Chapter 14

Airport Operations

Introduction

Each time a pilot operates an aircraft, the flight normally begins and ends at an airport. An airport may be a small sod field or a large complex utilized by air carriers. This chapter examines airport operations, identifies features of an airport complex, and provides information on operating on or in the vicinity of an airport.

Airport Categories

The definition for airports refers to any area of land or water used or intended for landing or takeoff of aircraft. This includes, within the five categories of airports listed below, special types of facilities including seaplane bases, heliports, and facilities to accommodate tilt rotor aircraft. An airport includes an area used or intended for airport buildings, facilities, as well as rights of way together with the buildings and facilities.

Color and Type of Signal	Movement of Vehicles, Equipment and Personnel	Aircraft on the Ground	Aircraft in Flight
Steady green	Cleared to cross, proceed or go	Cleared for takeoff	Cleared to land
Flashing green	Not applicable	Cleared for taxi	Return for landing (to be followed by steady green at the proper time)
Steady red	Stop	Stop	Give way to other aircraft and continue circling
Flashing red	Clear the taxiway/runway	Taxi clear of the runway in use	Airport unsafe, do not land
Flashing white	Return to starting point on airport	Return to starting point on airport	Not applicable
Alternating red and green	Exercise extreme caution!!!!	Exercise extreme caution!!!!	Exercise extreme caution!!!!

The law defines airports by categories of airport activities, including commercial service, primary, cargo service, reliever, and general aviation airports, as shown below:

- Commercial Service Airports—publicly owned airports that have at least 2,500 passenger boardings each calendar year and receive scheduled passenger service. Passenger boardings refer to revenue passenger boardings on an aircraft in service in air commerce whether or not in scheduled service. The definition also includes passengers who continue on an aircraft in international flight that stops at an airport in any of the 50 States for a non-traffic purpose, such as refueling or aircraft maintenance rather than passenger activity. Passenger boardings at airports that receive scheduled passenger service are also referred to as Enplanements.
- Cargo Service Airports—airports that, in addition to any other air transportation services that may be available, are served by aircraft providing air transportation of only cargo with a total annual landed weight of more than 100 million pounds. "Landed weight" means the weight of aircraft transporting only cargo in intrastate, interstate, and foreign air transportation. An airport may be both a commercial service and a cargo service airport.
- Reliever Airports—airports designated by the FAA to relieve congestion at Commercial Service Airports and to provide improved general aviation access to the overall community. These may be publicly or privately-owned.
- General Aviation Airports — the remaining airports are commonly described as General Aviation Airports. This airport type is the largest single group of airports in the U.S. system. The category also includes privately owned, public use airports that enplane 2500 or more passengers annually and receive scheduled airline service.

Types of Airports

There are two types of airports—towered and nontowered. These types can be further subdivided to:

- Civil Airports—airports that are open to the general public.
- Military/Federal Government airports—airports operated by the military, National Aeronautics and Space Administration (NASA), or other agencies of the Federal Government.
- Private Airports—airports designated for private or restricted use only, not open to the general public.

Towered Airport

A towered airport has an operating control tower. Air traffic control (ATC) is responsible for providing the safe, orderly, and expeditious flow of air traffic at airports where the type of operations and/or volume of traffic requires such a service. Pilots operating from a towered airport are required to maintain two-way radio communication with ATC and to acknowledge and comply with their instructions. Pilots must advise ATC if they cannot comply with the instructions issued and request amended instructions. A pilot may deviate from an air traffic instruction in an emergency, but must advise ATC of the deviation as soon as possible.

Nontowered Airport

A nontowered airport does not have an operating control tower. Two-way radio communications are not required, although it is a good operating practice for pilots to transmit their intentions on the specified frequency for the benefit of other traffic in the area. The key to communicating at an airport without an operating control tower is selection of the correct common frequency. The acronym CTAF, which stands for Common Traffic Advisory Frequency, is synonymous with this program. A CTAF is a frequency designated for the purpose of carrying out airport advisory practices while operating to or from an airport without an operating control tower. The CTAF may be a Universal Integrated Community (UNICOM), MULTICOM, Flight Service Station (FSS), or tower frequency and is identified in appropriate aeronautical publications. UNICOM is a nongovernment air/ground radio communication station that may provide airport information at public use airports where there is no tower or FSS. On pilot request, UNICOM stations may provide pilots with weather information, wind direction, the recommended runway, or other necessary information. If the UNICOM frequency is designated as the CTAF, it is identified in appropriate aeronautical publications. *Figure 14-1* lists recommended communication procedures. More information regarding radio communications is provided later in this chapter.

Nontowered airport traffic patterns are always entered at pattern altitude. How you enter the pattern depends upon the direction of arrival. The preferred method for entering from the downwind side of the pattern is to approach the pattern on a course 45 degrees to the downwind leg and join the pattern at midfield.

There are several ways to enter the pattern if you're coming from the upwind leg side of the airport. One method of entry from the opposite side of the pattern is to announce your intentions and cross over midfield at least 500 feet above

Facility at Airport	Frequency Use	Communication/Broadcast Procedures		
		Outbound	Inbound	Practice Instrument Approach
UNICOM (no tower or FSS)	Communicate with UNICOM station on published CTAF frequency (122.7, 122.8, 122.725, 122.975, or 123.0). If unable to contact UNICOM station, use self-announce procedures on CTAF.	Before taxiing and before taxiing on the runway for departure.	10 miles out. Entering downwind, base, and final. Leaving the runway.	
No tower, FSS, or UNICOM	Self-announce on MULTICOM frequency 122.9.	Before taxiing and before taxiing on the runway for departure.	10 miles out. Entering downwind, base, and final. Leaving the runway.	Departing final approach fix (name) or on final approach segment inbound.
No tower in operation, FSS open	Communicate with FSS on CTAF frequency.	Before taxiing and before taxiing on the runway for departure.	10 miles out. Entering downwind, base, and final. Leaving the runway.	Approach completed/terminated.
FSS closed (no tower)	Self-announce on CTAF.	Before taxiing and before taxiing on the runway for departure.	10 miles out. Entering downwind, base, and final. Leaving the runway.	
Tower or FSS not in operation	Self-announce on CTAF.	Before taxiing and before taxiing on the runway for departure.	10 miles out. Entering downwind, base, and final. Leaving the runway.	

Figure 14-1. *Recommended communication procedures.*

pattern altitude (normally 1,500 feet AGL.) However, if large or turbine aircraft operate at your airport, it is best to remain 2,000 feet AGL so you are not in conflict with their traffic pattern. When well clear of the pattern—approximately 2 miles–scan carefully for traffic, descend to pattern altitude, then turn right to enter at 45° to the downwind leg at midfield. *[Figure 14-2]*

An alternate method is to enter on a midfield crosswind at pattern altitude, carefully scan for traffic, announce your intentions, and then turn downwind. *[Figure 14-3]* This technique should not be used if the pattern is busy. Always remember to give way to aircraft on the preferred 45° entry and to aircraft already established on downwind.

In either case, it is vital to announce your intentions, and remember to scan outside. Before joining the downwind leg, adjust your course or speed to blend into the traffic. Adjust power on the downwind leg, or sooner, to fit into the flow of traffic. Avoid flying too fast or too slow. Speeds recommended by the airplane manufacturer should be used. They will generally fall between 70 to 80 knots for fixed-gear singles and 80 to 90 knots for high-performance retractable.

Sources for Airport Data

When a pilot flies into a different airport, it is important to review the current data for that airport. This data provides the pilot with information, such as communication frequencies, services available, closed runways, or airport construction. Three common sources of information are:

- Aeronautical Charts
- Chart Supplement U.S. (formerly Airport/Facility Directory)
- Notices to Airmen (NOTAMs)
- Automated Terminal Information Service (ATIS)

Aeronautical Charts

Aeronautical charts provide specific information on airports. Chapter 16, "Navigation," contains an excerpt from an aeronautical chart and an aeronautical chart legend, which provides guidance on interpreting the information on the chart.

Chart Supplement U.S. (formerly Airport/Facility Directory)

The Chart Supplement U.S. (formerly Airport/Facility Directory) provides the most comprehensive information on a given airport. It contains information on airports, heliports, and seaplane bases that are open to the public. The Chart Supplement U.S. is published in seven books, which are organized by regions and are revised every 56 days. The Chart Supplement U.S. is also available digitally at www.faa.

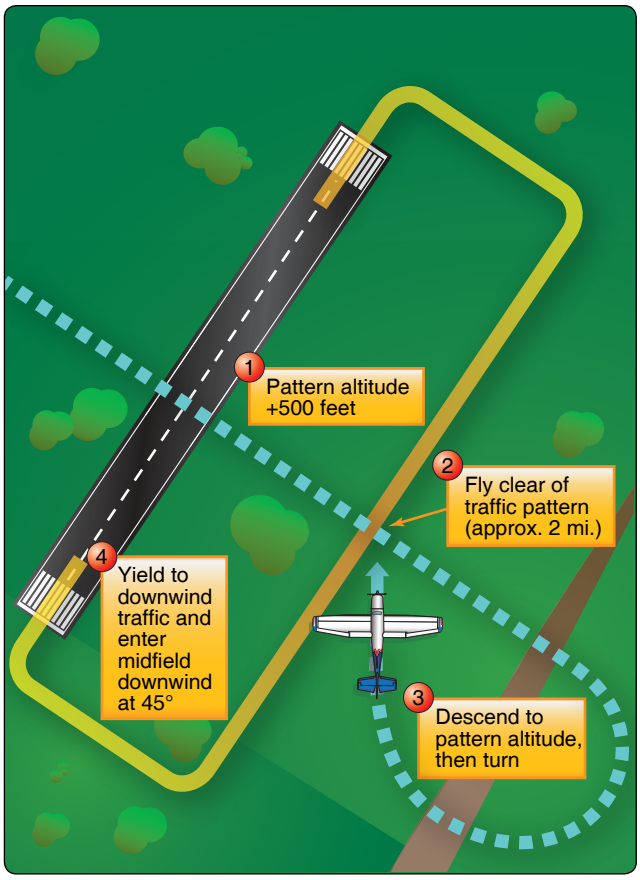


Figure 14-2. *Preferred Entry-Crossing Midfield.*

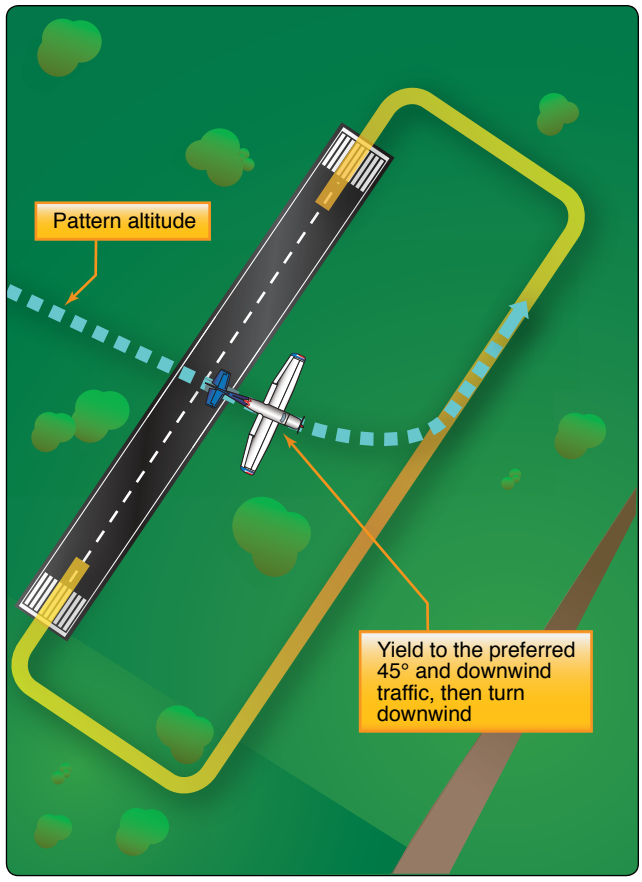


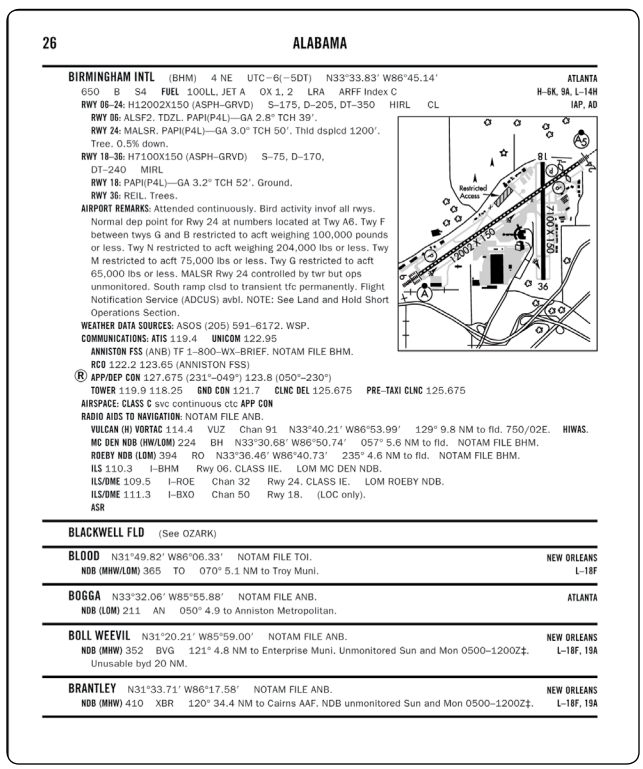
Figure 14-3. *Alternate Midfield Entry.*

gov/air_traffic/flight_info/aeronav. *Figure 14-4* contains an excerpt from a directory. For a complete listing of information provided in a Chart Supplement U.S. and how the information may be decoded, refer to the "Legend Sample" located in the front of each Chart Supplement U.S.

In addition to airport information, each Chart Supplement U.S. contains information such as special notices, Federal Aviation Administration (FAA) and National Weather Service (NWS) telephone numbers, preferred instrument flight rules (IFR) routing, visual flight rules (VFR) waypoints, a listing of very high frequency (VHF) omnidirectional range (VOR) receiver checkpoints, aeronautical chart bulletins, land and hold short operations (LAHSO) for selected airports, airport diagrams for selected towered airports, en route flight advisory service (EFAS) outlets, parachute jumping areas, and facility telephone numbers. It is beneficial to review a Chart Supplement U.S. to become familiar with the information it contains.

Notices to Airmen (NOTAM)

Time-critical aeronautical information, which is of a temporary nature or not sufficiently known in advance to permit publication, on aeronautical charts or in other operational


26 ALABAMA

BIRMINGHAM INTL (BHM) 4 NE UTC−6(−5DT) N33°33.83′ W86°45.14′ ATLANTA
650 B S4 **FUEL** 100LL, JET A OX 1, 2 LRA ARFF Index C H–6K, 9A, L–14H
RWY 06–24: H12002X150 (ASPH–GRVD) S–175, D–205, DT–350 HIRL CL IAP, AD
RWY 06: ALSF2. TDZL. PAPI(P4L)—GA 2.8° TCH 39′.
RWY 24: MALSR. PAPI(P4L)—GA 3.0° TCH 50′. Thld dsplcd 1200′. Tree. 0.5% down.
RWY 18–36: H7100X150 (ASPH–GRVD) S–75, D–170, DT–240 MIRL
RWY 18: PAPI(P4L)—GA 3.2° TCH 52′. Ground.
RWY 36: REIL. Trees.
AIRPORT REMARKS: Attended continuously. Bird activity invof all rwys. Normal dep point for Rwy 24 at numbers located at Twy A6. Twy F between twys G and B restricted to acft weighing 100,000 pounds or less. Twy N restricted to acft weighing 204,000 lbs or less. Twy M restricted to acft 75,000 lbs or less. Twy G restricted to acft 65,000 lbs or less. MALSR Rwy 24 controlled by twr but ops unmonitored. South ramp clsd to transient tfc permanently. Flight Notification Service (ADCUS) avbl. NOTE: See Land and Hold Short Operations Section.
WEATHER DATA SOURCES: ASOS (205) 591–6172. WSP.
COMMUNICATIONS: ATIS 119.4 **UNICOM** 122.95
ANNISTON FSS (ANB) TF 1–800–WX–BRIEF. NOTAM FILE BHM.
RCO 122.2 123.65 (ANNISTON FSS)
Ⓡ **APP/DEP CON** 127.675 (231°–049°) 123.8 (050°–230°)
TOWER 119.9 118.25 **GND CON** 121.7 **CLNC DEL** 125.675 **PRE–TAXI CLNC** 125.675
AIRSPACE: CLASS C svc continuous ctc **APP CON**
RADIO AIDS TO NAVIGATION: NOTAM FILE ANB.
VULCAN (H) VORTAC 114.4 VUZ Chan 91 N33°40.21′ W86°53.99′ 129° 9.8 NM to fld. 750/02E. HIWAS.
MC DEN NDB (HW/LOM) 224 BH N33°30.68′ W86°50.74′ 057° 5.6 NM to fld. NOTAM FILE BHM.
ROEBY NDB (LOM) 394 RO N33°36.46′ W86°40.73′ 235° 4.6 NM to fld. NOTAM FILE BHM.
ILS 110.3 I–BHM Rwy 06. CLASS IIE. LOM MC DEN NDB.
ILS/DME 109.5 I–ROE Chan 32 Rwy 24. CLASS IE. LOM ROEBY NDB.
ILS/DME 111.3 I–BXO Chan 50 Rwy 18. (LOC only).
ASR

BLACKWELL FLD (See OZARK)

BLOOD N31°49.82′ W86°06.33′ NOTAM FILE TOI. NEW ORLEANS
NDB (MHW/LOM) 365 TO 070° 5.1 NM to Troy Muni. L–18F

BOGGA N33°32.06′ W85°55.88′ NOTAM FILE ANB. ATLANTA
NDB (LOM) 211 AN 050° 4.9 to Anniston Metropolitan.

BOLL WEEVIL N31°20.21′ W85°59.00′ NOTAM FILE ANB. NEW ORLEANS
NDB (MHW) 352 BVG 121° 4.8 NM to Enterprise Muni. Unmonitored Sun and Mon 0500–1200Z‡. L–18F, 19A
Unusable byd 20 NM.

BRANTLEY N31°33.71′ W86°17.58′ NOTAM FILE ANB. NEW ORLEANS
NDB (MHW) 410 XBR 120° 34.4 NM to Cairns AAF. NDB unmonitored Sun and Mon 0500–1200Z‡. L–18F, 19A

Figure 14-4. *Chart Supplement U.S. (formerly Airport/Facility Directory excerpt.*

publications receives immediate dissemination by the NOTAM system. The NOTAM information could affect your decision to make the flight. It includes such information as taxiway and runway closures, construction, communications, changes in status of navigational aids, and other information essential to planned en route, terminal, or landing operations. Exercise good judgment and common sense by carefully regarding the information readily available in NOTAMs.

Prior to any flight, pilots should check for any NOTAMs that could affect their intended flight. For more information on NOTAMs, refer back to Chapter 1, "Pilot and Aeronautical Information" section.

Automated Terminal Information Service (ATIS)

The Automated Terminal Information Service (ATIS) is a recording of the local weather conditions and other pertinent non-control information broadcast on a local frequency in a looped format. It is normally updated once per hour but is updated more often when changing local conditions warrant. Important information is broadcast on ATIS including weather, runways in use, specific ATC procedures, and any airport construction activity that could affect taxi planning.

When the ATIS is recorded, it is given a code. This code is changed with every ATIS update. For example, ATIS Alpha is replaced by ATIS Bravo. The next hour, ATIS Charlie is recorded, followed by ATIS Delta and progresses down the alphabet.

Prior to calling ATC, tune to the ATIS frequency and listen to the recorded broadcast. The broadcast ends with a statement containing the ATIS code. For example, "Advise on initial contact, you have information Bravo." Upon contacting the tower controller, state information Bravo was received. This allows the tower controller to verify the pilot has the current local weather and airport information without having to state it all to each pilot who calls. This also clears the tower frequency from being overtaken by the constant relay of the same information, which would result without an ATIS broadcast. The use of ATIS broadcasts at departure and arrival airports is not only a sound practice but a wise decision.

Airport Markings and Signs

There are markings and signs used at airports that provide directions and assist pilots in airport operations. It is important for you to know the meanings of the signs, markings, and lights that are used on airports as surface navigational aids. All airport markings are painted on the surface, whereas some signs are vertical and some are painted on the surface. An overview of the most common signs and markings are described on the following pages. Additional information may be found in Chapter 2, "Aeronautical Lighting and Other Airport Visual Aids," of the Aeronautical Information Manual (AIM).

Runway Markings and Signs

Runway markings vary depending on the type of operations conducted at the airport. A basic VFR runway may only have centerline markings and runway numbers. Refer to Appendix C of this publication for an example of the most common runway markings that are found at airports.

Since aircraft are affected by the wind during takeoffs and landings, runways are laid out according to the local prevailing winds. Runway numbers are in reference to magnetic north. Certain airports have two or even three runways laid out in the same direction. These are referred to as parallel runways and are distinguished by a letter added to the runway number (e.g., runway 36L (left), 36C (center), and 36R (right)).

Relocated Runway Threshold

It is sometimes necessary, due to construction or runway maintenance, to close only a portion of a runway. When a portion of a runway is closed, the runway threshold is relocated as necessary. It is referred to as a relocated threshold and methods for identifying the relocated threshold vary. A common way for the relocated threshold to be marked is a ten foot wide white bar across the width of the runway. *[Figure 14-5A* and *B]*

When the threshold is relocated, the closed portion of the runway is not available for use by aircraft for takeoff or landing, but it is available for taxi. When a threshold is relocated, it closes not only a set portion of the approach end of a runway, but also shortens the length of the opposite direction runway. Yellow arrow heads are placed across the width of the runway just prior to the threshold bar.

Displaced Threshold

A displaced threshold is a threshold located at a point on the runway other than the designated beginning of the runway. Displacement of a threshold reduces the length of runway available for landings. The portion of runway behind a displaced threshold is available for takeoffs in either direction, or landings from the opposite direction. A ten feet wide white threshold bar is located across the width of the runway at the displaced threshold, and white arrows are located along the centerline in the area between the beginning of the runway and displaced threshold. White arrow heads are located across the width of the runway just prior to the threshold bar. *[Figure 14-6A* and *B]*

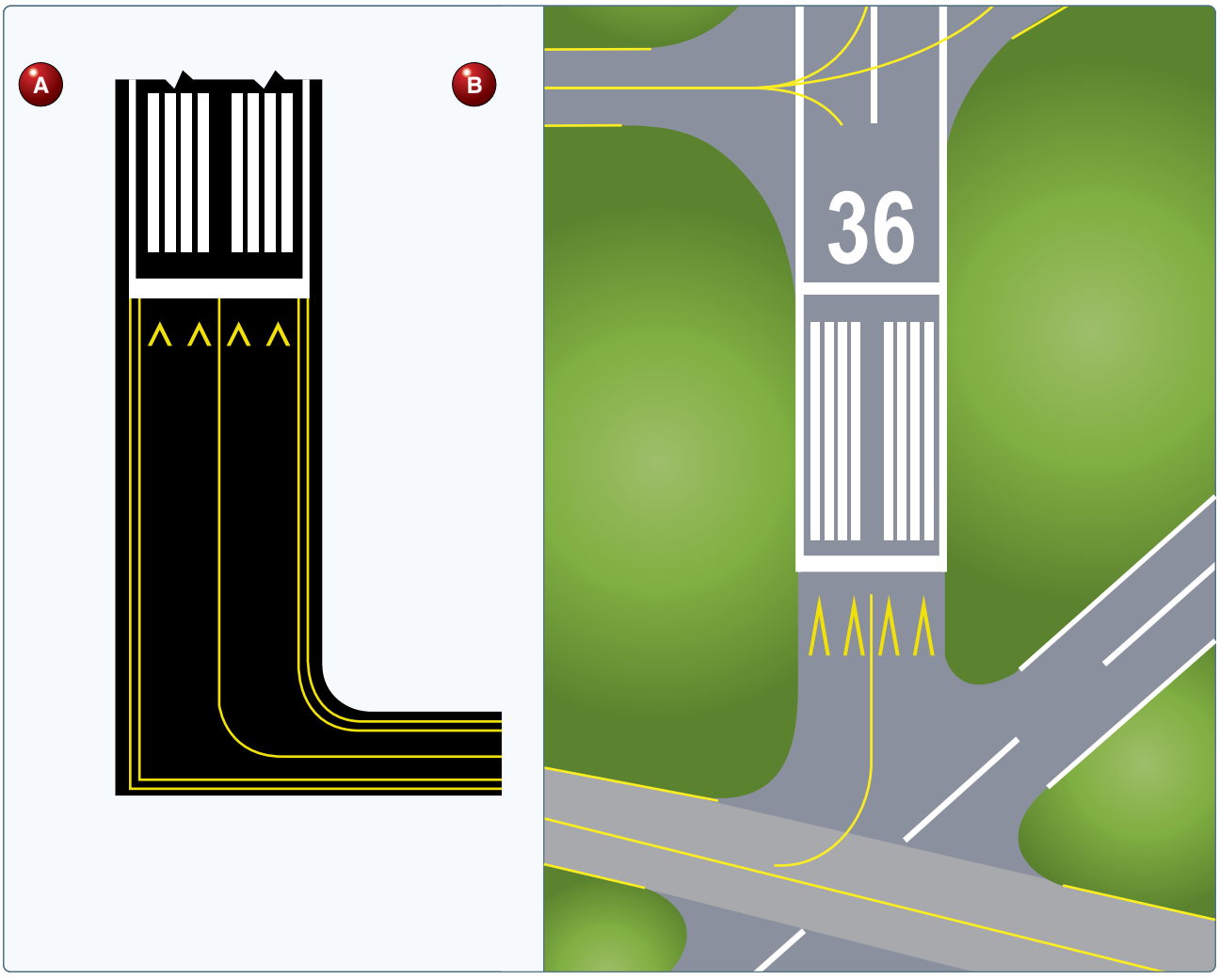


Figure 14-5. *(A) Relocated runway threshold drawing. (B) Relocated threshold for Runway 36 at Joplin Regional Airport (JLN).*

Runway Safety Area

The runway safety area (RSA) is a defined surface surrounding the runway prepared, or suitable, for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway. The dimensions of the RSA vary and can be determined by using the criteria contained within AC 150/5300-13, Airport Design, Chapter 3. Figure 3-1 in AC 150/5300-13 depicts the RSA. Additionally, it provides greater accessibility for firefighting and rescue equipment in emergency situations.

The RSA is typically graded and mowed. The lateral boundaries are usually identified by the presence of the runway holding position signs and markings on the adjoining taxiway stubs. Aircraft should not enter the RSA without making sure of adequate separation from other aircraft during operations at uncontrolled airports. *[Figure 14-7]*

Runway Safety Area Boundary Sign

Some taxiway stubs also have a runway safety area boundary sign that faces the runway and is visible to you only when exiting the runway. This sign has a yellow background with black markings and is typically used at towered airports where a controller commonly requests you to report clear of a runway. This sign is intended to provide you with another visual cue that is used as a guide to determine when you are clear of the runway safety boundary area. The sign shown in *Figure 14-8* is what you would see when exiting the runway at Taxiway Kilo. You are out of the runway safety area boundary when the entire aircraft passes the sign and the accompanying surface painted marking.

Runway Holding Position Sign

Noncompliance with a runway holding position sign may result in the FAA filing a Pilot Deviation against you. A

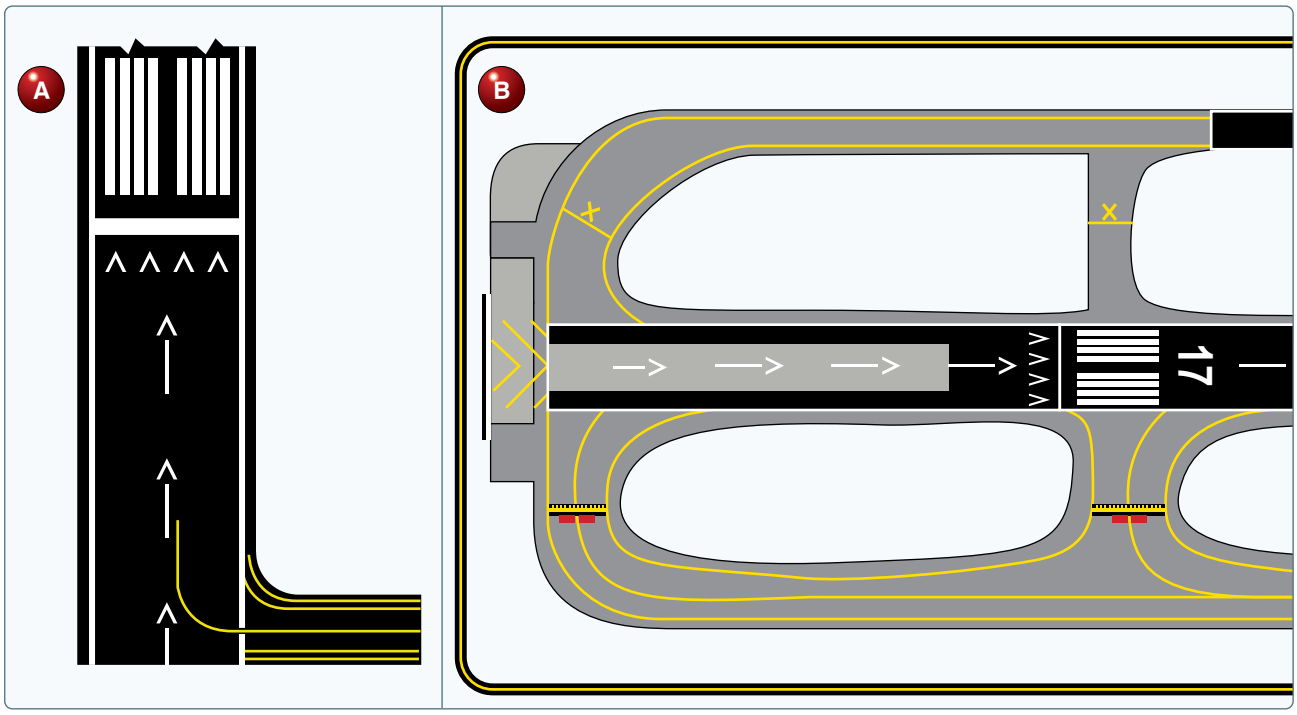


Figure 14-6. *(A) Displaced runway threshold drawing. (B) Displaced threshold for Runway 17 at Albuquerque International Airport (ABQ).*

runway holding position sign is an airport version of a stop sign. *[Figure 14-9]* It may be seen as a sign and/or its characters painted on the airport pavement. The sign has white characters outlined in black on a red background. It is always collocated with the surface painted holding position markings and is located where taxiways intersect runways. On taxiways that intersect the threshold of the takeoff runway, only the designation of the runway may appear on the sign.

If a taxiway intersects a runway somewhere other than at the threshold, the sign has the designation of the intersecting runway. The runway numbers on the sign are arranged to correspond to the relative location of the respective runway thresholds. *Figure 14-10* shows "18-36" to indicate the threshold for Runway 18 is to the left and the threshold for

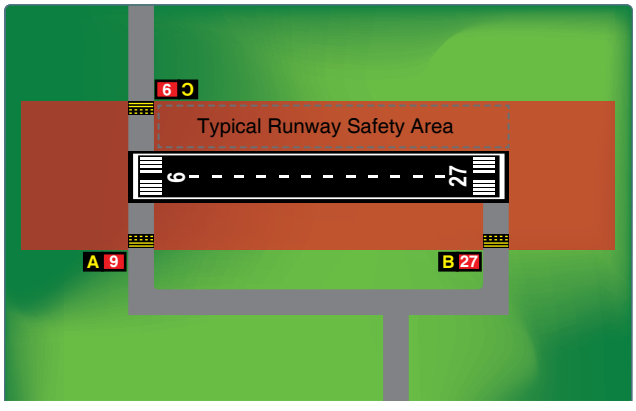


Figure 14-7. *Runway Safety Area.*

Figure 14-8. *Runway safety area boundary sign and marking located on Taxiway Kilo.*

Figure 14-9. *Runway holding position sign at takeoff end of Runway 14 with collocated Taxiway Alpha location sign.*

Figure 14-10. *Runway holding position sign at a location other than the takeoff end of Runway 18-36 with collocated Taxiway Alpha location sign.*

Runway 36 is to the right. The sign also indicates that you are located on Taxiway Alpha.

If the runway holding position sign is located on a taxiway at the intersection of two runways, the designations for both runways are shown on the sign along with arrows showing the approximate alignment of each runway. *[Figure 14-11A* and *B]* In addition to showing the approximate runway alignment, the arrows indicate the direction(s) to the threshold of the runway whose designation is immediately next to each corresponding arrow.

This type of taxiway and runway/runway intersection geometry can be very confusing and create navigational challenges. Extreme caution must be exercised when taxiing onto or crossing this type of intersection. *Figure 14-11A* and *B* shows a depiction of a taxiway, runway/runway intersection and is also designated as a "**hot spot**" on the airport diagram. In the example, Taxiway Bravo intersects with two runways, 31-13 and 35-17, which cross each other.

Surface painted runway holding position signs may also be used to aid you in determining the holding position. These markings consist of white characters on a red background and are painted on the left side of the taxiway centerline. *Figure 14-12* shows a surface painted runway holding position sign that is the holding point for Runway 32R-14L.

You should never allow any part of your aircraft to cross the runway holding position sign (either a vertical or surface painted sign) without a clearance from ATC. Doing so poses a hazard to yourself and others.

When the tower is closed or you are operating at a nontowered airport, you may taxi past a runway holding position sign only when the runway is clear of aircraft, and there are no aircraft on final approach. You may then proceed with extreme caution.

Runway Holding Position Marking

Noncompliance with a runway holding position marking may result in the FAA filing a Pilot Deviation against you. Runway holding position markings consist of four yellow lines, two solid and two dashed, that are painted on the surface and extend across the width of the taxiway to indicate where the aircraft should stop when approaching a runway. These markings are painted across the entire taxiway pavement, are in alignment, and are collocated with the holding position sign as described above.

As you approach the runway, two solid yellow lines and two dashed lines will be visible. Prior to reaching the solid lines, it is imperative to stop and ensure that no portion of the aircraft intersects the first solid yellow line. Do not cross the double solid lines until a clearance from ATC has been received. *[Figure 14-13]* When the tower is closed or when operating at a nontowered airport, you may taxi onto or across the runway only when the runway is clear and there are no aircraft on final approach. You should use extreme caution when crossing or taxiing onto the runway and always look both ways.

When exiting the runway, the same markings will be seen except the aircraft will be approaching the double dashed lines. *[Figure 14-14]* In order to be clear of the runway, the entire aircraft must cross both the dashed and solid lines. An ATC clearance is not needed to cross this marking when exiting the runway.

Runway Distance Remaining Signs

Runway distance remaining signs have a black background with a white number and may be installed along one or both sides of the runway. *[Figure 14-15]* The number on the signs indicates the distance, in thousands of feet, of landing runway remaining. The last sign, which has the numeral "1," is located at least 950 feet from the runway end.

Runway Designation Marking

Runway numbers and letters are determined from the approach direction. The runway number is the whole number nearest one-tenth the magnetic azimuth of the centerline of the runway, measured clockwise from the magnetic north. In the case where there are parallel runways, the letters differentiate between left (L), right (R), or center (C). *[Figure 14-16]* For example, if there are two parallel runways, they would show the designation number and then either L or R beneath it. For three parallel runways, the designation number would be presented with L, C, or R beneath it.

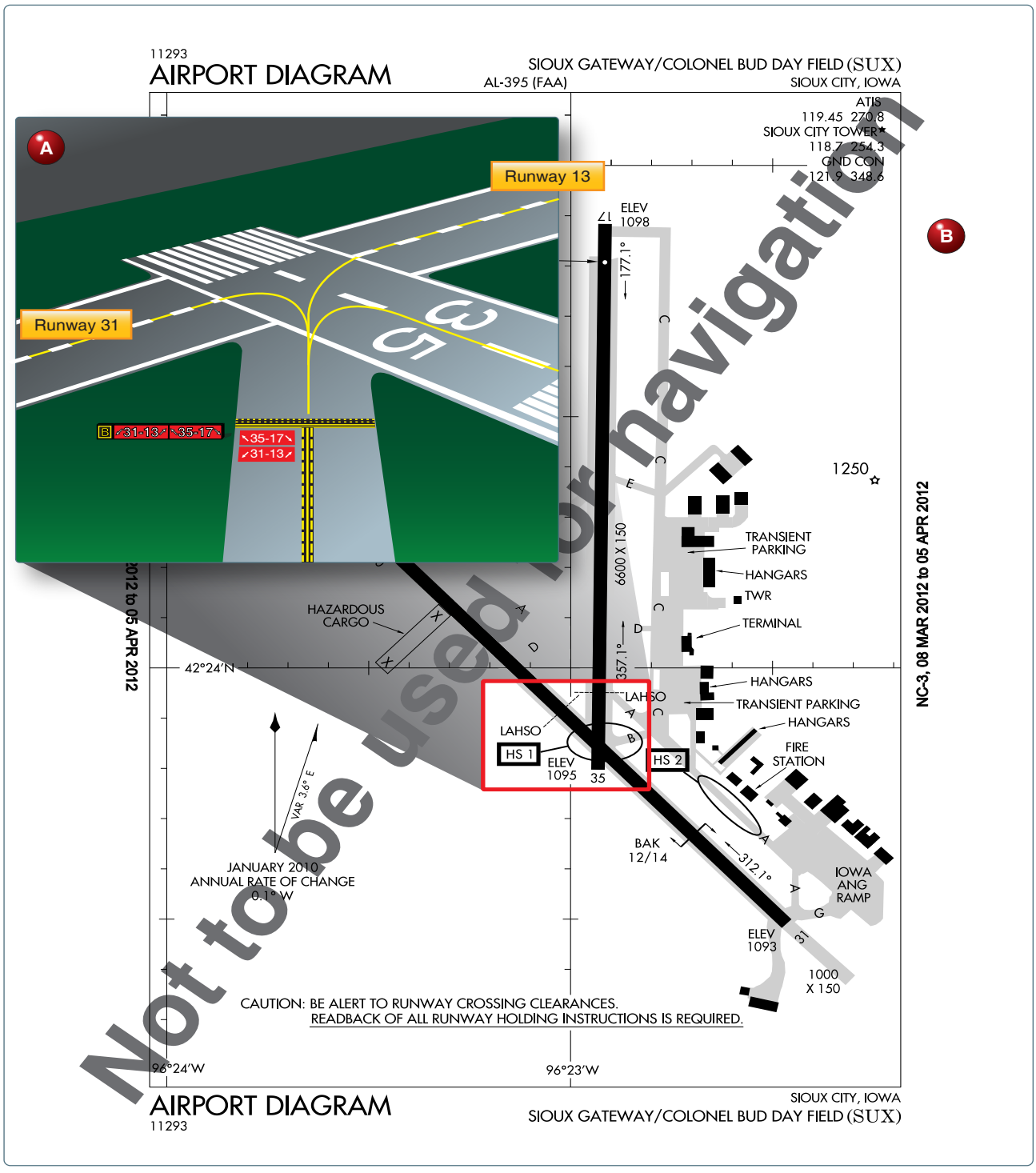


Figure 14-11. *(A) Taxiway Bravo location sign collocated with runway/runway intersection holding signs at Sioux Gateway Airport (SUX) (B) Airport diagram of Sioux Gateway Airport (SUX), Sioux City, Iowa. The area outlined in red is a designated "**hot spot**" (HS1).*

Figure 14-12. *Surface painted runway holding position signs for Runway 32R-14L along with the enhanced taxiway centerline marking.*

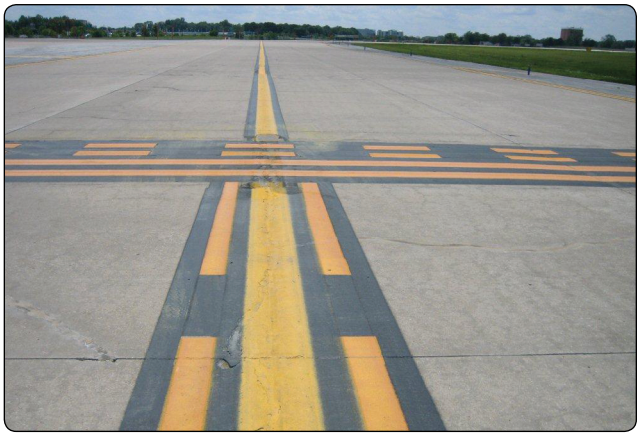


Figure 14-13. *Surface painted holding position marking along with enhanced taxiway centerline.*

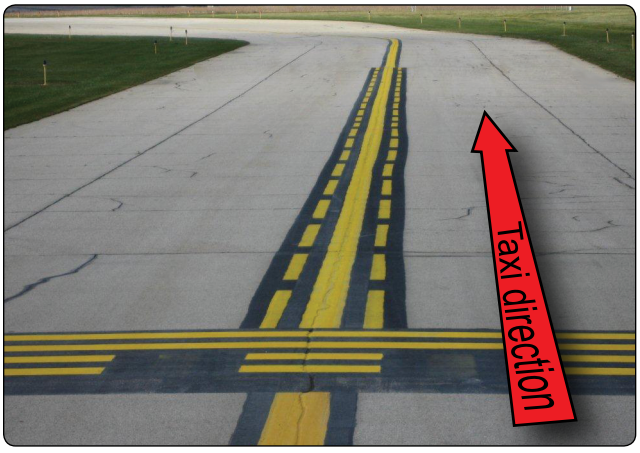


Figure 14-14. *Runway holding position markings as seen when exiting the runway. When exiting the runway, no ATC clearance is required to cross.*

Land and Hold Short Operations (LAHSO)

When simultaneous operations (takeoffs and landings) are being conducted on intersecting runways, Land and Hold Short Operations (LAHSO) may also be in effect. LAHSO is an ATC procedure that may require your participation and compliance. As pilot in command (PIC), you have the final authority to accept or decline any LAHSO clearance.

Figure 14-15. *Runway distance remaining sign indicating that there is 2,000 feet of runway remaining.*

If issued a land and hold short clearance, you must be aware of the reduced runway distances and whether or not you can comply before accepting the clearance. You do not have to accept a LAHSO clearance. Pilots should only receive a LAHSO clearance when there is a minimum ceiling of 1,000 feet and 3 statute miles of visibility.

Runway holding position signs and markings are installed on those runways used for LAHSO. The signs and markings are placed at the LAHSO point to aid you in determining where to stop and hold the aircraft and are located prior to the runway/runway intersection. *[Figure 14-17]*

The holding position sign has a white inscription with black border around the numbers on a red background and is installed adjacent to the holding position markings. If you accept a land and hold short clearance, you must comply so that no portion of the aircraft extends beyond these hold markings.

If receiving "cleared to land" instructions from ATC, you are authorized to use the entire landing length of the runway and should disregard any LAHSO holding position markings located on the runway. If you receive and accept LAHSO instructions, you must stop short of the intersecting runway prior to the LAHSO signs and markings.

Below is a list of items which, if thoroughly understood and complied with, will ensure that LAHSO operations are conducted properly.

- Know landing distance available.
- Be advised by ATC as to why LAHSO are being conducted.

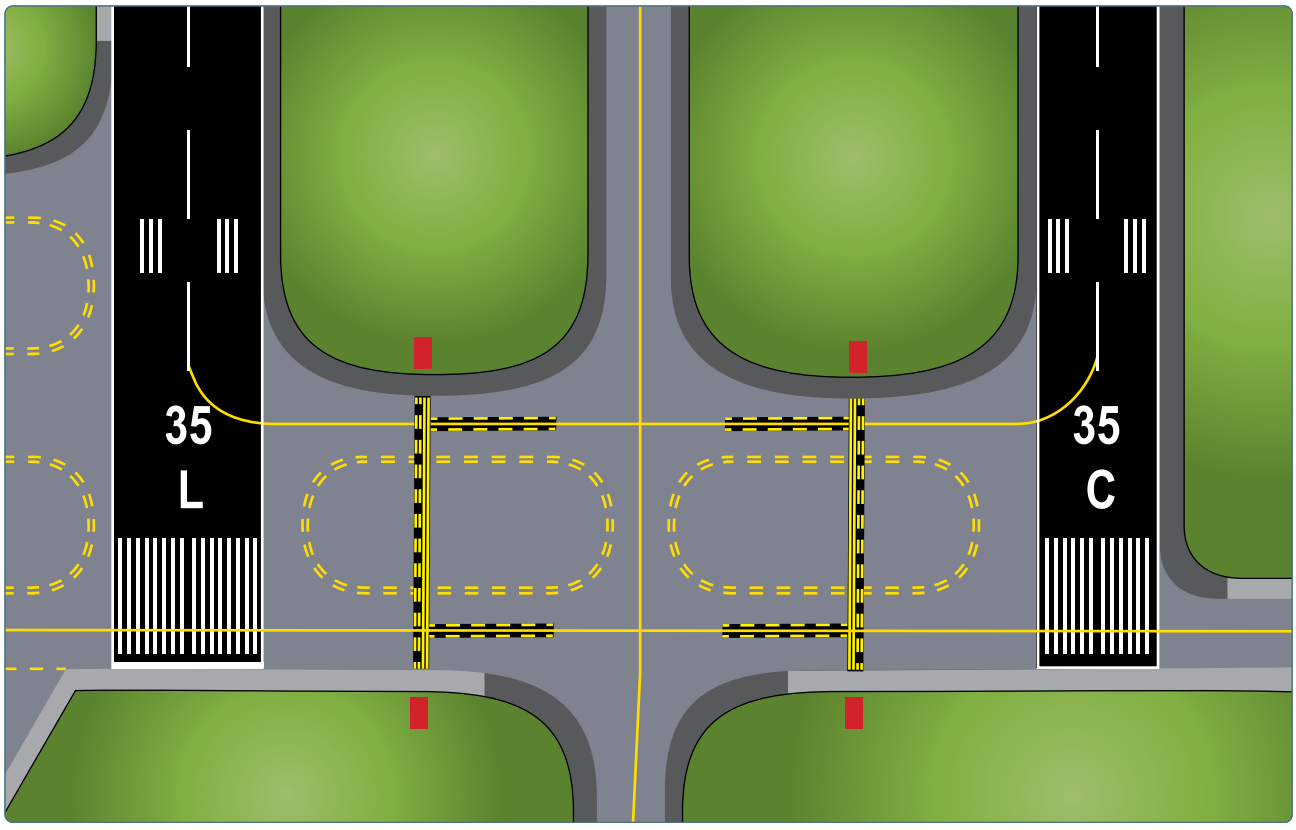


Figure 14-16. *Two of three parallel runways.*

- Advise ATC if you cannot comply with LAHSO.
- Know what signs and markings are at the LAHSO point.
- LAHSO are not authorized for student pilots who are performing a solo flight.
- At many airports air carrier aircraft are not authorized to participate in LAHSO if the other aircraft is a general aviation aircraft.
- Generally, LAHSO are not authorized at night.
- LAHSO are not authorized on wet runways.

Figure 14-17. *Runway holding position sign and marking for LAHSO.*

If you accept the following clearance from ATC: "Cleared to land Runway 36 hold short of Runway 23," you must either exit Runway 36 or stop at the holding position prior to Runway 23.

Taxiway Markings and Signs

Taxiway direction signs have a yellow background and black characters, which identifies the designation or intersecting taxiways. Arrows indicate the direction of turn that would place the aircraft on the designated taxiway. *[Figure 14-18]* Direction signs are normally located on the left side of the taxiway and prior to the intersection. These signs and markings (with a yellow background and black characters) indicate the direction toward a different taxiway, leading off a runway, or out of an intersection. *Figure 14-18* shows Taxiway Delta and how Taxiway Bravo intersects ahead at 90° both left and right.

Taxiway direction signs can also be displayed as surface painted markings. *Figure 14-19* shows Taxiway Bravo as proceeding straight ahead while Taxiway Alpha turns to the right at approximately 45°.

Figure 14-18. *Taxiway Bravo direction sign with a collocated Taxiway Delta location sign. When the arrow on the direction sign indicates a turn, the sign is located prior to the intersection.*

Figure 14-20A and *B* shows an example of a direction sign at a complex taxiway intersection. *Figure 14-20A* and *B* shows Taxiway Bravo intersects with Taxiway Sierra at 90°, but at 45° with Taxiway Foxtrot. This type of array can be displayed with or without the taxiway location sign, which in this case would be Taxiway Bravo.

Enhanced Taxiway Centerline Markings

At most towered airports, the enhanced taxiway centerline marking is used to warn you of an upcoming runway. It consists of yellow dashed lines on either side of the normal solid taxiway centerline and the dashes extend up to 150 feet prior to a runway holding position marking. *[Figure 14-21A* and *B]* They are used to aid you in maintaining awareness during surface movement to reduce runway incursions.

Destination Signs

Destination signs have black characters on a yellow background indicating a destination at the airport. These signs always have an arrow showing the direction of the taxi route to that destination. *[Figure 14-22]* When the arrow on the destination sign indicates a turn, the sign is located prior to the intersection. Destinations commonly shown on these types of signs include runways, aprons, terminals, military areas, civil aviation areas, cargo areas, international areas, and fixed-base operators. When the inscription for two or more destinations having a common taxi route are placed on a sign, the destinations are separated by a "dot" (•) and one arrow would be used as shown in *Figure 14-22.* When the inscription on a sign contains two or more destinations having different taxi routes, each destination is accompanied by an arrow and separated from the other destination(s) on the sign with a vertical black message divider as shown in *Figure 14-23.* The example shown in *Figure 14-23* shows two signs. The sign in the foreground explains that Runway 20 threshold is to the left, and Runways 32, 2, and 14 are to the right. The sign in the background indicates that you are located on Taxiway Bravo and Taxiway November will take you to those runways.

Figure 14-19. *Surface painted taxiway direction signs.*

Holding Position Signs and Markings for an Instrument Landing System (ILS) Critical Area

The instrument landing system (ILS) broadcasts signals to arriving instrument aircraft to guide them to the runway. Each of these ILSs have critical areas that must be kept clear of all obstacles in order to ensure quality of the broadcast signal. At many airports, taxiways extend into the ILS critical area. Most of the time, this is of no concern; however, during times of poor weather, an aircraft on approach may depend on a good signal quality. When necessary, ATC will protect the ILS critical area for arrival instrument traffic by instructing taxiing aircraft to "**hold short**" of Runway (XX) ILS critical area.

The ILS critical area hold sign has white characters, outlined in black, on a red background and is installed adjacent to the ILS holding position markings. *[Figure 14-24]* The holding position markings for the ILS critical area appear on the pavement as a horizontal yellow ladder extending across the width of the taxiway.

When instructed to "hold short of Runway (XX) ILS critical area," you must ensure no portion of the aircraft extends beyond these markings. *[Figure 14-25]* If ATC does not instruct you to hold at this point, then you may bypass the ILS critical area hold position markings and continue with your taxi. *Figure 14-24* shows that the ILS hold sign is located on Taxiway Golf and the ILS ladder hold position marking is adjacent to the hold sign.

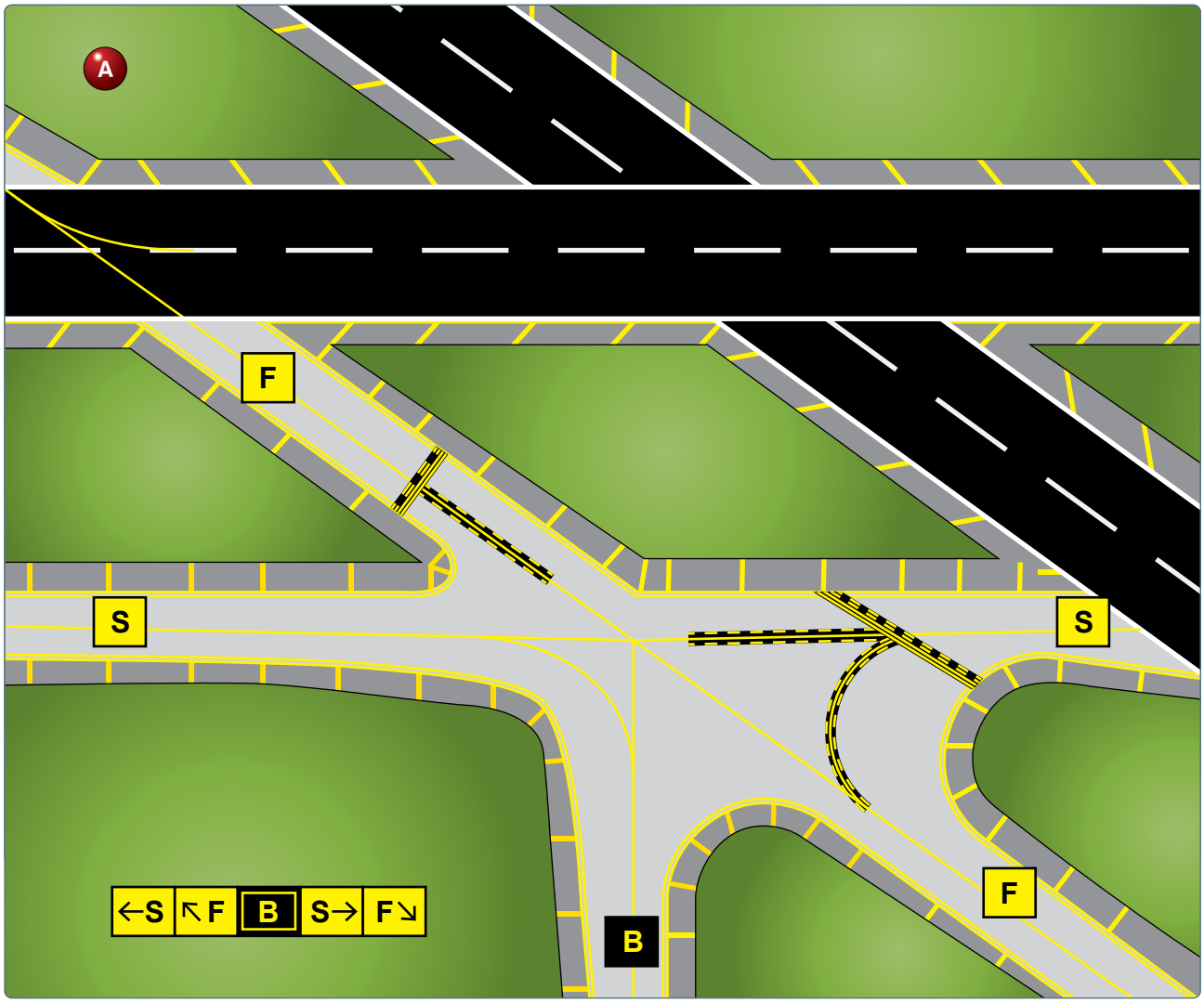


Figure 14-20. *Orientation of signs is from left to right in a clockwise manner. Left turn signs are on the left and right turn on the right. In this view, the pilot is on Taxiway Bravo.*

Figure 14-21. *(A) Enhanced taxiway centerline marking. (B) Enhanced taxiway centerline marking and runway holding position marking.*

Figure 14-22. *Destination sign to the fixed-base operator (FBO).*

Figure 14-23. *Runway destination sign with different taxi routes.*

Figure 14-24. *Instrument landing system (ILS) holding position sign and marking on Taxiway Golf.*

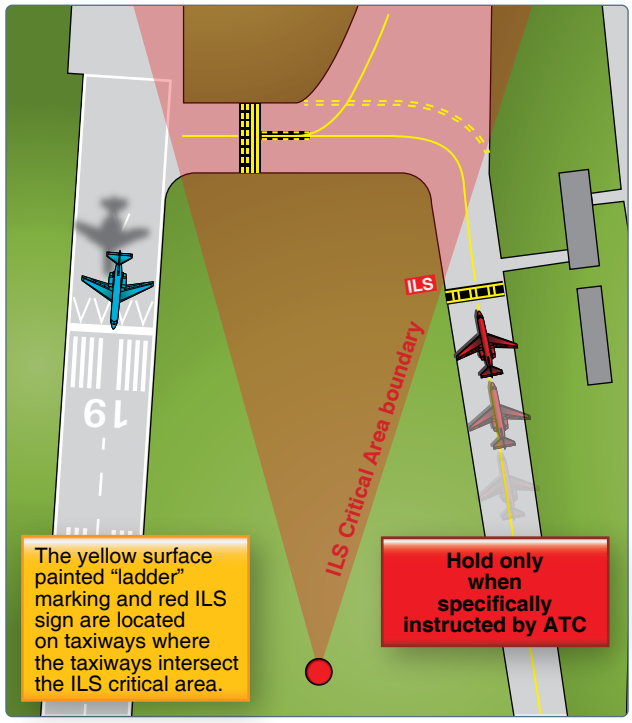


Figure 14-25. *Holding position sign and marking for instrument landing system (ILS) critical area boundary.*

Holding Position Markings for Taxiway/Taxiway Intersections

Holding position markings for taxiway/taxiway intersections consist of a single dashed yellow line extending across the width of the taxiway. *[Figure 14-26]* They are painted on taxiways where ATC normally holds aircraft short of a taxiway intersection. When instructed by ATC "hold short of Taxiway X," you should stop so that no part of your aircraft extends beyond the holding position marking. When the marking is not present, you should stop your aircraft at a point that provides adequate clearance from an aircraft on the intersecting taxiway.

Marking and Lighting of Permanently Closed Runways and Taxiways

For runways and taxiways that are permanently closed, the lighting circuits are disconnected. The runway threshold, runway designation, and touchdown markings are obliterated and yellow "Xs" are placed at each end of the runway and at 1,000-foot intervals.

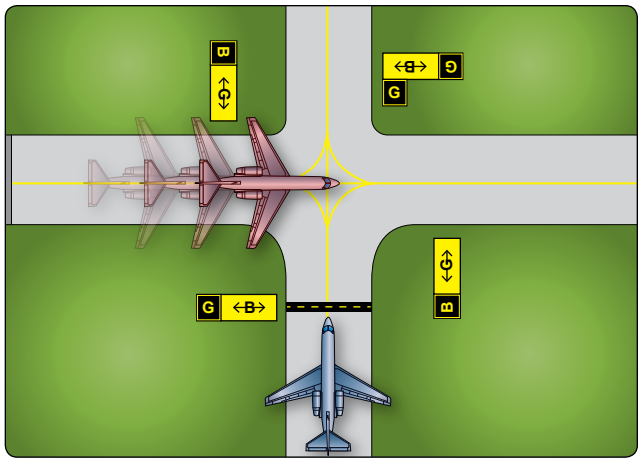


Figure 14-26. *Holding position marking on a taxiway.*

Temporarily Closed Runways and Taxiways

For temporarily closed runways and taxiways, a visual indication is often provided with yellow "Xs" or raised lighted yellow "Xs" placed at each end of the runway. Depending on the reason for the closure, duration of closure, airfield configuration, and the existence and the hours of operation of an ATC tower, a visual indication may not be present. As discussed previously in the chapter, you must always check NOTAMs and ATIS for runway and taxiway closure information.

Figure 14-27A shows an example of a yellow "X" laid flat with an adequate number of heavy sand bags to keep the wind from getting under and displacing the vinyl material.

A very effective and preferable visual aid to depict temporary closure is the lighted "X" placed on or near the runway designation numbers. *[Figure 14-27B* and *C]* This device is much more discernible to approaching aircraft than the other materials described above.

Other Markings

Some other markings found on the airport include vehicle roadway markings, VOR receiver checkpoint markings, and non-movement area boundary markings.

Airport Signs

There are six types of signs that may be found at airports. The more complex the layout of an airport, the more important the signs become to pilots. Appendix C of this publication shows examples of some signs that are found at most airports, their purpose, and appropriate pilot action. The six types of signs are:

- Mandatory instruction signs—red background with white inscription. These signs denote an entrance to a runway, critical area, or prohibited area.

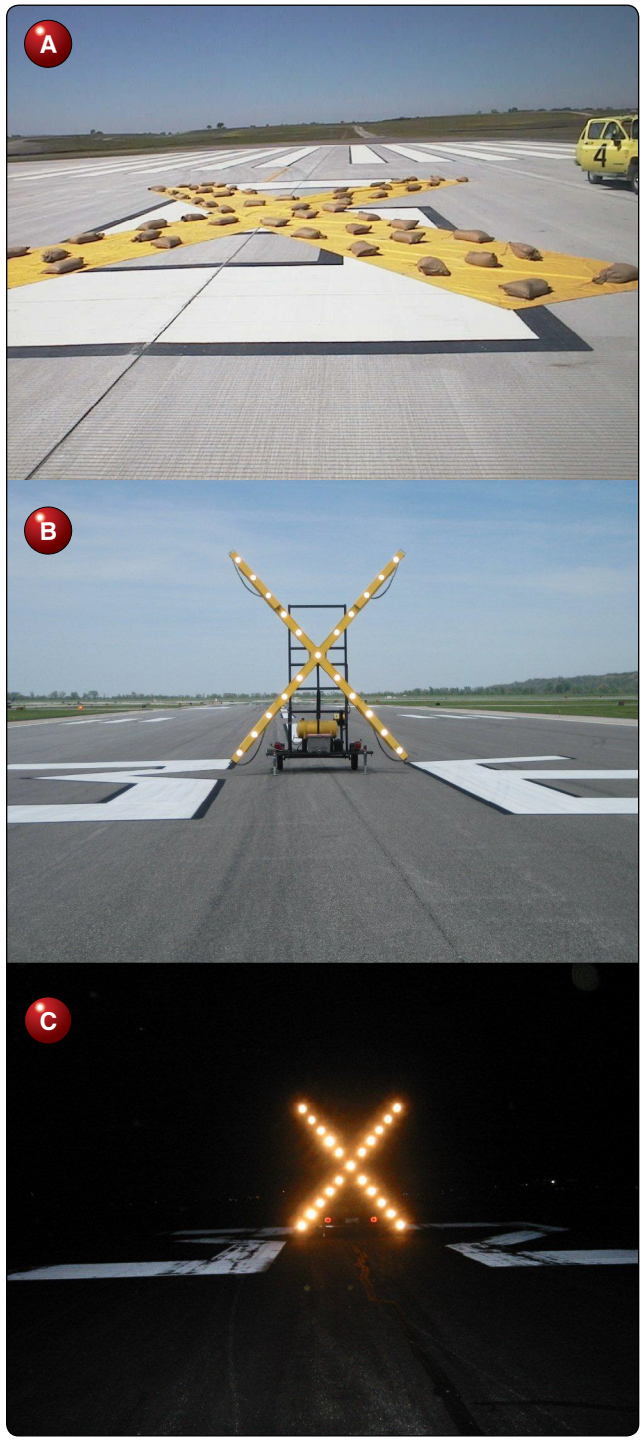


Figure 14-27. *(A) Yellow "X" placed on surface of temporarily closed runways. (B) Lighted "X" placed on temporarily closed runways. (C) Lighted "X" at night showing a temporarily closed runway.*

- Location signs—black with yellow inscription and a yellow border, no arrows. They are used to identify a taxiway or runway location, to identify the boundary of the runway, or identify an instrument landing system (ILS) critical area.

- Direction signs—yellow background with black inscription. The inscription identifies the designation of the intersecting taxiway(s) leading out of an intersection.
- Destination signs—yellow background with black inscription and arrows. These signs provide information on locating areas, such as runways, terminals, cargo areas, and civil aviation areas.
- Information signs—yellow background with black inscription. These signs are used to provide the pilot with information on areas that cannot be seen from the control tower, applicable radio frequencies, and noise abatement procedures. The airport operator determines the need, size, and location of these signs.
- Runway distance remaining signs—black background with white numbers. The numbers indicate the distance of the remaining runway in thousands of feet.

Airport Lighting

The majority of airports have some type of lighting for night operations. The variety and type of lighting systems depends on the volume and complexity of operations at a given airport. Airport lighting is standardized so that airports use the same light colors for runways and taxiways.

Airport Beacon

Airport beacons help a pilot identify an airport at night. The beacons are normally operated from dusk until dawn. Sometimes they are turned on if the ceiling is less than 1,000 feet and/or the ground visibility is less than 3 statute miles (VFR minimums). However, there is no requirement for this, so a pilot has the responsibility of determining if the weather meets VFR requirements. The beacon has a vertical light distribution to make it most effective from 1–10° above the horizon, although it can be seen well above or below this spread. The beacon may be an omnidirectional capacitor-discharge device, or it may rotate at a constant speed, that produces the visual effect of flashes at regular intervals. The combination of light colors from an airport beacon indicates the type of airport. *[Figure 14-28]* Some of the most common beacons are:

- Flashing white and green for civilian land airports
- Flashing white and yellow for a water airport
- Flashing white, yellow, and green for a heliport
- Two quick white flashes alternating with a green flash identifying a military airport

Approach Light Systems

Approach light systems are primarily intended to provide a means to transition from instrument flight to visual flight for landing. The system configuration depends on whether the runway is a precision or nonprecision instrument runway. Some systems include sequenced flashing lights that appear to the pilot as a ball of light traveling toward the runway at high speed. Approach lights can also aid pilots operating under VFR at night.

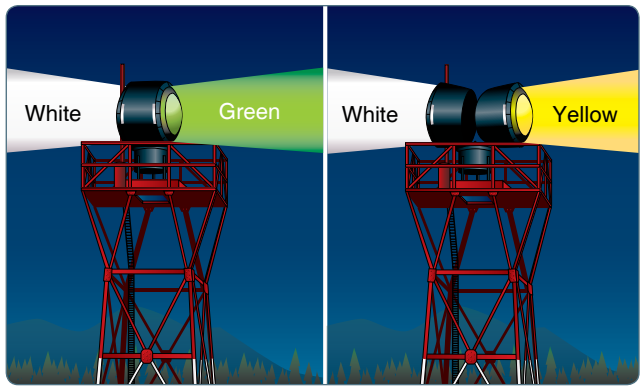


Figure 14-28. *Airport rotating beacons.*

Visual Glideslope Indicators

Visual glideslope indicators provide the pilot with glidepath information that can be used for day or night approaches. By maintaining the proper glidepath as provided by the system, a pilot should have adequate obstacle clearance and should touch down within a specified portion of the runway.

Visual Approach Slope Indicator (VASI)

VASI installations are the most common visual glidepath systems in use. The VASI provides obstruction clearance within 10° of the extended runway centerline and up to four nautical miles (NM) from the runway threshold.

The VASI consists of light units arranged in bars. There are 2-bar and 3-bar VASIs. The 2-bar VASI has near and far light bars and the 3-bar VASI has near, middle, and far light bars. Two-bar VASI installations provide one visual glidepath that is normally set at 3°. The 3-bar system provides two glidepaths, the lower glidepath normally set at 3° and the upper glidepath ¼ degree above the lower glidepath.

The basic principle of the VASI is that of color differentiation between red and white. Each light unit projects a beam of light, a white segment in the upper part of the beam and a red segment in the lower part of the beam. The lights are arranged so the pilot sees the combination of lights shown in *Figure 14-29* to indicate below, on, or above the glidepath.

Other Glidepath Systems

A precision approach path indicator (PAPI) uses lights similar to the VASI system, except they are installed in a single row, normally on the left side of the runway. *[Figure 14-30]*

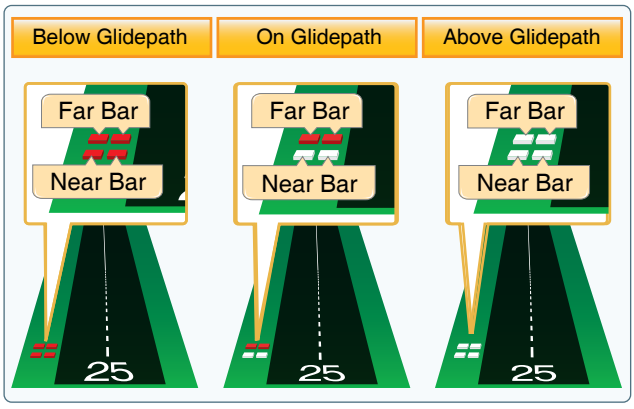


Figure 14-29. *Two-bar VASI system.*

A tri-color system consists of a single-light unit projecting a three-color visual approach path. Below the glidepath is indicated by red, on the glidepath is indicated by green, and above the glidepath is indicated by amber. When descending below the glidepath, there is a small area of dark amber. Pilots should not mistake this area for an "above the glidepath" indication. *[Figure 14-31]*

Pulsating VASIs normally consist of a single-light unit projecting a two-color visual approach path into the final approach area of the runway upon which the indicator is installed. The "on glidepath" indication is a steady white light. The "slightly below glidepath" indication is a steady red light. If the aircraft descends further below the glidepath, the red light starts to pulsate. The "above glidepath" indication is a pulsating white light. The pulsating rate increases as the aircraft gets further above or below the desired glideslope. The useful range of the system is about four miles during the day and up to ten miles at night. *[Figure 14-32]*

Runway Lighting

There are various lights that identify parts of the runway complex. These assist a pilot in safely making a takeoff or landing during night operations.

Runway End Identifier Lights (REIL)

Runway end identifier lights (REIL) are installed at many airfields to provide rapid and positive identification of the approach end of a particular runway. The system consists of a pair of synchronized flashing lights located laterally on each side of the runway threshold. REILs may be either omnidirectional or unidirectional facing the approach area.

Runway Edge Lights

Runway edge lights are used to outline the edges of runways at night or during low visibility conditions. *[Figure 14-33]* These lights are classified according to the intensity they are capable of producing: high intensity runway lights (HIRL), medium intensity runway lights (MIRL), and

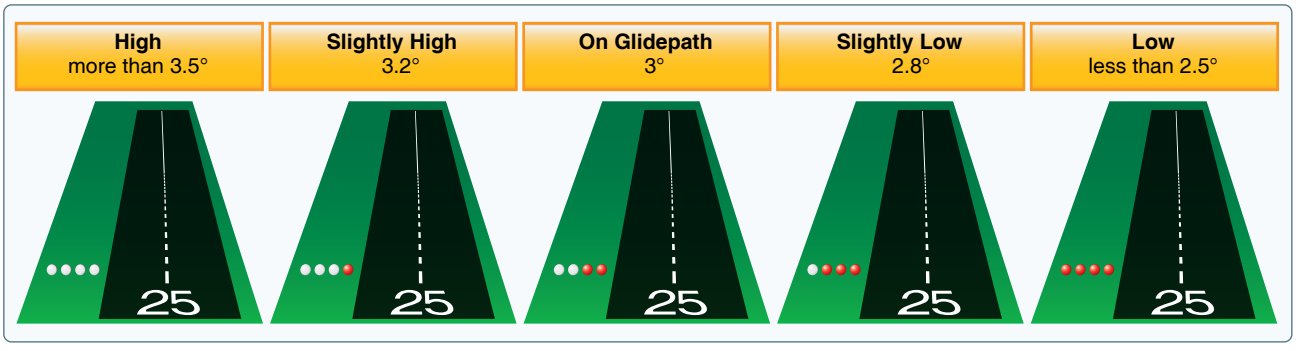


Figure 14-30. *Precision approach path indicator for a typical 3° glide slope.*

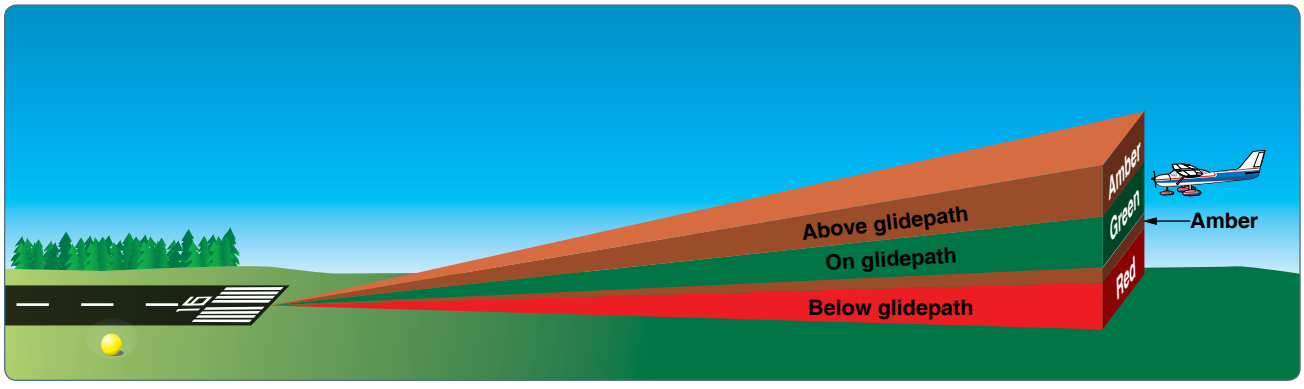


Figure 14-31. *Tri-color visual approach slope indicator.*

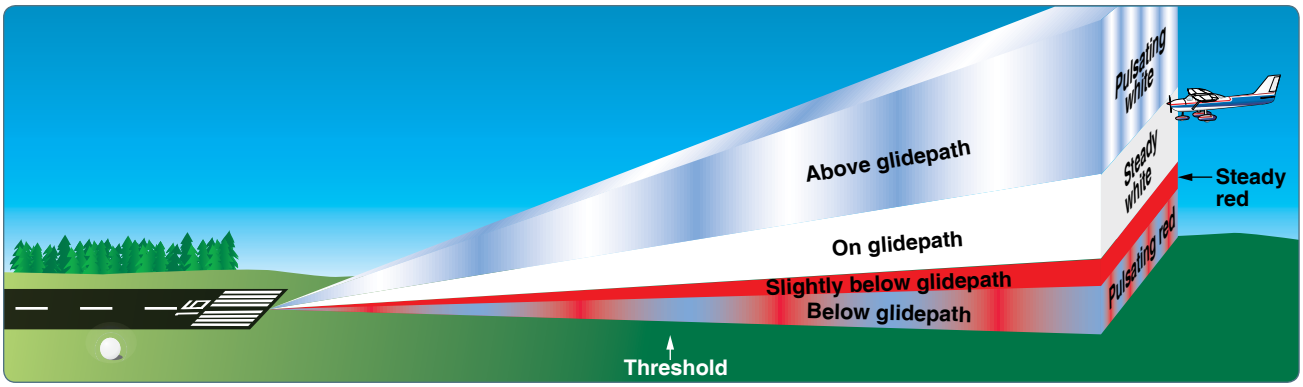


Figure 14-32. *Pulsating visual approach slope indicator.*

low intensity runway lights (LIRL). The HIRL and MIRL have variable intensity settings. These lights are white, except on instrument runways where amber lights are used on the last 2,000 feet or half the length of the runway, whichever is less. The lights marking the end of the runway are red.

In-Runway Lighting

Runway centerline lighting system (RCLS)—installed on some precision approach runways to facilitate landing under adverse visibility conditions. They are located along the runway centerline and are spaced at 50-foot intervals. When viewed from the landing threshold, the runway centerline lights are white until the last 3,000 feet of the runway. The white lights begin to alternate with red for the next 2,000 feet. For the remaining 1,000 feet of the runway, all centerline lights are red.

Touchdown zone lights (TDZL)—installed on some precision approach runways to indicate the touchdown zone when landing under adverse visibility conditions. They consist of two rows of transverse light bars disposed symmetrically about the runway centerline. The system consists of steady-burning white lights that start 100 feet beyond the landing threshold and extend to 3,000 feet beyond the landing threshold or to the midpoint of the runway, whichever is less.

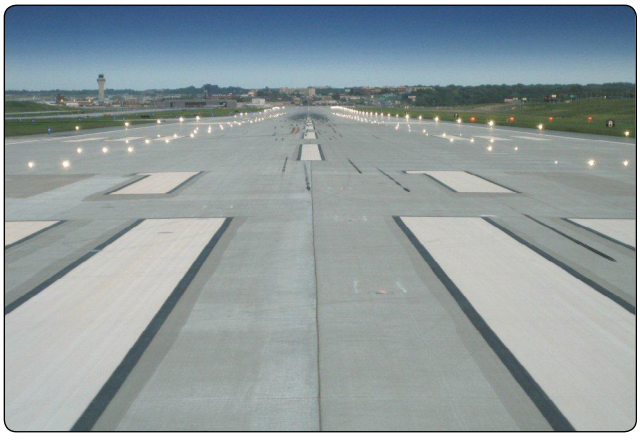


Figure 14-33. *Runway lights.*

Taxiway centerline lead-off lights—provide visual guidance to persons exiting the runway. They are color-coded to warn pilots and vehicle drivers that they are within the runway environment or ILS critical area, whichever is more restrictive. Alternate green and yellow lights are installed, beginning with green, from the runway centerline to one centerline light position beyond the runway holding position or ILS critical area holding position.

Taxiway centerline lead-on lights—provide visual guidance to persons entering the runway. These "lead-on" lights are also color-coded with the same color pattern as lead-off lights to warn pilots and vehicle drivers that they are within the runway environment or ILS critical area, whichever is more conservative. The fixtures used for lead-on lights are bidirectional (i.e., one side emits light for the lead-on function while the other side emits light for the lead-off function). Any fixture that emits yellow light for the lead-off function also emits yellow light for the lead-on function.

Land and hold short lights—used to indicate the hold short point on certain runways which are approved for LAHSO. Land and hold short lights consist of a row of pulsing white lights installed across the runway at the hold short point. Where installed, the lights are on anytime LAHSO is in effect. These lights are off when LAHSO is not in effect.

Control of Airport Lighting

Airport lighting is controlled by ATC at towered airports. At nontowered airports, the lights may be on a timer, or where an FSS is located at an airport, the FSS personnel may control the lighting. A pilot may request various light systems be turned on or off and also request a specified intensity, if available, from ATC or FSS personnel. At selected nontowered airports, the pilot may control the lighting by using the radio. This is done by selecting a specified frequency and clicking the radio microphone. *[Figure 14-34]* For information on pilot controlled lighting at various airports, refer to the Chart Supplement U.S. (formerly Airport/Facility Directory).

Key Mike	Function
7 times within 5 seconds	Highest intensity available
5 times within 5 seconds	Medium or lower intensity (Lower REIL or REIL off)
3 times within 5 seconds	Lowest intensity available (Lower REIL or REIL off)

Figure 14-34. *Radio controlled runway lighting.*

Taxiway Lights

Similar to runway lighting, taxiways also have various lights which help pilots identify areas of the taxiway and any surrounding runways.

Omnidirectional

Omnidirectional taxiway lights outline the edges of the taxiway and are blue in color. At many airports, these edge lights may have variable intensity settings that may be adjusted by an ATC when deemed necessary or when requested by the pilot. Some airports also have taxiway centerline lights that are green in color.

Clearance Bar Lights

Clearance bar lights are installed at holding positions on taxiways in order to increase the conspicuity of the holding position in low visibility conditions. They may also be installed to indicate the location of an intersecting taxiway during periods of darkness. Clearance bars consist of three in-pavement steady-burning yellow lights.

Runway Guard Lights

Runway guard lights are installed at taxiway/runway intersections. They are primarily used to enhance the conspicuity of taxiway/runway intersections during low visibility conditions, but may be used in all weather conditions. Runway guard lights consist of either a pair of elevated flashing yellow lights installed on either side of the taxiway, or a row of in-pavement yellow lights installed across the entire taxiway, at the runway holding position marking.

Note: Some airports may have a row of three or five in-pavement yellow lights installed at taxiway/runway intersections. They should not be confused with clearance bar lights described previously in this section.

Stop Bar Lights

Stop bar lights, when installed, are used to confirm the ATC clearance to enter or cross the active runway in low visibility conditions (below 1,200 ft Runway Visual Range (RVR)). A stop bar consists of a row of red, unidirectional, steady-burning in-pavement lights installed across the entire taxiway at the runway holding position, and elevated steady-burning red lights on each side. A controlled stop bar is operated in conjunction with the taxiway centerline lead-on lights which extend from the stop bar toward the runway. Following the ATC clearance to proceed, the stop bar is turned off and the lead-on lights are turned on. The stop bar and lead-on lights are automatically reset by a sensor or backup timer.

Obstruction Lights

Obstructions are marked or lighted to warn pilots of their presence during daytime and nighttime conditions. Obstruction lighting can be found both on and off an airport to identify obstructions. They may be marked or lighted in any of the following conditions.

- Red obstruction lights—flash or emit a steady red color during nighttime operations, and the obstructions are painted orange and white for daytime operations.
- High intensity white obstruction lights—flash high intensity white lights during the daytime with the intensity reduced for nighttime.
- Dual lighting—a combination of flashing red beacons and steady red lights for nighttime operation and high intensity white lights for daytime operations.

New Lighting Technologies

A top priority of the FAA is to continue to enhance airport safety while maintaining airport capacity. Reducing runway incursions is a major component of this effort. Runway incursions develop quickly and without warning during routine traffic situations on the airport surface, leaving little time for corrective action. The Runway Status Lights (RWSL) System is designed to provide a direct indication to you that it is unsafe to enter a runway, cross a runway, or takeoff from or land on a runway when the system is activated.

Runway status lights are red in color and indicate runway status only; they do not indicate clearance to enter a runway or clearance to takeoff. The RWSL system provides warning lights on runways and taxiways, illuminating when it is unsafe to enter, cross, or begin takeoff on a runway. Currently, there are two types: Runway Entrance Lights (REL) and Takeoff Hold Lights (THL). *[Figures 14-35* and *14-36]*

REL provide a warning to aircraft crossing or entering a runway from intersecting taxiways that there is conflicting traffic on the runway. THL provide a warning signal to aircraft in position for takeoff that the runway is occupied and it is unsafe to take off. As of 2016, the RWSL system is operational at 14 of the nation's busiest airports with 3 more airports scheduled to receive the system by 2017.