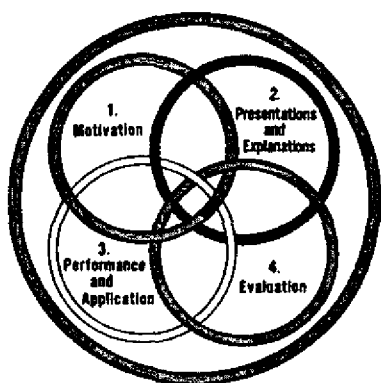


# ***Ground Instructor Written Test Guide Basic-Advanced***



**DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION**

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FEDERAL AVIATION ADMINISTRATION**

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**FLIGHT STANDARDS SERVICE**

**Ground Instructor  
WRITTEN TEST GUIDE  
Basic-Advanced**



**REVISED**

**1972**

## **Preface**

This test guide was prepared by the Federal Aviation Administration as Advisory Circular AC 143-1C to assist applicants who are preparing for the Ground Instructor Written Test. It supersedes the *Ground Instructor Examination Guide*, AC 143-1B, issued in 1967.

This guide outlines the scope of the basic aeronautical knowledge requirements for a ground instructor; acquaints the applicant with source material that may be used to acquire this basic knowledge; presents sample test items with answers and explanations, and illustrations representative of those used in the current Ground Instructor Written Test.

Comments regarding this publication should be directed to the Department of Transportation, Federal Aviation Administration, Flight Standards Technical Division, P.O. Box 25082, Oklahoma City, Oklahoma 73125.

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# **GROUND INSTRUCTOR WRITTEN TEST GUIDE**

## **FUNDAMENTALS OF INSTRUCTING**

### **BASIC-ADVANCED**

#### **Introduction**

This study guide was prepared by the Flight Standards Service of the Federal Aviation Administration. Its main purpose is to assist applicants who are preparing for the Basic or Advanced Ground Instructor Written Test. It is not offered as a quick and easy way to gain the knowledge necessary for passing the written test. 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.

Another 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 Test**

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 tests today require the ability to use basic knowledge in practical situations as well as in answering questions based on theoretical problems.

For this reason, the 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 tests 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 so that your students will be well prepared for their tests.

#### **Type of Test Questions**

The test questions are of the objective, multiple-choice type as illustrated by questions in the sample test. Each question can be answered on a special answer sheet with a pencil mark. To preclude the possibility of an applicant receiving a failing grade because of a mistake in grading, all tests scored below passing are rechecked by trained personnel.

#### **Taking the Test**

The equipment that the applicant will need for taking the test includes a protractor or plotter and a computer. It is also desirable to have a pair of dividers. The times allowed for completion are:

- A. Basic ----- 4 hours
  - B. Advanced ----- 5 hours
  - C. Fundamentals of Instructing ---- 2 hours
- (It is not necessary to take the Fundamentals of Instructing on the same day as the Basic or Advanced test.)

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

Always remember the following facts when you are taking the test:

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. Be sure you read the entire question carefully. Avoid “skimming” and hasty assumptions. This may lead to an 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 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 five or 10 questions during the time you work with one that is difficult. This procedure will enable you to make maximum use of the time available. It may mean the difference between a passing and a failing score.

5. In solving 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 small errors you may make in measuring distances, true courses, etc., it is possible that you will not get an exact agreement every time. Sufficient spread is provided between right and wrong answers, however, 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.

NOTE: When the test is constructed, various types of navigational computers are used to solve problems. The correct answer is an average of these computers; therefore, any one of the several types of computers authorized for use on FAA written tests should prove satisfactory.

## RECOMMENDED STUDY MATERIALS

The prospective Ground Instructor will find the following list of publications useful in his preparation for the written test. In addition, there are many other excellent commercially prepared textbooks, audiovisual training aids, and other instructional materials which may be helpful.

### AERONAUTICAL CHARTS

The National Ocean Survey publishes and distributes aeronautical charts of the United States. Charts for foreign areas are published by the U.S. Air Force Aeronautical Chart and Information Center (ACIC) and are sold to civil users by the National Ocean Survey.

A "Catalog of Aeronautical Charts and Related Publications" listing their prices and instructions for ordering may be obtained free, on request, from:

Distribution Division, (C-44)  
National Ocean Survey  
Washington, D.C. 20235

Orders for specific charts or publications should be accompanied by check or money order made payable to "NOS, Department of Commerce".

*Airman's Information Manual.* This publication presents, in four Parts, information necessary for the planning and conduct of flights in the U.S. national airspace. Besides providing frequently updated airport and NAVAID data, the AIM includes instructional and procedural information and is designed for use in the cockpit.

Each Part is available on a separate annual subscription to better serve the needs of the individual pilot.

**Part 1. Basic Flight Manual and ATC Procedures** (Annual subscription \$4, Foreign mailing—\$1 additional. GPO.) Catalog No. TD 4.12:Pt.1/. Issued quarterly.

**Part 2. Airport Directory** (Annual subscription \$4, Foreign mailing—\$1 additional. GPO.) Catalog No. TD 4.12:pt.2/. Issued semiannually.

**Part 3. Operational Data and Notices to Airmen** (Annual subscription \$20, Foreign mailing—\$5 additional. GPO.) Catalog No. TD 4.12:pt.3/. Issued every 28 days, supplemented by Part 3A (*Notices to Airmen*) every 28 days between issues of Part 3.

**Part 4. Graphic Notices and Supplemental Data** (Annual subscription \$1.50, Foreign mailing—\$0.50 additional. GPO.) Catalog No. TD 4.12:pt.4/. Issued semiannually.

### HANDBOOKS AND TECHNICAL MANUALS

*Pilot's Handbook of Aeronautical Knowledge.* AC 61-23A (\$4.00—GPO.) Catalog No. TD 4.408:P 64/5. This handbook contains essential, authoritative information used in training and guiding pilots. Subject areas in which an applicant may be tested are covered in the handbook. It tells how to use the Airman's Information Manual and the data in FAA-approved airplane flight manuals, as well as basic instruments for airplane attitude control.

*Personal Aircraft Inspection Handbook.* AC 20-9 (\$1.50—GPO.) Catalog No. FAA 5.8/2: Ai 7/2. This is a general guide for inspection of aircraft; Part I deals with the fundamentals of inspection and Part II covers a typical inspection in detail. As reliable inspection comes only with experience, it is emphasized that the use of this handbook by the novice does not qualify him to make final determinations regarding the airworthiness of the aircraft. This handbook supersedes TM-101 dated 1950.

*Flight Instructor's Handbook.* AC 61-16A (\$2.00—GPO.) Catalog No. TD 4.408:In 7/3. This revised handbook is one of the primary sources of information and guidance for pilots preparing for the flight instructor written test. It is basically a book which explains accepted theories and practices applicable to teaching and the learning process. Therefore, it will also prove most useful to those preparing for the Fundamentals of Instructing section of the Ground Instructor Written Test.

*Flight Training Handbook.* AC 61-21 (\$1.25—GPO.) Catalog No. FAA 1.8:F 64/4. This text deals with certain basic flight information such as load factor principles, weight and balance, and related aerodynamic aspects of flight, as well as principles of safe flight. This book also provides information and direction in the introduction and performance of training maneuvers. Thus it serves primarily as a text for student pilots, for pilots improving their qualifications or preparing for

additional ratings, and for flight instructors; however, it can also be useful to the ground instructor.

#### NAVIGATION AND WEATHER

*Practical Air Navigation.* 10th Edition. (\$4.00). This publication provides a comprehensive coverage of all subjects and areas dealing with navigation whether it be pilotage, dead reckoning, or radio and celestial navigation. Students who understand the material available in this highly recommended text will have no serious trouble with the navigation problems on their test. This text may be obtained from many book dealers or from the publisher, Jeppesen & Co., 8025 East 40th Ave., Denver, Colorado 80209.

*Aviation Weather.* AC 00-6 (\$4—GPO.) Catalog No. FAA 5.8/2:W 37. Contains information on weather phenomena for pilots and other flight operations personnel whose interest in meteorology is primarily in its application to flying.

*Federal Aviation Regulations (FARs).* The subscription prices listed include automatic revision service to all Parts contained in the Volume ordered. The FAR Parts contained in each Volume are listed in the "Advisory Circular Checklist and Status of Federal Aviation Regulations," obtainable free on request from FAA.

	Price	Additional For Foreign Mailing
Vol. I, Part 1, <i>Definitions and Abbreviations</i> ----	\$2.50	\$0.50
Vol. IX, Part 61, <i>Certification: Pilots &amp; Flight Instructors, and Part 141, Pilot Schools, and Part 143, Ground Instructors</i> -----	\$6.00	\$1.50
Vol. VI, Part 91, <i>General Operating and Flight Rules</i> -----	\$9.00	\$2.00

#### NATIONAL TRANSPORTATION SAFETY BOARD

*Procedural Regulation, Part 430.* (FREE from NTSB.) 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 Written Test Guide.* 1970 AC 61-28A (\$1.50—GPO.) Catalog No. TD 4.408:P 64/4. This guide gives detailed information on the scope and depth of knowledge required of the commercial pilot applicant.

*VFR and IFR Exam-O-Grams.* Brief, timely, and graphic articles developed and published on a continuing basis. They are nondirective in nature and are issued as an information service, particularly to individuals interested in airman written tests. They relate to concepts, practices, and procedures critical to aviation safety and assist in giving safety-oriented information to airman applicants and practicing airmen. Exam-O-Grams are available free of charge, but are limited to single copy per request. Requests for placement on the mailing list should be addressed to:

Department of Transportation  
Federal Aviation Administration  
Flight Standards Technical Division  
Operations Branch, AAC-240  
P.O. Box 25082  
Oklahoma City, Oklahoma 73125

#### HOW TO OBTAIN GPO PUBLICATIONS

1. Use an order form, not a letter unless absolutely necessary. Order forms, *which may be duplicated by the user*, are included in the catalog "FAA Publications," sent free upon request from:

Distribution Unit, TAD 484.3  
Department of Transportation  
Washington, D.C. 20590

2. Send separate orders for a subscription and a nonsubscription item.

3. Give the exact name of the publication and the agency number.

4. Send a check or money order, not cash. Send the exact amount.

5. Enclose a self-addressed mailing label if you have no order blank.

6. Use special delivery when needed.

7. Use GPO bookstores.

Several GPO bookstores have been established throughout the country for sale of publications. The public is encouraged to avail themselves of the mail order service offered by these facilities.

GPO bookstores are located at the following addresses:

GPO Bookstore  
Room 100, Federal Building  
275 Peachtree Street NE  
Atlanta, Georgia 30303

GPO Bookstore  
Room 102A, 2121 Building  
2121 Eighth Avenue North  
Birmingham, Alabama 35203



**GPO Bookstore**  
Room G25, John F. Kennedy Federal Building  
Sudbury Street  
Boston, Massachusetts 02203

**GPO Bookstore**  
Federal Office Building  
201 Cleveland Avenue SW  
Canton, Ohio 44702

**GPO Bookstore**  
Room 1463—14th Floor  
Everett McKinley Dirksen Building  
219 South Dearborn Street  
Chicago, Illinois 60604

**GPO Bookstore**  
Room 1C46  
Federal Building—U.S. Courthouse  
1100 Commerce Street  
Dallas, Texas 75202

**GPO Bookstore**  
Room 1421  
Federal Building—U.S. Courthouse  
1961 Stout Street  
Denver, Colorado 80202

**GPO Bookstore**  
Room 229, Federal Building  
231 W. Lafayette Blvd.  
Detroit, Michigan 48226

**GPO Bookstore**  
Room 135, Federal Office Building  
601 East 12th Street  
Kansas City, Missouri 64106

**GPO Bookstore**  
Room 1015, Federal Office Building  
300 North Los Angeles Street  
Los Angeles, California 90012

**GPO Bookstore**  
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26 Federal Plaza  
New York, New York 10007

**GPO Bookstore**  
U.S. Post Office and Courthouse  
Main Lobby  
Ninth and Chestnut Streets  
Philadelphia, Pennsylvania 19107

**GPO Bookstore**  
Room 1023, Federal Office Building  
450 Golden Gate Avenue  
San Francisco, California 94102

Mail orders may also be directed to:  
Superintendent of Documents  
U.S. Government Printing Office  
Washington, D.C. 20402

## STUDY OUTLINE

The study outline which follows is the framework for basic aeronautical knowledge that the prospective ground instructor must know; *every question* on the FAA test 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 student's 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 be 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 overall 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 Teaching Program.**

**1. What to test.**

- a. Understanding.
  - b. Actual performance—ability to apply knowledge to realistic problems is the only positive assurance 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—mockups, schematics, operational, sectionalized, and exploded.
- e. Training literature.
- f. Field trips.

**2. Caution in the use of instructional aids.**

- a. Contribute little unless 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 test you will 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.**

1. Follow the instructions given in the test and draw the course lines for the proposed route.

2. Determine the true courses with a protractor. Measure distances, *using the mileage scale at the bottom of the chart.* For accurate measurement, use the center of the airport symbols.

3. Study the area along your proposed route and note the locations of the following:

a. *Prominent checkpoints.*

b. Radio aids to navigation (VOR, non-directional radio beacons, VHF/DF and radar availability). Be certain to check this data against current information in the *Airman's Information Manual.*

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 FAA Flight Service Station or Weather Service Office for flight weather briefings. Be able to read and interpret the following data:

1. Surface weather map. (Identify fronts and read station model data, using the key furnished in the test.)

2. Area forecasts.

3. Terminal forecasts.

4. Winds aloft forecasts.

5. SIGMETS (significant meteorological developments) and AIRMETS (weather phenomena of less severity than that covered by SIGMETS).

6. Hourly Sequence Reports.

**C. Review the data in the flight planning publication—the *Airman's Information Manual.*** Be familiar with and able to use the information pertaining to:

1. Communication frequencies: control towers, approach control, primary traffic control, ground control, departure control, Flight Service Stations.

2. Navigation aid frequencies: VOR Stations, nondirectional radio beacons, VHF/DF, Radar.

3. NOTAMS (Notices to Airmen).

4. Special Notices: list of Military Training Routes, good operating practices, and other helpful information.

5. Airport data: location, runway information, availability of fuel and service, availability of UNICOM and weather reporting facilities, etc., lighting.

6. Review pertinent information on:

a. Enroute Cruising Altitudes.

b. Airport Traffic Control procedures.

c. Light Gun Signals.

d. Radio-telephone phraseology and techniques.

e. VOR receiver checkpoints.

f. Enroute communications.

g. U.S. Aircraft Emergency procedures, search and rescue procedures, emergency SCATANA rules (Security Control of Air Traffic and Air Navigation Aids).

h. U.S. Weather Service Office phone numbers.

i. FAA Flight Standards District Office telephone numbers.

j. Aircraft accident reporting.

**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 altitude, taking into consideration—

1. Regulations with regard to the hemispherical rule.
2. Enroute terrain and obstruction elevations.
3. VFR cloud separation requirements.
4. Winds aloft.
5. Prohibited, Restricted, Warning, and Alert Areas.

F. Review the *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 Denalt Performance Computer).
- 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 winds aloft.

1. Convert the forecast winds aloft which are given in knots to miles per hour (also convert, when required, temperatures given in Celsius to Fahrenheit or *vice versa*). Interpolate, if necessary, 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. 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.

NOTE: Except for knowledge and interpretation of instruments in relation to *attitude control* of the airplane, the Basic and Advanced Ground Instructor Written Tests 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 test, you may be questioned on additional aeronautical subjects. These subjects may not directly relate to the proposed cross-country flight, but are pertinent 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 ground-speed.

(2) Determine true heading and ground-speed.

(3) Determine wind direction and velocity.

(4) Determine true heading and true air-speed.

(5) Off-course corrections.

b. True course to compass heading.

c. Compass heading to true course. (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. Celsius—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.

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 knowledge of—

1. Aircraft structures.

2. Airframe components and control surfaces.

3. Fuel systems.

4. 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, 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 a 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. Know the importance of correct sensing.

f. Know and understand the procedures for VOR off-course navigation and for solving time and distance problems.

3. Nondirectional Radio Beacons and ADF.

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

b. 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. Understand the basic principles of operation and characteristics of flight instruments.

1. Know 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 the bowl magnetic compass:

(1) Deviation.

(2) Oscillation error.

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

(a) *Northerly turning 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 ( $V_{ne}$ ).

### III. Prestaring 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 fire.

3. Ground control or tower contacts where applicable for taxi clearance.

4. Careful observance of the oil pressure/temperature and magneto checks; 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 Fig. 12 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 FAR 91, *General Operating and Flight 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 destinations. 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 nondirectional radio beacon and VOR radials.

I. Know how to tune in and identify a radio beacon or VOR station. Understand how to utilize an air navigation radio aid, i.e., VOR radial 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 scheduled weather broadcasts. Maintain a continuous listening watch for possible in-flight weather safety advisories (SIGMET or AIRMET).

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

M. Avoid bad weather. Do not get trapped above 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. Monitor all engine instruments. Be able to recognize symptoms of carburetor icing such as loss of power. Remember that, on aircraft equipped with constant speed propellers, the initial loss of power will be reflected by decreased manifold pressure, not loss of r.p.m. The r.p.m. will remain constant 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. Before crossing a Military Training Route, be sure to check the current operational status with a Flight Service Station near the route.

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, do not switch until directed to do so by the controller, (*after turning off the active runway*) and exercise caution while taxiing to the tie-down area.

## VII. Post-Flight Activities.

A. Turn off all switches and secure the controls.

B. Close your flight plan with the appropriate facility.

C. Refuel to capacity, reducing 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 NTSB Procedural Regulation, Part 430.**

**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.)**

**G. Record airframe and engine time in appropriate logbooks.**

## SAMPLE TEST

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

The appendix contains the supplementary materials which will be required from time to time during this test. These materials include weather information, aircraft description and performance data, the flight planning data, excerpted information from the *Airman's Information Manual*, diagrams, charts, and illustrations.

This test 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 test dealing with the conditions, techniques, and

principles which control the learning process. The *Fundamentals of Instructing* section is separate from, and in addition to, the written tests on subjects which pertain to the rating he seeks (Basic, Advanced, or Instrument). The applicant may, if he chooses to do so, take the fundamentals portion on the same day that he takes the test on the subjects covered by the rating sought. He may, however, take it on another date before taking the written test on subjects pertaining to the rating sought. Regardless of his choice, he must pass both sections. It is *not* necessary, however, to take the test on *Fundamentals of Instructing* for each additional rating sought. For example, if an applicant for the Basic Ground Instructor rating passes *Fundamentals of Instructing*, it is not necessary for him to again pass the *Fundamentals of Instructing* to obtain either the Advanced Ground Instructor rating or the Instrument Ground Instructor rating.

The second section of this test 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 start on page 23.

## SAMPLE TEST

### Section 1

#### Fundamentals of Instructing

1. Test reliability refers to the

- 1—characteristic of a test which indicates consistent results for a test period over a period of time.
- 2—measure of temporary variations influenced by chance errors.
- 3—accuracy with which a test 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—public speaking technique.

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 tests 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 test is based on a flight within the state of 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. 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 a mining company. You are scheduled for a flight originating at Greenlee County Airport, Arizona, and terminating at Williams, Arizona, with intermediate stops at Holbrook, Arizona, and Flagstaff, Arizona.

You will carry three executives who are conducting a safety survey. You have established your tentative route on the 6th Edition of the Phoenix Sectional Aeronautical Chart as follows:

### LEG I

Greenlee County Airport, Arizona (see Clifton-Morenci in Airport Directory excerpts) direct to Holbrook Municipal Airport.

### LEG II

Holbrook Municipal Airport direct to Winslow VORTAC; thence direct to Flagstaff Pulliam Airport.

### LEG III

Flagstaff Municipal Airport direct to Williams Municipal Airport.

\* \* \* \* \*

The coordinates for the above airports are as follows:

Greenlee County Airport 32°57'N; 109°12'W.

Holbrook Municipal Airport 34°56'N; 110°-08'W.

Flagstaff Pulliam Airport 35°08'N; 111°40'W.

Williams Municipal Airport 35°18'N; 112°-12'W.

Your preflight activities include:

(1) Necessary review of the *Airplane Flight Manual*, *Operations Placards*, and *Owner's Handbook*, with 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 Information Manual*.

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

(4) A review of radio checkpoints and navigational facilities.

(5) Thorough check of 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 1400Z Hourly Sequence Report (see Fig. 5)

1—PHX reports a ceiling of 12,000 ft.

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 1500Z Hourly Sequence Report at Phoenix Arizona, (see Fig. 5) indicates that

1—the ceiling is 10,000 ft.

2—the ceiling is 1,200 ft.

3—the ceiling is 12,000 ft.

4—there is no reported ceiling at Phoenix.

4. You plan to depart at 0830 MST. After a study of all the Hourly Sequence Reports in Figure 5, you 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. After a study of *all* the weather information available to you, before you start the flight (see Figs. 3, 4, and 5) you determine 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. The Phoenix Sectional Aeronautical Chart is based on the Lambert Conformal Conic Projection. This type of map is used in aviation 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 most rhumb line and great circle navigational problems.

3—its directions conform closely to directions on the earth.

4—all of the above are true.

NOTE: See Figure 23 in the appendix for a diagram of this projection.

7. Suppose that pressure altitude and indicated altitude are approximately the same at 4,000 ft. *above the ground* over Prescott, Arizona. Indicated airspeed is 170 m.p.h. If you use the PRC FD (Winds Aloft Forecast) given in Figure 4 of the appendix, you determine that

1—TAS is approximately 200 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 Calibrated Airspeed (CAS) to be identical to Indicated Airspeed (IAS).

8. The statements listed below concerning the 7:00 a.m. EST surface weather map may or may not be correct.

A. Warmer air is south and east of the front while cooler air lies north and west of the front.

B. The front depicted on the weather map is an occluded front.

C. The front depicted on the weather map is a stationary front.

D. The isobar of lowest pressure that can be identified is the 1004.0-millibar line.

E. The distance between the isobars is such that the surface winds over the area pictured should be moderately strong (30 to 35 knots).

F. The surface wind at Winslow, Arizona, is from the north.

G. The surface temperature is 60° F. and dewpoint is 23° 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.
Aircraft empty weight moment -----	65.9

Using the above information, together with data from the Aircraft Description in Figure 8, you determine through use of the Loading Graph and Center of Gravity Envelope Graph (Fig. 10 of the appendix) that

1—the gross weight and balance requirements are both within limits.

2—the weight is in excess of maximum gross limit and should be reduced before an attempt is made to determine 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 limits on the basis of information supplied.

10. If you were to drain 21 gals. 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 comparatively short with two intermediate stops, so you decide to drain 21 gals. 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 ft. above the ground en-route. Your en-route altitude

1—would be indeterminable until you compute the magnetic heading.

2—should be odd thousand plus 500 ft. from Greenlee County Airport to Holbrook, Arizona.

3—should be odd thousand plus 500 ft.

4—should be even thousand plus 500 ft.

12. According to regulations concerning operations in Airport Traffic Areas, 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) 3,000 ft. above the surface of the airport at which an operative traffic control tower is located.

B. Aircraft, when operating to or from an airport having a tower operated by the United States, shall normally maintain two-way radio communication with that tower while in the Airport Traffic Area.

C. The basic VFR minimums when operating in an Airport Advisory Service Area are 5 miles visibility and a 1,500-foot ceiling.

D. 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, D.
- 2—A, B, C, D.
- 3—B, C.
- 4—A, B, C.

13. Refer to the *Airman's Information Manual* data in the appendix and determine which of the following statements are ACCURATE.

A. The Holbrook Municipal Airport, Holbrook, Arizona, has two runways.

B. The longest runway at Holbrook Municipal Airport is between 4,970 and 5,245 ft. in length.

C. A Flight Service Station is located on the Tucson Municipal Airport, Tucson, 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. At Prescott, Arizona, Runway 3-21 is closed for takeoff and landing until further notice.

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

14. Of the airports where you intend to land along your route of flight, the Winslow and Flagstaff Airports are within control zones. If you were to land here, the basic VFR weather 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 ft.

3—require 3 miles visibility and a ceiling of 1,200 ft.

4—require 3 miles visibility and a ceiling of at least 1,000 ft.

#### LEG 1

15. From the following conditions, compute the approximate compass heading and true airspeed.

Indicated airspeed	150 m.p.h.
Pressure altitude	10,000 ft.
Outside air temperature	+10° C.
True course	243°
Wind direction	230°
Wind velocity	25 knots
Magnetic variation	14° E.
Compass deviation	+3°

- 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.

16. Assuming a gross weight of 2,900 lbs., together with a surface temperature of 80° F. and an estimated surface wind of 13 knots, your approximate takeoff distance to clear a 50-foot obstacle at Greenlee County Airport is

- 1—1,156 ft.
- 2—1,188 ft.
- 3—1,078 ft.
- 4—1,006 ft.

NOTE: Refer to the performance charts (Fig. 12 of the appendix).

17. After your takeoff from Greenlee County Airport at 0830 MST, you notice as you climb out on course that you are passing through 8,800 ft. Which of the altimeter illustrations in Figure 24 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 ft. Approximately how long can you fly with a power setting of 2,200 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.

NOTE: Refer to the 10,000-ft. Cruise Performance Chart in the appendix, Figure 13.

19. While en-route to Holbrook, Arizona, you use ADF to tune in and properly identify the Winslow Nondirectional Radio Beacon. The proper setting for the function switch when warming up and tuning the ADF is

- 1—loop position.
- 2—antenna (receiver) position.
- 3—compass position.
- 4—aural null position.

20. VORs and VORTACs are classified as H, L, and T. If a VOR of the T classification is used for navigation at altitudes above 12,000 ft., dependable navigation signals may be received because

- 1—transmitter signal strength is less than that of the H or L ranges.
- 2—course azimuth is not accurate above 12,000 ft.
- 3—signals from another range may interfere.
- 4—atmospheric conditions affect the signal.

## LEG II

21. If you select 10,500 ft. 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 air temperature of +15° C. and the winds aloft as 230° at 25 knots, you compute the estimated average ground-speed 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: 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 approximately 3 miles behind and slightly below a four-engine 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 wingtips.

C. Clean, 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 26 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.

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 lbs. Referring to the illustrations in Figure 27 in the appendix, which of the following statements are correct?

A. In the situation depicted in illustration A, your approximate effective gross weight is 3,668 lbs.

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. To remain at or below a speed that would decrease the possibility of structural damage, you should not exceed the speed indicated by the

- 1—red radial line.
- 2—upper limit of the white arc.
- 3—upper limit of the green arc.
- 4—upper limit of the yellow arc.

27. In the vicinity of Winslow, Arizona, you decide to combine ADF navigation and pilotage. You tune in and identify the Winslow Nondirectional Radio Beacon. 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 28 in the appendix. This means you have a

- 1—magnetic bearing of 45° to the station. 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. You are southeast of the station.
- 4—magnetic bearing of 45° to the station. 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 Municipal Airport, after a total flying time of 1 hour and 15 minutes since leaving Greenlee County Airport. 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 12 of the appendix, your landing distance for clearing a 50-foot obstacle is approximately

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

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

### 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 and 4 of the appendix indicates that there should be

- 1—only scattered clouds at 8,000 ft. 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 ft. MSL, and turbulence should gradually decrease.
- 4—scattered clouds at 8,000 ft., broken clouds 12,000 to 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 omnibearing selector set on 270°. If you did not know your position and used *only* your omni, which reads as illustrated in Figure 29 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 while taxiing to the flight line on Williams Municipal Airport your nosewheel collapses. The damage is in excess of \$300.00. If you were unsure about accident reporting procedures, you could find the necessary information in

- 1—Vol. IX, Part 61, Federal Aviation Regulations.
- 2—Vol. IX, Part 67, Federal Aviation Regulations.
- 3—Vol. I, Part 1, Federal Aviation Regulations.
- 4—National Transportation Safety Board, Procedural Regulation, Part 430.

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.



## ANSWERS AND EXPLANATIONS

### Section 1

#### Fundamentals of Instructing

1. (1) 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) Alternates #1 and #2 are not complete. Alternate #4, while useful, is not as essential to success in teaching as item #3.

3. (3) 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 *Flight Instructor's Handbook*, AC 61-16A. 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 other 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.

### Section 2

#### Aeronautical Knowledge

1. (2) FAR 91.5, *Preflight Action*, states: "Each pilot in command shall, before beginning a flight, familiarize himself with all available information concerning that flight. This information must include, for a flight under IFR or a flight not in the vicinity of an airport, available weather reports and forecasts, fuel requirements, alternatives available if the planned flight cannot be completed, and any known traffic delays of which he has been advised by ATC."

2. (4) The 1400Z Sequence Report for GNT shows the numbers "Ø Ø Ø Ø" in the space for surface wind and denotes a calm wind condition.

3. (4) The reported layer of *thin* scattered clouds at 12,000 feet does not constitute a ceiling. (Reference *Aviation Weather*, AC 00-6, and Part 1 of the Federal Aviation Regulations.)

4. (4) The study of only hourly sequence reports will not furnish sufficient information to make a route forecast. (Reference *Aviation Weather*, AC 00-6.)

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 ft. until at least 1900M. Area forecasts covering the period between 0600 MST and 1800 MST call for light to moderate turbulence with locally severe turbulence 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. 16-28, *Practical Air Navigation*, 10th edition.)

7. (1) Using a pressure altitude of 9,042 (4,000 ft. plus ground elevation at PRC) and a forecast temperature of +12° C., your computer should indicate approximately 200 m.p.h. TAS opposite a CAS of 170 m.p.h. Normally the indicated airspeed should be corrected for instrument and installation errors to be calibrated airspeed. This can be done through the use of an airspeed correction table as shown in Figure 32. 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 warmer air as represented by the station symbols at the 10 o'clock position. The air mass to the northwest of the front is composed of cooler air. (Reference *Aviation Weather*, AC 00-6.) The front is stationary as indicated by a combination of the warm front and cold front symbols and their placement (opposing) on the frontal line.

Isobars are lines connecting points of equal pressure. The isobar curving southward from Casper, Wyoming, and northward into Nebraska; the isobar surrounding Grand Junction, Colorado; the isobar around the low over Las Vegas, Nevada, represent a pressure of 1004.0 millibars.

The figure "60" at the 10 o'clock position and the figure "23" at the 8 o'clock position on the Winslow station model represents a temperature of 60° F. and a dewpoint of 23° F. respectively. (See the specimen station model in Figure 6.)

9. (2) The empty weight, including unusable fuel, is 1,839 lbs. (Figures 8 and 10). The empty weight moment is approximately 65,000 pound-inches (empty weight X empty C.G.).

### LOADING PROBLEM

	Weight in	Moment in Thousand Pound- Inches
Airplane (empty) -----	1,839	65.9
Pilot and Front Seat Passenger	315	11.5
Rear Seat Passengers -----	365	25.4
Fuel (55 gal. @ 6 lbs. per gal., Fig. 11) -----	330	15.8
Oil (3 gal. @ 7.5 lbs. per gal., Fig. 11) -----	22.5	-4
Baggage -----	150	14.1*
<b>TOTAL</b> -----	<b>3,021.5</b>	<b>132.3</b>

\* Taken from Loading Graph, Figure 10.

Your gross weight is 121.5 lbs. in excess of the maximum allowable gross weight; therefore, you must reduce the load to 2,900 lbs. or less and compute the center of gravity. (Reference Figures 8 and 10, and *Flight Training Handbook*, AC 61-21.)

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 lbs. in the baggage compartment. (Reference Figure 8.)

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

a. Below 18,000 ft. At an altitude appropriate to the magnetic course being flown as follows:

(1) zero degrees to 179° inclusive, at odd thousands plus 500 (3,500; 5,500; etc.).

(2) 180° to 359° inclusive, at even thousands plus 500 (4,500; 6,500; etc.). (Reference FAR 91.109.)

12. (1) Statements A, B, and D are correct. (Reference FAR 1, *Definitions*, for Statement A; FAR 91.87, *Operation at Airports with Operating Control Towers*, for Statements B and D.)

13. (3) Statements B, C, and E are accurate and may be verified by referring to Figures 17, 18, and 19 in the appendix. A careful analysis of Figures 17, 18, and 19 will reveal that statements A, D, and F are erroneous.

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 ft. 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 FAR 91.105.

15. (1) Given Indicated Airspeed  
—150 m.p.h.

Given Pressure Altitude  
—10,000 Ft.

Given Outside Air Temperature  
—+10° C.

Computed True Airspeed  
—180 m.p.h.

Plotted True Course  
—243°

Wind  
—230°/25 knots

Computed Wind Correction Angle  
—2°

Computed True Heading  
—241°

Magnetic Variation  
—14° E.

Computed Magnetic Heading  
—227°

Figure Compass Deviation  
—+3°

Computed Compass Heading  
—230°

16. (2) The elevation of Greenlee County Airport is 3,811 ft. Referring to the takeoff data chart in Figure 12, you will note that interpolation between the 2,500-foot and 5,000-foot column will be necessary. Enter the chart at the 2,900 lb. gross weight block and read across (right) on the 15 m.p.h. (13 knots) line to:

2,500 ft.—950' to clear 50' obstacle

5,000 ft.—1,200' to clear 50' obstacle

Difference—250'

Interpolate for 3,811 feet—52% of 250' plus 950 ft. or 1,080 ft. to clear a 50' obstacle at standard temperatures

Interpolated standard temperature for 3,811 feet is +55° F. Current temperature of +80° F. will necessitate increasing the takeoff distance by 10% (current temperature is 25° higher than standard).

*Final Computed Takeoff Distance at Greenlee County Airport is 1,188 ft.*

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

A. 880 ft.

B. 8,800 ft.

- C. 18,800 ft.  
D. 7,880 ft.

18. (1) Figure 13 in the appendix shows a fuel consumption of 9.8 gal./hr. at 10,000 ft. with a power setting of 2,200 r.p.m. and 19 inches of manifold pressure. Subtracting the 30-minute fuel reserve from the total of 33 gals. leaves 28.1 gals. of fuel (33 gals. minus 4.9 gals). Burning 28.1 gals. of fuel at the rate of 9.8 gals. per hour would permit 2 hours 52 minutes of flying. Study the charts until you understand their use.

19. (2) When tuning a radio compass, the set should be allowed to warm up with the switch in the "Ant" or "Rec" position.

20. (3) The H, L, and T Classifications have a power output necessary to provide coverage within their assigned operational service volume. Since the frequency of an LVOR is not protected above 12,000 ft., another VOR on the same frequency may be close enough to produce signal interference through spillover which would result in undependable or inadequate indication in the aircraft.

21. (1) You must first correct indicated airspeed to true airspeed. An indicated airspeed of 170 m.p.h. at 10,500 ft. 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. Averaging true courses is not always absolutely accurate; however, in this case the difference in groundspeeds over the two segments is negligible; therefore, the time difference would be slight. The winds aloft forecast at 10,000 ft. 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 approximately 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 Chapter 18 of AC 61-23A, *Pilot's Handbook of Aeronautical Knowledge*.

23. (1) This problem is covered in detail in AC 90-23C, *Wake Turbulence*. You should study this publication.

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.

25. (4) The load factor for a 40° bank is determined by using the graph in Figure 27. This graph gives a load factor of approximately 1.31 for a 40° bank. Multiplying 2,800 by 1.31 results in an effective gross weight of 3,668 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.

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 FAR 23.1545.

27. (3) The magnetic bearing to the station is the magnetic heading  $\pm$  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 south-east 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 chapters 7 and 13 of *Practical Air Navigation* (10th Edition).

**28.** (1) Flying for 1 hour 15 minutes and burning fuel at the rate of 10 gals. per hour would mean a gross weight reduction of approximately 75 lbs. Interpolating weight to the closest 500 lbs. would mean using a weight of 2,900 lbs. for the following computation:

- (a) A 10-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 ft.; thus the closest 1,000-ft. value is 7,000 ft.
- (d) Interpolating on the chart, with a gross weight of 2,900 lbs. at 7,000 ft. and standard temperature, the landing distance to clear a 50' obstacle is 1,390 feet.
- (e) A 40% reduction of 1,390 ft. is 556 ft.
- (f) Subtracting 556 ft. from 1,390 ft. equals 834 ft.
- (g) This figure is valid only if the temperature is standard at 7,000 ft.

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

\*FA 1845Z

\*FT 2245Z

\*WA-A 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 ft. MSL. The 2320Z AIRMET indicates that the moderately turbulent conditions existing below 14,000 ft. in northern New Mexico and Arizona should decrease to light turbulence by 1900 MST. Study Chapter 17, *Aviation Weather*.

**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 33 of AC 61-23A, *Pilot's Handbook of Aeronautical Knowledge*, chapter 13 of the 10th edition of *Practical Air Navigation*, and VFR Exam-O-Grams 15 and 16.

**31.** (4) Figure 22 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. hp.) 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. If the r.p.m. is reduced *first* it 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 carburetor heat with full power setting will tend to cause or increase detonation.

\*See Figure 2 for meaning of code.

# 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 - Santa Fe, New Mexico  
TUS - Tucson, Arizona  
ZUN - Zuni, New Mexico

FIGURE 1. Station identifiers.

FT - Terminal Forecasts  
FA - Area Forecasts  
FD - Winds Aloft Forecasts  
WS - SIGMET - Weather significant to safety of all aircraft  
WA - AIRMET - Weather phenomena of operational interest to all aircraft, but potentially hazardous to aircraft of limited capability.  
UB - Pilot Report Summary  
SA - Hourly Sequence Report  
WW - Severe Weather Forecasts  
AC - Severe Weather Outlooks  
SD - Individual Single Station Radar Report

FIGURE 2. Letter designators for reports and forecasts.

## WEATHER INFORMATION

### Area Forecast

FA ABQ 111245Z  
13Z FRI - 01Z SAT (0600 MST - 1800 MST FRI)  
NRN ARIZ NRN NEW MEX

CLDS AND WX. MOSTLY CLR WITH OCNL -0 ABV 180 MSL. SCTD CU DVLPG  
OVR MTNS BCMG 140-1500 MSL DURG THE AFTN WITH A FEW HIGH LVL SHWRS  
OVR THE MTNS. SFC WND S W OF CONTDVD LCLY UP TO 1825G BY 1100M

ICG. LGT ICGIC. FRZG 135-145

TURBC LGT TO MDT. MDT TURBC TO 150 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  
19Z FRI - 07Z SAT  
NRN ARIZ NRN NEW MEX

CLDS AND WX. ERN PLAINS OF NRN NEW MEX 110-1200MSL CLRG AFT 2200M.  
NRN ARIZ AND RMNDR NRN NEW MEX 1300MSL WITH ABV 1500V0MSL BRFLY  
1200 MSL IN FEW SHWRS DURG EVE HRS. AFT 21M ABV 1500V0 MSL

ICG. NONE. FRZG LVL 120 - 135 MSL

TURBC. MDT FOR LGT ACFT DCRG DURG EVE BCMG LGT AFT 20M

OTLK 00M - 12M SAT. CLR OR ABV 1500 MSL DURG MRNG HRS. AFT 12M  
SCTD CU BASES 120 MSL BRFLY BRKN OVR MTNS IN FEW SHWRS

FIGURE 3. Area forecasts.

## Terminal Forecasts

FT 111045

INW 111123 O. 19Z 900 2325..  
 PRC 111123 O 2012. 17Z 8001200 2020..  
 FLG 111123 O. 17Z 7001200 2020..  
 FMN 111123 O. 19Z 900 2320..  
 ABQ 111123 O. 20Z 1000 2325..  
 FT 112245

INW 112311 O. 8001200 2525G. 02Z 1000..  
 PRC 112311 O. 80001200 2320G30. 02Z 01500. 05Z 150-0..  
 FLG 112311 O. 80001200 2020G. 02Z 01200 2325G. 05Z 120-0..  
 FMN 112311 O. 0800 2320 00ONLY 0700 BRF RW- VCNTY. 03Z 01000..  
 ABQ 112311 O. 8001200 2020 00ONLY 0800 2525G30. 02Z 1000..

## Winds Aloft Forecasts (FD)

10Z - 22Z (0300MST - 1500MST)

FT	3000	6000	9000	12000	18000
ABQ		2020	2325+10	2730+03	2740-10
FMN	1915	1920+18	2030+10	2040+02	2140-10
PRC		2715+20	2830+12	2940+05	3040-10
BLD		2816+22	3032+14	3131+07	3242-12
BCE		3018+24	3234+16	3444+09	3444-14

## In-Flight Weather Advisories

ABQ WA-A 111345Z  
 0645M - 1045M FRI  
 AIRMET ALPHA 1. NRN ARIZ AND W OF CONTDVD IN NW N NEW MEX LGT TO  
 LCLY MDT TURBC BLO 80 MSL WITH STNG DOWNDRAFTS OVER LEE SLPS  
 ABQ WA-A 112320Z  
 1620M - 1900M FRI  
 AIRMET ALPHA 2. NRN ARIZ NRN NEW MEX MDT TURBC BLO 140 MSL DCRG  
 BCMG LGT BY 1900M

FIGURE 4. Terminal forecasts, winds aloft forecasts, and in-flight weather advisories.

## Pilot Report Summaries

ABQ UB 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 C310

ABQ UB 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

SA 111400Z

PRC 140-020+064/60/32/1810/985

FLG 120-015+ 055/55/18/1812G18/993

INW 100060 045/55/26/1810/998

ZUN 120020+ 070/55/30/2005/995

GNT 120-035 065/55/31/0000/001

PHX 900120-045 075/70/30/2704/HK ALQDS

TUS E1500300050 060/75/35/1810/983

### Hourly Sequence Weather Reports 08M

SA 111500Z

PRC 130045 067/68/31/2728/991

FLG 120020+ 065/60/30/2015/993

INW 100060+ 047/65/31/1815/989

ZUN 100-025 065/60/33/2310/999

GNT 1200300-035 060/65/32/1810G15/000

PHX 1000120-035 082/75/33/2705/HK ALQDS

TUS E1500300070 075/75/32/2315/985

FIGURE 5. Pilot report summaries and hourly sequence reports.



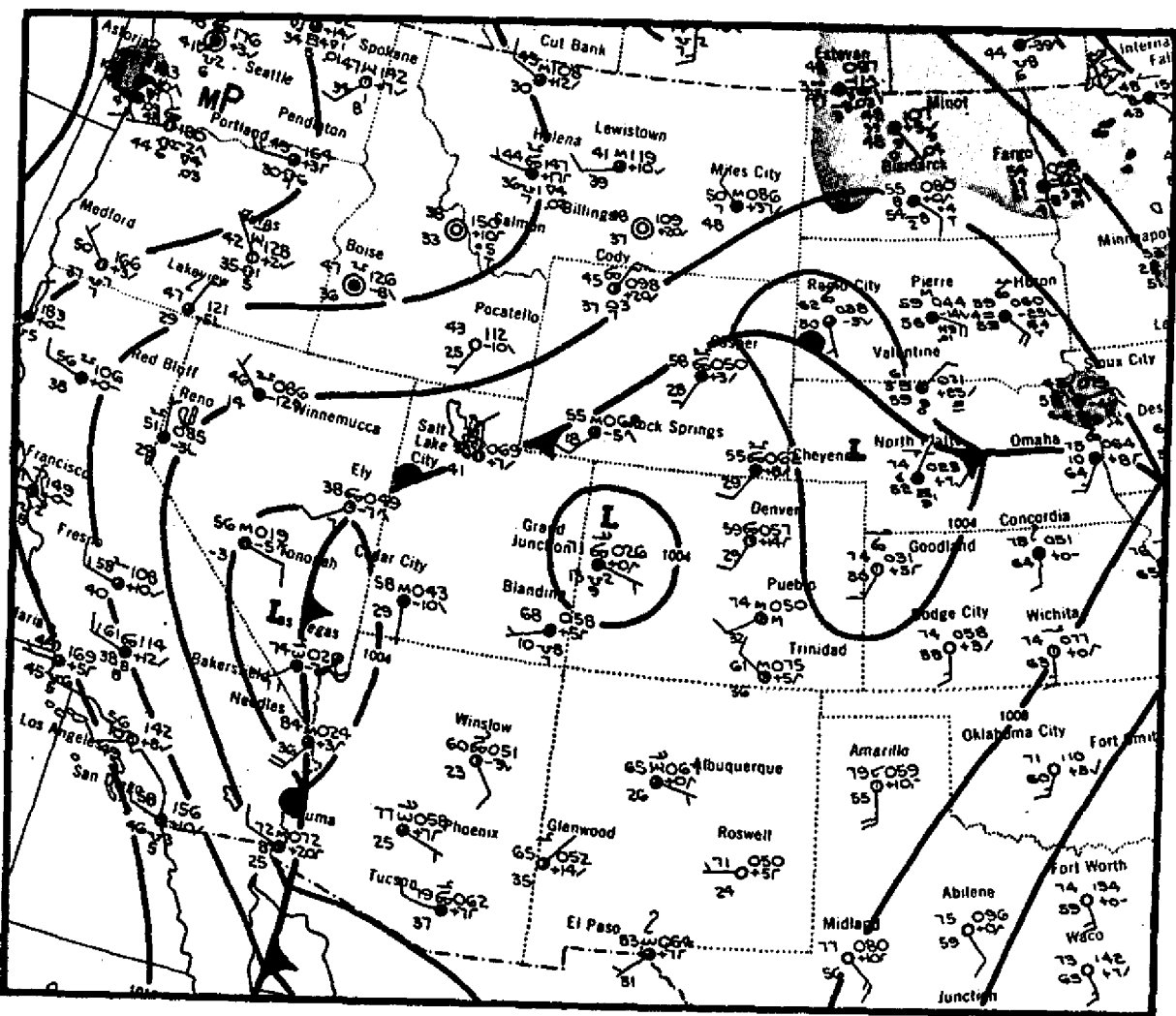


FIGURE 6a. Daily weather map excerpt.

# SURFACE WEATHER MAP AND STATION WEATHER AT 7:00 A. M., E. S. T.

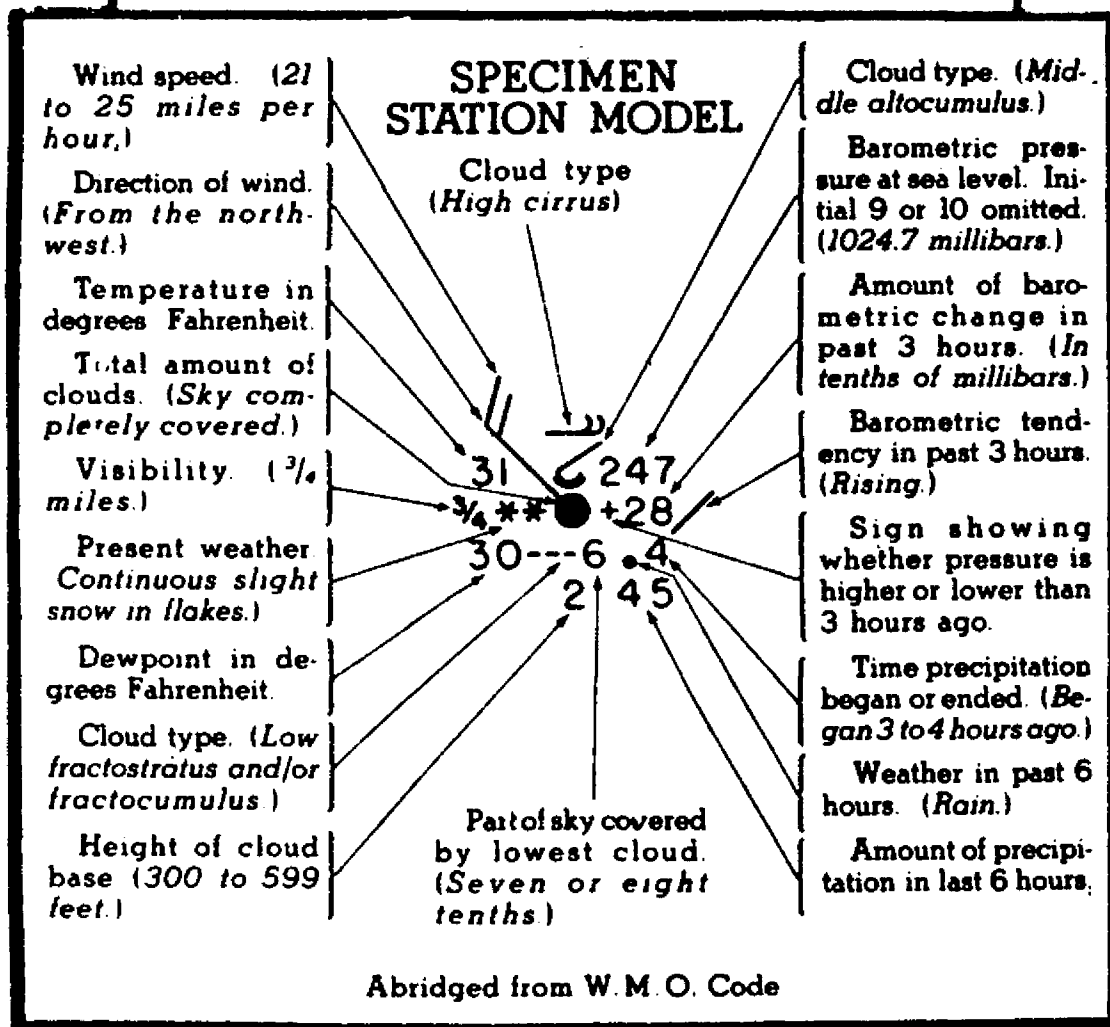


FIGURE 6b. Daily weather map excerpt—station weather.

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 7. 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)

table
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 8. Aircraft description placard (excerpt from Airplane Flight Manual).

## RADIO EQUIPMENT

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 9. Radio equipment and compass correction card.

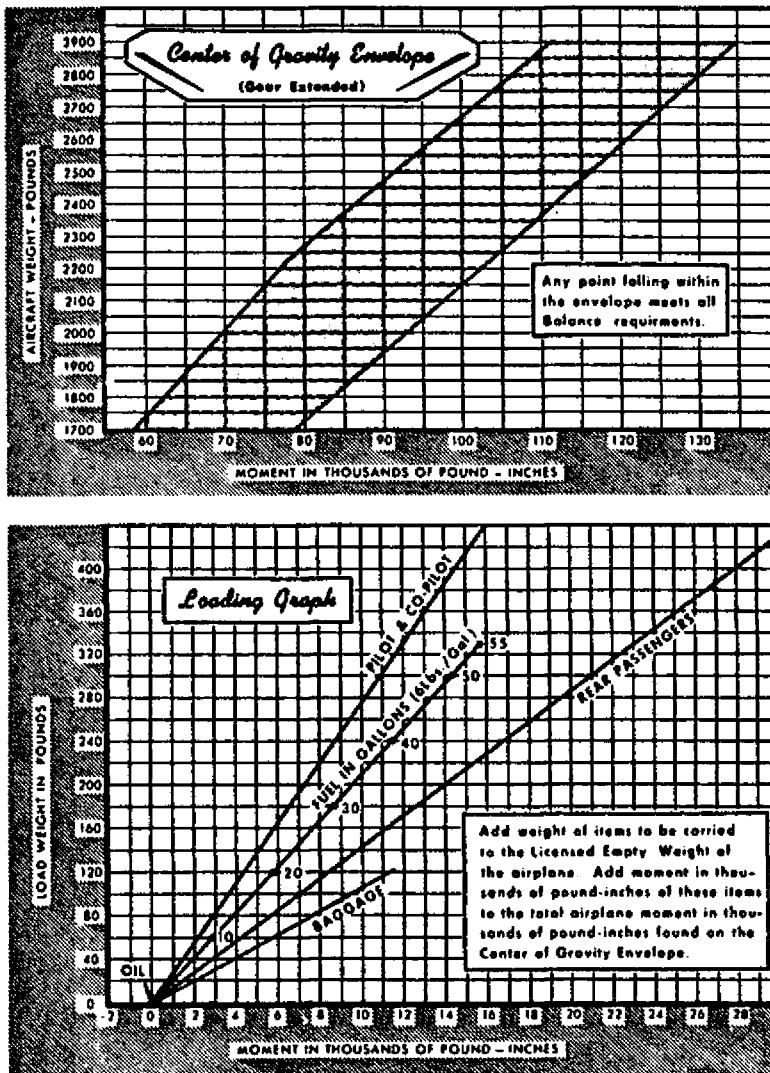


FIGURE 10. Center of gravity envelope and loading graph.

## 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 10.

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 in the aircraft maintenance records in accordance with Federal Aviation 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 latest entry pertaining to weight and balance in the aircraft maintenance record.
- (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 65,873 pound-inches: (Empty weight of 1,839 lbs. multiplied by the number of inches the empty C. G. is from the datum—in this airplane 35.82 inches. The figure thus obtained is arbitrarily divided by 1,000, the moment in pound inches.)

	<u>Weight</u> <u>Pounds</u>	<u>Moment (lb-in)</u> <u>1000</u>
Empty Weight (licensed) .....	1839.0	65.9
Oil (12 qts.) .....	22.5	-0.4
Pilot and 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
<b>TOTAL</b> .....	<b>2900.0</b>	<b>120.0</b>

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 11. Weight and balance.

## 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	1280	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	1160	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	100	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	1265	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 12. Takeoff, climb, and landing distance 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 13. Cruise performance chart.



## AIRPORT/FACILITY DIRECTORY

### LOCATION

The airport location is given in nautical miles (to the nearest mile) and direction from center of referenced city.

### ELEVATION

Elevation is given in feet above mean sea level and is based on highest usable portion of the landing area. When elevation is sea level, elevation will be indicated as "00." When elevation is below sea level, a minus sign (-) will precede the figure.

### RUNWAYS

The runway surface length, and weight bearing capacity are listed for the longest instrument runway or sealane, or the longest active landing portion of the runway or strip, given to the nearest hundred feet, using 70 feet as the division point, i.e., 1468 feet would be shown as "14"; 1474 feet would be shown as "15". Runway lengths prefixed by the letter "H" indicates that runways are hard surfaced (concrete; asphalt; bitumen, or macadam with a seal coat). If the runway length is not prefixed, the surface is sod, clay, etc. The total number of runways available is shown in parenthesis. (However, only hard surfaced runways are counted at airfields with both hard surfaced and sod runways.)

### RUNWAY WEIGHT BEARING CAPACITY

Runway strength data shown in this publication is derived from available information and is a realistic estimate of capability at an average level of activity. It is not intended as a maximum allowable weight or as an operating limitation. Many airport pavements are capable of supporting limited operations with gross weights of 25-50% in excess of the published figures. Permissible operating weights, insofar as runway strengths are concerned, are a matter of agreement between the owner and user. When desiring to operate into any airport at weights in excess of those published in this publication, users should contact the airport management for permission.

Add 000 to figure following S, D, DT and MAX for gross weight capacity, e.g., (S-000).

S—Runway weight bearing capacity for aircraft with single-wheel type landing gear. (DC-3), etc.

D—Runway weight bearing capacity for aircraft with twin-wheel type landing gear. (DC-6), etc.

DT—Runway weight bearing capacity for aircraft with twin-tandem type landing gear. (707), etc.

Quadricycle and twin-tandem are considered virtually equal for runway weight bearing considerations, as are single-tandem and twin-wheel.

Omission of weight bearing capacity indicates information unknown. Footnote remarks are used to indicate a runway with a weight bearing greater than the longest runway.

### LIGHTING

B: Rotating Beacon. Green and white, split-beam and other types.

L: Field Lighting. An asterisk (\*) may precede an element to indicate that it operates on prior request only (by phone call).

- 4—Low Intensity Runway
- 5—Medium Intensity Runway
- 6—High Intensity Runway
- 7—Instrument Approach (neon)
- 7A—Medium Intensity Approach Lights (MALS)
- 8—High Intensity Instrument Approach (ALS)
- 10—Visual Approach Slope Indicator (VASI)
- 11—Runway end identifier lights (threshold strobe) (REIL)
- 12—Short approach light systems (SALS)
- 13—Runway alignment lights (RAIL)
- 14—Runway centerline
- 15—Touchdown zone

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

### SERVICING

- S2: Minor airframe repairs.
- S3: Minor airframe and minor powerplant repairs.
- S4: Major airframe and minor powerplant repairs.
- S5: Major airframe and major powerplant repairs.

### FUEL

(Fuel data includes each grade available.)

Code	Grade
F12	80/87
F15	91/98
F18	100/130
F22	115/145
F30	Kerosene, freeze point -40°F
F34	Kerosene, freeze point -58°F
F40	Wide-cut gasoline, freeze point -60°F
F45	Wide-cut gasoline without icing inhibitor, freeze point -60°F

### OXYGEN

Ox1	High Pressure
Ox2	Low Pressure
Ox3	High Pressure—Replacement Bottles
Ox4	Low Pressure—Replacement Bottles

FIGURE 14. Airport/facility directory.

## OTHER

**1**—NOTAM Service is provided. Applicable only to airports with established instrument approach procedures, or high volume VFR activity.

**AOE**—Airport of Entry—A customs Airport of Entry where permission from U.S. Customs is not required, however, at least one hour advance notice of arrival must be furnished.

**FSS**—The name of the associated FSS is shown in all instances. When the FSS is located on the named airport, "on fld" is shown following the FSS name. When the FSS can be called through the local telephone exchange, (Foreign Exchange) at the cost of a local call, it is indicated by "(LC)" (local call) with the phone number immediately following the name of the FSS, i.e., "FSS: WICHITA (LC481-5867)." When an Interphone line exists between the field and the FSS, it is indicated by "(DL)" (direct line) immediately following the name of the FSS, i.e., "FSS: OTTO (DL)."

**IFR**—Airport with approved FAA Standard Instrument Approach Procedure.

**LRA**—Landing Rights Airport—Application for permission to land must be submitted in advance to U.S. Customs. At least one hour advance notice of arrival must also be furnished.

**TCH**—Threshold Crossing Height.

**RRP**—Runway Reference Point.

**RVV**—Runway Visibility Values, applicable runway provided.

**RVR**—Runway Visual Range, applicable runway provided.

**TPA**—Traffic Pattern Altitude.

**VASI**—Visual Approach Slope Indicator, applicable runway provided.

## AIRPORT REMARKS

"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.

"Rgt Hc 13-31" indicates right turns should be made on landings and takeoffs on runways 13 and 31.

Remarks data are confined to operational items affecting the status and usability of the airport, traffic patterns and departure procedures.

**Obstructions.**—Because of space limitations only the more dangerous obstructions are indicated. Natural obstructions, such as trees, clearly discernible for contact operations, are frequently omitted. On the other hand, all pole lines within at least 15:1 glide angle are indicated.

## FLIGHT SERVICE STATIONS

Flight Service Station (FSSs) and Combined Station/Tower (CS/Ts) are listed alphabetically by state in the Airport/Facility Directory. At certain locations the preflight briefing and flight plan processing responsibilities of the CS/T have been reassigned to an adjacent FSS. At these locations the adjacent FSS will be listed as the 'Associated FSS,' otherwise, the CS/T will be listed. Limited Remote Communications Outlet (LRCO) and Remote Communications Outlet (RCO), where

available at the facility, are shown following the three letter identifier. If located at other than a facility site they are listed alphabetically.

FSSs and CS/Ts provide information on airport conditions, radio aids and other facilities, and process flight plans. Airport Advisory Service is provided at the pilot's request on 123.6 by FSSs located at non-tower airports or when the tower is not in operation. (See Part 1, ADVISORIES AT NON TOWER AIRPORTS.)

Aviation weather briefing service is provided by FSSs and CS/Ts; however, CS/T personnel are not certified weather briefers and therefore provide only factual data from weather reports and forecasts. Flight and weather briefing services are also available by calling the telephone numbers listed in the chapter entitled 'FSS-CS/T Information and Weather Service Office Telephone Numbers,' located in Part 2."

Civil communication frequencies used in the flight service station air/ground system are now operated simplex on 122.0, 122.2, 122.3, 122.6, 123.6 and emergency 121.5 plus 122.1 and 123.6 receive only as follows:

a. 122.0 is assigned at selected FSSs as a weather channel for both general aviation and air carriers.

b. 123.6 is designated as an airport advisory channel at all FSSs which provide this service at nontower locations. 123.6 is still in commission at some FSSs collocated with towers for the purpose of providing part-time Airport Advisory Service.

c. Some FSS's use 123.65 or certain 50 KHz channels in the 122-123 MHz band (such as 122.05). Pilots using the FSS A/G system should refer to this directory or appropriate charts to determine frequencies available at the FSS or remote facility through which they wish to communicate.

Part time FSS hours of operation are shown in remarks under facility name.

## COMMUNICATIONS

Clearance is required prior to taxiing on a runway, taking off, or landing at a tower controlled airport.

When operating at an airport where the control tower is operated by the U.S. Government, two-way radio communication is required unless otherwise authorized by the tower. (When the tower is operated by someone other than the U.S. Government, two-way radio communication is required if the aircraft has the necessary equipment.)

Frequencies transmit and receive unless specified as: T—Transmit only, R—Receive only, X—On request. Primary frequencies are listed first in each frequency grouping, i.e., VHF, LF. Emergency frequency 121.5 is available at all TOWER, APPROACH CONTROL and RADAR facilities, unless indicated as not available in remarks.

Radar available is listed under "RADAR SERVICES" Radar beacons are indicated by "(BON)" after "RADAR SERVICES", when available.

## COMMUNICATIONS REMARKS

Remarks data are confined to operational items affecting the status and usability of navigational aids, such as: ILS component restrictions, part time hours of operation, frequency sectorization, VOT frequencies.

FIGURE 15. Airport/facility directory.

# AIRPORT/FACILITY DIRECTORY

## VOICE CALL

The voice call for contact with the air traffic control tower is listed at each airport assigned such a facility.

## SERVICES AVAILABLE

### TOWER

Pre-Taxi Clearance Procedure  
Clearance Delivery (CLRNC DEL).  
Approach Control (App Con) Radar and Non-Radar.  
Departure Control (Dep Con) Radar and Non-Radar.  
VFR Advisory Service (VFR ADV) Service provided by Non Radar Approach Control.  
Radar Advisory Service for VFR Acft (Stage I).  
Radar Advisory and Sequencing Service for VFR Acft (Stage II).  
Radar Sequencing and Separation Service for VFR Acft (TCA).  
Ground Control (GND CON).  
VHF Direction Finding (VHF/DF).

### RADIO NAVIGATION AIDS

Included in this section is a tabulation of all Air Navigation Radio Aids in the National Airspace System and those upon which the FAA has approved an instrument approach. Private or military Navigation Radio Aids not in the National Airspace System are not tabulated.

### AUTOMATIC TERMINAL INFORMATION SERVICE (ATIS)

ATIS is continuous broadcast of recorded non-control information in selected areas of high activity. See Part 1.

### FLIGHT SERVICE STATION (FSS)

Airport Advisory Service (AAS).  
Island, Mountain and Lake Reporting Service.  
Remote Weather Radar Display (WR).  
VHF Direction Finding (DF).

### UNICOM

A private aeronautical advisory communications facility operated for purposes other than air traffic control, transmits and receives on one of the following frequencies:

- U-1—122.8 MHz for Landing Areas (except heliports) without an ATC Tower or FSS;
- U-2—123.0 MHz for Landing Areas (except heliports with an ATC Tower or FSS);
- U-3—123.05 MHz for heliports with or without ATC Tower or FSS;
- U-4—122.85 MHz for landing areas not open to the public;
- U-5—122.95 MHz for landing areas not open to the public.

NOTE.—UNICOM used for communications must be licensed by the Federal Communication Commission in order to be listed in this publication.

## RADIO CLASS DESIGNATIONS

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

### Normal Usable Altitudes and Radius Distances

Class	Altitudes	Distance (miles)
T	12,000' and below	25
L	Below 18,000'	40
H	Below 18,000'	40
H	14,500' — 17,999'	100*
H	18,000' — FL 450	130
H	Above FL 450	100

\*Applicable only within the contiguous 48 States.

H=High L=Low T=Terminal

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

The term VOR is, operationally, a general term covering the VHF omnidirectional bearing type of facility without regard to the fact that the power, the frequency-protected service volume, the equipment configuration, and operational requirements may vary between facilities at different locations.

- AB ----- Automatic Weather Broadcast (also shown with ■ following frequency).
- B ----- Scheduled Broadcast Station (broadcasts weather at 15 minutes after the hour).
- DME ----- UHF standard (TACAN compatible) distance measuring equipment.
- H ----- Non-directional radio beacon (homing), power 50 watts to less than 2,000 watts.
- HH ----- Non-directional radio beacon (homing), power 2,000 watts or more.
- H-SAB ----- Non-directional radio beacons providing automatic transcribed weather service.
- ILS ----- Instrument Landing System (voice, where available, on localizer channel).
- LMM ----- Compass locator station when installed at middle marker site.
- LOM ----- Compass locator station when installed at outer marker site.
- MH ----- Non-directional radio beacon (homing) power less than 50 watts.
- SABH ----- Non-directional radio beacon having limited navigational use. Provides automatic weather broadcasts.
- SDF ----- Simplified Direction Facility
- 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 on radio facility frequency.
- Z ----- VHF station location marker at a LF radio facility.

FIGURE 16. Airport/facility directory.

# AIRPORT/FACILITY DIRECTORY

## SAMPLE

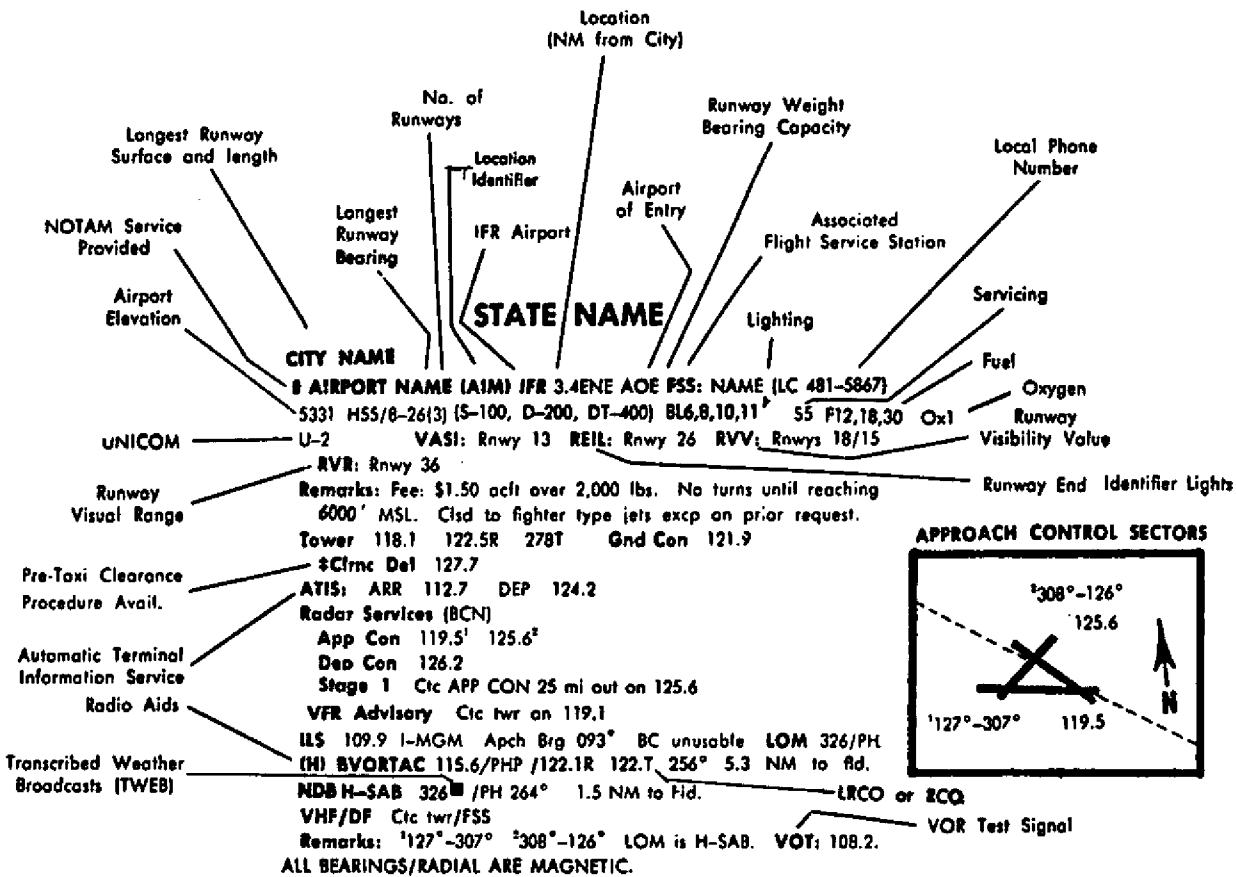


FIGURE 17. Airport/facility directory.

# AIRPORT/FACILITY DIRECTORY

## ARIZONA

BUCKEYE (L) BVORTAC 110.6/BXK/122.1R	FSS: PHOENIX	PRESCOTT FSS 121.5 122.1R 122.2 122.6 123.6	DF
CASA GRANDE (L) BVORTAC 114.8/CZG/122.1R	FSS: PHOENIX	Remarks: No wea bcat avbl 2200-0400 lcl time.	
COCHISE (L) BVORTAC 110.4/CIE/122.1R	FSS: DOUGLAS	PRESCOTT (H) BVORTAC 114.1/PRC	FSS: PRESCOTT
DOUGLAS FSS 121.5 122.1R 122.3 122.6 123.6		RYAN NDB H-SAB 338 <sup>■</sup> /RYN	FSS: TUCSON
Remarks: No wea bcat avbl 2200-0500 lcl time.		ST. JOHNS (H) BVORTAC 112.3/SJN/122.1R	FSS: ZUNI
DOUGLAS (L) BVORTAC 108.8/DUG	FSS: DOUGLAS	SAN SIMON (H) BVORTAC 115.4/SSO/122.1R	FSS: DOUGLAS
FLAGSTAFF (L) BVOR 108.2/FLG/122.3R	FSS: PRESCOTT	TUBA CITY (H) BVORTAC 113.5/TBC/122.2R	FSS: PRESCOTT
GILA BEND (H) BVORTAC 116.6/GBN/121.5 122.1R 122.6	FSS: PHOENIX	TUCSON LRCO 122.2	FSS: TUCSON
GLOBE LRCO 122.3	FSS: PHOENIX	TUCSON FSS 121.5 122.1R 122.2 122.6 123.65	DF
GOODYEAR		§ TUCSON INTL (TUS) IFR 75 AOE	FSS: TUCSON on Fld
§ PHOENIX-LITCHFIELD MUNI (GYR) 15W	FSS: PHOENIX (LC 261-4295)	2630 H120/12L-30R(3) (S-120, D-160, DT-260) BL5,10 S5 F12,18,22,30,40 Ox1,2,3,4 U2 VASI: Rwy 30R	
968 H85/3-21(1) (S-60, D-80, DT-140) BL6 S5 F12,18,22,30		Remarks: 1000' x 150' asph overrun each end rwy 12L-30R. Lndg fee. J-bar rwy 12L-30R. VASI rwy 30R upper TCH 78', lower TCH 42'; upper RRP 1690', lower RRP 1090'.	
Remarks: Rgt tlc rwy 3. Rwy 21 thr dsplcd 2000'.		Tucson Tower: 118.3 122.5R	Gnd Con 121.9
Litchfield Tower <sup>1</sup> 120.1 122.7R		Radar Services: (BCN)	
Radar Services:		App Con 118.5 125.1 125.9 134.1 117.1T	
App Con 120.7		Dep Con 125.9	
VFR Advisory Ctc App Con		Stage II Ctc App Con on 124.0 25 NM out	
Remarks: <sup>1</sup> Opens 0600-2200 lcl time. Two-way rdo required.		VHF/DF <sup>1</sup> Ctc FSS.	
GRAND CANYON (L) BVOR 109.0/GCN/122.1R	FSS: PRESCOTT	(H) BVORTAC 117.1/TUS 254° 6.1 NM to fld.	
IMPERIAL LRCO 122.0	FSS: IMPERIAL	Remarks: <sup>1</sup> Unusable beyond 40 NM below 13,500' MSL 345-070° below 12,500' MSL 070-090°.	
KINGMAN (L) BVOR 108.8/IGM/122.2R	FSS: PRESCOTT	WINSLOW (H) BVORTAC 112.6/INW/122.1R 122.6	FSS: PRESCOTT
MOQUI NDB HW 266/MQI	FSS: PRESCOTT	YUMA FSS 121.5 122.1R 122.2 122.6 123.6	
NOGALES RCO 122.2	FSS: TUCSON	Remarks: No sked wea bcat 2200-0500 lcl time.	
PAPAGO NDB H-SAB 326 <sup>■</sup> /PQO	FSS: PHOENIX	§ YUMA MCAS/INTL (YUM) IFR 45 AOE	FSS: YUMA on Fld
PEACH SPRINGS (H) BVORTAC 112.0/PGS/122.3R	FSS: PRESCOTT	213 H133/3L-21R(4) (S-103, D-200, DT-400) BL6 S5 F12,18,30 U2	
PHOENIX FSS 121.5 122.1R 122.3 122.6 122.05	DF	Remarks: Rwy 3R-21L GWT (S-162, T-200, TT-400). 1000 x 200' overrun each end rwy 3L-21R. A-gear rwnys 3L-21R and 3R-21L. 2200-0600 civil rwy will remain lgld and addnl lgtd avbl thru FSS in emerg.	
Remarks: No wea bcat avbl 2200-0600 lcl time.		Marine Yuma Tower <sup>1</sup> 119.3 126.2	Gnd Con 121.9
PHOENIX		App Con 120.0	
DEER VALLEY (PO9) 17N	FSS: PHOENIX	VHF/DF Ctc twr.	
1475 H51/7-25(1) (S-30, D-45, DT-60) BL4 S5 F12,18 U1		(H) BVORTAC 116.8/YUM 167° 6.0NM to fld.	
Remarks: 5150 x 60 extension E end clsd, but avbl on prior request. Glider ops in vicinity of arpt Sat & Sun 1100- Sunset.		NDB MHW 344/NYL on fld.	
Deer Valley Tower <sup>1</sup> 118.4	Gnd Con 121.8	Remarks: <sup>1</sup> Operates 0600-2200 lcl time except avbl for emrgy. Ctc FSS for airport advisory service when tower closed.	
Remarks: <sup>1</sup> Opens 1000-1800 lcl Mon-Fri, dawn-dusk Sat and Sun. Non-fed ATCT owned and oped by City of Phoenix.			
PHOENIX			
§ SKY HARBOR INTL (PHX) IFR 3E LRA FSS: PHOENIX on Fld			
1128 H103/8R-26L(2) (S-100, D-200, DT-350) BL5,7A,10,11,13 S5 F12,18,22,30 Ox1,2,3,4 U2 VASI: Rwy 8R REIL: Rwy 8L, 26R RVV: Rwy 8R.			
Remarks: Rgt tlc rwnys 8R, 26R. Rwy 26L threshold displaced 700'. VASI rwy 8R TCH 46', RRP 1010'. Unless adzd by ATC all turbine acft and acft 12,500 lbs and over remain at or above 3,000' MSL until establd on final. Fly base leg at least 5 mi fm arpt.			
Phoenix Tower 118.7 (Rwy 8L-26R) 120.9 (Rwy 8R-26L) 122.5R	Gnd Con 121.9		
§ Ctrc Del 118.1			
ATIS: 125.6			
Radar Services: (BCN)			
Phoenix App Con 119.2 (010-109°), 124.1 (110-269°), 120.7 (270-009°), 115.6T 122.5R			
Phoenix Dep Con 119.2 (010-109°), 124.1 (110-269°), 120.7 (270-009°), 115.6T 122.5R			
Stage I Ctc App Con beyond 10 miles			
Phoenix (H) BVORTAC <sup>1</sup> 115.6/PHX 256° 5.3 NM to fld.			
Remarks: <sup>1</sup> No wea bcat avbl 2200-0600 lcl time. VOT: 109.0.			

FIGURE 18. Airport/facility directory.

# AIRPORT DIRECTORY

## ARIZONA

AJO, MUNI (P01) 6N 32°27'00" 112°52'00"	FSS: PHOENIX	HEREFORD See HICKSVILLE/HEREFORD/	
1458 H63/12-30 (1) L4 F12		HOLBROOK, MUNI (P14) 3NE 34°56'20" 110°08'20"	FSS: ZUNI
REMARKS: ARPT UNATTENDED. HVT JET TFC VCNTY ARPT. FUEL AVBL EMERG, CALL SHERIFF 387-7621. LGTS ON CENTER 3950 FT.		5245 H50/3-21 (1) (S-12) BL5 S3 F12, 18	
ANGEL FLD See FORT GRANT		REMARKS: P-LINE IN RWY 29 APCH.	
ANTELOPE RANCH See ROLL		\$ PHOENIX, SKY HARBOR INTL (PHX) 3E 33°26'07"	FSS: PHOENIX ON FLD
ASH FORK 1N 35°13'55" 112°29'10"	FSS: PRESCOTT	112°00'43" IFR	
5169 34/7-25 (3)		1128 H103/BR-261 (2) (S-100, D-200, DT-350) BL5, 7A, 10, 11	
REMARKS: ARPT UNATTENDED P-LINE IN RWY 7 APCH. P-LINE IN RWY 25 APCH.		S5 F12, 18, 22, 30 OX1, 2, 3, 4 U-2	
BAGDAD 2NE 34°35'45" 113°10'10"	FSS: PRESCOTT	VASI: RWY 8R REM: RWY 8L, 26R RVV: RWY 8R	
4136 H36/5-23 (1) (S-4) BL4		REMARKS: (1) RWY 26L THRESHOLD DISPLACED 700'. RGT TFC RWY 26R, 8R.	
REMARKS: ARPT UNATTENDED. UNUSUAL AIR CURRENTS VICINITY ARPT, ESPECIALLY EAST APCH. RWY LGTS ACTIVATED BY KEYING 122.8 3 TIMES OR BY PRIOR REQ OR CIRCLING TOWN.		UNLESS ADZD BY ATC ALL TURBINE ACFT AND ACFT 12,500 LBS AND OVER REMAIN AT OR ABOVE 3000 FT MSL UNTIL ESTABD ON FINAL. FLY BASE LEG AT LEAST 5 MI FM ARPT.	
BISBEE, MUNI (P04) 6SE 31°21'50" 109°52'57"	FSS: DOUGLAS	POLARCA 4SW 35°48'00" 110°25'00"	FSS: PRESCOTT
4780 39/2-20 (3) L4 F12		5573 38/NE-SW (2)	
REMARKS: P-LINE IN RWY 2 APCH. P-LINE IN RWY 8 APCH. RWY LGTS ACTIVATED ON 122.8.		REMARKS: ARPT UNATTENDED. RGT TFC RWY NE, SW, NW, SE.	
\$ CLIFTON-MORENCI, GREENLEE COUNTY (CFT) 9SE	FSS: DOUGLAS	\$ PRESCOTT, MUN (PRC) 8N 34°39'05" 112°25'15" IFR	FSS: PRESCOTT ON FLD
32°57'10" 109°12'35"		5042 H76/3-21 (2) (S-40, D-60, DT-100) BL5 S5 F12, 18, 30	
3811 H49/7-25 (1) (S-21) *BL5		U-2	
REMARKS: ARPT UNATTENDED. FOR RWY LGTS & ROTG BCM PHONE 864-3080 OR 864-4149.		VHF/DF: CTC FSS	
COCHISE COUNTY See WILLCOX		REMARKS: RWY 3 THRESHOLD DISPLACED 797'.	
COLORADO CITY, MUNI 4SW 36°56'58" 113°00'50"	FSS: CEDAR CITY	PULLIAM See FLAGSTAFF	
4840 34/13-31 (2) F12		TUCSON, DOWNTOWN TUCSON ADJ SE 32°11'10"	FSS: TUCSON
REMARKS: ARPT UNATTENDED. FUEL IN EMERG ONLY.		110°56'55"	
COOLIDGE, MUNI 2SW 32°58'00" 111°32'45"	FSS: PHOENIX	2490 43/16-34 (2) S5 F12	(LC 792-6359)
1402 H21/8-26 (1) (S-4) F12	(LC 723-3392)	REMARKS: ARPT ATTENDED DAWN-DUSK. P-LINE IN RWY 11 APCH. P-LINE IN RWY 29 APCH. P-LINE IN RWY 16 APCH.	
REMARKS: ARPT ATTENDED DAYLIGHT. FUEL IN EMERG ONLY.		\$ TUCSON, FREEWAY (P12) 4NW 32°16'40" 111°00'30"	FSS: TUCSON
COOLIDGE, FLORENCE MUNI (P08) 6SE 32°56'00"	FSS: PHOENIX	2290 H45/12-30 (1) (S-6) BL4 S5 F12, 18 U-1	(LC 792-6359)
111°25'30"		REMARKS: RWY 30 THRESHOLD DISPLACED 300'. P-LINE IN RWY 30 APCH	
1587 H55/5-23 (4) (S-80, D-115, DT-210) S5 F12, 18 U-1	(LC 723-3392)	TUCSON, RYAN FIELD 12SW 32°08'29" 111°10'00"	FSS: TUCSON
REMARKS: RGT TFC RWY 5, 8, 11, 35. TRAFFIC PATTERN ALTITUDE 1000FT AGL		2413 H40/6R-24L (1) (S-9) BL4 S5 F12, 18	(LC 792-6359)
PARACHUTE JUMPING SAT & SUN ALL TFC PTNS VARY DURING AF TRAINING		REMARKS: ARPT ATTENDED 0700-1700. RGT TFC RWY 6R, 16. RWY 6L/24R	
\$ DOUGLAS BISBEE, BISBEE DOUGLAS INTERNATIONAL (DUG) FSS: DOUGLAS ON FLD		RESTRICTED TO GLIDERS ONLY. 2525 X 25 FT ASPH STRIP SUPERIMPOSED ON DIRT STRIP 6L/24R BEGINNING 625 FT FROM SOUTH END.	
9NW 31°28'04" 109°36'11" IFR AOE		\$ TUCSON, INTL (TUS) 7S 32°07'05" 110°56'32" IFR	FSS: TUCSON ON FLD
4158 H75/12-30 (4) (S-12) BL5 S5 F12, 18, 22, 30		AOE	
REMARKS: RWY 8-26 WT BRG CPTY S-85, D-95, DT-155. RWY LGTS OPER ON REQ THRU DUG FSS.		2630 H120/12L-30R (3) (S-120, D-160, DT-260) BL5, 10 S5	
DOWNTOWN TUCSON See TUCSON		F12, 18, 22, 30, 40 OX1, 2, 3, 4 U-2	
DVR See TACNA		VASI: RWY 30R	
EOS FIELD See PICACHO		VHF/DF: CTC FSS	
ELOY, MUNI 4NW 32°48'25" 111°35'10"	FSS: PHOENIX	REMARKS: (1) ARRESTING DEVICE RWY 21, 12L, 30R. 1000 X 150 ASPH OVERRUN EACH END RWY 12L-30R.	
1513 H39/2-20 (1) (S-12, 5) BL5 S5 F12, 18		WILLIAMS, MUNI (P32) 4N 35°18'08" 112°12'00"	FSS: PRESCOTT
ESTRELLA SAILPORT See MARICOPA		6700 H39/2-20 (1) (S-17) BL4 S5 F12, 18 U-1	
EUREKA RANCH See BONITA		REMARKS: ARPT ATTENDED 0800-1700	
FALCON FLD See MESA		WINDOW ROCK (P34) 1S 35°39'20" 109°03'45"	FSS: ZUNI
FARM AERO See PHOENIX		6755 H70/2-20 (1) (S-30, D-45, DT-75) L5 F18	
\$ FLAGSTAFF, PULLIAM (FLG) S5 35°08'16" 111°40'18"	FSS: PRESCOTT	REMARKS: ARPT ATTENDED 0800-1700	
IFR		\$ WINSLOW, MUNI (INW) 1W 35°01'20" 110°43'20" IFR	FSS: PRESCOTT
7012 H70/3-21 (1) (S-65, D-85, DT-130) BL5 S5 F12, 18	(LC 774-0475)	4938 H75/11-29 (2) (S-35, D-55) BL5 S3 F12, 18 U-1	(DL)
U-1		REMARKS: RWY 4-22 WT BRG CPTY S-50, D-70. ARPT ATTENDED 0700-1800	
REMARKS: ARPT ATTENDED 0700-2000. ARPT ATND ON CALL OTHER HRS.		ATTENDANT ON CALL FOR FUEL AFTER 1800 UNTIL 0700 WITH NO CHARGE	
FOREPAUGH See WICKENBURG		\$ YUMA, MCAS/YUMA INTERNATIONAL (YUM) 4S 32°39'24"	FSS: YUMA ON FLD
FOREST ACRES See SELIGMAN		114°36'18" IFR AOE	
		213 H133/3L-21R (4) (S-103, D-200, DT-400) BL6 S5 F12,	
		18, 30	
		VHF/DF: CTC TWR	
		REMARKS: (1) RWY 3R 21L WT BRG CPTY S-162, D-200, DT-400 1000 X 200	
		OVERRUN EACH END RWY 3L-21R FSS WILL PROVIDE ARPT ADV SVC WHEN TWR	
		IS CLSD. 2200-0600 APROP CIVIL RWY WILL REMAIN LGTD & ADDNL LGTG AVBL	
		THRU FSS IN EMERG	

FIGURE 19. Airport/facility directory.

## NOTICES TO AIRMEN

This part is issued every 28 days. It contains appropriate notices from the daily NOTAM Summary, and other items considered essential to flight safety. See Part 3A for additional data.

This section contains Notices to Airmen that are expected to remain in effect for at least seven days. Temporary notices without published duration dates are normally carried twice unless resubmitted.

NOTE: Data preceded by a checkmark (✓) are considered permanent and will be published one time only in this section. Data should be noted on charts and records.

NOTE: Notices are arranged in alphabetical order by State (and within the State by City or locality).

NEW OR REVISED DATA: New or revised data are indicated by underlining the first line of the affected item. The new information is not necessarily limited to the underlined portion, which is used only to attract attention to the new insert.

### ALABAMA

ANNISTON, ANNISTON-CALHOUN ARPT: Small arms firing ranges 6 NM from "ANB" NDB between 015-040° up to 2500' MSL, operates continuous. 1094' obstn 1.3 mi SE of arpt unlgtd. Rwy 5 ILS/LOC BC unusable UFN. Rwy lgts first 3500' and thr lgts rwy 5 OTS UFN. (9-71)

DOTHAN ARPT: Rwy 31 ILS/OM OTS UFN. (10-71)

GADSDEN RDO: VOR "GAD" has unusable sectors, for current information see Substitute Routes.

MOBILE, MOBILE AEROSPACE ARPT: Rwy 14-32 apch lgts not operg. (12-71)

REDSTONE RDO: TVOR "HUA" OTS UFN. (1-72)

TALLASSEE MUNI ARPT: A mobile ATCT will

be operd by Alabama ANG from 1000-1500 lcl on the following dates: Mar 11, 12, 18, 19; Apr 8, 9, 15, 16; May 13, 14, 20, 21; June 10, 11, 17 and 18. Civil acft etc Tallassee twr freq 128.2 for adzy info prior to entering tlc area. (2-72)

TUSCALOOSA, VAN DEGRAAF ARPT: ILS rwy 4 ident TCL comsng delayed until aprxly Mar 31, 1972.

### ALASKA

SPECIAL NOTICE: Pilots flying aircraft equipped with SCR-718 altimeters will assure that the altimeter is turned off within 200 NM of Clear, Alaska and Thule, Greenland.

For complete information on Alaska consult the Alaska Supplement.

### ARIZONA

COCHISE RDO: VORTAC "CIE" to be shutdown eff

6 Mar til on or about 10 Mar for freq change from 110.4 to 115.8. (2-72)

GRAND CANYON NATIONAL PARK: All pilots are requested to avoid flying below the canyon rim and to maintain a distance 1500' above and horizontally from all scenic overlooks, parks, trails and Grand Canyon Village.

MARICOPA: CAUTION—DO NOT MISTAKE FOR LANDING AREA. Space Surveillance Stn at lat 33°08'31", long 112°01'48" aprxly 4 mi N. 1200' W and parallel to hwy. Site is strip 300' x 1800' with paved portion lengthwise thru cntr 100' in width and studded with 6' steel posts. This permanent hazard lctd 22 nmi S Phoenix-Sky Harbor Intl Arpt.

MT. HOPKINS SPECIAL NOTICE: Controlled firing area for Laser Operations is established at the Mt. Hopkins Observatory located at 31°40'52"N, 110°52'41"W. Firing area includes the airspace from 7600' MSL to unlimited altitudes within a circular area with a one nautical mile radius extending outward and upward in a conical shape from the radius based on an angle of 25° above the horizon. All acft should avoid this area. Contact Tucson FSS for hours of operations.

WILCOX, COCHISE COUNTY ARPT: Rwy lgts inop and rwy 3-21 clsd UFN due resurfacing. (1-72)

YUMA, YUMA MCAS/YUMA INTL ARPT: Rwy 3L-21R clsd UFN. (1-72)

### ARKANSAS

HOT SPRINGS, MEML FLD ARPT: Rwy 13-31 clsd UFN. (10-71)

### CALIFORNIA

SPECIAL NOTICE: Do not mistake dirt strip on large island, Lake Berryessa, lctd lat 38-34 long 122-13 for airport. Strip is unauthorized and unsafe.

ANO NUEVO ISLAND: Avoid low flying in the vicinity and over island. Biological research of wild life in progress.

HLYTHE ARPT: Intensive airline jet acft training in progress 24 hrs daily. Inbound acft report 20 miles out on 123.6 and guard 123.6 for arpt advisory service, UFN. Use other freqs for other purposes. Unicom is not for arpt advisory use.

BURBANK, HOLLYWOOD-BURBANK ARPT: High rear mounted engine acft such as B-727, DC-9, shall not apply tkof thrust prior to threshold rwys 25 and 83. For these acft the usable length of rwy 25 for tkof is 5804'/for rwy 83, 6354'.

CAMBRIA, RANCHO SAN SIMEON ARPT: Clsd UFN. (7-71)

CARLSBAD, PALOMAR ARPT: Power lines twr to twr located 2 miles SW and W up to 850' MSL. (8-71)

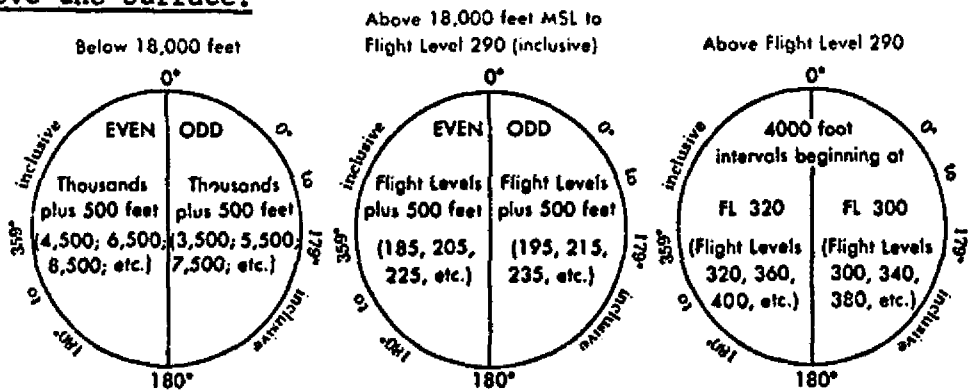
FIGURE 20. Notices to Airmen.

## THE AIRSPACE

### VFR ALTITUDES/FLIGHT LEVELS—CONTROLLED AND UNCONTROLLED AIRSPACE

UNDER VFR—More than 3,000'  
above the surface.

**COURSES ARE MAGNETIC**



### IFR ALTITUDES/FLIGHT LEVELS—UNCONTROLLED AIRSPACE

Outside Controlled Airspace.

**COURSES ARE MAGNETIC**

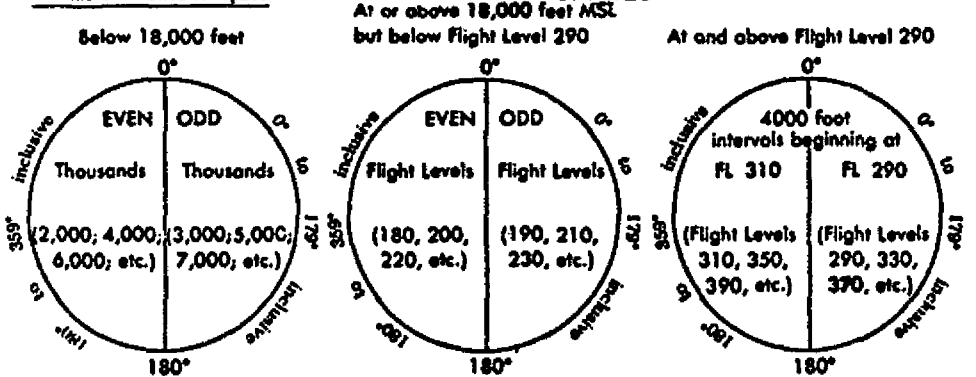


FIGURE 21. The Airspace (cruising altitudes).



## **RULES PERTAINING TO AIRCRAFT ACCIDENTS, INCIDENTS, OVERDUE AIRCRAFT, AND SAFETY INVESTIGATIONS**

(National Transportation Safety Board, Safety Investigation Regulations, Part 430 (in part)).

### **1. IMMEDIATE NOTIFICATION**

The operator of an aircraft shall immediately, and by the most expeditious means available, notify the nearest National Transportation Safety Board, Bureau of Aviation Safety Field Office when:

(a) An aircraft accident or any of the following listed incidents occur:

- (1) Flight control system malfunction or failure;
- (2) Inability of any required flight crewmember to perform his normal flight duties as a result of injury or illness;
- (3) Turbine engine rotor failures excluding compressor blades and turbine buckets;
- (4) In-flight fire;
- (5) Aircraft collide in flight.

(b) An aircraft is overdue and is believed to have been involved in an accident.

(c) The following information is required if available:

- (1) Location;
- (2) Date;
- (3) Time;
- (4) Aircraft make, model, and registration number and nationality.
- (5) Names of operator and crew;
- (6) Number of persons involved;
- (7) Injuries of each person;
- (8) Weather conditions.

### **2. MANNER OF NOTIFICATION**

The most expeditious method of notification to the National Transportation Safety Board by the operator will be determined by the circumstances existing at that time. The National Transportation Safety Board has advised that any of the following would be considered examples of the type of notification that would be acceptable:

- (a) Direct telephone notification.
- (b) Telegraphic notification.

(c) Notification to the Federal Aviation Administration who would in turn notify the NTSB by direct communication; i.e., dispatch or telephone.

### **3. REPORTS**

a. The operator shall file a report on NTSB Form 6120.1 or 6120.2, available from the National Transportation Safety Board Field Offices, or the National Transportation Safety Board, Washington, D.C.:

(1) Within ten (10) days after an occurrence for which notification is required in 1 (a) and (b) above;

(2) When, after seven (7) days, an overdue aircraft is still missing;

(3) Upon request of an authorized representative of the National Transportation Safety Board;

b. Each crew member, if physically able at the time the report is submitted, shall attach thereto a statement setting forth the facts, conditions and circumstances relating to the accident or occurrence as they appear to him to the best of his knowledge and belief. If the crew member is incapacitated, he shall submit the statement as soon as he is physically able.

### **4. WHERE TO FILE THE REPORTS**

a. The operator of an aircraft shall file with the Field Office of the National Transportation Safety Board nearest the accident or incident any report required by this section.

b. The National Transportation Safety Board field offices are listed under U.S. Government in the telephone directories in the following cities: Anchorage, Alaska; Chicago, Ill.; Denver, Colo.; Fort Worth, Texas; Kansas City, Mo.; Los Angeles, Calif.; Miami, Fla.; New York, N.Y.; Oakland, Calif.; Seattle, Wash.; Washington, D.C.

FIGURE 22. Excerpts from Procedural Regulation, Part 430.

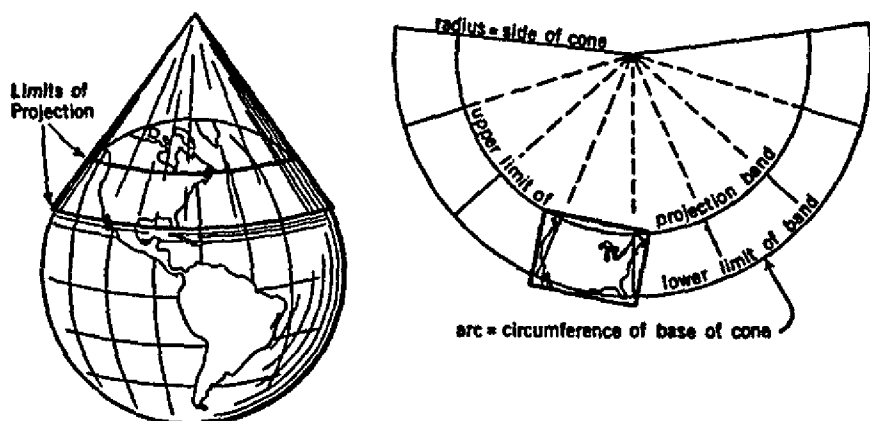
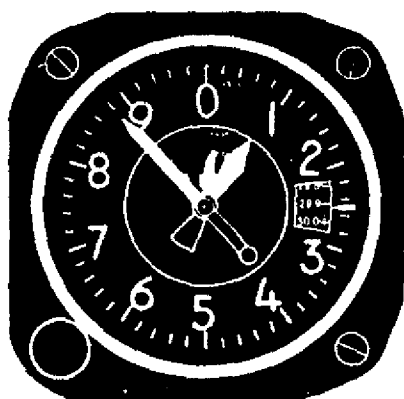
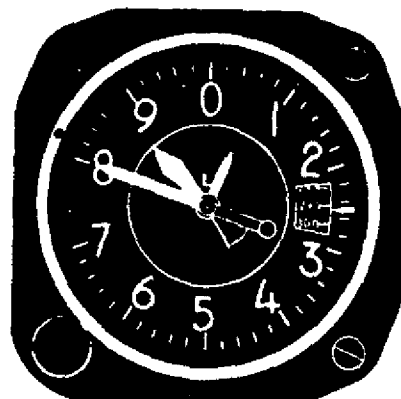


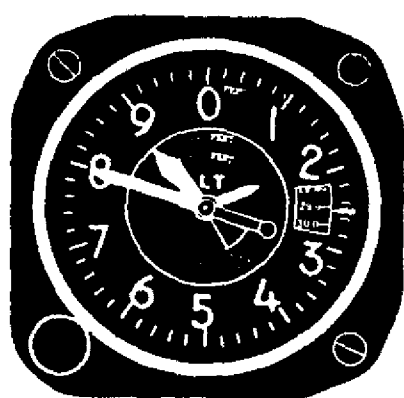
FIGURE 23. The Lambert conformal chart projection.



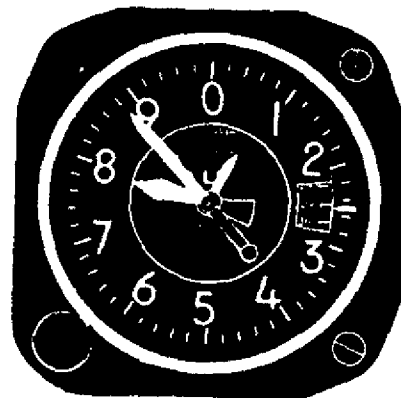
A



B



C



D

FIGURE 24. Altimeter readings.

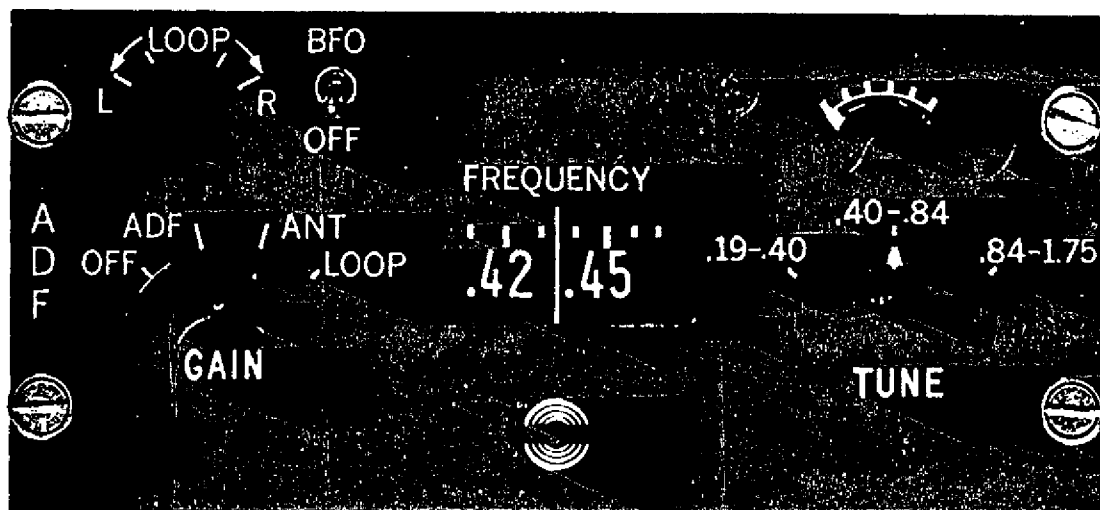
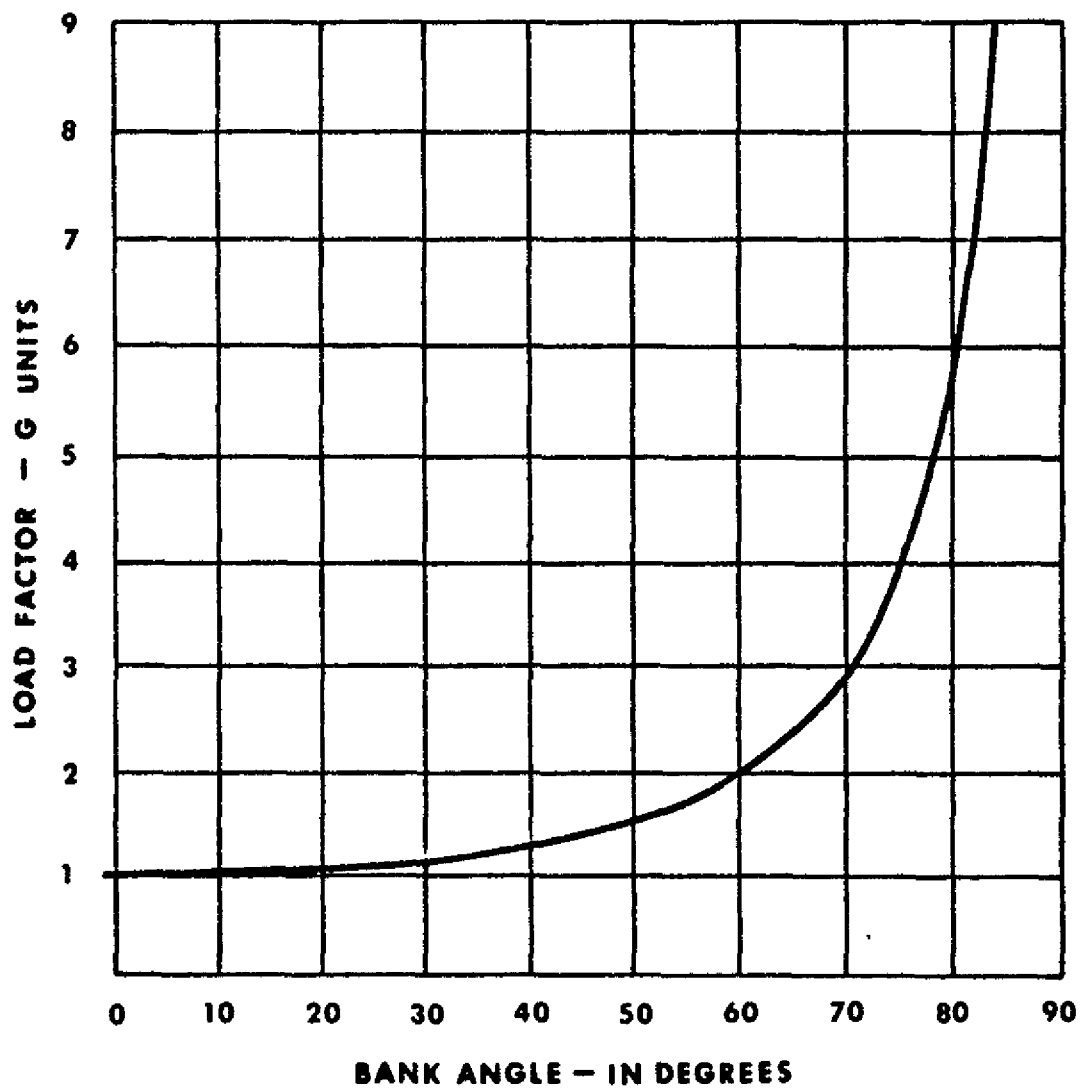


FIGURE 25. Radio compass (ADF).



FIGURE 26. Flight instruments.

# LOAD FACTOR CHART

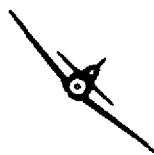


A



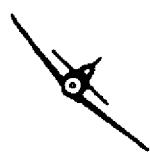
Bank 40°  
TAS 100 mph

B



Bank 40°  
TAS 150 mph

C



Bank 40°  
TAS 200 mph

FIGURE 27. Load factor chart.

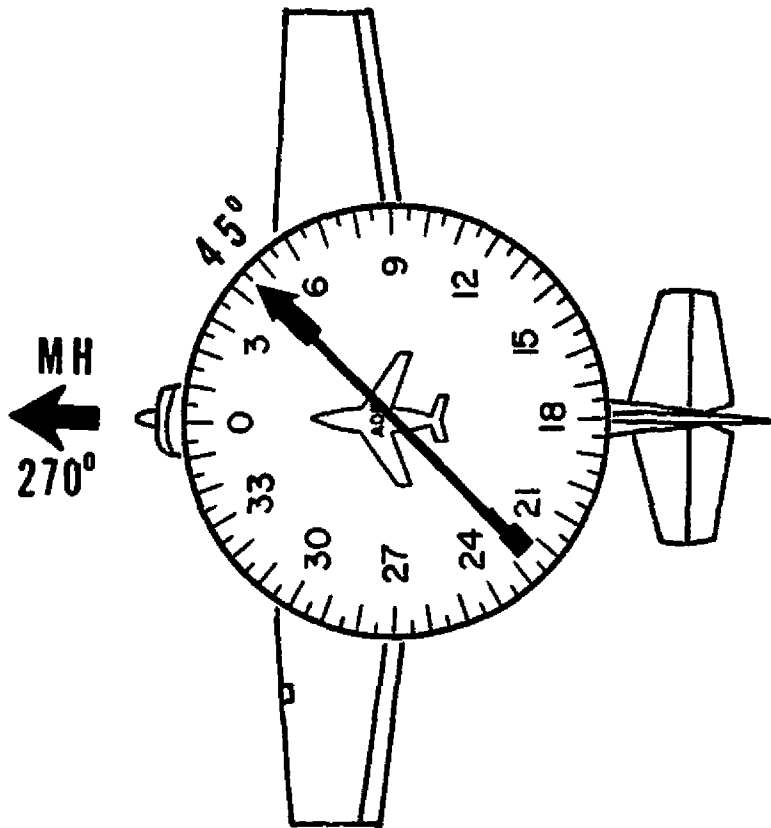


FIGURE 28. ADF indications.

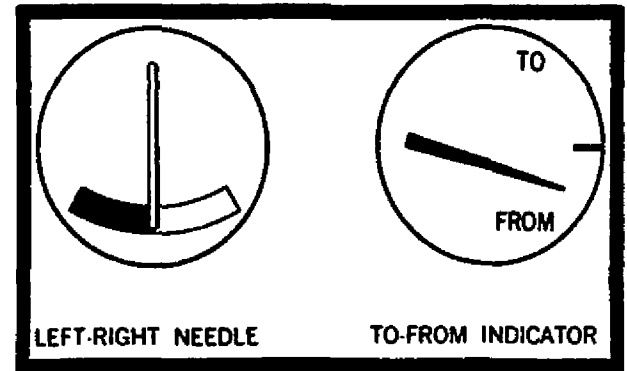


FIGURE 29. VOR navigation receiver indications.

DEPARTMENT OF TRANSPORTATION—FEDERAL AVIATION ADMINISTRATION					Form Approved OMB No. 04-R0072		
FLIGHT PLAN							
1. TYPE	2. AIRCRAFT IDENTIFICATION	3. AIRCRAFT TYPE/SPECIAL EQUIPMENT	4. TRUE AIRSPEED	5. DEPARTURE POINT	6. DEPARTURE TIME		7. CRUISING ALTITUDE
<input checked="" type="checkbox"/> VFR <input type="checkbox"/> IFR <input type="checkbox"/> DVFR	N2468W	DAEDALIAN DART	180 KTS	GREENLEE CO. CLIFTON-MORENCI	PROPOSED (Z)	ACTUAL (Z)	12,500
8. ROUTE OF FLIGHT DIRECT HOLBROOK, DIRECT WINSLOW VOR, DIRECT FLAGSTAFF, DIRECT WILLIAMS MUN.							
9. DESTINATION (Name of airport and city)		10. EST. TIME ENROUTE		11. REMARKS			
WILLIAMS MUNICIPAL WILLIAMS, ARIZONA		HOURS: 2 MINUTES: 36		INTERMEDIATE STOPS AT HOLBROOK AND FLAGSTAFF			
12. FUEL ON BOARD		13. ALTERNATE AIRPORT (S)		14. PILOT'S NAME, ADDRESS & TELEPHONE NUMBER & AIRCRAFT HOME BASE		15. NUMBER ABOARD	
HOURS: 3 MINUTES: 20				D. WALKER 1144 SW 25 ST OKC 632-7441		4	
16. COLOR OF AIRCRAFT		CLOSE VFR FLIGHT PLAN WITH _____ FSS ON ARRIVAL					
SILVER RED TRIM							

FAA Form 7233-1 (5-72)

FIGURE 30. Example of Flight Plan (VFR).

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 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 31. 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°

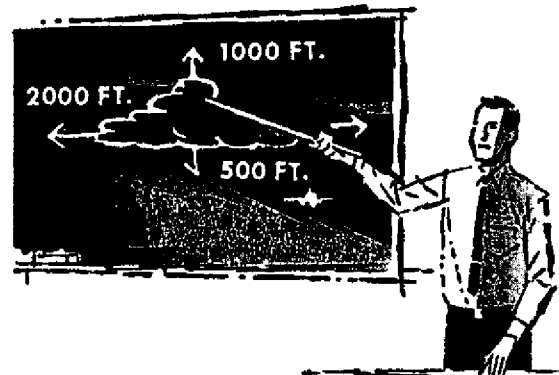
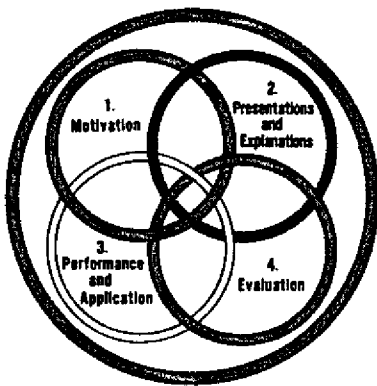
IAS - MPH	40	50	60	70	80	90	100	110
TIAS - MPH	59	62	67	73	81	91	101	111

### FLAPS 40°

IAS - MPH	40	50	60	70	80	90	100	110
TIAS - MPH	58	62	66	73	82	92	102	112

FIGURE 32. Airspeed correction table.

# ***Ground Instructor Written Test Guide Basic-Advanced***



**DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION**



**DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION**

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**FLIGHT STANDARDS SERVICE**

**Ground Instructor  
WRITTEN TEST GUIDE  
Basic-Advanced**



**REVISED**

**1972**

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## **Preface**

This test guide was prepared by the Federal Aviation Administration as Advisory Circular AC 143-1C to assist applicants who are preparing for the Ground Instructor Written Test. It supersedes the *Ground Instructor Examination Guide*, AC 143-1B, issued in 1967.

This guide outlines the scope of the basic aeronautical knowledge requirements for a ground instructor; acquaints the applicant with source material that may be used to acquire this basic knowledge; presents sample test items with answers and explanations, and illustrations representative of those used in the current Ground Instructor Written Test.

Comments regarding this publication should be directed to the Department of Transportation, Federal Aviation Administration, Flight Standards Technical Division, P.O. Box 25082, Oklahoma City, Oklahoma 73125.

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# GROUND INSTRUCTOR WRITTEN TEST GUIDE

## FUNDAMENTALS OF INSTRUCTING

### BASIC-ADVANCED

#### Introduction

This study guide was prepared by the Flight Standards Service of the Federal Aviation Administration. Its main purpose is to assist applicants who are preparing for the Basic or Advanced Ground Instructor Written Test. It is not offered as a quick and easy way to gain the knowledge necessary for passing the written test. 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.

Another 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 Test

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 tests today require the ability to use basic knowledge in practical situations as well as in answering questions based on theoretical problems.

For this reason, the 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 tests 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 so that your students will be well prepared for their tests.

#### Type of Test Questions

The test questions are of the objective, multiple-choice type as illustrated by questions in the sample test. Each question can be answered on a special answer sheet with a pencil mark. To preclude the possibility of an applicant receiving a failing grade because of a mistake in grading, all tests scored below passing are rechecked by trained personnel.

#### Taking the Test

The equipment that the applicant will need for taking the test includes a protractor or plotter and a computer. It is also desirable to have a pair of dividers. The times allowed for completion are:

- A. Basic ----- 4 hours
- B. Advanced ----- 5 hours
- C. Fundamentals of Instructing ---- 2 hours

(It is not necessary to take the Fundamentals of Instructing on the same day as the Basic or Advanced test.)

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

Always remember the following facts when you are taking the test:

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. Be sure you read the entire question carefully. Avoid “skimming” and hasty assumptions. This may lead to an 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 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 five or 10 questions during the time you work with one that is difficult. This procedure will enable you to make maximum use of the time available. It may mean the difference between a passing and a failing score.

5. In solving 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 small errors you may make in measuring distances, true courses, etc., it is possible that you will not get an exact agreement every time. Sufficient spread is provided between right and wrong answers, however, 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.

NOTE: When the test is constructed, various types of navigational computers are used to solve problems. The correct answer is an average of these computers; therefore, any one of the several types of computers authorized for use on FAA written tests should prove satisfactory.

## RECOMMENDED STUDY MATERIALS

The prospective Ground Instructor will find the following list of publications useful in his preparation for the written test. In addition, there are many other excellent commercially prepared textbooks, audiovisual training aids, and other instructional materials which may be helpful.

### AERONAUTICAL CHARTS

The National Ocean Survey publishes and distributes aeronautical charts of the United States. Charts for foreign areas are published by the U.S. Air Force Aeronautical Chart and Information Center (ACIC) and are sold to civil users by the National Ocean Survey.

A "Catalog of Aeronautical Charts and Related Publications" listing their prices and instructions for ordering may be obtained free, on request, from:

Distribution Division, (C-44)  
National Ocean Survey  
Washington, D.C. 20235

Orders for specific charts or publications should be accompanied by check or money order made payable to "NOS, Department of Commerce".

*Airman's Information Manual.* This publication presents, in four Parts, information necessary for the planning and conduct of flights in the U.S. national airspace. Besides providing frequently updated airport and NAVAID data, the AIM includes instructional and procedural information and is designed for use in the cockpit.

Each Part is available on a separate annual subscription to better serve the needs of the individual pilot.

**Part 1. *Basic Flight Manual and ATC Procedures*** (Annual subscription \$4, Foreign mailing—\$1 additional. GPO.) Catalog No. TD 4.12:Pt.1/. Issued quarterly.

**Part 2. *Airport Directory*** (Annual subscription \$4, Foreign mailing—\$1 additional. GPO.) Catalog No. TD 4.12:pt.2/. Issued semiannually.

**Part 3. *Operational Data and Notices to Airmen*** (Annual subscription \$20, Foreign mailing—\$5 additional. GPO.) Catalog No. TD 4.12:pt.3/. Issued every 28 days, supplemented by Part 3A (*Notices to Airmen*) every 28 days between issues of Part 3.

**Part 4. *Graphic Notices and Supplemental Data*** (Annual subscription \$1.50, Foreign mailing—\$0.50 additional. GPO.) Catalog No. TD 4.12:pt.4/. Issued semiannually.

### HANDBOOKS AND TECHNICAL MANUALS

*Pilot's Handbook of Aeronautical Knowledge.* AC 61-23A (\$4.00—GPO.) Catalog No. TD 4.408:P 64/5. This handbook contains essential, authoritative information used in training and guiding pilots. Subject areas in which an applicant may be tested are covered in the handbook. It tells how to use the Airman's Information Manual and the data in FAA-approved airplane flight manuals, as well as basic instruments for airplane attitude control.

*Personal Aircraft Inspection Handbook.* AC 20-9 (\$1.50—GPO.) Catalog No. FAA 5.8/2:AI 7/2. This is a general guide for inspection of aircraft; Part I deals with the fundamentals of inspection and Part II covers a typical inspection in detail. As reliable inspection comes only with experience, it is emphasized that the use of this handbook by the novice does not qualify him to make final determinations regarding the airworthiness of the aircraft. This handbook supersedes TM-101 dated 1950.

*Flight Instructor's Handbook.* AC 61-16A (\$2.00—GPO.) Catalog No. TD 4.408:In 7/3. This revised handbook is one of the primary sources of information and guidance for pilots preparing for the flight instructor written test. It is basically a book which explains accepted theories and practices applicable to teaching and the learning process. Therefore, it will also prove most useful to those preparing for the Fundamentals of Instructing section of the Ground Instructor Written Test.

*Flight Training Handbook.* AC 61-21 (\$1.25—GPO.) Catalog No. FAA 1.8:F 64/4. This text deals with certain basic flight information such as load factor principles, weight and balance, and related aerodynamic aspects of flight, as well as principles of safe flight. This book also provides information and direction in the introduction and performance of training maneuvers. Thus it serves primarily as a text for student pilots, for pilots improving their qualifications or preparing for

additional ratings, and for flight instructors; however, it can also be useful to the ground instructor.

## NAVIGATION AND WEATHER

**Practical Air Navigation.** 10th Edition. (\$4.00). This publication provides a comprehensive coverage of all subjects and areas dealing with navigation whether it be pilotage, dead reckoning, or radio and celestial navigation. Students who understand the material available in this highly recommended text will have no serious trouble with the navigation problems on their test. This text may be obtained from many book dealers or from the publisher, Jeppesen & Co., 8025 East 40th Ave., Denver, Colorado 80209.

**Aviation Weather.** AC 00-6 (\$4—GPO.) Catalog No. FAA 5.8/2:W 37. Contains information on weather phenomena for pilots and other flight operations personnel whose interest in meteorology is primarily in its application to flying.

**Federal Aviation Regulations (FARs).** The subscription prices listed include automatic revision service to all Parts contained in the Volume ordered. The FAR Parts contained in each Volume are listed in the "Advisory Circular Checklist and Status of Federal Aviation Regulations," obtainable free on request from FAA.

	Price	Additional For Foreign Mailing
Vol. I, Part 1, <i>Definitions and Abbreviations</i> ----	\$2.50	\$0.50
Vol. IX, Part 61, <i>Certification: Pilots &amp; Flight Instructors, and Part 141, Pilot Schools, and Part 143, Ground Instructors</i> -----	\$6.00	\$1.50
Vol. VI, Part 91, <i>General Operating and Flight Rules</i> -----	\$9.00	\$2.00

## NATIONAL TRANSPORTATION SAFETY BOARD

**Procedural Regulation, Part 430.** (FREE from NTSB.) 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 Written Test Guide.** 1970 AC 61-28A (\$1.50—GPO.) Catalog No. TD 4.408:P 64/4. This guide gives detailed information on the scope and depth of knowledge required of the commercial pilot applicant.

**VFR and IFR Exam-O-Grams.** Brief, timely, and graphic articles developed and published on a continuing basis. They are nondirective in nature and are issued as an information service, particularly to individuals interested in airman written tests. They relate to concepts, practices, and procedures critical to aviation safety and assist in giving safety-oriented information to airman applicants and practicing airmen. Exam-O-Grams are available free of charge, but are limited to single copy per request. Requests for placement on the mailing list should be addressed to:

Department of Transportation  
Federal Aviation Administration  
Flight Standards Technical Division  
Operations Branch, AAC-240  
P.O. Box 25082  
Oklahoma City, Oklahoma 73125

## HOW TO OBTAIN GPO PUBLICATIONS

1. Use an order form, not a letter unless absolutely necessary. Order forms, *which may be duplicated by the user*, are included in the catalog "FAA Publications," sent free upon request from:

Distribution Unit, TAD 484.3  
Department of Transportation  
Washington, D.C. 20590

2. Send separate orders for a subscription and a nonsubscription item.

3. Give the exact name of the publication and the agency number.

4. Send a check or money order, not cash. Send the exact amount.

5. Enclose a self-addressed mailing label if you have no order blank.

6. Use special delivery when needed.

7. Use GPO bookstores.

Several GPO bookstores have been established throughout the country for sale of publications. The public is encouraged to avail themselves of the mail order service offered by these facilities.

GPO bookstores are located at the following addresses:

GPO Bookstore  
Room 100, Federal Building  
275 Peachtree Street NE  
Atlanta, Georgia 30303

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Birmingham, Alabama 35203

GPO Bookstore  
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San Francisco, California 94102

Mail orders may also be directed to:  
Superintendent of Documents  
U.S. Government Printing Office  
Washington, D.C. 20402



## STUDY OUTLINE

The study outline which follows is the framework for basic aeronautical knowledge that the prospective ground instructor must know; *every question* on the FAA test 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 student's 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 be 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 overall 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 Teaching Program.**

1. What to test.
  - a. Understanding.
  - b. Actual performance—ability to apply knowledge to realistic problems is the only positive assurance 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—mockups, schematics, operational, sectionalized, and exploded.
  - e. Training literature.
  - f. Field trips.
2. Caution in the use of instructional aids.
  - a. Contribute little unless 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 test you will 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.

1. Follow the instructions given in the test and draw the course lines for the proposed route.

2. Determine the true courses with a protractor. Measure distances, using the *mileage scale at the bottom of the chart*. For accurate measurement, use the center of the airport symbols.

3. Study the area along your proposed route and note the locations of the following:

a. Prominent checkpoints.

b. Radio aids to navigation (VOR, non-directional radio beacons, VHF/DF and radar availability). Be certain to check this data against current information in the *Airman's Information Manual*.

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 FAA Flight Service Station or Weather Service Office for flight weather briefings. Be able to read and interpret the following data:

1. Surface weather map. (Identify fronts and read station model data, using the key furnished in the test.)

2. Area forecasts.

3. Terminal forecasts.

4. Winds aloft forecasts.

5. SIGMETs (significant meteorological developments) and AIRMETS (weather phenomena of less severity than that covered by SIGMETs).

6. Hourly Sequence Reports.

C. Review the data in the flight planning publication—the *Airman's Information Manual*. Be familiar with and able to use the information pertaining to:

1. Communication frequencies: control towers, approach control, primary traffic control, ground control, departure control, Flight Service Stations.

2. Navigation aid frequencies: VOR Stations, nondirectional radio beacons, VHF/DF, Radar.

3. NOTAMS (Notices to Airmen).

4. Special Notices: list of Military Training Routes, good operating practices, and other helpful information.

5. Airport data: location, runway information, availability of fuel and service, availability of UNICOM and weather reporting facilities, etc., lighting.

6. Review pertinent information on:

a. Enroute Cruising Altitudes.

b. Airport Traffic Control procedures.

c. Light Gun Signals.

d. Radio-telephone phraseology and techniques.

e. VOR receiver checkpoints.

f. Enroute communications.

g. U.S. Aircraft Emergency procedures, search and rescue procedures, emergency SCATANA rules (Security Control of Air Traffic and Air Navigation Aids).

h. U.S. Weather Service Office phone numbers.

i. FAA Flight Standards District Office telephone numbers.

j. Aircraft accident reporting.

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 altitude, taking into consideration—

1. Regulations with regard to the hemispherical rule.
2. Enroute terrain and obstruction elevations.
3. VFR cloud separation requirements.
4. Winds aloft.
5. Prohibited, Restricted, Warning, and Alert Areas.

F. Review the *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 Denalt Performance Computer).
  - 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 winds aloft.

1. Convert the forecast winds aloft which are given in knots to miles per hour (also convert, when required, temperatures given in Celsius to Fahrenheit or *vice versa*). Interpolate, if necessary, 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. 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.

NOTE: Except for knowledge and interpretation of instruments in relation to *attitude control* of the airplane, the Basic and Advanced Ground Instructor Written Tests 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 test, you may be questioned on additional aeronautical subjects. These subjects may not directly relate to the proposed cross-country flight, but are pertinent 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 ground-speed.

(2) Determine true heading and ground-speed.

(3) Determine wind direction and velocity.

(4) Determine true heading and true air-speed.

(5) Off-course corrections.

b. True course to compass heading.

c. Compass heading to true course. (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. Celsius—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.

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 knowledge of—

1. Aircraft structures.

2. Airframe components and control surfaces.

3. Fuel systems.

4. 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, 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 a 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. Know the importance of correct sensing.

f. Know and understand the procedures for VOR off-course navigation and for solving time and distance problems.

3. Nondirectional Radio Beacons and ADF.

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

b. 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. Understand the basic principles of operation and characteristics of flight instruments.

1. Know 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 the bowl magnetic compass:

(1) Deviation.

(2) Oscillation error.

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

(a) *Northerly turning 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 ( $V_{ne}$ ).

### III. Prestaring 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 fire.

3. Ground control or tower contacts where applicable for taxi clearance.

4. Careful observance of the oil pressure/temperature and magneto checks; 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 Fig. 12 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 FAR 91, *General Operating and Flight 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 destinations. 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 nondirectional radio beacon and VOR radials.

I. Know how to tune in and identify a radio beacon or VOR station. Understand how to utilize an air navigation radio aid, i.e., VOR radial 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 scheduled weather broadcasts. Maintain a continuous listening watch for possible in-flight weather safety advisories (SIGMET or AIRMET).

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

M. Avoid bad weather. Do not get trapped above 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. Monitor all engine instruments. Be able to recognize symptoms of carburetor icing such as loss of power. Remember that, on aircraft equipped with constant speed propellers, the initial loss of power will be reflected by decreased manifold pressure, not loss of r.p.m. The r.p.m. will remain constant 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. Before crossing a Military Training Route, be sure to check the current operational status with a Flight Service Station near the route.

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, do not switch until directed to do so by the controller, (*after turning off the active runway*) and exercise caution while taxiing to the tie-down area.

## VII. Post-Flight Activities.

A. Turn off all switches and secure the controls.

B. Close your flight plan with the appropriate facility.

C. Refuel to capacity, reducing 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 NTSB Procedural Regulation, Part 430.**

**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.)**

**G. Record airframe and engine time in appropriate logbooks.**



## SAMPLE TEST

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

The appendix contains the supplementary materials which will be required from time to time during this test. These materials include weather information, aircraft description and performance data, the flight planning data, excerpted information from the *Airman's Information Manual*, diagrams, charts, and illustrations.

This test 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 test dealing with the conditions, techniques, and

principles which control the learning process. The *Fundamentals of Instructing* section is separate from, and in addition to, the written tests on subjects which pertain to the rating he seeks (Basic, Advanced, or Instrument). The applicant may, if he chooses to do so, take the fundamentals portion on the same day that he takes the test on the subjects covered by the rating sought. He may, however, take it on another date before taking the written test on subjects pertaining to the rating sought. Regardless of his choice, he must pass both sections. It is *not* necessary, however, to take the test on *Fundamentals of Instructing* for each additional rating sought. For example, if an applicant for the Basic Ground Instructor rating passes *Fundamentals of Instructing*, it is not necessary for him to again pass the *Fundamentals of Instructing* to obtain either the Advanced Ground Instructor rating or the Instrument Ground Instructor rating.

The second section of this test 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 start on page 23.

## SAMPLE TEST

### Section 1

#### Fundamentals of Instructing

1. Test reliability refers to the
  - 1—characteristic of a test which indicates consistent results for a test period over a period of time.
  - 2—measure of temporary variations influenced by chance errors.
  - 3—accuracy with which a test 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—public speaking technique.
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 tests 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 test is based on a flight within the state of 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. 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 a mining company. You are scheduled for a flight originating at Greenlee County Airport, Arizona, and terminating at Williams, Arizona, with intermediate stops at Holbrook, Arizona, and Flagstaff, Arizona.

You will carry three executives who are conducting a safety survey. You have established your tentative route on the 6th Edition of the Phoenix Sectional Aeronautical Chart as follows:

### LEG I

Greenlee County Airport, Arizona (see Clifton-Morenci in Airport Directory excerpts) direct to Holbrook Municipal Airport.

### LEG II

Holbrook Municipal Airport direct to Winslow VORTAC; thence direct to Flagstaff Pulliam Airport.

### LEG III

Flagstaff Municipal Airport direct to Williams Municipal Airport.

\* \* \* \* \*

The coordinates for the above airports are as follows:

Greenlee County Airport 32°57'N; 109°12'W.

Holbrook Municipal Airport 34°56'N; 110°08'W.

Flagstaff Pulliam Airport 35°08'N; 111°40'W.

Williams Municipal Airport 35°18'N; 112°12'W.

Your preflight activities include:

(1) Necessary review of the *Airplane Flight Manual*, *Operations Placards*, and *Owner's Handbook*, with 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 Information Manual*.

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

(4) A review of radio checkpoints and navigational facilities.

(5) Thorough check of 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 1400Z Hourly Sequence Report (see Fig. 5)

1—PHX reports a ceiling of 12,000 ft.

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 1500Z Hourly Sequence Report at Phoenix Arizona, (see Fig. 5) indicates that

1—the ceiling is 10,000 ft.

2—the ceiling is 1,200 ft.

3—the ceiling is 12,000 ft.

4—there is no reported ceiling at Phoenix.

4. You plan to depart at 0830 MST. After a study of all the Hourly Sequence Reports in Figure 5, you 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. After a study of *all* the weather information available to you, before you start the flight (see Figs. 3, 4, and 5) you determine 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. The Phoenix Sectional Aeronautical Chart is based on the Lambert Conformal Conic Projection. This type of map is used in aviation 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 most rhumb line and great circle navigational problems.

3—its directions conform closely to directions on the earth.

4—all of the above are true.

NOTE: See Figure 23 in the appendix for a diagram of this projection.

7. Suppose that pressure altitude and indicated altitude are approximately the same at 4,000 ft. above the ground over Prescott, Arizona. Indicated airspeed is 170 m.p.h. If you use the PRC FD (Winds Aloft Forecast) given in Figure 4 of the appendix, you determine that

1—TAS is approximately 200 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 Calibrated Airspeed (CAS) to be identical to Indicated Airspeed (IAS).

8. The statements listed below concerning the 7:00 a.m. EST surface weather map may or may not be correct.

A. Warmer air is south and east of the front while cooler air lies north and west of the front.

B. The front depicted on the weather map is an occluded front.

C. The front depicted on the weather map is a stationary front.

D. The isobar of lowest pressure that can be identified is the 1004.0-millibar line.

E. The distance between the isobars is such that the surface winds over the area pictured should be moderately strong (30 to 35 knots).

F. The surface wind at Winslow, Arizona, is from the north.

G. The surface temperature is 60° F. and dewpoint is 23° 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.
Aircraft empty weight moment -----	65.9

Using the above information, together with data from the Aircraft Description in Figure 8, you determine through use of the Loading Graph and Center of Gravity Envelope Graph (Fig. 10 of the appendix) that

1—the gross weight and balance requirements are both within limits.

2—the weight is in excess of maximum gross limit and should be reduced before an attempt is made to determine 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 limits on the basis of information supplied.

10. If you were to drain 21 gals. 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 comparatively short with two intermediate stops, so you decide to drain 21 gals. 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 ft. above the ground en-route. Your en-route altitude

1—would be indeterminable until you compute the magnetic heading.

2—should be odd thousand plus 500 ft. from Greenlee County Airport to Holbrook, Arizona.

3—should be odd thousand plus 500 ft.

4—should be even thousand plus 500 ft.

12. According to regulations concerning operations in Airport Traffic Areas, 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) 3,000 ft. above the surface of the airport at which an operative traffic control tower is located.

B. Aircraft, when operating to or from an airport having a tower operated by the United States, shall normally maintain two-way radio communication with that tower while in the Airport Traffic Area.

C. The basic VFR minimums when operating in an Airport Advisory Service Area are 5 miles visibility and a 1,500-foot ceiling.

D. 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, D.
- 2—A, B, C, D.
- 3—B, C.
- 4—A, B, C.

13. Refer to the *Airman's Information Manual* data in the appendix and determine which of the following statements are ACCURATE.

A. The Holbrook Municipal Airport, Holbrook, Arizona, has two runways.

B. The longest runway at Holbrook Municipal Airport is between 4,970 and 5,245 ft. in length.

C. A Flight Service Station is located on the Tucson Municipal Airport, Tucson, 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. At Prescott, Arizona, Runway 3-21 is closed for takeoff and landing until further notice.

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

14. Of the airports where you intend to land along your route of flight, the Winslow and Flagstaff Airports are within control zones. If you were to land here, the basic VFR weather 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 ft.

3—require 3 miles visibility and a ceiling of 1,200 ft.

4—require 3 miles visibility and a ceiling of at least 1,000 ft.

### LEG 1

15. From the following conditions, compute the approximate compass heading and true airspeed.

Indicated airspeed .....	150 m.p.h.
Pressure altitude .....	10,000 ft.
Outside air temperature ....	+10° C.
True course .....	243°
Wind direction .....	230°
Wind velocity .....	25 knots
Magnetic variation .....	14° E.
Compass deviation .....	+3°

- 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.

16. Assuming a gross weight of 2,900 lbs., together with a surface temperature of 80° F. and an estimated surface wind of 13 knots, your approximate takeoff distance to clear a 50-foot obstacle at Greenlee County Airport is

- 1—1,156 ft.
- 2—1,188 ft.
- 3—1,078 ft.
- 4—1,006 ft.

NOTE: Refer to the performance charts (Fig. 12 of the appendix).

17. After your takeoff from Greenlee County Airport at 0830 MST, you notice as you climb out on course that you are passing through 8,800 ft. Which of the altimeter illustrations in Figure 24 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 ft. Approximately how long can you fly with a power setting of 2,200 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.

NOTE: Refer to the 10,000-ft. Cruise Performance Chart in the appendix, Figure 13.

19. While en-route to Holbrook, Arizona, you use ADF to tune in and properly identify the Winslow Nondirectional Radio Beacon. The proper setting for the function switch when warming up and tuning the ADF is

- 1—loop position.
- 2—antenna (receiver) position.
- 3—compass position.
- 4—aural null position.

20. VORs and VORTACs are classified as H, L, and T. If a VOR of the T classification is used for navigation at altitudes above 12,000 ft., undependable navigation signals may be received because

- 1—transmitter signal strength is less than that of the H or L ranges.
- 2—course azimuth is not accurate above 12,000 ft.
- 3—signals from another range may interfere.
- 4—atmospheric conditions affect the signal.

## LEG II

21. If you select 10,500 ft. 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 air temperature of  $+15^{\circ}$  C. and the winds aloft as  $230^{\circ}$  at 25 knots, you compute the estimated average ground-speed 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: 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 approximately 3 miles behind and slightly below a four-engine 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 wingtips.

C. Clean, 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 26 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.  $20^{\circ}$  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.

25. Assume that you now find yourself in a coordinated level turn with a  $40^{\circ}$  bank. Your present gross weight, when in straight and level flight, is 2,800 lbs. Referring to the illustrations in Figure 27 in the appendix, which of the following statements are correct?

A. In the situation depicted in illustration A, your approximate effective gross weight is 3,668 lbs.

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. To remain at or below a speed that would decrease the possibility of structural damage, you should not exceed the speed indicated by the

- 1—red radial line.
- 2—upper limit of the white arc.
- 3—upper limit of the green arc.
- 4—upper limit of the yellow arc.

27. In the vicinity of Winslow, Arizona, you decide to combine ADF navigation and pilotage. You tune in and identify the Winslow Nondirectional Radio Beacon. 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 28 in the appendix. This means you have a

1—magnetic bearing of  $45^\circ$  to the station. You are southwest of the station.

2—relative bearing of  $45^\circ$ , but your bearing to the station cannot be determined with the information supplied.

3—magnetic bearing of  $315^\circ$  to the station. You are southeast of the station.

4—magnetic bearing of  $45^\circ$  to the station. 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 Municipal Airport, after a total flying time of 1 hour and 15 minutes since leaving Greenlee County Airport. Fuel consumption has been at the rate of 10 gallons per hour. Surface wind is 20 knots from  $210^\circ$ , and surface temperature is  $75^\circ$  F. You will use  $40^\circ$  of flaps for the landing. Referring to the landing table in Figure 12 of the appendix, your landing distance for clearing a 50-foot obstacle is approximately

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

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

### 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 and 4 of the appendix indicates that there should be

1—only scattered clouds at 8,000 ft. 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 ft. MSL, and turbulence should gradually decrease.

4—scattered clouds at 8,000 ft., broken clouds 12,000 to 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 omnibearing selector set on  $270^\circ$ . If you did not know your position and used *only* your omni, which reads as illustrated in Figure 29 in the appendix, you would know that you are

1—on the  $90^\circ$  radial and flying toward the station.

2—on the  $270^\circ$  radial and flying away from the station.

3—unable to determine at the moment where you are going, but you are on the  $270^\circ$  radial.

4—unable to determine *anything* about where you are or where you are going.

31. Assume that while taxiing to the flight line on Williams Municipal Airport your nosewheel collapses. The damage is in excess of \$300.00. If you were unsure about accident reporting procedures, you could find the necessary information in

1—Vol. IX, Part 61, Federal Aviation Regulations.

2—Vol. IX, Part 67, Federal Aviation Regulations.

3—Vol. I, Part 1, Federal Aviation Regulations.

4—National Transportation Safety Board, Procedural Regulation, Part 430.

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.

## ANSWERS AND EXPLANATIONS

### Section 1

#### Fundamentals of Instructing

1. (1) 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) Alternates #1 and #2 are not complete. Alternate #4, while useful, is not as essential to success in teaching as item #3.

3. (3) 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 *Flight Instructor's Handbook*, AC 61-16A. 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 other 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.

### Section 2

#### Aeronautical Knowledge

1. (2) FAR 91.5, *Preflight Action*, states: "Each pilot in command shall, before beginning a flight, familiarize himself with all available information concerning that flight. This information must include, for a flight under IFR or a flight not in the vicinity of an airport, available weather reports and forecasts, fuel requirements, alternatives available if the planned flight cannot be completed, and any known traffic delays of which he has been advised by ATC."

2. (4) The 1400Z Sequence Report for GNT shows the numbers "Ø Ø Ø Ø" in the space for surface wind and denotes a calm wind condition.

3. (4) The reported layer of *thin* scattered clouds at 12,000 feet does not constitute a ceiling. (Reference *Aviation Weather*, AC 00-6, and Part 1 of the Federal Aviation Regulations.)

4. (4) The study of only hourly sequence reports will not furnish sufficient information to make a route forecast. (Reference *Aviation Weather*, AC 00-6.)

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 ft. until at least 1900M. Area forecasts covering the period between 0600 MST and 1800 MST call for light to moderate turbulence with locally severe turbulence 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. 16-28, *Practical Air Navigation*, 10th edition.)

7. (1) Using a pressure altitude of 9,042 (4,000 ft. plus ground elevation at PRC) and a forecast temperature of +12° C., your computer should indicate approximately 200 m.p.h. TAS opposite a CAS of 170 m.p.h. Normally the indicated airspeed should be corrected for instrument and installation errors to be calibrated airspeed. This can be done through the use of an airspeed correction table as shown in Figure 32. 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 warmer air as represented by the station symbols at the 10 o'clock position. The air mass to the northwest of the front is composed of cooler air. (Reference *Aviation Weather*, AC 00-6.) The front is stationary as indicated by a combination of the warm front and cold front symbols and their placement (opposing) on the frontal line.

Isobars are lines connecting points of equal pressure. The isobar curving southward from Casper, Wyoming, and northward into Nebraska; the isobar surrounding Grand Junction, Colorado; the isobar around the low over Las Vegas, Nevada, represent a pressure of 1004.0 millibars.

The figure "60" at the 10 o'clock position and the figure "23" at the 8 o'clock position on the Winslow station model represents a temperature of 60° F. and a dewpoint of 23° F. respectively. (See the specimen station model in Figure 6.)



9. (2) The empty weight, including unusable fuel, is 1,839 lbs. (Figures 8 and 10). The empty weight moment is approximately 65,000 pound-inches (empty weight X empty C.G.).

### LOADING PROBLEM

	Weight in	Moment in Thousand Pound- Inches
Airplane (empty) -----	1,839	65.9
Pilot and Front Seat Passenger	315	11.5
Rear Seat Passengers -----	365	25.4
Fuel (55 gal. @ 6 lbs. per gal., Fig. 11) -----	330	15.8
Oil (3 gal. @ 7.5 lbs. per gal., Fig. 11) -----	22.5	-4
Baggage -----	150	14.1*
<b>TOTAL -----</b>	<b>3,021.5</b>	<b>132.3</b>

\* Taken from Loading Graph, Figure 10.

Your gross weight is 121.5 lbs. in excess of the maximum allowable gross weight; therefore, you must reduce the load to 2,900 lbs. or less and compute the center of gravity. (Reference Figures 8 and 10, and *Flight Training Handbook*, AC 61-21.)

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 lbs. in the baggage compartment. (Reference Figure 8.)

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

a. Below 18,000 ft. At an altitude appropriate to the magnetic course being flown as follows:

(1) zero degrees to 179° inclusive, at odd thousands plus 500 (3,500; 5,500; etc.).

(2) 180° to 359° inclusive, at even thousands plus 500 (4,500; 6,500; etc.). (Reference FAR 91.109.)

12. (1) Statements A, B, and D are correct. (Reference FAR 1, *Definitions*, for Statement A; FAR 91.87, *Operation at Airports with Operating Control Towers*, for Statements B and D.)

13. (3) Statements B, C, and E are accurate and may be verified by referring to Figures 17, 18, and 19 in the appendix. A careful analysis of Figures 17, 18, and 19 will reveal that statements A, D, and F are erroneous.

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 ft. 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 FAR 91.105.

15. (1) Given Indicated Airspeed

—150 m.p.h.

Given Pressure Altitude

—10,000 Ft.

Given Outside Air Temperature

—+10° C.

Computed True Airspeed

—180 m.p.h.

Plotted True Course

—243°

Wind

—230°/25 knots

Computed Wind Correction Angle

—-2°

Computed True Heading

—241°

Magnetic Variation

—14° E.

Computed Magnetic Heading

—227°

Figure Compass Deviation

—+3°

Computed Compass Heading

—230°

16. (2) The elevation of Greenlee County Airport is 3,811 ft. Referring to the takeoff data chart in Figure 12, you will note that interpolation between the 2,500-foot and 5,000-foot column will be necessary. Enter the chart at the 2,900 lb. gross weight block and read across (right) on the 15 m.p.h. (13 knots) line to:

2,500 ft.—950' to clear 50' obstacle

5,000 ft.—1,200' to clear 50' obstacle

Difference—250'

Interpolate for 3,811 feet—52% of 250' plus 950 ft. or 1,080 ft. to clear a 50' obstacle at standard temperatures

Interpolated standard temperature for 3,811 feet is +55° F. Current temperature of +80° F. will necessitate increasing the takeoff distance by 10% (current temperature is 25° higher than standard).

*Final Computed Takeoff Distance at Greenlee County Airport is 1,188 ft.*

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

A. 880 ft.

B. 8,800 ft.

- C. 18,800 ft.  
D. 7,880 ft.

18. (1) Figure 13 in the appendix shows a fuel consumption of 9.8 gal./hr. at 10,000 ft. with a power setting of 2,200 r.p.m. and 19 inches of manifold pressure. Subtracting the 30-minute fuel reserve from the total of 33 gals. leaves 28.1 gals. of fuel (33 gals. minus 4.9 gals.). Burning 28.1 gals. of fuel at the rate of 9.8 gals. per hour would permit 2 hours 52 minutes of flying. Study the charts until you understand their use.

19. (2) When tuning a radio compass, the set should be allowed to warm up with the switch in the "Ant" or "Rec" position.

20. (3) The H, L, and T Classifications have a power output necessary to provide coverage within their assigned operational service volume. Since the frequency of an LVOR is not protected above 12,000 ft., another VOR on the same frequency may be close enough to produce signal interference through spillover which would result in undependable or inadequate indication in the aircraft.

21. (1) You must first correct indicated airspeed to true airspeed. An indicated airspeed of 170 m.p.h. at 10,500 ft. 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. Averaging true courses is not always absolutely accurate; however, in this case the difference in groundspeeds over the two segments is negligible; therefore, the time difference would be slight. The winds aloft forecast at 10,000 ft. 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 approximately 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 Chapter 18 of AC 61-23A, *Pilot's Handbook of Aeronautical Knowledge*.

23. (1) This problem is covered in detail in AC 90-23C, *Wake Turbulence*. You should study this publication.

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.

25. (4) The load factor for a 40° bank is determined by using the graph in Figure 27. This graph gives a load factor of approximately 1.31 for a 40° bank. Multiplying 2,800 by 1.31 results in an effective gross weight of 3,668 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.

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 FAR 23.1545.

27. (3) The magnetic bearing to the station is the magnetic heading  $\pm$  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 south-east 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 chapters 7 and 13 of *Practical Air Navigation* (10th Edition).

28. (1) Flying for 1 hour 15 minutes and burning fuel at the rate of 10 gals. per hour would mean a gross weight reduction of approximately 75 lbs. Interpolating weight to the closest 500 lbs. would mean using a weight of 2,900 lbs. for the following computation:

- (a) A 10-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 ft.; thus the closest 1,000-ft. value is 7,000 ft.
- (d) Interpolating on the chart, with a gross weight of 2,900 lbs. at 7,000 ft. and standard temperature, the landing distance to clear a 50' obstacle is 1,390 feet.
- (e) A 40% reduction of 1,390 ft. is 556 ft.
- (f) Subtracting 556 ft. from 1,390 ft. equals 834 ft.
- (g) This figure is valid only if the temperature is standard at 7,000 ft.

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

\*FA 1845Z  
\*FT 2245Z  
\*WA-A 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 ft. MSL. The 2320Z AIRMET indicates that the moderately turbulent conditions existing below 14,000 ft. in northern New Mexico and Arizona should decrease to light turbulence by 1900 MST. Study Chapter 17, *Aviation Weather*.

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 33 of AC 61-23A, *Pilot's Handbook of Aeronautical Knowledge*, chapter 13 of the 10th edition of *Practical Air Navigation*, and VFR Exam-O-Grams 15 and 16.

31. (4) Figure 22 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. hp.) 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. If the r.p.m. is reduced *first* it 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 carburetor heat with full power setting will tend to cause or increase detonation.

\*See Figure 2 for meaning of code.

## **APPENDIX**

# 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 - Santa Fe, New Mexico  
TUS - Tucson, Arizona  
ZUN - Zuni, New Mexico

FIGURE 1. Station identifiers.

FT - Terminal Forecasts  
FA - Area Forecasts  
FD - Winds Aloft Forecasts  
WS - SIGMET - Weather significant to safety of all aircraft  
WA - AIRMET - Weather phenomena of operational interest to all aircraft, but potentially hazardous to aircraft of limited capability.  
UB - Pilot Report Summary  
SA - Hourly Sequence Report  
WW - Severe Weather Forecasts  
AC - Severe Weather Outlooks  
SD - Individual Single Station Radar Report

FIGURE 2. Letter designators for reports and forecasts.

# WEATHER INFORMATION

## Area Forecast

FA ABQ 111245Z  
13Z FRI - 01Z SAT (0600 MST - 1800 MST FRI)  
NRN ARIZ NRN NEW MEX

CLDS AND WX. MOSTLY CLR WITH OCNL -0 ABV 180 MSL. SCTD CU DVLPG  
OVR MTNS BCMG 140-1500 MSL DURG THE AFTN WITH A FEW HIGH LVL SHWRS  
OVR THE MTNS. SFC WND S W OF CONTDVD LCLY UP TO 1825G BY 1100M

ICG. LGT ICGIC. FRZG 135-145

TURBC LGT TO MDT. MDT TURBC TO 150 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  
19Z FRI - 07Z SAT  
NRN ARIZ NRN NEW MEX

CLDS AND WX. ERN PLAINS OF NRN NEW MEX 110-1200MSL CLRG AFT 2200M.  
NRN ARIZ AND RMNDR NRN NEW MEX 1300MSL WITH ABV 1500V0MSL BRFLY  
1200 MSL IN FEW SHWRS DURG EVE HRS. AFT 21M ABV 1500V0 MSL

ICG. NONE. FRZG LVL 120 - 135 MSL

TURBC. MDT FOR LGT ACFT DCRG DURG EVE BCMG LGT AFT 20M

OTLK 00M - 12M SAT. CLR OR ABV 1500 MSL DURG MRNG HRS. AFT 12M  
SCTD CU BASES 120 MSL BRFLY BRKN OVR MTNS IN FEW SHWRS

FIGURE 3. Area forecasts.

## ERRATA SHEET

### AC 143-1C—Ground Instruction Written Test Guide

#### Basic—Advanced

Because of undetected publication problems a portion of page 31 of this book is illegible. A copy of that portion is reprinted below.

Please cut off the "In-Flight Weather Advisories" portion below, and paste over that portion of Figure 4, page 31.

This paper is pre-gummed and needs no further adhesive—just moisten and affix.

#### In-Flight Weather Advisories

ABQ WA-A 111345Z

0645M - 1045M FRI

AIRMET ALPHA 1. NRN ARIZ AND W OF CONTDVD IN NW/N NEW MEX LGT TO  
LCLY MDT TURBC BLO 80 MSL WITH STNG DOWNDRAFTS OVER LEE SLPS

ABQ WA-A 112320Z

1620M - 1900M FRI

AIRMET ALPHA 2. NRN ARIZ NRN NEW MEX MDT TURBC BLO 140 MSL DCRG  
BCMG LGT BY 1900M

## Terminal Forecasts

FT 111045

INW 111123 O. 19Z 900 2325..  
 PRC 111123 O 2012. 17Z 8001200 2020..  
 FLG 111123 O. 17Z 7001200 2020..  
 FMN 111123 O. 19Z 900 2320..  
 ABQ 111123 O. 20Z 1000 2325..  
 FT 112245

INW 112311 O. 8001200 2525G. 02Z 1000..  
 PRC 112311 O. 80001200 2320G30. 02Z 01500. 05Z 150-0..  
 FLG 112311 O. 80001200 2020G. 02Z 01200 2325G. 05Z 120-0..  
 FMN 112311 O. 0800 2320 00ONLY 0700 BRW- VCNTY. 03Z 01000..  
 ABQ 112311 O. 8001200 2020 00ONLY 0800 2525G30. 02Z 1000..

## Winds Aloft Forecasts (FD)

10Z - 22Z (0300MST - 1500MST)

FT	3000	6000	9000	12000	18000
ABQ		2020	2325+10	2730+03	2740-10
FMN	1915	1920+18	2030+10	2040+02	2140-10
PRC		2715+20	2830+12	2940+05	3040-10
BLD		2816+22	3032+14	3131+07	3242-12
BCE		3018+24	3234+16	3444+09	3444-14

## In-Flight Weather Advisories

ABQ WA-A 111345Z  
 0645M - 1045M FRI  
 ALPHA 1. NRN ARIZ AND W OF CONTDVD IN NW N NEW MEX LGT TO  
 MDT TURBC BLO 80 MSL WITH STNG DOWNDRAFTS OVER LEE SLPS  
 WA-A 112320Z  
 - 1900M FRI  
 ALPHA 2. NRN ARIZ NRN NEW MEX MDT TURBC BLO 140 MSL DCRG  
 LGT BY 1900M

FIGURE 4. Terminal forecasts, winds aloft forecasts, and in-flight weather advisories.



## Pilot Report Summaries

ABQ UB 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 C310  
ABQ UB 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

SA 111400Z  
PRC 140-020+064/60/32/1810/985  
FLG 120-015+ 055/55/18/1812018/993  
INW 100060 045/55/26/1810/998  
ZUN 120020+ 070/55/30/2005/995  
GNT 120-035 065/55/31/0000/001  
PHX 900120-045 075/70/30/2704/HK ALQDS  
TUS E1500300050 060/75/35/1810/983

### Hourly Sequence Weather Reports 08M

SA 111500Z  
PRC 130045 067/68/31/2728/991  
FLG 120020+ 065/60/30/2015/993  
INW 100060+ 047/65/31/1815/989  
ZUN 100-025 065/60/33/2310/999  
GNT 1200300-035 060/65/32/1810G15/000  
PHX 1000120-035 082/75/33/2705/HK ALQDS  
TUS E1500300070 075/75/32/2315/985

FIGURE 5. Pilot report summaries and hourly sequence reports.

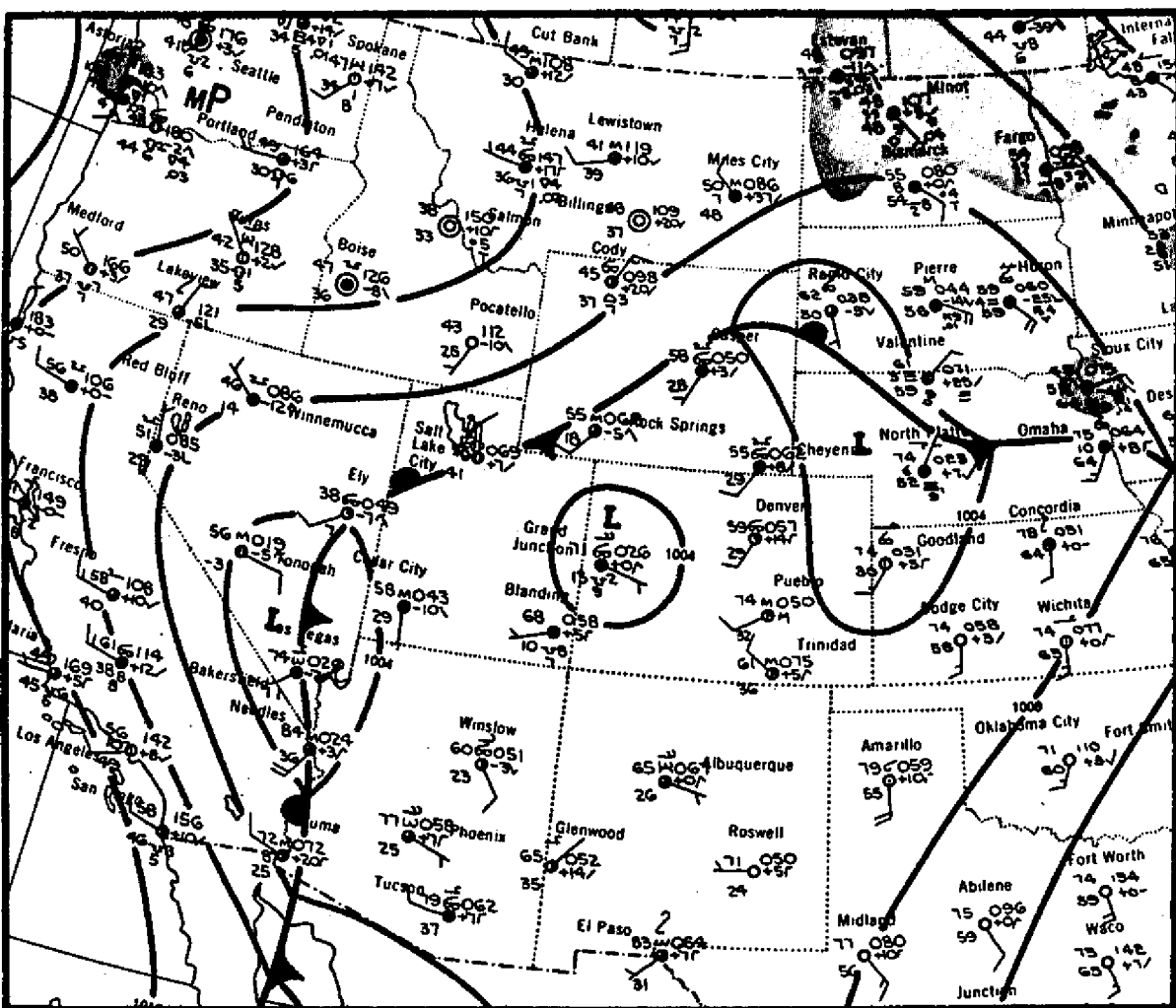


FIGURE 6a. Daily weather map excerpt.

# SURFACE WEATHER MAP AND STATION WEATHER AT 7:00 A. M., E. S. T.

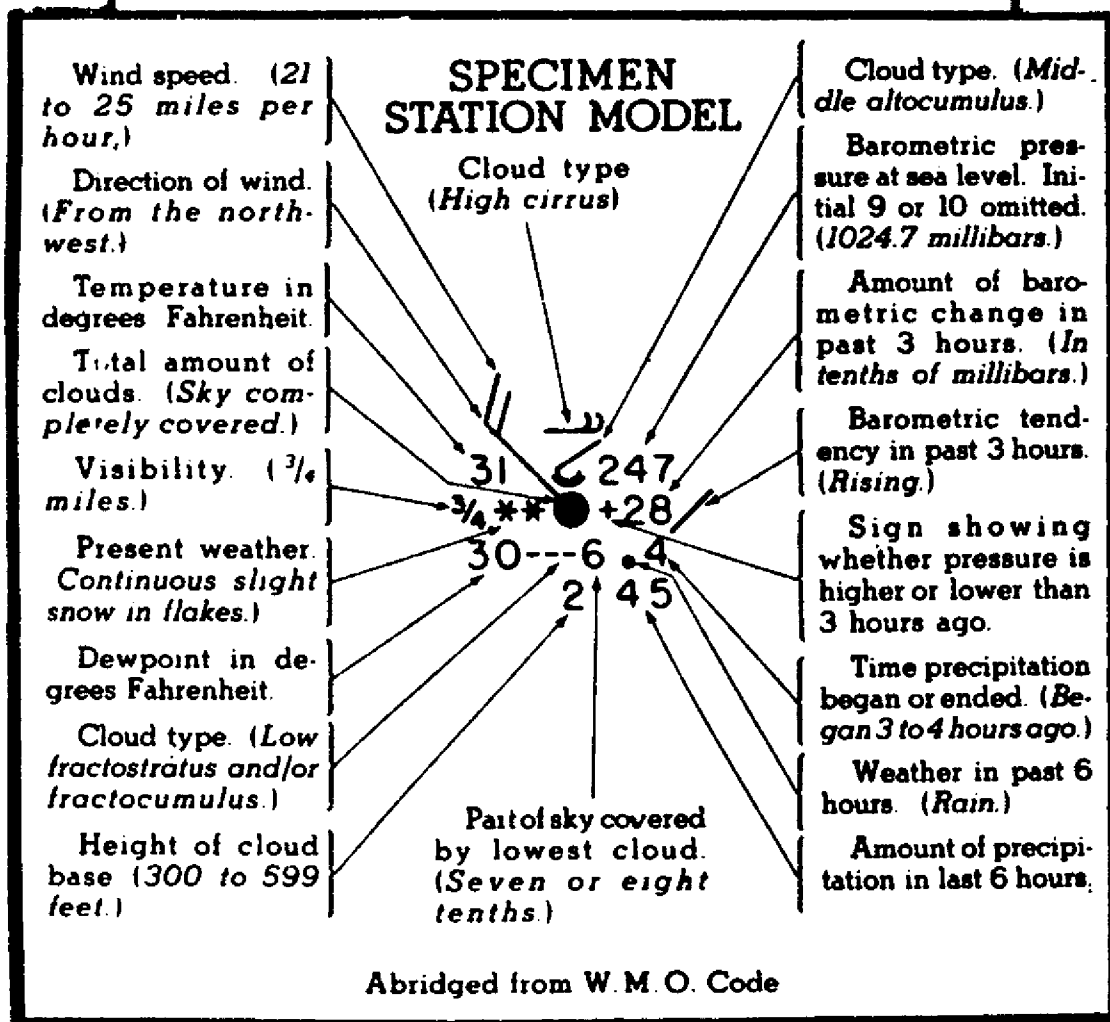


FIGURE 6b. Daily weather map excerpt—station weather.

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 7. 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 8. Aircraft description placard (excerpt from Airplane Flight Manual).

## RADIO EQUIPMENT

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 9. Radio equipment and compass correction card.

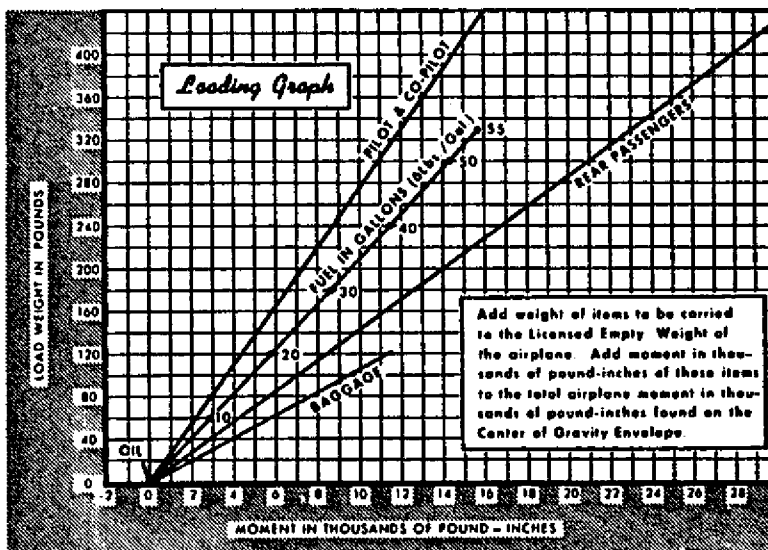
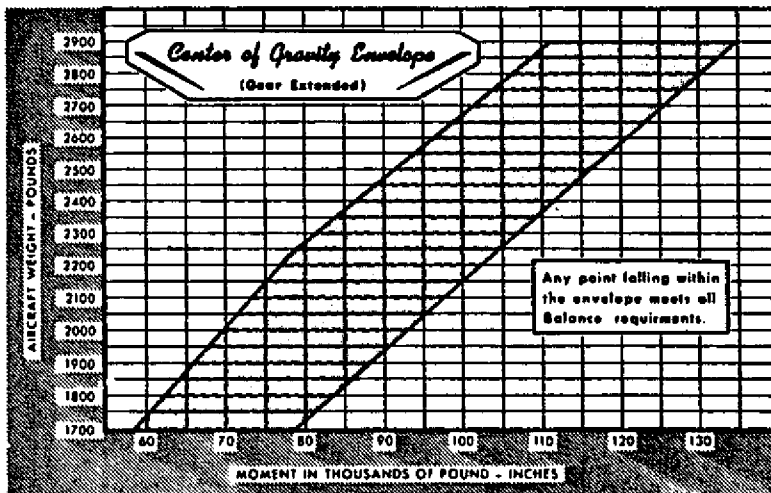


FIGURE 10. Center of gravity envelope and loading graph.

## 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 10.

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 in the aircraft maintenance records in accordance with Federal Aviation 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 latest entry pertaining to weight and balance in the aircraft maintenance record.
- (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.

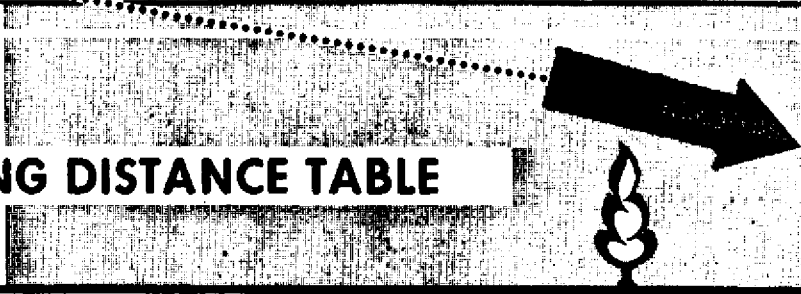
### EXAMPLE PROBLEM

Example for an airplane with a licensed empty weight of 1839 pounds and a moment of 65,873 pound-inches: (Empty weight of 1,839 lbs. multiplied by the number of inches the empty C. G. is from the datum—in this airplane 35.82 inches. The figure thus obtained is arbitrarily divided by 1,000, the moment in pound inches.)

	<u>Weight</u> <u>Pounds</u>	<u>Moment (lb-in)</u> <u>1000</u>
Empty Weight (licensed) .....	1839.0	65.9
Oil (12 qts.) .....	22.5	-0.4
Pilot and 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
<b>TOTAL</b> .....	<u>2900.0</u>	<u>120.0</u>

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 11. Weight and balance.

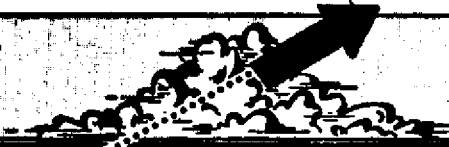


# LANDING DISTANCE TABLE

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.

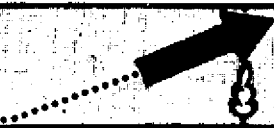
# CLIMB DATA



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	1190	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, 3625 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	815	805	815	950	740	1145
		15	265	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	580	385	725
2900	65	0	740	1135	680	1355	1055	1655	1285	2155
		15	480	790	560	950	705	1200	875	1580
		30	270	600	335	615	425	795	540	1080

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

FIGURE 12. Takeoff, climb, and landing distance tables.



CRUISE PERFORMANCE						10000	
NORMAL LEAN MIXTURE							
Standard Atmosphere Zero Wind				Gross Weight - 2900 Pounds 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 13. Cruise performance chart.

## AIRPORT/FACILITY DIRECTORY

### LOCATION

The airport location is given in nautical miles (to the nearest mile) and direction from center of referenced city.

### ELEVATION

Elevation is given in feet above mean sea level and is based on highest usable portion of the landing area. When elevation is sea level, elevation will be indicated as "00." When elevation is below sea level, a minus sign (-) will precede the figure.

### RUNWAYS

The runway surface length, and weight bearing capacity are listed for the longest instrument runway or sealane, or the longest active landing portion of the runway or strip, given to the nearest hundred feet, using 70 feet as the division point, i.e., 1468 feet would be shown as "14"; 1474 feet would be shown as "15". Runway lengths prefixed by the letter "H" indicates that runways are hard surfaced (concrete; asphalt; bitumen, or macadam with a seal coat). If the runway length is not prefixed, the surface is sod, clay, etc. The total number of runways available is shown in parenthesis. (However, only hard surfaced runways are counted at airfields with both hard surfaced and sod runways.)

### RUNWAY WEIGHT BEARING CAPACITY

Runway strength data shown in this publication is derived from available information and is a realistic estimate of capability at an average level of activity. It is not intended as a maximum allowable weight or as an operating limitation. Many airport pavements are capable of supporting limited operations with gross weights of 25-50% in excess of the published figures. Permissible operating weights, insofar as runway strengths are concerned, are a matter of agreement between the owner and user. When desiring to operate into any airport at weights in excess of those published in this publication, users should contact the airport management for permission.

Add 000 to figure following S, D, DT and MAX for gross weight capacity, e.g., (S-000).

S-Runway weight bearing capacity for aircraft with single-wheel type landing gear. (DC-3), etc.

D-Runway weight bearing capacity for aircraft with twin-wheel type landing gear. (DC-6), etc.

DT-Runway weight bearing capacity for aircraft with twin-tandem type landing gear. (707), etc.

Quadricycle and twin-tandem are considered virtually equal for runway weight bearing considerations, as are single-tandem and twin-wheel.

Omission of weight bearing capacity indicates information unknown. Footnote remarks are used to indicate a runway with a weight bearing greater than the longest runway.

### LIGHTING

B: Rotating Beacon. Green and white, split-beam and other types.

L: Field Lighting. An asterisk (\*) may precede an element to indicate that it operates on prior request only (by phone call).

- 4—Low Intensity Runway
- 5—Medium Intensity Runway
- 6—High Intensity Runway
- 7—Instrument Approach (neon)
- 7A—Medium Intensity Approach Lights (MALS)
- 8—High Intensity Instrument Approach (ALS)
- 10—Visual Approach Slope Indicator (VASI)
- 11—Runway end identifier lights (threshold strobe) (REIL)
- 12—Short approach light systems (SALS)
- 13—Runway alignment lights (RAIL)
- 14—Runway centerline
- 15—Touchdown zone

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

### SERVICING

- S2: Minor airframe repairs.
- S3: Minor airframe and minor powerplant repairs.
- S4: Major airframe and minor powerplant repairs.
- S5: Major airframe and major powerplant repairs.

### FUEL

(Fuel data includes each grade available.)

Code	Grade
F12	80/87
F15	91/98
F18	100/130
F22	115/145
F30	Kerosene, freeze point -40°F
F34	Kerosene, freeze point -58°F
F40	Wide-cut gasoline, freeze point -60°F
F45	Wide-cut gasoline without icing inhibitor, freeze point -60°F

### OXYGEN

Ox1	High Pressure
Ox2	Low Pressure
Ox3	High Pressure—Replacement Bottles
Ox4	Low Pressure—Replacement Bottles

FIGURE 14. Airport/facility directory.

## OTHER

**1—NOTAM** Service is provided. Applicable only to airports with established instrument approach procedures, or high volume VFR activity.

**ACE—Airport of Entry—A** customs Airport of Entry where permission from U.S. Customs is not required, however, at least one hour advance notice of arrival must be furnished.

**FSS—The name of the associated FSS is shown in all instances.** When the FSS is located on the named airport, "on fld" is shown following the FSS name. When the FSS can be called through the local telephone exchange, (Foreign Exchange) at the cost of a local call, it is indicated by "(LC)" (local call) with the phone number immediately following the name of the FSS, i.e., "FSS: WICHITA (LC481-5867)." When an Interphone line exists between the field and the FSS, it is indicated by "(DL)" (direct line) immediately following the name of the FSS, i.e., "FSS: OTTO (DL)."

**IFR—Airport with approved FAA Standard Instrument Approach Procedure.**

**LRA—Landing Rights Airport—**Application for permission to land must be submitted in advance to U.S. Customs. At least one hour advance notice of arrival must also be furnished.

**TCH—Threshold Crossing Height.**

**RRP—Runway Reference Point.**

**RVV—Runway Visibility Values,** applicable runway provided.

**RVR—Runway Visual Range,** applicable runway provided.

**TPA—Traffic Pattern Altitude.**

**VASI—Visual Approach Slope Indicator,** applicable runway provided.

## AIRPORT REMARKS

"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.

"Rgt Hc 13-31" indicates right turns should be made on landings and takeoffs on runways 13 and 31.

Remarks data are confined to operational items affecting the status and usability of the airport, traffic patterns and departure procedures.

**Obstructions.**—Because of space limitations only the more dangerous obstructions are indicated. Natural obstructions, such as trees, clearly discernible for contact operations, are frequently omitted. On the other hand, all pole lines within at least 15:1 glide angle are indicated.

## FLIGHT SERVICE STATIONS

Flight Service Station (FSSs) and Combined Station/Tower (CS/Ts) are listed alphabetically by state in the Airport/Facility Directory. At certain locations the preflight briefing and flight plan processing responsibilities of the CS/T have been reassigned to an adjacent FSS. At these locations the adjacent FSS will be listed as the 'Associated FSS,' otherwise, the CS/T will be listed. Limited Remote Communications Outlet (LRCO) and Remote Communications Outlet (RCO), where

available at the facility, are shown following the three letter identifier. If located at other than a facility site they are listed alphabetically.

FSSs and CS/Ts provide information on airport conditions, radio aids and other facilities, and process flight plans. Airport Advisory Service is provided at the pilot's request on 123.6 by FSSs located at non-tower airports or when the tower is not in operation. (See Part 1, ADVISORIES AT NON TOWER AIRPORTS.)

Aviation weather briefing service is provided by FSSs and CS/Ts; however, CS/T personnel are not certified weather briefers and therefore provide only factual data from weather reports and forecasts. Flight and weather briefing services are also available by calling the telephone numbers listed in the chapter entitled 'FSS-CS/T Information and Weather Service Office Telephone Numbers,' located in Part 2."

Civil communication frequencies used in the flight service station air/ground system are now operated simplex on 122.0, 122.2, 122.3, 122.6, 123.6 and emergency 121.5 plus 122.1 and 123.6 receive only as follows:

a. 122.0 is assigned at selected FSSs as a weather channel for both general aviation and air carriers.

b. 123.6 is designated as an airport advisory channel at all FSSs which provide this service at nontower locations. 123.6 is still in commission at some FSSs collocated with towers for the purpose of providing part-time Airport Advisory Service.

c. Some FSSs use 123.65 or certain 50 KHz channels in the 122-123 MHz band (such as 122.05). Pilots using the FSS A/G system should refer to this directory or appropriate charts to determine frequencies available at the FSS or remote facility through which they wish to communicate.

Part time FSS hours of operation are shown in remarks under facility name.

## COMMUNICATIONS

Clearance is required prior to taxiing on a runway, taking off, or landing at a tower controlled airport.

When operating at an airport where the control tower is operated by the U.S. Government, two-way radio communication is required unless otherwise authorized by the tower. (When the tower is operated by someone other than the U.S. Government, two-way radio communication is required if the aircraft has the necessary equipment.)

Frequencies transmit and receive unless specified as: T—Transmit only, R—Receive only, X—On request. Primary frequencies are listed first in each frequency grouping, i.e., VHF, LF. Emergency frequency 121.5 is available at all TOWER, APPROACH CONTROL and RADAR facilities, unless indicated as not available in remarks.

Radar available is listed under "RADAR SERVICES" Radar beacons are indicated by "(BCN)" after "RADAR SERVICES", when available.

## COMMUNICATIONS REMARKS

Remarks data are confined to operational items affecting the status and usability of navigational aids, such as: ILS component restrictions, part time hours of operation, frequency sectorization, VOT frequencies.

FIGURE 15. Airport/facility directory.

## AIRPORT/FACILITY DIRECTORY

### VOICE CALL

The voice call for contact with the air traffic control tower is listed at each airport assigned such a facility.

### SERVICES AVAILABLE

#### TOWER

Pre-Taxi Clearance Procedure  
 Clearance Delivery (CLRNC DEL).  
 Approach Control (App Con) Radar and Non-Radar.  
 Departure Control (Dep Con) Radar and Non-Radar.  
 VFR Advisory Service (VFR ADV) Service provided by Non Radar Approach Control.  
 Radar Advisory Service for VFR Acft (Stage I).  
 Radar Advisory and Sequencing Service for VFR Acft (Stage II).  
 Radar Sequencing and Separation Service for VFR Acft (TCA).  
 Ground Control (GND CON).  
 VHF Direction Finding (VHF/DF).

#### RADIO NAVIGATION AIDS

Included in this section is a tabulation of all Air Navigation Radio Aids in the National Airspace System and those upon which the FAA has approved an instrument approach. Private or military Navigation Radio Aids not in the National Airspace System are not tabulated.

#### AUTOMATIC TERMINAL INFORMATION SERVICE (ATIS)

ATIS is continuous broadcast of recorded non-control information in selected areas of high activity. See Part 1.

#### FLIGHT SERVICE STATION (FSS)

Airport Advisory Service (AAS).  
 Island, Mountain and Lake Reporting Service.  
 Remote Weather Radar Display (WR).  
 VHF Direction Finding (DF).

#### UNICOM

A private aeronautical advisory communications facility operated for purposes other than air traffic control, transmits and receives on one of the following frequencies:

- U-1—122.8 MHz for Landing Areas (except heliports) without an ATC Tower or FSS;
- U-2—123.0 MHz for Landing Areas (except heliports with an ATC Tower or FSS);
- U-3—123.05 MHz for heliports with or without ATC Tower or FSS;
- U-4—122.85 MHz for landing areas not open to the public;
- U-5—122.95 MHz for landing areas not open to the public.

NOTE.—UNICOM used for communications must be licensed by the Federal Communication Commission in order to be listed in this publication.

### RADIO CLASS DESIGNATIONS

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

#### Normal Usable Altitudes and Radius Distances

Class	Altitudes	Distance (miles)
T	12,000' and below	25
L	Below 18,000'	40
H	Below 18,000'	40
H	14,500' — 17,999'	100*
H	18,000' — FL 450	130
H	Above FL 450	100

\*Applicable only within the contiguous 48 States.

H=High L=Low T=Terminal

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

The term VOR is, operationally, a general term covering the VHF omnidirectional bearing type of facility without regard to the fact that the power, the frequency-protected service volume, the equipment configuration, and operational requirements may vary between facilities at different locations.

AB -----	Automatic Weather Broadcast (also shown with ■ following frequency).
B -----	Scheduled Broadcast Station (broadcasts weather at 15 minutes after the hour.
DME -----	UHF standard (TACAN compatible) distance measuring equipment.
H -----	Non-directional radio beacon (homing), power 50 watts to less than 2,000 watts.
HH -----	Non-directional radio beacon (homing), power 2,000 watts or more.
H-SAB ----	Non-directional radio beacons providing automatic transcribed weather service.
ILS -----	Instrument Landing System (voice, where available, on localizer channel).
LMM -----	Compass locator station when installed at middle marker site.
LOM -----	Compass locator station when installed at outer marker site.
MH -----	Non-directional radio beacon (homing) power less than 50 watts.
SABH -----	Non-directional radio beacon having limited navigational use. Provides automatic weather broadcasts.
SDF -----	Simplified Direction Facility
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 on radio facility frequency.
Z -----	VHF station location marker at a LF radio facility.

FIGURE 16. Airport/facility directory.

## AIRPORT/FACILITY DIRECTORY

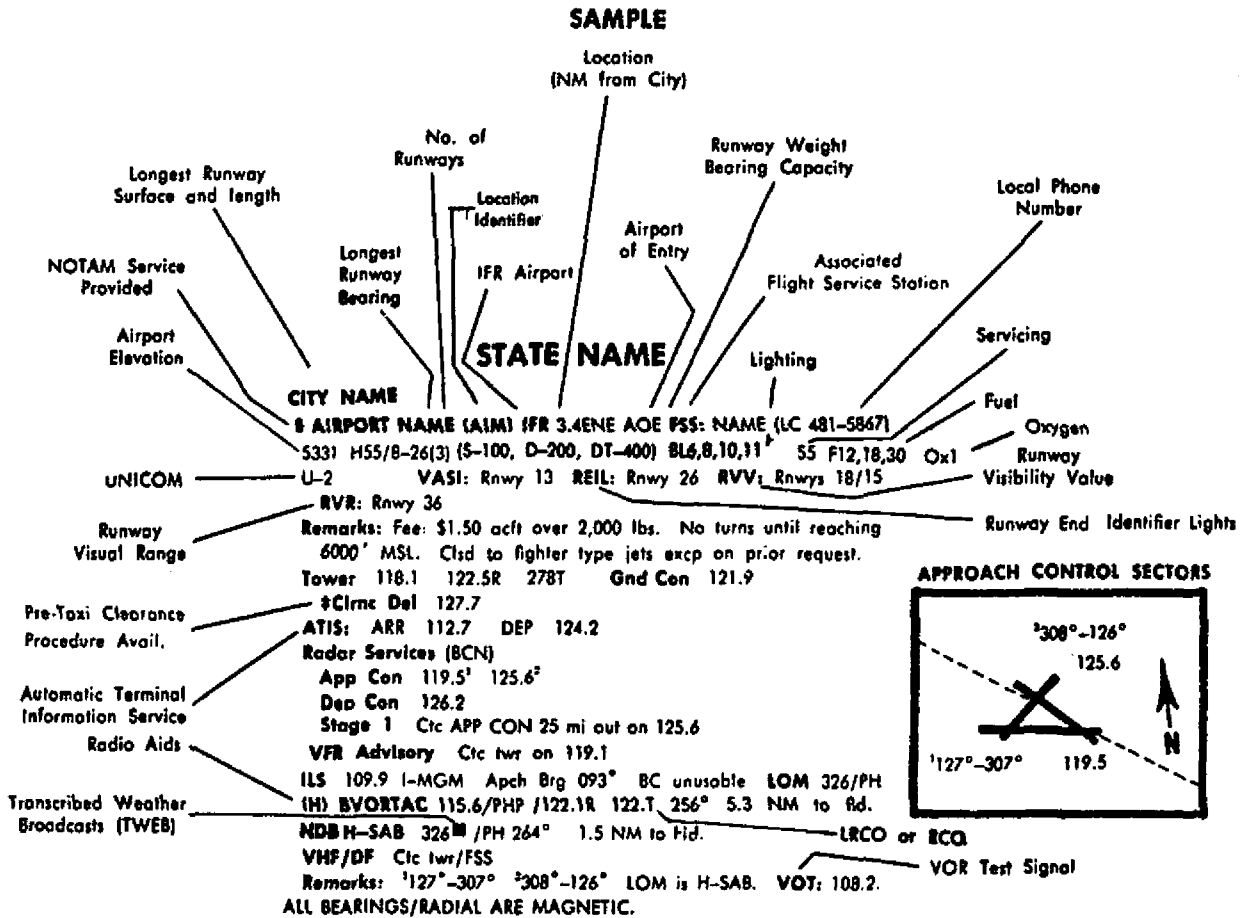


FIGURE 17. Airport/facility directory.

# AIRPORT/FACILITY DIRECTORY

## ARIZONA

BUCKEYE (L) BVORTAC 110.6/BXK/122.1R	FSS: PHOENIX	PRESCOTT FSS 121.5 122.1R 122.2 122.6 123.6	DF
CASA GRANDE (L) BVORTAC 114.8/CZG/122.1R	FSS: PHOENIX	Remarks: No wea bcast avbl 2200-0400 lcl time.	
COCHISE (L) BVORTAC 110.4/CIE/122.1R	FSS: DOUGLAS	PRESCOTT (H) BVORTAC 114.1/PRC	FSS: PRESCOTT
DOUGLAS FSS 121.5 122.1R 122.3 122.6 125.6		RYAN NDB H-SAB 338 M/RVN	FSS: TUCSON
Remarks: No wea bcast avbl 2200-0500 lcl time.		ST. JOHNS (H) BVORTAC 112.3/SJN/122.1R	FSS: ZUNI
DOUGLAS (L) BVORTAC 108.8/DUG	FSS: DOUGLAS	SAN SIMON (H) BVORTAC 115.4/SSO/122.1R	FSS: DOUGLAS
FLAGSTAFF (L) BVOR 108.2/FLG/122.3R	FSS: PRESCOTT	TUBA CITY (H) BVORTAC 113.5/TBC/122.2R	FSS: PRESCOTT
GILA BEND (H) BVORTAC 116.6/GBN/121.5 122.1R 122.6	FSS: PHOENIX	TUCSON LRCO 122.2	FSS: TUCSON
GLOBE LRCO 122.3	FSS: PHOENIX	TUCSON FSS 121.5 122.1R 122.2 122.6 123.65	DF
GOODYEAR		8 TUCSON INTL (TUS) IFR 75 AOE	FSS: TUCSON on Fld
8 PHOENIX-LITCHFIELD MUNI (GYR) 1SW	FSS: PHOENIX (LC 261-4295)	2630 H120/12L-30R(3) (S-120, D-160, DT-260) BL5,10 S5	
968 H85/3-21(1) (S-60, D-80, DT-140) BL6 S5 F12,18,22,30		F12,18,22,30,40 Oxl,2,3,4 U2 VASI: Rwy 30R	
Remarks: Rgt tlc rwy 3. Rwy 21 thr displcd 2000'.		Remarks: 1000' x 150' asph overrun each end rwy 12L-30R.	
Litchfield Tower <sup>1</sup> 120.1 122.7R		Lndg fee. J-bar rwy 12L-30R. VASI rwy 30R upper TCH 78',	
Radar Services:		lower TCH 42'; upper RRP 1690', lower RRP 1090'.	
App Con 120.7		Tucson Tower: 118.3 122.5R	Gnd Con 121.9
VFR Advisory Ctc App Con		Radar Services: (BCN)	
Remarks: 'Oper 0600-2200 lcl time. Two-way rdo required.		App Con 118.5 125.1 125.9 134.1 117.1T	
GRAND CANYON (L) BVOR 109.0/GCN/122.1R	FSS: PRESCOTT	Dep Con 125.9	
IMPERIAL LRCO 122.0	FSS: IMPERIAL	Stage II Ctc App Con on 124.0 25 NM out	
KINGMAN (L) BVOR 108.8/IGM/122.2R	FSS: PRESCOTT	VHF/DF <sup>1</sup> Ctc FSS.	
MOQUI NDB HW 266/MQI	FSS: PRESCOTT	(H) BVORTAC 117.1/TUS 254° 6.1 NM to fld.	
NOGALES RCO 122.2	FSS: TUCSON	Remarks: 'Unusable beyond 40 NM below 13,500' MSL 345-070°	
PAPAGO NDB H-SAB 326 M/PQO	FSS: PHOENIX	below 12,500' MSL 070-090°.	
PEACH SPRINGS (H) BVORTAC 112.0/PGS/122.3R	FSS: PRESCOTT	WINSLOW (H) BVORTAC 112.6/INW/122.1R 122.6	FSS: PRESCOTT
PHOENIX FSS 121.5 122.1R 122.3 122.6 122.05	DF	YUMA FSS 121.5 122.1R 122.2 122.6 123.6	
Remarks: No wea bcast avbl 2200-0600 lcl time.		Remarks: No sked wea bcast 2200-0500 lcl time.	
PHOENIX		8 YUMA MCAS/INTL (YUM) IFR 45 AOE	FSS: YUMA on Fld
DEER VALLEY (P09) 17N	FSS: PHOENIX	213 H133/3L-21R(4) (S-103, D-200, DT-400) BL6 S5 F12,18,30 U2	
1475 H51/7-25(1) (S-30, D-45, DT-60) BL4 S5 F12,18 U1		Remarks: Rwy 3R-21L GWT (S-162, T-200, TT-400). 1000 x 200'	
Remarks: 5150 x 60 extension E end clcd, but avbl on prior request. Glider ops in vicinity of arpt Sat & Sun 1100-Sunset.		overrun each end rwy 3L-21R. A-gear rwnys 3L-21R and 3R-21L. 2200-0600 civil rwy will remain lgtd and addnl lgtd avbl thru FSS in emerg.	
Deer Valley Tower <sup>1</sup> 118.4	Gnd Con 121.8	Marine Yuma Tower <sup>1</sup> 119.3 126.2	Gnd Con 121.9
Remarks: 'Oper 1000-1800 lcl Mon-Fri, dawn-dusk Sat and Sun. Non-fed ATCT owned and operd by City of Phoenix.		App Con 120.0	
PHOENIX		VHF/DF Ctc twr.	
8 SKY HARBOR INTL (PHX) IFR 3E LRA FSS: PHOENIX on Fld		(H) BVORTAC 116.8/YUM 167° 6.0NM to fld.	
1128 H103/8R-26L(2) (S-100, D-200, DT-350) BL5,7A,10,11,13 S5		NDB MHW 344/NYL on fld.	
F12,18,22,30 Oxl,2,3,4 U2 VASI: Rwy 8R REIL: Rwy 8L, 26R		Remarks: 'Operates 0600-2200 lcl time except avbl for emgcy.	
RVV: Rwy 8R.		Ctc FSS for airport advisory service when tower closed.	
Remarks: Rgt tlc rwnys 8R, 26R. Rwy 26L threshold displaced 700'. VASI rwy 8R TCH 46', RRP 1010'. Unless adzd by ATC all turbine acft and acft 12,500 lbs and over remain at or above 3,000' MSL until estab on final. Fly base leg at least 5 mi fm arpt.			
Phoenix Tower 118.7 (Rwy 8L-26R) 120.9 (Rwy 8R-26L) 122.5R			
	Gnd Con 121.9		
8 Cinc Del 118.1			
ATIS: 125.6			
Radar Services: (BCN)			
Phoenix App Con 119.2 (010-109°), 124.1 (110-269°), 120.7 (270-009°), 115.6T 122.5R			
Phoenix Dep Con 119.2 (010-109°), 124.1 (110-269°), 120.7 (270-009°), 115.6T 122.5R			
Stage I Ctc App Con beyond 10 miles			
Phoenix (H) BVORTAC <sup>1</sup> 115.6/PHX 256° 5.3 NM to fld.			
Remarks: 'No wea bcast avbl 2200-0600 lcl time. VOT: 109.0.			

FIGURE 18. Airport/facility directory.

# AIRPORT DIRECTORY

## ARIZONA

<b>AJO, MUNI (P01)</b> 6N 32°27'00" 112°52'00" <b>FSS: PHOENIX</b> 1458 H63/12-30 (1) L4 F12 REMARKS: ARPT UNATTENDED. HWY JET TFC VCNTY ARPT. FUEL AVBL EMERG. CALL SHERIFF 387-7621. LGTS ON CENTER 3950 FT.	
<b>ANGEL FLD See FORT GRANT</b>	
<b>ANTELOPE RANCH See ROLL</b>	
<b>ASH FORK</b> IN 35°13'55" 112°29'10" <b>FSS: PRESCOTT</b> 5169 34/7-25 (3) REMARKS: ARPT UNATTENDED P-LINE IN RWY 7 APCH. P-LINE IN RWY 25 APCH.	
<b>BAGDAD</b> 2NE 34°35'45" 113°10'10" <b>FSS: PRESCOTT</b> 4136 H36/5-23 (1) (S-4) BL4 REMARKS: ARPT UNATTENDED. UNUSUAL AIR CURRENTS VICINITY ARPT, ESPECIALLY EAST APCH. RWY LGTS ACTIVATED BY KEYING 122.8 3 TIMES OR BY PRIOR REQ OR CIRCLING TOWN.	
<b>BISBEE, MUNI (P04)</b> 6SE 31°21'50" 109°52'57" <b>FSS: DOUGLAS</b> 4780 39/2-20 (3) L4 F12 REMARKS: P-LINE IN RWY 2 APCH. P-LINE IN RWY 8 APCH. RWY LGTS ACTIVATED ON 122.8.	
<b>CLIFTON-MORENCI, GREENLEE COUNTY (CFT)</b> 9SE 32°57'10" 109°12'35" <b>FSS: DOUGLAS</b> 3811 H49/7-25 (1) (S-21) "BL5 REMARKS: ARPT UNATTENDED. FOR RWY LGTS & ROTC BCM PHONE 864-3080 OR 864-4149.	
<b>COCHISE COUNTY See WILLCOX</b>	
<b>COLORADO CITY, MUNI</b> 4SW 36°56'58" 113°00'50" <b>FSS: CEDAR CITY</b> 4840 34/13-31 (2) F12 REMARKS: ARPT UNATTENDED. FUEL IN EMERG ONLY.	
<b>COOLIDGE, MUNI</b> 2SW 32°58'00" 111°32'45" <b>FSS: PHOENIX</b> 1402 H21/8-26 (1) (S-4) F12 REMARKS: ARPT ATTENDED DAYLIGHT. FUEL IN EMERG ONLY.	
<b>COOLIDGE, FLORENCE MUNI (P08)</b> 6SE 32°56'00" 111°25'30" <b>FSS: PHOENIX</b> 1587 H55/5-23 (4) (S-80, D-115, DT-210) S5 F12, 18 U-1 (LC 723-3392) REMARKS: RGT TFC RWY 5, 8, 11, 35. TRAFFIC PATTERN ALTITUDE 1000FT AGL PARACHUTE JUMPING SAT & SUN. ALL TFC PTNS VARY DURING AF TRAINING	
<b>DOUGLAS BISBEE, BISBEE DOUGLAS INTERNATIONAL (DUG)</b> 9NW 31°28'04" 109°36'11" IFR AOE <b>FSS: DOUGLAS ON FLD</b> 4158 H75/12-30 (4) (S-12) BL5 S5 F12, 18, 22, 30 REMARKS: RWY 8-26 WT BRG CPT S-85, D-95, DT-155. RWY LGTS OPER ON REQ THRU DUG FSS.	
<b>DOWNTOWN TUCSON See TUCSON</b>	
<b>DVR See TACNA</b>	
<b>EDS FIELD See PICACHO</b>	
<b>ELY, MUNI</b> 4NW 32°48'25" 111°35'10" <b>FSS: PHOENIX</b> 1513 H39/2-20 (1) (S-12.5) BL5 S5 F12, 18	
<b>ESTRELLA SAILPORT See MARICOPA</b>	
<b>EUREKA RANCH See BOHITA</b>	
<b>FALCON FLD See MESA</b>	
<b>FARM AERO See PHOENIX</b>	
<b>FLAGSTAFF, PULLIAM (FLG)</b> 5S 35°08'16" 111°40'18" <b>FSS: PRESCOTT</b> IFR 7012 H70/3-21 (1) (S-65, D-85, DT-130) BL5 S5 F12, 18 (LC 774-0475) U-1 REMARKS: ARPT ATTENDED 0700-2000. ARPT ATND ON CALL OTHER HRS	
<b>FOREPAUGH See WICKENBURG</b>	
<b>FOREST ACRES See SELIGMAN</b>	
<b>GREEN VALLEY See MUNT</b>	
<b>GREENLEE COUNTY See CLIFTON-MORENCI</b>	
<b>HEREFORD See NICKSVILLE/HEREFORD/</b>	
<b>HOLBROOK, MUNI (P14)</b> 3NE 34°56'20" 110°08'20" <b>FSS: ZUNI</b> 5245 H50/3-21 (1) (S-12) BL5 S3 F12, 18 REMARKS: P-LINE IN RWY 29 APCH.	
<b>PHOENIX, SKY HARBOR (HTL) (PHX)</b> 3E 33°26'07" 112°00'43" IFR <b>FSS: PHOENIX ON FLD</b> 1128 H103/8R-26L (2) (S-100, D-200, DT-350) BL5, 7A, 10, 11 S5 F12, 18, 22, 30 OX1, 2, 3, 4 U-2 VASI: RWY 8R REIL: RWY 8L, 26R RVT: RWY 8R REMARKS: (+) RWY 26L THRESHOLD DISPLACED 700'. RGT TFC RWY 26R, 8R. UNLESS ADZO BY ATC ALL TURBINE ACFT AND ACFT 12,500 LBS AND OVER REMAIN AT OR ABOVE 3000 FT MSL UNTIL ESTABD ON FINAL. FLY BASE LEG AT LEAST 5 MI FM ARPT.	
<b>POLACCA</b> 4SW 35°48'00" 110°25'00" <b>FSS: PRESCOTT</b> 5573 38/NE-SW (2) REMARKS: ARPT UNATTENDED. RGT TFC RWY NE, SW, NW, SE.	
<b>PRESCOTT, MUN (PRC)</b> 8N 34°39'05" 112°25'15" IFR <b>FSS: PRESCOTT ON FLD</b> 5042 H76/3-21 (2) (S-40, D-60, DT-100) BL5 S5 F12, 18, 30 U-2 VHF/DF: CTC FSS REMARKS: RWY 3 THRESHOLD DISPLACED 797'.	
<b>PULLIAM See FLAGSTAFF</b>	
<b>TUCSON, DOWNTOWN TUCSON</b> ADJ SE 32°11'10" 110°56'55" <b>FSS: TUCSON</b> 2490 43/16-34 (2) S5 F12 (LC 792-6359) REMARKS: ARPT ATTENDED DAWN-DUSK. P-LINE IN RWY 11 APCH. P-LINE IN RWY 29 APCH. P-LINE IN RWY 16 APCH.	
<b>TUCSON, FREEWAY (P12)</b> 4NW 32°16'40" 111°00'30" <b>FSS: TUCSON</b> 2290 H45/12-30 (1) (S-6) BL4 S5 F12, 18 U-1 (LC 792-6359) REMARKS: RWY 30 THRESHOLD DISPLACED 300'. P-LINE IN RWY 30 APCH.	
<b>TUCSON, RYAN FIELD</b> 12SW 32°08'29" 111°10'00" <b>FSS: TUCSON</b> 2413 H40/6R-24L (1) (S-9) BL4 S5 F12, 18 (LC 792-6359) REMARKS: ARPT ATTENDED 0700-1700. RGT TFC RWY 6R, 16. RWY 6L/24R RESTRICTED TO GLIDERS ONLY. 2525 X 25 FT ASPH STRIP SUPERIMPOSED ON DIRT STRIP 6L/24R BEGINNING 625 FT FROM SOUTH END.	
<b>TUCSON, INTL (TUS)</b> 7S 32°07'05" 110°56'32" IFR <b>FSS: TUCSON ON FLD</b> AOE 2630 H120/12L-30R (3) (S-120, D-160, DT-260) BL5, 10 S5 F12, 18, 22, 30, 40 OX1, 2, 3, 4 U-2 VASI: RWY 30R VHF/DF: CTC FSS REMARKS: (+) ARRESTING DEVICE RWY 21, 12L, 30R. 1000 X 150 ASPH OVERRUN EACH END RWY 12L-30R.	
<b>WILLIAMS, MUNI (P32)</b> 4N 35°18'08" 112°12'00" <b>FSS: PRESCOTT</b> 6700 H39/2-20 (1) (S-17) BL4 S5 F12, 18 U-1 REMARKS: ARPT ATTENDED 0800-1700.	
<b>WINDOW ROCK (P34)</b> 1S 35°39'20" 109°03'45" <b>FSS: ZUNI</b> 6755 H70/2-20 (1) (S-30, D-45, DT-75) L5 F18 REMARKS: ARPT ATTENDED 0800-1700	
<b>WINSLOW, MUNI (HW)</b> 1W 35°01'20" 110°43'20" IFR <b>FSS: PRESCOTT</b> 4938 H75/11-29 (2) (S-35, D-55) BL5 S3 F12, 18 U-1 (DL) REMARKS: RWY 4-22 WT BRG CPT S-50, D-70. ARPT ATTENDED 0700-1800. ATTENDANT ON CALL FOR FUEL AFTER 1800 UNTIL 0700 WITH NO CHARGE.	
<b>YUMA, MCAS/YUMA INTERNATIONAL (YUM)</b> 4S 32°39'24" 114°36'18" IFR AOE <b>FSS: YUMA ON FLD</b> 213 H133/3L-21R (4) (S-103, D-200, DT-400) BL6 S5 F12, 18, 30 VHF/DF: CTC TWR REMARKS: (+) RWY 3R 21L WT BRG CPT S-162, D-200, DT-400 1000 X 200 OVERRUN EACH END RWY 3L 21R FSS WILL PROVIDE ARPT ADV SVC WHEN TWR IS CLSD 2200-0600 APROP CIVIL RWY WILL REMAIN LGTD & ADDNL LGTG AVBL THRU FSS IN EMERG	

FIGURE 19. Airport/facility directory.

## NOTICES TO AIRMEN

This part is issued every 28 days. It contains appropriate notices from the daily NOTAM Summary, and other items considered essential to flight safety. See Part 3A for additional data.

This section contains Notices to Airmen that are expected to remain in effect for at least seven days. Temporary notices without published duration dates are normally carried twice unless resubmitted.

NOTE: Data preceded by a checkmark (✓) are considered permanent and will be published one time only in this section. Data should be noted on charts and records.

NOTE: Notices are arranged in alphabetical order by State (and within the State by City or locality).

NEW OR REVISED DATA: New or revised data are indicated by underlining the first line of the affected item. The new information is not necessarily limited to the underlined portion, which is used only to attract attention to the new insert.

### ALABAMA

ANNISTON, ANNISTON-CALHOUN ARPT: Small arms firing ranges 6 NM from "ANB" NDB between 015-040° up to 2500' MSL, operates continuous. 1094' obstn 1.8 mi SE of arpt unlgtd. Rwy 5 ILS/LOC BC unusable UFN. Rwy lgts first 3500' and thr lgts rwy 5 OTS UFN. (9-71)

DOTHAN ARPT: Rwy 31 ILS/OM OTS UFN. (10-71)

GADSDEN RDO: VOR "GAD" has unusable sectors, for current information see Substitute Routes.

MOBILE, MOBILE AEROSPACE ARPT: Rwy 14-32 apch lgts not operg. (12-71)

REDSTONE RDO: TVOR "HUA" OTS UFN. (1-72)

TALLASSEE MUNI ARPT: A mobile ATCT will be operd by Alabama ANG from 1000-1500 lcl on the following dates: Mar 11, 12, 18, 19; Apr 8, 9, 15, 16; May 13, 14, 20, 21; June 10, 11, 17 and 18. Civil acft etc Tallassee twr freq 126.2 for adzy info prior to entering tlc area. (2-72)

TUSCALOOSA, VAN DEGRAAF ARPT: ILS rwy 4 Ident TCL comsng delayed until aprxly Mar 31, 1972.

### ALASKA

SPECIAL NOTICE: Pilots flying aircraft equipped with SCR-718 altimeters will assure that the altimeter is turned off within 200 NM of Clear, Alaska and Thule, Greenland.

For complete information on Alaska consult the Alaska Supplement.

### ARIZONA

COCHISE RDO: VORTAC "CIE" to be shutdown eff 6 Mar til on or about 10 Mar for freq change from 110.4 to 115.8. (2-72)

GRAND CANYON NATIONAL PARK: All pilots are requested to avoid flying below the canyon rim and to maintain a distance 1500' above and horizontally from all scenic overlooks, parks, trails and Grand Canyon Village.

MARICOPA: CAUTION—DO NOT MISTAKE FOR LANDING AREA. Space Surveillance Stn at lat 33°08'31", long 112°01'48" aprxly 4 mi N 1200' W and parallel to hwy. Site is strip 800' x 1800' with paved portion lengthwise thru cntr 100' in width and studded with 6' steel posts. This permanent hazard lctd 22 nmi S Phoenix-Sky Harbor Intl Arpt.

MT. HOPKINS SPECIAL NOTICE: Controlled firing area for Laser Operations is established at the Mt. Hopkins Observatory located at 31°40'52"N, 110°52'41"W. Firing area includes the airspace from 7600' MSL to unlimited altitudes within a circular area with a one nautical mile radius extending outward and upward in a conical shape from the radius based on an angle of 25° above the horizon. All acft should avoid this area. Contact Tucson FSS for hours of operations.

WILLCOX, COCHISE COUNTY ARPT: Rwy lgts inop and rwy 3-21 clsd UFN due resurfacing. (1-72)

YUMA, YUMA MCAS/YUMA INTL ARPT: Rwy 3L-21R clsd UFN. (1-72)

### ARKANSAS

HOT SPRINGS, MEML FLD ARPT: Rwy 13-31 clsd UFN. (10-71)

### CALIFORNIA

SPECIAL NOTICE: Do not mistake dirt strip on large island, Lake Berryessa, lctd lat 38-34 long 122-13 for airport. Strip is unauthorized and unsafe.

ANO NUEVO ISLAND: Avoid low flying in the vicinity and over island. Biological research of wild life in progress.

BLYTHE ARPT: Intensive airline jet acft training in progress 24 hrs daily. Inbound acft report 20 miles out on 123.6 and guard 123.6 for arpt advisory service, UFN. Use other freqs for other purposes. Unicom is not for arpt advisory use.

BURBANK, HOLLYWOOD-BURBANK ARPT: High rear mounted engine acft such as B-727, DC-9, shall not apply tkof thrust prior to threshold rwy 25 and 38. For these acft the usable length of rwy 25 for tkof is 5804'/for rwy 38, 6554'.

CAMBRIA, RANCHO SAN SIMEON ARPT: Clsd UFN. (7-71)

CARLSBAD, PALOMAR ARPT: Power lines twr to twr located 2 miles SW and W up to 650' MSL. (8-71)

FIGURE 20. Notices to Airmen.

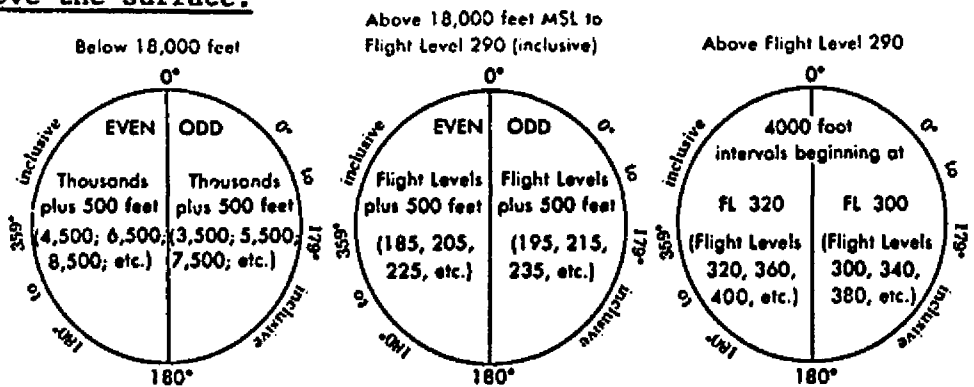


## THE AIRSPACE

### VFR ALTITUDES/FLIGHT LEVELS—CONTROLLED AND UNCONTROLLED AIRSPACE

UNDER VFR—More than 3,000'  
above the surface.

**COURSES ARE MAGNETIC**



### IFR ALTITUDES/FLIGHT LEVELS—UNCONTROLLED AIRSPACE

Outside Controlled Airspace.

**COURSES ARE MAGNETIC**

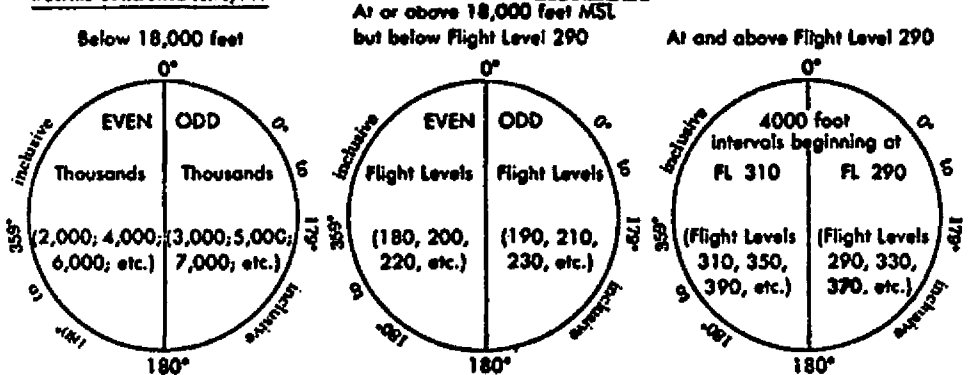


FIGURE 21. The Airspace (cruising altitudes).

## **RULES PERTAINING TO AIRCRAFT ACCIDENTS, INCIDENTS, OVERDUE AIRCRAFT, AND SAFETY INVESTIGATIONS**

(National Transportation Safety Board, Safety Investigation Regulations, Part 430 (in part)).

### **1. IMMEDIATE NOTIFICATION**

The operator of an aircraft shall immediately, and by the most expeditious means available, notify the nearest National Transportation Safety Board, Bureau of Aviation Safety Field Office when:

(a) An aircraft accident or any of the following listed incidents occur:

- (1) Flight control system malfunction or failure;
- (2) Inability of any required flight crewmember to perform his normal flight duties as a result of injury or illness;
- (3) Turbine engine rotor failures excluding compressor blades and turbine buckets;
- (4) In-flight fire;
- (5) Aircraft collide in flight.

(b) An aircraft is overdue and is believed to have been involved in an accident.

(c) The following information is required if available:

- (1) Location;
- (2) Date;
- (3) Time;
- (4) Aircraft make, model, and registration number and nationality.
- (5) Names of operator and crew;
- (6) Number of persons involved;
- (7) Injuries of each person;
- (8) Weather conditions.

### **2. MANNER OF NOTIFICATION**

The most expeditious method of notification to the National Transportation Safety Board by the operator will be determined by the circumstances existing at that time. The National Transportation Safety Board has advised that any of the following would be considered examples of the type of notification that would be acceptable:

- (a) Direct telephone notification.
- (b) Telegraphic notification.
- (c) Notification to the Federal Aviation Administration who would in turn notify the NTSB by direct communication; i.e., dispatch or telephone.

### **3. REPORTS**

a. The operator shall file a report on NTSB Form 6120.1 or 6120.2, available from the National Transportation Safety Board Field Offices, or the National Transportation Safety Board, Washington, D.C.:

(1) Within ten (10) days after an occurrence for which notification is required in 1 (a) and (b) above;

(2) When, after seven (7) days, an overdue aircraft is still missing;

(3) Upon request of an authorized representative of the National Transportation Safety Board;

b. Each crew member, if physically able at the time the report is submitted, shall attach thereto a statement setting forth the facts, conditions and circumstances relating to the accident or occurrence as they appear to him to the best of his knowledge and belief. If the crew member is incapacitated, he shall submit the statement as soon as he is physically able.

### **4. WHERE TO FILE THE REPORTS**

a. The operator of an aircraft shall file with the Field Office of the National Transportation Safety Board nearest the accident or incident any report required by this section.

b. The National Transportation Safety Board field offices are listed under U.S. Government in the telephone directories in the following cities: Anchorage, Alaska; Chicago, Ill.; Denver, Colo.; Fort Worth, Texas; Kansas City, Mo.; Los Angeles, Calif.; Miami, Fla.; New York, N.Y.; Oakland, Calif.; Seattle, Wash.; Washington, D.C.

FIGURE 22. Excerpts from Procedural Regulation, Part 430.

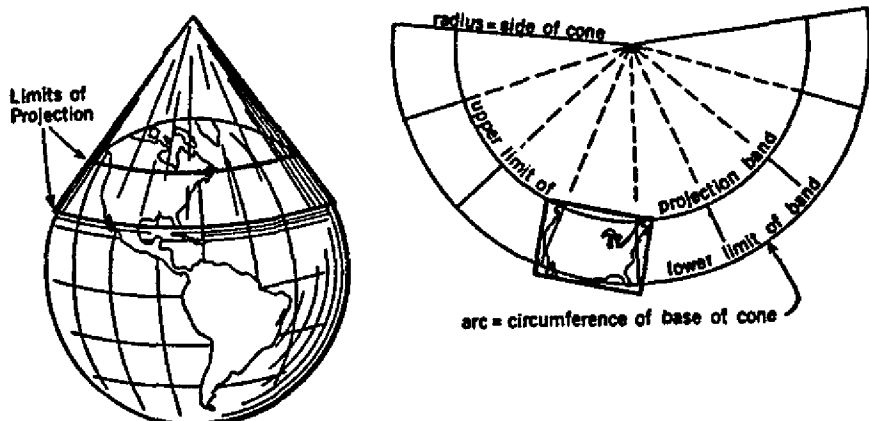
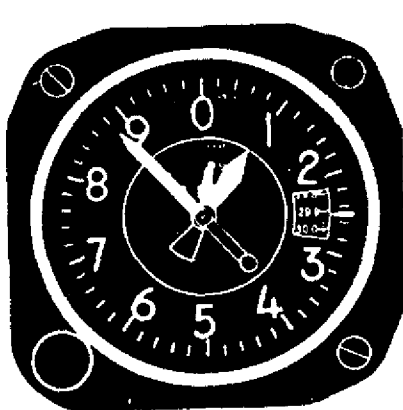
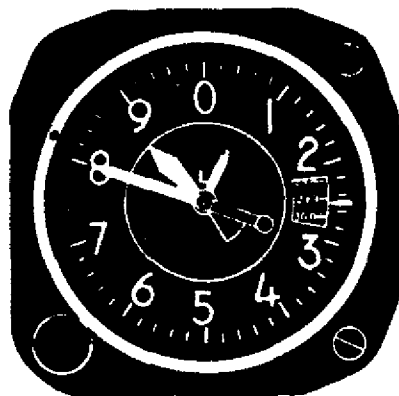


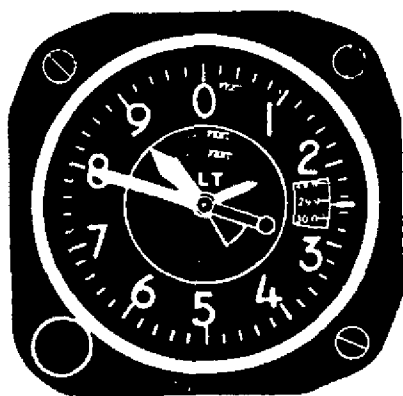
FIGURE 23. The Lambert conformal chart projection.



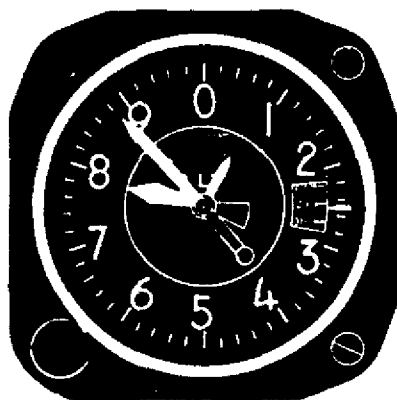
A



B



C



D

FIGURE 24. Altimeter readings.

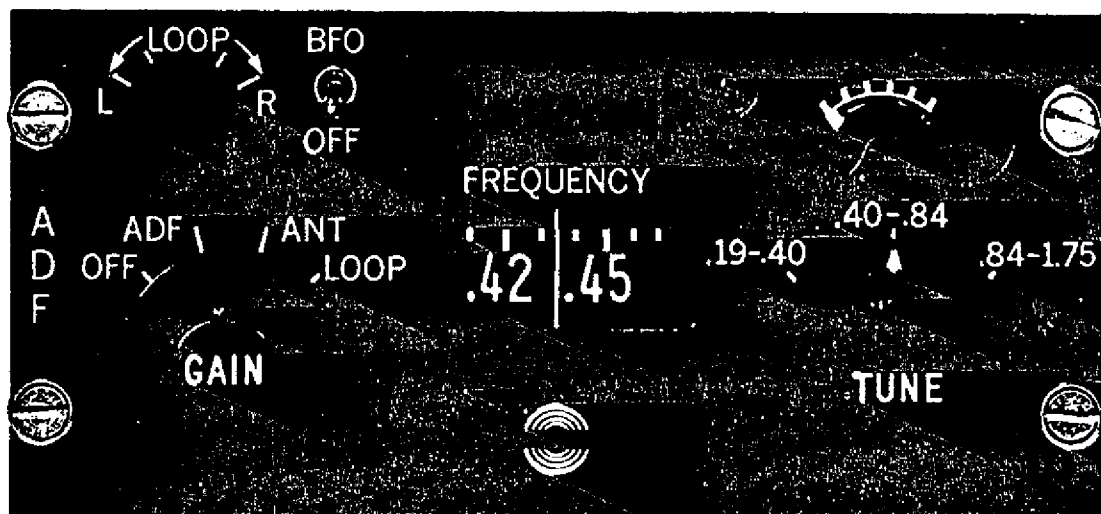
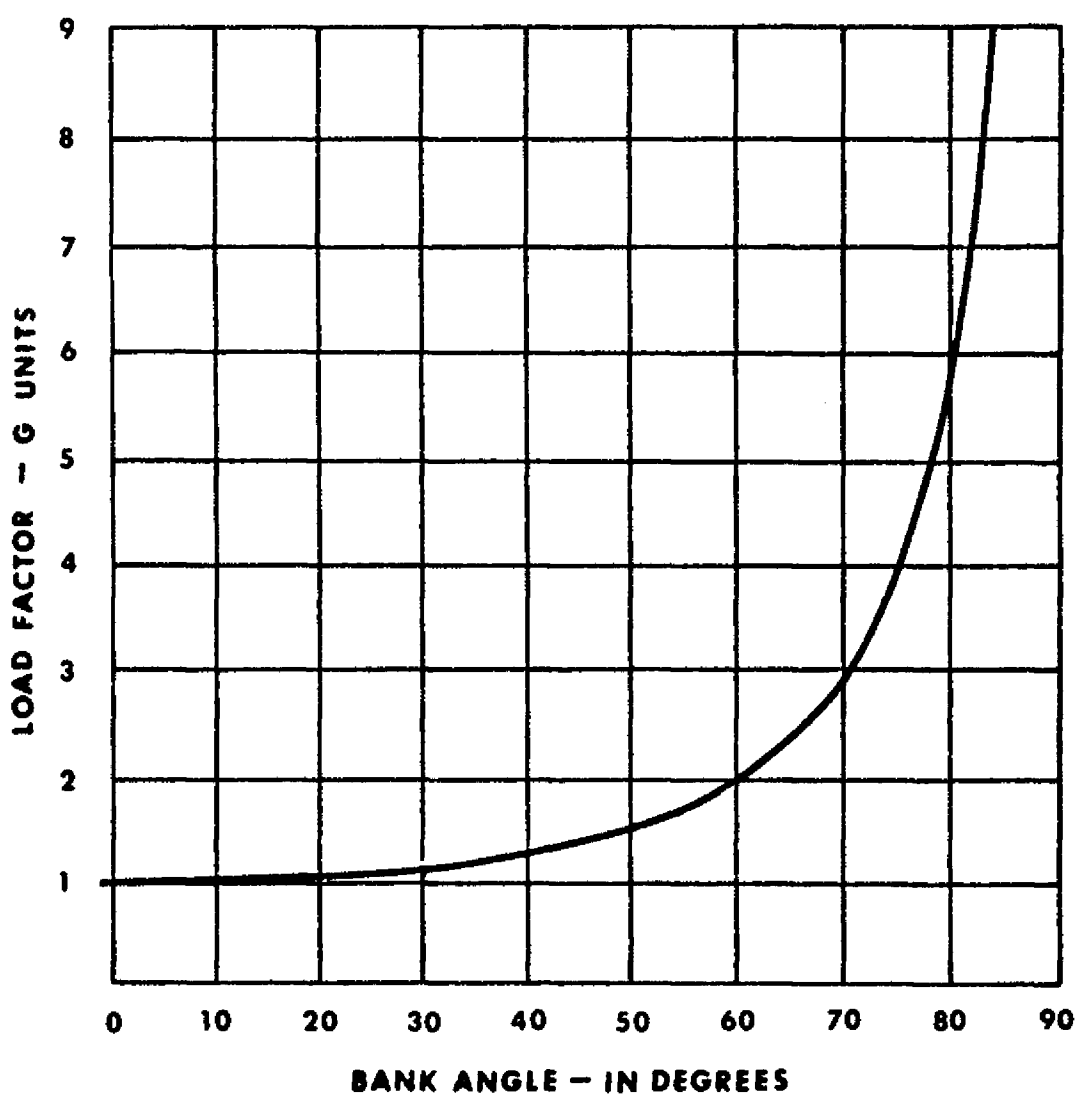


FIGURE 25. Radio compass (ADF).



FIGURE 26. Flight instruments.

# LOAD FACTOR CHART



A

Bank 40°  
TAS 100 mph

B

Bank 40°  
TAS 150 mph

C

Bank 40°  
TAS 200 mph

FIGURE 27. Load factor chart.

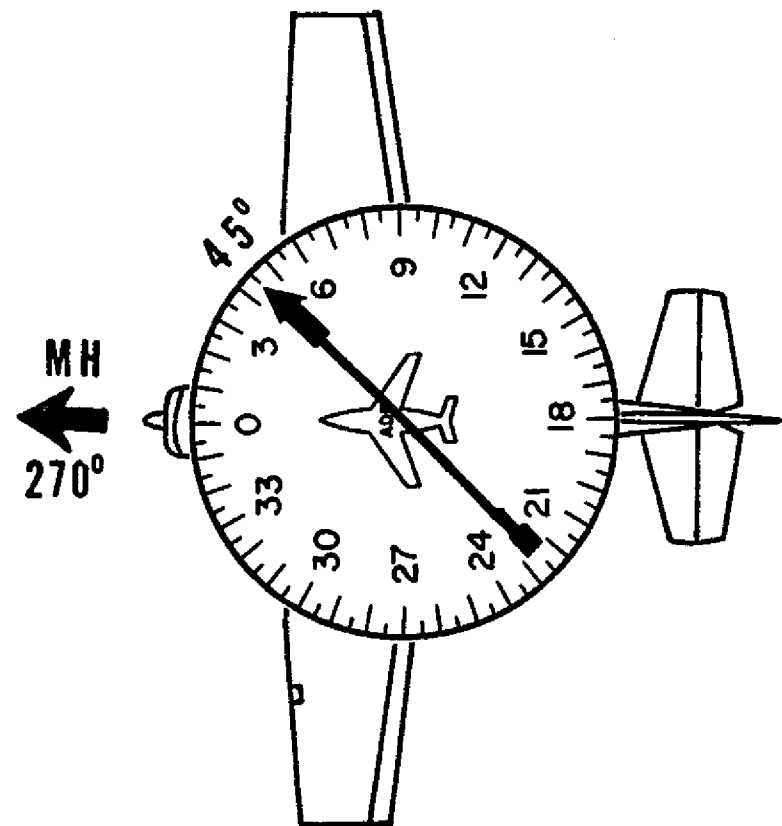


FIGURE 28. ADF indications.

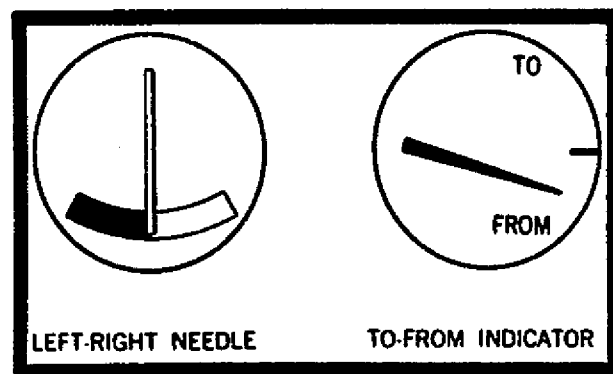


FIGURE 29. VOR navigation receiver indications.

DEPARTMENT OF TRANSPORTATION—FEDERAL AVIATION ADMINISTRATION <b>FLIGHT PLAN</b>					Form Approved OMB No. 04-R0072	
1. TYPE <input checked="" type="checkbox"/> VFR <input type="checkbox"/> IFR <input type="checkbox"/> DVFR	2. AIRCRAFT IDENTIFICATION <b>N2468W</b>	3. AIRCRAFT TYPE/SPECIAL EQUIPMENT <b>DAEDALIAN DART</b>	4. TRUE AIRSPEED <b>180 KTS</b>	5. DEPARTURE POINT <b>GREENLEE CO. CLIFTON-MORENCI</b>	6. DEPARTURE TIME PROPOSED (Z)    ACTUAL (Z) <b>1530</b>	7. CRUISING ALTITUDE <b>12,500</b>
8. ROUTE OF FLIGHT <b>DIRECT HOLBROOK, DIRECT WINSLOW VOR, DIRECT FLAGSTAFF, DIRECT WILLIAMS MUN.</b>						
9. DESTINATION (Name of airport and city) <b>WILLIAMS MUNICIPAL WILLIAMS, ARIZONA</b>		10. EST. TIME ENROUTE HOURS    MINUTES <b>2    36</b>		11. REMARKS <b>INTERMEDIATE STOPS AT HOLBROOK AND FLAGSTAFF</b>		
12. FUEL ON BOARD HOURS    MINUTES <b>3    20</b>		13. ALTERNATE AIRPORT (S)		14. PILOT'S NAME, ADDRESS & TELEPHONE NUMBER & AIRCRAFT HOME BASE <b>D. WALKER 1144 SW 25 ST OKC 632-7441</b>		15. NUMBER ABOARD <b>4</b>
16. COLOR OF AIRCRAFT <b>SILVER RED TRIM</b>		CLOSE VFR FLIGHT PLAN WITH _____ FSS ON ARRIVAL				

FAA Form 7233-1 (5-72)

FIGURE 30. Example of Flight Plan (VFR).

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 31. Light gun signals used in airport traffic control.

# **AIRSPEED CORRECTION TABLE**

## **FLAPS 0°**

**IAS - MPH**

**TIAS - MPH**

**60**

**80**

**100**

**120**

**140**

**160**

**180**

**200**

**66**

**80**

**97**

**117**

**137**

**158**

**178**

**198**

## **FLAPS 20°**

**IAS - MPH**

**TIAS - MPH**

**40**

**50**

**60**

**70**

**80**

**90**

**100**

**110**

**59**

**62**

**67**

**73**

**81**

**91**

**101**

**111**

## **FLAPS 40°**

**IAS - MPH**

**TIAS - MPH**

**40**

**50**

**60**

**70**

**80**

**90**

**100**

**110**

**58**

**62**

**66**

**73**

**82**

**92**

**102**

**112**

FIGURE 32. Airspeed correction table.