File Copy

50¢ - gpo

INSTRUMENT FLIGHT INSTRUCTOR

9/27/66

INSTRUMENT FLIGHT INSTRUCTOR WRITTEN EXAMINATION GUIDE

Revised 1966

FEDERAL AVIATION AGENCY

For sale by the Superintendent of Documents, U.S. Government Printing Office Washington, D.C. 20402
Price 50 cents

Preface

This examination guide was prepared by the Federal Aviation Agency as advisory circular AC 61-29 to assist applicants who are preparing for the Instrument Flight Instructor Written Examination. It supersedes the *Instrument Flight Instructor Examination Guide* issued in 1962.

This guide outlines the scope of the basic aeronautical knowledge requirements for an instrument flight instructor; acquaints the applicant with source material that may be used to acquire this basic knowledge; and presents a sample examination with answers and explanations to the sample test items, and many illustrations used in the current Instrument Flight Instructor Written Examination.

Contents

Appendix I

Appendix II

INSTRUMENT FLIGHT INSTRUCTOR WRITTEN EXAMINATION GUIDE

Introduction

The flight instructor must be a versatile individual. Not only must he be well grounded in the fundamentals of aeronautical knowledge for the instructor rating he holds (or for which he is a candidate), but he must also be a good teacher. In this connection, sometimes the question is asked: "Which is more important to a flight instructor: knowledge of his subject (and skill in flying) or the ability to teach so that he gets it across to the students?" Actually, there is nothing to be gained by debating such a question. The relative importance of one over the other is beside the point; both are essential and dependent on each other.

What is required to become a skilled and effective flight instructor? Although some possess in a greater degree than others those traits desirable in an instructor, no one is born a *natural instructor. Good flight instructors* become so through study, experience, and hard work. Probably more than any other single factor, the new flight instructor's own attitude toward flight instruction determines what kind of job he will do.

After the prospective flight instructor has acquired his rating, it is imperative that he make a continuous effort to stay current. This is extremely important for the practicing flight instructor because aviation is not static, it is dynamic and changing, and what holds true today may not necessarily apply tomorrow. The practicing flight instructor must keep himself informed about new techniques, new equipment, new procedures, and regulatory changes.

Knowledge and understanding are seldom gained quickly or easily. This is particularly true in the diversified field of instrument flight instruction. There can be no substitute for diligent study to attain basic knowledge, unremitting effort to develop competence, and continuous review to remain current in the many areas where technological change is the rule rather than the exception.

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

Type of Examination

The Instrument Flight Instructor Written Examination consists of two sections, each of which contains 50 questions. Section 1 deals with "Fundamentals of Flight Instruction"; Section 2 deals with "Performance and Analysis of Instrument Flight Training Maneuvers and Procedures." A detailed outline of subject areas covered in each section appears later in this guide. The time required for the examination is approximately 4 hours.

The examination questions are of the objective, multiple-choice type, and each can be answered by the selection of a single item as the correct choice. This method conserves the applicant's time, permits wider coverage of subject matter in the examination, saves time in scoring, and eliminates the element of individual judgment in determining grades.

Taking the Examination

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

1. There are no "trick" questions. Each statement means exactly what it says. Do not look for hidden meanings. The statement does not concern exceptions to the rule; it refers to the general rule.

2. Carefully read the statement or question *first*—before you look at the answers listed below it. Be sure you read the entire question carefully. Avoid "skimming" and hasty assumptions. This can lead to a completely er-

roneous approach to the problem or failure to consider vital words. Finally, look through the list of alternate answers or phrases and find the one that answers the question fully and correctly. Be sure that the one you select answers the question completely.

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

4. If you find that you have considerable difficulty with a particular question, do not spend too much time on it but go on to those of which you are certain. When you have completed the easier items, go back to the questions which you have passed over because of their difficulty. This procedure will enable you to use the total time available to maximum advantage in demonstrating your knowledge and understanding of the subject.

Study Outline for the Instrument Flight Instructor Written Examination

This study outline covers the basic aeronautical knowledge that the prospective instrument flight instructor must know. Every test item on the FAA written examination is related to topics mentioned in this outline.

Section 1. Fundamentals of Flight Instruction

Applicants should familiarize themselves with the following pertinent chapters of the Flight Instructor's Handbook, AC 61–16.

1. Fundamentals of Teaching and Learning (Chapter I).
2. Effective Teaching Methods (Chapter II).
3. Aeromedical Information Important to Flight Instructors (Chapter IV).
4. The Flight Training Syllabus (Chapter VI).
5. Flight Instructor Responsibilities (Chapter VII).

Section 2. Performance and Analysis of Instrument Flight Training Maneuvers and Procedures

I. INTRODUCTION TO INSTRUMENT FLYING. EXPLAINING TO THE NEW INSTRUMENT STUDENT THE FOLLOWING:

A. *Basic Concept of Attitude Instrument Flying.*

1. Attitude instrument system of aircraft control as compared to the earlier "1–2–3" (needle-ball-airspeed) system of aircraft control.
2. Comparison of instrument flying to visual flying.

B. *Sensations of Instrument Flying.*

1. Understanding of the three primary senses which provide signals for maintaining equilibrium and orientation.
   a. The motion sensing organs of the inner ear. (The sensations from the inner ear during instrument flying are not reliable and must be disregarded.)
   b. The postural senses which include touch, pressure, and tension. (These senses, like those of the inner ear, are unreliable in flight without visual aid.)
   c. The sense of sight. (The only reliable sense in instrument flying.)
2. Understanding of sensations and conditions that induce spatial disorientation (vertigo).

II. EXPLAINING TO THE STUDENT THE FLIGHT INSTRUMENTS AND SYSTEMS.

A. *The Gyroscopic Flight Instruments (Attitude Indicator, Turn-and-Bank Indicator, and the Heading Indicator—Directional Gyro).*

1. The properties of gyroscopic action.
   a. Rigidity in space.
   b. Precession.
2. Power systems.
   a. Electrical system.
   b. Suction system.
3. Construction, principles of operation, and operating limiations of—
   a. Attitude indicator (gyro-horizon).
   b. Turn-and-bank indicator.
   c. Heading indicator (directional gyro, slaved gyro, and radio magnetic indicator (RMI)).

B. *The Differential Pressure Flight Instruments (Altimeter, Vertical Speed Indicator, and Airspeed Indicator).*

1. The pitot-static system.
   a. Impact pressures.
   b. Static pressures.
2. Construction, principles of operation, and operating limitations.
   a. Altimeter. The instrument flight instructor should be able to explain thoroughly—

(1) Method of reading and interpreting the altimeter.
(2) Setting of the altimeter.
(3) Types of altitude.
(a) Absolute altitude.
(b) Indicated altitude.
(c) Pressure altitude.
(d) Density altitude.
(e) True altitude.

NOTE.—For additional information, see VFR Exam-O-Grams No. 9 and 11 in the appendix.

(4) Altimeter errors.
(a) Installation error.
(b) Effect of nonstandard temperature on indications.
(c) Effects of nonstandard pressure on indications.

NOTE.—For additional information on altimetry, see VFR Exam-O-Gram No. 9 and IFR Exam-O-Gram No. 10 in the appendix.

b. The vertical speed indicator—Understand the lag characteristics to use it to the best advantage.
c. The airspeed indicator.
(1) The standard system of airspeed indicator markings as specified in FAR Part 23.
(2) Types of airspeed.
(a) Indicated airspeed.
(b) Calibrated airspeed.
(c) Equivalent airspeed (important only at high airspeeds).
(d) True airspeed.
(3) Airspeed errors.
(a) Installation error.
(b) Compressibility error (significant only at high airspeeds).
(c) Air density error.

C. *The Magnetic Compass.*
1. Magnetic variation.
a. Isogonic lines.
b. Agonic line.
2. Compass errors.
a. Deviation.
b. Magnetic dip errors.
(1) Northerly turn error.
(2) Acceleration error.
c. Oscillation error.

NOTE.—For additional information on the magnetic compass, see VFR Exam-O-Gram No. 12 in the appendix.

III. BASIC INSTRUMENT MANEUVERS AND PROCEDURES.

A. *Aerodynamics Applied to Instrument Flight.*
1. Understanding of the three axes of an aircraft.
2. Understanding of longitudinal and lateral stability—static and dynamic.
3. Understanding of the forces acting upon an aircraft.
a. In level flight.
b. In climbing and descending flight.
c. During turns. Effect of angle of bank and true airspeed on rate of turn and radius of turn.

NOTE.—For additional information, see Aerodynamics Useful for Flight Instruction, Chapter III of *Flight Instructor's Handbook*, AC 61–16.

B. *Items Included in the Instrument Cockpit Check.*
1. Checking of flight instruments for proper operation.
2. Checking or radio navigation equipment for proper operation.
3. Checking to see that appropriate flight planning documents are aboard (charts, etc.).

C. *Basic Components of Attitude Instrument Flying.*
1. Instrument coverage (cross-checking).
2. Instrument interpretation (interpreting the aircraft's attitude by reference to the instrument indications).
3. Aircraft control.
a. Pitch control.
b. Bank control.
c. Power control.
d. Trim control.

D. *Demonstration and Explanation of Instrument Maneuvers.*
1. Straight-and-level flight.
a. Pitch control in level flight.
b. Bank control in level flight.
c. Power control—change of airspeeds in level flight.
(1) Proper use of power during airspeed changes.
(2) Proper use of trim.
2. Constant airspeed climbs, descents, and level-offs.
3. Rate climbs and descents.
4. Standard rate turns—level, climbing, and descending.

5. Turns to headings.
   a. Using the heading indicator to determine the lead point to start roll-out.
   b. Using the magnetic compass to determine the lead point to start roll-out.

   NOTE.—For additional information on this subject, see VFR Exam-O-Gram No. 12 in the appendix.

6. Maneuvering at approach speeds and stalls.
   a. Aircraft configurations (setting of gear, flaps, and use of appropriate airspeeds for particular aircraft, etc.).
   b. Stall recovery techniques.
7. Steep turns.
8. Climbs and descents to predetermined headings and altitudes.
9. Recovery from unusual attitudes.
10. "Partial panel" techniques (controlling the aircraft without reference to the gyroscopic attitude indicator and heading indicator).
11. Instrument patterns and procedure turns.
   a. Patterns designed by flight instructor to fit the needs of his student.
   b. Holding patterns—standard and nonstandard methods, entry, and correcting for drift in holding patterns.
   c. Procedure turns.
      (1) 40-second type.
      (2) 1-minute type.
      (3) 90°–270° type (or 80°–260° type).
      (4) tear-drop type.

IV. INSTRUCTING STUDENT IN ALL PHASES OF FLIGHT PLANNING.

A. *Checking Destination Airport.*

1. Adequacy for instrument flight.
   a. Landing aids (radio, approach lights, and visual glide slope indicator).
   b. Communication facilities.
   c. Lighting.
   d. Servicing.

B. *Selection of Appropriate Charts, Route, and Altitudes.*

1. Choice of airways—preferred routes, departures and arrivals.
2. Terrain.
3. Minimum altitudes.
   a. Minimum enroute altitude (MEA).
   b. Minimum obstruction clearance altitude (MOCA).
   c. Minimum crossing altitude (MCA).
   d. Minimum reception altitude (MRA).

   NOTE.—For additional information, see IFR Exam-O-Gram No. 8 in the appendix.

4. Understanding of weather.
   a. Basic weather knowledge.
      (1) Winds and general circulation.
      (2) Air masses.
      (3) Characteristics of fronts.
      (4) Factors affecting visibility.
      (5) Thunderstorms and airplanes in flight.
      (6) Icing.
      (7) Turbulence.
   b. Weather information for flight planning.
      (1) Weather forecasts.
         (a) Regional.
         (b) Area.
         (c) Terminal.
         (d) Winds aloft forecasts.
         (e) SIGMETs and AIRMETs.
      (2) Weather reports.
         (a) Hourly sequence reports and specials.
         (b) Pilot reports (PIREPs).
         (c) Winds aloft reports.
         (d) Radar reports.
5. Selection of enroute altitude(s).
6. Selection of an alternate airport.
7. Understanding of enroute radio aids.
   a. Navigational aids.
      (1) VOR/VORTAC.
      (2) L/MF radio range.
      (3) Location markers—radio beacons.
      (4) Homing facilities.
      (5) D/F facilities.
      (6) Standard broadcasting stations.
      (7) Radar.
      (8) Distance measuring equipment (DME).
   b. Communications.

C. *Making Flight Log Entries.*

1. Compulsory and noncompulsory reporting points.
2. Miles between reporting points.
3. Estimated number of minutes between reporting points.
4. Estimated groundspeed between reporting points.
5. Range, center, and tower frequencies.
6. Magnetic courses.
7. Fuel hours.

8. Airways and altitudes.
9. Other.

D. *Completing and filing the Instrument Flight Plan.*

V. INSTRUCTING STUDENT IN OPERATIONAL TECHNIQUES USED IN CROSS-COUNTRY INSTRUMENT FLIGHT.

A. *Reviewing All Applicable Air Traffic Control Procedures.*

B. *Understanding of Enroute Navigational Procedures.*
1. Dead reckoning.
2. Radio navigation.
   a. Radio compass (ADF and manual loop).
      (1) Aural null.
      (2) Lines of position.
      (3) Bearings.
      (4) Fixes.
      (5) Tracking.
      (6) Drift correction.
      (7) Time and distance determination.
      (8) Use of compass locators and homing facilities.
   b. VOR enroute flying.

C. *Understanding of Departure, Climb, Letdown, and Holding Procedures.*

D. *Knowledge and Procedures Associated With In-flight Weather.*
1. Weather recognition; VFR and IFR.
2. By radio—weather broadcasts from FAA Flight Service Stations.
3. By radio—in-flight weather safety service provided by U.S. Weather Bureau (SIGMETs and AIRMETs) concerning potentionally hazardous weather.
4. By radio—make "PIREPs" which describe weather conditions aloft.
5. Effects of changing pressure and/or temperature on altimeter and airspeed indicator.
6. Effect of weather changes on aircraft performance.
7. Procedures to be followed as a result of weather changes.

E. *Changes During Flight.*
1. Flight plan alterations.
   a. Deviations in ETA or TAS if beyond tolerance.
   b. Changing alternate.
   c. Changing altitude.
   d. Changing route.
   e. Changing destination.
   f. Air Traffic Control instructions.
   g. Closing instrument flight plan.

Note.—For additional information, see IFR Exam-O-Gram No. 6 in the appendix.

2. Emergency procedures.
   a. Equipment failure.
      (1) Instrument.
      (2) Radio navigation.
      (3) Airframe or powerplant.
   b. Radio communications failure procedures (FAR Part 91).
   c. Disorientation (lost).
      (1) Radar.
      (2) Radio bearings from ground stations.

F. *Understanding of Standard Instrument Approach Procedures and Criteria.*
1. VOR procedure and missed approach procedure.
2. ADF procedure and missed approach procedure.
3. ILS procedure and missed approach procedure.

G. *Utilization of Radar on Instrument Approaches and Departures.*

Note.—See IFR Exam-O-Grams No. 1 and 4 in the appendix and Part 1 of *Airman's Information Manual.*

H. *Communications Procedures to be Used.*
1. Departure, enroute, and arrival frequencies.
2. Clearances.
3. Emergencies.
4. Using proper radiotelephone phraseology when making IFR position reports.

Note.—For further information, see IFR Exam-O-Gram No. 11 in the appendix.

VI. USE OF INFORMATION SOURCES BY PILOTS.

A. *Airman's Information Manual (AIM)*—Know how to interpret and use the data contained in this important planning publication. The following is a list of applicable subjects included in this manual.
1. Communication frequencies (control towers—approach control, primary traffic control, ground control; Flight Service Stations; VHF/DF stations; communications failures).

2. Navigational aid frequencies (VOR stations, nondirectional beacons, and L/MF range stations).
3. Radar available—how service is provided to civil aircraft.
4. Instrument Landing System (ILS)— components and minimums.
5. List of preferred routes.
6. NOTAMs (Notice to Airmen). NOTAM code.
7. Special Notices (lists of Military Climb Corridors and Oil Burner Routes).
8. Airport data (location, runway information, availability of fuel and service, availability of UNICOM and weather reporting facilities, etc.).
9. Good operating practices and other helpful information.
10. VASI (Visual Approach Slope Indicator).
11. Vertigo.
12. Communications, direct pilot controller, departure and enroute.
13. Flight plan, IFR.
14. Airport traffic control procedures.
15. Light gun signals.
16. Radiotelephone phraseology and techniques.
17. List of VOR receiver checkpoints and procedures for making accuracy checks.
18. VHF/DF direction-finding data and procedures.
19. U.S. aircraft emergency procedures, search and rescue procedures, emergency SCATER rules (Security Control of Air Traffic and Electro-Magnetic Radiations).
20. Weather, briefing and broadcasts, PIREPs.
21. VOR/VORTAC/TACAN operational limitations.
22. Runway—Runway Visual Range (RVR), Runway Visibility (RVV), Runway End Identifiers (REIL).

B. *Charts for Instrument Navigation*—Understand how to interpret and use:

1. Enroute charts (low altitude).
2. Instrument approach and landing charts.
3. Area charts (departure and arrival).

C. *Airplane Flight Manual and Owner's Handbook*—Understand the meaning of and how to use the material in these manuals which are applicable to several makes and models of present-day aircraft.

1. Consult the weight and balance data and determine that the aircraft is properly loaded. Know how to compute empty weight, useful load, and gross weight.

   NOTE.—See Chapters 1 and II of the *Flight Training Handbook* concerning load factors and weight and balance.
2. Know the grade and quantity of fuel and oil required.
3. Review flight load factor limitations and airspeed limitations.
4. Be able to use performance charts as required for—
   a. Takeoff data.
   b. Climb data.
   c. Landing distance data.
   d. Cruise performance data (cruise power settings, approximate true airspeeds, fuel consumption rate).
5. Be able to use tables such as the—
   a. Stall Speed versus Angle-of-Bank table.
   b. Airspeed Calibration table.

D. *Understand and Be Able to Use other Pertinent Charts.*

1. Density Altitude charts.
2. Denalt Performance Computer (which replaces the Koch chart).
3. Load Factor chart.

VII. FEDERAL AVIATION REGULATIONS—THE INSTRUMENT FLIGHT INSTRUCTOR SHOULD BE FAMILIAR WITH THE FOLLOWING FEDERAL AVIATION REGULATIONS AND CIVIL AERONAUTICS BOARD REGULATION:

A. FAR Part 1—*Definitions and Abbreviations.*

B. FAR Part 23—*Airworthiness Standards: Normal, Utility, and Acrobatic Category Airplanes*—Sections 23.1545 and 23.1549.

C. Part 61—*Certification: Pilots and Flight Instructors*—Subparts A and F.

D. FAR Part 71—*Designation of Federal Airways, Controlled Airspace, and Reporting Points.*

E. FAR Part 91—*General Operating and Flight Rules.*

F. FAR Part 95—*IFR Altitudes.*

G. FAR Part 97—*Standard Instrument Approach Procedures.*

H. CivilAeronautics Board, Safety Investigation Regulations, Part 320—*Notification and Reporting of Aircraft Accidents and Overdue Aircraft, Subparts A, B, and D.*

VIII. OTHER AREAS OF IMPORTANCE.

A. *Altimeter.*

1. Understand how to apply altimeter settings to the altimeter setting window (Kollsman window) of the altimeter.
2. Be able to interpret the indications of the altimeter at all altitudes (including altitudes above 10,000 feet).

NOTE.—For additional information on altimetry, see VFR Exam-O-Gram No. 9 in the appendix.

B. *The Airspeed Indicator.*

1. Know the eight airspeed ranges and limitations that are reflected by the standard marking system on the face of the airspeed indicator (white, green, and yellow arcs, and the red line).
   a. Flap operating range.
   b. Normal operating range.
   c. Caution range.
   d. Power-off stalling speed with the wing flaps and the landing gear in the landing position (V_{so}).
   e. Power-off stalling speed "clean"—wing flaps and landing gear retracted (V_{s1})—if retractable gear type.
   f. Maximum flap extended speed (V_{fe}).
   g. Maximum structural cruising speed (V_{no}).
   h. Never-exceed speed (V_{ne}).
2. Know and understand the reason for other pertinent airspeed limitations such as the maneuvering speed (V_p).

C. *Communication Procedures.*

1. Know the meaning of standard radio telephone words and phrases and the normal phraseology to use on standard transmissions.
2. Know when and how to receive regularly scheduled broadcasts.

D. *Various Color of Lights Associated With An Airport—(Runway, Taxiway, Threshold, Obstruction, Beacon, etc.).*

Sample Examination

The following test items are included for one purpose—to familiarize you with the type of questions you may expect to find in the examination for the Instrument Flight Instructor rating. You should keep in mind that these few sample items do not include all of the topics on which you will be tested in the FAA examination. It is for this reason that you should concentrate your study on the subjects in the section, "Study Outline for the Instrument Flight Instructor Written Examination." A knowledge of all of the topics mentioned in this outline—not just the mastery of these sample test items—should be used as the criterion for determining that you are properly prepared to take the FAA written examination.

In some sample test items, reference is made to certain illustrations to be found in the appendix of this guide. *All illustrations found in the appendix are representative of the illustrations used with current Instrument Flight Instructor Written Examinations.*

This sample examination is divided into sections. The first section tests for basic knowledge in "Fundamentals of Flight Instruction" and the second section tests on the "Performance and Analysis of Instrument Flight Training Maneuvers and Procedures." If the applicant for the Instrument Flight Instructor Examination already possesses a Flight Instructor certificate (such as: Flight Instructor—Airplane, or Flight Instructor—Glider, etc.) he will not be required to take Section 1 of the Instrument Flight Instructor Examination.

Answers and explanations to the questions which follow may be found on pages 13 through 15.

Section 1. Fundamentals of Flight Instruction

1. Evoking "insights" as applied to learning is one of the flight instructor's major responsibilities. Insights as applied to learning—

   1. Concern the ability of the student to discover the reason for a procedure or a maneuver he has learned.
   2. Concern the analysis of the student by his instructor.
   3. Pertain to the student's grasp of theoretical principles taught in ground school.
   4. Involve the grouping of perceptions into meaningful wholes.

2. 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. Keep him aware of the progress and praise his good performance.
   2. Assign him tasks which are somewhat beyond his ability.
   3. Tell him that he will fail if he does not work.
   4. Remind him of his final goal in order to keep his interest high.

3. The use of lesson plans or syllabuses of instruction offers many advantages and perhaps a few disadvantages. Some of the statements below with regard to lesson plans are correct; some are incorrect. Select the answer which includes only the correct statements.

   A. Any practical flight training syllabus must be flexible, but should never be used primarily as a guide.

   B. Teaching success depends more upon lesson planning than it does on presentation, personality, flying ability, or experience.

   C. Lesson planning discourages the instructor who likes to organize his own thinking.

   D. A lesson plan prepared for one student is rarely appropriate to another without some modification.

   E. Lesson plans can be used only by the instructor who devised them.

F. The syllabus consists of the blocks of instruction to be completed in the most efficient order.
   1. A, E, F.
   2. B, D, F.
   3. A, B, E.
   4. B, C, D.

4. Reviews are an integral part of each lesson; before the completion of the instruction period, the instructor should recapitulate what has been covered during the lesson, in order to—
   1. Identify the blocks of learning which constitute the necessary parts of the total objective.
   2. Insure that the student is aware of his progress.
   3. Emphasize the competitive nature of the learning situation.
   4. Improve the student's grades based upon the objectives and goals of the lesson plan and syllabus.

5. In a good instrument flight curriculum, the presentation of maneuvers should be arranged—
   1. In the order that they appear in the instrument flight syllabus.
   2. In the order in which they would occur or be used in practical everyday instrument flying.
   3. So that each teaches an extension of the principles learned in previous instrument maneuvers.
   4. In any expedient order as long as no required instrument maneuvers are omitted.

6. If a student shows slow progress in effecting recoveries from unusual attitudes due to a lack of confidence, his flight instructor should—
   1. Use praise to a greater extent after each recovery.
   2. Continue the instruction on the recoveries from unusual attitudes but in a more brisk manner.
   3. Assign him goals which are less difficult.
   4. Point out the student's errors by exaggerated demonstrations of the errors.

7. From the list of statments below, select those which are true when working with slow or timid students.

A. Brisk instruction may force the slow student to apply himself more diligently.
B. It is impossible to give a slow student too much help and encouragement.
C. Criticism of his performance may completely subdue a timid person.
D. A slow student may understand the situation and know the correct procedures, but lack confidence in his capability.
   1. A and D only.
   2. A, C, and D only.
   3. B and C only.
   4. C and D only.

8. If a flight instructor is to deal with the problem of student airsickness, he should be aware that it is primarily—
   1. Confined to the emotionally unstable and is an indication of a weakness that is not desirable in pilots.
   2. A type of motion sickness which can be controlled and minimized if the instructor is careful to avoid overexposure to the disturbing maneuver.
   3. A reaction to fear and apprehension and is usually exhibited by the timid student.
   4. Misplaced emphasis, repetition, and a complete lack of confidence on the part of the student.

9. It is a major responsibility of the instructor to organize demonstrations and explanations so that the student will—
   1. Have better opportunities to understand the interrelationships of the many kinds of experiences he has perceived.
   2. Be able to learn through trial and error practice of the procedures.
   3. Experience a minimum amount of difficulty in memorizing the steps of a procedure.
   4. Be required to memorize the steps of a procedure and then practice until the performance becomes automatic.

10. The practice of giving written examinations to flight students at regular intervals, or at stated points in the flight syllabus—
   1. Will permit the instructor to establish the general intelligence level of students, and on this basis, determine what they should be capable of accomplishing.
   2. Will permit the instructor to identify the weak students.

3. Is very valuable in determining the student's ability to accept and effectively apply further instruction.
4. Is undesirable with those students in which it might produce an unfavorable self-image.

Section 2. Performance and Analyses of Instrument Flight Training Maneuvers and Procedures

11. Acceleration and deceleration errors of the magnetic compass will predominate on headings which are—

1. Northerly and easterly.
2. Easterly and westerly.
3. Northerly and southerly.
4. Southerly and westerly.

12. In introducing your student to the concept of Attitude Instrument Flying, you should begin by giving him an explanation of its principles. Which three of the following six statements best explain this concept?

A. The new instrument student should forget what he has previously learned from visual contact flying.

B. Much of the skill and knowledge previously learned during visual contact flying can be transferred to instrument flying.

C. The natural visual references which are used in visual contact flying—the relation of the nose and wings of the aircraft to the true horizon—are replaced by instrument references.

D. The basic concept of this method is predicted on the "1–2–3" system of aircraft control (the needle-ball-airspeed system).

E. The nature of instrument flying requires control movements and pressures to be largely mechanical.

F. The same smooth control movements and pressures desirable during visual contact flying are equally desirable during instrument flying.

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

13. A student pilot asks: "Assuming other conditions remain the same, will an increase in relative humidity affect the takeoff distance or climb performance of an airplane?" A correct reply to this question would be—

1. "No, humidity has no effect on aircraft performance."
2. "Yes, because the presence of additional water vapor in the air increases the effective thrust horsepower of the engine and propeller."
3. "Yes, because the presence of additional water vapor in the air decreases air density; therefore the takeoff distance will be increased and the climb performance reduced."
4. "Yes, because the presence of additional water vapor in the air increases the air density; therefore the takeoff distance will be decreased and the climb performance improved."

14. When using the radio compass, the formula for computing the approximate distance from a radio (homing) station is:

1. $\frac{\text{60 x minutes flown between bearings}}{\text{degrees of bearing change}}$
2. $\frac{\text{true airspeed x minutes flown between bearings}}{\text{degrees of bearing change}}$
3. $\frac{\text{true airspeed x 60}}{\text{degrees of bearing change}}$
4. $\frac{\text{rate of change x time}}{\text{degrees of bearing change}}$

15. A pilot tunes his omnireceiver to a VOR station while flying on a magnetic heading of 045°. His airplane is equipped with a radio magnetic indicator (RMI), and the needle of this instrument is used in conjunction with his omnireceiver installation. By referring to instrument A indication in figure 21 of the appendix, the pilot determines that his aircraft is located on what radial of the VOR station to which his equipment is tuned?

1. 300°.
2. 120°.
3. 075°.
4. 165°.

16. Accident reporting procedures are contained in—

1. *Federal Aviation Regulations, Part 61.*
2. *Federal Aviation Regulations, Part 91.*
3. *Civil Aeronautics Board, Safety Investigation Regulations, Part 320.*
4. *Federal Aviation Regulations, Part 63.*

17. Referring to the Enroute Low Altitude Chart (4) (figure 43) and the Cincinnati Departure Chart (figure 46) in the appendix, determine which of the following statements are true.

A. The preferred route from Cincinnati to Louisville is via V5.
B. The distance from Cincinnati CVG VORTAC to Louisville LOU VORTAC via V5 is 68 nautical miles.
C. The lowest minimum enroute altitude (MEA) on the preferred route between Cincinnati and Louisville is 2,100 feet MSL.
D. When flying northbound from Louisville on V51 the Nabb VOR is a compulsory reporting point.
E. There are no minimum obstruction clearance altitudes (MOCA) listed on the Victor Airways between Cincinnati and Louisville.
F. On V5 between Cincinnati and Louisville, the minimum enroute altitude (MEA) changes at Warsaw intersection.

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

18. Which of the following IFR position reports made to the Indianapolis Center over Louisville VORTAC, while enroute to St. Louis, contains all of the essential information and is given in the correct sequence?

NOTE.—In the interest of brevity and conciseness, words such as "THIS IS," "OVER," "AT," and "ESTIMATING" may be omitted if no confusion or misinterpretation will result from the omission.

1. "STINSON FOUR ONE ONE TWO YANKEE, LOUISVILLE ZERO FIVE, SIX THOUSAND, EVANSVILLE FIVE SEVEN, ST. LOUIS."
2. "STINSON FOUR ONE ONE TWO YANKEE, SIX THOUSAND, LOUISVILLE ZERO FIVE, INSTRUMENT FLIGHT PLAN, ST. LOUIS, EVANSVILLE FIVE SEVEN."
3. "STINSON FOUR ONE ONE TWO YANKEE, LOUISVILLE ZERO FIVE, SIX THOUSAND, IFR ST. LOUIS, EVANSVILLE FIVE SEVEN."
4. "STINSON FOUR ONE ONE TWO YANKEE, LOUISVILLE NOW, INSTRUMENT FLIGHT RULES, SIX THOUSAND, EVANSVILLE FIVE SEVEN, ST. LOUIS."

19. With the omnibearing selector set to 270°, select the sequence of VOR receiver indications that would occur as the sweptwing jet in figure 20 proceeds along its depicted course.

1. A, B, C, I.
2. F, E, D, G.
3. D, E, F, I.
4. D, E, F, H.

20. In introducing your student to ILS approaches, you begin by comparing the angular width of a localizer course to that of any selected VOR course in terms of a full scale deflection of the course deviation indicator (LEFT–RIGHT) needle. You explain that the angular width of the ILS localizer course—from full scale left to full scale right on the CDI—is approximately—

1. The same as a VOR course.
2. Twice as wide as a VOR course.
3. One-half as wide as a VOR course.
4. One-quarter as wide as a VOR course.

Answers and Explanations to Sample Test Items

Section 1. Fundamentals of Flight Instruction

item	*answer*	
1	4	This topic is covered on page 6 of the FAA *Flight Instructor's Handbook* (AC 61–16). Instruction speeds the learning process by teaching the relationship of perceptions as they occur, and so promoting the development of insight by the student. The mental relating and grouping of associated perceptions is called insight.
2	1	The reference is found in the FAA *Flight Instructor's Handbook* on page 7, which states: "In group instruction, praising and giving credit to students who have performed well not only encourages those praised, but also motivates 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.
3	2	Any practical flight training syllabus must be flexible, and *should* be used primarily as a guide. Lesson planning should not discourage the instructor, since it is prepared for the instructor's own benefit, and should be done by him in the form most useful to him. It is recommended that each flight instructor prepare and maintain a complete set of flight instruction breakdowns covering each maneuver and procedure. The instruction breakdowns should be prepared for insertion in looseleaf binders, so that they may be easily corrected or amended. Reference can be found in FAA *Flight Instructor's Handbook*, pages 26–28.
4	2	Review and evaluation are integral parts of each lesson. Before the completion of the instruction period, the instructor should recapitulate what has been covered during the lesson, and require the student to demonstrate the extent to which he has met the lesson objectives. The student should be aware of his progress and the advances and deficiencies noted at the conclusion of the lesson. Reference: page 24 of the FAA *Flight Instructor's Handbook.*
5	3	Using the "building block" principle of teaching dictates that the presentation of maneuvers must be made in a sequence and at a stage of training where their association by the student with other maneuvers already learned will be assembled to form correct insights and provide mastery of advanced skills. A maneuver which incorporates the elements used in the preceeding maneuvers and extends their application, or associates them with other flight elements, provides much more effective training than does a maneuver which is completely foreign to the preceeding maneuver. Reference on page 77 of the FAA *Flight Instructor's Handbook.*
6	3	Reference can be found on page 22 of FAA *Flight Instructor's Handbook* which states, "A student whose slow progress is due to discouragement and a lack of confidence should be assigned 'subgoals' which can be attained more easily than the normal learning goals. For this purpose, complex flight maneuvers can be separated into their elements, and each element practiced until an acceptable performance is achieved before the

Item answer

whole maneuver or operation is attempted."

7 2 The slow student requires instructional methods which combine tact, keen perception, and delicate handling. If he receives too much help and encouragement, he may develop a feeling of incompetence. Too much criticism of his performance may completely subdue a timid person, whereas brisk instruction may force him to apply himself more diligently. Self-concept, how a person pictures himself, is one of the most powerful determinates in learning. Negative self concepts may inhibit the ability to properly implement that which is perceived. Reference: pages 4 and 22, FAA *Flight Instructor's Handbook.*

8 2 Rough air and unexpected abrupt maneuvers tend to increase the chances of airsickness. All attempts at further instruction should be discontinued as soon as the student reports that he is experiencing airsickness. Reference: pages 9 and 10, FAA *Flight Instructor's Handbook.*

9 1 It is essential to keep each student constantly receptive to new experiences, and to help him realize the way that each piece relates to all other pieces of the total pattern of the task to be learned. It is a major responsibility of the instructor to organize his demonstrations and explanations, and the directed student practice, so that the learner has better opportunities to understand the interrelationships of the many kinds of experiences he has perceived. Reference: page 6 of the FAA *Flight Instructor's Handbook.*

10 3 The conduct of written examinations for flight students at regular intervals, or at stated points in the flight syllabus, is very valuable for evaluating the student's understanding of the training provided, and his ability to accept and effectively apply further instruction. Reference: page 39 of the FAA *Flight Instructor's Handbook.*

Section 2. Performance and Analysis of Instrument Flight Training Maneuvers and Procedures

Item answer

11 2 When you are flying on an *easterly* or *westerly* heading, it is important that a constant airspeed be maintained in order to get an accurate reading on the magnetic compass. If you increase the airspeed, although you are holding the aircraft straight ahead, the compass card erroneously indicates a turn toward *north.* If you decrease the airspeed the compass will give an erroneous indication of a turn toward *south.* Reference: VFR Exam-O-Gram No. 12 in the appendix.

12 4 See "Explanation of Attitude Instrument Flying" in the appendix.

13 3 See VFR Exam-O-Gram No. 11 in the appendix which deals with this subject.

14 2 The correct formula for approximate distance to the station is:

$$\frac{\text{true airspeed x minutes flown between bearings}}{\text{degrees of bearing change}}$$

(Groundspeed should be substituted for TAS if known.)

15 1 The rotating compass card of the RMI is actuated by the aircraft's master compass system. The compass card rotates as the aircraft turns so that the magnetic heading of the aircraft is under the index at the top of the instrument. The needles give the magnetic bearing (120°) from the aircraft to the omnirange station to which the receiver is tuned. Therefore, the station to aircraft bearing is the reciprocal of 120° or 300°, which can be read from the tail end of the RMI needle. Some RMI instruments incorporate two needles which can be used in conjunction with a radio compass or dual omnireceiver installation.

Item	answer	
16	3	See *Civil Aeronautics Board, Safety Investigation Regulations, Part 320.* All flight instructors should be familiar with rules pertaining to aircraft accidents, in-flight hazards, overdue aircraft, and safety investigation.
17	2	Refer to the legend of the Cincinnati Departure Chart, figure 46, to find a listing of the preferred routes. The Enroute Low Altitude Chart and legend, figures 39 and 43 in the appendix, explain the meaning of all symbols and other information necessary for reading the charts.
18	1	The type of flight plan is not required in IFR position reports made direct to ARTC centers or approach control. Reference: see Part 1 of the *Airman's Information Manual.*
19	3	For anyone who finds it difficult to visualize the omni indications in this problem, we suggest that you approach it in the following manner: At each position assume that you turn the aircraft parallel to the course you have selected (270°). In the first position the CDI needle is deflected to the left with a "TO" indication; in the second position the CDI needle is centered with a "TO" indication; in the third position the CDI needle is deflected to the right with a "TO" indication; and in the fourth position the CDI needle is deflected to the right with a neutral indication in the "TO-FROM" window, since you are on a line that passes through the station and this line is perpendicular to the course you have selected.
20	4	The ILS course width is 2.5° on each side of the centerline or 5° in width. The VOR course from full scale left to full scale right deflection is 20° in width or 10° on each side of the selected radial. Reference: *Airman's Information Manual*, Part 1.

Recommended Study Materials

The applicant for the Instrument Flight Instructor Written Examination will find the following list of publications useful in his preparation for the examination. In addition, there are many other excellent commercially prepared textbooks, audiovisual training aids, and other instruction materials which may be helpful in preparing for the examination.

1. *Flight Instructor's Handbook*, AC 61-16 ($.60). This handbook was prepared by the Federal Aviation Agency for the information and guidance of pilots preparing to apply for flight instructor certificates, and for use as a reference by certificated flight instructors. It has been prepared for use in conjunction with the *Flight Training Handbook*, AC 61-21.

2. *Air Traffic Control Procedures*, AT P 7110.1B ($4.00 for basic manual with supplements as issued). An FAA publication prescribing procedures and standard phraseology to be used by personnel of all facilities providing air traffic control service. Although written for the air traffic controller, the text is excellent for the study of standard communications procedures by others who need to be familiar with them.

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

The new format, effective with the May 26, 1966 issue, makes each Part available on a separate annual subscription to better serve the needs of the individual pilot.

Part 1. *Basic Flight Manual and ATC Procedures.* May 26, 1966. ($2.00 domestic; $2.50 foreign—GPO): combines the former Sections I and II and will be issued quarterly.

Part 2. *Airport Directory.* May 26, 1966. ($2.00 domestic; $2.50 foreign—GPO): This is a revised version of former Section IV expanded to include the physical description of those airports formerly shown only in Section IV–A. Will be issued semiannually.

Part 3. *Operational Data and Notices to Airmen.* May 26, 1966. ($9.00 domestic; $11.25 foreign—GPO): presents former Sections III, III–A and IV–A every 28 days, supplemented by Section III–A *(Notices to Airmen)* every 14 days midway of the 28-day cycle.

4. *Aviation Weather*, AC 00–6 ($2.25). This new publication replaces the *Pilot's Weather Handbook*, CAA Technical Manual No. 104. It contains weather phenomena for pilots and other flight operations personnel whose interest in meteorology is primarily in its application to flying.

5. *Civil Aeronautics Board*, *Safety Investigation Regulations*, *Part 320* ($.05).

6. *Federal Aviation Regulations:*

Part 1,	Definitions and Abbreviations	$0.25
Part 23,	Airworthiness Standards: Normal, Utility, and Acrobatic Category Airplanes	.65
Part 61,	Certification: Pilots and Flight Instructors	.50
Part 71,	Designation of Federal Airways, Controlled Airspace, and Reporting Points	.20
Part 91,	General Operating and Flight Rules	.50
Part 95,	IFR Altitudes	.20
Part 97,	Standard Instrument Approach Procedures	.20

7. Charts for instrument navigation:

(a) *Enroute Low Altitude Charts and Enroute High Altitude Charts* ($.25 each). These charts provide the necessary information for enroute instrument navigation (IFR) at established altitude levels.

(b) *Instrument Approach Procedure Charts* (available for range, ADF, VOR, and

ILS approach). ($.10 per airport.) These charts portray the aeronautical data which is required to execute instrument approaches to airports.

(c) *Low Altitude Area Charts* ($.10 each). These charts supplement the Instrument Enroute Charts by giving departure, arrival, and holding procedures at principal airports.

(d) *Local Aeronautical Charts* ($.30 each). The large-scale local charts provide a detailed depiction of highly congested metropolitan areas.

(e) *World Aeronautical Charts* ($.25 each). They provide a standard series of aeronautical charts, covering land areas of the world, at a scale convenient for navigation by moderate speed aircraft.

8. *Instrument Pilot Examination Guide*, AC 61-8 ($.40). This publication was prepared by the Federal Aviation Agency to assist applicants who are preparing for the Instrument Pilot Written Examination.

9. *Flight Test Guide—Instrument Pilot Airplane*, AC 61-17 ($.10). This is a Federal Aviation Agency publication designed to assist the instrument pilot applicant in preparing for the Instrument Rating Flight Test. The instrument flight instructor should find this guide helpful in preparing his students for the Instrument Rating Flight Test.

10. *Flight Training Handbook*, AC 61-21 ($.70). This is a Federal Aviation Agency publication that contains some information which is applicable to instrument flying; for example, Chapter I covers the subject of load factors, Chapter II contains material concerning weight and balance and spatial disorientation—vertigo, and Chapter V contains an instrument indoctrination course for private and student pilots.

NOTE.—References listed were available at the time this publication went to press.

How to Obtain Study Materials

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

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

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

U.S. Coast and Geodetic Survey
Environmental Science Services Administration
U.S. Department of Commerce
Washington, D.C. 20235

NOTE.—Domestic prices are given; for foreign delivery add 25 percent.

APPENDIX I

This section contains supplementary data for use with the sample examination.

The Exam-O-Grams presented in this Appendix are of value to the student preparing for the Instrument Flight Instructor Written Examination. These particular study aids have been selected because the information they contain is especially pertinent to this examination.

It should be noted that Exam-O-Grams are nondirective in nature, and are issued solely as an information service to individuals interested in airman written examinations.

Explanation of Attitude Instrument Flying

Attitude instrument flying means controlling the attitude of an aircraft through reference to flight instruments.

Attitude instrument flying is like visual flying in that both use reference points to determine the attitude of the aircraft. While flying by visual reference to the earth's surface, the pilot determines the attitude of the aircraft by observing the relation between the nose and wings of the aircraft and the natural horizon. While flying by reference to flight instruments, he determines the attitude of the aircraft by observing indications on the instruments which give him essentially the same information that he gets by visual reference to the earth's surface.

Another similarity between attitude instrument flying and visual flying is the way in which the aircraft is controlled. Exactly the same control techniques are used while flying by reference to instruments as are used in visual flying.

VFR Exam-O-Gram No. 9
Altimetry

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

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

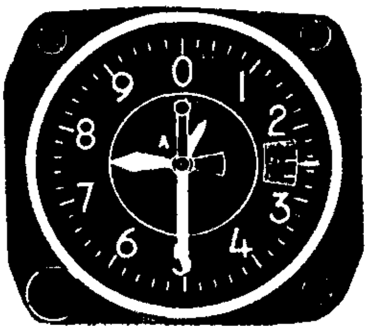
2. FAR requires that you maintain your cruising altitudes (VFR as well as IFR) by reference to your altimeter. What do regulations require concerning the setting (or adjustment) of your altimeter?

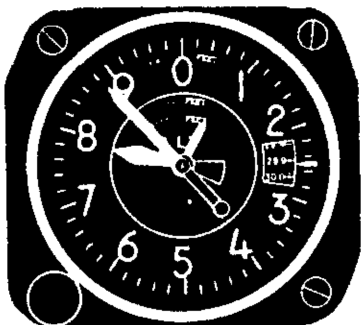
3. If you are flying in very cold air (colder than standard temperatures), you should expect your altimeter to read—

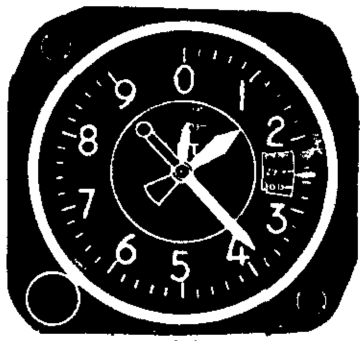
a. *higher* than your actual altitude above sea level.

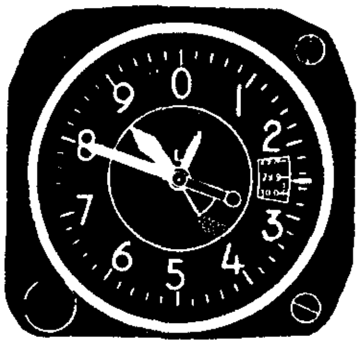
b. *lower* than your actual altitude above sea level.

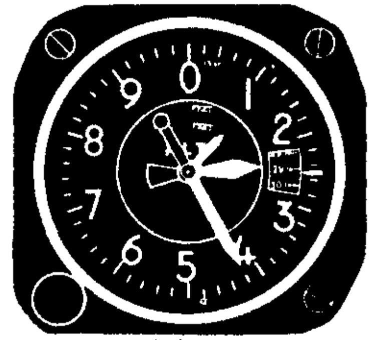
c. *the same* as your actual altimeter above sea level.

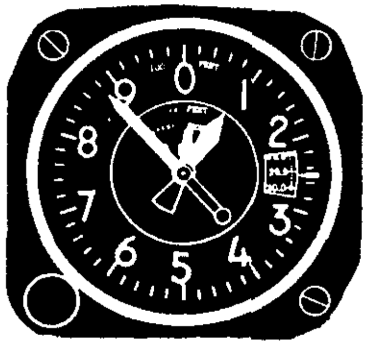

(1)


(2)


(3)


(4)


(5)


(6)

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

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

Answers to Questions on Altimetry

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

If your altimeter is the three-pointer type sensitive altimeter such as those pictured on page 21, an orderly approach to reading your altitude is to first glance at the smallest hand (10,000-ft. hand); next read the middle hand (1,000-ft. hand); and last, read the large hand (100-ft. hand). For the two-pointer altimeter, simply read the small hand first and the large hand next.

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

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

4. (1) *Indicated altitude*—That altitude read directly from the altimeter (uncorrected).

(2) *Pressure altitude*—The altitude read from the altimeter when the altimeter setting window is adjusted to 29.92. (This altitude is used for computer solutions for density altitude, true altitude, true airspeed, etc.)

(3) *Density altitude*—This altitude is pressure altitude corrected for nonstandard temperature variations. (It is an important altitude as *this altitude is directly related to the aircraft's takeoff and climb performance.)*

(4) *True altitude*—The true height of the aircraft above sea level—the actual altitude. (Often you will see a true altitude expressed in this manner: "10,900 ft. MSL"—the MSL standing for MEAN SEA LEVEL. Remember that airport, terrain, and obstacle elevations found on charts and maps are *true altitudes.*)

5. NO, you are not assured of 500 feet vertical clearance with these mountains. As a matter of fact, with certain atmospheric conditions, you might very well be 500 feet *BELOW* the peaks with this indicated altitude. (To begin with, 500 feet is hardly an adequate separation margin to allow on flights over mountainous terrain—1,500 to 2,000 feet is recommended in order to allow for possible altitude errors and downdrafts.) A majority of pilots confidently expect that the current altimeter setting will compensate for irregularities in atmospheric pressure. Unfortunately, this in not always true. Remember that the altimeter setting broadcast by ground stations is the *station pressure corrected to Mean Sea Level.* It does not reflect distortion at higher levels, *particularly the effect of nonstandard temperatures.*

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

KNOW YOUR ALTIMETER

VFR Exam-O-Gram No. 11
Density Altitude and Its Effect on Aircraft Performance

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

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

1. WHAT IS DENSITY ALTITUDE? It is a measure of air density. Under nonstandard conditions, density altitude will differ from the elevation. As the air density decreases (i.e., air becomes thinner), density altitude increases, and vice versa. *Low atmospheric pressure*, *high temperature*, and *high humidity* all result in a decrease in air density and an *increase in density altitude.* (Contrary to prevailing opinion, *moist air is less dense than dry air.* Water vapor actually weighs less than dry air—approximately ⅝ as much.)

2. WHAT EFFECT DOES AN INCREASE IN DENSITY ALTITUDE HAVE ON AIRCRAFT TAKEOFF PERFORMANCE?

A. Engine horsepower decreases (unless it is a supercharged engine).

B. The propeller loses some of its efficiency as it will not take as much of a bite out of the thinner air.

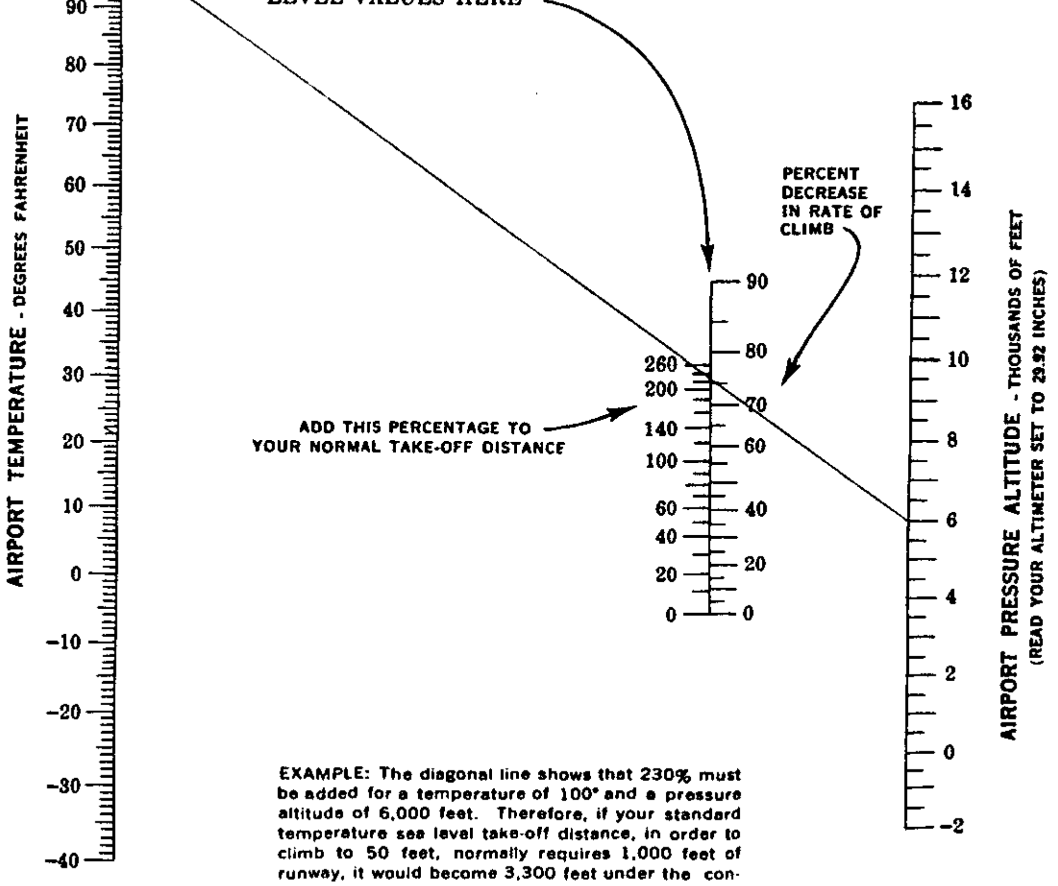
C. Takeoff distance is increased and rate of climb is decreased because of the loss of engine power and propeller efficiency, and the higher true airspeed necessary to obtain the required lift in the thinner air. (In other words, if the density altitude is 8,000 feet at an elevation of 5,000 feet, the aircraft flies as though it were at 8,000 feet.)

3. UNDER WHAT CONDITIONS IS A HIGH "DENSITY ALTITUDE" MOST HAZARDOUS? When it is present with other factors that tend to increase the takeoff distance or require that this distance be limited such as: heavy load; calm wind conditions; short runway; obstructions at or near the end of the runway; and unfavorable runway con-

THE KOCH CHART FOR ALTITUDE AND TEMPERATURE EFFECTS

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

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



EXAMPLE: The diagonal line shows that 230% must be added for a temperature of 100° and a pressure altitude of 6,000 feet. Therefore, if your standard temperature sea level take-off distance, in order to climb to 50 feet, normally requires 1,000 feet of runway, it would become 3,300 feet under the conditions shown. In addition, the rate of climb would be decreased 76%. Also, if your normal sea level rate of climb is 500 feet per minute, it would become 120 feet per minute.

This chart indicates typical representative values for "personal" airplanes. For exact values consult your airplane flight manual.

The chart may be conservative for airplanes with supercharged engines.

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

ditions (rough, tall grass, soft, snow, upgrade, etc.)

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

5. If an airplane requires a distance of 1,200 feet for takeoff at sea level (to clear a 50-foot obstacle) under standard conditions, what distance is required at (a) an elevation of 5,000 feet, temperature −6° F.; (b) an elevation of 5,000 feet, temperature 104° F.? Refer to the Koch Chart on page 24. (*Assume* that pressure altitude and elevation are equal.)

Problem A

The line joining 5,000 feet and −6° F. shows an increase in takeoff distance 20 percent.
Increase in
T.O. distance=.20 x 1,200′=240′
Total T.O. distance=1,200′+240′=1,440′

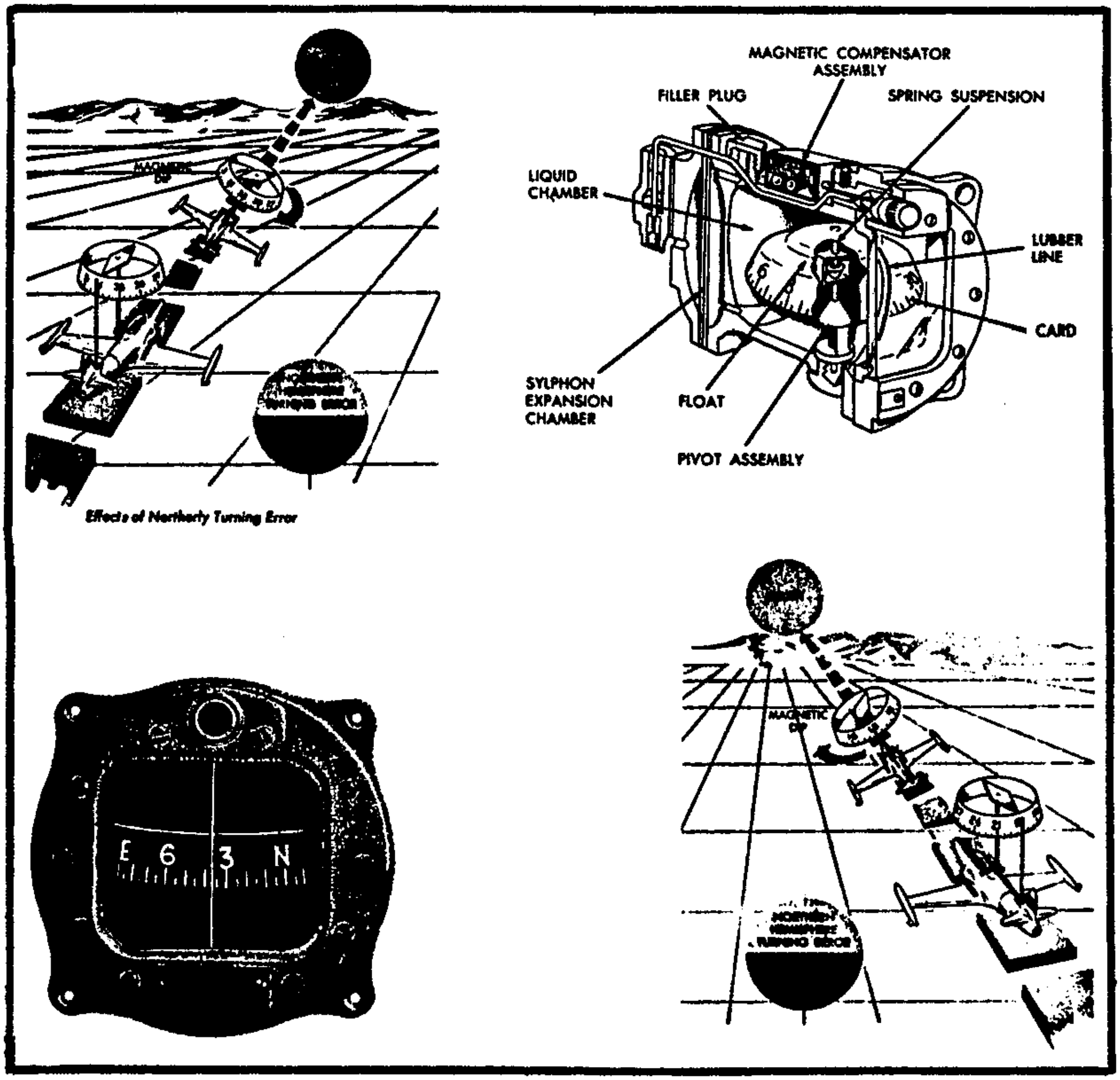
Problem B

The line joining 5,000 feet and 104° F. shows an increase in takeoff distance of 190 percent.
Increase in
T.O. distance=1.9 x 1,200′=2,280′
Total T.O. distance=1,200′+2,280′=3,480′
(Difference in takeoff distance
=3,480′−1,440′=2,040′

Under the above conditions presented in item 5, Problems A and B, it can be seen that the takeoff distance on the hot summer day increased more than 2,000 feet over that required on the cold winter day at the same airport.

BEWARE OF HIGH, HOT, AND HUMID CONDITIONS

VFR Exam-O-Gram No. 12
The Magnetic Compass



Effects of Northerly Turning Error

The Magnetic Compass

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

WHAT ARE SOME OF THE COMPASS ERRORS THAT THE PILOT SHOULD UNDERSTAND? The pilot should understand:

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

II. DEVIATION—This is the deflection of the compass needle from a position of magnetic north as a result of local magnetic disturbances in the aircraft. To reduce this deviation, the compass has a compensating device consisting of small adjustable magnets. The compass should be checked and compensated periodically. The errors remaining after "swinging" the compass should be recorded on a compass correction card which should be installed in the cockpit within the view of the pilot.

NOTE.—Avoid placing metallic objects such as metal computers, flashlights, etc. on top of the instrument panel near the magnetic compass as this practice may induce large amounts of deviation and seriously affect the instrument's accuracy.

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

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

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

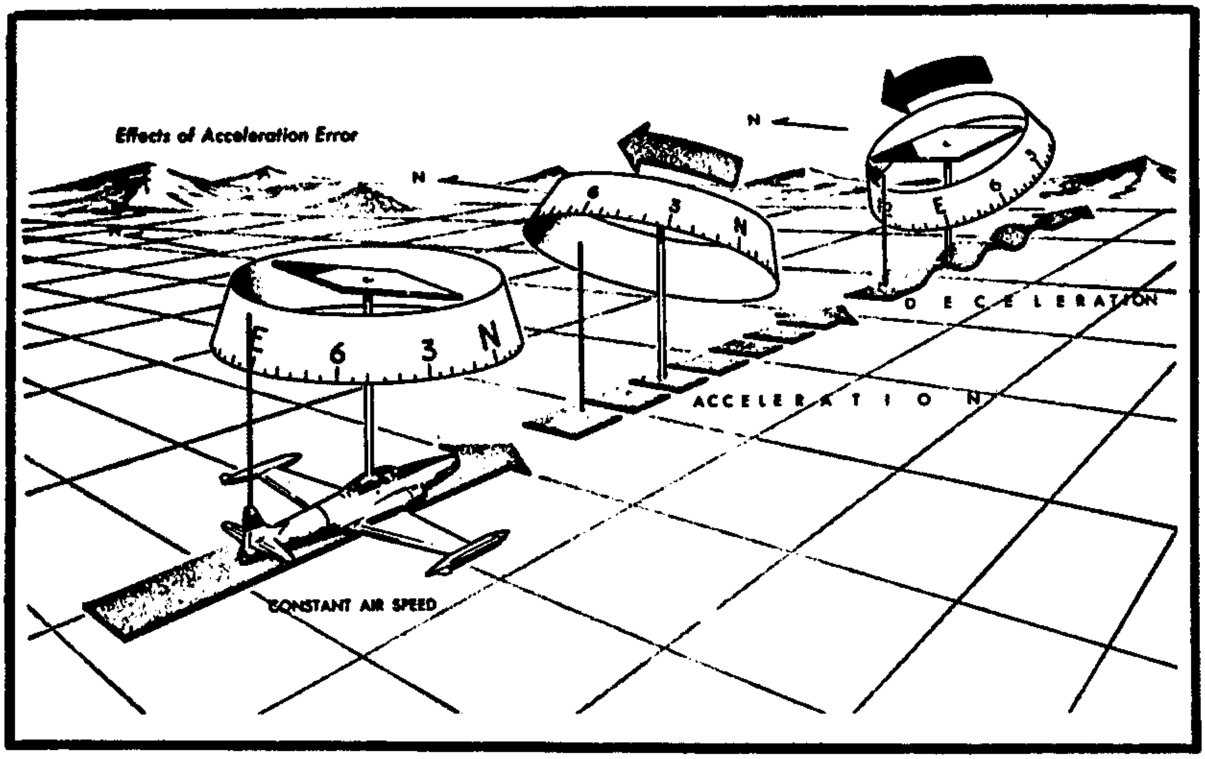
A. Northerly Turn Error—*This error is the most pronounced of the in-flight errors.* It is most apparent when turning to or from headings of north and south.

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

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

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

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



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

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

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

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

Turns to Headings by Reference to the Magnetic Compass

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

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

1. *When turning to a heading of north you must allow, in addition to your normal lead, a number of degrees approximately equal to the latitude at which you are flying.* Example: You are making a left turn to a heading of north in a locality where the latitude is 30° N. You have previously determined your normal lead to be approximately 5° for this particular angle of bank. In this case, you should start your rollout when the compass reads approximately 35°.

2. *When turning to a heading of south, you must turn past your normal lead point by a number of degrees approximately equal to the latitude at which you are flying.* Example: You are making a right turn to a heading of south in a locality where the latitude is 30° N. You have previously determined your normal lead to be approximately 5° for this particular angle of bank. In this case, you should turn past your normal lead point of 175° (180°–5°) by 30°, and start your rollout when the compass reads approximately 205°.

3. *The error is negligible when turning to east or west; therefore, use the normal amount of lead when turning to an east or west heading.*

4. *For intermediate headings that lie between the cardinal headings, use an approximation based on the heading's proximity to north or south, the direction of the turn, and your knowledge of the compass's lead and lag characteristics in these areas.* In other words, use an "educated guesstimate."

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

KNOW YOUR MAGNETIC COMPASS

Instrument Pilot Exam-O-Gram No. 1

Reports from controllers and operations inspectors indicate the need for more thorough understanding of approach and landing procedures by applicants for the Instrument Pilot Rating. Where radar is available, the pilot can become especially negligent about his own responsibilities. How would you cope with the following situation?

You are flying a light twin on an IFR flight plan to Lambert-St. Louis Airport, Missouri. Your radio equipment includes two VHF transceivers (108–126.9), two VOR receivers (no glide slope needle), an ADF receiver, and a marker beacon receiver. Prior to arrival at your clearance limit (STL VORTAC), you receive the St. Louis weather and clearance for an ILS approach to runway 24 at Lambert-St. Louis Airport. Weather at Lambert is 500–1, wind 220°/10 knots. Approach control vectors you from the VORTAC to the localizer course for a straight-in approach to runway 24 (see Approach and Landing Charts on page 31). Approaching the Outer Compass Locator inbound, you are advised that the Lambert weather is now 400–1, wind 140°/20 knots, and the active runway is being changed to 12. Approach Control requests your intentions.

1. UNDER THE WEATHER CONDITIONS FIRST REPORTED, WERE YOU EQUIPPED FOR AN ILS APPROACH TO RUNWAY 24? Yes. With either VOR receiver you can utilize the localizer course.

2. WHAT ARE YOUR MINIMUMS FOR AN ILS APPROACH TO RUNWAY 24? Straight in minimums (200–½) and RVR minimums (2600 feet) do not apply to you since you are not equipped with a glide-slope receiver (see notes under MINIMA). Your minimums are 400–1 for a straight-in approach.

3. SHOULD YOU REQUEST CLEARANCE TO LAND ON RUNWAY 24? You may, though the controller will add "at pilot's discretion" to the landing clearance if he considers landing on 24 inadvisable under existing wind conditions.

4. SHOULD YOU REQUEST A CIRCLING APPROACH TO RUNWAY 12? No, the ceiling is 100 feet below circling minimums (500–1).

5. IS THE CEILING AND VISIBILITY AT OR ABOVE THE MINIMUMS FOR LANDING RUNWAY 12? Yes, with two VOR receivers, your straight-in minimums are 400–1 (see note under MINIMA). Approach control will expect to vector you from your present position onto the final approach course for runway 12.

6. DOES THE ACCEPTANCE OF A RADAR VECTOR AFFECT THE PRESCRIBED MINIMUMS? No. It is the pilot's responsibility to determine whether approach and landing are authorized under existing weather conditions. You are informed of local weather conditions whenever the ceiling and visibility are at or below the highest circling minimums for the airport. If you violate the authorized minimums, the responsibility is your own.

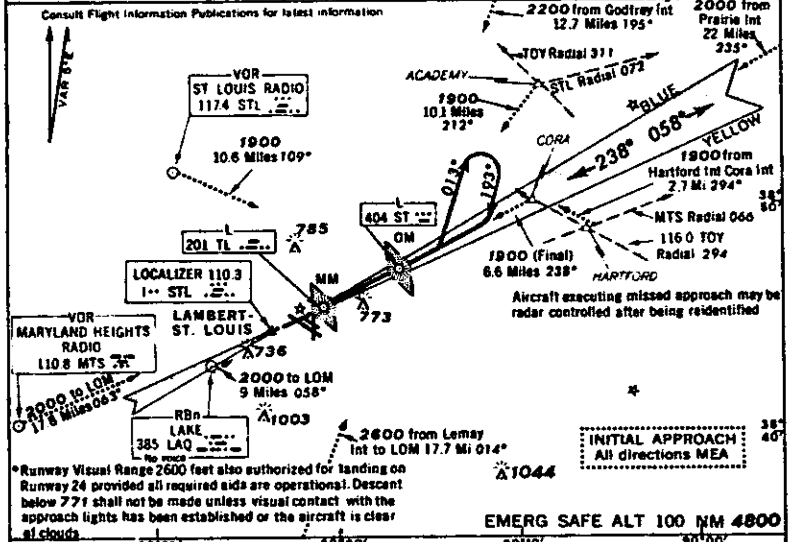
INST APCH PRC (FAA)

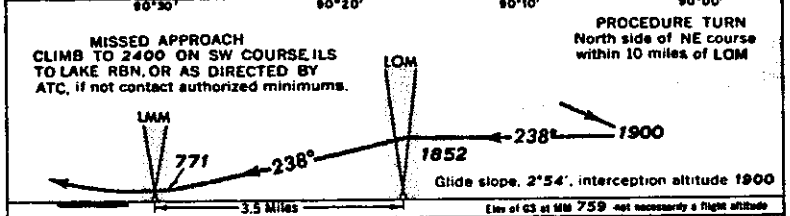
U.S. DEPARTMENT OF COMMERCE
COAST AND GEODETIC SURVEY

LAMBERT-ST. LOUIS AIRPORT
ST. LOUIS, MO.

ST LOUIS APPROACH CONTROL	LOCALIZER 110.3	ST LOUIS TOWER	RADAR AVAILABLE
059°-238° Sector 126.5 381.6 239°-058° Sector 118.1 360.6 117.4 123.7 126.2 338.2	I-- STL GLIDE SLOPE 335.0	118.5 126.2 257.7 GROUND CONTROL 121.9 348.6	

Consult Flight Information Publications for latest information





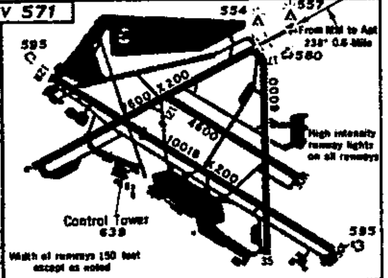
MINIMA — FIELD ELEV 571

	65 knots or less 2 eng or less		Over 65 knots 2 eng or less		Over 65 knots Over 2 eng	
	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT
T**	300-1	300-1	300-1	300-1	200-½	200-½
C	500-1	500-1	500-1	500-1	500-1½	500-1½
S 24*†	200-½	200-½	200-½	200-½	200-½	200-½
A	600-2	600-2	600-2	600-2	600-2	600-2

* See RVR note above for straight-in to Runway 24.
** Runway Visual Range 2600 feet also authorized for take-off on Runway 24 in lieu of 200-½ when 200-½ authorized, providing high intensity runway lights are operational.
†400-1 required with glide slope inoperative.

RATE OF DESCENT ON GLIDE SLOPE

KNOTS	90	100	110	130	150
FEET/MIN	460	515	565	665	770



AL-360-ILS-RWY 24 38°45'N - 90°22'W ST. LOUIS, MO. LAMBERT-ST. LOUIS AIRPORT

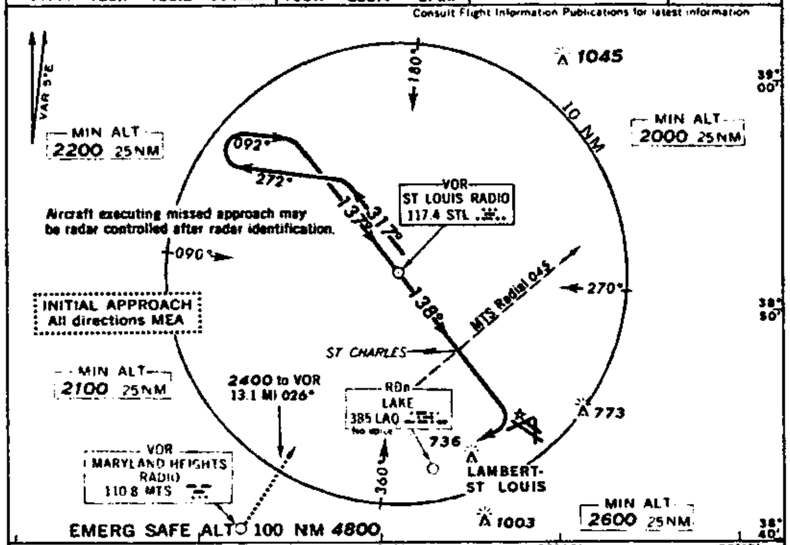
INST APCH PRO (FAA)

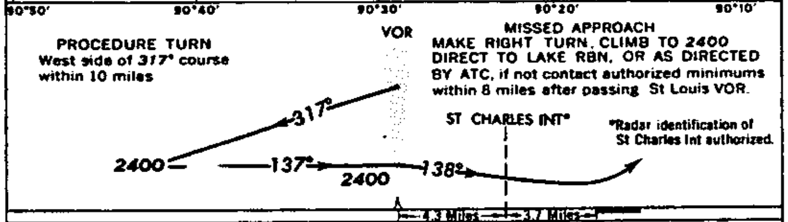
U.S. DEPARTMENT OF COMMERCE
COAST AND GEODETIC SURVEY

LAMBERT-ST. LOUIS AIRPORT
ST. LOUIS, MO.

ST. LOUIS APPROACH CONTROL	ST LOUIS RADIO	ST LOUIS TOWER	RADAR AVAILABLE
059°-238° Sector 126.5 381.6 239°-058° Sector 118.1 360.6 117.4 123.7 126.2 338.2	117.4 STL 122.2 126.7 135.9 255.4 272.7	118.5 126.2 257.7 GROUND CONTROL 121.9 348.6	

Consult Flight Information Publications for latest information





MINIMA — FIELD ELEV 571

	65 knots or less 2 eng or less		Over 65 knots 2 eng or less		Over 65 knots Over 2 eng	
	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT
T	300-1	300-1	300-1	300-1	200-½	200-½
C	500-1	500-2	500-1½	500-2	500-1½	500-2
S 12R	500-1	500-2	500-1	500-2	500-1	500-2
A	800-2	800-2	800-2	800-2	800-2	800-2

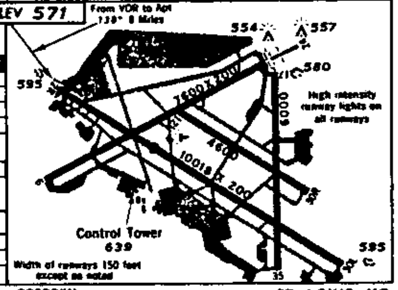
If aircraft dual omni equipped and St Charles Int identified, the following minimums apply:

S 12R	400-1	400-1	400-1	400-1	400-1	400-1

FACILITY TO AERODROME: 138° 8 NM

TIME FROM FACILITY TO MISSED APPROACH

KNOTS	90	100	110	130	150
MIN. SEC	5:20	4:48	4:22	3:42	3:12



AL-360-VOR-1 38°45'N - 90°22'W ST. LOUIS, MO. LAMBERT-ST. LOUIS AIRPORT

Instrument Pilot Exam-O-Gram No. 4
"ATC Clears . . ."

Unexpected clearances—and unpredictable reactions to them—are a familiar problem to the pilot preparing for his instrument rating. Take the following situation for example:

During your FAA flight check, you are taxiing out to the runup area at a busy airport. Everything is in order—oral examination is satisfactory, IFR flight plan filed, route familiar, ground operations completed except for instrument cockpit check, runup, and copying the clearance. As you check your flight instruments, Ground Control (obviously busy and hurried) calls you:

"FLYBIRD 22 CHARLIE,
ATC CLEARANCE."

Don't panic—this presents no problem. You are in no position to copy a clearance while you are busy taxiing, performing instrument checks, and watching for other traffic. Simply advise the controller that you are unable to copy and will request clearance at the runup area.

However simple this situation, instructors can recall a variety of other student reactions to an unexpected call from the controller, including loss of aircraft control, violent application of brakes, and other evidences of confusion in the cockpit. The phrase "ATC CLEARANCE" commonly arouses a sense of urgency in the pilot. The student prone to "checkitis," or the inexperienced pilot, is likely to react with confusion, attempting to copy with his hands already full, or trying to memorise the clearance and request a readback of portions missed. The obvious point is worth stressing, especially to the inexperienced pilot whose division of attention while under pressure may not be adequate to cope with the unexpected.

DON'T SAY YOU ARE READY TO COPY UNTIL YOU ARE READY!

Unfortunately the controller has no way of distinguishing between you and the pilot who knows the local area as well as he knows his backyard. He assumes that you are a competent rated pilot, that you have learned—and are proficient in using—clearance shorthand, and that you are familiar with appropriate route data. Until you reach the level of competence necessary for flying under Instrument Flight Rules in areas of high volume traffic, you should stay away from exceptionally busy terminals. If you are flying without a copilot, you might keep some additional points in mind in connection with IFR clearances before takeoff. "Ready to copy" should mean at least the following:

1. The aircraft is under control, preferably stopped, parking brake set.

2. You are ready with writing materials, not scrambling around a disorganized cockpit looking for misplaced pencils, paper, etc.

3. Your radio(s) are tuned properly, volume at a readable level.

4. Appropriate route data is handy. Your requested route may not be the one specified in your clearance. It the routing is different, don't read back until you have checked it. In accepting the clearance, you also assume responsibility for compliance. Better to take time to be thorough on the ground than to face confusion after takeoff.

5. If you have requested a SID (Standard Instrument Departure), you have indicated to ATC that you are familiar with the SID procedure and have a copy in the cockpit.

Listed below are six actual clearances for IFR departure from the OKLAHOMA CITY area. Some are more complicated than usual, but are representative of clearances you may have to copy and execute. A Departure Chart, on page 34 shows the area and airway structure. Have someone read the clearance to you as an aid in *developing your shorthand proficiency.* The FAA *Instrument Pilot Examination Guide* contains a clearance shorthand which you may want to use if you do not already have a different system.

Wiley Post Airport—Wichita Municipal Airport . . . OKC V77 ICT — Departure runway 17.

(The following two clearances do not make use of radar which would normally be provided.)

ATC clears Flybird two two Charlie to the Wichita Airport via direct Tulakes Radio Beacon—the north course of the Oklahoma City Localizer—Victor seventy seven. Turn left after departure—climb to intercept Victor seventy seven at five thousand or above—maintain seven thousand—report Tulakes and intercepting Victor seventy seven.

ATC clears Flybird two two Charlie to the Wichita Airport via direct Oklahoma City VORTAC Victor seventy seven. Turn right after departure—maintain two thousand five hundred to the VORTAC—hold west of the Oklahoma City VORTAC on the two five seven radial. Climb in the holding pattern to five thousand before proceeding on course—maintain seven thousand. Report reaching the Oklahoma City VORTAC and leaving five thousand. Departure control frequency will be one two one point one.

Will Rogers Airport—Amarillo Airport . . . OKC V272 V140 AMA—Departure runway 17.

(The following two clearances do not make use of radar, which would normally be provided.)

ATC clears Flybird two two Charlie to the Amarillo Airport via direct Oklahoma City VORTAC—Victor two seventy two—Victor one forty. Climb on departure heading to four thousand—turn right—cross the Oklahoma City VORTAC at seven thousand or above—cross Union Intersection at one zero thousand or above—maintain one two thousand. Report leaving four thousand—seven thousand and one zero thousand. Departure control frequency will be one two one point one.

ATC clears Flybird two two Charlie to the Amarillo Airport via direct Oklahoma City VORTAC—flight plan route. Turn right after departure—maintain five thousand or below to Oklahoma City VORTAC—hold west of the Oklahoma City VORTAC on the two five seven radial—climb in the holding pattern to one zero thousand before proceeding on course. Report leaving five thousand—reaching one zero thousand—and passing Union Intersection. Departure control frequency will be one two one point one.

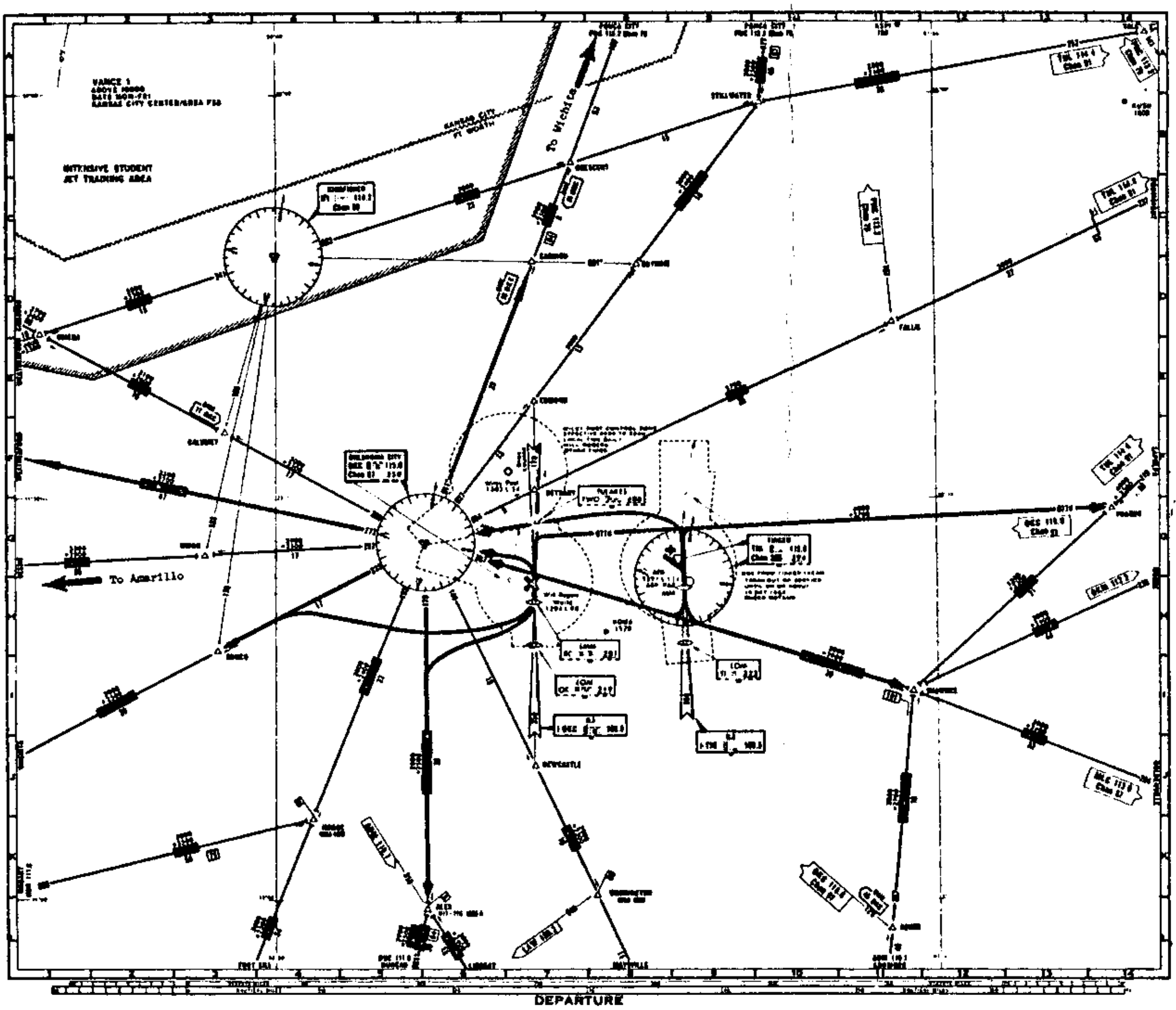
Will Rogers Airport—Tulsa Municipal Airport . . . OKC V14 TUL—Departure runway 17.

(The following two clearances make use of radar vectoring service.)

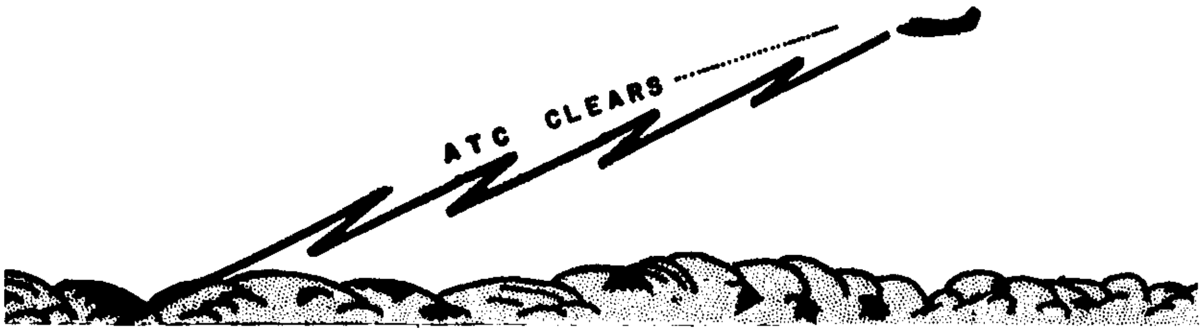
ATC clears Flybird two two Charlie to the Tulsa Airport via Victor fourteen—maintain three thousand. Turn right after departure—heading three four zero for Vector to Victor fourteen northeast of the Oklahoma City VORTAC—expect seven thousand after passing the north course of the Oklahoma City Localizer. Departure control frequency will be one two one point one.

ATC clears Flybird two two Charlie to the Prague Intersection via the zero seven seven radial of the Oklahoma City VORTAC—maintain three thousand. Turn left after departure—heading zero three zero for Vector to the zero seven seven radial. Departure control frequency will be one two one point one.

NOTE.—Departure clearances are normally to the destination airport, but may be to a fix only a few miles from the point of departure. The latter, or "short range,' clearance is often used to expedite departure while the flight is coordinated further by ATC. On short flights, the clearance may be to an approach fix serving the destination airport.


To Wichita
To Amarillo
DEPARTURE

Instrument Pilot Exam-O-Gram No. 6
VFR Operations on an Instrument Flight Plan



Analyses of answers to Instrument Pilot Written Examinations indicate that many applicants do not understand certain aspects of VFR and "VFR CONDITIONS ON TOP" operations while on IFR clearances. Applicants for the instrument rating should be able to answer the following questions relating to these operations. Answers and explanations follow.

1. Why request a "VFR CONDITIONS ON TOP" clearance?

2. When would a pilot request a clearance *to* "VFR CONDITIONS ON TOP?

3. What restrictions apply to the pilot's choice of altitude while operating on an IFR clearance with provision to "MAINTAIN VFR CONDITIONS ON TOP"?

4. When can a "VFR CONDITIONS ON TOP" request be approved by ATC?

5. What separation from other aircraft is provided to a "VFR CONDITIONS ON TOP" flight?

6. What is the recommended position reporting procedure for "VFR CONDITIONS ON TOP" operation?

7. A pilot is flying on an IFR clearance with an altitude assignment of "VFR CONDITIONS ON TOP." He anticipates that he will be unable to maintain flight in VFR conditions because of reduced visibility or increasing height of the tops. What should he do?

8. When may a pilot deviate from his route of flight while operating IFR with a "VFR CONDITIONS ON TOP" clearance?

9. Why would a pilot request a VFR climb or descent while on an IFR flight?

10. What are the procedures for radio communications failure during a "VFR CONDITIONS ON TOP" operation?

Explanations (numbers correspond to questions):

1. In preparation for IFR flight above an overcast, or in an area of generally unlimited ceilings and visibility, pilots may request "VFR CONDITIONS ON TOP" to permit them to select an altitude, or altitudes of their choice, rather than specific ATC assigned altitudes. If during flight "in the clear" at a specific assigned altitude, turbulence or unfavorable groundspeeds are encountered, or if icing in clouds ahead is expected, a "VFR CONDITIONS ON TOP" clearance may allow the pilot a greater choice of operating altitudes.

2. Departing instrument-rated pilots who wish an IFR clearance *only to climb through* a layer of overcast or reduced visibility, and then continue flight VFR, may request ATC clearance "TO VFR CONDITIONS ON TOP." This request may be made through a Flight Service Station, by telephone to ATC,

or by request to the tower before taxiing out. The clearance, which authorized IFR flight through the cloud layer, will contain a nearby clearance limit routing, and a request to report reaching "VFR CONDITIONS ON TOP." When the pilot reaches "VFR CONDITIONS ON TOP" and desires to cancel the IFR portion of his flight, he should so state. This type of operation can be combined with a VFR Flight Plan to destination.

3. The pilot may fly at an altitude of his choice, provided the altitude is—

a. at or above the MEA, or MOCA if appropriate, and

b. at least 1,000 feet above the existing meteorological condition (cloud layer, smog, haze, etc.) if any, and

c. at an altitude appropriate for the direction of flight (odd or even thousand, *plus 500 feet*) if operating at 3,000 feet or more above the surface.

Pilots should be especially alert for head-on traffic when climbing or descending on the airway centerline.

4. "VFR CONDITIONS ON TOP" may be approved by ATC when specifically requested by the pilot *in flight* provided pilot reports have not indicated that conditions are unsuitable. "VFR CONDITIONS ON TOP" may be approved by ATC when specifically requested by the pilot *prior to departure*, provided—

a. pilot reports have not indicated that conditions are unsuitable, and

b. the pilot is advised of the height of the tops, or that height of tops is unreported, and

c. if height of the tops is unreported, alternate altitude provisions are included in the clearance.

Exceptions:

ATC will not approve "VFR CONDITIONS ON TOP" operations—

a. to provide separation between aircraft holding at night, or

b. to aircraft operating in Positive Controlled Airspace.

5. No separation is provided. However, the pilot may expect to receive traffic information on known IFR traffic. Any time a pilot is flying "in the clear," whether at a specific assigned altitude or at an altitude assignment of "VFR CONDITIONS ON TOP," collision avoidance is the pilot's responsibility.

6. Regardless of the altitude being flown, pilots on IFR Flight Plans report those fixes designated as compulsory reporting points for all altitudes, and additional position reports as requested by ATC. A pilot operating on an IFR Flight Plan with an altitude assignment of "VFR CONDITIONS ON TOP" would report in the following manner:

SKYTWIN FOUR ONE ALPHA OVER OKLAHOMA CITY ONE EIGHT, VFR CONDITIONS ON TOP AT EIGHT THOUSAND FIVE HUNDRED, ESTIMATING SAYRE FOUR EIGHT, AMARILLO.

If position reports are made to a Flight Service Station for relay to the controlling facility (center or approach control), pilots should state that the flight is on an Instrument Flight Plan.

7. Pilots flying with a VFR restriction must not enter IFR weather conditions. In such situations, pilots must request a specific altitude assignment and maintain flight in VFR conditions until an appropriate amended clearance is obtained.

8. Remember that when flying on an IFR clearance with a VFR restriction, a pilot must comply with Instrument Flight Rules *plus* applicable Visual Flight Rules. A pilot operating "VFR CONDITIONS ON TOP" is expected to remain on the centerline of airways or routes described by his ATC clearance unless—

a. otherwise authorized by ATC, or

b. maneuvering as necessary to clear the intended flight path, or

c. the pilot exercises emergency authority.

9. If, at the start of an IFR flight, a pilot wishes to climb in VFR conditions, or if, while flying at a specific assigned altitude, he wishes to climb or descend in VFR conditions, he may request to do so (except in Positive Controlled Airspace). Sometimes such a procedure is considered a practical method of avoiding delay due to other traffic.

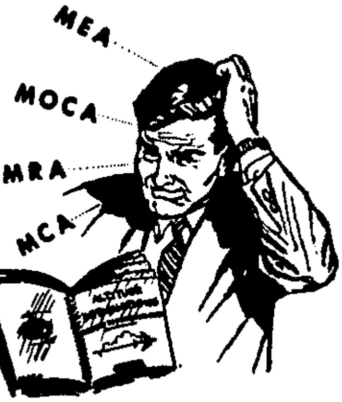
10. The procedures are the same as for operation at a specific assigned altitude. Pilot

action in compliance with regulations is determined by existing weather conditions (VFR or IFR), as outlined in the *Airman's Information Manual.*

References:

Airman's Information Manual, Part 1
"ATC Operations and Procedures"
FAR Part 91

Instrument Pilot Exam-O-Gram No. 8
Minimum IFR Altitudes



Applicants for the Instrument Pilot Written Examination should expect to be examined on the various minimum altitude designations related to instrument flight. Analysis of responses to current written examinations indicates that doubt exists as to the meaning of these designations and why they are specified.

General

Minimum IFR altitudes are established by the Administrator of the FAA for instrument flight along Federal Airways and off-routes in controlled airspace. They are established after consideration of—

1. obstruction clearance criteria
2. navigational signal coverage for accurate navigation, and
3. two-way radio communications.

Obstruction clearance is normally at least 1,000 feet (2,000 feet in designated mountainous areas) above the highest terrain 4 miles either side of the centerline of the airway or route.

For instrument flight along routes NOT in controlled airspace and for which no specific minimum IFR altitude has been established, it is the *pilot's* responsibility to select altitudes which comply with obstruction clearance requirements.

Definitions

1. MEA (Minimum Enroute Altitude) is the minimum altitude in effect between radio fixes, which—

   a. meets obstruction clearance requirements, and

   b. ensures acceptable navigational signal coverage for accurate navigation.

Remember that the MEA is often higher than is required for obstruction clearance only. This is to ensure reception of navigation and communication signals and to provide additional airspace for VFR operations below the airway during periods of less than 3 miles forward visibility. Remember also that the MEA is sometimes different for opposite directions along an airway due to rising or lowering terrain.

2. MOCA (Minimum Obstruction Clearance Altitude) is the specified minimum altitude in effect between radio fixes, which

   a. meets obstruction clearance requirements, and

   b. ensures acceptable navigational signal coverage *only* within 22 nautical miles of the VOR.

A MOCA is shown (on U.S. Coast and Geodetic Survey IFR charts) directly below the MEA and is identified by an asterisk. The designation of a MOCA indicates that a higher MEA has been established for that particular airway or segment because of signal reception requirements. When no MOCA is shown on the chart, the MEA and MOCA are considered to be the same.

Remember that the MOCA may be requested by a pilot, or assigned by ATC for traffic control purposes, for use within 22 nautical miles of the VOR. Beyond this 22 nautical mile area, the MOCA ensures *only* obstruction clearance.

3. MRA (Minimum Reception Altitude) is the lowest altitude at which accurate determination of position at a specified intersection can be made. Reception from the radio facilities used to establish an intersection may be inadequate at the lowest MEA; in such a case an MRA is designated for that intersection.

4. MCA (Minimum Crossing Altitude) is the minimum altitude at which certain radio facilities or intersections must be crossed in specified directions of flight. If a normal climb, commenced immediately after passing a fix beyond which a higher MEA applies, would *not ensure* adequate obstruction clearance, an MCA is specified.

The MCA at certain radio facilities could be lower for a departing aircraft than for an enroute aircraft; such a lower MCA would not be shown on an Enroute Chart but might be received in an IFR clearance.

Try this test:

Correct answers are shown at the end of this test.

1. The MEA ensures acceptable navigational signals for accurate navigation and ______.

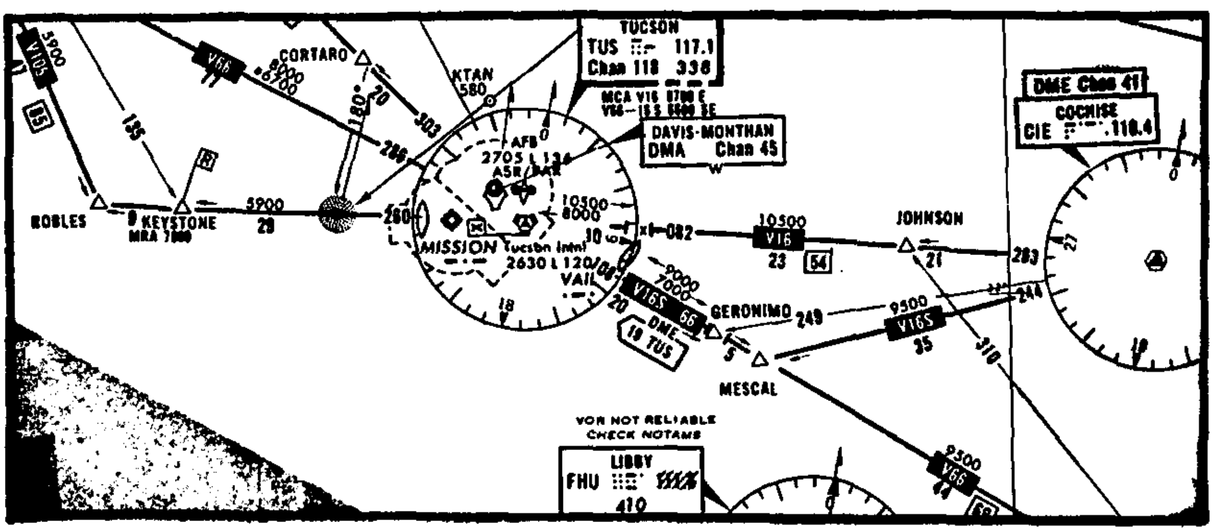
2. If the MOCA does not ensure reliable navigational signal coverage between fixes, a higher altitude is designated as the ______.

3. MRAs are designated at certain intersections where aircraft position cannot be determined accurately at the ______.

4. The lowest altitude for crossing a radio fix beyond which a higher minimum applies (if no minimum crossing altitude is specified) is the ______.

5. Different MEAs for opposite directions of flight along an airway are sometimes specified due to ______.

A PORTION OF CHART L-4 (September 1964) IS REPRODUCED BELOW FOR ANSWERING QUESTIONS 6 THROUGH 10.



6. A flight on V105 (west of TUS VORTAC) may not be able to determine position over KEYSTONE at an altitude below ______.

7. An enroute flight approaching TUS and proceeding east on V16 must cross the TUS VORTAC at or above ______.

8. The MOCA on V66, west northwest of TUS, is ______.

9. A southeast-bound flight on V66 must cross MESCAL at or above ______.

10. A northwest-bound flight on this airway

may cross GERONIMO at a minimum altitude of ______.

11. Acceptable navigational signal coverage at the MOCA is ensured for a distance from the VOR of only ______.

12. For flight outside controlled airspace, the responsibility for determining the minimum IFR altitude rests with the ______.

13. In what areas may ATC assign the MOCA to an IFR flight? ______

14. When or why would ATC assign the MOCA? ______.

15. The minimum IFR altitude for "VFR Conditions on Top" operation, except in an emergency, is the ______.

Answers to questions:

1. Obstruction clearance requirements.
2. MEA.
3. MEA.
4. MEA at which the fix is approached.
5. Rising or lowering terrain.
6. 7,000 feet.
7. 8,700 feet.
8. 6,700 feet.
9. 7,000 feet.
10. 9,500 feet.
11. 22 nautical miles.
12. Pilot.
13. Only within 22 nautical miles of a VOR.
14. For traffic control purposes, or at pilot's request.
15. MEA, or published MOCA within 22 nautical miles of a VOR.

Instrument Pilot Exam-O-Gram No. 10
Altimetry

In spite of the importance of the pressure altimeter, almost 50 percent of the applicants taking Instrument Pilot Written Examinations demonstrate a knowledge deficiency concerning the effect of atmospheric temperature and pressure changes on this instrument. The effects of other altimeter errors (mechanical, elastic, installation) are usually negligible for normal operations and will not be considered here.

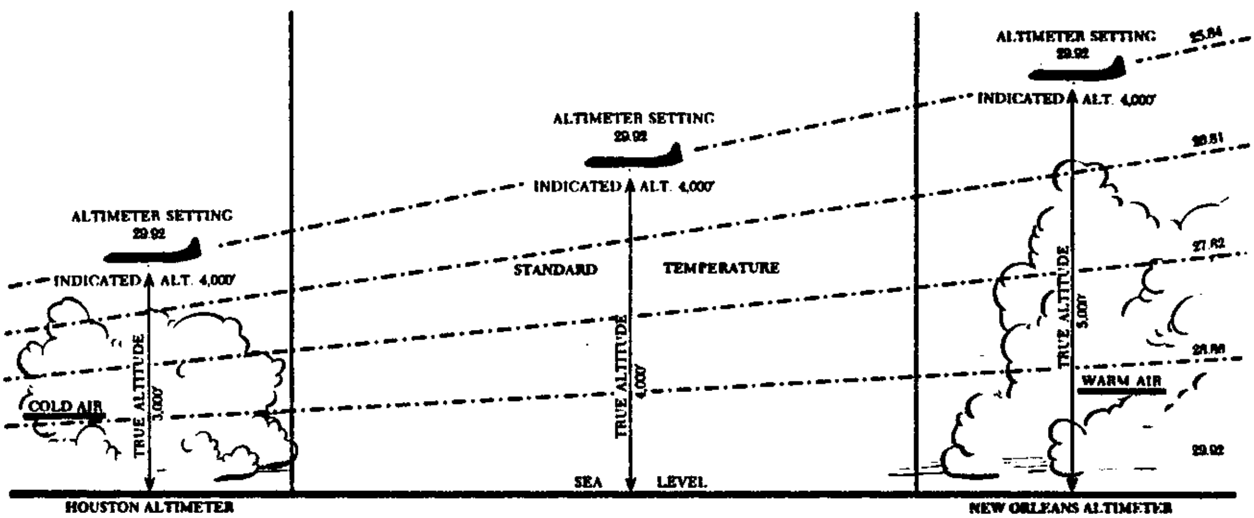
ATMOSPHERIC TEMPERATURE AND PRESSURE ERRORS: The effects of atmospheric temperature and pressure changes on the altimeter are summarized by the adage, "Cold or low, look out below." When flying from warm air to cold air, and/or from high pressure to low pressure, your aircraft is lower than the indicated altitude unless the altimeter is adjusted to compensate for the change.

An altimeter is accurate at all altitudes only when the conditions of a standard atmosphere exist. In general, a standard atmosphere occurs when the

1. sea level barometric pressure is 29.92″ Hg,
2. sea level free air temperature is +15° C., and
3. temperature decreases 2° C. with each 1,000-feet increase in altitude.

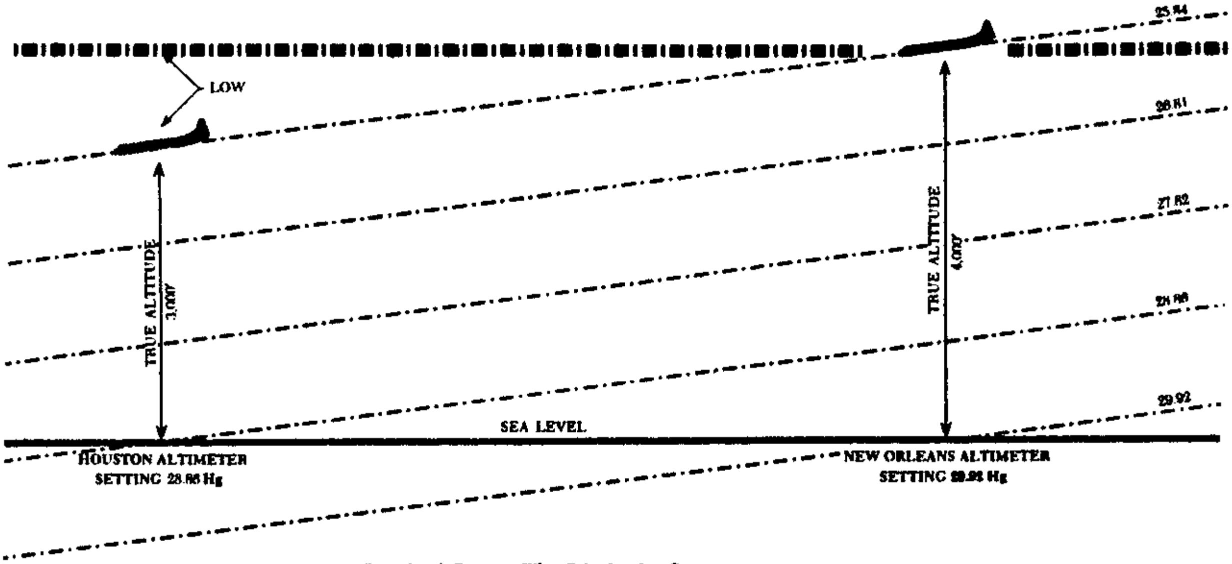
Since the above conditions rarely exist, the altimeter requires correction.

The altimeter is a pressure measuring device and when set at 29.92″ will indicate 4,000 feet at a level where the atmospheric pressure is 25.84″ Hg. The true altitude at which this pressure actually exists may be more or less than 4,000 feet. As shown in the illustration at the bottom of this page, on a warm day the expanded air is lighter in weight per unit volume than on a standard day or a cold day. Therefore, the pressure level where the altimeter will indicate 4,000 feet is *higher* than it would be under standard conditions. On a cold day the reverse would be true and the 4,000-foot pressure level would be *lower*.



True Altitude Decreases When Going Into Cold Air

Changes in surface pressure may also affect the pressure levels at altitude. You can see from the illustration below than an aircraft flying into an area of lower pressure will be *lower* than indicated altitude unless the altimeter is adjusted to the local altimeter setting.



True Altitude Decreases When Going Into Low Pressure

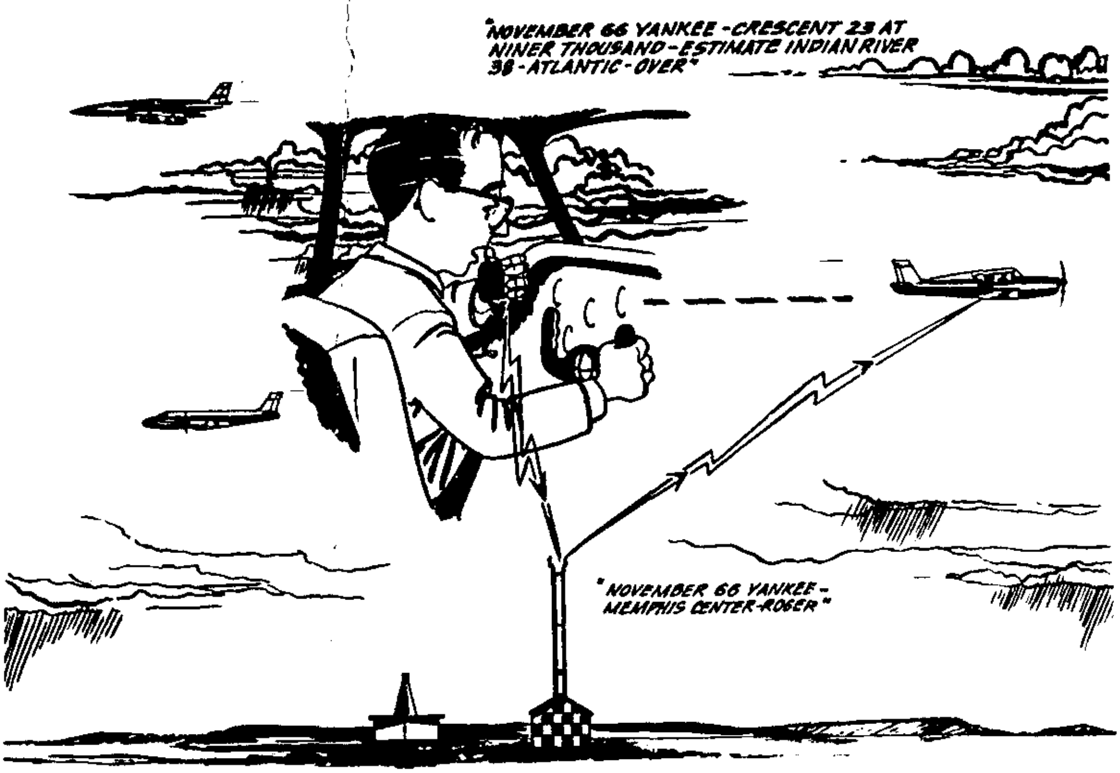
ALTIMETER SETTING: The local altimeter setting "corrects" for the difference between existing pressure and standard atmospheric pressure. Whether local pressure is higher or lower than standard, when the aircraft altimeter is set to the local altimeter setting (assuming no setting scale error) it will indicate true altitude (MSL) at *ground level.* The indicated altitudes *above* ground level are normally *not* true altitudes because of nonstandard lapse rates. The point to remember is that when all aircraft operating below 18,000 feet are using the current local altimeter setting, they have a common reference for indicated altitude. (See ALTIMETRY—*Airman's Information Manual* for additional details.)

Summary

1. For normal operations (except to determine true airspeed, true altitude, engine operations, etc.) pilots should disregard the effect of nonstandard temperatures. However, low temperatures may need to be considered when selecting altitude for terrain clearance purposes.

2. If the local altimeter setting is lower than the setting on the Kollsman dial, the aircraft will be lower than the indicated altitude. A reverse situation is also true.

Instrument Pilot Exam-O-Gram No. 11
Communications Procedures for Pilots on IFR Flight Plans



Many applicants taking the Instrument Pilot Written Examination have difficulty with test items concerning IFR radiotelephone procedures, techniques, and phraseologies. The services of Air Traffic Control (ATC), as well as the ability of a pilot to make maximum use of these services, are dependent upon effective communications. Several pages in the *Airman's Information Manual* specify pilot actions and responsibilities in this area, and these pages should be studied carefully.

The following questions and answers cover many problems involving IFR radiotelephone communications and may help to increase pilot understanding in this important area.

1. What is a Center *Sector* Discrete Frequency and why is it necessary? It is a "semi-private" frequency on which the pilot of an IFR flight has *direct* communications with the controller handling the flight. An Air Route Traffic Control Center (ARTCC) has jurisdiction over a large geographic area, within which 100 or more IFR flights are often operating simultaneously. Direct communications cannot be maintained with these flights on any one frequency, nor can the flights be handled by one controller. Consequently, the ARTCC is divided into sectors; each sector is handled by one controller, or team of controllers, and has its own sector discrete frequency. As an IFR flight progresses from one sector to another, the pilot is requested to change to the appropriate sector discrete frequency.

2. What is a Center *Area* Discrete Frequency? *It is a backup for the center sector* discrete frequencies and is available to each

sector in the ARTCC. It is always monitored by at least one controller who can quickly put an IFR flight in radio contact with the appropriate sector.

3. What communications frequency, or frequencies, should the IFR pilot monitor? Pilots who have sufficient radio equipment for direct pilot/controller communications monitor frequencies as directed by ATC. Departing pilots are instructed when, and on what frequencies, to contact Clearance Delivery, Tower, Departure Control, and appropriate Center Sectors. ATC assumes that pilots will make frequency changes as directed, will "check in" on newly assigned frequencies, and *will monitor the assigned frequency at all times.* In case of inability to establish communication on a newly assigned frequency, pilots are expected to follow a prescribed procedure to reestablish communication. This procedure is outlined in the *Airman's Information Manual.*

Communications between ARTCC controllers and pilots of aircraft with limited radio equipment capability may be conducted on the ARTCC *area* discrete frequency, or by relay through the Flight Service Station (FSS). The extra time consumed during this relay can be a severe handicap to IFR operations in high density areas.

4. How does the IFR pilot receive SIGMETs, AIRMETs, and other specific or general weather information while enroute? The IFR pilot who is monitoring the voice feature of a navigation aid with a "B" radio class designation (M-BVOR, H-BVORTAC, etc.) will hear all special and scheduled weather broadcasts. These broadcasts do not interfere with the pilot's monitoring ATC, because the broadcasts may be interrupted to relay an air traffic clearance.

Pilots in direct communication with the ARTCC should monitor the navigation aid voice feature at sufficient volume level to be aware of special and scheduled broadcasts, and possible interruption of the station identification. *Pilots should not voluntarily interrupt their listening watch on the assigned discrete frequency.* Centers may direct a pilot to contact an FSS for weather information, or may authorize a pilot's request to do so.

5. Should "type of flight plan" be included in position reports made by IFR pilots? Not if the position report is made directly to the controlling ATC facility (center or approach control). For initial contact, state the aircraft identification and the name of the reporting point; when requested to "GO AHEAD," give the report in accordance with suggested phraseology. If the position report is made to an FSS, it is *necessary* to state the type of flight plan. This will alert the FSS that the position report must be relayed to ATC.

6. Why is standard phraseology important in ATC radiotelephone contacts? Standard phraseology helps pilots organize their transmissions, reduces the possibility of misunderstanding, and saves time on the frequency. Remember that the controller may be working with a dozen or more aircraft on the same sector discrete frequency, and other pilots may be waiting to use this "party line."

7. If a pilot on a VFR flight encounters weather below VFR minimums and wishes to continue IFR, how should he make initial contact with ATC? Pilots enroute should contact the nearest FSS for relay of communications, or for assignment to the appropriate Center *Sector* Discrete Frequency. The Center *Area* Discrete Frequency, if known, could also be used for the initial contact.

Pilots in the vicinity (for example, 20 miles) of a destination airport which is served by an Approach Control may expedite receipt of an ATC clearance by calling Approach Control on an appropriate frequency.

IFR flight plans filed in flight impose an extra load on ATC and often result in delaying the pilot; for this reason, they should be filed at least 30 minutes in advance of clearance request whenever possible. If it becomes necessary to file in flight, state that the flight is VFR (if in controlled airspace), give reliable position information, and maintain VFR conditions until clearance is received.

8. What may you do to develop good radiotelephone techniques?

1. Study the pilot instructions and phraseology examples in the *Airman's Information Manual.*
2. Practice correct phraseology for position reports, speak distinctly, and identify yourself positively.

3. Know how to make the best use of the radiotelephone equipment in your aircraft.
4. Monitor ATC on the appropriate frequency at all times.
5. Listen to what is being said on the frequency.
6. Be as brief as practicable in your contacts.
7. Always be alert to receive and copy instructions.
8. Learn to copy clearances quickly and accurately.
9. Don't accept a clearance unless you understand it and can comply with it.
10. If your aircraft has limited frequency capability, advise ATC of this fact. Don't accept instructions to make contact on a frequency you don't have.

APPENDIX II

All of the illustrations in this appendix are representative of the illustrations used with current Instrument Flight Instructor Written Examinations.

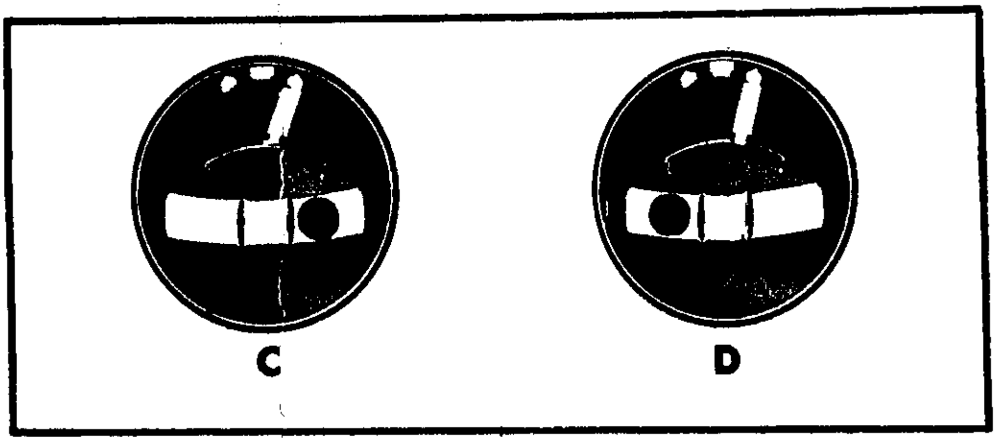


FIGURE 1.—*Turn-and bank indicators.*

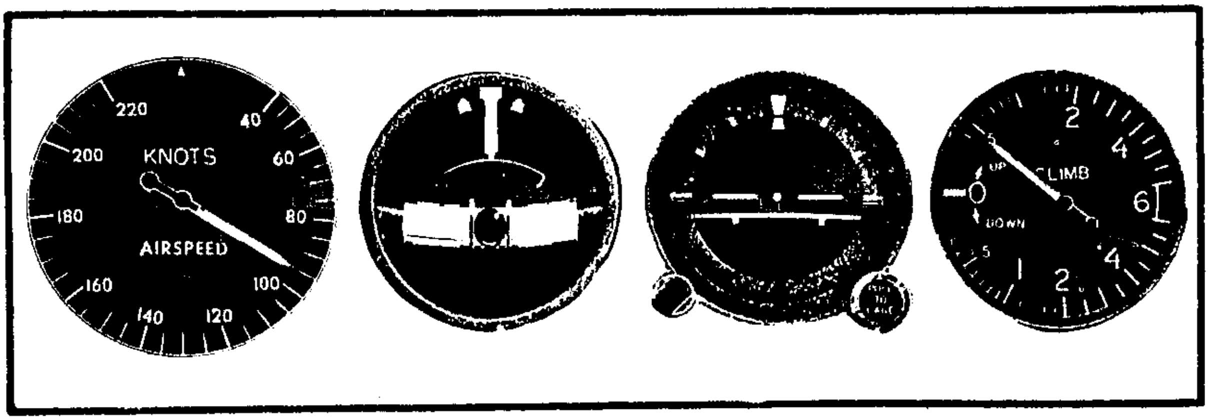


FIGURE 2.—*Instrument grouping.*

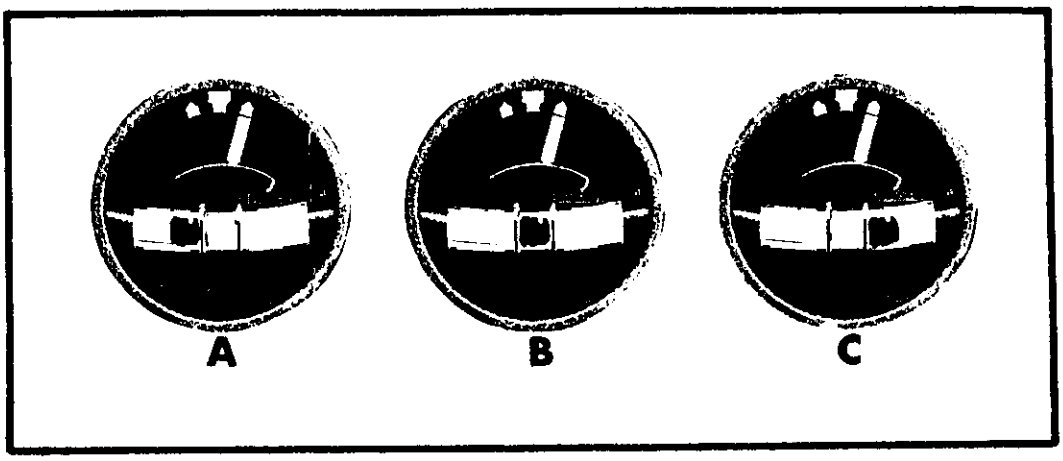


FIGURE 3.—*Three turn-and-bank indicators.*

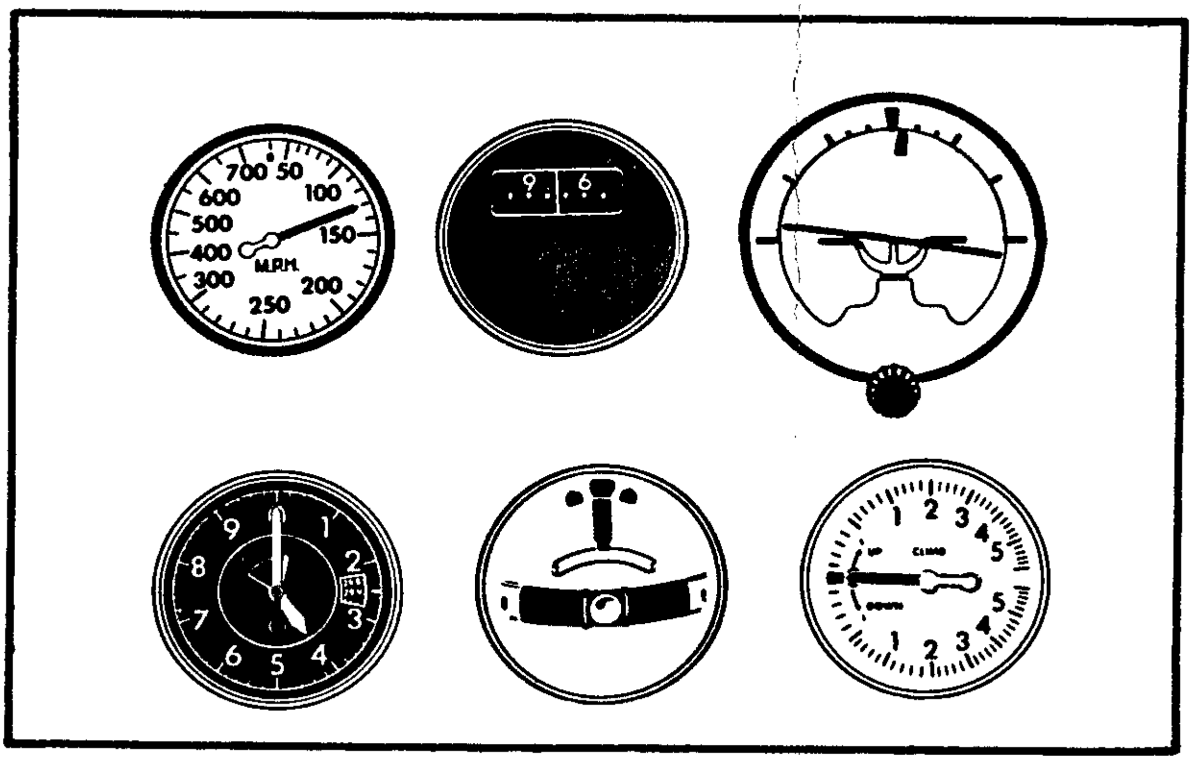


FIGURE 4.—*Instrument panel.*

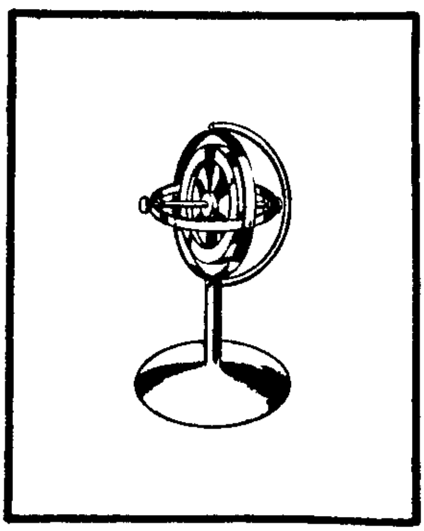


FIGURE 5.—*Model gyroscope.*

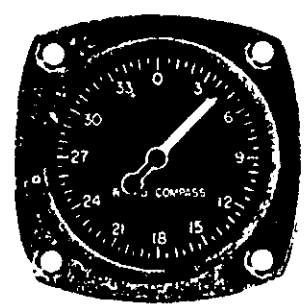


FIGURE 6.—*Radio compass dial.*

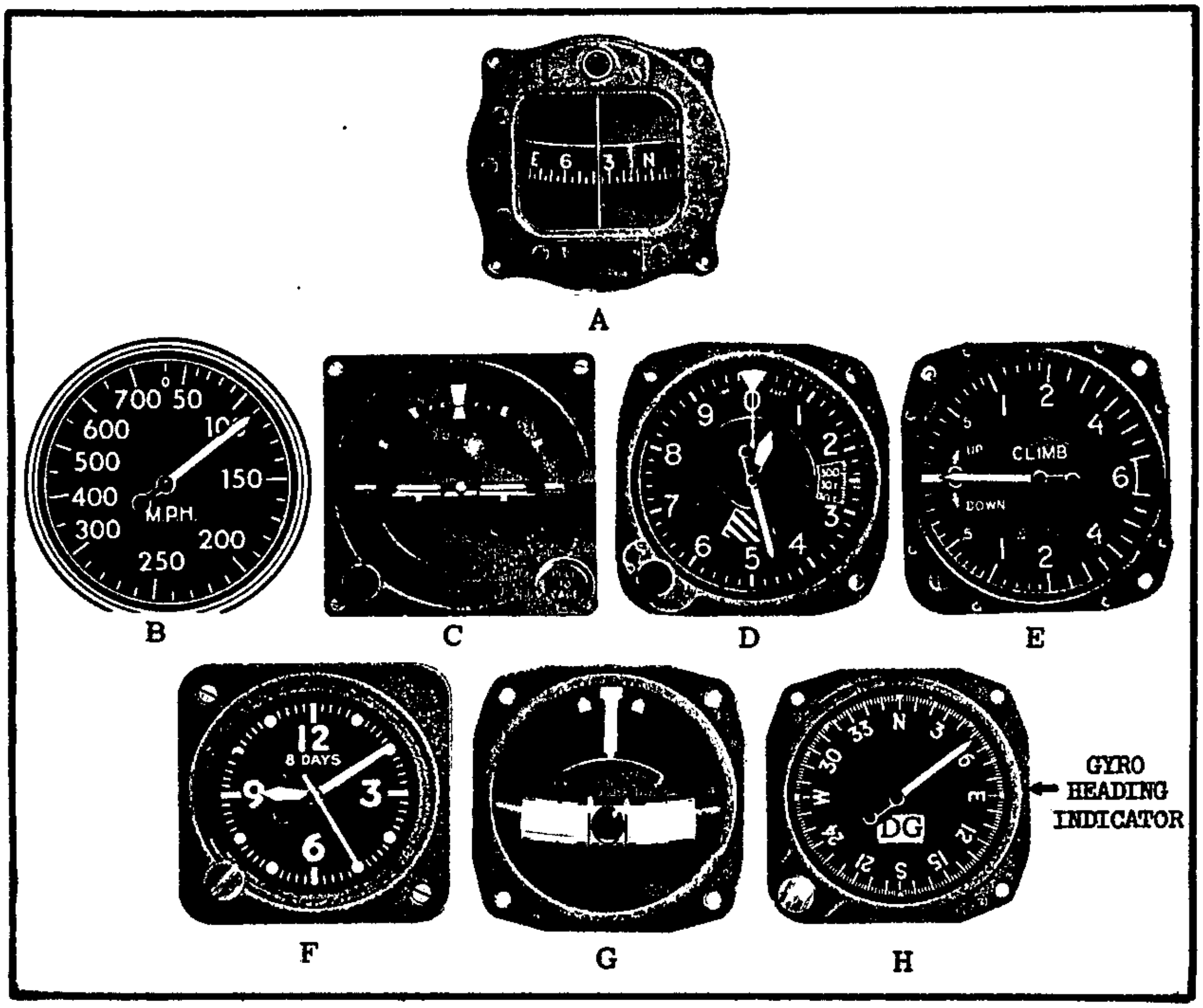


FIGURE 7.—*Full panel instrument grouping.*

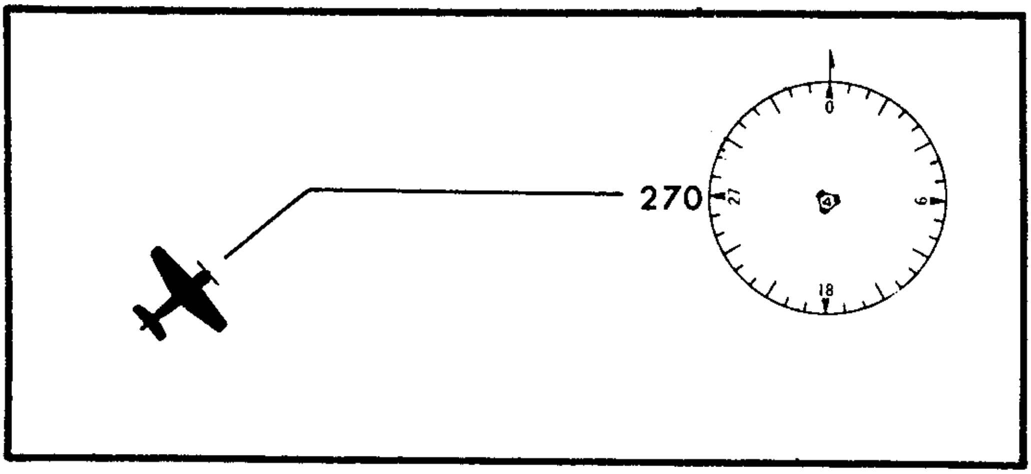


FIGURE 8.—*VOR radial interception.*

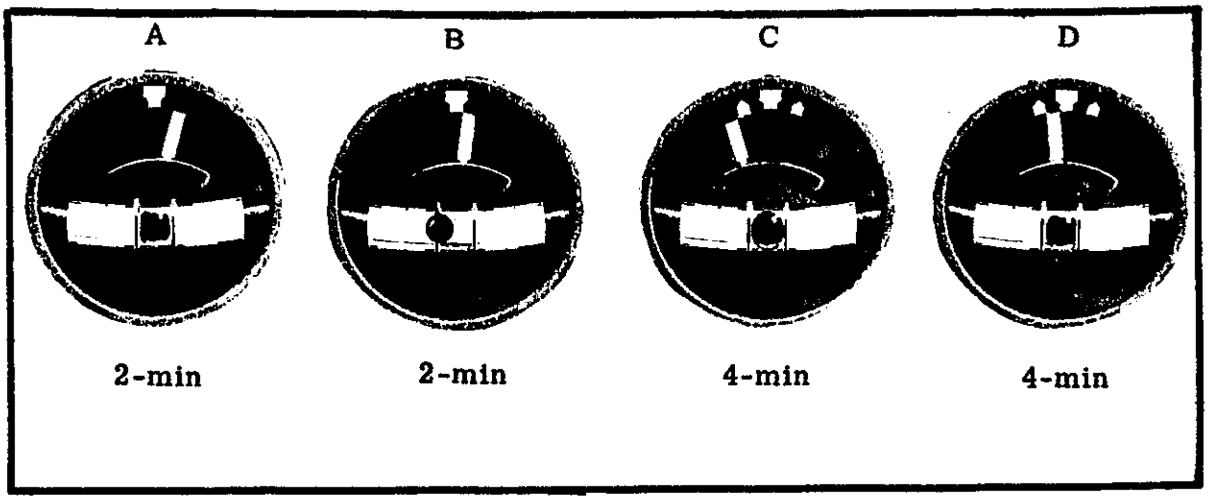


FIGURE 9.—*2- and 4-minute turn needles.*

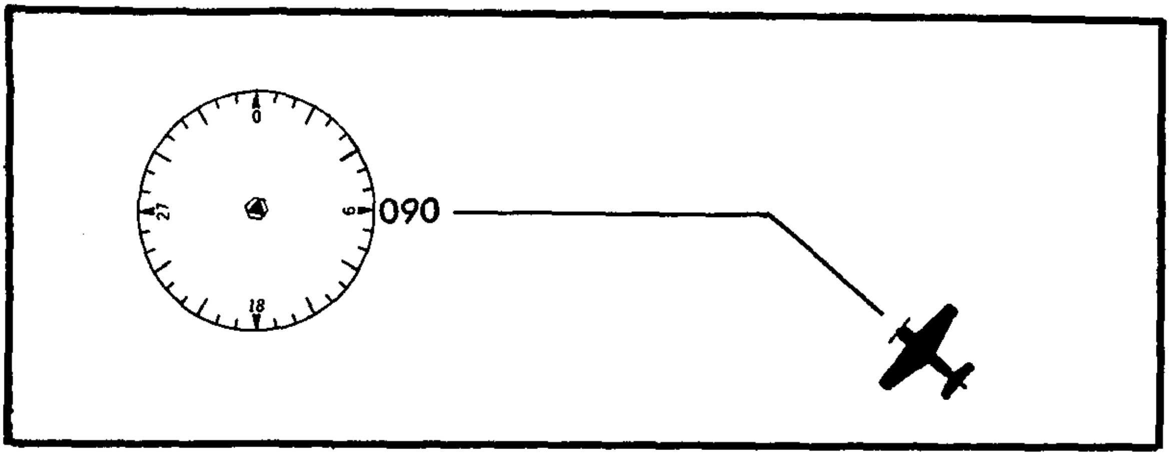


FIGURE 10.—*Intercepting the 090° radial.*

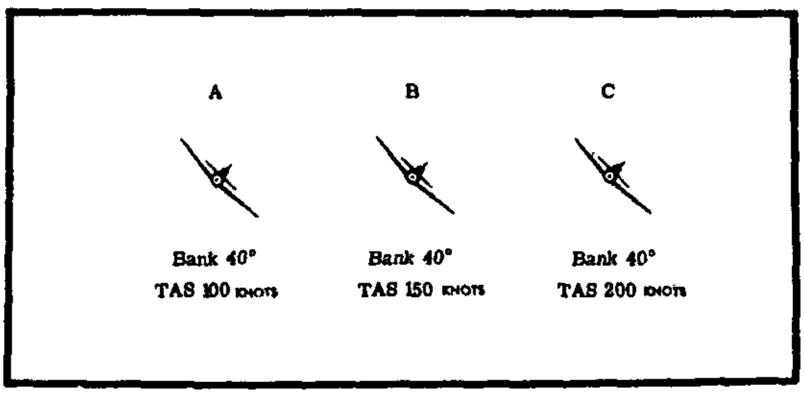


FIGURE 11.—*Bank, airspeed, and load factors.*

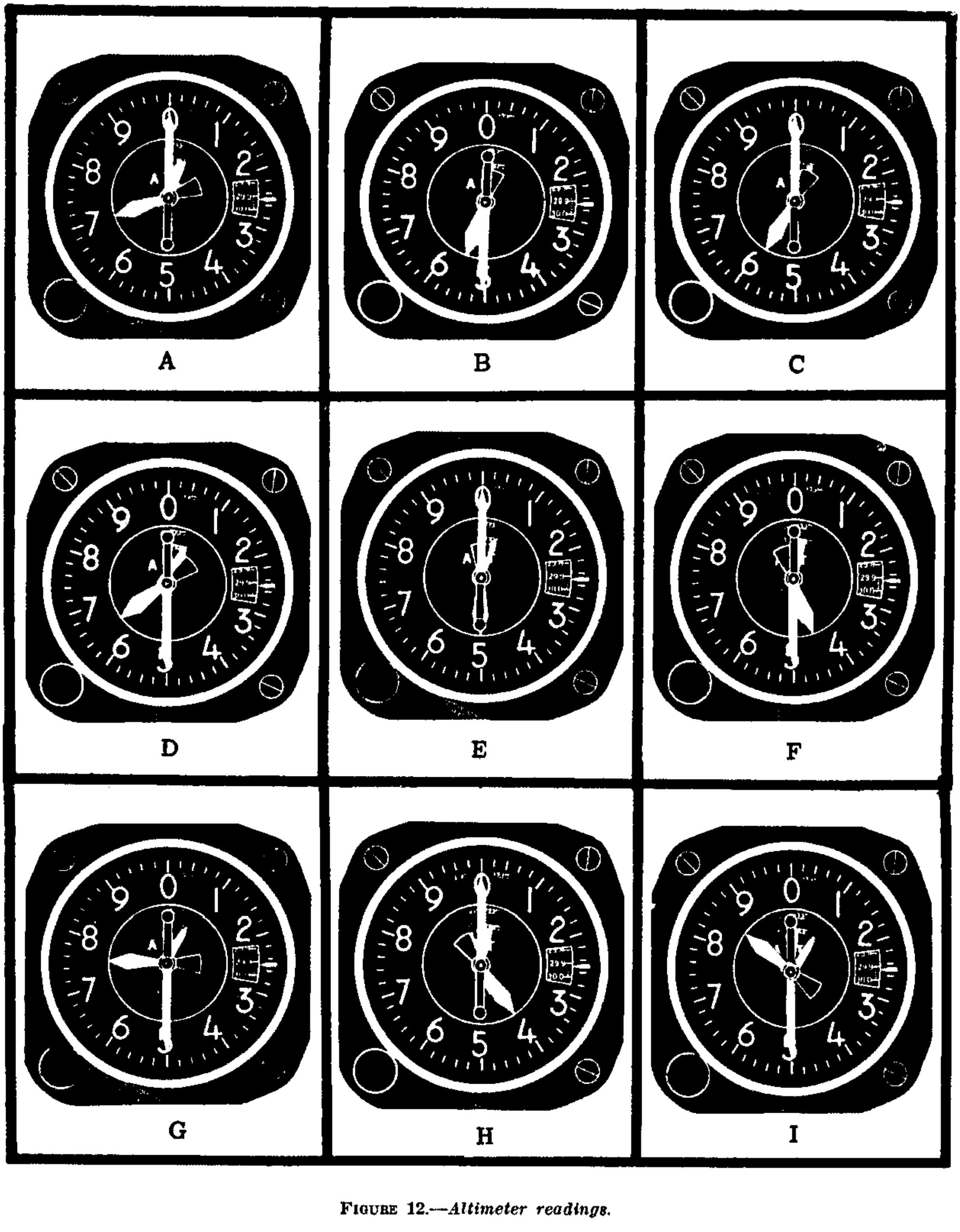
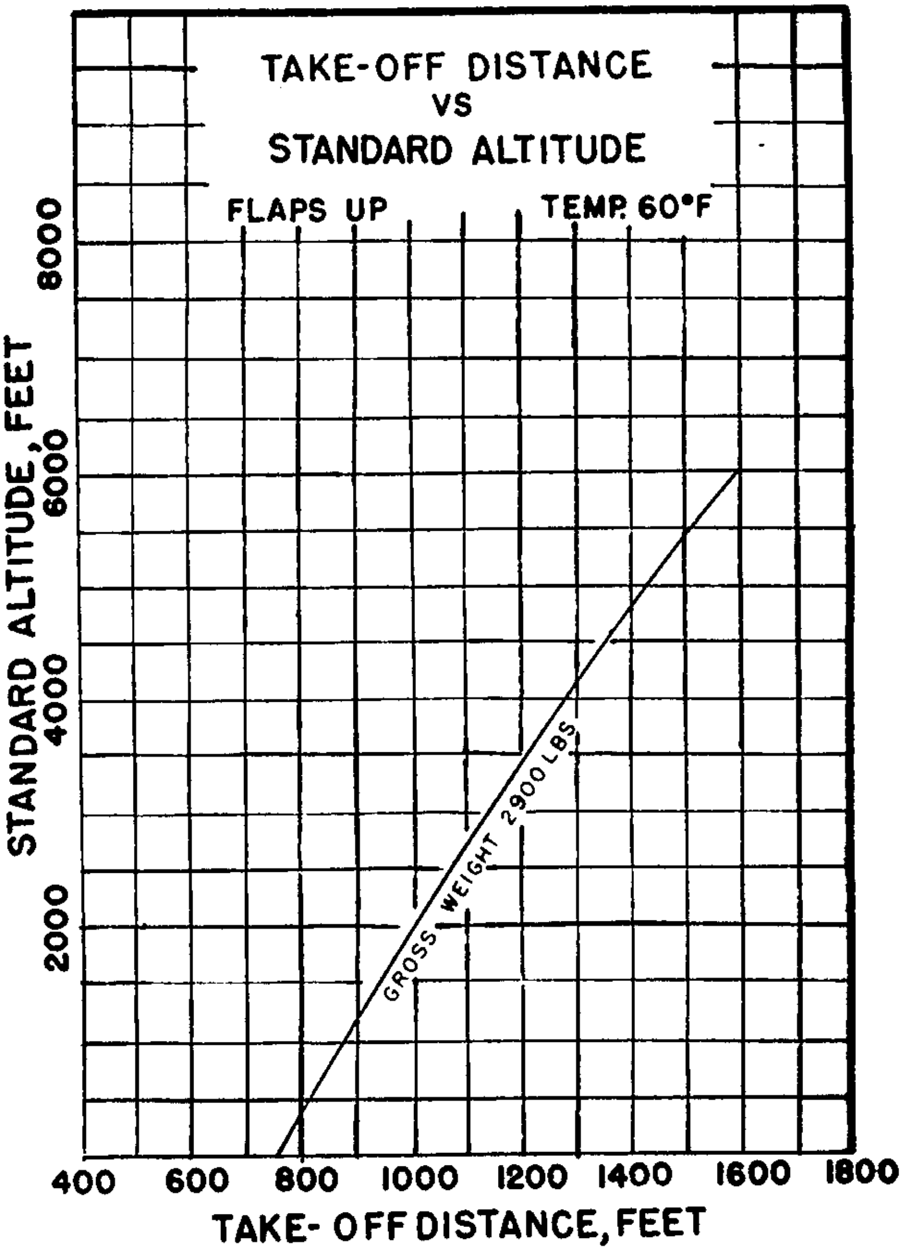


FIGURE 12.—*Altimeter readings.*



NOTE: Standard altitude, as used on this graph, means the same thing as density altitude. See Density Altitude Chart in Figure 14.

FIGURE 13.—*Takeoff distance chart.*

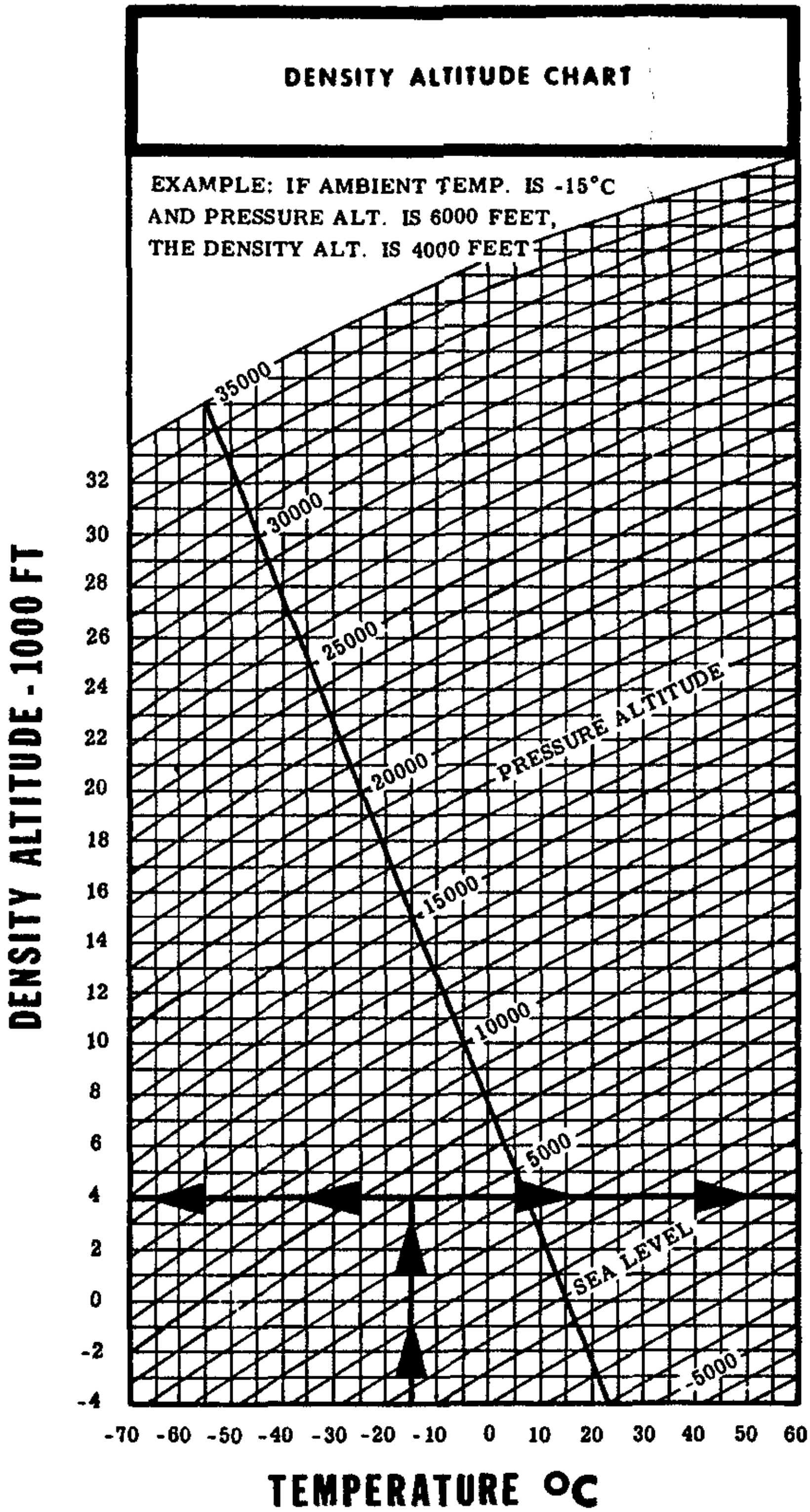
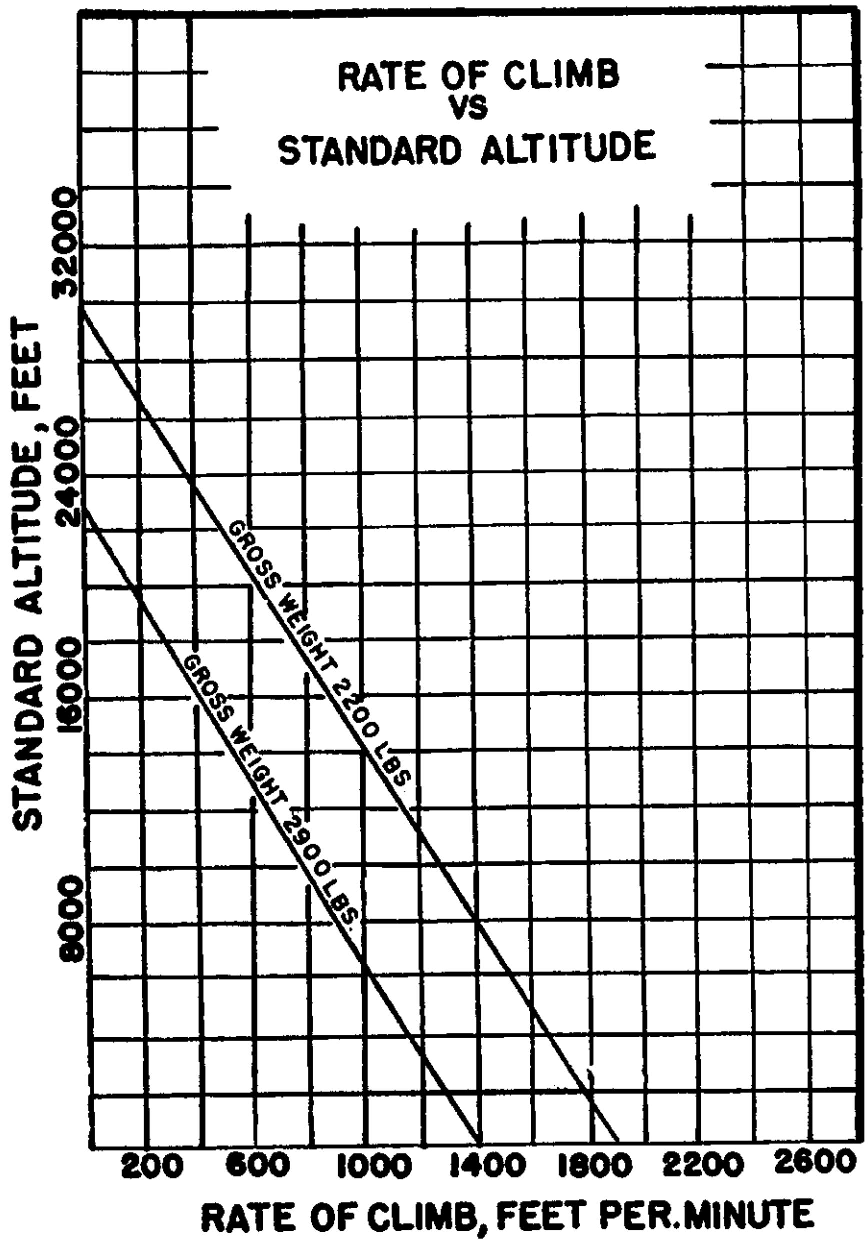


FIGURE 14.—*Density altitude chart.*



NOTE: Standard altitude, as used on this graph, means the same thing as density altitude. See Density Altitude Chart in Figure 14.

FIGURE 15.—*Rate of climb chart.*

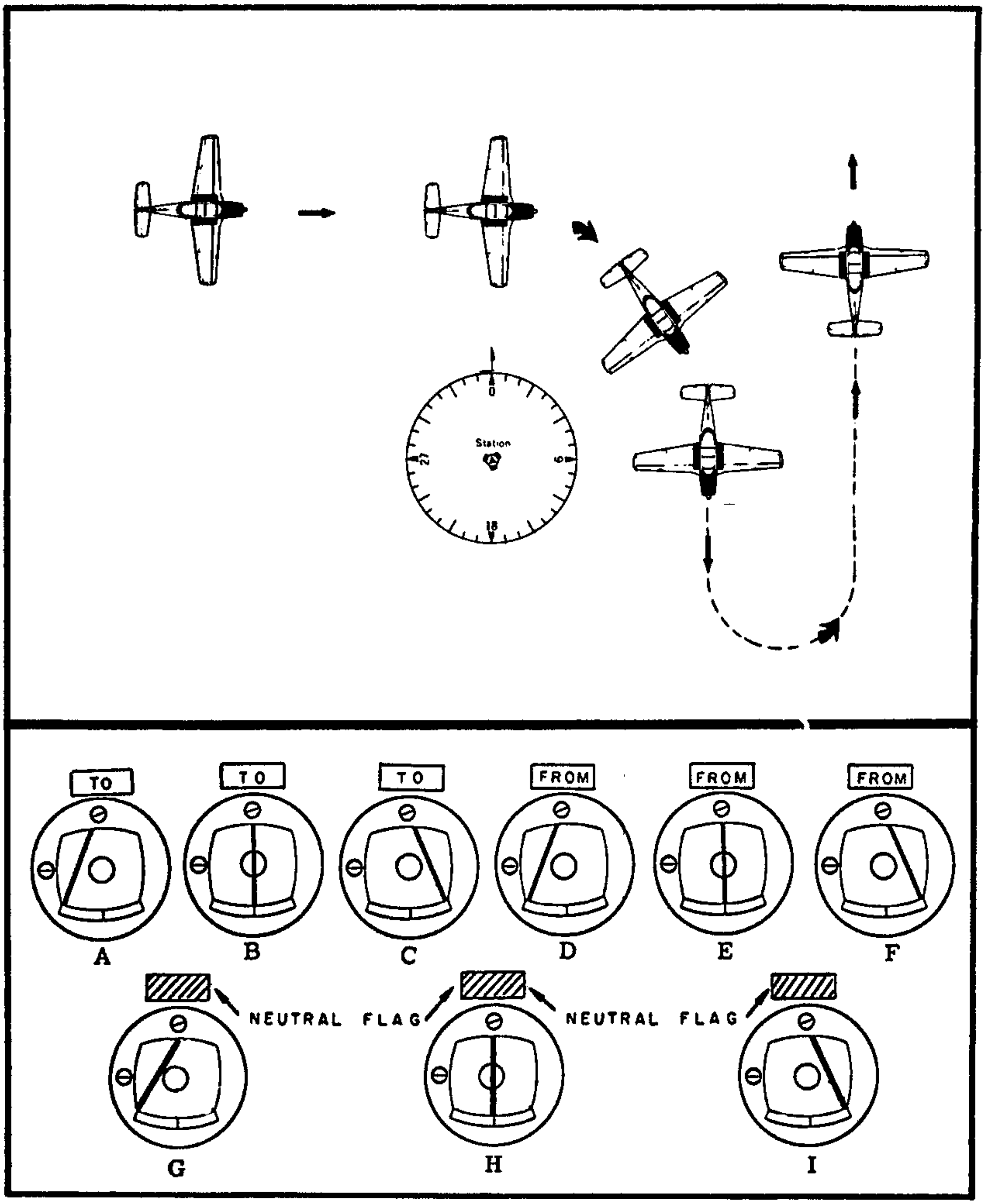


FIGURE 16.—*VOR orientation.*

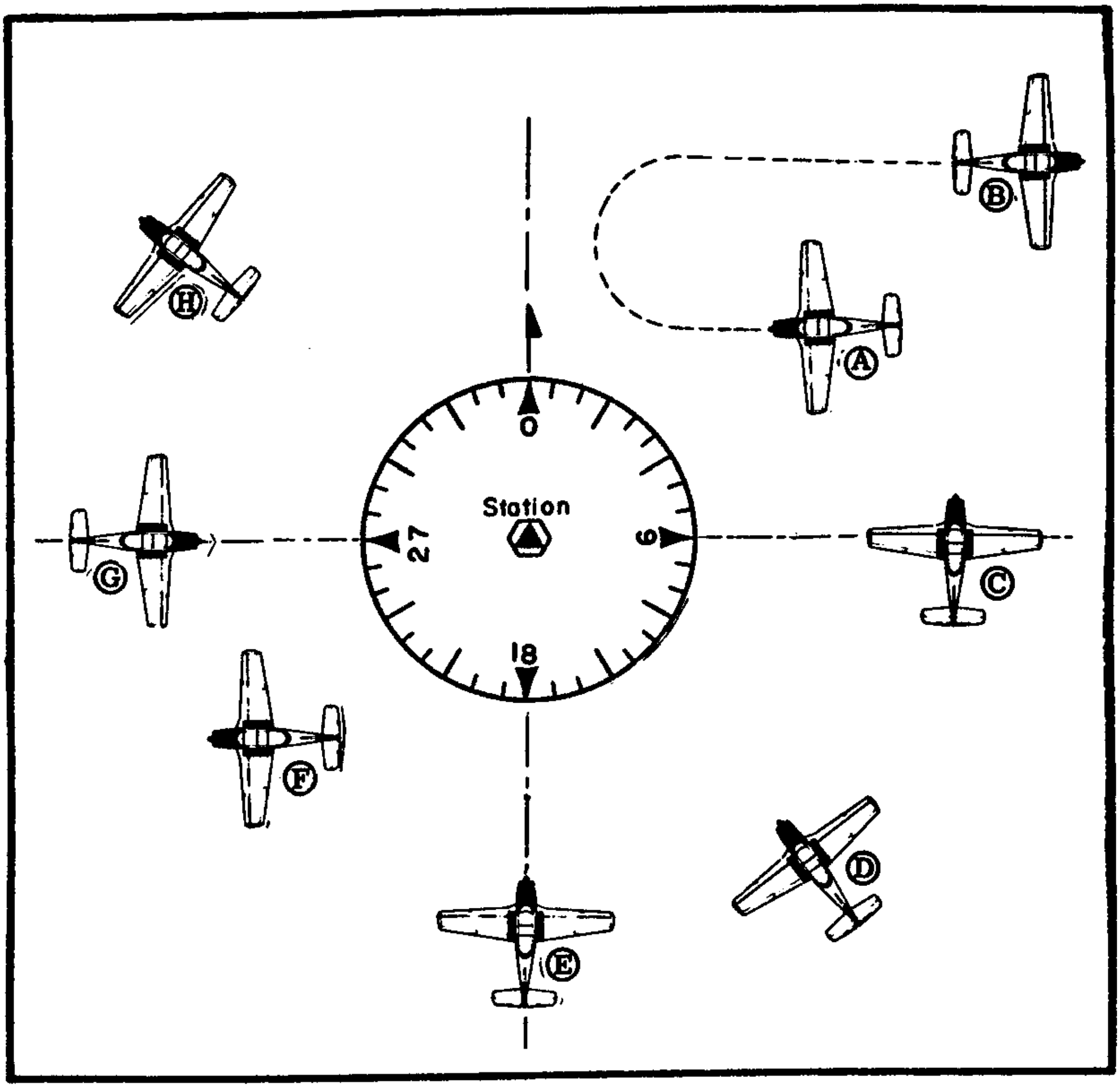


FIGURE 17.—*VHF omnirange.*

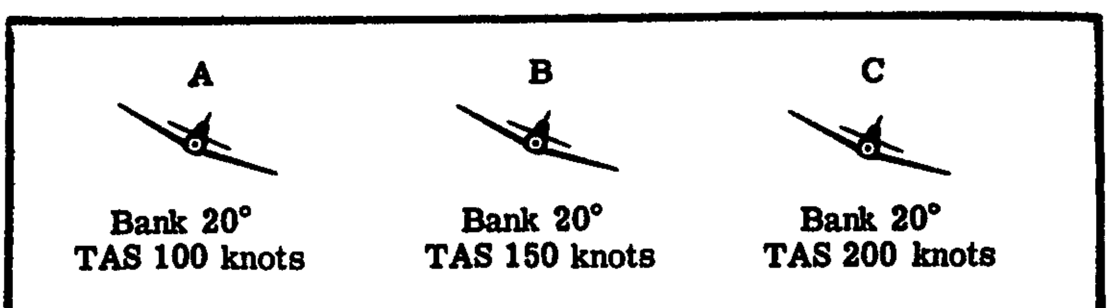


FIGURE 18.—*Bank versus airspeed.*

TEMPERATURE CONVERSION CHART

CENTIGRADE VS FAHRENHEIT

TEMPERATURE CONVERSION:

Centigrade = 5/9 (F — 32)
Fahrenheit = 9/5 C + 32

SAMPLE PROBLEM:
A. Centigrade = 10°
B. Fahrenheit = 50°

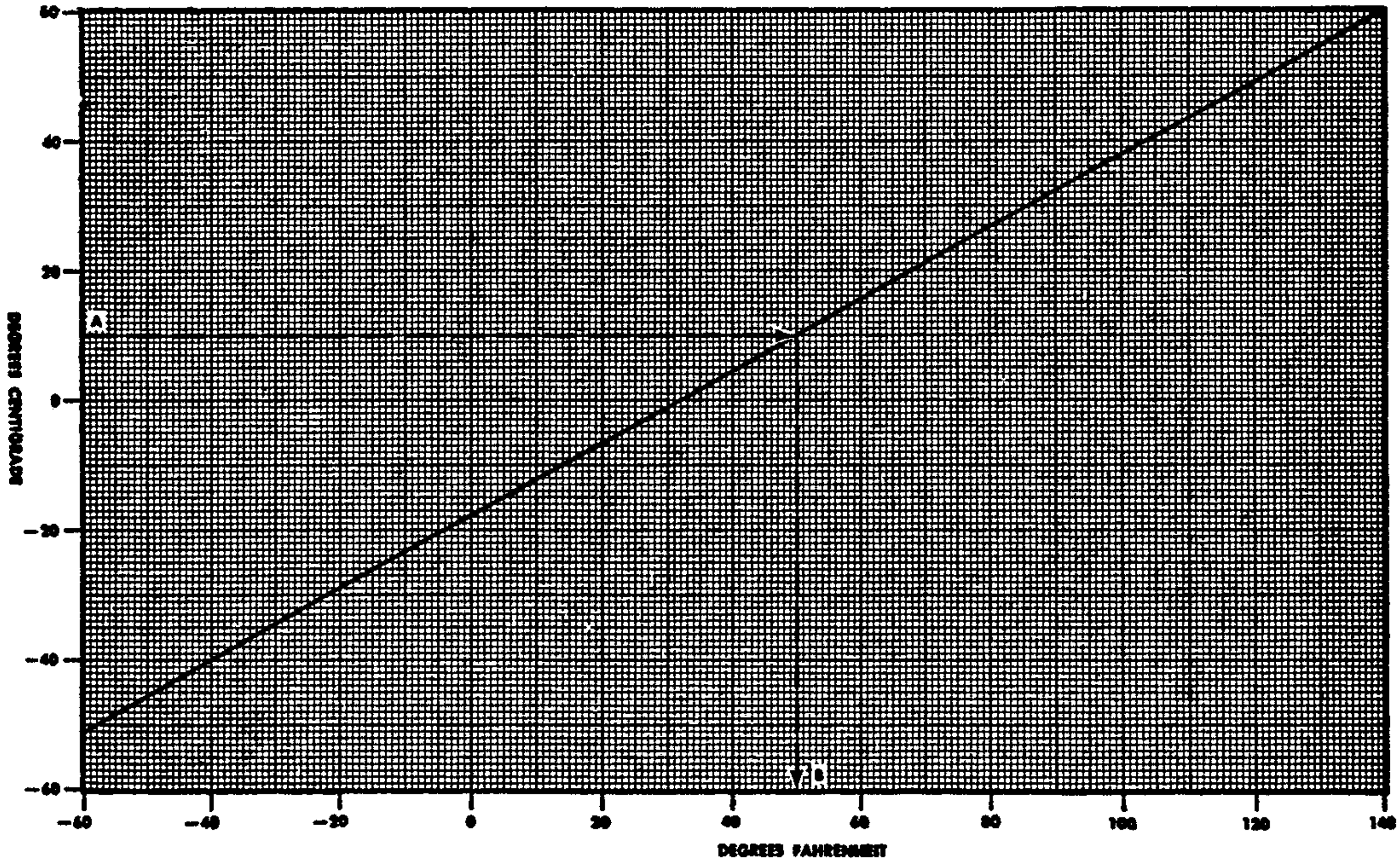


FIGURE 19.—*Temperature conversion chart.*

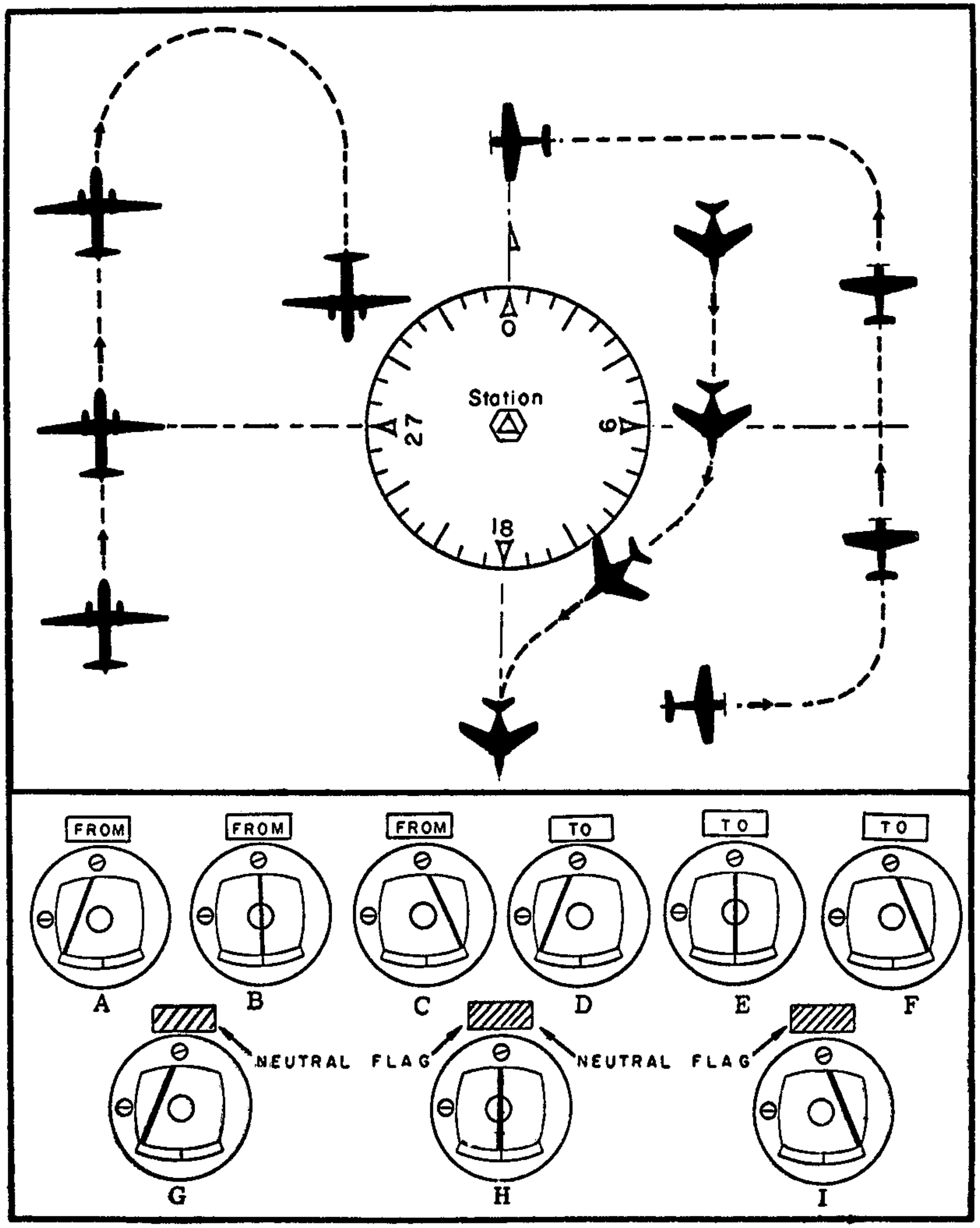


FIGURE 20.—*VOR indications.*

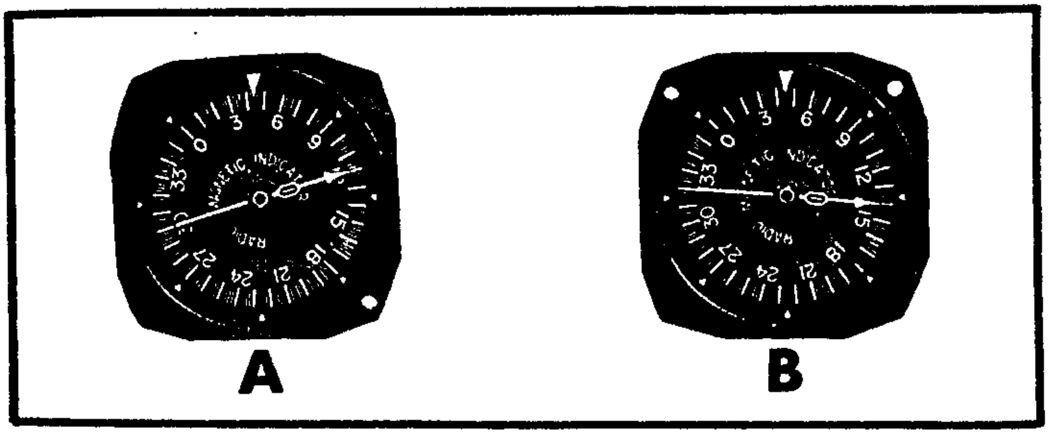


FIGURE 21.—*Radio magnetic indicator (RMI).*

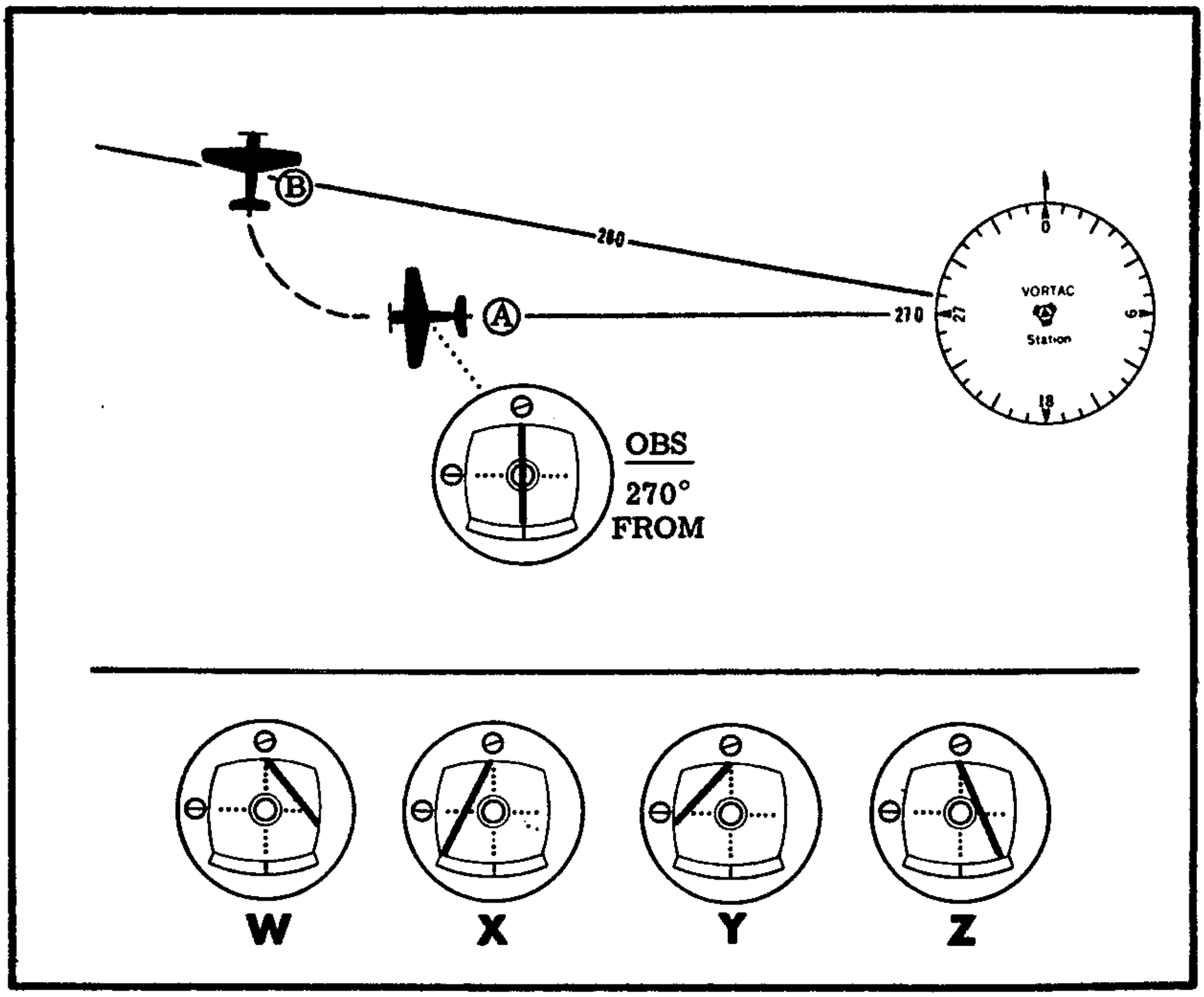


FIGURE 22.—*VOR course deviation indications.*

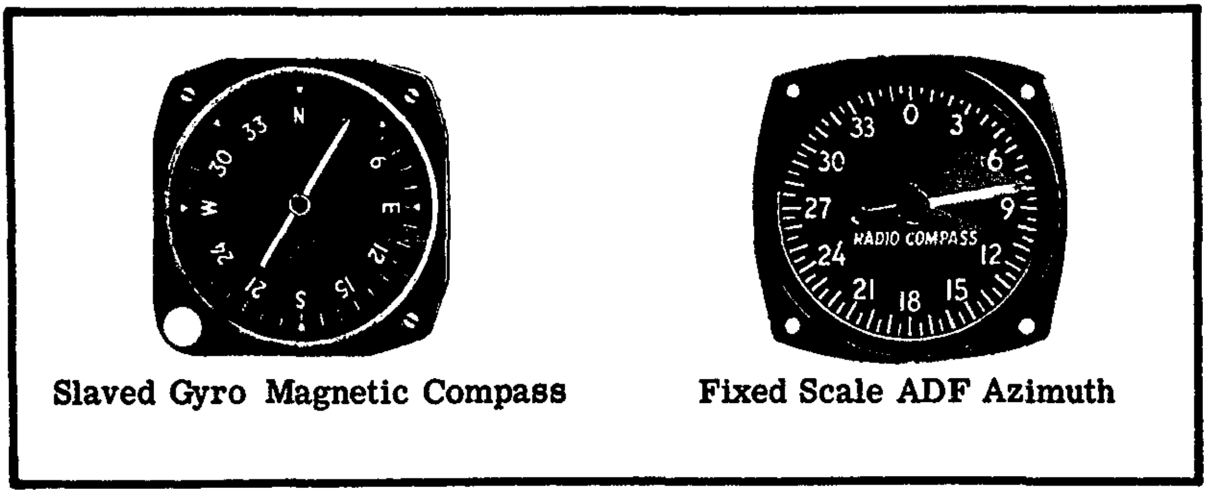


Figure 23.—*Slaved gyro and radio compass.*

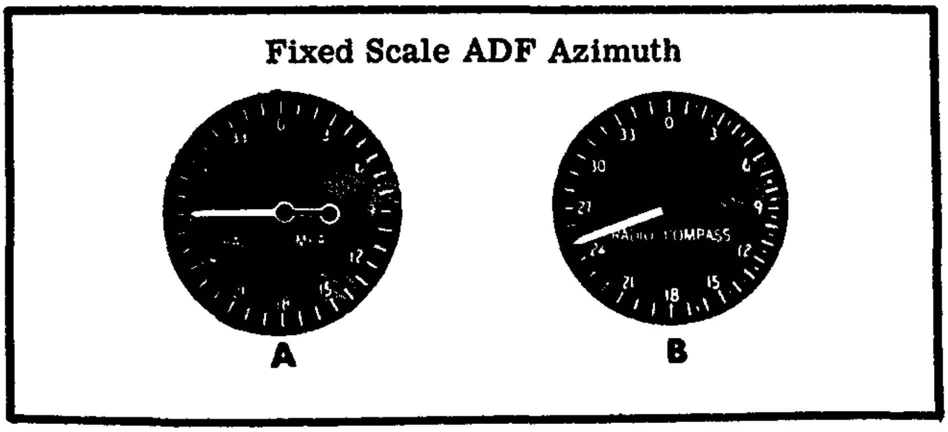


Figure 24.—*Radio compass indications.*

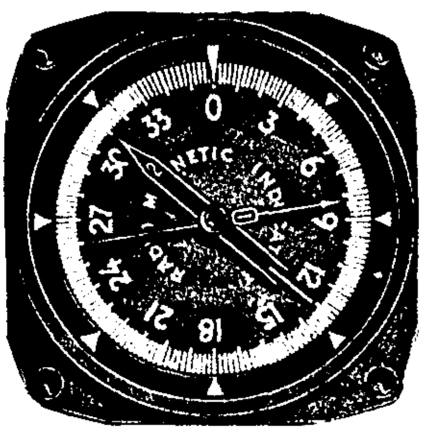


Figure 25.—*RMI indications.*

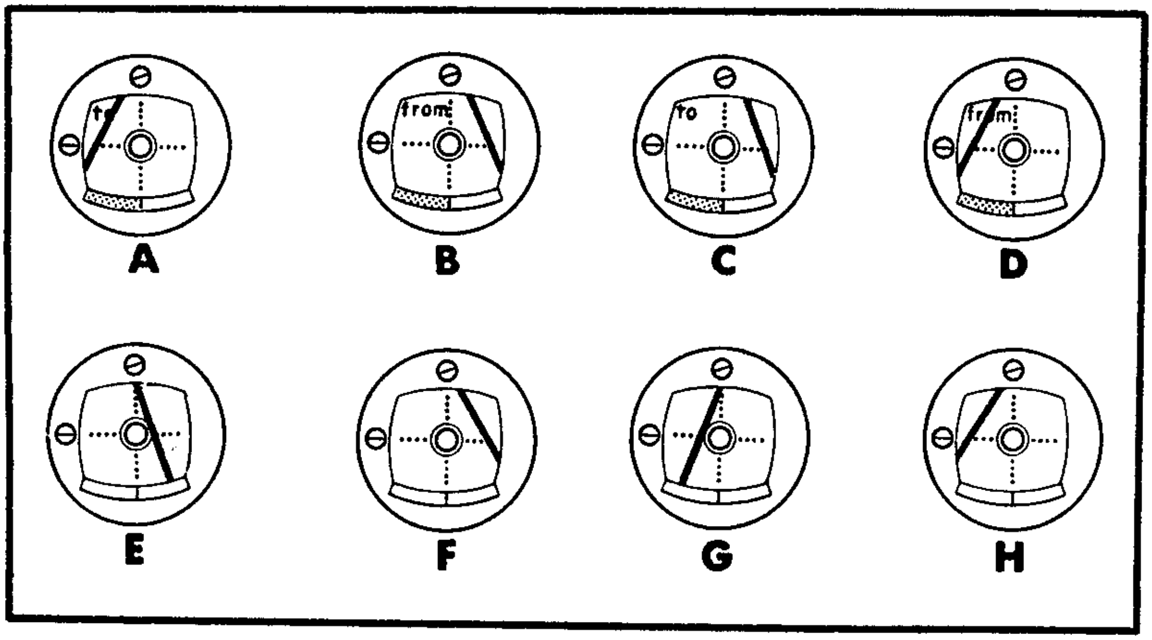


FIGURE 26.—*CDI needle deflections.*

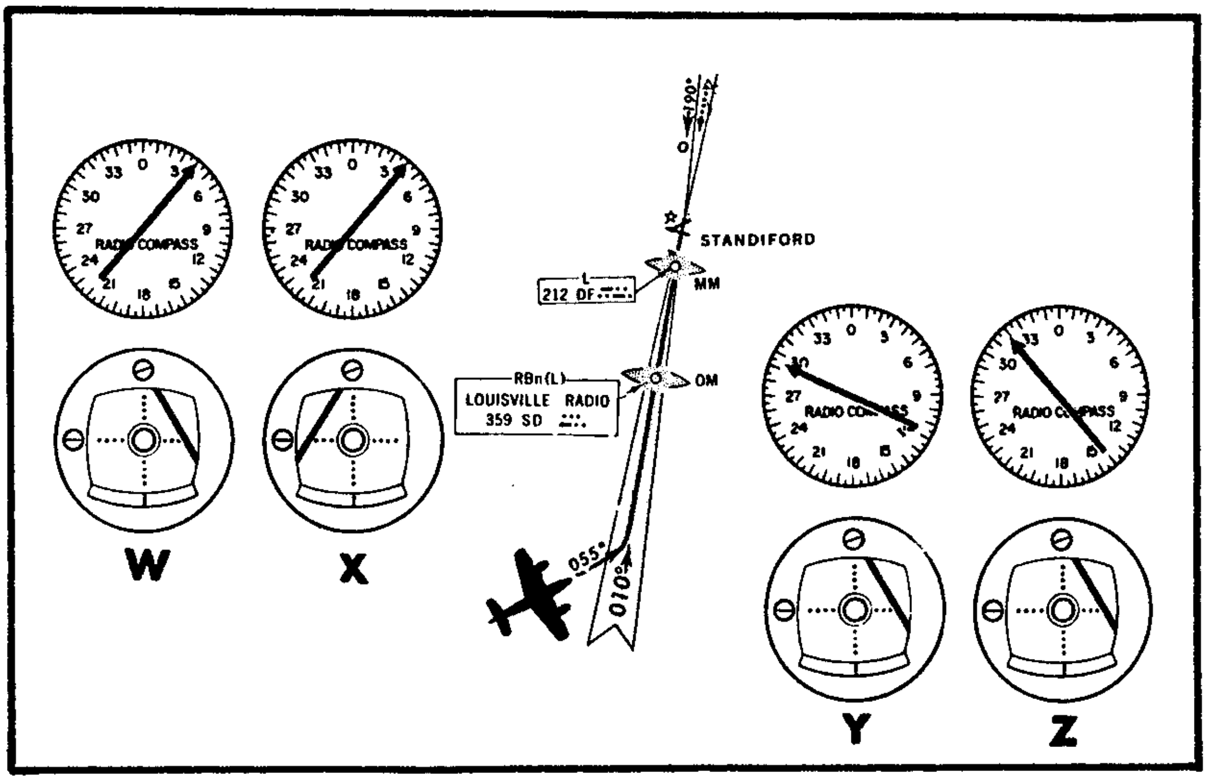


FIGURE 27.—*ILS interception.*

FEDERAL AVIATION AGENCY

FLIGHT PLAN

FORM APPROVED
BUDGET BUREAU NO. 04-8072.1

1. TYPE OF FLIGHT PLAN
- [ ] FVFR
- [ ] VFR
- [ ] IFR
- [ ] DVFR

2. AIRCRAFT IDENTIFICATION

3. AIRCRAFT TYPE

4. ESTIMATED TRUE AIR SPEED (*Knots*)

5. DEPARTURE TIME
PROPOSED (Z) | ACTUAL (Z)

6. INITIAL CRUISING ALTITUDE

7. POINT OF DEPARTURE

8. ROUTE OF FLIGHT

9. DESTINATION (*Airport & City*)

10. ALTITUDE CHANGES EN ROUTE

11. ESTIMATED TIME EN ROUTE
HOURS | MINUTES

12. FUEL ON BOARD
HOURS | MINUTES

13. ALTERNATE AIRPORT

14. REMARKS

15. NAME OF PILOT

16. ADDRESS OF PILOT OR AIRCRAFT HOME BASE

17. NO. OF PERSONS ABOARD

18. COLOR OF AIRCRAFT

19. FLIGHT WATCH STATIONS (*FAA use*)

AIR NAVIGATION RADIO AIDS

AIM-Excerpts

FREQUENCY UTILIZATION PLAN

AIR NAVIGATION AIDS

108.1–111.9 mc: ILS localizer with simultaneous radio-telephone channel operating on odd-tenth decimal frequencies (108.1, 108.3 etc.).

108.2–111.8 mc: VOR's operating on even-tenth decimal frequencies (108.2, 108.4 etc.).

112.0–117.9 mc: Airway track guidance. (VORs)

COMMUNICATIONS

118.0–121.4 mc: AIR TRAFFIC CONTROL COMMUNICATIONS

121.5 mc: EMERGENCY (WORLD-WIDE)

121.6–121.95 mc: AIRPORT UTILITY

122.1, 122.2 mc: PRIVATE AIRCRAFT ENROUTE

122.5, 122.7, 122.6, 122.4 mc: PRIVATE AIRCRAFT TO TOWERS

122.8, 123.0 mc: AERONAUTICAL ADVISORY STATIONS (UNICOM)

122.9 mc: AERONAUTICAL MULTICOM STATIONS

123.1–123.55 mc: FLIGHT TEST AND FLYING SCHOOLS

123.6–128.8 mc: AIR TRAFFIC CONTROL COMMUNICATIONS

126.7 mc: FLIGHT SERVICE STATIONS

128.85–132.0 mc: AERONAUTICAL ENROUTE STATIONS (AIR CARRIER)

132.05–135.95 mc: AIR TRAFFIC CONTROL COMMUNICATIONS

135.9 mc: FLIGHT SERVICE STATIONS

ILS CHANNEL/FREQUENCY

a. ILSs are being commissioned utilizing all 20 channels allotted to ILS by ICAO in Aeronautical Telecommunications Annex 10. Aircraft equipment should be checked to assure the receiving capability of all channels.

Sequence or Channel Number	Localizer Mc/s	Glide Path Mc/s	Sequence or Channel Number	Localizer Mc/s	Glide Path Mc/s
1	110.3	335.0	11	108.1	334.7
2	109.9	333.8	12	108.3	334.1
3	109.5	332.6	13	108.5	329.9
4	110.1	334.4	14	108.7	330.5
5	109.7	333.2	15	108.9	329.3
6	109.3	332.0	16	111.1	331.7
7	109.1	331.4	17	111.3	332.3
8	110.9	330.8	18	111.5	332.9
9	110.7	330.2	19	111.7	333.5
10	110.5	329.6	20	111.9	331.1

MAINTENANCE OF FAA NAVAIDS

During periods of routine or emergency maintenance, the coded identification (or code and voice, where applicable) will be removed from certain FAA Navaids, namely, ILS localizers, VHF ranges and L/MF ranges but not from "H" facilities, compass locators or 75 mc marker beacons. The removal of identification serves as warning to pilots that the facility has been officially taken over by "Maintenance" for tune-up or repair and may be unreliable even though on the air intermittently or constantly.

NAVAIDS WITH VOICE

1. Voice equipped en route radio navigational aids are under the operational control of an FAA Flight Service Station (FSS), or an approach control facility. Most are remotely operated.
2. *Unless otherwise noted on the chart, all radio navigation aids* operate continuously except during interruptions for voice transmissions on the same frequencies where simultaneous transmission is not available, and during shutdowns for maintenance purposes. Hours of operation of those facilities not operating continuously are annotated on the charts.

FIGURE 31.—*AIM excerpts—air navigation radio aids.*

VOR RECEIVER CHECK POINTS

AIM-Excerpt

The list of VOR airborne check points and ground check points is given on the following pages.

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

AIRBORNE

Casper, Wyo. (Air Trml): 201°; over intersection rnwys 21-25-30; 6300'.

Centralia, Ill. (Mun): 027°; at apch end of rnwy 36.

Chadron, Nebr.: 014°; railroad intersection 1.5 nmi N arpt bndry.

Champaign, Ill.: 175°; over grain elevator 8 nmi S at

GROUND

Cincinnati, Ohio: (See Covington, Ky.).

College Station, Tex.: 095°; on W edge of parking ramp on

Covington, Ky. (Greater Cincinnati): 043°; rnwy 27 E of intersection rnwys 27 and 22.

Crestview, Fla.: 104°; on center of concrete circle on rnwy.

Longview, Tex. (Gregg County): 125°; txwy adj to rnwy 13 to end of rnwy 13.

Louisville, Ky. (Bowman): 329°; taxiway W of rnwy 1.

Louisville, Ky. (Standiford): 301°; taxiway between ramp and rnwy 19.

Section III-A—NOTICES TO AIRMEN

AIM-Excerpt

This section is issued every 14 days and is primarily designed to supplement Section III of the AIM. It contains selected notices from the daily NOTAM Summary, Airman Advisories, new or revised Oil Burner Routes, hazardous airspace activities and other items considered essential to flight safety.

NOTE: Data printed entirely in bold face type are considered permanent and will usually be cited only once. Such information should be noted on charts and records. Temporary information is continuously cited until the condition is no longer in effect.

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

NEW OR REVISED DATA: New or revised data are indicated by a black dot (●) preceding the item.

INDIANA

SCOTLAND: Controlled explosive demolition is conducted week days 0730-1600, at the U.S. Naval Ammunition Depot, Crane, Ind in a controlled firing area one nmi in diameter lctd 160°/8.7 nmi from Scotland VORTAC from the surface to 2200' MSL.

MISSOURI

SPECIAL NOTICE: Extreme caution necessary on V-13 vcnty Grandview, Richards-Gebaur Arpt., due concentration of tfc alts. Where possible, suggest all users operate via V-13E btn Kansas City and Butler Arpts.

FT. LEONARD WOOD—FORNEY AAF: Radar Proc. No. 1, Amdt. 1, efctv. 31 Oct 64 is amended as follows: PAR and ASR: C-dn minimums 500-1, 600-1½, 600-1½.

OHIO

ATHENS RDO: About Dec 1, nonfederal Rbn will be comsnd, freq 206 kc ident: UOA. Lctd lat 39°20'11", long 81°58'25". 272 4.4 nmi from rnwy 27 Ohio University Arpt. Class: MHW. Facility owned and operated by Ohio University.

CINCINNATI: Moored mrkd balloon will be flown day or ngt up to an alt 1500' MSL. Site of operns 7½ mi NE Greater Cincinnati Arpt and 6½ mi W Lunken Arpt. Balloon will be tethered aprxly ½ mi W of Cincinnati Union Trml Bldg.

HAMILTON RDO: About Dec 1, Non-federal H fac will be comsnd. Ident: HAO, freq 260 kc. Class: MHW. Lctd lat 39°22'18", long 84°34'03". Variation 0°.

LAKE MILTON, KOASIS RESORT ARPT: Clsd until further notice.

RAVENNA ARSENAL (APCO): Ctld firing for demolition purposes, when wea permits, during regular working hrs, Mon-Fri within the following area: bounded on S by lat 41°11'30", on N by lat 41°12'20"; E long 81°04'22"; W long 81°06'14". Demolition activities in this area will go no higher than 5000' MSL and only when ceiling of 10,000' or better and vsby 10 mi or more. Notams regarding activities conducted will be filed with FSS Akron Mun Arpt (telephone STadium 4-1246).

FIGURE 32.—*AIM excerpts—NOTAMS.*

AIRPORT/FACILITY DIRECTORY LEGEND

AIM-Excerpt

LOCATION

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

ELEVATION

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

RUNWAYS

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

RUNWAY WEIGHT BEARING CAPACITY

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

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

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

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

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

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

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

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

SEAPLANE BASE FACILITIES

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

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

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

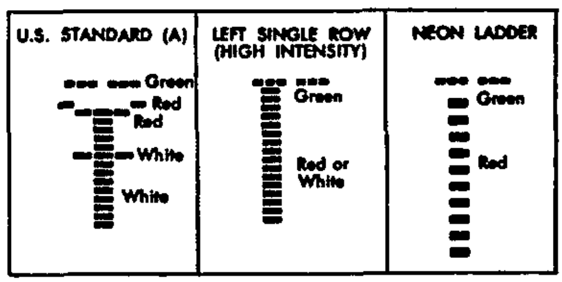
LIGHTING

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

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

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

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



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

FIGURE 33.—*AIM excerpts—airport facility directory legend.*

AIRPORT/FACILITY DIRECTORY

AIM-Excerpt

Lighting (Con't)

13—Runway alignment lights (RAIL)
14—Runway centerline
15—Touchdown zone

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

SERVICING

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

FUEL

F1	80 oct., at least.
F2	80/87 oct., or lower.
F3	91/96 oct., or lower.
F4	100/130 performance rating, or lower.
F5	115/145 performance rating, or lower.
F10	Helicopter.

TURBINE FUELS

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

OTHER

AOE—*Airport of Entry.*

VASI—Visual Approach Slope Indicator, applicable runway provided.

RVV—Runway visibility, applicable runway provided.

RVR—Runway Visual Range, applicable runway provided.

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

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

AIRPORT REMARKS

"**FEE**" indicates landing charges for private or non-revenue producing aircraft. In addition, fees may be charged for planes that remain over a couple of hours and buy no services, or at major airline terminals for all aircraft.

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

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

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

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

COMMUNICATIONS

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

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

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

Frequencies transmit and receive unless specified as: T—Transmit only, R—Receive only, X—On request. Primary frequencies are listed first in each frequency grouping, i.e., VHF, LF. Emergency frequency 121.5 is available at all TOWER, APPROACH CONTROL and RADAR facilities, unless indicated otherwise by a cross-out: 121.5

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

VOICE CALL

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

FIGURE 34.—*AIM excerpts—airport facility directory legend.*

AIRPORT/FACILITY DIRECTORY

AIM-Excerpt

SERVICES AVAILABLE

(See ATC Operations and Procedures, Section II)

TOWER

Clearance Delivery (CLRNC DEL).
Approach Control (APP CON) Radar and Non-Radar.
Departure Control (DEP CON) Radar and Non-Radar.
VFR Advisory Service (VFR ADV) Non-Radar.
Traffic Information Service (TFC INFO) Radar.
Surveillance Radar Approach (ASR).
Precision Radar Approach (PAR).
Ground Control (GND CON).
VHF Direction Finding (VHF/DF).

FLIGHT SERVICE STATION (FSS)

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

UNICOM

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

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

U-2—123.0 mc (at airports with a control tower).
tower).

SAMPLE

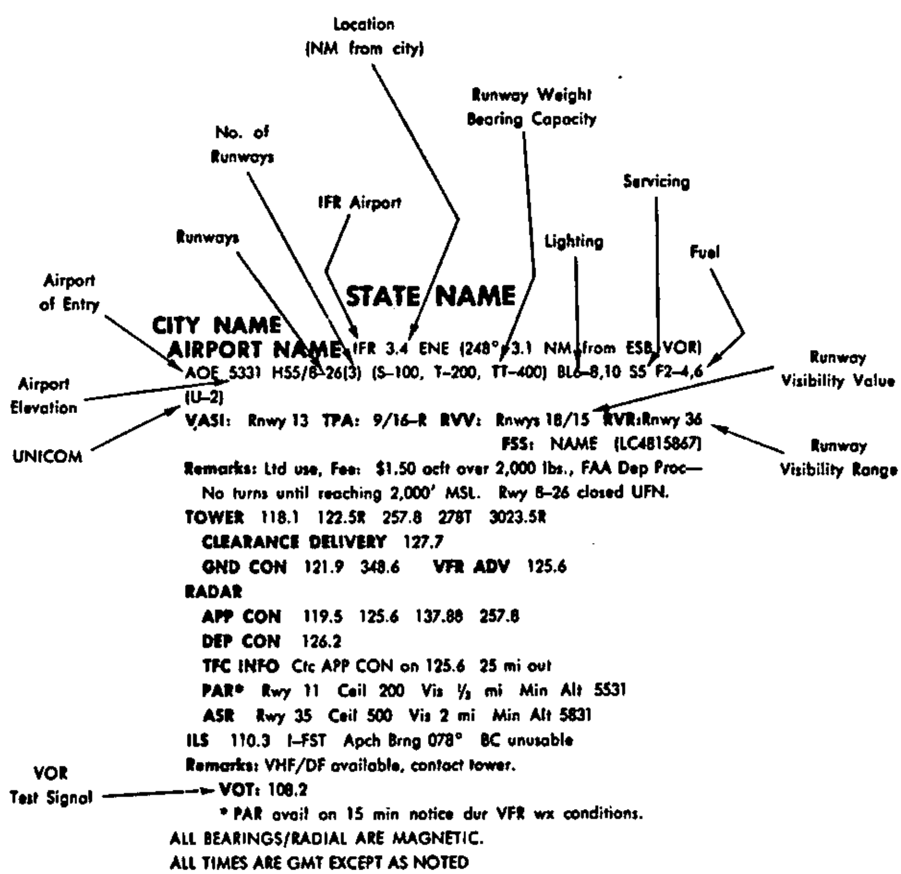


FIGURE 35.—*AIM excerpts—airport facility directory (sample).*

AIRPORT/FACILITY DIRECTORY

REMARKS:[1] TWR oper 1200-0400Z.

INDIANA

EVANSVILLE
DRESS MEMORIAL *IFR* 3 N (057° 12.4 NM from EVV VOR)
389 H60/3-21 (3) (S-70, T-90, TT-) BL4, 6 S-5 F5, JP1
FSS: EVANSVILLE on Fld
REMARKS: P-Line apch rnwy 31. Due non-vsby some areas of fld, ctc twr for instructions. Acft not vis on final apch to rnwy 9 within 1500' apch end at alt of 100' AGL or below.
EVANSVILLE TOWER 118.7 122.5R
EVANSVILLE GND CON 121.9
EVANSVILLE APP CON 119.4 122.5R 118.7 113.3T 109.9T
ILS 109.9 I-EVV Apch Brng 215° BC unusable

KENTUCKY

LOUISVILLE
BOWMAN FIELD *IFR* 5 SE (330° 8.3 NM from LOU VOR)
549 H43/6-24 (3) (Max 30) BL4 S-5 F-4, JP-4 U2
FSS: LOUISVILLE on Fld
TOWER 119.5 126.2 122.5R GND CON 121.9
RADAR SERVICES:
STANDIFORD APP CON 124.5 126.2 120.5 120.3
STANDIFORD DEP CON 119.0

LOUISVILLE
STANDIFORD FIELD *IFR* 4 S (300° 8.4 NM from LOU VOR)
497 H78/1-19 (3) (S-60, T-90, TT-200) BL4, 6, 8 S-4 F5, JP1, 5 U2 RVV: Rnwy 29 RVR: Rnwy 1
FSS: LOUISVILLE (DL)
REMARKS: FEE
TOWER 120.3 126.2 122.7R
CLRNC DEL 121.3 GND CON 121.7
RADAR SERVICES:
APP CON 124.5 126.2 120.5 120.3 DEP CON 119.0
ASR Rnwy 1 Ceiling 400 Vsby 1 mi Min Alt 897. Rnwy 19 Ceiling 500 Vsby 1 mi Min Alt 997. Rnwys 6, 11, 24, 29 Ceiling 600 Vsby 1 mi Min Alt 1097
ILS 110.3 I-SDF Apch Brng 010° 109.1 I-LKS Apch Brng 290°
VHF/DF Available, contact Tower
REMARKS: On apch to rnwy 19 maintain at least 1400' MSL within 3 mi of rnwy.
VOT: 111.0

MISSOURI

ST LOUIS
LAMBERT-ST LOUIS *IFR* 10 NW (137° 8 NM from STL VOR)
571 H100/12R-30L (4) (Max 75)[1] BL4, 6, 8 S5 F4, JP1, 5 U2 RVR: Rnwy 24 FSS: ST LOUIS on Fld
REMARKS: [1](Max-10D) aval rnwy 17-35. Birds in SE sector arpt nights.
ST LOUIS TOWER 118.5 126.2 122.7R 122.5R[1] 119.5 278T CLRNC DEL 119.5 ST LOUIS GND CON 121.9 122.5R
RADAR SERVICES:
ST LOUIS APP CONN 126.5[2] 123.7 122.5R 118.1 [3]117.4T 110.3T ST LOUIS DEP CON 119.9
PAR Rnwy 24 Ceil 200 Vsby ½ mi Min Alt 771.
ASR Rnwys 6, 17, 24, 30L, 35 Ceil 500 Vsby 1 mi Min Alt 1071. Rnwys 12L, 30R Ceil 500 Vsby 1 ½ mi Min Alt 1071. Rnwy 12R Ceil 400 Vsby 1 mi Min Alt 971.
ILS 110.3 I-STL Apch Brg 238°
VHF/DF available, contact tower.
REMARKS: [1]May be descmnd. [2]Southeast arrivals. [3]Northwest arrivals. Except rnwy 12.
VOT: 111.0

OHIO

COVINGTON, KY (CINCINNATI, OHIO)
GREATER CINCINNATI *IFR* 9 SW Cincinnati (043° 2.3 NM from CVG VOR)
890 H86/18-36 (3) (S-120, T-200, TT-345) BL4, 6, 8 S5 F5 FSS: CINCINNATI on Fld
REMARKS: Rnwy 4-22 clsd to acft over 30,000 lbs. Fee. Due non-visibility some areas field, ctc twr.
CINCINNATI TOWER 118.3 126.2 122.7R 317T
CLRNC DEL 121.3
CINCINNATI GND CON 121.7
RADAR SERVICES:
CINCINNATI APP CON 124.7 126.2 122.7R 119.7 112.9T CINCINNATI DEP CON 121.0
ASR Rnwys 4, 9, 18, 36 Ceiling 400 Vis 1 mi Min Alt 1290. Rnwys 22, 27 Ceiling 700 Vis 1 mi Min Alt 1590
ILS 109.9 I-CVG Apch Brng 360° 110.9 I-SIC Apch Brng 180°
VHF/DF available, contact tower
REMARKS: VOT: 112.0

AIM Excerpts

FIGURE 36.—*AIM excerpts—airport facility excerpts.*

PREFERRED ROUTES

A system of preferred routes has been established to guide pilots in planning their route of flight, to minimize route changes during the operational phase of flight, and to aid in the efficient orderly management of the air traffic using federal airways. The preferred routings which follow are designed to serve the needs of airspace users and to provide for a systematic flow of air traffic in the major terminal and en route flight environments. Cooperation by all pilots in filing preferred routes will result in fewer traffic delays and will better provide for efficient departure, en route and arrival air traffic control service.

The following list will hereafter appear in EACH issue of the AIRGI.
This list contains preferred routes for the low altitude stratum (below 18,000 feet MSL).

Low Altitude Stratum—A distinctive numbering system (800 Series) has been introduced to indicate some of the preferred routes in this stratum and thereby eliminate the present lengthy route descriptions. Many of the preferred routes, however, retain the common basic airway numbers or use the two systems of numbering in combination. Additional designations of "800 Series Airways" will be made where simplicity and convenience to both pilots and controllers dictate such assignments.

Preferred Route Starting and Terminating Fixes—Preferred routes generally commence and terminate at fixes on or near the perimeter of the terminal area.

Depicted on the Area Charts, produced by Coast and Geodetic Survey, are the normal routes between the airport and the preferred route starting/terminating fixes. Whenever a fix is shown in **bold-face** type, pilots should refer to the appropriate Area Chart for the routing he may expect prior to or after that fix as appropriate.

Preferred routes beginning/ending with an airway number indicate that the airway essentially overlies the airport and flights are normally cleared directly on the airway. All preferred routes are listed alphabetically under the name of the departure airport. Major airports in close proximity are listed under the principal airport and categorized as a metropolitan area; e.g., Chicago Metro Area. Official location identifiers are used in the route description for VOR/VORTAC navaids. L/MF navaids are identified by the identifier and type: e.g., MIV/LFR, DOV/Rbn. Intersection names are spelled out. Where two navaids or an intersection and a navaid follow in succession, the route is direct.

(L20, 23)=Enroute chart numbers.

CINCINNATI METRO AREA

Atlanta............ V97 TYS V267 **OCR** (L-21, 22, 20)
Charleston, W. Va.. V128 (L-21, 22, 20)
Chicago........... V97 **CGT** (L-21, 23)
Detroit (City)..... V275 VWV V47 **SVM** (L-21, 23)
Indianapolis...... V97 (L-21, 23)
La Guardia........ V128 YRK V44 MGW V106 SEG V6 V433 **Liberty** (L-22, 24)
Louisville......... V47 ABB V51 (L-21)
Metro Wayne Co... V275 VWV V47 **Dundee** (L-21, 23)
Miami............ V47 ABB V51 CSV V51W CHA V843 **Cypress**, or V97 ATL V843 **Cypress** (L-21, 22, 20, 18, 19)
Newark........... V128 YRK V44 MGW V106 V30 **Rocky Hill** (L-22, 24)
Pittsburgh........ V128 YRK V44 PKB V119 **HLG** (L-22, 24)
St. Louis.......... V47 ABB V44 ENL V4 **TOY** (L-21)
Willow Run....... V275 VWV V47 **Dundee** (L21, 23)

LOUISVILLE

La Guardia........ V4 CRW V106 SEG V6 V433 **Liberty** (L-21, 22, 24)
Newark........... V4 CRW V106 V30 **Rocky Hill** Hill (L-21, 22, 24)

ST. LOUIS METRO AREA

Cleveland .... **TOY** V12 Wilbur V11 IND V14 FDY V8 MFD V246 **Sharon** (L-21, 23)
Columbus........ **TOY** V12 (L-21, 23)
Dallas............ V14 EOS V845 **Gainesville** (L-21, 6, 13)
Ft. Worth......... V14 EOS V15 OKM V161 **Justin** (L-21, 6, 13)
Indianapolis..... **TOY** V12 Wilbur V11 (L-21, 23)
Kansas City....... V4 **Missouri City** (L-21)
Memphis.......... V9 Kerrville (L-21, 14)
Midway/O'Hare... V9 **JOT** (L-21, 11, 23)
Tulsa............. V14 (L-21, 6)
Washington....... **TOY** V52 EVV V4 **HRN** (L-21, 22)

Airman's Information Manual Excerpts

FIGURE 87.—*AIM excerpts—preferred routes.*

ARTCC COMMUNICATIONS FREQUENCIES

ALL—Normal communications between ARTCC controllers and pilots of IFR aircraft, at all altitudes, will be conducted via direct controller-to-pilot communication channels using the appropriate ARTCC **SECTOR** discretet frequency. Pilots will be advised of the frequency to be used and when a frequency change is required.

VHF—Communications between ARTCC controllers and pilots of limited radio equipped aircraft that do not have in-flight tuning capability will be conducted on the ARTCC **AREA** discrete (CAD) frequency, or by relay through the flight service station (FSS). The VHF CAD frequency is normally available to and shared by all non-radar equipped sectors.

The use of radar in air traffic control requires the capability of instantaneous interference free controller-to-pilot communications since radar separation minima may be used; therefore, radar equipped sectors used to control IFR traffic operating below 24,000 feet are provided discrete frequency assignments with normal 100 kc channel protection in the 118.0–127.0 mc band and VHF CAD frequency/communications capability is not provided at these sectors.

Communications with limited equipped aircraft operating at FL 240 and above will be handled by relay through FSS, or as directed by ATC.

EMERGENCY FREQUENCIES—Direct controller-to-pilot communications capability on the emergency frequenices 121.5/243.0 mc is limited to the area (dependent upon the location/altitude of the aircraft) within the vicinity of the ARTC Center since these frequencies are installed to Center use at the local ARTC Center transmitting/receiving site only.

MISC—Communication frequency information for use above FL 240 can also be found on the high-altitude charts.

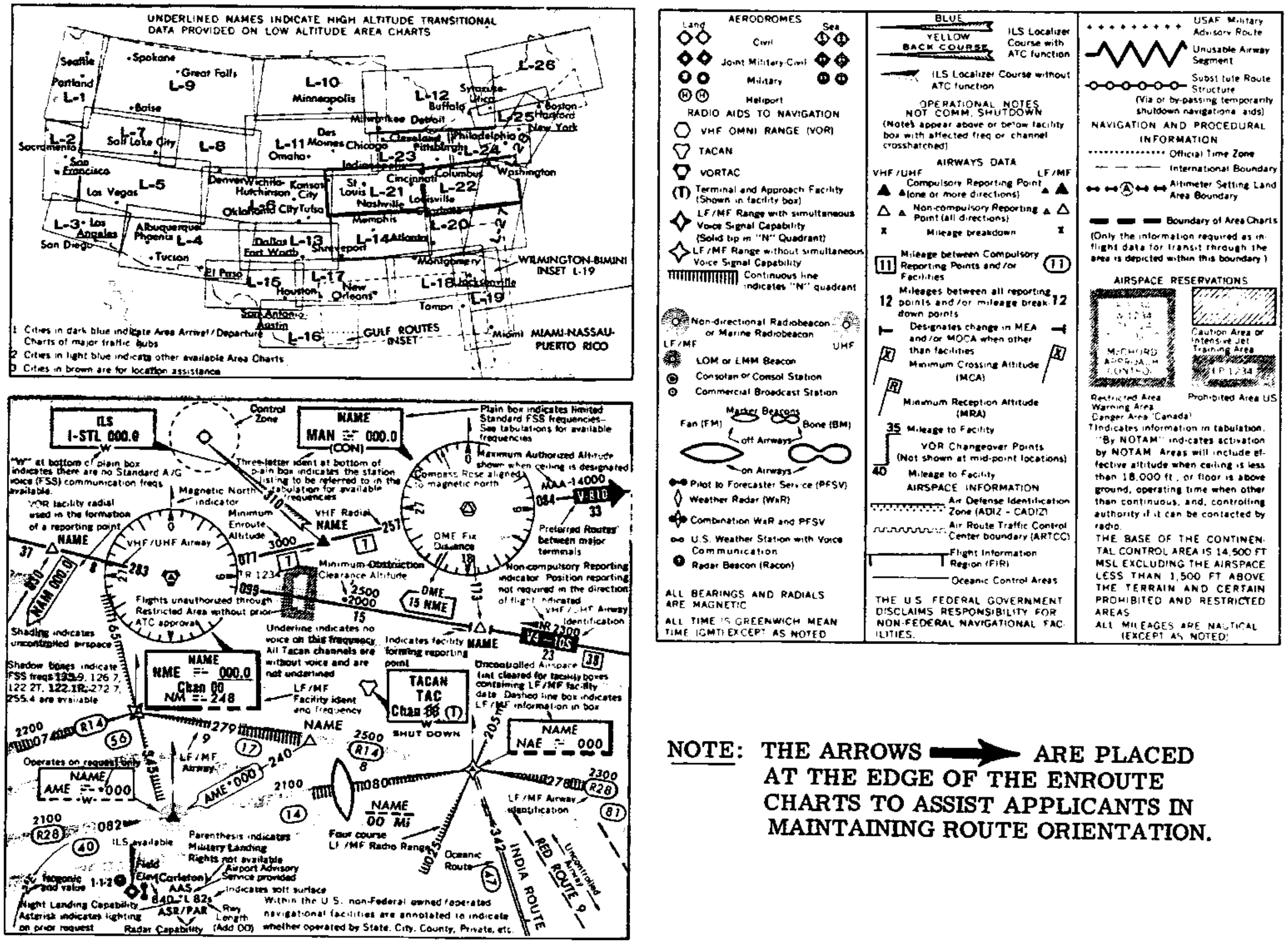
Center SECTOR Discrete Frequencies								Center AREA Discrete Frequency
INDIANAPOLIS								
VHF (Low)				VHF (High)				
118.2	123.6	124.2	124.4	132.7	133.05	133.45	133.75	124.9
124.8	126.0	127.0	127.1	134.35	134.75	134.9	134.95	
127.4	127.75	128.3	128.4					
128.55	128.8	132.6	135.1					
135.7	135.8							

Center SECTOR Discrete Frequencies								Center AREA Discrete Frequency
KANSAS CITY								
VHF (Low)				VHF (High)				
118.8	128.9	119.0	119.2	132.25	132.4	132.65	132.9	123.9
119.4	119.6	119.7	120.2	132.95	133.1	133.15	133.35	
121.0	123.6	123.8	124.2	133.45	133.8	134.3	134.7	
125.2	125.3	125.4	125.9	134.9	135.0	135.4	135.25	
126.4	127.2	127.8	128.0	135.65				
128.1	132.2	132.8						

AIM-Excerpt

FIGURE 88.—*AIM excerpts—ARTCC communications frequencies.*

ENROUTE LOW ALTITUDE CHART (LEGEND AND SYMBOLS)



NOTE: THE ARROWS ➡ ARE PLACED AT THE EDGE OF THE ENROUTE CHARTS TO ASSIST APPLICANTS IN MAINTAINING ROUTE ORIENTATION.

FIGURE 39.—*Enroute low altitude chart legend.*

ENRONTE LOW ALTITUDE CHART (1) ST. LOUIS TO LOUISVILLE →

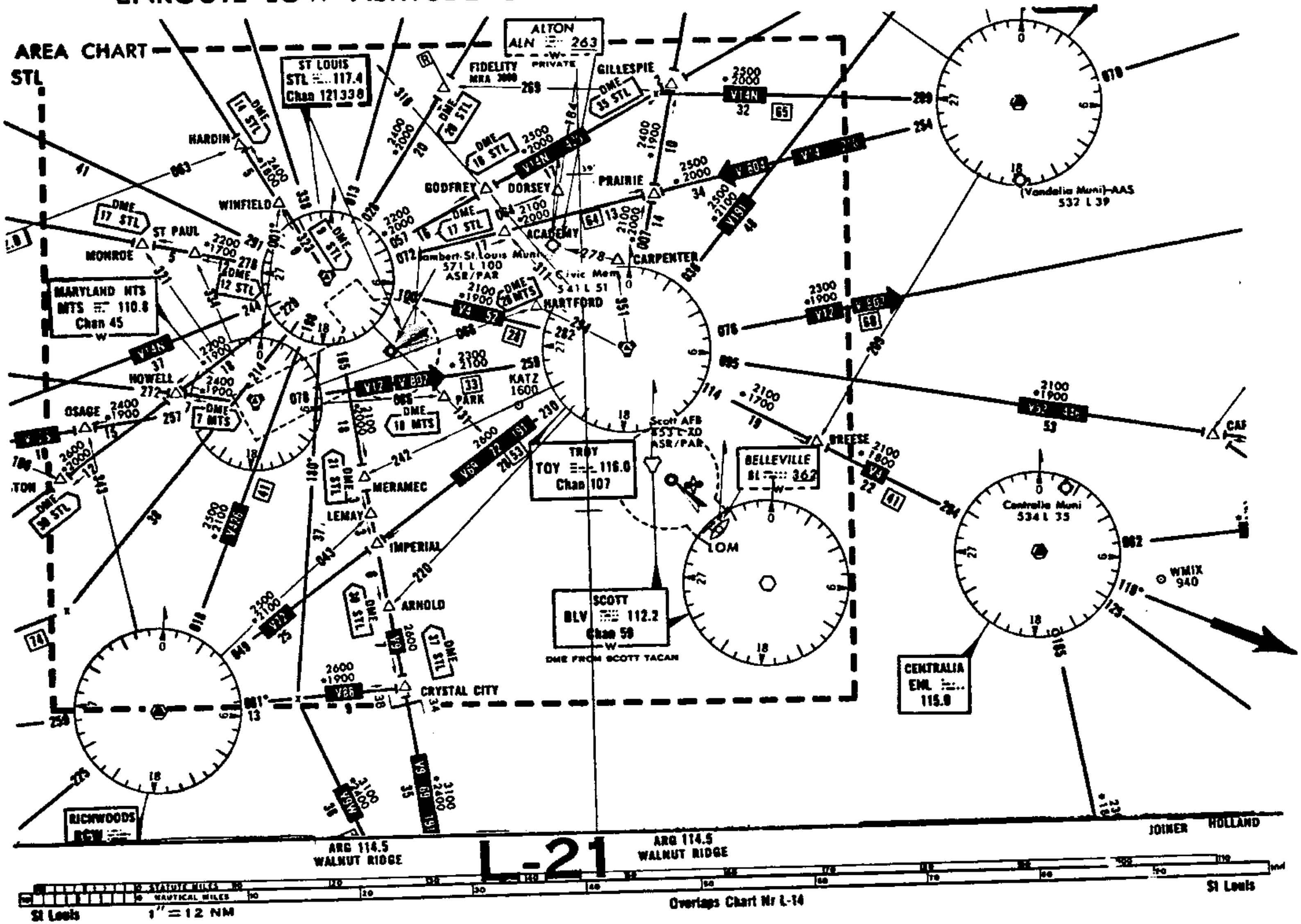


FIGURE 40.—*Enroute low altitude chart* (1).

75

ENROUTE LOW ALTITUDE CHART (2) TO LOUISVILLE

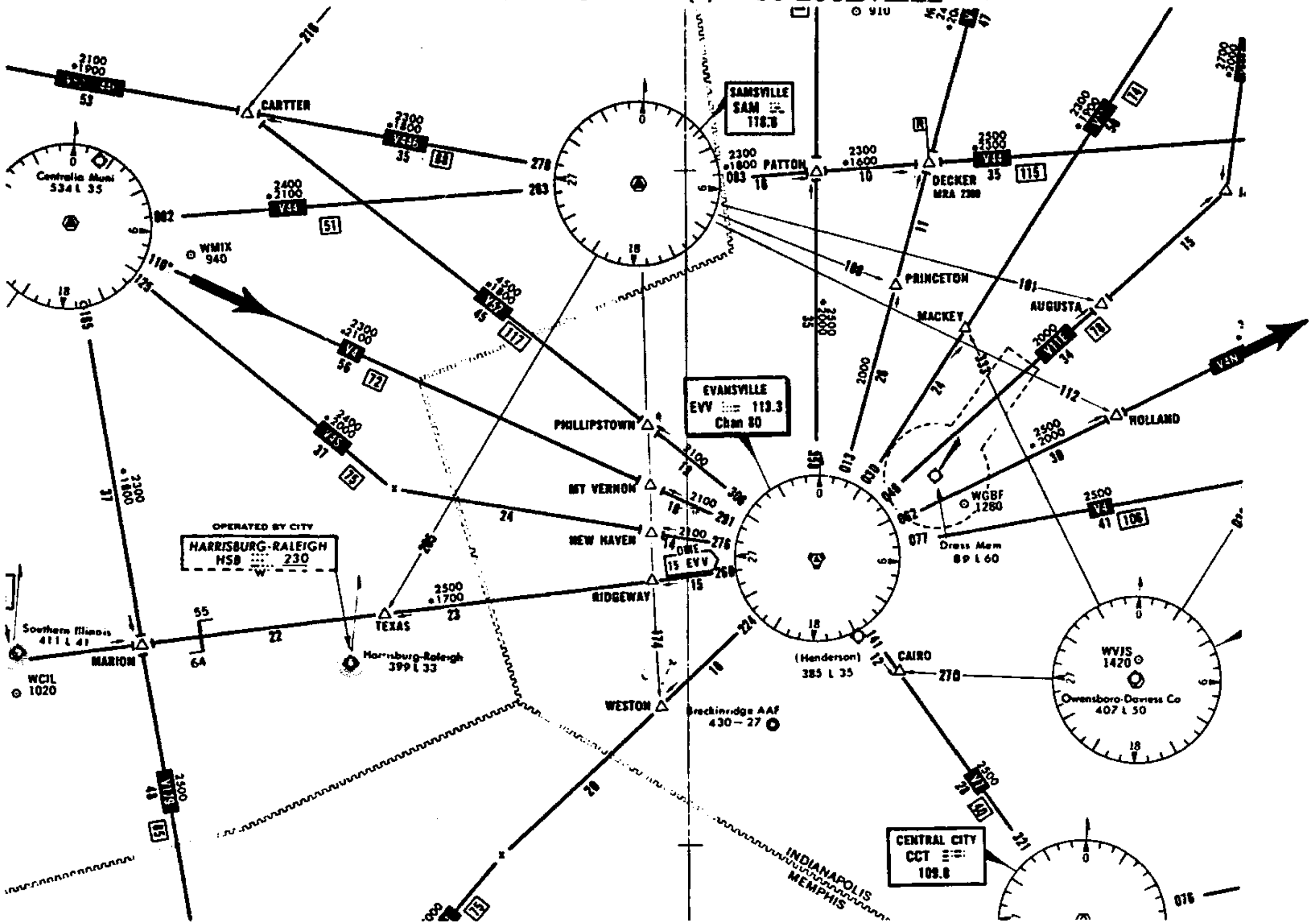


FIGURE 41.—*Enroute low altitude chart* (2).

ENROUTE LOW ALTITUDE CHART (3)

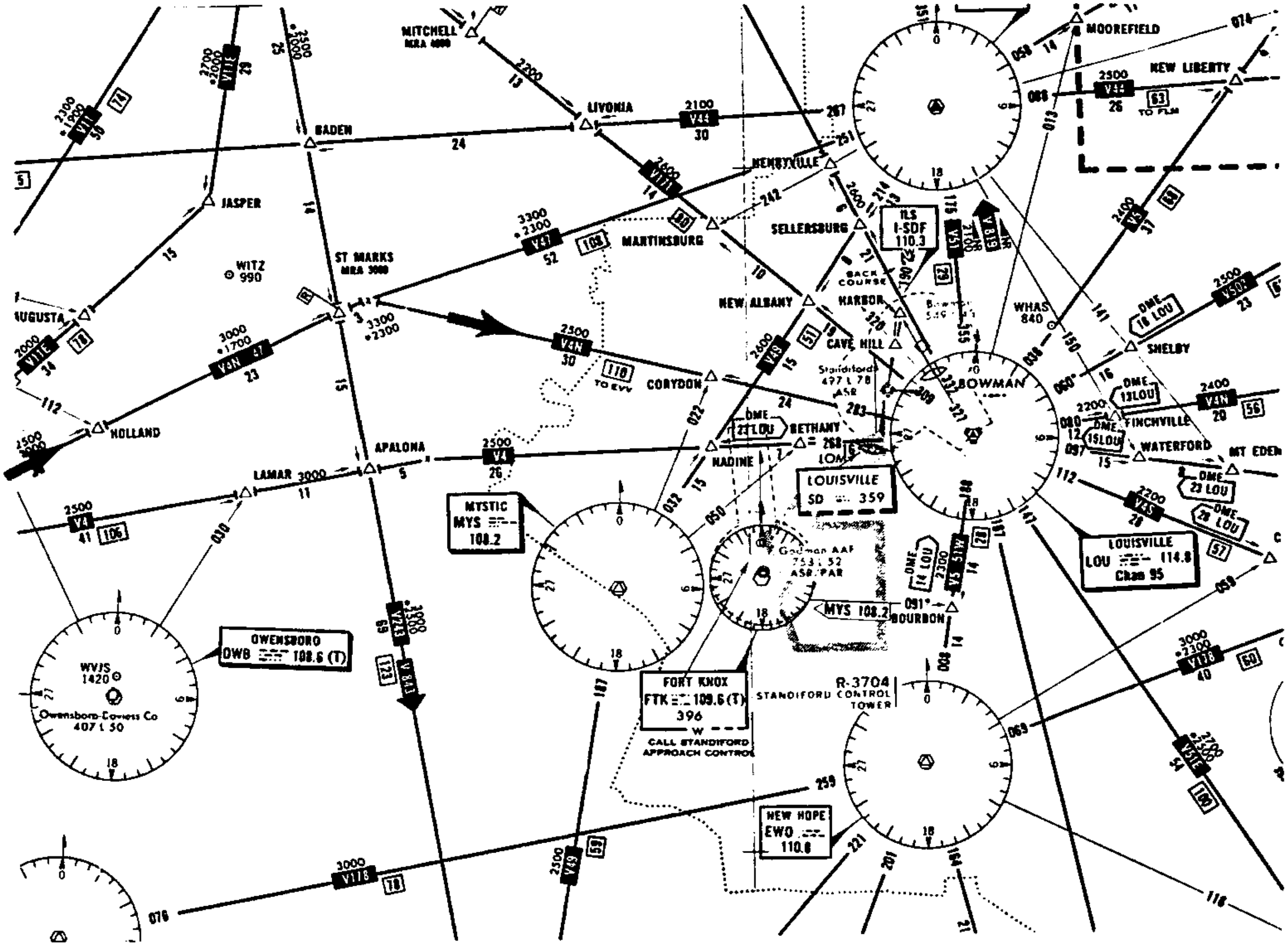


FIGURE 42.—*Enroute low altitude chart* (3).

ENROUTE LOW ALTITUDE CHART (4)

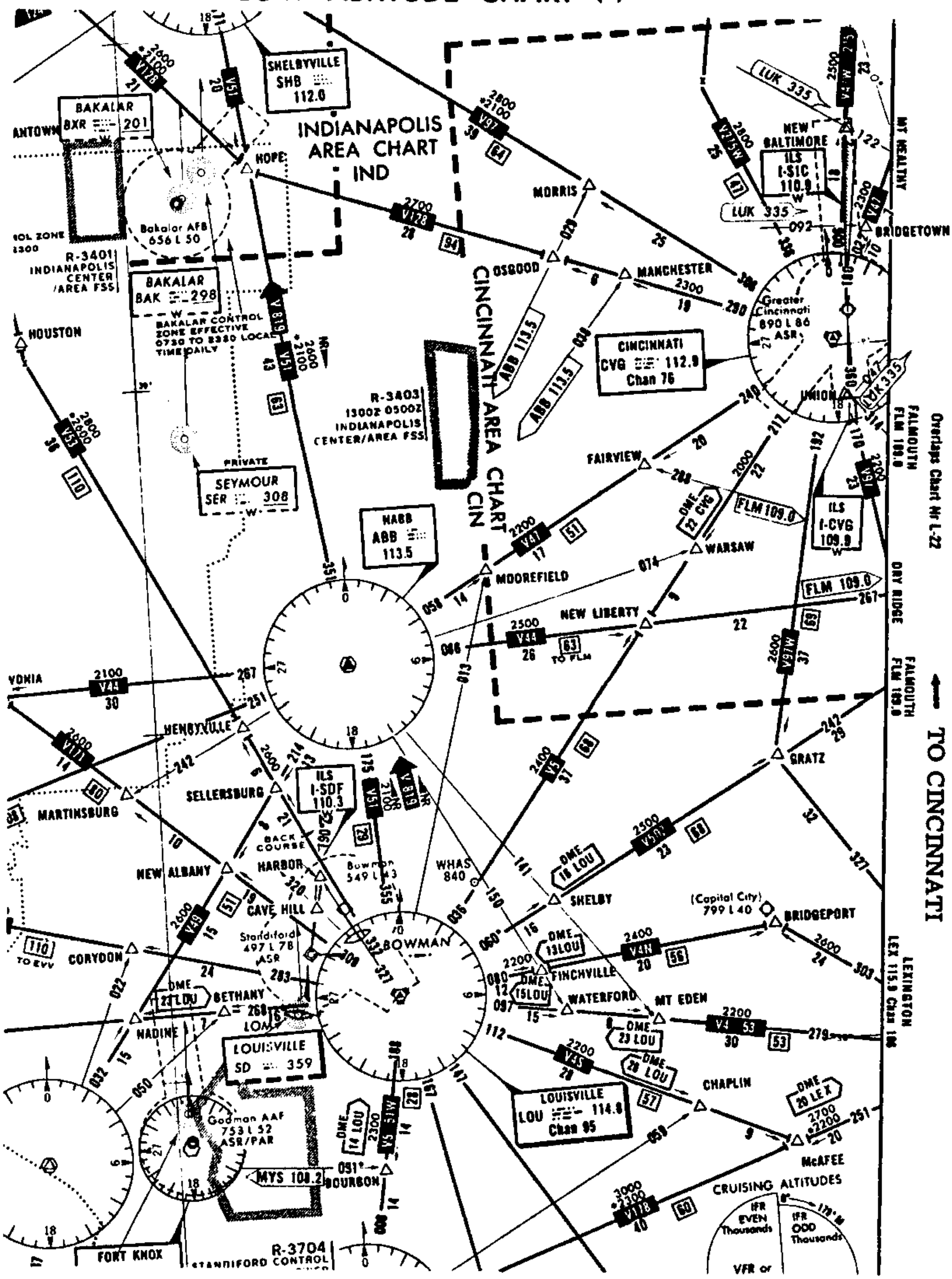


FIGURE 43.—*Enroute low altitude chart* (4).

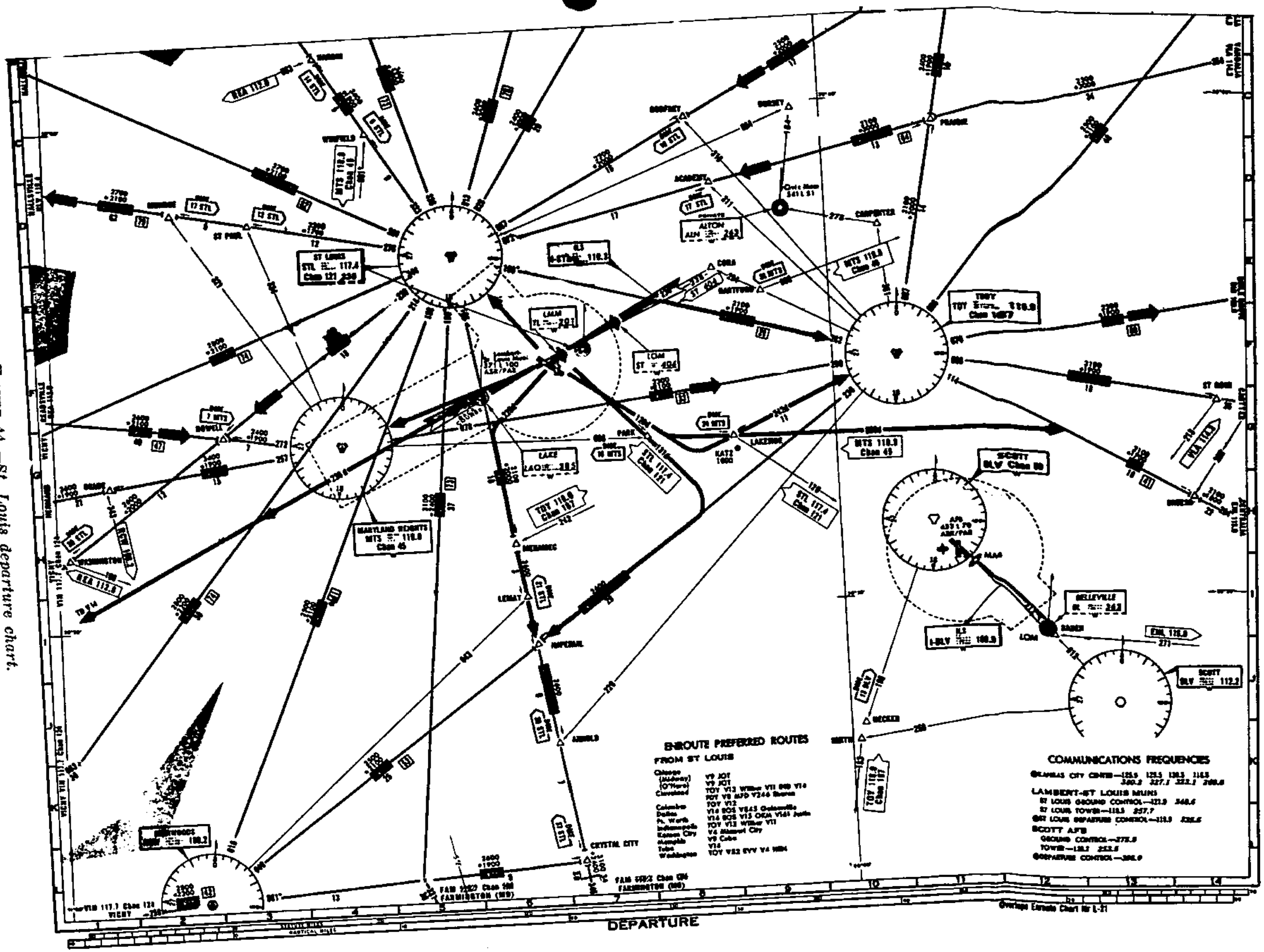


FIGURE 44.—*St. Louis departure chart.*

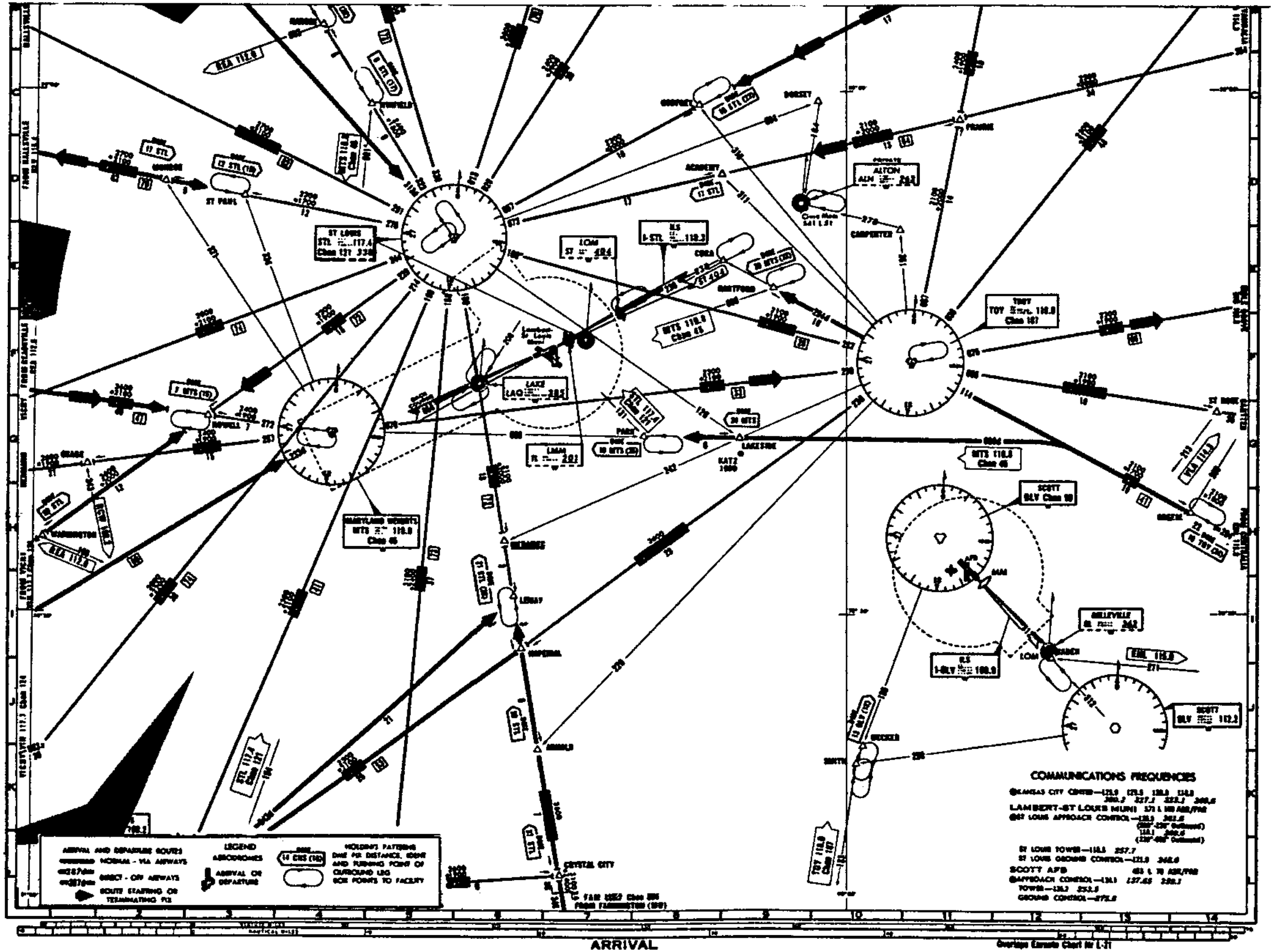


FIGURE 45.—*St. Louis arrival chart.*

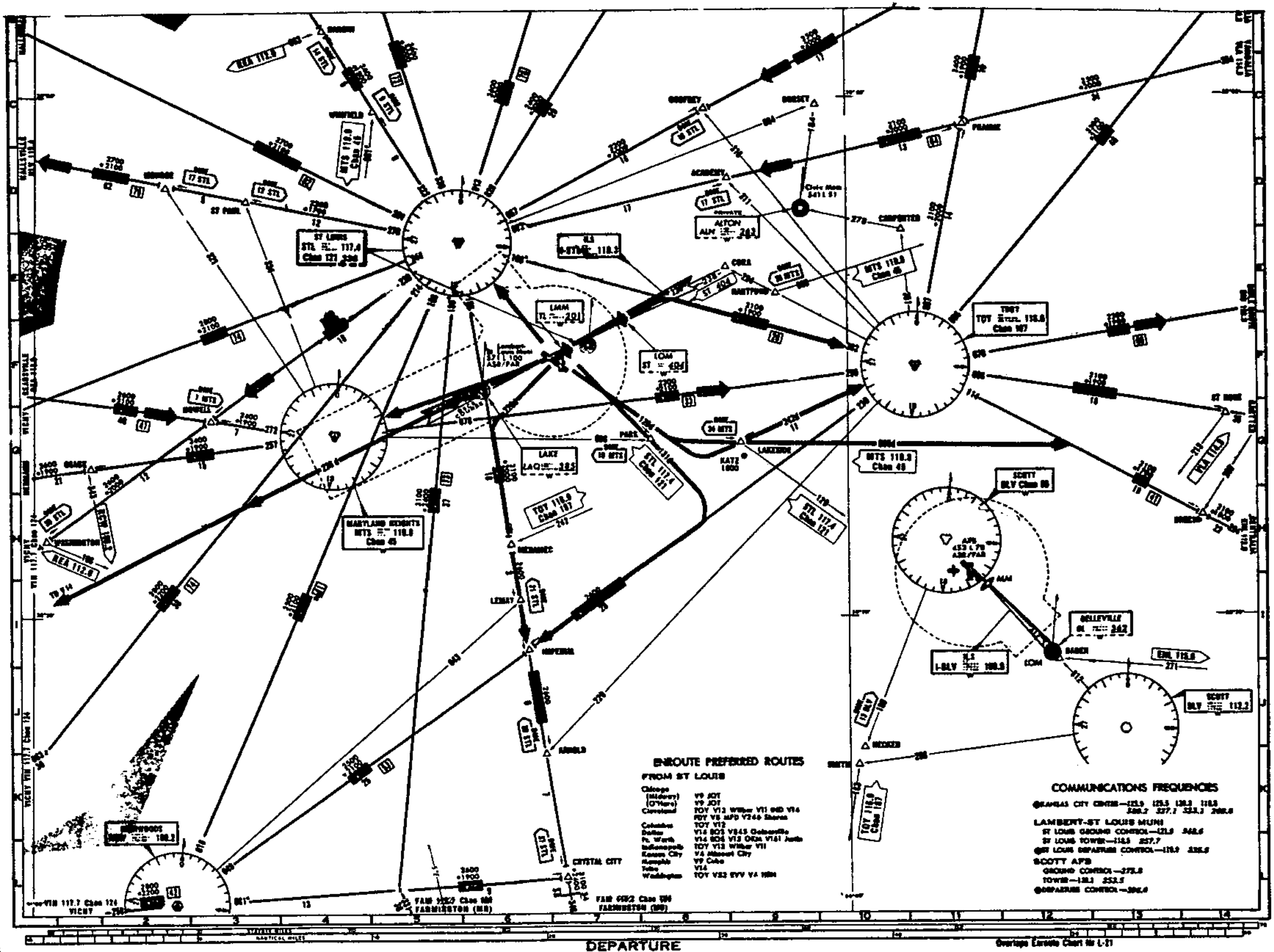


FIGURE 44.—St. Louis departure chart.

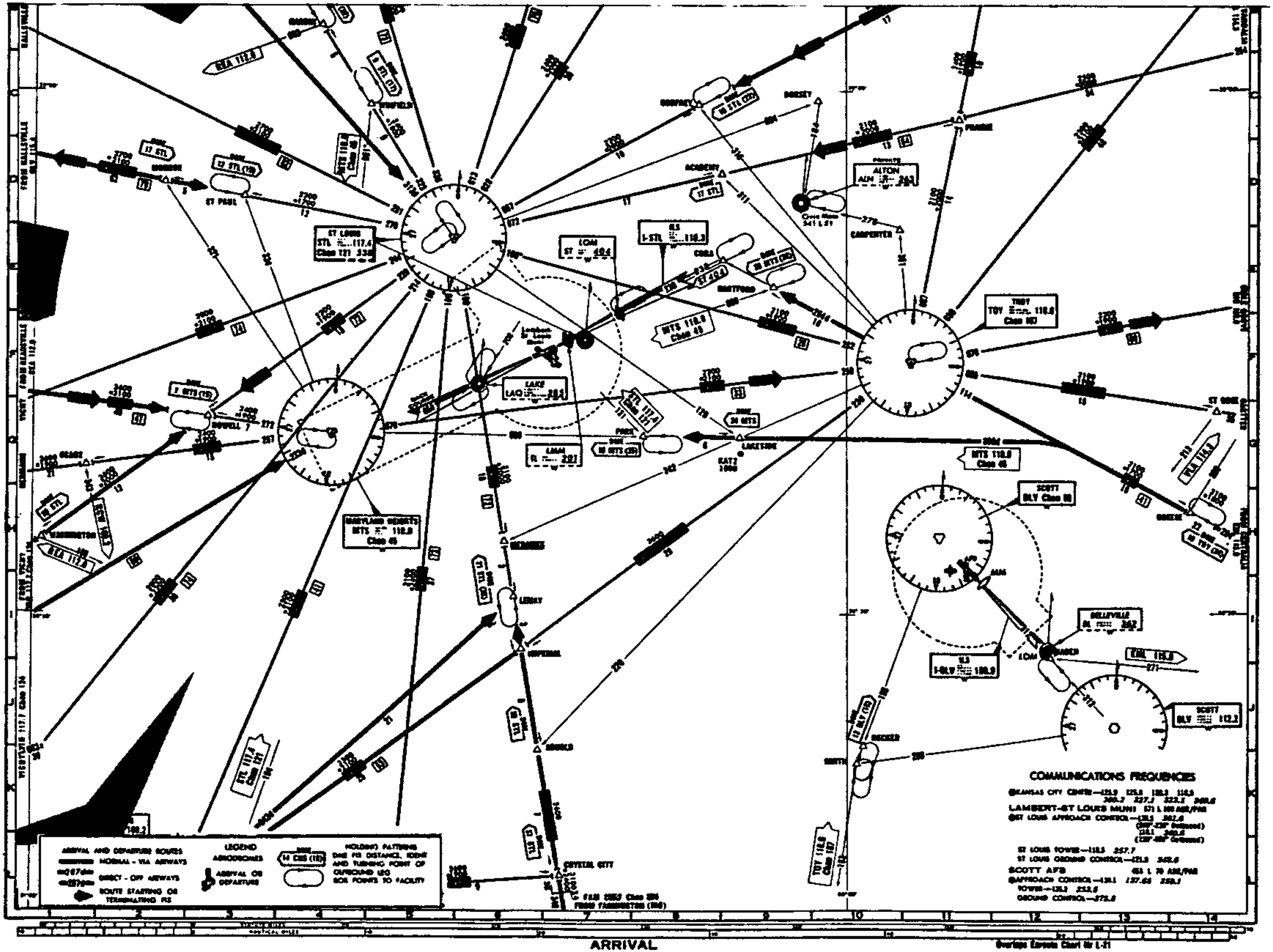


FIGURE 45.—*St. Louis arrival chart.*

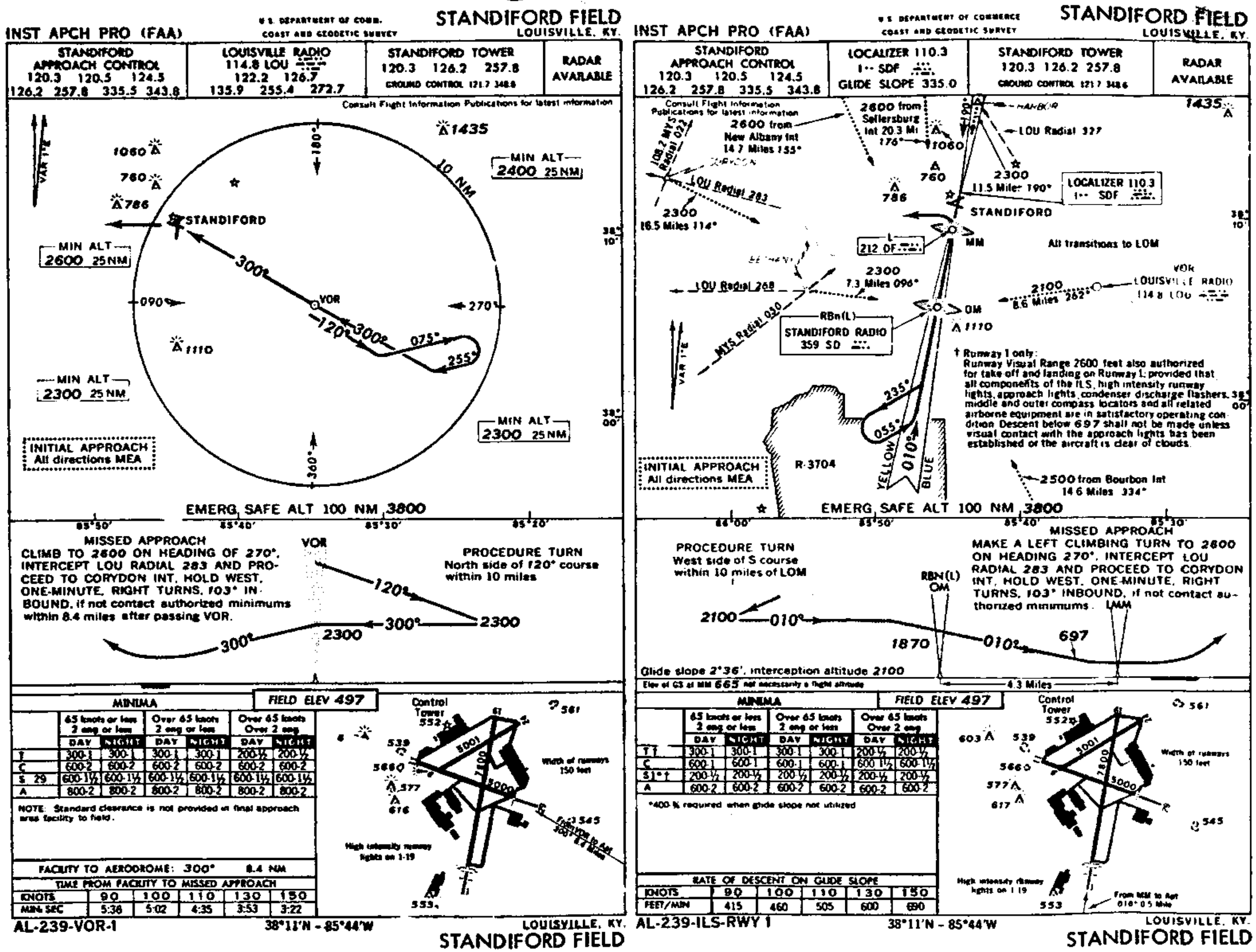
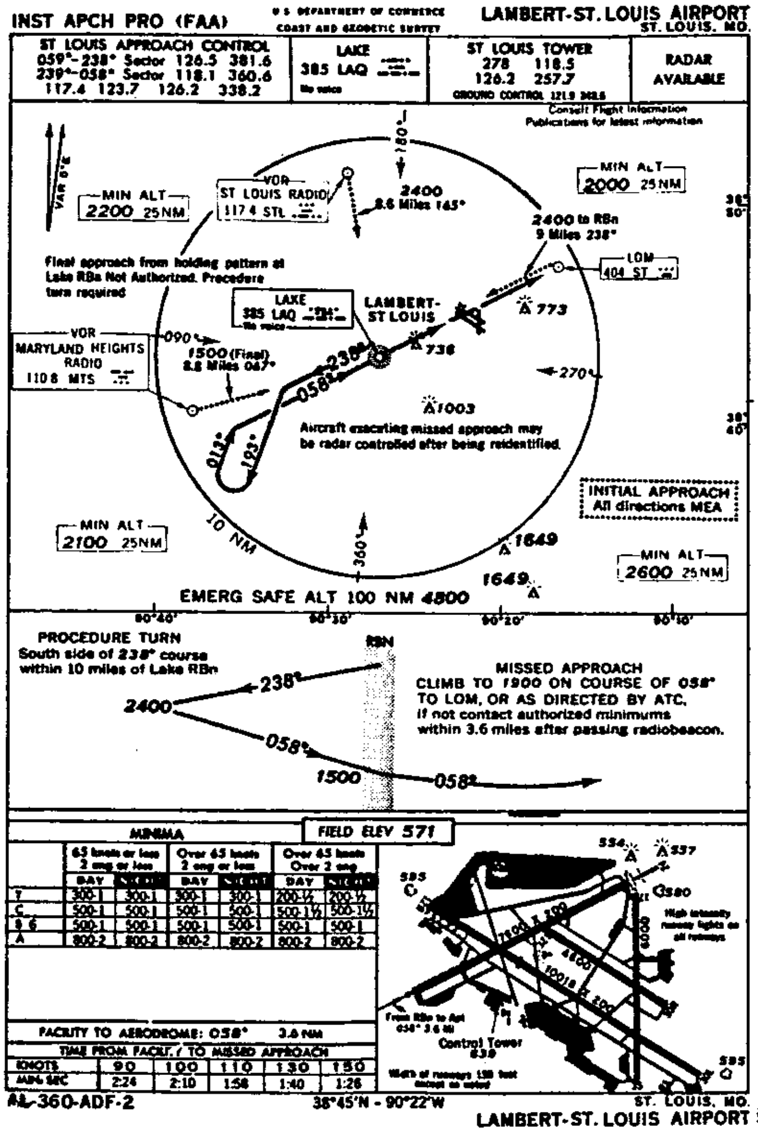


FIGURE 48.—*Louisville—instrument approach procedure charts.*



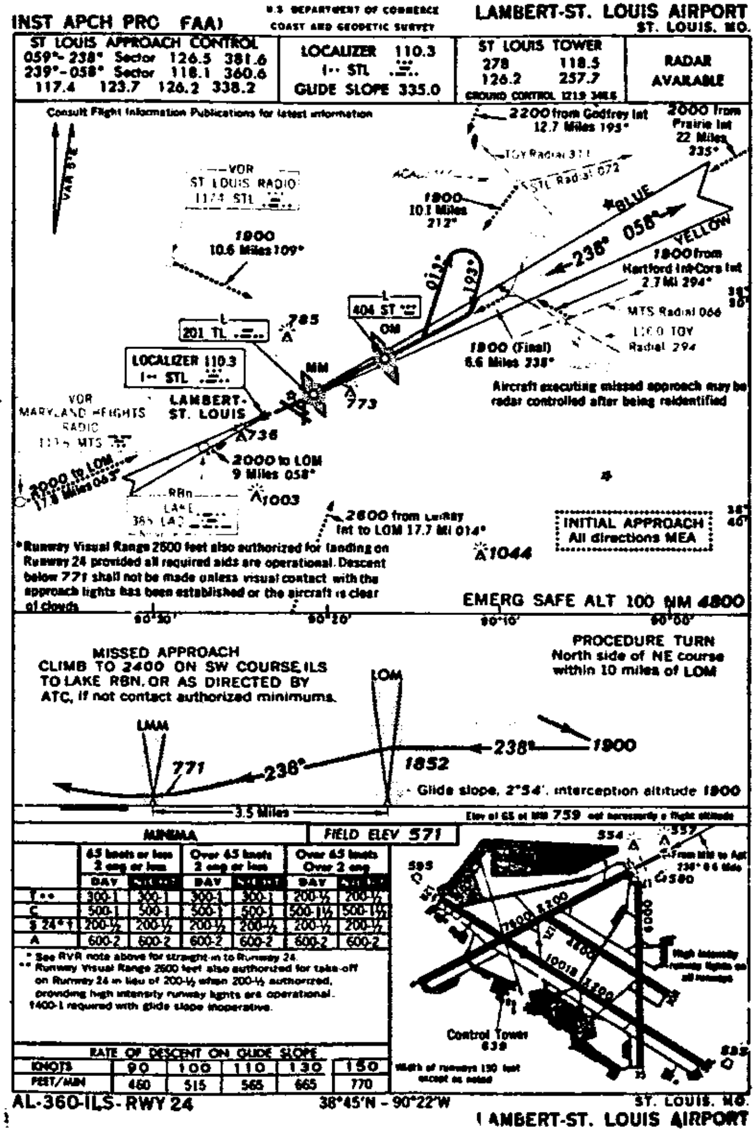


FIGURE 49.—*St. Louis—instrument approach procedure charts.*

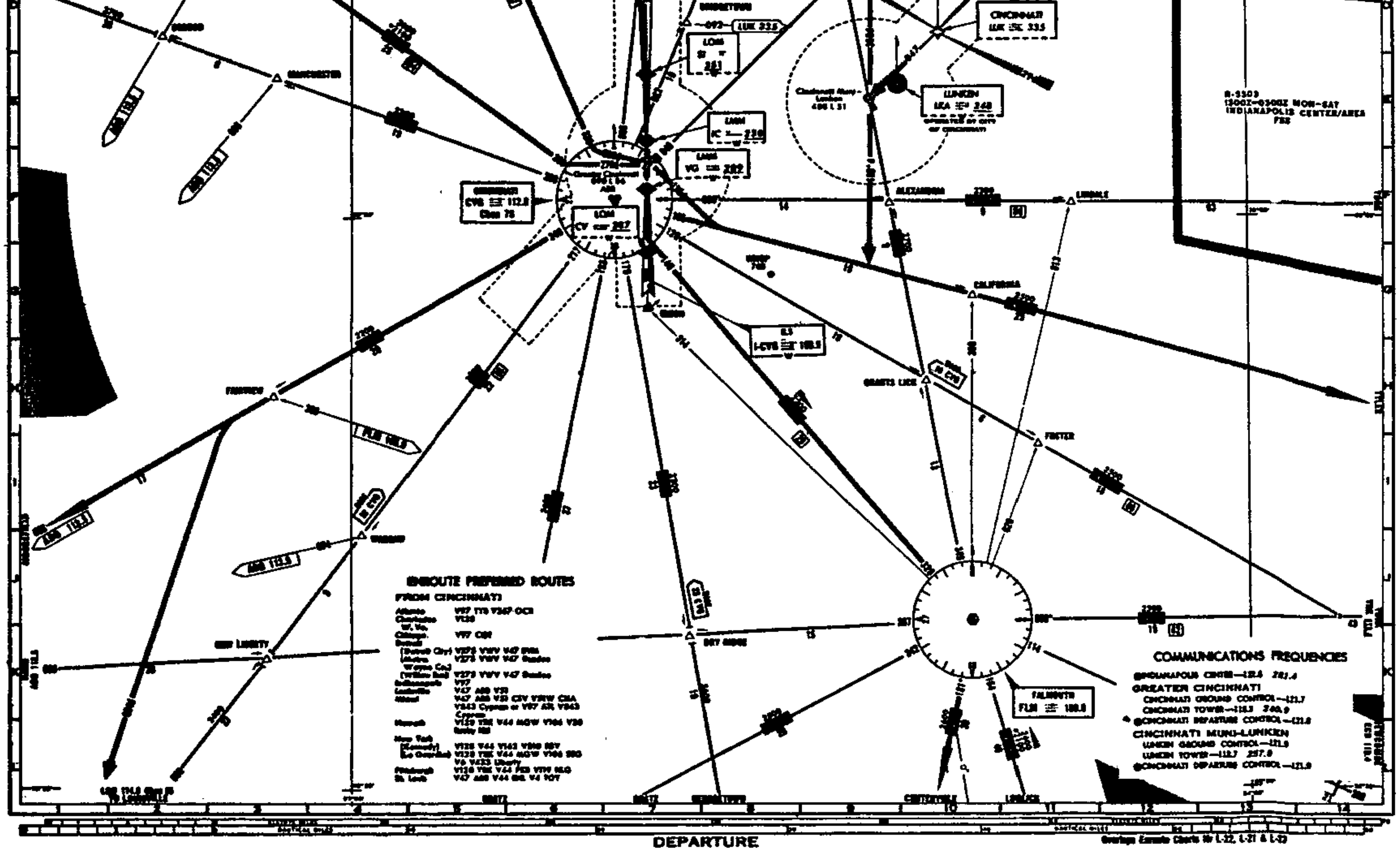


FIGURE 46.—*Cincinnati departure chart.*

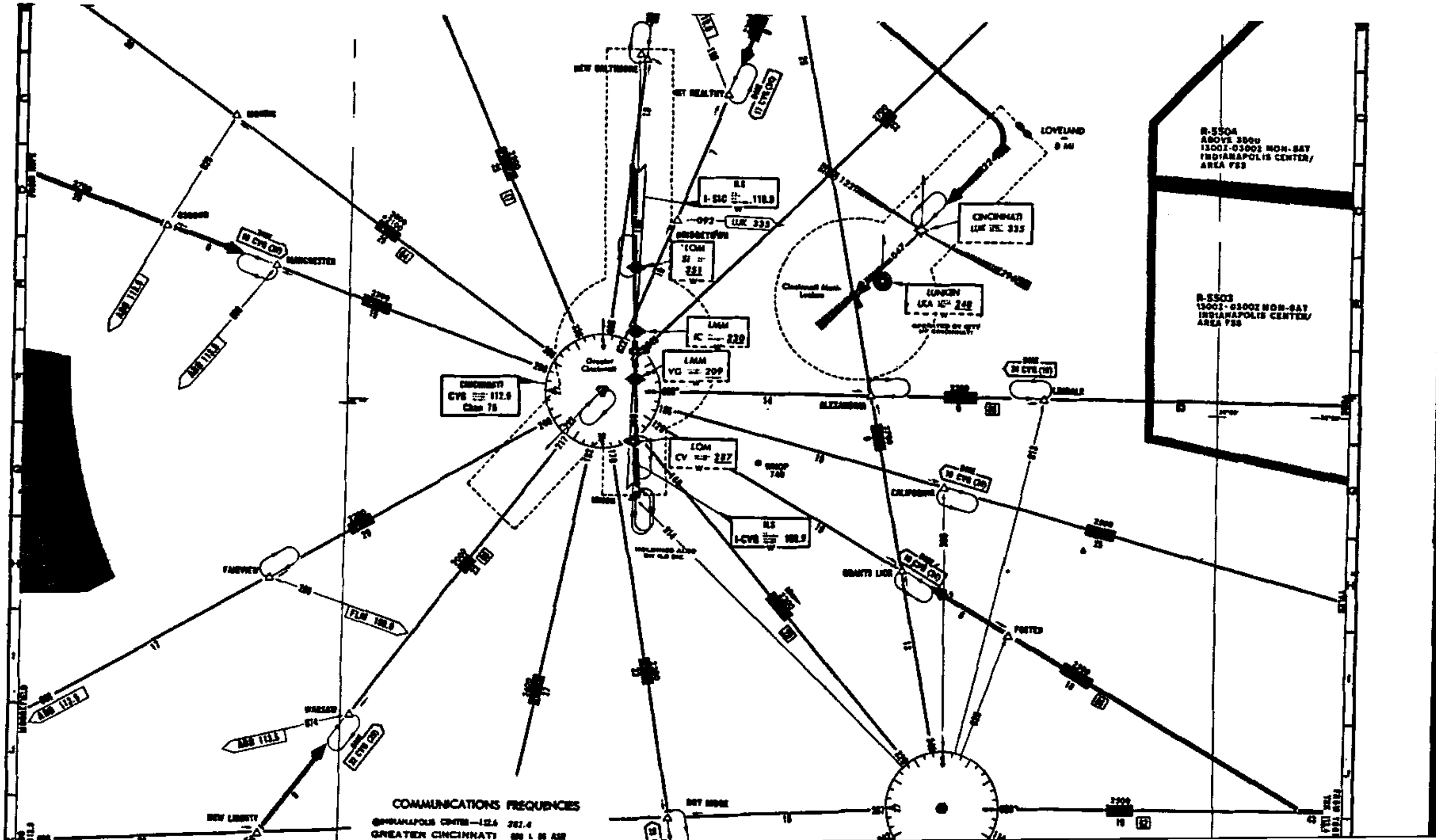


FIGURE 47.—Cincinnati arrival chart.

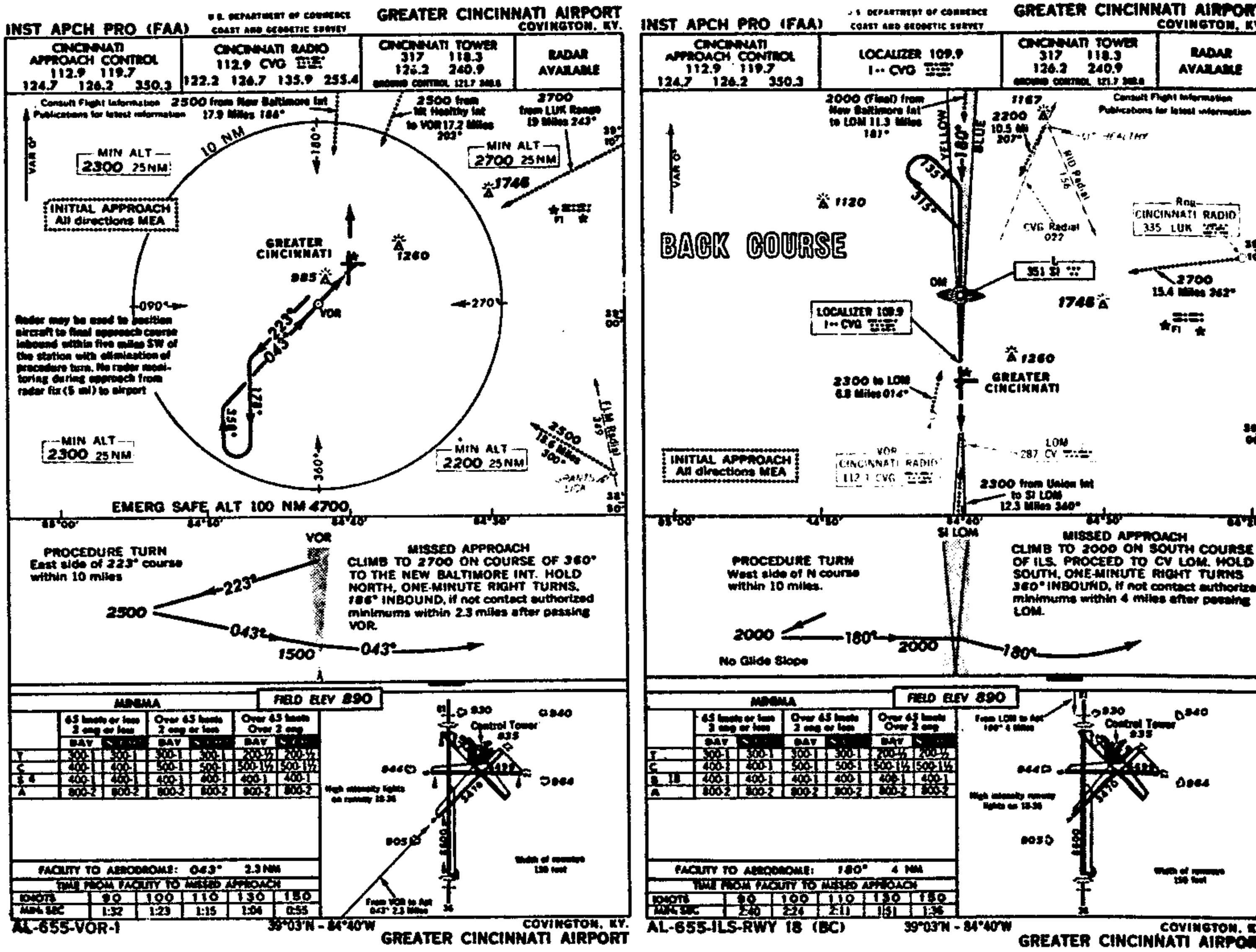


FIGURE 50.—*Cincinnati—instrument approach procedure charts.*

☆ U. S. GOVERNMENT PRINTING OFFICE : 1968 O - 228-585