SAFETY IN THE DEPARTURE ENVIRONMENT

Thousands of IFR takeoffs and departures occur daily in the National Airspace System (NAS). In order to accommodate this volume of Instrument Flight Rule (IFR) traffic, Air Traffic Control (ATC) must rely on pilots to use charted airport sketches and diagrams as well as standard instrument departures (SIDs) and obstacle departure procedures (ODPs). While many charted (and uncharted) departures are based on radar vectors, the bulk of IFR departures in the NAS require pilots to navigate out of the terminal environment to the en route phase.

IFR takeoffs and departures are fast-paced phases of flight, and pilots often are overloaded with critical flight information. During takeoff, pilots are busy requesting and receiving clearances, preparing their aircraft for departure, and taxiing to the active runway. During IFR conditions, they are doing this with minimal visibility, and they may be without constant radio communication if flying out of a non-towered airport. Historically, takeoff minimums for commercial operations have been successively reduced through a combination of improved signage, runway markings and lighting aids, and concentrated pilot training and qualifications. Today at major terminals, some commercial operators with appropriate equipment, pilot qualifications, and approved Operations Specifications (OpsSpecs) may takeoff with visibility as low as runway visual range (RVR) 3, or 300 feet runway visual range. One of the consequences of takeoffs with reduced visibility is that pilots are challenged in maintaining situational awareness during taxi operations.

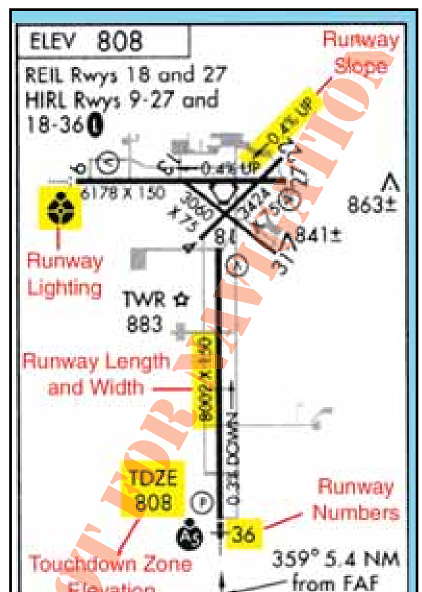
SURFACE MOVEMENT SAFETY

One of the biggest safety concerns in aviation is the surface movement accident. As a direct result, the FAA has rapidly expanded the information available to pilots including the addition of taxiway and runway information in FAA publications, particularly the *IFR U.S. Terminal Procedures Publication* (TPP) booklets and *Airport/Facility Directory* (A/FD) volumes. The FAA has also implemented new procedures and created educational and awareness programs for pilots, air traffic controllers, and ground operators. By focusing resources to attack this problem head on, the FAA hopes to reduce and eventually eliminate surface movement accidents.

AIRPORT SKETCHES AND DIAGRAMS

Airport sketches and **airport diagrams** provide pilots of all levels with graphical depictions of the airport layout. The National Aeronautical Charting Office (NACO) provides an airport sketch on the lower left or right portion of every instrument approach chart. [Figure 2-1] This sketch depicts the runways, their length, width, and slope, the touchdown zone elevation, the lighting system installed on the end of the runway, and taxiways.

For select airports, typically those with heavy traffic or complex runway layouts, NACO also prints an airport diagram. The diagram is located in the IFR TPP booklet following the instrument approach chart for a particular airport. It is a full-page depiction of the airport that includes the same features of the airport sketch plus additional details such as taxiway identifiers, airport latitude and longitude, and building identification. The airport diagrams are also available in the A/FD and on the NACO website,



FAF to MAP 5.4 NM					
Knots	60	90	120	150	180
Min:Sec	5:24	3:36	2:42	2:10	1:48

OSHKOSH, WISCONSIN
Amdt 6B 01137

Figure 2-1. Airport Sketch Included on the KOSH ILS RWY 36 Approach Chart.

http://naco.faa.gov. by selecting "Online *digital* - TPP." [Figure 2-2]

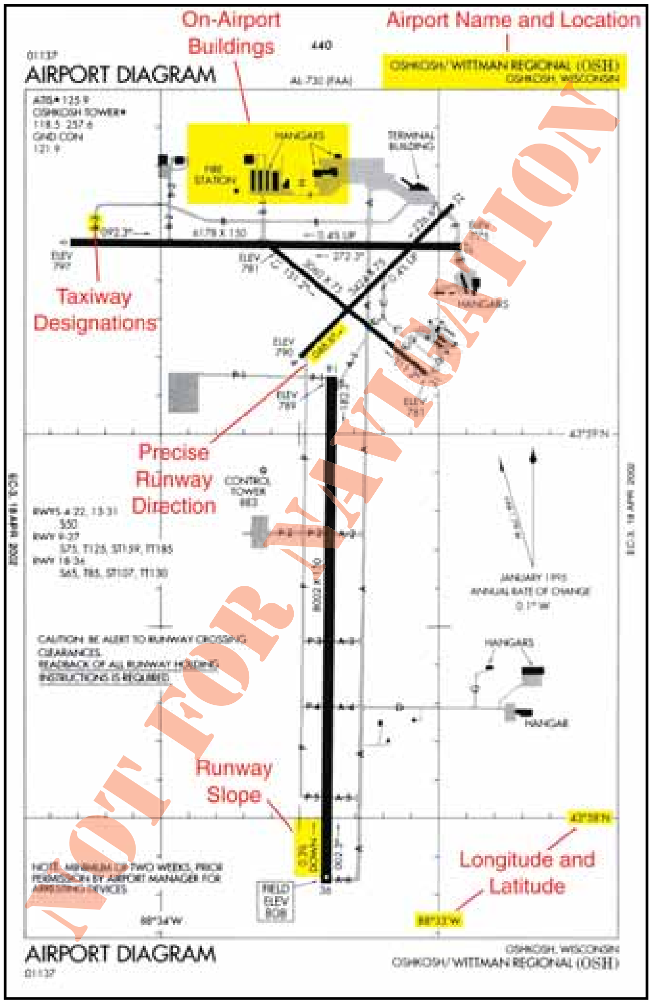


Figure 2-2. Airport Diagram for KOSH.

AIRPORT/FACILITY DIRECTORY

The ***Airport/Facility Directory* (A/FD)**, published in regional booklets by NACO, provides textual information about all airports, both VFR and IFR. The A/FD includes runway length and width, runway surface, load bearing capacity, runway slope, airport services, and hazards such as birds and reduced visibility. [Figure 2-3] Sketches of airports also are being added to aid VFR pilots in surface movement activities. In support of the FAA Runway Incursion Program, full-page airport diagrams are included in the A/FD. These charts are the same as those published in the IFR TPP and are printed for airports with complex runway or taxiway layouts.

SURFACE MOVEMENT GUIDANCE CONTROL SYSTEM

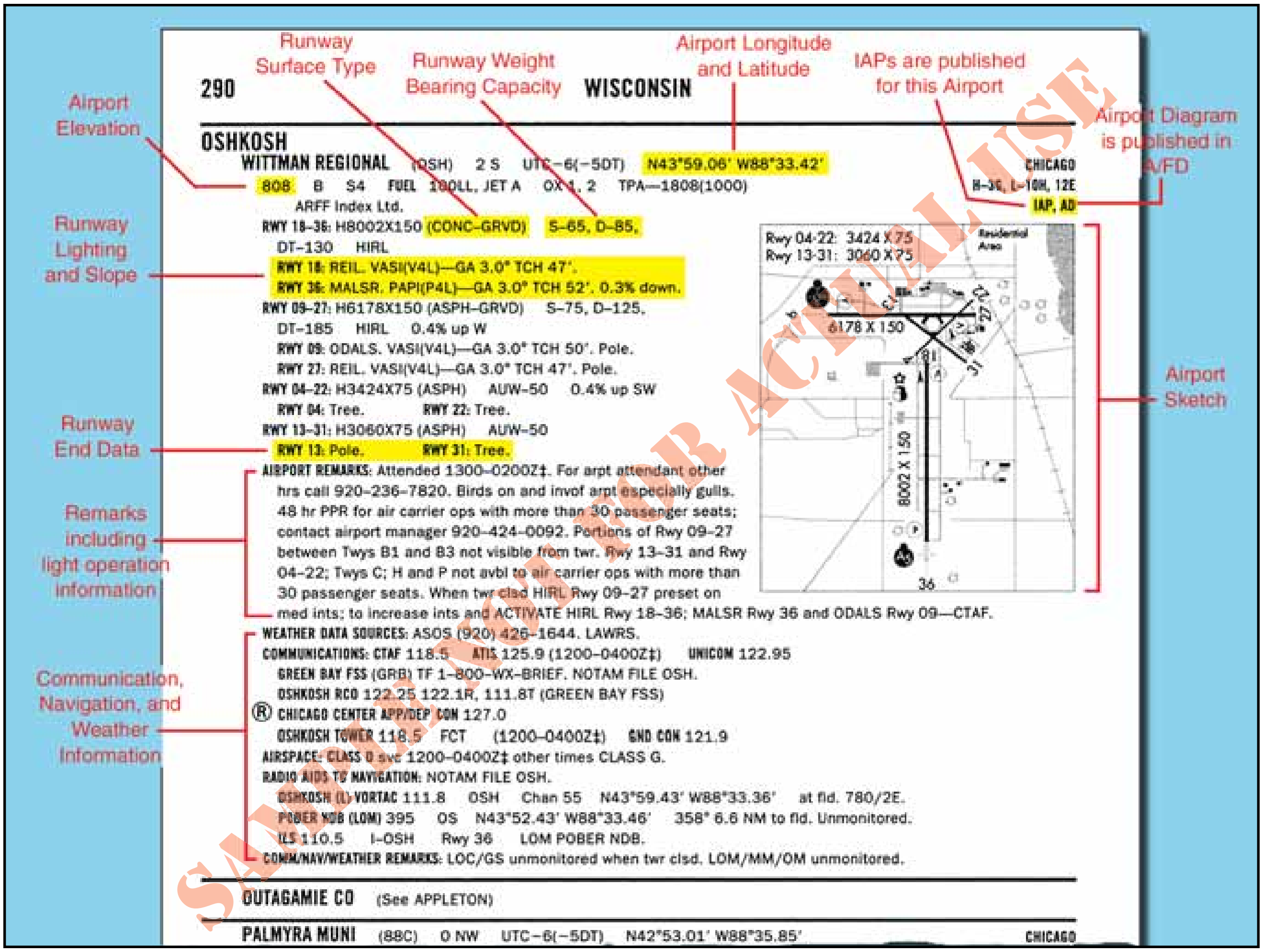
The **Surface Movement Guidance Control System (SMGCS)** was developed in 1992 to facilitate the safe movement of aircraft and vehicles at airports where scheduled air carriers were conducting authorized operations. This program was designed to provide guidelines for the creation of low visibility taxi plans for all airports with takeoff or landing operations using visibility minimums less than 1,200 feet RVR. For landing operations, this would be pertinent only to those operators whose OpsSpecs permit them to land with lower than standard minimums. For departures, however, since there are no regulatory takeoff minimums for Title 14 Code of Federal Regulations (14 CFR) Part 91 operators, the SMGCS information is pertinent to all departing traffic operating in Instrument Meteorological Conditions (IMC). *Advisory Circular (AC) 120-57A, Surface Movement Guidance and Control System*, outlines the SMGCS program in its entirety including standards and guidelines for establishment of a low visibility taxi plan.

The SMGCS low visibility taxi plan includes the improvement of taxiway and runway signs, markings, and lighting, as well as the creation of SMGCS low visibility taxi route charts. [Figure 2-4 on page 2-4] The plan also clearly identifies taxi routes and their supporting facilities and equipment. Airport enhancements that are part of the SMGCS program include (but are not limited to):

- **Stop bars** consist of a row of red unidirectional, in-pavement lights installed along the holding position marking. When extinguished by the controller, they confirm clearance for the pilot or vehicle operator to enter the runway. They are required at intersections of an illuminated taxiway and active runway for operations less than 600 feet RVR.
- **Taxiway centerline lights**, which work in conjunction with stop bars, are green in-pavement lights that guide ground traffic under low visibility conditions and during darkness.
- **Runway guard lights**, either elevated or in-pavement, will be installed at all taxiways that provide access to an active runway. They consist of alternately flashing yellow lights, used to denote both the presence of an active runway and identify the location of a runway holding position marking.
- **Geographic position markings**, used as hold points or for position reporting, enable ATC to verify the position of aircraft and vehicles. These checkpoints or "pink spots" are outlined with a black and white circle and designated with a number, a letter, or both.
- **Clearance bars** consist of three yellow in-pavement lights used to denote holding positions for aircraft and vehicles. When used for hold points, they are co-located with geographic position markings.

Additional information concerning airport lighting, markings, and signs can be found in the *Aeronautical Information Manual* (AIM), as well as on the FAA's website at:

http://www.faa.gov/library/manuals/aviation.



290 WISCONSIN

OSHKOSH
WITTMAN REGIONAL (OSH) 2 S UTC–6(–5DT) N43°59.06′ W88°33.42′ CHICAGO
808 B S4 FUEL 100LL, JET A OX 1, 2 TPA—1808(1000) H–3G, L–10H, 12E
ARFF Index Ltd. IAP, AD
RWY 18–36: H8002X150 (CONC–GRVD) S–65, D–85,
DT–130 HIRL
RWY 18: REIL. VASI(V4L)—GA 3.0° TCH 47′.
RWY 36: MALSR. PAPI(P4L)—GA 3.0° TCH 52′. 0.3% down.
RWY 09–27: H6178X150 (ASPH–GRVD) S–75, D–125,
DT–185 HIRL 0.4% up W
RWY 09: ODALS. VASI(V4L)—GA 3.0° TCH 50′. Pole.
RWY 27: REIL. VASI(V4L)—GA 3.0° TCH 47′. Pole.
RWY 04–22: H3424X75 (ASPH) AUW–50 0.4% up SW
RWY 04: Tree. RWY 22: Tree.
RWY 13–31: H3060X75 (ASPH) AUW–50
RWY 13: Pole. RWY 31: Tree.
AIRPORT REMARKS: Attended 1300–0200Z‡. For arpt attendant other hrs call 920–236–7820. Birds on and invof arpt especially gulls. 48 hr PPR for air carrier ops with more than 30 passenger seats; contact airport manager 920–424–0092. Portions of Rwy 09–27 between Twys B1 and B3 not visible from twr. Rwy 13–31 and Rwy 04–22; Twys C; H and P not avbl to air carrier ops with more than 30 passenger seats. When twr clsd HIRL Rwy 09–27 preset on med ints; to increase ints and ACTIVATE HIRL Rwy 18–36; MALSR Rwy 36 and ODALS Rwy 09—CTAF.
WEATHER DATA SOURCES: ASOS (920) 426–1644. LAWRS.
COMMUNICATIONS: CTAF 118.5 ATIS 125.9 (1200–0400Z‡) UNICOM 122.95
GREEN BAY FSS (GRB) TF 1–800–WX–BRIEF. NOTAM FILE OSH.
OSHKOSH RCO 122.25 122.1R, 111.8T (GREEN BAY FSS)
Ⓡ CHICAGO CENTER APP/DEP CON 127.0
OSHKOSH TOWER 118.5 FCT (1200–0400Z‡) GND CON 121.9
AIRSPACE: CLASS D svc 1200–0400Z‡ other times CLASS G.
RADIO AIDS TO NAVIGATION: NOTAM FILE OSH.
OSHKOSH (L) VORTAC 111.8 OSH Chan 55 N43°59.43′ W88°33.36′ at fld. 780/2E.
POBER NDB (LOM) 395 OS N43°52.43′ W88°33.46′ 358° 6.6 NM to fld. Unmonitored.
ILS 110.5 I–OSH Rwy 36 LOM POBER NDB.
COMM/NAV/WEATHER REMARKS: LOC/GS unmonitored when twr clsd. LOM/MM/OM unmonitored.

OUTAGAMIE CO (See APPLETON)

PALMYRA MUNI (88C) 0 NW UTC–6(–5DT) N42°53.01′ W88°35.85′ CHICAGO

Figure 2-3. Excerpt from Airport/Facility Directory for Oshkosh/Wittman Field.

Both flight and ground crews are required to comply with SMGCS plans when implemented at their specific airport. All airport tenants are responsible for disseminating information to their employees and conducting training in low visibility operating procedures. Anyone operating in conjunction with the SMGCS plan must have a copy of the low visibility taxi route chart for their given airport as these charts outline the taxi routes and other detailed information concerning low visibility operations. These charts are available from private sources outside of the FAA. Part 91 operators are expected to comply with the guidelines listed in the AC to the best of their ability and should expect "Follow Me" service when low visibility operations are in use. Any SMGCS outage that would adversely affect operations at the airport is issued as a Notice to Airmen (NOTAM).

AIRPORT SIGNS, LIGHTING, and MARKING

Flight crews use airport lighting, markings, and signs to help maintain situational awareness when operating on the ground and in the air. These visual aids provide information concerning the aircraft's location on the airport, the taxiway in use, and the runway entrance being used. Overlooking this information can lead to ground accidents that are entirely preventable. If you encounter unfamiliar markings or lighting, contact ATC for clarification and, if necessary, request progressive taxi instructions. Pilots are encouraged to notify the appropriate authorities of erroneous, misleading, or decaying signs or lighting that would contribute to the failure of safe ground operations.

RUNWAY INCURSIONS

A runway incursion is any occurrence at an airport involving aircraft, ground vehicles, people, or objects on the ground that creates a collision hazard or results in the loss of separation with an aircraft taking off, intending to take off, landing, or intending to land. Primarily, runway incursions are caused by errors resulting from a misunderstanding of the given clearance, failure to communicate effectively, failure to navigate the airport correctly, or failure to maintain positional awareness. Figure 2-5 on page 2-5 highlights several steps that reduce the chances of being involved in a runway incursion.

In addition to the SMGCS program, the FAA has implemented additional programs to reduce runway incursions and other surface movement issues. They

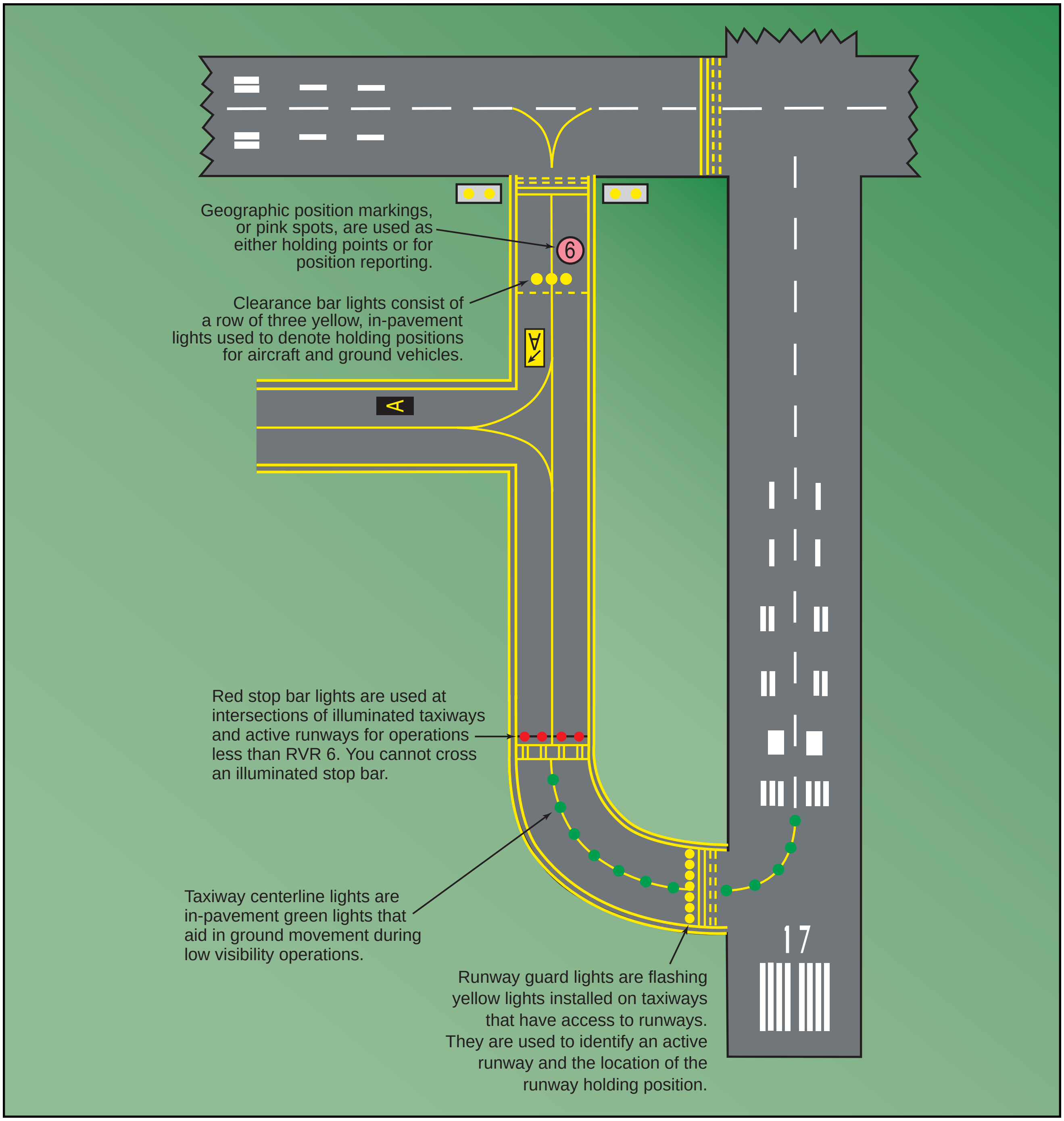


Figure 2-4. SMGCS Signage and Lighting.

identified runway hotspots, designed standardized taxi routes, and instituted the Runway Safety Program.

RUNWAY HOTSPOTS

Runway hotspots (some FAA Regions refer to them as high alert areas) are locations on particular airports that historically have hazardous intersections. These hotspots are depicted on some airport charts as circled areas. FAA Regions, such as the Western Pacific, notify pilots of these areas by Letter to Airmen. The FAA Office of Runway Safety website (www.faa.gov/runwaysafety) has links to the FAA regions that maintain a complete list of airports with runway hotspots. Also, charts provided by private sources show these locations. Hotspots alert pilots to the fact that there may be a lack of visibility at certain points or the tower may be unable to see that particular intersection. Whatever the reason, pilots need to be aware that these hazardous intersections exist and they should be increasingly vigilant when approaching and taxiing through these intersections.

STANDARDIZED TAXI ROUTES

Standard taxi routes improve ground management at high-density airports, namely those that have airline service. At these airports, typical taxiway traffic patterns used to move aircraft between gate and runway

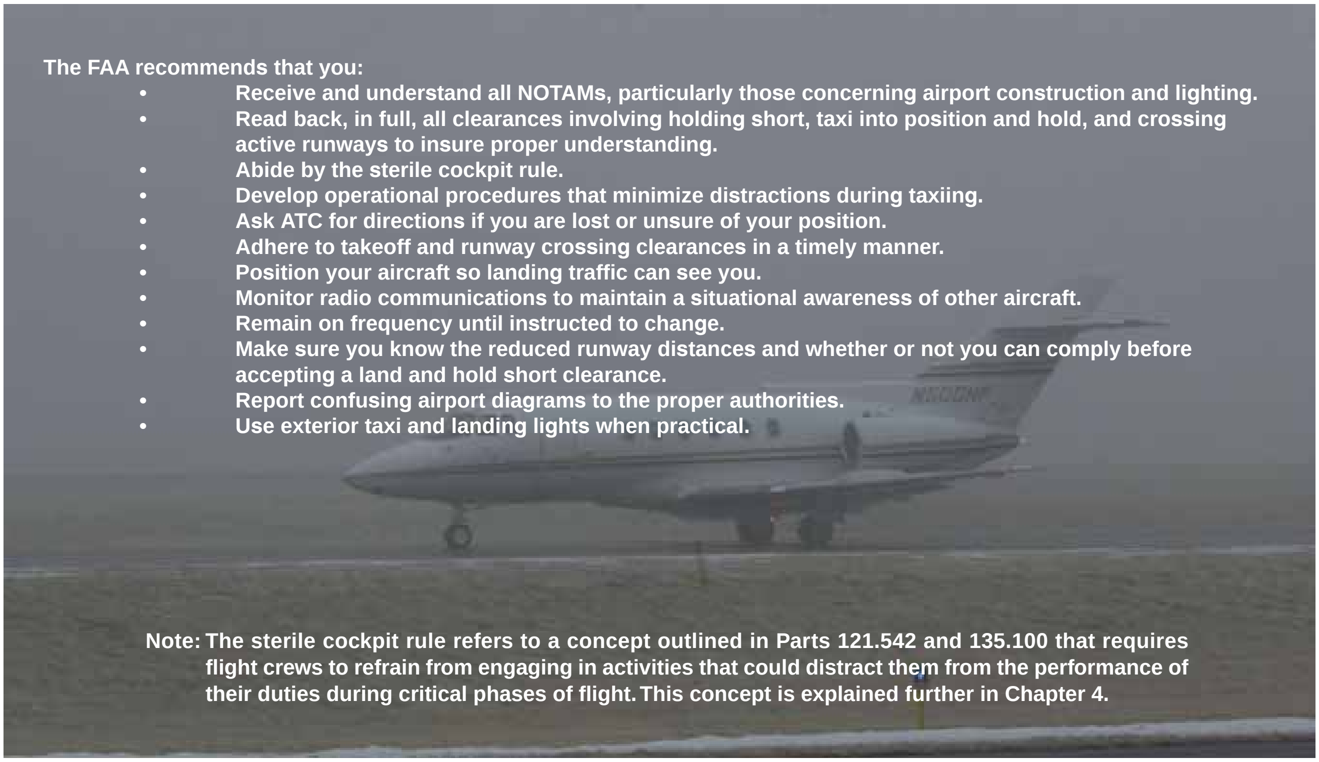
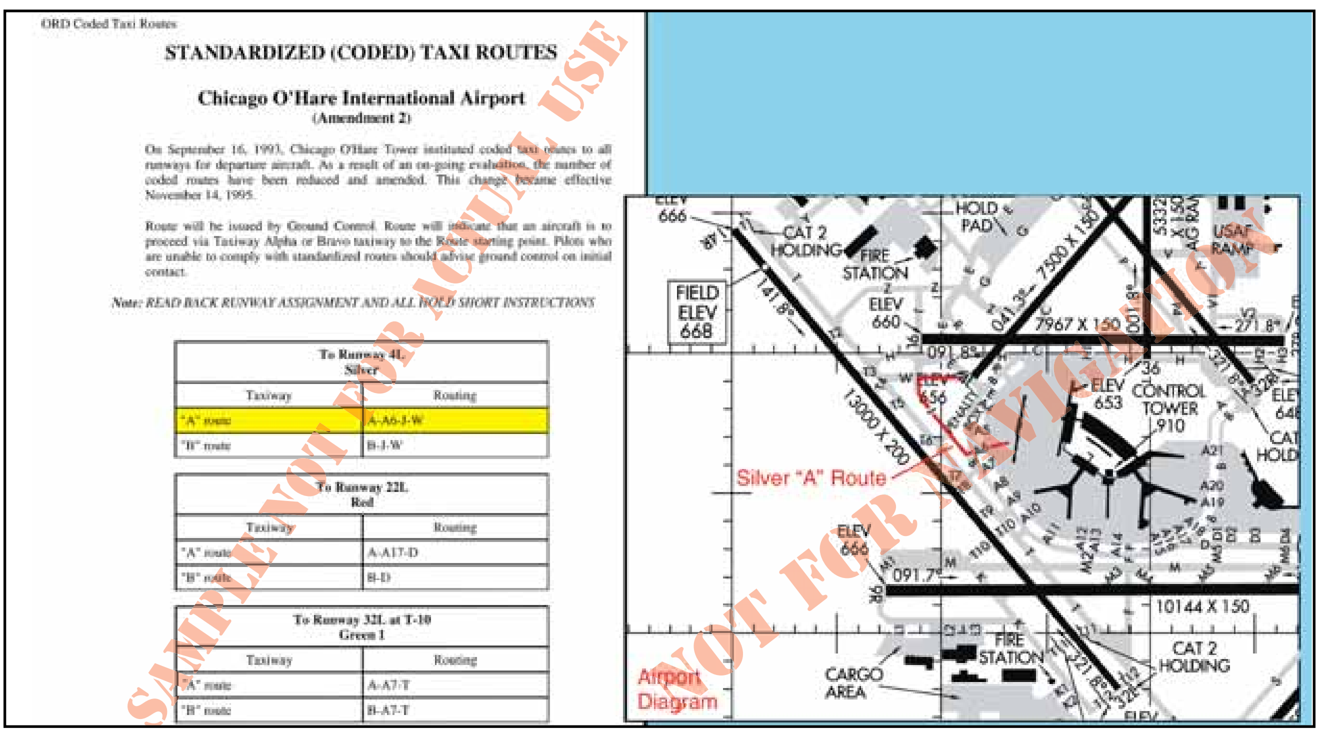


Figure 2-5. FAA Recommendations for Reducing Runway Incursions.

are laid out and coded. The ATC specialist (ATCS) can reduce radio communication time and eliminate taxi instruction misinterpretation by simply clearing the pilot to taxi via a specific, named route. An example of this would be Chicago O'Hare, where the Silver Alpha taxi route is used to transition to Runway 4L. [Figure 2-6] The "Silver A" route requires you to taxi via taxiway Alpha to Alpha Six, then taxiway Juliet, then taxiway Whiskey to Runway 4L. These routes are issued by ground control, and if unable to comply, pilots must advise ground control on initial contact. If for any reason the pilot becomes uncertain as to the correct taxi route, a request should be made for progressive taxi instructions. These step-by-step routing directions are also issued if the controller deems it necessary due to traffic, closed taxiways, airport construction, etc. It is the pilot's responsibility to



ORD Coded Taxi Routes

STANDARDIZED (CODED) TAXI ROUTES

Chicago O'Hare International Airport
(Amendment 2)

On September 16, 1993, Chicago O'Hare Tower instituted coded taxi routes to all runways for departure aircraft. As a result of an on-going evaluation, the number of coded routes have been reduced and amended. This change became effective November 14, 1995.

Route will be issued by Ground Control. Route will indicate that an aircraft is to proceed via Taxiway Alpha or Bravo taxiway to the Route starting point. Pilots who are unable to comply with standardized routes should advise ground control on initial contact.

Note: READ BACK RUNWAY ASSIGNMENT AND ALL HOLD SHORT INSTRUCTIONS

To Runway 4L Silver	
Taxiway	Routing
"A" route	A-A6-J-W
"B" route	B-J-W

To Runway 22L Red	
Taxiway	Routing
"A" route	A-A17-D
"B" route	B-D

To Runway 32L at T-10 Green 1	
Taxiway	Routing
"A" route	A-A7-T
"B" route	B-A7-T

Figure 2-6. Chicago O'Hare Silver Standardized Taxi Route and NACO Airport Diagram.

know if a particular airport has preplanned taxi routes, to be familiar with them, and to have the taxi descriptions in their possession. Specific information about airports that use coded taxiway routes is included in the Notice to Airmen Publication (NTAP).

RUNWAY SAFETY PROGRAM

On any given day, the NAS may handle almost 200,000 takeoffs and landings. Due to the complex nature of the airport environment and the intricacies of the network of people that make it operate efficiently, the FAA is constantly looking to maintain the high standard of safety that exists at airports today. Runway safety is one of its top priorities. The **Runway Safety Program (RSP)** is designed to create and execute a plan of action that reduces the number of runway incursions at the nation's airports.

The RSP office has created a National Blueprint for Runway Safety. [Figure 2-7] In that document, the FAA has identified four types of runway surface events:

- Surface Incident – an event during which authorized or unauthorized/unapproved movement occurs in the movement area or an occurrence in the movement area associated with the operation of an aircraft that affects or could affect the safety of flight.
- **Runway Incursion** – an occurrence at an airport involving an aircraft, vehicle, person, or object on the ground that creates a collision hazard or results in a loss of separation with an aircraft that is taking off, intending to take off, landing, or intending to land.
- Collision Hazard – a condition, event, or circumstance that could induce an occurrence of a collision or surface accident or incident.
- Loss of Separation – an occurrence or operation that results in less than prescribed separation between aircraft, or between an aircraft and a vehicle, pedestrian, or object.

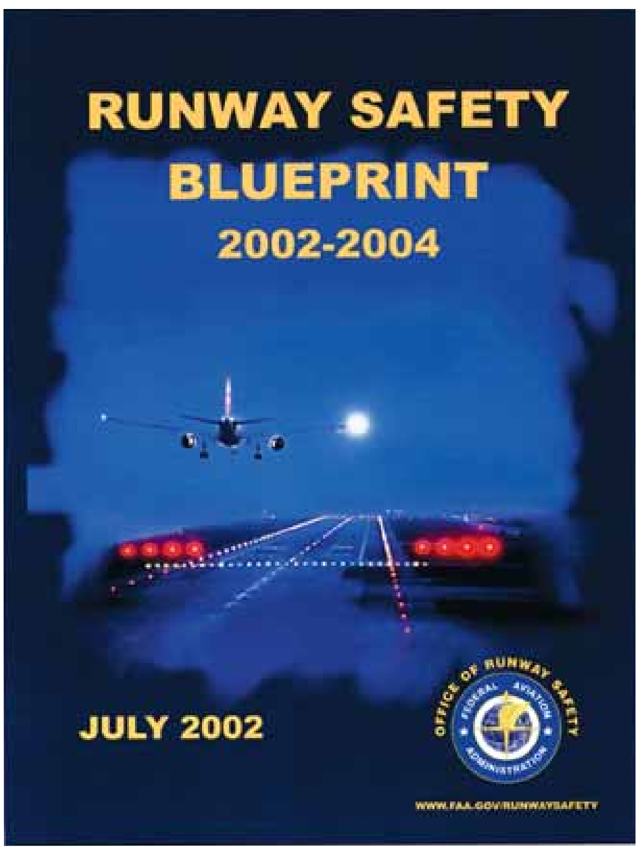


Figure 2-7. National Blueprint for Runway Safety.

Runway incursions are further identified by four categories: ATC operational error, pilot deviation, vehicle/pedestrian deviation, and miscellaneous errors that cannot be attributed to the previous categories.

Since runway incursions cannot be attributed to one single group of people, everyone involved in airport operations must be equally aware of the necessity to improve runway safety. As a result, the RSP created goals to develop refresher courses for ATC, promote educational awareness for air carriers, and require flight training that covers more in depth material concerning ground operations. Beyond the human aspect of runway safety, the FAA is also reviewing technology, communications, operational procedures, airport signs, markings, lighting, and analyzing causal factors to find areas for improvement.

Runway safety generates much concern especially with the continued growth of the aviation industry. The takeoff and departure phases of flight are critical portions of the flight since the majority of this time is spent on the ground with multiple actions occurring. It is the desire of the FAA and the aviation industry to reduce runway surface events of all types, but it cannot be done simply through policy changes and educational programs. Pilots must take responsibility for ensuring safety during surface operations and continue to educate themselves through government (www.faa.gov/runwaysafety) and industry runway safety programs.

TAKEOFF MINIMUMS

While mechanical failure is potentially hazardous during any phase of flight, a failure during takeoff under instrument conditions is extremely critical. In the event of an emergency, a decision must be made to either return to the departure airport or fly directly to a takeoff alternate. If the departure weather were below the landing minimums for the departure airport, the flight would be unable to return for landing, leaving few options and little time to reach a takeoff alternate.

In the early years of air transportation, landing minimums for commercial operators were usually lower than takeoff minimums. Therefore, it was possible that minimums allowed pilots to land at an airport but not depart from that airport. Additionally, all takeoff minimums once included ceiling as well as visibility requirements. Today, takeoff minimums are typically lower than published landing minimums and ceiling requirements are only included if it is necessary to see and avoid obstacles in the departure area.

The FAA establishes takeoff minimums for every airport that has published Standard Instrument Approaches. These minimums are used by commercially operated aircraft, namely Part 121 and 135 operators. At airports where minimums are not established, these same carriers are required to use FAA designated standard minimums (1 statute mile [SM] visibility for single- and twin-engine aircraft, and 1/2 SM for helicopters and aircraft with more than two engines).

Aircraft operating under Part 91 are not required to comply with established takeoff minimums. Legally, a zero/zero departure may be made, but it is never advisable. If commercial pilots who fly passengers on a daily basis must comply with takeoff minimums, then good judgment and common sense would tell all instrument pilots to follow the established minimums as well.

NACO charts list takeoff minimums only for the runways at airports that have other than standard minimums. These takeoff minimums are listed by airport in alphabetical order in the front of the TPP booklet. If an airport has non-standard takeoff minimums, a (referred to by some as either the "triangle T" or "trouble T") will be placed in the notes sections of the instrument procedure chart. In the front of the TPP booklet, takeoff minimums are listed before the obstacle departure procedure. Some departure procedures allow a departure with standard minimums provided specific aircraft performance requirements are met. [Figure 2-8]

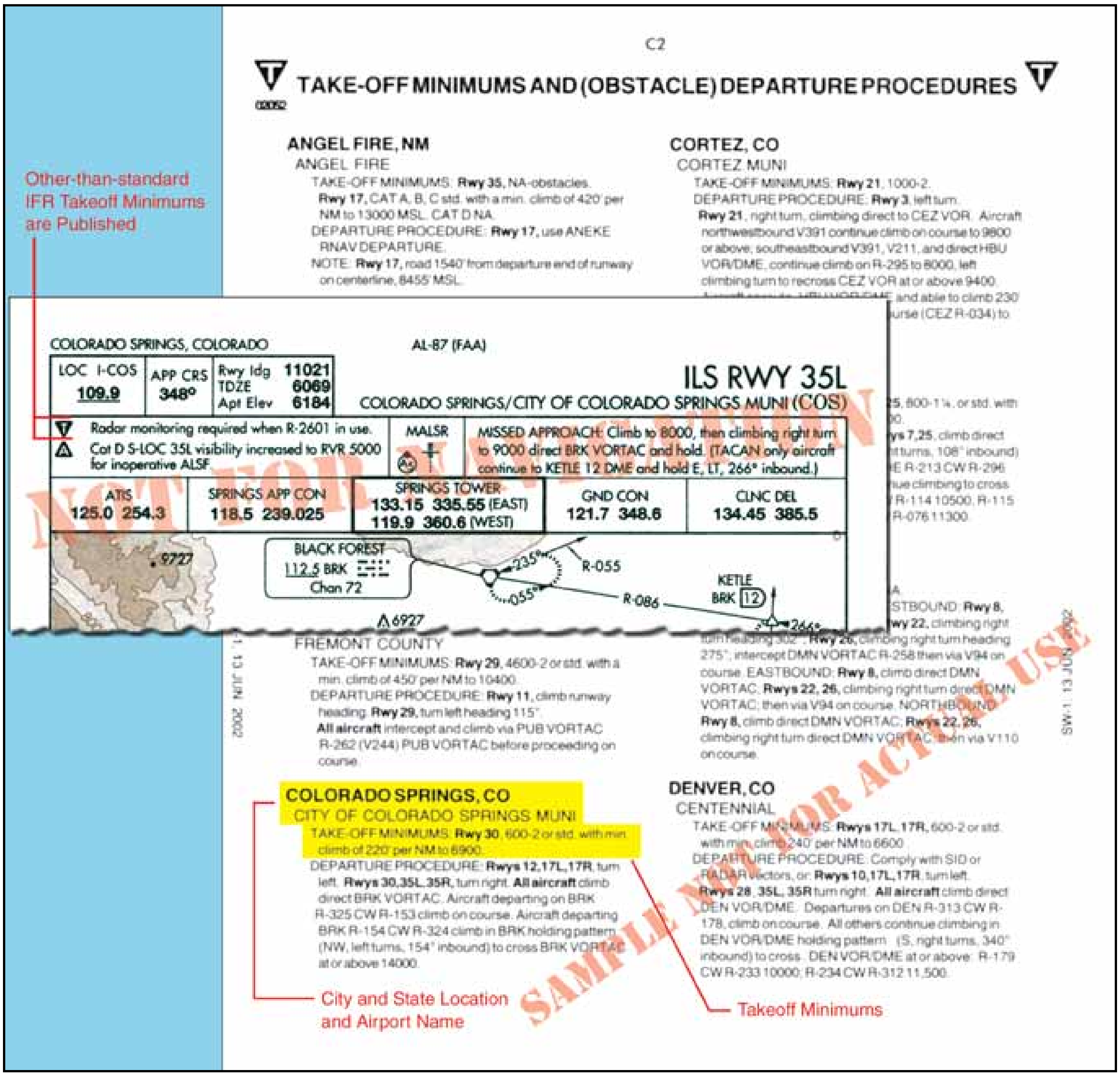


Figure 2-8. Takeoff minimums are listed in the front of each NACO U.S. Terminal Procedures booklet.

TAKEOFF MINIMUMS FOR COMMERCIAL OPERATORS

While Part 121 and 135 operators are the primary users of takeoff minimums, they may be able to use alternative takeoff minimums based on their individual OpsSpecs. Through these OpsSpecs, operators are authorized to depart with lower-than-standard minimums provided they have the necessary equipment and crew training.

OPERATIONS SPECIFICATIONS

Operations specifications (OpsSpecs) are required by Part 119.5 to be issued to commercial operators to define the appropriate authorizations, limitations, and procedures based on their type of operation, equipment, and qualifications. The OpsSpecs can be adjusted to accommodate the many variables in the air transportation industry, including aircraft and aircraft equipment, operator capabilities, and changes in aviation technology. The OpsSpecs are an extension of the CFR; therefore, they are legal, binding contracts between a properly certificated air transportation organization and the FAA for compliance with the CFR's applicable to their operation. OpsSpecs are designed to provide specific operational limitations and procedures tailored to a specific operator's class and size of aircraft and types of operation, thereby meeting individual operator needs.

Part 121 and 135 operators have the ability, through the use of approved OpsSpecs, to use lower-than-standard takeoff minimums. Depending on the equipment installed in a specific type of aircraft, the crew training, and the type of equipment installed at a particular airport, these operators can depart from appropriately equipped runways with as little as 300 feet RVR. Additionally, OpsSpecs outline provisions for approach minimums, alternate airports, and weather services in Part 119 and FAA Order 8400.10, *Air Transportation Operations Inspector's Handbook*.

HEAD-UP GUIDANCE SYSTEM

As technology improves over time, the FAA is able to work in cooperation with specific groups desiring to use these new technologies. **Head-up guidance system (HGS)** is an example of an advanced system currently being used by some airlines. Air carriers have requested the FAA to approve takeoff minimums at 300 feet RVR. This is the lowest takeoff minimum approved by OpsSpecs. As stated earlier, only specific air carriers with approved, installed equipment, and trained pilots are allowed to use HGS for decreased takeoff minimums. [Figure 2-9]

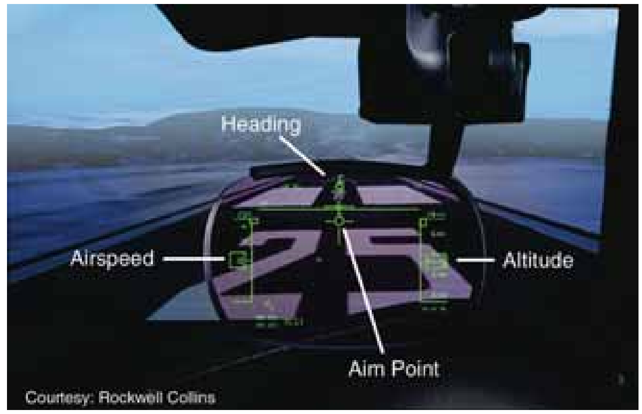


Figure 2-9. HGS Technology.

CEILING AND VISIBILITY REQUIREMENTS

All takeoffs and departures have visibility minimums (some may have minimum ceiling requirements) incorporated into the procedure. There are a number of methods to report visibility, and a variety of ways to distribute these reports, including automated weather observations. Flight crews should always check the weather, including ceiling and visibility information, prior to departure. Never launch an IFR flight without obtaining current visibility information immediately prior to departure. Further, when ceiling and visibility minimums are specified for IFR departure, both are applicable.

Weather reporting stations for specific airports across the country can be located by reviewing the A/FD. Weather sources along with their respective phone numbers and frequencies are listed by airport. Frequencies for weather sources such as automatic terminal information service (ATIS), digital automatic terminal information service (D-ATIS), Automated Weather Observing System (AWOS), Automated Surface Observing System (ASOS), and FAA Automated Flight Service Station (AFSS) are published on approach charts as well. [Figure 2-10]

RUNWAY VISUAL RANGE

Runway visual range (RVR) is an instrumentally derived value, based on standard calibrations, that represents the horizontal distance a pilot will see down the runway from the approach end. It is based on the sighting of either high intensity runway lights or on the

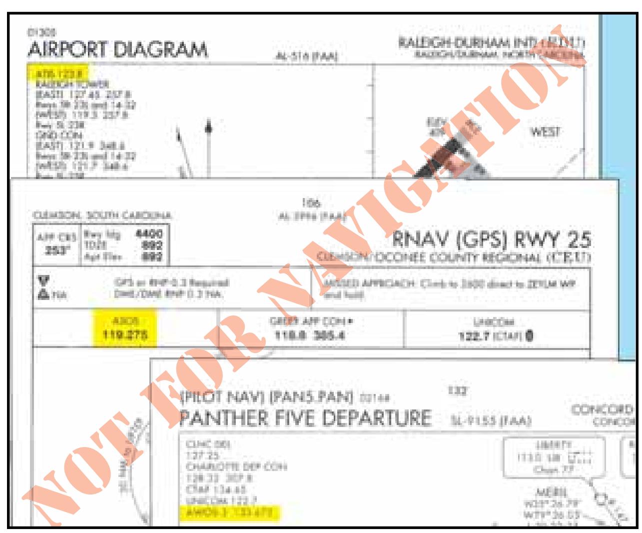


Figure 2-10. Frequencies for Weather Information are listed on Approach and Airport Charts.

visual contrast of other targets whichever yields the greater visual range. RVR, in contrast to prevailing or runway visibility, is based on what a pilot in a moving aircraft should see looking down the runway. RVR is reported in hundreds of feet, so the values must be converted to statute miles if the visibility in statute miles is not reported. [Figure 2-11] This visibility measurement is updated every minute; therefore, the most accurate visibility report will come from the local controller instead of a routine weather report. Transmissometers near the runway measure visibility for the RVR report. If multiple transmissometers are installed, they provide reports for multiple locations, including **touchdown RVR**, **mid-RVR**, and **rollout RVR**. RVR visibility may be reported as RVR 5-5-5. This directly relates to the multiple locations from which RVR is reported and indicates 500 feet visibility at touchdown RVR, 500 feet at mid-RVR, and 500 feet at the rollout RVR stations.

Conversion

RVR (FT)	Visibility (SM)
1,600	1/4
2,400	1/2
3,200	5/8
4,000	3/4
4,500	7/8
5,000	1
6,000	1 1/4

Figure 2-11. RVR Conversion Table.

RVR is the primary visibility measurement used by Part 121 and 135 operators, with specific visibility reports and controlling values outlined in their respective OpsSpecs. Under their OpsSpecs agreements, the operator must have specific, current RVR reports, if available, to proceed with an instrument departure. OpsSpecs also outline which visibility report is controlling in various departure scenarios.

RUNWAY VISIBILITY VALUE

Runway visibility value (RVV) is the distance down the runway that a pilot can see unlighted objects. It is reported in statute miles for individual runways. RVV, like RVR, is derived from a transmissometer for a particular runway. RVV is used in lieu of prevailing visibility in determining specific runway minimums.

PREVAILING VISIBILITY

Prevailing visibility is the horizontal distance over which objects or bright lights can be seen and identified over at least half of the horizon circle. If the prevailing visibility varies from area to area, the visibility of the majority of the sky is reported. When critical differences exist in various sectors of the sky and the prevailing visibility is less than three miles, these differences will be reported at manned stations. Typically, this is referred to as sector visibility in the remarks section of a METAR report. Prevailing visibility is reported in statute miles or fractions of miles.

TOWER VISIBILITY

Tower visibility is the prevailing visibility as determined from the air traffic control tower (ATCT). If visibility is determined from only one point on the airport and it is the tower, then it is considered the usual point of observation. Otherwise, when the visibility is measured from multiple points, the control tower observation is referred to as the tower visibility. It too is measured in statute miles or fractions of miles.

ADEQUATE VISUAL REFERENCE

Another set of lower-than-standard takeoff minimums is available to Part 121 and 135 operations as outlined in their respective OpsSpecs document. When certain types of visibility reports are unavailable or specific equipment is out of service, the flight can still depart the airport if the pilot can maintain adequate visual reference. An appropriate visual aid must be available to ensure the takeoff surface can be continuously identified and directional control can be maintained throughout the takeoff run. Appropriate visual aids include high intensity runway lights, runway centerline lights, runway centerline markings, or other runway lighting and markings. A visibility of 1600 feet RVR or 1/4 SM is below standard and may be considered adequate for specific commercial operators if contained in an OpsSpecs approval.

AUTOMATED WEATHER SYSTEM

An **automated weather system** consists of any of the automated weather sensor platforms that collect weather data at airports and disseminate the weather information via radio and/or landline. The systems consist of the **Automated Surface Observing System (ASOS)/Automated Weather Sensor System (AWSS)**, and the Automated Weather Observation System (AWOS). These systems are installed and maintained at airports across the United States (U.S.) by both government (FAA and NWS) and private entities. They are relatively inexpensive to operate because they require no outside observer, and they provide invaluable weather information for airports without operating control towers. [Figure 2-12 on page 2-10]

AWOS and ASOS/AWSS offer a wide variety of capabilities and progressively broader weather reports. Automated systems typically transmit weather every one to two minutes

Figure 2-12. ASOS Station Installation.

so the most up-to-date weather information is constantly broadcast. Basic AWOS includes only altimeter setting, wind speed, wind direction, temperature, and dew point information. More advanced systems such as the ASOS/AWSS and AWOS-3 are able to provide additional information such as cloud and ceiling data and precipitation type. ASOS/AWSS stations providing service levels A or B also report RVR. The specific type of equipment found at a given facility is listed in the A/FD. [Figure 2-13]

Automated weather information is available both over a radio frequency specific to each site and via telephone. When an automated system is brought online, it first goes through a period of testing. Although you can listen to the reports on the radio and over the phone during the test phase, they are not legal for use until they are fully operational, and the test message is removed.

The use of the aforementioned visibility reports and weather services are not limited for Part 91 operators. Part 121 and 135 operators are bound by their individual OpsSpecs documents and are required to use weather reports that come from the National Weather Service or other approved sources. While every operator's specifications are individually tailored, most operators are required to use ATIS information, RVR reports, and selected reports from automated weather stations. All reports coming from an AWOS-3 station are usable for Part 121 and 135 operators. Each type of automated station has different levels of approval as outlined in FAA Order 8400.10 and individual OpsSpecs. Ceiling and visibility reports given by the tower with the departure information are always considered official weather, and RVR reports are typically the controlling visibility reference.

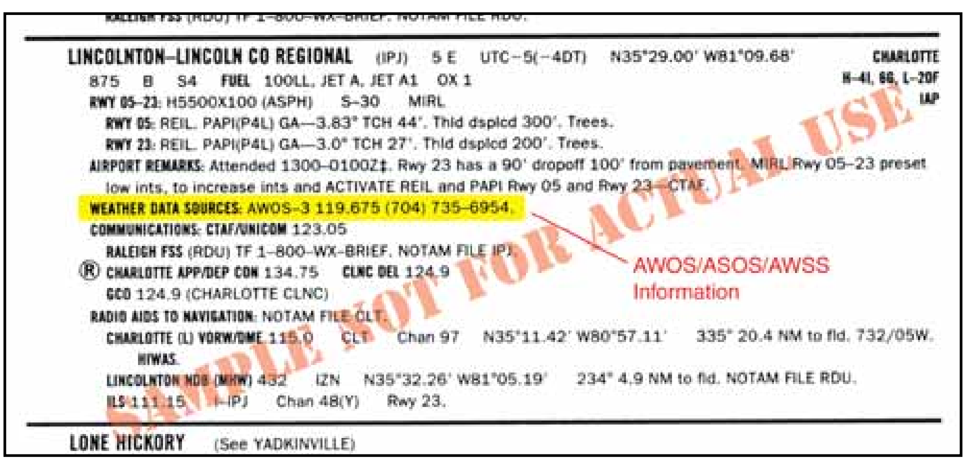
AUTOMATIC TERMINAL INFORMATION SERVICE AND DIGITAL ATIS

The **automatic terminal information service (ATIS)** is another valuable tool for gaining weather information. ATIS is available at most airports that have an operating control tower, which means the reports on the ATIS frequency are only available during the regular hours of tower operation. At some airports that operate part-time towers, ASOS/AWSS information is broadcast over the ATIS frequency when the tower is closed. This service is available only at those airports that have both an ASOS/AWSS on the field and an ATIS-ASOS/AWSS interface switch installed in the tower.

Each ATIS report includes crucial information about runways and instrument approaches in use, specific outages, and current weather conditions including visibility. Visibility is reported in statute miles and may be omitted if the visibility is greater than five miles. ATIS weather information comes from a variety of sources depending on the particular airport and the equipment installed there. The reported weather may come from a manual weather observer, weather instruments located in the tower, or from automated weather stations. This information, no matter the origin, must be from National Weather Service approved weather sources for it to be used in the ATIS report.

The **digital ATIS (D-ATIS)** is an alternative method of receiving ATIS reports. The service provides text messages to aircraft, airlines, and other users outside the standard reception range of conventional ATIS via landline and data link communications to the cockpit. Aircraft equipped with data link services are capable of receiving ATIS information over their Aircraft Communications Addressing and Reporting System (ACARS) unit. This allows the pilots to read and print out the ATIS report inside the aircraft, thereby increasing report accuracy and decreasing pilot workload.

Also, the service provides a computer-synthesized voice message that can be transmitted to all aircraft within range of existing transmitters. The Terminal Data Link System (TDLS) D-ATIS application uses weather inputs from local automated weather sources or manually entered meteorological data together with preprogrammed menus to provide standard information to users. Airports with D-ATIS capability are listed in the A/FD.



LINCOLNTON–LINCOLN CO REGIONAL (IPJ) 5 E UTC–5(–4DT) N35°29.00' W81°09.68' CHARLOTTE
875 B S4 FUEL 100LL, JET A, JET A1 OX 1 H-4I, 6G, L-20F
RWY 05–23: H5500X100 (ASPH) S–30 MIRL IAP
RWY 05: REIL. PAPI(P4L) GA—3.83° TCH 44'. Thld dsplcd 300'. Trees.
RWY 23: REIL. PAPI(P4L) GA—3.0° TCH 27'. Thld dsplcd 200'. Trees.
AIRPORT REMARKS: Attended 1300–0100Z‡. Rwy 23 has a 90' dropoff 100' from pavement. MIRL Rwy 05–23 preset low ints, to increase ints and ACTIVATE REIL and PAPI Rwy 05 and Rwy 23—CTAF.
WEATHER DATA SOURCES: AWOS–3 119.675 (704) 735–6954.
COMMUNICATIONS: CTAF/UNICOM 123.05
RALEIGH FSS (RDU) TF 1–800–WX–BRIEF. NOTAM FILE IPJ.
® CHARLOTTE APP/DEP CON 134.75 CLNC DEL 124.9
GCO 124.9 (CHARLOTTE CLNC)
RADIO AIDS TO NAVIGATION: NOTAM FILE CLT.
CHARLOTTE (L) VORW/DME 115.0 CLT Chan 97 N35°11.42' W80°57.11' 335° 20.4 NM to fld. 732/05W. HIWAS.
LINCOLNTON NDB (MHW) 432 IZN N35°32.26' W81°05.19' 234° 4.9 NM to fld. NOTAM FILE RDU.
ILS 111.15 I–IPJ Chan 48(Y) Rwy 23.
LONE HICKORY (See YADKINVILLE)

Figure 2-13. A/FD Entry for an AWOS Station.

It is important to remember that ATIS information is updated hourly and anytime a significant change in the weather occurs. As a result, the information is not the most current report available. Prior to departing the airport, you need to get the latest weather information from the tower. ASOS/AWSS and AWOS also provide a source of current weather, but their information should not be substituted for weather reports from the tower.

IFR ALTERNATE REQUIREMENTS

The requirement for an alternate depends on the aircraft category, equipment installed, approach NAVAID and forecast weather. For example, airports with only a global positioning system (GPS) approach procedure cannot be used as an alternate by TSO-C129/129A users even though the ▲N/A has been removed from the approach chart. For select RNAV (GPS) and GPS approach procedures the ▲ N/A is being removed so they may be used as an alternate by aircraft equipped with an approach approved WAAS receiver. Because GPS is not authorized as a substitute means of navigation guidance when conducting a conventional approach at an alternate airport, if the approach procedure requires either DME or ADF, the aircraft must be equipped with the appropriate DME or ADF avionics in order to use the approach as an alternate.

For airplane Part 91 requirements, an alternate airport must be listed on IFR flight plans if the forecast weather at the destination airport, from a time period of plus or minus one hour from the estimated time of arrival (ETA), includes ceilings lower than 2,000 feet and/or visibility less than 3 SM. A simple way to remember the rules for determining the necessity of filing an alternate for airplanes is the "1, 2, 3 Rule." For helicopter Part 91, similar alternate filing requirements apply. An alternate must be listed on an IFR flight plan if the forecast weather at the destination airport or heliport, from the ETA and for one hour after the ETA, includes ceilings lower than 1,000 feet, or less than 400 feet above the lowest applicable approach minima, whichever is higher, and the visibility less than 2 SM.

Not all airports can be used as alternate airports. An airport may not be qualified for alternate use if the airport NAVAID is unmonitored, or if it does not have weather reporting capabilities. For an airport to be used as an alternate, the forecast weather at that airport must meet certain qualifications at the estimated time of arrival. Standard alternate minimums for a precision approach are a 600-foot ceiling and a 2 SM visibility. For a non-precision approach, the minimums are an 800-foot ceiling and a 2 SM visibility. Standard alternate minimums apply unless higher alternate minimums are listed for an airport.

On NACO charts, standard alternate minimums are not published. If the airport has other than standard alternate minimums, they are listed in the front of the approach chart booklet. The presence of a triangle with an ▲on the approach chart indicates the listing of alternate minimums should be consulted. Airports that do not qualify for use as an alternate airport are designated with an ▲ N/A. [Figure 2-14]

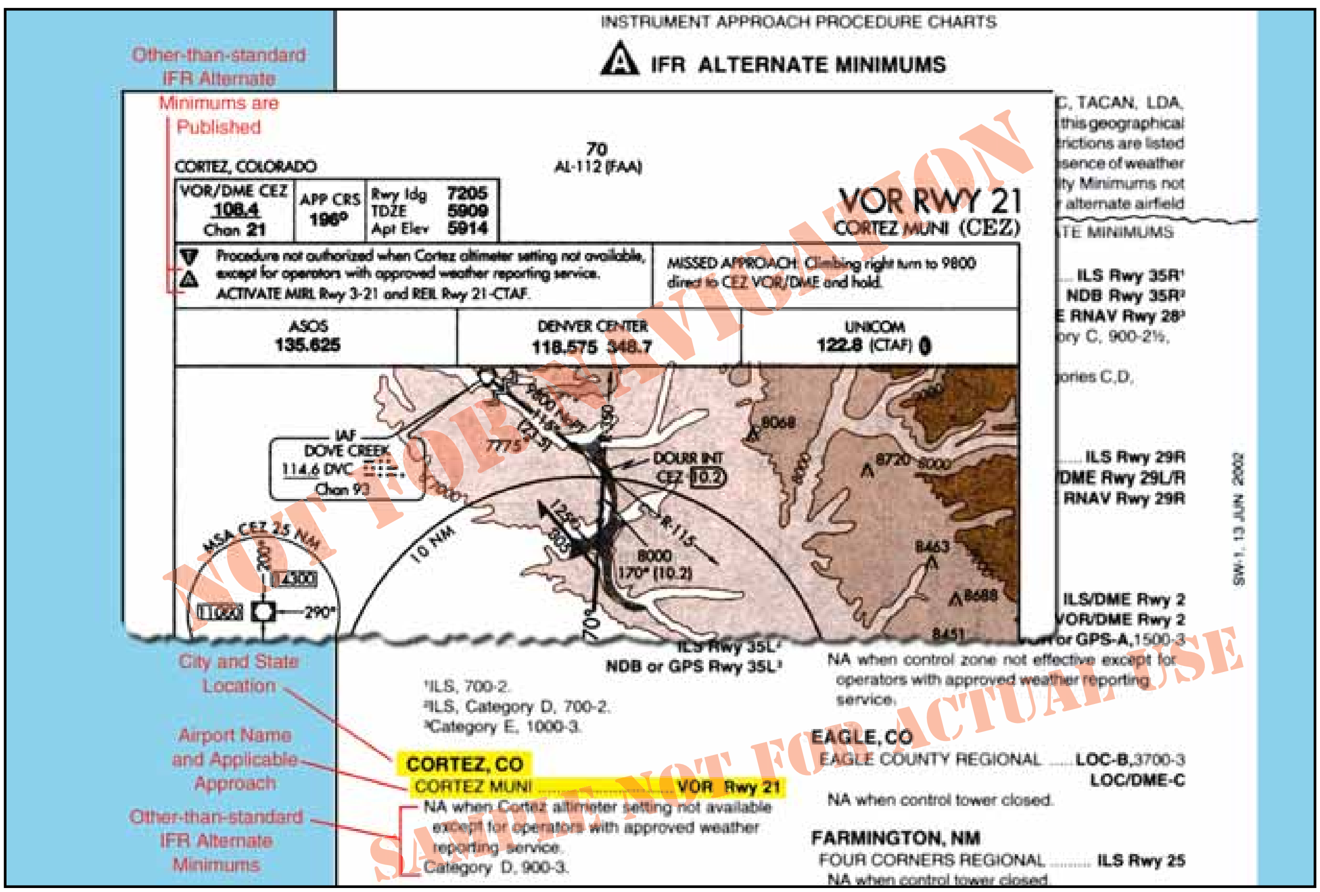


Figure 2-14. IFR Alternate Minimums.

ALTERNATE MINIMUMS FOR COMMERCIAL OPERATORS

IFR alternate minimums for Part 121 and 135 operators are very specific and have more stringent requirements than Part 91 operators.

Part 121 operators are required by their OpsSpecs and Parts 121.617 and 121.625 to have a takeoff alternate airport for their departure airport in addition to their airport of intended landing if the weather at the departure airport is below the landing minimums in the certificate holder's OpsSpecs for that airport. The alternate must be within two hours flying time for an aircraft with three or more engines with an engine out in normal cruise in still air. For two engine aircraft, the alternate must be within one hour. The airport of intended landing may be used in lieu of an alternate providing it meets all the requirements. Part 121 operators must also file for alternate airports when the weather at their destination airport, from one hour before to one hour after their ETA, is forecast to be below a 2,000-foot ceiling and/or less than 3 miles visibility.

For airports with at least one operational navigational facility that provides a straight-in non-precision approach, a straight-in precision approach, or a circling maneuver from an instrument approach procedure determine the ceiling and visibility by:

- Adding 400 feet to the authorized CAT I HAA/HAT for ceiling.
- Adding one mile to the authorized CAT I visibility for visibility minimums.

This is but one example of the criteria required for Part 121 operators when calculating minimums. Part 135 operators are also subject to their own specific rules regarding the selection and use of alternate minimums as outlined in their OpsSpecs and Part 135.219 through Part 135.225, and they differ widely from those used by Part 121 operators.

Typically, dispatchers who plan flights for these operators are responsible for planning alternate airports. The dispatcher considers aircraft performance, aircraft equipment and its condition, and route of flight when choosing alternates. In the event changes need to be made to the flight plan en route due to deteriorating weather, the dispatcher will maintain contact with the flight crew and will reroute their flight as necessary. Therefore, it is the pilot's responsibility to execute the flight as planned by the dispatcher; this is especially true for Part 121 pilots. To aid in the planning of alternates, dispatchers have a list of airports that are approved as alternates so they can quickly determine which airports should be used for a particular flight. Dispatchers also use flight-planning software that plans routes including alternates for the flight. This type of software is tailored for individual operators and includes their normal flight paths and approved airports. Flight planning software and services are provided through private sources.

Though the pilot is the final authority for the flight and ultimately has full responsibility, the dispatcher is responsible for creating flight plans that are accurate and comply with the CFRs. Alternate minimum criteria are only used as planning tools to ensure the pilot-in-command and dispatcher are thinking ahead to the approach phase of flight. In the event the flight would actually need to divert to an alternate, the published approach minimums or lower-than-standard minimums must be used as addressed in OpsSpecs documents.

DEPARTURE PROCEDURES

Departure procedures are preplanned routes that provide transitions from the departure airport to the en route structure. Primarily, these procedures are designed to provide obstacle protection for departing aircraft. They also allow for efficient routing of traffic and reductions in pilot/controller workloads. These procedures come in many forms, but they are all based on the design criteria outlined in TERPS and other FAA orders. The A/FD includes information on high altitude redesign RNAV routing pitch points, preferred IFR routings, or other established routing programs where a flight can begin a segment of nonrestrictive routing.

DESIGN CRITERIA

The design of a departure procedure is based on TERPS, a living document that is updated frequently. Departure design criterion assumes an initial climb of 200 feet per nautical mile (NM) after crossing the departure end of the runway (DER) at a height of at least 35 feet. [Figure 2-15] The aircraft climb path assumption provides a minimum of 35 feet of additional obstacle clearance above the required obstacle clearance (ROC), from the DER outward, to absorb variations ranging from the distance of the static source to the landing gear, to differences in establishing the minimum 200 feet per NM climb gradient, etc. The ROC is the planned separation between the obstacle clearance surface (OCS) and the required climb gradient of 200 feet per NM. The ROC value is zero at the DER elevation and increases along the departure route until the appropriate ROC value is attained to allow en route flight to commence. It is typically about 25 NM for 1,000 feet of ROC in non-mountainous areas, and 46 NM for 2,000 feet of ROC in mountainous areas.

Recent changes in TERPS criteria make the OCS lower and more restrictive. [Figure 2-16 on page 2-14] However, there are many departures today that were evaluated under the old criteria [Figure 2-15] that allowed some obstacle surfaces to be as high as 35 feet at the DER. Since there is no way for the pilot to determine whether the departure was evaluated using the

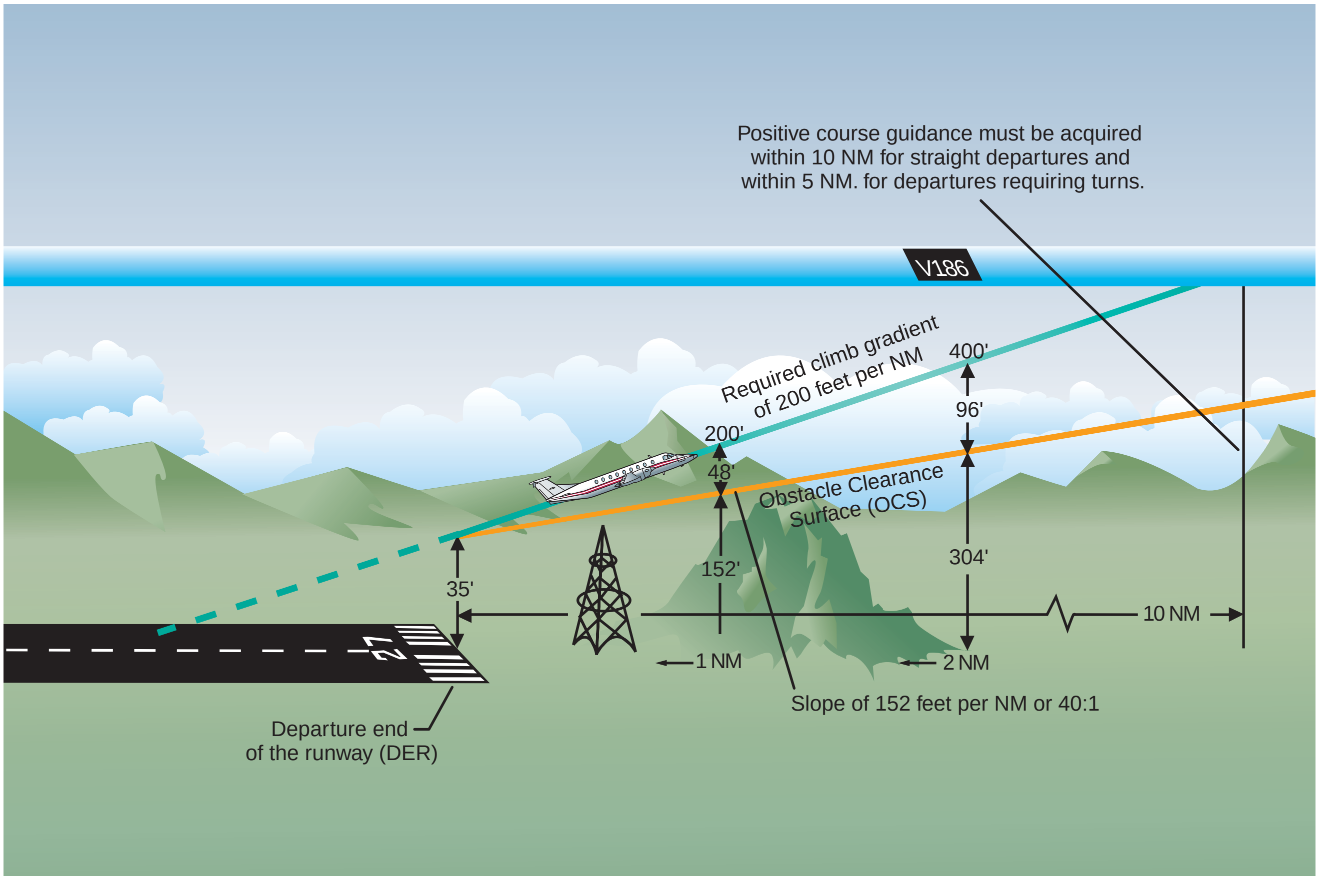


Figure 2-15. Previous TERPS Design Criteria for Departure Procedures.

previous or current criteria and until all departures have been evaluated using the current criteria, pilots need to be very familiar with the departure environment and associated obstacles especially if crossing the DER at less than 35 feet.

Assuming a 200-foot per NM climb, the departure is structured to provide at least 48 feet per NM of clearance above objects that do not penetrate the obstacle slope. The slope, known as the OCS, is based on a 40 to 1 ratio, which is the equivalent of a 2.5 percent or a 152-foot per NM slope. As a result, a departure is designed using the OCS as the minimum obstacle clearance, and then by requiring a minimum climb gradient of 200 feet per NM, additional clearance is provided. The departure design must also include the acquisition of positive course guidance (PCG) typically within 5 to 10 NM of the DER for straight departures and within 5 NM after turn completion on departures requiring a turn. Even when aircraft performance greatly exceeds the minimum climb gradient, the published departure routing must always be flown.

Airports declaring that the sections of a runway at one or both ends are not available for landing or takeoff publish the declared distances in the A/FD. These include takeoff runway available (TORA), takeoff distance available (TODA), accelerate-stop distance available (ASDA), and landing distance available (LDA). These distances are calculated by adding to the full length of paved runway, any applicable clearway or stopway, and subtracting from that sum the sections of the runway unsuitable for satisfying the required takeoff run, takeoff, accelerate/stop, or landing distance, as shown in Figure 2-16 on page 2-14.

In a perfect world, the 40 to 1 slope would work for every departure design; however, due to terrain and man-made obstacles, it is often necessary to use alternative requirements to accomplish a safe, obstacle-free departure design. In such cases, the design of the departure may incorporate a climb gradient greater than 200 feet per NM, an increase in the standard takeoff minimums to allow the aircraft to "see and avoid" the obstacles, standard minimums combined with a climb gradient of 200 feet per NM or greater with a specified reduced runway length, or a combination of these options and a specific departure route. If a departure route is specified, it must be flown in conjunction with the other options. A published climb gradient in this case is based on the ROC 24 percent rule. To keep the same ROC ratio as standard, when the required climb gradient is greater than 200 feet per NM, 24 percent of the total height

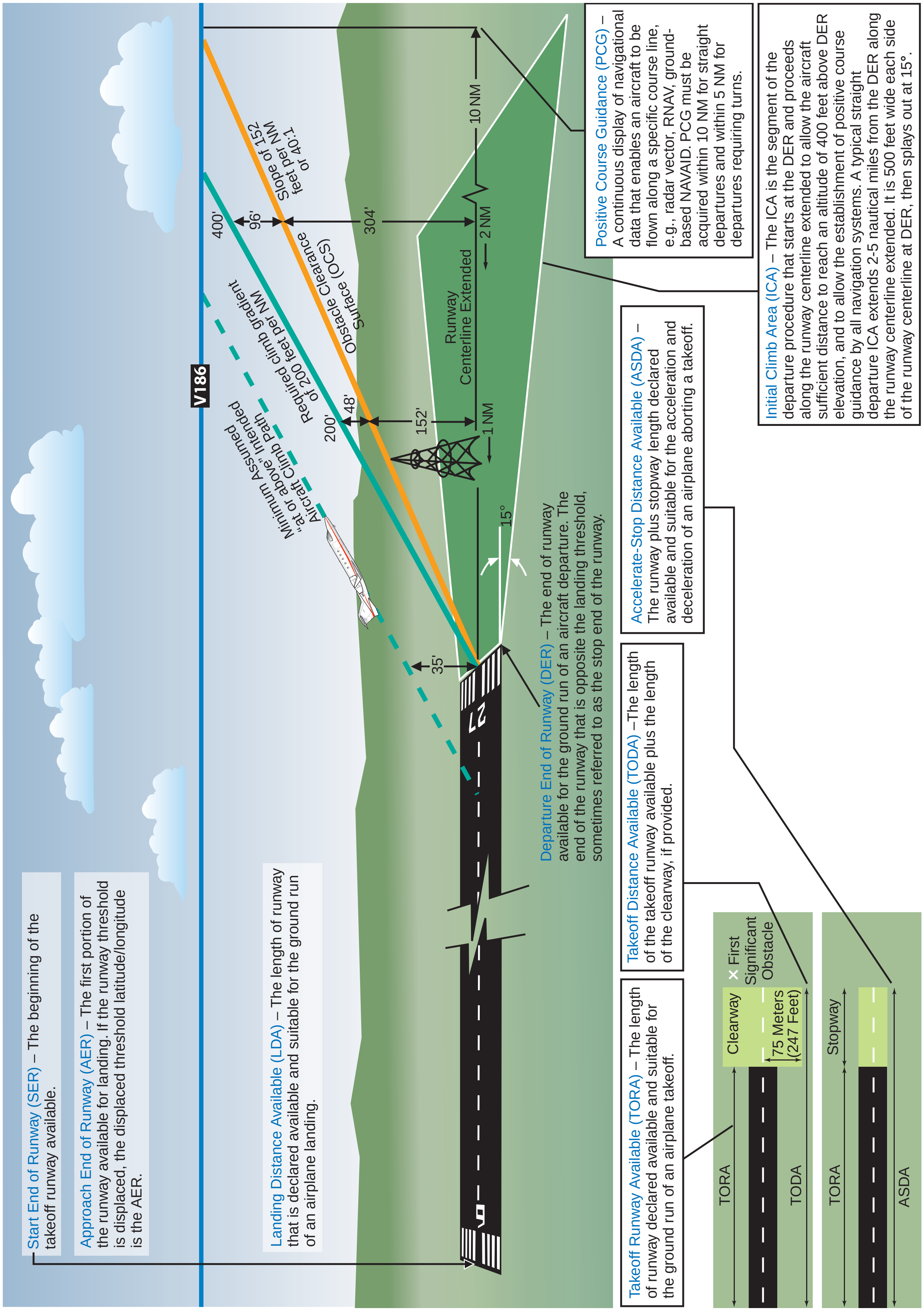


Figure 2-16. New TERPS Design Criteria for Departure Procedures.

C2

TAKE-OFF MINIMUMS AND (OBSTACLE) DEPARTURE PROCEDURES

02052

SAMPLE NOT FOR ACTUAL USE

ANGEL FIRE, NM
ANGEL FIRE
TAKE-OFF MINIMUMS: Rwy 35, NA-obstacles. Rwy 17, CAT A, B, C std. with a min. climb of 420' per NM to 13000 MSL. CAT D NA.
DEPARTURE PROCEDURE: Rwy 17, use ANEKE RNAV DEPARTURE.
NOTE: Rwy 17, road 1540' from departure end of runway on centerline, 8455' MSL.

ASPEN, CO
ASPEN-PITKIN COUNTY/SARDY FIELD
TAKE-OFF MINIMUMS: Rwy 15, NA. Rwy 33, 3100-3 or 1000-2 with a min. climb of 460' per NM to 14000.
DEPARTURE PROCEDURE: Climb heading 340° to 8700, then climbing left turn to 16000 heading 270° to intercept and proceed via I-PKN northwest course outbound on backcourse and DBL R-244 outbound to GLENO Int/DBL 22.7 DME. Climb in GLENO holding pattern (SW, left turns, 064° inbound) to cross GLENO at 16000 before proceeding in route.
NOTE: Rwy 33, 8179' tree 3447' from departure end of runway, 1379' left of centerline.

BUENA VISTA, CO
CENTRAL COLORADO REGIONAL
TAKE-OFF MINIMUMS: IFR DEPARTURE NA.

CANON CITY, CO

CORTEZ, CO
CORTEZ MUNI
TAKE-OFF MINIMUMS: Rwy 21, 1000-2.
DEPARTURE PROCEDURE: Rwy 3, left turn. Rwy 21, right turn, climbing direct to CEZ VOR. Aircraft northwestbound V391 continue climb on course to 9800 or above; southeastbound V391, V211, and direct HBU VOR/DME, continue climb on R-295 to 8000, left climbing turn to recross CEZ VOR at or above 9400. Aircraft enroute HBU VOR/DME and able to climb 230' per NM to 15000 may climb on course (CEZ R-034) to 16300 or above.

CRAIG, CO
CRAIG-MOFFAT
TAKE-OFF MINIMUMS: Rwys 7, 25, 800-1¼, or std. with a min. climb of 400' per NM to 7000.
DEPARTURE PROCEDURE: Rwys 7, 25, climb direct CHE VOR/DME and hold (W, right turns, 108° inbound) climbing to: aircraft departing CHE R-213 CW R-296 depart on course; all others continue climbing to cross CHE at or above; CHE R-076 CW R-114 10500, R-115 CW R-212 11300, and R-297 CW R-078 11300.

DEMING, NM
DEMING MUNI
TAKE-OFF MINIMUMS: Rwy 4, NA.
DEPARTURE PROCEDURE: WESTBOUND: Rwy 8, climbing left turn heading 214°; Rwy 22, climbing right

Figure 2-17. Obstacle Information for Aspen, Colorado.

above the starting elevation gained by an aircraft departing to a minimum altitude to clear an obstacle that penetrates the OCS is the ROC. The required climb gradient depicted in ODPs is obtained by using the formulas:

Standard Formula

$$CG = \frac{O - E}{0.76\ D}$$

DoD Option*

$$CG = \frac{(48D + O) - E}{D}$$

where O = obstacle MSL elevation
E = climb gradient starting MSL elevation
D = distance (NM) from DER to the obstacle

Examples:

$$\frac{2049-1221}{0.76 \times 3.1} = 351.44$$

Round to 352 ft/NM

$$\frac{(48 \times 3.1+2049)-1221}{3.1} = 315.10$$

Round to 316 ft/NM

*Military only

These formulas are published in TERPS Volume 4 for calculating the required climb gradient to clear obstacles.

The following formula is used for calculating climb gradients for other than obstacles, i.e., ATC requirements:

$$CG = \frac{A-E}{D}$$

where A = "climb to" altitude
E = climb gradient starting MSL elevation
D = distance (NM) from the beginning of the climb

Example:

$$\frac{3000-1221}{5} = 355.8 \text{ round to } 356 \text{ ft/NM}$$

NOTE: The climb gradient must be equal to or greater than the gradient required for obstacles along the route of flight.

Obstacles that are located within 1 NM of the DER and penetrate the 40:1 OCS are referred to as "low, close-in obstacles." The standard ROC of 48 feet per NM to clear these obstacles would require a climb gradient greater than 200 feet per NM for a very short distance, only until the aircraft was 200 feet above the DER. To eliminate publishing an excessive climb gradient, the obstacle AGL/MSL height and location relative to the DER is noted in the Take-off Minimums and (OBSTACLE) Departure Procedures section of a given TPP booklet. The purpose of this note is to identify the obstacle and alert the pilot to the height and location of the obstacle so they can be avoided. [Figure 2-17]

Departure design, including climb gradients, does not take into consideration the performance of the aircraft; it only considers obstacle protection for all aircraft. TERPS criteria assumes the aircraft is operating with all available engines and systems fully functioning. When a climb gradient is required for a specific departure, it is vital that pilots fully understand the performance of their aircraft and determine if it can comply with the required climb. The standard climb of 200 feet per NM is not an issue for most aircraft. When an increased climb gradient is specified due to obstacle issues, it is important to calculate aircraft performance, particularly when flying out of airports at higher altitudes on warm days. To aid in the calculations, the front matter of every TPP booklet contains a rate of climb table that relates specific climb gradients and typical airspeeds. [Figure 2-18 on page 2-16]

A **visual climb over airport (VCOA)** is an alternate departure method for aircraft unable to meet required climb gradients and for airports at which a conventional instrument departure procedure is impossible to design due to terrain or other obstacle hazard. The development

D1

01081

CLIMB TABLE

RATE OF CLIMB TABLE

A rate of climb table is provided for use in planning and executing takeoff procedures under known or approximate ground speed conditions.

(ft. per min.)

REQUIRED GRADIENT RATE (ft. per NM)	GROUND SPEED (KNOTS) 30	60	80	90	100	120	140
200	100	200	267	300	333	400	467
250	125	250	333	375	417	500	583
300	150	300	400	450	500	600	700
350	175	350	467	525	583	700	816
400	200	400	533	600	667	800	933
450	225	450	600	675	750	900	1050
500	250	500	667	750	833	1000	1167
550	275	550	733	825	917	1100	1283
600	300	600	800	900	1000	1200	1400
650	325	650	867	975	1083	1300	1516
700	350	700	933	1050	1167	1400	1633

SE-3, 13 JUN 2002

REQUIRED GRADIENT RATE (ft. per NM)	GROUND SPEED (KNOTS) 150	180	210	240	270	300
200	500	600	700	800	900	1000
250	625	750	875	1000	1125	1250
300	750	900	1050	1200	1350	1500
350	875	1050	1225	1400	1575	1750
400	1000	1200	1400	1600	1700	2000
450	1125	1350	1575	1800	2025	2250
500	1250	1500	1750	2000	2250	2500
550	1375	1650	1925	2200	2475	2750
600	1500	1800	2100	2400	2700	3000
650	1625	1950	2275	2600	2925	3250
700	1750	2100	2450	2800	3150	3500

Ground Speed is 180 knots

Required climb gradient of 300 feet per NM

Given the parameters, you would need to climb at a rate of 900 feet per minute to maintain the required climb gradient.

Figure 2-18. Rate of Climb Table.

TAKE-OFF MINIMUMS AND (OBSTACLE) DEPARTURE PROCEDURES

05244

BEALE AFB (KBAB)
MARYSVILLE, CA (KBAB) 04246
Runway 15 diverse departure not authorized. Use the following departure procedure for obstacle avoidance. Between 005° and 087° bearing from DER, standard with minimum climb rate 250 ft/NM to 4900.
Runway 33 diverse departure not authorized. Use the following departure procedures for obstacle avoidance. Between R-353 and R-066 bearing from DER, standard with minimum climb rate 250 ft/NM to 11,000.

BECKWOURTH, CA
NERVINO
TAKE-OFF MINIMUMS: Rwys 7, 25, 3500-3 for climb in visual conditions.
DEPARTURE PROCEDURE: Rwys 7, 25, for climb in visual conditions: cross Nervino Airport at or above 8300 before proceeding on course.

CLOVERDALE, CA
CLOVERDALE MUNI
TAKE-OFF MINIMUMS: Rwy 14, 400-2 or std. with a min. climb of 280' per NM to 1500, then a min. climb of 260' per NM to 3900. Rwy 32, NA.
DEPARTURE PROCEDURE: Rwy 14, climb direct STS VOR/DME. Continue climb in holding pattern (NW right turns, 140° inbound) to MEA for route of flight.
NOTE: Rwy 14, tree 9337' from departure end of runway, 4633' right of centerline, 150' AGL/889' MSL.

COLUMBIA, CA
COLUMBIA
TAKE-OFF MINIMUMS: Rwy 17, 300-1 with a min. climb rate of 300' per NM to 3000. Rwy 35, NA.
DEPARTURE PROCEDURE: Rwy 17, use FICHU RNAV DEPARURE. Rwy 35, NA.
NOTE: Rwy 17, 51' AGL pole 502' from departure end of

Figure 2-19. Beckwourth, CA.

of this type of procedure is required when obstacles more than 3 SM from the DER require a greater than 200 feet per NM climb gradient. An example of this procedure is visible at Nervino Airport in Beckwourth, California. [Figure 2-19]

The procedure for climb in visual conditions requires crossing Nervino Airport at or above 8,300 feet before proceeding on course. Additional instructions often complete the departure procedure and transition the flight to the en route structure. VCOA procedures are available on specific departure procedures, but are not established in conjunction with SIDs or RNAV obstacle departure procedures. Pilots must know if their specific flight operations allow VCOA procedures on IFR departures.

AIRPORT RUNWAY ANALYSIS

It may be necessary for pilots and aircraft operators to consult an aircraft performance engineer and airport/runway analysis service for information regarding the clearance of specific obstacles during IFR departure procedures to help maximize aircraft payload while complying with engine-out performance regulatory requirements. Airport/runway analysis involves the complex application of extensive airport databases and terrain information to generate computerized computations for aircraft performance in a specific configuration. This yields maximum allowable takeoff and landing weights for particular aircraft/engine configurations for a specific airport, runway, and range of temperatures. The computations also consider flap settings, various aircraft characteristics, runway conditions, obstacle clearance, and weather conditions. Data also is available for operators who desire to perform their own analysis.

When a straight-out departure is not practical or recommended, a turn procedure can be developed for the engine-out flight path for each applicable runway designed to maximize the allowable takeoff weights and ultimately, aircraft payload. Engine-out graphics are available, giving the pilot a pictorial representation of each procedure. Airport/runway analysis also is helpful for airline dispatchers, flight operations officers, engineering staff, and others to ensure that a flight does not exceed takeoff and landing limit weights.

CAUTION: Pilots and aircraft operators have the responsibility to consider obstacles and to make the necessary adjustments to their departure procedures to ensure safe clearance for aircraft over those obstacles.

Information on obstacle assessment, controlling obstacles, and other obstacles that may affect a pilot's IFR departure may not be depicted or noted on a chart and may be outside the scope of IFR departure procedure obstacle assessment criteria. Departure criteria is predicated on normal aircraft operations for considering obstacle clearance requirements. Normal aircraft operation means all aircraft systems are functioning normally, all required navigational aids (NAVAIDS) are performing within flight inspection parameters, and the pilot is conducting instrument operations utilizing instrument procedures based on the TERPS standard to provide ROC.

SID VERSUS DP

In 2000, the FAA combined into a single product both textual IFR departure procedures that were developed by the National Flight Procedures Office (NFPO) under the guidance of the Flight Standards Service (AFS) and graphic standard instrument departures (SIDs) that were designed and produced under the direction of the Air Traffic Organization (ATO). This combined product introduced the new term departure procedures (DPs) to the pilot and ATC community, and the aforementioned terms IFR departure procedure and SID were eliminated. The FAA also provided for the graphic publication of IFR departure procedures, as well as all area navigation (RNAV) DPs, to facilitate pilot understanding of the procedure. This includes both those developed solely for obstruction clearance and those developed for system enhancement. Elimination of the term SID created undue confusion in both the domestic and international aviation communities. Therefore, in the interest of international harmonization, the FAA reintroduced the term SID while also using the term obstacle departure procedure (ODP) to describe certain procedures.

There are two types of DPs: those developed to assist pilots in obstruction avoidance, ODP, and those developed to communicate air traffic control clearances, SID. DPs and/or takeoff minimums must be established for those airports with approved instrument approach procedures. ODPs are developed by the NFPO at locations with instrument procedure development responsibility. ODPs may also be required at private airports where the FAA does not have instrument procedure development responsibility. It is the responsibility of non-FAA proponents to ensure a TERPS diverse departure obstacle assessment has been accomplished and an ODP developed, where applicable. DPs are also categorized by equipment requirements as follows:

- **Non-RNAV DP**. Established for aircraft equipped with conventional avionics using ground-based NAVAIDs. These DPs may also be designed using dead reckoning navigation. A flight management system (FMS) may be used to fly a non-RNAV DP if the FMS unit accepts inputs from conventional avionics sources such as DME, VOR, and LOC. These inputs include radio tuning and may be applied to a navigation solution one at a time or in combination. Some FMSs provide for the detection and isolation of faulty navigation information.

- **RNAV DP**. Established for aircraft equipped with RNAV avionics; e.g., GPS, VOR/DME, DME/DME, etc. Automated vertical navigation is not required, and all RNAV procedures not requiring GPS must be annotated with the note: "RADAR REQUIRED." Prior to using GPS for RNAV departures, approach RAIM availability should be checked for that location with the navigation receiver or a Flight Service Station.

- **Radar DP**. Radar may be used for navigation guidance for SID design. Radar SIDs are established when ATC has a need to vector aircraft on departure to a particular ATS Route, NAVAID, or Fix. A fix may be a ground-based NAVAID, a waypoint, or defined by reference to one or more radio NAVAIDS. Not all fixes are waypoints since a fix could be a VOR or VOR/DME, but all waypoints are fixes. Radar vectors may also be used to join conventional or RNAV navigation SIDs. SIDs requiring radar vectors must be annotated "RADAR REQUIRED."

OBSTACLE DEPARTURE PROCEDURES

The term **Obstacle Departure Procedure (ODP)** is used to define procedures that simply provide obstacle clearance. ODPs are only used for obstruction clearance and do not include ATC related climb requirements. In fact, the primary emphasis of ODP design is to use the least onerous route of flight to the en route structure or at an altitude that allows random (diverse) IFR flight, while attempting to accommodate typical departure routes.

An ODP must be developed when obstructions penetrate the 40:1 departure OCS, using a complex set of ODP development combinations to determine each situation and required action. Textual ODPs are only issued by ATC controllers when required for traffic. If they are not issued by ATC, textual ODPs are at the pilot's option to fly or not fly the textual ODP, even in less than VFR weather conditions, for FAR Part 91 operators, military, and public service. As a technique, the pilot may enter "will depart (airport) (runway) via textual ODP" in the remarks section of the flight plan, this information to the controller clarifies the intentions of the pilot and helps prevent a potential pilot/controller misunderstanding.

ODPs are textual in nature, however, due to the complex nature of some procedures, a visual presentation may be necessary for clarification and understanding. Additionally, all newly developed area navigation (RNAV) ODPs are issued in graphic form. If necessary, an ODP is charted graphically just as if it were a SID and the chart itself includes "Obstacle" in parentheses in the title. A graphic ODP may also be filed in an instrument flight plan by using the computer code included in the procedure title.

Only one ODP is established for a runway. It is considered to be the default IFR departure procedure and is intended for use in the absence of ATC radar vectors or a SID assignment. ODPs use ground based NAVAIDS, RNAV, or dead reckoning guidance wherever possible, without the use of radar vectors for navigation.

Military departure procedures are not handled or published in the same manner as civil DPs. Approval authority for DPs at military airports rests with the military. The FAA develops U.S. Army and U.S. Air Force DPs for domestic civil airports. The National Geospatial-Intelligence Agency (NGA) publishes all military DPs. The FAA requires that all military DPs be coordinated with FAA ATC facilities or regions when those DPs affect the NAS.

All ODP procedures are listed in the front of the NACO approach chart booklets under the heading Takeoff Minimums and Obstacle Departure Procedures. Each procedure is listed in alphabetical order by city and state. The ODP listing in the front of the booklet will include a reference to the graphic chart located in the main body of the booklet if one exists. Pilots do not need ATC clearance to use an ODP and they are responsible for determining if the departure airport has this type of published procedure. [Figure 2-20]

FLIGHT PLANNING CONSIDERATIONS

During planning, pilots need to determine whether or not the departure airport has an ODP. Remember, an ODP can only be established at an airport that has instrument approach procedures (IAPs). An ODP may drastically affect the initial part of the flight plan. Pilots may have to depart at a higher than normal climb rate, or depart in a direction opposite the intended heading and maintain that for a period of time, any of which would require an alteration in the flight plan and initial headings. Considering the forecast weather, departure runway, and existing ODP, plan the flight route, climb performance, and fuel burn accordingly to compensate for the departure procedure.

Additionally, when close-in obstacles are noted in the Takeoff Minimums and (Obstacle) Departure Procedures section, it may require the pilot to take action to avoid these obstacles. Consideration must be given to decreased climb performance from an inoperative engine or to the amount of runway used for takeoff. Aircraft requiring a short takeoff roll on a long runway may have little concern. On the other hand, airplanes that use most of the available runway for takeoff may not have the standard ROC when climbing at the normal 200 feet per NM.

Another factor to consider is the possibility of an engine failure during takeoff and departure. During the preflight planning, use the aircraft performance charts to determine if the aircraft can still maintain the required climb performance. For high performance aircraft, an engine failure may not impact the ability to maintain the prescribed climb gradients. Aircraft that are performance limited may have diminished capability and may be

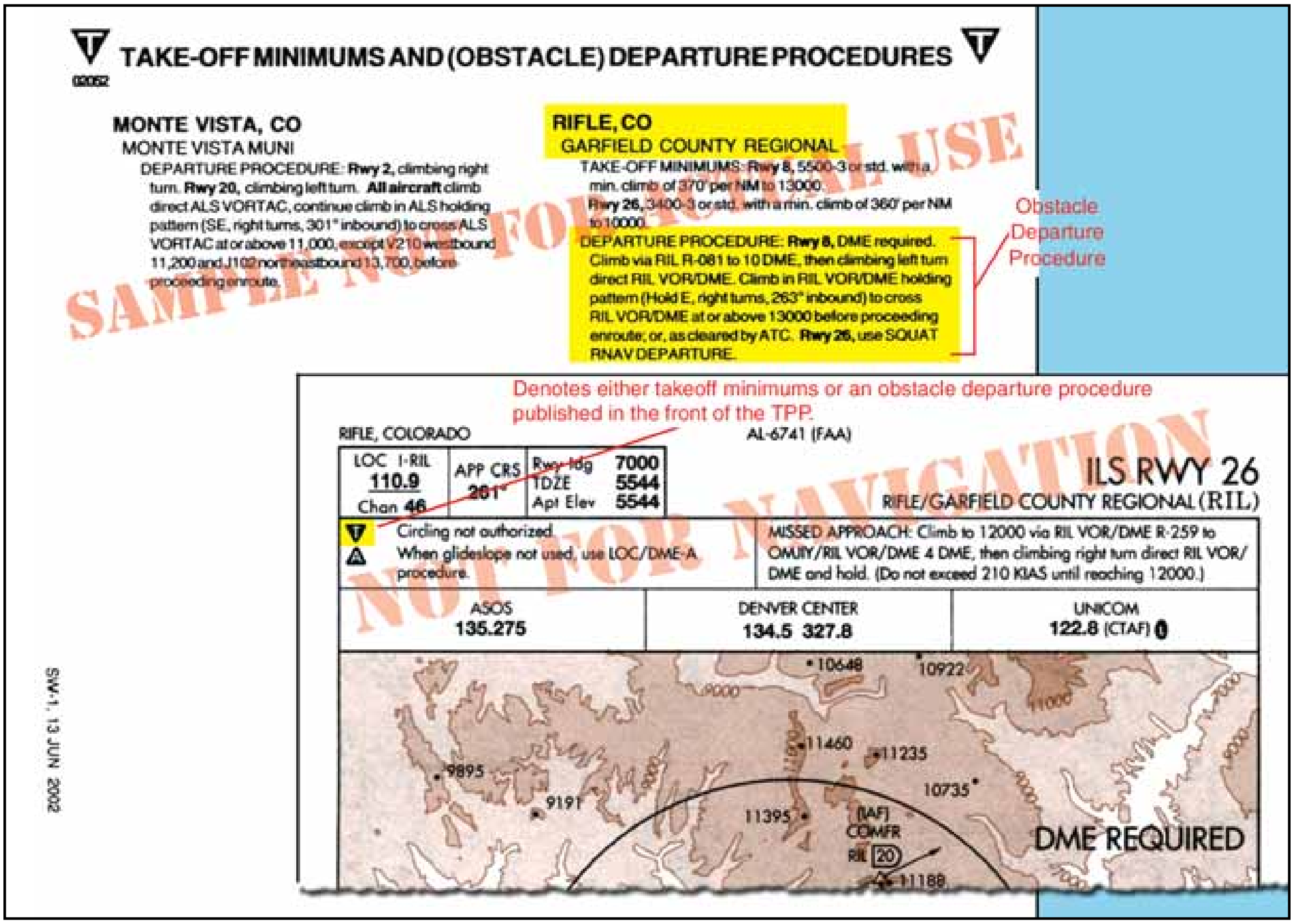


Figure 2-20. Graphic ODP/Booklet Front Matter.

unable to maintain altitude, let alone complete a climb to altitude. Based on the performance expectations for the aircraft, construct an emergency plan of action that includes emergency checklists and the actions to take to ensure safety in this situation.

STANDARD INSTRUMENT DEPARTURES

A **Standard Instrument Departure (SID)** is an ATC requested and developed departure route, typically used in busy terminal areas. It is designed at the request of ATC in order to increase capacity of terminal airspace, effectively control the flow of traffic with minimal communication, and reduce environmental impact through noise abatement procedures.

While obstacle protection is always considered in SID routing, the primary goal is to reduce ATC/pilot workload while providing seamless transitions to the en route structure. SIDs also provide additional benefits to both the airspace capacity and the airspace users by reducing radio congestion, allowing more efficient airspace use, and simplifying departure clearances. All of the benefits combine to provide effective, efficient terminal operations, thereby increasing the overall capacity of the NAS.

If you cannot comply with a SID, if you do not possess SID charts or textual descriptions, or if you simply do not wish to use standard instrument departures, include the statement "NO SIDs" in the remarks section of your flight plan. Doing so notifies ATC that they cannot issue you a clearance containing a SID, but instead will clear you via your filed route to the extent possible, or via a **Preferential Departure Route (PDR)**. It should be noted that SID usage not only decreases clearance delivery time, but also greatly simplifies your departure, easing you into the IFR structure at a desirable location and decreasing your flight management load. While you are not required to depart using a SID, it may be more difficult to receive an "as filed" clearance when departing busy airports that frequently use SID routing.

SIDs are always charted graphically and are located in the TPP after the last approach chart for an airport. The SID may be one or two pages in length, depending on the size of the graphic and the amount of space required for the departure description. Each chart depicts the departure route, navigational fixes, transition routes, and required altitudes. The departure description outlines the particular procedure for each runway. [Figure 2-21 on page 2-20]

Charted transition routes allow pilots to transition from the end of the basic SID to a location in the en route structure. Typically, transition routes fan out in various directions from the end of the basic SID to allow pilots to choose the transition route that takes them in the

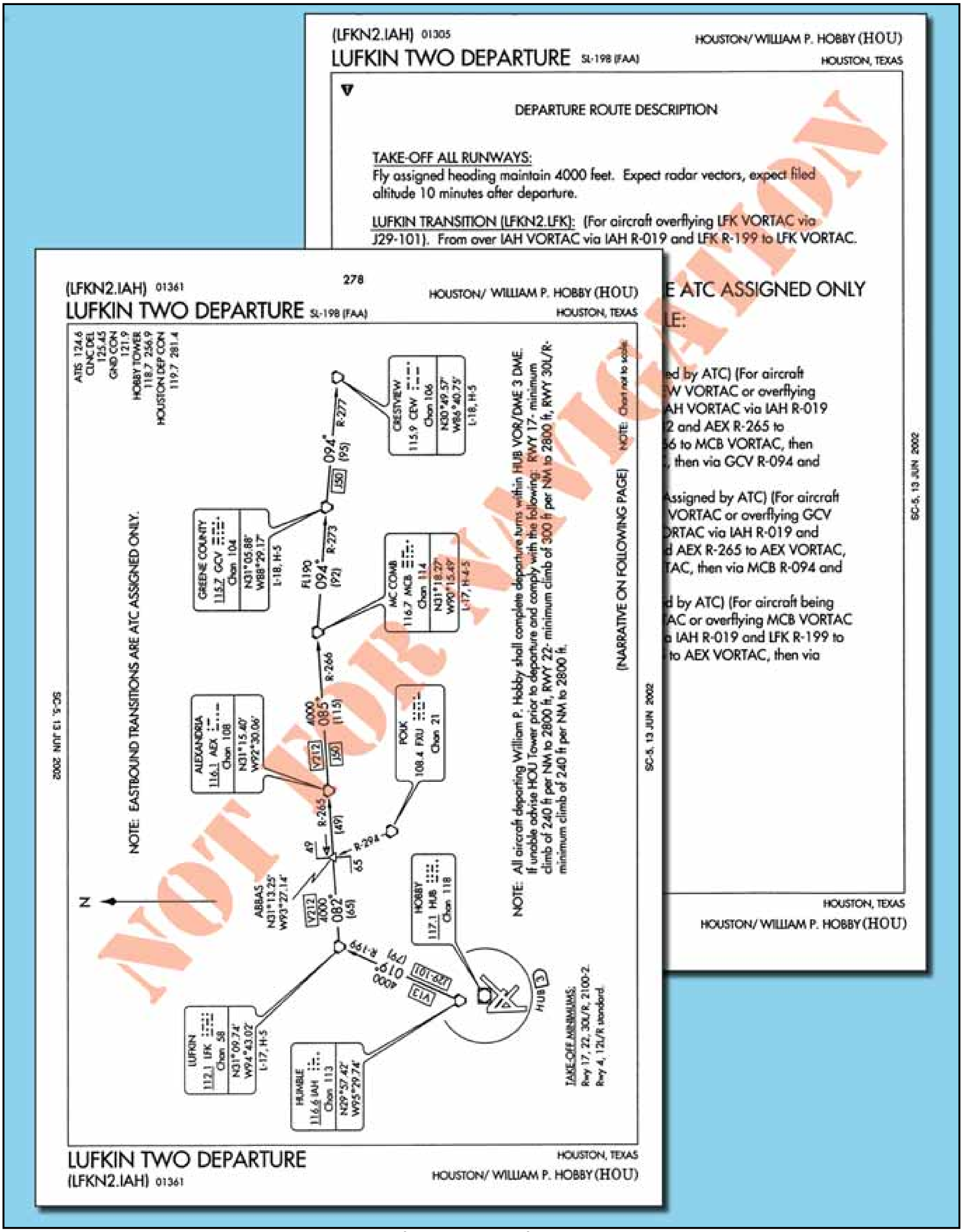


Figure 2-21. SID Chart

direction of intended departure. A transition route includes a course, a minimum altitude, and distances between fixes on the route. When filing a SID for a specific transition route, include the transition in the flight plan, using the correct departure and transition code. ATC also assigns transition routes as a means of putting the flight on course to the destination. In any case, the pilot must receive an ATC clearance for the departure and the associated transition, and the clearance from ATC will include both the departure name and transition e.g., Joe Pool Nine Departure, College Station Transition. [Figure 2-22]

PILOT NAV AND VECTOR SIDS

SIDs are categorized by the type of navigation used to fly the departure, so they are considered either pilot navigation or vector SIDs. Pilot navigation SIDs are

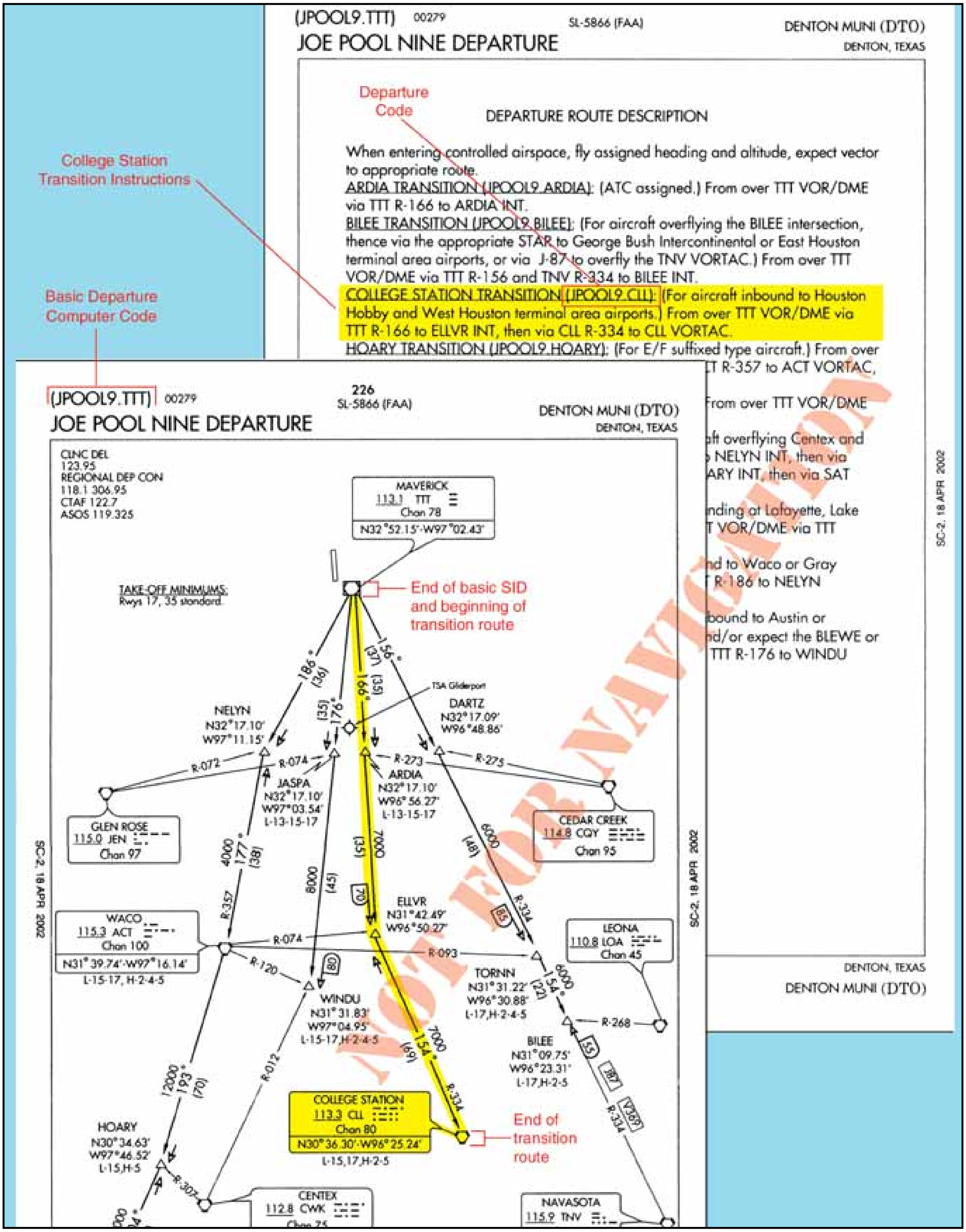


Figure 2-22. Transition Routes as Depicted on SIDs.

designed to allow you to provide your own navigation with minimal radio communication. This type of procedure usually contains an initial set of departure instructions followed by one or more transition routes. A pilot navigation SID may include an initial segment requiring radar vectors to help the flight join the procedure, but the majority of the navigation will remain the pilot's responsibility. These are the most common type of SIDs because they reduce the workload for ATC by requiring minimal communication and navigation support. [Figure 2-23].

A Vector SID usually requires ATC to provide radar vectors from just after takeoff (ROC is based on a climb to 400 feet above the DER elevation before making the initial turn) until reaching the assigned route or a fix depicted on the SID chart. However, some textual ODPs originate in uncontrolled airspace, while the SID begins in controlled airspace. Vector SIDs do not include departure routes or transition routes because independent pilot navigation is not involved. The procedure sets forth an initial set of departure instructions that typically include an initial heading and altitude. ATC must have radar contact with the aircraft to be able to provide vectors. ATC expects you to immediately comply with radar vectors and they expect you to notify them if you are unable to fulfill their request. ATC also expects you to make contact immediately if an instruction will cause you to compromise safety due to obstructions or traffic.

It is prudent to review vector SID charts prior to use because this type of procedure often includes nonstandard lost communication procedures. If you were to lose radio contact while being vectored by ATC, you would be expected to comply with the lost communication procedure as outlined on the chart, not necessarily those procedures outlined in the AIM. [Figure 2-24 on page 2-24]

FLIGHT PLANNING CONSIDERATIONS

Take into consideration the departure paths included in the SIDs and determine if you can use a standardized departure procedure. You have the opportunity to choose the SID that best suits your flight plan. During the flight planning phase, you can investigate each departure and determine which procedure allows you to depart the airport in the direction of your intended flight. Also consider how a climb gradient to a specific altitude will affect the climb time and fuel burn portions of the flight plan. If ATC assigns you a SID, you may need to quickly recalculate your performance numbers.

PROCEDURAL NOTES

Another important consideration to make during your flight planning is whether or not you are able to fly your chosen departure procedure as charted. Notes giving procedural requirements are listed on the graphic portion of a departure procedure, and they are mandatory in nature. [Figure 2-25 on page 2-25] Mandatory procedural notes may include:

- Aircraft equipment requirements (DME, ADF, etc.).
- ATC equipment in operation (RADAR).
- Minimum climb requirements.
- Restrictions for specific types of aircraft (TURBOJET ONLY).
- Limited use to certain destinations.

There are numerous procedural notes requiring specific compliance on your part. Carefully review the charts for the SID you have selected to ensure you can use the procedures. If you are unable to comply with a specific requirement, you must not file the procedure as part of your flight plan, and furthermore, you must not accept the procedure if ATC assigns it. Cautionary statements may also be included on the procedure to notify you of specific activity, but these are strictly advisory. [Figure 2-26 on page 2-26]

DP RESPONSIBILITY

Responsibility for the safe execution of departure procedures rests on the shoulders of both ATC and the pilot. Without the interest and attention of both parties, the IFR system cannot work in harmony, and achievement of safety is impossible.

ATC, in all forms, is responsible for issuing clearances appropriate to the operations being conducted, assigning altitudes for IFR flight above the minimum IFR altitudes for a specific area of controlled airspace, ensuring the pilot has acknowledged the clearance or instructions, and ensuring the correct read back of instructions. Specifically related to departures, ATC is responsible for specifying the direction of takeoff or initial heading when necessary, obtaining pilot concurrence that the procedure complies with local traffic patterns, terrain, and obstruction clearance, and including departure procedures as part of the ATC clearance when pilot compliance for separation is necessary.

The pilot has a number of responsibilities when simply operating in conjunction with ATC or when using departure procedures under an IFR clearance:

- Acknowledge receipt and understanding of an ATC clearance.
- Read back any part of a clearance that contains "hold short" instructions.
- Request clarification of clearances.

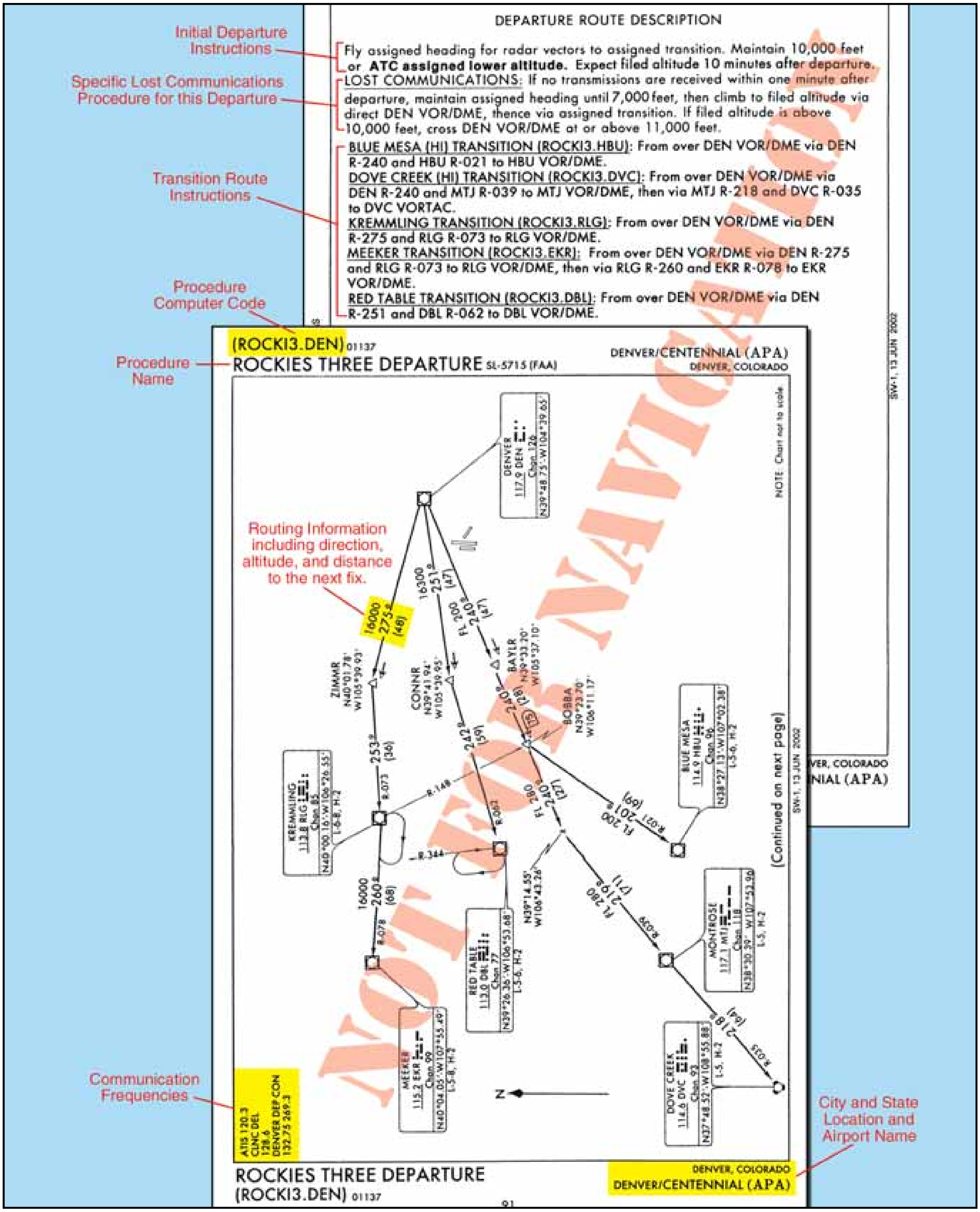


Figure 2-23. Pilot Navigation SID.

- Request an amendment to a clearance if it is unacceptable from a safety perspective.
- Promptly comply with ATC requests. Advise ATC immediately if unable to comply with a clearance.

When planning for a departure, pilots should:

- Consider the type of terrain and other obstructions in the vicinity of the airport.

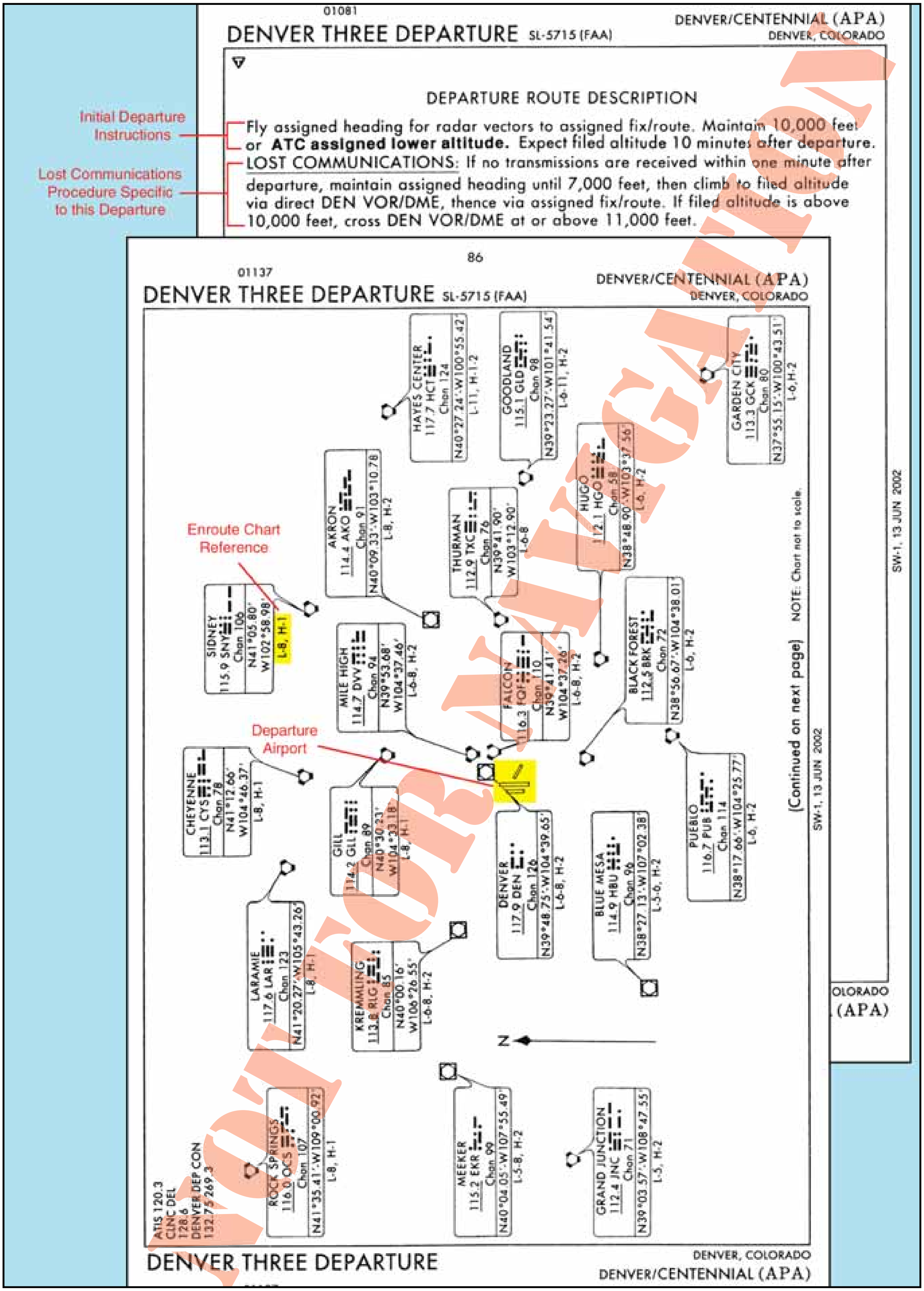


Figure 2-24. Vector SID.

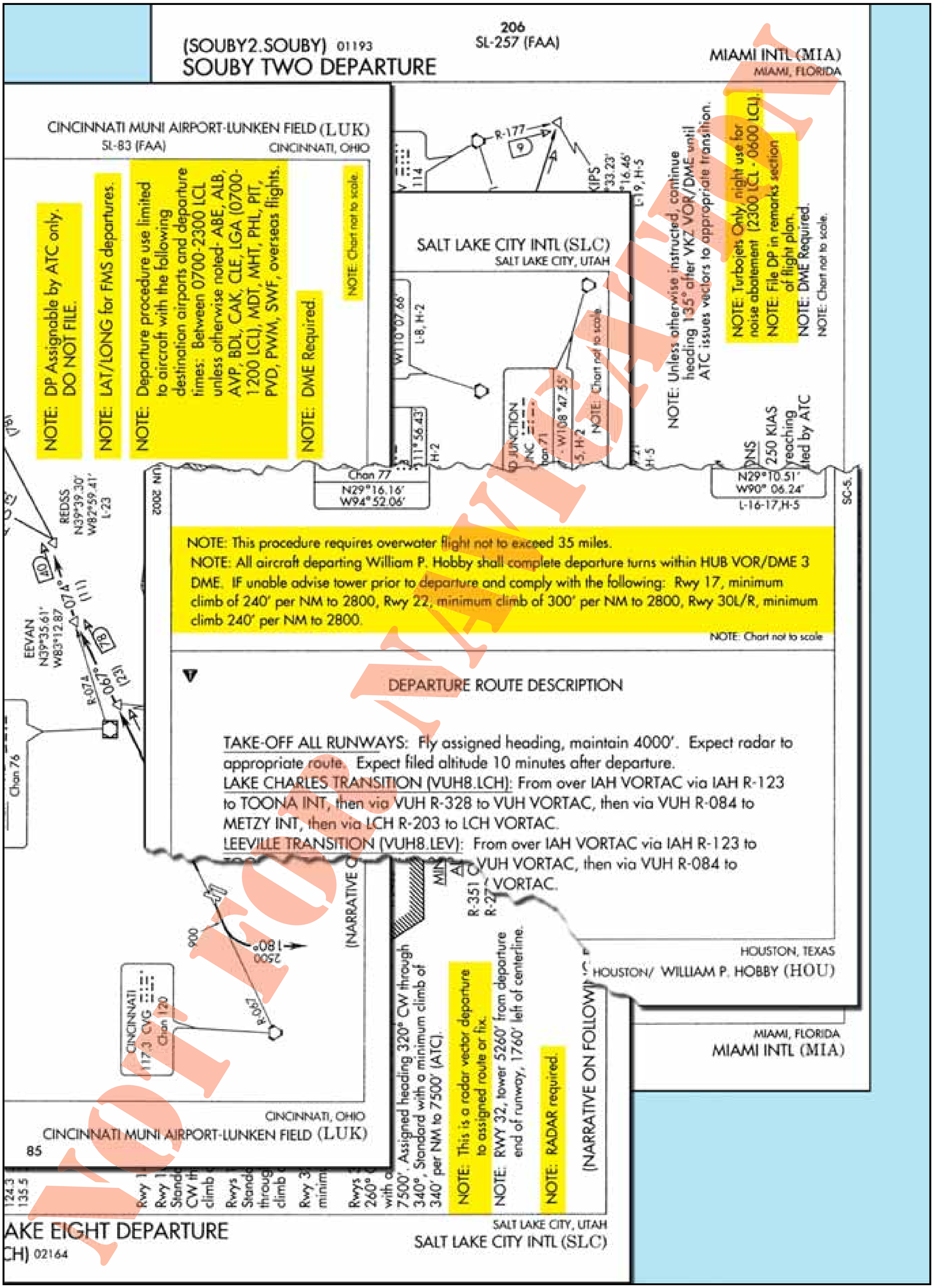


Figure 2-25. Procedural Notes.

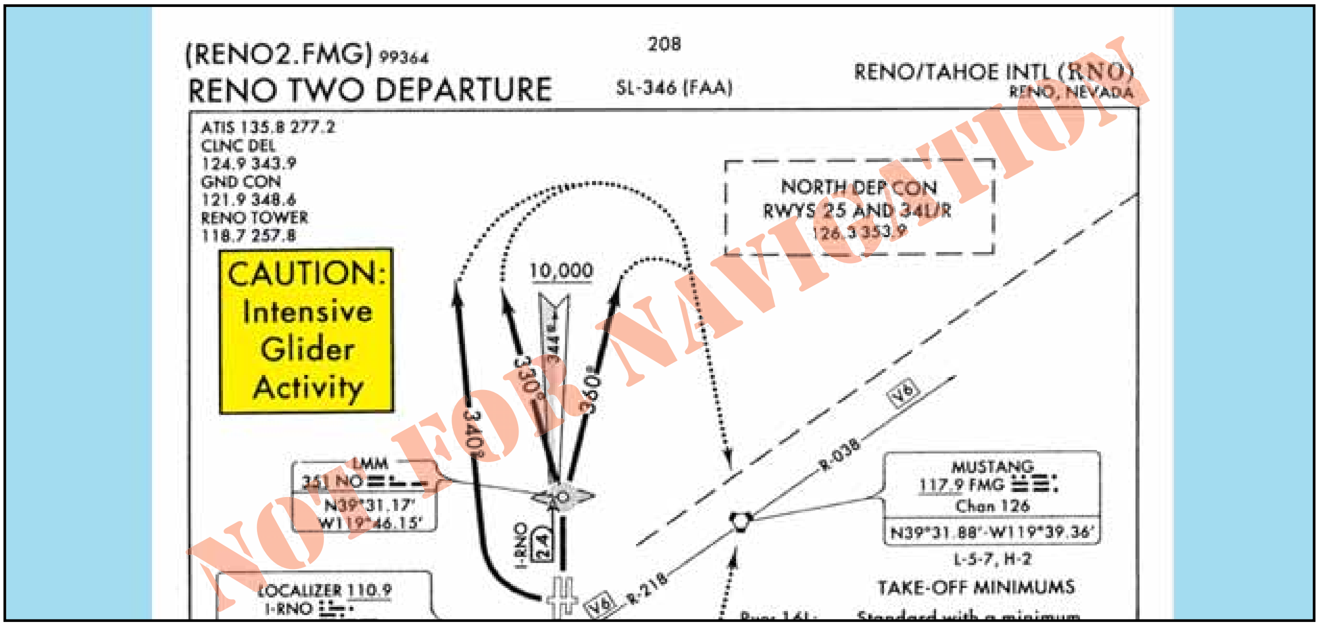


Figure 2-26. Cautionary Statements.

- Determine if obstacle clearance can be maintained visually, or if they need to make use of a departure procedure.
- Determine if an ODP or SID is available for the departure airport.
- Determine what actions allow for a safe departure out of an airport that does not have any type of affiliated departure procedures.

By simply complying with departure procedures in their entirety as published, obstacle clearance is guaranteed. Depending on the type of departure used, responsibility for terrain clearance and traffic separation may be shared between pilots and controllers.

PROCEDURES ASSIGNED BY ATC

ATC can assign SIDs or radar vectors as necessary for traffic management and convenience. You can also request a SID in your initial flight plan, or from ATC. To fly a SID, you must receive approval to do so in a clearance. In order to accept a clearance that includes a SID, you must have at least a textual description of the SID in your possession at the time of departure. It is your responsibility as pilot in command to accept or reject the issuance of a SID by ATC. You must accept or reject the clearance based on:

- The ability to comply with the required performance.
- Possession of at least the textual description of the SID.
- Personal understanding of the SID in its entirety.

When you accept a clearance to depart using a SID or radar vectors, ATC is responsible for traffic separation. ATC is also responsible for obstacle clearance. When departing with a SID, ATC expects you to fly the procedure as charted because the procedure design considers obstacle clearance. It is also expected that you will remain vigilant in scanning for traffic when departing in visual conditions. Furthermore, it is your responsibility to notify ATC if your clearance would endanger your safety or the safety of others.

PROCEDURES NOT ASSIGNED BY ATC

Obstacle departure procedures are not assigned by ATC unless absolutely necessary to achieve aircraft separation. It is the pilot's responsibility to determine if there is an ODP published for that airport. If a Part 91 pilot is not given a clearance containing an ODP, SID, or radar vectors and an ODP exists, compliance with such a procedure is the pilot's choice. If he/she chooses not to use the ODP, the pilot must be operating under visual meteorological conditions (VMC), which permits the avoidance of obstacles during the departure.

DEPARTURES FROM TOWER-CONTROLLED AIRPORTS

Departing from a tower-controlled airport is relatively simple in comparison to departing from an airport that isn't tower controlled. Normally you request your IFR clearance through ground control or clearance delivery. Communication frequencies for the various controllers are listed on departure, approach, and airport charts as well as the A/FD. At some airports, you may have the option of receiving a pre-taxi clearance. This program allows you to call ground control or clearance delivery no more than ten minutes prior to beginning taxi operations and receive your IFR clearance. A pre-departure clearance (PDC) program that allows pilots to receive a clearance via data link from a dispatcher is available for Part 121 and 135 operators. A clearance is given to the dispatcher who in turn relays it to the crew, enabling the crew to bypass communication with clearance delivery, thus reducing frequency congestion. Once you have received your clearance, it is your responsibility to comply with the instructions as given and notify ATC if you are unable to comply with the clearance. If you do not understand the clearance, or if you think that you have missed a portion of the clearance, contact ATC immediately for clarification.

DEPARTURES FROM AIRPORTS WITHOUT AN OPERATING CONTROL TOWER

There are hundreds of airports across the U.S. that operate successfully everyday without the benefit of a control tower. While a tower is certainly beneficial when departing IFR, most other departures can be made with few challenges. As usual, you must file your flight plan at least 30 minutes in advance. During your planning phase, investigate the departure airport's method for receiving an instrument clearance. You can contact the Automated Flight Service Station (AFSS) on the ground by telephone and they will request your clearance from ATC. Typically, when a clearance is given in this manner, the clearance includes a void time. You must depart the airport before the clearance void time; if you fail to depart, you must contact ATC by a specified notification time, which is within 30 minutes of the original void time. After the clearance void time, your reserved space within the IFR system is released for other traffic.

There are several other ways to receive a clearance at a non-towered airport. If you can contact the AFSS or ATC on the radio, you can request your departure clearance. However, these frequencies are typically congested and they may not be able to provide you with a clearance via the radio. You also can use a **Remote Communications Outlet (RCO)** to contact an AFSS if one is located nearby. Some airports have licensed UNICOM operators that can also contact ATC on your behalf and in turn relay your clearance from ATC. You are also allowed to depart the airport VFR if conditions permit and contact the controlling authority and request your clearance in the air. As technology improves, new methods for delivery of clearances at non-towered airports are being created.

GROUND COMMUNICATIONS OUTLETS

A new system, called a **Ground Communication Outlet (GCO)**, has been developed in conjunction with the FAA to provide pilots flying in and out of non-towered airports with the capability to contact ATC and AFSS via Very High Frequency (VHF) radio to a telephone connection. This lets pilots obtain an instrument clearance or close a VFR/IFR flight plan. You can use four key clicks on your VHF radio to contact the nearest ATC facility and six key clicks to contact the local AFSS, but it is intended to be used only as a ground operational tool. A GCO is an unstaffed, remote controlled ground-to-ground communication facility that is relatively inexpensive to install and operate. Installations of these types of outlets are scheduled at instrument airports around the country.

GCOs are manufactured by different companies including ARINC and AVTECH, each with different operating characteristics but with the ability to accomplish the same goal. This latest technology has proven to be an incredibly useful tool for communicating with the appropriate authorities when departing IFR from a non-towered airport. The GCO should help relieve the need to use the telephone to call ATC and the need to depart into marginal conditions just to achieve radio contact. GCO information is listed on airport charts and instrument approach charts with other communications frequencies. Signs may also be located on an airport to notify you of the frequency and proper usage.

OBSTACLE AVOIDANCE

Safety is always the foremost thought when planning and executing an IFR flight. As a result, the goal of all departure procedures is to provide a means for departing an airport in the safest manner possible. It is for this reason that airports and their surroundings are reviewed and documented and that procedures are put in place to prevent flight into terrain or other man-made obstacles. To aid in the avoidance of obstacles, takeoff minimums and departure procedures use minimum climb gradients and "see and avoid" techniques.

CLIMB GRADIENTS AND CLIMB RATES

You are required to contact ATC if you are unable to comply with climb gradients and climb rates. It is also expected that you are capable of maintaining the climb gradient outlined in either a standard or non-standard SID or ODP. If you cannot comply with the climb gradient in the SID, you should not accept a clearance for that SID. If you cannot maintain a standard climb gradient or the climb gradient specified in an ODP, you must wait until you can depart under VMC.

Climb gradients are developed as a part of a departure procedure to ensure obstacle protection as outlined in TERPS. Once again, the rate of climb table depicted in Figure 2-18, used in conjunction with the performance specifications in your airplane flight manual (AFM), can help you determine your ability to comply with climb gradients.

SEE AND AVOID TECHNIQUES

Meteorological conditions permitting, you are required to use "see and avoid" techniques to avoid traffic, terrain, and other obstacles. To avoid obstacles during a departure, the takeoff minimums may include a non-standard ceiling and visibility minimum. These are given to pilots so they can depart an airport without being able to meet the established climb gradient. Instead, they must see and avoid obstacles in the departure path. In these situations, ATC provides radar traffic information for radar-identified aircraft outside controlled airspace, workload permitting, and safety alerts to pilots believed to be within an unsafe proximity to obstacles or aircraft.

AREA NAVIGATION DEPARTURES

In the past, area navigation (RNAV) was most commonly associated with the station-mover/phantom waypoint technology developed around ground-based Very High Frequency Omni-directional Range (VOR) stations. RNAV today, however, refers to a variety of navigation systems that provide navigation beyond VOR and NDB. RNAV is a method of navigation which permits aircraft operation on any desired flight path within the coverage of station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these. The term also has become synonymous with the concept of “free flight,” the goal of which is to provide easy, direct, efficient, cost-saving traffic management as a result of the inherent flexibility of RNAV.

In the past, departure procedures were built around existing ground-based technology and were typically designed to accommodate lower traffic volumes. Often, departure and arrival routes use the same navigation aids creating interdependent, capacity diminishing routes. As a part of the evolving RNAV structure, the FAA has developed departure procedures for pilots flying aircraft equipped with some type of RNAV technology. RNAV allows for the creation of new departure routes that are independent of present fixes and navigation aids. RNAV routing is part of the National Airspace Redesign and is expected to reduce complexity and increase efficiency of terminal airspace.

When new RNAV departure procedures are designed with all interests in mind, they require minimal vectoring and communications between pilots and ATC. Usually, each departure procedure includes position, time, and altitude, which increase the ability to predict what the pilot will actually do. All told, RNAV departure procedures have the ability to increase the capacity of terminal airspace by increasing on-time departures, airspace utilization, and improved predictability.

If unable to comply with the requirements of an RNAV or required navigation performance (RNP) procedure, pilots need to advise ATC as soon as possible. For example, ". . .N1234, failure of GPS system, unable RNAV, request amended clearance." Pilots are not authorized to fly a published RNAV or RNP procedure unless it is retrievable by the procedure name from the navigation database and conforms to the charted procedure. Pilots shall not change any database waypoint type from a fly-by to fly-over, or vice versa. No other modification of database waypoints or creation of user-defined waypoints on published RNAV or RNP procedures is permitted, except to change altitude and/or airspeed waypoint constraints to comply with an ATC clearance/instruction, or to insert a waypoint along the published route to assist in complying with an ATC instruction, for example, "Climb via the WILIT departure except cross 30 north of CHUCK at/or above FL 210." This is limited only to systems that allow along track waypoint construction.

Pilots of aircraft utilizing DME/DME for primary navigation updating shall ensure any required DME stations are in service as determined by NOTAM, ATIS, or ATC advisory. No pilot monitoring of an FMS navigation source is required. While operating on RNAV segments, pilots are encouraged to use the flight director in lateral navigation mode. RNAV terminal procedures may be amended by ATC issuing radar vectors and/or clearances direct to a waypoint. Pilots should avoid premature manual deletion of waypoints from their active "legs" page to allow for rejoining procedures. While operating on RNAV segments, pilots operating /R aircraft shall adhere to any flight manual limitation or operating procedure required to maintain the RNP value specified for the procedure.

RNAV DEPARTURE PROCEDURES

There are two types of public RNAV SIDs and graphic ODPs. Type A procedures generally start with a heading or vector from the DER, and have an initial RNAV fix around 15 NM from the departure airport. In addition, these procedures require system performance currently met by GPS, DME/DME, or DME/DME/Inertial Reference Unit (IRU) RNAV systems that satisfy the criteria discussed in AC 90-100, U.S. Terminal and En Route Area Navigation (RNAV) Operations. Type A terminal procedures require that the aircraft's track keeping accuracy remain bounded by ±2 NM for 95 percent of the total flight time. For type A procedure RNAV engagement altitudes, the pilot must be able to engage RNAV equipment no later than 2,000 feet above airport elevation. For Type A RNAV DPs, it is recommended that pilots use a CDI/flight director and/or autopilot in lateral navigation mode.

Type B procedures generally start with an initial RNAV leg near the DER. In addition, these procedures require system performance currently met by GPS or DME/DME/IRU RNAV systems that satisfy the criteria discussed in AC 90-100. Type B procedures require the aircraft's track keeping accuracy remain bounded by ±1 NM for 95 percent of the total flight time. For type B procedures, the pilot must be able to engage RNAV equipment no later than 500 feet above airport elevation. For Type B RNAV DPs, pilots must use a CDI/flight director and/or autopilot in lateral navigation mode. For Type A RNAV DPs and STARs, these procedures are recommended. Other methods providing an equivalent level of performance may also be acceptable. For Type B RNAV

DPs, pilots of aircraft without GPS using DME/DME/IRU must ensure that the aircraft navigation system position is confirmed, within 1,000 feet, at the start point of take-off roll. The use of an automatic or manual runway update is an acceptable means of compliance with this requirement. Other methods providing an equivalent level of performance may also be acceptable.

For procedures requiring GPS and/or aircraft approvals requiring GPS, if the navigation system does not automatically alert the flight crew of a loss of GPS, aircraft operators must develop procedures to verify correct GPS operation. If not equipped with GPS, or for multi-sensor systems with GPS that do not alert upon loss of GPS, aircraft must be capable of navigation system updating using DME/DME or DME/DME/IRU for type A and B procedures. AC 90-100 may be used as operational guidance for RNAV ODPs. Pilots of FMS-equipped aircraft, who are assigned an RNAV DP procedure and subsequently receive a change of runway, transition, or procedure, must verify that the appropriate changes are loaded and available for navigation.

RNAV departure procedures are developed as SIDs and ODPs—both are charted graphically. An RNAV departure is identifiable by the inclusion of the term RNAV in the title of the departure. From an RNP standpoint, RNAV departure routes are designed with a 1 or 2 NM performance standard. This means you as the pilot and your aircraft equipment must be able to maintain the aircraft within 1 NM or 2 NM either side of route centerline. [Figure 2-27]

Additionally, new waypoint symbols are used in conjunction with RNAV charts. There are two types of waypoints currently in use: fly-by (FB) and fly-over (FO). A fly-by waypoint typically is used in a position at which a change in the course of procedure occurs. Charts represent them with four-pointed stars. This type of waypoint is designed to allow you to anticipate and begin your turn prior to reaching the waypoint, thus providing smoother transitions. Conversely, RNAV charts show a fly-over waypoint as a four-pointed star enclosed in a circle. This type of waypoint is used to denote a missed approach point, a missed approach holding point, or other specific points in space that must be flown over. [Figure 2-28 on page 2-30]

RNAV departure procedures are being developed at a rapid pace to provide RNAV capabilities at all airports. With every chart revision cycle, new RNAV departures are being added for small and large airports. These departures are flown in the same manner as traditional navigation-based departures; you are provided headings, altitudes, navigation waypoint, and departure descriptions. RNAV SIDs are found in the TPP with traditional departure procedures. On the plan view of this procedure, in the lower left corner of the chart, the previous aircraft equipment suffix code and equipment notes have been replaced with note 3, the new type code, Type B RNAV departure procedure. Additionally, ATC has the aircraft equipment suffix code on file from the flight plan. [Figure 2-29 on page 2-31]

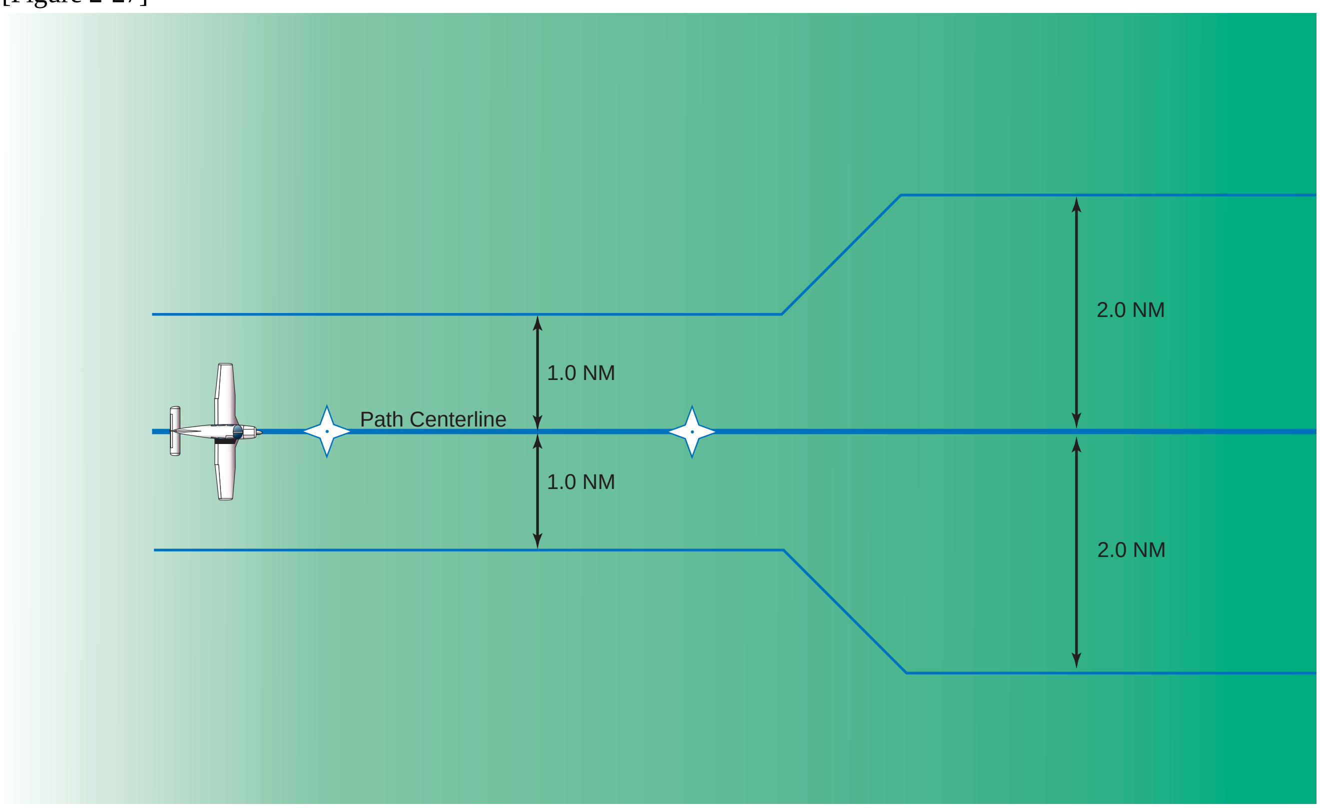


Figure 2-27. RNP Departure Levels.

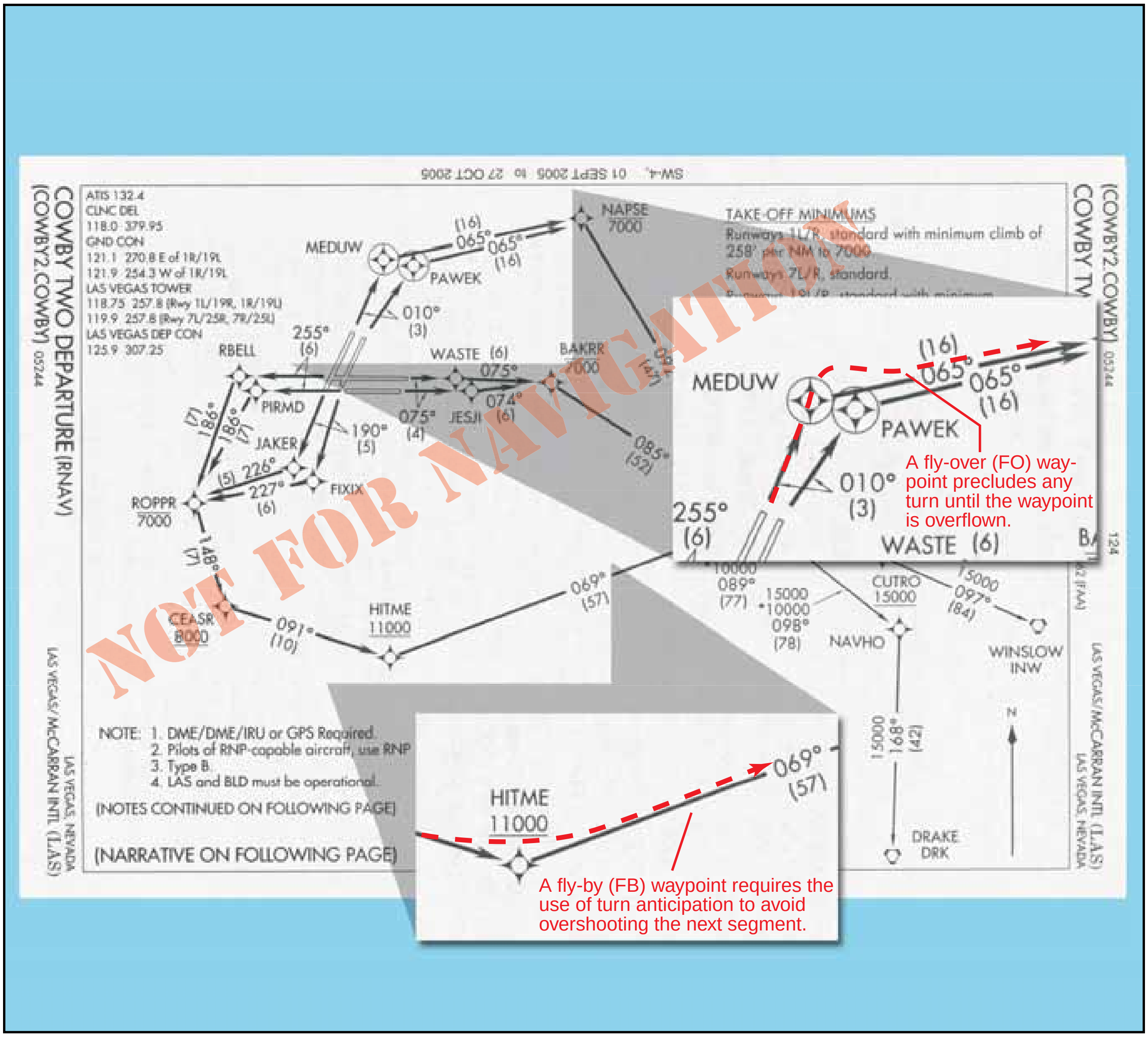


Figure 2-28. Fly-Over and Fly-By Waypoints.

RNAV ODPs are always charted graphically, and like other ODPs, a note in the Takeoff Minimums and IFR Obstacle Departure Procedures section refers you to the graphic ODP chart contained in the main body of the TPP. [Figure 2-30 on page 2-32]

There are specific requirements, however, that must be met before using RNAV procedures. Every RNAV departure chart lists general notes and may include specific equipment and performance requirements, as well as the type of RNAV departure procedure in the chart plan view. New aircraft equipment suffix codes are used to denote capabilities for advanced RNAV navigation, for flight plan filing purposes. [Figure 2-31 on page 2-33]

The chart notes may also include operational information for certain types of equipment, systems, and performance requirements, in addition to the type of RNAV departure procedure. DME/DME navigation system updating may require specific DME facilities to meet performance standards. Based on DME availability evaluations at the time of publication, current DME coverage is not sufficient to support DME/DME RNAV operations everywhere without IRU augmentation or use of GPS. [Figure 2-32 on page 2-33]

PILOT RESPONSIBILITY FOR USE OF RNAV DEPARTURES

RNAV usage brings with it multitudes of complications as it is being implemented. It takes time to transition, to disseminate information, and to educate current and potential users. As a current pilot using the NAS, you need to have a clear understanding of the aircraft equipment requirements for operating in a given RNP environment. You must understand the type of navigation system installed in your aircraft, and furthermore, you must know how your system operates to ensure that you can comply with all RNAV requirements. Operational information should be included in your AFM or its supplements. Additional information concerning how to use your

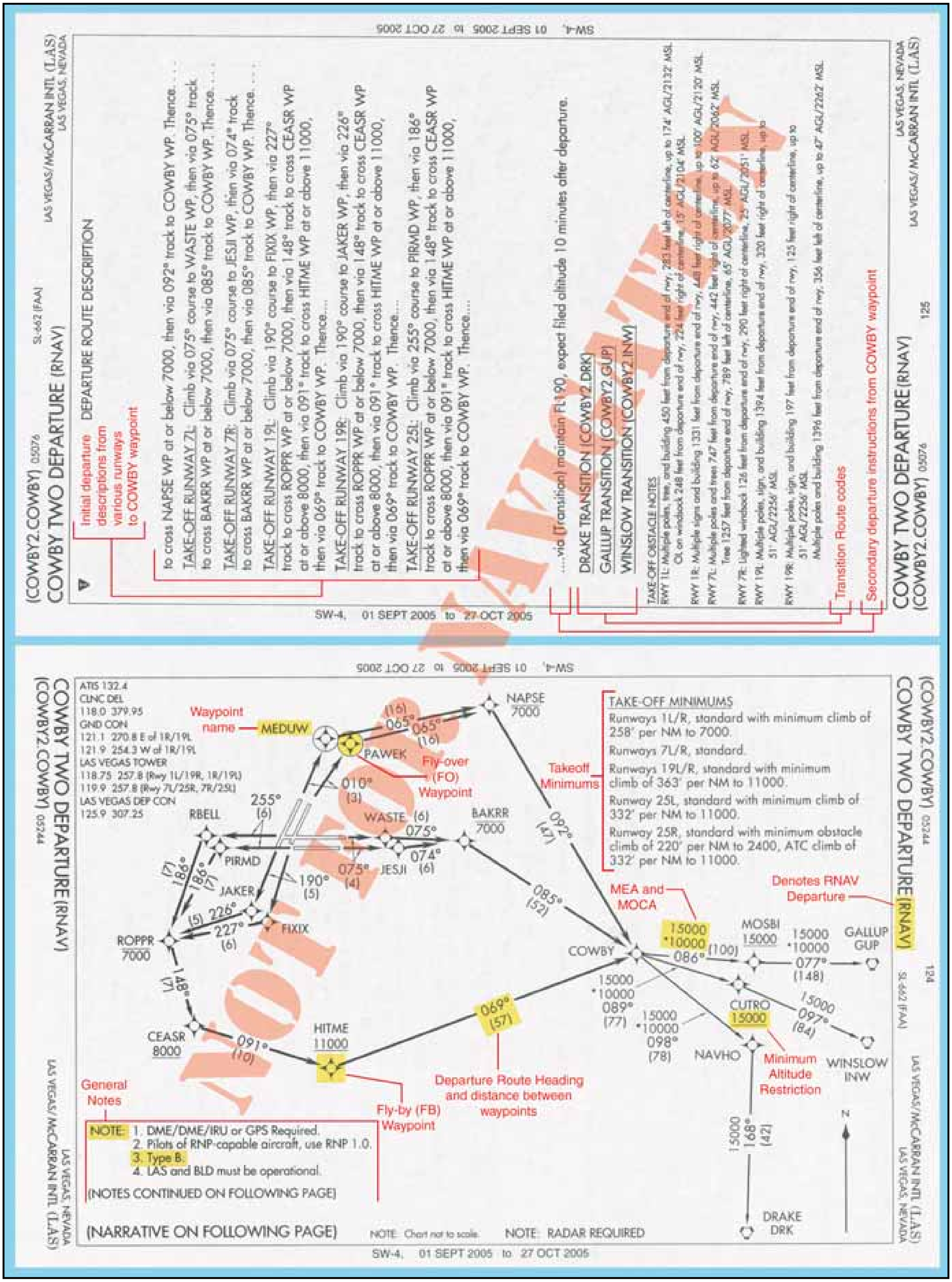


Figure 2-29. The COWBY TWO Departure, Las Vegas, Nevada, is an Example of an RNAV SID.

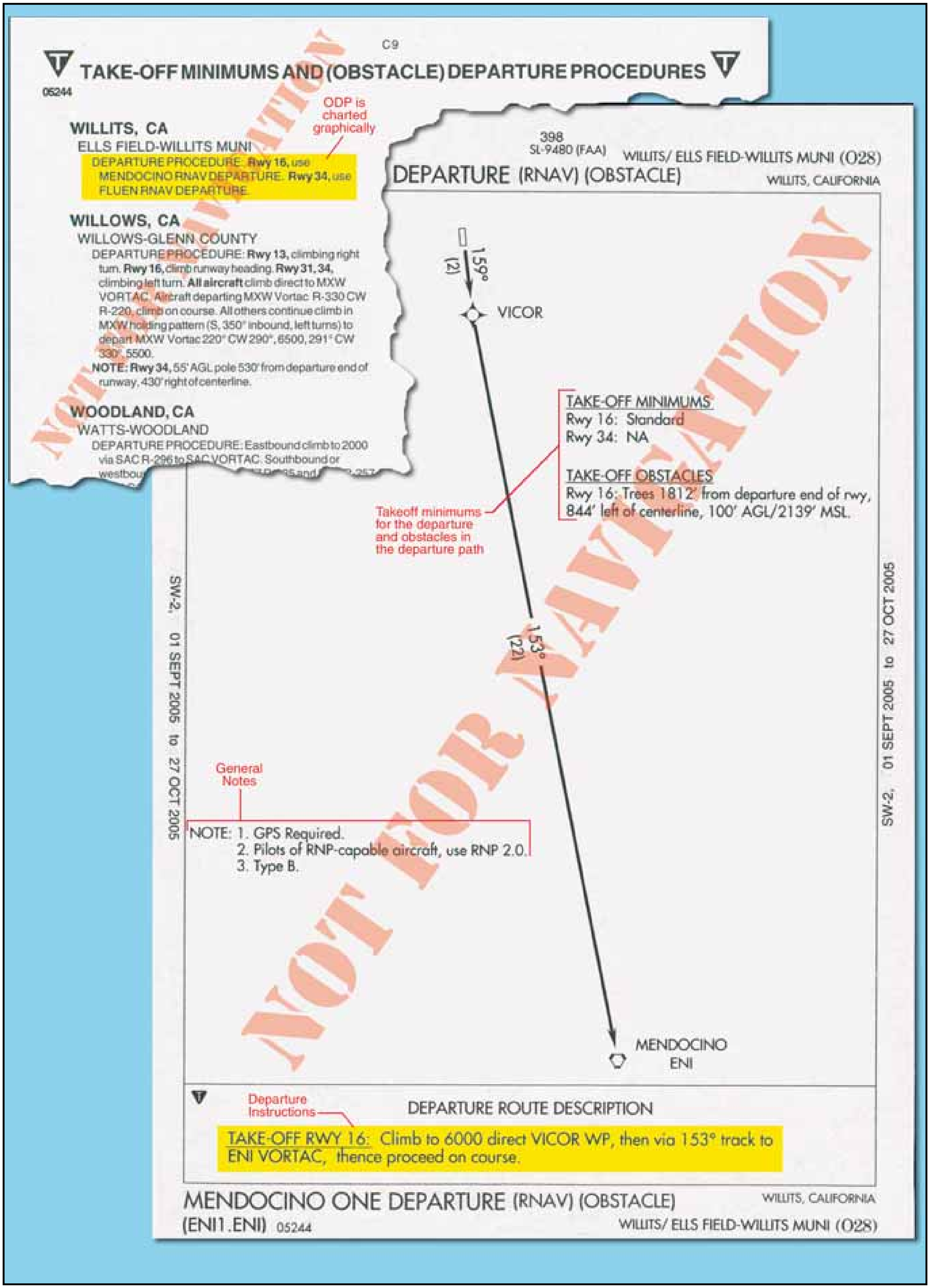


Figure 2-30. MENDOCINO ONE Departure, Willits, California, is an Example of an RNAV ODP.

RNAV Equipment Codes

ADVANCED RNAV WITH TRANSPONDER AND MODE C (If an aircraft is unable to operate with a transponder and/or Mode C, it will revert to the appropriate code listed above under Area Navigation.)

/E	**FMS with DME/DME and IRU position updating**
/F	**FMS with DME/DME position updating**
/G	**Global Navigation Satellite System (GNSS), including GPS or WAAS, with en route and terminal capability.**
/R	**RNP. The aircraft meets the RNP type prescribed for the route segment(s), route(s) and/or area concerned.**

Reduced Vertical Separation Minimum (RVSM). Prior to conducting RVSM operations within the U.S., the operator must obtain authorization from the FAA or from the responsible authority, as appropriate.

/J	**/E with RVSM**
/K	**/F with RVSM**
/L	**/G with RVSM**
/Q	**/R with RVSM**
/W	**RVSM**

Figure 2-31. RNAV Equipment Codes.

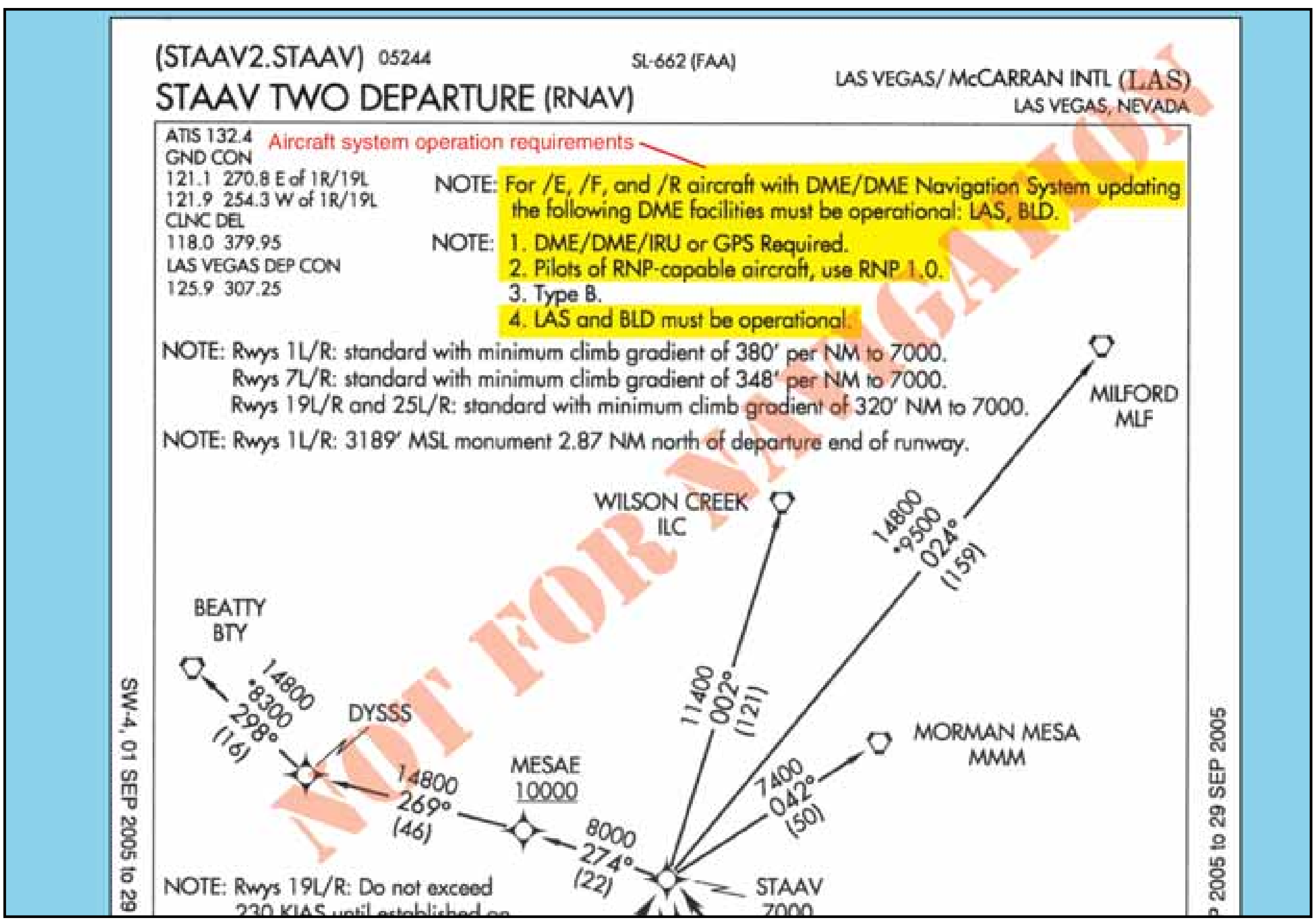


Figure 2-32. Operational Requirements for RNAV.

equipment to its fullest capacity, including "how to" training may be gathered from your avionics manufacturer. If you are in doubt about the operation of your avionics system and its ability to comply with RNAV requirements, contact the FAA directly through your local Flight Standards District Office (FSDO). In-depth information regarding navigation databases is included in Appendix A—Airborne Navigation Databases.

RADAR DEPARTURE

A radar departure is another option for departing an airport on an IFR flight. You might receive a radar departure if the airport does not have an established departure procedure, if you are unable to comply with a departure procedure, or if you request "No SIDs" as a part of your flight plan. Expect ATC to issue an initial departure heading if you are being radar vectored after takeoff, however, do not expect to be given a purpose for the specific vector heading. Rest assured that the controller knows your flight route and will vector you into position. By nature of the departure type, once you are issued your clearance, the responsibility for coordination of your flight rests with ATC, including the tower controller and, after handoff, the departure controller who will remain with you until you are released on course and allowed to "resume own navigation."

For all practical purposes, a radar departure is the easiest type of departure to use. It is also a good alternative to a published departure procedure, particularly when none of the available departure procedures are conducive to your flight route. However, it is advisable to always maintain a detailed awareness of your location as you are being radar vectored by ATC. If for some reason radar contact is lost, you will be asked to provide position reports in order for ATC to monitor your flight progress. Also, ATC may release you to "resume own navigation" after vectoring you off course momentarily for a variety of reasons including weather or traffic.

Upon initial contact, state your aircraft or flight number, the altitude you are climbing through, and the altitude to which you are climbing. The controller will verify that your reported altitude matches that emitted by your transponder. If your altitude does not match, or if you do not have Mode C capabilities, you will be continually required to report your position and altitude for ATC.

The controller is not required to provide terrain and obstacle clearance just because ATC has radar contact with your aircraft. It remains your responsibility until the controller begins to provide navigational guidance in the form of radar vectors. Once radar vectors are given, you are expected to promptly comply with headings and altitudes as assigned. Question any assigned heading if you believe it to be incorrect or if it would cause a violation of a regulation, then advise ATC immediately and obtain a revised clearance.

DIVERSE VECTOR AREA

ATC may establish a minimum vectoring altitude (MVA) around certain airports. This altitude is based on terrain and obstruction clearance and provides controllers with minimum altitudes to vector aircraft in and around a particular location. However, it may be necessary to vector aircraft below this altitude to assist in the efficient flow of departing traffic. For this reason, an airport may have established a **Diverse Vector Area (DVA)**. DVA design requirements are outlined in TERPS and allow for the vectoring of aircraft off the departure end of the runway below the MVA. The presence of a DVA is not published for pilots in any form, so the use of a textual ODP in a DVA environment could result in a misunderstanding between pilots and controllers. ATC instructions take precedence over an ODP. Most DVAs exist only at the busiest airports. [Figure 2-33]

VFR DEPARTURE

There may be times when you need to fly an IFR flight plan due to the weather you will encounter at a later time (or if you simply wish to fly IFR to remain proficient), but the weather outside is clearly VFR. It may be that you can depart VFR, but you need to get an IFR clearance shortly after departing the airport. A VFR departure can be used as a tool that allows you to get off the ground without having to wait for a time slot in the IFR system, however, departing VFR with the intent of receiving an IFR clearance in the air can also present serious hazards worth considering.

A VFR departure dramatically changes the takeoff responsibilities for you and for ATC. Upon receiving clearance for a VFR departure, you are cleared to depart; however, you must maintain separation between yourself and other traffic. You are also responsible for maintaining terrain and obstruction clearance as well as remaining in VFR weather conditions. You cannot fly in IMC without first receiving your IFR clearance. Likewise, a VFR departure relieves ATC of these duties, and basically requires them only to provide you with safety alerts as workload permits.

Maintain VFR until you have obtained your IFR clearance and have ATC approval to proceed on course in accordance with your clearance. If you accept this clearance and are below the minimum IFR altitude for operations in the area, you accept responsibility for terrain/obstruction clearance until you reach that altitude.

NOISE ABATEMENT PROCEDURES

As the aviation industry continues to grow and air traffic increases, so does the population of people and businesses around airports. As a result, noise abatement procedures have become commonplace at most of the nation's airports. Part 150 specifies the responsibilities of the FAA to investigate the recommendations of the airport operator in a noise compatibility program and approve or disapprove the noise abatement suggestions. This is a crucial step in ensuring that the airport is not unduly inhibited by noise requirements and that air traffic workload and efficiency are not significantly impacted, all while considering the noise problems addressed by the surrounding community.

While most departure procedures are designed for obstacle clearance and workload reduction, there are some SIDs that are developed solely to comply with noise abatement requirements. Portland International Jetport is an example of an airport where a SID was created strictly for noise abatement purposes as noted in the departure procedure. [Figure 2-34 on page 2-36] Typically, noise restrictions are incorporated into the main body of the SID. These types of restrictions require higher departure altitudes, larger climb gradients, reduced airspeeds, and turns to avoid specific areas.

Noise restrictions may also be evident during a radar departure. ATC may require you to turn away from your intended course or vector you around a particular area. While these restrictions may seem burdensome, it is important to remember that it is your duty to comply with written and spoken requests from ATC.

Additionally, when required, departure instructions specify the actual heading to be flown after takeoff, as is the case in figure 2-34 under the departure route description, "Climb via heading 112 degrees..." Some existing procedures specify, "Climb runway heading." Over time, both of these departure instructions will be updated to read, "Climb heading 112 degrees...." **Runway Heading** is the magnetic direction that corresponds with the runway centerline extended (charted on the AIRPORT DIAGRAM), not the numbers painted on the runway. Pilots cleared to "fly or maintain runway heading" are expected to fly or maintain the published heading that corresponds with the extended centerline of the departure runway (until otherwise instructed by ATC), and are not to apply drift correction; e.g. RWY 11, actual magnetic heading of the runway centerline 112.2 degrees, "fly heading 112 degrees". In the event of parallel departures this prevents a loss of separation caused by only one aircraft applying a wind drift.

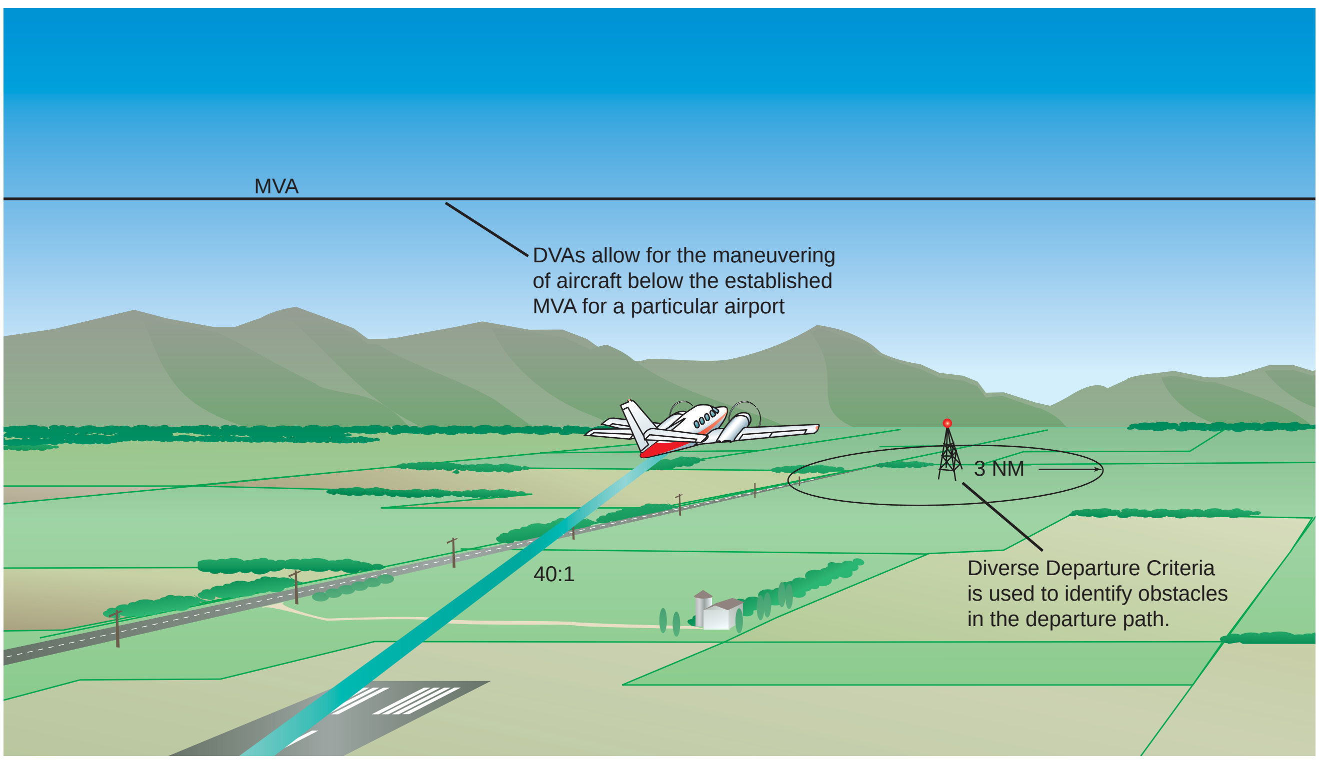


Figure 2-33. Diverse Vector Area Establishment Criteria.

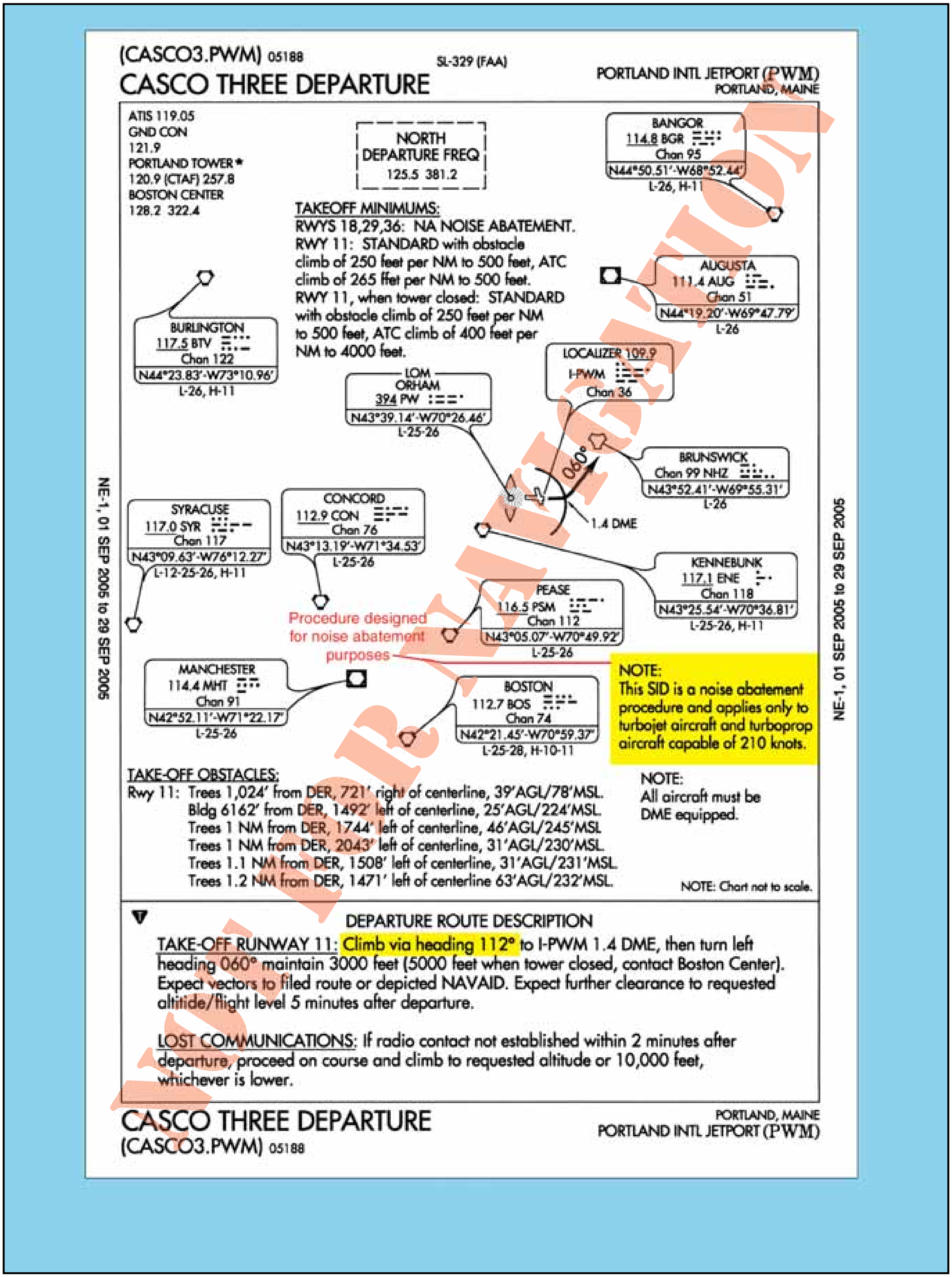


Figure 2-34. Noise Abatement SIDs.