AC 61-11

Airplane FLIGHT INSTRUCTOR Examination Guide

Federal Aviation Agency

AIRPLANE FLIGHT INSTRUCTOR EXAMINATION GUIDE

1965

Revised

FEDERAL AVIATION AGENCY

Flight Standards Service

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D. C. 20402 - 45 cents

PREFACE

The Operations Airman Examination Section of the Flight Standards Service, Federal Aviation Agency, has issued this *Airplane Flight Instructor Examination Guide* to provide information to prospective airplane flight instructors and other persons interested in Federal Aviation Agency certification of flight instructors.

The guide contains information about certification requirements, application procedures, and the required examination. Its purpose is to guide prospective applicants toward a clear understanding of the requirements, reference material, examinations, and the application and examining procedures. A sample examination is presented and explanations of the correct answers are given.

Superseding the *Airplane Flight Instructor Examination Guide* dated 1962, the guide is issued as Advisory Circular No. 61–11.

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AIRPLANE FLIGHT INSTRUCTOR EXAMINATION GUIDE

Introduction

This study guide was prepared by the Flight Standards Service of the Federal Aviation Agency to assist applicants who are preparing for the Airplane Flight Instructor Written Examination. It was prepared by the same personnel who were responsible for developing the airplane flight instructor written examination currently in use.

This guide is not offered as a quick and easy way to obtain the necessary knowledge for passing the written examination. There is no quick and easy way to obtain the background of experience, knowledge, and skill that the professional flight instructor must acquire in order to provide the high quality of training necessary to transform today's student into tomorrow's proficient pilot. Rather, the intent of this guide is to define the scope and narrow the field for study, insofar as possible, to the basic knowledge requisite to obtaining a flight instructor certificate.

Certificate Requirements

The general qualifications for an airplane flight instructor certificate require of the applicant a combination of experience, knowledge, and skill. An applicant for a flight instructor certificate with an airplane rating should carefully review the applicable sections of Federal Aviation Regulations, Part 61, for detailed information pertaining to this subject. (Effective April 1, 1965, a revised practical test will be administered to applicants for flight instructor certification. This test will be conducted in accordance with the *Flight Instructor Practical Test Guide*, AC 61–14, and will place increased emphasis on testing the ability of the applicant to apply the recognized principles of teaching and good flight instruction procedures.)

Type of Examination

The Airplane Flight Instructor Written Examination is necessarily comprehensive because the flight instructor must be knowledgeable in many areas. He must know not only "what" to do and "how" to do it; he must know also "why" a maneuver is performed in a certain order and what the results may be if the maneuver or procedure is not performed properly. It is generally accepted that a pilot with much knowledge but little skill is not adequately equipped for day-to-day flying. Today the pilot who is skillful in only the manipulative techniques of flying and lacking in aviation knowledge is not a very skillful airman with safety as his watchword.

In addition to his aviation qualifications, the flight instructor must be capable and well versed in one highly important area that is not required for any other pilot certificate. The flight instructor must be a teacher. He must have an understanding of the learning processes, the basic teaching principles, and the general application of these principles to teach his students effectively. There is much truth in the saying, "If there is no learning, there is no teaching."

The airplane flight instructor examination is divided into two sections: Section I "Fundamentals of Flight Instruction" and Section II "Performance and Analysis of Flight

Training Maneuvers." A detailed outline of the subject areas covered in each section appears later in this guide.

The time required for the examination is approximately 4 hours. Examination test items are of the objective, multiple-choice type, and each can be answered by the selection of a single item as the correct choice. This method conserves the applicant's time, the scorer's time, and eliminates the element of individual judgment in determining grades.

Taking The Examination

In addition to being an exercise in the application and use of aeronautical knowledge, an examination is also an exercise in communication since it involves the use of written language. Communication between individuals through the use of such abstract symbols as words is indeed a complicated process; so complicated, in fact, that at times communication may either break down or mislead if care is not exercised. The same word often means different things to different people. Carefully read the information and instructions.

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

1. The test items are not trick questions. Each statement means exactly what it says. Read each question and possible answer carefully, but do not look for hidden meanings. The statement does not concern exceptions to the rule; it refers to the general rule.

2. First, carefully read the test item before you look at the answers listed below it. Be sure that you understand what the question asks. Then decide what the correct answer should be or work out the problem to obtain the answer. Finally, look through the list of alternate answers or phrases and select the one that says the same thing as your answer. Be sure that the one you select answers the question completely.

3. Only one of the alternate answers given is completely correct. The others may be answers that result from incorrect procedure (in a problem, for example) or from lack of knowledge pertaining to the test item, or from popular misconceptions. Understand the question and then select the answer you consider to be the best.

4. If you find that you have considerable difficulty with a particular test item, do not spend too much time on it, but continue with the examination and answer those questions which are less difficult. Then go back and reconsider the test items you have passed over. This procedure will enable you to use the total time available to maximum advantage in demonstrating your knowledge and understanding of the subject.

RECOMMENDED STUDY MATERIALS

The applicant for the Airplane Flight Instructor rating will find the publications listed below helpful to him in his preparation for the examination.

The list identifies source material essential to preparing for the examination but does not include all available material on the subjects. Other excellent textbooks, audiovisual training aids, and instruction materials useful in preparing for the examination are available at bookstores and libraries.

It is the responsibility of each applicant to obtain the study materials appropriate to his needs.

Airman's Information Manual (annual subscription: $15 domestic; $10 foreign). This FAA publication, known as the "AIM," provides extensive information for the planning and conduct of flights in the Federal Airway System. Pilots, both novice and "old timers," will find it a valuable guide and especially useful in preflight and inflight planning and operations. The manual is designed to be carried in the cockpit and is published in sections and looseleaf style to permit removal of selected portions for easy carrying. Updating pages can readily be inserted as these are received from FAA. The basic manual provides fundamentals of aeronautical knowledge useful to both novice and experienced pilots. Five other sections offer procedural and directory information about airports, navigation facilities, and weather forecast services.

Currently, the manual is divided into six sections with specific revision cycles for each which will provide a completely new manual every 6 months. The various sections and the revision cycle of each are:

Section I—Basic Flight Manual—Semiannually.

Section II—ATC Operations and Procedures—Quarterly.

Section III—Flight Data and Special Operations—Every 28 days.

Section III-A—Notices to Airmen—Every 14 days.

Section IV—Airport Directory—Semiannually.

Section IV-A—Airport/Facility Directory—Every 28 days.

Private Pilot's Handbook of Aeronautical Knowledge ($2.50). This text on basic aeronautical knowledge was designed to meet the needs of the private pilot. However, it should be useful as a basic text for reference and for review of most aviation fundamentals, many of which are directly related to questions on the Airplane Flight Instructor Written Examination.

Aviation Weather ($2.25). Issued jointly by the U.S. Weather Bureau and the Federal Aviation Agency, this 300-page publication tells in nontechnical language the fundamentals of weather behavior in relation to flying, using many illustrations. It explains the aviation weather services offered to the pilot for his safety in flying and gives information on many other phases of meteorology through its 22 chapters.

Practical Air Navigation. 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. It may be obtained from book dealers or from the publisher, Weem's System of Navigation, Inc., 229 Prince George Street, Annapolis, Maryland.

Flight Instructor's Handbook, AC 61-16 (60¢). This revised handbook is one of the primary sources of information and guidance for pilots preparing for the flight instructor certificate and is also valuable as a reference text for certificated flight instructors. It is basically a book which deals with accepted theories and practices applicable to teaching and the learning process. As such it is the primary reference text when preparing for the "Fundamentals of Instruction" section of the Flight Instructor's Written Examination. It also deals with selected topics of aerodynamics which will be useful to the flight instructor, gives a comprehensive outline of flight training maneuvers currently in use, and includes a sample Private Pilot Flight Syllabus.

Flight Training Handbook AC 61-21 (in press). 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. The balance of the book provides information and direction in the introduction and performance of training maneuvers. Thus it serves as a text for student pilots, pilots improving their qualifications or preparing for additional ratings, and flight instructors who are teaching.

How to Instruct, AF Manual 50-9 ($2.00). Written primarily for the Air Force instructor, this manual is an excellent source of information on the fundamentals of instructing. The manual covers basic teaching principles and the application of tested techniques useful in the proper guidance of the learning process. It will be useful both as a reference text and as a manual for self-study.

Federal Aviation Regulation:

a. Part 1—*Definitions and Abbreviations* (25¢). This Regulation contains all needed definitions, abbreviations, symbols, and rules of construction which apply to all the Parts of the recodified Federal Aviation Regulations.

b. Part 61—*Certification: Pilots and Flight Instructors* (30¢). The applicant is responsible for the items in this Part which fall within the scope of knowledge required for his certification as a flight instructor.

c. Part 91—*General Operating and Flight Rules* (30¢). It is imperative that the applicant be familiar with all the information in this manual except that which pertains to instrument flight.

d. *FAR 23 Airworthiness Standards-Normal, Utility, and Acrobatic Category Airplanes* (65¢). Certain sections of this manual will prove most useful as a source of detailed information on the requirements pertaining to aircraft characteristics, performance, and operation.

Civil Aeronautics Board, Safety Investigation Regulations, Part 320 (5¢). This CAB publication deals with procedures required in dealing with accidents and lost or overdue aircraft in the United States and outlying areas.

Airplane Flight Manuals and Owners Manuals. Aircraft manufacturers issue manuals for each aircraft model. These may be obtained from individual aircraft manufacturing companies or from local dealers and distributors.

Pilots Radio Handbook (75¢). This manual explains in simple language the proper use of radio for communications and navigation. It explains the purpose and use of such equipment as DME, VHF, omnirange, radar, and standard air-to-ground communications equipment. It describes air traffic control procedures, weather reporting, and the U. S. Common System of Air Navigation.

Plane Sense (Free). This booklet helps to acquaint the prospective airplane owner with some fundamentals of owning and operating an airplane. Upon request, it is free from the Federal Aviation Agency, Washington, D. C. 20553.

Facts of Flight (50¢). This publication explains in nontechnical language why an airplane flies; the effect of the controls, stalls, and spins; facts about airplane structure and engine operation; and proper technique in takeoff, cruising, and landing.

Path of Flight (70¢). An illustrated publication for the student and novice pilots, it contains practical information about navigation of aircraft, radio communication, radio aids, and flight planning.

Realm of Flight (75¢). Written for the private pilot, this is a condensed elementary text on weather characteristics affecting flying. Many color pictures are included to illustrate atmospheric pressure, clouds, winds, fronts, and other weather phenomena.

VFR Pilot Exam-O-Grams. Dealing with selected topics of particular importance to safety in flight operations, these précis provide concise information on the specific subjects which results of pilot examinations, have indicated need clarification to correct common mistakes, misconceptions, and lack of information. A list of the currently available Exam-O-Grams appears in the Appendix. They are available free of charge from:

FAA Flight Standards Service
Operations Airman Examination
Section
5300 South Portland Avenue
Oklahoma City, Oklahoma 73119

How To Obtain Study Materials

All study materials listed above except *Airplane Flight Manuals* or *Owner's Manuals, Practical Air Navigation,* and *VFR Pilot Exam-O-Grams* may be obtained by remitting check or money order to:

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

In many instances, these publications may also be obtained at airports or from bookstores.

NOTE: The items listed were available at the time this publication went to press.

STUDY OUTLINE FOR THE AIRPLANE FLIGHT INSTRUCTOR WRITTEN EXAMINATION

SECTION I. FUNDAMENTALS OF FLIGHT INSTRUCTION

A. PRINCIPLES OF TEACHING AND LEARNING

1. *How People Learn.*

a. Perception—Understand its role in relation to learning and the important factors which affect a student's perception, such as—

(1) Individual mental, emotional, and physiological characteristics.
(2) Needs and requirements.
(3) Goals and values.
(4) Self-concept.
(5) Time and opportunity to perceive.
(6) The element of threat.

b. Insight—Understand its relationship to perception and the instructor's role in—

(1) Cultivating receptiveness to new experiences.
(2) Organizing demonstrations, explanations, and directed student practice.
(3) Pointing out related perceptions as they occur.
(4) Supervising the "trial and error" process.
(5) Assisting the student to group associated perceptions into meaningful wholes or "blocks" of learning.

c. Motivation—Understand its dominant role in relation to student progress and ability to learn

(1) Types of motivation.
(a) Negative motivation.
(b) Positive motivation.
(c) Tangible motivation.
(d) Intangible motivation.
(2) Use of factors which affect motivation.
(a) Gain or reward.
(b) Comfort and security.
(c) Favorable self-image.
(d) Group approval.
(e) Short and long-range goals.
(f) Praise.
(g) Criticism.

d. Obstacles to learning—Understand the effect of each of the following on the learning process and how they may be modified or eliminated

(1) Self-consciousness.
(2) Antagonism or feeling of unfair treatment.
(3) Impatience.
(4) Worry or lack of interest.
(5) Physical discomfort, fatigue, and illness.
(6) Apathy fostered by poor instruction.
(7) Fear, anxiety, and timidity.
(8) Lack of confidence.
(9) Airsickness.

e. Habits and transfer—Understand the influence of perceptions and insight on the development of performance habits and the influence of such habits in subsequent learning and transfer of learning.

(1) The importance of the formation of correct habit patterns.
(2) The importance of habit patterns in aircraft control.

(3) The promotion of transfer of learning through use of the flight syllabus.
(4) Positive transfer.
(5) Negative transfer.
(6) The influence of the "building block" technique of instruction in habit development.

2. *Levels of Learning.* Understand the progressive levels of learning as exemplified by the "building block" concept.
   a. Rote performance.
   b. True understanding.
   c. Correlation of previous learning, understanding, and skill with new tasks, problems, techniques, and procedures.

3. *Rates of Learning.*
   Have a knowledge and understanding of—
   a. The characteristics of a typical learning curve.
      (1) Initial learning rate.
      (2) Slumps or plateaus and their causes.
      (3) Reversals and their causes.
   b. The role of memory and the effect of forgetting in the achievement of satisfactory student progress.
      (1) Relationship between memory and habit patterns.
      (2) Usefulness of drill, recitation, and quizzing.
      (3) Continued usage, practice, and application.
   c. Significant principles which reinforce memory.
      (1) Praise.
      (2) Association.
      (3) Favorable attitude.
      (4) Learning with all the senses.
      (5) Meaningful repetition.

4. *Common Misconceptions About Learning.*
   a. Fear is the best motivator.
   b. Making it easy to learn is contrary to the principles of sound teaching.
   c. Pictures, illustrations, and diagrams are, per se, more effective than written or verbal presentations of information.
   d. The greater the experience, the better the performance.
   e. The impersonal approach is more effective than the friendly attitude in teaching.
   f. Competition is the key to successful learning.
   g. Frustration and failure are essential to learning.

B. HOW TO GUIDE THE LEARNING PROCESS

1. *Plan the Instructional Activity.*
   a. Establish clear objectives or goals.
   b. Identify the block of learning.
   c. Provide for student participation.
   d. Diagnose student ability.
   e. Use a teaching sequence that "makes sense."
   f. Work from the known to the unknown.
   g. Work from the easy to the difficult.
   h. Plan so the student will see the necessity and logic of each succeeding step.

2. *The Flight Training Syllabus.*
   a. Arrange for efficient sequence in "blocks" of training.
   b. Use syllabus as a guide.
   c. Keep flexibility in teaching procedures.

3. *The Lesson Plan.*
   a. Lesson planning is essential to teaching success.
   b. Items to include in lesson plan—
      (1) Lesson objectives.
      (2) Elements involved in satisfactory fulfillment of lesson objectives.
      (3) Allocation of time available.
      (2) Equipment needed.
      (5) Activity required of the instructor.
      (6) Activity required of the student.
      (7) Evaluation of student performance.

4. *The Flight Instruction Breakdown.*
   a. Useful in preparing meaningful lesson plans.

b. Useful for guidance in offering effective instruction.

c. Requires personal analysis of maneuver.

d. Requires personal analysis of proposed procedure for teaching maneuver.

5. *Presentation of the Instruction Material.*

a. Establish atmosphere of cooperation.

b. Explain, demonstrate, and direct.

c. Require student participation.

d. Keep goal in sight.

e. Be brief, clear, and to the point in explanations.

f. Use analogies as link between known and unknown.

g. Question technique: use and importance.

h. Deal with the individual needs of both poor students and apt students.

i Use training aids.

6. *Performance.*

a. Usually integrated with presentation.

b. Require discipline.

c. Make it realistic.

d. Guide student efforts.

e. Progress from easy to difficult.

f. Relate to previous explanations and practice.

g. Provide adequate practice but control blind "trial and error."

h. Understand factors relating to length and frequency of practices.

i. Use of briefings and critiques.

j. Skill versus knowledge.

k. Role of repetition in learning and retention.

7. *Evaluate the Performance.*

a. An integral part of each lesson.

b. Establishes need for selective reteaching or review.

c. Acquaints student with his progress.

d. Should include evaluation of things previously learned.

e. Should be based on standards established by the training syllabus.

C. ANALYSIS OF EFFECTIVE TEACHING METHODS AND TECHNIQUES

1. *The Four Basic Steps in the Teaching Process.*

a. Preparation (See Section IB, "How to Guide the Learning Process").

b. Presentation.

(1) Telling or explaining—the lecture method

(a) Does not permit student participation.

(b) Can be combined with other methods for greater effectiveness.

(2) Techniques of discussion

(a) Develop cooperative spirit.

(b) Clarify problems.

(c) Encourage participation.

(d) Avoid dominating discussion.

(e) Summarize frequently.

(3) Demonstration or showing

(a) Usually combined with explanations.

(b) Makes explanations concrete.

(c) Aids student understanding.

(d) Saves learning time.

(e) Effective with both large and small groups.

(f) Gives student overall perspective.

(g) Appeals to several senses.

(h) Has dramatic appeal.

c. Doing—trial and practice

(1) Essential to the learning process.

(2) Constitutes student's activity based on instructor's preparation and presentation.

(3) Requires careful guidance and correction.

(4) Requires student and instructor evaluation.

(5) Concentrate on strengthening weak points of performance.

d. Review and evaluation

(1) Review organizes thinking.

(2) Review develops understanding of basic principles.

(3) Help the student to see relationships.
(4) Evaluations are measures of the success of a teaching program.
(5) Test for both understanding and performance.
(6) Characteristics of good evaluation.
(a) Validity—does it measure what it is supposed to measure?
(b) Reliability—are the results consistent?
(c) Objectivity—does it limit the undesirable errors introduced by personal judgment in grading?
(d) Differentiation or discrimination—does it identify small but significant differences in achievement?
(e) Comprehensiveness—does it provide adequate sampling of the skill or proficiency being graded?
(7) Common techniques of evaluation
(a) Oral and written quizzes.
(b) Demonstrations of ability.
(c) Examination and tests.

D. HELPING STUDENTS TO LEARN—THE FLIGHT INSTRUCTOR'S ROLE

1. *Be a Professional*
a. Train and prepare.
b. Follow a program of self-improvement.
c. Adhere to ethical standards.
d. Be of real service.
e. Believe in your work.
f. Maintain a positive attitude—be sincere, enthusiastic, friendly, and patient.
g. Be proficient as a pilot.
h. Be proficient as a teacher.
2. *The Instructor-Student Relationship*
a. Gain the student's confidence.
b. Appreciate the student's problems.
c. Assess the student's personality, thinking, and ability.
d. Allow for individual differences.
e. Keep student aware of progress.
3. *Safety Practices*
a. Practice what you preach
(1) Use the checklists.
(2) Observe established safety practices.
(3) Observe regulations.
(4) Teach respect for limitations of self and equipment.
4. *Use of Training Aids*
Choose with care—
a. Models.
b. Charts, diagrams, and performance tables.
c. Audiovisual courses.
d. Programmed instruction.
e. "Handees" *(gestures and improvisations)*.

E. MAINTAIN STUDENT INTEREST AND MOTIVATION

1. *Motivation—Basic to All Learning*
a. Utilize interests noted during analysis of the student.
b. Direct and control student's attention.
c. Appeal to all the student's senses.
d. Contrive interesting experiences.
e. Teach from the known to the unknown.
f. "Watch your language"—explain technical terms.
g. Emphasize the positive.
h. Utilize the incentive provided by rewards.

F. IMPORTANT AEROMEDICAL INFORMATION

1. *The General Health Factor.*
2. *Specific Aeromedical Factors—Their Symptoms and Control*
a. Fatigue, boredom, inattention.
b. Hypoxia.
c. Alcohol.
d. Drugs.
e. Vertigo.
f. Carbon monoxide.
g. Vision.
h. Middle ear discomfort.
3. *Scuba Diving*—"Airman's Bends."
4. *Psychological Factors in Flying*

a. Anxiety.
b. Normal and abnormal reactions to stress.
c. The "difficult" student.
d. The seriously abnormal student.

G. FLIGHT INSTRUCTOR RESPONSIBILITIES

1. *Foster Student Learning*
   a. Know the objective.
   b. Devise a plan of action.
   c. Create a positive instructor-student relationship.
   d. Present information and guidance effectively.
   e. Transfer responsibility to the student as he learns.
   f. Evaluate teaching effectiveness through evaluation of student's learning and proficiency.
2. *Instruction of Student Pilots*
   a. Provide adequate instruction.
   b. Require an adequate standard of performance.
   c. Give adequate supervision.
   d. Endorse student pilot certificates.
   e. Endorse student logbooks.
   f. Maintain adequate records.
3. *Flight Test Recommendations.*
4. *Aircraft Checkouts*
   a. Use appropriate guides.
   b. Be fully qualified.
5. *Refresher Training*
   a. Know the objectives.
   b. Know the standards.
6. *The Flight Instructor Image*
   a. Be sincere.
   b. Accept the student as he is.
   c. Maintain professional appearance and habits.
   d. Avoid objectionable language.
   e. Develop and maintain a calm, thoughtful, and disciplined demeanor.

SECTION II. THE PERFORMANCE AND ANALYSIS OF FLIGHT TRAINING MANEUVERS

A. AERODYNAMICS. Have a knowledge and understanding of—

1. *Aerodynamic terms and definitions.*
2. *Airplane loading*
   a. Weight and balance and flight performance.
   b. Effects of load on airplane structure.
   c. Effects of loading on stability and controllability.
   d. Load factor principles.
      (1) Load factors and stalling speeds.
      (2) Load factors and flight maneuvers.
3. *Forces Acting on an Airplane in Flight.*
4. *The Airplane's Axes of Rotation.*
5. *Functions of the Control Surfaces and Trim Tabs.*
6. *Use of Flaps*
   a. Effects on flight performance.
   b. Effects on stability.
7. *Angle of Attack*
   a. In stalls.
   b. As an index of performance.
8. *Airspeed*
   a. Control effectiveness.
   b. Maximum performance speeds.
      (1) Slow flight.
      (2) Cruise.
      (3) Best rate-of-climb (V_y).
      (4) Best angle-of-climb (V_x).
      (5) Relationship between speed, angle of bank, and rate of turn.
9. *Turns*
   a. Forces acting on an aircraft in a normal turn.
   b. Changes of lift in a turn.
   c. Increase of drag in a turn.
10. *Ground Effect*
   a. As a factor in takeoffs.
   b. As a factor in landings.
   c. Its use in emergencies.
11. *Torque and "P" Factor*
   a. Aircraft rigging.
   b. Asymmetrical loading of the propeller.
   c. Action of the spiral slipstream.
   d. Gyroscopic action of the propeller.
   e. Torque reaction.
12. *Controllable Propellers*
   a. How a propeller works.
   b. Purpose of controllable propellers.
   c. Operation of controllable propellers—The relationship between mani-

fold pressure, RPM, and Brake Mean Effective Pressure (BMEP).

B. FLIGHT TRAINING MANEUVERS AND PROCEDURES

1. *Know How and When to Introduce Maneuvers and Procedures* (Item 5 below).
2. *Know the Correct Technique for the Maneuvers and Procedures.*
3. *Be Able to Recognize and Analyze Common Student Errors.*
4. *Be Familiar with Effective Methods of Correcting Student Errors.*
5. *Know the Required Maneuvers and Procedures*
   a. Preflight (including check of airplane documents and records), starting, warm-up, taxi, before takeoff, inflight, and postflight checks and procedures.
   b. Use of radio for voice communication.
   c. Straight-and-level flight, turns (including slips and skids), and confidence maneuvers.
   d. Climbs and glides (including powered descents).
   e. Ground track maneuvers
      (1) "S" turns across a road.
      (2) Turns about a point, including 720° steep turns.
      (3) Rectangular courses.
      (4) Traffic patterns.
   f. Stalls, stall recoveries, and flight at minimum controllable speeds.
   g. Takeoffs and landings
      (1) Normal.
      (2) Crosswind.
      (3) Short, soft and rough-field.
      (4) Slips, and slips to a landing.
      (5) Downwind landings.
      (6) Power approaches.
      (7) Touch and go landings.
      (8) Wheel landings (tail-wheel type airplanes), stall landings (nosewheel-type airplanes).
      (9) Go-arounds.
      (10) Emergencies, including those applicable to multiengine aircraft.
      (11) Solo flight.
   h. Eights on pylons (shallow and steep).
   i. Chandelles and lazy 8's.
   j. Steep turns (including 720° power turns).
   k. Constant radius power-off spirals.
   l. Spins.
   m. Post solo emergencies.
6. *Cross-country Flying*
   a. Planning.
   b. Pilotage.
   c. Dead reckoning.
   d. Use of radio aids. (See Section E, "Use of Radio.")
   e. Cross-country emergencies.
      (1) Lost.
      (2) Engine failure.
      (3) Adverse or marginal weather.
      (4) Icing.
      (5) Loss of or restriction to visual references.
      (6) Imminent fuel exhaustion.

C. THE INTEGRATION OF INSTRUCTION IN VISUAL AND INSTRUMENT FLYING.

1. *Flight Instructor Qualifications.*
2. *Objectives.*
   a. Development of habit patterns.
   b. Accuracy of flight control.
   c. Operating efficiency.
   d. Emergency capability.
3. *Procedures.*
4. *Safety Precautions.*

D. FUNDAMENTALS OF INSTRUMENT FLIGHT

1. *The Three Major Components of Attitude Instrument Flight*
   a. Instrument coverage (cross-check).
   b. Instrument interpretation.
   c. Aircraft control.
2. *Instrument Characteristics*
   a. Attitude indicator (artificial or gyro horizon).
   b. Heading indicator (directional gyro or gyro compass).
   c. Vertical speed indicator.
   d. Turn-and-bank indicator.
   e. Airspeed indicator.
   f. Altimeter.
   g. Magnetic compass.

3. *How to determine Attitude by Instrument Indications.*
4. *How to Recognize Incorrect Use of Controls by Flight Instrument References.*
5. *The Relationship Between Rate of Turn, Radius of Turn, True Airspeed, and Angle of Bank.*
6. *Standard Rate Turns.*
7. *Physiological Reactions and Sensory Illusions.*
8. *Required Maneuvers*
   a. Straight and level.
   b. Normal turns of at least 180°, left and right, to within 20° of a preselected heading.
   c. Shallow climbing turns to a predetermined altitude.
   d. Shallow descending turns at reduced power to a predetermined heading.
   e. Recovery from the approach to a climbing stall.
   f. Recovery from the start of a power-on spiral.

E. USE OF RADIO—Understand the basic characteristics, operations, frequency spectrum, advantages, and limitations of—

1. *VHF Communications Equipment*
   a. The "line-of-sight" range of transmissions.
   b. Understand how to utilize VHF/DF (direction finding) service and radar assistance from ground stations.

2. *VOR Equipment*
   a. Understand the meaning of the radio class designations of "H", "L", and "T" for VOR/VORTAC/TACAN stations.
   b. Know the components of the VOR receiver.
   c. Understand a radial as a line of magnetic bearing extending from a VOR station.
   d. Understand how to determine your approximate position relative to the station by interpreting the setting of the bearing selector, the position of the LEFT-RIGHT Needle, and the indication of the TO-FROM Indicator.
   e. Understand the use of VOR for time and distance checks and for off-course navigation.
   f. Understand the methods of checking VOR receiver accuracy.

3. *L/MF Range and ADF Equipment* Understand—
   a. How to determine the magnetic directions of the four legs of L/MF radio ranges and the relative positions of the "A" and "N" quadrants.
   b. How to interpret bi-signals and on-course and off-course signals.
   c. The importance of the station identification signal in quadrant identification and orientation problems.
   d. How to interpret bearing information when using ADF.
   e. The use of ADF in checking time and distance to radio stations.
   f. Tracking outbound and inbound on ADF.
   g. Operational characteristics and precautions to observe in use of L/F radio equipment.

F. USE OF PILOT INFORMATION PUBLICATIONS

1. *Airman's Information Manual*—Know how to use and interpret the data contained in this important publication, such as—
   a. Air navigation radio aids (NAVAIDS).
   b. Airport and air navigation lighting and marking aids.
   c. Altimetry.
   d. Good operating practices.
   e. Radar.
   f. Radiotelephone phraseology and techniques.
   g. Safety of flight.
   h. Weather.
   i. ATC operations and procedures.
   j. Flight data and special operations.
   k. Notice to Airmen (NOTAMS).

l. Airport directory.
m. Airport/Facility Directory.

2. *Airplane Flight Manual and Owner's Manual*—As applicable to the airplane(s) in the instruction program, understand the material in these manuals and how to use it.
   a. Know how to consult the weight and balance data to determine that the aircraft is properly loaded. Know how to compute empty weight, useful load, and gross weight. Know how to compute moments from weights and center of gravity arms.
   b. Know the grade and quantity of fuel and oil required.
   c. Know flight load factor limitations and airspeed limitations.
   d. Be able to use performance charts as required for:
      (1) Takeoff data.
      (2) Climb data.
      (3) Landing distance data.
      (4) Cruise performance data (cruise power settings, approximate true airspeeds, fuel consumption rate).
   e. Be able to use tables such as:
      (1) Stall speed versus angle-of-bank table.
      (2) Airspeed calibration table.
3. *Federal Regulations Governing Aviation*
   The Airplane Flight Instructor should be familiar with the following Civil Aeronautics Board Regulations and Federal Aviation Regulations:
   a. Civil Aeronautics Board, Safety Investigation Regulations, Part 320.
   b. Federal Aviation Regulations
      (1) Part 1, "Definition and Abbreviations."
      (2) Part 61, "Certification: Pilots and Flight Instructors."
      (3) Part 91, "General Operating and Flight Rules."

G. AIRFRAME AND POWERPLANT—

Have a working knowledge of—

1. Aircraft structures.
2. Airframe components and control surfaces.
3. Fuel and fuel systems.
4. Oil and oil systems.
5. Electrical system fundamentals.
6. Reciprocating engine principles and components.
7. Carburetion and fuel injection.
8. Ignition.
9. Propellers.
10. Engine instruments.

H. OTHER AREAS OF IMPORTANCE

1. *The Altimeter*
   a. Know the effect of nonstandard temperature and pressure on the indications of the altimeter.
   b. Understand how to apply altimeter settings to the Kollsman window of the altimeter.
   c. Understand how to obtain the pressure altitude.
   d. Be able to interpret the indications of the altimeter at all altitudes (including altitudes above 10,000 feet).
2. *The Airspeed Indicator*
   a. 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).
      (1) Flap operating range.
      (2) Normal operating range.
      (3) Caution range.
      (4) Power-off stalling speed with the wing flaps and the landing gear in the landing position (V_{so}).
      (5) Power-off stalling speed. "Clean"—wing flaps and landing gear retracted (V_{s1}), if retractable-gear type.
      (6) Maximum flap extended speed (V_{fe}).
      (7) Maximum structural cruising speed (V_{no}).
      (8) Never-exceed speed (V_{ne}).
   b. Know and understand the reason for other pertinent airspeed limitations such as the maneuvering speed (V_p).

NOTE: For additional information on airspeed, see Exam-O-Gram No. 8 in the Appendix.

3. *Aircraft Stability*—Understand both static and dynamic stability.

4. *Meaning of Colored Lights at an Airport.*
   a. Runway.
   b. Taxiway.
   c. Threshold.
   d. Beacon.
   e. Visual approach slope indicator.
   f. Nonstandard traffic light (controlled airports).
   g. Obstruction.

5. *Special Procedures for Multiengine Instruction.* Understand the importance of—
   a. Minimum control speed (V^{mc}) for single-engine operation.
   b. Proper use of single-engine best angle of climb speed and best rate of climb speed (single-engine V^x and V^y).
   c. Maneuvers and standards stipulated in *Multiengine Airplane Class or Type Rating Flight Test Guide,* AC No. 61–4.

6. *Understand the Special Procedures for Seaplane Instruction.*

7. *Understand and Be Able to Use Pertinent Charts,* such as—
   a. Density altitude charts.
   b. Koch Chart.
   c. Load factor chart.
   d. Oxygen duration charts.

8. *Safe Flying Practices.* Have a thorough understanding of
   a. Density altitude and its effects on aircraft performance
      (1) Understand that density altitude INCREASES with a decrease in pressure, increase in temperature, or an increase in relative humidity.
      (2) Understand that if density altitude increases, aircraft performance DECREASES.
   b. Carburetor icing
      (1) Symptoms in aircraft with fixed-pitch propellers and with constant-speed propellers.
      (2) Use of carburetor heat.
   c. Know the effects of snow, ice, and frost on an airfoil, and realize the importance of their removal prior to flight.
   d. Dangers associated with aircraft wake turbulence, i.e., wing-tip vortices; propeller, jet engine, and helicopter rotor wash—
      (1) Conditions and circumstances most conducive to such turbulence.
      (2) How to avoid these dangers.
      (3) Procedure to use if inadvertently encountered.
   e. Fuel contamination
      (1) Causes.
      (2) Precautions to take.

SAMPLE EXAMINATION

The following test items are only samples to indicate the general form of those used in the examination. They are included for one purpose—to familiarize you with the type of test items you may expect to find on the FAA examinations. Ability to answer these sample items *does not* indicate that you are fully prepared to take the examination since all topics on which you will be tested are not included.

You should concentrate on the section of this study guide entitled "Study Outline for the Airplane Flight Instructor Written Examination." A knowledge of all the topics mentioned in this outline—not just the mastery of the sample test items—should be used as the criterion for determining that you are properly prepared to take the FAA written examination. Proper preparation requires considerable time, effort, and the guidance of a competent instructor.

Correct answers to the sample test items, along with an explanation of each test item, are on pages 21 through 27. In some sample test items reference will be made to certain illustrations. These illustrations will be found in the Appendix of this guide. These are representative of illustrations which may be found in the written examination and with which the applicant should be familiar.

SECTION I. FUNDAMENTALS OF FLIGHT INSTRUCTION

1. In a good flight curriculum, the presentation of maneuvers should be arranged—

1—In the order in which they are used in normal flight.

2—In groups or stages to systematize flight instruction.

3—So that each successive maneuver is less difficult than the last.

4—So that each teaches an extension of the principles of previous ones.

2. If an instructor is to prepare his lesson plan properly for a flight training course, he should know which of the following?

A. The student's present ability.

B. What knowledge the student should acquire from his training.

C. The level of profficiency that the student should attain in the required flight maneuvers.

1—B only.

2—A and B only.

3—C only.

4—A, B, and C.

3. Motivation is a key factor in learning. In properly motivating students, a flight instructor should remember that—

1—Students are innately able to evaluate their proficiency and rate of progress and will instinctively tend to arrive at correct self-concepts if properly motivated.

2—It is best to emphasize long range goals more than short range goals.

3—Positive motivations are characteristically more effective than negative motivations.

4—All of the above statements are considered true.

4. Worry and emotional difficulties which are sometimes associated with flight training are usually a result of—

1—Personality problems of the student affected.

2—Inadequacies in the training course or flight instructor.

3—Personality conflicts between student and instructor.

4—The type of maneuvers, or the phase

of training with which the student is concerned at the time the difficulties arise.

5. The flight instructor's first step in teaching is to—

1—Gain the student's confidence.

2—Determine whether the student really wants to learn to fly.

3—Teach the student to fly straight and level.

4—Require the student to complete a short verbal or written quiz to test his ability to assimilate instruction.

6. If a student shows slow progress in learning to perform normal landings because of lack of confidence, his flight instructor should—

1—Continue the instruction on the landings but in a more energetic manner so that the student will apply himself with greater diligence.

2—Use praise to a greater extent after each landing attempt.

3—Assign him goals that are less difficult.

4—Point out the student's errors by exaggerated demonstrations of the errors.

7. A student who has been very quick to absorb instruction and has made few mistakes, suddenly begins to perform poorly during his dual instruction flights. The instructor correctly analyzes this poor performance to be a result of student overconfidence. The proper corrective action by the instructor would be to—

1—Lower the standard of performance expected by the student.

2—Demand greater effort from the student by raising the standard of performance on each lesson.

3—Praise the student only when he deserves it.

4—Do nothing, as this phase in learning is normal for this type of student and will correct itself in time.

8. The integration of instruction in aircraft control, through the use of outside visual references and through use of flight instruments only—

1—Tends to inhibit student progress if introduced prior to solo flight.

2—Is best accomplished during dual cross-country flights.

3—Will improve a student's precision, efficiency, and safety in flight.

4—Prepares a student pilot for extended operations in difficult weather situations.

9. It is important that a student know the objectives of a maneuver or procedure and the goals for which he is striving. A good indication that he has this knowledge concerning a given maneuver or procedure is—

1—The ease with which he is able to complete the maneuver or procedure.

2—The speed with which he is able to complete the maneuver or procedure.

3—His ability to evaluate his performance of the maneuver or procedure.

4—A flawless performance of the maneuver or procedure.

10. A flight instructor must be continually alert for new and better ways to do a more effective job of instructing. The best source of information that you, as an instructor, will have for self-improvement will be found in—

1—Observing the techniques and procedures of other instructors.

2—A comparison of the performance of your students with the performance of the students of another instructor.

3—Personal interviews with your supervisor.

4—The type of difficulties your students are experiencing.

11. The use of training films, slides, charts, models, mockups, etc., is—

1—Generally considered good teaching practice because their use lightens the load on the flight instructor.

2—Justified only if the students feel that they are useful and the instructor has time to include them in the course.

3—Justified when they are used as aids to teaching and are utilized in a meaningful manner along with other teaching methods.

4—Justified if they have been approved by the Federal Aviation Agency.

12. Criticism of a poor or unsatisfactory flight performance—

1—Is the most dependable method of forcing flight students to apply themselves more diligently.

2—Has no place in a good flight instruction program.

3—May completely subdue and destroy the initiative of a timid student.

4—Will cause reactions which the good instructor can utilize to determine if the student is highly motivated.

13. Lesson plans or course syllabuses should be—

1—Followed exactly if maximum benefit is to be derived from their use.

2—Adapted to the learning situation and changed when necessary.

3—Used primarily by inexperienced instructors.

4—Used primarily by those instructors who must teach students who have already received part of their flight training from another instructor.

14. The responsibilties of today's flight instructor are very real and very complex. The instructor can best live up to these responsibilities by—

1—Requiring a high standard of proficiency in his students.

2—Establishing his effectiveness as an instructor on the basis of an objective evaluation of his own flying proficiency.

3—Discouraging from further instruction those students who do not have a natural physical and mental capacity to fly.

4—A keen analysis of his students and a deep personal interest in their welfare.

15. The four basic steps in effective instruction are—

1—Straight and level, climbs, glides, and turns.

2—Preflight, air work, traffic patterns, and emergencies.

3—Preparation, explanation and demonstration, trial and practice, and review and evaluation.

4—Analysis, explanation, performance, and practice.

SECTION II. PERFORMANCE AND ANALYSIS OF FLIGHT TRAINING MANEUVERS

16. Prior to takeoff, a pilot sets his sensitive altimeter to the current altimeter setting at the airport from which the takeoff is being made. *His altimeter then reads the* same as the one illustrated in Figure 3 in the appendix. Assume that the terrain along the route which the pilot will be flying has the same elevation as the airport. Which of the following altitudes would satisfy FARs for VFR operations if the route of flight has a magnetic course of 135°?

A. 4,500 feet MSL.
B. 5,000 feet MSL.
C. 7,500 feet MSL.

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

17. A pilot is involved in a landing accident due to the inflight failure of an engine component of a *light airplane* (12,500 pounds or less). Following the accident, he wishes to check the appropriate Regulation to determine the procedure he should follow. Which of the following correctly gives the Regulation he should check and the complete procedure he should follow if the damage is reasonably estimated at $300 or more?

1—Civil Aeronautics Board, Safety Investigation Regulations, Part 320. He must notify the CAB immediately and within 10 days file a report of the accident with the CAB or the FAA.

2—Federal Aviation Regulations, Part 61. He must report the accident immediately to the Civil Aeronautics Board.

3—Federal Aviation Regulations, Part 91. He has 7 days in which to report the accident to the Federal Aviation Agency if the damage to the engine is more than $100.

4—Civil Aeronautics Board, Safety Investigation Regulations, Part 320. He must notify either the FAA or the CAB of the accident within 2 weeks of the occurence.

18. Referring to the excerpt from the *Airman's Information Manual* (see Figures 33 through 36 in the Appendix), you examine information for the following airports:

A. Tulsa International Airport, Tulsa, Oklahoma.
B. Will Rogers World Airport, Oklahoma City, Oklahoma.
C. Wiley Post Airport, Oklahoma City, Oklahoma.

You find that a Visual Approach Slope Indicator (VASI), an FAA-operated control tower, UNICOM facilities, and ground control are all available at—

1—Airport A only.
2—Airport B only.
3—Airports A and B only.
4—Airports A, B, and C.

19. A correct performance of "S" turns across a road and turns about a point requires that the bank must be steepest when—

1—Flying directly downwind.
2—Flying directly crosswind on the downwind side.
3—Entering the turn on the upwind side.
4—Flying directly crosswind on the upwind side.

20. Because of various factors which can cause a tailwheel-type airplane to deviate from the desired direction on the takeoff roll, many beginner students experience considerable difficulty on takeoff in such airplanes. To help the student overcome this difficulty, it would be best for the instructor to—

1—Thoroughly explain "P" factor (asymmetrical thrust).
2—Make certain that the student understands the relationship between control effectiveness and speed.
3—Give repeated demonstrations of the correct technique.
4—Demonstrate how crosswinds influence directional control on the ground.

21. Which of the following statements pertaining to angle of attack is correct?

1—If a constant airspeed can be maintained, the angle of attack will increase as the pitch is increased.
2—It is possible for the wing of an airplane to pass through the air at a high angle of attack even though a constant altitude is maintained.
3—An airplane in a power-off descent will normally have a negative angle of attack.
4—Regardless of the angle of attack, stalls will occur only at low or comparatively low airspeeds.

22. When performing the maneuver "eights on pylons" at a constant throttle setting during a strong wind, the pivotal altitude will—

1—Remain constant.
2—Decrease slightly when flying into the wind in the turns.
3—Increase slightly when flying into the wind in the turns.
4—Decrease slightly when flying downwind in the turns.

23. Although spins are not required on flight tests for private or commercial pilot certificates, airplane flight instructors should be familiar with the principles of spins and with spin performance and recovery procedures. A spin can be entered—

1—Only if the airplane first enters a stall.
2—Without first stalling the airplane if the pilot wishes to force it into the spin.
3—Only from a stall encountered at a high pitch altitude.
4—Without first stalling the airplane only when the entry is made from a tight diving spiral.

24. After scanning the instrument group which appears in Figure 25 in the Appendix, a pilot normally should interpret these indications to mean that the airplane is—

1—Descending, but because the primary instrument and supporting instruments for the turn do not agree, it is impossible to determine the direction

without cross-checking the directional gyro or the compass.
2—Descending in a standard rate turn to the right.
3—Descending at 1,200 feet per minute with a bank of approximately 23° to the left.
4—Descending in a slipping turn to the left.

25. In order to impress students with the importance of the performance charts in the *Airplane Flight Manual,* a flight instructor requires his students to compute the takeoff distance at two separate airports. The conditions at these two airports are assumed to be as follows:

	Airport "A"	*Airport "B"*
Elevation of Airport	30 feet	6,250 feet
Temperature	84°F	36.5°F
Windspeed (headwind component)	15 mph	Calm
Runway	Hard surface	Hard surface
Gross weight	1,900 pounds	2,200 pounds

Assuming normal engine operation and normal pilot technique, the distance that the airplane travels from the beginning of the takeoff roll until it reaches an altitude of 50 feet (above the runway) is approximately (refer to Figure 4 in the Appendix)—
1—370 feet for takeoff at Airport "A" and 1,300 feet for takeoff at Airport "B."
2—One and one-half times as long for takeoff at Airport "B" as for takeoff at Airport "A."
3—Twice as long for takeoff at Airport "B" as for takeoff at Airport "A."
4—Three times as long for takeoff at Airport "B" as for takeoff at Airport "A."

On the student's first cross-country flight, you wish to demonstrate the peculiarities of the magnetic compass while maneuvering on different headings. In order to stress the importance of maintaining straight-and-level, unaccelerated flight while reading the magnetic compass, you accomplish the demonstrations that follow: On the outbound leg which is on a northerly heading, you make shallow banked turns to the left and right and have the student observe the reaction of the magnetic compass; you repeat the same demonstration on the return flight which is on a southerly heading.

26. As the *entry into a left turn* is made on each of the above demonstrations, the student would most likely observe an indication on the magnetic compass as illustrated in (refer to Figure 9 in the Appendix).
1—MC–1 when on a north heading; MC–3 when on a south heading.
2—MC–1 when on a north heading; MC–4 when on a south heading.
3—MC–2 when on a north heading; MC–4 when on a south heading.
4—MC–2 when on a north heading; MC–3 when on a south heading.

27. Referring to Figure 7 in the Appendix, assume that the sets of instruments labelled A, B, and C are located in three different airplanes. Each airplane is flying at the same altitude and in the same atmospheric conditions. Match each set of instruments (airspeed and altitude indicator) with the turn-and-bank indicator which most nearly represents its rate of turn. The correct combination is—
1—(A, N–2), (B, N–2), (C, N–2).
2—(A, N–3), (B, N–1), (C, N–1).
3—(A, N–3), (B, N–2), (C, N–1).
4—(A, N–1), (B, N–2), (C, N–3).

28. Assume that the Airplane Flight Manual lists the following airspeeds for a light twin-engine airplane:

	Both engines operating (mph)	*One engine out (mph)*
Best rate-of-climb speed	150	100
Best angle-of-climb speed	80	95
V_{mc} (minimum control speed)	—	87

If one engine of this light twin becomes inoperative during flight, the pilot will lose altitude at the slowest rate, or gain altitude as quickly as possible if he establishes an airspeed of—
1—87 mph.
2—95 mph.
3—100 mph.
4—105 mph.

29. On a cross-country flight, you are demonstrating the use of the VOR as an aid to navigation to your student who is working toward a commercial pilot certificate. You are approaching the VOR station from the east, and are north of the 090° radial; the course (omnibearing) selector is set to 270°; and your omnireceiver indications are as depicted in illustration "OR–3" (Figure 8 in the Appendix). You make a 180° turn to the right to an easterly heading. The omnireceiver indication which the student will see in this new position will be approximately the same as illustration—

NOTE: Aircraft positions "A" and "B" in Figure 8 in the Appendix represent the situation.

1—OR–1.
2—OR–2.
3—OR–3.
4—OR–4.

30. The exact direction and magnitude of the forces (thrust, drag, lift, and weight) acting upon an airplane in powered flight may vary, but, for all practical purposes, which of the following would hold true in all normal flight attitudes?

A. Lift always acts perpendicular to the relative wind (flight path).
B. Weight always acts vertically downward (toward the center of the earth).
C. Thrust always acts parallel to the longitudinal axis (forward).
D. Drag always acts parallel to relative wind (rearward).

1—A, B, C, and D are all correct.
2—Only A, B, and C are correct.
3—Only A, C, and D are correct.
4—Only B is correct.

ANSWERS TO SAMPLE EXAMINATION ITEMS

Item	*Answer*	*Item*	*Answer*
1	4	16	4
2	4	17	1
3	3	18	3
4	2	19	1
5	1	20	2
6	3	21	2
7	2	22	2
8	3	23	1
9	3	24	2
10	4	25	4
11	3	26	4
12	3	27	3
13	2	28	3
14	4	29	3
15	3	30	1

ANALYSIS OF ANSWERS TO SAMPLE EXAMINATION ITEMS

Item	Answer	
1	4	*The Flight Instructor's Handbook,* AC 61–16, states, "The procedure and elements mastered in each step should be identified in demonstrating the performance of the subsequent step . . . each lesson should also require the student to recall and apply previous learning . . . a maneuver which incorporates the elements used in the preceding maneuver and extends their application or associates them with other flight elements, provides much more effective training than does a maneuver which is completely foreign to the preceding maneuvers."
2	4	*How to Instruct,* Air Force Manual 50–9, states, "In writing your lesson plan, you must know what a student should know and be able to do upon completion of his training as well as the present state of his ability." The *Flight Instructor's Handbook,* AC 61–16, states that, "The teacher takes the student from where he finds him toward the objective he seeks."
3	3	*The Flight Instructor's Handbook,* AC 61–16, states, "Negative motivations . . . are not characteristically as effective in promoting efficient learning as are positive motivations."
4	2	*The Flight Instructor's Handbook,* AC 61–16, states, "Worries and emotional upsets which result from the course at hand can be remedied. Such occurrences are usually evidence of inadequacies on the part of the course or of the instructor concerned."
5	1	*The Flight Instructor's Handbook,* AC 61–16, states, "The flight instructor's first step in teaching is to gain the student's confidence."
6	3	*The Flight Instructor's Handbook,* AC 61–16, states, "A student whose slow progress is found to be due to lack of confidence should be assigned subgoals which can be achieved easily."
7	2	*The Flight Instructor's Handbook,* AC 61–16, states, "For such a student the good instructor will continually raise the standard of performance for each lesson, demanding a greater effort from the student."
8	3	*The Flight Instructor's Handbook,* AC 61–16, states, ". . . it was soon recognized that students trained in this manner are more precise in their flight maneuvers and operations . . . the performance he obtains from an airplane increases noticeably . . . integrated flight instruction provides the student with the ability to control an airplane in flight for limited periods under favorable circumstances . . . this ability could save the pilot's life and those of his passengers. . . ."
9	3	*How to Instruct,* Air Force Manual 50–9, states, "It is important that each student be able to judge

Item	Answer	
		his performance as this is an indication that the objectives are clear to him and that he knows the goals for which he is striving."
10	4	*How to Instruct,* Air Force Manual 50–9, states, "The most significant source of information concerning your difficulties lies in the difficulties which students are having."
11	3	*How to Instruct,* Air Force Manual 50–9, states, "Unless an aid contributes to the development of student understanding and mastery, it is of little value in a training program . . . Above all, don't expect the aid to do your teaching for you. These aids are provided to help, not replace the instructor in achieving student development." The *Flight Instructor's Handbook,* AC 61–16, points out that ". . . they are valuable only as aids to good instruction; and none has yet been devised which successfully eliminated the need for an instructor."
12	3	*The Flight Instructor's Handbook,* AC 61–16, states. "Too much criticism of his flight performance may completely subdue a timid person."
13	2	*How to Instruct,* Air Force Manual 50–9, states, "Adapt the plan to the learning situation. If you find in presenting a lesson that the suggested procedures are not leading to the desired results, feel free to change the approach." The *Flight Instructor's Handbook,* AC 61–16, states, "Any practical flight training syllabus must be flexible, and should be used primarily as a guide. The order of training can and should be altered, when necessary, to suit the progress of the student and the exigencies of special circumstances."
14	4	The *Flight Instructor's Handbook,* AC 61–16, states, "Only by a keen analysis of his students, and a continuing deep interest in them, can he live up to his responsibilities and be an effective flight instructor."
15	3	The *Flight Instructor's Handbook,* AC 61–16, states, "There are four basic steps in the teaching process, without which effective instruction is impossible. They are (1) preparation, (2) explanation and demonstration, (3) trial and practice, (4) review and evaluation."
16	4	The altitude indicated on the altimeter in Figure 3 in the Appendix is 2,500 feet MSL. This is also assumed to be the elevation of the terrain along the route. Altitude "A" of 4,500 feet and Altitude "B" of 5,000 feet MSL are both less than 3,000 feet, but more than 500 feet above the surface, and therefore VFR flight at either of these two altitudes on a magnetic course of 135° would normally comply with Regulations. With an altitude of 7,500 feet, however, the flight would be *at* an altitude of 3,000 feet above the surface; therefore, subject to the provisions of FAR 91.109 which state in part ". . . each person operating an aircraft under VFR in level cruising flight *at or above* 3,000 feet above the surface shall maintain the appropriate altitude prescribed below: "(a) When operating at or below 18,000 feet MSL, and (1) on a magnetic course of zero degrees through 179 degrees, any odd thousand foot MSL altitude + 500 feet (such as 3,500; 5,500; or 7,500) or (2) on a magnetic course of 180 degrees through 359 degrees, any even thousand

Item Answer

foot MSL altitude plus 500 feet (such as 4,500; 6,500; or 8,500)."

It is apparent, therefore, that Altitude "C" also complies with FAR 91.109(a)(1). Hence, the fourth alternate response would be the correct answer. (See Exam-O-Gram No. 2 in the Appendix.)

17 1 At one time, Civil Air Regulations, Part 62, delineated the correct procedures for reporting and notification relative to accidents. Subsequently, it was superseded by Civil Aeronautics Board, Safety Investigation Regulations, Part 320, which requires that the CAB be notified immediately of any accident involving substantial damage (damage, exclusive of all engine damage, reasonably estimated at $300 or more) to the aircraft. Additionally, a written report on the accident must be submitted to either the CAB or the FAA (Part 320 of CAB Regulations stipulates as to which) within 10 days after the occurrence.

18 3 A check of the Airport/Facility Directory of the *Airman's Information Manual* (see excerpts in the Appendix) reveals that only Tulsa International and Will Rogers World Airports list as available each of the services noted in A, B, and C of the test items.

19 1 In any ground track maneuver in which a constant radius of turn is to be maintained, the angle of bank should be directly proportional to the groundspeed. The faster the groundspeed, the steeper the bank; the slower the groundspeed, the shallower the bank. The *Flight Training Handbook* states, "The steepest bank will be the point at which the groundspeed is highest." In "S" turns across the road, this point will be when entering the turn on the downwind side. This assumes that the wind direction is perpendicular to the road and the airplane is going directly downwind with a groundspeed greater than at any other point in the maneuver. This same rule would apply to constant radius turns about a point.

The *Flight Training Handbook* further states, "Throuthout the maneuver (turns about a point), the bank required at any given position is proportional to the groundspeed; the faster the groundspeed, the steeper the bank; the slower the groundspeed, the shallower the bank . . . it follows then that the steepest bank is required when the airplane is headed directly downwind. . . ."

20 2 "P" factor and crosswinds certainly play a part in the problems of directional control on takeoffs, but an understanding of these factors will not in itself correct the difficulties involved if the student does not have a clear concept of the *use of controls* and *how their effectiveness* changes with speed. The same thing is true in regard to repeated demonstrations. Therefore, alternate response 2 is the correct answer. (*See Flight Training Handbook.*)

21 2 The *Flight Instructor's Handbook*, AC 61-16, states, "It is possible for the wing to pass through the air at a high angle of attack when the airplane descends in a level flight altitude. Conversely, the angle of attack may be near zero in a steep dive." If, through analysis of the information contained in figure 31 in the Appendix, we can accept the validity of this

statement, then we can perceive that when using low power settings and slow speed, it will also be necessary to use a high angle of attack in order to maintain a constant altitude. (See *Flight Training Handbook* and Exam-O-Gram No. 28.)

22 2 The *Flight Training Handbook* states, "Since the headings throughout the turn vary from downwind to directly into the wind, the groundspeed will never be constant when there is a wind. This may result in variations in the pivotal altitude throughout the eight." A careful study of the material presented in the *Flight Training Handbook* will clarify the fact that, in the performance of pylons 8's in a stiff breeze, ". . . the average pivotal altitude will be slightly lower . . ." than when flying at the same airspeed in calm or light winds.

23 1 The *Flight Training Handbook* defines a spin as an aggravated stall that results in autorotation. It also states that "Care must be taken to completely stall the airplane; otherwise it may not spin and the only result will be a skidding spiral of increase speed. If such a maneuver results, it is useless to continue in hopes of spinning the airplane . . . Any tendency to relax on the controls after the spin is in progress will result in a sloppy spin and in many cases will completely stop the spin."

24 2 The airplane is descending in a turn to the right. The descent is confirmed by:

a. The nose down indication on the gyro-horizon.
b. The decreasing altitude as indicated on the altimeter.
c. The down trend indicated by the vertical speed indicator.
d. The increasing airspeed as shown by the airspeed indicator.

The right turn is confirmed by:

a. The turn needle of the turn-and-bank indicator.
b. The bank to the right as indicated by the attitude of the wings in relation to the horizon on the gyro-horizon. On most gyro-horizons in use with light airplanes today, the degree of bank index at the top of the instrument moves OPPOSITE to the direction of bank and turn. (See *Flight Instructor's Handbook* and *Private Pilot's Handbook of Aeronautical Knowledge.*)

25 4 In determining the takeoff distance at Airport "A," locate the "1,900 pound–15 mph" row on the Takeoff Data Chart, Figure 4 in the Appendix. Follow this row to the "At sea level and 59°F—Clear 50′ obstacle" column where you read 675 feet. Since the temperature at Airport "A" is 25° above standard, this distance will have to be increased by 10 percent (see Note at bottom of chart). Ten percent of 675 is 68 feet. 675 plus 68 feet gives a total takeoff distance at Airport "A" of 743 feet. In computing the takeoff distance at Airport "B," locate the "2,200 pound zero mph wind" row. 6,250 feet, 36½°F falls halfway between the "5,000-foot and 41° column" and the "7,500-foot and 32° F" column. Therefore, you will have to interpolate between the values found in these two columns. Follow the selected row out to these 2 columns ("to clear 50′ obstacle" portion) where you read 1,995 feet and 2,495 feet. The distance halfway between these two distances is 2,245 feet.

Item Answer

The takeoff distance at Airport "B" is 2,245 feet which is approximately 3 times the takeoff distance of 743 feet at Airport "A." (See *Private Pilot's Handbook of Aeronautical Knowledge*)

26 4 If a turn is made from a north heading, the magnetic compass will normally indicate a turn in the opposite direction, and then will lag behind the turn. If a turn is made from a south heading, the magnetic compass will indicate a turn in the same direction, but a much greater amount of turn than has actually been made. Therefore, as you enter a left turn from a north heading, the magnetic compass will indicate a turn toward the east. As you enter a left turn from a south heading, the magnetic compass will indicate a turn toward the east, but a much greater amount of turn than you have actually made. (See Exam-O-Gram No. 12)

27 3 The rate of turn of an airplane is directly proportional to the angle of bank and inversely proportional to the true airspeed. Therefore, as the angle of bank increases, the rate of turn increases, and as the airspeed increases, the rate of turn decreases. The angle of bank is the same for all three airplanes. Therefore, the rate of turn will depend upon the airspeed. Since Airplane "A" has the lowest airspeed, its rate of turn will be the greatest; Airplane "C" is flying at the highest airspeed, so its rate of turn will be the least; and the rate of turn for Airplane "B" will fall somewhere between that of "A" and "C." (See "Standard Rate, Level Turns" in *Flight Training Handbook*)

28 3 If one engine of a light twin-engine airplane becomes inoperative, the pilot will be able to gain altitude at the best rate or lose altitude at the slowest rate if he maintains the best single-engine rate-of-climb speed. The *Flight Training Handbook* states that "The engine-out best rate-of-climb speed is found in the Airplane Flight Manual . . . it is the airspeed which results in the greatest increase in altitude in a unit of time."

29 3 The indications on the TO-FROM Indicator and the LEFT-RIGHT needle are dependent *only* upon the setting of the omnibearing selector and your position relative to the VOR station. The indications are not dependent on the heading of the aircraft with respect to the VOR station. Therefore, regardless of the heading to which Aircraft "A" turns, the TO-FROM indicator and the LEFT-RIGHT Needle will not change their indications as long as the omnibearing selector setting remains constant and the aircraft remains north of the 090° radial and east of the 360° radial. The *Flight Instructor Handbook* states, "The vertical or deviation needle shows the position of the aircraft without any reference to its heading . . . the VOR bearing selector and the TO-FROM indicator always show correctly the position of the airplane in relation to the station, regardless of the heading of the airplane." Also refer to the *Private Pilot's Handbook of Aeronautical Knowledge.*

30 1 The following rules apply:

a. The force of lift always acts in a direction perpendicular to the relative wind and to the lateral axis of the aircraft (wingtip to wingtip axis).

b. The direction of weight is always toward the center of the earth and does not change even though the aircraft changes attitudes and flight paths.

c. For all practical purposes, thrust acts parallel to the longitudinal axis of the aircraft.

d. Drag acts in the opposite direction to the flight of the aircraft, and it is parallel to the relative wind.

References to the forces which act on an airplane in flight may be found in the *Flight Training Handbook* and in the *Private Pilot's Handbook of Aeronautical Knowledge*.

APPENDIX

All of the charts, illustrations, and selected EXAM-O-GRAMS presented in this Appendix are of value to the student preparing for the examination for the Flight Instructor Certificate. Users of this Guide should not assume that the questions appearing in the sample examination make full use of the material in the Appendix. This would seriously limit the benefits to be derived from the Appendix material. Every chart or illustration can be related to topics covered in the Study Outline. Even more important is the fact that every chart or illustration in the Appendix is either directly or indirectly related to the charts, illustrations, and questions that appear in the actual examination. Study all of them.

These several VFR Exam-O-Grams have been reprinted here for the study convenience of those interested in the rating of airplane flight instructor. These particular study aids have been selected because the information they contain is especially pertinent to this examination.

It should be noted that EXAM-O-GRAMS are nondirective in nature, and are issued solely as an information service to individuals interested in Airman Written Examinations.

A list of all the Exam-O-Grams available upon request from the Federal Aviation Agency is also included.

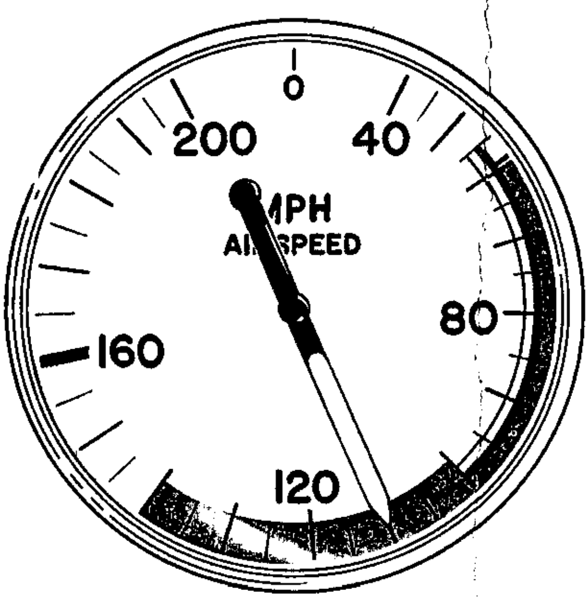


FIGURE 1. *Airspeed indicator with color-coded markings.*

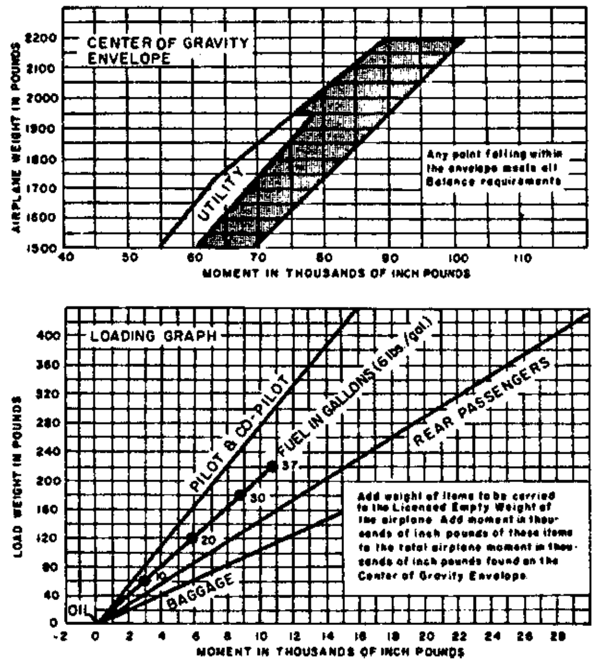


FIGURE 2. *Loading graph and center-of-gravity envelope.*

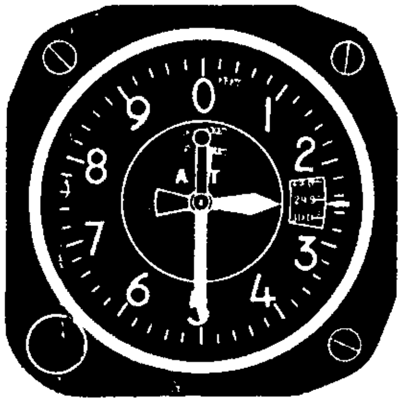


FIGURE 3. *Altimeter.*

TAKE OFF DATA

TAKE-OFF DISTANCE WITH FLAPS UP FROM HARD SURFACE RUNWAY

GROSS WEIGHT LBS.	IAS AT 50 FT.	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
1600	56	0	380	725	460	845	555	1000	680	1205
		15	215	470	265	560	330	670	415	820
		30	95	265	125	320	160	395	210	495
1900	61	0	560	1000	675	1185	820	1420	1015	1755
		15	335	675	415	805	515	980	645	1230
		30	165	400	210	490	275	610	360	785
2200	66	0	780	1370	945	1615	1155	1995	1435	2495
		15	490	945	605	1130	750	1410	950	1805
		30	260	690	330	710	425	915	560	1205

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

CLIMB DATA

GROSS WEIGHT LBS.	AT SEA LEVEL & 59°F			AT 5000 FT. & 41°F			AT 10000 FT. & 23°F			AT 15000 FT. & 50°F		
	BEST CLIMB IAS MPH	RATE OF CLIMB FT/MIN	GAL. OF FUEL USED	BEST CLIMB IAS MPH	RATE OF CLIMB FT/MIN	GAL. OF FUEL USED	BEST CLIMB IAS MPH	RATE OF CLIMB FT/MIN	GAL. OF FUEL USED	BEST CLIMB IAS MPH	RATE OF CLIMB FT/MIN	GAL. OF FUEL USED
1600	71	1220	1.0	69	955	1.8	67	690	2.6	65	425	3.8
1900	75	940	1.0	73	710	2.1	71	475	3.3	69	245	5.2
2200	78	730	1.0	77	520	2.4	75	310	4.1	74	105	7.6

NOTE: FLAPS UP, FULL THROTTLE, AND MIXTURE LEANED FOR SMOOTH OPERATION ABOVE 5000 FT.
FUEL USED INCLUDES WARM-UP AND TAKEOFF ALLOWANCE.

FIGURE 4. *Performance charts—takeoff and climb.*

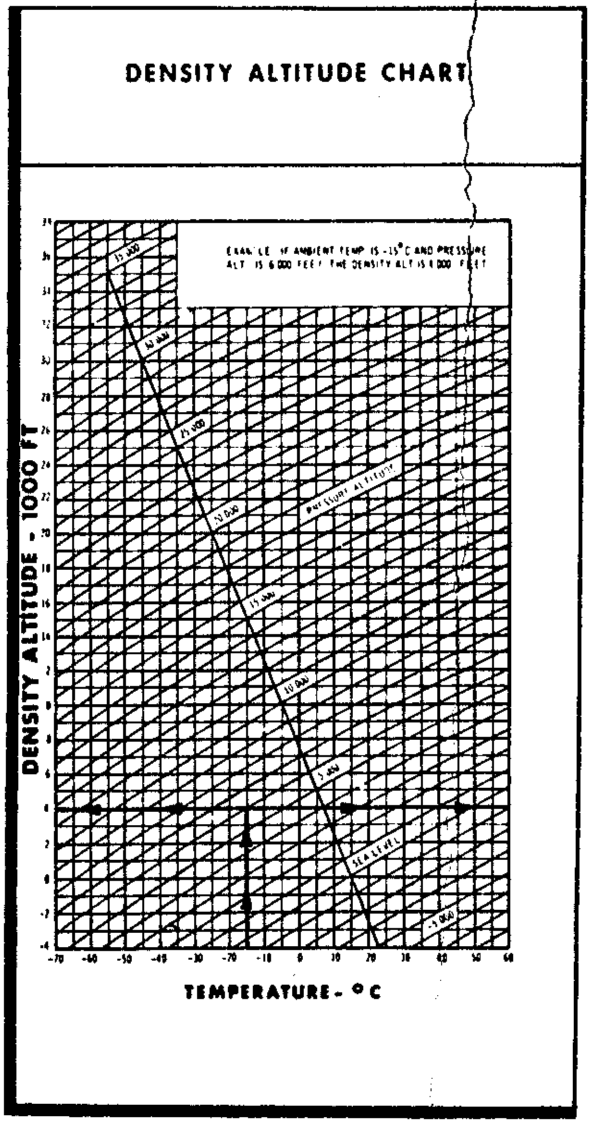


FIGURE 5. *Density altitude chart.*

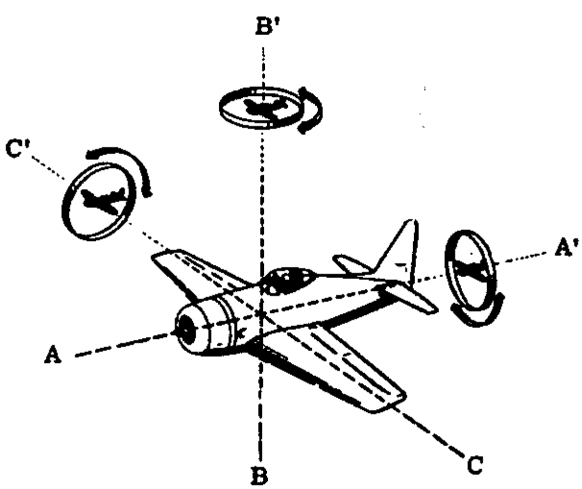


FIGURE 6. *Control axes of an airplane.*

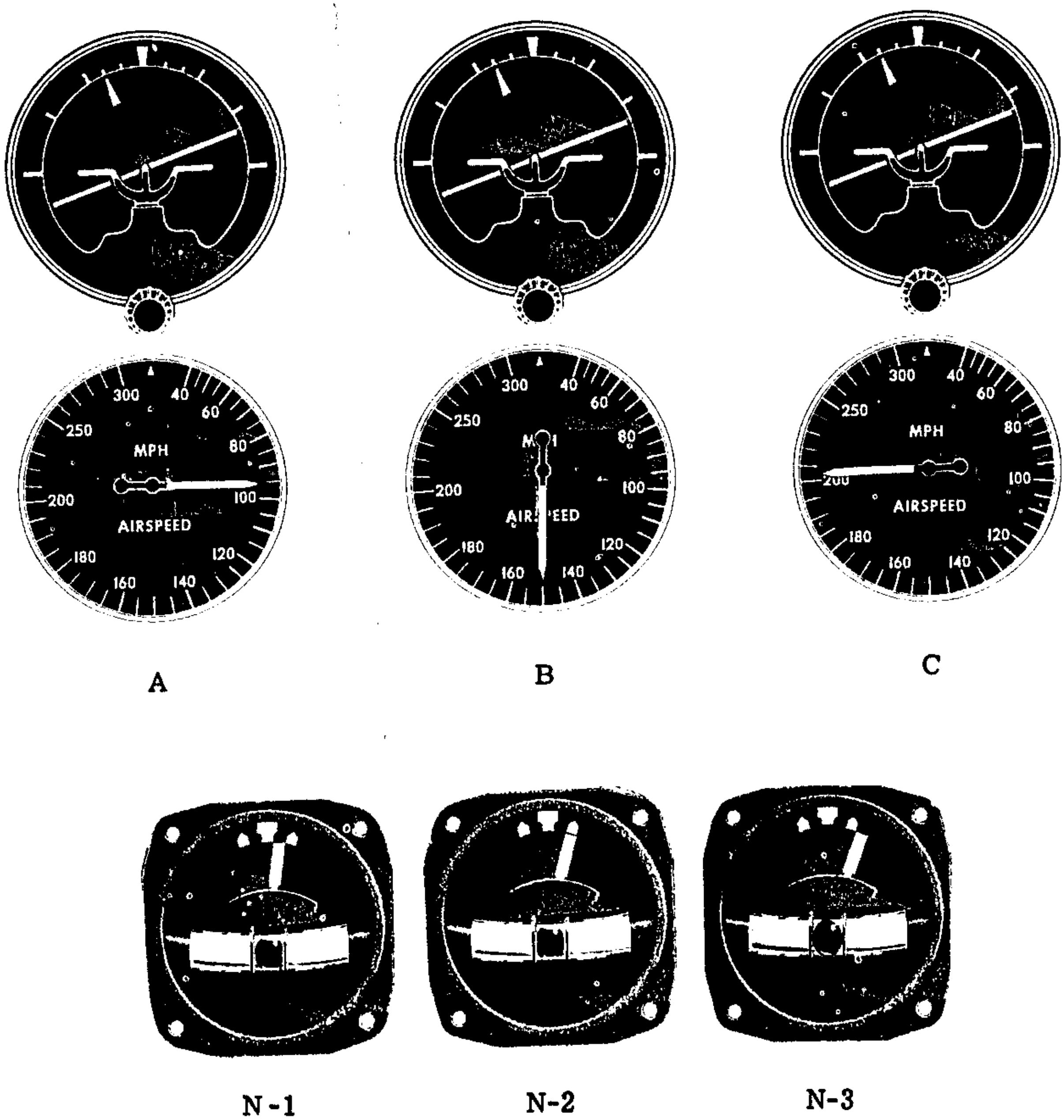


FIGURE 7. *Rate of turn versus true airspeed.*

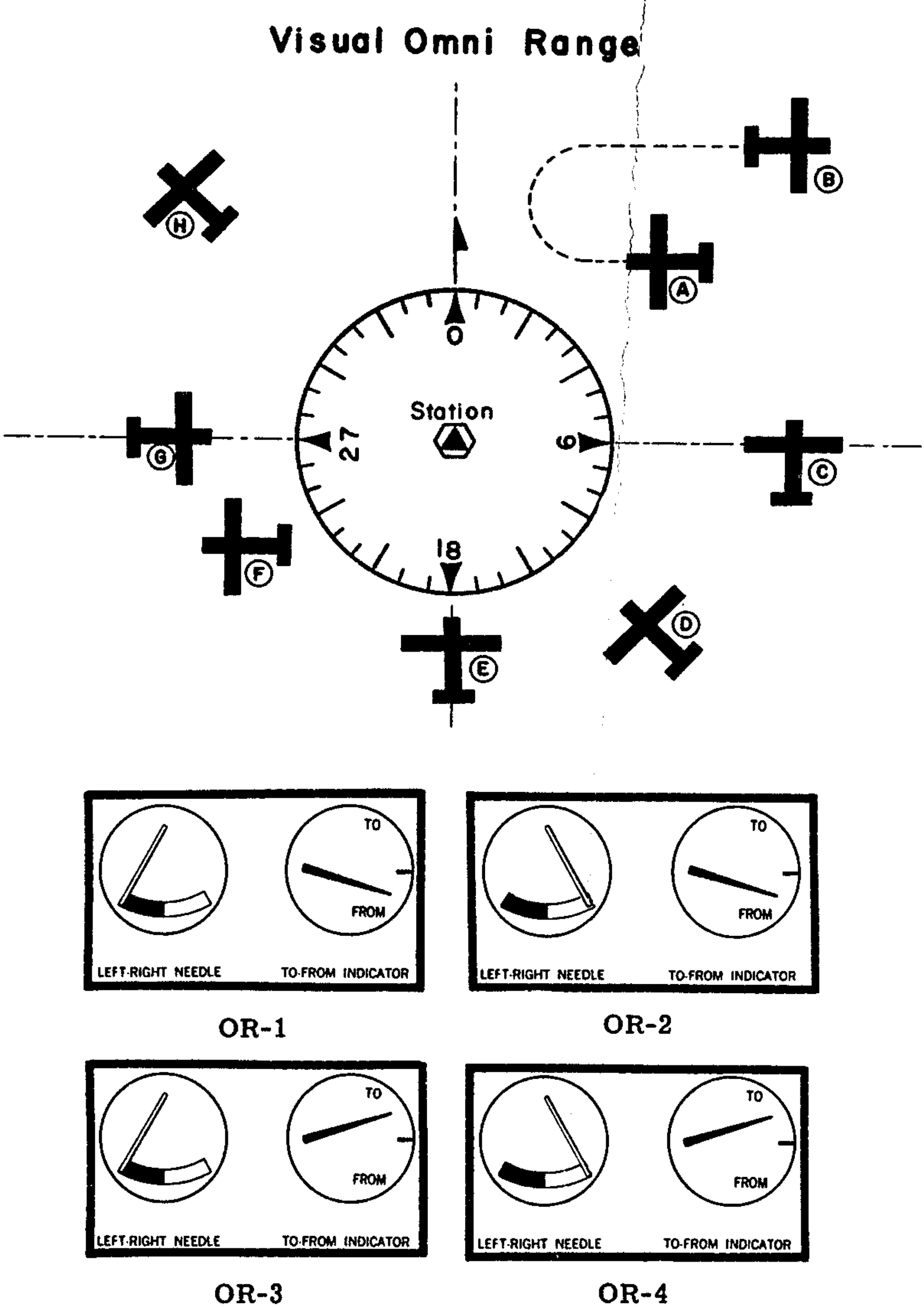


FIGURE 8. *VOR orientation and omnireceiver instrument indications.*

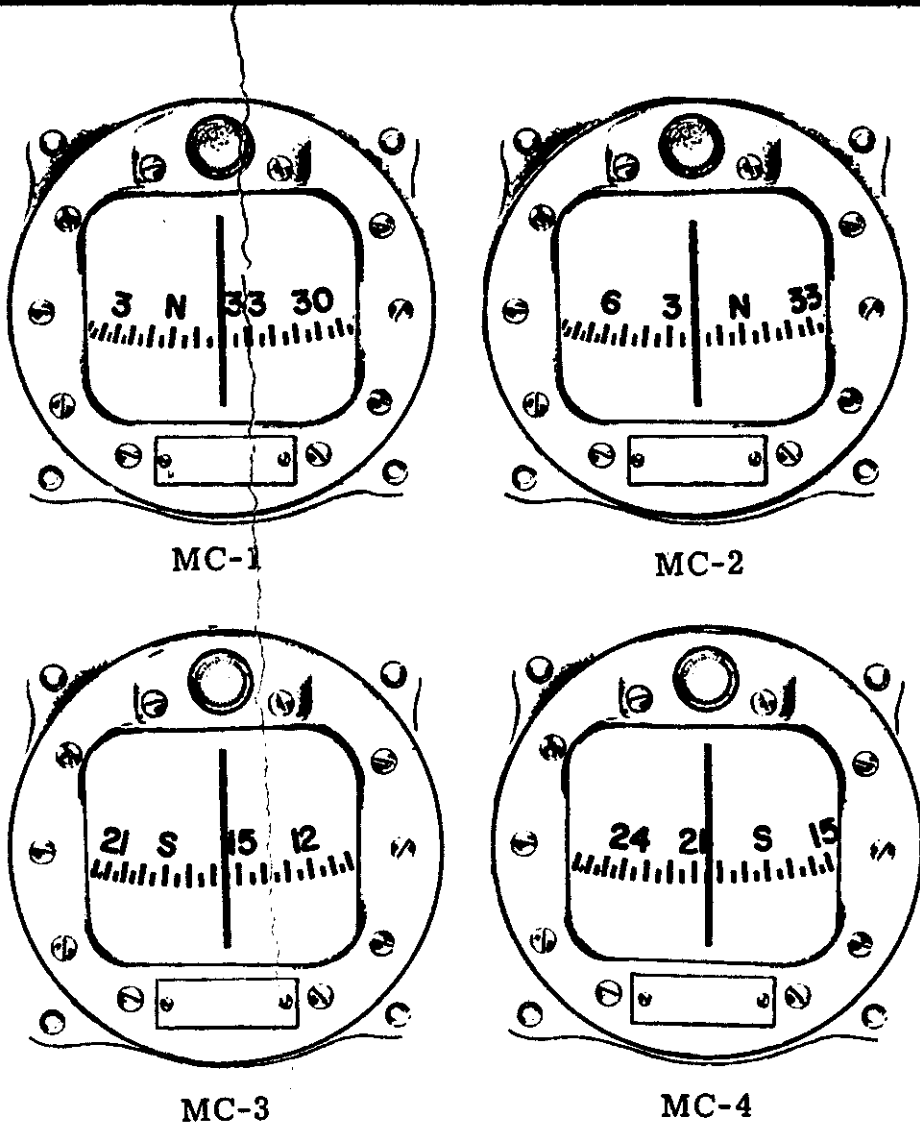


FIGURE 9. *Magnetic compass indications.*

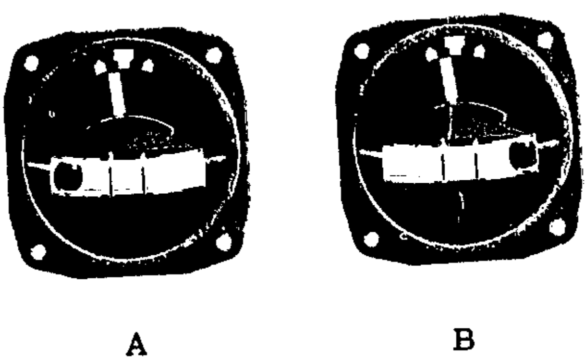


FIGURE 10. *Turn and bank indicator.*

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

*Maximum flap speed 110 MPH-TIAS

FIGURE 11. *Airspeed correction table.*

STALL SPEED, POWER OFF

CONFIGURATION (Gross Weight 2900 lbs.)	ANGLE OF BANK 0°	20°	40°	60°
GEAR & FLAPS UP	65	67	75	92
GEAR DOWN FLAPS 20°	60	62	68	84
GEAR DOWN FLAPS 40°	59	61	67	83

SPEEDS ARE MPH, TIAS (CAS)

FIGURE 12. *Stall speed versus angle of bank for various configurations (power off).*

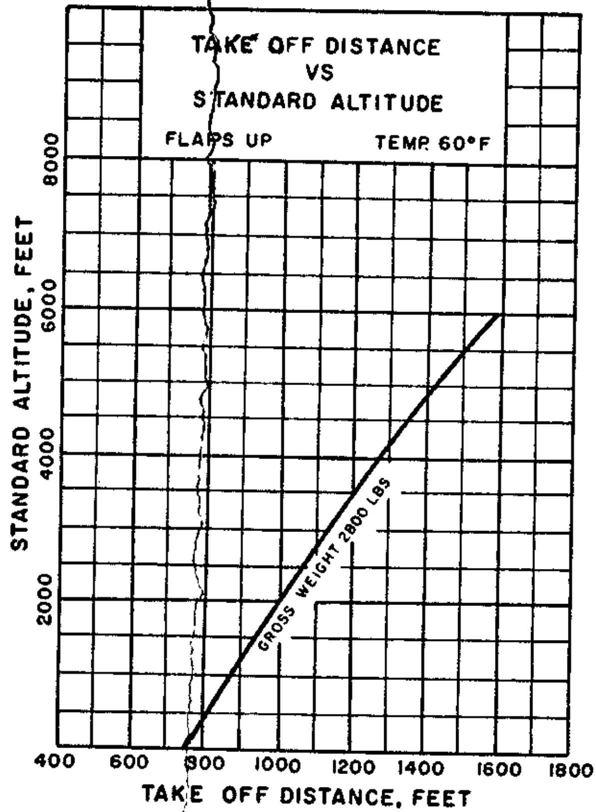


FIGURE 14. *Takeoff distance versus standard altitude.*

Power Setting Table –

Press. Alt. 1000 Feet	Std. Alt. Temp. °F	138 HP 55% Rated Approx. Fuel 10.3 Gal./Hr. RPM AND MAN. PRESS. 2100	2200	2300	2400	163 HP – 65% Rated Approx. Fuel 12.3 Gal. Hr. RPM AND MAN. PRESS. 2100	2200	2300	2400	188 HP – 75% Rated Approx. Fuel 14.0 Gal./Hr. RPM AND MAN. PRESS. 2200	2300	2400
SL	59	21.6	20.8	20.2	19.6	24.2	23.3	22.6	22.0	25.8	25.1	24.3
1	55	21.4	20.6	20.0	19.3	23.9	23.0	22.4	21.8	25.5	24.8	24.1
2	52	21.1	20.4	19.7	19.1	23.7	22.8	22.2	21.5	25.3	24.6	23.8
3	48	20.9	20.1	19.5	18.9	23.4	22.5	21.9	21.3	25.0	24.3	23.6
4	45	20.6	19.9	19.3	18.7	23.1	22.3	21.7	21.0	24.8	24.1	23.3
5	41	20.4	19.7	19.1	18.5	22.9	22.0	21.4	20.8	—	23.8	23.0
6	38	20.1	19.5	18.9	18.3	22.6	21.8	21.2	20.6	—	—	22.8
7	34	19.9	19.2	18.6	18.0	22.3	21.5	21.0	20.4	—	—	—
9	27	19.4	18.8	18.2	17.6	—	21.3	20.7	20.1			
8	31	19.6	19.0	18.4	17.8	—	—	20.5	19.9			
10	23	19.1	18.6	18.0	17.4	—	—	—	19.6			
11	19	18.9	18.3	17.8	17.2	—	—	—	—			
12	16	18.6	18.1	17.5	17.0	—	—	—	—			
13	12	—	17.9	17.3	16.8							
14	9	—	—	17.1	16.5							
15	5	—	—	—	16.3							

To maintain constant power, correct manifold pressure approximately 0.17" Hg for each 10° F. variation in carburetor air temperature from standard altitude temperature. Add manifold pressure for air temperatures above standard; subtract for temperatures below standard.

FIGURE 13. *Power setting table and cruise performance chart.*

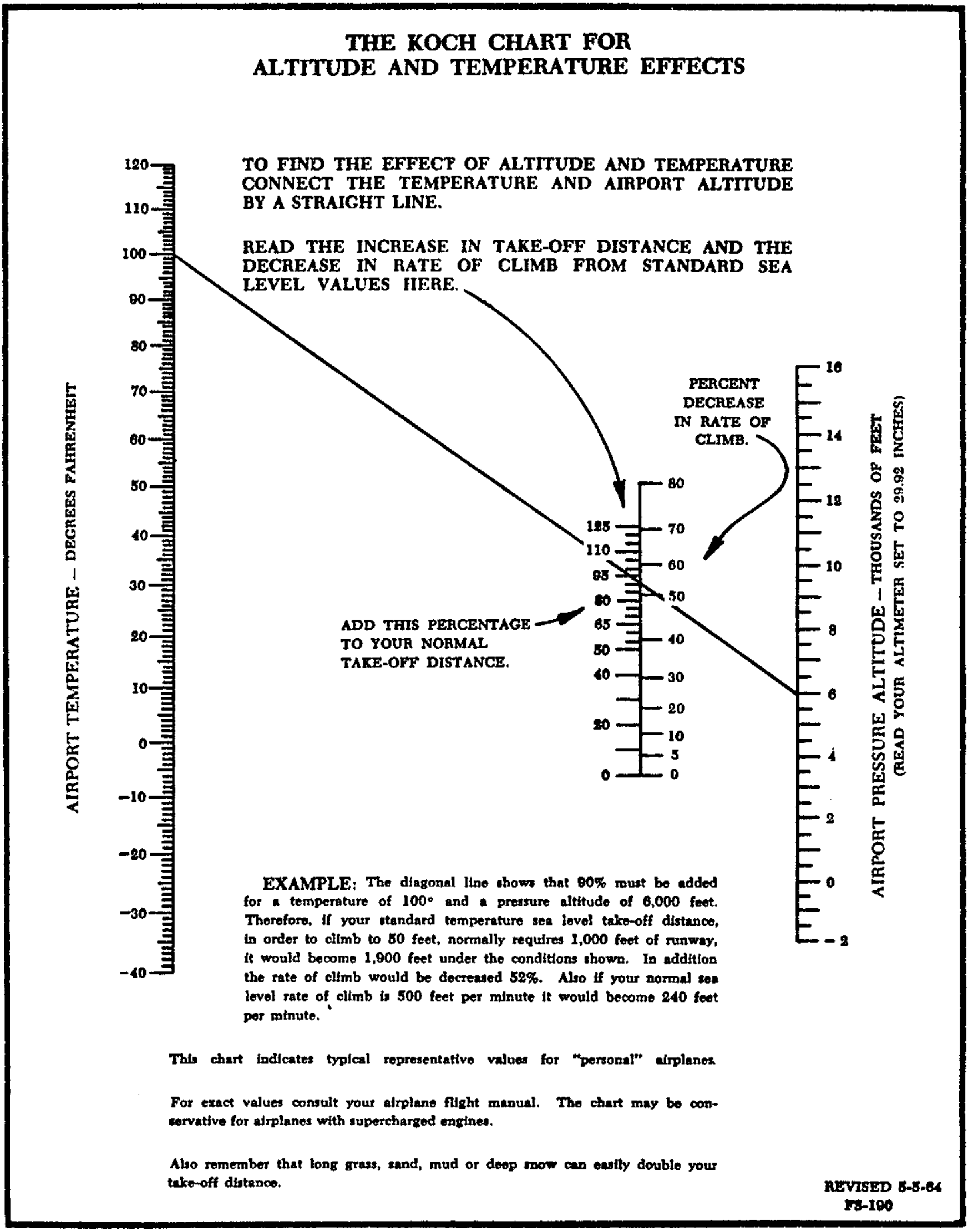


FIGURE 15. *Koch chart for altitude and temperature effects.*

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	7.6	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 16. *Cruise performance chart.*

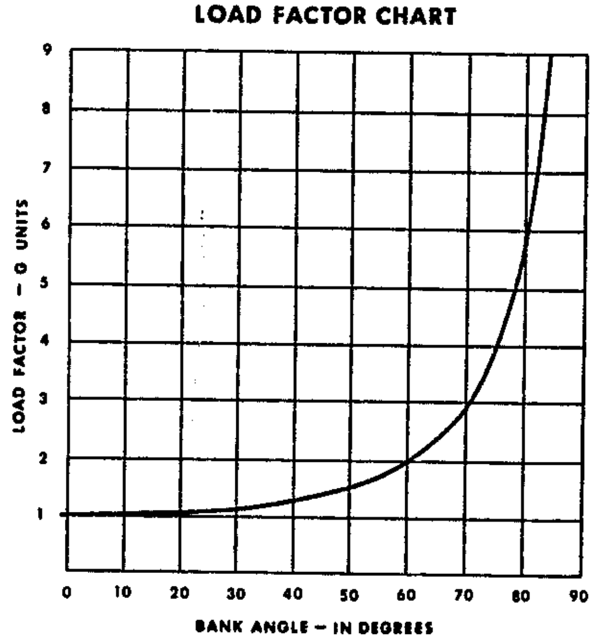


FIGURE 17. *Load factor chart.*

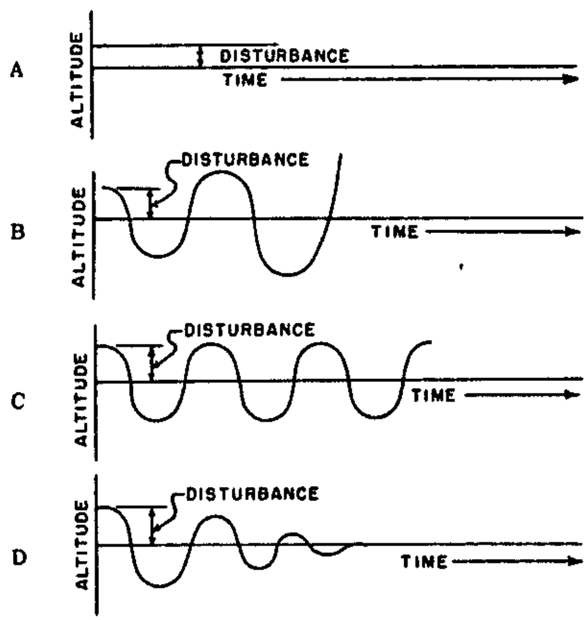


FIGURE 18. *Stability graphs.*

FIGURE 19. *Artificial horizon (attitude indicator) indications.*

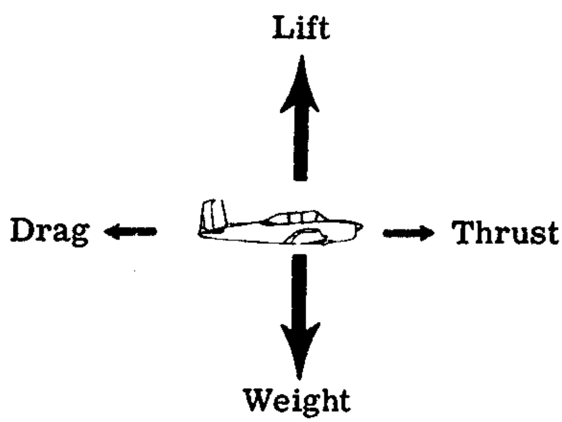


FIGURE 20. *Forces acting on an aircraft in straight-and-level unaccelerated flight.*

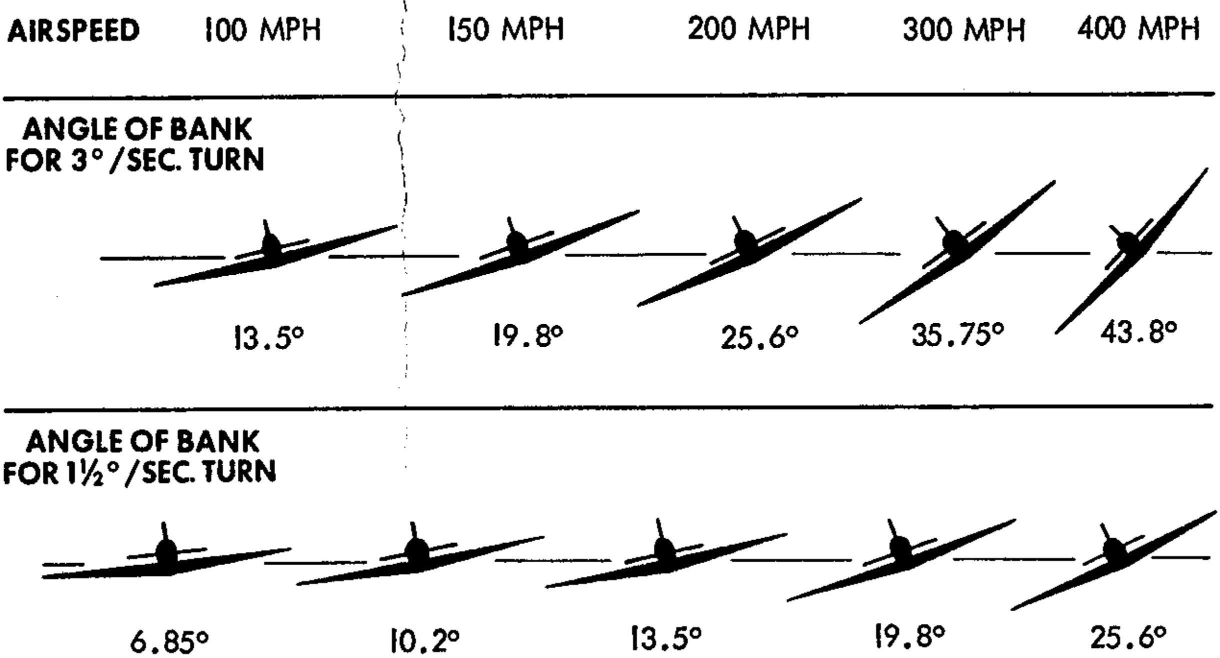


FIGURE 21. *Speed, bank, and rate of turn.*

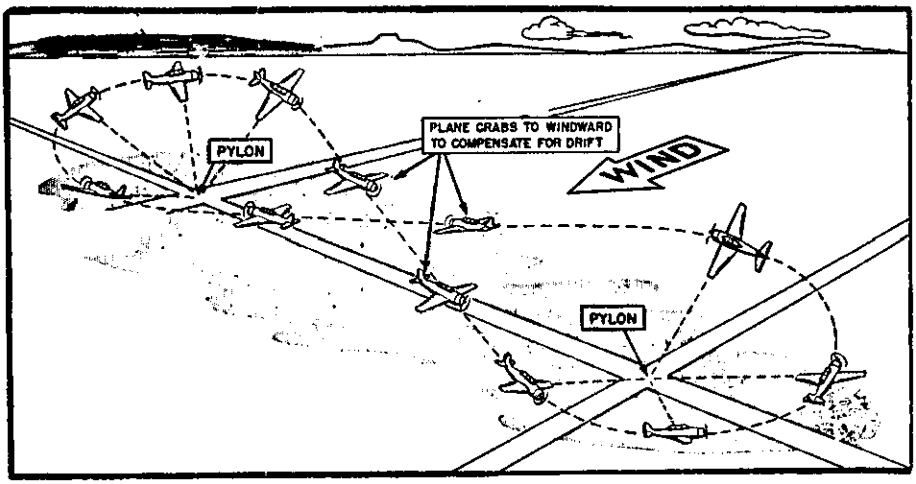


FIGURE 22. *Pylon eights.*

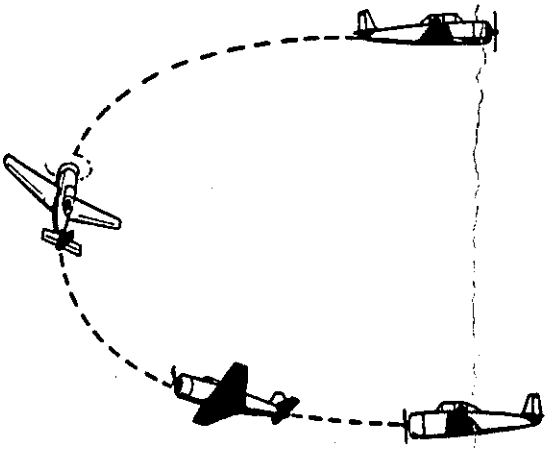


FIGURE 23. *Chandele.*

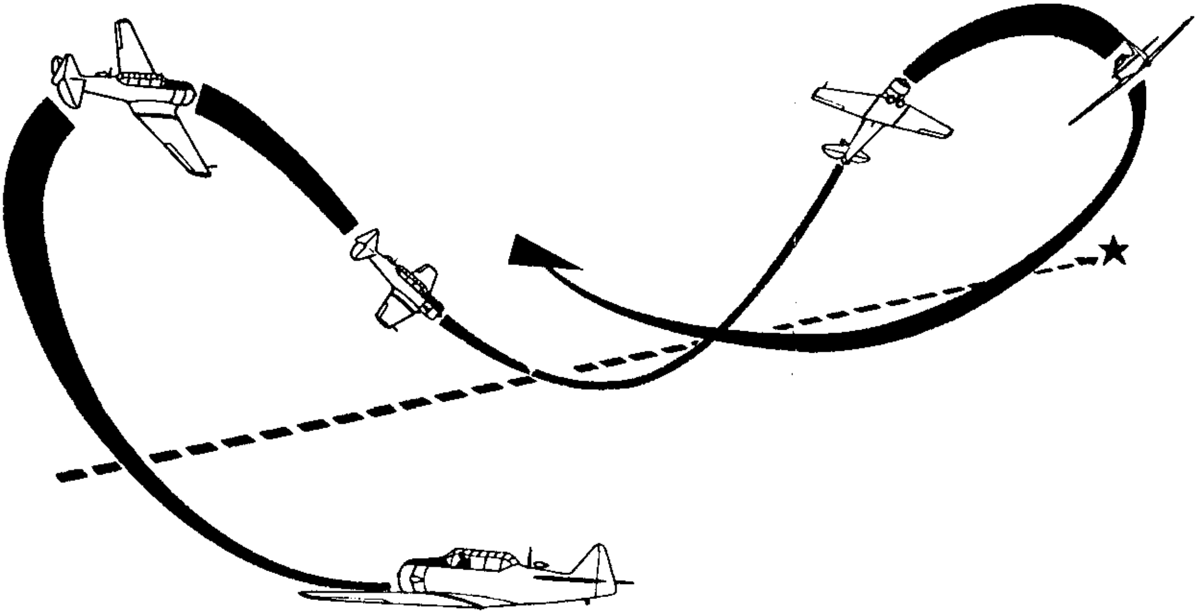


FIGURE 24. *Lazy eights.*

FIGURE 25. *Instrument Group.*

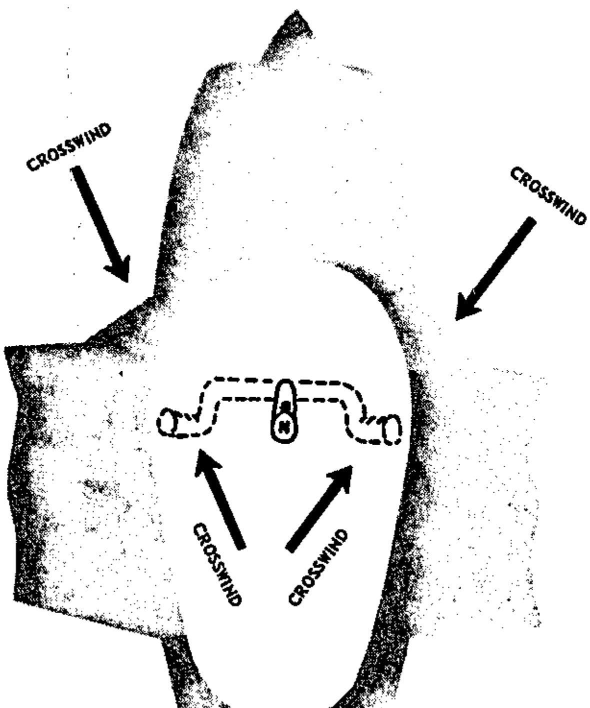


FIGURE 26. *Positioning of aileron controls while taxiing.*

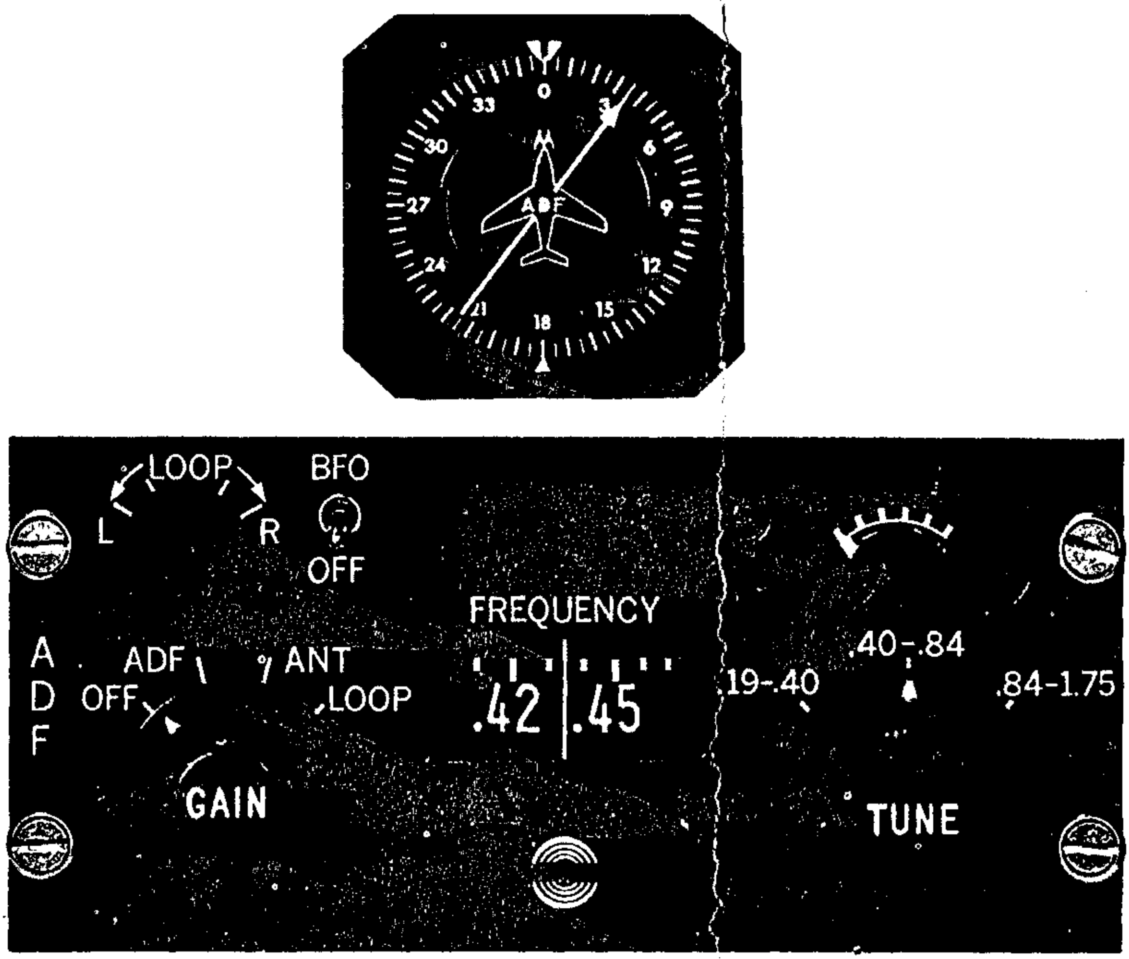


FIGURE 27. *Radiocompass (ADF)*

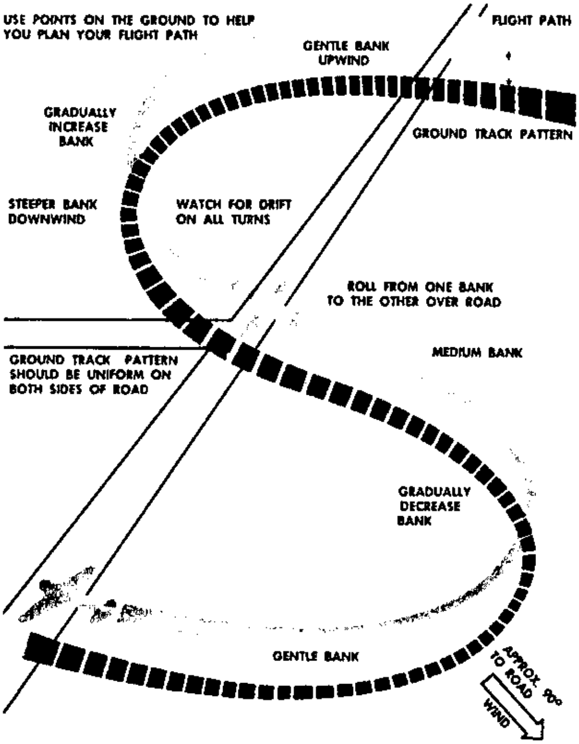


FIGURE 28. *S-turns across a road.*

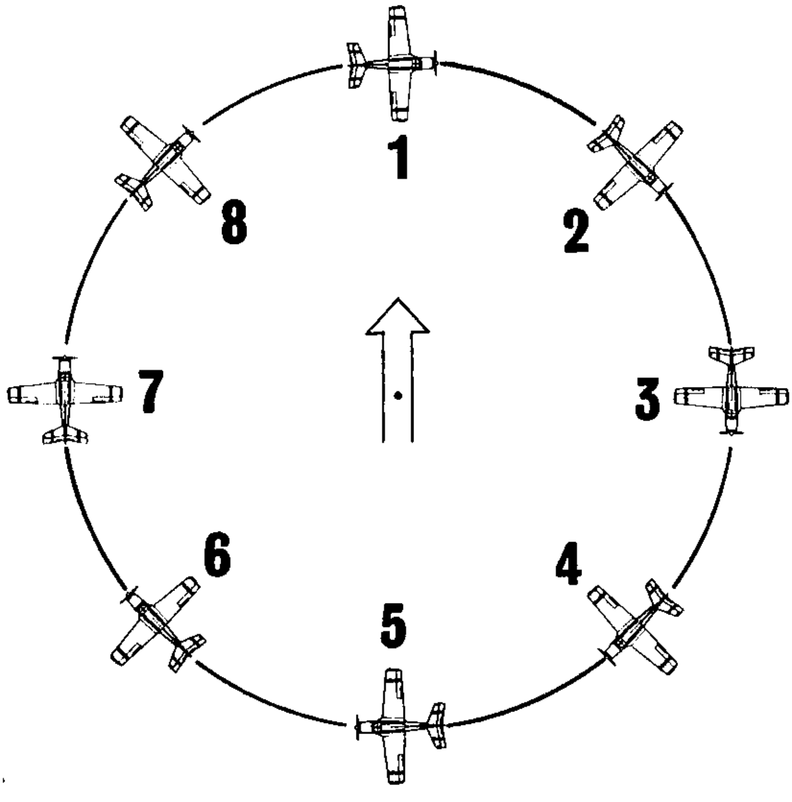


FIGURE 29. *Turns about a point.*

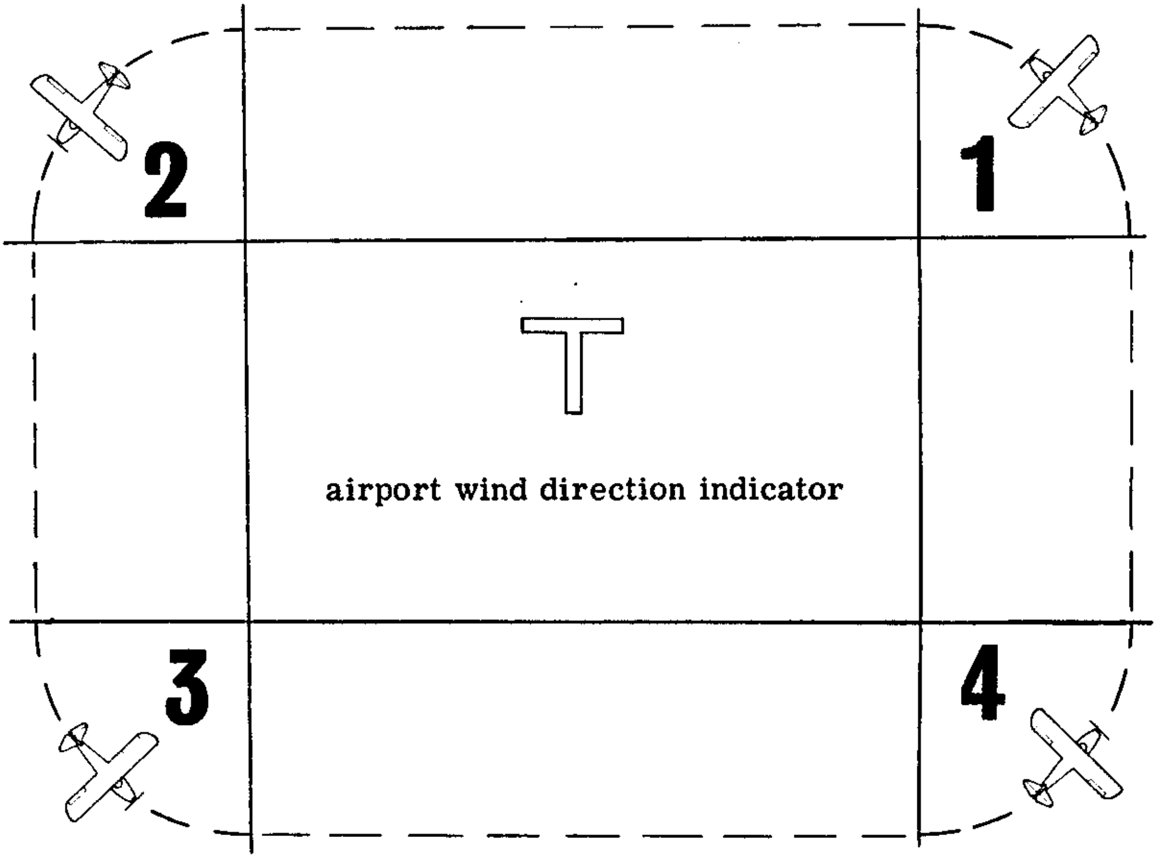
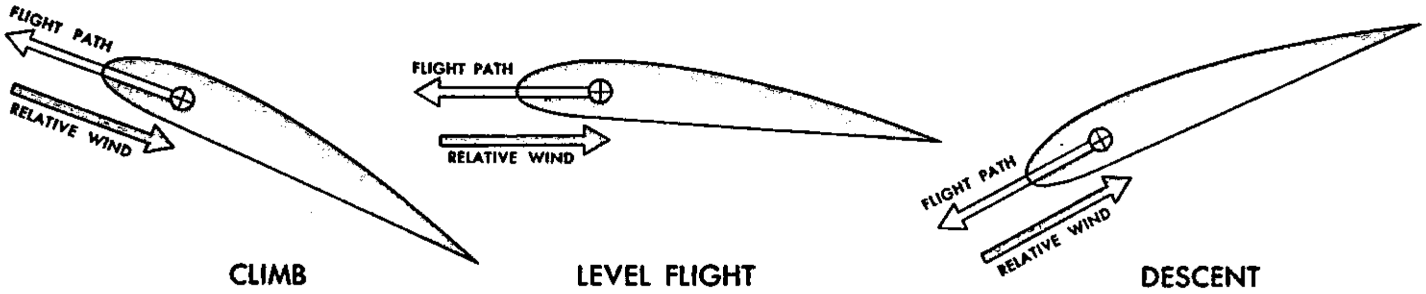
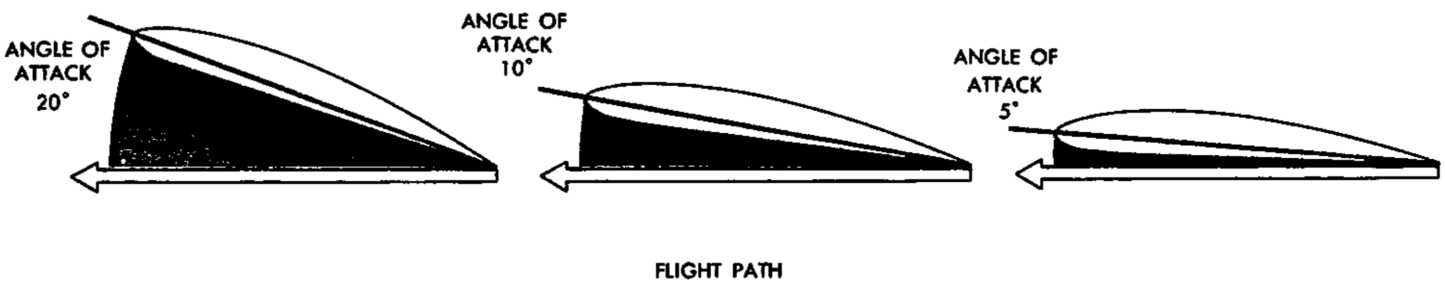


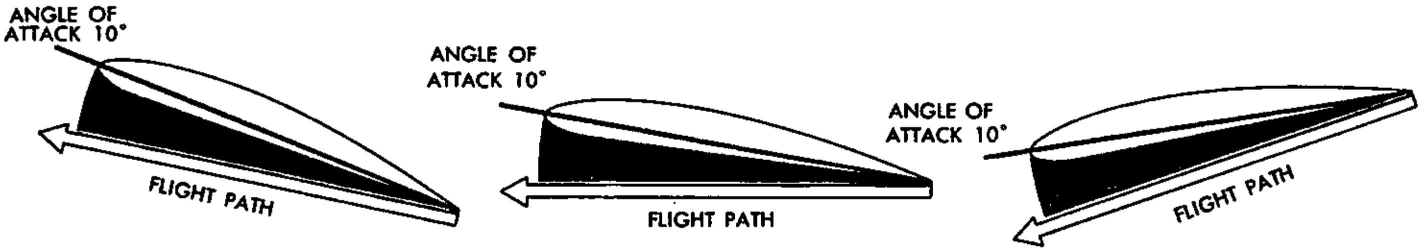
FIGURE 30. *Rectangular course.*



Relationship between flight path and relative wind.



The angle of attack is the angle between the chord and the flight path.



The angle of attack is always based on the flight path, not the ground.

FIGURE 31. *Angle of Attack.*

Federal Aviation Agency

Airman's INFORMATION MANUAL

AIRMAN'S INFORMATION MANUAL
Excerpt

SECTION IV A

AIRPORT/FACILITY DIRECTORY

FIGURE 32. Airman's Information Manual—*Airport/Facility Directory Excerpt.*

AIRPORT/FACILITY DIRECTORY LEGEND

AIM-Excerpt

LOCATION

The airport location is given in nautical miles (to the nearest mile) and direction from center of referenced city. This is followed by the bearing and distance from the principal NAVAID within 25 nautical miles of the airport. The distance is not specified if less than half mile from the field.

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, reciprocal headings, 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.

RUNWAY WEIGHT BEARING CAPACITY

Add 000 to figure following S, T, TT 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.

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

TT-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.

A blank space following the letter designation is used to indicate the runway weight bearing capacity to sustain aircraft with the same type landing gear, although definite figures are not available, e.g., (T-).

MAX-Maximum runway gross weight bearing capacity for all aircraft.

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.

SEAPLANE BASE FACILITIES

A number preceding the parenthetical designation, indicates the number (quantity) available.

Beaching gear, consisting of the quantity and type of beaching gear available.

The number (quantity) if available, of Mooring Buoys (MB) and Crash Boats (CB) available. MB & CB indicates details of quantity are not available.

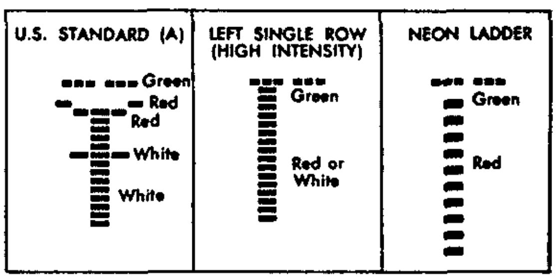
LIGHTING

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

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

L: Field Lighting (when code **L4–7** is indicated, lighting **4, 5, 6, 7** is available). An asterisk (*) preceding an element indicates that it operates on prior request only (by phone call, telegram or letter). Where the asterisk is not shown, the lights are in operation or available sunset to sunrise or by request (circling the field or radio call). **L** by itself indicates temporary lighting, such as flares, smudge pots, lanterns.

1—Strip lights or portable runway lights (electrical)
2—Boundary
3—Runway Floods
4—Low Intensity Runway
5—Medium Intensity Runway
6—High Intensity Runway
7—Instrument Approach (neon)
8A, B, or C—High Intensity Instrument Approach



9—Sequence Flashing Lights (3,000' out unless otherwise stated)
10—Visual Approach Slope Indicator (VASI)
11—Runway end identification lights (threshold strobe) (REIL)
12—Short approach light systems (SALS)

FIGURE 33. Airman's Information Manual—*Airport/Facility Directory Legend Excerpt.*

AIRPORT/FACILITY DIRECTORY

Lighting (Con't)

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

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

FUEL

F1	80 oct., at least.
F2	80/87 oct., or lower.
F3	91/96 oct., or lower.
F4	100/130 performance rating, or lower.
F5	115/145 performance rating, or lower.

TURBINE FUELS

TP-1	650 turbine fuels for civil jets.
JP-1	(Kerosene), JP-3, JP-4, JP-5.

OTHER

AOE—Airport of Entry.

VASI—Visual Approach Slope Indicator, applicable runway provided.

RVV—Runway visibility, applicable runway provided.

RVR—Runway Visual Range, applicable runway provided.

TPA—Traffic Pattern Altitude—This information is provided only at those airports without a 24-hour operating control tower or without an FSS providing Airport Advisory Service. Directions of turns are indicated only when turns of the pattern(s) are to the right (non-standard). TPA data is related to the runway listed under the tabulated airport information. Generally, only one altitude is listed; however, at some airports two altitudes have been established; one for conventional aircraft and one for high performance aircraft. They are shown in this manner, TPA 8/15-R (increments of 100 feet). The higher figure being the higher performance aircraft altitude.

FSS—The name of the controlling 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 Intephone 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)."

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 tfc 13–31**" indicates right turns should be made on landings and takeoffs on runways 13 and 31.

Limited—Intended for private use, but use by public is not prohibited.

Remarks data is 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.

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.)

When operating at an airport which is not tower controlled but at which a Flight Service Station (FSS) is located, two-way radio communication with the FSS is required when the aircraft has the necessary radio equipment. If the aircraft has receiver only, the pilot must maintain a listening watch on the appropriate frequency. These requirements are for the purpose of receiving Airport Advisory Service (AAS) and apply only when AAS is indicated on the current Sectional Chart and En Route Chart.

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 otherwise by a cross-out: 121.5

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

VOICE CALL

The voice call for contact with the traffic control services listed at each airport is the airport name followed by the call of the particular service desired, i.e., "LAGUARDIA TOWER." In these instances, only the name of the service is listed. When the voice call of the facility is not the same as the airport name, the complete voice call is listed.

FIGURE 34. Airman's Information Manual—*Airport/Facility Directory Legend Excerpt.*—Continued.

AIRPORT/FACILITY DIRECTORY

AIM-Excerpt

SERVICES AVAILABLE

(See ATC Operations and Procedures, Section II)

TOWER

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) Non-Radar.
Traffic Information Service (TFC INFO) Radar.
Surveillance Radar Approach (ASR).
Precision Radar Approach (PAR).
Ground Control (GND CON).
VHF Direction Finding (VHF/DF).

FLIGHT SERVICE STATION (FSS)

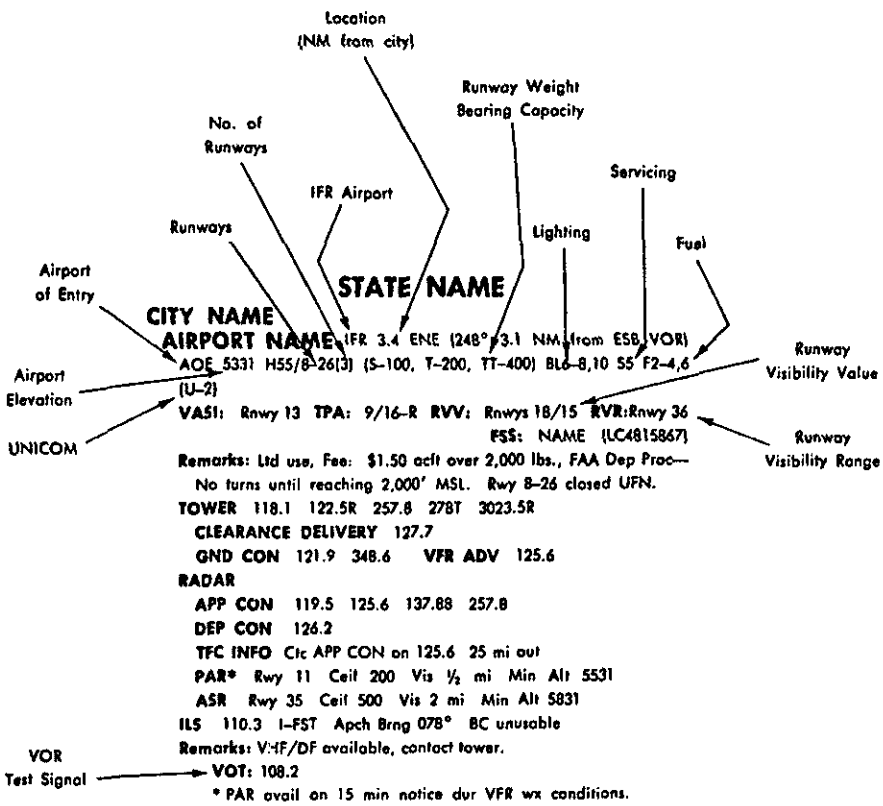
Airport Advisory Service (AAS).
Flight Following Service.
Island, Mountain and Lake Reporting Service.

UNICOM

Private aeronautical station, operates same hours as the airport, transmits and receives on one of the following frequencies:

U-1—122.8 mc (at airports without a control tower).
U-2—123.0 mc (at airports with a control tower). tower).

SAMPLE



ALL BEARINGS/RADIAL ARE MAGNETIC.
ALL TIMES ARE GMT EXCEPT AS NOTED

FIGURE 35. Airman's Information Manual—*Airport/Facility Directory Legend Excerpt.*—Continued.

AIRPORT/FACILITY DIRECTORY

REMARKS: Ctn-const rnwy 18-36 until oprx Apr 65, use for taxi only. Due non-vsby some areas of fld ctc twr for instr. Acft must park or tie down on ramp areas. Rnwy 5 apch rest by brush-glide angle 1 to 1.
TOWER 119.5 126.2 122.5R GND CON 121.9
APP CON 118.0 126.2 122.5R 110.1T
ILS 110.1 I-YNG Apch Brg 320°
VHF/DF available, contact tower.

OKLAHOMA

MUSKOGEE
DAVIS FLD *IFR* 6 S (MKO RBn on field)
610 H72/13-31 (2) (S-60, T-160, TT-) BL6, 8
FSS: TULSA (DL)
TOWER[1] 119.2 126.2
REMARKS: [1]1430-2230Z

OKLAHOMA CITY
WILEY POST *IFR* 7 NW (040° 8.1 NM from OKC VOR
1303 H54/17-35 (2) BL4 S5 F4, JP4 U2
FSS: OKLAHOMA CITY (DL)
REMARKS: Rgt tfc rnwys 12 and 19.
TOWER[1] 119.7 122.5R GND CON 121.7
RADAR SERVICES: (BCN)
OKLAHOMA CITY APP CON 119.3 134.1x 122.5R 120.5
OKLAHOMA CITY DEP CON 121.1
REMARKS: [1]Oper 1200-0400Z.

OKLAHOMA CITY
WILL ROGERS WORLD *IFR* 6 SW (097° 8.1 NM from OKC VOR)
1284 H98/17-35 (3) (S-120, T-160, TT) BL4, 6, 8 S5
F5, JP1, 4 U2 VASI: Rnwy 17 RVV: Rnwy 35
FSS: OKLAHOMA CITY on Fld
REMARKS: Rnwy 3-21 and txwy (C-1) W side rnwy 3 rest to 15000 lbs or less.
TOWER 118.3 126.2R 122.7R GND CON 121.9
RADAR SERVICES: (BCN)
OKLAHOMA CITY APP CON 119.3 134.1x 122.5R 120.5 OKLAHOMA CITY DEP CON 121.1
ASR Rnwy 17, 35 Ceiling 400 Vsby 1 mi Min Alt 1684
ILS 109.9 I-OKC Apch Brg 350°
REMARKS: IFF svc avbl.
VOT: 108.8

TULSA INTL *IFR* 5 NE (259° 4.3 NM from TUL VOR)
674 H100/17L-35R (5) (S-200, T-200, TT-400) BL4, 6, 8
S5 F5, JP1, 4 U2 VASI: Rwy 17L RVR: Rnwy 35R
FSS: TULSA on Fld
REMARKS: Rgt tfc rnwys 17 R, 21R. Rnwy 35L thsld displcd 510', 3690' aval for tkof.
TOWER 118.7 126.2 122.5R
CLRNC DEL 124.0 GND CON 121.9
RADAR SERVICES: (BCN)
APP CON 119.1 122.5R 110.3T DEP CON 120.7
TFC INFO Ctc APP CON on 119.1
ASR Rnwys 17L, 26[1], 35R Ceiling 400 Vsby 1 mi Min Alt 1074
ILS 109.7 I-DWE Apch Brg 174° 110.3 I-TUL Apch Brg 3 4° BC unusable
REMARKS: [1]500-1 required when apch is made until psn is estab over 910 stack 3 mi E. IFF/SIF svc avbl.

OREGON

EUGENE
MAHLON-SWEET FLD *IFR* 7 NW (EUG VOR on field)
365 H55/16-34 (2) (S-80, T-120, TT-190) BL4, 6, 8 S5
F4, JP1 U2 RVV: Rnwy 16 FSS: EUGENE on Fld
REMARKS: CTN-birds vic arpt. Rnwy lgts on req thru FSS.
EUGENE TOWER 118.9 122.5R
EUGENE GND CON 121.9
ILS 109.5 I-EUG Apch Brg 159°

KLAMATH FALLS
KINGSLEY FLD *IFR* 4 SE (LMT VOR on Fld)
4092 H103/14-32 (3) (S-75, T-100, TT) BL4, 6, 8 S5
F4, JP1 U2 FSS: KLAMATH FALLS on Fld
REMARKS: Due non-vsby some areas of fld ctc twr for instr. Hvy jet tfc rnwy 14-32.
TOWER 118.5 126.2 122.5R 269T
GND CON 121.9
KLAMATH APP CON 118.5 126.2 122.5R 115.9T 242T
ILS 109.5 I-LMT
REMARKS: IFF/SIF

AIM-Excerpt

MEDFORD MUNI *IFR* 2 N (.3 NM from MFR VOR)
1330 H54/14-32 (2) (S-65, T-90, TT-150) BL4, 6, 8 S5
F4, JP4, 5 U2 RVV: Rnwy 14 FSS: MEDFORD on Fld
TOWER 118.3 126.2 122.5R 119.8 278T
GND CON 121.9
APP CON 118.3 126.2 122.5R 278T 263T
ILS 110.3 I-MFR Apch Brg 139°
VHF/DF available, contact tower.

PENDLETON MUNI *IFR* 2 NW (071° 3.6 NM from PDT VOR)
1493 H63/7L-25R (4) (S-75, T-100, TT-) BL4, 6, 8 S5
F4 U2 RVV: Rnwy 25 FSS: PENDLETON on Fld
REMARKS: Rnwy 25L threshold displaced 821' W. 2029 ft avbl lndg rnwy 25L, 7R-25L daylite operns only lgt planes.
TOWER 118.7 122.5R 3023.5Rx 278T
GND CON 121.9
APP CON 118.7 114.7T 3023.5Rx 341T
ILS 110.3 I-PDT Apch Brg 250°

PORTLAND INTL *IFR* 4 NE (159° 9.2 NM from PDX VOR)
23 H88/10R-28L (3) (S-200, T-200, TT-400) BL4, 6, 8A, 10
S5 F5, JP4 U2 RVV: Rnwy 28R RVR: Rnwy 10R
FSS: PORTLAND on Fld
REMARKS: Ctn-birds vic arpt. Jet barrier rnwy 10R emgcy use only.
TOWER 118.7 126.2 122.7R CLRNC DEL 119.0
GND CON 121.9
RADAR SERVICES: (BCN)
APP CON 118.1[2] 126.2 122.5R 119.8[3] 109.9T
DEP CON 124.9
TFC INFO Ctc APP CON
PAR Rnwy 10R Ceiling 200 Vsby ½ mi Min Alt 223
ASR Rnwys 10R[1], 28R Ceiling 700 Vsby 1 mi Min Alt 723
ILS 109.9 I-PDX Apch Brg 098° BC restd 111.3 I-IAP Apch Brg 278°
VHF/DF available, contact tower.
REMARKS: [1]Min alt over 3-mi radar fix inbnd on final, 900. [2]North [3]South
VOT: 111.0

FIGURE 36. Airman's Information Manual—*Airport/Facility Directory Excerpt.*

VFR EXAM-O-GRAM NO. 1

CONTROL ZONE VFR WEATHER MINIMUMS

Situation

A pilot plans a VFR cross-country flight with his destination airport located in a control zone. The terminal forecast indicates that the ceiling and visibility will be decreasing but remain above VFR minimums until his estimated time of arrival. Upon arrival, he enters the control zone, contacts the tower, and indicates that he desires to land. He is cleared to land by the tower.

We shall assume that one or more of the following conditions actually existed at the time he entered the control zone:

(1) Flight or ground visibility was less than 3 miles but not less than 1 mile; and

(2) Ceiling was *less than* 1,000 feet.

Analysis

1. WAS THE PILOT LEGAL? NO! The fact that the control tower operator cleared him to land *does not mean* that he is legal. The tower controller is concerned with the safe, orderly and expeditious movement of air traffic. He will refuse landing only on the basis of other traffic.

2. WHY WAS THE PILOT NOT LEGAL? FAR Part 91.105, states in part, that no person may operate an aircraft under VFR within a control zone, beneath the ceiling when the ceiling is less than 1,000 feet. No person may operate an aircraft under VFR within a control zone unless flight visibility is at least 3 statute miles (at least 5 statute miles in a continental control area).

3. WHAT ACTION SHOULD THE PILOT HAVE TAKEN TO BE LEGAL? He should have remained clear of the control zone, called the control tower, and requested an air traffic control clearance to land. He should remember that such a clearance does not constitute authority for him to deviate from the *minimum safe altitudes* as given in FAR, Part 91.79.

4. WHAT ACTION IS DICTATED BY GOOD OPERATING PRACTICES? He should have used reasonable restraint in exercising the prerogative of VFR flight, especially in terminal areas. The weather minimums and distances from clouds are *minimums*. Giving oneself a greater margin in specific instances is just *good judgment*. Conducting a VFR operation in a control zone at weather minimums is not prohibited, but good judgment would dictate that pilots flying VFR keep out of the approach area.

VFR EXAM-O-GRAM NO. 3

AN INVISIBLE HAZARD TO LIGHT AIRCRAFT

The Civil Aeronautics Board listed the probable cause of a recent fatal light aircraft accident as structural failure of a light aircraft resulting from excessive airloads created by *wingtip* fortices behind a large aircraft. The report also states: "The dangers of wake or vortex turbulence are still unknown to many pilots."

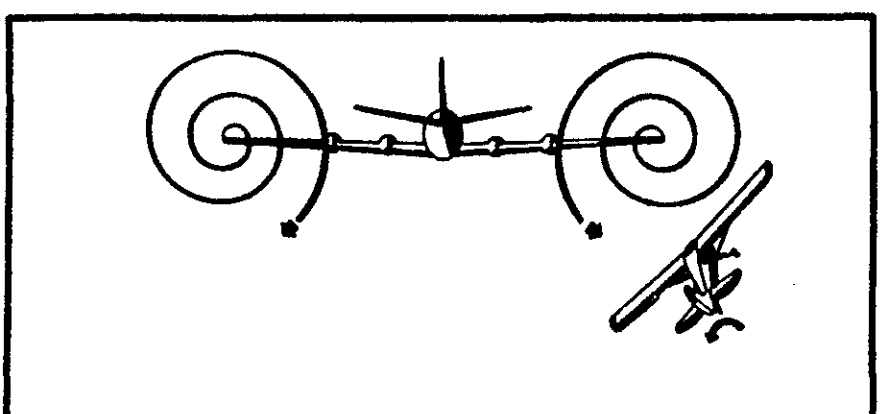
Discussion of Wingtip Vortices

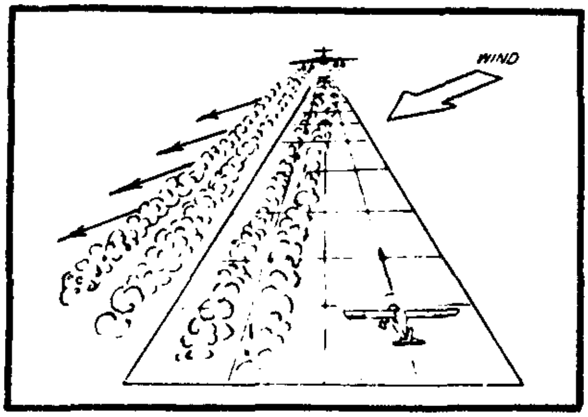
1. WHAT ARE WINGTIP VORTICES? It is unfortunate that vortices are invisible. If you could see them, they would look like a pair of horizontal tornadoes stretching back from each wingtip. These violent, compact, and fast-spinning air masses extend behind an aircraft for miles. Many pilots refer to this phenomenon as "propwash" or "jetwash," but engineering studies have revealed this term a misnomer. The main source of this disturbance is not from the powerplant; it is from the wingtip.

2. WHY ARE THEY DANGEROUS? They are dangerous because all tests to date indicate that *structural failure in the air* can occur in light aircraft upon penetration of the vortices behind larger transport aircraft. During takeoff or landing, care should be taken to *avoid vortex disturbance.* Loss of control could be the result at a critical time when control is of prime importance to safety.

3. UNDER WHAT CONDITIONS ARE THEY MOST DANGEROUS? There are many factors affecting the intensity of a wingtip vortex, but it is a safe and practical generalization that *the bigger the airplane the more violent and long-lived* will be the vortex disturbance. The source of this insidious danger can be out of sight by the time you encounter the wake. For example, when a large jet aircraft climbs at approximately 420 mph, the peak turbulence is *3½ miles* behind, and a relatively high degree of turbulence will exist for *7 miles.* The most severe turbulence, however, is left by a large aircraft when it is flying at slow operational speed—immediately after takeoff or just before landing.

4. WHAT ACTION CAN THE PILOT TAKE TO AVOID OR REDUCE THIS HAZARD?





a. Avoid passing behind any large aircraft.

b. Avoid, when possible, places and altitudes frequented by large aircraft. Constantly monitor your radio for location of such aircraft.

c. When it is necessary to operate behind a large, heavy aircraft, remain *above* the flight path of that aircraft. Vortices settle downward toward the surface. They are also affected by the wind and move with the encompassing air mass.

d. When taking off or landing behind large aircraft, be on the alert for the first sign of turbulence; allow adequate spacing, maintain higher than normal speeds, use the windward (upwind) side of the runway, and maintain a flight path to the windward side of the preceding aircraft.

5. RECOMMENDED READING FOR ALL PILOTS. Your attention is invited to the Safety of Flight Section of the *Airman's Information Manual* which thoroughly and completely explains "Wake Turbulence." This article has been reprinted in FAA Advisory Circular AC 90–23 (which may be obtained free of charge from: Office of Headquarters Operations, HQ–438, Federal Aviation Agency, Washington, D. C. 20553). We recommend that *all pilots read, study,* and *think* through the contents of this "Wake Turbulence" article.

VFR EXAM-O-GRAPH NO. 8

AIRSPEED INDICATOR MARKINGS

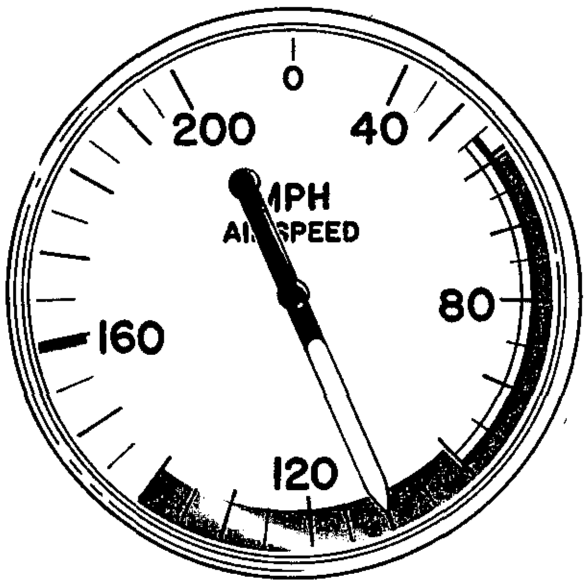


FIGURE 37. *Airspeed indicator with color-coded markings.*

The above airspeed indicator depicts the airspeed limitation markings of a late model civilian airplane. *How many* of the airspeed questions below can you answer by studying the airspeed indicator pictured above?

1. *WHAT IS THE FLAP OPERATING RANGE?*
2. *WHAT IS THE POWER-OFF STALLING SPEED WITH THE WING FLAPS AND LANDING GEAR IN THE LANDING POSITION?*
3. *WHAT IS THE MAXIMUM FLAPS EXTENDED SPEED?*
4. *WHAT IS THE NORMAL OPERATING RANGE?*
5. *WHAT IS THE POWER-OFF STALLING SPEED "CLEAN"—* (GEAR AND FLAPS RETRACTED)?
6. *WHAT IS THE MAXIMUM STRUCTURAL CRUISING SPEED?*
7. *WHAT IS THE CAUTION RANGE?*
8. *WHAT IS THE "NEVER EXCEED" SPEED?*

Airplanes manufactured after 1945 and certificated under the provisions of FAR Part 23 (12,500 lbs. or less) are required to have the standard system of airspeed indicator markings described in this Exam-O-Gram. In the interest of safety, it is important for you as a pilot to recognize and understand these airspeed limitation markings. And too, this information will come in handy if you are planning to take a written examination for a pilot's certificate; current FAA written examinations contain questions on this subject. A short explanation of the airspeeds and airspeed ranges you need to know follows. The descriptions, through choice, are limited to simple layman language. (For the more technical engineering nomenclature, refer to FAR Part 23.)

Answers to Questions on Airspeeds

Starting with the *lower speeds and working up*, we have

	Airspeed (See illustration)
1. *FLAP OPERATING RANGE* (the white arc).	55 to 100 mph
2. *POWER-OFF STALLING SPEED WITH THE WING FLAPS AND LANDING GEAR IN THE LANDING POSITION* (the lower limit of the white arc).	55 mph
3. *MAXIMUM FLAPS EXTENDED SPEED* (the upper limit of the white arc). This is the highest airspeed at	100 mph

which you can put down full flaps. If flaps are operated at higher speeds, severe strain or structural failure may result.

4. *THE NORMAL OPERATING RANGE* (the green arc).	59 to 140 mph
5. *POWER-OFF STALLING SPEED "CLEAN"—WING FLAPS AND LANDING GEAR RETRACTED* (the lower limit of the green arc).	59 mph
6. *MAXIMUM STRUCTURAL CRUISING SPEED* (the upper limit of the green arc). This is the maximum speed for normal operation.	140 mph
7. *CAUTION RANGE* (the yellow arc). You should avoid this area unless you are in smooth air.	140 to 160 mph
8. *"NEVER EXCEED" SPEED* (the radial red line). This is the maximum speed at which the airplane can be operated in smooth air. No pilot should ever exceed this speed intentionally.	160 mph

There are other airspeed limitations *not marked on the airspeed indicator* which you should know. They are generally found on placards in view of the pilot or in the Airplane Flight Manual. One of these speeds, a very important one, is the *MANEUVERING SPEED*. This is your "rough air" speed and the maximum speed for abrupt maneuvers. If during flight you should encounter severe turbulence, you should reduce your airspeed to maneuvering speed or less in order to reduce the stress upon the airplane structure.

KNOW YOUR AIRSPEED LIMITATIONS. THIS KNOWLEDGE MAY SAVE YOUR LIFE.

VFR EXAM-O-GRAM NO. 9

ALTIMETRY

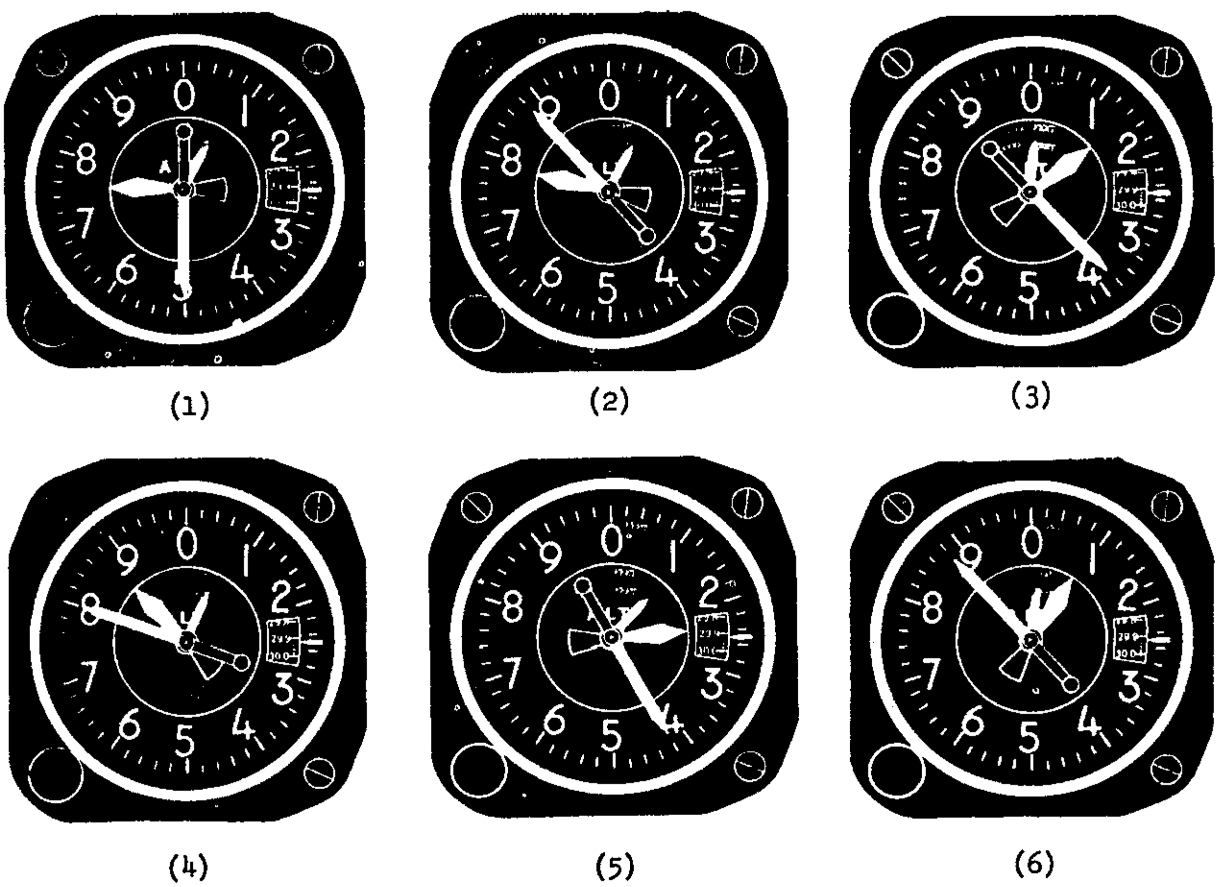


FIGURE 38. *Altimeter readings.*

Your altimeter is a vitally important instrument. You will agree that flight without this instrument would indeed be a haphazard undertaking—yet, *HOW WELL DO YOU KNOW YOUR ALTIMETER?* Take this short quiz on altimetry; grade yourself by checking the answers and explanations that follow.

1. Check your ability to quickly interpret your altitude by jotting down the readings of the 6 altimeters in Figure 38. *Allow yourself 1 minute.*

2. FAR require that you maintain your cruising altitudes (VFR as well as IFR) by reference to your altimeter. What do regulations require concerning the setting (or adjustment) of your altimeter?

3. If you are flying in very cold air (colder than standard temperatures), you should expect your altimeter to read:

a) *higher* than your actual altitude above sea level.
b) *lower* than your actual altitude above sea level.
c) *the same* as your actual altitude above sea level.

4. Here are 4 altitudes with which you should be familiar. Briefly give the meaning of each.
(1) *Indicated altitude.* (2) *Pressure altitude.* (3) *Density altitude.* (4) *True altitude.*

5. *Assume* that your proposed route crosses mountains with peaks extending to 10,900 feet above sea level. Prior to crossing this range, you adjust the altimeter setting window of your altimeter to the *current altimeter setting* reported by a Flight Service Station located in a valley near the base of this mountain range. If you maintain an indicated altitude of 11,500 feet by your altimeter, *can you be assured of at least 500 feet vertical clearance of these mountain peaks?*

ANSWERS TO QUESTIONS ON ALTIMETRY

1. 1) 7,500 ft. 2) 7,880 ft. 3) 1,380 ft. 4) 8,800 ft. 5) 12,420 ft. 6) 880 ft.

If your altimeter is the three-pointer-type sensitive altimeter such as those pictured on the opposite side of this sheet, an orderly approach to reading your altitude is to first glance at the smallest hand (10,000 ft. hand); next read the middle hand (1,000 ft. hand); and last, read the large hand (100 ft. hand). For the two-pointer altimeter, simply read the small hand first and the large hand next.

2. Your altimeter should be set to the *current reported altimeter setting* of a station along the route of flight (Flight Service Stations, Control Towers, etc.). If your aircraft is not equipped with a radio, you should obtain an altimeter setting prior to departure if one is available, or *you should adjust your altimeter to the elevation of the airport of departure.*

3. If you are flying in cold air, you should expect your altimeter to indicate HIGHER than you actually are. There is an old saying —one well worth remembering—that goes something like this: "WHEN FLYING FROM A HIGH TO A LOW OR HOT TO COLD, *LOOK OUT BELOW!*" In other words, if you are flying from a high pressure area to a low pressure area or into colder air, you had better be careful because you probably aren't as high as you think—assuming, of course, that no compensations are made for these atmospheric conditions.

4. (1) *Indicated altitude*—That altitude read directly from the altimeter (uncorrected).
(2) *Pressure altitude*—The altitude read from the altimeter when the altimeter setting window is adjusted to 29.92. (This altitude is used for computer solutions for density altitude, true altitude, true airspeed, etc.).
(3) *Density altitude*—This altitude is pressure altitude corrected for nonstandard temperature variations. (It is an important altitude as *this altitude is directly related to the aircraft's takeoff and climb performance.*)
(4) *True altitude*—The true height of the aircraft above sea level—the actual altitude. (Often you will see a true altitude expressed in this manner: "10,900 ft. MSL"—the MSL standing for MEAN SEA LEVEL. Remember that airport, terrain, and obstacle elevations found on charts and maps are *true altitudes.*)

5. No, you are not assured of 500 feet vertical clearance with these mountains. As a matter of fact, with certain atmospheric conditions, you might very well be 500 feet *BELOW* the peaks with this indicated altitude. (To begin with, 500 feet is hardly an adequate separation margin to allow on flights over mountainous terrain—1,500 to 2,000 feet is recommended in order to allow for possible altitude errors and downdrafts.)

A majority of pilots confidently expect that the current altimeter setting will compensate for irregularities in atmospheric pressure. Unfortunately, this is not always true. Remember that the altimeter setting broadcast by ground stations is the *station pressure corrected to Mean Sea Level.* It does not reflect distortion at higher levels, *particularly the effect of nonstandard temperature.*

When flying over mountainous country, allow yourself a generous margin for terrain and obstacle clearances.

KNOW YOUR ALTIMETER

VFR EXAM-O-GRAM NO. 10

FUEL CONTAMINATION

EXCERPTS FROM A RECENT AIRCRAFT ACCIDENT REPORT: ". . . Subsequent examination of the engine and its components revealed large deposits of foreign material, sediment, and water in the fuel strainer, carburetor bowl, and fuel pump in sufficient quantities to cause stoppage. . . . Probable cause of accident: Inadequate preflight action by the pilot; subsequent *engine failure due to fuel contamination. . . .*"

DO YOU KNOW—AND PRACTICE—THE PRECAUTIONS YOU SHOULD TAKE TO AVOID FUEL CONTAMINATION? Perhaps you do, but there are many pilots who obviously do not—*as evidenced by the alarming increase in the number of accidents caused by fuel contamination.* The modern aircraft engine is a remarkably reliable and dependable mechanism, but it will not run on water, dirt particles, and other noncombustibles. Let's review this insidious problem by asking—and answering—a couple of rather pointed questions about this subject.

1. *WHAT CAUSES FUEL CONTAMINATION?*

   A. *Storing the aircraft with partially filled fuel tanks may cause condensation and water contamination.* You have, no doubt, often noticed moisture (or dew) on the outside of your aircraft early in the morning. When you noticed this, did it occur to you that this same moisture could form on the inside walls of your fuel tanks? Water is the worst offender in these contamination cases, and condensation inside the tank is one of the methods by which it finds its way into your fuel system.

   B. *Servicing the aircraft from improperly filtered tanks, particularly small tanks or drums, is another principal source of fuel contamination.* This practice frequently introduces both dirt and water into the aircraft fuel system.

2. *WHAT PRECAUTIONS SHOULD THE PILOT TAKE TO AVOID FUEL CONTAMINATION?*

   A. PRELIGHT ACTION: Drain a generous sample of fuel (several ounces—not just a trickle or two) into a transparent container from each of the fuel sumps. (Notice that we specified each of the fuel sumps. This includes not only the main gascolator, but also the wing tank sumps.) Examine the sample of fuel from each sump for water and dirt contamination. Water *will not mix* with gasoline. If present, it will collect at the bottom of the transparent container and will be easily detected. If water or dirt appears, continue to drain fuel from that sump until you are sure the system is clear of all water and dirt. (NOTE: If your aircraft is not equipped with wing tank quick-drain petcocks, it is recommended they be installed. This can make the preflight check of the wing tank sumps much more convenient, as the frequent removal and replacement of wing tank sump drain plugs can be a time-consuming operation.)

B. POSTFLIGHT ACTION: (1) *Top off your tanks at the end of the day to avoid condensation and water contamination inside your fuel tanks.* Although this is a desirable procedure to follow at the end of each flying day (assuming your loading schedule for the next day will permit a full load of fuel), it is particularly important that this is done if the aircraft is to stand idle for several days—whether it is tied down out-of-doors or stored in a hangar. (2) Avoid, if possible, servicing your aircraft from small tanks or drums. *Should this become necessary, the fuel should always be strained through a chamois skin that is in good condition.*

C. PRECAUTIONARY MAINTENANCE ACTION: In addition to the previously discussed precautions, the following maintenance precautions should be performed on your aircraft at periodic intervals:
(1) Inspect and clean the tank fuel outlet finger strainer.
(2) Inspect and clean the inlet carburetor screen.
(3) Flush the carburetor bowl.

BY FOLLOWING ALL OF THESE PRECAUTIONS, YOU CAN GREATLY REDUCE THE HAZARD OF ENGINE FAILURE DUE TO FUEL CONTAMINATION.

To better understand the reasons for the PREFLIGHT ACTION we have recommended, let's take a brief look at an actual water contamination test recently conducted by FAA—it's a real eye opener!

After all water was removed from the fuel system of a popular make high-wing monoplane, three gallons of water were added to the half-full fuel tank. After a few minutes, the fuel strainer (gascolator) was checked for water. *It was necessary to drain 10 liquid ounces of fuel before any water appeared.* This is considerably more than most pilots drain when checking for water.

In a second test with the same aircraft in flying attitude (to simulate a later tricycle geared model), the fuel system was again cleared of all water; then one gallon of water was added to the half-full tank. Upon checking the fuel strainer (gascolator) quick drain, *more than a quart of fuel was drained before any water appeared.*

In both of the above-described tests, about nine ounces of water remained in the fuel tank after the belly drain and the fuel strainer (gascolator) had ceased to show any trace of water. *This residual water could be removed only by draining the tank sumps.*

Two significant findings emerged from the above tests and from tests made on a plastic mockup of a similar fuel system:

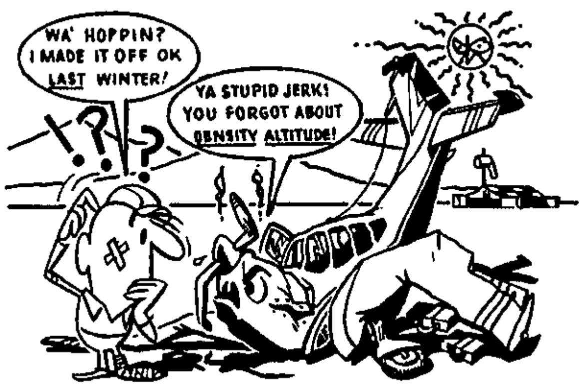
1—When water was introduced into the fuel tank, it immediately settled to the bottom, but did not flow down the fuel lines to the fuel strainer until all fuel was drained from the lines. Remember the fuel tank must be turned ON to drain the tank lines through the gascolator.

2—Since it was found impossible to drain all water from the tank through the fuel lines, it was necessary to drain the fuel tank sumps in order to remove all water from the system.

VFR EXAM-O-GRAM NO. 11

DENSITY ALTITUDE AND ITS EFFECT ON AIRCRAFT PERFORMANCE

A report of a recent accident was stated in the following words: "Takeoff was attempted on a 1,600-foot strip; the airplane cleared the fences but sank back and struck a ditch." The pilot states that he failed to consider the effect of the grassy, rough field, the *90° temperature,* heavy load of fuel and passengers, and the calm wind.



This EXAM-O-GRAM discusses the effect that high temperature and other factors had on this takeoff.

1. *WHAT IS DENSITY ALTITUDE?* It is a measure of air density. Under non-standard conditions, density altitude will differ from the elevation. As the air density decreases (i.e., air becomes thinner), density altitude increases, and vice versa. *Low atmospheric pressure, high temperature,* and *high humidity* all result in a decrease in air density and an *increase in density altitude.* (Contrary to prevailing opinion, *moist air is less dense than dry air.* Water vapor actually weighs less than dry air—approximately 5/8 as much).

2. *WHAT EFFECT DOES AN INCREASE IN DENSITY ALTITUDE HAVE ON AIRCRAFT TAKEOFF PERFORMANCE?*
   A. Engine horsepower decreases (unless it is a supercharged engine).
   B. The propeller loses some of its efficiency as it will not take as much of a bite out of the thinner air.
   C. Takeoff distance is increased and rate of climb is decreased because of the loss of engine power and propeller efficiency, and the higher true airspeed necessary to obtain the required lift in the thinner air. (In other words, if the density altitude is 8,000 feet at an elevation of 5,000 feet, the aircraft flies as though it were at 8,000 feet.)

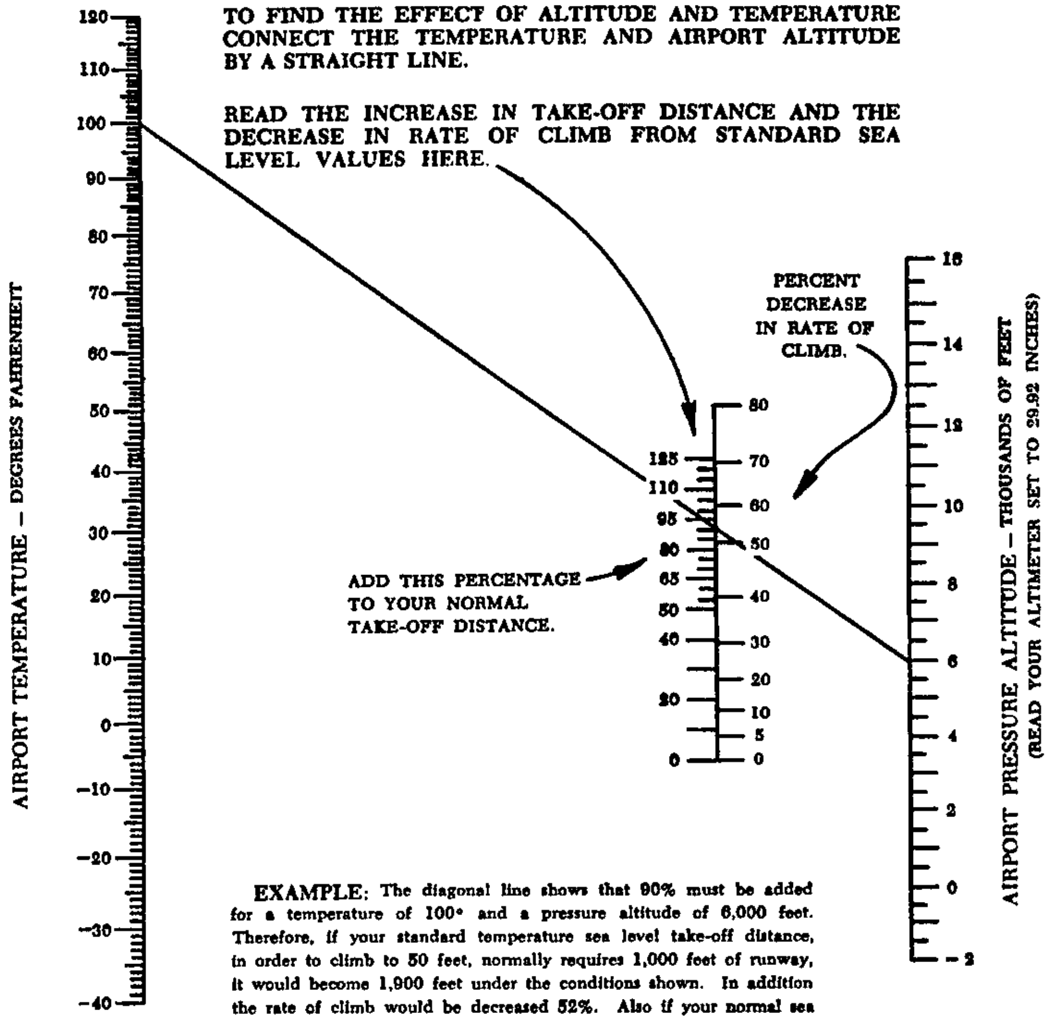
3. *UNDER WHAT CONDITIONS IS A HIGH "DENSITY ALTITUDE" MOST HAZARDOUS?* When it is present with other factors that tend to increase the takeoff distance or require that this distance be limited such as: heavy load; calm wind conditions; short runway; obstructions at or near the end of the runway; and unfavorable runway conditions (rough, tall grass, soft, snow, upgrade, etc.).

4. *HOW MUCH CAN THE DENSITY ALTITUDE VARY AT A GIVEN AIRPORT DURING SEASONAL*

THE KOCH CHART FOR ALTITUDE AND TEMPERATURE EFFECTS

TO FIND THE EFFECT OF ALTITUDE AND TEMPERATURE CONNECT THE TEMPERATURE AND AIRPORT ALTITUDE BY A STRAIGHT LINE.

READ THE INCREASE IN TAKE-OFF DISTANCE AND THE DECREASE IN RATE OF CLIMB FROM STANDARD SEA LEVEL VALUES HERE.



EXAMPLE: The diagonal line shows that 90% must be added for a temperature of 100° and a pressure altitude of 6,000 feet. Therefore, if your standard temperature sea level take-off distance, in order to climb to 50 feet, normally requires 1,000 feet of runway, it would become 1,900 feet under the conditions shown. In addition the rate of climb would be decreased 52%. Also if your normal sea level rate of climb is 500 feet per minute it would become 240 feet per minute.

This chart indicates typical representative values for "personal" airplanes.

For exact values consult your airplane flight manual. The chart may be conservative for airplanes with supercharged engines.

Also remember that long grass, sand, mud or deep snow can easily double your take-off distance.

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EXTREMES? This depends mostly on the extremes in temperature variation. From a density altitude chart, it can be determined that, at an elevation of 5,000 feet, temperature -6°F, the density altitude would be approximately 2,200 feet; at a temperature of 104°F, the density altitude would be approximately 8,900 feet. These figures do not include the increase due to a high relative humidity on the 104° day. *Do not let the performance of your airplane on a cold winter day lull you into a sense of security when taking off on a hot, humid summer day.* (Note the pilot's remarks in the cartoon.)

5. If an airplane requires a distance of 1,200 feet for takeoff at sea level (to clear a 50-foot obstacle) under standard conditions, what distance is required at (a) an elevation of 5,000 feet, temperature -6°F; (b) an elevation of 5,000 feet, temperature 104°F? Refer to the Koch Chart. (*Assume* that pressure altitude and elevation are equal.)

Problem A

The line joining 5,000 feet and -6°F shows an increase in takeoff distance of 15%.

Increase in
T.O. Distance=.15 × 1,200'=180'
Total T.O.
Distance =1,200'+180'=1,380'

Problem B

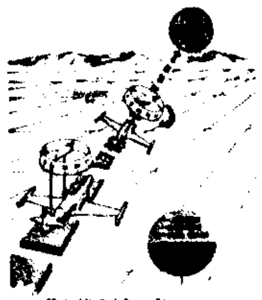
The line joining 5,000 feet and 104°F shows an increase in takeoff distance of 80%.

Increased in
T.O. Distance=.80 × 1,200'=960'
Total T.O.
Distance =1,200'+960'=2,160'
Difference in Takeoff Distance = 2,160'—1,380' =2,040'

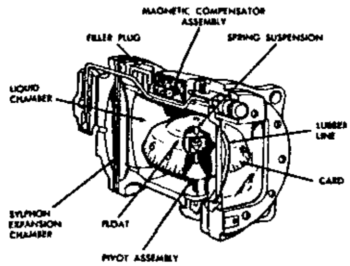
Under the above conditions presented in Item 5, Problems A and B, it can be seen that the takeoff distance on the hot summer day increased *almost 800 feet* over that required on the cold winter day at the same airport.

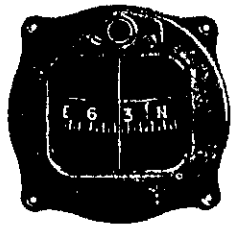
BEWARE OF HIGH, HOT, AND HUMID CONDITIONS

VFR EXAM-O-GRAM NO. 12

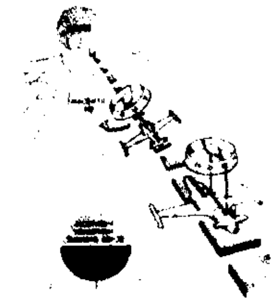


Effects of Northerly Turning Error





The Magnetic Compass



THE MAGNETIC COMPASS

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

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

The pilot should understand:

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

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

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

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

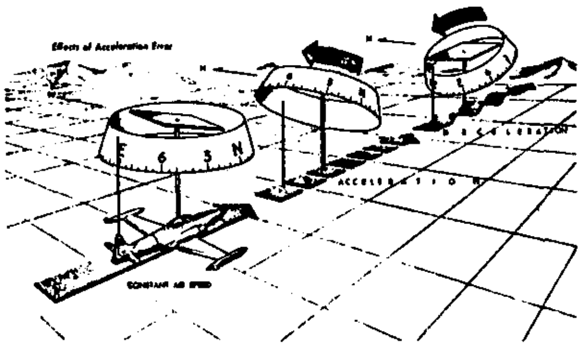
IV. MAGNETIC DIP—The tendency of the magnetic compass to point down as well as north in certain latitudes. This tendency is responsible for:

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

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

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

DEMONSTRATION NO. 1 (Heading—North; Error—Northerly Turn Error). As we start a turn in either direction from this heading, we notice that momentarily the compass *gives an indication of a turn opposite the direction of the actual turn.* (While the compass card is in a banked attitude, the vertical component of the earth's magnetic field causes the north-seeking end of the compass to dip to the low side of the turn, giving the pilot an erroneous turn indication). If we continue the turn toward east or west, the compass card will begin to indicate a turn in the correct direction, *but will lag behind the actual turn*—at a diminishing rate—until we are within a few degrees of east or west. One additional demonstration which we will cover before leaving north is the Slow Turn Error. If, while holding a compass indication of north, we sneak into a very gradual and shallow banked turn—say 3° or 4° of bank—it is possible to change the actual heading of the aircraft by 20° or more *while still maintaining an indication of north by the compass.*



DEMONSTRATION NO. 2 (Heading—East; Error-Acceleration Error). The Northerly Turn Error that we previously experienced is not apparent on this heading (or on a west heading). However, let's see what happens when we accelerate and decelerate by changing the airspeed. With the wings level, we will *increase* the airspeed by increasing the power setting or by lowering the nose—or both. Result—although we are holding the nose of the aircraft straight ahead, our compass card erroneously indicates a turn toward *north.* On the other hand, if we *decrease* the airspeed by reducing the power setting or raising the nose of the aircraft—or both, the compass will give an erroneous indication of a turn toward *south.* (Because of the pendulous-type mounting, the end of the compass card which the pilot sees is tilted upward while accelerating, and downward while decelerating during changes of airspeed. This momentary deflection of the compass card from the horizontal, results in an error that is most apparent on headings of east and west).

DEMONSTRATION NO. 3 (Heading—South; Error—Northerly Turn Error). Again we are presented with the Northerly Turn Error problem that we encountered in Demonstration No. 1. Although the same set of forces that caused the erroneous indication when we banked the aircraft while on a north heading will likewise be working against us on this heading, the compass indications will appear quite different. For example, as we roll into a turn in either direction, the compass gives us an indication of a turn in the *correct direction* but at a *much faster rate than is actually being turned.* As we continue our turn toward west or east, the compass indications will continue to precede the actual turn—but at a diminishing rate—until we are within a few degrees of west or east. (It might be noted that the Acceleration Error is not apparent on this heading or on a north heading.)

DEMONSTRATION NO. 4 (Heading—West; Error—Acceleration Error). On this heading we encounter the exact same errors that we have previously covered on a heading of east in Demonstration No. 2. If we *increase the airspeed,* we will get an erroneous indication of a *turn toward north.* If we *decrease the airspeed,* we will get an erroneous indication of a *turn toward north.* If we *decrease the airspeed,* we will get an erroneous indication of a *turn toward south.* (A memory aid that might assist you in recalling this relationship between airspeed change and direction of the error is the word "ANDS"—*A*ccelerate-*N*orth, *D*ecelerate-*S*outh.)

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

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

(NOTE: If your aircraft is equipped with a gyro-driven heading indicator, check it frequently with your magnetic compass.)

TURNS TO HEADINGS BY REFERENCE TO THE MAGNETIC COMPASS

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

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

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

an approximation based on the heading's proximity to north or south, the direction of the turn, and your knowledge of the compass's lead and lag characteristics in these areas. In other words, use an "educated guesstimate."

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

KNOW YOUR MAGNETIC COMPASS

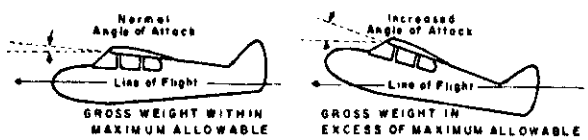
VFR EXAM-O-GRAM NO. 13

WEIGHT AND BALANCE

Loading the family automobile for a trip requires little serious planning. You can C-R-A-M as much luggage into the trunk as you have space, squeeze as many persons into the seats as you have room, and top off the gas tank with no thought given to Gross Weight or Center of Gravity. A similar approach to loading your "flying machine" could result in a serious accident.

WHAT IS EXCESSIVE WEIGHT? Assume that your airplane is a 4-place airplane with a baggage allowance of 120 pounds, a usable fuel capacity of 39 gallons, and an oil supply of 8 quarts. On a hypothetical flight you take on full fuel and oil servicing, toss the suitcases in the baggage compartment, and you and your three passengers eagerly climb aboard. This seems like a reasonable load, but if you had placed each of them on the scales you might have found that you and the passengers average 180 lbs. each (720 lbs.), and the four suitcases, 30 lbs. each (120 lbs.). The usable fuel load weighs 234 lbs. and the oil 15 lbs. Assume, also, that the Weight and Balance Data for the airplane shows an *empty weight* of 1325 lbs. and a maximum allowable gross weight of 2200 lbs. NOW, add the weight of the useful load to the empty weight and compare the total to the allowable gross weight. . . . (1089 lbs. +1325 lbs.=2414 lbs. . . . *214 lbs. excess!*

WHAT RESTRICTIONS ARE THERE ON WEIGHT AND BALANCE? In many civilian airplanes it is not possible to fill all seats, baggage compartment, and tanks, and still remain within the approved weight and balance limits. If you do not wish to leave a passenger behind (a normal reaction), you must reduce your fuel load and plan on shorter legs en route or cut down on the baggage carried, or both. Frequently, restrictions are placed on rear seat occupancy with maximum baggage allowance aboard. By all means, follow the Airplane Weight and Balance Form restrictions. The loading conditions and the empty weight of your particular airplane may differ from those shown in the Owner's Manual, especially if modifications have been made or equipment has been added to the basic airplane.

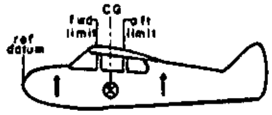


IS CRUISE PERFORMANCE AFFECTED BY AN EXCESS LOAD? At normal weight, the airplane requires a certain angle of attack to maintain straight-and-level flight at a given airspeed. To sustain a heavier load at that same airspeed, the angle of attack must be greater to provide the increased lift that is necessary. More power must be added to overcome the increased drag which results from the increased angle of attack. Additional power, in turn, burns more fuel, thereby reducing the range of the aircraft.

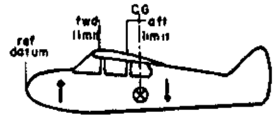
IS CLIMB PERFORMANCE AFFECTED BY AN EXCESS LOAD? Time to climb to a given altitude is lengthened, because extra thrust required to carry the additional weight limits the rate of climb and may limit the climbing speed, since this depends on the surplus power available. The additional time in climbing at the higher power setting also increases the fuel consumption.

IS "G" FORCE TOLERANCE AFFECTED? Assume that your airplane has a limit-load factor of 3.8 "G's". If the allowable gross weight is not exceeded, this means the wings can safely support 3.8 times the weight of the airplane and its contents. In accelerated flight (pull-ups, turns, turbulent air), the actual load on the wings would be much greater than the normal load, which of course results in much greater stresses in the wing structure. Overloading, therefore, has the effect of decreasing the "G" load capability of the aircraft and thus could result in the wing being stressed to the point of popped rivets, permanent distortion, or structural failure.

HOW IS AN AIRPLANE BALANCED? An airplane, like a steelyard scale, is in perfect balance when the weight is distributed in such a manner that it remains level when freely suspended. In an airplane, however, as long as the center of gravity lies anywhere within specified limits, balance can be maintained in flight. Flight with the CG outside of this range results in unsatisfactory or *dangerous flight characteristics.* Loading an airplane then, is simply a matter of distributing the load so that the CG falls within the allowable range. This can be accomplished by arranging the load in accordance with the Center of Gravity Envelope provided for each airplane.



WEIGHT PROPERLY DISTRIBUTED



EXCESS WEIGHT PLACED AFT

DOES IMPROPER LOADING AFFECT SAFETY? YES! When loading conditions cause the center of gravity to fall outside allowable limits, stability is adversely affected and erratic control forces may develop. Stalling speed, takeoff distance, and landing speed may be increased to the point of *actual danger.*

Due to the size of many baggage compartments there might be a tendency to fill them to capacity, ignoring the placarded baggage weight limitations. This could produce a center of gravity aft of allowable limits creating a highly dangerous flight condition. The result would be a nose high attitude which could lead to a stall from which recovery might not be effected due to inadequate elevator control.

AN AIRPLANE'S BEHAVIOR IN THE AIR IS DEPENDENT ON WEIGHT AND BALANCE!

VFR EXAM-O-GRAM NO. 17

COMMON MISCONCEPTIONS (Series #1)

The following are actual excerpts from a pilot's written report of an accident in which he was involved.

"I was climbing at an airspeed of 60 mph. I started a climbing turn to the right. The wind now became a cross wind instead of a head wind. This (lack of head wind) caused the airplane to stall—to recover from the stall I turned the airplane back into the wind . . . (Later) I was in a quartering tailwind from the right . . . Went into a second stall . . . This is all I remember."

This pilot had over 100 hours, yet stalled and crashed due to an apparent misuse of controls at a *slow airspeed* (*high angle of attack*). The inspector who took this pilot's statement decided to pursue this theory with a group of student pilots. He posed this question to them.

"If the aircraft's stalling speed was 60 mph and you were flying at an airspeed of 70 mph into a 30 mph wind, what would happen if you maintained this airspeed of 70 mph but turned *downwind?*"

Five of the six students said the airplane would stall.

IS THIS ANSWER CORRECT? *No.*

IS THE STALLING SPEED OF AN AIRPLANE A FUNCTION OF THE AIRSPEED OR THE GROUND SPEED? *The airspeed.*

DOES THE DIRECTION OF THE WIND HAVE ANY EFFECT ON THE AIRSPEED OF AN AIRCRAFT IN FLIGHT? *No.*

Now to summarize our point: Airspeed is the only speed which holds any significance for an airplane. Once it is off the ground, an airplane feels nothing but its own speed through the air. It makes absolutely no difference what its speed happens to be in relation to the ground. The aircraft in flight feels no wind. It simply proceeds, operating with the same mechanical efficiency, upwind, downwind, crosswind, or in no wind at all. (NOTE: We are referring here to a steady wind. Turbulence, gusts, or wind shears can lead to stalls even though airspeed is being maintained above the normal stalling speed. In such conditions it is wise to add a safe margin to normal climbout or approach speeds.)

Based on the performance of many applicants on the Private Pilot Written Examination, here are some of other common misconceptions.

IF IT IS NECESSARY TO CLEAR OBSTRUCTIONS IMMEDIATELY AFTER TAKEOFF, SHOULD YOU USE BEST ANGLE-OF-CLIMB SPEED OR BEST RATE-OF-CLIMB SPEED? *Best angle-of-climb speed.* Simply stated, the difference is this. The best angle-of-climb speed produces the greatest climb in a given distance; the best rate-of-climb speed produces the greatest climb in a given time. Distance, of course, is the determining factor for takeoff obstruction clearance.

DO ALL WIND REPORTS INDICATE A TRUE DIRECTION? *No.* The wind direction, as reported by a control tower in pilot instructions, is magnetic. All other wind directions (Sequence Reports, Terminal Forecasts, Winds Aloft Forecasts, etc.) are true.

WHAT IS THE HEIGHT OF A CLOUD CEILING BASED ON? *The height of the clouds above the ground, not the height above sea level (MSL).* For example, let's examine the following weather report: ABQ M30⊕. The station is Albuquerque, N.M., which has an elevation of 5,352 feet above sea level. The ceiling is reported as a 3,000-foot overcast. Using the current Albuquerque altimeter setting, your altimeter would indicate approximately 8,352 feet at the base of the clouds when over the airport, but your height above the ground would be 3,000 feet. As a word of caution, the 10,000-foot plus mountains a few miles east of the city would probably extend up into the clouds since this ceiling report is based on an observation taken over the airport.

WHICH IS MORE DENSE—MOIST AIR OR DRY AIR? *Dry air.* It is generally understood that high temperatures and high elevations result in a higher density altitude, but there seems to be a general impression that moist air has the reverse effect. The common misconception is that moist air is heavier than dry air. This is not true! Water vapor weighs less than an equal amount of dry air. Dry air is therefore denser and heavier than moist air. Since both engine and aircraft performance decrease with an increase in density altitude, you should remember that high relative humidities (small spreads between temperature and dew point), especially on hot summer days, will result in longer takeoff runs.

IS AN AIRCRAFT CRUISING VFR AT 5,500 FEET MSL ALWAYS GOVERNED BY THE VFR CRUISING ALTITUDE REQUIREMENTS (HEMISPHERICAL RULE)? *Not necessarily.* The rule pertains to aircraft operated in level cruising flight at 3,000 feet or more above the surface. The aircraft in this case (5,500 feet MSL) might be operating above a surface elevation of 3,500 feet. The hemispherical rule would not apply.

* * * * *

These are, by no means, all of the common misconceptions that prevail among student pilots; but as we stated earlier, a trend has become apparent in the Private Pilot Written Examination results which high-lights these that are discussed. Additional misconceptions are discussed in Exam-O-Gram No. 26.

VFR EXAM-O-GRAM NO. 26

COMMON MISCONCEPTIONS (SERIES 2)

Each question in FAA Airman Written Examinations offers the examinee a group of four answers from which to select the answer he believes to be correct. Applicant's comments and the analyses of the answer sheets indicate that particular incorrect answers are frequently being chosen because of a misconception regarding certain items of required aeronautical knowledge. This Exam-O-Gram and Exam-O-Gram No. 17 attempt to correct a few of these preconceived ideas.

WHAT INDICATED AIRSPEED SHOULD BE USED FOR LANDING APPROACHES TO FIELDS OF HIGHER ELEVATIONS? For all practical purposes, use the SAME indication as you use at fields of lower elevations.

WILL THE SAME INDICATED APPROACH SPEED BE SAFE AT HIGH ELEVATIONS? YES, in relatively smooth air. We all know that as altitude increases, the air becomes less dense, and consequently with decreased drag the airplane travels faster through the air. However, this faster speed creates no increase in impact pressure on the airspeed pitot system because of the lesser air density. In other words, we get a higher True Airspeed (TAS) with the same Indicated Airspeed.

Although the True Airspeed at which an airplane stalls in thinner air is higher, the margin of safety is unaffected since the airplane is actually flying at a higher True Airspeed. Nevertheless, for the purpose of maintaining positive control in unstable air, the use of a higher than normal indicated speed is recommended for approaches during the turbulent or gusty conditions prevalent in mountainous areas, just as is used at fields of lower elevations in these conditions.

WHAT EFFECT DOES THINNER AIR HAVE ON APPROACH AND LANDING? Even though using the same *indicated* airspeed that is appropriate for sea level operations, the True Airspeed is faster, resulting in a faster groundspeed (with a given wind condition). This increase in groundspeed naturally makes the landing distance longer and should be carefully considered when landing at high elevation fields, particularly if the field is short.

WHAT INDICATED AIRSPEED SHOULD BE USED ON TAKEOFF AT HIGH ELEVATIONS? Just as in landing, the groundspeed, as well as the takeoff distance, will be greater at high elevation fields. However, don't let this mislead you into P-U-L-L-I-N-G the airplane off the ground. If you do, the airplane will mush and settle back to the ground in a stalled condition. Use the same indicated airspeed as you use for takeoff at fields with lower elevations.

WHAT WOULD YOU THINK IF YOU OVERHEARD THIS AIRPLANE "DISCREPANCY" REPORT? "Hey, Chief, fix this goofed-up airspeed indicator! I was practicing power-off stalls with the gear and flaps down, but the airplane didn't stall until the pointer was 10 mph less than the white arc painted on the dial."

IS THE AIRSPEED INDICATOR FAULTY OR IS THE WHITE ARC MISPLACED? Not necessarily either one! Remember, the colored arcs on the airspeed dial (see Exam-O-Gram No. 8) mark the *Calibrated* Airspeed (CAS) and not merely the observed Indicated Airspeed (IAS) limitations.

WHAT IS CALIBRATED AIRSPEED? Calibrated Airspeed, frequently called True Indicated Airspeed (TIAS), is Indicated Airspeed corrected for installation and instrument error. A wide difference between these speeds may exist, particularly at low airspeeds or under landing conditions. Installation error is caused when the relative wind or impact air in certain pitch attitudes does not enter the pitot-tube opening as it would under normal cruising conditions. Check the airspeed correction data for each airplane. You may find (as in the typical table below) that an IAS of 60 mph is actually a CAS (or TIAS) of 69 mph. (TRUE INDICATED AIRSPEED is not to be confused with TRUE AIRSPEED which is the actual speed of the airplane through the air.)

WHAT IS THE RELATIONSHIP BETWEEN AIRSPEED INDICATOR COLORED ARCS AND STALLING SPEEDS? In the illustration below, the white arc shows a stalling speed of 57 mph (TIAS or CAS), but because of installation error (reflected in the table), this airplane may not stall with power-off and gear and flaps down until the pointer is on 40 mph (IAS).

A similar variation is noted for the green arc and stalling speed with gear and flaps UP. Since an airplane in flight is operated most of the time within the upper speed range, installation error is normally adjusted so as to be at a minimum in that range. This results in the greatest error at the lower speed range, but provides a corresponding increase in the margin of safety at the critical lower airspeeds.

* * * * *

CAN NORMAL IN-FLIGHT ASSISTANCE BE RECEIVED FROM ALL VOR STATIONS? NO. Many VOR stations can be used only for navigation purposes. These stations with no capability to transmit voice signals are so marked on the chart with the notation "NO VOICE." Stations of this type cannot be used for weather information, position reporting, flight plans, or emergency assistance.

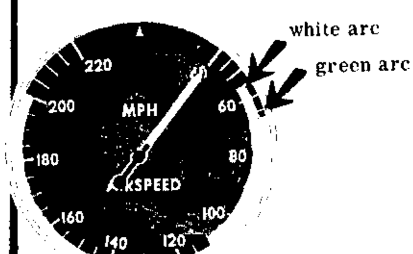
IN TERMINAL FORECASTS DOES THE LETTER "C" MEAN CLEAR SKIES? NO. When used in the cloud group of the forecast, it indicates the cloud layer that constitutes the CEILING; when used in the time group for predicted weather changes within the period, it signifies CENTRAL TIME.

IS THE WIND ALWAYS SHOWN IN

AIRSPEED CORRECTION TABLE

FLAPS 0°								
IAS - MPH	60	80	100	120	140	160	180	200
TIAS - MPH	69	82	100	119	139	160	181	202
***FLAPS 20°**								
IAS - MPH	40	50	60	70	80	90	100	110
TIAS - MPH	57	62	68	75	84	93	102	112
***FLAPS 40°**								
IAS - MPH	40	50	60	70	80	90	100	110
TIAS - MPH	57	62	68	75	83	92	102	111

*Maximum flap speed 110 MPH-TIAS



TERMINAL FORECASTS? NO. If the wind is forecast to be less than 10 knots, it is omitted.

IS THE VISIBILITY ALWAYS SHOWN IN TERMINAL FORECASTS? NO. If the visibility is forecast to be more than 8 miles, it is omitted.

IS THE HEIGHT OF CLOUD TOPS PREDICTED IN TERMINAL FORECASTS? NO. Only the base of the clouds above the surface is predicted. Cloud tops are usually found in Pilot Reports (PIREPS), and often in Area Forecasts.

ARE ICING AND TURBULENT CONDITIONS PREDICTED IN TERMINAL FORECASTS? NO. This information may be found in the Area Forecasts. However, a prediction of gusty surface conditions may be included in the wind group of Terminal Forecasts. A report of existing icing and turbulence at flight levels may be found in PIREPS.

* * * * *

IN TELETYPE FORECASTS AND REPORTS, IS THE WIND INFORMATION RELATIVE TO *TRUE* NORTH OR *MAGNETIC* NORTH? All printed weather information, such as Area Forecasts, Terminal Forecasts, Aviation Weather Sequence Reports, Winds Aloft Forecasts, etc., presents the wind direction as measured from TRUE NORTH. To use this wind direction for the computations of problems in which magnetic values are required, magnetic variation should be applied. That is, add or subtract variation as appropriate to the area involved, when magnetic headings are desired.

IN RADIO BROADCASTS, IS THE WIND DIRECTION RELATIVE TO *TRUE* NORTH OR *MAGNETIC* NORTH? Surface wind direction given in traffic instructions by the tower, or in airport advisories by an FSS, is always given as MAGNETIC direction, so as to be readily related to the runway number which is also a magnetic direction. In scheduled weather broadcasts, the wind is given in True direction for all reported stations except that of the station making the broadcast, in which case the wind is reported in Magnetic direction.

CAN THE DATE A PERIODIC INSPECTION IS DUE BE DETERMINED FROM AIRWORTHINESS CERTIFICATES? NO. With regard to the due date of a Periodic Inspection, the Airworthiness Certificate is of no value unless it was issued within the preceding 12 calendar months. This certificate is issued only when the aircraft is certificated as being airworthy at the time of original manufacture (or after being substantially altered or repaired), and in most cases is issued only once in the lifetime of the aircraft.

FROM WHICH DOCUMENTS CAN THE DUE DATE OF A PERIODIC INSPECTION BE DETERMINED? By checking the entries in the aircraft and engine maintenance records (in most cases aircraft and engine logbooks) certifying the latest Periodic Inspection. If the records show the preceding inspection was performed on April 5, 1964, then the next inspection is due at the end of the 12th month subsequent to that date; that is, by the end of April 30, 1965.

IS THERE A DIFFERENCE BETWEEN AN AIRPORT TRAFFIC AREA AND A CONTROL ZONE? YES, definitely; although in some cases they coincide laterally, in which case rules applicable to each are in effect.

WHAT IS AN AIRPORT TRAFFIC AREA? An Airport Traffic Area is the airspace surrounding an airport at which there is an operating control tower.

The traffic area extends from the surface upward to 2,000 feet, and although not marked on the chart (except by the presence of control tower frequencies), it includes the area within a 5-mile radius from that airport (see Fig. 39). When operating within the Airport Traffic Area, a pilot is required, unless otherwise authorized, to maintain two-way radio communications with the tower. This does not apply when operating for the purpose of taking off or landing at airports without a control tower that happen to be within the Airport Traffic Area of another airport. This rule is also not applicable when the tower is *not* in operation nor at airports without control towers outside of an Airport Traffic Area (see Fig. 40). The airport traffic *pattern* of an airport is

Airport Traffic Area

(Tower Frequencies)

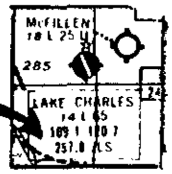


FIGURE 39.

No
Airport Traffic
Area

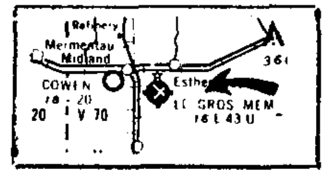


FIGURE 40.

not to be confused with an Airport Traffic *Area.*

WHAT IS A CONTROL ZONE? A control zone is an airspace, surrounding one or more airports, within which rules additional to those governing flight in control areas and "airport traffic areas," apply for the protection of air traffic. Normally, an aircraft shall not be operated under Visual Flight Rules within a Control Zone *beneath a ceiling of less than 1,000 feet or with a visibility of less than 3 miles.* To do so requires a *special VFR clearance from Air Traffic Control.*

If the airport lies within a Control Zone as well as an Airport Traffic Area (see Fig. 41), this clearance is obtained through the control tower. However, *all Control Zones do not have a control tower* or lie within an Airport Traffic Area (see Fig. 42). In this case arriving and departing traffic is controlled by ATC either by direct communication between the control center and the pilot, or through an appropriate radio facility. Frequently, clearances are conveyed to an aircraft by a nearby Flight Service Station (FSS). All Control Zones are marked on charts by a circular broken line, normally a 5-mile radius with extensions as necessary for IFR approaches, extending from the *surface upward (with no vertical limits)*, and may encompass more than one airport. These special rules are also applicable to the other airports within the Control Zone boundaries.

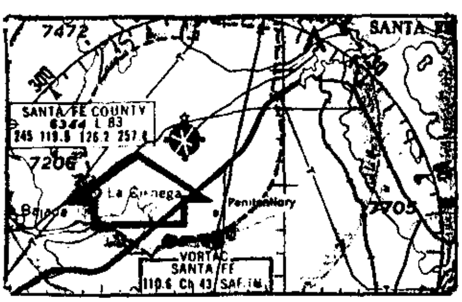


FIGURE 41.

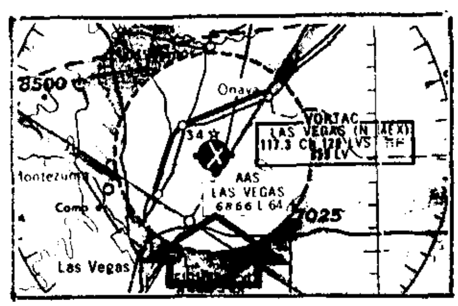


FIGURE 42.

VFR EXAM-O-GRAM NO. 28

FACTORS AFFECTING STALL SPEED

A recent report indicates that approximately 80 percent of all accidents are pilot caused. The major cause of fatal accidents is listed as "failed to maintain airspeed (or flying speed) resulting in a stall." Although many of these stalls may have occurred under the stress and duress of other problems such as disorientation during limited visibility or at night, improper division of attention, etc., statistical analyses of written examinations indicate a lack of knowledge and understanding of the various factors that can cause or contribute to a stall.

This Exam-O-Gram discusses some of the more important, ever-present factors of which the pilot must have an understanding so that he will instinctively avoid or compensate for situations, conditions, and attitudes that may lead to a stall—even under the stress and duress of additional problems he may encounter in flight.

WHAT CAUSES AN AIRPLANE TO STALL? All stalls are caused by exceeding the critical angle of attack. Knowing this particular fact does not necessarily help the pilot. What is more important to the pilot is to know what factors are likely to contribute to or cause this angle of attack to be exceeded.

IS IT NECESSARY FOR THE AIRPLANE TO HAVE A RELATIVELY LOW AIRSPEED IN ORDER FOR IT TO STALL? No. An airplane can be stalled *at any airspeed.* All that is necessary is to exceed the critical angle of attack. This can be done at any airspeed if the pilot applies abrupt or excessive back pressure on the elevator control. A stall that occurs at a relatively high speed is referred to as an accelerated or high speed stall.

IS IT NECESSARY FOR THE AIRPLANE TO HAVE A RELATIVELY HIGH PITCH ATTITUDE IN ORDER FOR IT TO STALL? No. An airplane can be stalled *at any attitude.* Repeating again the statement made above—all that is necessary is to exceed the critical angle of attack. This can occur in any attitude by application of abrupt or excessive back pressure on the elevator control.

DOES WEIGHT AFFECT THE STALLING SPEED? Yes. As the weight of the airplane is increased, the stall speed increases. Due to the greater weight, a higher angle of attack must be maintained to produce the additional lift to support the additional weight in flight. Therefore, the critical angle of attack will be reached at a higher airspeed when loaded to maximum gross weight than when flying solo with no baggage. (See Exam-O-Gram No. 13.)

DOES THE CENTER-OF-GRAVITY LOCATION (WEIGHT DISTRIBUTION) AFFECT STALL SPEED? Yes. The farther forward the center of gravity, the higher the stalling speed. The farther aft the center of gravity, the lower the stalling speed. (See Exam-O-Gram No. 13.)

DOES THIS MEAN THAT THE WEIGHT SHOULD BE DISTRIBUTED IN THE AIRPLANE SO THAT THE CG IS AS FAR TO THE REAR AS POSSIBLE? No. This may present problems with stability that will far outweigh any advantages obtained by the decrease in stall speed. (See Exam-O-Gram No. 13.)

DO FLAPS AFFECT STALLING SPEED? Yes. The use of flaps reduces stalling speed. The Stall Speed Chart (Figure 43) excerpted from an airplane flight manual illustrates this fact. This also can be readily verified by checking the color

STALL SPEED, POWER OFF

Gross Weight 3000 lbs. CONFIGURATION	ANGLE OF BANK 0°	20°	40°	60°
GEAR & FLAPS UP	65	67	74	92
GEAR DOWN, FLAPS 20°	61	63	70	86
GEAR DOWN, FLAPS 40°	60	62	69	85

SPEEDS ARE MPH, TIAS

FIGURE 43.

coding on any airspeed indicator. The lower airspeed limit of the white arc (power-off stalling speed with gear and flaps in the landing configuration) is less than the lower airspeed limit of the green arc (power-off stalling speed in the clean configuration). (See Exam-O-Gram No. 8). This fact is important to the pilot in that when making no-flap landings, a higher indicated airspeed should be maintained than when landing with flaps.

The manufacturers' recommendations should be adhered to as to approach speeds with various configurations.

DOES AN ACCUMULATION OF FROST, SNOW, OR ICE ON THE WINGS AFFECT STALLING SPEED? Yes. Even a light accumulation of frost, snow, or ice on the wings can cause a significant increase in stalling speed. It can increase it so much that the airplane is unable to take off. The accumulation disrupts the smooth flow of air over the wing thus decreasing the life it produces. To make up for the lost lift, a higher angle of attack must be used or a higher speed must be attained on the takeoff roll.

The runway may not be long enough to attain the necessary speed and even though the airplane may become airborne, it could be so close to the stall speed that it would not be possible to maintain flight once the airplane climbs above the comparatively shallow zone where ground effect prevails. DO NOT TAKE OFF UNTIL ALL FROST, SNOW, AND ICE HAS MELTED OR BEEN REMOVED FROM THE AIRPLANE.

DOES AN INCREASE IN ALTITUDE AFFECT THE INDICATED AIRSPEED AT WHICH AN AIRPLANE STALLS? An increase in altitude has no effect on the *indicated airspeed* at which an airplane stalls at altitudes normally used by general aviation aircraft. That is, for all practical purposes, the indicated stalling speed remains the same regardless of altitude in this range. This fact is important to the pilot in that the same indicated airspeed should be maintained during the landing approach regardless of the elevation or the density altitude at the airport of landing. (Follow the manufacturer's recommendations in this regard.) If higher than normal approach airspeed is used, a longer landing distance will be required.

DOES AN INCREASE IN ALTITUDE AFFECT THE TRUE AIRSPEED AT WHICH AN AIRPLANE STALLS? Since true airspeed normally increases as altitude increases (for a given indicated airspeed), then true airspeed at which an airplane stalls generally increases with an increase in altitude. Under nonstandard conditions (temperature warmer than standard) there is an additional increase in true airspeed above the indicated airspeed.

OF WHAT SIGNIFICANCE IS THIS TO THE PILOT? It is significant in that when landing at higher elevations or under higher density altitudes, he is operating at higher true airspeeds (and therefore higher groundspeeds) throughout the approach, touchdown, and landing roll. This results in a greater distance to clear obstacles during the approach, a longer ground roll, and consequently, the need for a longer runway. If, in addition, the pilot is operating under the misconception that a higher than normal indicated airspeed should be used under these conditions, the situation is further compounded due to the additional increase in groundspeed (See Exam-O-Gram No. 26.)

DOES TURBULENCE AFFECT STALLING SPEED? Yes! Turbulence can cause a big increase in stalling speed. Encountering an upward vertical gust causes an abrupt change in relative wind. This results in an equally abrupt increase in angle of attack which could result in a stall. This fact is important to the pilot in that when making an approach under turbulent conditions, a higher than normal approach speed should be maintained. Also, in moderate or greater turbulence, an airplane should not be flown above maneuvering speed. (See Exam-O-Gram No. 8.) At the same time, it should not be flown too far below maneuvering speed since a sudden severe vertical gust may cause the airplane to stall due to the higher angle of attack at which it will already be flying.

Also note from the Stall Speed Chart (Fig. 44) that at this angle of bank, the stall maneuvering that will increase the centrifugal force and thus produce an increase in

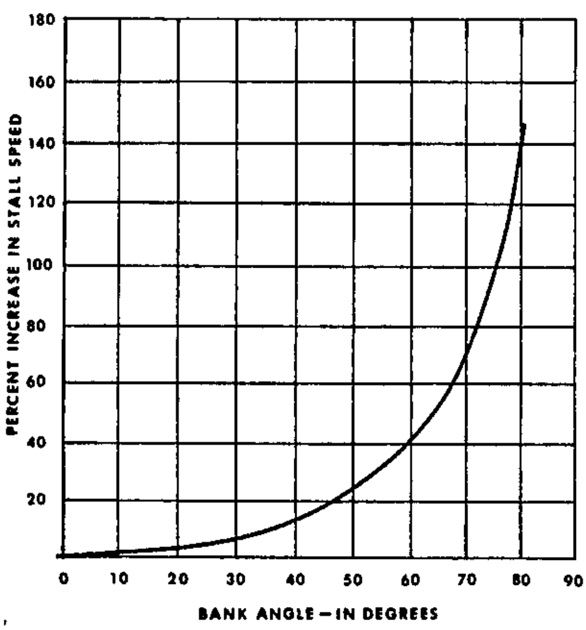


FIGURE 44.

speed is twice as great as in straight-and-level flight. There are two reasons then why excessively steep banks should be avoided:—an airplane will stall at a much higher airspeed and the limit load factor can be exceeded. The danger is compounded when the nose gets down in a steep turn if the pilot attempts to raise it to the level flight attitude without shallowing the bank since the load factor will be increased even more. This is the situation as it generally exists when, due to disorientation, the pilot enters a diving spiral (often referred to as the "graveyard spiral") and attempts to recover with elevator pressure alone.

WHAT FACTORS CAUSE AN INCREASE IN LOAD FACTOR? Any maneuvering of the airplane that produces an increase in centrifugal force will cause an increase in load factor. Turning the airplane or pulling out of a dive are examples of maneuvering that will increase the centrifugal force and thus produce an increase in load factor. When you have a combination of turning and pulling out of a dive, such as recovering from a diving spiral, you are, in effect, placing yourself in double jeopardy. This is why you must avoid high-speed diving spirals or if you accidentally get into one—be careful how you recover. Turbulence also can produce large load factors. This is why an airplane should be slowed to maneuvering speed or below when encountering moderate or greater turbulence.

DOES ANGLE OF BANK AFFECT STALLING SPEED? Yes. As the angle of bank increases in a constant altitude turn, the stalling speed increases. This is easily seen from the STALL SPEED CHARTS (Figs. 43 and 44) which show the increase in stall speed as the angle of bank increases—Figure 43 the actual values for one airplane and Figure 44 in terms of percent. At a 60° bank, stalling speed is 40 percent greater than in straight-and-level flight (25-27-mph for the specific example.) At angles of bank above 60°, stall speed increases very rapidly, and at approximately 75° it is doubled with respect to straight-and-level stall speed (Fig. 45).

DOES LOAD FACTOR AFFECT STALLING SPEED? Yes. As the load factor increases, stalling speed increases. When the load factor is high, stalling speed is high. A comparison of the two charts (Figs. 44 and 45) should easily show this relationship. Load factor is the ratio of the effective weight of an airplane and its contents to its actual weight. At a load factor of 2, the airplane weighs twice its normal weight; at a load factor of 4, it weighs 4 times its normal weight. Normal category airplanes with a maximum gross weight of less than 4,000 pounds are required to have a minimum

LOAD FACTOR CHART

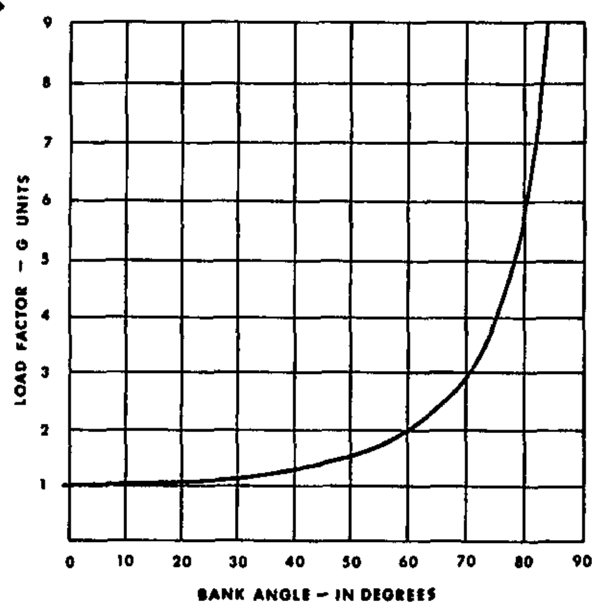


FIGURE 45.

limit load factor of 3.8. (The limit load factor is that load factor an airplane can sustain without taking a permanent set in the structure.) Note from the load factor chart (Fig. 45) that this minimum limit load factor is attained in a constant altitude turn at a bank of approximately 75°.

CAN THE PILOT RECOGNIZE WHEN THERE IS AN INCREASE IN LOAD FACTOR? Yes. He can recognize it by the feeling of increased body weight or the feeling that he is being forced down into the seat—the greater the load factor the greater this feeling of increased weight or of being forced down in the seat. It is the same feeling one has when riding the roller coaster at the bottom of a dip or going around a banked curve. This feeling of increased body weight is important to the pilot because it should, if it becomes excessive, have the imediate effect of a red flag being waved in his face to warn him that the airplane will now stall at a higher airspeed or that the limit load factor can be exceeded, resulting in structural failure.

DOES SPEED AFFECT LOAD FACTOR? Speed does not, in itself, affect load factor. However, it has a pronounced effect on how much of an increase in load factor can be produced by strong vertical gusts, or by the pilot through abrupt or excessive application of back pressure on the elevator control. This is why airspeed should be reduced to maneuvering speed or below if moderate or greater turbulence is encountered.

At maneuvering speed or below, the airplane is stressed to handle any vertical gust that will normally be encountered. Also, below this speed, the pilot can make abrupt full deflection of the elevator control and not exceed the maximum load factor for which the airplane is stressed. However, it should be noted that the reason this is possible is because the airplane will stall, thus relieving the load factor. At airspeeds above maneuvering speed, abrupt full deflection of the elevator control or strong vertical gusts can cause the limit load factor to be exceeded. As airspeed continues to increase above maneuvering speed, the limit load factor can be exceeded with less and less turbulence or abrupt use or deflection of the controls.

WHAT IS THE RELATIONSHIP BETWEEN A HIGH-SPEED (ACCELERATED) STALL AND LOAD FACTOR? The higher the airspeed when an airplane is stalled, the greater the load factor. When an airplane stalls at a slow airspeed, the load factor will be very little more than one. When stalled at an airspeed twice as great as the normal stall speed, the limit load factor for normal category airplanes probably will be exceeded. This fact can be determined from the stall speed (Fig. 44) and load factor (Fig. 45) charts. See also the discussion of "How Does Load Factor Affect Stalling Speed."

VFR EXAM-O-GRAMS Available from FAA

NO.	
1	CONTROL ZONE VFR WEATHER MINIMUMS
2	VFR CRUISING ALTITUDES
3	AN INVISIBLE HAZARD TO LIGHT AIRCRAFT
4	PREFLIGHT PLANNING FOR A VFR CROSS-COUNTRY FLIGHT (Series 1)
5	PREFLIGHT PLANNING FOR A VFR CROSS-COUNTRY FLIGHT (Series 2)
6	PREFLIGHT PLANNING FOR A VFR CROSS-COUNTRY FLIGHT (Series 3)
7	GETTING CAUGHT ON TOP OF AN OVERCAST
8	AIRSPEED INDICATOR MARKINGS
9	ALTIMETRY
10	FUEL CONTAMINATION
11	DENSITY ALTITUDE AND ITS EFFECT ON AIRCRAFT PERFORMANCE
12	THE MAGNETIC COMPASS
13	WEIGHT AND BALANCE
14	RADIO COMMUNICATIONS FREQUENCIES
15	HOW TO USE VOR (Series 1)
16	HOW TO USE VOR (Series 2)
17	COMMON MISCONCEPTIONS (Series 1)
18	LOST PROCEDURES—PILOTAGE
19	EMERGENCY OR LOST PROCEDURES (RADIO)
20	CEILING AND VISIBILITY
21	FLYING INTO UNFAVORABLE WEATHER
22	POTENTIAL MID-AIR COLLISIONS
23	INTERPRETING SECTIONAL CHARTS (Series 1)
24	INTERPRETING SECTIONAL CHARTS (Series 2)
25	INTERPRETING SECTIONAL CHARTS (Series 3)
26	COMMON MISCONCEPTIONS (Series 2)
27	THE EFFECT OF WIND ON AN AIRPLANE
28	FACTORS AFFECTING STALL SPEED

GENERAL AVIATION DISTRICT OFFICES

Address letters to: Supervising Inspector, GADO, Federal Aviation Agency in the area nearest to you.

State	*City*	*Address*
ALABAMA	Birmingham	Municipal Airport, Birmingham, Ala. 35212
ALASKA	Anchorage	P. O. Box 440, Anchorage, Alaska 99501
	Fairbanks	Arctic Airways Hangar, International Airport, Fairbanks, Alaska 99701
	Juneau	Star Route, Terminal Bldg., Juneau Municipal Airport, Juneau, Alaska 99801
ARIZONA	Phoenix	2800 Sky Harbor Blvd., Sky Harbor Airport, Phoenix, Ariz. 85034
ARKANSAS	Little Rock	Terminal Annex Bldg., RFD 77, Adams Field, Little Rock, Ark. 72202
CALIFORNIA	Fresno	Government Agency Bldg., Suite 1-B, Fresno, Calif. 93727
	Long Beach	3421 Lakewood Blvd., Long Beach Municipal Airport, Long Beach, Calif. 90808
	Oakland	P. O. Box 2397, Oakland, Calif. 94614
	Ontario	Administration Bldg., Ontario International Airport, Ontario, Calif. 91761
	Sacramento	Municipal Airport, Sacramento, California 95822
	San Diego	3110 Goddard Way, Administration Bldg., Lindberg Field, San Diego, Calif. 92101
	Santa Monica	3200 Airport Ave., Santa Monica, California 90405
	Van Nuys	16700 Roscoe Blvd., Van Nuys, Calif. 91406
COLORADO	Denver	P. O. Box 326, Broomfield, Colo. 80020
D. C.	Washington	West Public Roads Bldg., Washington National Airport, Washington, D. C. 20001
FLORIDA	Jacksonville	P. O. Box 1527, Jacksonville, Fla. 32201
	Miami	P. O. Box 365, Opa Locka, Fla. 33054
	St. Petersburg	St. Petersburg-Clearwater Airport, St. Petersburg, Fla. 33732
GEORGIA	Atlanta	3999 Gordon Rd. SW, Atlanta, Ga. 30331
HAWAII	Honolulu	P. O. Box 4009, Honolulu, Hawaii 96812
IDAHO	Boise	1412 Idaho Street, Boise, Idaho 83706
ILLINOIS	Chicago	P. O. Box 337, West Chicago, Ill. 60185
	Springfield	P. O. Box 197, Springfield, Ill. 62705
INDIANA	Indianapolis	Administration Bldg., Weir-Cook Municipal Airport, Indianapolis, Ind. 46231

State	*City*	*Address*
	South Bend	St. Joseph County Airport, South Bend, Ind. 46628
IOWA	Des Moines	Rm. 132, Admin. Bldg., Des Moines Municipal Airport, Des Moines, Iowa 50321
KANSAS	Kansas City	2nd Floor, Administration Building, Fairfax Airport, Kansas City, Kans. 66115
	Wichita	Flight Standards Bldg., Municipal Airport, Wichita, Kans. 67209
KENTUCKY	Louisville	Central American Airways Hangar, Bowman Field, Louisville, Ky. 40205
LOUISIANA	New Orleans	Room 227, New Orleans Lakefront Airport, New Orleans, La. 70126
	Shreveport	Admin. Bldg., Downtown Airport, Shreveport, La. 71107
MAINE	Portland	Municipal Airport, Portland, Maine 04106
MARYLAND	Baltimore	Friendship Int'l Airport, Baltimore, Md. 21240
MASS.	Norwood	Municipal Airport, Norwood, Mass. 02062
	Westfield	P. O. Box 544, Westfield, Mass. 01085
MICHIGAN	Detroit	Will Run Airport, Ypsilanti, Mich. 48197
	Grand Rapids	Kent County Airport, Grand Rapids, Mich. 49508
MINNESOTA	Minneapolis	6301 34th Ave. South, Minneapolis, Minn. 55406
MISSISSIPPI	Jackson	P. O. Box 5855, Pearl Station, Jackson, Miss. 39208
MISSOURI	St. Louis	Box 6127, St. Louis, Mo. 63134
MONTANA	Billings	Rm. 205, Admin. Bldg., Billings-Logan Field, Billings, Mont. 59101
	Helena	P. O. Box 1167, Helena, Mont. 59601
NEBRASKA	Lincoln	General Aviation Bldg., Lincoln Municipal Airport, Lincoln, Neb. 68524
NEVADA	Reno	Room 234, Terminal Bldg., Reno Mun. Airport, Reno, Nev. 89502
NEW JERSEY	Teterboro	Teterboro Air Terminal, Teterboro, N. J. 07608
NEW MEXICO	Albuquerque	P. O. Box 9026, Albuquerque, N. M. 87119
NEW YORK	Albany	Albany County Airport, Albany, New York 12211
	La Guardia	P. O. Box 575, LaGuardia Airport, Flushing. N. Y. 11371
	Lindenhurst	Zahns Airport, North Wellwood Avenue, Lindenhurst, N. Y. 11757
	Rochester	Municipal Airport, Rochester, N. Y. 14624
NORTH CAROLINA	Charlotte	Municipal Airport, Post Office, Charlotte, North Carolina 28208
	Raleigh	P. O. Box 1858, Raleigh, N. C. 27602
NORTH DAKOTA	Fargo	P. O. Box 2128, Fargo, N. D. 58103
OHIO	Cincinnati	Administration Bldg., Lunken Airport, Cincinnati, Ohio 45226

State	*City*	*Address*
	Cleveland	Cleveland Hopkins Airport, Bldg. S-21, Cleveland, Ohio 44135
	Columbus	Terminal Bldg., Box 214, Port Columbus Airport, Columbus, Ohio 43219
OKLAHOMA	Oklahoma City	P. O. Box 359, Bethany, Okla. 73008
OREGON	Portland	Service Office Bldg., 5410 N.E. Marine Drive, Portland, Ore. 97218
PENNSYLVANIA	Allentown	Allentown-Bethlehem-Easton Airport, Allentown, Pa. 18103
	Harrisburg	P. O. Box 390, New Cumberland, Pennsylvania 17070
	Philadelphia	Admin. Bldg., 1st Floor, North Philadelphia Airport, Philadelphia, Pa. 19114
	Pittsburgh	Allegheny County Airport, West Mifflin, Pa. 15122
SOUTH CAROLINA	Columbia	534 Knox Abbott Dr., Cayce, S. C. 29033
SOUTH DAKOTA	Rapid City	P. O. Box 27, Rapid City, S. D. 57702
TENNESSEE	Memphis	P. O. Box 30050, Memphis, Tenn. 38118
	Nashville	Berry Field, Nashville, Tenn. 37217
TEXAS	Dallas	3323 Grove Street, Dallas, Tex. 75235
	El Paso	Room 202, Federal Aviation Bldg., El Paso, Tex. 79925
	Fort Worth	P. O. Box 1689, Fort Worth, Tex. 76101
	Houston	P. O. Box 60158, Houston, Tex. 77060
	Lubbock	P. O. Box 5247, Lubbock, Tex. 79415
	San Antonio	Room 2, International Airport, 371 North Terminal Drive, San Antonio, Tex. 78216
UTAH	Salt Lake City	116 North 23rd West, Room 104, Salt Lake City, Utah 84116
VIRGINIA	Richmond	Byrd Field, Sandston, Va. 23150
WASHINGTON	Seattle	Room 118, FAA Building, Boeing Field, Seattle, Wash. 98101
	Spokane	P. O. Box 247, Parkwater Station, Spokane, Wash. 99211
WISCONSIN	Milwaukee	General Mitchell Field, Milwaukee, Wis. 53207
WYOMING	Cheyenne	P. O. Box 2166, Cheyenne, Wyo. 82002

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