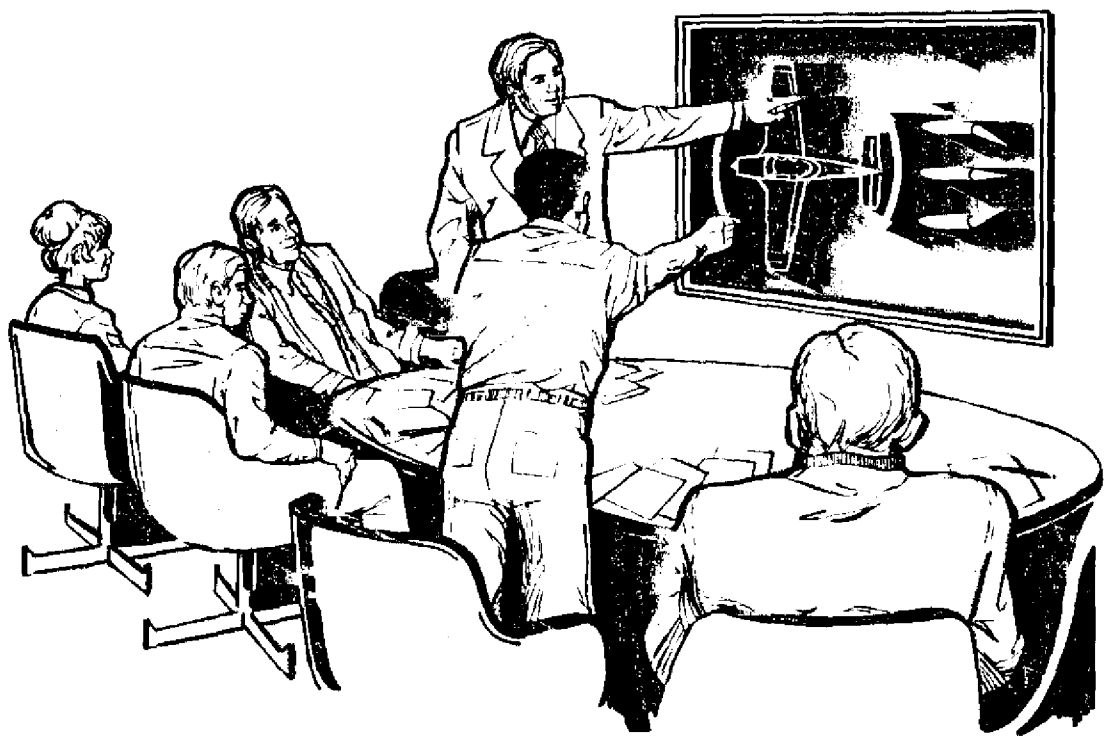
Ground Instructor Written Test Guide

Basic - Advanced

1. Motivation
2. Presentations and Explanations
3. Performance and Application
4. Evaluation



U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

GROUND INSTRUCTOR WRITTEN TEST GUIDE BASIC–ADVANCED

REVISED

1976

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Flight Standards Service

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CONTENTS

	Page
Preface	v
Introduction	1
Certification Requirements	1
The Written Tests	1
Taking the Tests	1
Recommended Study Materials	2
How to Obtain GPO Publications	4
Study Outline—Fundamentals of Instruction	4
Study Outline—Aeronautical Knowledge	7
Sample Test Items	12
Additional Questions for Study	16
Appendix	19

PREFACE

The Flight Standards Service of the Federal Aviation Administration has developed this guide to assist applicants who are preparing for the Ground Instructor Certificate, Basic or Advanced.

This guide contains study outlines and a list of recommended study materials and explains how to obtain those publications. Included in this guide are sample test items with explanations of the correct answers, and illustrations representative of those found on FAA written tests. It supersedes the Ground Instructor Written Test Guide, Basic-Advanced, AC 143-1D, issued in 1974.

Comments regarding this publication may be directed to the U.S. Department of Transportation, Federal Aviation Administration, Flight Standards National Field Office, P.O. Box 25082, Oklahoma City, Oklahoma 73125.

GROUND INSTRUCTOR WRITTEN TEST GUIDE
BASIC–ADVANCED

INTRODUCTION

Knowledge and understanding are seldom gained quickly or easily. This is particularly true in the diversified field of aviation instruction. Ground instructors become more competent through study, experience, and hard work. The instructor's attitude toward instruction, and continuous review to remain current in the many areas where technological change is the rule rather than the exception, determine what kind of a job a person will do.

The purpose of this publication is to provide guidance to the applicant by outlining the scope of knowledge required of a ground instructor. By using this guide, the applicant should be able to intelligently develop a study plan.

CERTIFICATION REQUIREMENTS

To be eligible for a Ground Instructor's Certificate with a Basic or Advanced Instructor's Rating, the certification process requires that the applicant pass a Basic or Advanced Ground Instructor's Written Test and Fundamentals of Instructing Written Test. However, if the applicant holds a valid FAA Flight or Ground Instructor Certificate, the applicant is not required to take the separate test on Fundamentals of Instructing when applying for an additional instructor's certificate or rating.

It is not necessary to take this Fundamentals of Instructing Test on the same day as the Ground Instructor's Written Test and it is immaterial which test is taken first.

THE WRITTEN TEST

The Fundamentals of Instructing and the Ground Instructor written tests are comprehensive because they test an applicant's knowledge in many subject areas. These areas include all required subjects common to all aircraft pilot certificates, as well as the Fundamentals of Instructing subject areas, such as: The Learning Process, Elements of Effective Teaching, Student Evaluation, Quizzing and Testing, Course Development, Lesson Planning, and Classroom Instruction Techniques.

The Fundamentals of Instructing written test contains 50 test items. Three hours are allowed for taking this test. The Basic Ground Instructor written test contains 80 items, and the time allowed for taking this test is 4 hours. The Advanced Ground Instructor written test contains 100 items, and the time allowed for taking this test is 5 hours. All test items are of the objective multiple-choice type, and each item can be answered by selection of a single response as the correct choice. The correct response of one test item does not depend upon or influence the correct response of another test item.

The applicant's answer sheet is forwarded to the FAA Aeronautical Center for processing by ADP computers. Shortly thereafter, the applicant will receive an Airmen Written Test Report which not only includes the score but lists, in code, those subject areas answered incorrectly. These codes refer to a list of subject matter which accompanies the report. The applicant can thus determine those subject areas which should be studied.

TAKING THE TESTS

The tests may be taken at General Aviation District Offices of the Federal Aviation Administration and other designated places.

When reporting for the written test, be prepared to present to the person administering the test documentary evidence of your identity. *Normally, you will not be permitted to begin the test unless there is sufficient time to complete it.*

The equipment needed for taking the test includes a straight edge, a plotter or protractor, and a computer (preferably one with a wind vector face). It is also desirable to have dividers for accurate measurement.

Consider these points:

1. Test items should be answered in accordance with the latest regulations and procedures.

2. Read the information, instructions, and test items carefully. Do not try to solve the problem before understanding the question. Be sure the objectives of the test item are fully understood, then work the problem or analyze the choices and select the correct answer.

3. Do not consider a complicated problem a "trick" item; each item has an objective. There are no trick items. The questions and answers mean exactly what is stated, and refer to the general rule rather than the exception to the rule.

4. There is only one correct and complete answer to each item.

5. If you find you have difficulty with a particular test item, do not spend too much time on it. Go to the items that you can answer readily, then return to the difficult items.

6. If you have solved a computer-type problem correctly, your answer will be closer to the correct answer than to any of the other choices. The correct answer is an average of solutions obtained by using several types of computers.

7. When marking the test answer sheet be sure that the number of the question matches the number on the answer sheet and that you mark only one answer block per question. An answer block for a test question that is left blank, a partially erased answer block, or more than one answer block marked is scored as wrong. Carefully check your answer sheet for these types of errors before turning it in.

RECOMMENDED STUDY MATERIALS

Professionalism in instruction is very important. One thing that enhances professionalism is the possession of a technical library. By obtaining study materials that are beneficial and appropriate to preparation for certification, the prospective instructor will be laying the foundation upon which to build an aeronautical library.

The following list of source material outlines essential publications produced by the FAA but does not include all the useful and available material that is produced commercially. Other excellent textbooks, audio-visual training aids, and instructional materials may be obtained from various commerical bookstores and fixed-base operators engaged in flight training.

A. Advisory Circulars.

1. AC 00–6A, *Aviation Weather.* Contains a text for pilots and other flight operations personnel whose interest in meteorology is primarily in its application to flying. (Sup't. Doc's.)

2. AC 00–45, *Aviation Weather Services.* Supplements AC 00–6A, and explains the use and interpretation of reports, forecasts, weather maps, and prognostic charts. (Sup't. Doc's.)

3. AC 61–16A, *Flight Instructor's Handbook.* Designed to give guidance and information to applicants preparing for ground and flight instructor certificates. It explains accepted theories and practices applicable to teaching and the learning process. It is also reference material for applicants preparing for Fundamentals of Instructing Written Test. (Sup't. Doc's.)

4. *Aviation Instructor's Handbook.* (Available in the near future.) In the process of being developed to replace Flight Instructor's Handbook AC 61–16A. It is being designed to provide currently certificated flight and ground instructors and applicants for such certificates, with comprehensive, accurate, and easily understood information on learning and teaching, and to relate this information to the aviation instructor's task of conveying aeronautical knowledge and skill to students.

5. AC 61-23A, *Pilot's Handbook of Aeronautical Knowledge.* Contains essential, authoritative information used in training and guiding private pilots, and covers most subject areas in which an applicant may be tested. Explains the use of the Airman's Information Manual, the data in FAA-approved airplane flight manuals, and the basic instruments for airplane attitude control. (Sup't. Doc's.)

6. AC 61-21, *Flight Training Handbook.* Contains information and direction in the introduction and performance of training maneuvers for student pilots, pilots who are requalifying or preparing for additional ratings, and for flight instructors. (Sup't. Doc's.)

7. AC 61-32A, *Private Pilot Written Test Guide.* Contains information, guidelines, and sample test items to assist applicants for the Private Pilot Certificate in attaining necessary aeronautical knowledge. (Sup't. Doc's.)

8. AC 61-71, *Commercial Pilot Written Test Guide.* Reflects current operating procedures and techniques for use in preparing for the Commercial Pilot-Airplane Written Test. (Sup't. Doc's.)

9. AC 90-23D, *Wake Turbulence.* Presents information on the subject of wake turbulence and suggests techniques that may help pilots avoid the hazards associated with wingtip vortex turbulence. (FREE) FAA

10. AC 91-15, *Terrain Flying.* This pocket-size booklet contains observations, opinions, warnings, and advice from veteran pilots regarding flight over various types of terrain throughout the U.S. (Sup't. Doc's.)

11. AC 20-9, *Personal Aircraft Inspection Handbook.* This is a general guide for inspection of aircraft; Part I deals with the fundamentals of inspection, and Part II covers a typical inspection in detail.

12. AC 91-23, *Pilot's Weight and Balance Handbook.* Contains a text on aircraft weight and balance. It progresses from an explanation of basic fundamentals to the complete application of weight and balance principles. (Sup't. Doc's.)

B. **Airman's Information Manual (AIM).** Contains information necessary for planning and conducting flights within the National Airspace System. Besides providing the most current airport and NAVAID data, AIM includes material of interest to everyone in aviation.

To better serve pilots, AIM is available in five parts which may be purchased separately on an annual basis.

Part 1. *Basic Flight Manual and ATC Procedures.* Issued semiannually. (Sup't. Doc's.)

Part 2. *Airport Directory.* Issued semiannually. (Sup't. Doc's.)

Part 3. *Operational Data and Notices to Airmen.* Issued every 56 days. (Sup't. Doc's.)

Part 3A. *Notices to Airmen.* Issued every 14 days. (Sup't. Doc's.)

Part 4. *Graphic Notices and Supplemental Data.* Issued quarterly. (Sup't. Doc's.)

C. **Federal Aviation Regulations (FAR).**

Part 1, Definitions and Abbreviations (Sup't. Doc's.)

Part 61, Certification: Pilots and Flight Instructors (Sup't. Doc's.)

Part 71, Designation of Federal Airways, Area Low Routes, Controlled Airspace and Reporting Points (Sup't. Doc's.)

Part 91, General Operating and Flight Rules (Sup't. Doc's.)

Part 135, Air Taxi Operators and Commercial Operators of Small Aircraft (Sup't. Doc's.)

D. **National Transportation Safety Board Regulation (NTSB), Part 830.** Deals with procedures required in the notification and reporting of accidents and lost or overdue aircraft within the United States, its territories, and possessions. (FREE) from NTSB

E. **VFR/IFR Pilot Exam-O-Grams.** Provides information about concepts and procedures critical to aviation safety. Lists of current Exam-O-Grams appear in Figures 20 and 21 of the Appendix. (FREE) FAA

F. **Practical Air Navigation**—10th Edition. Provides coverage dealing with navigation including pilotage, dead reckoning, radio, and celestial navigation. This text may be obtained from many book dealers or from the publisher, Jeppesen & Co., 8025 East 40th Ave., Denver, Colorado 80209.

G. **Aeronautical Charts.** The National Ocean Survey publishes and distributes aeronautical charts of the United States.

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

National Ocean Survey
Distribution Division, (C–44)
Riverdale, Maryland 20840

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

HOW TO OBTAIN REFERENCE PUBLICATIONS

The reference materials listed, except for free Advisory Circulars, Exam-O-Grams, Aeronautical Charts, and Practical Air Navigation, may be obtained by sending a check or money order to:

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

To obtain the latest information regarding prices of Federal Aviation Regulations, number of changes, and ordering information, request a free copy of Advisory Circular 00–44, "Status of Federal Aviation Regulations" from:

U.S. Department of Transportation
Publications Section, TAD–443.1
Washington, D.C. 20590

Free FAA publications may also be obtained from this address.

If you are presently on one of FAA's Advisory Circular mailing lists, you will receive Advisory Circular 00–44. If not, and you wish to be on the list to receive current copies as issued, send your name and address to:

U.S. Department of Transportation
Distribution Unit, TAD–482.3
Washington, D.C. 20590

To receive the latest information on how to obtain the Airman's Information Manual, free Advisory Circulars, and other FAA material, consult the Advisory Circular Checklist, AC 00–2. A copy of this checklist may be obtained free of charge by sending your request to:

U.S. Department of Transportation
Publications Section, TAD–443.1
Washington, D.C. 20590

National Transportation Safety Board Regulation, Part 830, may be obtained free of charge upon request from:

National Transportation Safety Board
Publications Unit
Washington, D.C. 20594

Exam-O-Grams may be obtained free of charge (one copy per each request), and names may be added to the mailing list by writing to:

U.S. Department of Transportation
FAA Aeronautical Center
Flight Standards National Field Office
Examinations Branch, AFS–590
P.O. Box 25082
Oklahoma City, Oklahoma 73125

STUDY OUTLINE

This outline is primarily for use with AC 60–14 "Aviation Instructor's Handbook," but will also be useful when used with AC 61–16A, Flight Instructor's Handbook.

Fundamentals of Instructing

I. The Learning Process

A. Definition of Learning.

B. Characteristics of Learning.
1. Learning is purposeful.
2. Learning comes through experience.
3. Learning is multifaced.
4. Learning is an active process.

C. Laws of Learning.
1. Law of readiness.
2. Law of exercise.
3. Law of effect.
4. Law of primacy.
5. Law of intensity.
6. Law of recency.

D. How People Learn.
   1. Perceptions.
   2. Factors which affect perception.
   3. Insights.
   4. Motivation.

E. Levels of Learning.

F. Learning Skills.
   1. Physical skills involve more than muscles.
   2. Desire to learn.
   3. Patterns to follow.
   4. Perform the skill.
   5. Knowledge of results.
   6. Progress follows a pattern.
   7. Duration and organization of lesson.
   8. Evaluation versus critique.
   9. Application of skill.

G. Forgetting and Retention.
   1. Theories of forgetting.
   2. Retention of learning.

H. Transfer of Learning.

I. Habit Formation.

II. Human Behavior.

A. Control of Human Behavior.

B. Human Needs.
   1. Physical needs.
   2. Social needs.
   3. Egoistic needs.
   4. Self-fulfillment needs.

C. Defense Mechanisms.
   1. Rationalization.
   2. Flight.
   3. Aggression.
   4. Resignation.

D. The Instructor's Role in Human Relations.
   1. Keep students motivated.
   2. Keep students informed.
   3. Approach students as individuals.
   4. Give credit when due.
   5. Criticize constructively.
   6. Be consistent.
   7. Admit errors.

III. Effective Communications.

A. Basic Elements of Communication Process.
   1. Source.
   2. Symbols.
   3. Receiver.

B. Barriers to Effective Communications.
   1. Lack of common core of experience.
   2. Confusion between the symbol and the thing symbolized.
   3. Overuse of abstractions.

IV. The Teaching Process.

A. Preparation.

B. Presentation.

C. Application.

D. Review and Evaluation.

V. Teaching Methods.

A. Organizing Material.
   1. Introduction.
   2. Development.
   3. Conclusion.

B. Lecture Method.
   1. Types of lectures.
   2. Teaching lecture.
   3. Preparing the teaching lecture.
   4. Suitable language.
   5. Types of delivery.
   6. Use of notes.
   7. Formal versus informal lectures.
   8. Advantages and disadvantages of the lecture.

C. Guided Discussion Method.
   1. Use of questions in a guided discussion.
   2. Planning a guided discussion.
   3. Student preparation for a guided discussion.
   4. Guiding a discussion—instructor technique.
   5. Conclusion.

D. Demonstration/Performance Method.
   1. Explanation phase.
   2. Demonstration phase.
   3. Student performance and instructor supervision phases.
   4. Evaluation phase.

E. Programed Instruction.
   1. General discussion.
   2. One method of programming.

VI. The Instructor as a Critic.

A. Purpose of a Critique.

B. Characteristics of an Effective Critique.

A critique should be—objective
—flexible
—acceptable
—comprehensive
—constructive
—well organized
—thoughtful
—specific

C. Methods of Critique.
   1. Instructor—student critique.
   2. Student-led critiques.
   3. Small-group critiques.
   4. Individual student critique.
   5. Written critique.
   6. Self-critique.

D. Ground Rules for Critiquing.

VII. Evaluation.

A. Oral Quizzing.
   1. Characteristics of effective questions.
   2. Types of questions to avoid.
   3. Answering students' questions.

B. Written Tests.
   1. Characteristics of a good test.
   2. Written test items.
   3. Effective item writing.
   4. Principles to follow.

C. Performance Tests.

VIII. Instruction Aids.

A. Theory Behind Use of Instructional Aids.

B. Reasons for Using Instructional Aids.

C. Guidelines for Use of Instructional Aids.

D. Types of Instructional Aids.
   1. Chalkboard.
   2. Models.
   3. Charts.
   4. Projected material.

E. Future Developments.

IX. Flight Instructor Characteristics and Responsibilities.

A. Professionalism.
   1. Sincerity.
   2. Acceptance of the student.
   3. Personal appearance and habits.
   4. Demeanor.
   5. Safety practices and accident prevention.
   6. Proper language.
   7. Self improvement.

B. Helping Student Pilots Learn.
   1. Providing adequate instruction.
   2. Demanding an adequate standard of performance.
   3. Emphasizing the "positive."

C. Evaluation of Student Piloting Ability.

D. The Flight Instructor as a Practical Psychologist.
   1. Anxiety.
   2. Normal reactions to stress.
   3. Abnormal reaction to stress.
   4. Instructor's actions regarding seriously abnormal students.

E. Student Pilot Supervision and Surveillance.

F. Flight Instructor Endorsements.

G. Flight Test Recommendations.

H. Airplane Checkouts.

I. Refresher Training.

X. Techniques of Flight Instruction.

A. The "Telling and Doing" Technique in Flight Instruction.
   1. Instructor tells—instructor does.
   2. Student tells—instructor does.
   3. Student tells—student does.
   4. Student does—instructor evaluates.

B. The Integrated Technique of Flight Instruction.
   1. Objectives.
   2. Development of habit patterns.
   3. Accuracy of flight control.
   4. Operating efficiency.
   5. Emergency capability.
   6. Procedures.
   7. Precautions.
   8. Flight instructor qualifications.

C. Obstacles to Learning During Flight Instruction.

XI. Planning Instructional Activity.

A. Course of Training.
1. Determination of standards and objectives.
2. Identification of blocks of learning.

B. Training Syllabus.
1. Sample Private Pilot (Airplane) ground training syllabus.
2. Sample Private Pilot (Airplane) flight training syllabus.

C. Lesson Plan.
1. Purpose of the lesson plan.
2. Characteristics of a well-planned lesson.
3. How to use a lesson plan properly.
4. Lesson plan items.

Aeronautical Knowledge Study References

I. Federal Aviation Regulations.

A. Parts 1 and 71: Definitions and Abbreviations, and Controlled Airspace.
1. Air commerce.
2. Airport traffic area.
3. Ceiling.
4. Commercial operator.
5. Flight level.
6. Flight visibility.
7. Interstate air commerce.
8. Large aircraft.
9. Major alteration.
10. Major repair.
11. Pilot in command.
12. Second in command.
13. Federal airway.
14. Control area.
15. Continental control area.
16. Control zone.
17. Route segment.
18. Terminal control area.
19. Positive control area.

B. Part 61: Certification: Pilots and Flight Instructors.
1. Required certificates/ratings.
2. Certificates and ratings issued.
3. Expired pilot certificates/reissuance.
4. Carriage of narcotic drugs/marihuana.
5. Duration of pilot certificates.
6. Duration of medical certificates.
7. General limitations
8. Pilot logbooks.
9. Operations during known medical deficiency.
10. Second in command qualifications.
11. Recent experience: Pilot in command.
12. Pilot in command proficiency check.
13. Falsification, reproduction, alteration.
14. Change of address.
15. Private pilot privileges/limitations.
16. Commercial pilot privileges/limitations.

C. Part 91: General Operating and Flight Rules—Subpart A—General.
1. Responsibility of pilot in command.
2. Pilot in command/more than one pilot.
3. Preflight action.
4. Flight crewmembers at stations.
5. Interference with crewmembers.
6. Careless or reckless operation.
7. Liquor and drugs.
8. Dropping objects.
9. Fastening of safety belts.
10. Parachutes and parachuting.
11. Portable electronic devices.
12. ATC transponder equipment requirements.
13. Civil aircraft: certificates required.
14. Aircraft airworthiness.
15. Aircraft operating limitations/markings.
16. Supplemental oxygen.
17. Instrument and equipment requirements.
18. Limited/restricted aircraft limitations.
19. Ferry flight with one engine inoperative.
20. Emergency exits for airplanes.
21. Aural speed warning device.
22. Emergency locator transmitters.
23. Report: aircraft identification/activity.

D. Part 91: General Operating and Flight Rules—Subpart B—Flight Rules.

1. Waivers.
2. Operating near other aircraft.
3. Right-of-way rules.
4. Aircraft speed.
5. Acrobatic flight.
6. Aircraft lights.
7. Complying—ATC clearances/instructions.
8. ATC light signals.
9. Minimum safe altitudes; general.
10. Altimeter settings.
11. Flight plan; information required.
12. Operation—in vicinity of airport.
13. Operation—airport with control tower.
14. Operation—airport without control tower.
15. Flight in terminal control areas.
16. Temporary flight restrictions.
17. Flight test areas.
18. Restricted and prohibited areas.
19. Positive control areas; route segments.
20. Basic VFR weather minimums.
21. Special VFR weather minimums.
22. VFR cruising altitude or flight level.
23. ATC transponder test/inspection.

E. Part 91: General Operating and Flight Rules—Subpart C—Maintenance, Preventive Maintenance, and Alterations.

1. General maintenance and alterations.
2. Maintenance required.
3. Carrying persons after repair/alteration.
4. Inspections/progressive inspections.
5. Altimeter system tests/inspections.
6. Maintenance records/transfer of records.
7. Rebuilt engine maintenance records.
8. ATC transponder test/inspection.

F. Part 135: Air Taxi Operators and Commercial Operators of Small Aircraft.

1. SubpartA—General.
2. Subpart B—Rules—ATCO certificate holder.
3. Subpart C—Operating rules.
4. Subpart D—Crewmember qualifications.
5. Subpart E—Aircraft and equipment.

II. National Transportation Safety Board—Part 830.

A. General.

1. Applicability.
2. Definitions.

B. Initial Notification of Aircraft Accidents, Incidents, and Overdue Aircraft.

1. Immediate notification.
2. Information to be given in notification.

C. Preservation of Aircraft Wreckage, Mail, Cargo, and Records.

D. Reporting of Aircraft Accidents, Incidents, and Overdue Aircraft.

III. FAA Advisory Circulars.

A. Series 00—General.

B. Series 20—Aircraft.

C. Series 60—Airmen.

D. Series 70—Airspace.

E. Series 90—Air Traffic Control and General Operations.

F. Series 120—Air Carrier and Commercial Operators and Helicopters.

G. Series 150—Airports.

H. Series 170—Air Navigation Facilities.

IV. Airman's Information Manual.

A. Part 1: Basic Flight Manual and ATC Procedures.

1. Glossary of aeronautical terms.
2. Airport lighting/marking/aids.
3. Air navigation radio aids.
4. Visual approach slope indicator (VASI).
5. Controlled/uncontrolled airspace.
6. Operating at nontower airports.
7. Special use airspace—prohibited, restricted, MOA's, alert areas.
8. Automatic terminal information service (ATIS).
9. ATC departure/en route/arrival procedures.
10. Radar traffic information service.
11. Terminal radar program for VFR aircraft.

12. Aeronautical advisory stations (UNICOM).
13. Radio/telephone phraseology/technique.
14. Traffic/wind direction indicators.
15. Obtaining weather information/briefing.
16. Flight plans.
17. VHF/UHF direction finder.
18. ADIZ and designated mountainous areas.
19. Medical facts for pilots.
20. Good operating practices.

B. Part 2: Airport Directory.
1. Obtaining airport/heliport data.
2. FSS/Weather service telephone numbers.

C. Part 3: Operational Data and Notices to Airmen.
1. Obtaining radio facility/FSS data.
2. Special notices/special operations.
3. Notices to Airmen (NOTAMS).
4. VOR receiver checkpoints.
5. Restrictions to en route navigation aids.
6. Special notices.

D. Part 3A: Notices to Airmen.

E. Part 4: Graphic Notices and Supplemental Data.
1. Parachute jumping areas.
2. Military training routes.
3. Terminal control areas (TCA's).
4. Terminal area graphic notices.
5. Terminal radar service areas (TRSA's).

V. Aviation Weather, AC 00-6A.

A. The Earth's Atmosphere.
1. Composition.
2. Vertical structure.
3. The standard atmosphere.
4. Density and hypoxia.

B. Temperature.
1. Temperature scales.
2. Heat and temperature.
3. Temperature variation.

C. Atmospheric Pressure and Altimetry.
1. Atmospheric pressure.
2. Altimetry.

D. Wind.
1. Convection.
2. Pressure gradient force.
3. Coriolis force.
4. The general circulation.
5. Friction.
6. The jet stream.
7. Local and small scale winds.
8. Wind shear.
9. Wind, pressure systems, and weather.

E. Moisture, Cloud Formation, and Precipitation.
1. Water vapor.
2. Change of state.
3. Cloud formations.
4. Precipitation.
5. Land and water effects.

F. Stable and Unstable Air.
1. Changes within upward and downward moving air.
2. Stability and instability.

G. Clouds.
1. Identification.
2. Signposts in the sky.

H. Air Masses and Fronts.
1. Air masses.
2. Fronts.
3. Fronts and flight planning.

I. Turbulence.
1. Convective currents.
2. Obstructions to wind flow.
3. Wind shear.
4. Wake turbulence.

J. Icing.
1. Structural icing.
2. Induction system icing.
3. Instrument icing.
4. Icing and cloud types.
5. Other factors in icing.
6. Ground icing.
7. Frost.

K. Thunderstorms.
1. Where and when?
2. They just don't happen.
3. The inside story.
4. Rough and rougher.
5. Hazards.
6. Thunderstorms and radar.
7. Do's and don'ts of thunderstorm flying.

L. Common IFR Procedures.
   1. Fog.
   2. Low stratus clouds.
   3. Haze and smoke.
   4. Blowing restrictions to vision.
   5. Precipitation.
   6. Obscured or partially obscured sky.

VI. Aviation Weather Services, AC 00–45.

A. The Aviation Weather Service Program.
B. Surface Aviation Weather Reports.
C. Pilot and Radar Reports.
D. Aviation Weather Reports.
E. Surface Analysis.
F. Weather Depiction Chart.
G. Radar Summary Chart.
H. Significant Weather Prognostics.
I. Winds and Temperatures Aloft.
J. Freezing Level Chart.
K. Stability Chart.
L. Severe Weather Outlook Chart.
M. Constant Pressure Charts.
N. Constant Pressure Prognostics.
O. Tables and Conversion Charts.

VII. Aerodynamics and Principles of Flight.

A. Laws of motion.
B. Functions of the flight controls.
C. Principles of airfoils.
D. Wing planform.
   1. Area/span/chord.
   2. Aspect ratio/taper/sweepback.
   3. Effect of planform on stall patterns.
E. Forces acting on an airplane.
F. Flight controls/axes of an airplane.
G. Lift/drag during turns.
H. Lift versus angle of attack.
I. Lift/thrust versus air density.
J. Types/effect of flaps. spoilers, divebrakes.
K. Effect of flaps on lift/drag/trim.
L. Effect of ice/snow/frost on airfoils.
M. Power versus climb/descent/level flight.
N. Gyroscopic precession.
O. Types and effect of drag—induced/parasite/profile.
P. Ground effect.
Q. Loads/load factors.
R. Stability—static and dynamic/longitudinal/lateral/directional.
S. Stalls/spins.
T. Relative wind/angle of attack.
U. Effect of wind during turns.
V. Torque effects—"P" factor.

VIII. Aircraft Operation.

A. General.
   1. Preflight/postflight safety practices.
   2. Use of proper fuel grade/type.
   3. Fuel contamination—prevention/elimination.
   4. Fuel system operation.
   5. Proper loading of the aircraft.
   6. Use of mixture/throttle/propeller control.
   7. Taxiing during strong surface winds.
   8. Normal takeoff/landing.
   9. Crosswind takeoff/landing.
   10. Maximum performance takeoff/landing.
   11. Retractable landing gear operation.
   12. Flap operation.
   13. Controllable pitch propeller operation.
   14. Aircraft operating limitations.
   15. Maneuvering speed.
   16. Supercharged engine operation.
   17. High altitude operations/pressurization.
   18. Use of supplemental oxygen and oxygen equipment.
   19. Multiengine critical engine failure.
   20. Recovery from critical flight situations.
   21. Midair collision avoidance precautions.
   22. Wake turbulence—causes/precautions.
   23. Emergency landings.

B. Performance.
   1. Takeoff charts.
   2. Rate of climb charts.
   3. Cruise charts.
   4. Maximum safe crosswind charts.
   5. Use of Denalt computer.
      a. Fixed pitch propeller.
      b. Variable pitch propeller.
   6. Landing charts.
   7. Stall speed charts.
   8. Airspeed correction charts.
   9. Computing density/pressure altitudes.
   10. Effect of density altitude on performance.
   11. Effect of weight/balance on performance.
   12. Critical performance speeds—"V" speeds.
   13. Effect of wind on aircraft performance.
   14. Bank/speed versus rate/radius of turns.
   15. Stall speed versus altitude or attitude.
   16. Stall speed versus indicated/true airspeed.

17. Obstacle clearance takeoff/landing.
18. Best angle/rate of climb.
19. Computations of gross weight/useful load.
20. Computation of center of gravity.

IX. Engine Operation.

A. Reciprocating Engine Principles.
B. Engine Oil System.
C. Ignition or Electrical Systems/Units.
D. Fuel Injection/Carburetor Principles.
E. Engine Controls.
F. Engine Starting/Shutdown.
G. Manifold Pressure Versus RPM.
H. Detonation Cause/Effect.
I. Carburetor Icing—Cause/Detection/Elimination.
J. Carburetor Heat Effect on Fuel Mixture.
K. Interpreting Engine Instruments.
L. Emergency—Engine/Systems/Equipment/Fire.

X. Flight Instruments and Systems.

A. Attitude Indicator Operation/Errors.
B. Heading Indicator Operation/Errors.
C. Turn Indicator/Coordinator.
D. Altimeter Operation/Errors.
E. Vertical Speed Indicator Operation/Errors.
F. Airspeed Indicator Operation/Errors.
G. Vacuum Systems/Instruments.
H. Pitot-Static Systems/Instruments.
I. Magnetic Compass Operation/Errors.
J. Altimeter Setting Procedure/Significance.
K. Pressure Altitude Significance/Obtaining.
L. Gyroscopic Principles.

XI. Radio Communications.

A. VHF radio Communications/Phraseology.
B. Position Reporting Procedures.
C. Tower/FSS/Enroute Advisories/Instructions.
D. FSS Communications Procedures.
E. Obtaining Emergency Assistance.
F. Lost Procedure When Radio is Inoperative.
G. Use of Proper Communications Frequencies.

XII. Instrument Flying Procedures.

A. Components of Attitude Instrument Flying.
B. Pitch, Bank, Power Control.
C. Straight-and-Level Flight.
D. Turns/Turns to Predetermined Headings.
E. Constant Rate Climbs/Descents/Level-offs.
F. Constant Speed Climbs/Descents/Level-offs.
G. Magnetic Compass Turns.
H. Effect of Changes in Airspeed.
I. False Sensations in Filght.

XIII. Navigation.

A. General.
1. Sectional chart interpretation.
2. Relating chart symbols to regulations.
3. Pilotage/recognition of landmarks.
4. Determining courses/distances on charts.
5. Navigation computer principles.
6. Computing heading/courses.
7. Computing time, distance, speed, fuel.
8. Computing rates of climb/descent.
9. Computing wind directions/speed in-flight.
10. Computing off-course corrections.
11. Selecting VFR cruising altitudes.
12. Planning traffic pattern entry.

B. Radio.
1. Characteristics of VOR facilities.
2. Tuning VOR receivers.
3. Identifying VOR stations.
4. VOR interpretation/orientation.
5. Intercepting VOR radials.
6. Tracking VOR radials.
7. Groundspeed checks using VOR radials.
8. VOR frequency interference.
9. VOR test signals/VOR receiver checks.
10. Characteristics of ADF facilities.
11. Tuning ADF receivers.
12. Identifying stations used for ADF.
13. ADF/RMI interpretation/orientation.
14. Intercepting ADF/RMI bearings.
15. Tracking ADF/RMI bearings or "homing."
16. Marker beacons/outer compass locators.

SAMPLE TEST ITEMS

It is recommended that a study program be completed prior to answering the sample test items. When the program is completed, answer the sample test items without referring to the study material or the answer (with explanation) which follows each sample test item. Should the answer chosen differ from the one given as the correct answer, return to the study materials recommended in the appropriate study outline for verification.

The following test item samples are included to acquaint applicants with the format used in the construction of FAA written tests. They *do not* include all of the topics on which the applicant will be tested. For this reason, applicants should concentrate on the sections entitled "Study Outline, Fundamentals of Instructing," and "Study Outline, Aeronautical Knowledge." A knowledge of all the topics presented in the two outlines, not just the ability to answer these few sample test items, should be the goal in preparing for the written tests in either of the two certification areas.

Some of the test items refer to certain illustrations located in the Appendix. The illustrations are representative of those used in the Ground Instructor—Basic and Advanced Written Tests.

Fundamentals of Instructing

Sample Test Items

1. Motivation is probably the dominant force which governs the student's progress and ability to learn. One of the more effective means of properly motivating a student is to
   1—assign tasks which are somewhat beyond the student's ability.
   2—praise good performances and keep the student aware of progress.
   3—keep interest high by reminding the student of the final goal.
   4—tell the student that hard work is a must or failure is certain.

Answer. Response 2. In group instruction, praising and giving credit to students who have performed well not only encourages those praised, but also may motivate others in the group to greater efforts. Negative motivations in the form of reproof and threats should be avoided with all but the most overconfident and impulsive students.

2. When students cannot accept the real reason for their behavior, they may attempt to alleviate their feelings of guilt by relying on the defense mechanism called
   1—aggression.
   2—resignation.
   3—flight.
   4—rationalization.

Answer. Response 4. If a student cannot accept the real reason for his behavior, he may rationalize.

3. Evoking "insights" as applied to learning is one of the flight instructor's major responsibilities. Insights as applied to learning
   1—involve the grouping of preceptions into meaningful wholes.
   2—pertain to the student's grasp of theoretical principles taught in ground school.
   3—concern the analysis of the student by the instructor.
   4—concern the ability of the student to discover the reason for a procedure or a maneuver already learned.

Answer. Response 1. Instruction speeds the learning process by teaching the relationship of perceptions as they occur, thus promoting the development of insight by the student. The mental relating and grouping of associated perceptions is called insight.

4. Without perception, can learning take place?
   1—Yes; real meaning (learning) comes from external stimuli, while perceptions come only from within.
   2—Yes, but only when motivation is strong enough to overcome the lack of perceptual cues.
   3—No; perceptions are the basis of all learning.
   4—Yes; learning takes place when a person gives meaning to one's insights, while perceptions merely involve the grouping of insights into meaningful wholes.

Answer. Response 3. Initially, all learning comes from perceptions which are directed to the brain by one or more of the five senses (sight, hearing, touch, smell, and taste). Real meaning comes only from within a person, even though the sensations which evoke these meanings result from external stimuli. Because the meaning which is derived from the information furnished by the senses may depend on many factors within each person concerned, and because perceptions are the basis of all learning, a knowledge of the factors which affect the perceptual process is very important to the instructor.

5. For presenting new material, the lecture method is excellent—and is most effective when
   1—facts and ideas are to be formulated during the presentation.
   2—accompanied by training devices and visual aids.
   3—motor skills are to be taught.
   4—notes are used extensively.

Answer. Response 2. The lecture method is suitable for presenting new material, for summarizing ideas, and for relationships between theory and practice. For example, it is suitable for the presentation of a ground school lesson on basic instrument flying. This method is most effective if accompanied by visual aids and training devices.

6. Reviews are an integral part of each lesson; before the completion of the instruction period, the instructor should review what has been covered during the lesson to
   1—ensure that the student is aware of progress to date.
   2—identify the blocks of learning which constitute the necesasry parts of the total objective.
   3—improve the students' grades based upon the objectives and goals of the lesson plan and syllabus.
   4—emphasize the competitive nature of the learning situation.

Answer. Response 1. Review and evaluation are integral parts of each lesson. Before the completion of the instruction period, the instructor should review what has been covered during the lesson, and require the student to demonstrate the extent to which lesson objectives have been met. The student should be aware of progress, and the advances and deficienices noted at the conclusion of the lesson.

7. The highest level of learning has been achieved when the student is able to
   1—correlate what has been learned with other things previously learned.
   2—apply the skill that has been learned.
   3—repeat back something that has been taught.
   4—understand what has been taught.

Answer. Response 1. Learning may be accomplished at any of several levels. The lowest level, rote learning, is the ability to repeat back something which one has been taught without understanding or without being able to apply what has been learned. Progressively higher levels of learning are understanding what has been taught, achieving the skill to apply what has been learned and to perform correctly, and associating and correlating what has been learned with other things previously learned or subsequently encountered.

8. Which statement is true regarding effective communication?
   1—Effective communication has taken place when the receiver acknowledges receipt of the information.
   2—Unless a common core of experience exists between the communicator and the receptor, effective communication will be difficult to achieve.
   3—The most effective communicator relies on a single, proven channel to transmit ideas.
   4—To be most effective as a communicator, an instructor should use abstract words as much as possible.

Answer. Response 2. Probably the greatest single barrier to effective communication is the lack of a common core of experience between communicator and receptor. Communication can be effective only to the extent that the experiences—physical, mental, or emotional—of the people concerned are similar.

9. Flight instructors can minimize student anxiety by
   1—keeping the student busy while airborne.
   2—giving brisk instruction.
   3—terminating the flight period immediately upon detecting student fear.
   4—emphasizing the positive rather than the negative experiences of flying.

Answer. Response 4. Student anxieties can be minimized throughout training by emphasizing the benefits and pleasurable experiences which can be derived from flying, rather than continuously citing the unhappy consequences of faulty performance.

10. To be effective, a critique should
    1—reflect instructor likes, dislikes, and personal opinions.
    2—emphasize the negative aspects of student performance.
    3—be subjective, dogmatic, and comprehensive in nature.
    4—focus on student performance.

Answer. Response 4. The effective critique is focused on student performance and should not reflect the personal opinions, likes, dislikes, or biases of the instructor.

Aeronautical Knowledge

Sample Test Items

1. Each pilot in command is required to become familiar with all available information concerning a proposed flight. This information must include available weather reports and forecasts for
   1—IFR cross-country flights only.
   2—all IFR and VFR cross-country flights.
   3—all flights which carry passengers.
   4—all flights for hire.

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

2. Assume that you have a Second-Class Medical Certificate dated July 5, 1976, and your Commercial Pilot Certificate was issued August 1, 1976. Under these circumstances, you could continue to exercise the privileges of
   1—either a private or commercial pilot until September 1, 1977.
   2—neither a private nor a commercial pilot after July 5, 1977.
   3—a commercial pilot until August 1, 1977, and those of a private pilot until August 1, 1978.
   4—a commercial pilot only until July 5, 1977, and those of a private pilot until July 5, 1978.

Answer. Response 3. A Commercial Pilot Certificate has no specific expiration date and the issuance date is irrelevant to the situation. To be valid, however, the pilot must possess a current, appropriate medical certificate. For operations requiring a Commercial Pilot Certificate, the second-class medical certificate expires at the end of the last day of the 12th month after the month in which it is issued. Thus, commercial pilot privileges may be exercised until August 1, 1977. For operations requiring only a Private Pilot Certificate, a second-class medical certificate expires at the end of the last day of the 24th month after the month in which it is issued. In this case, private pilot privileges may be exercised until August 1, 1978.

3. Accident reporting procedures are contained in
   1—National Transportation Safety Board Regulation, Part 830.
   2—Federal Aviation Regulations, Part 61.
   3—Federal Aviation Regulations, Part 91.
   4—Federal Aviation Regulations, Part 141.

Answer. Response 1. See NTSB Regulation, Part 830, effective July 17, 1975. Pilots should be familiar with rules pertaining to aircraft accidents, in-flight hazards, overdue aircraft, and safety investigations.

4. Appropriate VFR cruising altitudes are required to be maintained when an aircraft is operated more than 3,000 feet above the surface. The appropriate altitude is determined by the

   1—true course being flown.

   2—magnetic course being flown.

   3—magnetic heading being flown.

   4—magnetic bearing being flown.

Answer. Response 2. FAR 91.109 requires that all aircraft operating under VFR in level cruising flight at an altitude of more than 3,000 feet above the surface and below 18,000 feet MSL shall: Maintain an odd-thousand-foot MSL altitude +500 feet when operating on a magnetic course of 0° through 179°; and an even-thousand-foot MSL altitude +500 feet when operating on a magnetic course of 180° through 359°.

5. Areas of forecast icing conditions aloft can be determined by referring to

   1—Weather Depiction Charts.

   2—Aviation Sequence Reports.

   3—Area Forecasts.

   4—Terminal Forecasts.

Answer. Response 3. Refer to AC 00-45, Aviation Weather Services, page 44, which states: "The contraction ICG identifies the icing section which gives location, type, and extent of expected icing. It always includes the freezing level in hundreds of feet ASL. It may contain qualifying terms such as 'ICG LKLY,' icing likely; 'MDT MXD ICGIC ABV FRZLVL,' moderate mixed icing in clouds above the freezing level."

6. What is the most important function of a rudder during coordinated flight?

   1—The rudder prevents skids.

   2—The rudder turns the airplane.

   3—Applying rudder overcomes the asymmetrical thrust of the propeller as a turn is initiated.

   4—Properly applied, the rudder helps to overcome the effects of adverse yaw and torque.

Answer. Response 4. The rudder controls movement of the airplane about its vertical axis. Movement about the vertical axis is called yaw. The displacement of the ailerons as an aircraft rolls into or out of a turn induces aileron drag. When the ailerons alone are used to roll into a turn, the aircraft will tend to yaw opposite to the direction of turn. Deflection of the ailerons increases the lift on the outside wing and decreases the lift on the inside wing. The drag is proportionately increased on the outside wing, resulting in the yawing effect known as "aileron drag" or "adverse yaw." The function of the rudder in a correctly executed entry into and recovery from a turn is to counteract aileron drag. The rudder is also used to counteract yaw caused by engine torque.

7. When considering the forces acting upon an airplane in straight-and-level flight at a constant airspeed, which statement is true?

   1—Weight always acts vertically toward the center of the earth.

   2—Drag always acts rearward parallel to relative wind and is less than thrust.

   3—Thrust always acts forward parallel to the relative wind and is greater than drag.

   4—Lift always acts perpendicular to the longitudinal axis of the wing and is greater than weight.

Answer. Response 1. Gravity, the downward acting force, tends to draw all bodies toward the center of the earth. Lift, the upward acting force, must equal gravity, the downward acting force, in straight-and-level unaccelerated flight.

8. When operating powered aircraft at high density altitudes, you should expect

   1—increased profile, parasite, and induced drag.

   2—increased engine and propeller efficiency.

   3—improved acceleration to takeoff speed, but a slower rate of climb.

   4—a significant decrease in takeoff and climb performance.

Answer. Response 4. Refer to AC 00-6A, Aviation Weather, page 20, which states: "Density altitude is not a height reference; rather it is an index to aircraft performance, low density altitude increases performance. *High*

density altitude can be a real hazard, since it *reduces aircraft performance.* It affects performance in three ways; (1) it reduces power because the engine takes in less dense air to support combustion, (2) it reduces thrust because the propeller is less effective in less dense air or a jet engine has less thrust due to the less dense air, (3) it reduces lift because the less dense air exerts less force on the airfoils."

9. Given:

Magnetic Heading	185°
Relative Bearing	045°

Based on the given information, the magnetic bearing to the station would be approximately

1—045°.

2—140°.

3—185°.

4—230°.

Answer. Response 4. By adding the magnetic heading (185°) to the relative bearing (045°), the magnetic bearing (230°) to the station is verified (MH + RB = MB).

10. Using the appropriate information in Figure 31 and the charts in Figures 35 and 36 of the Appendix, determine the center of gravity of the Condor 410 under the following conditions:

Pilot and front passenger weight	360.0 lbs.
Rear passenger weight	120.0 lbs.
Baggage	100.0 lbs.
Fuel	63.5 gals.
Oil	12.0 qts.

Under these conditions, the center of gravity would be located

1—within the CG envelope; the loading would be acceptable.

2—forward of the forward CG limit; the loading would be unacceptable because the airplane would be dangerously nose-heavy.

3—aft of the aft CG limit; the loading would be unacceptable because the airplane would be dangerously tail-heavy.

4—within the CG envelope, but the loading would be unacceptable because the maximum allowable gross weight would be exceeded.

Answer. Response 1. Applying the information to the loading graph, the following conclusions are made:

	Weight	*Moment/ 1000*
Empty airplane	1,840.0	+63.7
Pilot and front passenger	360.0	+13.0
Rear passenger	120.0	+ 8.4
Baggage	100.0	+10.4
Fuel @ 6.0 lbs. per gal.	381.0	+18.2
Oil @ 7.5 lbs. per gal.	22.5	− 0.4
Totals	2,823.5	113.3

Drawing a horizontal line on the center of gravity moment envelope from left to right (2,823.5 lbs.) and a vertical line from bottom to top (113.3/1,000 lbs.-ins.), the two lines intersect at a point well within the center of gravity envelope.

Additional Questions for Study

The following questions are offered for the primary purpose of encouraging study.

1. What is the definition of "learning?"

2. Before any important instruction can begin, a determination of objectives and standards is necessary. Is this a true statement?

3. What is probably the dominant force which governs a student's progress and ability to learn?

4. Learning occurs most rapidly when information is received through more than one sense. Is this a true statement?

5. In what manner are "insights" and "perceptions" involved in the learning process?

6. How can an instructor minimize frustration and help achieve good human relations when dealing with students?

7. Why should an instructor avoid negative teaching?

8. The teaching process normally is broken down into how many steps?

9. Lesson plans and course syllabi should be followed exactly if maximum benefit is to be derived from their use. Is this a true statement?

10. What are some of the barriers to effective communications?

11. Is it necessary to keep a student aware of his progress?

12. Should an instructor admit errors?

13. When can a written test be termed reliable?

14. What is the primary purpose of a critique?

15. May a pilot receive compensation when acting as pilot in command of an aircraft?

16. What preflight action do Federal Aviation Regulations require for flights away from the vicinity of an airport?

17. When an aircraft is operated VFR in level cruising flight at an altitude of more than 3,000 feet above the surface, what cruising altitudes would be appropriate if the magnetic course falls between 0° and 180°?

18. Recency of experience requirements are mandatory prior to conducting night operations with passengers aboard. What are these requirements?

19. What experience requirements are necessary regarding a commercial pilot acting in command of a complex airplane?

20. What are "V" speeds and how are they identified or where can they be found?

21. At and above what altitude are pilots required to adjust their altimeters to 29.92" Hg?

22. What is the purpose of the elevator trim tab?

23. Does the center of gravity location affect stall speed?

24. Does the amount of power being used affect stall speed?

25. Aerodynamically, what causes an airplane to stall?

26. Is it necessary for the airplane to have a relatively low airspeed for it to stall?

27. Do flaps affect stalling speed? How?

28. Does load factor affect stalling speed? How?

29. What is calibrated airspeed? What is indicated airspeed?

30. What is the relationship between the colored arcs on the airspeed indicator and calibrated airspeed?

31. What are aircraft performance charts and where can they be found for a particular aircraft?

32. What is induced drag? Parasite drag? Profile drag?

33. What is the relationship between static and dynamic stability?

34. What is ground effect?

35. What is detonation?

36. What is preignition?

37. What are the requirements for the notification and reporting of aircraft accidents?

38. What effect will lower than standard temperatures have upon an altimeter?

39. Is cold dry air more dense than cold moist air?

40. How can one tell when a thunderstorm has reached its mature stage of development?

41. What are types of in-flight structural icing?

42. What is pressure altitude? What is density altitude?

43. In what manner does high outside air temperature affect an aircraft's performance?

44. What does the absence of a VOR station identifier mean?

45. How can a pilot use a transponder to alert ATC that radio communications failure has occurred?

46. What is "hypoxia?" What is "hyperventilation?"

47. What are wingtip vortices? How are they generated? What action can a pilot take to avoid them?

48. Does wind affect the airplane's airspeed?

49. Does wind affect the airplane's groundspeed?

50. How does a person file, open, and close a VFR or IFR flight plan?

APPENDIX

This appendix contains excerpts and illustrations to familiarize applicants with some of the materials similar to those used in written tests, and to encourage study in these subject areas. Because certain data may become obsolete, do not use these excerpts and illustrations for operational purposes.

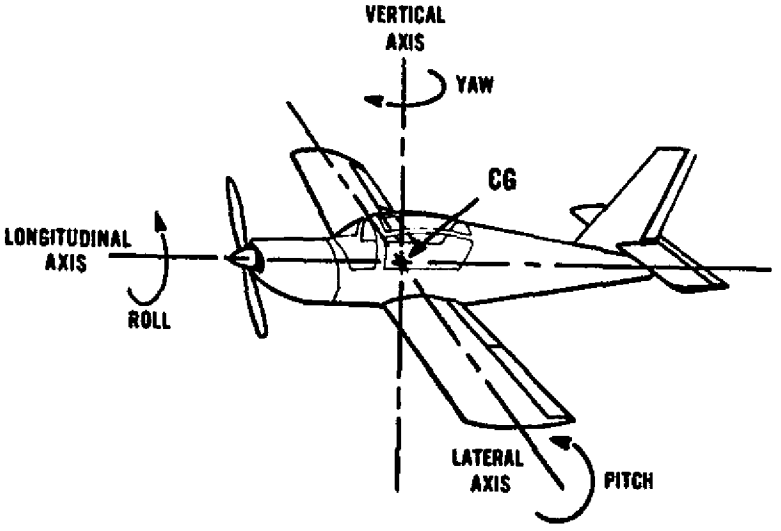


FIGURE 1.—Axes of an airplane.

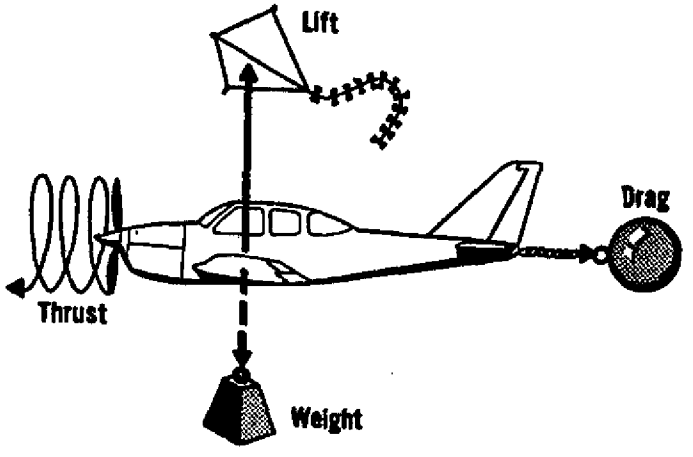


FIGURE 2.—Forces that act on an airplane in flight.

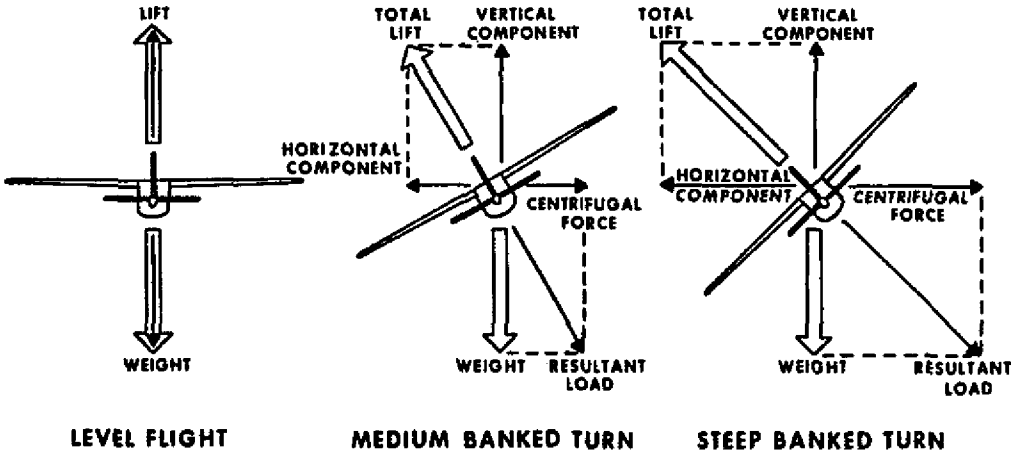


FIGURE 3.—Forces acting on an airplane in level flight and coordinated medium and steep banked turns.

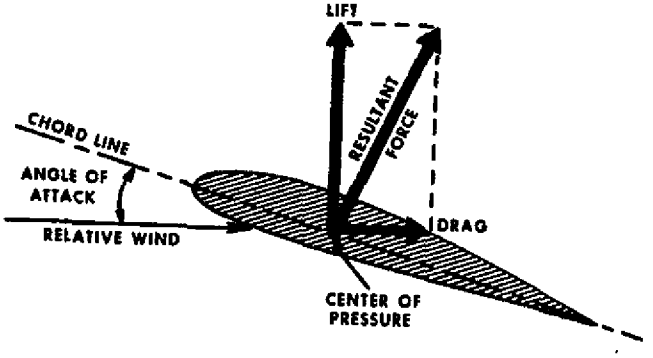


FIGURE 4.—Force vectors on an airfoil.

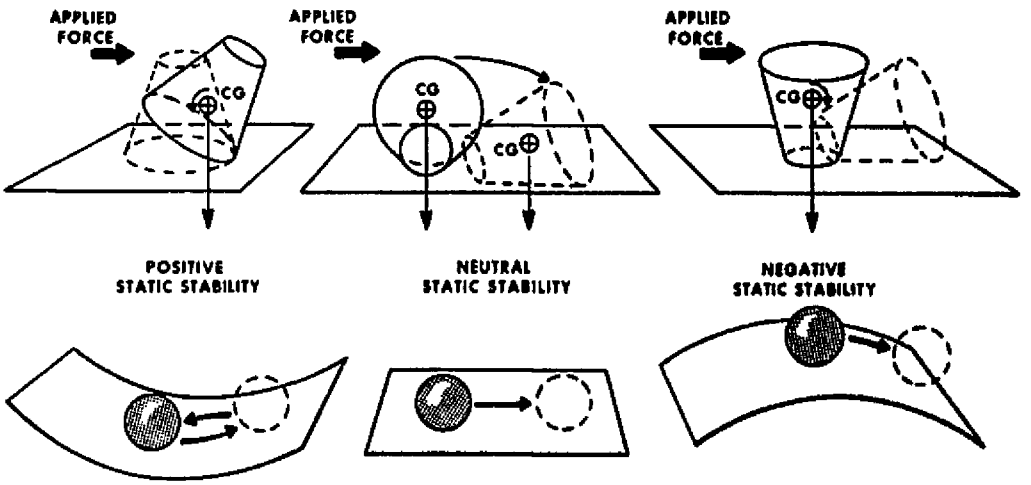


FIGURE 5.—Types of static stability.

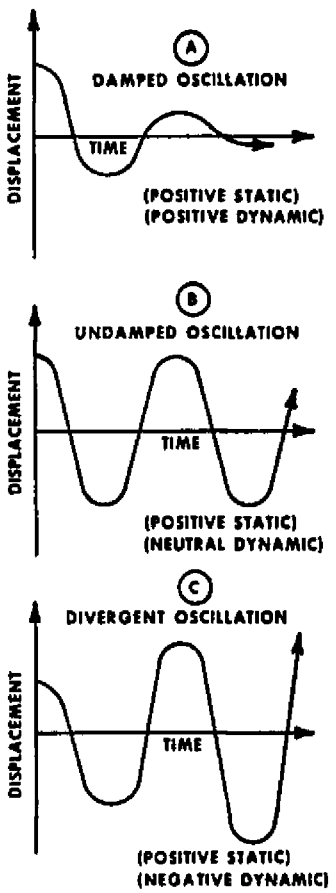


FIGURE 6.—Damped versus undamped stability.

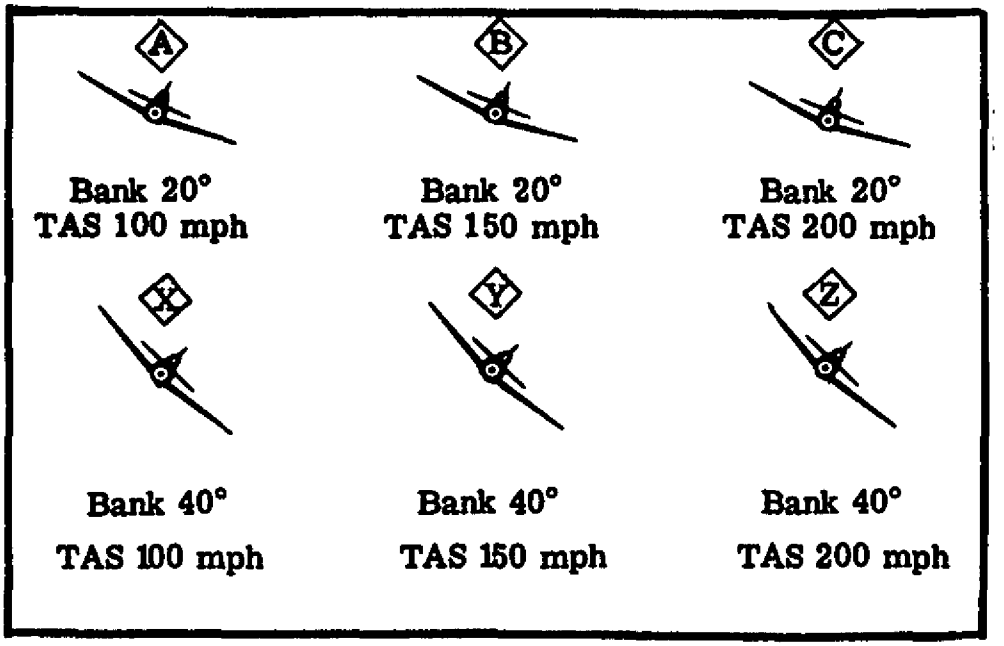


FIGURE 7.—Angle of bank versus airspeed.

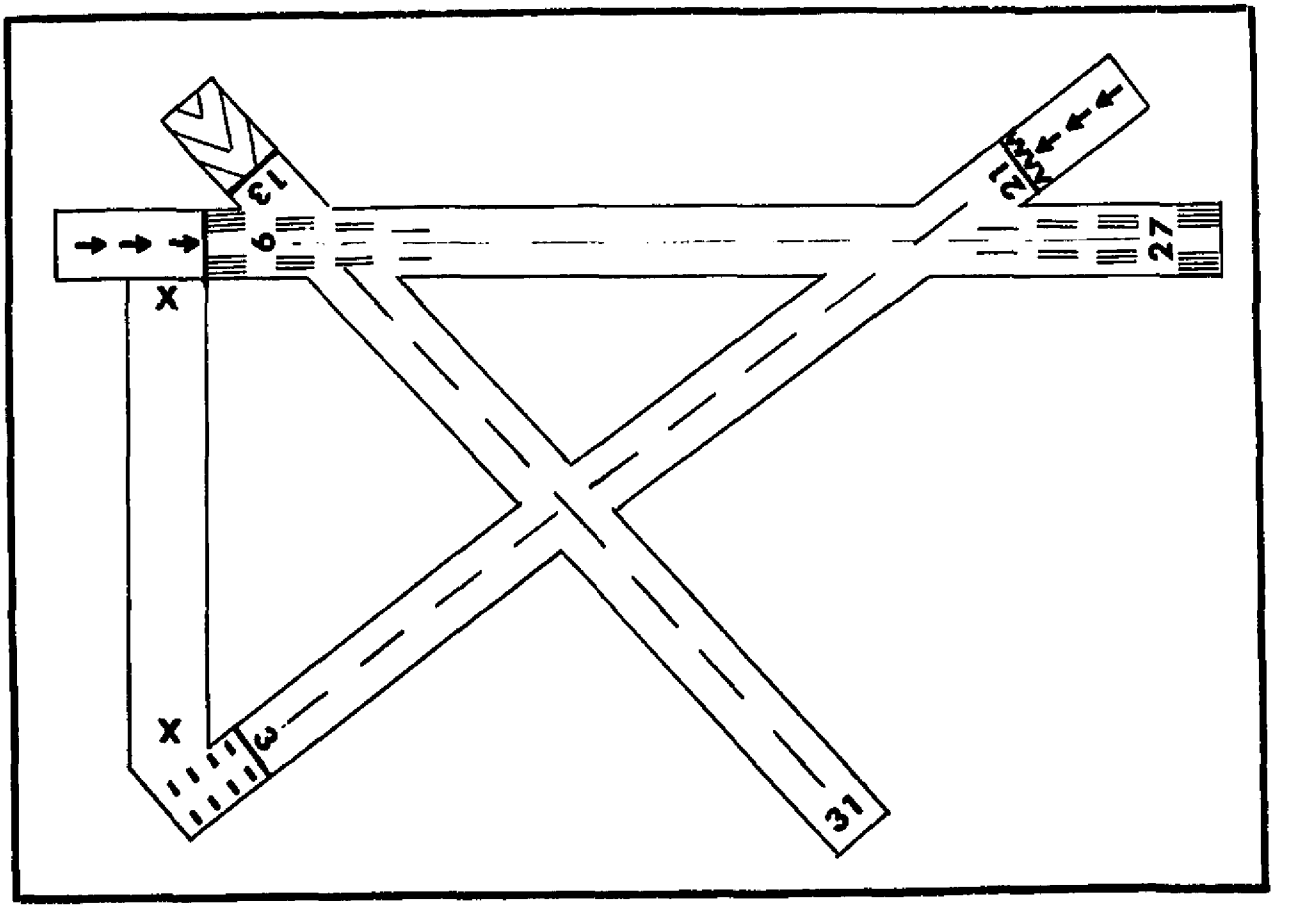


FIGURE 8.—Runway markings.

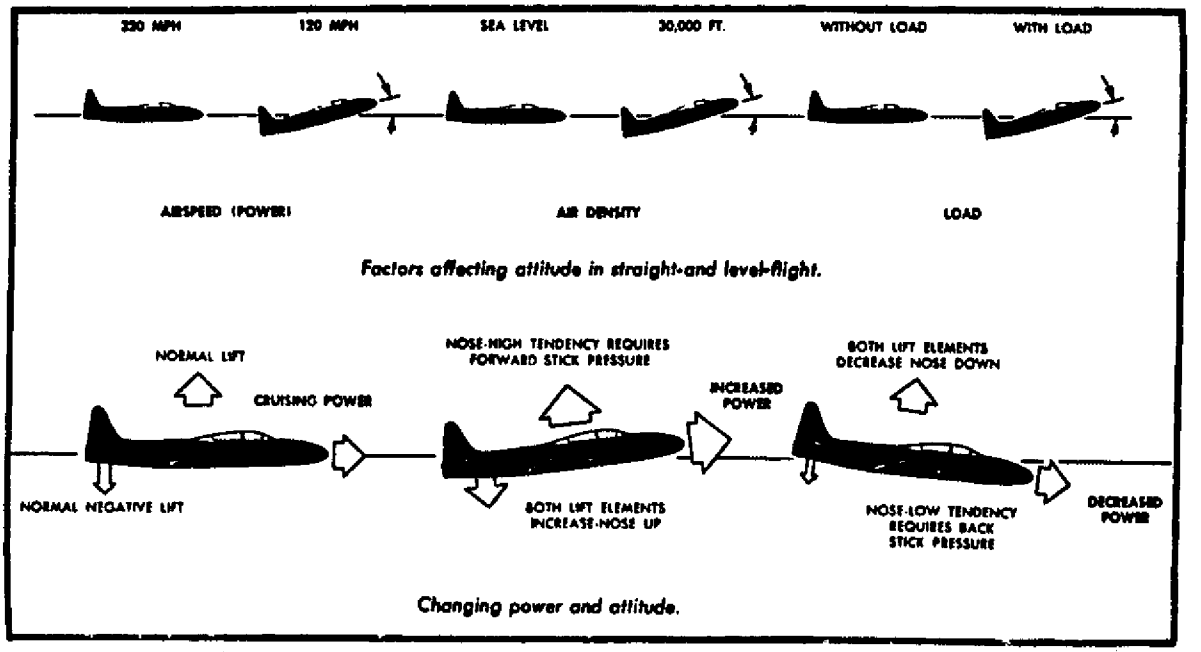


FIGURE 9.—Aerodynamics—power and pitch attitude.

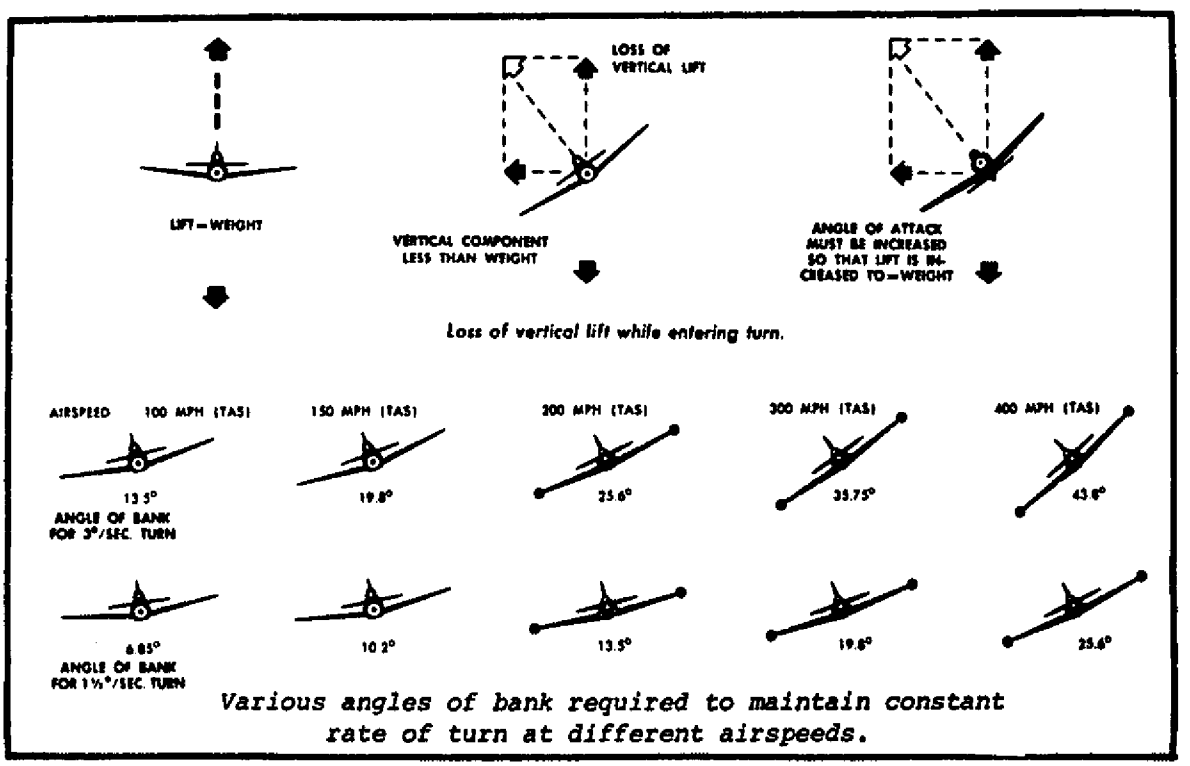


FIGURE 10.—Angle of bank—rate of turn.

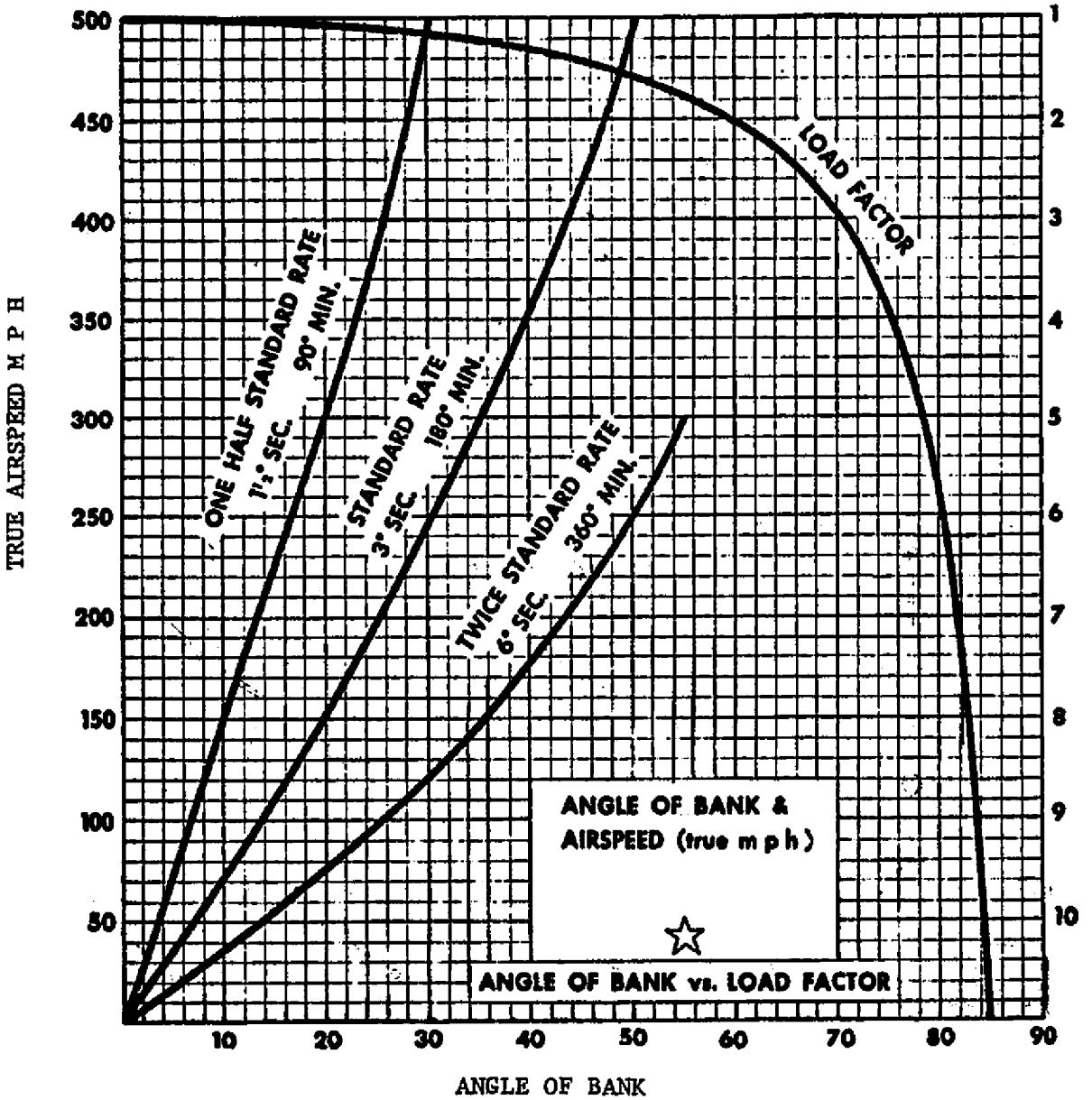


FIGURE 11.—TAS—angle of bank—rate of turn—load factor.

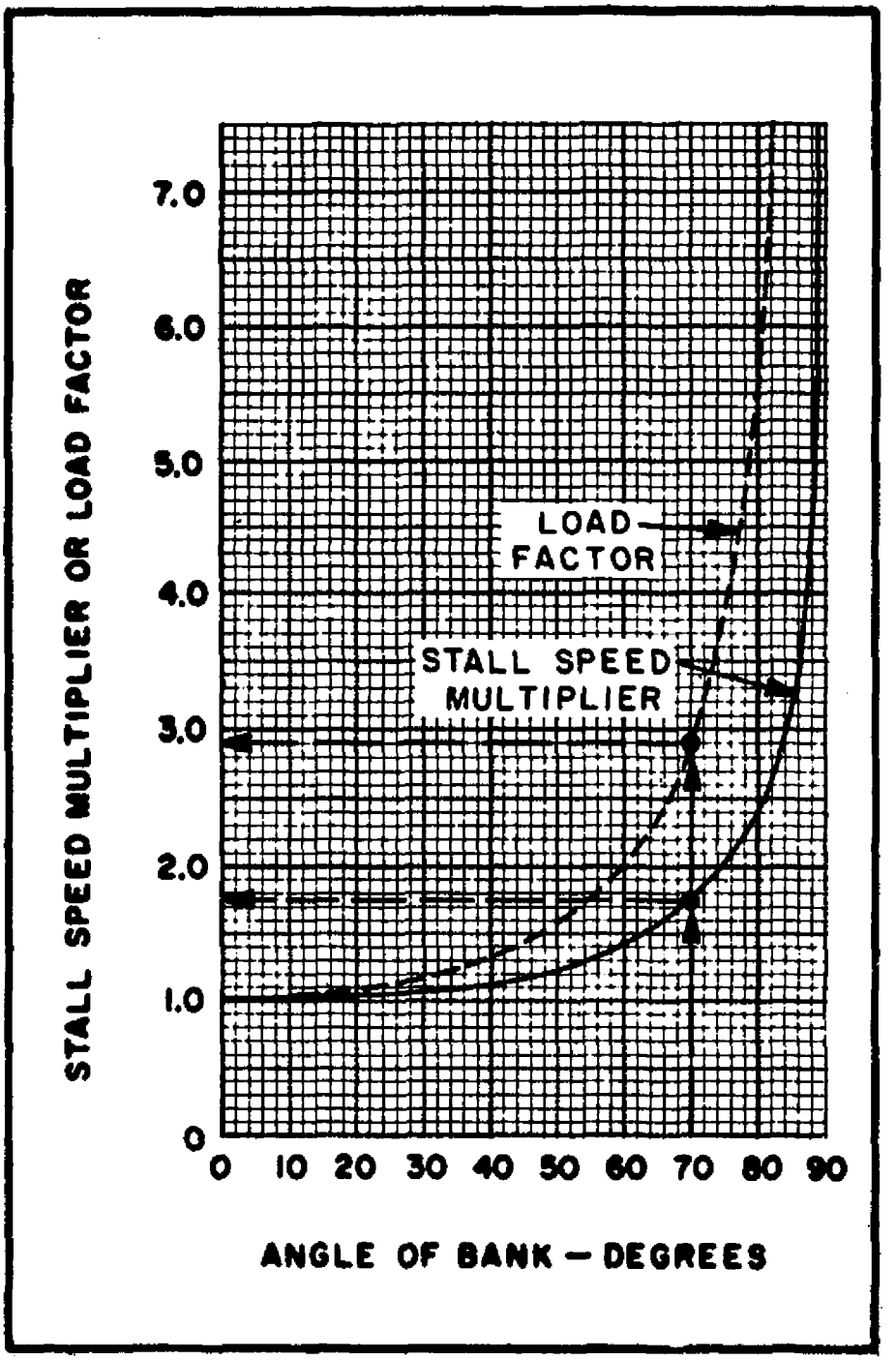


FIGURE 12.—Stall speed multiplier and load factor chart.

STALL SPEED, POWER OFF

Gross Weight 2900 lbs.	ANGLE OF BANK			
CONFIGURATION	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, CAS

FIGURE 13.—Stall speed chart.

AIRSPEED CORRECTION TABLE

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

*Maximum flap speed 120 MPH-CAS

FIGURE 14.—Airspeed correction table.

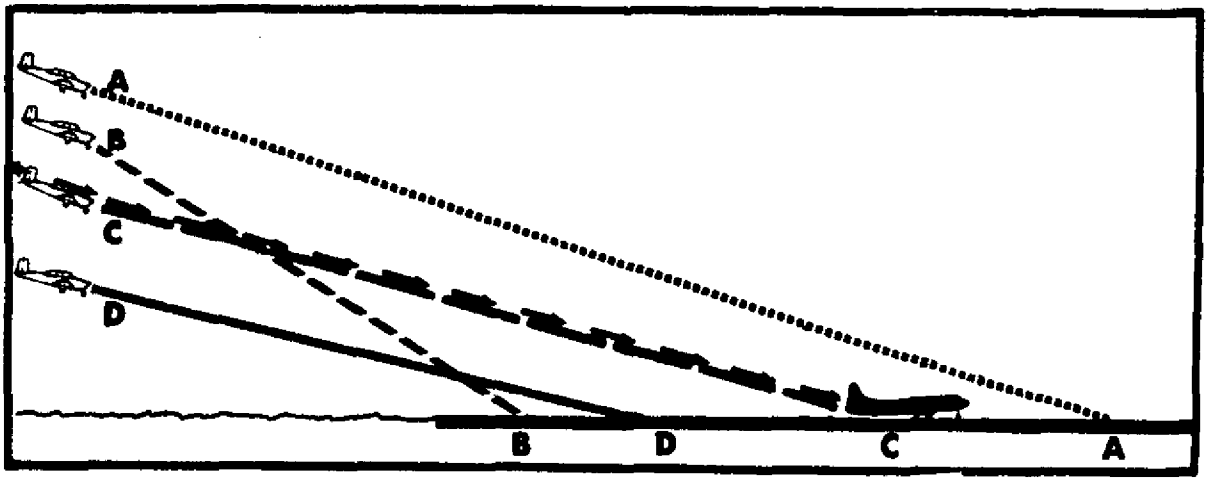


FIGURE 15.—Wake turbulence avoidance on final approach.

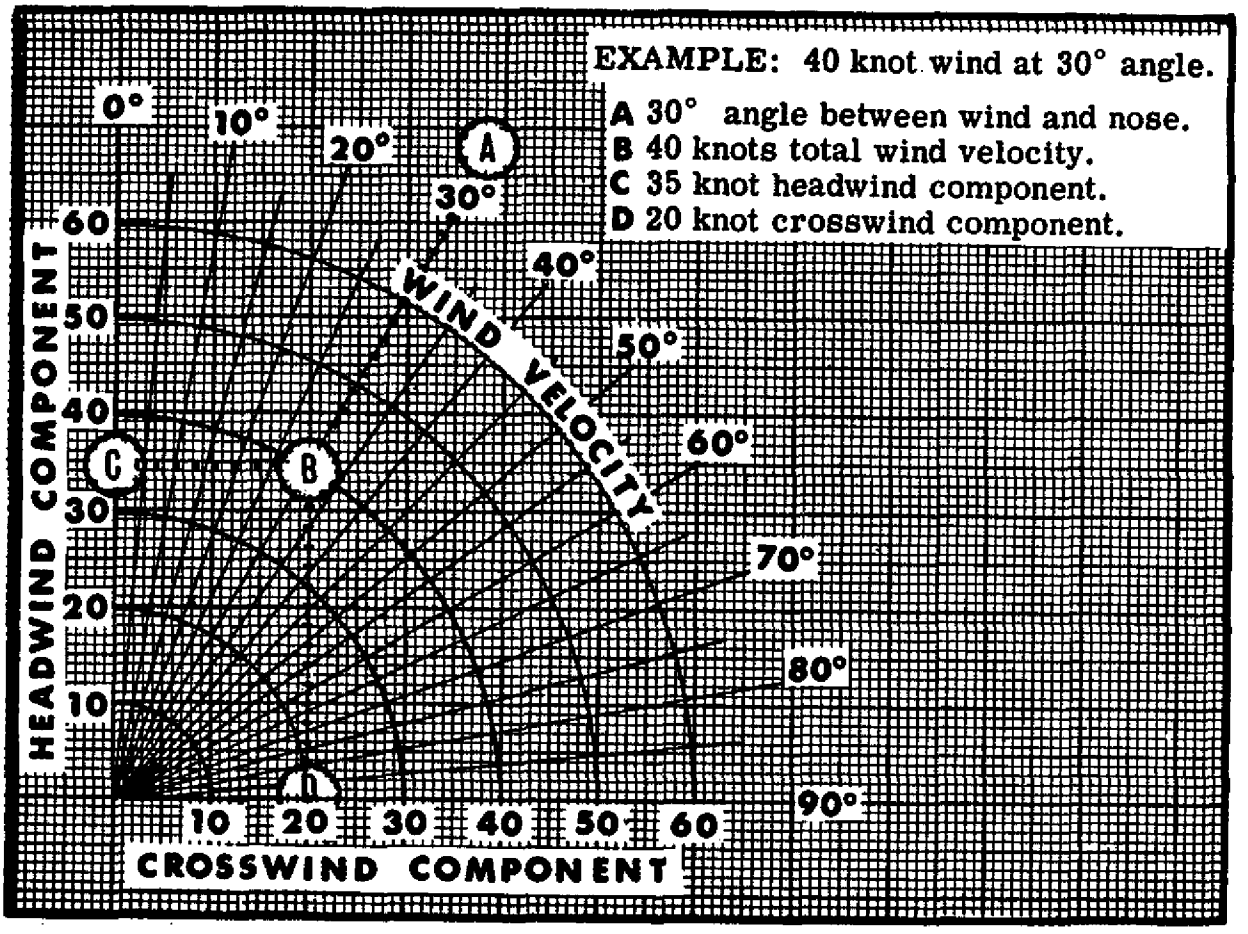


FIGURE 16—Wind component chart.

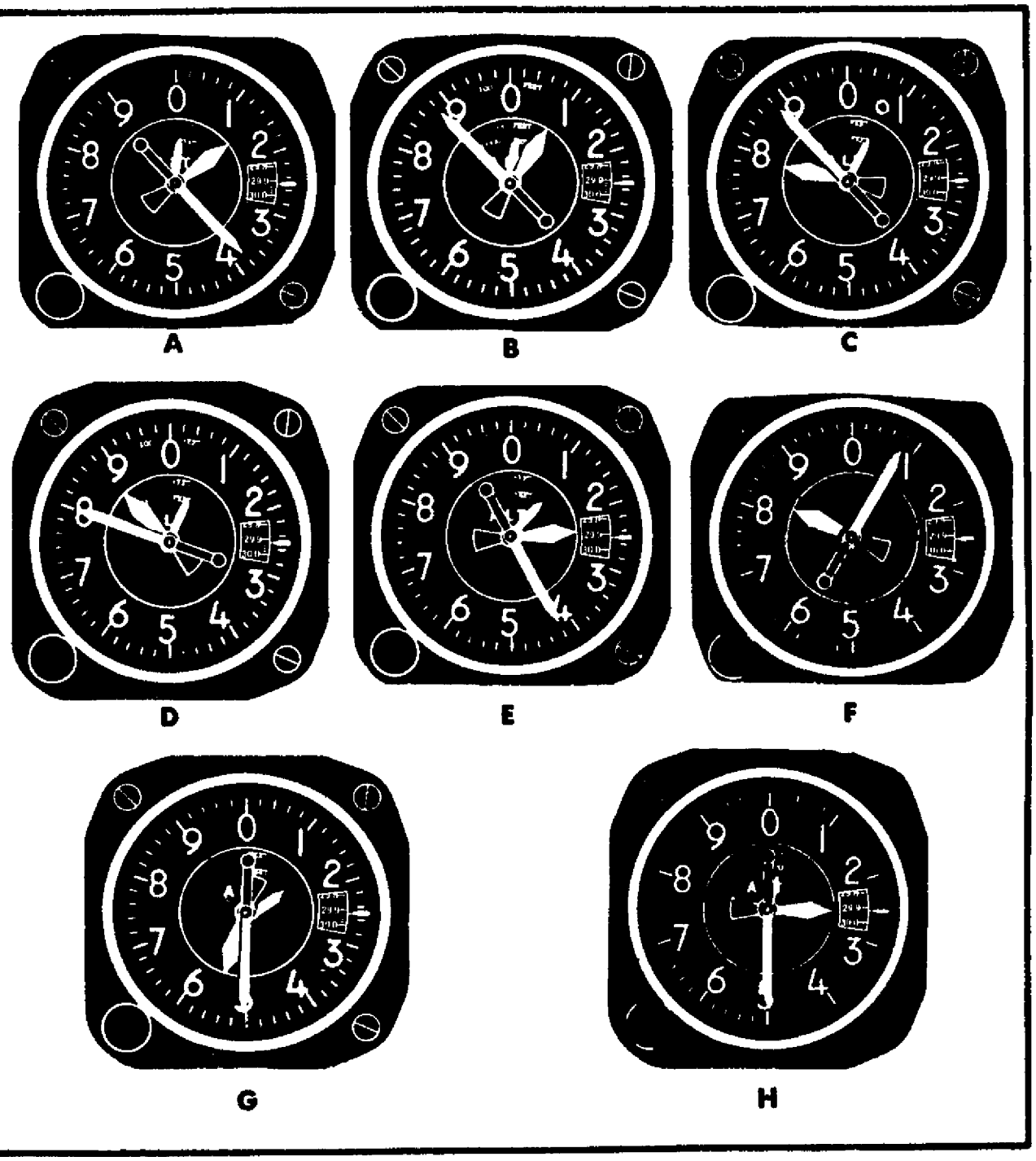
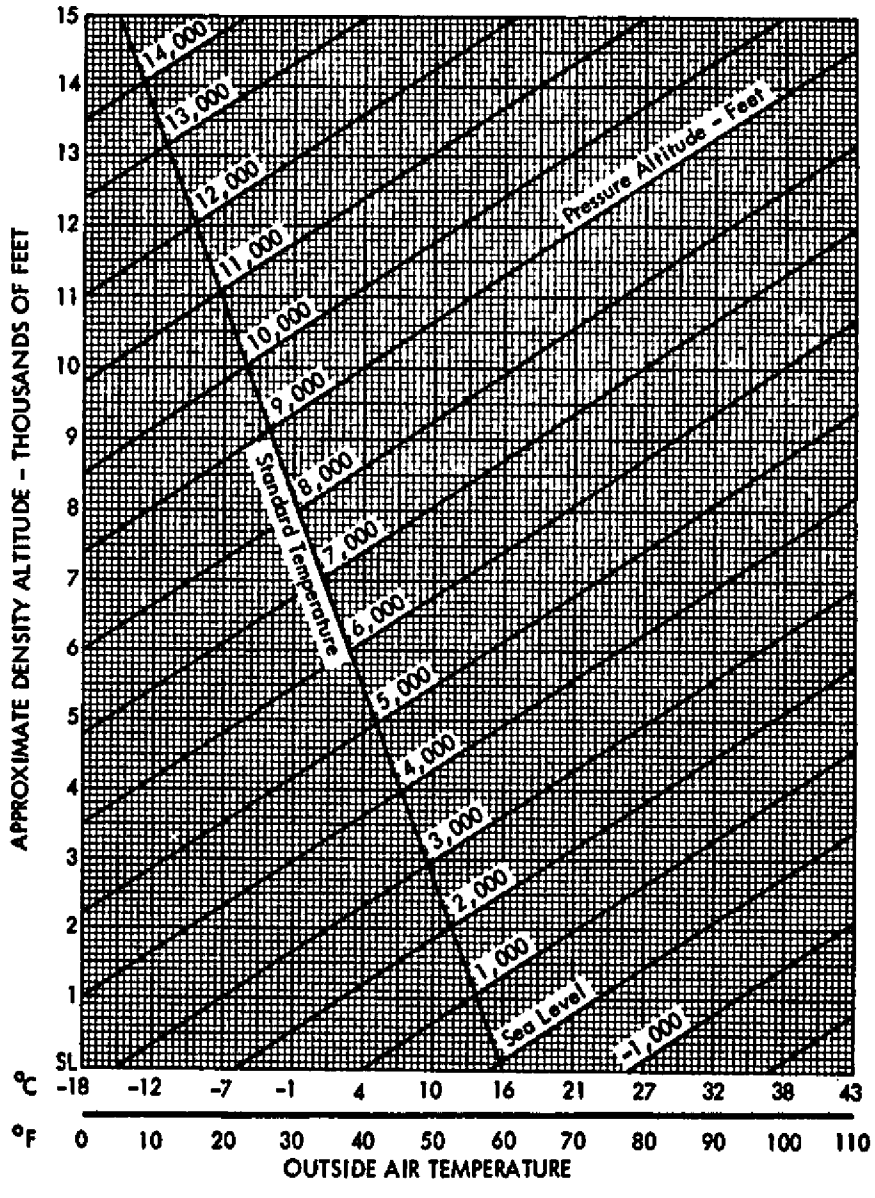


FIGURE 17.—Altimeter illustration.

Set Altimeter to 29.92 in. Hg.
When Reading Pressure Altitude



Altitude Setting in Hg.	Altitude Correction
28.0	1,825
28.1	1,725
28.2	1,630
28.3	1,535
28.4	1,435
28.5	1,340
28.6	1,245
28.7	1,150
28.8	1,050
28.9	955
29.0	865
29.1	770
29.2	675
29.3	580
29.4	485
29.5	390
29.6	300
29.7	205
29.8	110
29.9	20
29.92	0
30.0	-75
30.1	-165
30.2	-225
30.3	-350
30.4	-440
30.5	-530
30.6	-620
30.7	-710
30.8	-805
30.9	-895
31.0	-965

FIGURE 18.—Density altitude.

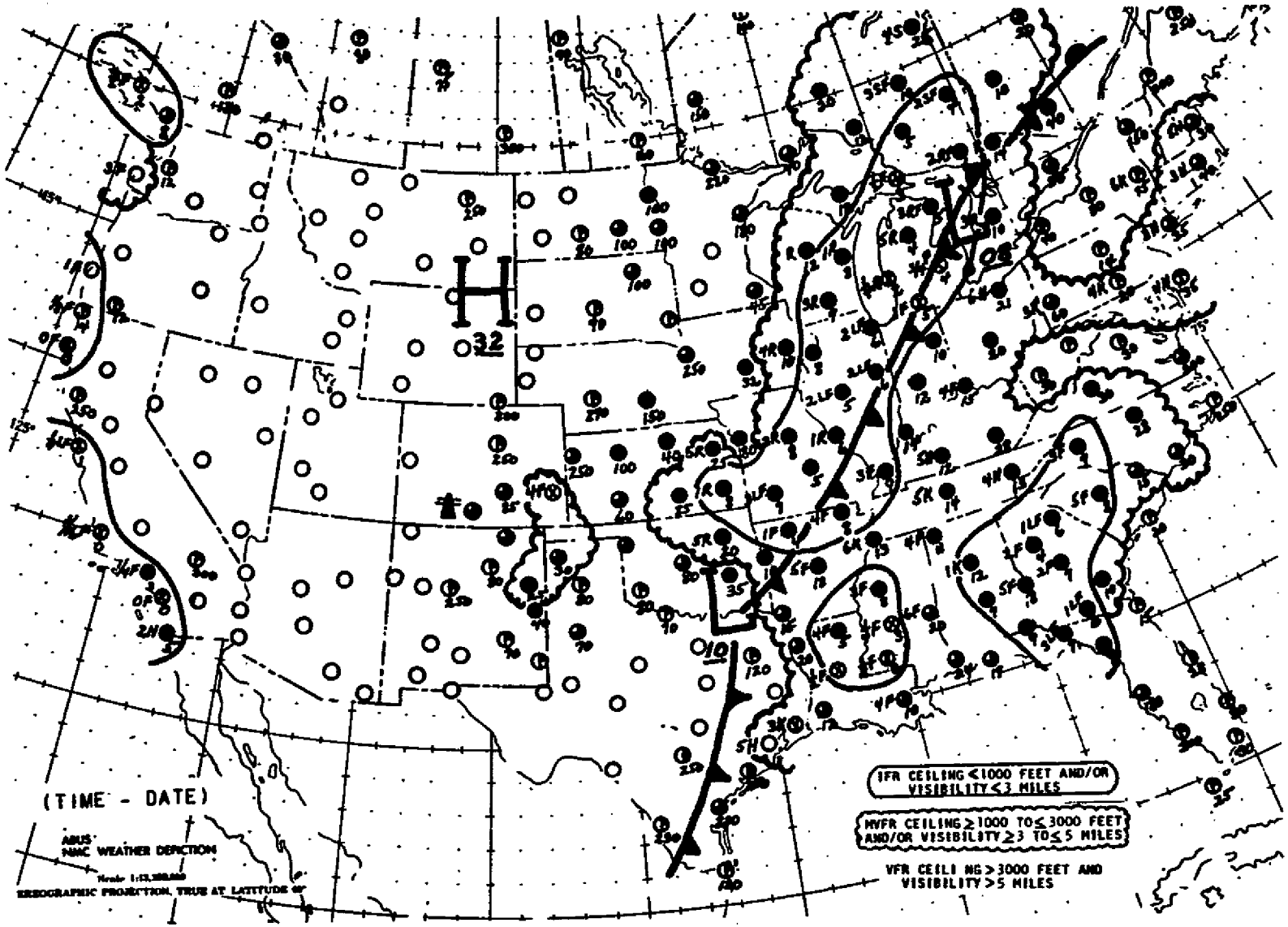


FIGURE 19.—A weather depiction chart.

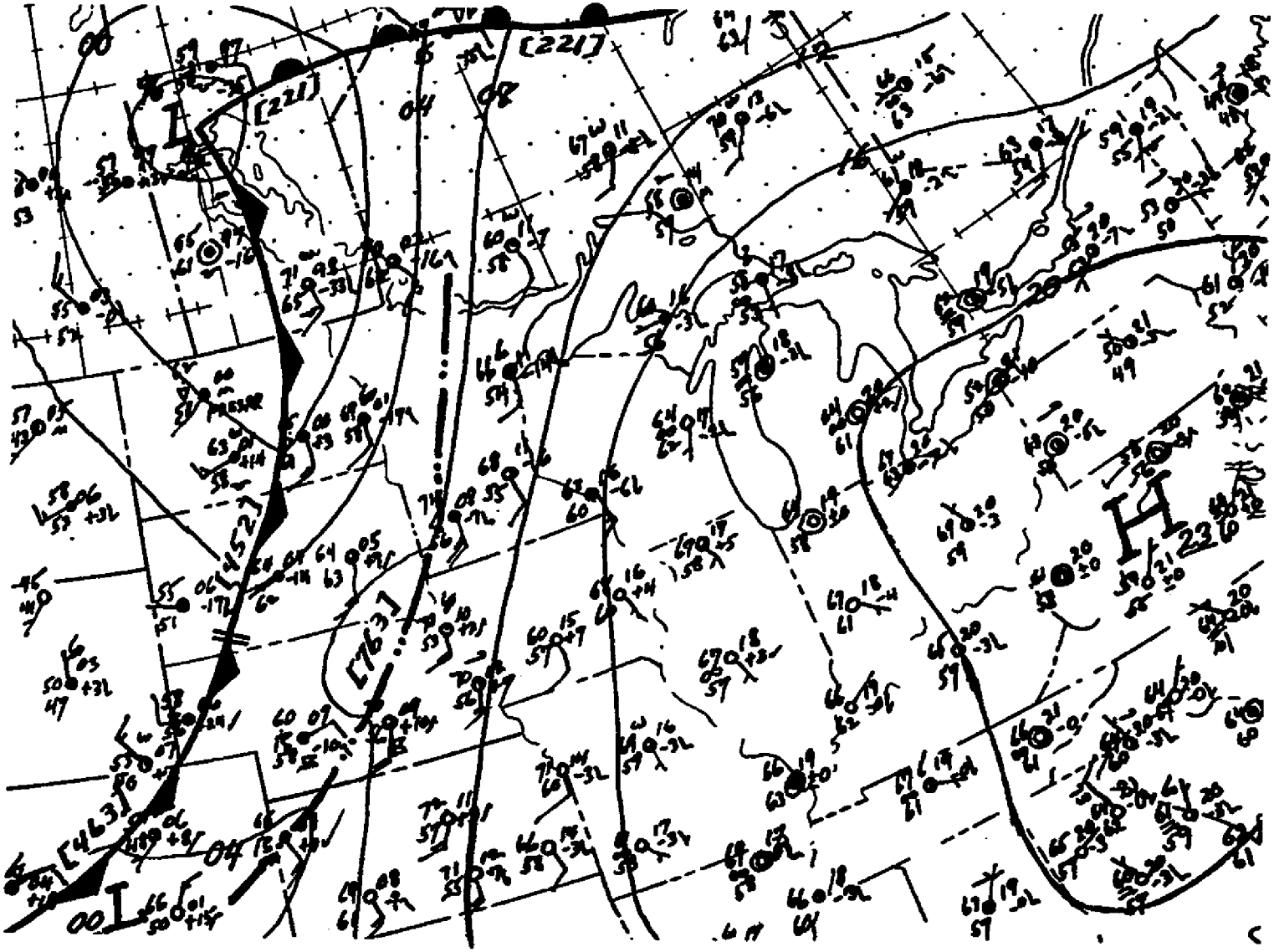


FIGURE 20.—Section of a surface weather analysis.

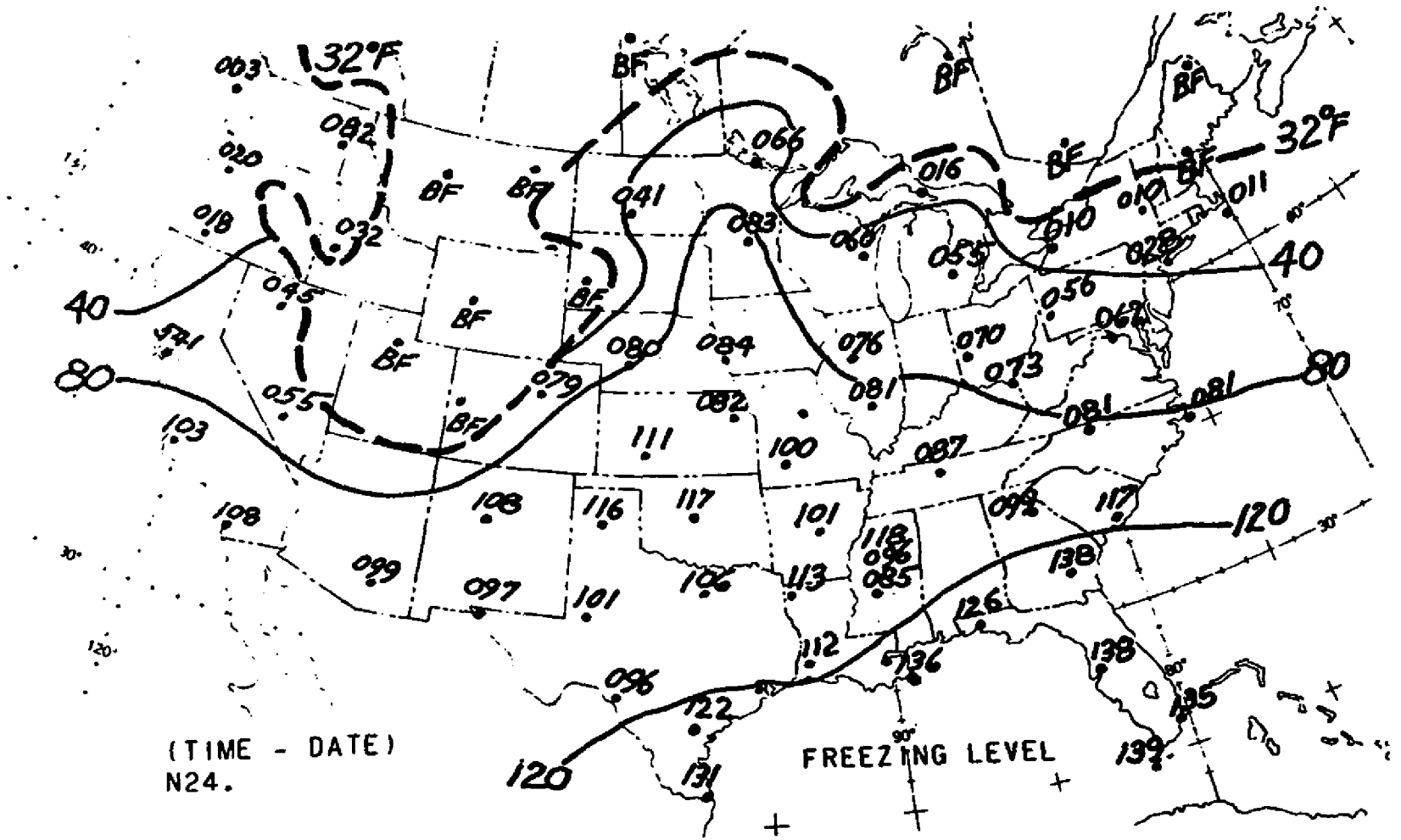


FIGURE 21.—A freezing level chart.

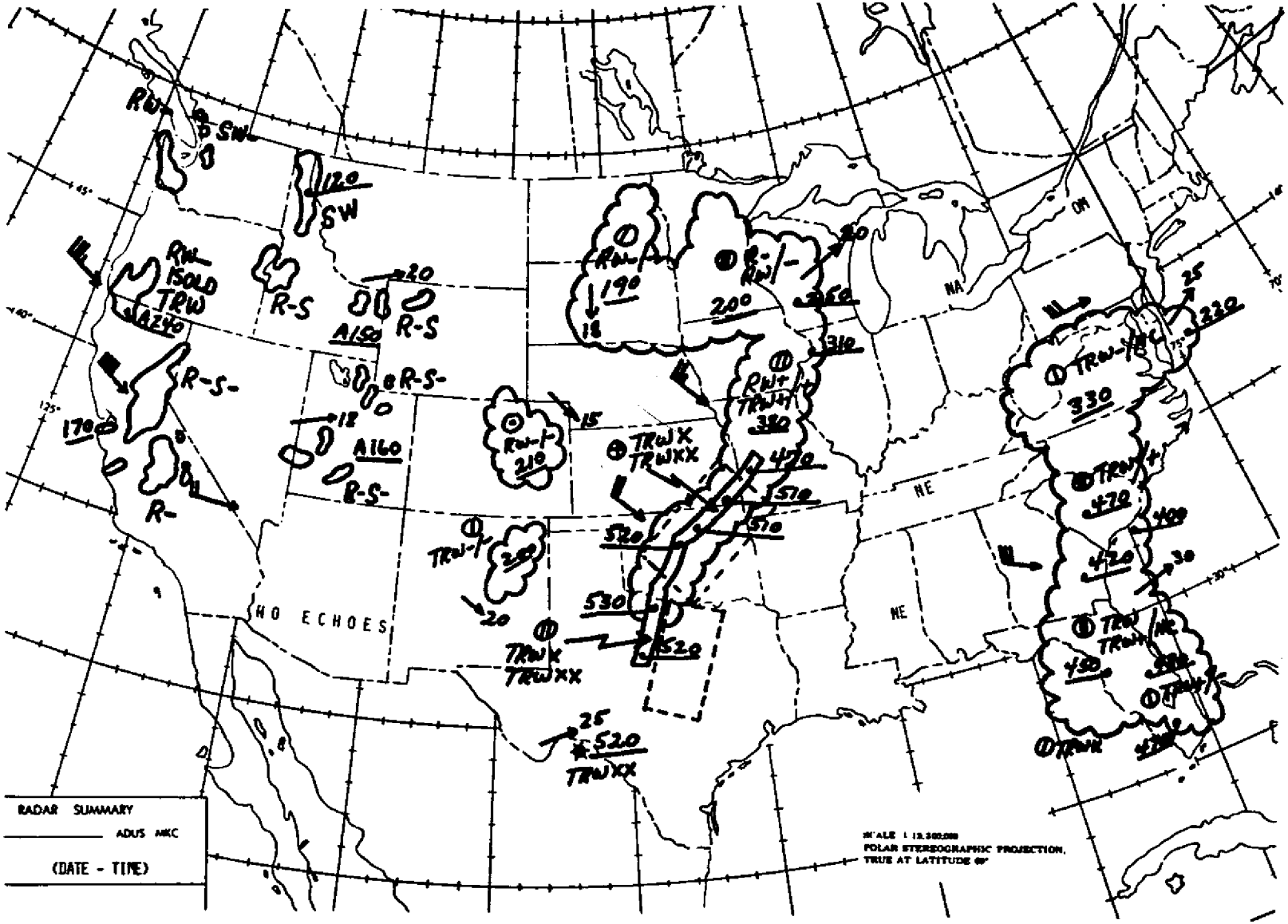


FIGURE 22.—A radar summary chart.

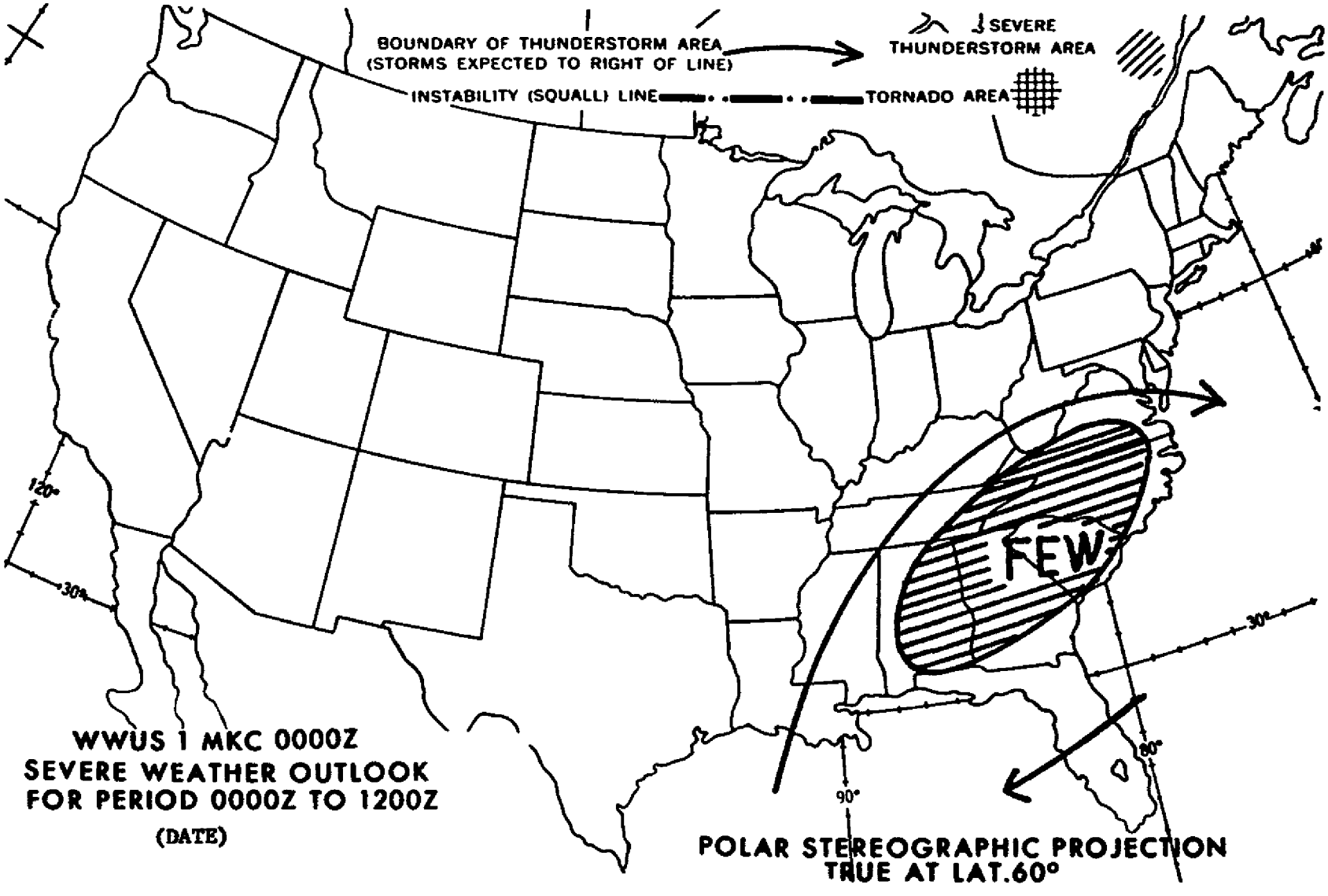


FIGURE 23.—A panel of a severe weather outlook chart.

SURFACE AVIATION WEATHER REPORTS

```
KS 1218Ø9
CNU E25 BKN 15 157/35/28/312Ø/999/ 246 33
DDC CLR 6BD 215/31/1Ø/3327G36/Ø14/PK WND 3442/11/ 232 25
EMP E2Ø BKN 1Ø 162/33/22/3125G35/999/PK WND 3235/2Ø 234 28
GCK 1ØØ -SCT 6BD 227/3Ø/17/332ØG28/Ø16/PK WND 3328/5Ø/ 225 25
GLD 3Ø SCT 5D 246/22/8/3432G42/Ø16/PK WND 3343/19/ 22ØØØ 15ØØ 13
 → GLD↘ 3/1 CBK NDB OTS
HLC -X E5Ø BKN 8 223/25/19/3227G4Ø/Ø13/4BD PK WND 3244/51/ 317 14
 → HLC↘ 3/5 K77 1/2IN 1R 13-31
HUT 15 SCT 15 35/18/322ØG3Ø/ØØ6/ 25
ICT 28 SCT 2Ø 185/34/16/3422G33/ØØ6 PK WND 3434/28/ 229 15ØØ 28 2ØØ24
RSL 2Ø SCT 15 192/29/16/3323G4Ø/ØØ7/PK WND 3345/4Ø 229 2Ø
SLN 3Ø SCT 15 178/3Ø/2Ø/3225G32/ØØ3 PK WND 3239/48/ Ø2Ø 25→ SLN↘ 12/9
 → SLN 12/9 SLN ILS 35 CAT 2 NA
TOP E3Ø BKN 18Ø BKN 1Ø 15Ø/28/18/3Ø18G32/997/ FEW CI SE4Ø PK WND 3Ø36/41
 LWR LYR BKN V OVC
```

FIGURE 24.—Surface aviation weather reports.

TERMINAL FORECASTS

```
KS 121452
CNU 121515 C2Ø BKN 2925G35 BKN V SCT. ØØZ CLR 3425G3Ø.
 Ø9Z VFR..
DDC 121515 C35 BKN 3335G5Ø CHC 4BD BKN V SCT. 2ØZ CLR
 3335G5Ø CHC 4BD. Ø9Z VFR..
GCK 121515 C35 BKN 333ØG45 CHC 4BD BKN V SCT. 2ØZ CLR
 3425G35 CHC 4BD. Ø9Z VFR..
GLD 121515 C35 BKN 6BD 3335G5Ø CHC SW-. 21Z CLR 3335G45.
 Ø9Z VFR..
ICT 121515 C2Ø BKN 3425G4Ø BKN V SCT. 17Z C35 BKN 3425G4Ø
 BKN V SCT. 22Z CLR 3325G35. Ø9Z VFR..
SLN 121515 C25 BKN 313ØG45 CHC SW- BKN V SCT. 21Z CLR
 333ØG4Ø. Ø9Z VFR..
TOP 121515 C25 BKN 293ØG5Ø CHC SW-. 19Z C3Ø BKN 3Ø3ØG5Ø
 CHC SW-. Ø1Z CLR 333ØG4Ø. Ø9Z VFR..
```

FIGURE 25.—Terminal forecasts.

AREA FORECASTS

MKC FA 121240.
13Z FRI-07Z SAT.
OTLK 07Z-19Z SAT.

WY CO KS NE SD ND...

HGTS ASL UNLESS NOTED...

SYNS... DP LOW PRES CNTR TO E OF NEB WITH STG CDFNT SWD FM LOW THEN CURVG SWWD ACRS EXTRM SE KANS AT 13Z MOVG TO E OF KANS BY 14Z. STG NWLY TO NLY WNDS NRN AND CNTRL PLNS BHND LOW GRDL DMSHG FM W. HI PRES CNTR MONT AT 13Z MOVG SEWD TO NW KANS BY 07Z.

SIG CLD AND WX...
WY COLO...
MTNS SRN AND ERN WYO LAND NRN AND S CNTRL COLO OCNL OBSCD ABV 70-90 IN CLDS AND SNW IPVG GRDL FM W NO SIGCLD BY 00Z. RMNDR MTNS 70-100 SCT LCL BKN WITH SCTD SW- TO NO SIGCLD. E COLO AND HI PLNS E WYO CIGS 20-40 OVC VRBL BKN WITH OCNL 3-5S-BS IPVG AFT 18Z TO NO SIGCLD BY 00Z. CLD TOPS 200. SFC WNDS E COLO AND HI PLNS E WYO OCNL 3420G30 TIL 19Z OTLK... VFR.

KANS...
CIGS 15-30 OVC VRBL BKN WITH OCNL 3-5S-BS AND LCL VSBY BLO 3 MI IN BLOWING SNW OCNL BD W KANS. CIGS SPRDG SEWD ACRS SE BY 15Z. CONDS IPVG GRDL FM S TO NO SIGCLD THRUT BY 00Z CLD TOPS 120.
SFC
WNDS OCNL 3325V35G45 DMSHG SLOLY FM W OTLK .. VFR.

NEB SDAK NDAK...
OCNL CIGS BLO 10 VSBYS BLO 3S-BS MOST NEB SRN AND ERN HLF SDAK AND ERN NDAK. RMNDR E NDAK SDAK AND NEB CIG S 15-30 OVC VRBL BKN WITH OCNL 3-5S-BS. CONDS IPVG GRDL FM W TO NO SIGCLD E NDAK WRN SDAK AND PNHDL AND CNTRL NEB BY 21Z AND E SDAK AND E NEB BY 03Z. CLD TOPS 150. CNTRL AND W NDAK AGL 30 SCT CIG 70 BKN TO CLR. VSBY OCNL 3-5BS TIL 19Z. SFC WNDS E NDAK SDAK AND NEB OCNL 3430G40-50 KT DMSHG GRDL FM W. OTLK... VFR.

ICG... OCNL MDT MXD ICGICIP MTNS WYO AND COLO AND E NDAK SDAK NEB E COLO AND NW KANS DMSHG GRDL FM W. OTRW OCNL LGT RIME ICGIC. FRZLVL AT OR NR SFC EXCP NR 40 SE KANS LWRG TO SFC BY 00Z.

FIGURE 26.—Area forecasts.

RADAR WEATHER REPORTS

(RAREPS)

LIT 1133 AREA 4TRW+/ +22/1ØØ 88/17Ø 196/18Ø 22Ø/115 CELLS 2425
MT 31Ø AT 162/11Ø
JAN 1935 SPL LN 1ØTRWX/NC 86/4Ø 164/6Ø 199/115 12W CELLS 243Ø
MT 44Ø AT 159/65 D1Ø
MAF 113Ø AREA 2S 27/8Ø 9Ø/125 196/5Ø 268/1ØØ 241Ø MT 1ØØ UNIFORM
HBO 1132 AREA 2TRW++6R-/NC 67/13Ø 3Ø8/45 1Ø5W CELLS 224Ø
MT 38Ø AT 66/54
OKC 1934 LN 8TRW++/+ 86/4Ø 164/6Ø 199/115 15W 2425
MT 57Ø AT 159/65 2 INCH HAIL RPRTD THIS ECHO

FIGURE 27.—Radar weather reports.

SELECTED PILOT REPORTS

MSY UA 1328 BTR 8 BKN 17 36 BKN 4Ø 47 BKN 6Ø EST 8Ø BKN ABV

GAG UA 18Ø6 GAG AREA TOPS D LYR 6Ø.FAIRLY SMTH BUT OCNL LGT TURB 65.C175

MKC UA 121Ø 23SE TOP AT 12Ø SMOOTH VSBY CRISP BE9Ø.

MKC UA 132Ø 7S MKC MXD ICGIC 45-55. C4Ø2

STL UA 16Ø3 STL SCT V BKN 75 8Ø SMOOTH RIDE BE18

MSY UA 162Ø ESF-BTR 2Ø SCT CLR ABV BLDUPS S

MKC UA 1623 MHK-MCI BENEATH CLDS LGT CHOP LGT SW GOOD VSBY C2Ø7

AMA UA 1633 8N AMA D TOPS 65. 1ØNNE AMA SMTH 85.PA28

MKC UA 1758 22 DME E MKC 85 SMTH BE35 TOPS 65

FIGURE 28.—Select pilot reports.

WINDS AND TEMPERATURES ALOFT FORECAST

FD WBC 151745
BASED ON 151200Z DATA
VALID 1600Z FOR USE 1800-0300Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
ALS			2420	2635-08	2535-18	2444-30	245945	246755	246862
AMA		2714	2725+00	2625-04	2531-15	2542-27	265842	256352	256762
DEN			2321-04	2532-08	2434-19	2441-31	235347	236056	236262
HLC		1707-01	2113-03	2219-07	2330-17	2435-30	244145	244854	245561
MKC	0507	2006+03	2215-01	2322-06	2338-17	2348-29	236143	237252	238160
STL	2113	2325+07	2332+02	2339-04	2356-16	2373-27	239440	730649	731960

FIGURE 29.—Wind and temperatures aloft forecast.

WEATHER ADVISORIES

DFW WA 121737
121737-122400

AIRMET CHARLIE 5. FLT PRCTN. GUSTY SFC WNDS MDT TURBC BLO 5 THSD FT ALG AND N OF CDFNT OVR OKLA AND TEX. CDFNT ALG FSM FTW ABI HOB LN AT 17Z MOVG SWD ABT 25 KTS. SOME BLWG DUST VSBYS LCLY ARND 3 MIS MAINLY OVR NWRN TEX AND WRN OKLA. CONDS CONTG PAST 24Z.

MSY WS 121250
121250-121700

SIGMET ALFA 4. FLT PRCTN. OVR NRN ALA S CNTRL TENN FOR TSTMS. OVR ALA N OF BHM TENN S OF BNA-TYS LN SCTD EMBDD TSTMS TOPS NR 350 MOVG EWD NR 45 KT WL SPRD INTO ERN TENN BY 16Z. CONT BYD 17Z.

FIGURE 30.—Weather advisories.

AIRCRAFT DESIGNATION:- Condor 410.
ENGINE OPERATION LIMITATIONS:- 260 HP at 2625 RPM.
FUEL SYSTEM:- Fuel injection System (Fuel discharged into combustion chamber)
Recommended Fuel 100/130 Minimum Grade.
Fuel Capacity Standard Tanks 65 gallons.
Usable Fuel All Flight Conditions 63.5 gallons.
OIL CAPACITY:- Total 12 quarts. (moment -0.4)
PROPELLER:- Constant-speed Hydraulically Controlled.
LANDING GEAR:- Retractable Tricycle Landing Gear.
Hydraulic Actuators Powered By Engine Driven Hydraulic Pump.
Emergency Operation:- Manual Hydraulic Pump.
WING FLAPS:- Hydraulically Operated; Powered By Engine Driven Hydraulic Pump.
EMPTY WEIGHT:- 1840 lbs. (moment 63.7)
MAXIMUM GROSS WEIGHT:- 3000 lbs.
LOAD FACTOR:-
Flaps Up + 3.8, -1.52
Flaps Dn. +3.5

RADIO EQUIPMENT:-

1 VHF Communications Transceiver	118.0 to 135.95 MHz
1 VHF Localizer/VOR Receiver	108.0 to 117.9 MHz
1 ADF Receiver (fixed azimuth)	200 kHz to 1750 kHz

AIRSPEED LIMITATIONS:-

Never exceed speed	225 mph CAS
Maximum structural cruising speed	190 mph CAS
Maximum maneuvering speed	132 mph CAS
Maximum gear operating speed	160 mph CAS
Maximum gear extended speed	160 mph CAS
Maximum flap extended speed	
Flaps 10°	160 mph CAS
Flaps 10° - 40°	110 mph CAS

MAXIMUM ALLOWABLE WEIGHT IN BAGGAGE COMPARTMENT - 120 LBS.

FIGURE 81.—Condor—airplane owner's manual.

TAKE-OFF DATA

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

GROSS WEIGHT LBS.	IAS AT 50 FT. MPH	HEAD WIND MPH	AT SEA LEVEL & 59°F		AT 2500 FEET & 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
2200	55	0	345	680	405	770	480	885	580	1040
		15	205	460	245	525	295	615	365	725
		30	100	275	120	320	155	380	195	460
2600	60	0	500	915	585	1045	705	1230	855	1470
		15	310	635	370	735	455	870	560	1055
		30	165	395	200	465	295	565	335	695
3000	64	0	685	1210	820	1405	990	1675	1205	2045
		15	450	855	535	1005	660	1215	815	1505
		30	250	555	310	665	390	820	500	1030

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

FIGURE 32.—Condor—takeoff data.

CLIMB DATA

GROSS WEIGHT LBS.	AT SEA LEVEL & 59°F			AT 5000 FT. & 41°F			AT 10000 FT. & 23°F			AT 15000 FT. & 5°F			AT 20000 FT. & -13°F		
	BEST CLIMB IAS MPH	RATE OF CLIMB FT/MIN	GAL. OF FUEL USED	BEST CLIMB IAS MPH	RATE OF CLIMB FT/MIN	FROM S.L. FUEL USED	BEST CLIMB IAS MPH	RATE OF CLIMB FT/MIN	FROM S.L. FUEL USED	BEST CLIMB IAS MPH	RATE OF CLIMB FT. MIN	FROM S.L. FUEL USED	BEST CLIMB IAS MPH	RATE OF CLIMB FT. MIN	FROM S.L. FUEL USED
2200	98	1900	2.0	92	1530	2.9	88	1150	3.9	83	780	5.1	78	410	6.6
2600	100	1540	2.0	97	1210	3.1	93	890	4.4	88	580	6.1	84	250	8.6
3000	105	1270	2.0	101	980	3.4	97	690	5.0	94	400	7.3	90	120	11.5

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

FIGURE 33.—Climb data.

LANDING DISTANCE TABLE

GROSS WEIGHT LBS.	APPROACH IAS MPH	AT SEA LEVEL & 59°F		AT 2500 FT & 50°F		AT 5000 FT & 41°F		AT 7500 FT & 32°F	
		GROUND ROLL	TO CLEAR 50' OBSTACLE	GROUND ROLL	TO CLEAR 50' OBSTACLE	GROUND ROLL	TO CLEAR 50' OBSTACLE	GROUND ROLL	TO CLEAR 50' OBSTACLE
2200	61	355	945	385	980	415	1020	445	1060
2600	66	420	1030	455	1070	490	1110	530	1155
3000	71	485	1110	525	1150	565	1200	610	1255

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

FIGURE 34.—Condor—landing distance table.

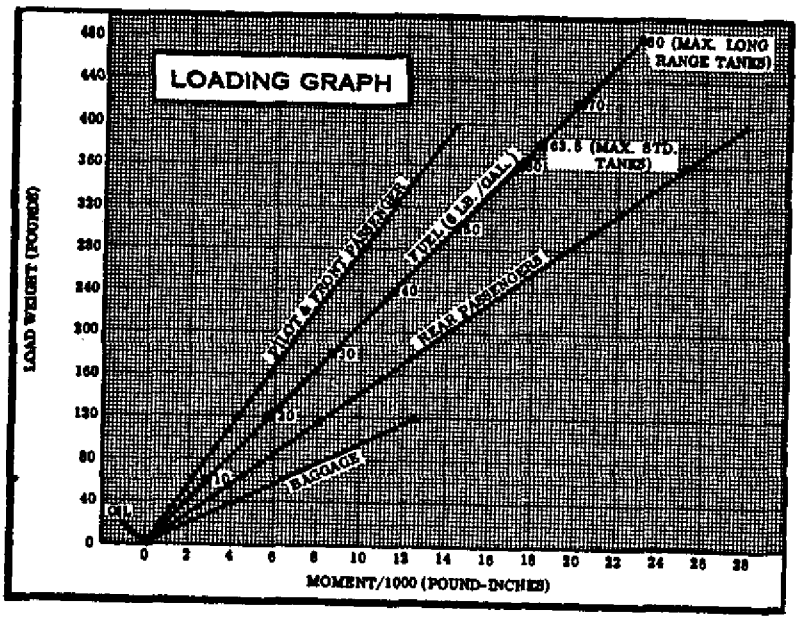


FIGURE 35.—Condor—loading graph.

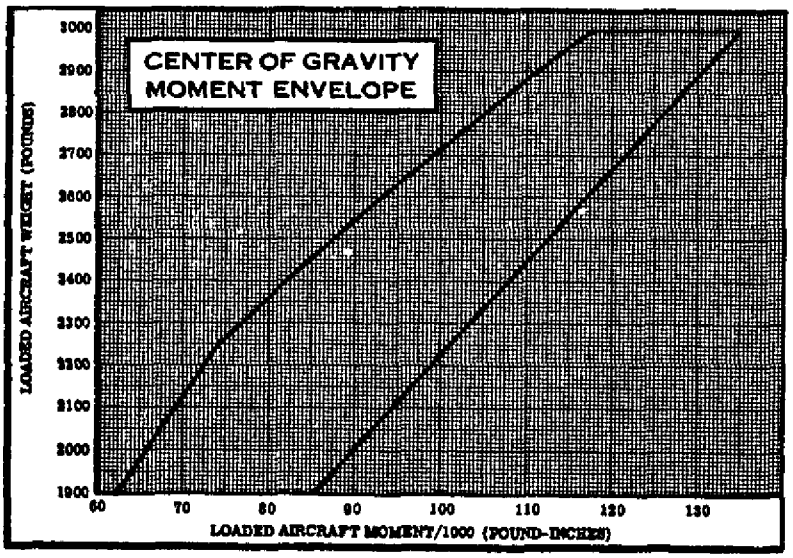


FIGURE 36.—Condor—center of gravity moment envelope.

2500 CRUISE PERFORMANCE

NORMAL LEAN MIXTURE

Standard Atmosphere • Zero Wind • Gross Weight - 3000 Pounds

2500 FEET

RPM	MP	% BHP	TAS MPH	Gal/ Hour	63.5 Gal. (No Reserve)		80 Gal. (No Reserve)	
					Endr. Hours	Range Miles	Endr. Hours	Range Miles
2450	24	76	180	14.3	4.4	800	5.6	1010
	23	71	177	13.4	4.7	835	6.0	1050
	22	67	173	12.7	5.0	865	6.3	1090
	21	63	169	11.9	5.3	900	6.7	1135
2300	24	68	174	12.8	4.9	860	6.2	1085
	23	64	170	12.1	5.2	890	6.6	1120
	22	61	166	11.4	5.6	925	7.0	1165
	21	57	163	10.8	5.9	960	7.4	1210
2200	23	60	166	11.3	5.6	930	7.1	1175
	22	56	162	10.7	6.0	965	7.5	1215
	21	53	158	10.0	6.3	1005	8.0	1265
	20	49	154	9.4	6.7	1035	8.5	1305
2100	22	52	157	9.9	6.4	1010	8.1	1275
	21	48	153	9.3	6.8	1045	8.6	1320
	20	45	148	8.7	7.3	1080	9.2	1360
	19	42	144	8.3	7.7	1105	9.7	1390
	18	39	139	7.8	8.1	1130	10.2	1420
	17	35	133	7.3	8.7	1150	10.9	1445
	16	32	126	6.9	9.2	1160	11.6	1460

FIGURE 37.—Condor—cruise performance—(2,500')

CRUISE PERFORMANCE 5000

NORMAL LEAN MIXTURE

Standard Atmosphere • Zero Wind • Gross Weight - 3000 Pounds

5000 FEET

RPM	MP	% BHP	TAS MPH	Gal/ Hour	63.5 Gal. (No Reserve)		80 Gal. (No Reserve)	
					Endr. Hours	Range Miles	Endr. Hours	Range Miles
2450	24	79	187	14.8	4.3	800	5.4	1010
	23	74	183	14.0	4.5	830	5.7	1050
	22	70	179	13.1	4.8	870	6.1	1095
	21	65	175	12.3	5.2	905	6.5	1140
2300	24	71	180	13.3	4.8	860	6.0	1080
	23	67	177	12.6	5.0	890	6.4	1125
	22	63	173	11.8	5.4	925	6.8	1170
	21	59	169	11.1	5.7	965	7.2	1215
2200	23	62	172	11.7	5.4	935	6.8	1175
	22	58	168	11.0	5.8	970	7.2	1220
	21	55	165	10.4	6.1	1005	7.7	1265
	20	51	160	9.8	6.5	1040	8.2	1310
2100	22	53	163	10.1	6.3	1020	7.9	1290
	21	50	159	9.6	6.6	1055	8.4	1330
	20	46	154	9.0	7.1	1090	8.9	1370
	19	43	150	8.5	7.5	1115	9.4	1405
	18	40	145	8.1	7.9	1140	9.9	1435
	17	37	139	7.6	8.4	1160	10.6	1465
	16	34	132	7.1	8.9	1175	11.2	1480
	15	31	125	6.7	9.4	1180	11.9	1485

FIGURE 38.—Condor—cruise performance—(5,000')

7500 CRUISE PERFORMANCE

NORMAL LEAN MIXTURE

Standard Atmosphere • Zero Wind • Gross Weight-3000 Pounds

7500 FEET

RPM	MP	% BHP	TAS MPH	Gal/ Hour	63.5 Gal. (No Reserve) Endr. Hours	63.5 Gal. (No Reserve) Range Miles	80 Gal. (No Reserve) Endr. Hours	80 Gal. (No Reserve) Range Miles
2450	22	72	186	13.6	4.7	870	5.9	1095
	21	67	182	12.7	5.0	910	6.3	1145
	20	64	178	12.0	5.3	945	6.7	1190
	19	59	173	11.1	5.7	990	7.2	1245
2300	22	65	179	12.2	5.2	930	6.6	1175
	21	61	175	11.5	5.5	970	7.0	1220
	20	57	171	10.8	5.9	1005	7.4	1270
	19	53	167	10.1	6.3	1040	7.9	1320
2200	22	61	175	11.4	5.6	970	7.0	1225
	21	57	171	10.7	5.9	1010	7.5	1275
	20	53	166	10.1	6.3	1045	7.9	1315
	19	50	162	9.5	6.7	1080	8.4	1360
2100	21	52	165	9.8	6.4	1060	8.1	1335
	20	48	160	9.3	6.8	1095	8.6	1380
	19	45	155	8.7	7.3	1125	9.2	1420
	18	42	150	8.3	7.7	1150	9.7	1450
	17	39	145	7.8	8.1	1175	10.2	1485
	16	35	138	7.4	8.6	1190	10.9	1500
	15	32	131	6.9	9.1	1200	11.5	1510

FIGURE 39.—Condor—cruise performance—(7,500')

CRUISE PERFORMANCE 10,000

NORMAL LEAN MIXTURE

Standard Atmosphere • Zero Wind • Gross Weight-3000 Pounds

10,000 FEET

RPM	MP	% BHP	TAS MPH	Gal/ Hour	63.5 Gal. (No Reserve) Endr. Hours	63.5 Gal. (No Reserve) Range Miles	80 Gal. (No Reserve) Endr. Hours	80 Gal. (No Reserve) Range Miles
2450	20	65	184	12.3	5.2	950	6.5	1200
	19	61	179	11.5	5.5	995	7.0	1250
	18	57	174	10.7	5.9	1035	7.5	1305
	17	52	169	10.0	6.4	1075	8.0	1355
2300	20	59	177	11.1	5.7	1010	7.2	1275
	19	55	173	10.4	6.1	1050	7.7	1325
	18	51	168	9.8	6.5	1090	8.2	1370
	17	48	162	9.1	6.9	1125	8.7	1420
2200	20	55	173	10.4	6.1	1050	7.7	1325
	19	52	168	9.9	6.4	1085	8.1	1365
	18	48	163	9.2	6.9	1120	8.7	1410
	17	44	158	8.7	7.3	1155	9.2	1450
2100	20	50	166	9.5	6.7	1105	8.4	1390
	19	47	161	9.0	7.0	1135	8.9	1430
	18	44	156	8.5	7.4	1160	9.4	1465
	17	40	150	8.0	7.9	1185	9.9	1495
	16	37	144	7.6	8.4	1205	10.5	1520
	15	34	137	7.1	8.9	1215	11.2	1530
	14	30	126	6.6	9.6	1200	12.0	1510

FIGURE 40—Condor—cruise performance—(10,000')

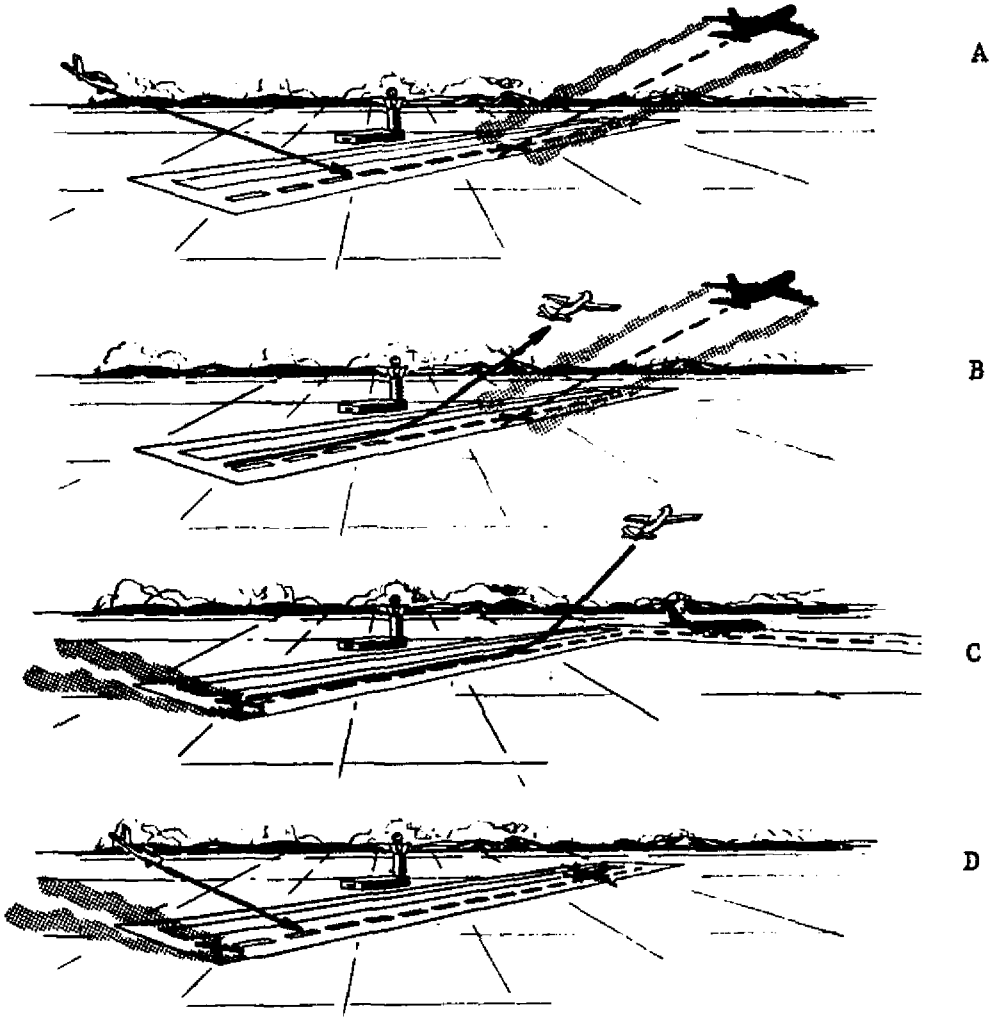


FIGURE 41.—Avoidance of wingtip vortices during takeoffs and landings.

A. Landing

B. Takeoff

C. Takeoff

D. Landing

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

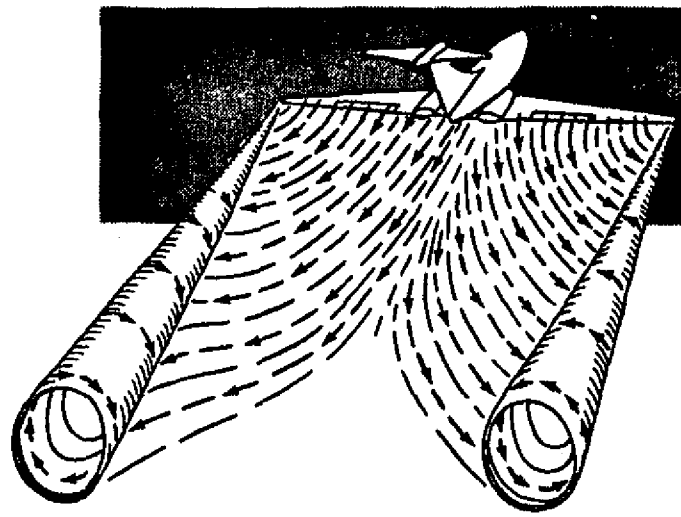
VFR PILOT EXAM-O-GRAM* NO. 53

DANGERS OF WINGTIP VORTICES

Investigations of several fatal and near-fatal accidents show the probable cause to be loss of control when encountering wingtip vortices created by large aircraft. Reports indicate that many pilots are unaware of the dangers associated with wake or vortex turbulence; therefore, applicants for pilot certificates are being tested on their knowledge of this subject.

WHAT ARE WINGTIP VORTICES? Wingtip vortices are compact, fast-spinning, violently turbulent air masses that trail behind an airplane, sometimes for miles. Unfortunately they are invisible, but if you could see them they would look like two tornadoes stretching back horizontally from each wingtip. Many pilots refer to this phenomenon as "prop wash" or "jet wash," but engineering studies have revealed that the main source of this disturbance is from the wingtips, not the props or engines. These vortex systems are generated by the flow of air from the high pressure region under the wing, and curl around the wingtip to the region of lower pressure on the upper surface forming the two rotating vortices.

WHY ARE THEY DANGEROUS? They are dangerous because loss of control of aircraft can occur when flying into the wingtip vortices of large aircraft. The velocity of the air circulating about the core of these vortex systems can be extremely high, particularly those generated by the larger airplanes, and these velocities can exceed the control power of most airplanes. A smaller airplane flying into one of these rotating air masses can experience dangerous upsets and excessive load factors causing structural damage to the airplane. Particular care should be taken to avoid the vortices during landing and taking off.



WHEN ARE THEY STRONGEST? There are many factors affecting the intensity of wingtip vortices, but it is a safe and practical generalization that the bigger the airplane the more violent and long-lived will be the vortex disturbance. Recent studies indicated that the strongest vortex systems trailing behind the very large airplanes will descend 400-500 feet per minute to approximately 1,000 feet below the airplane. The vortices retain their lateral separation and drift with the wind. The aircraft creating the vortices may be out of sight, and the turbulence generated might be still lingering in the area. The heavier and cleaner the airplane and the slower it is flying, the stronger the air circulation in the vortex cores.

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

a. Avoid passing behind any large aircraft. Alter course to avoid the area behind and below the generating aircraft.

b. Avoid, when possible, places and altitudes frequented by large aircraft. If possible, monitor approach control and control tower frequencies at airports where large aircraft operate. These radio transmissions may give you a clue to the locations and paths of large aircraft.

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

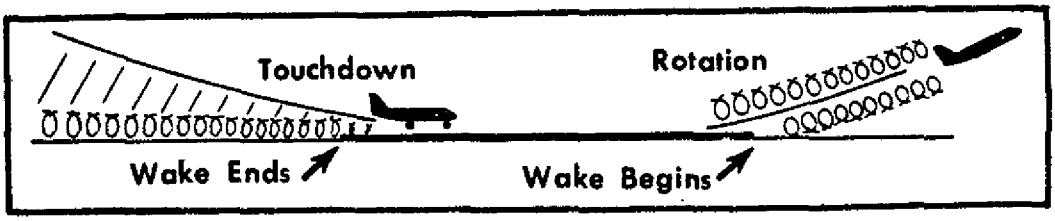
d. When taking off or landing behind large aircraft, be on the alert for turbulence and allow adequate spacing. Visualize the location of the vortex trail and avoid those areas.

* Exam-O-Grams are non-directive in nature and are issued solely as an information service to individuals interested in Airman Written Examinations.

DISTRIBUTION: ZC-307

FIGURE 42.—VFR pilot Exam-O-Gram No. 53.

e. The best way of avoiding wingtip vortices is to know where they are most likely to be encountered and act accordingly. Since vortices are not produced until lift is produced, they will not be generated by an aircraft taking off until the aircraft rotates for lift-off. Vortices cease to be generated by a landing aircraft when its wings cease to produce lift -- when it has actually landed. Plan your takeoff and landing accordingly.



RECOMMENDED READING FOR ALL PILOTS. Your attention is invited to the Wake Turbulence Section of the Airman's Information Manual, which thoroughly explains this subject. It is also described in FAA Advisory Circular AC 90-23D (which may be obtained free of charge from: Distribution Unit, TAD-484.3, Department of Transportation, Washington, D.C. 20590).

FAA Aeronautical Center
Flight Standards Technical Division, Operations Branch
P. O. Box 25082
Oklahoma City, Oklahoma 73125 1/74

Exam-O-Grams available free of charge--single copy only per request. Permission is hereby granted to reproduce this material.

VFR – No. 53

LIST OF CURRENT VFR PILOT EXAM-O-GRAMS

June 1, 1976

No.	Title & Revision Date
2	VFR Cruising Altitudes - 10/71
4	Preflight Planning for a VFR Cross-Country Flight (Series 1) - 1/74
5	Preflight Planning for a VFR Cross-Country Flight (Series 2) - 10/71
6	Preflight Planning for a VFR Cross-Country Flight (Series 3) - 3/71
15	How to Use VOR (Series 1) - 8/64
16	How to Use VOR (Series 2) - 8/64
17	Common Misconceptions (Series 1) - 10/71
18	Lost Procedures - Pilotage - 9/64
19	Emergency or Lost Procedures (Radio) - 1/74
20	Ceiling and Visibility - 1/74
21	Flying into Unfavorable Weather - 7/69
22	Potential Midair Collisions - 1/74
23	Interpreting Sectional Charts (Series 1) 11/70
26	Common Misconceptions (Series 2) - 1/74
27	The Effect of Wind on an Airplane - 1/74
28	Factors Affecting Stall Speed - 9/65
29	Potential Midair Collisions (Series 2) - 1/74
33	Use of Performance Charts - 4/66
34	How to Obtain Proper Weather Briefing - 1/74
35	UNICOM Frequencies & Uses - 11/67
36	Commonly Misunderstood Areas of Aeronautical Knowledge (Series 1) - 1/72
37	Commonly Misunderstood Areas of Aeronautical Knowledge (Series 2) - 1/72
38	Mixture Control - Fuel/Air Ratio - 11/66
39	Simple ADF for VFR Navigation - 8/67
40	Visual Approach Slope Indicator (VASI) - 1/74
41	Controlled Airspace (Series 1) - 10/71
42	Controlled Airspace (Series 2) - 10/71
43	ATIS (Automatic Terminal Information Service) - 1/74
44	How High the Clouds? - 1/74
45	Airspeeds and Airspeed Indicator Markings (Series 2) - 1/69
46	Aviation Weather Reports - Remarks - 1/74
47	Ground Effect - 1/74
48	Midair Collisions (Series 3) - 1/74
49	Use of Oxygen in General Aviation Aircraft - 1/71
50	Interpreting Sectional Charts (Series 2) - 1/74
51	Interpreting Sectional Charts (Series 3) - 4/71
52	Sky Cover and Ceiling - 4/72
53	Dangers of Wingtip Vortices - 1/74
54	Emergency Locator Transmitters (ELTs) - 5/74
55	Terminal Radar Service Areas (TRSAs) - "Stage III" - 3/75
56	Sky Cover Symbols in Weather Reports and Forecasts - 7/75
57	Flight in the Region of Reversed Command in Relation to Takeoffs and Landings - 7/75

Exam-O-Grams 1, 3, 7, 8, 9, 10, 11, 12, 13, 14, 24, 25, 30, 31, and 32, have been discontinued since the subject areas which they cover are now adequately treated in other FAA publications.

FIGURE 48.—List of current VFR pilot Exam-O-Grams.

LIST OF CURRENT IFR PILOT June 1, 1976

EXAM-O-GRAMS

No.	Title & Revision Date
2	Use and Abuse of Radar - 2/71
5	Aviation Weather Reports and Forecasts - 3/74
6	VFR Operations on an Instrument Flight Plan - 9/69
7	CDI Interpretation - 9/69
8	IFR Altitudes - 11/75
10	Altimetry - 12/67
11	Communications Procedures for Pilots on Instrument Flight Plans - 2/71
14	VOR Quiz - 8/65
15	The Weather Depiction Chart is for You - 2/74
16	The Low Level Prognostic Chart - 11/73
17	The Radar Summary Chart - 3/74
18	Rate of Turn - 1/67
19	Telephone Weather Briefing - 6/71
21	IFR Weight and Balance Computations - 9/67
22	VOR Receiver Accuracy Check - 2/74
23	Fundamental ADF Procedures - 1/71
24	The Attitude Indicator - 5/70
25	The ATC Transponder - 2/71
26	Runway Marking - 10/71
27	Airport Surveillance Radar (ASR) Approaches - 4/73
28	Category II Taxiway Holding Lines - 7/69
29	When an Alternate Airport is Not Required - 3/70
30	VORTAC Area Navigation - 3/74
31	Is Your Instrument Flight Really Legal? - 11/73
32	Aircraft Performance Charts - 3/71
33	Runway and Displaced Threshold Lighting - 1/72
34	IFR Departure Clearances - 9/71
35	Clearance Delivery Procedures - 1/72
36	Lost Communications Procedures - Altitude Requirements - 1/72
37	Lost Communications Procedures - Route Requirements - 9/72
38	Lost Communications Procedures - Approach Requirements - 3/73
39	Enroute Chart Information - 4/73

Exam-O-Grams 1, 3, 4, 9, 12, 13, and 20 have been deleted since the subject areas are adequately treated in other FAA publications.

FIGURE 44.--List of current IFR pilot Exam-O-Grams.

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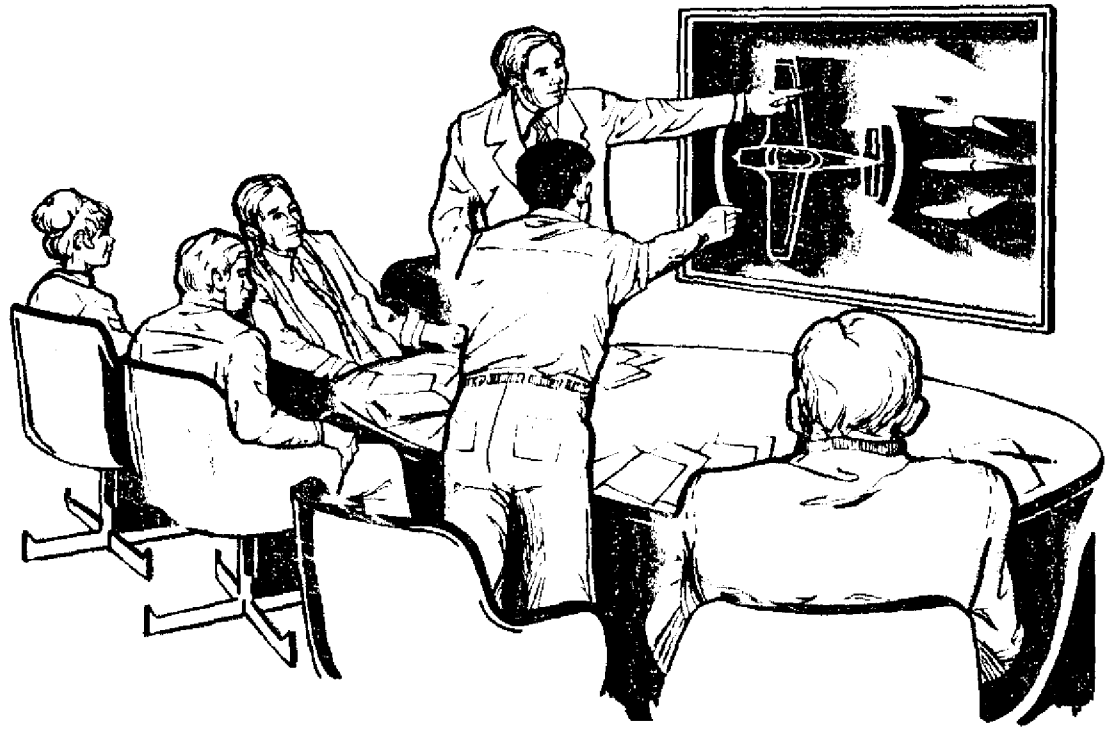
3. Performance and Application
4. Evaluation



U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

GROUND INSTRUCTOR WRITTEN TEST GUIDE BASIC–ADVANCED

REVISED

1976

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
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CONTENTS

	Page
Preface	v
Introduction	1
Certification Requirements	1
The Written Tests	1
Taking the Tests	1
Recommended Study Materials	2
How to Obtain GPO Publications	4
Study Outline—Fundamentals of Instruction	4
Study Outline—Aeronautical Knowledge	7
Sample Test Items	12
Additional Questions for Study	16
Appendix	19

PREFACE

The Flight Standards Service of the Federal Aviation Administration has developed this guide to assist applicants who are preparing for the Ground Instructor Certificate, Basic or Advanced.

This guide contains study outlines and a list of recommended study materials and explains how to obtain those publications. Included in this guide are sample test items with explanations of the correct answers, and illustrations representative of those found on FAA written tests. It supersedes the Ground Instructor Written Test Guide, Basic-Advanced, AC 143–1D, issued in 1974.

Comments regarding this publication may be directed to the U.S. Department of Transportation, Federal Aviation Administration, Flight Standards National Field Office, P.O. Box 25082, Oklahoma City, Oklahoma 73125.

GROUND INSTRUCTOR WRITTEN TEST GUIDE
BASIC–ADVANCED

INTRODUCTION

Knowledge and understanding are seldom gained quickly or easily. This is particularly true in the diversified field of aviation instruction. Ground instructors become more competent through study, experience, and hard work. The instructor's attitude toward instruction, and continuous review to remain current in the many areas where technological change is the rule rather than the exception, determine what kind of a job a person will do.

The purpose of this publication is to provide guidance to the applicant by outlining the scope of knowledge required of a ground instructor. By using this guide, the applicant should be able to intelligently develop a study plan.

CERTIFICATION REQUIREMENTS

To be eligible for a Ground Instructor's Certificate with a Basic or Advanced Instructor's Rating, the certification process requires that the applicant pass a Basic or Advanced Ground Instructor's Written Test and Fundamentals of Instructing Written Test. However, if the applicant holds a valid FAA Flight or Ground Instructor Certificate, the applicant is not required to take the separate test on Fundamentals of Instructing when applying for an additional instructor's certificate or rating.

It is not necessary to take this Fundamentals of Instructing Test on the same day as the Ground Instructor's Written Test and it is immaterial which test is taken first.

THE WRITTEN TEST

The Fundamentals of Instructing and the Ground Instructor written tests are comprehensive because they test an applicant's knowledge in many subject areas. These areas include all required subjects common to all aircraft pilot certificates, as well as the Fundamentals of Instructing subject areas, such as: The Learning Process, Elements of Effective Teaching, Student Evaluation, Quizzing and Testing, Course Development, Lesson Planning, and Classroom Instruction Techniques.

The Fundamentals of Instructing written test contains 50 test items. Three hours are allowed for taking this test. The Basic Ground Instructor written test contains 80 items, and the time allowed for taking this test is 4 hours. The Advanced Ground Instructor written test contains 100 items, and the time allowed for taking this test is 5 hours. All test items are of the objective multiple-choice type, and each item can be answered by selection of a single response as the correct choice. The correct response of one test item does not depend upon or influence the correct response of another test item.

The applicant's answer sheet is forwarded to the FAA Aeronautical Center for processing by ADP computers. Shortly thereafter, the applicant will receive an Airmen Written Test Report which not only includes the score but lists, in code, those subject areas answered incorrectly. These codes refer to a list of subject matter which accompanies the report. The applicant can thus determine those subject areas which should be studied.

TAKING THE TESTS

The tests may be taken at General Aviation District Offices of the Federal Aviation Administration and other designated places.

When reporting for the written test, be prepared to present to the person administering the test documentary evidence of your identity. *Normally, you will not be permitted to begin the test unless there is sufficient time to complete it.*

The equipment needed for taking the test includes a straight edge, a plotter or protractor, and a computer (preferably one with a wind vector face). It is also desirable to have dividers for accurate measurement.

Consider these points:

1. Test items should be answered in accordance with the latest regulations and procedures.

2. Read the information, instructions, and test items carefully. Do not try to solve the problem before understanding the question. Be sure the objectives of the test item are fully understood, then work the problem or analyze the choices and select the correct answer.

3. Do not consider a complicated problem a "trick" item; each item has an objective. There are no trick items. The questions and answers mean exactly what is stated, and refer to the general rule rather than the exception to the rule.

4. There is only one correct and complete answer to each item.

5. If you find you have difficulty with a particular test item, do not spend too much time on it. Go to the items that you can answer readily, then return to the difficult items.

6. If you have solved a computer-type problem correctly, your answer will be closer to the correct answer than to any of the other choices. The correct answer is an average of solutions obtained by using several types of computers.

7. When marking the test answer sheet be sure that the number of the question matches the number on the answer sheet and that you mark only one answer block per question. An answer block for a test question that is left blank, a partially erased answer block, or more than one answer block marked is scored as wrong. Carefully check your answer sheet for these types of errors before turning it in.

RECOMMENDED STUDY MATERIALS

Professionalism in instruction is very important. One thing that enhances professionalism is the possession of a technical library. By obtaining study materials that are beneficial and appropriate to preparation for certification, the prospective instructor will be laying the foundation upon which to build an aeronautical library.

The following list of source material outlines essential publications produced by the FAA but does not include all the useful and available material that is produced commercially. Other excellent textbooks, audio-visual training aids, and instructional materials may be obtained from various commerical bookstores and fixed-base operators engaged in flight training.

A. Advisory Circulars.

1. AC 00–6A, *Aviation Weather.* Contains a text for pilots and other flight operations personnel whose interest in meteorology is primarily in its application to flying. (Sup't. Doc's.)

2. AC 00–45, *Aviation Weather Services.* Supplements AC 00–6A, and explains the use and interpretation of reports, forecasts, weather maps, and prognostic charts. (Sup't. Doc's.)

3. AC 61–16A, *Flight Instructor's Handbook.* Designed to give guidance and information to applicants preparing for ground and flight instructor certificates. It explains accepted theories and practices applicable to teaching and the learning process. It is also reference material for applicants preparing for Fundamentals of Instructing Written Test. (Sup't. Doc's.)

4. *Aviation Instructor's Handbook.* (Available in the near future.) In the process of being developed to replace Flight Instructor's Handbook AC 61–16A. It is being designed to provide currently certificated flight and ground instructors and applicants for such certificates, with comprehensive, accurate, and easily understood information on learning and teaching, and to relate this information to the aviation instructor's task of conveying aeronautical knowledge and skill to students.

5. AC 61-23A, *Pilot's Handbook of Aeronautical Knowledge.* Contains essential, authoritative information used in training and guiding private pilots, and covers most subject areas in which an applicant may be tested. Explains the use of the Airman's Information Manual, the data in FAA-approved airplane flight manuals, and the basic instruments for airplane attitude control. (Sup't. Doc's.)

6. AC 61-21, *Flight Training Handbook.* Contains information and direction in the introduction and performance of training maneuvers for student pilots, pilots who are requalifying or preparing for additional ratings, and for flight instructors. (Sup't. Doc's.)

7. AC 61-32A, *Private Pilot Written Test Guide.* Contains information, guidelines, and sample test items to assist applicants for the Private Pilot Certificate in attaining necessary aeronautical knowledge. (Sup't. Doc's.)

8. AC 61-71, *Commercial Pilot Written Test Guide.* Reflects current operating procedures and techniques for use in preparing for the Commercial Pilot-Airplane Written Test. (Sup't. Doc's.)

9. AC 90-23D, *Wake Turbulence.* Presents information on the subject of wake turbulence and suggests techniques that may help pilots avoid the hazards associated with wingtip vortex turbulence. (FREE) FAA

10. AC 91-15, *Terrain Flying.* This pocket-size booklet contains observations, opinions, warnings, and advice from veteran pilots regarding flight over various types of terrain throughout the U.S. (Sup't. Doc's.)

11. AC 20-9, *Personal Aircraft Inspection Handbook.* This is a general guide for inspection of aircraft; Part I deals with the fundamentals of inspection, and Part II covers a typical inspection in detail.

12. AC 91-23, *Pilot's Weight and Balance Handbook.* Contains a text on aircraft weight and balance. It progresses from an explanation of basic fundamentals to the complete application of weight and balance principles. (Sup't. Doc's.)

B. **Airman's Information Manual (AIM).** Contains information necessary for planning and conducting flights within the National Airspace System. Besides providing the most current airport and NAVAID data, AIM includes material of interest to everyone in aviation.

To better serve pilots, AIM is available in five parts which may be purchased separately on an annual basis.

Part 1. *Basic Flight Manual and ATC Procedures.* Issued semiannually. (Sup't. Doc's.)

Part 2. *Airport Directory.* Issued semiannually. (Sup't. Doc's.)

Part 3. *Operational Data and Notices to Airmen.* Issued every 56 days. (Sup't. Doc's.)

Part 3A. *Notices to Airmen.* Issued every 14 days. (Sup't. Doc's.)

Part 4. *Graphic Notices and Supplemental Data.* Issued quarterly. (Sup't. Doc's.)

C. **Federal Aviation Regulations (FAR).**

Part 1, Definitions and Abbreviations (Sup't. Doc's.)

Part 61, Certification: Pilots and Flight Instructors (Sup't. Doc's.)

Part 71, Designation of Federal Airways, Area Low Routes, Controlled Airspace and Reporting Points (Sup't. Doc's.)

Part 91, General Operating and Flight Rules (Sup't. Doc's.)

Part 135, Air Taxi Operators and Commercial Operators of Small Aircraft (Sup't. Doc's.)

D. **National Transportation Safety Board Regulation (NTSB), Part 830.** Deals with procedures required in the notification and reporting of accidents and lost or overdue aircraft within the United States, its territories, and possessions. (FREE) from NTSB

E. **VFR/IFR Pilot Exam-O-Grams.** Provides information about concepts and procedures critical to aviation safety. Lists of current Exam-O-Grams appear in Figures 20 and 21 of the Appendix. (FREE) FAA

F. **Practical Air Navigation**—10th Edition. Provides coverage dealing with navigation including pilotage, dead reckoning, radio, and celestial navigation. This text may be obtained from many book dealers or from the publisher, Jeppesen & Co., 8025 East 40th Ave., Denver, Colorado 80209.

G. **Aeronautical Charts.** The National Ocean Survey publishes and distributes aeronautical charts of the United States.

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

National Ocean Survey
Distribution Division, (C–44)
Riverdale, Maryland 20840

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

HOW TO OBTAIN REFERENCE PUBLICATIONS

The reference materials listed, except for free Advisory Circulars, Exam-O-Grams, Aeronautical Charts, and Practical Air Navigation, may be obtained by sending a check or money order to:

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

To obtain the latest information regarding prices of Federal Aviation Regulations, number of changes, and ordering information, request a free copy of Advisory Circular 00–44, "Status of Federal Aviation Regulations" from:

U.S. Department of Transportation
Publications Section, TAD–443.1
Washington, D.C. 20590

Free FAA publications may also be obtained from this address.

If you are presently on one of FAA's Advisory Circular mailing lists, you will receive Advisory Circular 00–44. If not, and you wish to be on the list to receive current copies as issued, send your name and address to:

U.S. Department of Transportation
Distribution Unit, TAD–482.3
Washington, D.C. 20590

To receive the latest information on how to obtain the Airman's Information Manual, free Advisory Circulars, and other FAA material, consult the Advisory Circular Checklist, AC 00–2. A copy of this checklist may be obtained free of charge by sending your request to:

U.S. Department of Transportation
Publications Section, TAD–443.1
Washington, D.C. 20590

National Transportation Safety Board Regulation, Part 830, may be obtained free of charge upon request from:

National Transportation Safety Board
Publications Unit
Washington, D.C. 20594

Exam-O-Grams may be obtained free of charge (one copy per each request), and names may be added to the mailing list by writing to:

U.S. Department of Transportation
FAA Aeronautical Center
Flight Standards National Field Office
Examinations Branch, AFS–590
P.O. Box 25082
Oklahoma City, Oklahoma 73125

STUDY OUTLINE

This outline is primarily for use with AC 60–14 "Aviation Instructor's Handbook," but will also be useful when used with AC 61–16A, Flight Instructor's Handbook.

Fundamentals of Instructing

I. The Learning Process

A. Definition of Learning.

B. Characteristics of Learning.
1. Learning is purposeful.
2. Learning comes through experience.
3. Learning is multifaced.
4. Learning is an active process.

C. Laws of Learning.
1. Law of readiness.
2. Law of exercise.
3. Law of effect.
4. Law of primacy.
5. Law of intensity.
6. Law of recency.

D. How People Learn.

1. Perceptions.
2. Factors which affect perception.
3. Insights.
4. Motivation.

E. Levels of Learning.

F. Learning Skills.

1. Physical skills involve more than muscles.
2. Desire to learn.
3. Patterns to follow.
4. Perform the skill.
5. Knowledge of results.
6. Progress follows a pattern.
7. Duration and organization of lesson.
8. Evaluation versus critique.
9. Application of skill.

G. Forgetting and Retention.

1. Theories of forgetting.
2. Retention of learning.

H. Transfer of Learning.

I. Habit Formation.

II. Human Behavior.

A. Control of Human Behavior.

B. Human Needs.

1. Physical needs.
2. Social needs.
3. Egoistic needs.
4. Self-fulfillment needs.

C. Defense Mechanisms.

1. Rationalization.
2. Flight.
3. Aggression.
4. Resignation.

D. The Instructor's Role in Human Relations.

1. Keep students motivated.
2. Keep students informed.
3. Approach students as individuals.
4. Give credit when due.
5. Criticize constructively.
6. Be consistent.
7. Admit errors.

III. Effective Communications.

A. Basic Elements of Communication Process.

1. Source.
2. Symbols.
3. Receiver.

B. Barriers to Effective Communications.

1. Lack of common core of experience.
2. Confusion between the symbol and the thing symbolized.
3. Overuse of abstractions.

IV. The Teaching Process.

A. Preparation.

B. Presentation.

C. Application.

D. Review and Evaluation.

V. Teaching Methods.

A. Organizing Material.

1. Introduction.
2. Development.
3. Conclusion.

B. Lecture Method.

1. Types of lectures.
2. Teaching lecture.
3. Preparing the teaching lecture.
4. Suitable language.
5. Types of delivery.
6. Use of notes.
7. Formal versus informal lectures.
8. Advantages and disadvantages of the lecture.

C. Guided Discussion Method.

1. Use of questions in a guided discussion.
2. Planning a guided discussion.
3. Student preparation for a guided discussion.
4. Guiding a discussion—instructor technique.
5. Conclusion.

D. Demonstration/Performance Method.

1. Explanation phase.
2. Demonstration phase.
3. Student performance and instructor supervision phases.
4. Evaluation phase.

E. Programed Instruction.
   1. General discussion.
   2. One method of programming.

VI. The Instructor as a Critic.

A. Purpose of a Critique.

B. Characteristics of an Effective Critique.

A critique should be—objective
—flexible
—acceptable
—comprehensive
—constructive
—well organized
—thoughtful
—specific

C. Methods of Critique.
   1. Instructor—student critique.
   2. Student-led critiques.
   3. Small-group critiques.
   4. Individual student critique.
   5. Written critique.
   6. Self-critique.

D. Ground Rules for Critiquing.

VII. Evaluation.

A. Oral Quizzing.
   1. Characteristics of effective questions.
   2. Types of questions to avoid.
   3. Answering students' questions.

B. Written Tests.
   1. Characteristics of a good test.
   2. Written test items.
   3. Effective item writing.
   4. Principles to follow.

C. Performance Tests.

VIII. Instruction Aids.

A. Theory Behind Use of Instructional Aids.

B. Reasons for Using Instructional Aids.

C. Guidelines for Use of Instructional Aids.

D. Types of Instructional Aids.
   1. Chalkboard.
   2. Models.
   3. Charts.
   4. Projected material.

E. Future Developments.

IX. Flight Instructor Characteristics and Responsibilities.

A. Professionalism.
   1. Sincerity.
   2. Acceptance of the student.
   3. Personal appearance and habits.
   4. Demeanor.
   5. Safety practices and accident prevention.
   6. Proper language.
   7. Self improvement.

B. Helping Student Pilots Learn.
   1. Providing adequate instruction.
   2. Demanding an adequate standard of performance.
   3. Emphasizing the "positive."

C. Evaluation of Student Piloting Ability.

D. The Flight Instructor as a Practical Psychologist.
   1. Anxiety.
   2. Normal reactions to stress.
   3. Abnormal reaction to stress.
   4. Instructor's actions regarding seriously abnormal students.

E. Student Pilot Supervision and Surveillance.

F. Flight Instructor Endorsements.

G. Flight Test Recommendations.

H. Airplane Checkouts.

I. Refresher Training.

X. Techniques of Flight Instruction.

A. The "Telling and Doing" Technique in Flight Instruction.
   1. Instructor tells—instructor does.
   2. Student tells—instructor does.
   3. Student tells—student does.
   4. Student does—instructor evaluates.

B. The Integrated Technique of Flight Instruction.
   1. Objectives.
   2. Development of habit patterns.
   3. Accuracy of flight control.
   4. Operating efficiency.
   5. Emergency capability.
   6. Procedures.
   7. Precautions.
   8. Flight instructor qualifications.

C. Obstacles to Learning During Flight Instruction.

XI. Planning Instructional Activity.

A. Course of Training.
1. Determination of standards and objectives.
2. Identification of blocks of learning.

B. Training Syllabus.
1. Sample Private Pilot (Airplane) ground training syllabus.
2. Sample Private Pilot (Airplane) flight training syllabus.

C. Lesson Plan.
1. Purpose of the lesson plan.
2. Characteristics of a well-planned lesson.
3. How to use a lesson plan properly.
4. Lesson plan items.

Aeronautical Knowledge Study References

I. Federal Aviation Regulations.

A. Parts 1 and 71: Definitions and Abbreviations, and Controlled Airspace.
1. Air commerce.
2. Airport traffic area.
3. Ceiling.
4. Commercial operator.
5. Flight level.
6. Flight visibility.
7. Interstate air commerce.
8. Large aircraft.
9. Major alteration.
10. Major repair.
11. Pilot in command.
12. Second in command.
13. Federal airway.
14. Control area.
15. Continental control area.
16. Control zone.
17. Route segment.
18. Terminal control area.
19. Positive control area.

B. Part 61: Certification: Pilots and Flight Instructors.
1. Required certificates/ratings.
2. Certificates and ratings issued.
3. Expired pilot certificates/reissuance.
4. Carriage of narcotic drugs/marihuana.
5. Duration of pilot certificates.
6. Duration of medical certificates.
7. General limitations
8. Pilot logbooks.
9. Operations during known medical deficiency.
10. Second in command qualifications.
11. Recent experience: Pilot in command.
12. Pilot in command proficiency check.
13. Falsification, reproduction, alteration.
14. Change of address.
15. Private pilot privileges/limitations.
16. Commercial pilot privileges/limitations.

C. Part 91: General Operating and Flight Rules—Subpart A—General.
1. Responsibility of pilot in command.
2. Pilot in command/more than one pilot.
3. Preflight action.
4. Flight crewmembers at stations.
5. Interference with crewmembers.
6. Careless or reckless operation.
7. Liquor and drugs.
8. Dropping objects.
9. Fastening of safety belts.
10. Parachutes and parachuting.
11. Portable electronic devices.
12. ATC transponder equipment requirements.
13. Civil aircraft: certificates required.
14. Aircraft airworthiness.
15. Aircraft operating limitations/markings.
16. Supplemental oxygen.
17. Instrument and equipment requirements.
18. Limited/restricted aircraft limitations.
19. Ferry flight with one engine inoperative.
20. Emergency exits for airplanes.
21. Aural speed warning device.
22. Emergency locator transmitters.
23. Report: aircraft identification/activity.

D. Part 91: General Operating and Flight Rules—Subpart B—Flight Rules.
   1. Waivers.
   2. Operating near other aircraft.
   3. Right-of-way rules.
   4. Aircraft speed.
   5. Acrobatic flight.
   6. Aircraft lights.
   7. Complying—ATC clearances/instructions.
   8. ATC light signals.
   9. Minimum safe altitudes; general.
   10. Altimeter settings.
   11. Flight plan; information required.
   12. Operation—in vicinity of airport.
   13. Operation—airport with control tower.
   14. Operation—airport without control tower.
   15. Flight in terminal control areas.
   16. Temporary flight restrictions.
   17. Flight test areas.
   18. Restricted and prohibited areas.
   19. Positive control areas; route segments.
   20. Basic VFR weather minimums.
   21. Special VFR weather minimums.
   22. VFR cruising altitude or flight level.
   23. ATC transponder test/inspection.

E. Part 91: General Operating and Flight Rules—Subpart C—Maintenance, Preventive Maintenance, and Alterations.
   1. General maintenance and alterations.
   2. Maintenance required.
   3. Carrying persons after repair/alteration.
   4. Inspections/progressive inspections.
   5. Altimeter system tests/inspections.
   6. Maintenance records/transfer of records.
   7. Rebuilt engine maintenance records.
   8. ATC transponder test/inspection.

F. Part 135: Air Taxi Operators and Commercial Operators of Small Aircraft.
   1. SubpartA—General.
   2. Subpart B—Rules—ATCO certificate holder.
   3. Subpart C—Operating rules.
   4. Subpart D—Crewmember qualifications.
   5. Subpart E—Aircraft and equipment.

II. National Transportation Safety Board—Part 830.

A. General.
   1. Applicability.
   2. Definitions.

B. Initial Notification of Aircraft Accidents, Incidents, and Overdue Aircraft.
   1. Immediate notification.
   2. Information to be given in notification.

C. Preservation of Aircraft Wreckage, Mail, Cargo, and Records.

D. Reporting of Aircraft Accidents, Incidents, and Overdue Aircraft.

III. FAA Advisory Circulars.

A. Series 00—General.

B. Series 20—Aircraft.

C. Series 60—Airmen.

D. Series 70—Airspace.

E. Series 90—Air Traffic Control and General Operations.

F. Series 120—Air Carrier and Commercial Operators and Helicopters.

G. Series 150—Airports.

H. Series 170—Air Navigation Facilities.

IV. Airman's Information Manual.

A. Part 1: Basic Flight Manual and ATC Procedures.
   1. Glossary of aeronautical terms.
   2. Airport lighting/marking/aids.
   3. Air navigation radio aids.
   4. Visual approach slope indicator (VASI).
   5. Controlled/uncontrolled airspace.
   6. Operating at nontower airports.
   7. Special use airspace—prohibited, restricted, MOA's, alert areas.
   8. Automatic terminal information service (ATIS).
   9. ATC departure/en route/arrival procedures.
   10. Radar traffic information service.
   11. Terminal radar program for VFR aircraft.

12. Aeronautical advisory stations (UNICOM).
13. Radio/telephone phraseology/technique.
14. Traffic/wind direction indicators.
15. Obtaining weather information/briefing.
16. Flight plans.
17. VHF/UHF direction finder.
18. ADIZ and designated mountainous areas.
19. Medical facts for pilots.
20. Good operating practices.

B. Part 2: Airport Directory.
1. Obtaining airport/heliport data.
2. FSS/Weather service telephone numbers.

C. Part 3: Operational Data and Notices to Airmen.
1. Obtaining radio facility/FSS data.
2. Special notices/special operations.
3. Notices to Airmen (NOTAMS).
4. VOR receiver checkpoints.
5. Restrictions to en route navigation aids.
6. Special notices.

D. Part 3A: Notices to Airmen.

E. Part 4: Graphic Notices and Supplemental Data.
1. Parachute jumping areas.
2. Military training routes.
3. Terminal control areas (TCA's).
4. Terminal area graphic notices.
5. Terminal radar service areas (TRSA's).

V. Aviation Weather, AC 00-6A.

A. The Earth's Atmosphere.
1. Composition.
2. Vertical structure.
3. The standard atmosphere.
4. Density and hypoxia.

B. Temperature.
1. Temperature scales.
2. Heat and temperature.
3. Temperature variation.

C. Atmospheric Pressure and Altimetry.
1. Atmospheric pressure.
2. Altimetry.

D. Wind.
1. Convection.
2. Pressure gradient force.
3. Coriolis force.
4. The general circulation.
5. Friction.
6. The jet stream.
7. Local and small scale winds.
8. Wind shear.
9. Wind, pressure systems, and weather.

E. Moisture, Cloud Formation, and Precipitation.
1. Water vapor.
2. Change of state.
3. Cloud formations.
4. Precipitation.
5. Land and water effects.

F. Stable and Unstable Air.
1. Changes within upward and downward moving air.
2. Stability and instability.

G. Clouds.
1. Identification.
2. Signposts in the sky.

H. Air Masses and Fronts.
1. Air masses.
2. Fronts.
3. Fronts and flight planning.

I. Turbulence.
1. Convective currents.
2. Obstructions to wind flow.
3. Wind shear.
4. Wake turbulence.

J. Icing.
1. Structural icing.
2. Induction system icing.
3. Instrument icing.
4. Icing and cloud types.
5. Other factors in icing.
6. Ground icing.
7. Frost.

K. Thunderstorms.
1. Where and when?
2. They just don't happen.
3. The inside story.
4. Rough and rougher.
5. Hazards.
6. Thunderstorms and radar.
7. Do's and don'ts of thunderstorm flying.

L. Common IFR Procedures.
1. Fog.
2. Low stratus clouds.
3. Haze and smoke.
4. Blowing restrictions to vision.
5. Precipitation.
6. Obscured or partially obscured sky.

VI. Aviation Weather Services, AC 00-45.

A. The Aviation Weather Service Program.
B. Surface Aviation Weather Reports.
C. Pilot and Radar Reports.
D. Aviation Weather Reports.
E. Surface Analysis.
F. Weather Depiction Chart.
G. Radar Summary Chart.
H. Significant Weather Prognostics.
I. Winds and Temperatures Aloft.
J. Freezing Level Chart.
K. Stability Chart.
L. Severe Weather Outlook Chart.
M. Constant Pressure Charts.
N. Constant Pressure Prognostics.
O. Tables and Conversion Charts.

VII. Aerodynamics and Principles of Flight.

A. Laws of motion.
B. Functions of the flight controls.
C. Principles of airfoils.
D. Wing planform.
1. Area/span/chord.
2. Aspect ratio/taper/sweepback.
3. Effect of planform on stall patterns.
E. Forces acting on an airplane.
F. Flight controls/axes of an airplane.
G. Lift/drag during turns.
H. Lift versus angle of attack.
I. Lift/thrust versus air density.
J. Types/effect of flaps. spoilers, divebrakes.
K. Effect of flaps on lift/drag/trim.
L. Effect of ice/snow/frost on airfoils.
M. Power versus climb/descent/level flight.
N. Gyroscopic precession.
O. Types and effect of drag—induced/parasite/profile.
P. Ground effect.
Q. Loads/load factors.
R. Stability—static and dynamic/longitudinal/lateral/directional.
S. Stalls/spins.
T. Relative wind/angle of attack.
U. Effect of wind during turns.
V. Torque effects—"P" factor.

VIII. Aircraft Operation.

A. General.
1. Preflight/postflight safety practices.
2. Use of proper fuel grade/type.
3. Fuel contamination—prevention/elimination.
4. Fuel system operation.
5. Proper loading of the aircraft.
6. Use of mixture/throttle/propeller control.
7. Taxiing during strong surface winds.
8. Normal takeoff/landing.
9. Crosswind takeoff/landing.
10. Maximum performance takeoff/landing.
11. Retractable landing gear operation.
12. Flap operation.
13. Controllable pitch propeller operation.
14. Aircraft operating limitations.
15. Maneuvering speed.
16. Supercharged engine operation.
17. High altitude operations/pressurization.
18. Use of supplemental oxygen and oxygen equipment.
19. Multiengine critical engine failure.
20. Recovery from critical flight situations.
21. Midair collision avoidance precautions.
22. Wake turbulence—causes/precautions.
23. Emergency landings.

B. Performance.
1. Takeoff charts.
2. Rate of climb charts.
3. Cruise charts.
4. Maximum safe crosswind charts.
5. Use of Denalt computer.
a. Fixed pitch propeller.
b. Variable pitch propeller.
6. Landing charts.
7. Stall speed charts.
8. Airspeed correction charts.
9. Computing density/pressure altitudes.
10. Effect of density altitude on performance.
11. Effect of weight/balance on performance.
12. Critical performance speeds—"V" speeds.
13. Effect of wind on aircraft performance.
14. Bank/speed versus rate/radius of turns.
15. Stall speed versus altitude or attitude.
16. Stall speed versus indicated/true airspeed.

17. Obstacle clearance takeoff/landing.
18. Best angle/rate of climb.
19. Computations of gross weight/useful load.
20. Computation of center of gravity.

IX. Engine Operation.

A. Reciprocating Engine Principles.
B. Engine Oil System.
C. Ignition or Electrical Systems/Units.
D. Fuel Injection/Carburetor Principles.
E. Engine Controls.
F. Engine Starting/Shutdown.
G. Manifold Pressure Versus RPM.
H. Detonation Cause/Effect.
I. Carburetor Icing—Cause/Detection/Elimination.
J. Carburetor Heat Effect on Fuel Mixture.
K. Interpreting Engine Instruments.
L. Emergency—Engine/Systems/Equipment/Fire.

X. Flight Instruments and Systems.

A. Attitude Indicator Operation/Errors.
B. Heading Indicator Operation/Errors.
C. Turn Indicator/Coordinator.
D. Altimeter Operation/Errors.
E. Vertical Speed Indicator Operation/Errors.
F. Airspeed Indicator Operation/Errors.
G. Vacuum Systems/Instruments.
H. Pitot-Static Systems/Instruments.
I. Magnetic Compass Operation/Errors.
J. Altimeter Setting Procedure/Significance.
K. Pressure Altitude Significance/Obtaining.
L. Gyroscopic Principles.

XI. Radio Communications.

A. VHF radio Communications/Phraseology.
B. Position Reporting Procedures.
C. Tower/FSS/Enroute Advisories/Instructions.
D. FSS Communications Procedures.
E. Obtaining Emergency Assistance.
F. Lost Procedure When Radio is Inoperative.
G. Use of Proper Communications Frequencies.

XII. Instrument Flying Procedures.

A. Components of Attitude Instrument Flying.
B. Pitch, Bank, Power Control.
C. Straight-and-Level Flight.
D. Turns/Turns to Predetermined Headings.
E. Constant Rate Climbs/Descents/Level-offs.
F. Constant Speed Climbs/Descents/Level-offs.
G. Magnetic Compass Turns.
H. Effect of Changes in Airspeed.
I. False Sensations in Filght.

XIII. Navigation.

A. General.
1. Sectional chart interpretation.
2. Relating chart symbols to regulations.
3. Pilotage/recognition of landmarks.
4. Determining courses/distances on charts.
5. Navigation computer principles.
6. Computing heading/courses.
7. Computing time, distance, speed, fuel.
8. Computing rates of climb/descent.
9. Computing wind directions/speed in-flight.
10. Computing off-course corrections.
11. Selecting VFR cruising altitudes.
12. Planning traffic pattern entry.

B. Radio.
1. Characteristics of VOR facilities.
2. Tuning VOR receivers.
3. Identifying VOR stations.
4. VOR interpretation/orientation.
5. Intercepting VOR radials.
6. Tracking VOR radials.
7. Groundspeed checks using VOR radials.
8. VOR frequency interference.
9. VOR test signals/VOR receiver checks.
10. Characteristics of ADF facilities.
11. Tuning ADF receivers.
12. Identifying stations used for ADF.
13. ADF/RMI interpretation/orientation.
14. Intercepting ADF/RMI bearings.
15. Tracking ADF/RMI bearings or "homing."
16. Marker beacons/outer compass locators.

SAMPLE TEST ITEMS

It is recommended that a study program be completed prior to answering the sample test items. When the program is completed, answer the sample test items without referring to the study material or the answer (with explanation) which follows each sample test item. Should the answer chosen differ from the one given as the correct answer, return to the study materials recommended in the appropriate study outline for verification.

The following test item samples are included to acquaint applicants with the format used in the construction of FAA written tests. They *do not* include all of the topics on which the applicant will be tested. For this reason, applicants should concentrate on the sections entitled "Study Outline, Fundamentals of Instructing," and "Study Outline, Aeronautical Knowledge." A knowledge of all the topics presented in the two outlines, not just the ability to answer these few sample test items, should be the goal in preparing for the written tests in either of the two certification areas.

Some of the test items refer to certain illustrations located in the Appendix. The illustrations are representative of those used in the Ground Instructor—Basic and Advanced Written Tests.

Fundamentals of Instructing

Sample Test Items

1. Motivation is probably the dominant force which governs the student's progress and ability to learn. One of the more effective means of properly motivating a student is to
   1—assign tasks which are somewhat beyond the student's ability.
   2—praise good performances and keep the student aware of progress.
   3—keep interest high by reminding the student of the final goal.
   4—tell the student that hard work is a must or failure is certain.

Answer. Response 2. In group instruction, praising and giving credit to students who have performed well not only encourages those praised, but also may motivate others in the group to greater efforts. Negative motivations in the form of reproof and threats should be avoided with all but the most overconfident and impulsive students.

2. When students cannot accept the real reason for their behavior, they may attempt to alleviate their feelings of guilt by relying on the defense mechanism called
   1—aggression.
   2—resignation.
   3—flight.
   4—rationalization.

Answer. Response 4. If a student cannot accept the real reason for his behavior, he may rationalize.

3. Evoking "insights" as applied to learning is one of the flight instructor's major responsibilities. Insights as applied to learning
   1—involve the grouping of preceptions into meaningful wholes.
   2—pertain to the student's grasp of theoretical principles taught in ground school.
   3—concern the analysis of the student by the instructor.
   4—concern the ability of the student to discover the reason for a procedure or a maneuver already learned.

Answer. Response 1. Instruction speeds the learning process by teaching the relationship of perceptions as they occur, thus promoting the development of insight by the student. The mental relating and grouping of associated perceptions is called insight.

4. Without perception, can learning take place?
   1—Yes; real meaning (learning) comes from external stimuli, while perceptions come only from within.
   2—Yes, but only when motivation is strong enough to overcome the lack of perceptual cues.
   3—No; perceptions are the basis of all learning.
   4—Yes; learning takes place when a person gives meaning to one's insights, while perceptions merely involve the grouping of insights into meaningful wholes.

Answer. Response 3. Initially, all learning comes from perceptions which are directed to the brain by one or more of the five senses (sight, hearing, touch, smell, and taste). Real meaning comes only from within a person, even though the sensations which evoke these meanings result from external stimuli. Because the meaning which is derived from the information furnished by the senses may depend on many factors within each person concerned, and because perceptions are the basis of all learning, a knowledge of the factors which affect the perceptual process is very important to the instructor.

5. For presenting new material, the lecture method is excellent—and is most effective when
   1—facts and ideas are to be formulated during the presentation.
   2—accompanied by training devices and visual aids.
   3—motor skills are to be taught.
   4—notes are used extensively.

Answer. Response 2. The lecture method is suitable for presenting new material, for summarizing ideas, and for relationships between theory and practice. For example, it is suitable for the presentation of a ground school lesson on basic instrument flying. This method is most effective if accompanied by visual aids and training devices.

6. Reviews are an integral part of each lesson; before the completion of the instruction period, the instructor should review what has been covered during the lesson to
   1—ensure that the student is aware of progress to date.
   2—identify the blocks of learning which constitute the necesasry parts of the total objective.
   3—improve the students' grades based upon the objectives and goals of the lesson plan and syllabus.
   4—emphasize the competitive nature of the learning situation.

Answer. Response 1. Review and evaluation are integral parts of each lesson. Before the completion of the instruction period, the instructor should review what has been covered during the lesson, and require the student to demonstrate the extent to which lesson objectives have been met. The student should be aware of progress, and the advances and deficienices noted at the conclusion of the lesson.

7. The highest level of learning has been achieved when the student is able to
   1—correlate what has been learned with other things previously learned.
   2—apply the skill that has been learned.
   3—repeat back something that has been taught.
   4—understand what has been taught.

Answer. Response 1. Learning may be accomplished at any of several levels. The lowest level, rote learning, is the ability to repeat back something which one has been taught without understanding or without being able to apply what has been learned. Progressively higher levels of learning are understanding what has been taught, achieving the skill to apply what has been learned and to perform correctly, and associating and correlating what has been learned with other things previously learned or subsequently encountered.

8. Which statement is true regarding effective communication?
   1—Effective communication has taken place when the receiver acknowledges receipt of the information.
   2—Unless a common core of experience exists between the communicator and the receptor, effective communication will be difficult to achieve.
   3—The most effective communicator relies on a single, proven channel to transmit ideas.
   4—To be most effective as a communicator, an instructor should use abstract words as much as possible.

Answer. Response 2. Probably the greatest single barrier to effective communication is the lack of a common core of experience between communicator and receptor. Communication can be effective only to the extent that the experiences—physical, mental, or emotional—of the people concerned are similar.

9. Flight instructors can minimize student anxiety by
   1—keeping the student busy while airborne.
   2—giving brisk instruction.
   3—terminating the flight period immediately upon detecting student fear.
   4—emphasizing the positive rather than the negative experiences of flying.

Answer. Response 4. Student anxieties can be minimized throughout training by emphasizing the benefits and pleasurable experiences which can be derived from flying, rather than continuously citing the unhappy consequences of faulty performance.

10. To be effective, a critique should
    1—reflect instructor likes, dislikes, and personal opinions.
    2—emphasize the negative aspects of student performance.
    3—be subjective, dogmatic, and comprehensive in nature.
    4—focus on student performance.

Answer. Response 4. The effective critique is focused on student performance and should not reflect the personal opinions, likes, dislikes, or biases of the instructor.

Aeronautical Knowledge

Sample Test Items

1. Each pilot in command is required to become familiar with all available information concerning a proposed flight. This information must include available weather reports and forecasts for
   1—IFR cross-country flights only.
   2—all IFR and VFR cross-country flights.
   3—all flights which carry passengers.
   4—all flights for hire.

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

2. Assume that you have a Second-Class Medical Certificate dated July 5, 1976, and your Commercial Pilot Certificate was issued August 1, 1976. Under these circumstances, you could continue to exercise the privileges of
   1—either a private or commercial pilot until September 1, 1977.
   2—neither a private nor a commercial pilot after July 5, 1977.
   3—a commercial pilot until August 1, 1977, and those of a private pilot until August 1, 1978.
   4—a commercial pilot only until July 5, 1977, and those of a private pilot until July 5, 1978.

Answer. Response 3. A Commercial Pilot Certificate has no specific expiration date and the issuance date is irrelevant to the situation. To be valid, however, the pilot must possess a current, appropriate medical certificate. For operations requiring a Commercial Pilot Certificate, the second-class medical certificate expires at the end of the last day of the 12th month after the month in which it is issued. Thus, commercial pilot privileges may be exercised until August 1, 1977. For operations requiring only a Private Pilot Certificate, a second-class medical certificate expires at the end of the last day of the 24th month after the month in which it is issued. In this case, private pilot privileges may be exercised until August 1, 1978.

3. Accident reporting procedures are contained in
   1—National Transportation Safety Board Regulation, Part 830.
   2—Federal Aviation Regulations, Part 61.
   3—Federal Aviation Regulations, Part 91.
   4—Federal Aviation Regulations, Part 141.

Answer. Response 1. See NTSB Regulation, Part 830, effective July 17, 1975. Pilots should be familiar with rules pertaining to aircraft accidents, in-flight hazards, overdue aircraft, and safety investigations.

4. Appropriate VFR cruising altitudes are required to be maintained when an aircraft is operated more than 3,000 feet above the surface. The appropriate altitude is determined by the

   1—true course being flown.

   2—magnetic course being flown.

   3—magnetic heading being flown.

   4—magnetic bearing being flown.

Answer. Response 2. FAR 91.109 requires that all aircraft operating under VFR in level cruising flight at an altitude of more than 3,000 feet above the surface and below 18,000 feet MSL shall: Maintain an odd-thousand-foot MSL altitude +500 feet when operating on a magnetic course of 0° through 179°; and an even-thousand-foot MSL altitude +500 feet when operating on a magnetic course of 180° through 359°.

5. Areas of forecast icing conditions aloft can be determined by referring to

   1—Weather Depiction Charts.

   2—Aviation Sequence Reports.

   3—Area Forecasts.

   4—Terminal Forecasts.

Answer. Response 3. Refer to AC 00-45, Aviation Weather Services, page 44, which states: "The contraction ICG identifies the icing section which gives location, type, and extent of expected icing. It always includes the freezing level in hundreds of feet ASL. It may contain qualifying terms such as 'ICG LKLY,' icing likely; 'MDT MXD ICGIC ABV FRZLVL,' moderate mixed icing in clouds above the freezing level."

6. What is the most important function of a rudder during coordinated flight?

   1—The rudder prevents skids.

   2—The rudder turns the airplane.

   3—Applying rudder overcomes the asymmetrical thrust of the propeller as a turn is initiated.

   4—Properly applied, the rudder helps to overcome the effects of adverse yaw and torque.

Answer. Response 4. The rudder controls movement of the airplane about its vertical axis. Movement about the vertical axis is called yaw. The displacement of the ailerons as an aircraft rolls into or out of a turn induces aileron drag. When the ailerons alone are used to roll into a turn, the aircraft will tend to yaw opposite to the direction of turn. Deflection of the ailerons increases the lift on the outside wing and decreases the lift on the inside wing. The drag is proportionately increased on the outside wing, resulting in the yawing effect known as "aileron drag" or "adverse yaw." The function of the rudder in a correctly executed entry into and recovery from a turn is to counteract aileron drag. The rudder is also used to counteract yaw caused by engine torque.

7. When considering the forces acting upon an airplane in straight-and-level flight at a constant airspeed, which statement is true?

   1—Weight always acts vertically toward the center of the earth.

   2—Drag always acts rearward parallel to relative wind and is less than thrust.

   3—Thrust always acts forward parallel to the relative wind and is greater than drag.

   4—Lift always acts perpendicular to the longitudinal axis of the wing and is greater than weight.

Answer. Response 1. Gravity, the downward acting force, tends to draw all bodies toward the center of the earth. Lift, the upward acting force, must equal gravity, the downward acting force, in straight-and-level unaccelerated flight.

8. When operating powered aircraft at high density altitudes, you should expect

   1—increased profile, parasite, and induced drag.

   2—increased engine and propeller efficiency.

   3—improved acceleration to takeoff speed, but a slower rate of climb.

   4—a significant decrease in takeoff and climb performance.

Answer. Response 4. Refer to AC 00-6A, Aviation Weather, page 20, which states: "Density altitude is not a height reference; rather it is an index to aircraft performance, low density altitude increases performance. *High*

density altitude can be a real hazard, since it *reduces aircraft performance.* It affects performance in three ways; (1) it reduces power because the engine takes in less dense air to support combustion, (2) it reduces thrust because the propeller is less effective in less dense air or a jet engine has less thrust due to the less dense air, (3) it reduces lift because the less dense air exerts less force on the airfoils."

9. Given:

Magnetic Heading	185°
Relative Bearing	045°

Based on the given information, the magnetic bearing to the station would be approximately

1—045°.

2—140°.

3—185°.

4—230°.

Answer. Response 4. By adding the magnetic heading (185°) to the relative bearing (045°), the magnetic bearing (230°) to the station is verified (MH + RB = MB).

10. Using the appropriate information in Figure 31 and the charts in Figures 35 and 36 of the Appendix, determine the center of gravity of the Condor 410 under the following conditions:

Pilot and front passenger weight	360.0 lbs.
Rear passenger weight	120.0 lbs.
Baggage	100.0 lbs.
Fuel	63.5 gals.
Oil	12.0 qts.

Under these conditions, the center of gravity would be located

1—within the CG envelope; the loading would be acceptable.

2—forward of the forward CG limit; the loading would be unacceptable because the airplane would be dangerously nose-heavy.

3—aft of the aft CG limit; the loading would be unacceptable because the airplane would be dangerously tail-heavy.

4—within the CG envelope, but the loading would be unacceptable because the maximum allowable gross weight would be exceeded.

Answer. Response 1. Applying the information to the loading graph, the following conclusions are made:

	Weight	*Moment/ 1000*
Empty airplane	1,840.0	+63.7
Pilot and front passenger	360.0	+13.0
Rear passenger	120.0	+ 8.4
Baggage	100.0	+10.4
Fuel @ 6.0 lbs. per gal.	381.0	+13.2
Oil @ 7.5 lbs. per gal.	22.5	− 0.4
Totals	2,823.5	113.3

Drawing a horizontal line on the center of gravity moment envelope from left to right (2,823.5 lbs.) and a vertical line from bottom to top (113.3/1,000 lbs.-ins.), the two lines intersect at a point well within the center of gravity envelope.

Additional Questions for Study

The following questions are offered for the primary purpose of encouraging study.

1. What is the definition of "learning?"

2. Before any important instruction can begin, a determination of objectives and standards is necessary. Is this a true statement?

3. What is probably the dominant force which governs a student's progress and ability to learn?

4. Learning occurs most rapidly when information is received through more than one sense. Is this a true statement?

5. In what manner are "insights" and "perceptions" involved in the learning process?

6. How can an instructor minimize frustration and help achieve good human relations when dealing with students?

7. Why should an instructor avoid negative teaching?

8. The teaching process normally is broken down into how many steps?

9. Lesson plans and course syllabi should be followed exactly if maximum benefit is to be derived from their use. Is this a true statement?

10. What are some of the barriers to effective communications?

11. Is it necessary to keep a student aware of his progress?

12. Should an instructor admit errors?

13. When can a written test be termed reliable?

14. What is the primary purpose of a critique?

15. May a pilot receive compensation when acting as pilot in command of an aircraft?

16. What preflight action do Federal Aviation Regulations require for flights away from the vicinity of an airport?

17. When an aircraft is operated VFR in level cruising flight at an altitude of more than 3,000 feet above the surface, what cruising altitudes would be appropriate if the magnetic course falls between 0° and 180°?

18. Recency of experience requirements are mandatory prior to conducting night operations with passengers aboard. What are these requirements?

19. What experience requirements are necessary regarding a commercial pilot acting in command of a complex airplane?

20. What are "V" speeds and how are they identified or where can they be found?

21. At and above what altitude are pilots required to adjust their altimeters to 29.92" Hg?

22. What is the purpose of the elevator trim tab?

23. Does the center of gravity location affect stall speed?

24. Does the amount of power being used affect stall speed?

25. Aerodynamically, what causes an airplane to stall?

26. Is it necessary for the airplane to have a relatively low airspeed for it to stall?

27. Do flaps affect stalling speed? How?

28. Does load factor affect stalling speed? How?

29. What is calibrated airspeed? What is indicated airspeed?

30. What is the relationship between the colored arcs on the airspeed indicator and calibrated airspeed?

31. What are aircraft performance charts and where can they be found for a particular aircraft?

32. What is induced drag? Parasite drag? Profile drag?

33. What is the relationship between static and dynamic stability?

34. What is ground effect?

35. What is detonation?

36. What is preignition?

37. What are the requirements for the notification and reporting of aircraft accidents?

38. What effect will lower than standard temperatures have upon an altimeter?

39. Is cold dry air more dense than cold moist air?

40. How can one tell when a thunderstorm has reached its mature stage of development?

41. What are types of in-flight structural icing?

42. What is pressure altitude? What is density altitude?

43. In what manner does high outside air temperature affect an aircraft's performance?

44. What does the absence of a VOR station identifier mean?

45. How can a pilot use a transponder to alert ATC that radio communications failure has occurred?

46. What is "hypoxia?" What is "hyperventilation?"

47. What are wingtip vortices? How are they generated? What action can a pilot take to avoid them?

48. Does wind affect the airplane's airspeed?

49. Does wind affect the airplane's groundspeed?

50. How does a person file, open, and close a VFR or IFR flight plan?

APPENDIX

This appendix contains excerpts and illustrations to familiarize applicants with some of the materials similar to those used in written tests, and to encourage study in these subject areas. Because certain data may become obsolete, do not use these excerpts and illustrations for operational purposes.

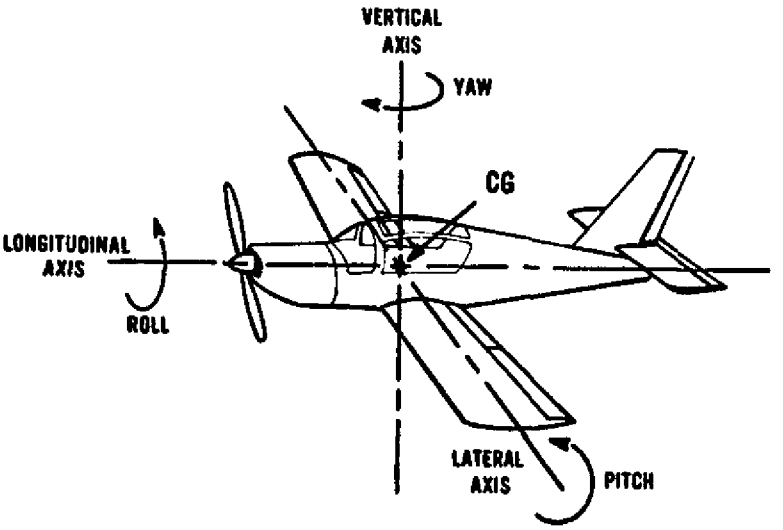


FIGURE 1.—Axes of an airplane.

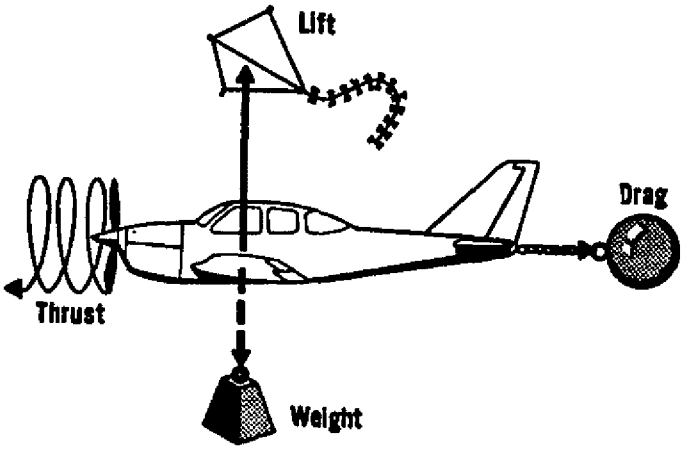


FIGURE 2.—Forces that act on an airplane in flight.

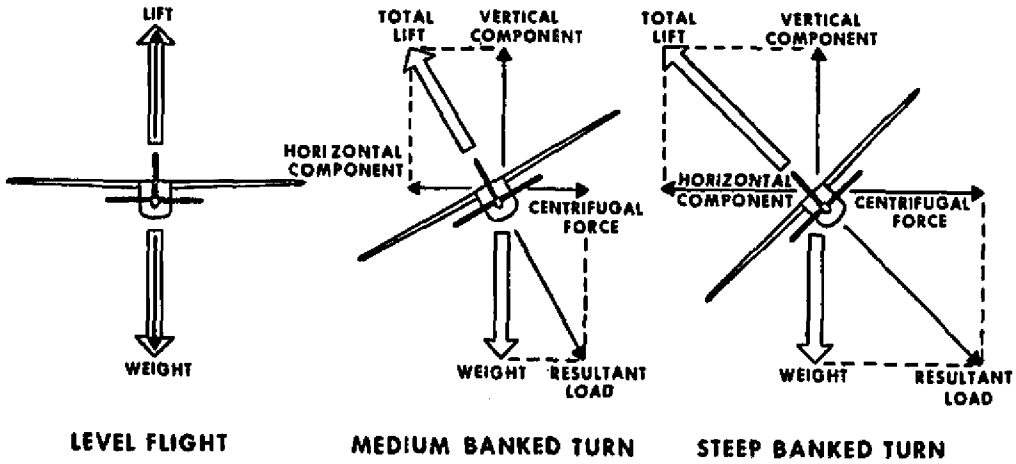


FIGURE 3.—Forces acting on an airplane in level flight and coordinated medium and steep banked turns.

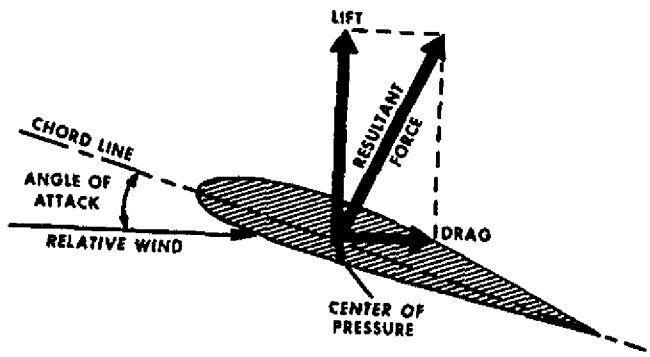


FIGURE 4.—Force vectors on an airfoil.

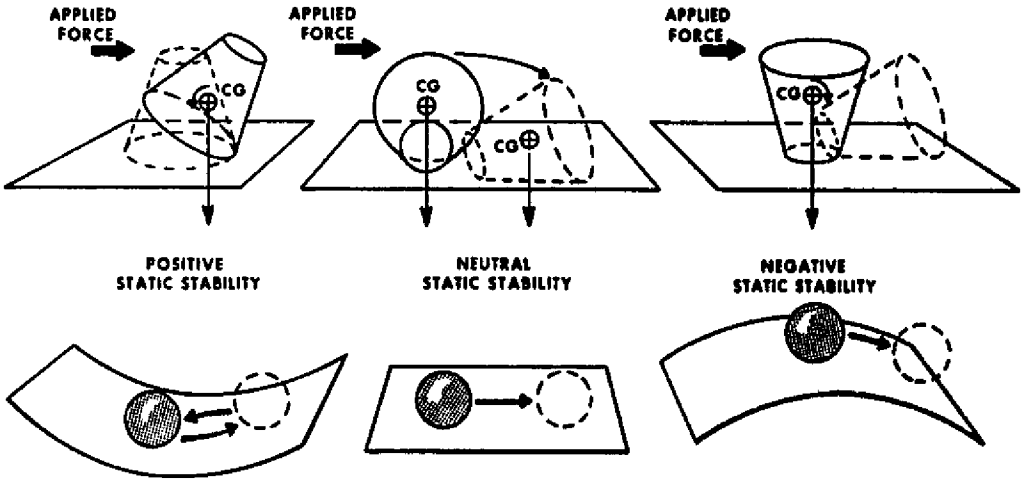


FIGURE 5.—Types of static stability.

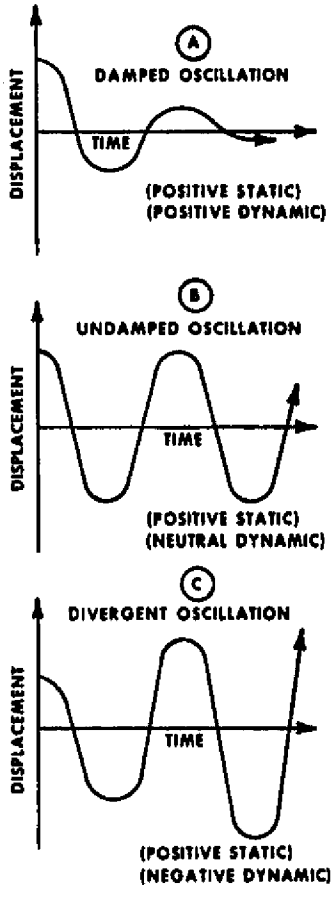


FIGURE 6.—Damped versus undamped stability.

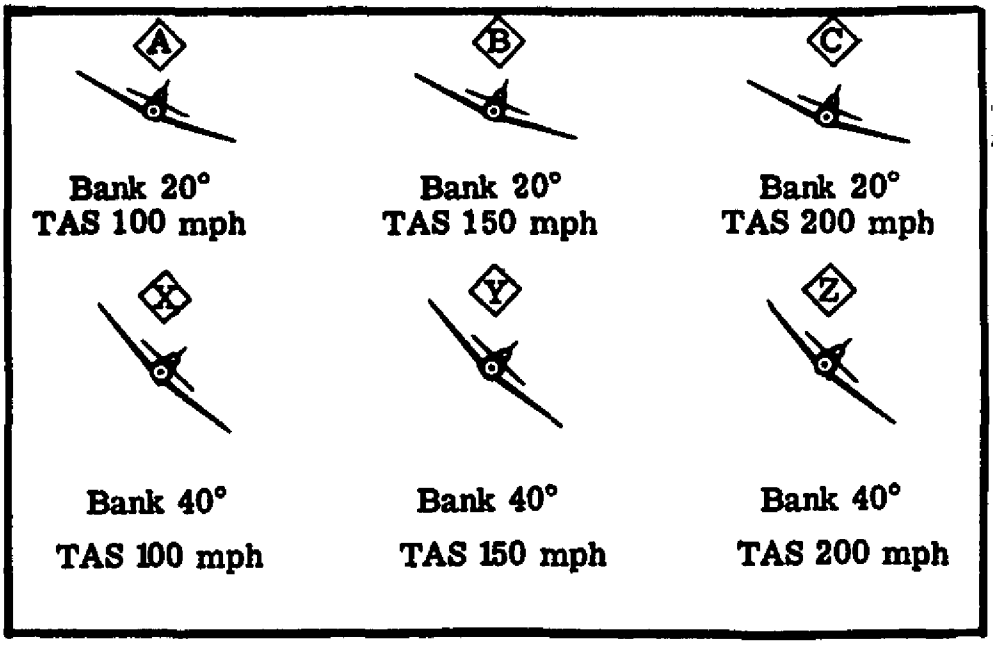


FIGURE 7.—Angle of bank versus airspeed.

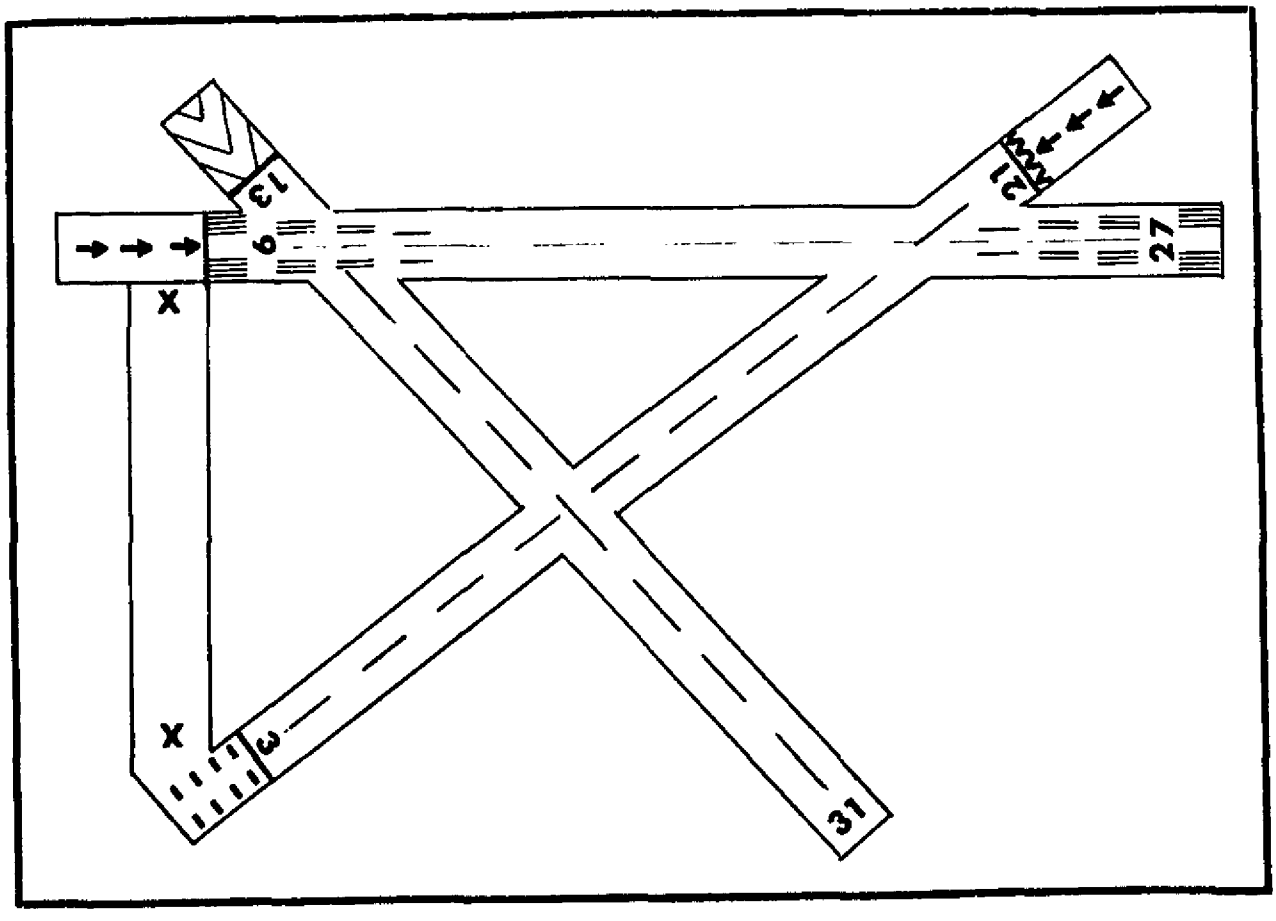


FIGURE 8.—Runway markings.

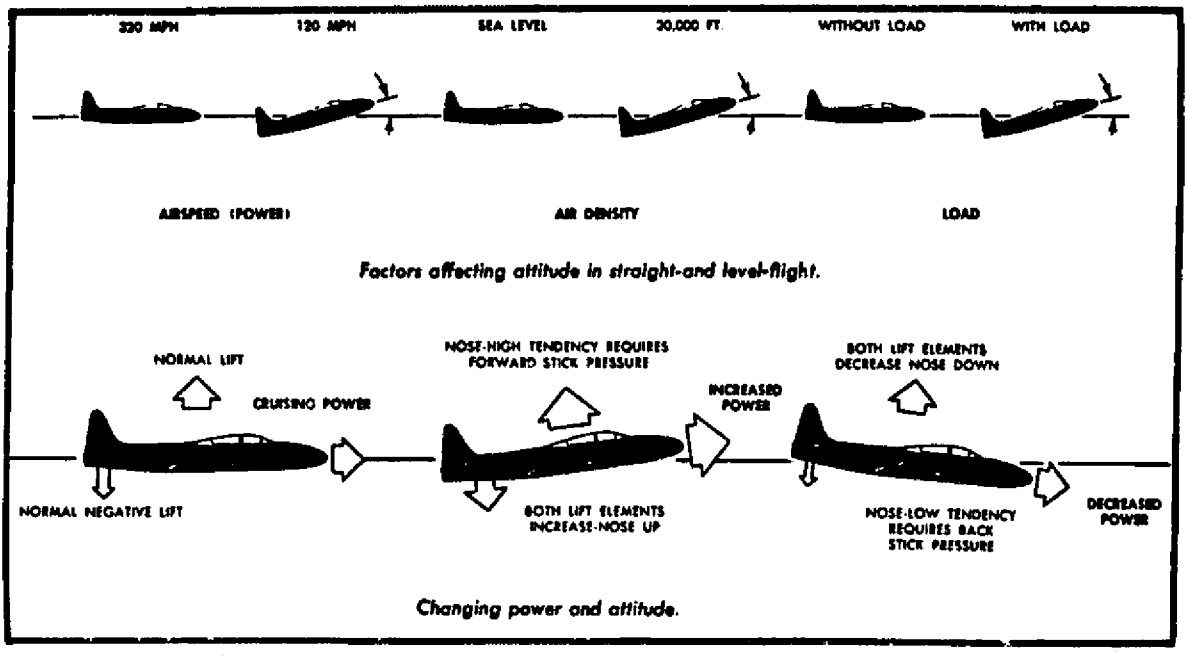


FIGURE 9.—Aerodynamics—power and pitch attitude.

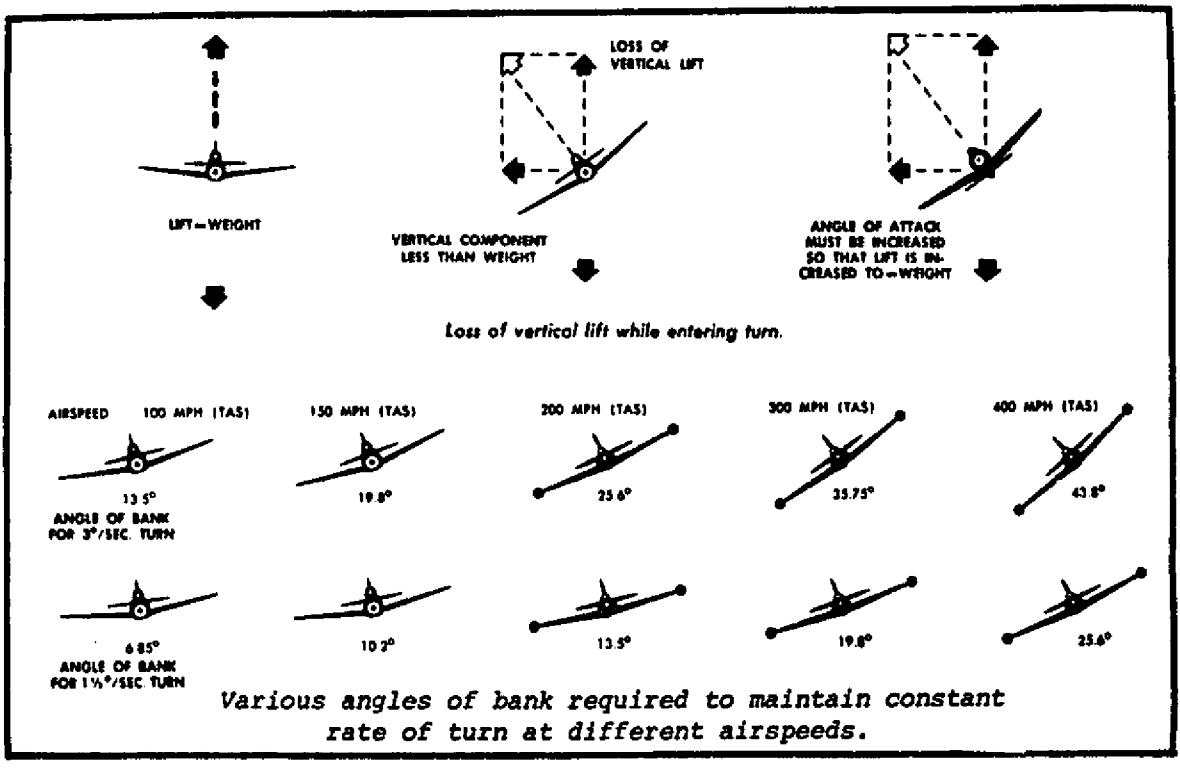


FIGURE 10.—Angle of bank—rate of turn.

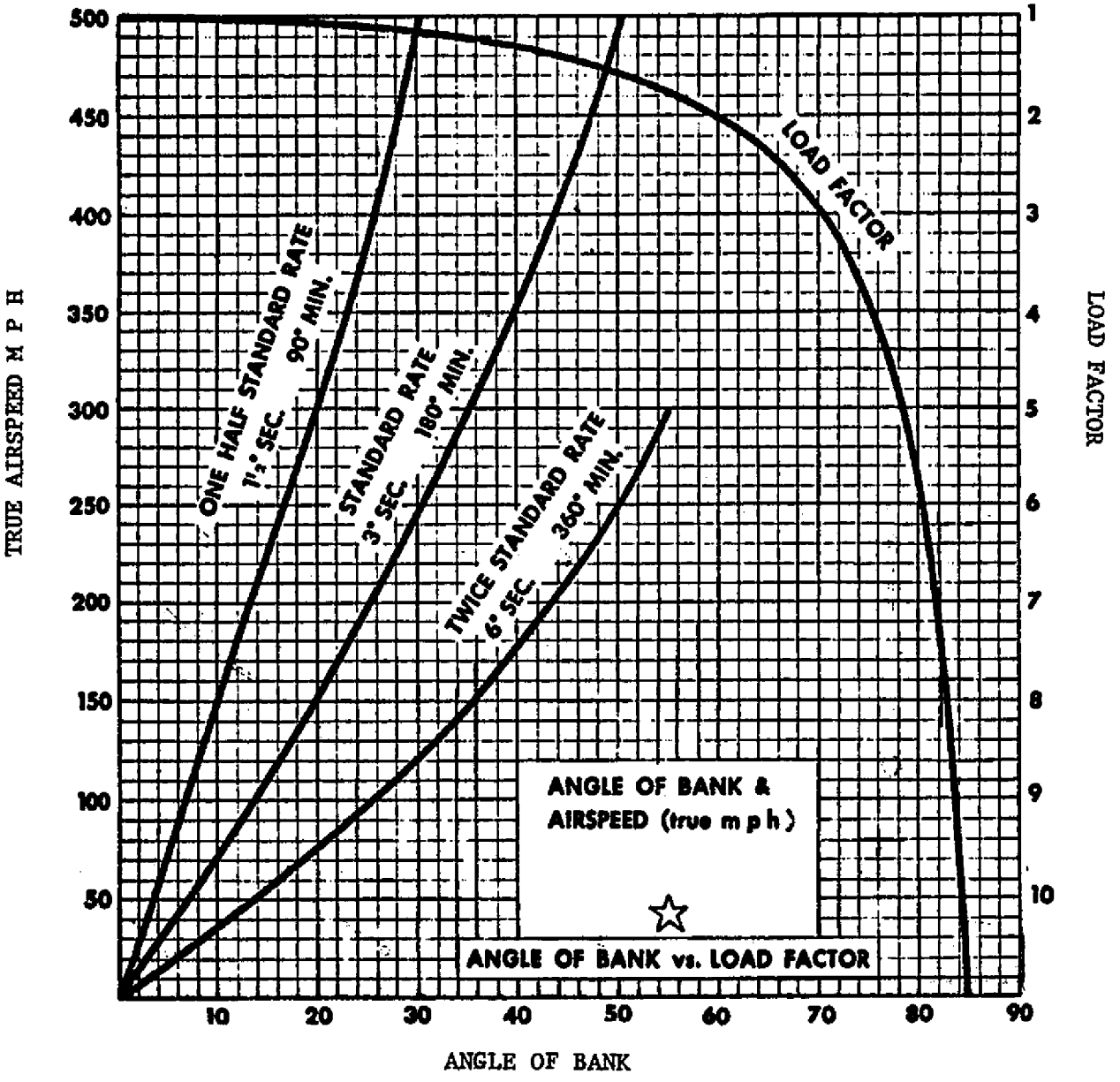


FIGURE 11.—TAS—angle of bank—rate of turn—load factor.

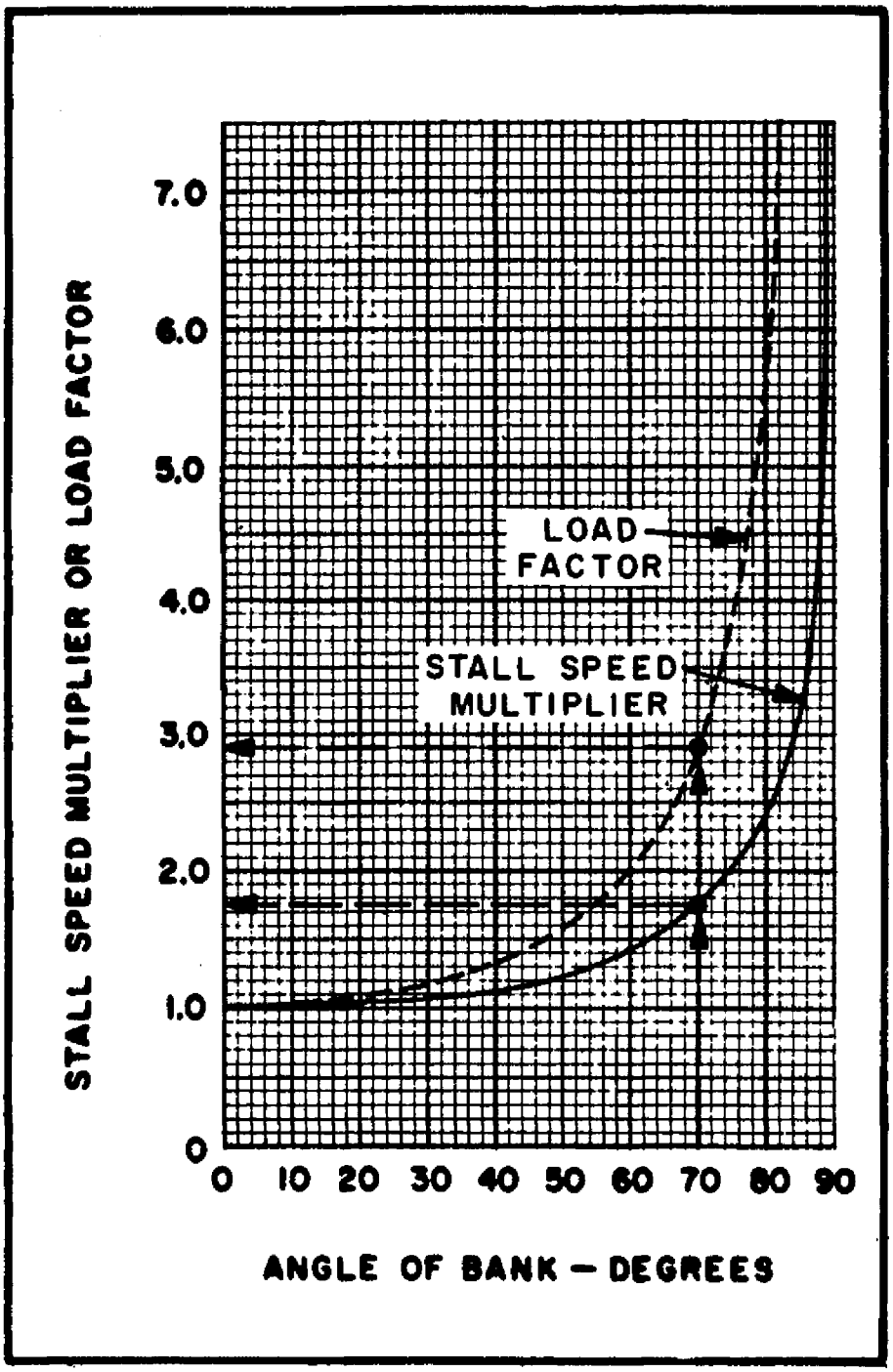


FIGURE 12.—Stall speed multiplier and load factor chart.

STALL SPEED, POWER OFF

Gross Weight 2900 lbs.	ANGLE OF BANK			
CONFIGURATION	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, CAS

FIGURE 13.—Stall speed chart.

AIRSPEED CORRECTION TABLE

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

*Maximum flap speed 120 MPH-CAS

FIGURE 14.—Airspeed correction table.

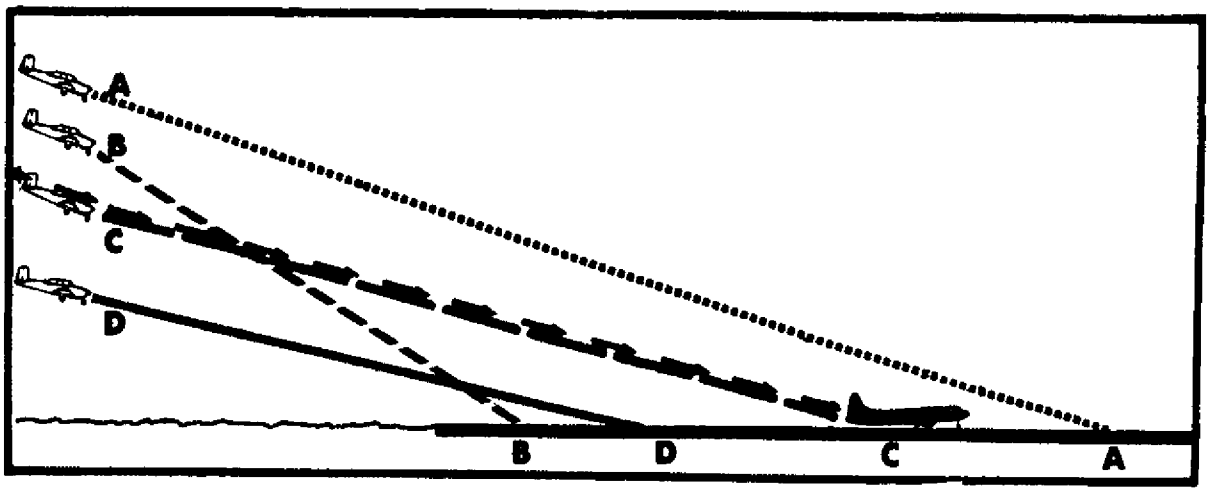


FIGURE 15.—Wake turbulence avoidance on final approach.

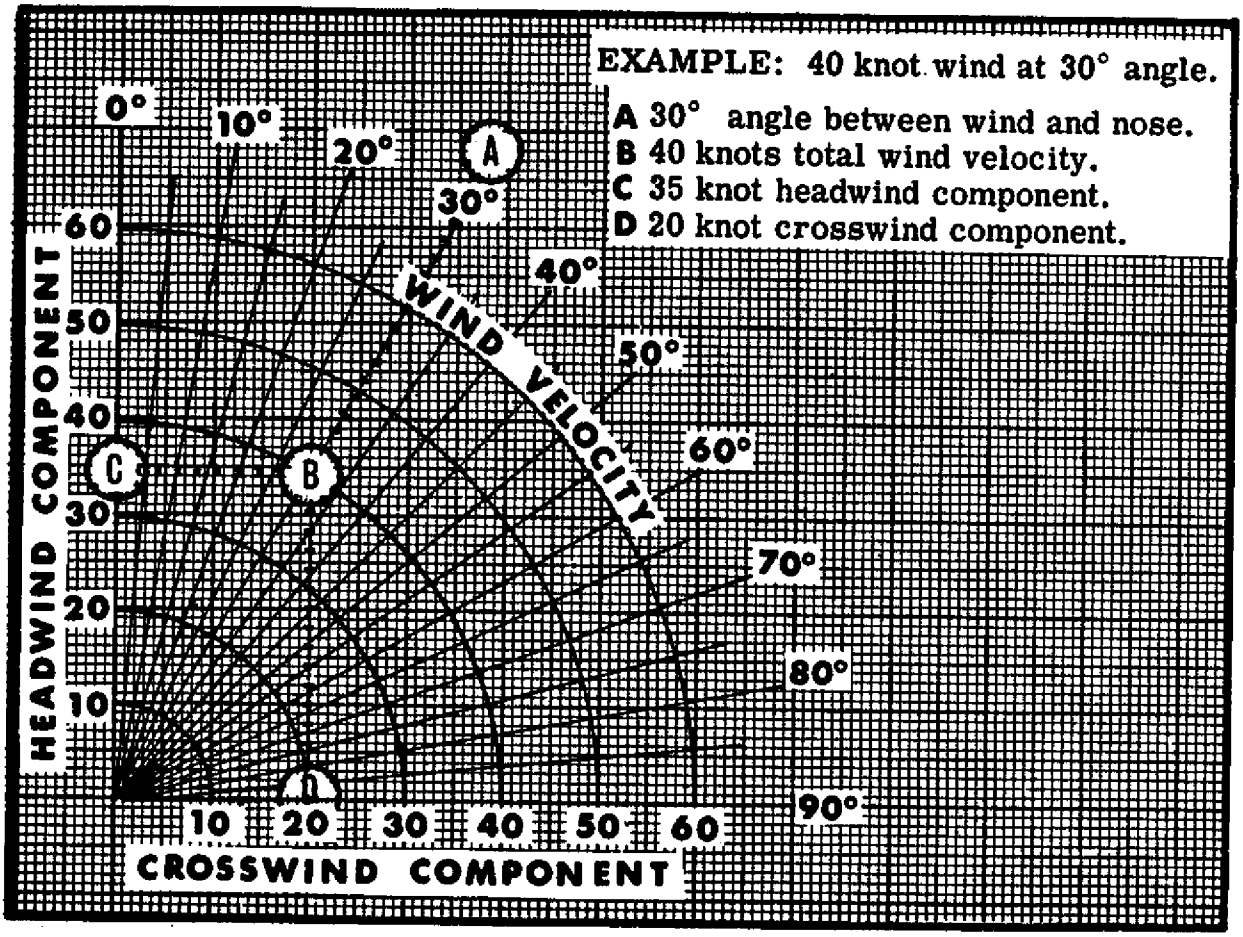


FIGURE 16—Wind component chart.

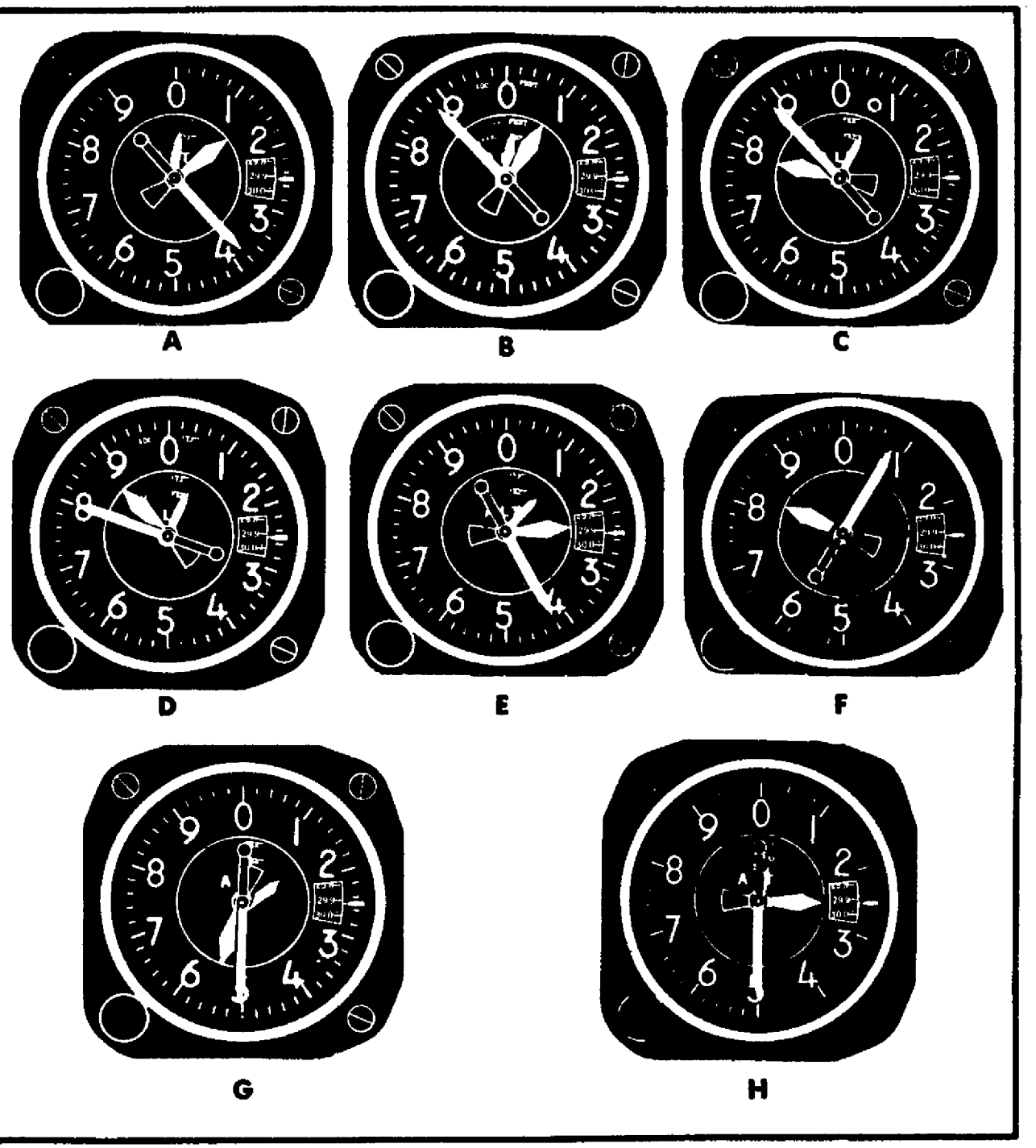
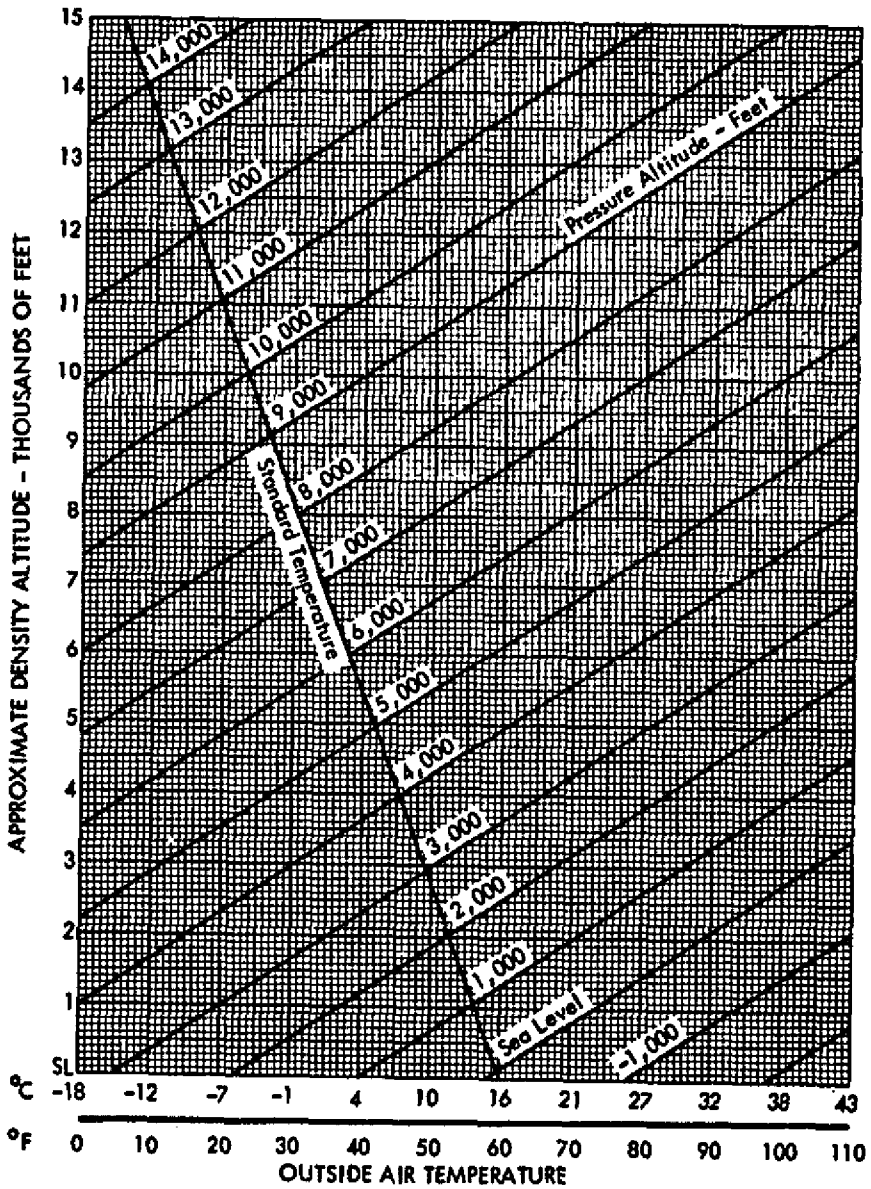


FIGURE 17.—Altimeter illustration.

Set Altimeter to 29.92 In. Hg.
When Reading Pressure Altitude



Altitude Setting in Hg.	Altitude Correction
28.0	1,825
28.1	1,725
28.2	1,630
28.3	1,535
28.4	1,435
28.5	1,340
28.6	1,245
28.7	1,150
28.8	1,050
28.9	955
29.0	865
29.1	770
29.2	675
29.3	580
29.4	485
29.5	390
29.6	300
29.7	205
29.8	110
29.9	20
29.92	0
30.0	-75
30.1	-165
30.2	-225
30.3	-350
30.4	-440
30.5	-530
30.6	-620
30.7	-710
30.8	-805
30.9	-895
31.0	-965

FIGURE 18.—Density altitude.

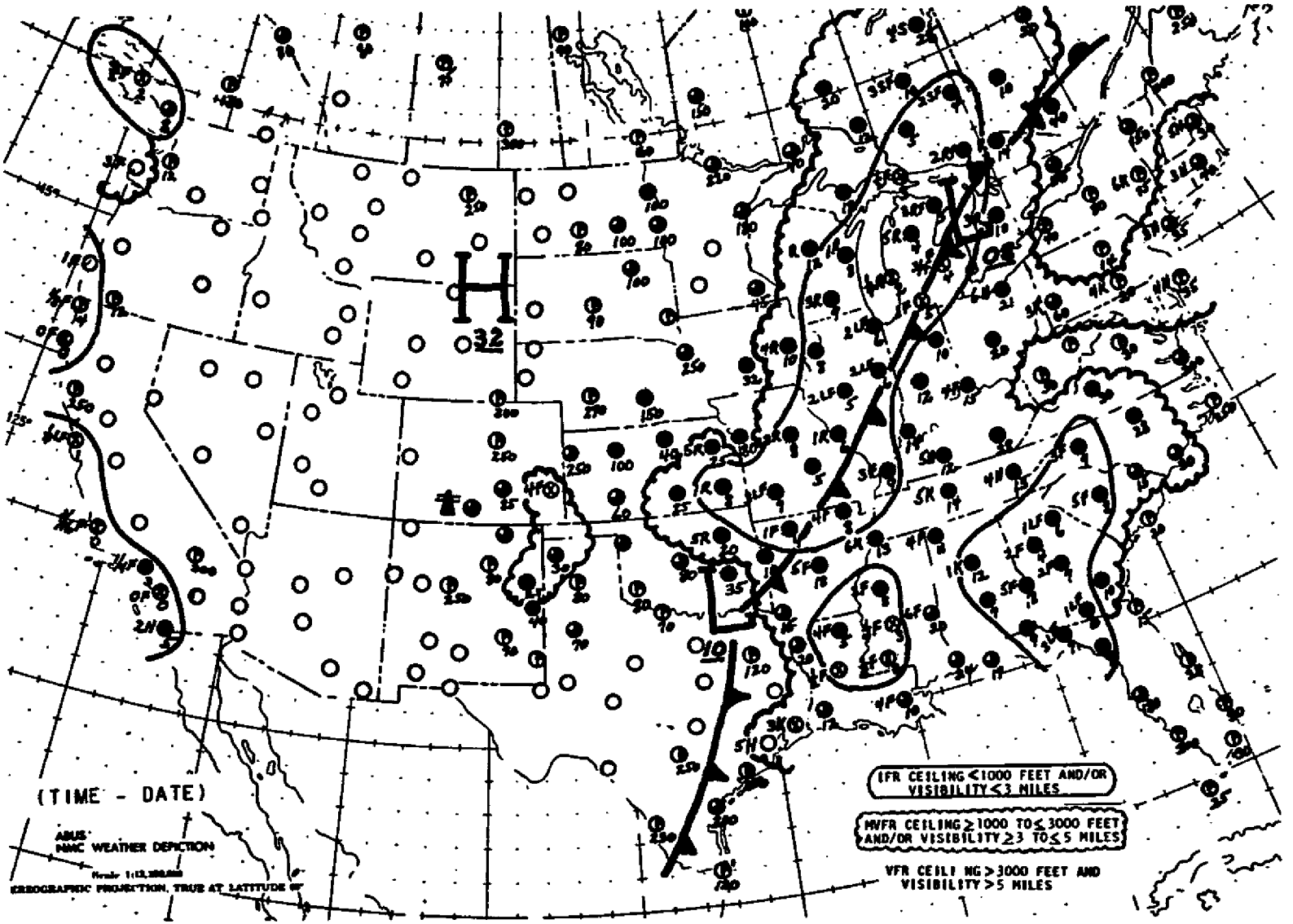


FIGURE 19.—A weather depiction chart.

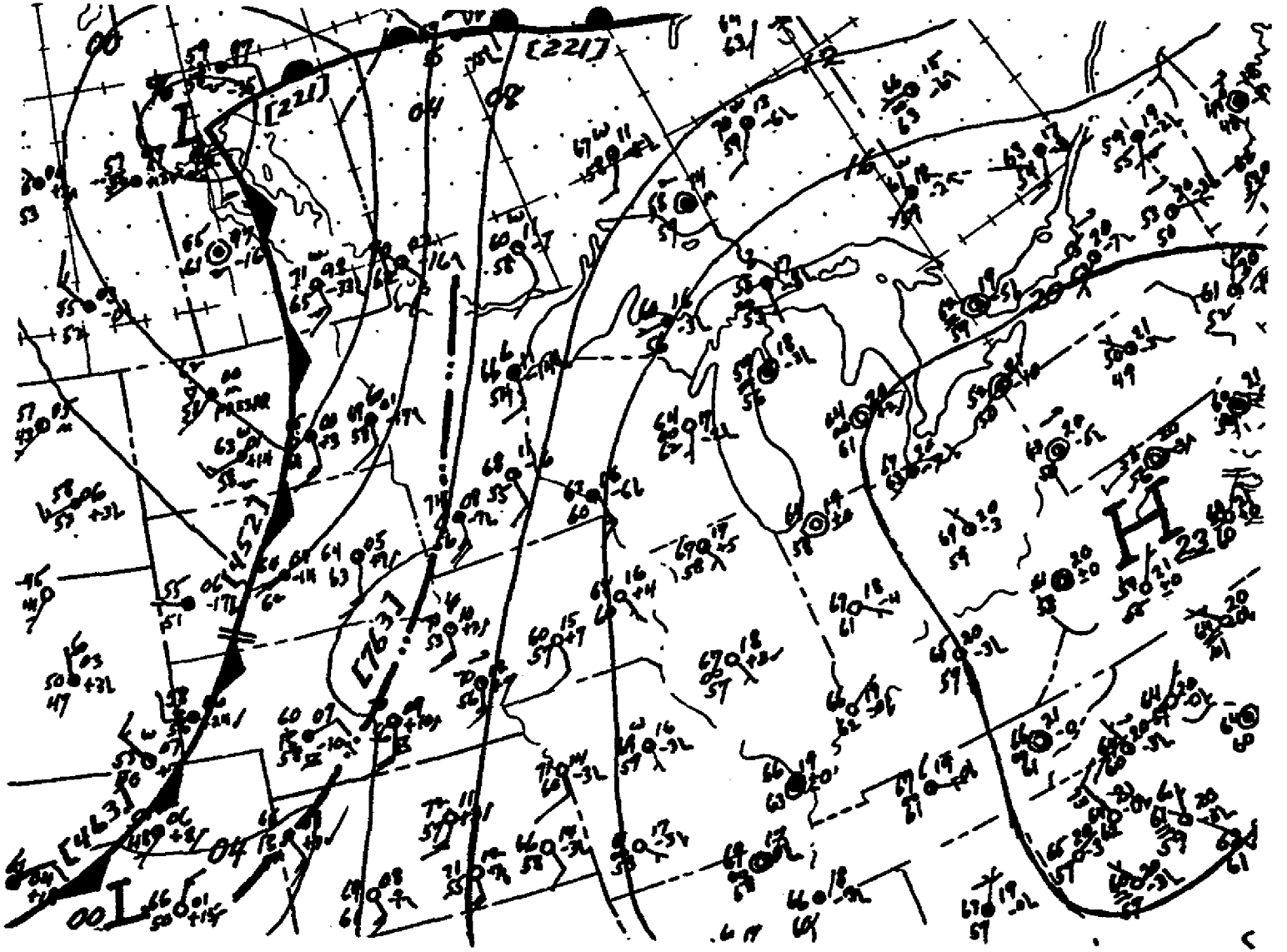


FIGURE 20.—Section of a surface weather analysis.

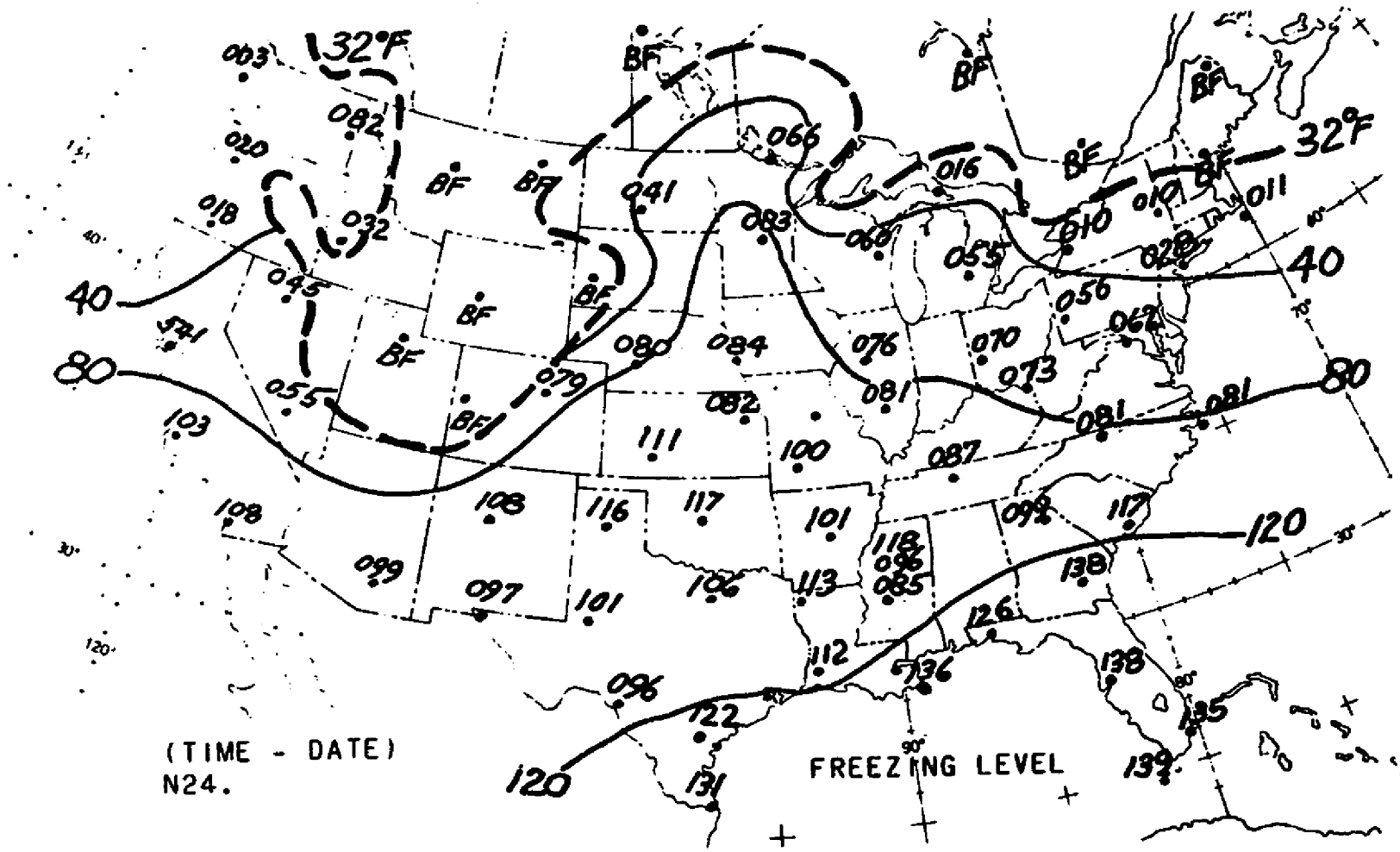


FIGURE 21.—A freezing level chart.

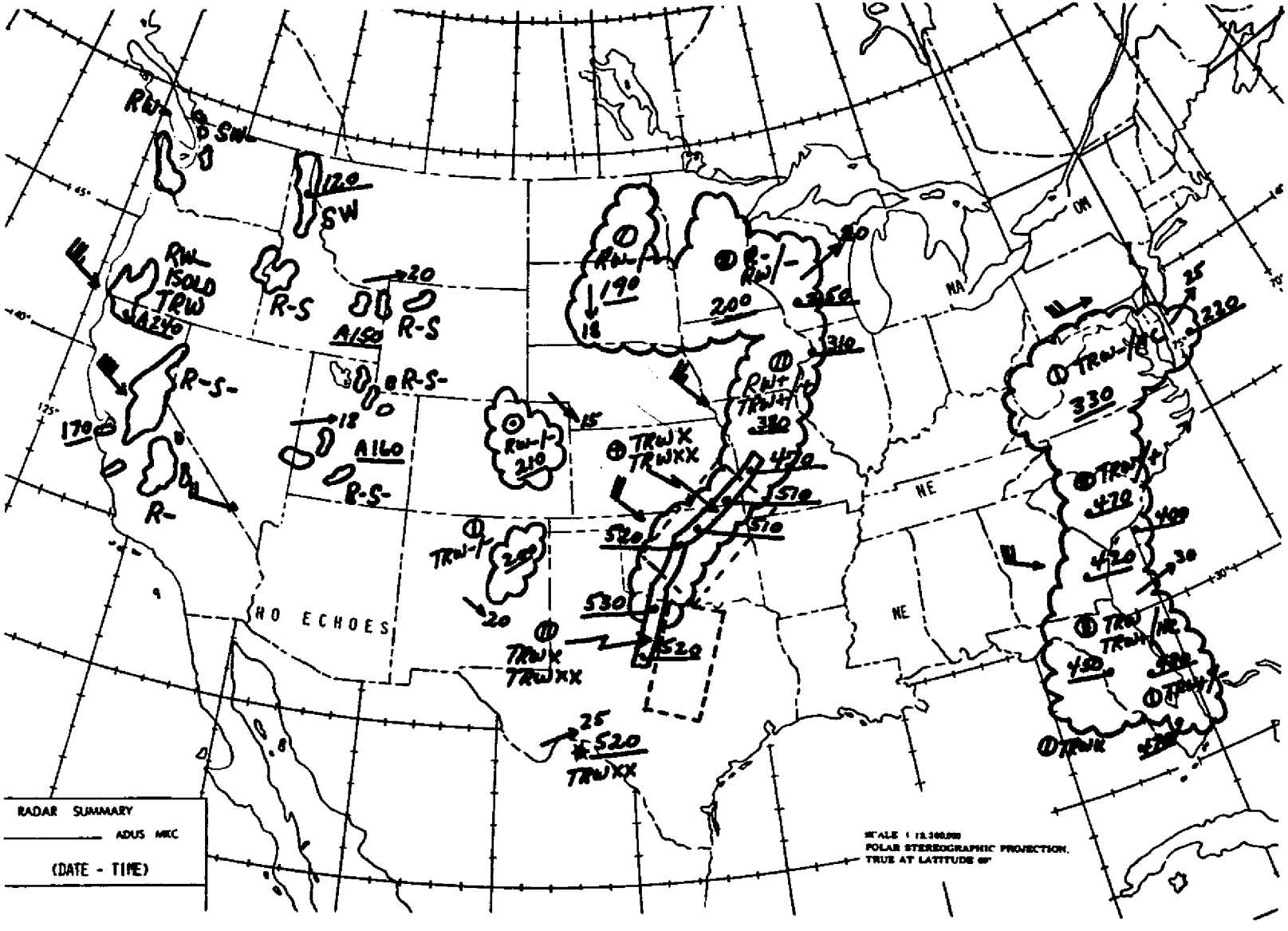


FIGURE 22.—A radar summary chart.

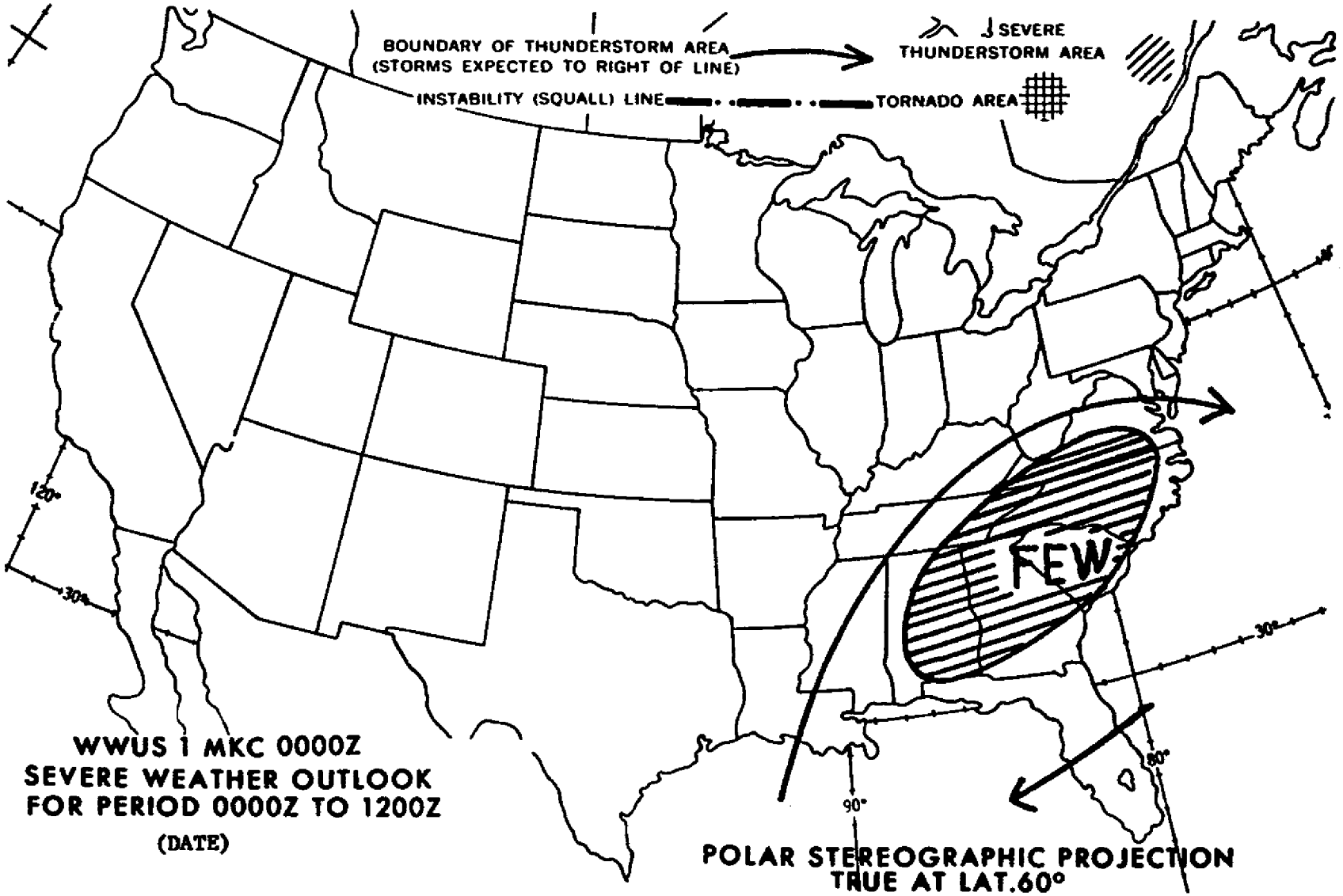


FIGURE 23.—A panel of a severe weather outlook chart.

SURFACE AVIATION WEATHER REPORTS

```
KS 1218Ø9
CNU E25 BKN 15 157/35/28/312Ø/999/ 246 33
DDC CLR 6BD 215/31/1Ø/3327G36/Ø14/PK WND 3442/11/ 232 25
EMP E2Ø BKN 1Ø 162/33/22/3125G35/999/PK WND 3235/2Ø 234 28
GCK 1ØØ -SCT 6BD 227/3Ø/17/332ØG28/Ø16/PK WND 3328/5Ø/ 225 25
GLD 3Ø SCT 5D 246/22/8/3432G42/Ø16/PK WND 3343/19/ 22ØØØ 15ØØ 13
 → GLD↘ 3/1 CBK NDB OTS
HLC -X E5Ø BKN 8 223/25/19/3227G4Ø/Ø13/4BD PK WND 3244/51/ 317 14
 → HLC↘ 3/5 K77 1/2IN 1R 13-31
HUT 15 SCT 15 35/18/322ØG3Ø/ØØ6/ 25
ICT 28 SCT 2Ø 185/34/16/3422G33/ØØ6 PK WND 3434/28/ 229 15ØØ 28 2ØØ24
RSL 2Ø SCT 15 192/29/16/3323G4Ø/ØØ7/PK WND 3345/4Ø 229 2Ø
SLN 3Ø SCT 15 178/3Ø/2Ø/3225G32/ØØ3 PK WND 3239/48/ Ø2Ø 25→ SLN↘ 12/9
 → SLN 12/9 SLN ILS 35 CAT 2 NA
TOP E3Ø BKN 18Ø BKN 1Ø 15Ø/28/18/3Ø18G32/997/ FEW CI SE4Ø PK WND 3Ø36/44
 LWR LYR BKN V OVC
```

FIGURE 24.—Surface aviation weather reports.

TERMINAL FORECASTS

```
KS 121452
CNU 121515 C2Ø BKN 2925G35 BKN V SCT. ØØZ CLR 3425G3Ø.
 Ø9Z VFR..
DDC 121515 C35 BKN 3335G5Ø CHC 4BD BKN V SCT. 2ØZ CLR
 3335G5Ø CHC 4BD. Ø9Z VFR..
GCK 121515 C35 BKN 333ØG45 CHC 4BD BKN V SCT. 2ØZ CLR
 3425G35 CHC 4BD. Ø9Z VFR..
GLD 121515 C35 BKN 6BD 3335G5Ø CHC SW-. 21Z CLR 3335G45.
 Ø9Z VFR..
ICT 121515 C2Ø BKN 3425G4Ø BKN V SCT. 17Z C35 BKN 3425G4Ø
 BKN V SCT. 22Z CLR 3325G35. Ø9Z VFR..
SLN 121515 C25 BKN 313ØG45 CHC SW- BKN V SCT. 21Z CLR
 333ØG4Ø. Ø9Z VFR..
TOP 121515 C25 BKN 293ØG5Ø CHC SW-. 19Z C3Ø BKN 3Ø3ØG5Ø
 CHC SW-. Ø1Z CLR 333ØG4Ø. Ø9Z VFR..
```

FIGURE 25.—Terminal forecasts.

AREA FORECASTS

MKC FA 121240.
13Z FRI-07Z SAT.
OTLK 07Z-19Z SAT.

WY CO KS NE SD ND...

HGTS ASL UNLESS NOTED...

SYNS... DP LOW PRES CNTR TO E OF NEB WITH STG CDFNT SWD FM LOW THEN CURVG SWWD ACRS EXTRM SE KANS AT 13Z MOVG TO E OF KANS BY 14Z. STG NWLY TO NLY WNDS NRN AND CNTRL PLNS BHND LOW GRDL DMSHG FM W. HI PRES CNTR MONT AT 13Z MOVG SEWD TO NW KANS BY 07Z.

SIG CLD AND WX...
WY COLO...
MTNS SRN AND ERN WYO LAND NRN AND S CNTRL COLO OCNL OBSCD ABV 70-90 IN CLDS AND SNW IPVG GRDL FM W NO SIGCLD BY 00Z. RMNDR MTNS 70-100 SCT LCL BKN WITH SCTD SW- TO NO SIGCLD. E COLO AND HI PLNS E WYO CIGS 20-40 OVC VRBL BKN WITH OCNL 3-5S-BS IPVG AFT 18Z TO NO SIGCLD BY 00Z. CLD TOPS 200. SFC WNDS E COLO AND HI PLNS E WYO OCNL 3420G30 TIL 19Z. OTLK... VFR.

KANS...
CIGS 15-30 OVC VRBL BKN WITH OCNL 3-5S-BS AND LCL VSBY BLO 3 MI IN BLOWING SNW OCNL BD W KANS. CIGS SPRDG SEWD ACRS SE BY 15Z. CONDS IPVG GRDL FM S TO NO SIGCLD THRUT BY 00Z CLD TOPS 120.
SFC
WNDS OCNL 3325V35G45 DMSHG SLOLY FM W OTLK .. VFR.

NEB SDAK NDAK...
OCNL CIGS BLO 10 VSBYS BLO 3S-BS MOST NEB SRN AND ERN HLF SDAK AND ERN NDAK. RMNDR E NDAK SDAK AND NEB CIG S 15-30 OVC VRBL BKN WITH OCNL 3-5S-BS. CONDS IPVG GRDL FM W TO NO SIGCLD E NDAK WRN SDAK AND PNHDL AND CNTRL NEB BY 21Z AND E SDAK AND E NEB BY 03Z. CLD TOPS 150. CNTRL AND W NDAK AGL 30 SCT CIG 70 BKN TO CLR. VSBY OCNL 3-5BS TIL 19Z. SFC WNDS E NDAK SDAK AND NEB OCNL 3430G40-50 KT DMSHG GRDL FM W. OTLK... VFR.

ICG... OCNL MDT MXD ICGICIP MTNS WYO AND COLO AND E NDAK SDAK NEB E COLO AND NW KANS DMSHG GRDL FM W. OTRW OCNL LGT RIME ICGIC. FRZLVL AT OR NR SFC EXCP NR 40 SE KANS LWRG TO SFC BY 00Z.

FIGURE 26.—Area forecasts.

RADAR WEATHER REPORTS

(RAREPS)

```
LIT 1133 AREA 4TRW+/ +22/1ØØ 88/17Ø 196/18Ø 22Ø/115 CELLS 2425
 MT 31Ø AT 162/11Ø
JAN 1935 SPL LN 1ØTRWX/NC 86/4Ø 164/6Ø 199/115 12W CELLS 243Ø
 MT 44Ø AT 159/65 D1Ø
MAF 113Ø AREA 2S 27/8Ø 9Ø/125 196/5Ø 268/1ØØ 241Ø MT 1ØØ UNIFORM
HBO 1132 AREA 2TRW++6R-/NC 67/13Ø 3Ø8/45 1Ø5W CELLS 224Ø
 MT 38Ø AT 66/54
OKC 1934 LN 8TRW++/+ 86/4Ø 164/6Ø 199/115 15W 2425
 MT 57Ø AT 159/65 2 INCH HAIL RPRTD THIS ECHO
```

FIGURE 27.—Radar weather reports.

SELECTED PILOT REPORTS

```
MSY UA 1328 BTR 8 BKN 17 36 BKN 4Ø 47 BKN 6Ø EST 8Ø BKN ABV

GAG UA 18Ø6 GAG AREA TOPS D LYR 6Ø.FAIRLY SMTH BUT OCNL LGT TURB
65.C175

MKC UA 121Ø 23SE TOP AT 12Ø SMOOTH VSBY CRISP BE9Ø.

MKC UA 132Ø 7S MKC MXD ICGIC 45-55. C4Ø2

STL UA 16Ø3 STL SCT V BKN 75 8Ø SMOOTH RIDE BE18

MSY UA 162Ø ESF-BTR 2Ø SCT CLR ABV BLDUPS S

MKC UA 1623 MHK-MCI BENEATH CLDS LGT CHOP LGT SW GOOD
VSBY C2Ø7

AMA UA 1633 8N AMA D TOPS 65. 1ØNNE AMA SMTH 85.PA28

MKC UA 1758 22 DME E MKC 85 SMTH BE35 TOPS 65
```

FIGURE 28.—Select pilot reports.

WINDS AND TEMPERATURES ALOFT FORECAST

FD WBC 151745
BASED ON 151200Z DATA
VALID 1600Z FOR USE 1800-0300Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
ALS			2420	2635-08	2535-18	2444-30	245945	246755	246862
AMA		2714	2725+00	2625-04	2531-15	2542-27	265842	256352	256762
DEN			2321-04	2532-08	2434-19	2441-31	235347	236056	236262
HLC		1707-01	2113-03	2219-07	2330-17	2435-30	244145	244854	245561
MKC	0507	2006+03	2215-01	2322-06	2338-17	2348-29	236143	237252	238160
STL	2113	2325+07	2332+02	2339-04	2356-16	2373-27	239440	730649	731960

FIGURE 29.—Wind and temperatures aloft forecast.

WEATHER ADVISORIES

DFW WA 121737
121737-122400

AIRMET CHARLIE 5. FLT PRCTN. GUSTY SFC WNDS MDT TURBC BLO 5 THSD FT ALG AND N OF CDFNT OVR OKLA AND TEX. CDFNT ALG FSM FTW ABI HOB LN AT 17Z MOVG SWD ABT 25 KTS. SOME BLWG DUST VSBYS LCLY ARND 3 MIS MAINLY OVR NWRN TEX AND WRN OKLA. CONDS CONTG PAST 24Z.

MSY WS 121250
121250-121700

SIGMET ALFA 4. FLT PRCTN. OVR NRN ALA S CNTRL TENN FOR TSTMS. OVR ALA N OF BHM TENN S OF BNA-TYS LN SCTD EMBDD TSTMS TOPS NR 350 MOVG EWD NR 45 KT WL SPRD INTO ERN TENN BY 16Z. CONT BYD 17Z.

FIGURE 30.—Weather advisories.

AIRCRAFT DESIGNATION:- Condor 410.
ENGINE OPERATION LIMITATIONS:- 260 HP at 2625 RPM.
FUEL SYSTEM:- Fuel injection System (Fuel discharged into combustion chamber)
Recommended Fuel 100/130 Minimum Grade.
Fuel Capacity Standard Tanks 65 gallons.
Usable Fuel All Flight Conditions 63.5 gallons.
OIL CAPACITY:- Total 12 quarts. (moment -0.4)
PROPELLER:- Constant-speed Hydraulically Controlled.
LANDING GEAR:- Retractable Tricycle Landing Gear.
Hydraulic Actuators Powered By Engine Driven Hydraulic Pump.
Emergency Operation:- Manual Hydraulic Pump.
WING FLAPS:- Hydraulically Operated; Powered By Engine Driven Hydraulic Pump.
EMPTY WEIGHT:- 1840 lbs. (moment 63.7)
MAXIMUM GROSS WEIGHT:- 3000 lbs.
LOAD FACTOR:-
Flaps Up + 3.8, -1.52
Flaps Dn. +3.5

RADIO EQUIPMENT:-

1 VHF Communications Transceiver	118.0 to 135.95 MHz
1 VHF Localizer/VOR Receiver	108.0 to 117.9 MHz
1 ADF Receiver (fixed azimuth)	200 kHz to 1750 kHz

AIRSPEED LIMITATIONS:-

Never exceed speed	225 mph CAS
Maximum structural cruising speed	190 mph CAS
Maximum maneuvering speed	132 mph CAS
Maximum gear operating speed	160 mph CAS
Maximum gear extended speed	160 mph CAS
Maximum flap extended speed	
Flaps 10°	160 mph CAS
Flaps 10° - 40°	110 mph CAS

MAXIMUM ALLOWABLE WEIGHT IN BAGGAGE COMPARTMENT - 120 LBS.

FIGURE 31.—Condor—airplane owner's manual.

TAKE-OFF DATA

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

GROSS WEIGHT LBS.	IAS AT 50 FT. MPH	HEAD WIND MPH	AT SEA LEVEL & 59°F		AT 2500 FEET & 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
2200	55	0	345	680	405	770	480	895	580	1040
		15	205	460	245	525	295	615	365	725
		30	100	275	120	320	155	380	195	460
2600	60	0	560	915	585	1045	705	1230	855	1470
		15	310	635	370	735	455	870	560	1055
		30	165	395	200	465	255	565	325	695
3000	64	0	695	1210	820	1405	990	1675	1205	2045
		15	450	855	535	1005	660	1215	815	1505
		30	250	555	310	665	390	820	500	1030

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

FIGURE 32.—Condor—takeoff data.

CLIMB DATA

GROSS WEIGHT LBS.	AT SEA LEVEL & 59°F			AT 5000 FT. & 41°F			AT 10000 FT. & 23°F			AT 15000 FT. & 5°F			AT 20000 FT. & -13°F		
	BEST CLIMB IAS MPH	RATE OF CLIMB FT./MIN	GAL. OF FUEL USED	BEST CLIMB IAS MPH	RATE OF CLIMB FT./MIN	FROM S.L. FUEL USED	BEST CLIMB IAS MPH	RATE OF CLIMB FT./MIN	FROM S.L. FUEL USED	BEST CLIMB IAS MPH	RATE OF CLIMB FT./MIN	FROM S.L. FUEL USED	BEST CLIMB IAS MPH	RATE OF CLIMB FT./MIN	FROM S.L. FUEL USED
2200	96	1800	2.0	93	1530	2.9	88	1150	3.9	83	780	5.1	78	410	6.8
2600	100	1540	2.0	97	1310	3.1	93	890	4.4	88	580	6.1	84	250	8.6
3000	105	1270	2.0	101	980	3.4	97	690	5.0	94	400	7.3	90	120	11.5

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

FIGURE 33.—Climb data.

LANDING DISTANCE TABLE

GROSS WEIGHT LBS.	APPROACH IAS MPH	AT SEA LEVEL & 59°F		AT 2500 FT & 50°F		AT 5000 FT & 41°F		AT 7500 FT & 32°F	
		GROUND ROLL	TO CLEAR 50' OBSTACLE	GROUND ROLL	TO CLEAR 50' OBSTACLE	GROUND ROLL	TO CLEAR 50' OBSTACLE	GROUND ROLL	TO CLEAR 50' OBSTACLE
2200	61	335	945	385	980	415	1020	445	1060
2600	66	420	1030	455	1070	490	1110	530	1155
3000	71	485	1110	525	1150	565	1200	610	1255

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

FIGURE 34.—Condor—landing distance table.

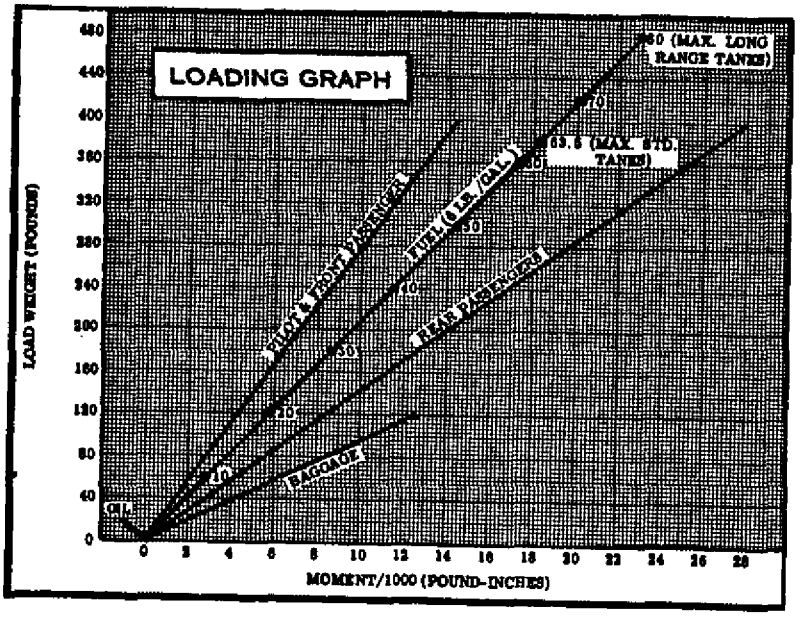


FIGURE 85.—Condor—loading graph.

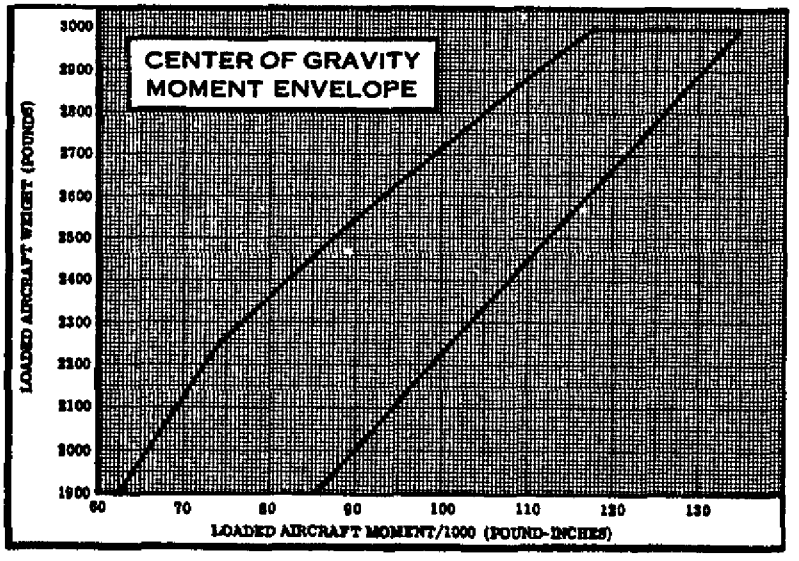


FIGURE 86.—Condor—center of gravity moment envelope.

2500 CRUISE PERFORMANCE

NORMAL LEAN MIXTURE

Standard Atmosphere • Zero Wind • Gross Weight - 3000 Pounds

2500 FEET

RPM	MP	% BHP	TAS MPH	Gal/ Hour	63.5 Gal. (No Reserve) Endr. Hours	63.5 Gal. (No Reserve) Range Miles	80 Gal. (No Reserve) Endr. Hours	80 Gal. (No Reserve) Range Miles
2450	24	76	180	14.3	4.4	800	5.6	1010
	23	71	177	13.4	4.7	835	6.0	1050
	22	67	173	12.7	5.0	865	6.3	1090
	21	63	169	11.9	5.3	900	6.7	1135
2300	24	68	174	12.8	4.9	860	6.2	1085
	23	64	170	12.1	5.2	890	6.6	1120
	22	61	166	11.4	5.6	925	7.0	1165
	21	57	163	10.8	5.9	960	7.4	1210
2200	23	60	168	11.3	5.6	930	7.1	1175
	22	56	162	10.7	6.0	965	7.5	1215
	21	53	158	10.0	6.3	1005	8.0	1265
	20	49	154	9.4	6.7	1035	8.5	1305
2100	22	52	157	9.9	6.4	1010	8.1	1275
	21	48	153	9.3	6.8	1045	8.6	1320
	20	45	148	8.7	7.3	1080	9.2	1360
	19	42	144	8.3	7.7	1105	9.7	1390
	18	39	139	7.8	8.1	1130	10.2	1420
	17	35	133	7.3	8.7	1150	10.9	1445
	16	32	126	6.9	9.2	1160	11.6	1460

FIGURE 37.—Condor—cruise performance—(2,500')

CRUISE PERFORMANCE 5000

NORMAL LEAN MIXTURE

Standard Atmosphere • Zero Wind • Gross Weight - 3000 Pounds

5000 FEET

RPM	MP	% BHP	TAS MPH	Gal/ Hour	63.5 Gal. (No Reserve) Endr. Hours	63.5 Gal. (No Reserve) Range Miles	80 Gal. (No Reserve) Endr. Hours	80 Gal. (No Reserve) Range Miles
2450	24	79	187	14.8	4.3	800	5.4	1010
	23	74	183	14.0	4.5	830	5.7	1050
	22	70	179	13.1	4.8	870	6.1	1095
	21	65	175	12.3	5.2	905	6.5	1140
2300	24	71	180	13.3	4.8	860	6.0	1080
	23	67	177	12.6	5.0	890	6.4	1125
	22	63	173	11.8	5.4	925	6.8	1170
	21	59	169	11.1	5.7	965	7.2	1215
2200	23	62	172	11.7	5.4	935	6.8	1175
	22	58	168	11.0	5.8	970	7.2	1220
	21	55	165	10.4	6.1	1005	7.7	1265
	20	51	160	9.8	6.5	1040	8.2	1310
2100	22	53	163	10.1	6.3	1020	7.9	1290
	21	50	159	9.6	6.6	1055	8.4	1330
	20	46	154	9.0	7.1	1090	8.9	1370
	19	43	150	8.5	7.5	1115	9.4	1405
	18	40	145	8.1	7.9	1140	9.9	1435
	17	37	139	7.6	8.4	1160	10.6	1465
	16	34	132	7.1	8.9	1175	11.2	1480
	15	31	125	6.7	9.4	1180	11.9	1485

FIGURE 38.—Condor—cruise performance—(5,000')

7500 CRUISE PERFORMANCE

NORMAL LEAN MIXTURE

Standard Atmosphere • Zero Wind • Gross Weight-3000 Pounds

7500 FEET

RPM	MP	% BHP	TAS MPH	Gal/ Hour	63.5 Gal. (No Reserve) Endr. Hours	63.5 Gal. (No Reserve) Range Miles	80 Gal. (No Reserve) Endr. Hours	80 Gal. (No Reserve) Range Miles
2450	22	72	186	13.6	4.7	870	5.9	1095
	21	67	182	12.7	5.0	910	6.3	1145
	20	64	178	12.0	5.3	945	6.7	1190
	19	59	173	11.1	5.7	990	7.2	1245
2300	22	65	179	12.2	5.2	930	6.6	1175
	21	61	175	11.5	5.5	970	7.0	1220
	20	57	171	10.8	5.9	1005	7.4	1270
	19	53	167	10.1	6.3	1040	7.9	1320
2200	22	61	175	11.4	5.6	970	7.0	1225
	21	57	171	10.7	5.9	1010	7.5	1275
	20	53	166	10.1	6.3	1045	7.9	1315
	19	50	162	9.5	6.7	1080	8.4	1360
2100	21	52	165	9.8	6.4	1060	8.1	1335
	20	48	160	9.3	6.8	1095	8.6	1380
	19	45	155	8.7	7.3	1125	9.2	1420
	18	42	150	8.3	7.7	1150	9.7	1450
	17	39	145	7.8	8.1	1175	10.2	1485
	16	35	138	7.4	8.6	1190	10.9	1500
	15	32	131	6.9	9.1	1200	11.5	1510

FIGURE 39.—Condor—cruise performance—(7,500')

CRUISE PERFORMANCE 10,000

NORMAL LEAN MIXTURE

Standard Atmosphere • Zero Wind • Gross Weight-3000 Pounds

10,000 FEET

RPM	MP	% BHP	TAS MPH	Gal/ Hour	63.5 Gal. (No Reserve) Endr. Hours	63.5 Gal. (No Reserve) Range Miles	80 Gal. (No Reserve) Endr. Hours	80 Gal. (No Reserve) Range Miles
2450	20	65	184	12.3	5.2	950	6.5	1200
	19	61	179	11.5	5.5	995	7.0	1250
	18	57	174	10.7	5.9	1035	7.5	1305
	17	52	169	10.0	6.4	1075	8.0	1355
2300	20	59	177	11.1	5.7	1010	7.2	1275
	19	55	173	10.4	6.1	1050	7.7	1325
	18	51	168	9.8	6.5	1090	8.2	1370
	17	48	162	9.1	6.9	1125	8.7	1420
2200	20	55	173	10.4	6.1	1050	7.7	1325
	19	52	168	9.9	6.4	1085	8.1	1365
	18	48	163	9.2	6.9	1120	8.7	1410
	17	44	158	8.7	7.3	1155	9.2	1450
2100	20	50	166	9.5	6.7	1105	8.4	1390
	19	47	161	9.0	7.0	1135	8.9	1430
	18	44	156	8.5	7.4	1160	9.4	1465
	17	40	150	8.0	7.9	1185	9.9	1495
	16	37	144	7.6	8.4	1205	10.5	1520
	15	34	137	7.1	8.9	1215	11.2	1530
	14	30	126	6.6	9.6	1200	12.0	1510

FIGURE 40—Condor—cruise performance—(10,000')

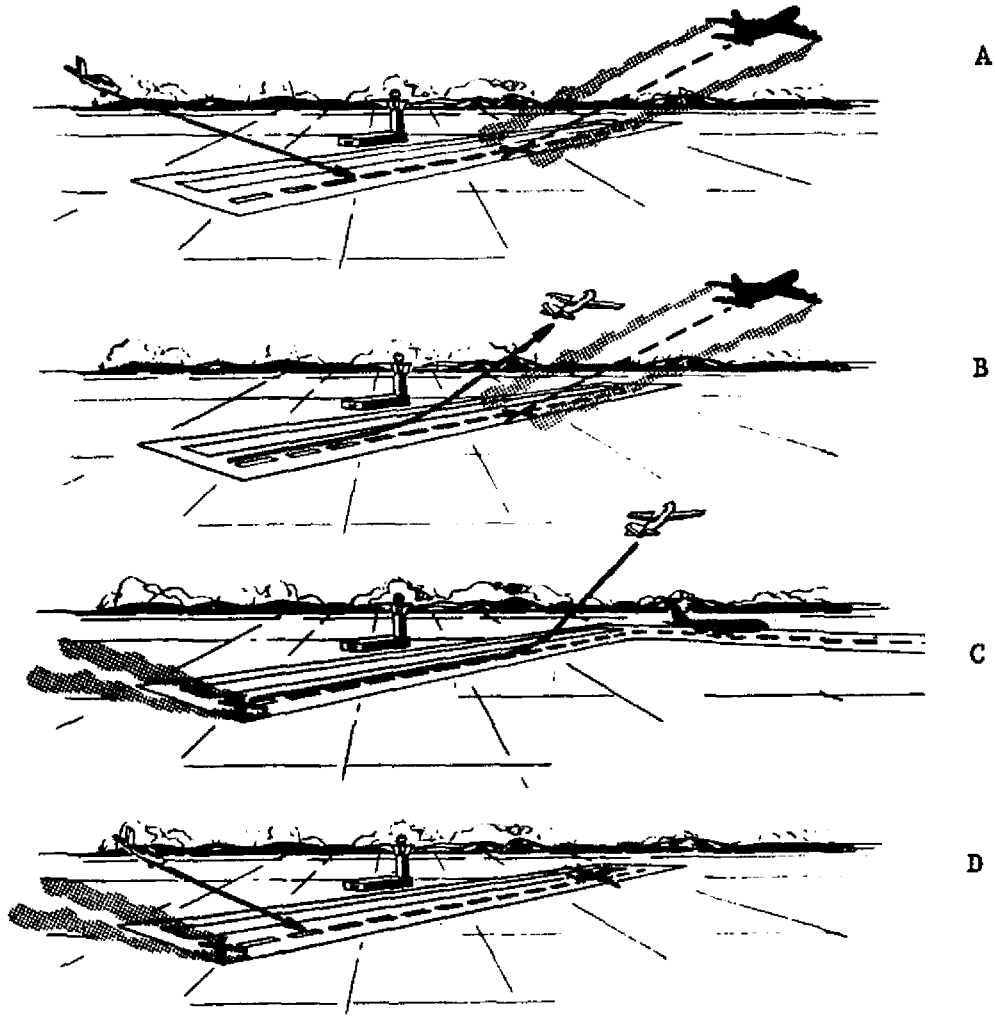


FIGURE 41.—Avoidance of wingtip vortices during takeoffs and landings.

A. Landing
B. Takeoff
C. Takeoff
D. Landing

DEPARTMENT OF TRANSPORTATION

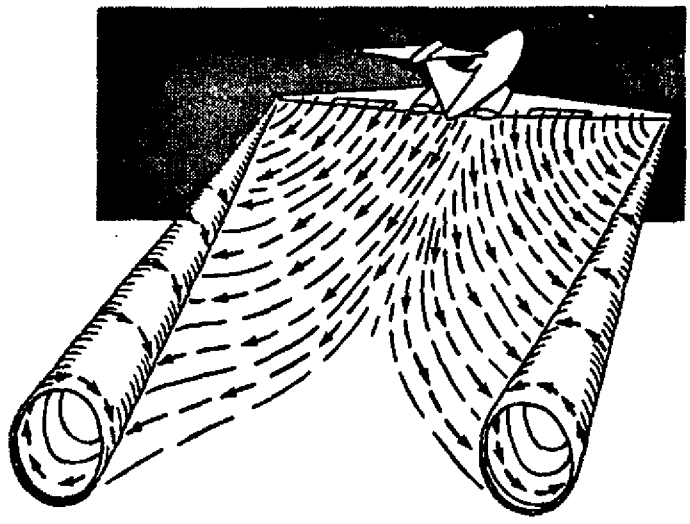
Federal Aviation Administration

VFR PILOT EXAM-O-GRAM* NO. 53

DANGERS OF WINGTIP VORTICES

Investigations of several fatal and near-fatal accidents show the probable cause to be loss of control when encountering wingtip vortices created by large aircraft. Reports indicate that many pilots are unaware of the dangers associated with wake or vortex turbulence; therefore, applicants for pilot certificates are being tested on their knowledge of this subject.

WHAT ARE WINGTIP VORTICES? Wingtip vortices are compact, fast-spinning, violently turbulent air masses that trail behind an airplane, sometimes for miles. Unfortunately they are invisible, but if you could see them they would look like two tornadoes stretching back horizontally from each wingtip. Many pilots refer to this phenomenon as "prop wash" or "jet wash," but engineering studies have revealed that the main source of this disturbance is from the wingtips, not the props or engines. These vortex systems are generated by the flow of air from the high pressure region under the wing, and curl around the wingtip to the region of lower pressure on the upper surface forming the two rotating vortices.



WHY ARE THEY DANGEROUS? They are dangerous because loss of control of aircraft can occur when flying into the wingtip vortices of large aircraft. The velocity of the air circulating about the core of these vortex systems can be extremely high, particularly those generated by the larger airplanes, and these velocities can exceed the control power of most airplanes. A smaller airplane flying into one of these rotating air masses can experience dangerous upsets and excessive load factors causing structural damage to the airplane. Particular care should be taken to avoid the vortices during landing and taking off.

WHEN ARE THEY STRONGEST? There are many factors affecting the intensity of wingtip vortices, but it is a safe and practical generalization that the bigger the airplane the more violent and long-lived will be the vortex disturbance. Recent studies indicated that the strongest vortex systems trailing behind the very large airplanes will descend 400-500 feet per minute to approximately 1,000 feet below the airplane. The vortices retain their lateral separation and drift with the wind. The aircraft creating the vortices may be out of sight, and the turbulence generated might be still lingering in the area. The heavier and cleaner the airplane and the slower it is flying, the stronger the air circulation in the vortex cores.

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

a. Avoid passing behind any large aircraft. Alter course to avoid the area behind and below the generating aircraft.

b. Avoid, when possible, places and altitudes frequented by large aircraft. If possible, monitor approach control and control tower frequencies at airports where large aircraft operate. These radio transmissions may give you a clue to the locations and paths of large aircraft.

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

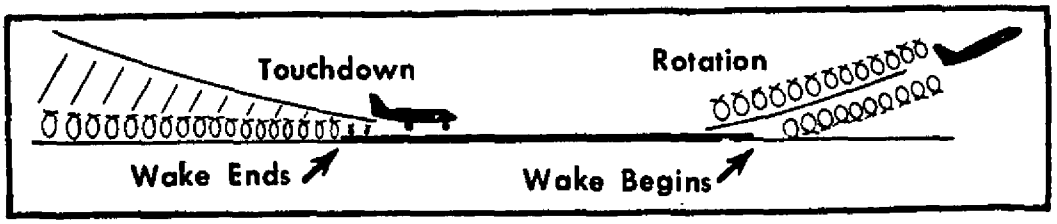
d. When taking off or landing behind large aircraft, be on the alert for turbulence and allow adequate spacing. Visualize the location of the vortex trail and avoid those areas.

* Exam-O-Grams are non-directive in nature and are issued solely as an information service to individuals interested in Airman Written Examinations.

DISTRIBUTION: EC-361

FIGURE 42.—VFR pilot Exam-O-Gram No. 53.

e. The best way of avoiding wingtip vortices is to know where they are most likely to be encountered and act accordingly. Since vortices are not produced until lift is produced, they will not be generated by an aircraft taking off until the aircraft rotates for lift-off. Vortices cease to be generated by a landing aircraft when its wings cease to produce lift -- when it has actually landed. Plan your takeoff and landing accordingly.



RECOMMENDED READING FOR ALL PILOTS. Your attention is invited to the Wake Turbulence Section of the Airman's Information Manual, which thoroughly explains this subject. It is also described in FAA Advisory Circular AC 90-23D (which may be obtained free of charge from: Distribution Unit, TAD-484.3, Department of Transportation, Washington, D.C. 20590).

FAA Aeronautical Center
Flight Standards Technical Division, Operations Branch
P. O. Box 25082
Oklahoma City, Oklahoma 73125 1/74

VFR – No. 53

LIST OF CURRENT VFR PILOT June 1, 1976

EXAM-O-GRAMS

No.	Title & Revision Date
2	VFR Cruising Altitudes - 10/71
4	Preflight Planning for a VFR Cross-Country Flight (Series 1) - 1/74
5	Preflight Planning for a VFR Cross-Country Flight (Series 2) - 10/71
6	Preflight Planning for a VFR Cross-Country Flight (Series 3) - 3/71
15	How to Use VOR (Series 1) - 8/64
16	How to Use VOR (Series 2) - 8/64
17	Common Misconceptions (Series 1) - 10/71
18	Lost Procedures - Pilotage - 9/64
19	Emergency or Lost Procedures (Radio) - 1/74
20	Ceiling and Visibility - 1/74
21	Flying into Unfavorable Weather - 7/69
22	Potential Midair Collisions - 1/74
23	Interpreting Sectional Charts (Series 1) 11/70
26	Common Misconceptions (Series 2) - 1/74
27	The Effect of Wind on an Airplane - 1/74
28	Factors Affecting Stall Speed - 9/65
29	Potential Midair Collisions (Series 2) - 1/74
33	Use of Performance Charts - 4/66
34	How to Obtain Proper Weather Briefing - 1/74
35	UNICOM Frequencies & Uses - 11/67
36	Commonly Misunderstood Areas of Aeronautical Knowledge (Series 1) - 1/72
37	Commonly Misunderstood Areas of Aeronautical Knowledge (Series 2) - 1/72
38	Mixture Control - Fuel/Air Ratio - 11/66
39	Simple ADF for VFR Navigation - 8/67
40	Visual Approach Slope Indicator (VASI) - 1/74
41	Controlled Airspace (Series 1) - 10/71
42	Controlled Airspace (Series 2) - 10/71
43	ATIS (Automatic Terminal Information Service) - 1/74
44	How High the Clouds? - 1/74
45	Airspeeds and Airspeed Indicator Markings (Series 2) - 1/69
46	Aviation Weather Reports - Remarks - 1/74
47	Ground Effect - 1/74
48	Midair Collisions (Series 3) - 1/74
49	Use of Oxygen in General Aviation Aircraft - 1/71
50	Interpreting Sectional Charts (Series 2) - 1/74
51	Interpreting Sectional Charts (Series 3) - 4/71
52	Sky Cover and Ceiling - 4/72
53	Dangers of Wingtip Vortices - 1/74
54	Emergency Locator Transmitters (ELTs) - 5/74
55	Terminal Radar Service Areas (TRSAs) - "Stage III" - 3/75
56	Sky Cover Symbols in Weather Reports and Forecasts - 7/75
57	Flight in the Region of Reversed Command in Relation to Takeoffs and Landings - 7/75

Exam-O-Grams 1, 3, 7, 8, 9, 10, 11, 12, 13, 14, 24, 25, 30, 31, and 32, have been discontinued since the subject areas which they cover are now adequately treated in other FAA publications.

FIGURE 48.—List of current VFR pilot Exam-O-Grams.

LIST OF CURRENT IFR PILOT EXAM-O-GRAMS

June 1, 1976

No.	Title & Revision Date
2	Use and Abuse of Radar - 2/71
5	Aviation Weather Reports and Forecasts - 3/74
6	VFR Operations on an Instrument Flight Plan - 9/69
7	CDI Interpretation - 9/69
8	IFR Altitudes - 11/75
10	Altimetry - 12/67
11	Communications Procedures for Pilots on Instrument Flight Plans - 2/71
14	VOR Quiz - 8/65
15	The Weather Depiction Chart is for You - 2/74
16	The Low Level Prognostic Chart - 11/73
17	The Radar Summary Chart - 3/74
18	Rate of Turn - 1/67
19	Telephone Weather Briefing - 6/71
21	IFR Weight and Balance Computations - 9/67
22	VOR Receiver Accuracy Check - 2/74
23	Fundamental ADF Procedures - 1/71
24	The Attitude Indicator - 5/70
25	The ATC Transponder - 2/71
26	Runway Marking - 10/71
27	Airport Surveillance Radar (ASR) Approaches - 4/73
28	Category II Taxiway Holding Lines - 7/69
29	When an Alternate Airport is Not Required - 3/70
30	VORTAC Area Navigation - 3/74
31	Is Your Instrument Flight Really Legal? - 11/73
32	Aircraft Performance Charts - 3/71
33	Runway and Displaced Threshold Lighting - 1/72
34	IFR Departure Clearances - 9/71
35	Clearance Delivery Procedures - 1/72
36	Lost Communications Procedures - Altitude Requirements - 1/72
37	Lost Communications Procedures - Route Requirements - 9/72
38	Lost Communications Procedures - Approach Requirements - 3/73
39	Enroute Chart Information - 4/73

Exam-O-Grams 1, 3, 4, 9, 12, 13, and 20 have been deleted since the subject areas are adequately treated in other FAA publications.

FIGURE 44.—List of current IFR pilot Exam-O-Grams.