The AOPA Instrument En Route Procedures Course

A uniform system of study for the noninstrument pilot who wishes to become more proficient and fly more safely by learning more about the air traffic control system under the direction of a qualified instructor.

The AOPA Instrument En Route Procedures Course is designed to follow the AOPA Instrument Nav/Com Course and is the third in a series of five AOPA flight training courses leading to an FAA instrument rating. This course consists of four hours of ground school and four hours of flight instruction.

A Safety Project of the AOPA Foundation, Inc.

Developed under an AOPA Foundation grant by the Department of Aviation, Ohio State University

• The AOPA Foundation, Inc., has attempted to make available to private pilots, through this and its companion courses, a programmed approach toward attainment of an instrument rating. This manual is intended to help those who seek greater aeronautical knowledge and proficiency to gain insight in the use of the en route portion of the air traffic control system. It was developed by the Ohio State University Department of Aviation and instructor William Hubbard (AOPA 31737) under an AOPA Foundation grant.

The AOPA Instrument En Route Procedures Course Manual was designed to answer questions most frequently asked by noninstrument pilots concerning IFR en route techniques and requirements. It is not intended, however, to serve as an independent means of teaching such techniques and procedures. As a text, it is meant to be used under the guidance of an instructor who is teaching the course in accordance with an instructor's syllabus which is furnished by the AOPA Foundation. In addition to being offered through the AOPA Flight Training Clinic program, complete materials for the AOPA Instrument En Route Procedures Course will be provided by the AOPA Foundation to qualified flight instructors on request.

Development of the AOPA Instrument En Route Procedures Course, its associated training aids and this manual were made possible by voluntary contributions to the AOPA Foundation, Inc., by AOPA members. The course represents another addition to the many projects the AOPA Foundation has sponsored in the interest of furthering aviation education and flying safety.

For information on how instructors may obtain copies of the AOPA Instrument En Route Procedures syllabus, turn to the back page of this manual.

In this course the pilot will learn to use his knowledge of handling an airplane by reference to instruments only as a means of flying from one place to another safely on established airways and under the control of the Air Traffic Control service of the Federal Aviation Agency.

En route instrument flight is essentially a management task for the pilot. Utilizing the basic instrument flying skills learned and the knowledge gained in the AOPA 360° Rating Course and the AOPA Instrument Nav/Com Course, you will now learn how to manage an instrument cross-country flight, how to file a flight plan, how to copy an IFR flight clearance, the mechanics of an instrument departure, and the correct radio techniques and phraseology for the entire flight up to the point where it would come under the jurisdiction of an approach control. Approach control and final landing will be the subject of a future course.

To conduct a flight under actual instrument conditions, certain minimum equipment is required by Part 91 of the Federal Air Regulations. This includes two-way radio communications, navigation equipment appropriate to the ground facilities, gyroscopic rate of turn indicator, bank indicator, a sensitive altimeter adjustable to barometric pressure, a clock with a sweep second hand, artificial horizon, gyroscopic direction indicator, and all instruments necessary for VFR flight.

To obtain the greatest benefit from this course, the flying portion should be done in an airplane equipped for IFR flight.

AIRWAYS/ROUTE SYSTEM

Two route systems have been established for air navigational purposes in the continental United States—the VOR and L/MF system, and the Jet Route system. In this course we will not discuss the L/MF portion, which is now practically nonexistent.

VOR SYSTEM

The VOR airways are based solely on VOR navigation aids and are shown on aeronautical charts by the letter "V" (Victor) followed by an airway number.

Even-numbered airways—Victor 12, Victor 50, etc.—run generally east and west. Odd-numbered airways are aligned north and south. It can be seen that the airways numbering system is similar to the numbering of the U. S. highway system. There is another similarity. Some route segments are common to several airways. In this case all airways numbers are shown on the chart.

Preferred airways between major terminals are designated "800" airways. Although these are often made up of several numbered airway segments, the pilot need only specify the 800 series airway assigned to the route he is flying.

The Jet Route system includes all instrument flight above 18,000 feet MSL to flight level 450 (45,000 feet MSL).

MINIMUM EN ROUTE ALTITUDES

The minimum en route altitude (MEA) is the lowest altitude a pilot can fly along a particular route or route segment and be able to receive a reliable omni signal at all points along the route. It is printed along the airways on instrument flight charts. This altitude will also assure the pilot of 1,000 feet clearance above the ground within five miles of the airway center line in nonmountainous terrain and 2,000 feet clearance above mountainous terrain, also within five miles of the airway center line.

OBSTRUCTION CLEARANCE ALTITUDE

The minimum obstruction clearance altitude (MOCA) is also published on en route charts. It is a number preceded by an asterisk and indicates the minimum obstruction clearance altitude of the route segment and also the minimum altitude at which a reliable signal can be received within 25 miles of the omni station.

This altitude would normally be used only in case of emergency. It may be used as a minimum en route altitude within 25 miles of an omni station.

NAVIGATION RADIO AIDS

Only the navigation aids used in the cross-country portion of the instrument flight will be studied in this course. These include the L/MF ranges, radio beacons, VOR, Tacan and Vortac. Refer to page 8 of the AOPA Instrument Nav/Com Course pilot training manual for a chart comparing navigation aids.

LOW/MEDIUM FREQUENCY RANGES

L/MF ranges are disappearing from use with only a very few airways still predicated on their operation. For this reason we will only list their classifications.

L/MF ranges use a letter to indicate the power output of the station. These are R (more than 150 watts), MR (between 50 and 150 watts), and M (less than 50 watts).

RADIO BEACONS

Low and medium frequency range beacons transmit nondirectional signals that enable the pilot of an aircraft equipped with an automatic direction finder (ADF) to determine his position by taking bearings on at least two stations and to fly toward any station. The radio beacons used in air navigation normally transmit in the 200-400 kc frequency band.

Power output and classification of these beacons is determined by the operational purpose it serves. Beacon classifications are:

Compass locators—power output less than 25 watts, range 15 miles.

MH facility—power output less than 50 watts, range 25 miles.

H facility—power output more than 50 watts but less than 2,000 watts, range 50 miles.

HH facility—power output greater than 2,000 watts, range 75 miles.

When an LF nondirectional homing beacon is used in conjunction with instrument landing system markers, it is called a compass locator.

All radio beacons except the compass locators transmit a continuous three-letter identification in code except during voice transmission.

VHF OMNIDIRECTIONAL RANGE

Omniranges (VOR) operate in the frequency band between 108 and 118 mc and have a power output of approximately 200 watts. Because the equipment is VHF, it is subject to line of sight restriction, thus its range varies with the altitude of the receiving equipment.

The accuracy of course alignment of VOR is usually plus or minus 1°. This may vary because of improper use or adjustment of either ground or airborne equipment. All omniranges are flight checked periodically by the FAA to maintain proper operation of transmitting equipment.

Remember that the only *positive* way of identifying a ground station is by its coded identification or by the recorded voice identification now included at many stations.

You should never assume that you have the omni tuned in properly because you can hear the voice transmission of the Flight Service Station (FSS). Many Flight Service Stations broadcast remotely over several omni stations, each with a different frequency and different identification. In some cases none of these has the name of the parent FSS.

Part 91.25 of the Federal Aviation Regulations requires certain accuracy tests before the pilot is authorized to use the VOR as a navigation aid under IFR conditions. Each aircraft VOR must be maintained, checked and inspected under an approved procedure or it must be operationally checked within the preceding 10 hours of flight time and within 10 days before flight to meet the following requirements:

Aircraft omni receivers must be accurate within plus or minus 4° as determined by a ground check or plus or minus 6° using an airborne check. Error in excess of these limits must be corrected before IFR flight is commenced.

The FAA has provided three means of checking the VOR receiver:

(1) VOR Test Facility (VOT), (2) certified airborne checkpoints and (3) certified checkpoints on the airport surface.

VOT transmits a test signal for VOR receivers which provides a quick means of determining the accuracy of the receiver. The radiated test signal is used by tuning to the published VOT frequency. With the flight path deviation indicator (FPDI) centered, the omni bearing selector should read zero with the TO-FROM indication reading FROM. Information concerning an individual test signal may be obtained from the local Flight Service Station, and all VOT's are listed in the Airman's Information Manual.

Airborne and ground checks are made by determining which radial is indicated when the airplane is at a specific point on the airport surface or over a specific landmark in the vicinity of the airport. This is the most common way to check for airborne VOR receiver accuracy. However, if dual system VOR (units independent of each other except for antenna) is installed in the aircraft, the person checking the equipment may check one system against the other. Both VOR's should be tuned to the same VOR ground facility, and the indicated bearings to the station of each set should be noted. The maximum permissible variation is 4°. A list of the FAA designated VOR checkpoints is found in the Airman's Information Manual.

Each person making a VOR operational check must make a record of such in the aircraft logbook or other permanent record.

TACTICAL AIR NAVIGATION

Tacan was developed by the military air forces to meet specific requirements that could not be met through the civil VOR system.

Tacan ground equipment consists of a fixed or mobile transmitting unit. It sends a signal that is transformed into a visual presentation of azimuth and distance information in the receiving aircraft. It operates in the ultra-high frequency (UHF) band.

While Tacan does not operate through conventional VOR equipment, it is possible to integrate the two systems in what is called Vortac. Vortac provides VOR azimuth information, Tacan azimuth, and Tacan distance measurement from one site. Where automatic voice identification is used, the word "Vortac" is added to the usual VOR identification.

There are three classes of VOR's in service—high altitude, low altitude and terminal. They are identified by the letters H, L and T.

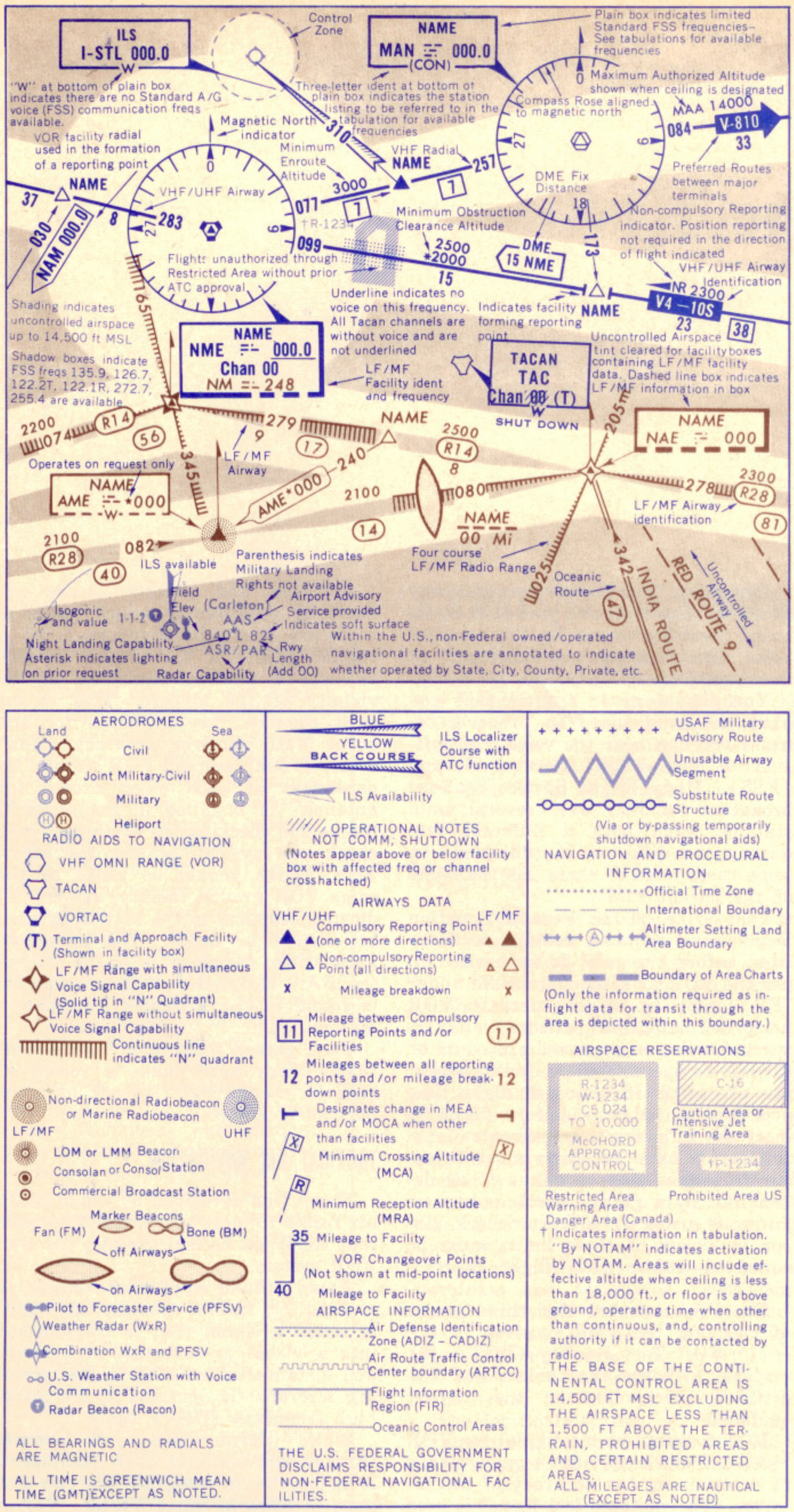


FIGURE 1

CHARTS USED IN INSTRUMENT FLIGHT

The IFR pilot utilizes airways to get from point to point rather than referring to terrain features and a map. Because the instrument pilot flies solely by reference to instruments and uses only electronic aids for navigation, he needs special kinds of navigation charts.

His destination is an omni station, a nondirectional radio beacon or an instrument landing system. He uses electronic intersections along airways to keep track of his progress.

Instrument flight requires the following special charts:

1. Low altitude area charts (arrival side and departure side)
2. En route charts (high altitude and low altitude)
3. Standard instrument departure (SID) charts
4. Approach and landing charts.

In this course we will be concerned mainly with departure charts and en route low altitude charts.

LOW ALTITUDE EN ROUTE CHARTS

The continental United States, Nassau, Puerto Rico and the Gulf of Mexico are covered by 28 low altitude en route charts. The Coast and Geodetic Charts (which we will study in this manual) are issued monthly to cover revisions in the airways system. Each chart has its own legend to aid in its use (Figure 1).

A limited amount of radio frequency information is shown on the chart. Detailed information is given on one or more side panels. Figure 2 shows the Communications and Aerodrome Data section of the low altitude en route chart. All ground control, tower, departure control, and approach control frequencies are listed. To get complete information on all of these frequencies, it is usually necessary to refer to the top of the section to determine the meaning of the symbols used in conjunction with the frequencies listed.

AERODROMES

Symbols used to designate aerodromes are essentially the same as those used on VFR aeronautical charts. They are printed in blue and brown on the en route charts (Figure 3).

Information printed next to the airport symbol indicates field elevation, lighting facilities and length of the longest runway in feet. The last two figures are dropped in showing runway length. Thus the length of the longest runway at Columbus Municipal Airport (Figure 4) is 10,700 feet.

Radar information is given for military airports and major terminals. The letters ASR (Figure 4) indicate that Columbus has approach surveillance radar. At some airports you will find "PAR" for precision approach radar.

Control zones, showing the area of

positive control around controlled airports, are enclosed by dash lines. These form the familiar keyhole pattern with the elongated portions showing the approach corridors to the airport (see arrow in Figure 4).

White areas on the chart indicate controlled areas, and brown areas are those that are not controlled (Figure 5).

OMNIRANGES

VHF omnirange (VOR) stations are shown by three symbols on en route charts. Figure 6a is a VHF omni station. Figure 6b is a Tacan station. Figure 6c is a Vortac station.

Each omni symbol has a box printed nearby to show the name of the facility, the identifying code letters, the code in dots and dashes, and the frequency of the station in megacycles.

The symbol (T) following the frequency indicates the omni series as a terminal and approach facility only and has no airways function (Figure 6a).

This figure also has a heavier line along the bottom and along one side of the facility box. This is called a shadow box and indicates the availability of certain FSS frequencies at the facility (see the circled portion of Figure 1 for a list of available FSS frequencies).

FIGURE 3

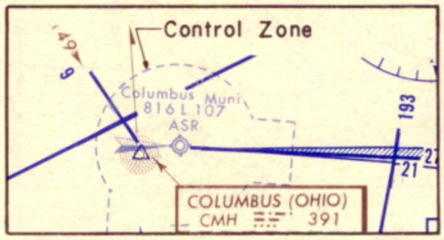


FIGURE 4

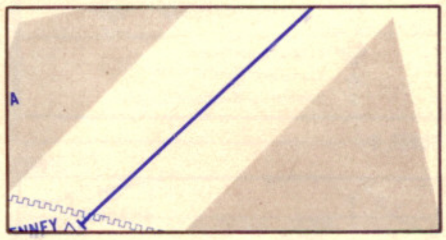


FIGURE 5

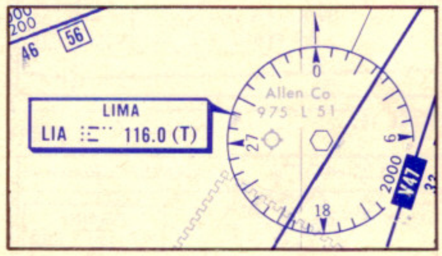


FIGURE 6A

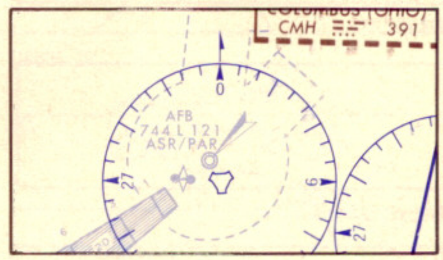


FIGURE 6B

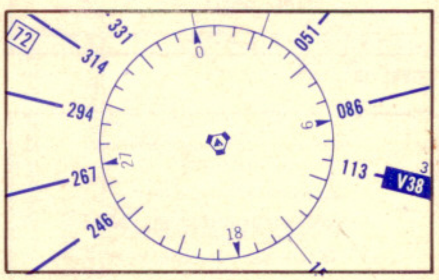
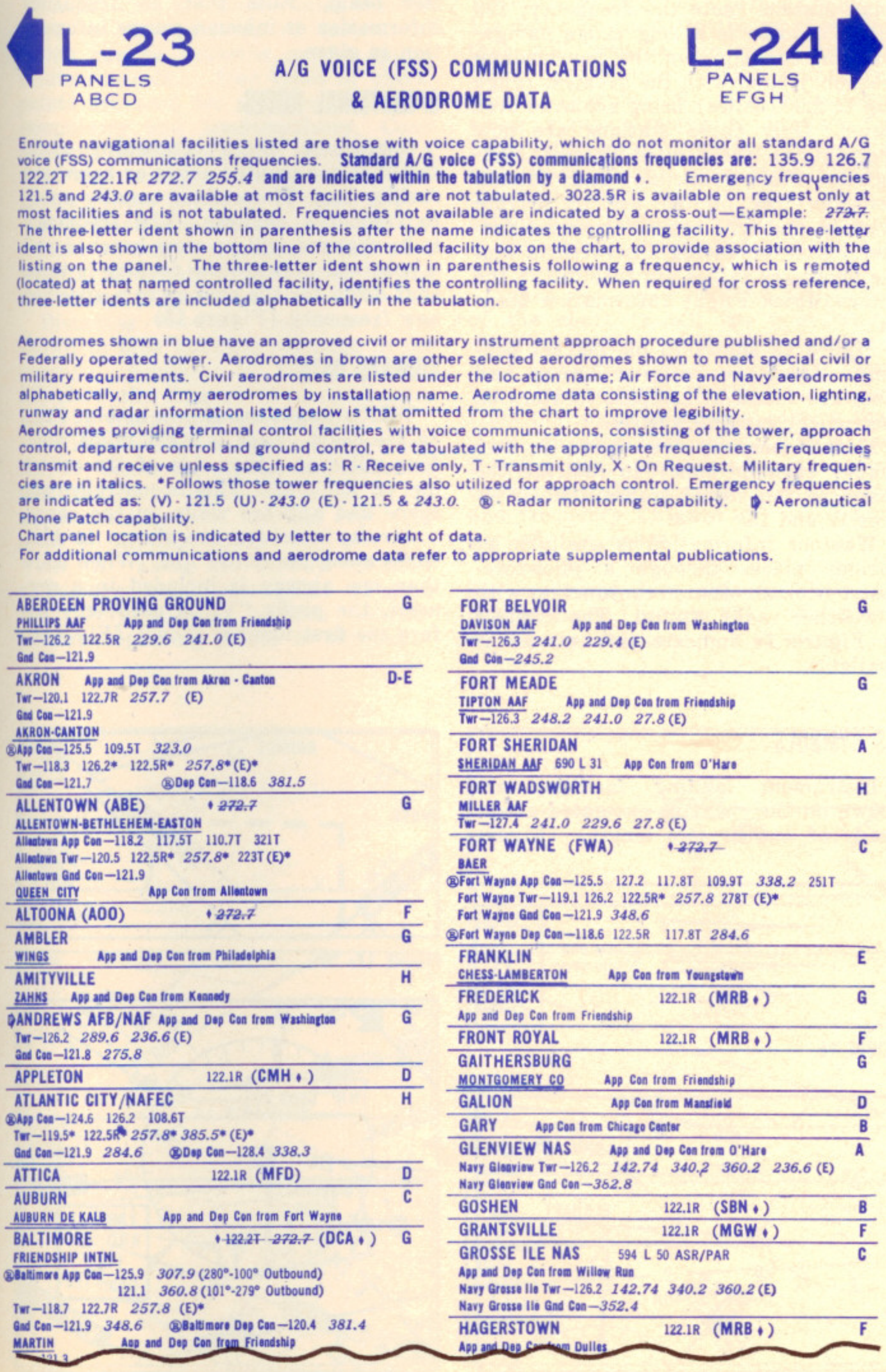


FIGURE 6C



L-23 PANELS ABCD

A/G VOICE (FSS) COMMUNICATIONS & AERODROME DATA

L-24 PANELS EFGH

Enroute navigational facilities listed are those with voice capability, which do not monitor all standard A/G voice (FSS) communications frequencies. **Standard A/G voice (FSS) communications frequencies are:** 135.9 126.7 122.2T 122.1R *272.7* *255.4* **and are indicated within the tabulation by a diamond ♦.** Emergency frequencies 121.5 and *243.0* are available at most facilities and are not tabulated. 3023.5R is available on request only at most facilities and is not tabulated. Frequencies not available are indicated by a cross-out—Example: ~~*272.7*~~. The three-letter ident shown in parenthesis after the name indicates the controlling facility. This three-letter ident is also shown in the bottom line of the controlled facility box on the chart, to provide association with the listing on the panel. The three-letter ident shown in parenthesis following a frequency, which is remoted (located) at that named controlled facility, identifies the controlling facility. When required for cross reference, three-letter idents are included alphabetically in the tabulation.

Aerodromes shown in blue have an approved civil or military instrument approach procedure published and/or a Federally operated tower. Aerodromes in brown are other selected aerodromes shown to meet special civil or military requirements. Civil aerodromes are listed under the location name; Air Force and Navy aerodromes alphabetically, and Army aerodromes by installation name. Aerodrome data consisting of the elevation, lighting, runway and radar information listed below is that omitted from the chart to improve legibility.
Aerodromes providing terminal control facilities with voice communications, consisting of the tower, approach control, departure control and ground control, are tabulated with the appropriate frequencies. Frequencies transmit and receive unless specified as: R - Receive only, T - Transmit only, X - On Request. Military frequencies are in italics. *Follows those tower frequencies also utilized for approach control. Emergency frequencies are indicated as: (V) - 121.5 (U) - *243.0* (E) - 121.5 & *243.0*. ® - Radar monitoring capability. ⏀ - Aeronautical Phone Patch capability.
Chart panel location is indicated by letter to the right of data.
For additional communications and aerodrome data refer to appropriate supplemental publications.

ABERDEEN PROVING GROUND — G
PHILLIPS AAF — App and Dep Con from Friendship
Twr—126.2 122.5R *229.6* *241.0* (E)
Gnd Con—121.9

AKRON App and Dep Con from Akron - Canton — D-E
Twr—120.1 122.7R *257.7* (E)
Gnd Con—121.9
AKRON-CANTON
®App Con—125.5 109.5T *323.0*
Twr—118.3 126.2* 122.5R* *257.8** (E)*
Gnd Con—121.7 ®Dep Con—118.6 *381.5*

ALLENTOWN (ABE) ♦ ~~*272.7*~~ — G
ALLENTOWN-BETHLEHEM-EASTON
Allentown App Con—118.2 117.5T 110.7T 321T
Allentown Twr—120.5 122.5R* *257.8** 223T (E)*
Allentown Gnd Con—121.9
QUEEN CITY — App Con from Allentown

ALTOONA (AOO) ♦ ~~*272.7*~~ — F

AMBLER — G
WINGS — App and Dep Con from Philadelphia

AMITYVILLE — H
ZAHNS — App and Dep Con from Kennedy

⏀**ANDREWS AFB/NAF** App and Dep Con from Washington — G
Twr—126.2 *289.6* *236.6* (E)
Gnd Con—121.8 *275.8*

APPLETON 122.1R (CMH ♦) — D

ATLANTIC CITY/NAFEC — H
®App Con—124.6 126.2 108.6T
Twr—119.5* 122.5R* *257.8** *385.5** (E)*
Gnd Con—121.9 *284.6* ®Dep Con—128.4 *338.3*

ATTICA 122.1R (MFD) — D

AUBURN — C
AUBURN DE KALB — App and Dep Con from Fort Wayne

BALTIMORE ♦ ~~122.2T~~ ~~*272.7*~~ (DCA ♦) — G
FRIENDSHIP INTNL
®Baltimore App Con—125.9 *307.9* (280°-100° Outbound)
121.1 *360.8* (101°-279° Outbound)
Twr—118.7 122.7R *257.8* (E)*
Gnd Con—121.9 *348.6* ®Baltimore Dep Con—120.4 *381.4*
MARTIN — App and Dep Con from Friendship

FORT BELVOIR — G
DAVISON AAF — App and Dep Con from Washington
Twr—126.3 *241.0* *229.4* (E)
Gnd Con—*245.2*

FORT MEADE — G
TIPTON AAF — App and Dep Con from Friendship
Twr—126.3 *248.2* *241.0* *27.8* (E)

FORT SHERIDAN — A
SHERIDAN AAF 690 L 31 — App Con from O'Hare

FORT WADSWORTH — H
MILLER AAF
Twr—127.4 *241.0* *229.6* *27.8* (E)

FORT WAYNE (FWA) ♦ ~~*272.7*~~ — C
BAER
®Fort Wayne App Con—125.5 127.2 117.8T 109.9T *338.2* 251T
Fort Wayne Twr—119.1 126.2 122.5R* *257.8* 278T (E)*
Fort Wayne Gnd Con—121.9 *348.6*
®Fort Wayne Dep Con—118.6 122.5R 117.8T *284.6*

FRANKLIN — E
CHESS-LAMBERTON — App Con from Youngstown

FREDERICK 122.1R (MRB ♦) — G
App and Dep Con from Friendship

FRONT ROYAL 122.1R (MRB ♦) — F

GAITHERSBURG — G
MONTGOMERY CO — App Con from Friendship

GALION App Con from Mansfield — D

GARY App Con from Chicago Center — B

GLENVIEW NAS App and Dep Con from O'Hare — A
Navy Glenview Twr—126.2 *142.74* *340.2* *360.2* *236.6* (E)
Navy Glenview Gnd Con—*352.8*

GOSHEN 122.1R (SBN ♦) — B

GRANTSVILLE 122.1R (MGW ♦) — F

GROSSE ILE NAS 594 L 50 ASR/PAR — C
App and Dep Con from Willow Run
Navy Grosse Ile Twr—126.2 *142.74* *340.2* *360.2* (E)
Navy Grosse Ile Gnd Con—*352.4*

HAGERSTOWN 122.1R (MRB ♦) — F
App and Dep Con from Dulles

FIGURE 2

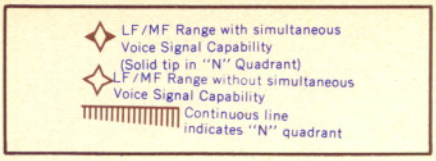


FIGURE 7

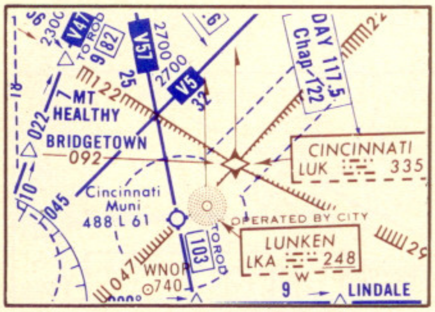


FIGURE 8

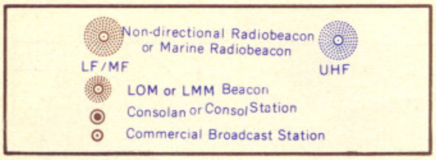


FIGURE 9

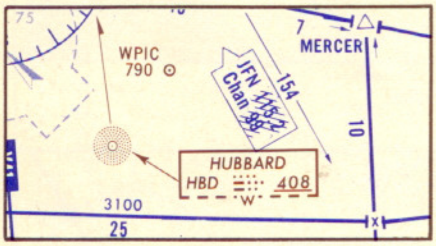


FIGURE 10

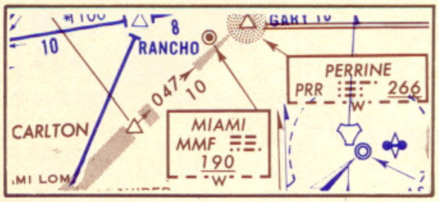


FIGURE 11

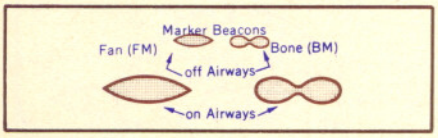


FIGURE 12

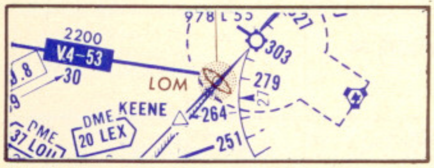


FIGURE 13

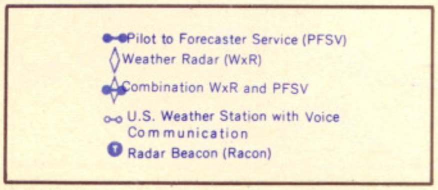


FIGURE 14

LOW FREQUENCY RADIO

Low frequency radio range information is shown on the en route chart in brown (Figure 7). One of the few low frequency ranges still in operation is shown in Figure 8.

Low frequency nondirectional radio beacons, compass locators, Consolan stations (see explanation below) and commercial broadcast stations are also shown in brown (Figure 9).

Figure 10 shows a low frequency nondirectional radio beacon. The box has a dash line at the bottom to indicate L/MF information. This figure also shows commercial broadcast station WPIC. These stations can be used for homing with the ADF, but are not approved for IFR navigation.

Figure 11 shows the Miami Consolan station (note the frequency, 190 kc). Consolan is a long range navigation aid operating in the low/medium frequency band with the greatest range (up to 2,000 miles) being achieved over water. Only three stations are now operating in the United States: Nantucket. San Francisco and Miami. Consolan has limited use in private aviation and will not be discussed further. Full operating instructions and the necessary tables are included in the International Flight Information Manual.

Figure 12 shows 75 mc marker beacons. These are colored brown and most are found at compass locators on instrument landing systems.

Marker beacons are shown in two shapes (fan or bone) to indicate the shape of the signal transmitted (Figures 12 and 13.

Weather information is available at various places through a pilot-forecaster hookup, often in conjunction with a weather radar station. The symbols in Figure 14 indicate this service is available.

ILS SYMBOLS

Instrument landing facilities are shown on the chart as elongated arrow heads of one or two lengths (Figure

FIGURE 15

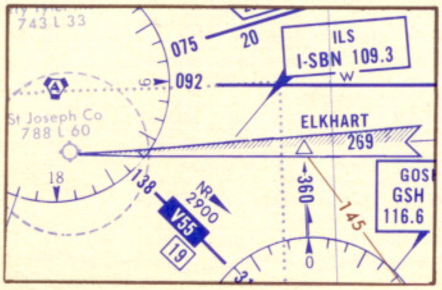


FIGURE 16

15). The longer arrow (Figure 16) indicates a facility with an air traffic control function. The shorter arrow (Figure 17) means that this capability is absent.

The barbed side of the ILS arrow indicates the blue side of the localizer. The inbound magnetic course is printed in a break in the arrow (Figure 16). The facility box next to the arrow shows the name of the ILS facility, printed and coded identification, and the frequency of the localizer beam.

The "W" at the bottom of the facility box indicates no standard air/ground voice FSS communication frequencies are available.

Figure 17 illustrates ILS without air traffic control communication frequencies available. The blue side of the arrow indicates the blue side of the localizer beam. Note that no frequency information or inbound course information is given.

OPERATIONAL NOTES

Operational notes concerning radio facilities are printed above or below the facility box. These notes usually apply to frequency changes. The frequency to be changed will be cross-hatched and a note will indicate the facility is to be shut down for the change to a specified new frequency (Figure 18).

AIRWAYS DATA

VHF airways are shown as blue lines on the chart. Each is eight miles wide, four miles on either side of the center line on the chart. This is controlled air space and appears white on the chart.

Airway numbers are shown in blue boxes along the center line. When more than one airway is included in a segment, the prefix "V" is used only before the first number shown (Fig. 19).

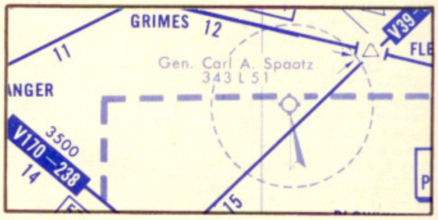


FIGURE 17

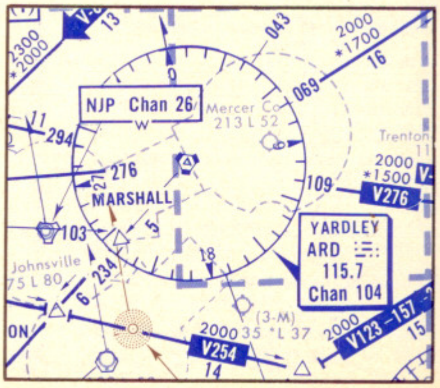


FIGURE 18

Alternate airways have the letter N, E, S, or W added to indicate direction: for instance, V55E (Figure 19).

Arrow heads on airways boxes indicate preferred airways between major terminals. There are 800 series airways (Figure 20). When two preferred routes coincide (Figure 21) the first digit of the second route is dropped. The second airway shown is V880 but is shown as 80.

Figures above the blue airways boxes indicate the minimum en route altitude (MEA) and the minimum obstruction clearance altitude (MOCA), which is always preceded by an asterisk.

In the example shown (Figure 22), the MEA is 2,500 feet and the MOCA is 2,100 feet (see section on VHF airways for an explanation of MEA and MOCA).

Checkpoints are placed along the airways so the progress of instrument flights can be reported to the appropriate controller. Two types of checkpoints are used for progress reports—compulsory and noncompulsory. Compulsory checkpoints are shown by a solid blue triangle. The pilot *must* report at these locations (Figure 23).

Noncompulsory checkpoints are indicated by open triangles. The pilot reports here only if requested by the controller (Figure 24).

Distances between checkpoints are shown in blue numbers adjacent to the airways. Numbers in boxes (Figure 25) show the distance in nautical miles between compulsory checkpoints.

In Figure 19, for instance, the number, 29, below the airway box indicates that the next reporting point is 29 nautical miles from the last reporting point on airway V55E.

An "X" along the airway indicates a mileage breakdown point (Figure 26). Only mileage between noncompulsory reporting points is affected.

An airway that changes its MEA or MOCA at an intersection will be indicated by a short line forming a T with the airway centerline (Figure 27).

An intersection that is formed by radials of two VOR stations will often have a flag symbol showing the minimum altitude at which the intersection can be accurately identified. Figure 28 shows that the minimum reception altitude (MRA) for the Plain City intersection is 4,000 feet.

Intersections having a minimum crossing altitude are also marked by a flag with an "X" (Figure 29). The minimum crossing altitude for the Coldwater intersection is 6,000 feet southwestbound on V14. Note also that there is a minimum reception altitude for the intersection of 3,500 feet.

Accurate IFR navigation requires the radio be tuned to the omni station that will provide the most accurate track information. VOR changeover points (Figure 30) are established along many airways to provide the pilot with this information. If the airway leads to the next radio facility chart, the omni station name, identification and frequency will be printed at the edge of the chart beside the airway (Figure 31).

Notes are also placed on the border of the chart to tell the pilot which chart to consult next. Airways running along the border of a chart often have intersections that are identified from the radial of an omni station that is on an adjoining chart. The radial forming the intersection has an arrow containing the station identification and frequency (Figure 32) and pointing off the chart.

Area chart boundaries are shown on the en route low altitude chart as dashed lines (Figure 33). The name of the area outlined is also given.

FIGURE 19

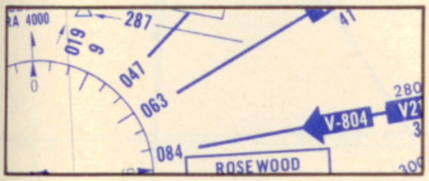


FIGURE 20

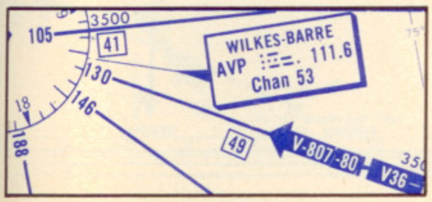


FIGURE 21

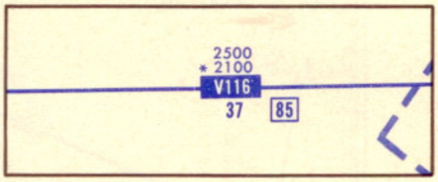


FIGURE 22

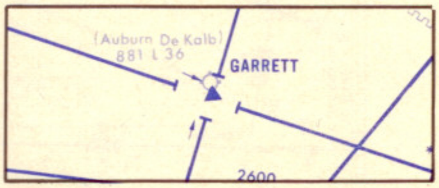


FIGURE 23

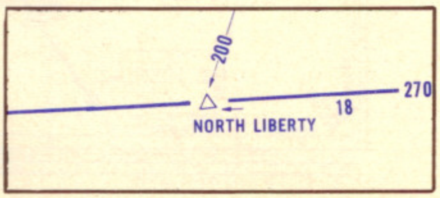


FIGURE 24

FIGURE 25

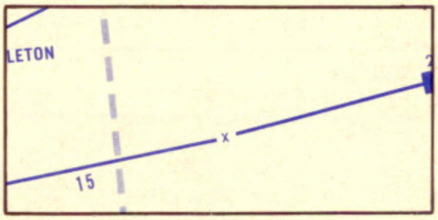


FIGURE 26

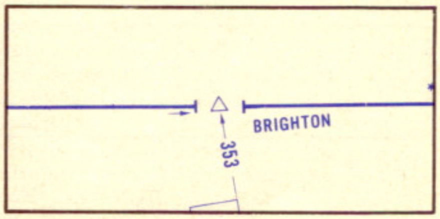


FIGURE 27

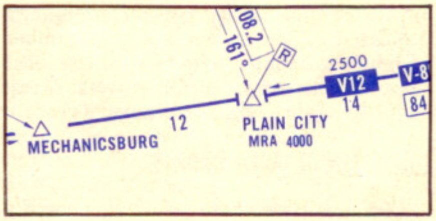


FIGURE 28

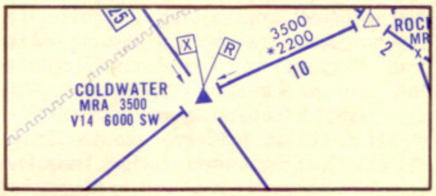


FIGURE 29

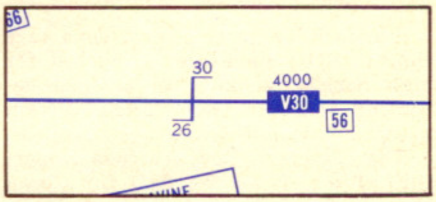


FIGURE 30

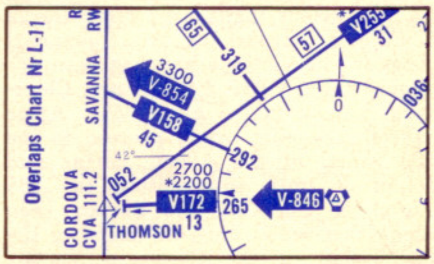


FIGURE 31

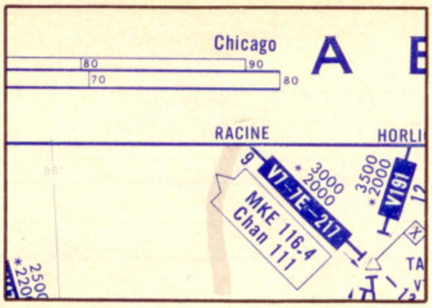


FIGURE 32

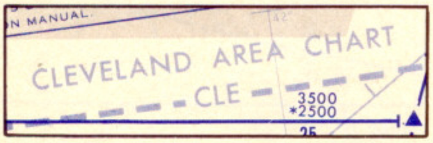


FIGURE 33

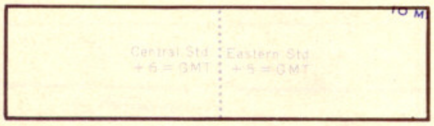


FIGURE 34

Time change lines are shown as dotted lines in blue with the time zones on either side of the time change line indicated. Also shown are the number of hours that must be added to the local time to convert it to Greenwich Mean Time or Zebra time (Figure 34).

LOW-ALTITUDE AREA CHARTS

Low altitude area charts, showing enlarged views of arrival and departure routes, are published for high density traffic areas. The Cleveland low altitude area chart (Figure 35) shows departure routes—heavy, dark blue lines—from Cleveland Hopkins and Burke Lakefront Airports. An index gives reporting points on the chart, en route preferred routes from Cleveland and communication frequencies available at Cleveland.

INSTRUMENT DEPARTURE CHARTS

Standard instrument departure charts (SID) have been published for high density airports to channel departing IFR air traffic along certain predetermined routes.

The Cleveland Low Altitude Departure Chart shows the SID for Cleveland Burke Lakefront Airport. It is called CRIB 2 departure (Figure 35).

Let us assume that a pilot has filed an instrument flight plan from Burke Lakefront Airport to the Cincinnati Airport via Victor 5 and has been approved for a CRIB 2 departure, Cleveland transition (Figure 35). After takeoff, the pilot would proceed to the 323 radial of the Akron Vortac and follow it until intercepting the 285 radial of the Chardon Vortac, then along this radial until intercepting the 027 radial of the Cleveland Vortac. This is the CRIB intersection.

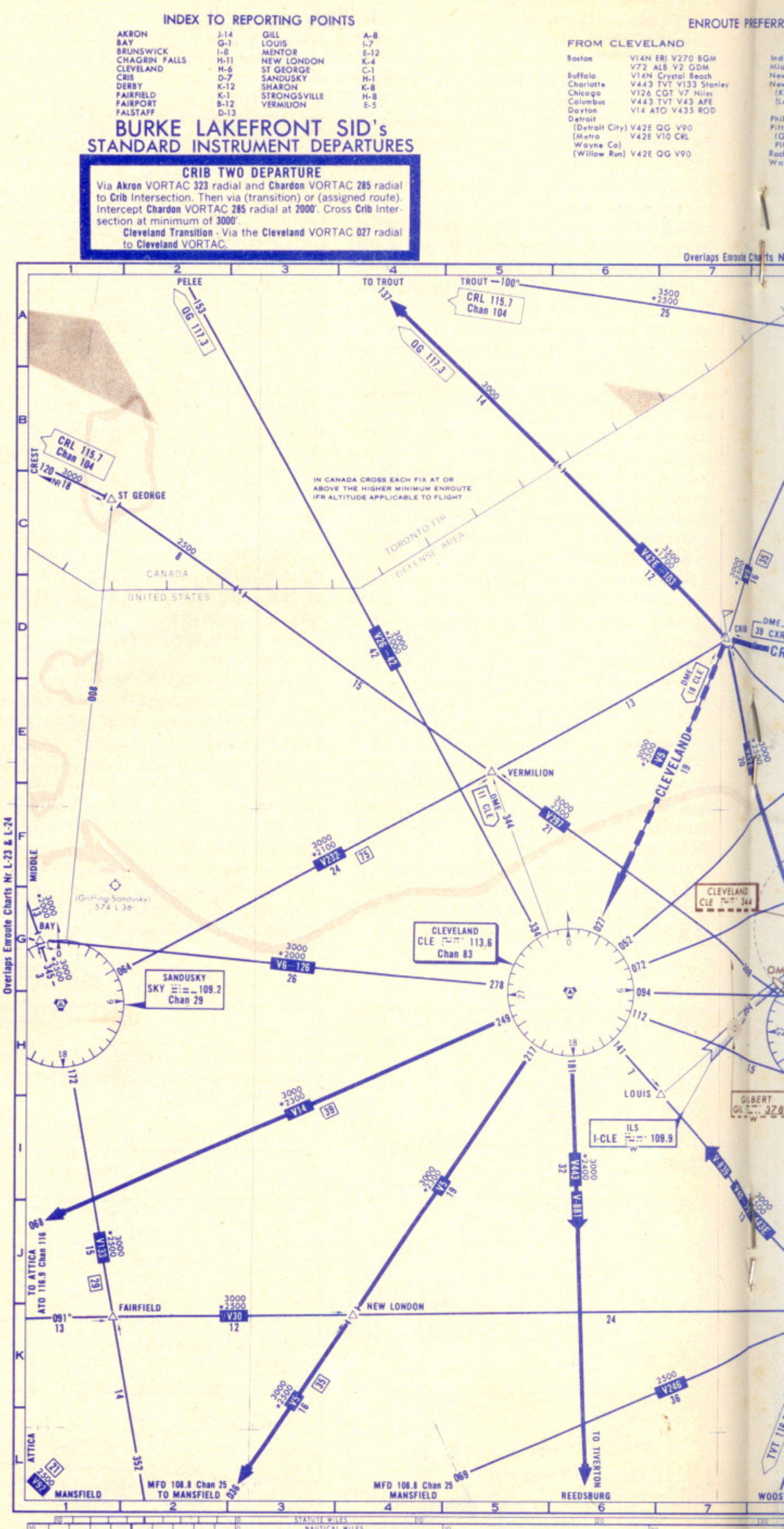
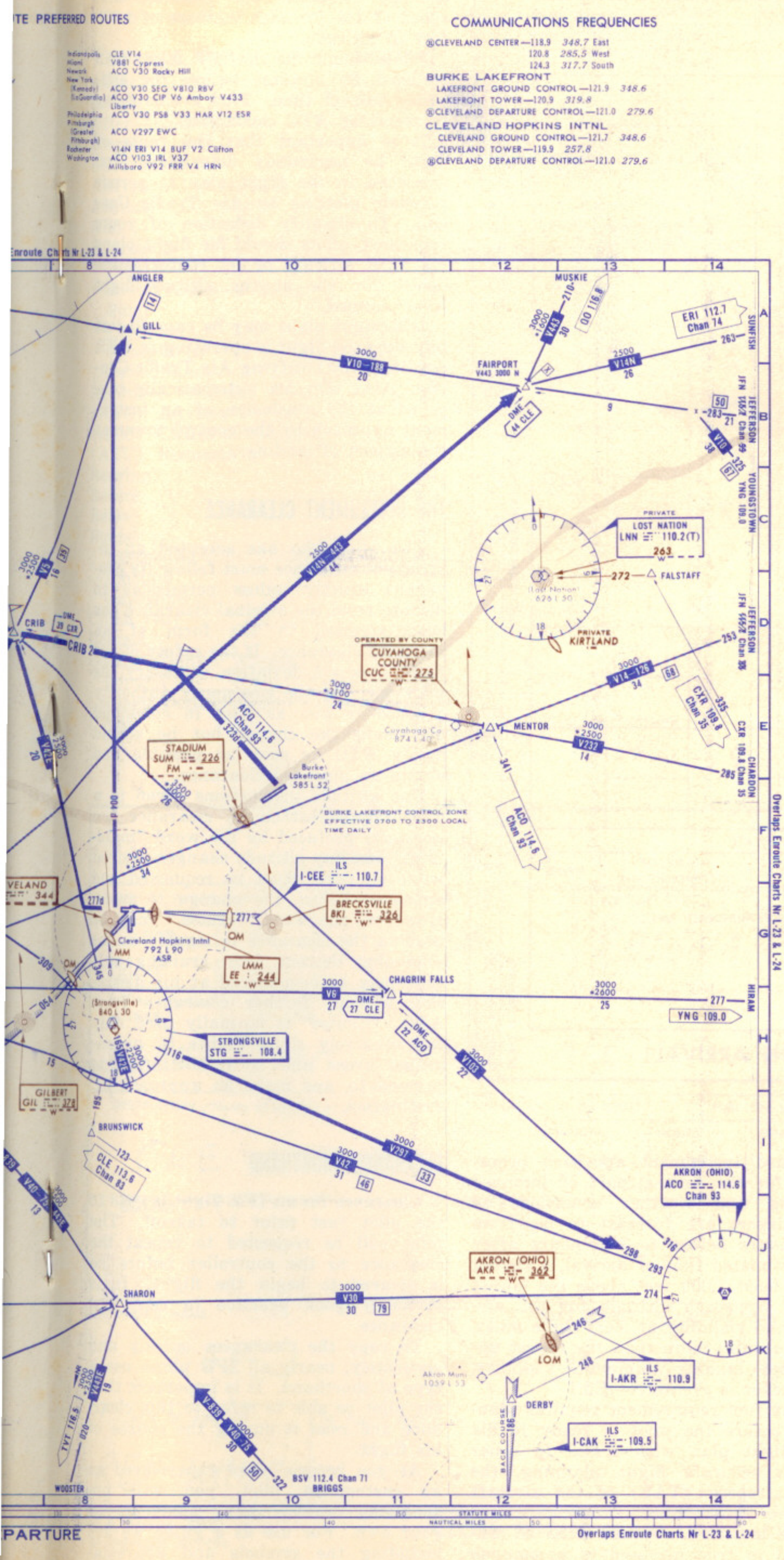


FIGURE 35



The pilot must remain at 2,000 feet until intercepting the 285 radial of Chardon and then climb to 3,000 feet before reaching the CRIB intersection. Flags on the chart indicate the altitude restrictions. Since the clearance specified the Cleveland transition, after the CRIB intersection the pilot would proceed to the Cleveland Vortac via the 027 radial and then proceed via Victor 5 to his destination.

IFR FLIGHT PLANNING

While you have learned that careful preflight planning is important in all flying, it is indispensable when the flight is to be made under instrument flight rules.

It is particularly important that you make all of the checks necessary to get the most up-to-date information for your flight. These will include checking weather advisories, en route weather, destination weather, alternate weather, weather forecasts, winds aloft, airspace restrictions, and any Notams such as VOR shutdowns, frequency changes, etc., for the route you intend to fly.

INSTRUMENT FLIGHT LOG

Once all the necessary checks have been made, a flight log should be prepared. There are many types of such logs. The one we show here is the one printed on the reverse side of the FAA flight plan form.

The flight log contains departure point, all compulsory checkpoints, radio frequencies, routing, airway radials, miles between compulsory reporting points, estimated and actual time to the point in minutes, estimated and actual clock time over each point, ground speed and clearances.

The flight log should be filled out as completely as possible before takeoff. As the flight progresses, remaining portions are filled in. Figure 36 shows a flight log as it would appear before takeoff. During the flight portion of this course your instructor will show you how the flight log is filled in during an instrument flight.

IFR FLIGHT PLANS

Federal Air Regulation 91.115 provides that no person may operate an aircraft in controlled airspace under instrument flight rules unless he has filed an IFR flight plan and received a clearance. After all the preflight checks have been made and the flight log has been filled out, the instrument flight plan should be filed with ATC. This should be done in person or by phone to the nearest Flight Service Station. Figure 37 shows a flight plan as it would appear for an instrument flight.

The IFR flight plan has one significant difference from the VFR flight plan. The IFR flight plan must contain, under certain conditions, an alter-

PILOT'S PREFLIGHT CHECK LIST			DATE
	WEATHER ADVISORIES	ALTERNATE WEATHER	NOTAMS
	EN ROUTE WEATHER	FORECASTS	AIRSPACE RESTRICTIONS
	DESTINATION WEATHER	WINDS ALOFT	MAPS

FLIGHT LOG

DEPARTURE POINT	VOR IDENT. / FREQ.	RADIAL TO / FROM	DISTANCE LEG / REMAINING	TIME PT.-TO-PT. / CUMULATIVE	TAKEOFF	GROUND SPEED
CMH						
CHECK POINT APE	APE	DR	16	7	ETA	142
	116.7	051	87	7	ATA	
TVT	TVT	052	28	12		140
	116.5	020	59	19		
SHARON XN		020	41	19		138
			18	37		
DESTINATION CLE			18	8		
			TOTAL 103	45		

POSITION REPORT: FVFR report hourly, IFR as required by ATC

ACFT. IDENT.	POSITION	TIME	ALT.	IFR/VFR	EST. NEXT FIX	NAME OF SUCCEEDING FIX	PIREPS

REPORT CONDITIONS ALOFT—
CLOUD TOPS, BASES, LAYERS, VISIBILITY, TURBULENCE, HAZE, ICE, THUNDERSTORMS

CLOSE FLIGHT PLAN UPON ARRIVAL

SCALE 1:1,000,000 — Nautical Miles — Statute Miles — WORLD AERONAUTICAL CHARTS

SECTIONAL AERONAUTICAL CHARTS — SCALE 1:500,000 — Nautical Miles — Statute Miles

FIGURE 36

nate airport as provided for in Federal Air Regulation 91.23. This section states, "No person may operate a civil aircraft in IFR conditions unless it carries enough fuel (considering weather reports and forecasts, and weather conditions) to complete the flight to the first intended point of landing, to fly from that point to an alternate airport, and to fly thereafter for forty five minutes at normal cruising speed."

[Part 91.23 was revised as of May 28, 1965, to relax alternate airport requirements under some conditions. The following wording was added to that cited above: "However, the requirement for fuel to fly from the first airport of intended landing to an alternate airport does not apply if Part 97 of this subchapter prescribes a standard instrument approach procedure for the first airport of intended landing and weather conditions at the airport are forecast to be, from two hours before to two hours after the estimated time of arrival, a ceiling of at least 1,000 feet above the lowest initial approach altitude for the airport and visibility at least three miles, or two miles more than the lowest authorized landing minimum visibility, whichever is greater."—Ed.]

This fuel requirement requires planning before the pilot is ready to file the flight plan with ATC. In order to do accurate flight planning, the true airspeed (TAS) of the aircraft must be used.

The indicated airspeed must be converted to true airspeed to accomplish these calculations. This can easily be done on all good computers. You will find generally that there is an increase of true airspeed over indicated airspeed of 2% for each increase of 1,000 feet in altitude.

Pilots should file the IFR flight plan at least 30 minutes before the estimated takeoff time. This avoids delay in receiving ATC clearances.

It is important that the route of flight be accurately determined and described in the flight plan to permit accurate plotting by Air Traffic Control. To simplify definition of route requested, pilots should file flight plans via VOR airways or jet routes established for use at the altitude/flight level planned.

IFR flight plans may be cancelled at any time the flight is operating in VFR conditions by notifying Air Traffic Control. Also, they are automatically cancelled at the conclusion of an instrument approach by the control tower at the airport of landing.

THE INSTRUMENT CLEARANCE

The pilot who has accepted an instrument clearance must follow its provisions exactly unless permission to deviate from the original clearance has been received in the form of an amended clearance. If the safety of the flight makes a deviation necessary the pilot may use the emergency authority granted to him as pilot in command and make the change but he should notify ATC as soon as possible and obtain an amended clearance.

The altitude instructions given to a pilot in an instrument clearance are *normally* prefaced by the word "maintain," and any altitude changes desired while en route must be requested and approved before the change is made. However, the word, "cruise," may be used in the clearance to signify to the pilot that descent from cruising altitude may be commenced at his discretion without further clearance from ATC. "Cruise" is normally used only for relatively short flights in uncongested areas and is authorization to proceed to, and make an approach at, destination.

CLEARANCE SHORTHAND

Clearance for an IFR flight is read to the pilot just prior to takeoff. The pilot will be requested to repeat the clearance to the controller before he is cleared to begin the flight. It is obviously good practice to copy the clearance.

To copy the clearances quickly and accurately, nearly all IFR pilots use a type of shorthand. It is important that the pilot be able to refer to this clearance and read it during the course of his flight.

As you become more experienced as an instrument pilot, you will undoubtedly develop many shortcuts of your own. For use as a guide we are including the symbols and abbreviations used by FAA personnel in recording clearance information. These are standardized because they must be read by more than one person during the course of a flight.

Words and Phrases	Shorthand
Above	ABV
Advise	ADV
After (passing)	<
Airport	A
All turns left	↰
Alternate Instructions	( )
Altitude 6,000-17,000	60-170
And	&
Approach	AP
Final	F
Low Frequency Range	R
Omni	O
Precision	PAR
Straight-In	SI
Surveillance	ASR
Approach Control	APC
(ATC) Advises	CA
(ATC) Clears or Cleared	C
(ATC) Requests	CR
Bearing	Bear
Before	>
Below	BLO
Bound	B
Eastbound	EB
Inbound	IB
Outbound	OB
Climb (to)	↑
Contact	CT
Contact Denver Approach Control	(DEN)
Contact Denver Center	(DEN
Course	CRS
Cross	X
Cross Civil Airways	≠
Cruise	→
Delay Indefinite	DLI
Depart	DEP
Descend (to)	↓
Direct	DR
Each	ea
Enter Control Area	⍋
Expect Approach Clearance	EAC
Expect Further Clearance	EFC
Fan Marker	FM
Flight Planned Route	FPR
For Further Clearance	FFC
For Further Headings	FFH
Heading	HDG
Hold (Direction)	H-W
If Not Possible	or
Intersection	XN
Join Civil Airways	⟹
(ILS) Localizer	L
Maintain	M
(Maintain) VFR Above All Clouds	$\underline{\text{VFR}}$
All Haze	$\frac{\text{VFR}}{\text{H}}$
All Dust	$\frac{\text{VFR}}{\text{D}}$
All Smoke	$\frac{\text{VFR}}{\text{K}}$
All Fog	$\frac{\text{VFR}}{\text{F}}$
Non Standard Pattern	⬭
Omni (Range)	○
Outer Compass Locator	LOM
Outer Marker	OM
Out of Control Area	⍋
Over (ident)	$\overline{\text{APE-O}}$
Radar Vector	R‿V
Radial	⊖
Range (LF/MF)	R
Remain Well to Left Side	LS
Remain Well to Right Side	RS
Report Departing	RD
Report Leaving	RL
Report on Course	R-CRS
Report Over	RO
Report Passing	RP
Report Reaching	RR
Report Starting Procedure Turn	RSPT
Request Altitude Changes En Route	RACE
Reverse Course	RC
Runway	RY
Standard Jet Penetration	SJP
Standby	STBY
Takeoff (Direction)	T→N
Tower	Z
Traffic is	TFC
Track	TR
Turn Left After Takeoff	LT
Turn Right After Takeoff	RT
Until	/
Until Advised (by)	UA
Until Further Advised	UFA
Victor	V
While in Control Areas	△
While in Civil Airways	=

FEDERAL AVIATION AGENCY

FLIGHT PLAN

FORM APPROVED
BUDGET BUREAU NO. 04-R072.2

1. TYPE OF FLIGHT PLAN	2. AIRCRAFT IDENTIFICATION	3. AIRCRAFT TYPE	4. TRUE AIRSPEED	5. DEPARTURE TIME PROPOSED (Z)	ACTUAL (Z)
☐ FVFR ☐ VFR ☒ IFR ☐ DVFR	9893A	CESSNA	130 KNOTS	1315	

6. INITIAL CRUISING ALTITUDE	7. POINT OF DEPARTURE	8. ROUTE OF FLIGHT
5000	CMH	DIRECT APE V43 TUT V443E TUT SHARON XN DIRECT

9. DESTINATION (*Name of airport and city*)	10. ESTIMATED TIME EN ROUTE HOURS	MINUTES	11. FUEL ON BOARD HOURS	MINUTES	12. ALTERNATE AIRPORT(S)
CLE HOPKINS	-	45	4	30	YNG

13. REMARKS

14. PILOT'S NAME	15. PILOT'S ADDRESS OR AIRCRAFT HOME BASE	16. NO. OF PERSONS ABOARD
DOE, J	HOMETOWN AIR PARK	1

17. COLOR OF AIRCRAFT	18. FLIGHT WATCH
RED WHITE	

FAA Form 398 (7-64) USE PREVIOUS EDITION — CLOSE FLIGHT PLAN UPON ARRIVAL — GPO : 1964 OF—739-500 — SEE REVERSE (7233)

FIGURE 37

COMMUNICATIONS FACILITIES AND PROCEDURES

The first radio contact for an instrument flight is made with the airport ground controller. This is done immediately after starting the engine or engines. The first call after tuning to the ground control frequency would be:

"Columbus Ground, Cessna niner-eight-niner-three Alpha at transient parking ready to taxi, instruments to Cleveland." Always include the word "instruments" and give the destination of the flight. This tells the ground controller the pilot has filed an instrument flight plan and will be expecting an airways clearance for an IFR flight.

The ground controller will then issue taxi instructions. While the airplane is taxiing out, the controller will call by telephone to the Air Route Traffic Control Center (ARTCC) controlling the area and tell them that Cessna 9893A is ready to depart. The ARTCC will check traffic along the requested route and then issue a clearance to ground control for Cessna 9893A.

Ground control may read the clearance to the pilot or may instruct him to tune to a new frequency used exclusively for delivering instrument flight clearances. When the pilot reads the clearance back correctly he is ready to be released to local control (tower) for takeoff instructions.

The local controller will clear the pilot for takeoff, give instructions for the first turn when necessary and release the flight to departure control.

The departure controller will follow the flight on radar, if available, and will provide traffic information and radar vectors if necessary. When the flight approaches a designated fix or selected altitude, the departure controller turns the flight over to center control.

Center control will then monitor the flight, receive position reports, issue amended clearances, give traffic information, provide radar vectors as needed and finally, as the flight nears its destination, turn over control to the approach controller at the destination airport.

OMNI TRACKING

The primary navigation instrument for the cross-country portion of the instrument flight is the flight path deviation indicator (vertical needle).

When the omni bearing selector (OBS) is set to the desired radial and the needle is centered, the aircraft is on the desired course. The techniques of staying on course have been covered in the AOPA Instrument Nav/Com Course.

The pilot must now identify the intersections on his path along the airway. The method of identifying the intersection usually is by tuning in the station and making positive identification. The OBS is then turned to the proper FROM radial that marks the intersection. When the needle centers, the aircraft is at the intersection.

A different type of identification occurs when the controller asks if the flight has passed a specific radial of an adjacent omni. The pilot tunes in and identifies the omni and turns the OBS to the radial specified by the controller. The vertical needle will show whether the aircraft is approaching, at, or past the radial (The exact location of the airplane along the airway may be found by turning the OBS until the needle centers and the omni indicates either TO or FROM).

POSITION REPORTING

Safe and efficient instrument flight depends on accurate position reporting. Air Traffic Control must have position reports to provide proper horizontal and vertical separation between aircraft operating on IFR flight plans.

Pilots are required to maintain a continuous listening watch on the appropriate frequencies and to furnish position reports as shown on the en route chart or requested by the controller.

Solid triangles mark the positions on the airway where a pilot must make a position report unless he has been specifically instructed by ATC to "omit position report."

Noncompulsory reporting points are indicated by an open triangle. Reports are required over these points only when requested by ATC.

Position reports should include the following items:

1. Aircraft identification.
2. Position.
3. Time (Greenwich Mean Time expressed by the 24-hour clock system).
4. Altitude (MSL).
5. Type of flight plan (not required in position reports made direct to center or approach control).
6. ETA (Estimated time of arrival) over next reporting point.
7. Name only of the second reporting point along the route of flight.
8. Any pertinent remarks.

Example of position report: An aircraft operating IFR between Columbus and Youngstown would cross the Tiverton VOR. The following exchange would take place between the pilot and the controller at the Indianapolis Center:

"Indianapolis Center, Cessna niner-eight-niner-three Alpha, Tiverton, over."

"Niner-three Alpha, this is Indianapolis Center. Go Ahead."

"Cessna niner-three Alpha, Tiverton, five-five, maintaining seven thousand, estimating Briggs one-six-four-eight zebra, Youngstown."

The phrase "five-five" indicates the pilot was over the checkpoint at 55 minutes past the hour. The use of both hours and minutes in the 1648 estimate is to prevent confusion and is commonly used when reporting points are slightly less or more than an hour apart.

A corrected estimate should be forwarded to Air Traffic Control any time an estimate previously made is in error in excess of three minutes. Aircraft are separated by at least 10 minutes horizontally on the airways. It is easy to see, therefore, that the controller must be notified of these errors in estimates.

In addition to reports over compulsory reporting points, there are five other instances in which the pilot should initiate a report to the controller (ATC or FSS) without a request:

1. The time and altitude/flight level reaching a holding fix or the point to which the flight has been cleared. For example: "Cleveland Center, Cessna niner-eight-niner-three Alpha, entering holding pattern at Wooster intersection, one-six, seven thousand."

2. When leaving a previously assigned altitude/flight level for a new altitude/flight level. Example: "Indianapolis Center, Cessna niner-eight-niner-three Alpha leaving six thousand." No report is required when reaching an assigned altitude/flight level unless requested.

3. When leaving any assigned holding fix or point. Example: "Indianapolis Center, Cessna niner-eight-niner-three Alpha leaving Dublin intersection at four-five."

4. When leaving fix inbound on final approach. Example: "Columbus tower, Cessna niner-eight-niner-three Alpha, outer marker."

5. When an approach has been missed. Example: "Columbus tower, Cessna niner-three Alpha missed approach, request clearance for another approach."

Pilots encountering weather conditions which have not been forecast, or hazardous conditions which have not been forecast, shall forward a report of these conditions to Air Traffic Control.

The pilot should remember that the reporting of unanticipated weather or hazardous conditions may be of importance to the safety of other aircraft in the area.

There are other instances when pilots must make reports when requested. These are:

1. The time of starting a procedure turn to final approach.
2. Time over a range station on approach or the time over the outer marker inbound on final approach.
3. The time of reaching a newly assigned altitude or when passing through an intermediate altitude.
4. Any other information that may aid in controlling air traffic.

Pilots of radar-identified aircraft which will remain under radar surveillance may be authorized to discontinue position reports over compulsory reporting points. In such cases the controller will say, "Omit position reports."

When the radar service is terminated

or at the controller's discretion, the pilot will be instructed, "Resume normal position reporting." Pilots operating below flight level 240 (24,000 feet MSL) who have been advised to omit position reports will be given the altimeter setting when passing compulsory reporting points. Pilots operating above flight level 240 keep a standard altimeter setting of 29.92.

ATC facilities are equipped to carry on direct communications with IFR traffic on certain VHF, UHF and L/MF frequencies. Air Route Traffic Control Centers are divided into sectors with each sector being handled by a controller or team of controllers.

Each sector has its own frequency, known as a "sector discrete frequency." The pilot will be requested to change to the appropriate discrete frequency as the flight progresses from one sector to the next.

Each Air Traffic Control center has an additional frequency (center discrete) used as a backup for the sector frequencies. It is always monitored by at least one controller who can quickly put the pilot of an IFR flight in radio contact with the appropriate sector.

The IFR flight will also often pass from one ATC center to another. The controller will tell the pilot when to contact the next center to transfer the control of the flight to that center.

The following is an example of how this transfer is made:

"Cessna niner-eight-niner-three Alpha, contact Indianapolis center, one-three-five point five."

The pilot will write down the new frequency (135.5), acknowledge receipt of the transmission, switch to the new frequency and make contact on the new frequency as follows:

"Indianapolis Center, this is Cessna niner-eight-niner-three Alpha estimating Columbus at three-five at seven thousand. Over."

The controller in the new sector of the Indianapolis Center will reply, "niner-eight-niner-three Alpha, Indianapolis Center, Roger. Columbus altimeter three-zero-zero-one."

Contact has now been established between the flight and the new controller. In this instance no position report was made, so the estimate for the next reporting point was made along with the altitude the flight was maintaining.

If a position report is to be made after a control transfer, the pilot will give the name of the reporting point in his first transmission on the new frequency. This will alert the controller that a position report will be made.

Federal Air Regulations require the pilot to maintain a continuous listening watch on the appropriate frequency. When directed to contact another frequency at a stated time, the pilot should remain on the first frequency until the time designated for the frequency change. If two-way communication cannot be established with the new frequency, the pilot should contact the transferring controller and request an alternate frequency.

If unable to reestablish contact with the last controller, the pilot should attempt to establish contact with one of the following control agencies, in the following order:

1. Sector discrete frequency (This is the frequency assigned by the last controller).
2. Center area discrete frequency if aircraft is below flight level 240 (This frequency is listed in Section IV of the Airman's Information Manual); above FL240, call FSS on 126.7 mc.
3. Flight Service Station on 126.7, 122.1, 122.2, 135.9 or VOR.

This order of priority applies only to general aviation aircraft. Other frequencies will be used by air carrier and military aircraft.

HOLDING

When air traffic density is such that holding becomes necessary, ATC will issue a clearance containing the following information for standard and nonstandard patterns:

1. The direction to hold from holding point.
2. The holding fix.
3. A specified radial, course, magnetic bearing, airway number, or jet route.
4. The outbound leg in nautical miles if DME is used, or minutes if not used.
5. Left turns, if nonstandard pattern is used, or right turns if standard pattern is to be used.
6. Time to expect further clearance or time to expect approach clearance.

The direction to hold will be specified as one of eight general points of the compass in relation to the holding fix (north, northeast, east, southeast, etc.). Pilots are expected to hold in a standard right turn pattern unless specifically directed otherwise by ATC.

HOLDING PATTERN SPEEDS

The maximum holding airspeed for propeller-driven aircraft is 175 knots indicated airspeed. Civil and military turbojet aircraft may hold at airspeeds as high as 310 knots indicated airspeed, depending on aircraft type and holding altitude.

HOLDING PATTERN ENTRY

Figure 38 shows the three approved ways to enter a holding pattern:

a. Parallel Procedure: In this entry the aircraft crosses the holding fix and turns outbound on a heading parallel to the holding course, then turns left to return to the holding fix.

b. Teardrop Procedure: The aircraft crosses the holding fix and turns to a heading 30° or less to the holding course, then turns right to intercept and track inbound on the holding course.

c. Direct Entry Procedure: The aircraft crosses the holding fix, turns right to the holding course and flies the holding pattern.

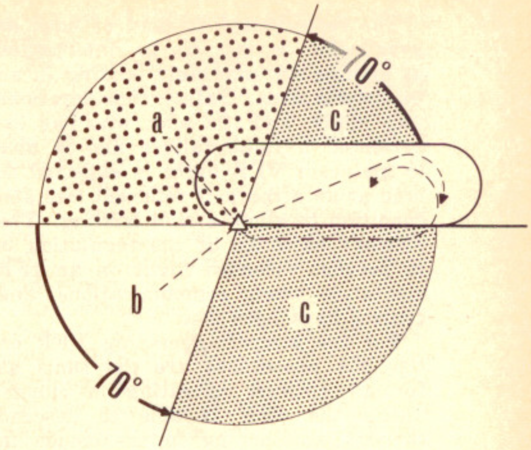


FIGURE 38

The inbound leg of the holding pattern is timed according to the holding altitude being used. At or below 14,000 feet MSL a one-minute inbound leg is used; above 14,000 feet the inbound leg is one-and-one-half minutes. Timing of the outbound leg is adjusted to allow compliance with the inbound leg time requirement; however, the initial outbound leg *must* be one minute below 14,000 feet, and one-and-one-half minutes above 14,000 feet.

RADIO COMMUNICATION FAILURE PROBLEMS

One of the most serious problems of instrument flight is radio communication failure. Since the safety of everyone using the airways depends on communications, it is important that you comply with the regulations regarding this emergency.

Pilots who experience radio communication failure should listen on any available operational radio receiver. Air Traffic Controllers have the capability of transmitting on most navigational frequencies.

This, combined with the widespread radar coverage in existence today, may enable the pilot to establish some form of contact with the controller even though direct pilot-controller contact is lost.

The pilot should not hesitate to take the emergency action contained in the Federal Aviation Regulations (FAR 91.127) described below. The controller will expect this action and plan accordingly.

IN VFR CONDITIONS

If you are able to maintain flight under VFR conditions, continue to the nearest airport, land as soon as practicable and notify ATC.

The requirement to land as soon as practicable is not to be interpreted as making an immediate landing in an unsuitable area. Safety considerations still apply, and the pilot who has experienced a radio failure and is able to maintain VFR flight is expected to land at an airport of sufficient size and condition to allow a safe landing. The primary objective of the regulation is to prevent extended flight on an IFR clearance when communications and control have been lost.

For the aircraft operating VFR on top, the procedures are the same as for an aircraft operating in clouds, unless the pilot is able to descend through an opening in the clouds in accordance with visual flight rules.

The following procedures apply to aircraft losing communications under IFR conditions when the pilot is unable to descend and land in VFR conditions. Each procedure will be followed by a sample clearance, an explanation of the clearance and the action required of the pilot.

1. Route

Proceed:

(I) By the route assigned in the last ATC clearance received.

Example: C9893A CLE A DR APE 43 TVT 443 East Sharon XN DR ↑ M 50 (The flight has been cleared to the Cleveland Airport via direct to Appleton Omni, Victor 43 to Tiverton omni, Victor 443 East to Sharon intersection direct to Cleveland Airport. To maintain 5,000 feet).

Required Action: If loss of radio communication occurs after receiving this clearance, the pilot will climb to 5,000 feet and proceed via the designated airways to the Sharon intersection and then go direct to the appropriate radio facility serving the Cleveland Airport and make the approach to the airport.

(II) If being radar vectored, by the direct route from the point of radio failure to the fix, route, or airway specified in the vector clearance.

Example: C9893A APE Radar V↑M 50 (The pilot is expecting a radar vector to the Appleton omni).

Required Action: The pilot would proceed direct to the Appleton VOR after losing communication during the radar vector. He would then proceed via the flight plan route to the destination airport to arrive at the time specified in the flight plan.

(III) In the absence of an assigned route, by the route that ATC has advised may be expected in a further clearance.

Example: C9893A TVT DR ACO R M 50 EFC VIA SUM (The pilot has secured an amended clearance after leaving Appleton and before reaching Tiverton. He is now cleared over Tiverton, direct to Akron omni as the clearance limit. He has been told to expect further clearance via the Stadium radio beacon (SUM) to the Cleveland Airport).

Required Action: The pilot will leave the Tiverton omni and then proceed direct to the Akron omni, then direct to the Stadium radio beacon and make the approach to the Cleveland Airport.

(IV) In the absence of an assigned route or a route that ATC has advised may be expected in a further clearance, by the route filed in the flight plan.

Example: C9893A DR APE↑M 50 (The flight has received a short range clearance only.)

Required Action: If loss of radio communication occurs after receiving this clearance the pilot will proceed to Cleveland via the route filed in the flight plan and make an approach at the estimated time of arrival as shown on the flight plan.

2. Altitude

Proceed at the highest of the following altitudes or flight levels:

(I) The altitude or flight level assigned in the last ATC clearance received.

Example: C9893A CLE A DR APE 43 TVT 443 E Sharon XN DR M50 (The pilot is cleared to 5,000 feet on the flight).

Required Action: Climb to and maintain 5,000 feet to the facility serving the Cleveland Airport.

(II) The minimum altitude for IFR operations.

Example: C9893A CLE A DR APE 43 TVT 443 E Sharon XN DR↑M20 (The pilot is cleared to 2,000 feet on the flight).

Required Action: Since the minimum en route altitude for the flight is higher than the 2,000 feet given in the clearance, the pilot would climb to the minimum en route altitude and continue the flight.

(III) The altitude or flight level ATC has advised may be expected in a further clearance.

Example: C9893A CLE A DR APE 43 TVT 443 E Sharon XN DR M25 EFC 50 (The flight has been cleared to the Cleveland Airport via direct Appleton Victor 43 Tiverton Victor 443 East Sharon direct to the Cleveland Airport to maintain 2,500 feet and to expect further clearance to 5,000 feet).

Required Action: If radio contact is lost, the flight would climb to 5,000 feet and maintain this altitude to Cleveland.

3. Climb

When it is necessary to climb in order to comply with any of the above, the following applies:

(I) Climb to the assigned altitude or flight level in accordance with the last ATC clearance received.

Example: C9893A CLE A DR APE 43 TVT 443 E Sharon XN DR ↑ M50 (The flight has been cleared to the Cleveland Airport via direct Appleton Victor 43 Tiverton Victor 443 East Sharon intersection direct to climb to and maintain 5,000 feet).

Required Action: The flight would climb to and maintain 5,000 feet and proceed to the Cleveland Airport.

(II) Climb to the minimum altitude for IFR operation at the time or place necessary to comply with that minimum.

Example: C9893A CLE A DR APE 43 TVT 443 E Sharon XN DR ↑ M25 (The flight has been cleared to the Cleveland Airport via direct Appleton Victor 43 Tiverton 443 East Sharon intersection direct to climb to and maintain 2,500 feet).

Required Action: The flight would maintain 2,500 feet until Appleton then climb to the required minimum en route altitude as shown on the low altitude en route chart and continue to the Cleveland Airport.

(III) Climb to the altitude or flight level ATC has advised may be expected in a further clearance at the time or place included in the expect further clearance message.

Example: C9893A CLE A DR APE 43 TVT 443 E Sharon XN DR ↑ M30 EFC 50 TVT (The flight has been cleared to the Cleveland Airport via direct Appleton Victor 43 Tiverton Victor 443 East Sharon intersection direct to climb to and maintain 3,000 feet and to expect further clearance to 5,000 feet at the Tiverton VOR).

Required Action: The flight would maintain 3,000 feet until Tiverton, then climb to and maintain 5,000 feet and proceed to the destination.

4. Holding

If holding instructions have been received, leave the holding fix at the expect further clearance time received, or if an expected approach clearance time has been received, leave the holding fix in order to arrive over the fix from which the approach begins as close as possible to the expected approach clearance time.

Example: C9893A Sharon XN 443 E M 50 Hold S 1 minute RT EFC 2140 (The flight has been cleared to the Sharon intersection via Victor 443 East to maintain 5,000 feet and to hold south of the Sharon intersection in a standard holding pattern).

Required Action: The flight would continue to Sharon and begin holding at the intersection, timing the holding pattern so as to leave the Sharon intersection at 2140.

5. Descent

Begin descent from the enroute altitude or flight level upon reaching the fix from which the approach begins, but not before:

(I) The expect approach clearance time, if received.

Example: C9893A DR CLE OM M 50 E A C 2140 (The flight has been cleared to the Cleveland outer marker to maintain 5,000 feet and to expect approach clearance at 2140).

Required Action: The pilot will maintain 5,000 feet while proceeding to the Cleveland outer marker and at 2140 begin his descent.

(II) If no expect approach clearance time has been received, begin descent at the estimated time of arrival shown on the flight plan as amended with ATC.

Example: C9893A Sharon XN 443 E M 50 (The flight has been cleared to the Sharon intersection to maintain 5,000 feet but no expect approach clearance time has been given).

Required Action: If loss of radio communication occurred after receiving this clearance the pilot would continue to the Sharon intersection maintaining 5,000 feet and from there proceed direct to the Cleveland outer marker and begin his descent from 5,000 feet at the estimated time of arrival as shown on the flight plan.

IN IFR CONDITIONS (HOLDING)

If holding is necessary at the radio facility to be used for the approach at the destination airport, holding and descent to the initial altitude for the execution of the instrument approach should be accomplished in a holding pattern on the side of the final approach course on which the procedure turn is prescribed.

COCKPIT MANAGEMENT

One of the most frustrating parts of instrument flying is when things pile up on you to the point that you feel like you're getting behind the airplane. A student instrument pilot is likely to feel that his flight is becoming a series of irritating interruptions. As in almost everything, a few principles of management go a long way in helping you spread the workload so the essentials are taken care of immediately and the rest of the total operation is spread over a period of time. Careful management of activities in the cockpit will greatly contribute to a pleasant instrument flight as opposed to one that is a constant scramble to keep up.

It is impossible to anticipate all the problems that will arise, but here are a few general hints that may help you avoid those extremely busy moments in the cockpit.

PREFLIGHT PLANNING

Comprehensive planning is a must for any pilot before flying under instrument conditions. This goes beyond the mere preparation of a flight log.

Departure routes should be checked carefully so the pilot has a mental picture of the departure airport and the surrounding airways. The names of nearby reporting points should be noted mentally because the most commonplace names often sound nearly unintelligible when coming through the speaker just when a power change is necessary or the cowl flaps demand attention.

Perhaps the best suggestion here is to tell the student to fly the departure mentally on the ground (perhaps several times) before trying it in the air. This hint can apply to all portions of the flight.

As in any venture, the more you accomplish on the ground in preflight planning, the fewer the demands in the air.

TAKING THE CLEARANCE

Don't try to copy a clearance while taxiing the airplane. Inform the ground controller that you will take the clearance on the runup pad. This can be done at the conclusion of the first call to ground control.

Don't hesitate to ask for clarification if you don't understand some part of the clearance. It should be noted here that once the clearance has been accepted it must be followed exactly until a new clearance has been requested and issued.

Whenever possible, use the SID. Much of the clearance is written on the SID chart and if used it will simplify taking the clearance.

Don't be surprised if ATC clears you on a route that differs from the one you requested in the flight plan. Here is where preflight planning can help you. If a preferred routing exists for your planned flight, use it; it is there to expedite the flow of traffic. Acquaint yourself with any alternate departure clearances you may receive.

If you have any doubt about possible departure routes, use the telephone and get the information you need from the tower or the IFR room. It is better to get as much information as possible on the ground prior to the flight than to tie up radio frequencies getting information while busy with the airplane.

EN ROUTE

Be prepared for busy periods. There will be times of increased cockpit workloads. They occur most often at compulsory reporting points, especially if a change of heading is required at the checkpoint.

Be ready to write down the time over the station when the TO-FROM indicator shows you have passed the station. Set the new magnetic course with the omni bearing selector, turn to the new heading and intercept the new radial, write down the estimated time over the next reporting point, then call the controller and give your position report.

Remember, the initial call should include the name of the fix and the altitude being maintained. If you are climbing, give your present altitude and the assigned altitude. Use the en route low altitude charts when flying the airways. Much of the information from the chart will be transferred to your flight log, but consult the chart when radial or frequency changes are required. The reason for this is that the flight log may not be as legible as the chart and there is always the possibility that information on the flight log was not copied correctly from the chart. It is good operating procedure to use the en route chart as a primary source of information during the flight.

Write down the frequency when given instructions to call another controller on another frequency. If contact is not established, the pilot must return to the last controller and request an alternate frequency.

Don't have a cluttered cockpit. If you haven't learned this already you will upon the first experience in trying to locate a map, computer, pencil, or what have you. When you are through with one en route chart put it back in its proper place for the next time. This way, only the chart that you are using is out and can't be confused with one that is no longer needed. No one can possibly describe to you where everything should be placed, but charts, computers, pencils, and all the other necessary tools of instrument flight should be kept in a proper place for your use on a moment's notice. In this way you're not wasting a lot of time and effort frantically trying to search for something when immediate information is needed for the successful conduct of the IFR operation.

Many of the problems involved in instrument flight can be eliminated by accurate trimming of the aircraft. Remember, however, the relationship between airspeed, power and trim.

The amount of power used determines the airspeed at which an airplane will fly straight and level at a given attitude. There is only one proper trim setting for this speed. Do not waste time making trim changes until the airspeed has stabilized. Then trim carefully for hands-off flight. Now when taking clearances, filling in the flight log or anything else that makes it necessary to remove at least one hand from the controls, fly the aircraft completely hands-off. Glance occasionally at the directional gyro and make any needed minor corrections with the rudders only. ●

How To Obtain An AOPA Instrument En Route Procedures Certificate

When the pilot finishes the AOPA Instrument En Route Procedures Course, his instructor should fill out the blank form supplied with course materials and send it to the AOPA Foundation, Inc., 4650 East-West Highway, Bethesda, Maryland 20014. A certificate of completion will then be sent directly to the pilot by the AOPA Foundation. For the pilot who desires to continue training, a minimum of four hours of practice should be performed after each course, reviewing and practicing each test and procedure included in the course completed.

For Flight Instructors

A properly certificated flight instructor may obtain at no cost one copy of the AOPA Instrument En Route Procedures syllabus and 10 copies of the pilot training manual by sending his name, address and certificate number to the AOPA Foundation, Inc., 4650 East-West Highway, Bethesda, Maryland 20014. Copies of the syllabus and manual also may be obtained by fixed-base operators who supply the AOPA Foundation with the names, addresses and certificate numbers of their flight instructors. One copy of the syllabus and 10 pilot training manuals will be provided for each flight instructor listed. Operators and others desiring copies of the manual in bulk may obtain them from the AOPA Foundation at a cost of $10 for 100 copies. The syllabus is not available in bulk orders. Its distribution will be limited to fixed-base operators, flight instructors and others having a bonafide need for it.

References for Further Study

1. **The AOPA 360° Rating Pilot Training Manual,** AOPA Foundation, Inc. Copyrighted 1961, AOPA Foundation, Inc.

2. **The AOPA Instrument Nav/Com Course Pilot Training Manual,** AOPA Foundation, Inc. Copyrighted 1963, AOPA Foundation, Inc.

3. **Low Altitude En Route Radio Facility Charts,** U.S. Coast and Geodetic Survey.