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AC 143-1

Ground Instructor Examination Guide

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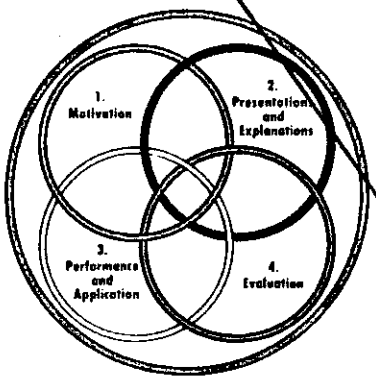
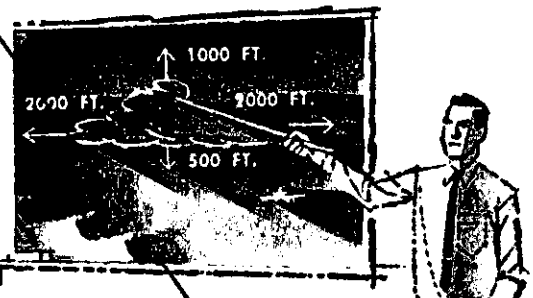
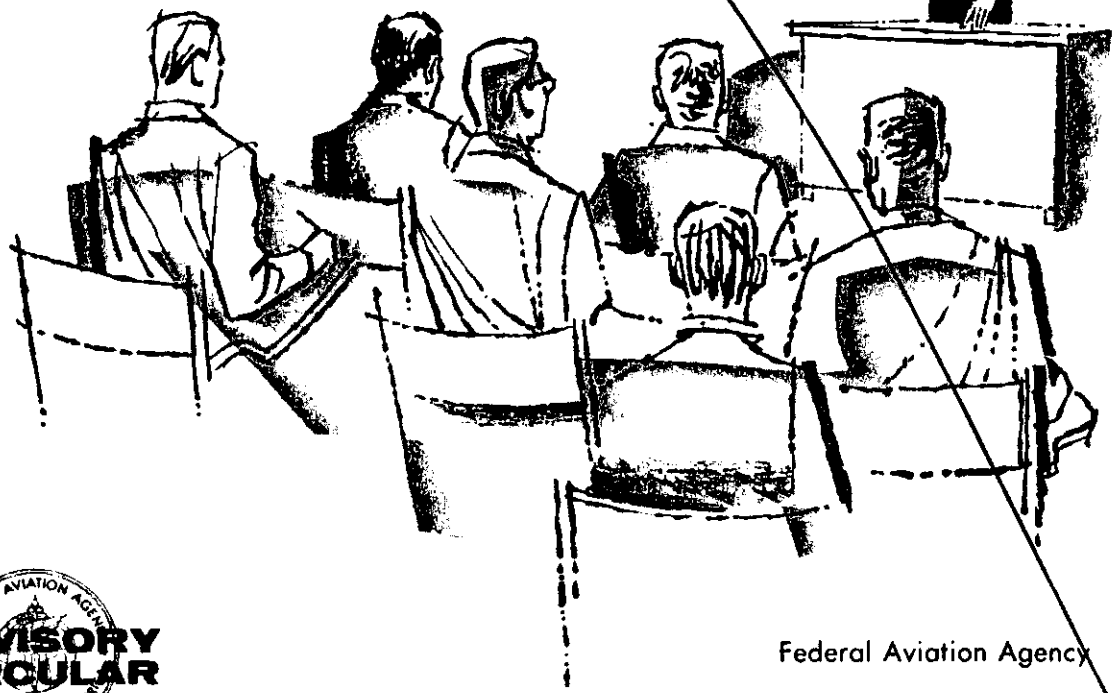
Basic-Advanced







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Federal Aviation Agency

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FEDERAL AVIATION AGENCY
N. E. Halaby, Administrator

FLIGHT STANDARDS SERVICE

Ground Instructor Examination Guide

Basic-Advanced

1963

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CONTENTS

GROUND INSTRUCTOR EXAMINATION GUIDE BASIC–ADVANCED

Introduction

This study guide was prepared by the Flight Standards Service of the Federal Aviation Agency to assist applicants who are preparing for the Basic or Advanced Ground Instructor Written Examination. It is not offered as a quick and easy way to gain the knowledge necessary for passing the written examination. Knowledge and understanding are seldom gained quickly or easily. This is particularly true in the diversified field of aviation ground instruction. There can be no substitute for diligent study to attain basic knowledge, unremitting effort to develop competence, and continuous review to remain current in the many areas where technological change is the rule rather than the exception.

The purpose of this guide is to provide guidance for the serious student by outlining the scope of knowledge required. Thus, the student is better able to intelligently direct his study plan.

Nature of the Examination

Much of the information and knowledge required of the instructor in aviation ground subjects is essentially the same today as it was many years ago, yet there has been a gradual and definite change in some areas. Technological advancements and refinements in today's aircraft, plus the increased use made of their capabilities by the general flying public, have outmoded the practice of testing for memory alone. Of course, basic knowledge is still necessary but it must be related to the operationally realistic situation. An aircraft's primary commercial use is to provide safe, speedy, and efficient transportation and all civilian training, flight or ground, is directed toward this end. For this reason, knowledge must be related to skill, and skill is inextricably interwoven with knowledge. Therefore, written examinations today require the ability to use basic knowledge in practical situations as well as in answering questions based on theoretical problems.

For this reason, this examination guide will deal with questions that test for knowledge alone as well as questions that test for the ability to apply and use this knowledge in a realistic environment. Some of the questions will deal with specific subjects (navigation, radio navigation, meteorology, Federal Aviation Regulations, aircraft and powerplants) and test for basic knowledge and grasp of theory in regard to fundamentals of instructing. Other questions will require the ability to combine and synthesize knowledge in two or more of the specific subject areas.

The FAA Written Examinations your students will take are of similar format and nature with regard to requiring competence at practical application of theory and knowledge. Knowing this should enable you to organize course material and direct classroom efforts to the end that your students will be well prepared for their examinations.

Ground Instructor Certificate Requirements

A new system of ground instructor ratings has been established by the Federal Aviation Agency. The new ratings will in no way affect the validity of previously issued ratings, which may be retained or exchanged for the new type ratings, as their holders desire.

The new ratings are designed to simplify ground instructor qualification or rating procedures by providing basic ratings appropriate to the pilot ground schools in which ground instructors serve. The new ratings are:

Ground Instructor—Basic——Qualifies the holder to instruct in a basic pilot ground school.

Ground Instructor — Advanced——Qualifies the holder to instruct in a basic or advanced pilot ground school.

Ground Instructor—Instrument——Qualifies the holder for ground instruction in an instrument flying school, and for the operation of synthetic instrument flight trainers.

Presently valid ground instructor certificates and ratings will continue to remain in effect; however, they may be exchanged for the new combined type ratings in accordance with the following:

1. For the issuance of a *Basic Ground Instructor* rating—
   Aircraft
   Aircraft Engines
   Civil Air Regulations
   Navigation
   Meteorology
2. For the issuance of an *Advanced Ground Instructor* rating—
   Aircraft
   Aircraft Engines
   Civil Air Regulations
   Navigation
   Meteorology
   Radio Navigation
3. For the issuance of an *Instrument Ground Instructor* rating—
   Civil Air Regulations
   Link Trainer Operator
   Navigation
   Meteorology
   Radio Navigation

Old-type ground instructor ratings in excess of those used to qualify by exchange for new type ratings may be retained on the ground instructor's certificate.

Type of Examination Questions

The examination questions are of the objective, multiple-choice type as illustrated by questions in the sample examination. Each question can be answered on a special answer sheet with a pencil mark. These special answer sheets are then graded electrically by a machine which is virtually infallible. However, to preclude the possibility of an applicant's receiving a failing grade because of a mistake in machine grading, all tests machine-scored as below passing are hand-graded by trained personnel.

Taking the Examination

The equipment that the applicant will need for taking the examination includes a protractor or plotter and a computer. It is also desirable to have a pair of dividers. The applicant is allowed the following number of hours to complete the Ground Instructor Examination:

A. Basic ---------- 5 hours
B. Advanced ---------- 6 hours
C. Fundamentals of Instructing- 2 hours

(It is not necessary to take this on the same day as the Basic or Advanced Examinations.)

While it may be possible to complete in less time, it would be unwise to plan on this. If it becomes necessary to hurry in order to finish the exam, it will only increase the probability of mistakes.

Always bear in mind the following facts when you are taking the examination:

1. The questions are not trick questions. Each statement means exactly what it says. Do not look for hidden meanings. The statement does not concern exceptions to the rule; it refers to the general rule.

2. Always read the statement or question first—before you look at the answers listed below it. Be sure you read the entire question carefully. Avoid "skimming" and hasty assumptions. This can lead to a completely erroneous approach to the problem or failure to consider vital words.

3. Only *one* of the alternate answers given is completely correct. Other answers may be correct as far as they go, but are not complete or are answers based on erroneous assumptions, misconceptions, or incorrect procedures and interpretations. *Understand* the question or statement. *Then work out your* answer before choosing from the list of alternate answers the response which you consider to be the best.

4. Do not spend too much time on a question which you cannot solve or on one where you have considerable doubt as to the correct answer. By so doing you deprive yourself of

the opportunity to mark all those questions which you can promptly solve or answer. You may always go back to the questions you skipped after you are through with all those which you can readily answer. Many times you could have answered 5 or 10 questions during the time you work with one that is difficult. The procedure which will enable you to make maximum use of time available can well mean the difference between a passing and failing score.

5. In working problems which require computations or use of the plotter and computer, select the answer which is closest to the result you get. Due to slight differences in individual computers and many small errors you may make in measuring distances, true courses, etc., it is possible that you will not get an exact agreement every time. However, sufficient spread is provided between right and wrong answers so that the selection of the answer closest to your solution will be the right choice, *providing* you have used correct technique and reasonable care in making your computations.

6. Throughout this study guide, reference will be made to both Federal Aviation Regulations (FARs), and Civil Air Regulations (CARs). Federal Aviation Regulations is the classification which applies to all those Regulations that have undergone recodification in accordance with the straight subject matter arrangement adopted for this program. Since this program is not complete (recodification is expected to be completed by late 1963) the familiar term of Civil Air Regulations (CARs) will still apply to some Regulations.

NOTE: When the test is constructed, the correct answers are "double-checked" by several types of computers. Any of the several types of computers which are commonly used throughout the country should prove satisfactory.

RECOMMENDED STUDY MATERIALS

Aeronautical Charts

World Aeronautical Charts. (25 cents each)

Sectional Aeronautical Charts. (25 cents each)

**Enroute Low Altitude Radio Navigation Charts.* (25 cents each). This particular chart is not used on the Ground Instructor —Basic or Advanced Examination, but instructor applicants and certificated instructors should be familiar with its format and use.

Flight Information

Airman's Guide. (Annual subscription $7.00 domestic; $10.50 foreign). The AIRMAN'S GUIDE is published every 2 weeks. Every issue contains Radar-Radio Listings, NOTAMS, and Special Notices. Once every quarter the Directory of Airports and Seaplane Bases is included as a separate supplement. The annual subscription covers 26 bi-weekly issues, however, single copies may be purchased. Since the issue prices vary, information should be requested from the Superintendent of Documents as to price and availability of individual issues. All pilots and instructors should be familiar with the contents of both the *Airman's Guide* and *Flight Information Manual.*

Flight Information Manual. (Subscription $1.50 domestic; $2.00 foreign). This publication supplements the *Airman's Guide* and contains the relatively permanent information essential to the pilot with regard to air traffic control procedures (*VFR* and *IFR*), emergency procedures, radar, search and rescue, air navigation radio aids, good operating practices, *D/F* data, *DME, VOR,* weather broadcast service, and many other vital matters. Subscription consists of the basic looseleaf manual and amendments for a six-month period.

General Information

Rules of Flight. September 1962. (55 cents). This is an excellent publication covering basic information on requirements for pilot certification, rules of the air, air traffic control, aircraft registration, airworthiness, maintenance, and inspection. It also tells where more detailed information about each of these subjects may be found.

Handbooks and Technical Manuals

Aircraft Powerplant Handbook. Technical Manual No. 107. January 1949. ($1.50). This text is intended for students, mechanics, pilots, and instructors with limited experience and knowledge relative to aircraft powerplant fundamentals. You will not need to study this text in detail, but it will prove useful in the study of selected subjects covered in the examination.

Flight Instructors' Handbook. Technical Manual No. 105. January 1956. ($1.50). This textbook is composed of two parts, "Fundamentals of Teaching" and "Training Curriculum and Flight Instruction Procedures." While it is designed primarily for flight instructors, the first part offers much useful material on good instruction techniques and the learning process which will be of much help in preparing for the "Fundamentals of Instructing" section of the Ground Instructor's Written Examination.

Pilots Radio Handbook. 1962. (75 cents). This useful manual explains in simple language the proper use of radio for communication and navigation. It offers worthwhile information relative to DME, terminal omnirange, radar, and standard air-to-ground communication equipment. It explains correct air traffic control procedures, weather reporting, and U.S. Common System of Air Navigation.

Navigation and Weather

**Instrument Flying.* AF Manual 51-37. November 15, 1960. ($2.25). This U.S.

Air Force Manual contains many sections quite useful to the ground instructor with regard to proven and effective basic instrument flying and radio navigation techniques.

Practical Air Navigation. 8th Edition, 1960. ($4.00). This is the revised commercial edition of CAA Bulletin No. 24. It provides a very comprehensive coverage of all subjects and areas dealing with navigation whether it be pilotage, dead reckoning, or radio and celestial navigation. Any student who understands the material available in this highly recommended text will have no serious trouble with the navigation problems on his examination. This text may be obtained from many book dealers or from the publisher, Weems System of Navigation, Inc., 229 Prince George Street, Annapolis, Maryland.

Weather Services for Pilots. 1962. (10 cents). This publication should do much to explain the weather services available through U.S. Weather Bureau stations and FAA Flight Service Stations. It explains in considerable detail weather reports and forecasts available and useful to pilots.

* *All-Weather Flight Manual.* NAVWEPS 00-80T-60. 1957. ($3.50). Revised 1961 pages ($1.75). This text was originally written specifically for naval aviation but civilian airmen will find much of it applicable to their needs. It is a very comprehensive text, and in addition to its usefulness in specific areas, it is an excellent general reference text for instrument flying and advanced pilot training.

Regulations

The Civil Air Regulations and their related material are gradually being replaced by new Federal Aviation Regulations. This changeover is to be completed in late 1963. In the meantime, the Civil Air Regulations and their related Civil Aeronautics Manuals will remain in effect until superseded by new Federal Aviation Regulations.

Federal Aviation Regulations

Part 1—Definitions and Abbreviations. May 15, 1962. (25 cents). This lists abbreviations and definitions to be used with the new Federal Aviation Regulations.

Part 61—Certification: Pilots and Flight Instructors. November 1, 1962. (30 cents). The applicant is responsible for the items in the Part which pertain to competency in all those areas which fall within the scope of knowledge required for his certification as a ground instructor.

Part 71—Designation of Federal Airways, Controlled Airspace and Reporting Points. December 12, 1962. (20 cents). The applicant will be directly concerned with this new Part of the Federal Aviation Regulations dealing with airspace.

Part 91—General Operating and Flight Rules. September 30, 1963. (30 cents). It is imperative that the applicant be thoroughly familiar with the material contained in this Part, except those which pertain to Instrument Flight Rules.

Part 141—Pilot Schools. September 17, 1962. (25 cents). Although this Part of the Federal Aviation Regulations deals similarly with pilot schools, it includes the regulations pertaining to ground schools with which the applicant should be familiar. General knowledge of various aspects of pilot school requirements will be of considerable value to the applicant.

Part 143—Ground Instructors. September 17, 1962. (15 cents). This short Part to the Regulations prescribes the requirements for issuing ground instructor certificates and associated ratings, and the general operating rules for the holders of those certificates and ratings.

Civil Aeronautics Manuals

* *Civil Aeronautics Manual 3—Airplane Airworthiness, Normal, Utility, and Acrobatic Categories.* December 15, 1959. ($1.50 domestic; $2.00 foreign). While it is not likely that the ground instructor will need to know in detail information available in the CAM, it is an excellent reference publication and will prove useful as a source of detailed information regarding aircraft specifications, operations, and performance on which the applicant may be tested.

Civil Aeronautics Manual 43—General Operation Rules. September 1959. ($1.25 domestic; $2.75 foreign). The applicant

should be familiar with all the information contained in this manual. It is essential to all pilot training.
(This manual will be superseded by FAR Part 91 effective September 30, 1963.)

Civil Aeronautics Manual 60—Air Traffic Rules. May 15, 1961. ($1.50 domestic; $2.00 foreign). It is imperative that the applicant be thoroughly familiar with all the provisions of this manual, except those which pertain to Instrument Flight Rules. (This manual will be superseded by FAR Part 91 effective September 30, 1963.)

Civil Aeronautics Board

Safety Investigation Regulations, Part 320. April 1, 1963. (5 cents). This publication deals with procedures required in dealing with accidents and lost or overdue aircraft in the United States, its territories, and possessions.

Training Aids

• *Commercial Pilot Examination Guide.* 1962. (65 cents). This guide outlines in rather complete detail the scope and depth of knowledge required of the commercial pilot applicant. It also includes Exam-O-Grams 1, 3, 8, 9, 10, 11, 12, and 13.

How to Instruct. AF Manual 50–9. November 1952. ($2.00). Although written primarily for the Air Force instructor, this manual covers basic teaching techniques to properly encourage the learning processes that will prove helpful to any instructor. It will be of great value both as a text and a manual for self study. It provides the basic knowledge in teaching principles requisite to preparing for the "Fundamentals of Instructing" section of the Ground Instructor Written Examination.

Advance Notice of New and Revised Publications

The following publications are either out of print at the Superintendent of Documents pending revision or reprinting, or are being printed. For information concerning their prices and availability you may apply to FAA, Publishing and Graphics Division, Attn: HQ–440, Washington, D.C. 20553

They are listed here because they are available from various sources other than the Superintendent of Documents.

Personal Aircraft Inspection Manual. Technical Manual *No. 101.* November 1950. (75 cents). This manual is a nontechnical book on light aircraft maintenance and inspection. It is out of print and is currently being revised as the *Personal Aircraft Inspection Handbook.*

Pilot Instruction Manual. Technical Manual No. 106. July 1958. ($1.50). This text is divided into three parts. Part one is of particular interest to the ground instructor since it deals with basic flight information. Load factor principles, stalls, weight and balance, and related aerodynamic aspects of flight are presented here as well as principles of safe flight. The other two parts of the book are primarily a reference text for flight students but it can provide much valuable information for the ground instructor.

This manual is out of print and will be replaced by the *Private Pilot's Handbook of Aeronautical Knowledge.*

Pilots' Weather Handbook. Technical Manual No. 104. Revised 1955. ($1.50) This is a comparatively nontechnical approach to the study of weather and the weather information processing system of the Federal Government. It is necessary the ground instructor be thoroughly conversant with its contents.

This manual is out of print and is currently being revised by FAA in conjunction with the Weather Bureau.

Private Pilot's Handbook of Aeronautical Knowledge. ($2.50). This text of basic aeronautical knowledge was designed to meet the needs of the private pilot. However, it should be most useful as a basic text for reference and review on most aviation fundamentals.

Terrain Flying. July 1960. (40 cents). This contains a very useful compilation of practical observations with warnings and advice gleaned from the long years of experience of veteran pilots in various sections of the North American continent. It is an invaluable handbook for the pilot venturing into geographical areas which,

to him, present new and possible unusual flying conditions.

This publication is being reprinted and should be available in the near future.

* Indicates texts or material more specifically suited to the applicant for the Ground Instructor-Advanced Certificate. However, they will prove useful to the applicant for the Ground Instructor-Basic Certificate as well.

How to Obtain Study Materials

All study material, except charts and *Practical Air Navigation* may be obtained by remitting check or money order to:

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

Charts may be procured at most local airports, or by remitting check or money order to:

Coast and Geodetic Survey
U.S. Department of Commerce
Washington, D.C. 20230

In many instances the above materials may be obtained at airports or from book stores which carry them in stock.

In addition, there are many other excellent commercially prepared textbooks, audio-visual training aids, and other instruction materials which may be helpful in preparation for the examination.

STUDY OUTLINE FOR THE GROUND INSTRUCTOR WRITTEN EXAMINATION

The study outline which follows is the framework for basic aeronautical knowledge that the prospective ground instructor must know; *every question* on the FAA examination can be *directly* related to one or more of the topics contained in this outline. This subject matter is predicated on both theoretical questions in specific areas and on operationally realistic airman activity, and encompasses the knowledge requirements specified in Federal Aviation Regulations.

Section I— Fundamentals of Instructing

I. The Ground Instructor — Desirable Qualities.
   A. Good attitude toward teaching.
      1. Desire to do a competent job.
      2. Ability to develop and improve.
      3. Sincerity, enthusiasm, and patience.

II. The Pattern for Instruction—How to Guide the Learning Process.
   A. *Understand* the factors, conditions, and principles which guide the learning process.
      1. Establish clear objectives.
      2. Provide for student participation.
      3. Develop understanding and insight.
      4. Develop ability to think and reason through use of known facts.
      5. Use of motivation, presentation, trial performance and evaluation.

III. Planning—Vital to Teaching Success.
   A. Diagnose present student ability and ability desired upon completion of course.
   B. Arrange teaching sequence to "make sense".
      1. Proceed from the known to the unknown.
      2. Proceed from the easy to the difficult.
      3. Plan so student will see necessity and logic of each succeeding step.
      4. Use a lesson plan—know its advantages.

IV. Presentation—Procedure to Follow.
   A. Plan.
      1. Student-instructor relations—establish an atmosphere of cooperation.
      2. Direct and explain.
      3. Discuss.
         a. Get *all* students to participate.
         b. Keep discussion moving toward goal.
         c. Emphasize important points.
         d. Keep explanation short, clear, and to the point.
      4. Question technique—its use and importance.
      5. Use analogies as a link between known and unknown.
      6. Use instructional aids.

V. Performance, Practice, and Application.
   A. Steps to follow.
      1. Start with the easy and work toward the difficult.
      2. Make performance realistic.
      3. Guide students' efforts.
      4. Get each student to participate.
      5. Relate performance to previous explanations and directions.
      6. Provide adequate practice but guard against blind "trial and error".
      7. Evaluate student progress.

VI. Motivation—Basic to All Learning.
- A. Reward—use and limitations.
- B. Immediate and long-range goals and their relative usefulness.
- C. Arousing interest.
  1. Use of student's background.
  2. Use of your own experience and background.
  3. Use of anecdotes and stories.
- D. Conditions detrimental to good motivation.
  1. Self-consciousness.
  2. Antagonism.
  3. Impatience.
  4. Worry.
  5. Physical discomfort.
  6. Boredom.

VII. Teaching Methods and Techniques.
- A. Telling — sometimes called the "lecture" method.
  1. Does not permit student participation.
  2. Can be combined with other methods to make it more effective.
- B. Discussions—techniques of.
  1. Develop cooperative spirit.
  2. Clarify problems.
  3. Encourage participation.
  4. Avoid dominating discussion.
  5. Summarize frequently.
- C. Demonstrations or showing.
  1. Must be combined with telling.
  2. Advantages.
     a. Makes explanations concrete.
     b. Aids student understanding.
     c. Saves learning time.
     d. Effective with large groups.
     e. Gives students over-all perspective.
     f. Appeals to several senses.
     g. Has dramatic appeal.
- D. Performing or Doing—Essential to the Learning Process.
  1. Techniques.
     a. Plan the performance.
     b. Prepare the student for performance.
     c. Guide the performance.
     d. Give individual attention.
     e. Evaluate the performance.
     f. Have the student evaluate the performance.
     g. Practice the performance.
     h. Supervised study—a form of performance.
        (1) Survey—student must get a picture of the problems.
        (2) Assign reading material.
        (3) Student must practice self-questioning.
        (4) Recite.
        (5) Review — necessary to develop and firmly fix learning and improve weakness revealed by recitations.
        (6) Critique — an analysis of performance.
- E. Test Administration Procedures—Preceding, During, and After Student Participation.
  1. Preceding.
     a. Be on time.
     b. Check tests for errors.
     c. Give clear instructions.
     d. Create relaxed atmosphere.
  2. During.
     a. Avoid distractions.
     b. Limit student discussions.
     c. Be alert to student need for permissible assistance.
  3. After.
     a. Review.
     b. Permit constructive student criticism—written and oral.
- F. Evaluation—The measure of Success of the Teaching Program.
  1. What to test.
     a. Understanding.
     b. Actual performance—ability to apply knowledge to realistic problems is the only positive assurances of mastery of subject.
  2. Characteristics of Good Evaluation Devices.
     a. Validity—does it measure what it is supposed to measure?
     b. Reliability—are the results consistent?

c. Objectivity—limit personal judgments.
d. Differentiate — test must measure small but significant differences in achievement.
e. Comprehensive — provide adequate sampling.

3. Types of tests.
a. Multiple-choice.
b. Matching.
c. True-False.
d. Completion.
e. Essay.

G. Instructional Aids — Choose the Aid that Fits the Learning Situation.

1. Usual types of aids.
a. Films, strips, slides.
b. Training graphics — diagrams, charts, pictures, etc.
c. The blackboard.
d. Training devices — mock-ups, schematics, operational, sectionalized, and exploded.
e. Training literature.
f. Field trips.

2. Caution in the use of instructional aids.
a. Contribute little u n l e s s they develop student understanding.
b. Don't expect them to do your teaching.

VIII. Student-Instructor Relationship.

A. Establish receptive, cooperative working relationship.

1. Be natural, enthusiastic, and helpful.
2. Realize you are dealing with men, not machines.
3. Be a guide, not a driver.
4. Treat students as adults—do not talk down to them.
5. Be fair, firm, and friendly.

B. Additional suggestions for establishing atmosphere conducive to learning.

1. Show no partiality or favoritism.
2. Never try to bluff.
3. Never harshly criticize in front of others.
4. Acknowledge your own mistakes.
5. Act decisively.
6. Keep student headed toward his objective.
7. Be interested in your pupils as individuals.
8. Be courteous.
9. Recognize and reward excellence.
10. Encourage class participation.
11. Encourage initiative and self-reliance.

Section 2—Aeronautical Knowledge

I. Preflight—Activities Relating to the Proposed Cross-Country Flight.

During the preflight portion of the examination you will be required to perform most of the following activities which are directly related to the proposed cross-country flight:

A. Lay out the proposed route on the aeronautical chart provided with the examination.

1. Follow the instructions given in the examination and draw the course lines for the proposed route. Time can be saved in locating turning points, destination airports, and radio aids, by utilizing the geographic coordinates which are provided in the excerpts from the *Airman's Guide.*
2. Determine the true courses with a protractor and measure distances, *using the mileage scale at the bottom of the chart.* For accurate measurement, use the center of the airport symbols—not the edge.
3. Study the area along your proposed route and note the locations of the following:
a. *Prominent* checkpoints.
b. Radio aids to navigation (VOR, nondirectional radio

beacons, and L/MF range stations). Be certain to check this data against current information in the *Airman's Guide.*

c. High terrain (particular attention should be made to note the elevations—heights above sea level—of the higher ridges and peaks along the routes that traverse rough or mountainous country).

d. Obstructions (note the elevations of high obstructions enroute and in the vicinity of destination landing fields).

e. Control areas, control zones, and airport traffic areas.

f. Prohibited, restricted, caution, and warning areas.

B. Check the weather. Consult your local Weather Bureau Airport Station, or an FAA Flight Service Station for flight weather briefings. Be able to read and interpret the following data:

1. Surface weather map. (Identify fronts, air masses, and read station model data, using the key furnished in the examination.)
2. Area forecasts.
3. Terminal forecasts.
4. Winds-aloft forecasts.
5. SIGMETS (significant meteorological developments) and Advisories for Light Aircraft.
6. Hourly Sequence Reports.

C. Review data in two important flight planning publications—the *Airman's Guide* and the *Flight Information Manual.* Be familiar with and able to use the information contained in each of these publications.

1. For example, you will normally refer to the *Airman's Guide* for information concerning—

a. Communication frequencies (control towers—approach control, primary traffic control, ground control; Flight Service Stations; VHF/DF Stations).

b. Navigation aid frequencies (VOR Stations, nondirectional radio beacons, and L/MF Range Stations).

c. NOTAMS (Notices to Airmen).

d. Special Notices (lists of Military Climb Corridors and Oil Burner Routes, good operating practices, and other helpful information).

e. Airport data (location, runway information, availability of fuel and service, availability of UNICOM and weather reporting facilities, etc.).

2. Review pertinent information in the *Flight Information Manual.* Some of the many subjects contained in this publication include:

a. ATC Visual Flight Rule procedures.

b. Airport Traffic Control procedures.

c. Light Gun Signals.

d. Radio - telephone phraseology and techniques.

e. Complete list of VOR receiver checkpoints.

f. VHF/DF Direction-finding data and procedures.

g. U.S. Aircraft Emergency procedures, search and rescue procedures, emergency SCATER rules (Security Control of Air Traffic and Electro-Magnetic Radiations).

h. U.S. Weather Bureau telephone numbers.

i. FAA Flight Standards District Offices' telephone numbers.

D. Check your aircraft equipment and records, and your personal qualifications to see that regulations have been met.
   1. Check to see that your aircraft—
      a. Has the required documents aboard.
      b. Has had the necessary inspections within the required time.
      c. Is properly equipped for flight (including operations at night and operations in and out of airports on which United States Government-operated control towers are located).
   2. Check your pilot qualifications to ascertain that—
      a. You have the proper pilot and medical certificates.
      b. You have complied with recency of experience requirements for carrying passengers (day and night).

E. Select your cruising altitudes, taking into consideration—
   1. Regulations with regard to the hemispherical rule (semi-circular rule).
   2. Enroute terrain and obstruction elevations.
   3. VFR cloud separation requirements.
   4. Winds aloft.
   5. Restricted areas such as Military Climb Corridors. (For additional information concerning ing prohibited, restricted, caution, and warning areas, see reverse side of your chart.)

F. Review your *Airplane Flight Manual* and *Owner's Handbook.*
   1. Understand the difference between normal and utility category.
   2. Consult the weight and balance data and determine that the aircraft is properly loaded. Know how to compute empty weight, useful load, gross weight, and moments.
   3. Check on the grade and quantity of fuel and oil required.
   4. Review flight load factor limitations and airspeed limitations.
   5. Check your performance charts as required for—
      a. Takeoff data (*Airplane Flight Manual* or *Owner's Handbook* charts or Koch Chart).
      b. Climb data.
      c. Landing distance data.
      d. Cruise performance data (cruise power settings, approximate true airspeeds, fuel consumption rate).
      e. Airspeed calibration table.
      f. Stall speed vs. angle of bank table.

G. Compute navigation data for the flight based on selected cruising altitudes, cruise performance data from the *Airplane Flight Manual* or *Owner's Handbook,* and the appropriate winds aloft.
   1. Convert the forecast winds aloft which are given in knots to miles per hour (also convert, when required, temperatures given in Centigrade to Fahrenheit or vice versa). Interpolate for winds (and temperatures) at intermediate altitudes.
   2. Compute true headings and convert to magnetic headings by applying the appropriate magnetic variation corrections. Convert magnetic headings to compass headings by applying correction for deviation.
   3. Compute estimated groundspeeds and estimated times enroute.
   4. Compute estimated fuel required for flight based on estimated times enroute and the aircraft cruise performance charts.

5. Compute normal range and maximum range based on Cruise Performance Charts. Compute range with reserve allowance.
6. Make a thorough visual inspection. During this inspection, drain a generous amount of fuel from your fuel supply (fuel strainer and wing tank sump drains), and inspect for evidence of water contamination. If ice, snow, or frost is on the aircraft, remove completely.

H. Follow the recommended procedures in filing your VFR flight plan. Understand how to use Flight Following Service.

NOTE: Except for knowledge and interpretation of instruments in relation to *attitude control* of the airplane, the Basic and Advanced Ground Instructor Written Examinations will deal only with flight under VFR conditions.

II. Preflight—Basic Aeronautical Knowledge Indirectly Related to the Proposed Cross-Country Flight.

During the preflight portion of the examination, you will be questioned on additional aeronautical subjects. Some of these subjects may not directly relate to the proposed cross-country flight, but they are germane to the various airman certificates and ratings. These subject areas include:

A. Weather. As a ground instructor, you should demonstrate a broad understanding of weather. You should be familiar with—
1. Basic concepts of the earth's atmosphere and the composition of air.
2. Types of clouds and associated weather phenomena.
3. General circulation patterns (winds).
4. Air masses.
5. Low and high pressure centers.
6. Frontal weather (weather conditions generally associated with cold fronts, warm fronts, occluded fronts, etc.).
7. Thunderstorms.
8. Ice and turbulence.
9. Fog and other visibility obscurations.
10. Meteorological terminology (definitions).

B. Navigation. You should understand the following:
1. The earth and its coordinates of latitude and longitude.
2. Chart projections used for air navigation (with emphasis on the properties of the Lambert Conformal Conic Projection).
3. Map reading.
4. Dead reckoning.
   a. Wind triangle (vector) problems.
      (1) Determine true course and groundspeed.
      (2) Determine true heading and groundspeed.
      (3) Determine wind direction and velocity.
      (4) Determine true heading and true airspeed.
      (5) Off-course corrections.
   b. True course to compass heading.
   c. Compass heading to true course.
      (1) Application of wind, variation, and deviation corrections.
   d. Speed — time — distance problems.
   e. Knots—m.p.h. conversions.
   f. Nautical—statute conversions for both speed and distance.
   g. Rates of climb and descent computations.
   h. Airspeed and altitude corrections.
   i. Centigrade — Fahrenheit conversions.
   j. Estimated time of arrival (ETA), estimated time enroute (ETE), and arrival scheduling.

k. Cruise control.
l. Use of flight log (preflight and in-flight).

5. Radio navigation as it pertains to VFR flight. (See item E.)
6. Navigation terminology (definitions).
7. The vital relationship between weather phenomena and problems of navigation.

C. Aerodynamics and Principles of Flight. You should demonstrate a knowledge of—
1. Forces acting on an aircraft.
2. Principles of basic maneuvers.
3. Aircraft performance and factors affecting performance (with emphasis on the effect of density altitude on aircraft performance).
4. Static and dynamic stability (longitudinal and lateral).
5. V_y and V_x speeds.
6. Terminology and definitions.

D. Airframe and Powerplant. You should have a working knowledge of—
1. Aircraft structures.
2. Airframe components and control surfaces.
3. Fuel and fuel systems.
4. Oil and oil systems.
5. Electrical system fundamentals.
6. Reciprocating engine principles and components.
7. Carburetion and fuel injection.
8. Ignition.
9. Propellers.
10. Engine instruments.
11. Engine controls (throttle, propeller, mixture, carburetor heat, cowl flaps, etc.).
12. Relationship between r.p.m. and manifold pressure.
13. Brake mean effective pressure (BMEP), and its significance.

E. Radio Equipment. You should understand the basic characteristics, operations, frequency ranges, advantages, and limitations of—
1. VHF Communications Equipment. Understand the "line of sight" range of transmissions. Understand that an operative transmitter and receiver are all that are required to use VHF Direction Finding Service and radar assistance from ground stations. (In some instances, assistance may be available even when all radios are out if proper procedures are followed.)
2. VOR Equipment.
a. Understand principle of VOR operation. Be able to recognize a usable signal.
b. Know the components of your VOR receiver and the importance of proper tuning.
c. Understand that a radial is a line of magnetic bearing extending *from* a VOR.
d. Understand how to utilize receiver checkpoints to establish receiver accuracy.
e. Be able to work a VOR orientation. Understand how to determine your approximate position relative to the station by interpreting the setting of the omnibearing selector, the position of the LEFT-RIGHT needle, and the indication of the TO-FROM indicator. Understand the importance of correct "sensing".
f. Know and understand the procedures for VOR off-course navigation and for solving time and distance problems.

* 3. L/MF Range and ADF.
a. By referring to your chart, be able to determine the magnetic direction of the

* Applicable primarily to Ground Instructor-Advanced Examination.

four legs of low frequency ranges and the relative position of the "A" and "N" quadrants.

b. Know how range legs are numbered, why average quadrant bisectors are used, and how they are obtained.

c. Know the types of markers used with the L/MF range and their functions.

d. Understand nondirectional beacons—their use, classification and range.

e. Understand how to interpret bearing information when using your ADF for tracking inbound and outbound and for track interception.

(1) Relative Bearings.

(2) Magnetic Bearings.

(3) True Bearings.

F. Flight Instruments. You should understand the basic principles of operation and characteristics of all flight instruments.

1. Understand the basic similarity between visual and instrument flying with regard to control of aircraft attitude.

2. Be able to interpret the pitch-and-bank attitude of your aircraft by reference to the flight instruments.

3. Understand the bowl-type magnetic compass.

a. Know the method of making turns by referring to the magnetic compass to determine the lead point at which to begin rolling out.

b. Understand the following errors of bowl magnetic compass:

(1) Deviation.

(2) Oscillation error.

(3) Magnetic dip error. Dip error is responsible for:

(*a*) *Northerly turn error* which is most pronounced on northerly and southerly headings; and

(*b*) *Acceleration error* which is most pronounced on easterly and westerly headings.

4. Thoroughly understand the altimeter (sensitive altimeter adjustable for changes in barometric pressure).

a. Know the effect of nonstandard temperature and pressure on the indications of the altimeter.

b. Understand how to apply altimeter settings to the altimeter setting window of the altimeter.

c. Be able to interpret the indications of the altimeter.

d. Know how to determine pressure altitude.

5. The Airspeed Indicator. Know the eight airspeed ranges and limitations that are reflected by the standard marking system on the face of the airspeed indicator (white, green, and yellow arcs, and the red line).

a. Flap operating range.

b. Normal operating range.

c. Caution range.

d. Power-off stalling speed with the wing flaps and the landing gear in the landing position (V_{so}).

e. Power-off stalling speed "clean"——wing flaps up and landing gear retracted (V_{s1}), if equipped with a retractable landing gear.

f. Maximum flap extended speed (V_{fe}).

g. Maximum structural cruising speed (V_{no}).

h. Never-exceed speed (V_{ne}). (See fig. 24 in appendix.)

III. Prestarting Inspections.

A. Exterior Visual Inspection. Understand the importance of—

1. The use of a checklist in establishing good habit patterns.
2. Allowing sufficient time for a thorough and complete walk-around inspection as recommended by the aircraft manufacturer.
3. The emphasis placed on checking for, and adequate drainage of possible fuel contamination.
4. Checking the pitot tube and static pressure orifice.
5. Ice, snow, and frost removal from the aircraft.

IV. Starting, Taxiing, and Engine Runup.

A. Understand the need for—

1. Following a checklist based on manufacturer's recommendations.
2. Familiarity with emergency procedures with regard to engine or induction system fires.
3. Ground control or tower contacts where applicable for taxi clearance.
4. Careful observance of the oil pressure/temperature, and magneto checks; and where applicable, check on fuel pressure, cylinder head temperature, r.p.m., manifold pressure, flaps, trim, and full control travel in the proper direction.
5. Courtesy in control of propeller blast in taxiing and runup where proximity of other aircraft, buildings, and personnel are involved.

V. Takeoff.

A. Use your checklist.

B. Contact tower for takeoff clearance but check traffic carefully yourself. You are still responsible for the safety of your operation.

C. Activate any VFR flight plan by reporting time off to appropriate facility.

D. Be certain you clearly understand tower instructions.

E. Follow tower instructions without deviation except when cleared to do so, or in an emergency.

F. Check density altitude/performance.

G. Use takeoff performance charts. (See figs. 13 and 14 in the appendix.)

VI. In-Flight.

A. Climb to your selected altitude and complete your level-off procedures. Take necessary precautions to ensure accuracy when making readings from the bowl magnetic compass. Reset the gyro-driven heading indicator to the magnetic compass frequently.

B. Comply with CAR 60, *Air Traffic Rules,* at all times. Maintain a constant vigilance for other traffic.

C. Compute estimated true airspeeds and true altitudes. Be forever alert to density altitude, etc.

D. Determine time between checkpoints and compute groundspeed. Compute ETA over various checkpoints and destination. Keep log of time over various points.

E. Use good fuel management procedures. Keep close check on fuel consumption rate. Maintain proper fuel/air mixture setting appropriate to cruising altitude through proper use of mixture control.

F. If the winds-aloft forecast proves inaccurate, or if you drift off your flight-planned course, compute new headings and groundspeeds to destination from your present position.

G. Make periodic VFR position reports to Flight Service Stations. Give PIREPS (Pilot Reports) on unusual weather or erratic operation of radio navigation aids. Request weather information if necessary.

H. Be able to follow L/MF Range Legs and VOR radials.

I. Know how to tune in and identify a radio range or VOR station.

Understand how to utilize an air navigation radio aid, i.e., VOR radial, L/MF range leg, and ADF bearing.

J. Have a working knowledge of the procedures for requesting radar vectors, D/F steers and associated enroute emergency navigation assistance.

K. Monitor appropriate stations for 15 minutes after the hour (area) and 45 minutes after the hour (airway) weather broadcasts. Maintain a continuous listening watch for possible in-flight weather safety advisories (SIGMET or Advisory for Light Aircraft).

L. When operating in the vicinity of a large aircraft, be on the alert for wing-tip vortices (wakes of extreme turbulence behind aircraft). Take recommended action if you inadvertently encounter wing-tip vortices.

M. Avoid bad weather. Do not get trapped over an overcast. When necessary, use the 180° turn, but this device is reliable only when you have not waited too long to make the decision to turn.

N. Avoid turbulent air if possible. If you encounter severe turbulence, slow the aircraft to at least the recommended maneuvering speed.

O. Keep a continuous watch of all engine instruments. Be able to recognize symptoms of carburetor icing. Remember that, on aircraft equipped with constant speed propellers, the initial loss of power will be reflected by manifold pressure, not by loss of r.p.m. due to action of propeller governor.

P. When making in-flight power adjustments, sequence your throttle and propeller controls in the correct order. Remember BMEP tolerances.

Q. Be prepared for in-flight emergencies—equipment failure, loss of orientation, or unexpected weather. Have alternate plans of action.

R. If you cross a Military Climb Corridor, be sure to fly at an altitude appropriate to the segment crossed.

S. If you take off or land at an airport located within an airport traffic area, follow applicable Regulations.

T. Know the official sunset time for the area over which you are flying. Turn your navigational lights on at the required time. Be familiar with airport lighting, runway lighting, and taxiway lighting.

U. Prior to starting your letdown, check to see that fuel selector is on the appropriate tank, and mixture control is in proper position. Take necessary precautions to avoid possible carburetor icing during prolonged letdowns at reduced power settings.

V. When approaching your destination, contact the tower for landing instructions. Be able to interpret instructions. (For example, if you are instructed to land on "RUNWAY 22 RIGHT TRAFFIC", you should understand you are to land on a runway with magnetic direction of 220°, using a right-hand traffic pattern.)

W. Use standard practice when entering traffic. Watch for light gun signals from the tower, in the air, or on the ground if your radio receiver becomes inoperative. Maintain a constant vigilance for other traffic. Be alert for segmented marker system or flashing amber light as indications of nonstandard traffic.

X. Run a complete prelanding check, *using your checklist.*

Y. Understand the purpose and use of the Visual Approach Slope Indicator (VASI).

Z. After landing, switch to the appropriate ground control frequency if applicable (*after* turning off the active runway), and exercise extreme caution while taxiing back to ramp.

VII. Post-Flight Activities.

A. Turn off all switches and secure the controls.

B. Close your flight plan with the appropriate facility if you have not done so.

C. Refuel the aircraft in order to reduce condensation in the tanks and possible water contamination of the fuel.

D. If applicable, arrange for hangar space or tie-downs.

E. Understand procedures for notification and reporting of aircraft accidents and overdue aircraft as specified in CAB Safety Investigation Regulation Part 320.

F. Record your flight time. (Not mandatory except to verify recent experience or to substantiate claim to experience necessary for grade of certificate or rating sought.)

THE SAMPLE EXAMINATION

The following test items are included for one purpose—to familiarize you with the type of questions you may expect to find on FAA examinations. Keep in mind that these few sample items do not include all of the topics on which you will be tested in the FAA examination. For this reason you should concentrate on the section entitled "Study Outline for the Ground Instructor Written Examination." A KNOWLEDGE OF ALL THE TOPICS MENTIONED IN THIS OUTLINE—NOT JUST THE MASTERY OF THE SAMPLE TEST ITEMS—SHOULD BE USED AS THE CRITERION FOR DETERMINING THAT YOU ARE PROPERLY PREPARED TO TAKE THE FAA WRITTEN EXAMINATION.

The appendix of this booklet contains the supplementary materials which will be required from time to time during the sample examination. These materials include weather information, aircraft description and performance data, the flight planning data (excerpted information from the *Airman's Guide*), diagrams, charts, and illustrations.

This examination is divided into two sections. The first section tests for basic knowledge in *Fundamentals of Instructing*. It is necessary that an applicant for a Ground Instructor certificate pass a written examination dealing with the conditions, techniques, and principles which control the learning process. This examination is separate from, and in addition to, the written examination on subjects which pertain to the rating he seeks (Basic, Advanced or Instrument). The applicant may, if he chooses to do so, take this written examination on the same day that he takes the examination on the subjects covered by the rating sought. However, he may take it on another date before taking the written examination on subjects pertaining to the rating sought. Regardless of his choice as to when he takes this examination, *both* sections must be passed by an applicant. It is *not* necessary, however, to take the examination on *Fundamentals of Instructing* for each additional rating sought. For example, if an applicant for the Basic Ground Instructor rating passes both the section on *Fundamentals of Instructing* and the section pertaining to Navigation, Meteorology, Civil/Federal Aviation Regulations, Aircraft and Engines, it is not necessary for him to again pass the section on *Fundamentals of Instructing* to obtain either the Advanced Ground Instructor rating or the Instrument Ground Instructor rating. He only needs to pass an examination on the subject matter pertaining to the rating he seeks.

The second section of the sample examination is based on an operational realistic cross-country flight where general knowledge must be applied to practical situations. Answers and explanations to the questions which follow may be found on page 31 through page 36.

SAMPLE EXAMINATION

Section I—

Fundamentals of Instructing

1. Test reliability refers to the
   1——characteristic of a test which indicates consistent results for a test over a period of time.
   2——measure of temporary variations influenced by chance errors.
   3——accuracy with which an examination identifies the superior students.
   4——exactness with which a test measures what it is supposed to measure.
2. If an instructor wishes to do an effective job of teaching, the most important requirement is that he master
   1——only teaching methods.
   2——only his subject matter.
   3——both teaching methods and subject matter.
   4——a good speaking voice, posture, and public speaking ability.
3. One of the most significant sources of information for an instructor with regard to the need to develop new and better ways of improving his teaching effectiveness lies in
   1——noting whether a comparison between his methods and those used by successful teachers is favorable or unfavorable.
   2——the observations and suggestions made by supervisors and other instructors.
   3——the observation and evaluation of the difficulties which his students are having.
   4——listening to student's suggestions.
4. Good instruction techniques involve many important elements. Select the answer which includes only those items important to good instruction.
   A. Evaluate the student and recognize his difficulties as an individual.
   B. Instruct each class in exactly the same manner so as to assure a constant level of student proficiency.
   C. Set specific goals.
   D. Avoid setting standards of performance lest failure to meet them prevents progress.
   E. Acquaint the student with his progress only if he seems concerned about the matter.
   F. Keep student informed of his progress.
   G. Allow the student to participate in the class session and demonstrate his ability, but anticipate mistakes, and if possible correct them before they occur.
   H. Use a teaching sequence that "makes sense" from the learner's point of view.
   I. Improve motivation through use of negative incentives.
   J. Use oral questions in the classroom to evaluate progress and level of learning.
   K. Use a lesson plan even if it is inadequate.
   L. Emphasize the lecture method of instruction.
   M. Limit classroom practice as much as possible since it consumes too much time.
   1——A, C, F, H, J, K.
   2——B, D, E, G, I, L, M.
   3——A, D, E, H, L.
   4——C, F, G, H, K.
5. True comprehension and understanding of a subject is the very essence of any learning. The best way to determine if a student really understands a subject is to
   1——accept a high grade average as evidence of such understanding.
   2——give examinations which require high levels of retention in order to make a good grade.

3——ascertain that the student can actually apply his knowledge to all the problems covered in the classroom program.

4——test the student's ability to apply his knowledge toward solving new and difficult situations.

Section 2—Aeronautical Knowledge

This part of the examination is based on a flight from Gallup, New Mexico, to Holbrook, Arizona, to Flagstaff, Arizona, and to Williams, Arizona.

Although this is a hypothetical cross-country, the weather data is authentic. The airplane you are assumed to be flying is a late model, 4-place, single-engine airplane. It is equipped with retractable, tricycle landing gear and a constant speed propeller. It is typical of several models currently being produced by various manufacturers. This airplane is designated as DAEDALIAN DART 2468–W. It is to be flown in accordance with FAA-approved Airplane Flight Manuals and placards that appear in the airplane.

PROPOSED CROSS-COUNTRY FLIGHT DATA

You are a professional pilot employed by an engineering corporation whose home office is in Gallup, New Mexico. You are scheduled for a flight originating in Gallup, New Mexico, and terminating in Williams, Arizona, with intermediate stops at Holbrook, Arizona, and Flagstaff, Arizona.

You will carry three corporation executives who are conducting a business survey. You have established your tentative route on WAC Chart 405 as follows:

LEG I

McKinley County Airport, Gallup, New Mexico, to Holbrook Municipal Airport, Holbrook, Arizona, via direct route.

LEG II

Holbrook Municipal Airport, Holbrook, Arizona, to Flagstaff Municipal Airport, Flagstaff, Arizona, via direct route to Winslow, Arizona, VORTAC; thence direct route to Flagstaff Airport.

LEG III

Flagstaff Municipal Airport, Flagstaff, Arizona, to Williams Municipal Airport, Williams, Arizona via direct route.

The places named can be located by referring to the excerpts from the *Directory of Airports and Seaplane Bases* supplement to the *Airman's Guide* in figures 16a and 16b of the appendix.

Your preflight activities include:

1. Any necessary review of the *Airplane Flight Manual, Operation Placards,* and *Owner's Handbook,* with particular emphasis on operating speeds, power and mixture settings, weight and balance considerations, and emergency procedures.

2. A study of pertinent information in the *Airman's Guide* and *Flight Information Manual.*

3. A review of your map with emphasis on the relationship between your route and airway structure, terrain and obstruction elevations, and all airport facilities available enroute in event of emergency.

4. A review of radio checkpoints and facilities.

5. Thorough check of all available weather information.

6. Filing a flight plan.

7. Preflight check of the airplane.

1. Federal Aviation Regulations require careful preflight planning

1——only on flights that are conducted off-airways.

2——on all cross-country flights.

3——only on flights for hire.

4——only on flights which carry passengers.

2. According to the 0700 Hourly Sequence Report (see fig. 5 in the appendix),

1——PHX reports a ceiling of 12,000 feet.

2——PRC reports a pressure of 906.4 millibars.

3——TUS reports an altimeter setting of 39.83 inches.

4——GNT reports calm surface winds.

3. The 0800 Hourly Sequence Report at Phoenix, Arizona, (see fig. 5) indicates that

1——the ceiling is 10,000 feet.

2——the ceiling is 1,200 feet.
3——the ceiling is 12,000 feet.
4——there is no reported ceiling at Phoenix.

4. You plan to depart at 0830 MST and a study of all the Hourly Sequence Reports in figure 5 permits you to conclude that
1——you have no weather problem with regard to the flight.
2——you can anticipate frontal activity between *0700* MST and *0800* MST.
3——ceilings will decrease along the route.
4——you are unable to ascertain what the weather is likely to do in the next few hours.

5. A study of *all* the weather information *available* to you before you start the flight (see figs. 3, 4, and 5 of the appendix) will allow you to deduce that
1——it is not possible to estimate what the weather is likely to do in the next few hours.
2——turbulence and surface winds are likely to be your principal enroute weather problems.
3——scattered thunderstorms will probably occur along your route before *1200* MST.
4——it would be best to fly as low as terrain and obstruction clearance will permit because of more favorable winds.

6. Your World Aeronautical Chart 405 is based on the Lambert Conformal Conic Projection, a chart projection which is much used for aeronautical charts because
1——scale errors are small, so for all practical purposes, scale may be considered constant over a single sheet.
2——it affords a simple and satisfactory solution for all problems of navigation, both rhumb line and great circle.
3——its directions conform very closely to directions on the earth.
4——all of the above are true.

NOTE: See figure 19 in the appendix for a diagram of this projection.

7. Pressure altitude and indicated altitude are approximately the same at 5,000 feet *above the ground* over Tucson, Arizona. Indicated airspeed is 170 m.p.h. If you use the TUS AW (Winds-Aloft Forecast) given in figure 4 of the appendix, you determine that
1——TAS is approximately 197 m.p.h.
2——TAS is approximately 183 m.p.h.
3——TAS is approximately 190 m.p.h.
4——there is not enough information available to find true airspeed.

NOTE: Assume CAS (Calibrated Airspeed) to be identical to IAS.

8. The statements listed below concerning the 1:00 a.m. EST surface weather map (see fig. 7 of appendix) may or may not be correct.
A. Tropical maritime air is south and east of the front while polar maritime air lies northwest of the front.
B. The front which extends eastward from Salt Lake City is an occluded front.
C. The front which extends eastward from Salt Lake City is a stationary front.
D. The isobar of lowest pressure that can be identified is the 1004.0-millibar line.
E. The isobaric pattern is such that the surface winds over the area pictured should be moderately strong (25 to 30 knots).
F. The surface wind at Winslow, Arizona, is from the north.
G. The surface temperature is 67° F. and dewpoint is 29° F. at Winslow, Arizona.

In selecting all the correct statements from the preceding, you would include items
1——A, B, E, and G.
2——A, C, D, and G.
3——C, D, and G.
4——B, E, and F.

9.
Your weight	165 lbs.
Front seat passenger weight	150 lbs.
Rear seat passenger weight	365 lbs.
Fuel	Full
Oil	Full
Baggage	150 lbs.

Using the above information, together with data from the Aircraft Description in figure 9, and the Repair and Alteration Form in figure 12 of the appendix, you are able to de-

termine through use of the Loading Graph and Center of Gravity Envelope Graph (fig. 11 of the appendix) that

1——your gross weight and balance requirements are both within limits.
2——your weight is in excess of maximum gross limit and until it is within limits it would be a waste of time to attempt to evaluate the center of gravity condition.
3——both weight and balance conditions are outside of established limits.
4——it is not possible to determine if the weight and balance conditions are within limit on the basis of information supplied.

10. If you were to drain 21 gallons of fuel from your tanks, you will

1——be within all placarded limitations.
2——still exceed placarded baggage limitations.
3——still exceed gross weight and balance limitations.
4——still be unable to figure your weight and balance problems because there is not enough information.

Your flight is compartively short with two intermediate stops, so you decide to drain 21 gallons of gas and readjust your load in order to provide for better aircraft performance as well as allow for other important considerations.

11. You plan to remain VFR at all times, and to avoid turbulence as much as possible, you plan to fly more than 3,000 feet above the ground enroute. Your enroute altitude

1——would be indeterminable until you compute the magnetic heading.
2——should be odd thousand plus 500 feet from Gallup, New Mexico, to Holbrook, Arizona.
3——should be odd thousand plus 500 feet.
4——should be even thousand plus 500 feet.

12. Concerning Airport Traffic Area Rules as required by Federal Aviation Regulations, which of the following statements apply?

A. An Airport Traffic Area is defined as the space included within a 5-statute-mile horizontal radius of the geographical center of an airport and extending up to (but not including) 2,000 feet above the surface of the airport at which an operative traffic control tower is located.
B. Unless otherwise authorized, two-way radio communications shall be maintained with the FAA-operated control tower while operating within the Airport Traffic Area.
C. Pilots operating under VFR conditions with aircraft having adequate radio equipment shall maintain communications with the appropriate Flight Service Station when within 5-statute miles of an uncontrolled airport on which an FSS is located (provided the aircraft is being operated to or from this airport and it is listed in the "Air Navigation Radio Aids" section of the *Airman's Guide*).
D. The basic VFR minimums when operating in an Airport Advisory Service Area is 5 miles visibility and 1,500-foot ceiling.
E. Unless he receives subsequent instructions to the contrary, a pilot who has been authorized by the tower to taxi "TO" a designated runway may cross any runways that intersect or cross his taxi route.

1——A, B, C, E.
2——A, B, C, D, E.
3——B, C, E.
4——A, B, C, E.

13. Refer to the *Airman's Guide* data in figures 16, 16a, 16b, 16c, 16d, and 16e of the appendix, and determine which of the following statements are *ACCURATE*.

A. The Holbrook Municipal Airport, Holbrook, Arizona, has only one runway.
B. The longest runway at Holbrook Municipal Airport is between 4,070 and 5,069 feet in length.

C. A Flight Service Station is located on the Prescott Municipal Airport, Prescott, Arizona.
D. Neither the Holbrook nor the Flagstaff Airport has UNICOM facilities.
E. Both the Holbrook and the Flagstaff Airports have the proper fuel for your airplane.
F. The usable length of Runway 3–21 at the Flagstaff, Arizona, Municipal Airport is 7,000 feet.

1——A, B, D, E.
2——A, C, E.
3——B, C, E, F.
4——B, D.

14. Of the airports where you intend to land along your route of flight, only the Winslow Municipal Airport, Winslow, Arizona, is within a control zone. If you were to land here, your basic VFR minimums would

1——be the same as for the other airports where you intend to land.
2——require 5 miles visibility and a ceiling of 1,500 feet.
3——require 3 miles visibility and a ceiling of 1,200 feet.
4——require 3 miles visibility and a ceiling of at least 1,000 feet.

LEG 1

15. If you were to select 10,500 feet MSL as your cruising altitude on the first leg of your flight, and at that indicated altitude found your pressure altitude to be 10,000 feet, your approximate compass heading and true airspeed should be

1——230° and 180 m.p.h.
2——229° and 173 m.p.h.
3——251° and 173 m.p.h.
4——251° and 179 m.p.h.

NOTE: Use an indicated airspeed of 150 m.p.h., outside air temperature of 10° C and the Winslow Winds Aloft Forecast (fig. 4). You need not interpolate the winds. (See fig. 10 for compass correction card.)

16. Assuming a gross weight of 2,900 lbs., together with a surface temperature of 73° F. and an estimated surface wind of 13 knots, your approximate takeoff distance to clear a 50-foot obstacle at Gallup, New Mexico, is

1——1,955 feet.
2——1,638 feet.
3——1,817 feet.
4——1,390 feet.

NOTE: Refer to the performance charts (fig. 14 of the appendix).

17. After your takeoff from Gallup, New Mexico, at 0830 MST, you notice as you climb out on course that you are passing through 8,800 feet. Which of the altimeter illustrations in figure 20 of the appendix indicates this altitude?

1——A.
2——B.
3——C.
4——D.

18. Assume that you have 33 gallons of usable fuel remaining after you reach 10,500 feet. Approximately how long can you fly with a power setting of 2200 r.p.m. and 19 inches of manifold pressure if you retain a 30-minute fuel reserve?

1——2 hours and 52 minutes.
2——5 hours and 6 minutes.
3——3 hours and 21 minutes.
4——None of the above are correct.

NOTE: Refer to the 10,000-ft. Cruise Performance Chart in the appendix, figure 15.

* 19. While enroute to Holbrook, Arizona, you use ADF to tune in and properly identify the Winslow, Arizona, low frequency navigation aid. The proper setting for the function switch when warming up and tuning the ADF is

1——loop position.
2——antenna position.
3——compass position.
4——aural null position.

NOTE: See figure 21 for a picture of an ADF (radio compass).

* 20. You are able to read the coded identifier for the Winslow L/MF facility satisfactorily, but repeated trials prove that there are neither "A" nor "N" quadrant signals, nor on-course signals. After a careful check of your equipment, the map and the "Air Navigation Radio Aids" section of the *Airman's Guide* (figs. 16d and 16e of the appendix), you decide

1——the L/MF ground facility is not functioning properly.

2——you have lost your sensing antenna.
3——your function switch was on the aural null position.
4——the Winslow L/MF navigation aid is no longer an L/MF radio range station.

LEG II

21. If you select 10,500 feet as your cruising altitude on the flight from Holbrook, Arizona, to Flagstaff, Arizona, and use an estimated indicated airspeed of 170 m.p.h., an outside ai rtemperature of +15° C. and the Winslow Winds-Aloft Forecast (fig. 4 in the appendix), you compute your estimated average groundspeed for this leg to be approximately
1——187 m.p.h.
2——175 m.p.h.
3——150 m.p.h.
4——None of the above.

NOTE: You need not interpolate winds. Assume pressure altitude and indicated altitude to be the same.

22. Assume that on this leg of the flight, conditions are favorable for carburetor icing. To properly cope with this condition, you should know that
A. in your airplane, the first evidence of carburetor icing would be a decrease in r.p.m., followed by engine roughness.
B. the first indication of carburetor icing is engine roughness, followed by loss of engine r.p.m.
C. in your airplane the first evidence of carburetor icing would most likely be a decrease in manifold pressure.
D. it is best to use carburetor heat as a preventive measure rather than as a measure to cure the icing condition.
E. it is best to wait until there is some evidence of carburetor icing before application of carburetor heat since application of heat when no ice is present will result in a lean mixture and possible detonation.

In selecting correct statements from the above list, you would include items
1——A and D.
2——B and E.
3——C and E.
4——C and D.

23. As you approach the Winslow, Arizona, VORTAC, you note that your course will cause you to cross the path of a four-engine jet. This crossing will be approximately 3 miles behind and slightly below the jet. If you are familiar with hazards involving turbulence in the wake of large aircraft, you would select which of the following as correct statements?
A. The main source of the disturbance or turbulence is the "jet wash" or "prop wash".
B. The main source of the disturbance or turbulence is the vortex created by the wing tips.
C. Large, heavy, slow flying aircraft produce the most violent turbulence or vortices.
D. The violent, compact, tornado-like air masses associated with this phenomena can cause loss of aircraft control or even structural failure.
E. Under the circumstances described, you are too far from the jet to be affected by this invisible hazard.
F. If you encounter this hazard in cruising flight, you should decrease speed as fast as possible, avoid "fighting the controls", and if possible change altitude.
G. If taking off or landing behind large aircraft, fly up-wind of their track, KEEP PLENTY OF DISTANCE, and request delay from the tower on takeoffs and landings if in doubt about wake turbulence or spacing.
H. Helicopters can create conditions of vortex turbulence similar to that produced by fixed-wing aircraft and you should stay above their flight path.
1——B, C, D, F, G, and H.
2——A, D, E, F, and G.

3——A, C, D, E, and G.
4——B, E, F, and H.

24. If, for some reason, you were to lose your visual references while taking evasive action with regard to the jet, and a check of your instruments showed the readings pictured in figure 22 in the appendix, which of the following statements are true? You are in a

A. coordinated, descending turn to the right, and should first reduce power and bank to return to level flight.
B. coordinated, descending turn to the right, and should first add power and increase back pressure to return to level flight.
C. skidding, climbing turn to the left.
D. nose-high attitude.
E. nose-low attitude.
F. 20° bank, approximately.
G. standard rate turn.

1——A, D, F, and G.
2——B, E, F, and G.
3——A, E, F, and G.
4——C and D only.

NOTE: Assume a 2-minute turn needle on the turn-and-bank indicator.

25. Assume that you now find yourself in a coordinated level turn with a 40° bank. Your present gross weight, when in straight and level flight, is 2,800 pounds. Referring to the illustrations in figure 23 in the appendix, which of the following statements are correct?

A. In the situation depicted in illustration A, your approximate effective gross weight is 3,360 pounds.
B. Your rate of turn is the same for situation A, B, and C, but the radius of turn increases as the speed increases.
C. The radius of turn remains constant for situations A, B, and C, but the rate of turn will increase as the speed increases.
D. The radius of turn is less, but the rate of turn is greater in situation A than in either B or C.
E. The load factor increases as the speed increases.

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

26. Soon after leveling off on-course, you encounter moderate turbulence and quickly you check your airspeed indicator which appears in figure 24 of the appendix. If you wished to remain at or below maximum structural cruising speed, you could not exceed

1——252 m.p.h.
2——10 m.p.h. less than red line speed.
3——210 m.p.h.
4——None of the above are correct.

*27. In the vicinity of Winslow, Arizona, you decide to combine ADF navigation and pilotage. You tune in and identify the Winslow low frequency radio aid to navigation. You next place the ADF function switch on COMP. After the ADF needle holds a steady indication, you check your magnetic heading and the ADF readings. Their indications are shown in figure 25 in the appendix. This means you have a

1——magnetic bearing of 45° to the station and that you are southwest of the station.
2——relative bearing of 45°, but your bearing to the station cannot be determined with the information supplied.
3——magnetic bearing of 315° to the station, and that you are southeast of the station.
4——magnetic bearing of 45° to the station and that you are southeast of the station.

NOTE: Assume a nonrotatable azimuth dial on the ADF.

28. You are ready to land on Runway 21 at Flagstaff, Arizona, Municipal Airport, after a total flying time of 1 hour and 5 minutes since leaving Gallup, New Mexico. Fuel consumption has been at the rate of 10 gallons per hour. Surface wind is 20 knots from 210°, and surface temperature is 75° F. You will use 40° of flaps for the landing. Referring to the landing table in figure 14 of the appendix, your landing distance for clearing a 50-foot obstacle is approximately

1——834 feet if the temperature were standard at your altitude.
2——973 feet regardless of the temperature.
3——1,390 feet.
4——645 feet.

NOTE: Interpolate weight to the closest 500 pounds, altitude to the closest 500 feet, and wind to the closest 6 m.p.h. Assume takeoff gross weight was 2,900 pounds.

LEG III

29. It is 1700 MST before your clients are ready to take off for Williams, Arizona. A check of the *latest* area forecast, terminal forecast, and in-flight weather advisories in figures 3, 4, and 5 of the appendix indicates that there should be

1——only scattered clouds at 8,000 feet above the ground, and turbulence should remain about the same as the evening progresses.
2——increasing turbulence and decreasing clouds as the evening progresses.
3——no ceilings below 10,000 feet MSL, and turbulence should gradually decrease.
4——scattered clouds at 8,000 feet, broken clouds 12,000 — 15,000 above ground, and gradually decreasing turbulence.

30. After departing Flagstaff, Arizona, you wish to "dog-leg" your direct route so as to stay away from the Restricted Area (R–2302), 7 miles west of Flagstaff, and yet stay close to the highway and railroad to Williams. You tune in and identify the Winslow VORTAC with the omni bearing selector set on 270°. If you did not know your position and used *only* your omni, which reads as illustrated in figure 26 in the appendix, you would know that you are

1——on the 90° radial and flying toward the station.
2——on the 270° radial and flying away from the station.
3——unable to determine at the moment where you are going, but you are on the 270° radial.
4——unable to determine *anything* about where you are, or where you are going.

31. Assume that in taxiing to the flight line at the Williams Municipal Airport, Williams, Arizona, your nosewheel collapses causing damage in excess of $100.00. If you were unsure about accident reporting procedures, you could find the necessary information in

1——Part 61, Federal Aviation Regulations.
2——Part 67, Federal Aviation Regulations.
3——Civil Aeronautics Manual 43.
4——Civil Aeronautics Board, Safety Investigation Regulations Part 320.

32. Usually the first measure appropriate for control of detonation on takeoff in an aircraft with constant speed propellers is the

1——reduction of manifold pressure.
2——reduction of r.p.m.
3——adjustment of mixture to a leaner setting.
4——application of carburetor heat.

• Indicates questions that are applicable primarily to the Ground Instructor—Advanced Examination.

ANSWERS AND EXPLANATIONS

Section I. Fundamentals of Instructing

1. (1) On page 104 of the Air Force Manual, *How to Instruct,* the topic "Reliability" deals with this question. Alternate #2 is incorrect because it refers only to one of the factors which affect reliability, not the complete evaluation of reliability. Alternate #3 has nothing to do with reliability of a test. Alternate #4 is the definition for validity.

2. (3) On page 4 of the Air Force Manual, *How to Instruct,* the paragraph on specialization answers this question. Alternates #1 and #2 are not complete. Alternate #4, while useful, is not as essential to success in teaching as item #3.

3. (3) This is covered in the first sentence on page 50 of the Air Force Manual, *How to Instruct.* All of the other responses are means of effecting improvement, not clues to determining the need for improvement.

4. (1) The statements made in this question cover a broad range of items; however, the correct response may be found in Technical Manual No. 105, *Flight Instructor's Handbook,* page 4, and in various sections of the Air Force Manual, *How to Instruct.* Response #2 is incorrect because every item included in it is incorrect. Response #3 is incorrect because items D, E, and L are incorrect. Response #4 is incorrect because it includes item G.

5. (4) All the alternate responses will test for rote memory on ability to deal with familiar problems which, in themselves, will not effectively prove that the student *understands* what he knows. This question is discussed in the first paragraph on page 16 of the Air Force Manual, *How to Instruct.*

Section 2. Aeronautical Knowledge

1. (2) CAR 60.11, *Preflight action* states: "Before beginning a flight, the pilot in command of the aircraft shall familiarize himself with all the available information appropriate to the intended operation. Preflight action for flights away from the vicinity of an airport and all IFR flights, shall include a careful study of available current weather reports and forecasts, taking into consideration fuel requirements, an alternate course of action if the flight cannot be completed as planned, and also any known traffic delays of which he has been advised by air traffic control." (CAR 60 is to be recodified as Federal Aviation Regulation Part 91, and is scheduled to be issued in the near future.)

2. (4) The 0700 Sequence Report for GNT shows the letter "C" in the space denoting surface wind which designates a calm wind condition.

3. (4) The reported layer of *thin* broken clouds at 12,000 feet does not constitute a ceiling. (Reference p. 34, *Flight Information Manual* and Part 1 of the new Federal Aviation Regulations.)

4. (4) The study of hourly sequence reports *only* will not furnish sufficient information to make a route forecast of your own. (Reference p. 100, *Pilot's Weather Handbook.*)

5. (2) The terminal forecasts call for surface winds in this area to be 20 to 30 knots. The in-flight advisory calls for light to moderate turbulence below 14,000 feet until at least 1900M. Area forecasts covering the period between 0600 MST and 1800 MST call for light to moderate turbulence with locally severe turbulenec in some areas. The 1245Z Pilot Report Summary supports the Terminal and Area Forecasts and In-Flight Advisory.

6. (4) The first three statements are all true. (Reference p. 1–26, *Practical Air Navigation.*)

7. (1) Using a pressure altitude of 7,630 (5,000 feet plus ground elevation at TUS), and a forecast temperature of +20° C., (you must interpolate the temperature between 5,000 feet and 10,000 feet) your computer should indicate approximately 197 m.p.h. TAS opposite a CAS of 170 m.p.h. Normally

the indicated airspeed should be corrected for instrumental and installation errors to calibrated airspeed. This can be done through the use of an airspeed correction table as shown in figure 30. Remember, calibrated airspeed (CAS) is the same as true indicated airspeed (TIAS).

8. (2) The air mass to the south and east of the front is composed of tropical maritime air as represented by the symbol "MT" located in the Texas Panhandle. The air mass to the northwest of the front is composed of maritime polar air as represented by the symbol "MP" located in Northern California. (Reference p. 40, *Pilot's Weather Handbook.*) The portion of the front extending eastward from Salt Lake City is stationary as indicated by a combination of the warm front and cold front symbols and their placement (opposing) on the frontal line. (Reference p. 92, *Pilot's Weather Handbook.*)

Isobars are lines connecting points of equal pressure. The line curving into Nevada from Cedar, Utah, and back to the front at a point north of Salt Lake City, Utah, represents a pressure of 1004.0 millibars as indicated by the figure "1004." (Reference p. 92, *Pilot's Weather Handbook.*)

The figure "67" at the 10 o'clock position and the figure "29" at the 8 o'clock position on the Winslow station model represent a temperature of 67° F. and a dewpoint of 29° F. respectively. (See the specimen station model in fig. 7.)

9. (2) The empty weight, including unusable fuel, is 1839 lbs. (figs. 9, 11a. and 12). The empty weight moment is 65,900 pound-inches (empty weight X empty C.G.).

LOADING PROBLEM

	Weight in Pounds	*Moment in Thousand Pound-Inches*
Airplane (empty)	1839	65.9
Pilot and Front Seat Passenger	315	11.5
Rear Seat Passengers	365	25.4
Fuel (55 gal. @ 6 lbs. per gal., fig. 9)	330	15.8
Oil (3 gal. @ 7.5 lbs. per gal., fig. 9)	22.5	— .4
Baggage	150	14.1
TOTAL	3021.5	132.3

In this particular instance it is not possible to state with absolute certainty that the airplane is not within safe balance limits even though it exceeds weight limits. The moment of 132.3 does lie within the extended lines on the chart which delineate the forward and rearward C.G. limits. In reality, the question becomes rather academic since you could not legally take off with a gross weight of 3021.5 pounds, regardless of the situation with regard to C.G. Your gross weight is 121.5 pounds in excess of the maximum allowable gross weight; therefore, you must reduce the load to 2900 pounds or less and recompute the center of gravity. (Reference figs. 11 and 11a and chapter I, page 7 of *Pilot Instruction Manual.*)

10. (2) The draining of 21 gallons (126 lbs.) of fuel would reduce the gross weight below the maximum allowable, but the baggage weight still would exceed maximum allowable weight of 125 pounds in the baggage compartment. (Reference fig. 9.)

11. (4) When an aircraft is operated in level cruising flight at 3,000 feet or more above the surface, the cruising altitudes . . . shall be observed:

(a) "Below 29,000 feet. At an altitude appropriate to the magnetic course being flown as follows:

(1) ". . ."

(2) "180° to 359° inclusive, at even thousands plus 500 (4,500; 6,500; etc.)." (Reference CAR 60.32.)

12. (1) Statements A, B, C, and E are correct. (Reference CAR 60.60, *Definitions*, for Statement A; CAR 60.18, *Operation on and in the vicinity of an airport*, for Statements B, C, and E.)

13. (3) Statements B, C, E, and F are accurate. B and E can be verified by referring to the *Directory of Airports* excerpt (figs. 16 and 16a); C can be verified by referring to the "Air Navigation Radio Aids" excerpt (figs. 16d and 16e); and F by referring to the NOTAMS excerpt (fig. 16c).

14. (4) Regulations pertaining to basic VFR minimums state that an aircraft shall not be flown within a control zone beneath the

ceiling if the ceiling is less than 1,000 feet. Neither shall any person operate an aircraft in flight within a control zone when the flight visibility is less than 3 miles. When ground visibility is less than 3 miles no person shall take off or land an aircraft, or enter the traffic pattern of an airport within a control zone. Study CAR 60.30.

15. (1) Given Indicated Airspeed
——150 m.p.h.
Given Pressure Altitude
——10,000 Feet
Given Outside Air Temperature
——+10° C.
Computed True Airspeed
——180 m.p.h.
Plotted True Course
——243°
Figure 4—Wind
——230°/29 m.p.h. (25 knots)
Computed Wind Correction Angle
—— —2°
Computed True Heading
——241°
Chart Magnetic Variation
——14° E.
Computed Magnetic Heading
——227°
Figure 10 (intermediate) compass deviation
——+3°
Computed Compass Heading
——230°

16. (2) The elevation of McKinley County Airport at Gallup, New Mexico, is 6,467 feet. Referring to the takeoff data chart in figure 14, you will note that interpolation between the 5,000-foot and 7,500-foot column will be necessary. Enter the chart at the 2900 lb. gross weight block and read across (right) on the 15 m.p.h. (13 knots) line to:

5,000 ft.—1,200′ to clear 50′ obstacle
7,500 ft.—1,580′ to clear 50′ obstacle
Difference—380′
Interpolate for 6,467 feet—59% of 380′ plus 1,200 feet (in actual practice 60% would probably be more desirable)
6,467 feet—1,424′ to clear 50′ obstacle (*with standard temperature*)
Interpolated standard temperature for 6,467 feet is +36° F. Current temperature of +73° F. will necessitate increasing the takeoff distance by 15% (current temperature is 37° higher than standard).

Final Computed Takeoff Distance at Gallup is *1,638* feet.

17. (2) The altitudes indicated by the four altimeters are as follows:

A. 880 feet.
B. 8,800 feet.
C. 18,800 feet.
D. 7,880 feet.

18. (1) Figure 15 in the appendix shows a fuel consumption of 9.8 gal./hr. at 10,000 feet with a power setting of 2200 r.p.m. and 19 inches of manifold pressure. Subtracting the 30-minute fuel reserve from the total of 33 gallons leaves 28.1 gallons of fuel (33 gallons—4.9 gallons). Burning 28.1 gallons of fuel at the rate of 9.8 gallons per hour would permit 2 hours 52 minutes of flying. Study the charts until you understand their use.

19. (2) Study chapter 7 of *Pilots Radio Handbook*. Part of this chapter deals with terminology associated with the radio compass and deals specifically with tuning of the equipment. It is also discussed in chapter 18 of the *All-Weather Flight Manual*.

20. (4) A careful check of the excerpt from the "Air Navigation Radio Aids" section of the *Airman's Guide* (figure 16e) shows that the Winslow low frequency facility is an SABH class radio. Using figure 16d, we find that this means that it is a L/F nondirectional radio beacon. It is of medium power with continuous automatic transcribed broadcast service and simultaneous homing signal and voice capability. The WAC Chart is not current in the information it provides with regard to this radio navigation aid. This illustrates one of the reasons why some of the information which appears on charts must be cross-checked against appropriate supplemental sources of information. *Use the Airman's Guide* and *Flight Information Manual* in planning and conducting flights. Study chapter 1 of the *Pilots Radio Handbook*, chapter 4 of *Rules of Flight, FAA*, and chapter 4 of *Practical Air Navigation*. Note in particular the last paragraph on page 58.

21. (1) You must first correct indicated airspeed to true airspeed. An indicated airspeed of 170 m.p.h. at 10,500 feet and +15° C. results in a true airspeed of 207 m.p.h. To compute the average groundspeed you could either use an average true course and apply the wind to this or apply the wind to each segment of the leg and average the resulting groundspeeds. It should be noted that technically this procedure is not absolutely accurate since it is 10 miles more from the INW to Flagstaff than from Holbrook Airport to INW VORTAC. However, the difference in groundspeeds over the two segments is negligible; therefore, the time difference would be slight. The INW winds aloft forecast shows the wind at 10,000 feet is from 230° true, at approximately 29 m.p.h. Whether you apply this wind to an average true course of 279° or to the exact true course for each segment and average the resulting groundspeeds, the answer is the same —187 m.p.h.

22. (4) In aircraft with constant speed propellers, loss of power is first reflected in the manifold pressure reading since the propeller governor will maintain the r.p.m. setting made with the propeller control. Engine roughness generally does not develop to a noticeable degree until icing has progressed beyond the point where it could have been recognized by loss of manifold pressure. It is far easier and safer to prevent the formation of carburetor ice than to remove it after it has formed. Study page 21 of *Facts of Flight*, and pages 231 and 269 of the *Aircraft Powerplant Handbook*.

23. (1) This problem is covered in detail in Exam-O-Gram No. 3 and Aviation Safety Release No. 460 (information available at General Aviation District Offices or through the FAA, Washington, D.C. 20553). You should study both of these publications carefully.

24. (3) The quality of a turn (slipping, skidding, coordinated) is indicated by the position of the ball in the turn-and-bank indicator. If the ball is in the center between the two reference markers, the turn is coordinated. The aircraft is in a nose-low attitude since the attitude indicator (artificial horizon) shows the nose below the horizon and the other instruments show a descent. Even if the attitude indicator were malfunctioning, it is scarcely possible to be in other than a nose-low attitude in your airplane with the airspeed, vertical speed, and altimeter indicating as illustrated. The attitude indicator shows a 20° bank to the right (each of the small graduations on the scale at the top of the instrument is for 10°). The turn needle also indicates a turn to the right at a standard rate. Reduce power, decrease bank, and then apply back pressure as necessary to recover when the nose is low and the airspeed is increasing. This is much safer than adding back pressure first which might well increase the load factor beyond safe limits. Study chapter 8 in the *All-Weather Flight Manual* and chapter 8 of *Air Force Manual 51–37*, Nov. 15, 1960.

25. (4) The load factor for a 40° bank is determined by using the graph in figure 30. This graph gives a load factor of approximately 1.2 for a 40° bank. Multiplying 2800 by 1.2 results in an effective gross weight of 3,360 lbs. In order to maintain a given rate of turn, the angle of bank must be varied with the TAS. If, for example, you wish to hold a standard rate turn of 3° per second at a true airspeed of 100 m.p.h., your angle of bank will be 13.5°. The bank required to produce this same rate of turn at 200 m.p.h. TAS is nearly double the bank required at 100 m.p.h. It now becomes 25.6°; therefore, the rate of turn must decrease if the TAS increases while the bank remains constant. It then follows that any given bank at slow speed provides a higher rate of turn and results in a smaller radius of turn than the same degree of bank at higher speeds. Study the last sentence of the first paragraph on page 3–18, and pages 6–11, 6–12, 6–13, and 8–20 of the *All-Weather Flight Manual*.

26. (3) Maximum structural speed (V_{no}) is the maximum speed for normal operation. It is located at the juncture point of the lower limit of the yellow arc (caution), and the upper limit of the green arc (normal operating range) on the face of the airspeed indicator. Study Exam-O-Gram No. 8 and Civil Aeronautics Manual 3, sections 3.664 and 3.738.

27. (3) The magnetic bearing to the station is the magnetic heading ± the relative bearing. 270°, the magnetic heading, plus 45°, the relative bearing, is 315°, the magnetic bearing *to* the station. If the magnetic bearing to the station is 315°, then the magnetic bearing *from* the station is the reciprocal of this, or 135°. A magnetic bearing of 135° from the station places you southeast of the station. Because of meridian convergence and possible difference in variation values between the location of the station and the location of the aircraft, certain errors are inherent to the use of radio bearings. Therefore, the serious student should study carefully chapters 11 and 14 of *Practical Air Navigation* (8th Edition), chapter 18 of the *All-Weather Flight Manual* and that portion of chapter 7 in the *Pilots Radio Handbook* which deal with operation of the radio compass (ADF).

28. (1) Flying for 1 hour 5 minutes burning fuel at the rate of 10 gallons per hour would mean a gross weight reduction of approximately 65 pounds. Interpolating weight to the closest 500 pounds would mean using a weight of 2,900 pounds for the following computation:

(a) A 20-knot headwind equals 23 m.p.h.
(b) 24 m.p.h. means a 40% reduction in landing distance.
(c) Field elevation of Flagstaff is 7,012 feet; thus the closest 1,000-ft. value is 7,000 feet.
(d) Interpolating on the chart, with a gross weight of 2,900 lbs. at 7,000 feet and standard temperature, the landing distance to clear a 50′ obstacle is *1,390* feet.
(e) A 40% reduction of 1,390 feet is 556 feet.
(f) Subtracting 556 feet from 1,390 feet equals 834 feet.
(g) This figure is valid only if the temperature is standard at 7,000 feet.

29. (3) The latest weather information in figures 3 and 4, pertaining to those items mentioned in the question are:

*FA 1845Z
*FT 2245Z
*FL 2320Z

Area forecasts report heights of cloud bases above mean sea level, not the ground, unless stated to the contrary. Cloud bases on terminal forecasts are reported in feet above the ground. A check of the terminal and area forecasts reveals that in both instances clouds are forecast to be above 10,000 feet MSL. The 2320Z Advisory for Light Aircraft indicates that the moderately turbulent conditions existing below 14,000 feet in northern New Mexico and Arizona should decrease to light turbulence by 1900 MST. Study page 106 of the *Pilots' Weather Handbook.*

30. (3) With the information supplied, you cannot fix your location by use of omni alone, but under the circumstances given here you can only determine that you are on the 270° radial. At any given moment, omni alone tells you only where you are and *not* where you are going. Only by relating the course selector value and the TO-FROM indication to the magnetic compass reading can you determine whether you are actually going TO the station or FROM the station on the selected radial or simply crossing that radial. Even after you have determined which radial you are on you can determine your position or "fix" along this radial only by use of geographical landmarks, or an accurate groundspeed estimate, or by a cross-bearing from another station. For a more detailed explanation of omni (VOR) and its use, study chapter 8 of the 1962 edition of the *Pilots Radio Handbook,* chapter 13 of the 8th edition of *Practical Air Navigation,* and chapter 19 of the *All-Weather Flight Manual.*

31. (4) Figure 18 gives an explanation of how to report an accident and refers to the Regulation which pertains to this requirement.

32. (1) Horsepower is a function of both torque and r.p.m. That is, an engine can deliver the same brake horsepower (b.h.p.)

* See figure 2 for meaning of code.

at different combinations of crankshaft r.p.m. and crankshaft torque. The pilot, through adjustment of throttle and r.p.m., exercises control over these factors. One of the basic limitations placed on engine operation is the amount of pressure developed within a cylinder as controlled by combination of torque and r.p.m. values. An increase in these values will increase pressure and pressure will increase power. It will also increase the loads imposed on the engine, and if they are not controlled or kept within limits, it can ultimately result in engine failure. Power is therefore limited by the pressures developed within the cylinders. The most convenient way of estimating cylinder pressure is through the index of Brake Mean Effective Pressure (BMEP).

The limits of operation within which the accepted degree of reliability can be obtained are known as engine ratings. Takeoff power generally approaches the limits of these ratings for an engine. If detonation should occur on takeoff, the throttle should be retarded in order to reduce the cylinder pressure. A reduction of r.p.m. will cause an *increase* in BMEP, and only aggravate the condition. Adjustments of mixture may produce just the opposite of results desired if the cause of the detonation is improperly evaluated. Application of carbuertor heat with full power setting will tend to cause or increase detonation.

Study chapter IV, *Aircraft Powerplant Handbook, Technical Manual 107*. Note particularly pages 29 through 36.

WEATHER INFORMATION

ABQ—Albuquerque, New Mexico
FMN—Farmington, New Mexico
FLG—Flagstaff, Arizona
GNT—Grants, New Mexico
INW—Winslow, Arizona
PHX—Phoenix, Arizona
PRC—Prescott, Arizona
SAF—San Francisco, California
TUS—Tucson, Arizona
ZUN—Zuni, New Mexico

FIGURE 1. *Decoding of station identifiers.*

WEATHER INFORMATION

1. FT1—12-hr. Terminal Forecasts
2. FT2—24-hr. Terminal Forecasts
3. FA —Area Forecasts
4. AW—Winds Aloft Forecasts
5. FL —In-Flight Advisory
   a. SIGMET—Weather significant to safety of all aircraft.
   b. Advisories for light aircraft—Weather potentially hazardous to light, single, and multiengine aircraft.
6. UA —Pilot Report Summary
7. SA —Hourly Sequence Report
8. WW—Severe Weather Forecasts
9. AC —Severe Weather Outlooks

FIGURE 2. *Decoding of aviation weather forecasts and reports.*

WEATHER INFORMATION

Albuquerque Area Forecast

FA ABQ 111245Z
ø6M-18M FRI (0600 MST—1800 MST FRI)
NRN ARIZ NRN NEW MEX
CLDS AND WX. MOSTLY CLR WITH OCNL -⏀ ABV 18ø MSL. SCTD CU DVLPG OVR MTNS BCMG 14ø-15ø⏀ MSL DURG THE AFTN WITH A FEW HIGH LVL SHWRS OVR THE MTNS. SFC WNDS W OF CONTDVD LCLY UP TO ↑25+ BY 11ØØM
ICG. LGT ICGIC. FRZG LVL 135-145
LGT TO MDT TURBC. MDT TURBC TO 15ø DVLPG BY LATE MRNG WITH LCL SVR TURBC VCNTY HIER MTNS AND NEAR SHWRS
OTLK 18M FRI-06M SAT. NO RSTV WX

FA ABQ 111845Z
12M FRI-ØØM SAT (Noon Friday—Midnight Friday)
NRN ARIZ NRN NEW MEX
CLDS AND WX. ERN PLAINS OF NRN NEW MEX 11ø-12ø⏀MSL CLRG AFT 22ØØM. NRN ARIZ AND RMNDR NRN NEW MEX 13ø⏀MSL WITH ABV 15ø◍V⊕MSL BRFLY 12ø◍ MSL IN FEW SHWRS DURG EVE HRS. AFT 21M ABV 15ø◍V⏀ MSL
ICG. NONE. FRZG LVL 12ø-135 MSL
TURBC. MDT FOR LGT ACFT DCRG DURG EVE BCMG LGT AFT 2ØM
OTLK ØØM-12M SAT. CLR OR ABV 15ø⏀ MSL DURG MRNG HRS. AFT 12M SCTD CU BASES 12ø MSL BRFLY BRKN OVR MTNS IN FEW SHWRS

FIGURE 3. *Albuquerque area forecasts.*

Albuquerque Terminal Forecasts

FT1 30 111045Z
ø4M–16M FRI (0400 MST—1600 MST)
INW ○. 12øøM 9ø◑↗25
PRC ○. ↑↗12. 1øøøM 8ø◑+1øø◑↑↗2ø
FLG ○. 1øøøM 7ø◑+1øø◑ ↑↗2ø
FMN ○. 12øøM 9ø◑ ↗2ø
ABQ ○. 13øøM 1øø◑ OCNLY ↗25
FT1 30 112245Z
16M FRI–ø4M SAT (1600 MST FRI—0400 MST SAT)
INW 8ø◑+1øø◑ OCNLY →↗25+. 19øøM+1øø◑
PRC 8ø◑C+12ø◍ ↗2ø+3ø. 19øøM C+15ø◍. 22øøM+15ø–◍
FLG 8ø◑C+12ø◍ ↑↗2ø+. 19øøM C+12ø◍↗25+. 22øøM+1øø–◍
FMN C8ø◍↗2ø OCNLY 7ø◍ BRF RW— — VCNTY. 2øøøM C+1øø◍
ABQ 8ø◑+1øø◑↑↗2ø OCNLY C8ø◍→↗25+3ø. 19øøM+1øø◑
NOTE: FMN (Farmington, New Mexico) is approximately 180 Statute Miles N. E. of Winslow, Arizona.

Winds Aloft Forecasts (AW)
03M—15M (0300 MST—1500 MST)

INW 8–2120 10–2325 15–2730 20–2740
PHX 3–1915 5–1920 10–2030 15–2040 20–2140
TUS 5–2715/25 10–2830/15 15–2940/5 20–3040/–10

Albuquerque In-Flight Weather Advisories

FL ABQ 111345Z
0645M—1045M FRI
ADVY FOR LGT ACFT NR 1. NRN ARIZ AND W OF CONTDVD IN NWN NEW MEX LGT TO LCLY MDT TURBC BLO 80 MSL WITH STNG DOWNDRAFTS OVER LEE SLPS.
FL ABQ 112320Z
1620M–1900M FRI
ADVY FOR LGT ACFT NR 2. NRN ARIZ NRN NEW MEX MDT TURBC BLO 140 MSL DCRG BCMG LGT BY 1900M

FIGURE 4. *Albuquerque forecasts and in-flight weather advisories.*

Albuquerque Pilot Report Summaries

ABQ UA 111245Z
GNT—40 W GNT MDT TURBC 105 BN35. FLG AREA LGT TURBC SFC TO 105 PA23.
50 E PRC LGT MDT TURBC 105 PA24. ZUN—INW MDT TURBC 9500 C 310
ABQ UA 111625Z
ZUN V-62 SAF MDT TURBC 120 C 182
INW—PRC MDT OCNLY SVR TURBC 105 PA22
ZUN–GNT MDT TURBC ICRG 9500 C 172

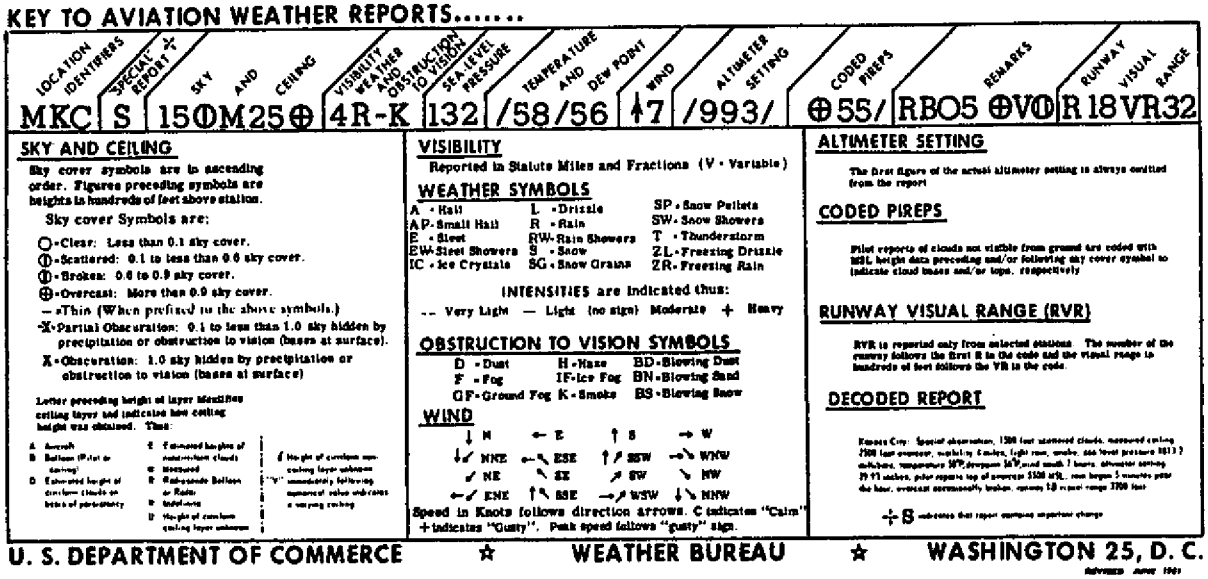
Hourly Sequence Weather Reports
07M

SA33 111400Z
PRC 14ø–⏀20+ 064/60/32 ↑10/985
FLG 12ø–⏀15+ 055/55/18↑12+18/993
INW 1øø⏀6ø 045/55/26↑10/998
ZUN 12ø⏀20+ 070/55/30↗↑5/995
GNT 12ø–⏀35 065/55/31 C/001
PHX 9ø⏀12ø–◍45 075/70/30→4 HK ALQDS
TUS E15ø◍/◍50 060/75/35↑10/983

Hourly Sequence Reports
08M

SA33 111500Z
PRC 18ø⏀45 067/68/31→18/991
FLG 12ø⏀20+ 065/60/30↗↑15/993
INW 1øø⏀6ø+ 047/65/31↑15/989
ZUN 1øø–◍25 065/60/33↗10/999
GNT 12ø⏀/–⏀35 060/65/32↑10+15/000
PHX 1øø⏀12ø–◍35 082/75/33→5 HK ALQDS
TUS E15ø◍U⊕70 075/75/32↗15/985

FIGURE 5. *Albuquerque pilot report summaries and hourly sequence reports.*



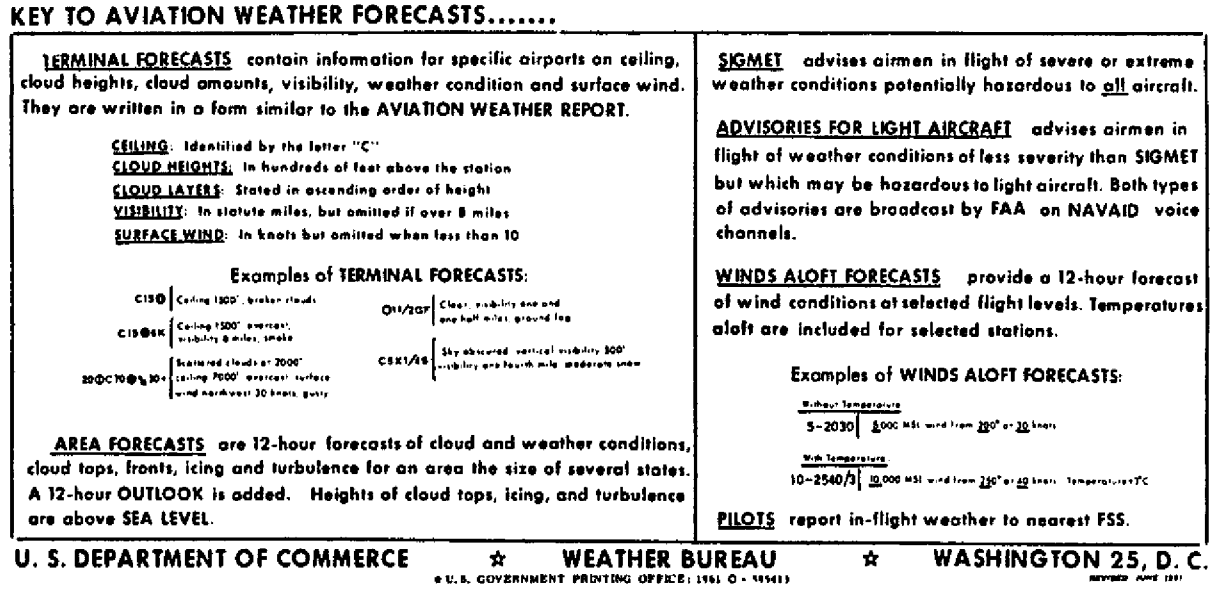


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FIGURE. 6. *Key to aviation weather reports and forecasts.*

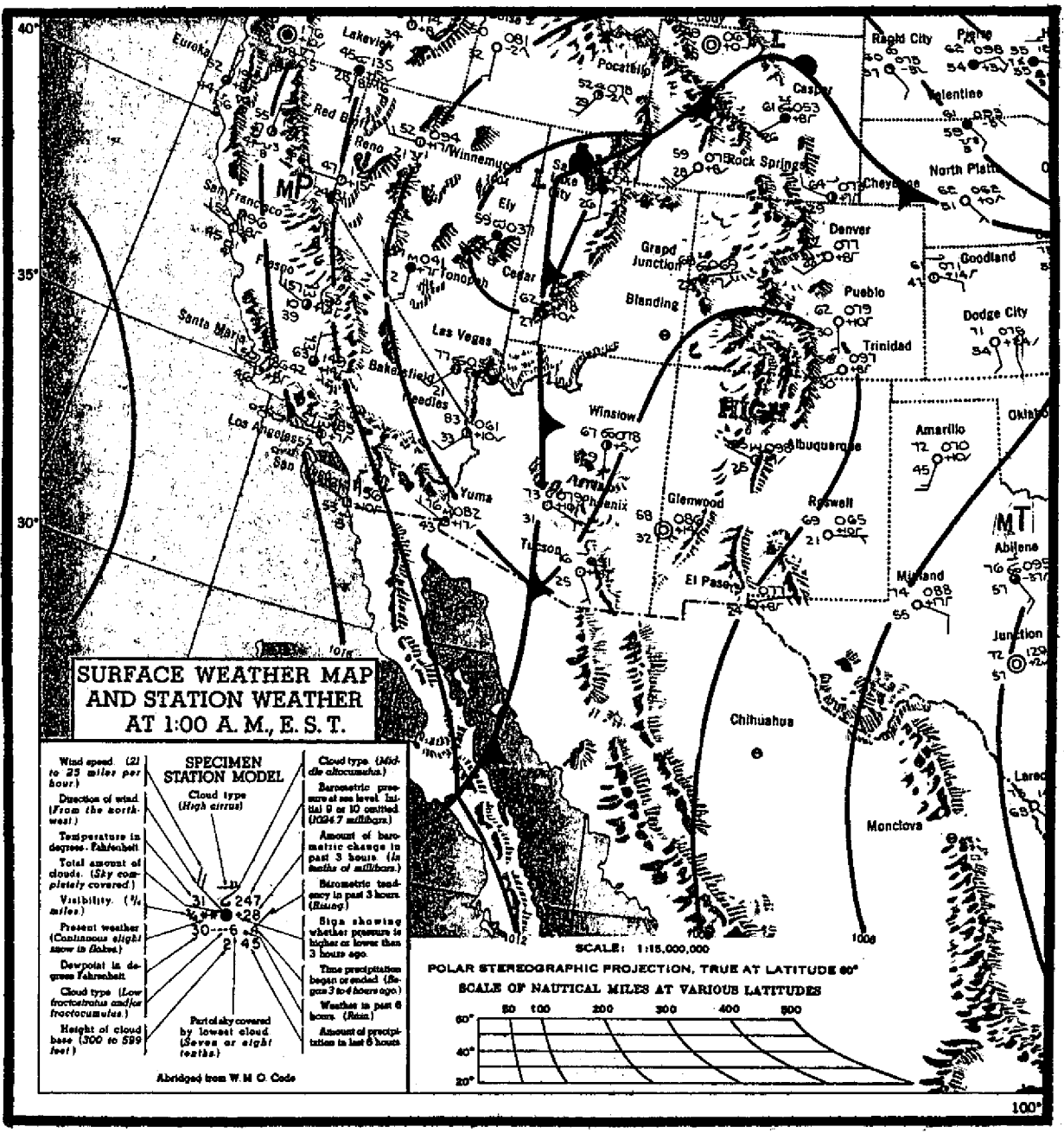


FIGURE 7. *Surface weather map excerpt—1:00 a.m. EST.*

Standard time zone	Letter designator	Meridian (degrees)	To convert to GMT, add (hours)--
Atlantic	. . . . .	60	4
Eastern	E	75	5
Central	C	90	6
Mountain	M	105	7
Pacific	P	120	8
Yukon	Y	135	9
Alaskan	A	150	10
Bering.	B	165	11

FIGURE 8. *Meridians of standard time zones and conversion to Greenwich (Z) time.*

AIRCRAFT DESCRIPTION
PLACARDS IN THE AIRPLANE

THIS AIRPLANE MUST BE OPERATED AS A NORMAL CATEGORY AIRPLANE. NO ACROBATIC MANEUVERS (INCLUDING SPINS) APPROVED

IDENTIFICATION: N 2468W.

MAXIMUM GEAR OPERATING SPEED: 135 mph, CAS.

MANEUVERING SPEED: 130 mph, CAS.

MAXIMUM ALLOWABLE WEIGHT IN BAGGAGE COMPARTMENT: 125 lbs.

The following information is excerpted from the AIRPLANE FLIGHT MANUAL.

ENGINE OPERATION LIMITATION:
Power and Speed 260 bhp at 2625 rpm.

FUEL SYSTEM: The engine is approved for 100/130 fuel only. Fuel is supplied from 2 tanks of 32.5 gallons total capacity each.

Separate electric gauges indicate the quantity in each tank. The gauges read empty when the level is down to 5 gallons since the last 5 gallons in each tank are unusable. The airplane is equipped with an electrically-driven auxiliary fuel pump for standby use in the event the engine-driven pump fails.

OIL: The engine uses a wet-sump, full-pressure oil system. The oil capacity is 12 quarts.

For temperature above 40° F use SAE 50; below 40° F use SAE 30.

PROPELLER: The propeller is a single-acting, hydraulic constant-speed type with two forged aluminum blades, controlled by an engine-driven governor.

HYDRAULIC SYSTEM: The landing gear and flaps are extended and retracted by hydraulic actuators, powered by an engine-driven hydraulic pump and a pressure accumulator.

ENGINE INSTRUMENT MARKINGS:

Oil Pressure Gauge	
Idling	10 psi (red line)
Normal Operating Range	30–60 psi (green arc)
Maximum Pressure	100 psi (red line)
Manifold Pressure Gauge	
Normal Operating Range	15–24 in. Hg (green arc)
Cylinder Head Temperature	
Normal Operating Range	300–460° F (green arc)
Do Not Exceed	460° F (red line)
Tachometer	
Normal Operating Range	2200–2450 rpm (green arc)
Maximum (Engine-rated speed)	2625 rpm (red line)
Fuel Quantity Indicators	
Less than one-quarter tank remaining	red arc to red line
Empty (includes 5 gallons each tank unusable)	E (red line)

EMPTY WEIGHT: 1839 lbs.

MAXIMUM GROSS WEIGHT: 2900 lbs.

FLIGHT LOAD FACTORS:

Flaps Up	+3.8, − 1.52
Flaps Down	+3.5

EMERGENCY PROCEDURES:

Emergency Gear Extension Procedure.

When the landing gear will not extend hydraulically, it may be extended manually as follows:

(1) Place the gear handle in the full down position.

(2) Pull the auxiliary pump handle out its full extension.

(3) Operate the auxiliary pump handle up and down until the green gear-down light comes on.

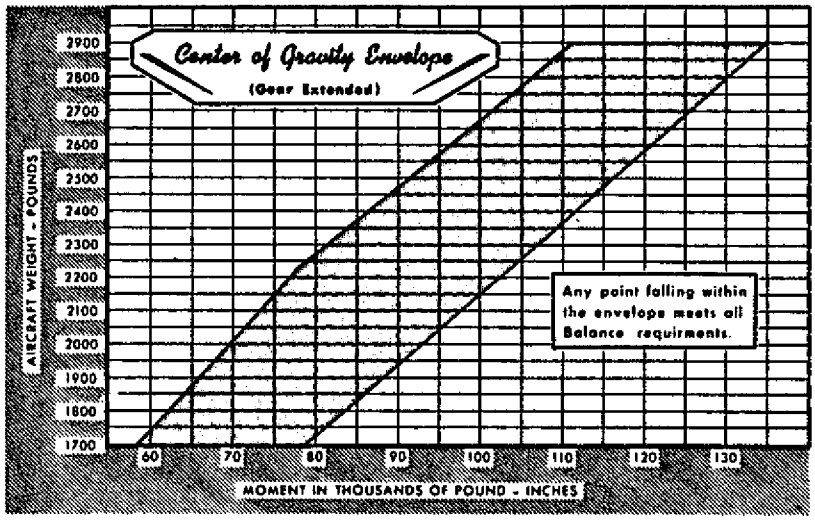
* * * * *

FIGURE 9. *Aircraft description, placards, and excerpts from* Airplane Flight Manual.

1. VHF transmitter ..... 118.1 mc to 126.8 mc.
2. VHF receiver with OMNI ..... 108.1 mc to 126.8 mc.
3. ADF receiver ..... 200 kc to 1750 kc.

COMPASS CORRECTION CARD												
FOR(MH)	0	30	60	90	120	150	180	210	240	270	300	330
STEER(CH)	0	28	56	88	120	151	183	216	240	268	296	328

FIGURE 10. *Radio equipment and compass correction card.*



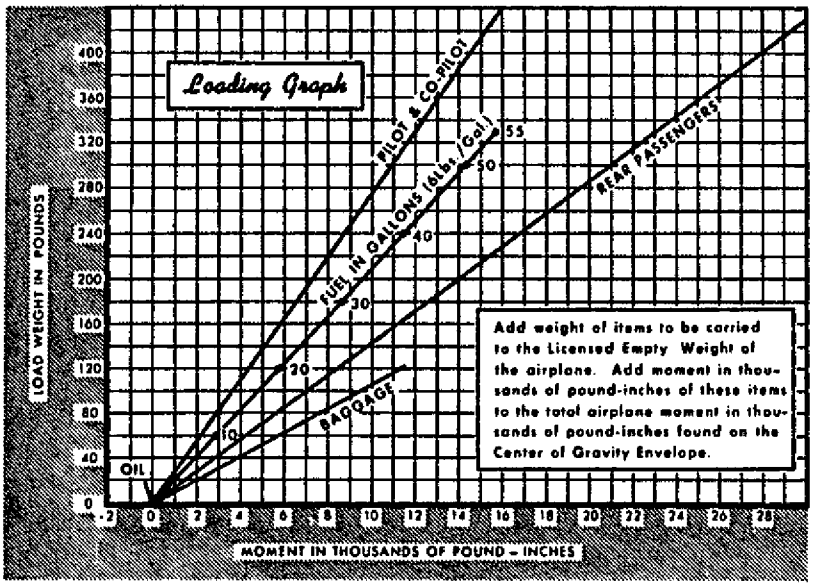


FIGURE 11. *Loading graph and center of gravity envelope.*

WEIGHT AND BALANCE

All airplanes are designed for certain limit loads and balance conditions. These limits for your aircraft are shown on the graphs for Figure 11.

An individual weight and balance report and equipment list is furnished with each airplane; these documents list the empty weight and empty weight center of gravity of the individual airplane as equipped when it left the factory. Changes in equipment which affect the empty weight and empty weight center of gravity must be entered on the repair and alteration report, form ACA-337, in accordance with Civil Air Regulations.

To determine that your gross weight and center of gravity for a given flight are within limits, use the following procedure:

(1, From the weight and balance report (or the current form 337) for your own airplane, determine the empty weight and empty weight moment.

(2) Determine the weights and moments of your disposable load items, using the loading graph.

(3) Add these items, as shown in the sample problem.

(4) Plot the totals on the center of gravity envelope graph.

EXAMPLE PROBLEM

Example for an airplane with a licensed empty weight of 1839 pounds and a moment of 65,914 pound-inches:

	Wt. Lbs.	Moment (lb-in) 1000
Empty Weight (licensed)	1839.0	65.9
Oil (12 qts.)	22.5	-0.4
Pilot & Front Seat Passenger . . .	340.0	12.2
Rear Seat Passengers	340.0	23.8
Full Fuel (55 gal.)	330.0	15.8
Baggage.	28.5	2.7
Total . . .	2900.0	120.0

Locate this point (2900 - 120.0) on the center of gravity envelope graph. Since the point falls within the envelope the above loading meets all the balance requirements.

FIGURE 11a. *Weight and balance instructions.*

Form approved.
Budget Bureau No. 04-R060.

FEDERAL AVIATION AGENCY

MAJOR REPAIR AND ALTERATION FORM (AIRFRAME, POWERPLANT, PROPELLER OR APPLIANCE)

1. AIRCRAFT	MAKE	MODEL	SERIAL NO.	NATIONALITY AND REGISTRATION MARK
	DAEDALIAN	DART	12345	N2468-W

2. OWNER	NAME (*First, middle, last*)	ADDRESS (*Street and number, city, zone and State*)
	ZUNI ENGINEERING COMPANY	CHISOLM RD. GALLUP, N. M.

3. COMPLETE ONLY FOR UNIT REPAIRED AND/OR ALTERED. DESCRIBE WORK ACCOMPLISHED ON REVERSE IN ACCORDANCE WITH CIVIL AERONAUTICS MANUAL 18.

UNIT	MAKE	MODEL	SERIAL NO.	NATURE OF WORK (*Check*) MAJOR REPAIR	MAJOR ALTERATION
a. AIRFRAME	********** (*As described in item 1 above*) **********				
b. POWERPLANT		The alterations identified herein complied with			applicable
c. PROPELLER		airworthiness requirements and are approved only for the above-described aircraft, subject to conformity by a person authorized in CAR 18.11(B).			inspection
d. APPLIANCE	TYPE AND MANUFACTURER				
		Date	/s/ Dan Kildare		SW-GADO-1

4. AIRCRAFT WEIGHT AND BALANCE DATA (**AFTER the repairs and/or alterations described below were made.*)

This item must be completed by repair or alteration agency. However, in the case of a spare component, it will not be completed until such component is installed in an aircraft. At this time, it will be completed by the installing agency, if applicable.

CATEGORY	EMPTY WEIGHT (*Pounds*)*	EMPTY CENTER OF GRAVITY (*Inches from datum*)*	USEFUL LOAD (*Pounds*)*
NORMAL	1839	35.82	1061

5. CONFORMITY STATEMENT (*Complete and check*)

a. AGENCY'S NAME AND ADDRESS	b. KIND OF AGENCY	c. CERTIFICATE NO.
	☒ U. S. Certificated Mechanic. ☐ Foreign Certificated Mechanic. ☐ Certificated Repair Station. ☐ Manufacturer. ☐ (Check if repair or alteration was made under delegation option procedures.)	A & P

d. I certify that the repair and/or alteration made to the unit(s) identified under item 3 above and described on the reverse or attachments hereto have been made in accordance with the requirements of Part 18 of the U. S. Civil Air Regulations and that the information furnished herein is true and correct to the best of my knowledge.

(Date repair and/or alteration completed) (Signature of authorized individual)

6. APPROVAL FOR RETURN TO SERVICE (*Check and complete appropriate items*)

Pursuant to the authority specified below the unit identified in item 3 was inspected in the manner prescribed by the Administrator of the Federal Aviation Agency and is

☒ APPROVED ☐ REJECTED BY ☐ FAA Designee ☐ Manufacturer ☐ Canadian Department of Transport Inspector of Aircraft ☐ FAA Flight Standards Inspector ☐ Repair Station ☐ Other (*Specify*)

2-12-63 (Date of approval or rejection)

/s/ G. D. Kotterkey (Signature of authorized individual; title or identification number)

7. TO BE COMPLETED ONLY BY FAA PERSONNEL

a. ☐ Forwarded for engineering comment ☐ See attached memorandum

b. ☐ Accepted _____ (Date) ☐ Reinspected _____ (Date) ☐ Spot Checked _____ (Date)

(FAA designation number) (Signature Flight Standards Inspector)

Form FAA-337 (4-52)

FIGURE 12. *Major repair and alteration form.*

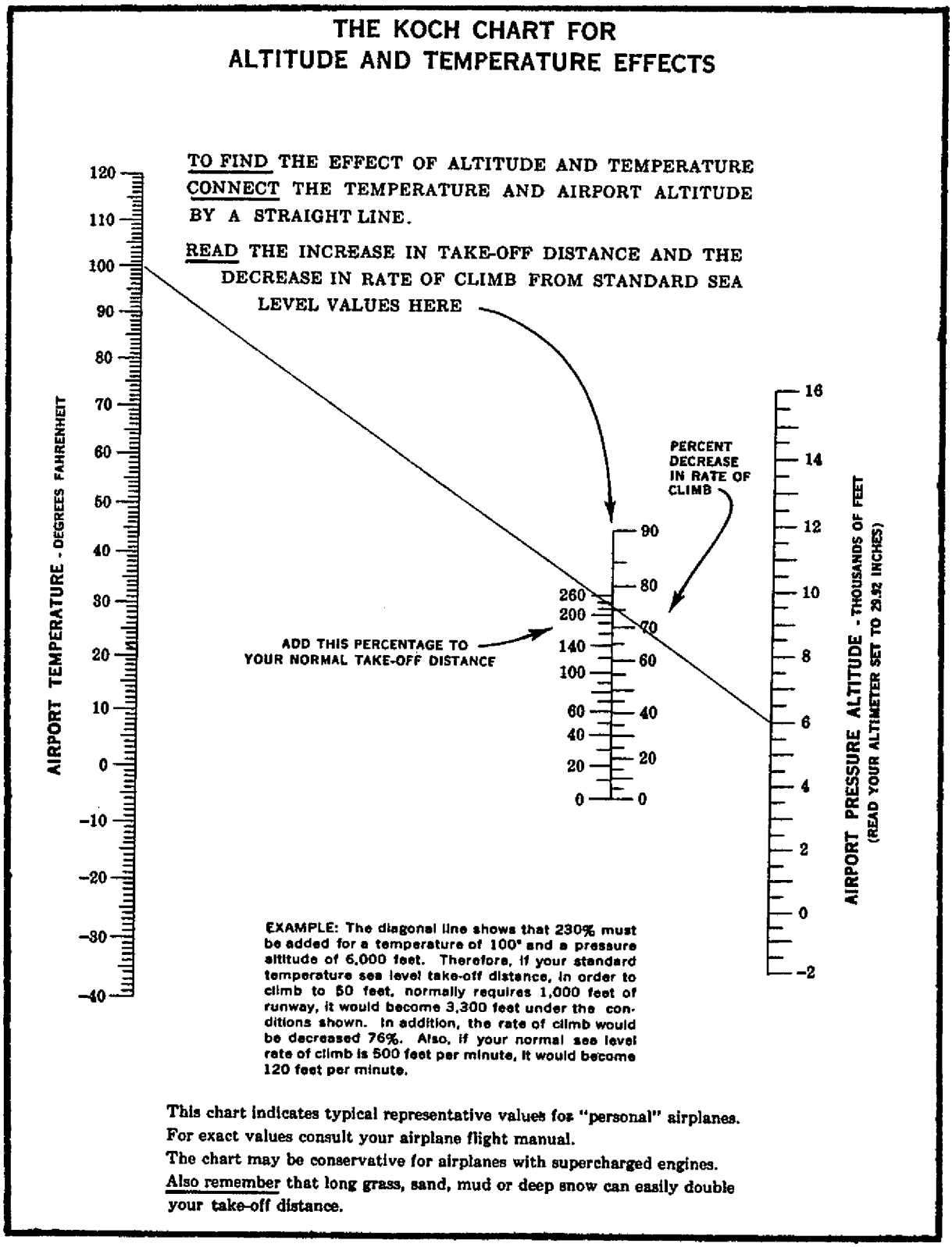


FIGURE 18. *The Koch Chart.*

LANDING DISTANCE TABLE

GROSS WEIGHT LBS.	APPROACH IAS MPH	AT SEA LEVEL & 59°F		AT 2500 FT & 50°F		AT 5000 FT & 41°F		AT 7500 FT & 32°F	
		GROUND ROLL	TO CLEAR 50' OBSTACLE	GROUND ROLL	TO CLEAR 50' OBSTACLE	GROUND ROLL	TO CLEAR 50' OBSTACLE	GROUND ROLL	TO CLEAR 50' OBSTACLE
2300	68	415	1015	445	1070	480	1130	520	1190
2600	72	470	1105	505	1165	545	1230	590	1300
2900	76	520	1190	560	1260	605	1330	655	1405

NOTE: REDUCE LANDING DISTANCES 10% FOR EACH 6 MPH HEADWIND. FLAPS 40° AND POWER OFF.

CLIMB DATA

GROSS WEIGHT LBS.	AT SEA LEVEL & 59°F			AT 5000 FT. & 41°F			AT 10000 FT. & 23°F			AT 15000 FT. & 5°F			AT 20000 FT. & -12°F		
	BEST CLIMB IAS MPH	RATE OF CLIMB FT/MIN	GAL. OF FUEL USED	BEST CLIMB IAS MPH	RATE OF CLIMB FT/MIN	FROM S.L. FUEL USED	BEST CLIMB IAS MPH	RATE OF CLIMB FT/MIN	FROM S.L. FUEL USED	BEST CLIMB IAS MPH	RATE OF CLIMB FT/MIN	FROM S.L. FUEL USED	BEST CLIMB IAS MPH	RATE OF CLIMB FT/MIN	FROM S.L. FUEL USED
2300	97	1770	2.0	94	1415	3.0	91	1065	4.0	88	715	5.1	85	370	6.3
2600	100	1510	2.0	98	1150	3.1	95	875	4.4	92	560	5.8	89	250	7.5
2900	104	1300	2.0	101	1010	3.3	98	720	4.8	96	430	6.7	94	140	9.2

NOTE: THROTTLE, 2625 RPM. MIXTURE AT RECOMMENDED LEANING SCHEDULE-FLAPS AND GEAR UP. FUEL USED INCLUDES WARM-UP AND TAKE-OFF ALLOWANCE.

TAKE-OFF DATA

TAKE-OFF DISTANCE WITH 20° FLAPS FROM HARD-SURFACED RUNWAY

GROSS WEIGHT LBS.	IAS AT 50 FT. MPH	HEAD WIND MPH	AT SEA LEVEL & 59°F		AT 2500 FT. & 50°F		AT 5000 FT. & 41°F		AT 7500 FT. & 32°F	
			GROUND RUN	TO CLEAR 50' OBSTACLE	GROUND RUN	TO CLEAR 50' OBSTACLE	GROUND RUN	TO CLEAR 50' OBSTACLE	GROUND RUN	TO CLEAR 50' OBSTACLE
2300	58	0	435	695	515	805	615	950	740	1145
		15	285	465	320	545	390	650	480	800
		30	135	270	170	330	215	400	270	505
2600	62	0	570	885	680	1040	815	1250	985	1550
		15	360	605	435	720	530	880	655	1105
		30	195	365	240	445	305	560	385	725
2900	65	0	740	1135	880	1355	1055	1655	1285	2155
		15	480	790	580	950	705	1200	875	1580
		30	270	500	335	615	425	795	540	1080

NOTE: INCREASE DISTANCES 10% FOR EACH 25°F ABOVE STANDARD TEMPERATURE FOR PARTICULAR ALTITUDE.

FIGURE 14. *Takeoff, climb, and landing performance tables.*

CRUISE PERFORMANCE — 10000

NORMAL LEAN MIXTURE

Standard Atmosphere — Gross Weight - 2900 Pounds
Zero Wind — 55 Gallons - No Reserve

10,000 FEET

RPM	MP	% BHP	Fuel Press.	MPH TAS	Gal/ Hour	Endurance Hours	Range Sta. Miles
2450	20	65	7.5	184	12.2	4.5	830
	19	60	6.8	179	11.4	4.8	860
	18	56	6.2	174	10.6	5.2	900
	17	52	5.6	169	9.9	5.6	940
2300	20	59	6.5	177	11.0	5.0	885
	19	55	6.0	172	10.4	5.3	910
	18	51	5.5	167	9.7	5.7	950
	17	47	5.1	162	9.1	6.0	975
2200	20	55	5.9	172	10.3	5.3	915
	19	51	5.5	168	9.8	5.6	940
	18	48	5.1	163	9.1	6.0	985
	17	44	4.8	157	8.6	6.4	1005
2100	20	50	5.3	165	9.5	5.8	955
	19	47	5.0	161	9.0	6.1	980
	18	43	4.7	156	8.5	6.5	1010
	17	40	4.4	151	8.0	6.9	1035
	16	37	4.2	145	7.6	7.2	1050
	15	34	4.0	138	7.1	7.8	1070
	14	30	3.8	129	6.6	8.3	1075

FIGURE 15. *Cruise performance chart.*

DIRECTORY OF AIRPORTS—LEGEND

CITY AND AIRPORT NAME

City or Airport Name followed by:

(AF)—A civil airport with Air Force operations, reserve training, or other such activity thereon.

NOTE: Similar combinations of above citation of A, AFRes, ANG, CG, MC, N and NG indicate the same is applicable for Army, Air Force Reserve, Air National Guard, Coast Guard, Marine Corp, Navy and National Guard (Army) respectively.

(P)—A civil airport covered by an agreement between municipality and U.S. Government which permits use by transient military aircraft.

NOTES

1. Where lights are owned or maintained by FAA the site number and airway abbreviation are included in the city and airport name column, i.e.: Chadron, 15, CYS-HON.
2. USAF aircraft are permitted to use only those fields with AF, AFRes, A, ANG, CG, MC, N, NG, P, after airport name.
3. When city and airport name is capitalized it indicates a Scheduled Airline Stop, i.e.: MOBILE, BATES FLD.
4. When city and airport names are identical, the airport name is omitted to conserve space.
5. When city is part of airport name, a dash will appear between city and airport, such as Venice-State.

LOCATION

Location is given in statute miles (rounded off to nearest mile) and/or direction from the center of referenced city, this is followed by geographical position to the nearest minute. The word "miles" has been eliminated due to space limitations.

If orientation features are less than ½ mile from the field, distance is not specified.

ELEVATION

Elevation is given in feet above mean sea level and is based on highest usable portion of landing area.

LONGEST RUNWAY AND FACILITIES

In this column are included the length and surfacing of the longest useable landing runway, the lighting and servicing facilities, weather reports and unicom available.

RUNWAYS

The length of the longest paved runway or non-paved strip is stated in *hundreds of feet*, using 70 as division point. If the length is not prefixed, the surface is sod, clay, gravel, etc.

h —runway is paved (concrete, asphalt or similar type of paving)

aw—allway field.

LIGHTS

B: Rotating Light (Rotating beacon)
(Green and white, split-beam and other types.) Omission of B indicates rotating light is either not available or not operating standard hours (sunset-sunrise).

NOTE: Code lights are not codified, and are carried in Remarks Column.

L: Field Lighting (when code L4-7 is indicated, lighting 4, 5, 6, 7 is available).

*An asterisk preceding an element indicates that it operates on *prior request only* (by phone call, telegram or letter). Where the asterisk is not shown, the lights are in operation or available sunset to sunrise by request (circling the field or radio call)

L—by itself indicates temporary lighting, such as flares, smudge pots, lanterns.
1—Portable lights (Electrical)
2—Boundary
3—Runway floods
4—Runway or Strip
5—Instrument approach (neon)
6—High intensity runway
7 or 7a—High intensity instrument approach

Because the obstructions on virtually all lighted fields are obstruction lighted, obstruction lights have not been included in the codification.

SERVICING

S1. Storage
S2: Storage, minor airframe repairs
S3: Storage, minor airframe and minor powerplant repairs
S4: Storage, major airframe and minor powerplant repairs
S5: Storage, major airframe and major powerplant repairs

WEATHER

W: Weather reports available from Weather Bureau or FAA communications station on field.

UNICOM

Unicom (Aeronautical Advisory Station transmitting and receiving, during the airport hours only, as follows):
U—122.8 mc (for airports *without* a control tower; and
V—123.0 mc (for airports *with* a control tower).

FUEL

Civil Fuel:	Air Force and Navy Fuel
F1: 80 oct., at least	A+: 115/145 oct.
F2: 80/87 oct., and lower	A: 100/130 oct.
F3: 91/96 oct., and lower	B 91/96 oct.
F4: 100/130 oct., and lower	C 73/80 oct.
F5: 115/145 oct., and lower	J Jet fuel.
F6: Kerosene	
F7: JP-4	
F8: JP-5	

REMARKS

1. "FEE" indicates landing charges for private or non-revenue producing aircraft. In addition, fees may be charged for planes that remain over a couple of hours and buy no services, or at major airline terminals for all aircraft.
2. "Rgt tfc N" indicates right turns should be made on landings and take-offs to N.
3. Limited—intended for private use, but use by public is not prohibited.

NOTES

1. OBSTRUCTIONS: Because of space limitations only the more dangerous obstructions are indicated. Natural obstructions, like trees, for example, clearly discernible for contact operations, are frequently omitted. On the other hand, all pole lines within at least 15:1 glide angle are indicated.
2. The Federal Government disclaims responsibility for non-Federal airports.

FIGURE 16. *Legend for interpretation of airport information.*

DIRECTORY OF AIRPORTS

CITY AND AIRPORT NAME	LOCATION	ELEV.	LONGEST RNWY FACILITIES	FUEL	REMARKS
ARIZONA					
Ajo Mun (P)	6N; 32°27′, 112°51′	1458	h63-S1		Unattended. 80/87 Fuel avbl by phone call.
Bagdad (P)	2NE; 34°35′, 113°10′	4136	28-B*L4		Use with caution. Unattended. 80/87 fuel avbl emgcy.
Bisbee Mun	6SE; 31°22′, 109°53′	4750	39-S3	F2	Caution—horses on field.
Bowie	1NE; 32°20′, 109°28′	3750	39		P-line S.
Buckeye Mun	6NW; 33°25′, 112°41′	1024	h38		
Buckeye-Stephens	1W; 33°22′, 112°36′	890	26-S3-U-W	F2	
Bullhead City	1N; 35°10′, 114°33′	550	h30		
Cameron	2NE; 35°53′, 111°24′	4200	40-S1	F2	Unattended. Circle town for service.
Camp Verde	2SE; 34°32′, 111°51′	3150	40		
Carefree	22N; Scottsdale 33°49′, 111°54′	2600	40-U	F4	Rgt tfc rnwy 6. P-line SW.
Casa Grande Mun	5N; 32°57′, 111°46′	1462	h38-BL4-S3	F4	P-line S, E.
Casa Grande, Three Point	1NW; 32°54′, 111°45′	1389	38-L4-S5-U		Lgts operg until 0100.
Casa Grande, San Francisco Giants	5W; 32°53′, 111°51′	1338	40		P-line E.
Chandler Mun (P)	3SE; 33°16′, 111°49′	1235	h26-BL4-S5	F4	
Chinle	2W; 36°09′, 105°35′	5500	50		P-line N.
Clifton, Greenlee County	8SE; 32°57′, 109°12′	3811	h49-*L4		P-line E. Unattended.
Coolidge-Florence Mun (P)	6SE; 32°56′, 111°26′	1587	h55-S5-U		
Coolidge Mun	2SW; 32°56′, 111°33′	1402	h21		
Coolidge, Sarita	5SE; 32°56′, 111°29′	1500	20-*L-S5	F2	P-line E. No storage.
Cottonwood-Clemenceau	1SW; 34°43′, 112°02′	3588	48-BL4	F4	Hazardous take-off SW.
DOUGLAS, BISBEE-DOUGLAS INTL (P)	9NW; 31°28′, 109°36′	4158	h75-BL4-S4-W-U	F4	ARPT OF ENTRY. Inner dual rnwys clsd. Tfc patn alt 1000′. Rnwy 12-30 unavbl for acft heavier than 12,500 lbs.
Douglas Mun	2E; 31°20′, 109°30′	4181	53-L4-S3	F4	Rnwy lgts on center 2000′ of N/S/ rnwy.
Douglas, Puerto Cielo	4NW; 31°23′, 109°37′	3980	23-S5		
Duncan Mun (P)	2SW; 32°42′, 109°08′	3878	23		Use ctr of strips; washout NE end NE/SW strip.
FLAGSTAFF MUN (P)	5S; 35°08′, 111°40′	7012	h63-BL4-S5-U-W	F4	
Glendale, Fram	5W; 33°32′, 112°16′	1060	21		P-lines E, W
Gila Bend	2SE; 32°56′, 112°41′	800	32-*L4-S5	F4	
Globe Mun (P)	7ESE; 33°21′, 110°41′	3193	49		Unattended.
Grand Canyon	14S; 35°51′, 112°05′	6400	100-S3-U	F4	Clsd winter months.
Gray Mountain	Adj W; 35°45′, 110°29′	5040	31	F2	
Hereford, Thompson Intl Aviation	31°26′, 110°05′	4230	29-L4-S3		
Holbrook Mun (P)	3NE; 34°56′, 110°08′	5241	50-BL4	F4	Rnwy 12-30 rolling.
Kayenta	2ESE; 36°43′, 110°14′	5810	53		80/87 oct fuel avbl emgcy.
Kearney	1S; 33°02′, 110°54′	1850	30		
KINGMAN MUN (P)	9NE; 35°16′, 113°56′	3446	h68-BL4-SI-U	F4	
Litchfield Park	5NW; 33°30′, 112°22′	1062	h36-L4-S5	F4	Hvy jet tfc W. Rgt tfc E.
Marana Arpk	8NW; 32°30′, 119°19′	1891	h68-L4-S5	F4	Attended 24 hrs.
Marble Canyon (P)	1SW; 36°49′, 111°39′	3600	38	F2	Cliffs E, N and NW.
Marble Canyon, Cliff Dwellers	10SW; 36°44′, 111°45′	4210	43-S3	F2	Unattended.
Mayer, Orme Ranch	10NE; 34°26′, 112°04′	3925	23		
Mesa, Falcon Fld.	6NE; 33°27′, 111°44′	1387	h22-S3	F4	
Mesa, Oasis	12E; 33°25′, 111°38′	1512	30	F4	P-line SW & NE.
Mormon Lake	1N; 34°55′, 111°28′	7180	40		Clsd winter months.
Nogales-Intl (P)	8NE; 31°25′, 110°51′	3938	h60-BL4-S5-U	F4	ARPT OF ENTRY.
PAGE, GLEN CANYON	1NE; 36°56′, 111°27′	4292	h45-B-*L4-S5-U	F4	Rgt tfc rnwys 33 & 25. Use E/W strip only during periods of high winds.

Phoenix-Sky Harbor Mun (P, ANG, NG)—Rgt tfc rnwys 26R, 8R. Due nonvsby twr, unable to determine if the flwg areas of the arpt are clear of obstns and/or acft: 300′ of ramp area N and NW of FAA bldg; 100′ of txwy 1 SW of ctl twr; and parking areas N and NW of bldg line on N and NW area of arpt. All use of these areas is at pilot's discretion. VASI avbl.

FIGURE 16a. *Directory of airports.*

CITY AND AIRPORT NAME	LOCATION	ELEV.	LONGEST RNWY FACILITIES	FUEL	REMARKS
			ARIZONA—*Continued*		
Page, Wahweap	6N; 36°59′, 111°30′	3850	26		
Parker Mun	1E; 34°09′, 114°16′	450	h32-L4-S3	F4	
Peach Springs Fld	1N; 35°33′, 113°25′	4825	24		P-line S & W
Phoenix, Deer Valley	17N; 33°42′, 112°05′	1450	h50-BL4-S5-U	F4	Glider towing being conducted Sat & Sun 1600Z-SS.
PHOENIX-SKY HARBOR MUN (P, ANG)	3SE; 33°26′, 112°01′	1122	h88-BL4, S5-X-W	F5, 6	See footnote.
Picacho, Ed's Fld	2S; 32°41′, 111°28′	1640	51-S3-U	F2	P-line N.
Pierce Ferry	4WSW; 36°06′, 113°57′	2941	30		
PRESCOTT MUN (P)	8N; 34°39′, 112°25′	5042	h68-BL4-S5-W	F4	See footnote.
Rimrock	2SE; 34°39′, 111°47′	3955	26		
Rock Point—Mission	Adj N; 36°43′, 109°37′	5000	40		Hangar at int.
Roll, Antelope Ranch	3SW; 32°43′, 114°01′	250	26		P-line E & W. Occasionally clsd for irrigation. F2 fuel emgcy
Roosevelt, Grapevine	6ESE; 33°38′, 111°03′	2350	42		Unattended.
SAFFORD MUN (P)	4E; 32°51′, 109°38′	3176	h48-BL4-S5-U	F4	
St. Johns (P)	Adj NW; 34°31′, 109°22′	5700	56		F2 fuel emgcy.
Salome, 27B, LAX-PHX	18SW; 33°35′, 113°35′	1362	41-BL2		Caution—puncture vines. Unattended.
Scottsdale, Thunderbird Academy	9N; 33°37′, 111°55′	1500	43-*L4-S5	F4	P-line W. Clsd Sat.
Sedona, Oak Creek Canyon	2SW; 34°51′, 111°47′	4826	h34-BL4-S3	F4	Caution ngts due hi elevations within 3 miles.
Seligman	Adj W; 35°20′, 112°53′	5300	49		Fuel avbl emgcy only.
Sells	2NW; 31°56′, 111°54′	2380	26		Embankment WSW. P-line WSW.
Show Low	2NE; 34°16′, 110°00′	6412	43-L4-S5	F4	
Snowflake Mun	3NW; 34°33′, 110°06′	5750	42		Unattended.
Springerville-Eagar (P)	2W; 34°08′, 109°19′	7021	49-B*L4	F4	Attended on call.
Stanfield, Potters Fld	1SE; 32°53′, 111°57′	1350	37-S3-U	F2	P-line N & S
Superior Mun	2W; 33°16′, 111°08′	2646	35		P-line NE. Mountains WSW. Unattended.
Tacna	Adj S; 32°40′, 114°04′	350	33-L4	F2	P-line NW. Unattended
Tempe, Sanders	5SSW; 33°21′, 111°58′	1240	26	F2	P-lines N, S.
Tombstone Mun (P)	4SE; 31°40′, 110°02′	4743	45-S1		Unattended. Use cntr strip only.
Topock, Site 6	19SE; 34°27′, 114°21′	490	h45-L4-U	F4	6000′ strip avbl.
Tubac	2N; 31°37′, 111°03′	3238	26-S3-U	F2	P-line N.
Tuba City	Adj E; 36°08′, 111°16′	4950	43		
Tucson, Freeway	4NW; 32°16′, 111°00′	2290	45-L4-S5-U	F4	
TUCSON MUN (ANG, NG)	7S; 32°07′, 110°57′	2630	h120-BL4-S5-W-X	F5, 6, 7	See footnote.
Tucson, Ryan Fld	12SW; 32°08′, 111°10′	2413	h40-BL4-S5	F4	P-line SSE.
Tucson, Thunderhead	15ESE; 32°09′, 110°44′	2896	31		
VALLE, ARIZONA STATE (P)	3E; 35°39′, 112°10′	6001	57-BL4		Use cntr of strips. Bcn and lgts avbl May 1 thru Oct 31 operg SS-SR.
Wellton	3SE; 32°39′, 114°06′	315	h40		
White River (P)	3SSW; 33°49′, 109°59′	5109	42		State hwy usable when arpt is muddy.
Wickenburg, Flying-E-Ranch	4SW; 33°57′, 112°48′	2417	32-*L4	F2	Hills SW. Uphill lndgs to SW. Take-off NE. Unattended during summer months.
Wickenburg Mun	15W; 33°57′, 112°59′	2380	36		
Wickenburg, Rancho de los Caballeros	4SW; 33°56′, 112°47′	2510	26		P-line ENE. Hill WSW.
Willcox, Cochise Co (P)	4W; 32°15′, 109°54′	4188	h61-S1	F4	
Williams Mun (P)	4N; 35°18′, 112°12′	6700	45-BL4-S5-U	F4	Muddy when wet.
Window Rock Mun	2SW; 35°39′, 109°04′	6738	h70-S2-U	F4	
Winslow Mun (P)	2W; 35°01′, 110°44′	4937	h75-BL4, 5-U-W	F5	P-line ENE.
Young, Q Ranch	9S; 34°05′, 110°48′	5515	34		Cattle on fld.
Yuma, Marsh	1E; 32°43′, 114°37′	130	33-S5	F4	Rgt tfc N. Ditch N end. Muddy when wet.
YUMA-MCAS/YUMA CO (MC)	5S; 32°39′, 114°36′	213	h133-BL4, 6-S5-W-X		See footnote

Prescott Mun (P)—Use runways. Taxi strips to rnwy 12 & 21 not to be used by acft with total gross load of 20,000 lbs or greater single wheel gear, 40,000 lbs or greater dual wheel gear, 60,000 lbs or greater dual tandem gear. Heavier acft taxi on rnwy.

Tuscon Mun (ANG, NG)—2-way rdo rqrd. Inbnd VFR acft are encouraged to make initial call to Tucson Apch Ctl when approx 25 mi out on freq 118.5, 137.88, 142.02, or 363.8 mc. Apch ctl will give initial tfc ctl instr & advise pilot when to chg to twr freq. Jet arresting barriers rnwys 12-30 emgcy only.

Yuma-MCAS/Yuma Co (MC)—Rgt tfc rnwys 17, 26. Civil acft tfc patn within 5 mi radius 1000′ MSL. Rnwy 17-35 clsd ngts. Hi density jet tfc vcnty of arpt. Navy chain type arresting gear lctd rnwys 3R-21L and 3L-21R.

FIGURE 16b. *Directory of airports.*

NOTAMS (Notices to Airmen)

ARIZONA

BUCKEYE RDO: VOR unusable below 7000' MSL beyond 40 nmi 320-345° account reduced coverage.

COCHISE RDO: About Feb 18, VOR will be shut down until aprxly Mar 2. For substitute route structures and MEAs during shutdown, use flwg:

LOW ALTITUDE

EXISTING AIRWAYS	SUBSTITUTE ROUTES	MEA
V-16: Rincon, Ariz. Int to Animas, Ariz. Int	None	
V-168: Tucson, Ariz. VORTAC to Cochise, Ariz. VOR	None	
V-66: Tucson, Ariz. VORTAC to Douglas, Ariz. VOR	Tucson VORTAC to Douglas VOR	10,000
Douglas, Ariz. VOR to Heath, Ariz. Int	Douglas VOR to *Heath Int *MRA 13,000	11,000–NE 9000–SW
V-202: Tucson, Ariz. Rbn to Cochise, Ariz. VOR	None	
Cochise, Ariz. VOR to San Simon, Ariz. VOR	Cochise Int to San Simon VOR via SSO 228 rad	10,000

EXISTING REPORTING POINTS	SUBSTITUTE REPORTING POINTS	MRA
Cochise, Ariz. VOR	Cochise Int DUG 340 rad and SSO 228 rad	10,000
Geronimo, Ariz. Int	None	
Heath, Ariz. Int	Heath Int DUG 050 rad and SSO 178 rad	13,000
Johnson, Ariz. Int	None	
Kinsley, Ariz. Int	None	
Mescal, Ariz. Int	None	
Portal, Ariz. Int	None	

INTERMEDIATE ALTITUDE

EXISTING AIRWAYS	SUBSTITUTE ROUTES	MEA
V-1562: Tucson, Ariz. VORTAC to Columbus, N.M. VORTAC via Cochise, Ariz. VOR	Tucson VORTAC to Columbus VORTAC	19,000
V-1625: Tucson, Ariz. VORTAC to San Simon, Ariz. VOR via Cochise, Ariz. VOR	Tucson VORTAC to San Simon VOR via TUS 082 rad and SSO 228 rad	16,000

EXISTING REPORTING POINTS	SUBSTITUTE REPORTING POINTS
Cochise, Ariz. VOR	None

The High Altitude Route System does not utilize Cochise VOR.

COTTONWOOD-CLEMENCEAU ARPT: Closed due resurfacing of N/S rnwy.

FLAGSTAFF MUN ARPT: 700' extension of rnwy 3-21 completed; usable length of rnwy 7000'.

FT HUACHUCA SPECIAL NOTICE: See Yuma Special Notice.

FORT HUACHUCA, LIBBY AAF SPECIAL NOTICE: Effective immediately Procedure No. ADF 1, amendment, original, effective 12/2/61. Use of this procedure not authorized until further notice.

GILA BEND SPECIAL NOTICE: See Yuma Special Notice.

LITCHFIELD PARK ARPT: Clsd to all operns due contr.

MARICOPA SPECIAL NOTICE: CAUTION—DO NOT MISTAKE FOR LANDING AREA. Space Surveillance Stn at lat 33°06'31", long 112°01'48" aprxly 4 mi N, 120° W and parallel to hwy. Site is strip 300' x 1800' with paved portion longitudinal thru cntr 100' in width and studded with 6' steel posts. This permanent hazard lctd 22 nmi S Phoenix-Sky Harbor Arpt.

PEACH SPRINGS RDO: VORTAC unusable below 10,000' MSL beyond 40 nmi from 195 239° account reduced coverage.

PHOENIX SPECIAL NOTICE: Pilots on other than IFR clearances should avoid traversing the following areas between 0600 1830MST Mon thru Fri. **Luke AFB:** Hi-density jet tfc will be operg VFR on V461/V176l between a point 5 mi S of Buckeye VOR and a point 10 mi N of Gila Bend VORTAC at alt 3000' thru 6000' and 15,000 'thru 16,000'; and V66/V94/V1540 and V1542 from 112°19'W to 113°45'W and V461/V1716 from Gila Bend VORTAC to a point 10 mi N of Gila Bend VORTAC at alts 4000' thru 6000' and 15,000' thru 16,000'. **Williams AFB:** Due to intensive student jet tfc within the Williams Student trng Areas 1 thru 4, it is suggested all acft operg VFR below FL 240 with 75 nmi radius of Williams AFB between the Eastern edge of V105/V257/V1845 N of Phoenix and V16 S of Phoenix; and the N edge of V94/V1540 E to Tottec Int, remain on arwys and/or at appropriate hemispherical alts below the base alts when traversing the trng areas (see appropriate R/F charts). In addition, intensive jet tfc will be operg in the vcnty of V16/V105/V93 between 6 and 20 nmi S of Phoenix VORTAC at and below 3500' MSL and within a 6 mi radius of Coolidge-Florence Arpt, exclusive of that portion overlying V16/V94, at and below 7000' MSL. Request all acft to avoid overflying Williams AFB control zone at all alts. Acft operg VFR at FL 240 thru FL 450 incl within 100 mi radius of Williams AFB in the area E of the E edge of J11/J92, the S edge of J6/J78 and the N edge of J2/J4, are requested to remain on arwys or contact Phoenix ARTCC for clearance thru the area. Student VFR jet tfc will be crossing arwys at appropriate hemispherical alts for direction of flt when transitioning from one trng area to another. VFR tfc may contact Phoenix, Tucson, Zuni, or Douglas FSS for further info. VFR tfc advisory info may be obtained from Williams AFB twr on 126.2 or 236.6 mc.

PHOENIX, DEER VALLEY ARPT: E 5000' E/W rnwy, one way clsd excp for emgcy or special use until planned changes.

PHOENIX, LUKE AFB SPECIAL NOTICE: Hi-density jet tfc operg 0600 1800 on Sats.

PHOENIX RDO: About Feb 4, LFR will be shut down until aprxly Feb 7, 1963, for conversion to H facil. Ident: PHX. Class: HHZ. Perryville FM ident will be changed to dash dot.

PHOENIX, SKY HARBOR SPECIAL NOTICE: VOR procedure No. 2, amendment 8, effective 28 Oct 1961 is amended as follows effective immediately: circling minimums day-night 800-1, 800-1, 800-1, 800-1½. Automatic cancellation of this notam will be the effective date of the revised procedure appearing in the Federal Register.

PRESCOTT SPECIAL NOTICE: J78V ABQ-PRC not usable below FL280. MRA for J78V ABQ PRC FL280 changeover point 150 nmi W ABQ 131 nmi E PRC.

PRESCOTT RDO: VORTAC unusable beyond 30 nmi at MOCA 110-200°; 15 nmi 200 234°; 30 nmi 225-275° excp on awys. About Jan 28, VOR will be shut down until aprxly Feb 8. For substitute route structures and MEAs during shutdown, use flwg:

LOW ALTITUDE

EXISTING AIRWAY	SUBSTITUTE ROUTE	MEA
V-12: EED VORTAC to INW VORTAC	EED VORTAC to INW VORTAC	10,000
V-128, EED VORTAC to INW VORTAC	EED VORTAC to PC LFR via EED 076 rad and 257 mag brg from PC	10,000
	*PC FLR to INW VORTAC via 082 mag brg from PC and Int of INW 234 rad *MCA 11,500 E bound **MOCA 11,600	**13,000

TUCSON RDO: Z marker operg without ident due identification confliction with Gilpin FM. About Jan 24, 1963, Gilpin FM ident will be changed to dash dot dash; Vail FM ident will be changed to dot dash dot. About Feb 7, Z mrkr ident will be changed to dot dash.

WINDOW ROCK MUN ARPT: Rnwy and boundary lgts operg hrs of darkness on rnwy 2-20. Aux dirt strip clsd due to constr.

WINSLOW SPECIAL NOTICE: About Feb 1, 1963, jet advisory VHF freq 133.2 mc at GCI site will be decmsnd. Jet advisory freq 125.8 remains cmsnd.

WINSLOW MUN ARPT SPECIAL NOTICE: Effective immediately, ADF procedure No. 1, Amendment No. 1, effective 10 Nov 1962 and Amendment No. 2, effective 17 Nov 1962 is amended as follows: Course and dist, fac to arpt: 160°, 1.8 mi. This NOTAM cancels all previous notams related to this procedure. Automatic cancellation of this NOTAM will be the effective date of the revised procedure appearing in the Federal Register.

WINSLOW MUN ARPT: Rnwy 4-22 usable dalgt hrs until about Jan 2, 1963. Rnwy 17-35 permly clsd.

YUMA SPECIAL NOTICE: Caution, extsv jet activity penetrating V-66 aprxly 20 mi E at 4000' MSL and below, contact Yuma rdo for details.

YUMA SPECIAL NOTICE: U.S. Army conducting SD-2 and SD-1 pilotless acft (drone) flts on a cont 24 hr basis, personnel and hvy eqpmt drops from cargo type acft on a cont dalgt to dark basis and intermittent ballistic missile and rocket launching to an alt of 20,000' MSL in the cstd firing area (W portion of former C-308) bounded on the W by line extending from the W bndry of R-2307 to V16, on N by V16, on the E by the Castle Dome Mtns and on S by R-2307.

YUMA RDO: VOR unusable beyond 30 nmi at MOCA 280-300°.

FIGURE 16c. *NOTAMS (Notices to Airmen).*

RADAR - RADIO LISTINGS

(ICAO) INTERNATIONAL PHONETIC ALPHASET

A	ALFA	●▬	J	JULIETT	●▬▬▬	S	SIERRA	●●●
B	BRAVO	▬●●●	K	KILO	▬●▬	T	TANGO	▬
C	CHARLIE	▬●▬●	L	LIMA	●▬●●	U	UNIFORM	●●▬
D	DELTA	▬●●	M	MIKE	▬▬	V	VICTOR	●●●▬
E	ECHO	●	N	NOVEMB'R	▬●	W	WHISKEY	●▬▬
F	FOXTROT	●●▬●	O	OSCAR	▬▬▬	X	XRAY	▬●●▬
G	GOLF	▬▬●	P	PAPA	●▬▬●	Y	YANKEE	▬●▬▬
H	HOTEL	●●●●	Q	QUEBEC	▬▬●▬	Z	ZULU	▬▬●●
I	INDIA	●●	R	ROMEO	●▬●			

ALWAYS CHECK NOTICES TO AIRMEN SECTION

VOR MONITORING CLASSIFICATION FOR AIR TRAFFIC CONTROL PURPOSES: Category I=Course alignment and signal level are monitored continuously, VOR has automatic transfer and shutdown unit, and is monitored remotely by a person. Category II=This is a Category I VOR wherein remote monitoring capability has failed and the VOR is temporarily monitored solely through use of automatic equipment which monitors course and signal level and has an automatic transfer unit. Upon receipt of a pilot report that the VOR is operating normally, it is placed in Category II which permits it to be used for air navigation and air traffic control purposes. Category III=VOR monitored solely through use of automatic equipment which monitors course and signal level and has automatic transfer and shutdown unit. Such a VOR may be inoperative for a limited period before a NOTAM is issued. VORs which are not controlled by an FSS, and are located too far from a staffed facility to be monitored with a VHF receiver, will fall into Category III. Category IV=Course alignment and signal level are monitored continously at an adjacent FSS but there is no automatic transfer and shutdown unit. During periods when the remote control feature is inoperative, a VOR in this category will be advertised, by NOTAM, as out-of-service regardless of its operating condition. **Note:** Category I, III, IV shown by 1, 3, 4 following name in Location Column.

LEGEND

FSS=Flight Service Station (FAA) (Formerly ATCS) location capitalized.

NOTE: The Federal Government disclaims responsibility for non-Federal air navigation facilities.

(A)=Army facility.
(AF)=Air Force facility.
(ANG)=Air National Guard facility.
(N)=Navy facility.
(P)=Private facility.
(S)=State facility.
(0700 2300)=Hours of operation local time
3=Monitoring category
●=New or revised data

RADIO CLASS DESIGNATIONS

Identification of VOR/VORTAC/TACAN Stations by Class (Operational Limitations):

Class	Normally Anticipated Altitude Service	Normally Anticipated Interference-free Distance Service
H-	30,000-75,000' MSL	180 smi (156.31 nmi)
M-	15,000-30,000' MSL	90 smi (78.16 nmi)
L-	Up to 15,000' MSL	45 smi (39.08 nmi)

NOTE: An H-VOR facility is capable of providing M- and L- service volume and an M- facility additionally provides L- service volume.

AAS ..... Airport Advisory Service at FSS-located airport.
AB ..... Continuous automatic transcribed broadcast service.
AC ..... Approach Control Tower, FAA (transmits on voice channel or associated ranges and ILS in addition to frequencies listed.)
B ..... Scheduled Broadcast Station (broadcasts weather at 15 and 45 minutes after the hour; Air Force Broadcasts, generally, 29 minutes).
C ..... Control Tower, FAA.
CI ..... Control Tower (City, County, Private, etc.).
CM ..... Control Tower (Military, listing only civil frequencies available).
CONSOLAN .. LF/MF long range navigation aid; aircraft must have beat frequency oscillator (BFO).
DME ..... UHF standard (TACAN compatible) distance measuring equipment.
GCA ..... Ground Controlled Approach System.
H ..... Non-directional radio beacon (homing), power 50 watts to less than 2000 watts.
HH ..... Non-directional radio beacon (homing), power 2000 watts or more.
ILS ..... Instrument Landing System (voice on localizr channel).
J ..... L/MF (200-415 kc) voice facility on other than range frequency.
LFM ..... VHF fan marker, low powered (5 watts).
LMM ..... Compass locator station when installed at middle marker site.
LOM ..... Compass locator station when installed at outer marker site.
LRCO ..... Limited Remote Communication Outlet.
MA ..... Range (adcock, vertical radiors), power less than 50 watts.
MH ..... Non-directional radio beacon (homing) power less than 50 watts.
ML ..... Range (loop radiators), power less than 50 watts.
MM ..... VHF middle marker.
MRA ..... Range (adcock, vertical radiators), power 50 watts or more, but less than 150 watts.
MRL ..... Range (loop radiators), power 50 watts or more, but less than 150 watts.
NSME ..... UHF nonstandard distance measuring equipment.
OM ..... VHF outer marker.
RA ..... Range (adcock, vertical radiators), power 150 watts or more.
RCO ..... Remote Communications Outlet.
Req ..... Operates on request.
RL ..... Range (loop radiators), power 150 watts or more.
S ..... Simultaneous range, homing signal and/or voice.
SLMM ..... Simultaneous middle marker compass locator and twr voice transmission.
SLOM ..... Simultaneous outer marker compass locator and twr voice transmission.
TACAN ..... UHF navigational facility—omnidirectional course and distance information.
VOR ..... VHF navigational facility—omnidirectional, course only.
VOR/DME ... Collocated VOR navigational facility and UHF standard distance measuring equipment.
VORTAC ..... Collocated VOR and TACAN navigational facilities.
W ..... Without voice facilities on range frequency.
Z ..... VHF station location marker at a LF range station.

NOTES

1. Range courses are magnetic in-bearings.
2. All FAA MH facilities operate continuously unless cited as follows: (on req).
3. All FAA ranges operate continuously. Those which are not manned continuously are cited in the remarks column with hours of operation in parentheses, e.g., (0600-2400).
4. LMF and VHF ranges listed at the same location are controlled by the same FSS. The communication frequencies and the controlling FSS are listed with either the LF/LMF or the VOR facility.
5. The controlling facility is shown in the Remarks column for an aid the name of which is NOT capitalized in the Location column and is NOT suffixed by the letter "W" in the Class column; e.g., Eufaula, (Alabama), L-BVOR is controlled by the Columbia, Georgia, FSS. Drake, (Arizona), L-VOR/W not controlled remotely.

FIGURE 16d. *Radar-radio listings.*

AIR NAVIGATION RADIO AIDS—*Continued*

LOCATION	CLASS	IDENT	FREQUENCIES		REMARKS
			TRANSMITS	RECEIVES	
ARIZONA					
Buckeye [1]	L-BVOR	BXK	110.6		NSME. Phoenix FSS
Casa Grande [1]	M-BVOR	CZG	114.8		Phoenix FSS
Chandler (AF)	HW	CHD	356		
Cochise [4]	L-BVOR-DME	CIE	110.4		NSME. Douglas FSS
DOUGLAS (AAS) [1]	L-BVOR	DUG	110.0 V 243.0 255.4 272.7	(3) —3023.5 req◆	
Douglas	BJ		379		
Drake [1]	L-VORW	DRK	110.4		
Flagstaff	LRCO		122.2	122.1	Prescott FSS
Ft Huachuca-Libby AAF	HW	FHU	410		
Ft Huachuca-Libby AAF	CM		126.2	122.5	
GILA BEND [1]	H-BVORTAC	GBN	116.6 V 243.0 255.4 272.7	(3) —3023.5 req◆	
Luke (AF)	HW	LUF	219		
Peach Springs [1]	H-BVORTAC	PGS	112.0	122.1	Prescott FSS
PHOENIX	SBMRAZ	PX	326 V 243.0 255.4 272.7	(3) —3023.5◆	81A 154N 261A 346N
Phoenix [1]	H-BVORTAC	PHX	115.6		NSME
Phoenix, Sky Harbor	AC(g)		278 118.1 118.7 120.2 126.2 243.0 257.8 348.6 353.8	(2)◆	
Phoenix	Center		See page 47 for center frequencies		
PRESCOTT (AAS)	SBRAZ	PC	347 V 255.4 243.0 272.7	(3) —3023.5 req◆	78A 147N 241A 322N
Prescott	VHF/DF			122.1 126.7	
Prescott [1]	H-BVORTAC	PRC	114.1		
St. Johns [1]	M-BVORTAC	SJN	112.3		Zuni, N Mex FSS
San Simon [1]	M-VORW	SSO	115.4		
Tuba City [1]	H-BVOR	TBC	113.5		Prescott FSS
●TUCSON	SABHZ	TUS	338 V 243.0 255.4 272.7	(3) —3023.5 req◆	63A 125N 262A 324N
Tucson [1]	H-BVORTAC	TUS	117.1		NSME
Tucson Mun	C(g)		371 118.3 243.0 257.8 348.6	(2)◆	
Winslow	SABH	INW	266 V-255.4	(3) —3023.5◆	Prescott FSS
Winslow [1]	L-BVORTAC	INW	110.0		NSME
YUMA [1]	H-BVOR	YUM	116.6 V 243.0 255.4 272.7	(3) —3023.5 req◆	
Yuma MCAS	MHW	NYL	344		
Yuma MCAS	CM		290 119.1 126.2 243.0 340.2 360.2 382.8	(2)◆	

V=122.2, 126.7, 135.9 mc transmitted. ◆=Guards same VHF and UHF freqs facility transmits except 122.2 mc. (1)=3023.5 kc guarded. (2)=3023.5 kc: 126.6 mc. (3)=3023.5 kc: 122.1, 126.7, 135.9 mc., e.g. (3)-135.9 guards every frequency in group (3) except 135.9 mc. (g)=Tower equipped with 121.9 mc or (g.7)=Tower equipped with 121.7 mc for control of ground traffic. EMERGENCY FREQUENCY (121.5 mc) transmits and guards at all FSS, Towers (FAA and Military), Centers and DF Stations; this frequency is not tabulated in the list above. *=Automatic voice identification. NOTE: FIRST FREQUENCY LISTED IS THE NAVIGATIONAL AID CHANNEL; OTHERS ARE COMMUNICATIONS CHANNELS. See Legend Page (Radar/Rdo-1) for VOR Monitoring Classification and Radio Class Designations.

FIGURE 16e. *Air navigation radio aids.*

VOR RECEIVER CHECK POINT

INTRODUCTION

Part 43 of the Civil Air Regulations provides, among other things, for certain VOR equipment accuracy checks prior to flight under instrument flight rules. To comply with this requirement and to insure satisfactory operation of the airborne system, the FAA has provided pilots with the following means of checking VOR receiver accuracy: (1) radiated test signals, (2) certified airborne check points and (3) certified check points on the airport surface.

The VOT facility transmits a test signal for VOR receivers which provides users of VOR a convenient and accurate means to determine the operational status of their receivers. The facility is primarily designed to provide a means of checking the accuracy of a VOR receiver while the aircraft is on the ground. The radiated test signal is used by tuning the receiver to the published frequency of the test facility. With the flight path deviation indicator (FPDI) centered the omnibearing selector should read 0° with the to-from indication being "from" or the omnibearing selector should read 180° with the to-from indication reading "to." Should the VOR receiver be of the automatic indicating type, the indication should be 180°. (This is true for all airborne receivers except Mitchell which will indicate 0°). Two means of identification are used with the VOR radiated test signal. In some cases a continuous series of dots is used while in others a continuous 1020 cycle tone will identify the test signal. Information concerning an individual test signal can be obtained from the local flight service station.

Airborne and ground check points consist of certified radials that should be received at specific points on the airport surface or over specific landmarks while airborne in the immediate vicinity of the airport. Should an error in excess of ±4° be indicated through use of the ground check or ±6° using the airborne check, IFR flight should not be attempted without first correcting the source of the error. CAUTION, no correction other than the "correction card" figures supplied by the manufacturer should be applied in making these VOR receiver checks.

The list of radiated test signals, airborne check points and ground check points is given on the following pages.

NOTE: The information is provided in the following order: Facility name (plus airport name, if needed); bearing in degrees magnetic from the VOR; location of the check point (distances in nautical miles); and altitude (in feet MSL, if any).

RADIATED TEST SIGNAL

†ALBANY (County 109.0 mc)
*ALBUQUERQUE (Kirtland AFB 111.0 mc)
*ANCHORAGE (International 111.0 mc)
*AKRON (Canton 112.0 mc)
*BEDFORD (Hanscom 110.0 mc)
*BIRMINGHAM (Municipal 111.0 mc)
*BOSTON (Logan International 111.0 mc)
*BUFFALO (Greater Buffalo Int'l 109.0 mc)
*BURBANK (Lockheed Air Trml 110.0 mc)
*BURLINGTON (Municipal) 109.0 mc)
*CHARLESTON (AFB/Municipal 111.0 mc)
*CHARLESTON (Kanawha Co 111.0 mc)
*CHARLOTTE (Douglas Municipal 111.0 mc)
*CHICAGO (Midway 111.0 mc)
*CHICAGO (O'Hare International 112.0 mc)
*CINCINNATI (Greater Cincinnati 112.0 mc)
*CLEVELAND (Hopkins 110.4 mc)
*COLUMBUS (Port Columbus 111.0 mc)
*DALLAS (Love 111.0 mc)
*DAYTON (Municipal 111.0 mc)
*DENVER (Stapleton Airfld 111.0 mc)
*DETROIT (City 112.0 mc)
*DETROIT (Willow Run 109.0 mc)
*EL PASO (International 111.0 mc)
*FORT WAYNE (Baer 111.0 mc)
*FORT WORTH (Amon Carter 111.8 mc)
*FORT WORTH (Meacham 108.2 mc)
*HOUSTON (International 111.0 mc)
*INDIANAPOLIS (Weir Cook 109.0 mc)
*JACKSONVILLE (Imeson 111.0 mc)
*KANSAS CITY (Municipal 108.6 mc)
*KNOXVILLE (McGhee-Tyson 111.0 mc)
*LONG BEACH 109.0 mc)
*LOS ANGELES (International 112.0 mc)
*LOS ANGELES (Van Nuys 109.0 mc)
*LOUISVILLE (Standiford Fld 111.0 mc)
*MEMPHIS (Municipal 111.0 mc)
†MIAMI (International 112.0 mc)
*MILWAUKEE (General Mitchell 109.0 mc)
*MINNEAPOLIS-ST PAUL (Wold-Chamberlain 111.0 mc)
*NASHVILLE MUN (Berry 111.0 mc)
*NEWARK 111.4 mc
*NEW YORK (Idlewild 112.0 mc)
*NEW YORK (La Guardia 108.4 mc)
*OAKLAND (Metro.-Oakland Intl 108.8 mc)
*PHILADELPHIA (International 111.0 mc)
*PHOENIX (Sky Harbor 109.0 mc)
*PITTSBURGH (Greater Pittsburgh 111.0 mc)
*PORTLAND (International 111.0 mc)
*RICHMOND (Byrd Fld 110.8 mc)
*ST. LOUIS (Lambert 111.0 mc)
*SALT LAKE CITY (Municipal #1—111.0 mc)
*SAN ANTONIO (International 108.8 mc)
*SAN DIEGO (Lindbergh 109.0 mc)
*SAN FRANCISCO (International 111.0 mc)
*SANTA MONICA (Municipal 110.2 mc)
*SAVANNAH, Travis (Chatham 111.0 mc)
*SPOKANE (International 109.6 mc)
*TALLAHASSEE (Municipal 111.0 mc)
*TAMPA (International 111.0 mc)
*TULSA (Municipal 109.0 mc)
*WASHINGTON, D.C. (National 108.2 mc)
*WEST PALM BEACH (Palm Beach Intl 109.0 mc)
†WICHITA (Municipal 111.0 mc)

Notes: *Continuous monitoring
†Checked daily for accuracy

FIGURE 17. *VOR receiver checkpoints.*

DEFINITIONS

AIR ROUTE TRAFFIC CONTROL CENTER (CENTER) - A facility established to provide air traffic control service to IFR flights operating within controlled airspace and principally during the en route phase of flight.

AIR TRAFFIC - Aircraft in operation anywhere in the airspace and on that area of an airport normally used for movement of aircraft.

AIR TRAFFIC CLEARANCE - Authorization by air traffic control, for the purpose of preventing collision between known aircraft, for an aircraft to proceed under specified traffic conditions within controlled airspace.

AIR TRAFFIC CONTROL - A service operated by appropriate authority to promote the safe, orderly, and expeditious flow of air traffic.

AIRPORT ADVISORY AREA - The area within five statute miles of an uncontrolled airport on which is located a Flight Service Station so depicted on the appropriate Sectional Aeronautical Chart.

AIRPORT ADVISORY SERVICE - A service provided by a Flight Service Station to enhance the safety of terminal operations at airports where a station is operating but where there is no control tower.

AIRPORT TRAFFIC AREA - That airspace within a circular limit defined by a five statute mile horizontal radius from the geographical center of an airport at which an operative airport traffic control tower is located and extending upwards from the surface to, but not including, 2,000 feet above the surface.

AIRPORT TRAFFIC CONTROL TOWER (TOWER) - A facility providing airport traffic control service.

APPROACH CLEARANCE - The clearance issued to the pilot of an aircraft making a flight subject to instrument flight rules authorizing an approach for landing by such aircraft.

APPROACH CONTROL SERVICE - Air traffic control service, provided by a terminal area traffic control facility, for arriving and/or departing IFR flights.

APPROACH SEQUENCE - The order in which aircraft are positioned while awaiting approach clearance or while on approach.

ATC - An abbreviation used in radiotelephone, interphone, or other conversation to mean the air traffic control service of the FAA.

CONTINENTAL CONTROL AREA - The continental control area consists of the airspace of the continental United States at and above 14,500 feet MSL, but excludes: (1) the state of Alaska, (2) the airspace less than 1500 feet above terrain, and (3) prohibited and restricted areas except those restricted areas specified in Part 601 of the Regulations of the Administrator.

CONTROL AREA - Unless otherwise provided in appropriate cases, control areas extend upward from 700 feet above the surface until designated from 1200 feet above the surface or from at least 500 feet below the MEA, whichever is higher, to the base of the continental control area.

CONTROL ZONE - Control zones extend upward from the surface. A control zone may include one or more airports and is normally a circular area of 5 statute miles in radius with extensions where necessary to include instrument approach and departure paths.

CONTROLLED AIRSPACE - Airspace of defined dimensions designated by the Administrator as continental control area, control area, control zone or transition area, within which air traffic control is exercised.

CRUISING ALTITUDE - Cruising altitude is a level determined by vertical measurement from mean sea level.

FLIGHT ASSISTANCE SERVICE - An assistance and advisory service to promote the safe conduct of flight.

FLIGHT LEVEL - Flight level is a level of constant atmospheric pressure related to a reference datum of 29.92" Hg. For example, flight level 250 is equivalent to an altimeter indication of 25,000 feet, and flight level 265 is 26,500 feet.

FLIGHT PLAN - Specified information filed either verbally or in writing with air traffic control relative to the intended flight of an aircraft.

FLIGHT SERVICE STATION (FSS) - A facility operated by the FAA to provide flight assistance service.

IFR - The symbol used to designate instrument flight rules.

IFR CONDITIONS - Weather conditions below the minimum prescribed for flights under VFR.

LARGE AIRCRAFT - Aircraft of more than 12,500 pounds maximum certificated take-off weight.

FIGURE 17a. *Definitions, air traffic control.*

RADIAL - A magnetic bearing extending from a VOR/VORTAC/TACAN.

REPORTING POINT - A geographical location in relation to which the position of an aircraft is reported.

SPECIAL VFR CONDITIONS (Special VFR minimum weather conditions) - Weather conditions which are less than basic VFR weather conditions and which permit flight under visual flight rules as specified in CAR 60.31.

TRAFFIC PATTERN - The flow of aircraft operating on and in the vicinity of an airport during specified wind conditions as established by appropriate authority.

TRANSITION AREA - Transition areas extend upward from 1200 feet or higher above the surface when designated to complement control zones; from 700 feet above the surface when designated in conjunction with an airport with no control zone but for which an instrument approach procedure has been prescribed; or from 1200 feet or higher above the surface when designated in conjunction with airway route structures or segments. Unless otherwise limited, transition areas terminate at the base of the overlying controlled airspace.

VFR - The symbol used to designate visual flight rules.

VFR CONDITIONS - (VFR minimum weather conditions) Basic weather conditions prescribed in CAR 60.30 for flight under VFR.

VISIBILITY - (a) Flight visibility - The average horizontal distance that prominent objects may be seen from the cockpit. (b) Ground visibility - The average range of vision in the vicinity of an airport as reported by the U.S. Weather Bureau or, if unavailable, by an accredited observer.

FIGURE 17b. *Definitions, air traffic control.*

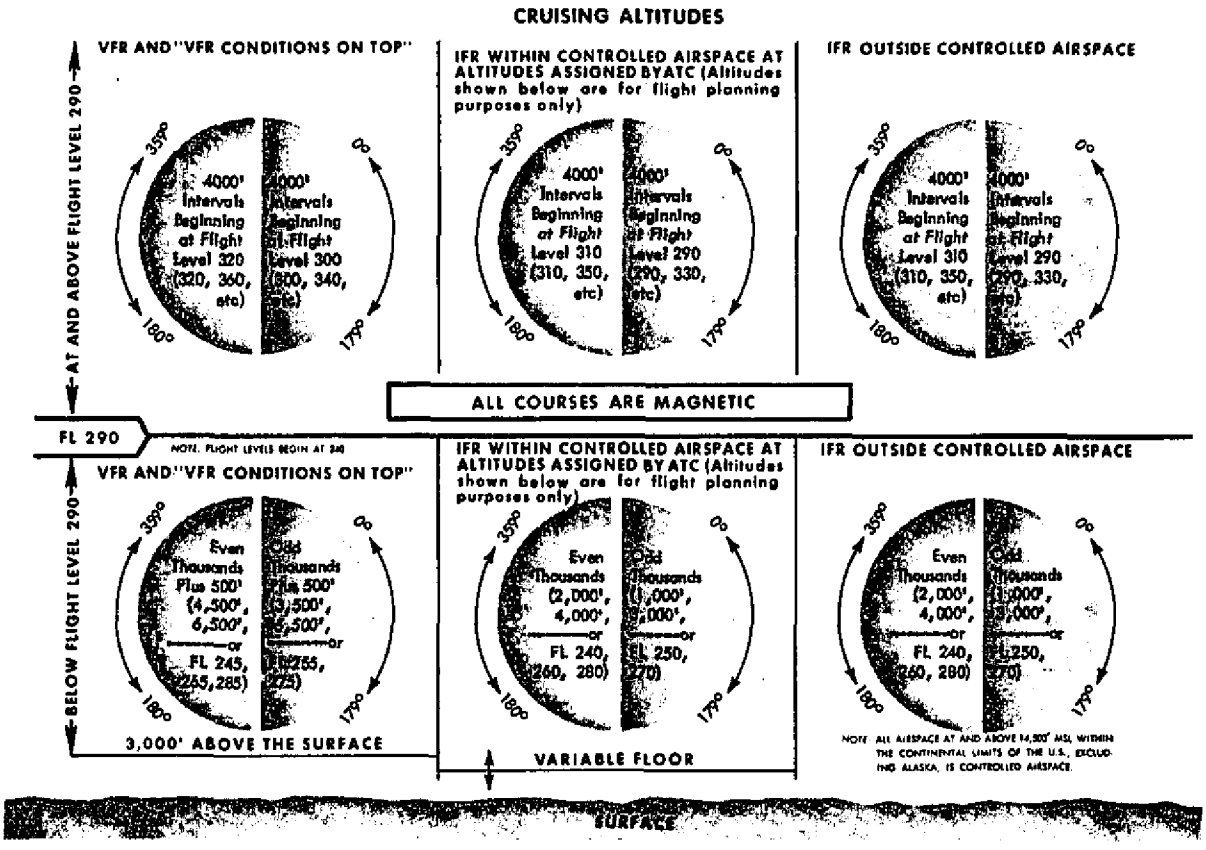


FIGURE 17c. *Cruising altitudes.*

How to Report an Accident

Notification Requirements

The pilot, or operator, of an aircraft of U.S. registry *must immediately* notify the FAA of any aircraft accident which:

(a) Is known or believed to have been caused by structural failure of the aircraft, engine, or propeller.
(b) Involves midair collision of two or more aircraft.
(c) Results in serious injury to any person, or fatal injury to any person not an occupant of the aircraft.
(d) Involves fire in any of the components or systems on board the aircraft regardless of the extent of injury to the occupants or damage to the aircraft.

The pilot, or operator, shall notify the nearest FAA Flight Service Station, or General Aviation District Office informing them of:

1. Location.
2. Date.
3. Time of day.
4. Number of persons involved.
5. Injuries to each.
6. Aircraft registration number.
7. Aircraft make and model.
8. Names of crewmembers and operator.
9. The circumstances surrounding the accident.

Reporting Requirements

The pilot, or operator, of an aircraft of U.S. registry must, as soon as possible, after the accident, complete a written report to the FAA if the accident involved:

(a) Serious or fatal injury to a nonoccupant of the aircraft, or
(b) Estimated repair cost of $100 or more.

The written report must be submitted in triplicate on Form FAA-916 and mailed or delivered to the nearest FAA General Aviation District Office or Regional Office, or to the State aviation official or investigator, where applicable. (CAB Safety Investigation Regulations, Part 320, Subch. II.)

FIGURE 18. *How to report an accident.*

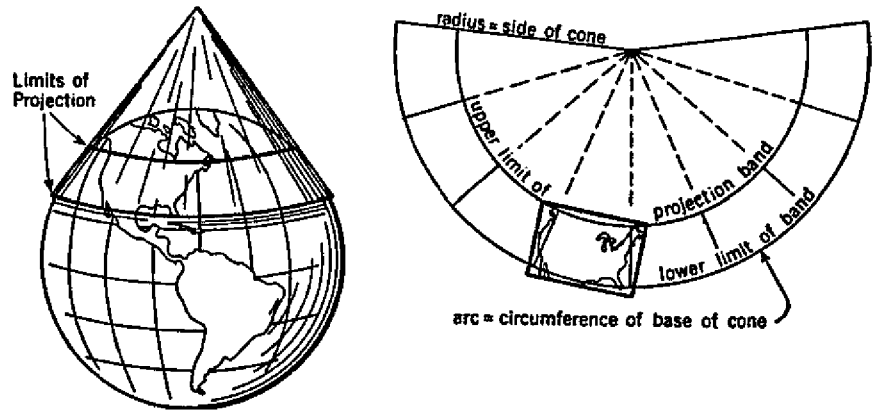


FIGURE 19. *The Lambert conformal chart projection.*

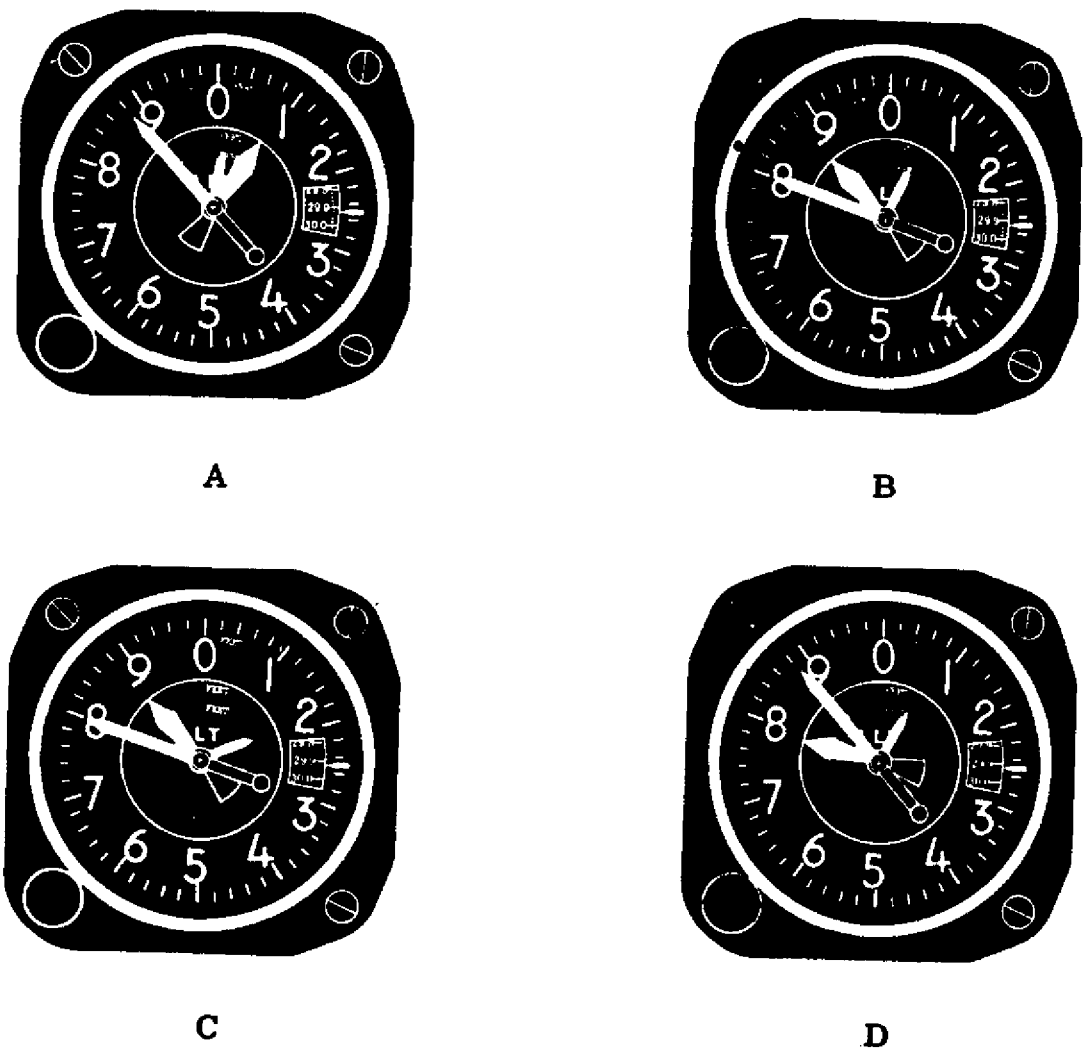


FIGURE 20. *Altimeter readings.*

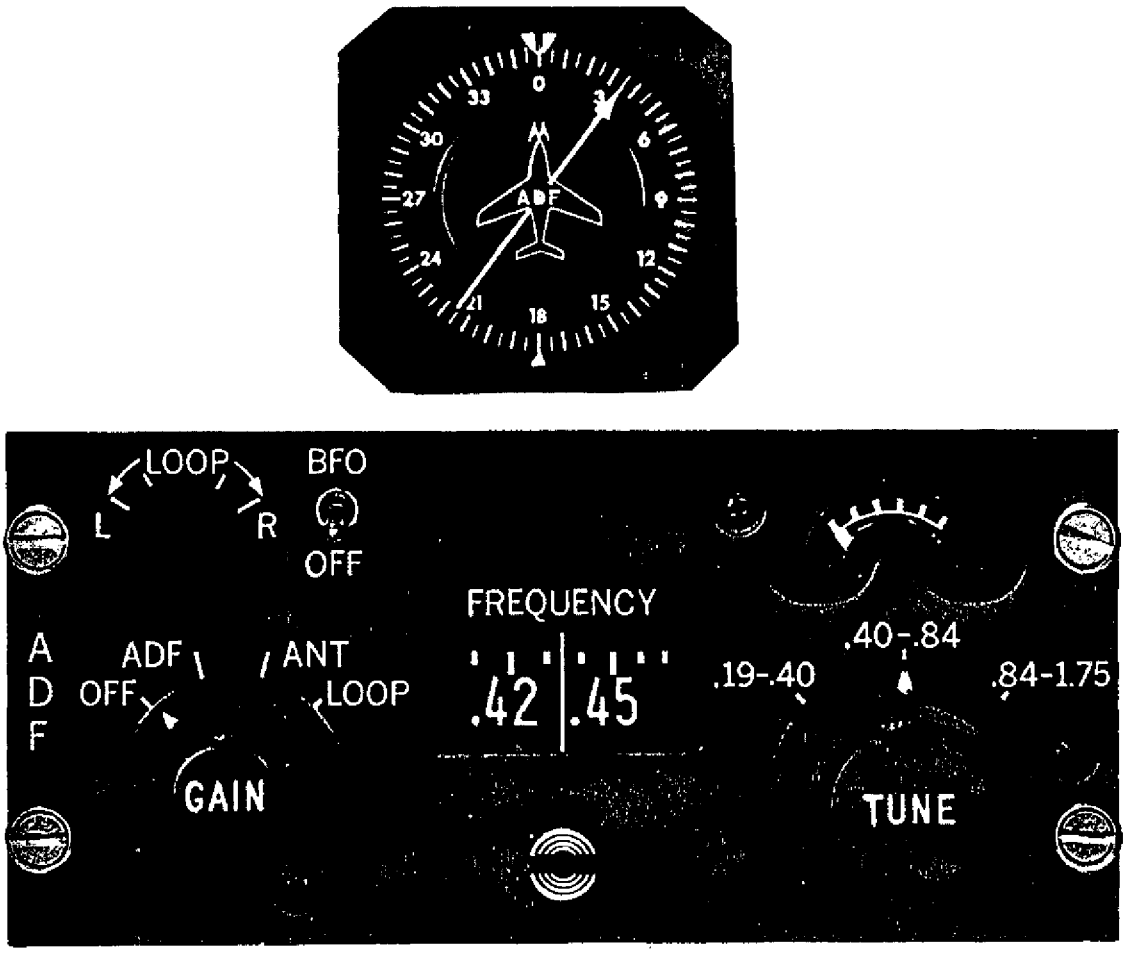


FIGURE 21. *Radio compass (ADF).*

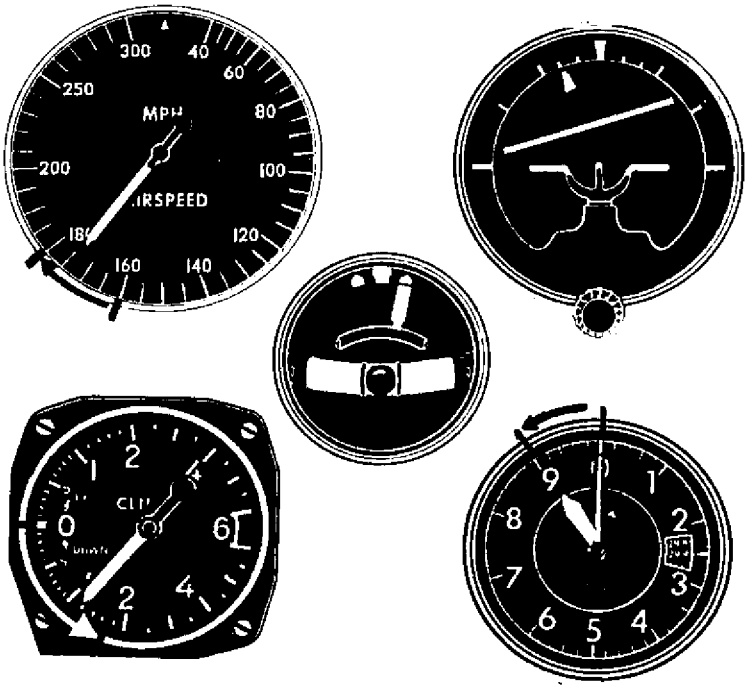


FIGURE 22. *Instrument grouping.*

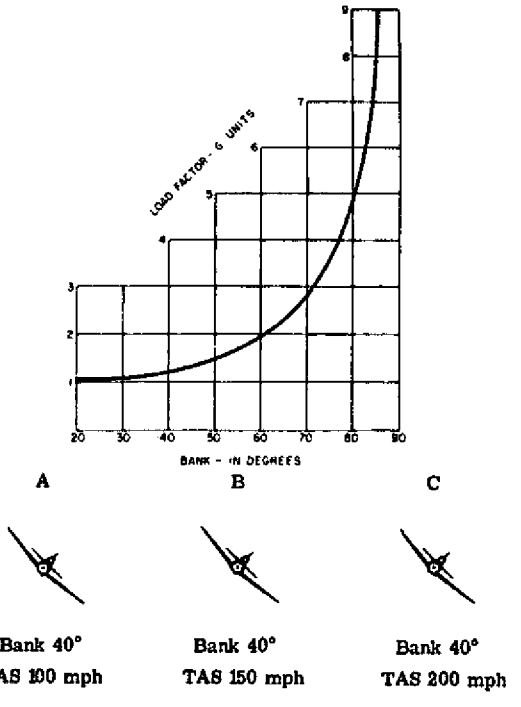


FIGURE 23. *Bank, airspeed, and load factors.*

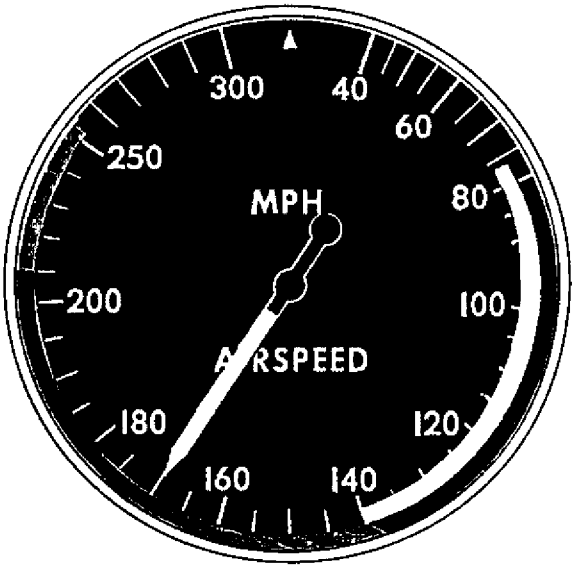


FIGURE 24. *The airspeed indicator.*

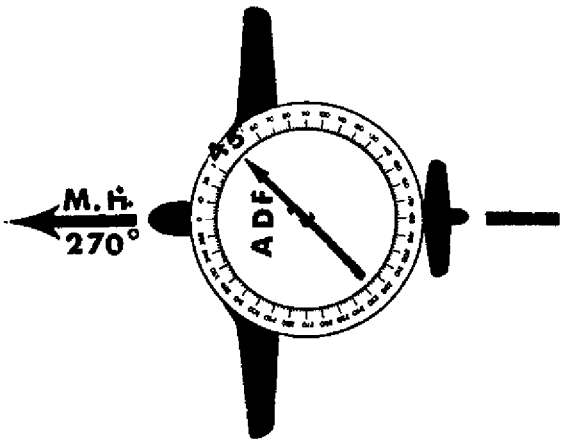


FIGURE 25. *ADF indications.*

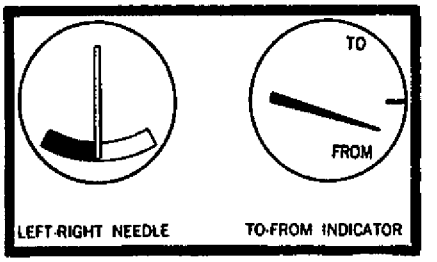


FIGURE 26. *VOR navigation receiver indications.*

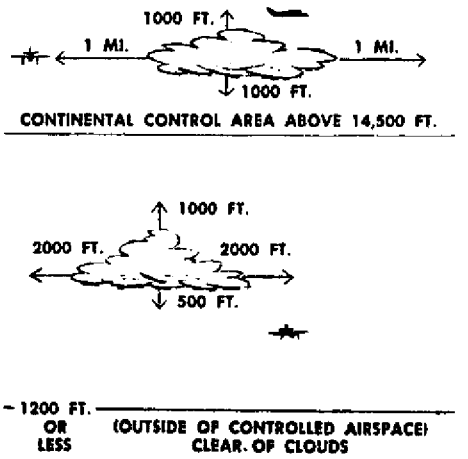


FIGURE 27. *Minimum VFR distance from clouds; airport traffic area.*

FEDERAL AVIATION AGENCY

FLIGHT PLAN

FORM APPROVED
BUDGET BUREAU NO. 04-R072.1

1. TYPE OF FLIGHT PLAN	2. AIRCRAFT IDENTIFICATION	3. AIRCRAFT TYPE	4. ESTIMATED TRUE AIR SPEED (Knots)	5. DEPARTURE TIME	
☑ VFR ☐ VFR ☐ IFR ☐ DVFR	N2468W	DAEDALIAN DART	180	PROPOSED (Z) 1530	ACTUAL (Z)

6. INITIAL CRUISING ALTITUDE	7. POINT OF DEPARTURE	8. ROUTE OF FLIGHT
10,500	GALLUP, New Mex.	Direct HOLBROOK, Direct WINSLOW VOR, Direct FLAGSTAFF, Direct WILLIAMS MUN.

9. DESTINATION (Airport & City)	10. ALTITUDE CHANGES EN ROUTE	11. ESTIMATED TIME EN ROUTE		12. FUEL ON BOARD	
		HOURS	MINUTES	HOURS	MINUTES
Williams MUN. Williams, ARIZ.	NONE	2	20	3	20

13. ALTERNATE AIRPORT	14. REMARKS
--	WILL GIVE TIME OFF TO ZUN FSS WHEN AIRBORNE INTERMEDIATE STOPS AT HOLBROOK AND FLAGSTAFF WILL CANCEL WITH PRS FSS

15. NAME OF PILOT	16. ADDRESS OF PILOT OR AIRCRAFT HOME BASE	17. NO. OF PERSONS ABOARD
C. Breeze	McKINLEY COUNTY AIRPORT GALLUP, NEW MEXICO	4

18. COLOR OF AIRCRAFT	19. FLIGHT WATCH STATIONS (FAA use)
Silver Red Trim	

FAA FORM 398 (6-62)
USE PREVIOUS EDITIONS.

SEE REVERSE

CLOSE FLIGHT PLAN UPON ARRIVAL

FIGURE 28. *Example of VFR flight plan with flight following service requested.*

Color and type of signal	On the ground	In flight
Steady green	Cleared for takeoff	Cleared to land.
Flashing green	Cleared for taxi	Return for landing (to be followed by steady green at proper time).
Steady red	Stop	Give way to other aircraft and and continue circling.
Flashing red	Taxi clear of landing area (runway) in use.	Airport unsafe—do not land.
Flashing white	Return to starting point on airport.	
Alternating red and green.	General warning signal—exercise extreme caution.	

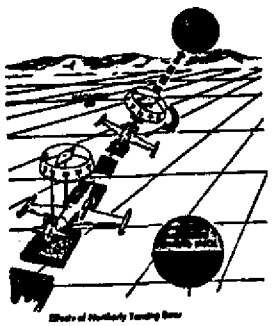
FIGURE 29. *Light gun signals used in airport traffic control.*

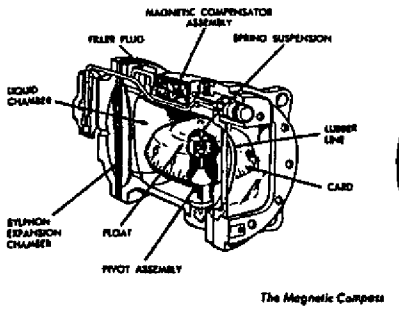
AIRSPEED CORRECTION TABLE

FLAPS 0°								
IAS - MPH	60	80	100	120	140	160	180	200
TIAS - MPH	66	80	97	117	137	158	178	198
FLAPS 20°								
IAS - MPH	40	50	60	70	80	90	100	110
TIAS - MPH	59	62	67	73	81	91	101	111
FLAPS 40°								
IAS - MPH	40	50	60	70	80	90	100	110
TIAS - MPH	58	62	66	73	82	92	102	112

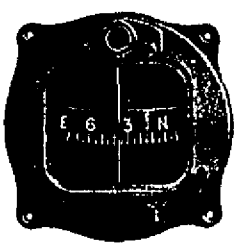
FIGURE 30. *Airspeed correction table.*

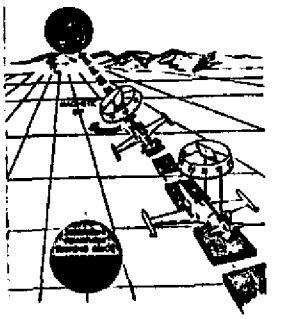
EXAM-O-GRAM NO. 12
THE MAGNETIC COMPASS





The Magnetic Compass





The magnetic compass, in terms of its errors, limitations, and in-flight characteristics, is one of those aeronautical subjects in which consistently large numbers of pilots fare poorly on FAA written examinations. There is evidence that this veteran instrument—it was one of the first to be installed in an aircraft—is one of the least understood instruments in the cockpit of today's modern general aviation aircraft. Many pilots seem to operate on the premise that it is easier to ignore this instrument's errors than it is to learn them. However, it should be remembered that (1) this is the only directional-seeking instrument in the cockpit of most general aviation aircraft, and (2) it is mechanically a simple, self-contained unit (independent of external suction or electrical power for its operation) that is likely to remain reliable at all times—reliable, that is, if the pilot understands its inherent errors.

WHAT ARE SOME OF THE COMPASS ERRORS THAT THE PILOT SHOULD UNDERSTAND?

The pilot should understand:

I. VARIATION—This is the angular difference between *true north* and *magnetic north* which is plotted on charts in *degrees east or west.* The pilot should understand perfectly *which to add and which to subtract* when converting from true headings or courses to magnetic headings or courses and vice versa. (Many pilots find such memory aids as "east is least and west is best" helpful in remembering that *east is subtracted* and *west is added* when going from *true* to *magnetic.*)

II. DEVIATION—This is the deflection of the compass needle from a position of magnetic north as a result of local magnetic disturbances in the aircraft. To reduce this deviation, the compass has a compensating device consisting of small adjustable magnets. The compass should be checked and compensated periodically. The errors remaining after "swinging" the compass should be recorded on a compass correction card which should be installed in the cockpit within the view of the pilot. (NOTE: Avoid placing metallic objects such as metal computers, flashlights, etc., on top of the instrument panel near the magnetic compass as this practice may induce large amounts of deviation and seriously affect the instrument's accuracy.)

In addition to these errors, the pilot should have a *working knowledge* of the following in-flight errors:

III. OSCILLATION ERROR—The erratic swinging of the compass card which may be the result of turbulence or rough pilot technique.

IV. MAGNETIC DIP—The tendency of the magnetic compass to point down as well as north in certain latitudes. This tendency is responsible for:

A. Northerly Turn Error—*This error is the most pronounced of the in-flight errors.* It is most apparent when turning to or from headings of north and south.

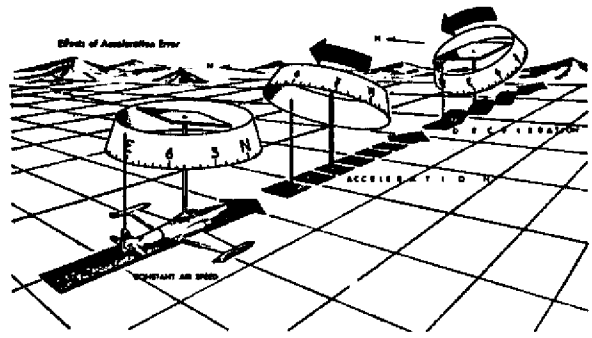
B. Acceleration Error—An error that can occur during airspeed changes. It is most apparent on headings of east and west.

As a quick refresher on this instrument's in-flight dip error, we invite you to accompany us on a simulated demonstration flight around the compass rose. Unless otherwise noted, we will limit our bank during turns to a gentle bank. Also, we will assume that we are in the northern hemisphere because the characteristics which we will observe would not be present at the magnetic equator, and would be reversed in the southern hemisphere.

DEMONSTRATION NO. 1 (Heading—North; Error—Northerly Turn Error)

As we start a turn in either direction from this heading, we notice that momentarily the compass *gives an indication of a turn opposite the direction of the actual turn.* (While the compass card is in a banked attitude, the vertical component of the earth's magnetic field causes the north-seeking end of the compass to dip to the low side of the turn, giving the pilot an erroneous turn indication.) If we continue the turn toward east or west, the compass card will begin to indicate a turn in the correct direction, *but will lag behind the actual turn*—at a diminishing rate—until we are within a few degrees east or west. One additional demonstration which we will cover before leaving north is the Slow Turn Error. If, while holding a compass indication of north, we sneak into a very gradual and shallow banked turn—say 3° or 4° of bank—it is possible to change the actual heading of the aircraft by 20° or more *while still maintaining an indication of north by the compass.*

DEMONSTRATION NO. 2 (Heading—East; Error—Acceleration Error)



The Northerly Turn Error that we previously experienced is not apparent on this heading (or on a west heading). However, let's see what happens when we accelerate and decelerate by changing the airspeed. With the wings level, we will *increase* the airspeed by increasing the power setting or by lowering the nose, or both. Result—although we are holding the nose of the aircraft straight ahead, our compass card erroneously indicates a turn toward *north.* On the other hand, if we decrease the airspeed by reducing the power setting or raising the nose of the aircraft, or both, the compass will give an erroneous indication of a turn toward *south.* (Because of the pendulous-type mounting, the end of the compass card, which the pilot sees, is tilted upward while accelerating and downward while decelerating during changes of airspeed. This momentary deflection of the compass card from the horizontal, results in an error that is most apparent on headings of east and west.)

DEMONSTRATION NO. 3 (Heading—South; Error—Northerly Turn Error)

Again we are presented with the Northerly Turn Error problem that we encountered in Demonstration No. 1. Although the same set of forces that caused the erroneous indication when we banked the aircraft while on a north heading will likewise be working against us on this heading, the compass indications will appear quite different. For example, as we roll into a turn in either direction, the compass gives us an indication of a turn in the

correct direction but at a *much faster rate than is actually being turned.* As we continue our turn toward west or east, the compass indications will continue to precede the actual turn—but at a diminishing rate—until we are within a few degrees of west or east. (It might be noted that the Acceleration Error is not apparent on this heading or on a north heading.)

DEMONSTRATION NO. 4 (Heading—West; Error—Acceleration Error)

On this heading we encounter the exact same errors that we have previously covered on a heading of east in Demonstration No. 2. If we *increase the airspeed,* we will get an erroneous indication of a *turn toward north.* If we *decrease the airspeed,* we will get an erroneous indication of a *turn toward south.* (A memory aid that might assist you in recalling this relationship between airspeed change and direction of the error is the word ANDS — Accelerate-North, Decelerate-South.)

WHAT ARE THE MAIN POINTS THAT SHOULD BE REMEMBERED CONCERNING THESE FOUR DEMONSTRATIONS?

The points we are trying to get across are these: (1) WHEN TAKING READINGS FROM THE MAGNETIC COMPASS WHILE ON A NORTHERLY OR SOUTHERLY HEADING (for establishing a course, setting the gyro-driven heading indicator, etc.), REMEMBER THAT IT IS ESSENTIAL TO HAVE THE WINGS PERFECTLY LEVEL FOR SEVERAL SECONDS PRIOR TO TAKING THE READING. (2) IF YOU ARE ON AN EASTERLY OR WESTERLY HEADING, IT IS IMPORTANT THAT THE AIRSPEED IS CONSTANT IN ORDER TO GET AN ACCURATE READING. (3) ON AN INTERMEDIATE HEADING, BOTH OF THE ABOVE CONDITIONS SHOULD BE MET. (Note: If your aircraft is equipped with a gyro-driven heading indicator, check it frequently with your magnetic compass.)

TURNS TO HEADINGS BY REFERENCE TO THE MAGNETIC COMPASS

For the pilot who would like a general set of rules for determining his lead point for making turns by reference to the Magnetic Compass, the following is submitted:

(NOTE: The angle of bank should not exceed 15° in order to minimize dip error.)

1. *When turning to a heading of north you must allow, in addition to your normal lead, a number of degrees approximately equal to the latitude at which you are flying. Example:* You are making a left turn to a heading of north in a locality where the latitude is 30°N. You have previously determined your normal lead to be approximately 5° for this particular angle of bank. In this case, you should start your rollout when the compass reads approximately 35°.
2. *When turning to a heading of south, you must turn past your normal lead point by a number of degrees approximately equal to the latitude at which you are flying. Example:* You are making a right turn to a heading of south in a locality where the latitude is 30°N. You have previously determined your normal lead to be approximately 5° for this particular angle of bank. In this case, you should turn past your normal lead point of 175° (180° — 5°) by 30°, and start your rollout when the compass reads approximately 205°.
3. *The error is negligible when turning to east or west; therefore, use the normal amount of lead when turning to an east or west heading.*
4. *For intermediate headings that lie between the cardinal headings, use an approximation based on the heading's proximity to north or south, the direction of the turn, and your knowledge of the compass's lead and lag characteristics in these areas.* In other words, use an "educated guesstimate".

We won't guarantee you that the above method will roll you out on the exact heading every time—at best, it is an approximate method. But it will get you reasonably close to your desired heading, and this beats having no method at all.

KNOW YOUR MAGNETIC COMPASS

How to Obtain EXAM-O-GRAMS

Many EXAM-O-GRAMS for Private, Commercial, and Instrument Pilots have been published, and as the need arises, more will be made available. Some EXAM-O-GRAMS are intended to provide specific, detailed information on those subjects that seem to cause applicants the most difficulty on examinations. Other EXAM-O-GRAMS deal with items of vital importance to the pilot, but available information may not adequately cover the subject for various reasons. All of the EXAM-O-GRAMS should prove most useful on any training program.

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Oklahoma City, Oklahoma

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