
31 through 60	2
61 or more	3

DEFINITIONS

Speed of sound—the speed at which sound waves travel through a medium which is solely a function of temperature.

Mach number—the ratio of the true airspeed to the speed of sound.

$$\text{Mach No. (M)} = \frac{\text{True Airspeed (TAS)}}{\text{Speed of Sound}}$$

Speed of Sound = Mach 1.00

Subsonic—less than the speed of sound.

Transonic—airflow on aircraft components may be partly subsonic and partly supersonic. Mach numbers from 0.75 to 1.20.

Supersonic—definite supersonic airflow on all parts of the aircraft. Mach numbers from 1.20 to 5.00.

Hypersonic—Mach numbers above 5.00.

Critical Mach number—the highest flight speed possible without supersonic flow over any part of the aircraft.

Mean Aerodynamic Chord (MAC)—is the mean chord of the wing which is established by the manufacturer for engineering design and weight and balance purposes.

Specific range—is the nautical miles of flying distance per pound of fuel. The specific range can be defined by the following relationships:

$$\text{specific range} = \frac{\text{nautical miles}}{\text{lbs. of fuel}} \quad \text{or} \quad \frac{\text{nautical miles/hr.}}{\text{lbs. of fuel/hr.}}$$

$$\text{thus, specific range} = \frac{\text{velocity, knots}}{\text{fuel flow, lbs./hr.}}$$

Because of high fuel flow in jet aircraft, specific range is usually expressed as nautical *air* miles per 1,000 lbs. of fuel. (N.A.M./1,000 lbs.)

Clearway—expressed in terms of a clearway plane, extending from the end of the runway with an upward slope not exceeding 1.25 percent, above which no object nor any terrain protrudes.

Stopway—an area beyond the runway, not less in width than the runway, for use in decelerating the airplane during an aborted takeoff. A stopway can be used for increasing the accelerate-stop distance.

Takeoff Distance—The greater of:

1. The horizontal distance from the point of brake release to a point where the airplane attains a height of 35 feet above the takeoff surface, assuming an engine failure at the V_1 speed, or

2. 1.15 times the horizontal distance from the point of brake release to the point where the airplane attains a height of 35 feet above the takeoff surface with all engines operating.

The takeoff distance available, used in entering the chart, is the sum of the runway length plus the actual or maximum allowable clearway length. The length of the clearway used must not be greater than one-half the length of the runway.

Takeoff Run—The greater of:

1. The horizontal distance from the point of brake release to a point equidistant between the lift-off point and the point where the airplane attains a height of 35 feet above the takeoff surface, assuming an engine failure at V_1 speed, or

2. 1.15 times the horizontal distance from the point of brake release to a point equidistant between the lift-off point and the point where the airplane attains a height of 35 feet above the takeoff surface with all engines operating.

The takeoff run, used in entering the chart, must not exceed the length of the runway.

Accelerate-Stop Distance—The horizontal distance to accelerate from a standing start to the V_1 speed and thereafter, assuming an engine failure at this speed, to bring the airplane to a full stop. The accelerate-stop distance, used in entering the chart, must not exceed the length of the runway plus the length of the stopway.

Balanced Field Length—The condition where the takeoff distance is equal to the accelerate-stop distance. This distance must not exceed the length of the runway.

Unbalanced Field Length—The condition where the takeoff distance and accelerate-stop distance are not equal.

AIRCRAFT PARTICULARS

Fuel System

All fuel must be distributed equally on both sides of the aircraft. All main tanks must be equally filled first, then the alternates in accordance with prescribed procedures.

Total capacity: 3,840 gallons
Fuel weight: 6 pounds per gallon
Number of tanks: 8

Tanks	*Capacity*
1 and 4 main	360 gal. each
1 and 4 alternates	520 gal. each
2 and 3 main	510 gal. each
2 and 3 alternates	530 gal. each

Fuel dumping facilities are provided for the emergency jettisoning of fuel in flight to decrease airplane gross weight. A standpipe is installed in each main tank so that when all possible fuel is jettisoned, in level flight, sufficient fuel will remain in the main tanks for 45 minutes of flight at 75% of rated METO power. (Ref: FAR 25.1001)

Total time to jettison from full tanks (3,840 gal.) to standpipes (420 gal.) is 7.6 minutes.

Airplane Weights	*Pounds*
Maximum takeoff gross weight	105,000
Maximum landing gross weight	92,360
Maximum zero fuel weight	87,360
Basic operating weight	60,660

Basic operating weight includes the following items:

1. Airplane empty weight.
2. Flight crew.
3. Flight attendants.
4. Crew baggage.
5. Food and beverage.
6. Engine oil.
7. ADI fluid.

Weight and Balance Data

The aircraft must be loaded in accordance with approved weight distribution tables. A range of center of gravity (C.G.) movement must be computed prior to each flight for Takeoff Gross Weight down to the Zero Fuel Weight (ZFW). When a point is listed as a station, it means inches aft of the datum line.

Mean Aerodynamic Chord (MAC): 164 inches
Leading edge of MAC (LEMAC): station 395
C.G. Limits:
  Gear up: Forward C.G., 13% MAC; Aft C.G., 33% MAC
  Gear down: Forward C.G., 14.6% MAC; aft C.G., 33% MAC
Nose gear station: 40
Main gear station: 470
Forward cargo compartment:
  Maximum allowable load ---------- 5,700 pounds

Average station	230
Aft cargo compartment:	
Maximum allowable load	3,400 pounds
Average station	730
1 and 4 Main tank station	460
1 and 4 Alternate tank station	449
2 and 3 Main tank station	441
2 and 3 Alternate tank station	449

Flight Planning Data

CLIMB TABLE

Takeoff Gross Weight (1,000 lbs.)	*Average Rate of Climb Ft./Min.*	*Climb Speed Indicated (IAS) Kts.*	*Total Fuel Flow (Lbs.Hr.)*
105	550	160	3,750
100	600	160	3,750
95	650	160	3,750
90	700	160	3,750

CRUISE CHART

Flight Level	*Gross Weight (1,000 Lbs.) 105*	*100*	*95*	*90*	*Total Fuel Flow (Lbs./Hr.)*
		Indicated Airspeed—Knots			
180	183	188	193	198	2,100
190	180	185	190	195	2,100
200	177	182	187	192	2,100

AIRSPEED CORRECTION TABLE

	160 kts.	*200 kts.*	*250 kts.*
Instrument and Position	+3	+4	+4
Compressibility	0	−1	−2

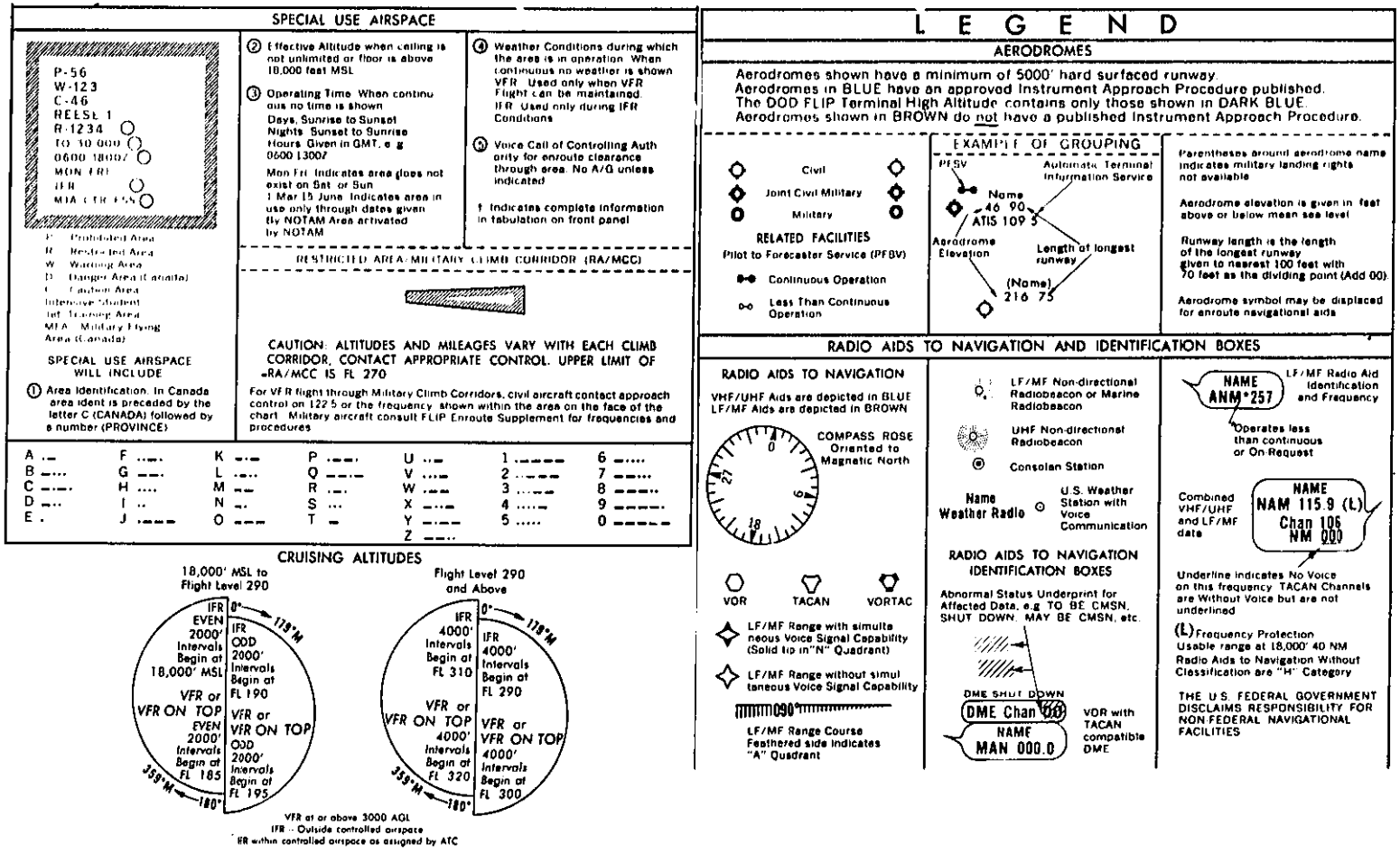

SPECIAL USE AIRSPACE
P-56
W-123
C-46
REESE 1
R-1234
TO 10 000
0600 1800Z
MON FRI
IFR
MIA CTR FSS
P Prohibited Area
R Restricted Area
W Warning Area
D Danger Area (Canada)
C Caution Area
Intensive Student Jet Training Area
MFA Military Flying Area (Canada)
SPECIAL USE AIRSPACE WILL INCLUDE
① Area Identification. In Canada area ident is preceded by the letter C (CANADA) followed by a number (PROVINCE)
② Effective Altitude when ceiling is not unlimited or floor is above 18,000 feet MSL
③ Operating Time. When continuous no time is shown
Days, Sunrise to Sunset
Nights Sunset to Sunrise
Hours Given in GMT, e g 0600 1300Z
Mon Fri Indicates area does not exist on Sat or Sun
1 Mar 15 June Indicates area in use only through dates given (By NOTAM Area activated by NOTAM
④ Weather Conditions during which the area is in operation. When continuous no weather is shown
VFR Used only when VFR Flight can be maintained.
IFR Used only during IFR Conditions
⑤ Voice Call of Controlling Authority for enroute clearance through area. No A/G unless indicated
† Indicates complete information in tabulation on front panel
RESTRICTED AREA/MILITARY CLIMB CORRIDOR (RA/MCC)
CAUTION: ALTITUDES AND MILEAGES VARY WITH EACH CLIMB CORRIDOR, CONTACT APPROPRIATE CONTROL. UPPER LIMIT OF RA/MCC IS FL 270
For VFR flight through Military Climb Corridors, civil aircraft contact approach control on 122 5 or the frequency shown within the area on the face of the chart. Military aircraft consult FLIP Enroute Supplement for frequencies and procedures
A .- B -... C -.-. D -.. E . F ..-. G --. H .... I .. J .--- K -.- L .-.. M -- N -. O --- P .--. Q --.- R .-. S ... T - U ..- V ...- W .-- X -..- Y -.-- Z --..
1 .---- 2 ..--- 3 ...-- 4 ....- 5 ..... 6 -.... 7 --... 8 ---.. 9 ----. 0 -----
CRUISING ALTITUDES
18,000' MSL to Flight Level 290
IFR EVEN 2000' Intervals Begin at 18,000' MSL
VFR or VFR ON TOP EVEN 2000' Intervals Begin at FL 185
IFR ODD 2000' Intervals Begin at FL 190
VFR or VFR ON TOP ODD 2000' Intervals Begin at FL 195
0° 179°M 180° 359°M
Flight Level 290 and Above
IFR 4000' Intervals Begin at FL 310
VFR or VFR ON TOP 4000' Intervals Begin at FL 320
IFR 4000' Intervals Begin at FL 290
VFR or VFR ON TOP 4000' Intervals Begin at FL 300
0° 179°M 180° 359°M
VFR at or above 3000 AGL
IFR - Outside controlled airspace
IFR within controlled airspace as assigned by ATC
LEGEND
AERODROMES
Aerodromes shown have a minimum of 5000' hard surfaced runway.
Aerodromes in BLUE have an approved Instrument Approach Procedure published.
The DOD FLIP Terminal High Altitude contains only those shown in DARK BLUE.
Aerodromes shown in BROWN do not have a published Instrument Approach Procedure.
Civil
Joint Civil Military
Military
RELATED FACILITIES
Pilot to Forecaster Service (PFSV)
Continuous Operation
Less Than Continuous Operation
EXAMPLE OF GROUPING
PFSV
Automatic Terminal Information Service
Name
46 90
ATIS 109 5
Aerodrome Elevation
Length of longest runway
(Name)
216 75
Parenthesis around aerodrome name indicates military landing rights not available
Aerodrome elevation is given in feet above or below mean sea level
Runway length is the length of the longest runway given to nearest 100 feet with 70 feet as the dividing point (Add 00)
Aerodrome symbol may be displaced for enroute navigational aids
RADIO AIDS TO NAVIGATION AND IDENTIFICATION BOXES
RADIO AIDS TO NAVIGATION
VHF/UHF Aids are depicted in BLUE
LF/MF Aids are depicted in BROWN
COMPASS ROSE Oriented to Magnetic North
VOR TACAN VORTAC
LF/MF Range with simultaneous Voice Signal Capability (Solid tip in "N" Quadrant)
LF/MF Range without simultaneous Voice Signal Capability
090°
LF/MF Range Course Feathered side indicates "A" Quadrant
LF/MF Non-directional Radiobeacon or Marine Radiobeacon
UHF Non-directional Radiobeacon
Consolan Station
Name Weather Radio
U.S. Weather Station with Voice Communication
RADIO AIDS TO NAVIGATION IDENTIFICATION BOXES
Abnormal Status Underprint for Affected Data, e.g TO BE CMSN, SHUT DOWN, MAY BE CMSN, etc.
DME SHUT DOWN
DME Chan 00
NAME
MAN 000.0
VOR with TACAN compatible DME
NAME
ANM*257
LF/MF Radio Aid Identification and Frequency
Operates less than continuous or On-Request
Combined VHF/UHF and LF/MF data
NAME
NAM 115.9 (L)
Chan 106
NM 000
Underline indicates No Voice on this frequency. TACAN Channels are Without Voice but are not underlined
(L) Frequency Protection
Usable range at 18,000' 40 NM
Radio Aids to Navigation Without Classification are "H" Category
THE U.S. FEDERAL GOVERNMENT DISCLAIMS RESPONSIBILITY FOR NON-FEDERAL NAVIGATIONAL FACILITIES

FIGURE 1

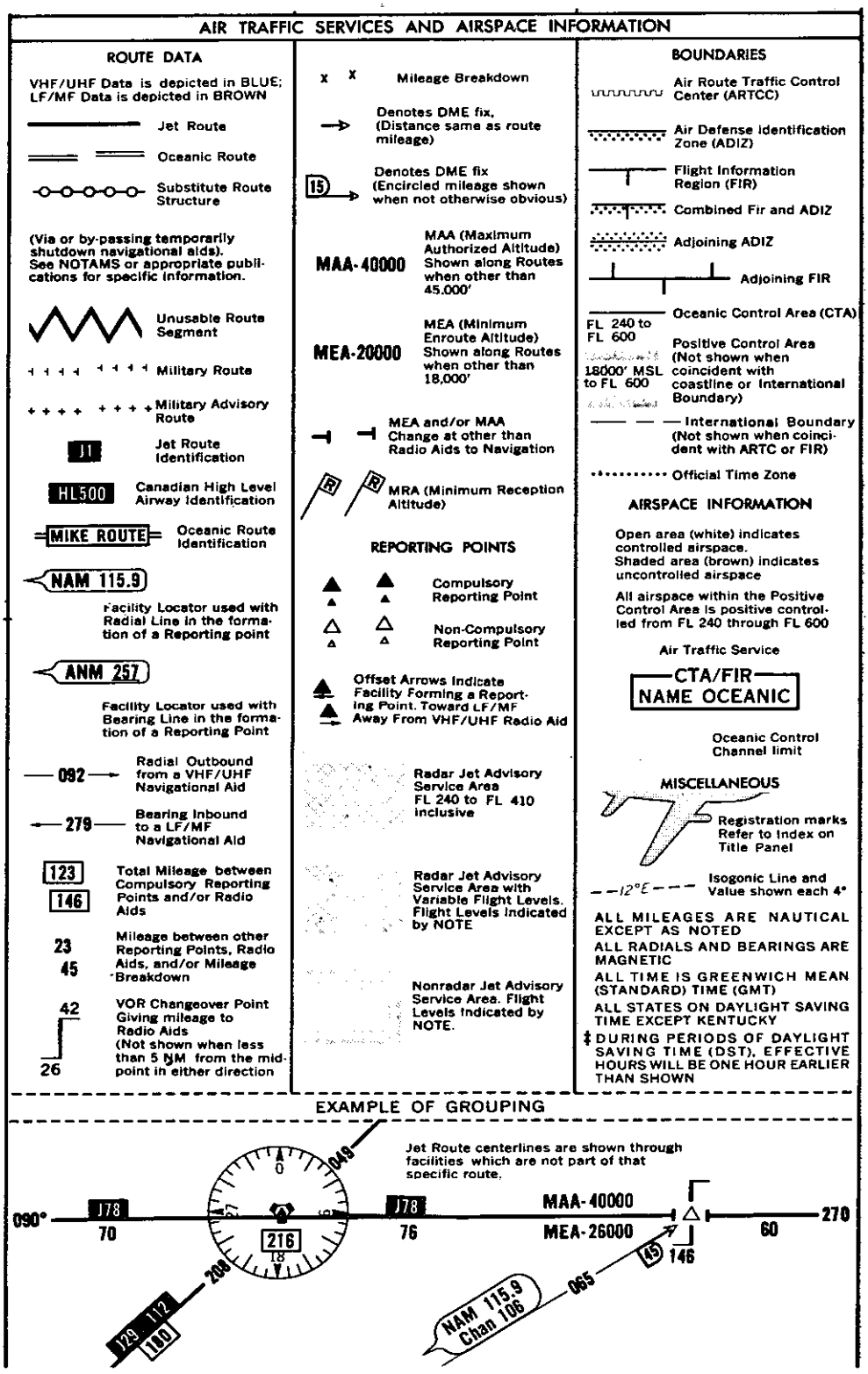

AIR TRAFFIC SERVICES AND AIRSPACE INFORMATION
ROUTE DATA
VHF/UHF Data is depicted in BLUE; LF/MF Data is depicted in BROWN
Jet Route
Oceanic Route
Substitute Route Structure
(Via or by-passing temporarily shutdown navigational aids). See NOTAMS or appropriate publications for specific information.
Unusable Route Segment
Military Route
Military Advisory Route
J1
Jet Route Identification
HL500
Canadian High Level Airway Identification
MIKE ROUTE
Oceanic Route Identification
NAM 115.9
Facility Locator used with Radial Line in the formation of a Reporting point
ANM 257
Facility Locator used with Bearing Line in the formation of a Reporting Point
092
Radial Outbound from a VHF/UHF Navigational Aid
279
Bearing Inbound to a LF/MF Navigational Aid
123
146
Total Mileage between Compulsory Reporting Points and/or Radio Aids
23
45
Mileage between other Reporting Points, Radio Aids, and/or Mileage Breakdown
42
26
VOR Changeover Point Giving mileage to Radio Aids (Not shown when less than 5 NM from the midpoint in either direction
x x
Mileage Breakdown
Denotes DME fix, (Distance same as route mileage)
15
Denotes DME fix (Encircled mileage shown when not otherwise obvious)
MAA-40000
MAA (Maximum Authorized Altitude) Shown along Routes when other than 45,000'
MEA-20000
MEA (Minimum Enroute Altitude) Shown along Routes when other than 18,000'
MEA and/or MAA Change at other than Radio Aids to Navigation
R
MRA (Minimum Reception Altitude)
REPORTING POINTS
Compulsory Reporting Point
Non-Compulsory Reporting Point
Offset Arrows Indicate Facility Forming a Reporting Point. Toward LF/MF Away From VHF/UHF Radio Aid
Radar Jet Advisory Service Area FL 240 to FL 410 inclusive
Radar Jet Advisory Service Area with Variable Flight Levels. Flight Levels Indicated by NOTE
Nonradar Jet Advisory Service Area. Flight Levels Indicated by NOTE.
BOUNDARIES
Air Route Traffic Control Center (ARTCC)
Air Defense Identification Zone (ADIZ)
Flight Information Region (FIR)
Combined Fir and ADIZ
Adjoining ADIZ
Adjoining FIR
Oceanic Control Area (CTA)
FL 240 to FL 600
18000' MSL to FL 600
Positive Control Area (Not shown when coincident with coastline or International Boundary)
International Boundary (Not shown when coincident with ARTC or FIR)
Official Time Zone
AIRSPACE INFORMATION
Open area (white) indicates controlled airspace.
Shaded area (brown) indicates uncontrolled airspace
All airspace within the Positive Control Area is positive controlled from FL 240 through FL 600
Air Traffic Service
CTA/FIR
NAME OCEANIC
Oceanic Control Channel limit
MISCELLANEOUS
Registration marks Refer to Index on Title Panel
12°E
Isogonic Line and Value shown each 4°
ALL MILEAGES ARE NAUTICAL EXCEPT AS NOTED
ALL RADIALS AND BEARINGS ARE MAGNETIC
ALL TIME IS GREENWICH MEAN (STANDARD) TIME (GMT)
ALL STATES ON DAYLIGHT SAVING TIME EXCEPT KENTUCKY
‡ DURING PERIODS OF DAYLIGHT SAVING TIME (DST), EFFECTIVE HOURS WILL BE ONE HOUR EARLIER THAN SHOWN
EXAMPLE OF GROUPING
Jet Route centerlines are shown through facilities which are not part of that specific route.
090°
J78
70
216
18
J78
76
MAA-40000
MEA-26000
45
146
60
270
049
065
208
J29 112
180
NAM 115.9
Chan 106

FIGURE 2

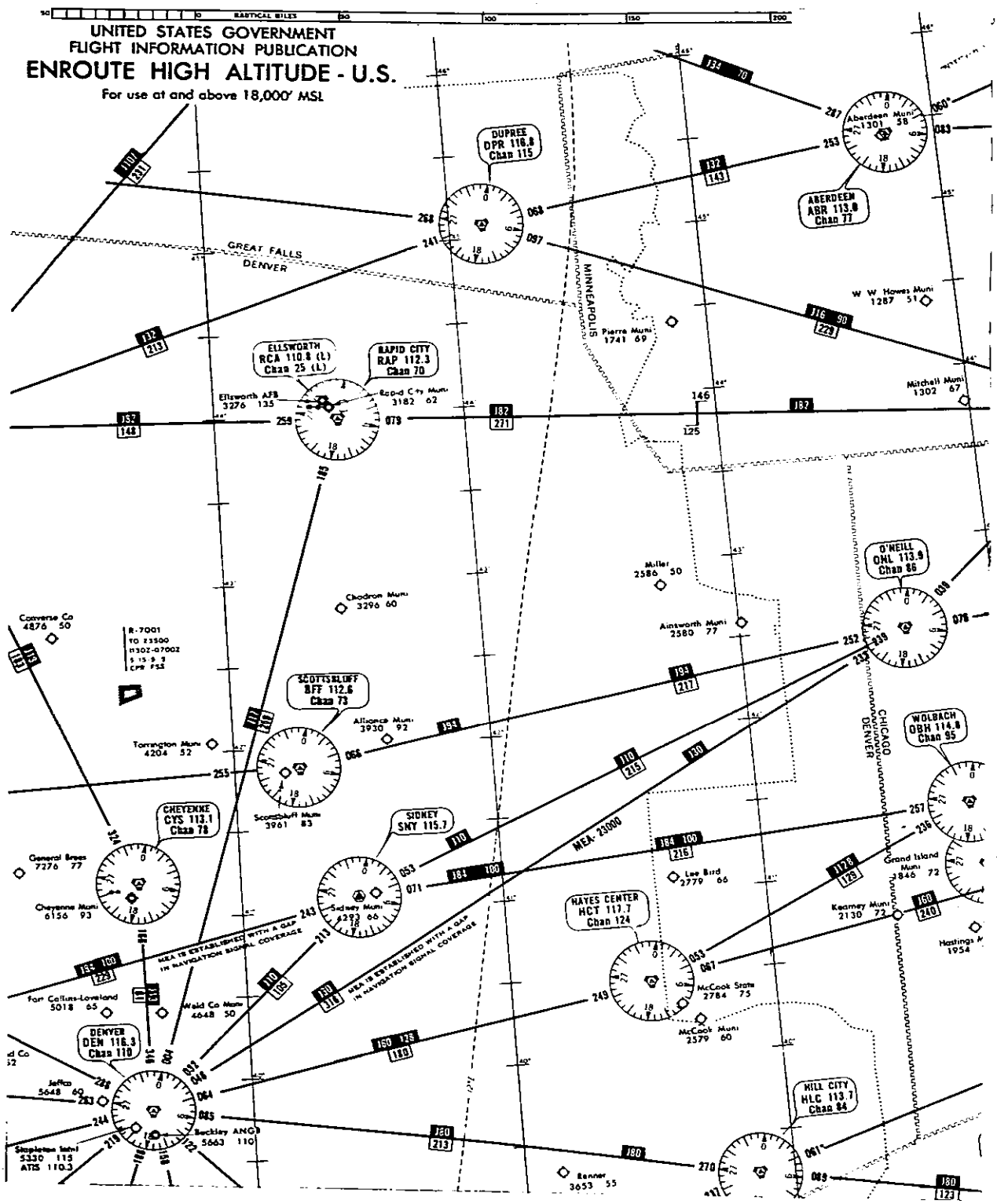

UNITED STATES GOVERNMENT
FLIGHT INFORMATION PUBLICATION
ENROUTE HIGH ALTITUDE - U.S.
For use at and above 18,000' MSL
NAUTICAL MILES
DUPREE DPR 116.8 Chan 115
ABERDEEN ABR 113.8 Chan 77
ELLSWORTH RCA 110.8 (L) Chan 25 (L)
RAPID CITY RAP 112.3 Chan 70
SCOTTSBLUFF BFF 112.6 Chan 73
CHEYENNE CYS 113.1 Chan 78
SIDNEY SNY 115.7
HAYES CENTER HCT 117.7 Chan 124
O'NEILL ONL 113.9 Chan 86
WOLBACH OBH 114.8 Chan 95
HILL CITY HLC 113.7 Chan 84
DENVER DEN 116.3 Chan 110
GREAT FALLS
DENVER
MINNEAPOLIS
CHICAGO
DENVER
MEA 23000
AREA IS ESTABLISHED WITH A GAP IN NAVIGATION SIGNAL COVERAGE
AREA IS ESTABLISHED WITH A GAP IN NAVIGATION SIGNAL COVERAGE
R-7001
TO 23500
H30Z-07002
CPD FSS
Aberdeen Muni 1301 58
W W Howes Muni 1287 51
Pierre Muni 1741 69
Ellsworth AFB 3276 135
Rapid City Muni 3182 62
Mitchell Muni 1302 67
Converse Co 4876 50
Chadron Muni 3296 60
Muller 2586 50
Ainsworth Muni 2580 77
Torrington Muni 4204 52
Alliance Muni 3930 92
Scottsbluff Muni 3961 83
General Brees 7276 77
Cheyenne Muni 6156 93
Sidney Muni 4293 66
Lee Bird 2779 66
Grand Island Muni 1846 72
Kearney Muni 2130 72
Hastings Muni 1954
McCook State 2784 75
McCook Muni 2579 60
Fort Collins-Loveland 5018 65
Weld Co Muni 4648 50
Jeffco 5648 69
Buckley ANGB 5663 110
Stapleton Intnl 5330 115
ATIS 110.3
Banner 3653 55

FIGURE 3

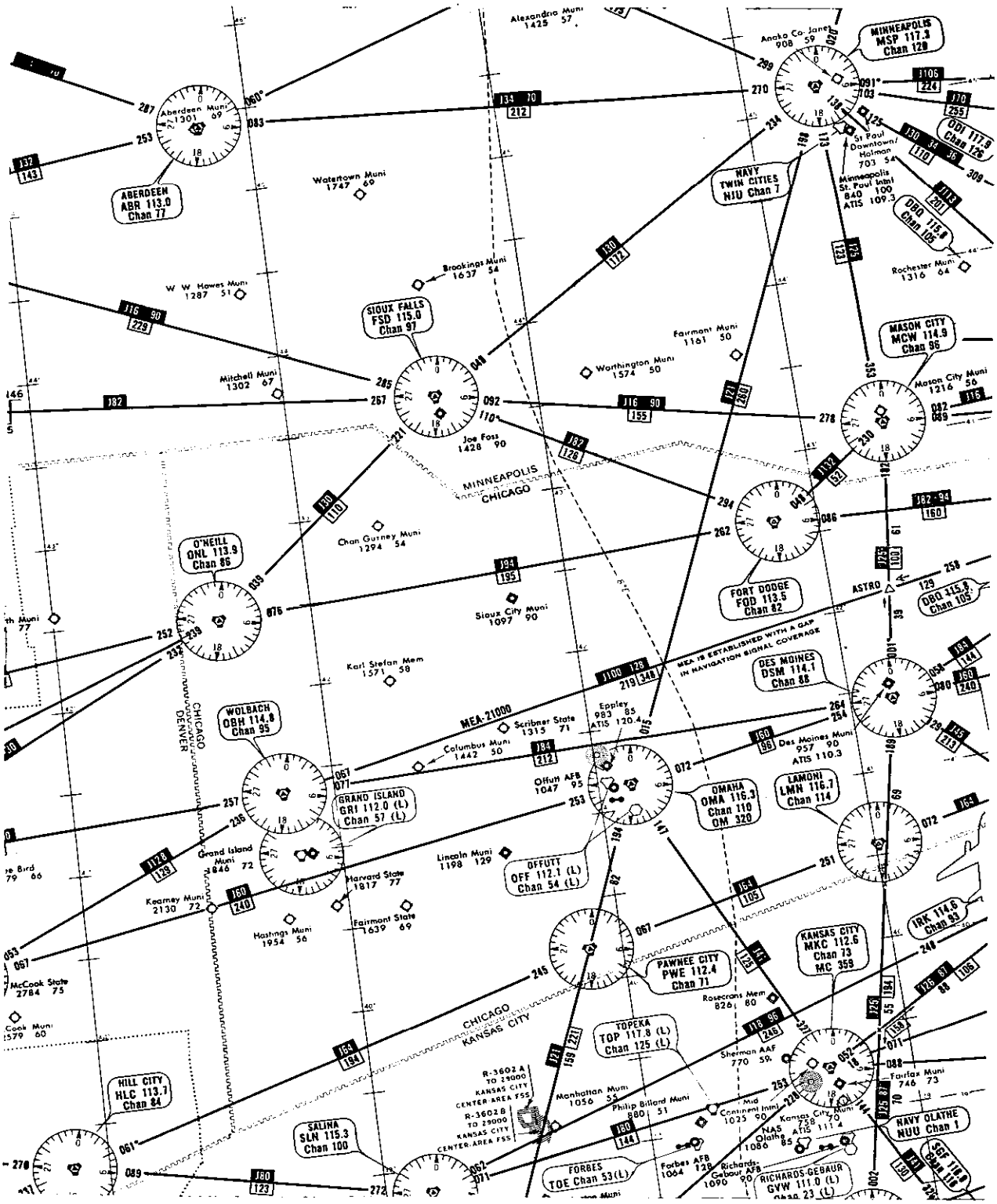

MINNEAPOLIS
CHICAGO
CHICAGO
DENVER
CHICAGO
KANSAS CITY
ABERDEEN
ABR 113.0
Chan 77
SIOUX FALLS
FSD 115.0
Chan 97
MINNEAPOLIS
MSP 117.3
Chan 128
NAVY
TWIN CITIES
NIU Chan 7
DBQ 115.4
Chan 105
MASON CITY
MCW 114.9
Chan 96
O'NEILL
ONL 113.9
Chan 86
FORT DODGE
FOD 113.5
Chan 82
DBQ 115.9
Chan 109
DES MOINES
DSM 114.1
Chan 88
WOLBACH
OBH 114.8
Chan 95
GRAND ISLAND
GRI 112.0 (L)
Chan 57 (L)
OFFUTT
OFF 112.1 (L)
Chan 54 (L)
OMAHA
OMA 116.3
Chan 110
OM 320
LAMONI
LMN 116.7
Chan 114
IRK 114.6
Chan 93
KANSAS CITY
MKC 112.6
Chan 73
MC 359
PAWNEE CITY
PWE 112.4
Chan 71
TOPEKA
TOP 117.8 (L)
Chan 125 (L)
HILL CITY
HLC 113.7
Chan 84
SALINA
SLN 115.3
Chan 100
FORBES
TOE Chan 53(L)
RICHARDS-GEBAUR
GVW 111.0 (L)
Chan 23 (L)
NAVY OLATHE
NUU Chan 1
ASTRO
MEA-21000
MEA IS ESTABLISHED WITH A GAP IN NAVIGATION SIGNAL COVERAGE
R-3602A
TO 29000
KANSAS CITY
CENTER AREA FSS
R-3602B
TO 29000
KANSAS CITY
CENTER-AREA FSS
Aberdeen Muni
1301 69
Watertown Muni
1747 60
W W Howes Muni
1287 51
Brookings Muni
1637 54
Alexandria Muni
1425 57
Anoka Co. Jane
908 59
St Paul
Downtown/
Holman
703 54
Minneapolis
St. Paul Intnl
840 100
ATIS 109.3
Rochester Muni
1310 64
Fairmont Muni
1161 50
Worthington Muni
1574 50
Mason City Muni
1216 56
Mitchell Muni
1302 67
Joe Foss
1428 90
Chan Gurney Muni
1294 54
Sioux City Muni
1097 90
Karl Stefan Mem
1571 58
Eppley
983 85
ATIS 120.4
Scribner State
1315 71
Columbus Muni
1442 50
Des Moines Muni
957 90
ATIS 110.3
Offutt AFB
1047 95
Grand Island
Muni
846 72
Harvard State
1817 77
Lincoln Muni
1198 129
Kearney Muni
2130 72
Hastings Muni
1954 56
Fairmont State
1639 69
McCook State
2784 75
Cook Muni
1579 60
Rosecrans Mem
826 80
Sherman AAF
770 59
Manhattan Mun
1056 55
Philip Billard Muni
880 51
Continent Intnl
1025 90
Kansas City
NAS
Olathe
1086 85
ATIS 111.4
Forbes AFB
1064 128
Richards-
Gebaur AFB
1090 90
Fairfax Muni
746 73

FIGURE 4

LOCATION IDENTIFIERS

BFF	SCOTTSBLUFF, NEBRASKA
DEN	DENVER, COLORADO
DSM	DES MOINES, IOWA
FSD	SIOUX FALLS, SOUTH DAKOTA
MCW	MASON CITY, IOWA
MSP	MINNEAPOLIS, MINNESOTA
OMA	OMAHA, NEBRASKA
ONL	O'NEILL, NEBRASKA
RST	ROCHESTER, MINNESOTA

TERMINAL FORECASTS contain information for specific airports on ceiling, cloud heights, cloud amounts, visibility, weather condition and surface wind. They are written in a form similar to the **AVIATION WEATHER REPORT.**

CEILING: Identified by the letter "C"
CLOUD HEIGHTS: In hundreds of feet above the station (ground)
CLOUD LAYERS: Stated in ascending order of height
VISIBILITY: In statute miles, but omitted if over 8 miles
SURFACE WIND: In tens of degrees and knots; omitted when less than 10.

EXAMPLE OF TERMINAL FORECASTS

C15O — Ceiling 1500', broken clouds

20OC7O●6K 3230G— Scattered clouds at 2000', ceiling 7000' overcast, visibility 6 miles, smoke, surface wind 320 degrees 30 knots, gusty.

O11/2GF — Clear, visibility one and one-half miles, ground fog.

C5X1/4S — Sky obscured, vertical visibility 500., visibility one-fourth mile, moderate snow.

AREA FORECASTS are 12-hour forecasts plus 12-hour OUTLOOKS of cloud, weather and frontal conditions for an area the size of several states. Heights of cloud tops, icing, and turbulence are above SEA LEVEL; ceiling heights, ABOVE GROUND LEVEL; bases of cloud layers are MSL OR ABV GRND LVL, as indicated. Area Forecasts are amended by SIGMET and AIRMET.

SIGMET and AIRMET warn airmen in flight of potentially hazardous weather such as squall lines, thunderstorms, fog, icing, and turbulence. SIGMET's concern severe and extreme conditions of importance to all aircraft. AIRMET's concern less severe conditions which may be hazardous to some aircraft or to relatively inexperienced pilots. Both are broadcast by FAA on NAVAID voice channels.

WINDS (AND TEMPERATURES) ALOFT FORECASTS are 6- and 12-hour forecasts of direction (nearest 10° true N) and speed (knots) for selected flight levels. Temperatures aloft (°C) are included for all but the lowest and 7000-foot levels.

EXAMPLES OF WINDS ALOFT FORECASTS:

LVL 3000 5000 FT 7000 10000FT
MLT 2925 2833+00 2930 3030-06

At 5000 MSL wind from 280° at 33 knots with temperature 0°Celsius

FIGURE 5

FA DEN 261145
13Z FRI–Ø1 SAT
COLO NEB IA MINN
CLDS AND WX. HGTS ASL UNLESS NOTED. NEARLY STNRY PAC FRONT FROM SERN COLO NWWD TO SWRN WYO THENCE WSWWD TO LOW PRES IN NEV.
PAC CDFNT SERN MINN TO NERN KANS TO NRN TEX PNHDL MOVG SLOLY SEWD WHILE POLAR CDFNT SERN MINN THRU SRN SDKT WL OVERTAKE PAC CDFNT AND BCM ABT STNRY FM E CNTRL IA BDR NERN KANS THRU A WK LO PRES AREA OVR ERN KAN.
THRU WRN KANS CNTRL AND W PTNS OF ERN NEB C3–8⊕ WITH LCL FOG CONDS RESTRG VSBYS TO 1 TO 3 MI LFTG TO C1Ø–18◍V⊕ BY AFTN. LCL ZL– –NWRN KANS AND IN PTNS OF CNTRL AND ERN NEB. IN RMNDR OF ERN NEB AND IA C8Ø–1ØØ◍V⊕ DVLPG AFT 17Z CONTG TIL Ø1Z WITH LCL R– OR S–.
MINN. 2Ø–3Ø◍V◍ AGL OVR NRN PTNS WITH OCNL C15⊕SW– WITH LWR CLDNS GRDLY SPRDG SWD AFT 18Z PRECDD BY 8Ø–12Ø◍V◍ AGL OVR S PTNS LWRG TO C6Ø–9Ø⊕ EXTRM SE PTNS.
ICG. MDT MXD ICGICIP. FRZLVL NEAR OR AT SFC.
TURBC. MDT OVR AND NEAR MTNS LCLY SVR IMDTLY E OF HIR PKS AND RDGS.
OTLK Ø1Z–19Z SAT. PAC FRONT DRFTG SLOLY SWD EXTDG FRM SRN COLO NWWD TO NWRN COLO BY 19Z. NOT MUCH CHG S OF FRONT. N OF FRONT CIGS LWRG BCMG C5–15◍V⊕ 2Ø–3Ø⊕1–3S– –F OCNL C2–4x1/4–3/4S–F. SLOW LFTG OF CONDS AFT DABRK.

FT–1 2611ØØ–23ØØZ

DEN C5⊕3F OCNL C3X3/4S– –F CHC ZL– –. 16ØØZ C1Ø⊕7. 18ØØZ C25◍
OMA C1ØØ◍ Ø212. 15ØØZ C12◍8Ø⊕ Ø212 CHC OF BRF ZL– –OR S–.
17ØØZ C18◍8Ø⊕ OCNL R– – Ø212. 2ØØØZ C2Ø⊕7 3615
DSM 18◍C1ØØ⊕ Ø612. 16ØØZ C25⊕ 3415 OCNL R– OR S– 22ØØZ C25⊕ 3415
MCW C8Ø◍25Ø⊕7 Ø21Ø. 16ØØZ C25◍8Ø⊕7 3615 FEW SW– OR RW– BRFLY
FSD 15◍C8Ø⊕ Ø31Ø OCNL C15◍. 18ØØZ C8Ø⊕ Ø31Ø
MSP 25◍C8Ø◍. 14ØØZ C8Ø◍ 3412

FD–1 261145Z

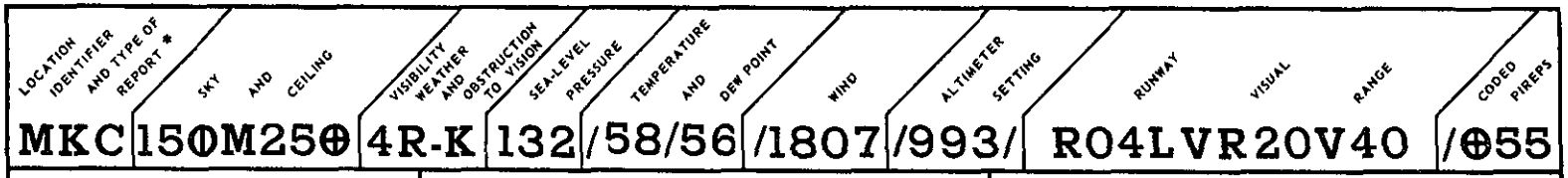
LVL	3ØØØ	5ØØØ	7ØØØ	1ØØØØFT	14ØØØFT	18ØØØFT	24ØØØFT
DSM	1313	1813+Ø5	2121	2328–Ø1	2438–Ø8	2446–17	2552–29
ONL		Ø818	151Ø	2214–Ø3	2526–Ø9	2541–18	2551–3Ø
BFF			16Ø8	2315–Ø4	2426–1Ø	2539–18	2449–3Ø
DEN			23Ø9	2516–Ø1	2423–Ø9	2432–17	244Ø–3Ø

SA3Ø2614ØØ

DEN M4⊕5L--Ø74/32/25/ØØØØ/972/CIG RGD
OMA 1ØØⓘ/ⓘ8 115/34/27/Ø4Ø7/984
DSM E12Øⓘ6H 135/34/3Ø/Ø7Ø7/989
MCW E45ⓘ1ØØ⊕4GF 149/32/28/Ø9Ø9/992
FSD M11ⓘ6Øⓘ1ØØ⊖12 157/33/29/Ø411/994
RST M5Ø⊕5GF 167/3Ø/26/Ø8Ø4/996
MSP 31ⓘE15Øⓘ15 179/3Ø/24/Ø31Ø/ØØ1

SA3Ø2615ØØ

DEN S M4⊕4L--F Ø75/32/25/Ø9Ø5/974/CIG RGD LB35
OMA /-ⓘ5KH 125/35/27/Ø4Ø6/987
DSM 7Øⓘ E12Øⓘ6H 142/34/31/Ø8Ø8/991
MCW E45ⓘ8Ø⊕4GF 151/32/28/Ø8Ø8/993
FSD 12ⓘM6Øⓘ1ØØ⊖12 164/33/29/Ø413/996/ⓘVⓘ
RST M6Ø⊖5GF 176/3Ø/27/Ø8Ø5/999
MSP 35ⓘE1ØØⓘ15 193/3Ø/24/Ø3Ø9/ØØ5



SKY AND CEILING

Sky cover symbols are in ascending order. Figures preceding symbols are heights in hundreds of feet above station.

Sky cover symbols are:

- ○ Clear: Less than 0.1 sky cover
- ◐ Scattered: 0.1 to less than 0.6 sky cover.
- ◍ Broken: 0.6 to 0.9 sky cover.
- ⊕ Overcast: More than 0.9 sky cover
- — Thin (When prefixed to the above symbols.)
- −X Partial obscuration: 0.1 to less than 1.0 sky hidden by precipitation or obstruction to vision (bases at surface)
- X Obscuration: 1.0 sky hidden by precipitation or obstruction to vision (bases at surface)

Letter preceding height of layer identifies ceiling layer and indicates how ceiling height was obtained. Thus:

A	Aircraft	R	Radiosonde Balloon or Radar.
B	Balloon (Pilot or ceiling).	W	Indefinite
D	Estimated height of cirriform clouds on basis of persistency.	U	Height of cirriform. ceiling layer unknown.
		/	Height of cirriform non-ceiling layer unknown.
E	Estimated heights of noncirriform clouds	"V"	Immediately following numerical value indicates a varying ceiling.
M	Measured		

VISIBILITY

Reported in Statute Miles and Fractions. (V=Variable)

WEATHER AND OBSTRUCTION TO VISION SYMBOLS

A	Hail	F	Fog	RW	Rain Showers
AP	Small Hail	GF	Ground Fog	S	Snow
BD	Blowing Dust	H	Haze	SG	Snow Grains
BN	Blowing Sand	IC	Ice Crystals	SP	Snow Pellets
BS	Blowing Snow	IF	Ice Fog	SW	Snow Showers
D	Dust	K	Smoke	T	Thunderstorm
E	Sleet	L	Drizzle	ZL	Freezing Drizzle
EW	Sleet Showers	R	Rain	ZR	Freezing Rain

Precipitation intensities are indicated thus:
.. Very Light; − Light; (no sign) Moderate; + Heavy

WIND

Direction in tens of degrees from true north, speed in knots. 0000 indicates calm. G indicates gusty. Peak speed of gusts follows G or Q when squall is reported. The contraction WSHFT followed by local time group in remarks indicates wind-shift and its time of occurrence. (Kts. x 1.15 = statute mi/hr.)

EXAMPLES: 3627 360 Degrees, 27 Knots;
3627G40 360 Degrees, 27 Knots Peak speed in gusts 40 knots.

ALTIMETER SETTING

The first figure of the actual altimeter setting is always omitted from the report.

RUNWAY VISUAL RANGE (RVR)

RVR is reported from some stations. Extreme values for 10 minutes prior to observation are given in hundreds of feet. Runway identification precedes RVR report.

CODED PIREPS

Pilot reports of clouds not visible from ground are coded with MSL height data preceding and/or following sky cover symbol to indicate cloud bases and/or tops, respectively.

DECODED REPORT

Kansas City: Record observation, 1500 feet scattered clouds, measured ceiling 2500 feet overcast, visibility 4 miles, light rain, smoke, sea level pressure 1013.2 millibars, temperature 58°F, dewpoint 56°F, wind 180°, 7 knots, altimeter setting 29.93 inches. Runway 04 left, visual range 2000 ft. variable to 4000. Pilot reports top of overcast 5500 feet.

*TYPE OF REPORT

The omission of type-of-report data identifies a scheduled record observation for the hour specified in the sequence heading; the time of an out-of-sequence, special observation is given as "S" followed by a time group (24-hour clock GMT) e.g., "PIT S 0715 -XM..." A special indicates a significant change in one or more elements. Local reports are identified by "LCL" and a time group. Locals are transmitted on local teletypewriter circuits only.

FIGURE 6

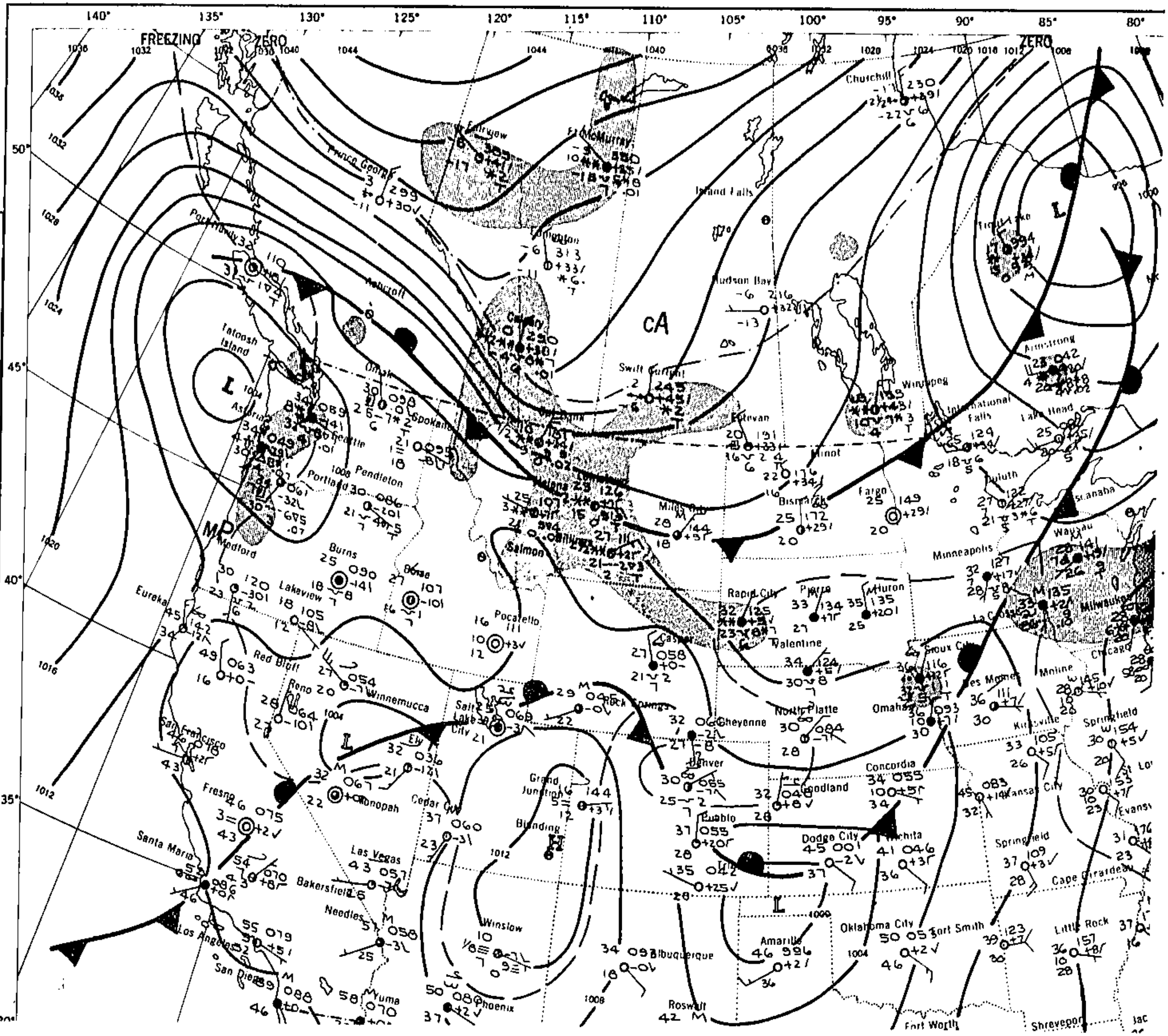

FREEZING
ZERO
cA
Churchill
Fairview
Ft McMurray
Prince George
Island Falls
Ashcroft
Calgary
Hudson Bay
Tatoosh Island
Swift Current
Winnipeg
Astoria
Seattle
Spokane
Estevan
International Falls
Lake Head
Armstrong
Minot
Portland
Pendleton
Helena
Fargo
Bismarck
Duluth
Escanaba
Medford
Miles City
Salmon
Wausau
Burns
Boise
Minneapolis
Eureka
Lakeview
Pocatello
Rapid City
Pierre
Huron
Milwaukee
Casper
Valentine
Sioux City
La Crosse
Chicago
Red Bluff
Reno
Winnemucca
Rock Springs
North Platte
Omaha
Des Moines
Moline
Salt Lake City
Cheyenne
San Francisco
Ely
Denver
Springfield
Goodland
Concordia
Kansas City
Grand Junction
Fresno
Tonopah
Cedar City
Pueblo
Blanding
Santa Maria
Las Vegas
Dodge City
Wichita
Cape Girardeau
Bakersfield
Needles
Winslow
Los Angeles
Albuquerque
Amarillo
Oklahoma City
Fort Smith
Little Rock
San Diego
Yuma
Phoenix
Roswell
Fort Worth
Shreveport

Figure 7

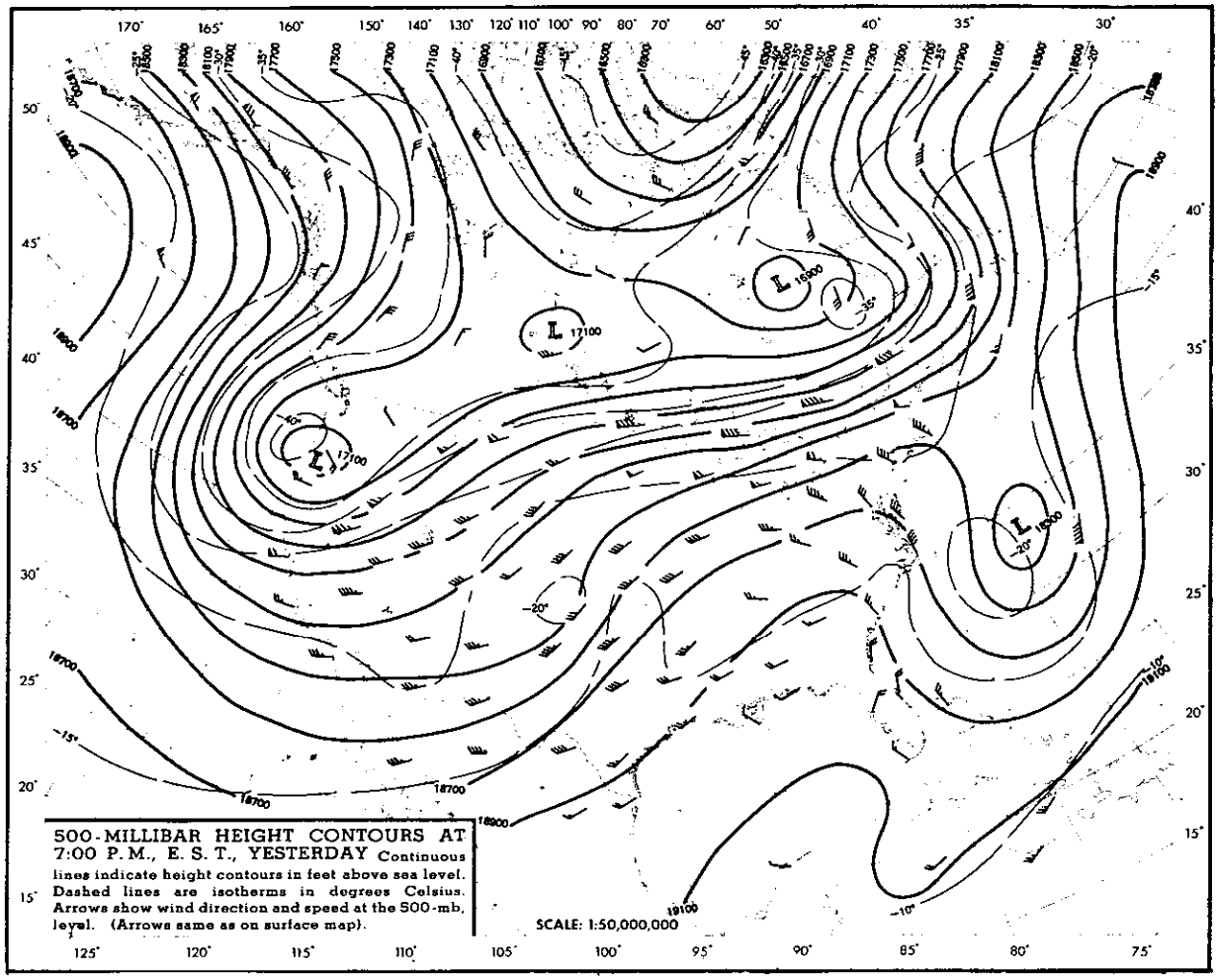


FIGURE 8

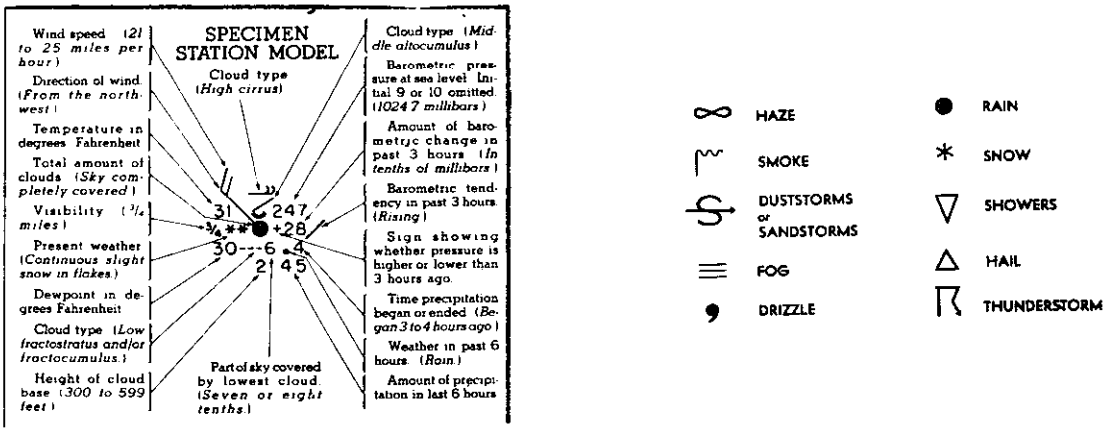


FIGURE 9

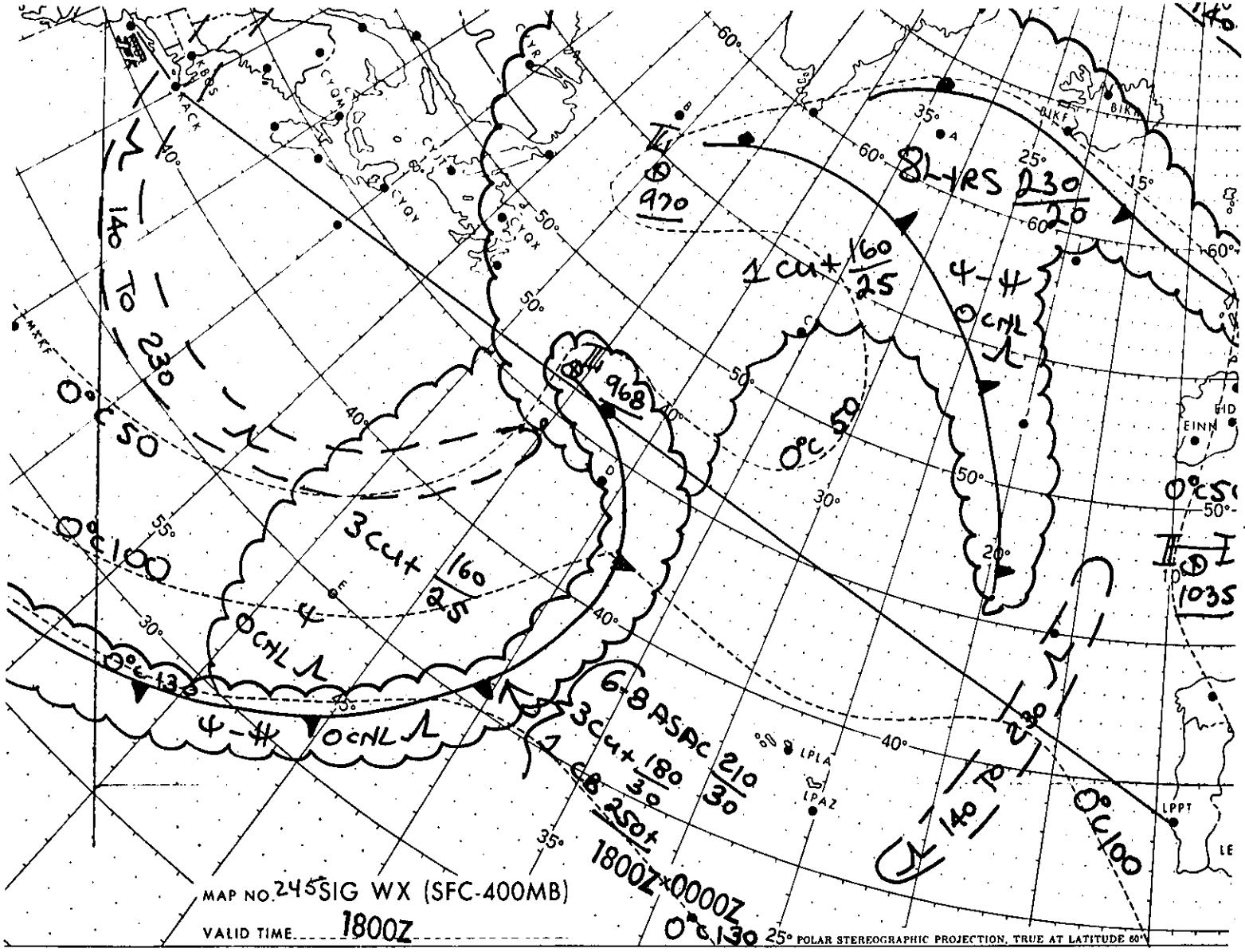

MAP NO. 245 SIG WX (SFC-400MB)
VALID TIME 1800Z
1800Z-0000Z
25° POLAR STEREOGRAPHIC PROJECTION, TRUE AT LATITUDE 60°
970
968
1035
8-12RS 230/20
1 CU+ 160/25
3 CU+ 160/25
6-8 ASPC 210/30
3 CU+ 180/30
6-8 2SOT
140 TO 230
0°C 50
0°C 100
0°C 130
0°C 50
0°C 100
4-4 OCNL
4-4 OCNL
4-4 OCNL
KACK
CYQY
CYQX
BIKF
EINN
LPLA
LPAZ
LPPT

FIGURE 10

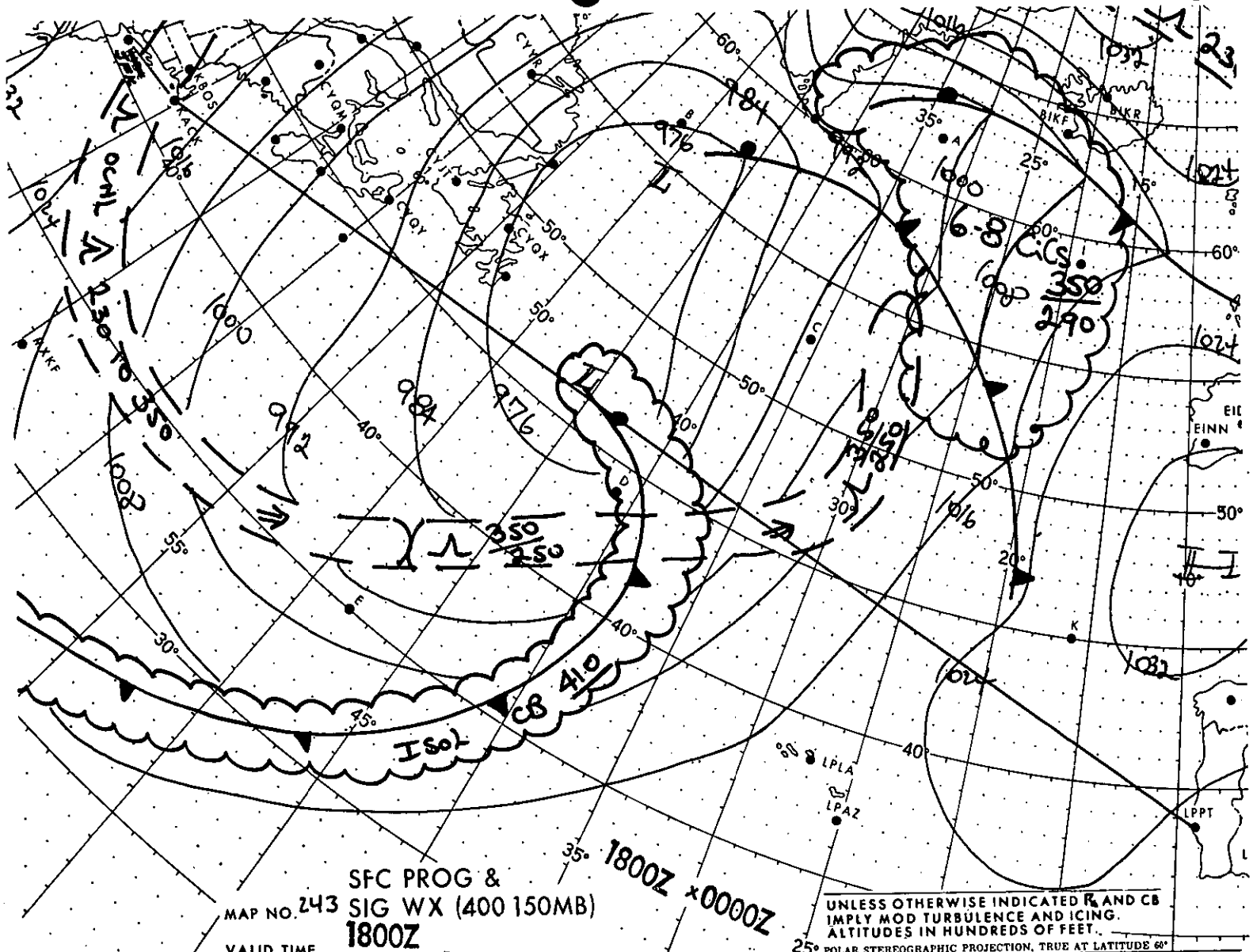

SFC PROG &
MAP NO. 243 SIG WX (400 150MB)
VALID TIME 1800Z
1800Z ×0000Z
UNLESS OTHERWISE INDICATED R AND CB IMPLY MOD TURBULENCE AND ICING. ALTITUDES IN HUNDREDS OF FEET.
POLAR STEREOGRAPHIC PROJECTION, TRUE AT LATITUDE 60°
CB 410
ISOL
6-8 CCS 350 290
OCNL 230 TO 350
LPLA
LPAZ
LPPT
BIKF
BIKR
EINN

FIGURE 11

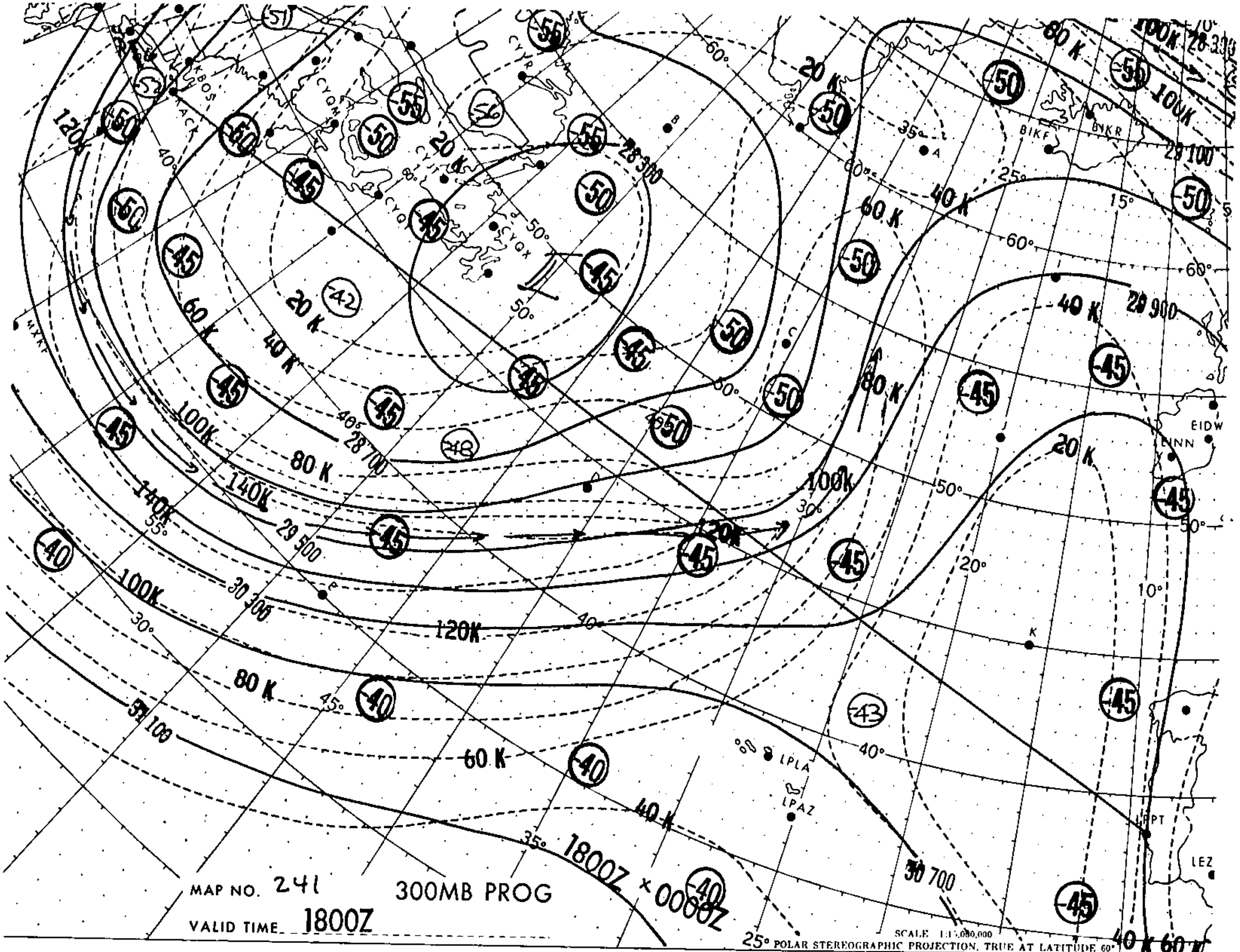

MAP NO. 241
300MB PROG
VALID TIME 1800Z
1800Z × 0000Z
25° POLAR STEREOGRAPHIC PROJECTION, TRUE AT LATITUDE 60°
120K
140K
100K
80 K
60 K
40 K
20 K
29 500
30 300
28 700
28 300
29 900
30 700

FIGURE 12

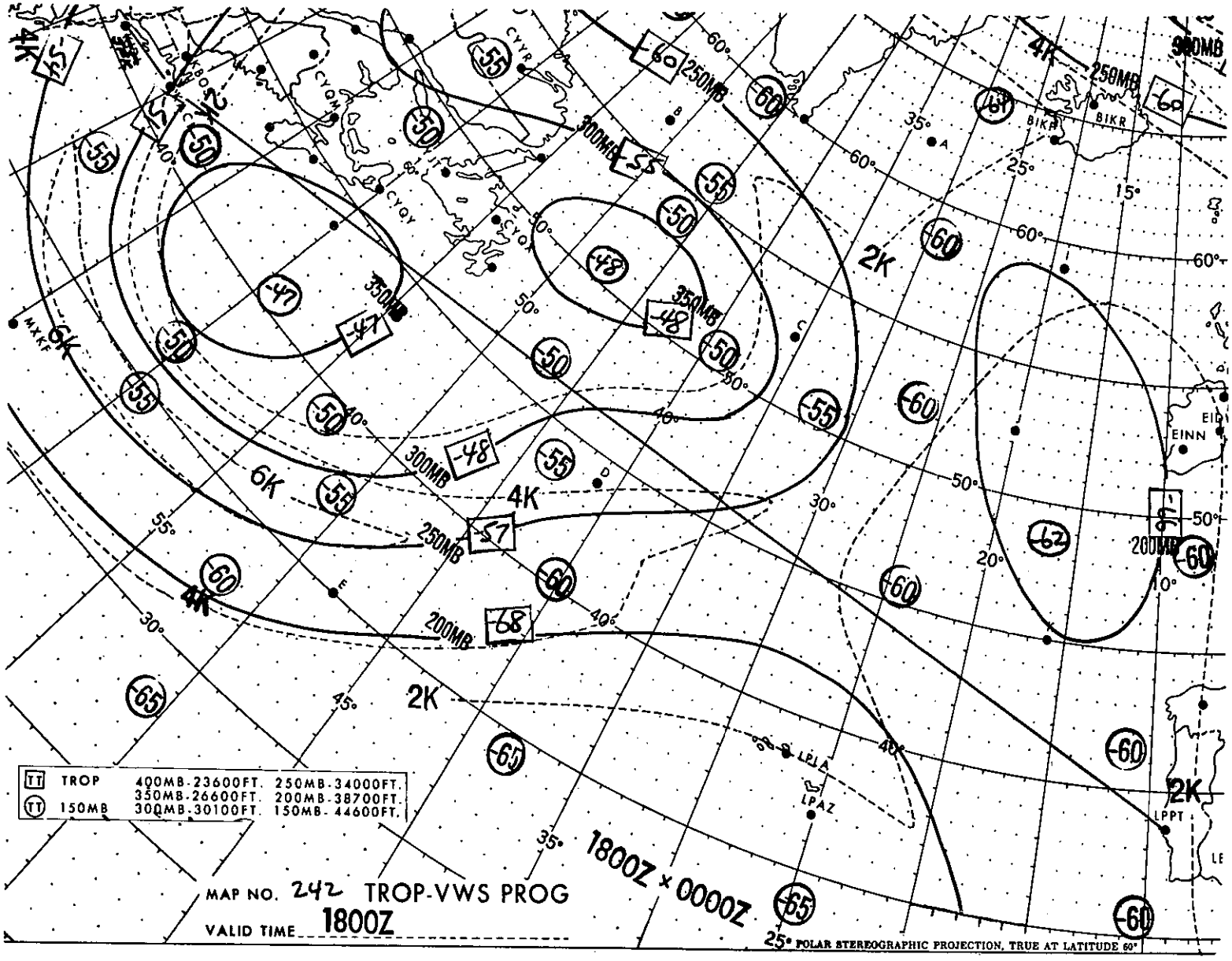

TT TROP 400MB-23600FT. 250MB-34000FT.
350MB-26600FT. 200MB-38700FT.
(TT) 150MB 300MB-30100FT. 150MB-44600FT.
MAP NO. 242 TROP-VWS PROG
VALID TIME 1800Z
1800Z x 0000Z
25° POLAR STEREOGRAPHIC PROJECTION, TRUE AT LATITUDE 60°
BIKR
EINN
LPLA
LPAZ
LPPT
CYQM
CYQY
CYQX
CYYR
MXKF
250MB
300MB
350MB
200MB
2K
4K
6K

FIGURE 13

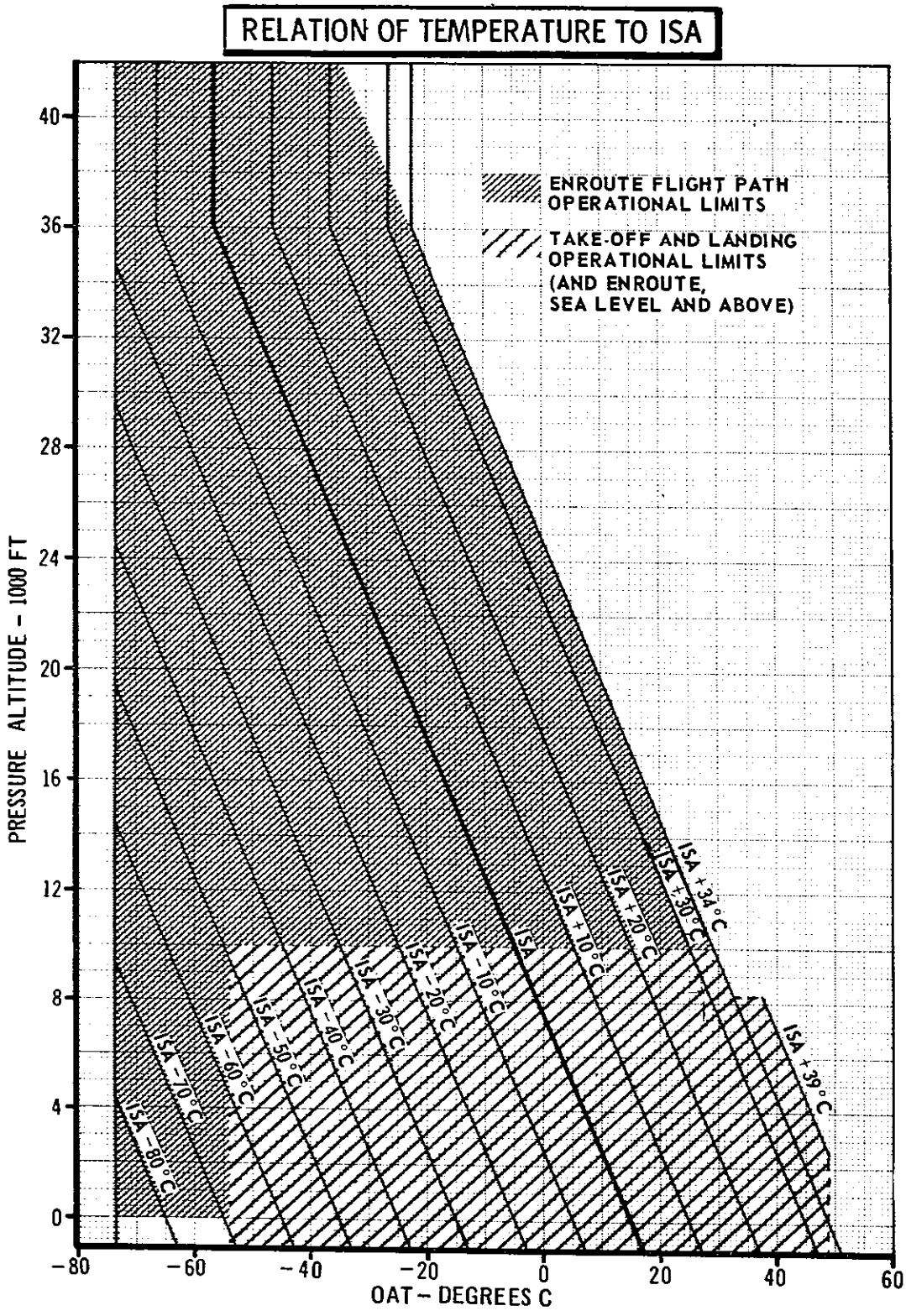

RELATION OF TEMPERATURE TO ISA
ENROUTE FLIGHT PATH OPERATIONAL LIMITS
TAKE-OFF AND LANDING OPERATIONAL LIMITS (AND ENROUTE, SEA LEVEL AND ABOVE)
PRESSURE ALTITUDE - 1000 FT
OAT - DEGREES C
ISA +39°C
ISA +34°C
ISA +30°C
ISA +20°C
ISA +10°C
ISA
ISA -10°C
ISA -20°C
ISA -30°C
ISA -40°C
ISA -50°C
ISA -60°C
ISA -70°C
ISA -80°C

FIGURE 14

TAKEOFF

EPR

ENG 1 & 3 - A/C ON
ENG 2 - NO BLEED

EPR BLEED CORRECTIONS	ENG 1 & 3	ENG 2
AIR CONDITIONING	OFF: +.03	ON: -.03
ENGINE ANTI-ICE ON	———	-.03

OAT	°F	-65	-49	-40	-31	-22	-13	- 4	5	14	23	32	41	50	59	68	77	86	95	104	120
	°C	-54	-45	-40	-35	-30	-25	-20	-15	-10	- 5	0	5	10	15	20	25	30	35	40	49
PRESS. ALT ~1000 FT	S. L. TO 5	SET MAX. EPR FOR ALT			2.23	2.20	2.18	2.15	2.12	2.10	2.07	2.04	2.01	1.98	1.95	1.95	1.95	1.94	1.90	1.85	1.78
	6-7	2.31	2.27	2.25	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1.96	1.96	1.96	↓	↓	↓	↓
	8-10	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1.97	1.97	1.97	↓	↓	↓	↓

2.23 5000 | 2.16 4000 | 2.10 3000 | 2.05 2000 | 2.00 1000 | 1.95 S.L. ← MAX EPR FOR COLDER TEMP AT PRESS ALT

$V_1 = V_R$ V_2

ANTI-SKID AND NOSE BRAKES OPERATIVE.

PRESS ALT ~1000 FT		OAT			
9 TO 10	°F		- 66 TO - 8	- 7 TO 32	33 TO 95
	°C		- 54 TO - 22	- 21 TO 0	1 TO 35
7 TO 9	°F	-65 TO - 26	- 25 TO 15	16 TO 50	51 TO 113
	°C	-54 TO - 32	- 31 TO - 9	- 8 TO 10	11 TO 45
5 TO 7	°F	-65 TO 8	9 TO 44	45 TO 95	96 TO 120
	°C	-54 TO - 13	- 12 TO 7	8 TO 35	36 TO 49
3 TO 5	°F	-65 TO 39	40 TO 89	90 TO 110	111 TO 120
	°C	-54 TO - 4	5 TO 32	33 TO 43	44 TO 49
1 TO 3	°F	-65 TO 86	87 TO 106	107 TO 120	
	°C	-54 TO 30	31 TO 41	41 TO 49	
-1 TO 1	°F	-65 TO 102	103 TO 120		
	°C	-54 TO 39	40 TO 49		

FLAPS	WEIGHT 1000 LB	$V_1=V_R$	V_2	$V_1=V_R$	V_2	$V_1=V_R$	V_2	$V_1=V_R$	V_2
5°	170	144	160	146	160	147	159		
	160	139	156	141	155	142	155		
	150	133	151	135	151	137	150		
	140	128	147	130	146	132	145	133	145
	130	122	142	124	141	126	141	128	140
	120	116	137	118	136	120	136	122	135
	110	109	132	112	131	113	131	116	130
	100	102	127	105	126	107	125	109	124
15°	170	136	150	138	149				
	160	131	147	133	146	134	145		
	150	127	143	128	142	129	141		
	140	121	139	123	138	124	137	126	135
	130	116	135	117	133	119	132	120	131
	120	110	130	112	129	113	128	115	127
	110	104	126	106	125	107	124	109	122
	100	98	121	100	120	101	119	103	117
25°	160	123	138	124	137	125	136		
	150	118	135	120	134	121	133		
	140	114	131	115	130	116	129	117	127
	130	108	127	110	126	111	125	113	123
	120	103	123	105	122	106	121	108	120
	110	98	118	99	117	100	116	102	115
	100	92	114	93	113	95	112	97	111

ADD 1 KNOT FOR CG FWD. OF 14% OR GROSS WEIGHT IN EXCESS OF 16[illegible],000 LB

AFTER TAKEOFF NORMAL MANEUVERING SPEEDS

- KTS IAS

FLAPS	BELOW MAX LANDING WT	ABOVE MAX LANDING WT
0	200	210
2	190	200
5	160	170
15	150	160
25	140	150

FOR MANEUVERS IMMEDIATELY AFTER TAKE-OFF EXCEEDING 15° BANK, MAINTAIN AT LEAST V_2 + 10 AT TAKE-OFF FLAPS

ENGINE LIMITS

N_1 RPM - 100.1%
N_2 RPM - 100.0%

STARTING EGT
420°C ABOVE 15°C OAT
350°C BELOW 15°C OAT

MAX CONT EGT - 535°C
TAKE-OFF EGT - 570°C

FIGURE 15

Figure 16, Takeoff Performance Flaps 15X—Gross Weight at Brake Release

Given:

Runway length available	8,150 feet
Tailwind component	4 knots
Slope	1% UP
Airport pressure altitude	4,000 feet
Outside air temperature	+88°F.
Average Takeoff EPR	1.88

For runway limit: start at runway length available line and follow dotted line and arrows. Answer is 132,000 pounds.

For climb limit: start where EPR 1.88 intersects climb limit base line and follow dotted line and arrows. Answer is 143,500 pounds.

EXPLANATION OF CHART

Gross Weight at Brake Release for this aircraft under the conditions specified on the chart is seen to be influenced by either *Runway* or *Climb* limitations. The following explanation of these limits is offered.

Runway Limit: Based on the runway length available, the operating variables (wind, runway slope, pressure altitude, and temperature) together with average takeoff EPR directly influence the Gross Weight at Brake Release. In the plotted example, this value is seen to be 132,000 pounds.

Climb Limit: Regulations specify that certain climb gradients or profiles must be met during the takeoff and climb phases. (See FAR 25.121.) This chart, therefore, shows the weights for various combinations of power (EPR) and pressure altitude at which the aircraft is able to equal the prescribed climb gradients. In the plotted example, the Gross Weight at Brake Release is 143,500 pounds. This value far exceeds the runway limit of 132,000 pounds. Of these two weights, the *smaller value* is *always* used and in *most* cases, this is the *runway limit.* Structural weight limitations, of course, must not be exceeded.

NOTE.—Under certain conditions, the Climb Limit Gross Weight at Brake Release will be *less than* the Runway Limit value and thus it becomes the limiting value. Plot the example below which shows this relationship:

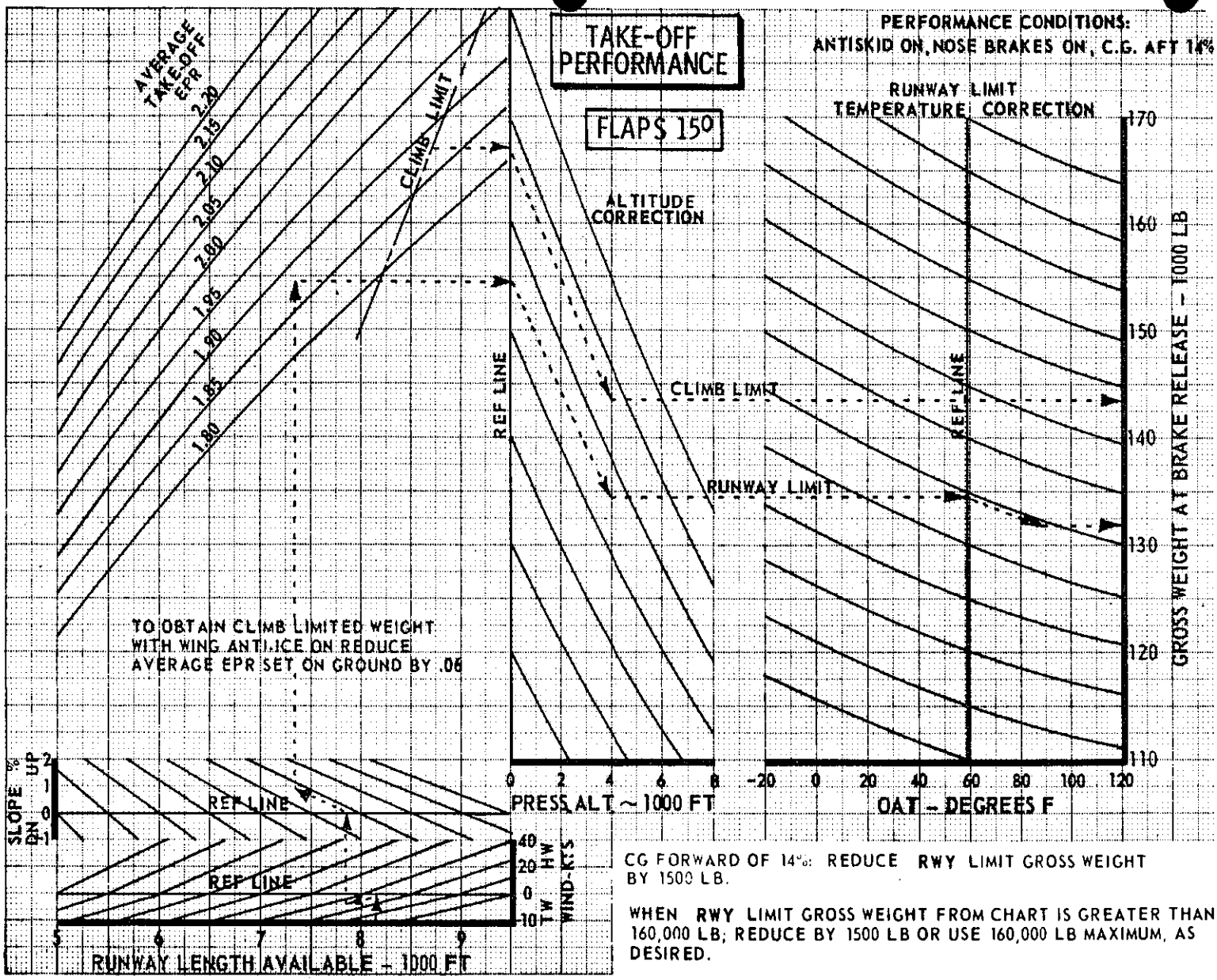
Given:

Runway Length Available	9,250 feet
Wind	Calm
Slope	0
Airport Pressure Altitude	3,000 feet
Outside Air Temperature	+59°F.
Average Takeoff EPR	1.90

Solution:

Runway Limit Gross Weight at Brake Release	156,000 pounds
Climb Limit Gross Weight at Brake Release	153,000 pounds

(The Climb Limit value is the limiting weight in this case.)



CG FORWARD OF 14%: REDUCE RWY LIMIT GROSS WEIGHT BY 1500 LB.

WHEN RWY LIMIT GROSS WEIGHT FROM CHART IS GREATER THAN 160,000 LB; REDUCE BY 1500 LB OR USE 160,000 LB MAXIMUM, AS DESIRED.

FIGURE 16

Figure 17, Flight Planning Indicated .82 Mach

Given:

Trip distance	950 Nautical ground miles
Landing gross weight	124,000 pounds
Cruise pressure altitude	Flight Level 310
Tailwind component	60 Knots
Outside air temperature	−53°C.

From Figure 14, plot ISA deviation (ISA −6°C.)

Start at trip distance line, follow dotted line and arrows to cruise pressure altitude line 31; plot across to find trip fuel (16,200 pounds). Proceed up to the cruise pressure altitude line 31–35 and plot across to find trip time (1 hour, 57 minutes).

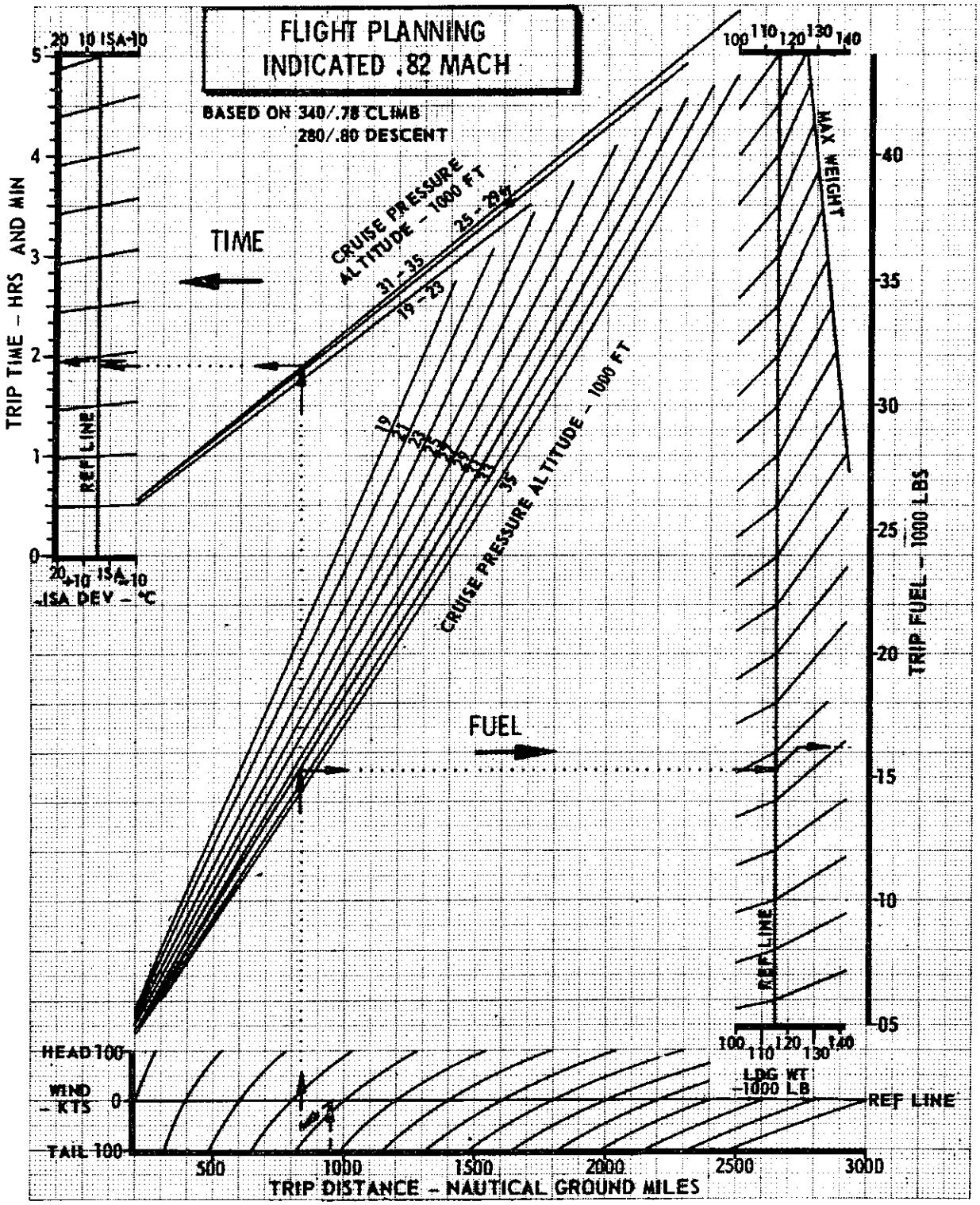

FLIGHT PLANNING
INDICATED .82 MACH
BASED ON 340/.78 CLIMB
280/.80 DESCENT
TRIP TIME – HRS AND MIN
TIME
CRUISE PRESSURE ALTITUDE – 1000 FT
19 – 23
25 – 29
31 – 35
REF LINE
20 10 ISA-10
ISA DEV – °C
FUEL
CRUISE PRESSURE ALTITUDE – 1000 FT
19
23
25
27
29
31
35
MAX WEIGHT
100 110 120 130 140
TRIP FUEL – 1000 LBS
40
35
30
25
20
15
10
05
REF LINE
LDG WT –1000 LB
HEAD 100
WIND – KTS
0
TAIL 100
REF LINE
500
1000
1500
2000
2500
3000
TRIP DISTANCE – NAUTICAL GROUND MILES

FIGURE 17

340/.78 CLIMB

GROSS WT -1000 LB	FIELD ELEVATION			
	S.L. FUEL LB	2000 FT FUEL LB	4000 FT FUEL LB	6000 FT FUEL LB
170	1030	1090	1150	1210
165	970	1020	1080	1140
160	920	980	1030	1090
155	880	930	980	1030
150	840	890	940	990
145	800	840	890	940
140	770	810	850	900
135	740	780	820	870
130	710	750	790	830
125	690	720	760	800
120	660	690	730	770
115	640	670	700	740
110	620	650	680	710
105	600	620	650	680
100	590	610	630	660

TIME AND FUEL FROM BRAKE RELEASE TO CLIMB SPEED

TIME = APPROX 3 MIN

FIGURE 18

PRESS ALT - 1000 FT	TIME-MIN	FUEL-LBS	DIST-NAM
39	20	850	124
37	19	800	112
35	18	700	101
33	17	650	92
31	16	600	86
29	15	600	80
27	14	550	74
25	13	550	68
23	12	500	63
21	11	500	58
19	10	450	52
17	10	450	46
15	9	400	41
10	6	300	26
5	3	150	13

DESCENT PLANNING

.80/280

FIGURE 19

ALL ENGINES 2 AIRBLEEDS 340/.78	ENROUTE CLIMB START CLIMB WT 150,000 LB

PRESS. ALT-FT	CLIMB DATA	DEVIATION FROM ISA - DEGREE(C)								
		-15	-10	-5	-0	5	10	15	20	25
40000	TIME MIN									
	FUEL LBS									
	DIST NAM									
	AVTAS KTS									
39000	TIME MIN	25	31							
	FUEL LBS	5367	6157							
	DIST NAM	177	218							
	AVTAS KTS	423	429							
38000	TIME MIN	21	23	27	33					
	FUEL LBS	4749	5194	5787	6661					
	DIST NAM	145	167	197	243					
	AVTAS KTS	422	427	433	438					
37000	TIME MIN	18	20	23	26	31	39			
	FUEL LBS	4397	4752	5190	5748	6506	7663			
	DIST NAM	128	144	165	193	231	292			
	AVTAS KTS	421	426	431	437	442	448			
36000	TIME MIN	17	18	21	23	27	32	39	52	
	FUEL LBS	4145	4456	4830	5289	5871	6647	7775	9742	
	DIST NAM	116	130	147	169	197	236	294	401	
	AVTAS KTS	420	425	430	436	441	447	453	459	
35000	TIME MIN	15	17	19	21	24	28	34	42	
	FUEL LBS	3952	4236	4574	4983	5491	6144	7031	8354	
	DIST NAM	107	120	135	154	178	209	253	321	
	AVTAS KTS	420	425	430	435	440	446	451	458	
34000	TIME MIN	14	16	18	20	22	26	30	37	47
	FUEL LBS	3788	4053	4366	4740	5199	5777	6536	7592	9217
	DIST NAM	100	112	125	142	163	190	226	279	362
	AVTAS KTS	419	424	429	434	439	445	450	456	463
33000	TIME MIN	13	15	16	18	21	24	28	33	41
	FUEL LBS	3640	3889	4181	4529	4952	5478	6153	7059	8360
	DIST NAM	94	104	117	132	151	175	207	250	314
	AVTAS KTS	418	423	428	433	438	443	449	455	461
32000	TIME MIN	13	14	15	17	19	22	26	30	37
	FUEL LBS	3503	3739	4014	4340	4734	5220	5834	6639	7754
	DIST NAM	88	98	110	124	141	163	190	228	281
	AVTAS KTS	417	422	426	432	437	442	448	453	460
31000	TIME MIN	12	13	15	16	18	21	24	28	34
	FUEL LBS	3375	3598	3859	4167	4537	4989	5555	6285	7274
	DIST NAM	83	92	103	116	132	152	177	210	256
	AVTAS KTS	415	420	425	430	435	441	446	452	458
30000	TIME MIN	11	12	14	15	17	19	22	26	31
	FUEL LBS	3253	3466	3713	4005	4354	4778	5304	5976	6873
	DIST NAM	79	87	97	109	124	142	165	195	236
	AVTAS KTS	414	419	424	429	434	439	444	450	456
29000	TIME MIN	11	12	13	14	16	18	21	24	29
	FUEL LBS	3137	3340	3576	3853	4184	4583	5075	5700	6527
	DIST NAM	74	82	92	103	117	134	155	182	219
	AVTAS KTS	413	417	422	427	432	437	443	448	454
28000	TIME MIN	10	11	12	14	15	17	20	23	27
	FUEL LBS	3025	3219	3444	3708	4021	4397	4858	5441	6207
	DIST NAM	70	78	87	97	110	126	145	170	203
	AVTAS KTS	411	416	420	425	430	435	441	446	452

FIGURE 20

IND. MACH .82 CRUISE
PLANNING
ALL ENGINES 2 AIRBLEEDS

30,000 FT

ISA=-44.4 DEG C

GROSS WT	OAT-DEG C	-60	-55	-50	-45	-40	-35	-30	-25	-20
165000 LB	MACH/TAS TOTAL FF	.820/464 9219	.820/469 9351	.820/474 9483	.820/480 9615	.820/485 9744	.813/486 9711			
160000 LB	MACH/TAS TOTAL FF	.820/464 9012	.820/469 9141	.820/474 9270	.820/480 9399	.820/485 9528	.820/490 9654			
155000 LB	MACH/TAS TOTAL FF	.820/464 8820	.820/469 8946	.820/474 9072	.820/480 9198	.820/485 9324	.820/490 9447	.811/490 9375		
150000 LB	MACH/TAS TOTAL FF	.820/464 8631	.820/469 8757	.820/474 8880	.820/480 9003	.820/485 9126	.820/490 9246	.820/495 9369		
145000 LB	MACH/TAS TOTAL FF	.820/464 8457	.820/469 8580	.820/474 8700	.820/480 8823	.820/485 8943	.820/490 9060	.820/495 9180	.807/492 9012	
140000 LB	MACH/TAS TOTAL FF	.820/464 8295	.820/469 8415	.820/474 8535	.820/480 8652	.820/485 8769	.820/490 8886	.820/495 9003	.816/498 9042	
135000 LB	MACH/TAS TOTAL FF	.820/464 8139	.820/469 8256	.820/474 8373	.820/480 8487	.820/485 8604	.820/490 8718	.820/495 8832	.820/500 8946	.800/493 8640
130000 LB	MACH/TAS TOTAL FF	.820/464 7992	.820/469 8106	.820/474 8220	.820/480 8334	.820/485 8448	.820/490 8562	.820/495 8673	.820/500 8787	.810/499 8670
125000 LB	MACH/TAS TOTAL FF	.820/464 7845	.820/469 7959	.820/474 8070	.820/480 8184	.820/485 8295	.820/490 8406	.820/495 8517	.820/500 8625	.818/504 8694
120000 LB	MACH/TAS TOTAL FF	.820/464 7713	.820/469 7824	.820/474 7935	.820/480 8043	.820/485 8154	.820/490 8262	.820/495 8370	.820/500 8478	.820/505 8586
115000 LB	MACH/TAS TOTAL FF	.820/464 7581	.820/469 7689	.820/474 7800	.820/480 7908	.820/485 8016	.820/490 8121	.820/495 8229	.820/500 8334	.820/505 8442
110000 LB	MACH/TAS TOTAL FF	.820/464 7467	.820/469 7575	.820/474 7680	.820/480 7788	.820/485 7893	.820/490 7998	.820/495 8103	.820/500 8208	.820/505 8313
105000 LB	MACH/TAS TOTAL FF	.820/464 7356	.820/469 7461	.820/474 7566	.820/480 7671	.820/485 7776	.820/490 7881	.820/495 7983	.820/500 8088	.820/505 8190
100000 LB	MACH/TAS TOTAL FF	.820/464 7251	.820/469 7356	.820/474 7458	.820/480 7563	.820/485 7665	.820/490 7767	.820/495 7869	.820/500 7971	.820/505 8073

FIGURE 21

FLIGHT TIME ANALYSIS

CHECK POINTS		ROUTE CRUISE ALT./FLT. LEVEL	TRUE COURSE	AIRSPEED-KTS.		WINDS ALOFT DIRECTION VELOCITY TEMPERATURE	DRIFT CORR ANGLE	GROUND SPEED	DISTANCE N.M.	TIME		FUEL CONSUMPTION LBS./GALS.		MISC.
FROM	TO			EAS OR MACH NO.	TAS					LEG	TOTAL	LEG	TOTAL	
DEN	TOC*	↗			195	+20 kts.				0:22				
TOC	HCT	190	079°			2440/-20								
HCT	OMA	190	080°			2440/-20								
OMA	MSP	190	023°			2447/-20								
MSP	AIRPORT	↘	---	---	---	-----	---	---	---	0:20		600		
*TOP-OF-CLIMB														

ALTERNATE DATA

FUEL SUMMARY

	TIME	LBS./GALS.
ENROUTE		
ALTERNATE		
RESERVE		
EXTRA		
TOTAL		

NOTE:

(1) This form is provided to assist applicants in the orderly arrangement of flight planning data used in written examinations.
(2) The use of all or any part of this form is optional.
(3) Return this sheet to the monitor upon completing the exmination.

FIGURE 22

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