AIP

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UNITED STATES OF AMERICA

NINETEENTH EDITION DATED 15 MARCH 2007

AMENDMENT 1

30 AUGUST 2007

CONSULT NOTAM FOR LATEST INFORMATION

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

AIP Amendment 1

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GEN 0.5 List of Hand Amendments to the AIP - Not applicable

FIG GEN 3.5-1

Weather Elements Conversion Tables

TIME

STANDARD TO UTC

Eastern + 5 hr = UTC
Central + 6 hr = UTC
Mountain + 7 hr = UTC
Pacific + 8 hr = UTC
Alaskan + 9 hr = UTC
Hawaii & Aleutian Islands + 10 hr = UTC

Subtract one hour for Daylight Time

WINDSPEED

MPH	KNOTS
1-2	1-2
3-8	3-7
9-14	8-12
15-20	13-17
21-25	18-22
26-31	23-27
32-37	28-32
38-43	33-37
44-49	38-42
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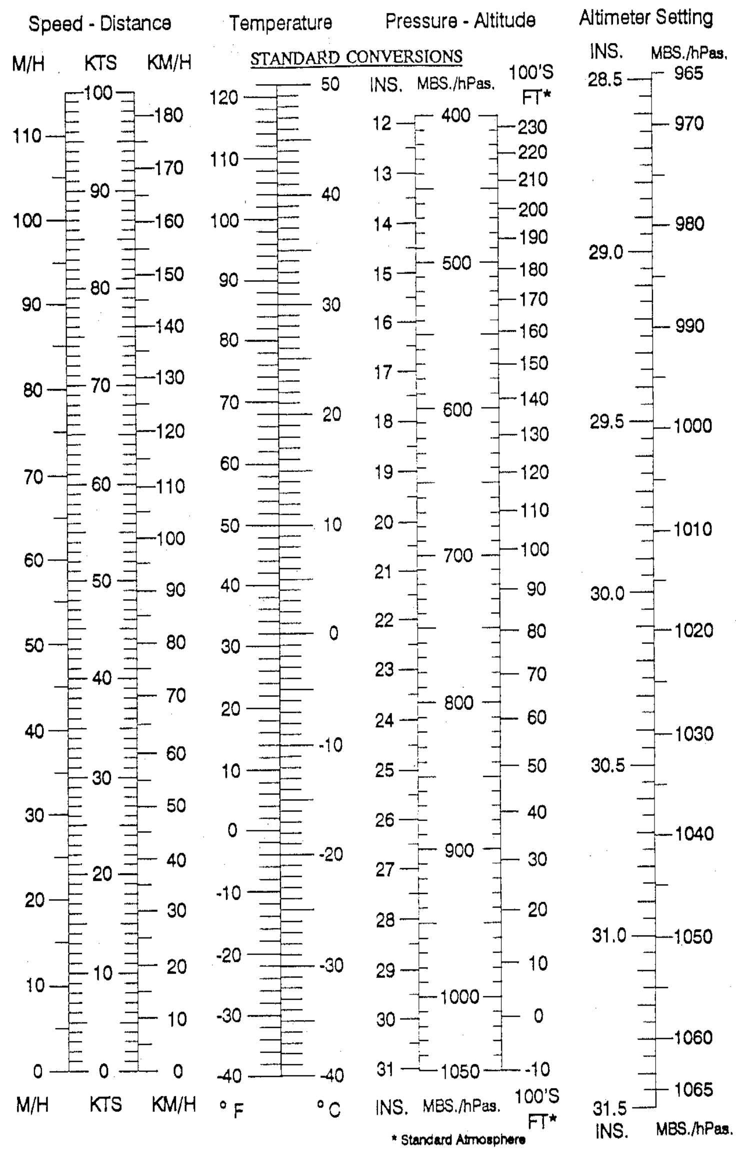
55-60	48-52
61-66	53-57
67-71	58-62
72-77	63-57
78-83	68-72
84-89	73-77
119-123	103-107

Knots x 1.15 = Miles Per Hour
Miles Per Hour x 0.869 = Knots



3.5 FAA Weather Services

3.5.1 The FAA maintains a nationwide network of AFSSs/FSSs to serve the weather needs of pilots. In addition, NWS meteorologists are assigned to all Air Route Traffic Control Centers (ARTCCs) as part the Center Weather Service Unit (CWSU). They provide advisory service and short-term forecasts (nowcasts) to support the needs of the FAA and other users of the national airspace system.

3.5.2 The primary source of preflight weather briefings is an individual briefing obtained from a briefer at the AFSS/FSS. These briefings, which are tailored to your specific flight, are available 24 hours a day through the use of toll free lines (INWATS). Numbers for these services can be found in the Airport/Facility Directory under the "FAA and NWS Telephone Numbers" section. They are also listed in the U.S. Government section of your local telephone directory under Department of Transportation, Federal Aviation Administration or Department of Commerce, National Weather Service. See paragraph 3.7, Preflight Briefing, for the types of preflight briefings available and the types of information contained in each.

3.5.3 Other Sources of Weather Information

3.5.3.1 Telephone Information Briefing Service (TIBS) (AFSS); and in Alaska, Transcribed Weather Broadcast (TWEB) locations, and telephone access to the TWEB (TEL-TWEB) provide continuously updated recorded weather information for short or local flights. Separate paragraphs in this section give additional information regarding these services.

3.5.3.2 Weather and aeronautical information is also available from numerous private industry sources on an individual or contract pay basis. Information on how to obtain this service should be available from local pilot organizations.

3.5.3.3 The Direct User Access System (DUATS) can be accessed by U.S. certified pilots with a current medical certificate toll-free via personal computer. Pilots can receive alpha-numeric preflight weather data and file domestic VFR and IFR flight plans. The following are the contract DUATS vendors:

GTE Information Federal Systems
15000 Conference Center Drive
Chantilly, VA 22021-3808
Computer Modem Access Number:
For filing flight plans and obtaining weather briefings: 1-800-767-9989
For customer service: 1-800-345-3828

Data Transformation Corporation
108-D Greentree Road
Turnersville, NJ 08012
Computer Modem Access Number:
For filing flight plans and obtaining weather briefings: 1-800-245-3828
For customer service: 1-800-243-3828

3.5.4 Inflight weather information is available from any AFSS/FSS within radio range. The common frequency for all AFSSs is 122.2. Discrete frequencies for individual stations are listed in the Airport/Facility Directory. See paragraph 6 for information on broadcasts. En Route Flight Advisory Service (EFAS) is provided to serve the non-routine weather needs of pilots in flight. See paragraph 3.8, En Route Flight Advisory Service (EFAS), for details on this service.

3.6 Use of Aviation Weather Products

3.6.1 Air carriers and operators certificated under the provisions of 14 CFR Part 119 are required to use the aeronautical weather information systems defined in the Operations Specifications issued to that certificate holder by the FAA. These systems may utilize basic FAA/National Weather Service (NWS) weather services, contractor- or operator-proprietary weather services and/or Enhanced Weather Information System (EWINS) when approved in the Operations Specifications. As an integral part of this system approval, the procedures for collecting, producing and disseminating aeronautical weather information, as well as the crew member and dispatcher training to support the use of system weather products, must be accepted or approved.

3.6.2 Operators not certificated under the provisions of 14 CFR Part 119 are encouraged to use FAA/NWS products through Flight Service Stations, Direct User Access Terminal System (DUATS), and/or Flight Information Services Data Link (FISDL).

3.6.3 The suite of available aviation weather product types is expanding, with the development of new sensor systems, algorithms and forecast models. The FAA and NWS, supported by the National Center for Atmospheric Research and the Forecast Systems Laboratory, develop and implement new aviation weather product types through a comprehensive process known as the Aviation Weather Technology Transfer process. This process ensures that user needs and technical readiness requirements are met before experimental products mature to operational application.

3.6.4 The FAA, in conjunction with the NWS, established the Aviation Weather Technology Transfer (AWTT) Board so that newly developed aviation weather products meet regulatory requirements and enhance safety. The AWTT is charged with managing and accelerating the transfer of these products into operational use. Members of the AWTT Board include mid-level managers from the FAA and NWS who are responsible for various aspects of the development and use of aviation weather products (e.g., aviation weather R & D, transition of weather products from R & D to operational use, etc.).

3.6.5 The AWTT is a management-review and decision-making process that applies criteria to weather products at various development stages (decision stages, i.e., "D-stages"). The D-stages are composed of the following:

3.6.5.1 (D1) Sponsorship of user needs.

3.6.5.2 (D2) R & D and controlled testing.

3.6.5.3 (D3) Experimental application.

3.6.5.4 (D4) Operational application.

3.6.6 Weather products maturing into the D3 experimental stage of the AWTT process are often made available to the public on the Aviation Weather Center's Experimental Aviation Digital Data Service (ADDS) website at: **http://weather.aero/**. The intent is to allow public access to this information in order to obtain feedback for product development and improvement. However, it is important to note that weather products displayed on this site are experimental, and although they may appear to be fully operational products, they are subject to change without notification and may *not* be used for any flight related decisions. At the D4 stage, the FAA approves a weather product for operational use by end users (with restrictions, if necessary), and the product is made available to the public via long-line circuit, satellite, and/or other means of communication.

3.6.7 Pilots and operators should be aware that weather services provided by entities other than FAA, NWS or their contractors (such as the DUATS and FISDL providers) may not meet FAA/NWS quality control standards. Hence, operators and pilots contemplating using such services should request and/or review an appropriate description of services and provider disclosure. This should include, but is not limited to, the type of weather product (e.g., current weather or forecast weather), the currency of the product (i.e., product issue and valid times), and the relevance of the product. Pilots and operators should be cautious when using unfamiliar products, or products not supported by FAA/NWS technical specifications.

NOTE-
When in doubt, consult with a FAA Flight Service Station Specialist.

3.6.8 In addition, pilots and operators should be aware there are weather services and products available from government organizations beyond the scope of the AWTT process mentioned earlier in this section. For example, governmental agencies such as the NWS, the Aviation Weather Center (AWC), and the National Center for Atmospheric Research (NCAR) display weather "model data" and "experimental" products which require training and/or expertise to properly interpret and use. These products are developmental prototypes that are subject to ongoing research and can change without notice. Therefore, some data on display by government organizations, or government data on display by independent organizations may be unsuitable for flight planning purposes. Operators and pilots contemplating using such services should request and/or review an appropriate description of services and provider disclosure. This should include, but is not limited to, the type of weather product (e.g., current weather or forecast weather), the currency of the product (i.e., product issue and valid times), and the relevance of the product. Pilots and operators should be cautious when using unfamiliar weather products.

NOTE-
When in doubt, consult with a FAA Flight Service Station Specialist.

3.6.9 The development of new weather products coupled with increased access to these products via the public Internet, created confusion within the aviation community regarding the relationship between regulatory requirements and new weather products. Consequently, FAA differentiates between those weather products that may be utilized to comply with regulatory requirements and those that may only be used to improve situational awareness. To clarify the proper use of aviation weather products to meet the requirements of 14 CFR, FAA defines weather products as follows:

3.6.9.1 Primary Weather Product. An aviation weather product that meets all the regulatory requirements and safety needs for use in making flight related, aviation weather decisions.

3.6.9.2 Supplementary Weather Product. An aviation weather product that may be used for enhanced situational awareness. If utilized, a supplementary weather product must only be used in conjunction with one or more primary weather product. In addition, the FAA may further restrict the use of supplementary aviation weather products through limitations described in the product label.

NOTE-
An aviation weather product produced by the Federal Government and managed by the AWTT is classified a primary weather product unless designated a supplementary weather product by the FAA.

3.6.10 In developing the definitions of primary and supplementary weather products, it is not the intent of FAA to change or increase the regulatory burden on the user. Rather, the definitions are meant to eliminate confusion by differentiating between weather products that may be utilized to meet regulatory requirements and other weather products that may only be used to improve situational awareness.

3.6.11 All flight-related, aviation weather decisions must be based on primary weather products. Supplementary weather products augment the primary products by providing additional weather information but may not be used as stand-alone weather products to meet aviation weather regulatory requirements or without the relevant primary products. When discrepancies exist between primary and supplementary weather products describing the same weather phenomena, users must base flight-related decisions on the primary weather product. Furthermore, multiple primary products may be necessary to meet all aviation weather regulatory requirements.

3.6.12 The development of enhanced communications capabilities, most notably the Internet, has allowed pilots access to an ever-increasing range of weather service providers and proprietary products. The FAA has identified three distinct types of weather information available to pilots and operators.

3.6.12.1 Observations. Raw weather data collected by some type of sensor suite including surface and airborne observations, radar, lightning, satellite imagery, and profilers.

3.6.12.2 Analysis. Enhanced depiction and/or interpretation of observed weather data.

3.6.12.3 Forecasts. Predictions of the development and/or movement of weather phenomena based on meteorological observations and various mathematical models.

3.6.13 Not all sources of aviation weather information are able to provide all three types of weather information. The FAA has determined that operators and pilots may utilize the following approved sources of aviation weather information:

3.6.13.1 Federal Government. The FAA and NWS collect raw weather data, analyze the observations, and produce forecasts. The FAA and NWS disseminate meteorological observations, analyses, and forecasts through a variety of systems. In addition, the Federal Government is the only approval authority for sources of weather observations; for example, contract towers and airport operators may be approved by the Federal Government to provide weather observations.

3.6.13.2 Enhanced Weather Information System (EWINS). An EWINS is an FAA approved, proprietary system for tracking, evaluating, reporting, and forecasting the presence or lack of adverse weather phenomena. An EWINS is authorized to produce flight movement forecasts, adverse weather phenomena forecasts, and other meteorological advisories. For more detailed information regarding EWINS, see the Aviation Weather Services Advisory Circular 00-45 and the Air Transportation Operations Inspector's Handbook 8400.10.

3.6.13.3 Commercial Weather Information Providers. In general, commercial providers produce proprietary weather products based on NWS/FAA products with formatting and layout modifications but no material changes to the weather information itself. This is also referred to as "repackaging." In addition, commercial providers may produce analyses, forecasts, and other proprietary weather products that substantially alter the information contained in government-produced products. However, those proprietary weather products that substantially alter government-produced weather products or information, may only be approved for use by 14 CFR Part 121 and Part 135 certificate holders if the commercial provider is EWINS qualified.

NOTE-
Commercial weather information providers contracted by FAA to provide weather observations, analyses, and forecasts (e.g., contract towers) are included in the Federal Government category of approved sources by virtue of maintaining required technical and quality assurance standards under Federal Government oversight.

3.6.14 As a point of clarification, Advisory Circular 00-62, Internet Communications of Aviation Weather and NOTAMS, describes the process for a weather information provider to become a Qualified Internet Communications Provider (QICP) and only applies to 14 CFR Part 121 and Part 135 certificate holders. Therefore, pilots conducting operations under 14 CFR Part 91 may access weather products via the public Internet.

3.7 Preflight Briefing

3.7.1 Flight Service Stations are the primary source of obtaining preflight briefings and inflight weather information. Flight Service Specialists are qualified and certificated by the NWS as Pilot Weather Briefers. They are not authorized to make original forecasts, but are authorized to translate and interpret available forecasts (TAF) and reports (METAR/SPECI) directly into terms describing the weather conditions which you can expect along your flight route and at your destination. Available aviation weather reports and forecasts are displayed at each AFSS/FSS. Some of the larger AFSSs/FSSs provide a separate display for pilot use. Pilots should feel free to use these self-briefing displays where available, or to ask for a briefing or for assistance from the specialist on duty. Three basic types of preflight briefings are available: Standard Briefing, Abbreviated Briefing, and Outlook Briefing. You should specify to the briefer the type of briefing you want, along with appropriate background information. This will enable the briefer to tailor the information to your intended flight. The following paragraphs describe the types of briefings available and the information provided in each.

3.7.2 Standard Briefing. You should request a Standard Briefing any time you are planning a flight and you have not received a previous briefing or have not received preliminary information through mass dissemination media; e.g., TIBS, TWEB (Alaska only), etc. International data may be inaccurate or incomplete. If you are planning a flight outside of U.S. controlled airspace, the briefer will advise you to check data as soon as practical after entering foreign airspace, unless you advise that you have the international cautionary advisory. The briefer will automatically provide the following information in the sequence listed, except as noted, when it is applicable to your proposed flight.

3.7.2.1 Adverse Conditions. Significant meteorological and aeronautical information that might influence the pilot to alter the proposed flight; e.g., hazardous weather conditions, runway closures, NAVAID outages.

3.7.2.2 VFR Flight Not Recommended. When VFR flight is proposed and sky conditions or visibilities are present or forecast, surface or aloft, that in the briefer's judgment would make flight under visual flight rules doubtful, the briefer will describe the conditions, affected locations, and use the phrase "VFR flight not recommended." This recommendation is advisory in nature. The final decision as to whether the flight can be conducted safely rests solely with the pilot.

3.7.2.3 Synopsis. A brief statement describing the type, location, and movement of weather systems and/or air masses which might affect the proposed flight.

NOTE-
The first 3 elements of a standard briefing may be combined in any order when the briefer believes it will help to describe conditions more clearly.

3.7.2.4 Current Conditions. Reported weather conditions applicable to the flight will be summarized from all available sources; e.g., METARs, PIREPs, RAREPs. This element may be omitted if the proposed time of departure is beyond two hours, unless the information is specifically requested by the pilot.

3.7.2.5 En Route Forecast. En route conditions forecast for the proposed route are summarized in logical order; i.e., departure-climbout, en route, and descent.

3.7.2.6 Destination Forecast. The destination forecast (TAF) for the planned estimated time of arrival (ETA). Any significant changes within 1 hour before and after the planned arrival are included.

3.7.2.7 Winds Aloft. Forecast winds aloft for the proposed route will be provided using degrees of the compass. The briefer will interpolate wind directions and speeds between levels and stations as necessary to provide expected conditions at planned altitudes.

3.7.2.8 Notices to Airmen (NOTAMs)

a) Available NOTAM (D) information pertinent to the proposed flight.

b) Available NOTAM (L) information pertinent to the departure and/or local area, and pertinent FDC NOTAMs.

c) FSS briefers do not provide FDC NOTAM information for special instrument approach procedures unless specifically asked. Pilots authorized by the FAA to use special instrument approach procedures must specifically request FDC NOTAM information for these procedures.

NOTE-
NOTAM information may be combined with current conditions when the briefer believes it is logical to do so.

NOTE-
NOTAM (D) information and Flight Data Center NOTAMs which have been published in the Notices to Airmen Publication are not included in pilot briefings unless a review of this publication is specifically requested by the pilot. For complete flight information you are urged to review both the Notices to Airmen Publication and the Airport/Facility Directory in addition to obtaining a briefing.

3.7.2.9 Air Traffic Control (ATC) Delays. Any known ATC delays and flow control advisories which might affect the proposed flight.

3.7.2.10 Pilots may obtain the following from AFSS/FSS briefers upon request:

a) Information on Special Use Airspace (SUA), SUA related airspace and Military Training Routes (MTRs) activity within the flight plan area and a 100 NM extension around the flight plan area.

NOTE-
1. *SUA and related airspace includes the following types of airspace: Alert Area, Military Operations Area (MOA), Prohibited Area, Restricted Area, Refueling Anchor, Warning Area and Air Traffic Control Assigned Airspace (ATCAA). MTR data includes the following types of airspace: IFR Military Training Route (IR), VFR Military Training Route (VR), Slow Training Route (SR) and Aerial Refueling Track (AR).*

2. *Pilots are encouraged to request updated information from ATC facilities while in flight.*

b) A review of the Notices to Airmen publication for pertinent NOTAMs and Special Notices.

c) Approximate density altitude data.

d) Information regarding such items as air traffic services and rules, customs/immigration procedures, ADIZ rules, and search and rescue.

e) LORAN-C NOTAMs, available military NOTAMs, runway friction measurement value NOTAMs.

f) GPS RAIM availability for 1 hour before to 1 hour after ETA, or a time specified by the pilot.

g) Other assistance as required.

3.7.3 Abbreviated Briefing. Request an Abbreviated Briefing when you need information to supplement mass disseminated data, to update a previous briefing, or when you need only one or two specific items. Provide the briefer with appropriate background information, the time you received the previous information, and/or the specific items needed. You should indicate the source of the information already received so that the briefer can limit the briefing to the information that you have not received, and/or appreciable changes in meteorological/aeronautical conditions since your previous briefing. To the extent possible, the briefer will provide the information in the sequence shown for a Standard Briefing. If you request only one or two specific items, the briefer will advise you if adverse conditions are present or forecast. Adverse conditions contain both meteorological and aeronautical information. Details on these conditions will be provided at your request.

3.7.4 Outlook Briefing. You should request an Outlook Briefing whenever your proposed time of departure is 6 or more hours from the time of the briefing. The briefer will provide available forecast data applicable to the proposed flight. This type of briefing is provided for planning purposes only. You should obtain a Standard or Abbreviated Briefing prior to departure in order to obtain such items as adverse conditions, current conditions, updated forecasts, winds aloft, and NOTAMs.

3.7.5 Inflight Briefing. You are encouraged to obtain your preflight briefing by telephone or in person before departure. In those cases where you need to obtain a preflight briefing or an update to a previous briefing by radio, you should contact the nearest AFSS/FSS to obtain this information. After communications have been established, advise the specialist of the type briefing you require and provide appropriate background information. You will be provided information as specified in the above paragraphs, depending upon the type briefing requested. In addition, the specialist will recommend shifting to the flight watch frequency when conditions along the intended route indicate that it would be advantageous for you to do so.

3.7.6 Following any briefing, feel free to ask for any information that you or the briefer may have missed. It helps to save your questions until the briefing has been completed. This way the briefer is able to present the information in a logical sequence and lessens the chance of important items being overlooked.

3.8 En Route Flight Advisory Service (EFAS)

3.8.1 EFAS is a service specifically designed to provide en route aircraft with timely and meaningful weather advisories pertinent to the type of flight intended, route of flight, and altitude. In conjunction with this service, EFAS is also a central collection and distribution point for pilot-reported weather information. EFAS is provided by specially trained specialists in selected AFSSs/FSSs controlling multiple remote communications outlets covering a large geographical area and is normally available throughout the conterminous U.S. and Puerto Rico from 6 a.m. to 10 p.m. EFAS provides communications capabilities for aircraft flying at 5,000 feet AGL to 17,500 feet MSL on a common frequency of 122.0 MHz. Discrete EFAS frequencies have been established to ensure communications coverage from 18,000 through 45,000 MSL serving in each specific ARTCC area. These discrete frequencies may be used below 18,000 feet when coverage permits reliable communication.

NOTE-
When an EFAS outlet is located in a time zone different from the zone in which the flight watch control station is located, the availability of service may be plus or minus 1 hour from the normal operating hours.

3.8.2 In some regions of the contiguous U.S., especially those that are mountainous, it is necessary to be above 5000 feet AGL in order to be at an altitude where the EFAS frequency, 122.0 MHz, is available. Pilots should take this into account when flight planning. Other AFSS communication frequencies may be available at lower altitudes. See FIG GEN 3.5-2.

3.8.3 Contact flight watch by using the name of the ARTCC facility serving the area of your location, followed by your aircraft identification and the name of the nearest VOR to your position. The specialist needs to know this approximate location to select the most appropriate outlet for communications coverage.

EXAMPLE-
Cleveland flight watch, Cessna One Three Four Two Kilo, Mansfield V-O-R, over.

3.8.4 Charts depicting the location of the flight watch control stations (parent facility) and the outlets they use are contained in the Airport/Facility Directory. If you do not know in which flight watch area you are flying, initiate contact by using the words "FLIGHT WATCH," your aircraft identification, and the name of the nearest VOR. The facility will respond using the name of the flight watch facility.

EXAMPLE-
Flight watch, Cessna One Two Three Four Kilo, Mansfield V-O-R, over.

3.8.5 The AFSSs/FSSs which have implemented En Route Flight Advisory Service are listed in the Airport/Facility Directory.

3.8.6 EFAS is not intended to be used for filing or closing flight plans, position reporting, getting complete preflight briefings, or obtaining random weather reports and forecasts. En route flight advisories are tailored to the phase of flight that begins after climb-out and ends with descent to land. Immediate destination weather and terminal airport forecasts will be provided on request. Pilots requesting information not within the scope of flight watch will be advised of the appropriate AFSS/FSS frequency to contact to obtain the information. Pilot participation is essential to the success of EFAS by providing a continuous exchange of information on weather, winds, turbulence, flight visibility, icing or other hazardous conditions between pilots and flight watch specialists. Pilots are encouraged to report good weather as well as bad, and to confirm both expected conditions and unexpected conditions to EFAS facilities.

3.9 Inflight Aviation Weather Advisories

3.9.1 Background

3.9.1.1 Inflight Aviation Weather Advisories are forecasts to advise en route aircraft of development of potentially hazardous weather. All inflight aviation weather advisories in the conterminous U.S. are issued by the Aviation Weather Center (AWC) in Kansas City, Missouri. The Weather Forecast Office (WFO) in Honolulu issues advisories for the Hawaiian Islands. In Alaska, the Alaska Aviation Weather Unit (AAWU) issues inflight aviation weather advisories. All heights are referenced MSL, except in the case of ceilings (CIG) which indicate AGL.

3.9.1.2 There are three types of inflight aviation weather advisories: the Significant Meteorological Information (SIGMET), the Convective SIGMET and the Airmen's Meteorological Information (AIRMET). All of these advisories use the same location identifiers (either VORs, airports, or well-known geographic areas) to describe the hazardous weather areas. See FIG GEN 3.5-3 and FIG GEN 3.5-4. Graphics with improved clarity can be found in Advisory Circular AC 00-45E, Aviation Weather Services, which is available on the following web site: **http://www.faa.gov**.

3.9.1.3 Two other weather products supplement these Inflight Aviation Weather Advisories:

a) The Severe Weather Watch Bulletins (WWs), (with associated Alert Messages) (AWW), and

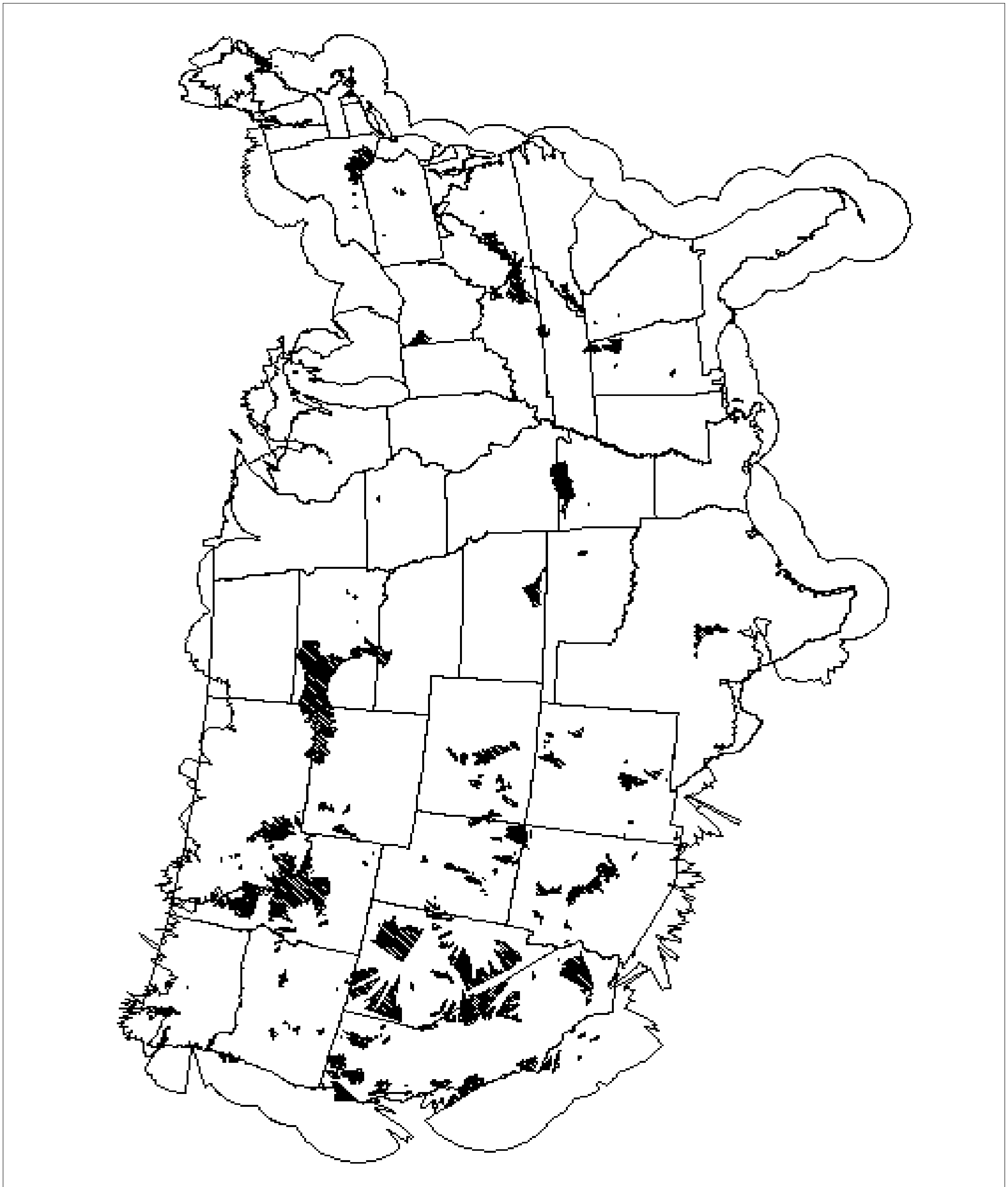
b) The Center Weather Advisories (CWAs).

3.9.2 SIGMET (WS)/AIRMET (WA)

SIGMETs/AIRMETs are issued corresponding to the Area Forecast (FA) areas described in FIG GEN 3.5-4, FIG GEN 3.5-6 and FIG GEN 3.5-6. The maximum forecast period is 4 hours for SIGMETs and 6 hours for AIRMETs. Both advisories are considered "widespread" because they must be either affecting or be forecasted to affect an area of at least 3,000 square miles at any one time. However, if the total area to be affected during the forecast period is very large, it could be that in actuality only a small portion of this total area would be affected at any one time.

FIG GEN 3.5-2

EFAS Radio Coverage Areas



NOTE-

EFAS radio coverage at 5000 feet AGL. The shaded areas depict limited coverage areas in which altitudes above 5000 feet AGL would be required to contact EFAS.

FIG GEN 3.5-3

Inflight Advisory Plotting Chart

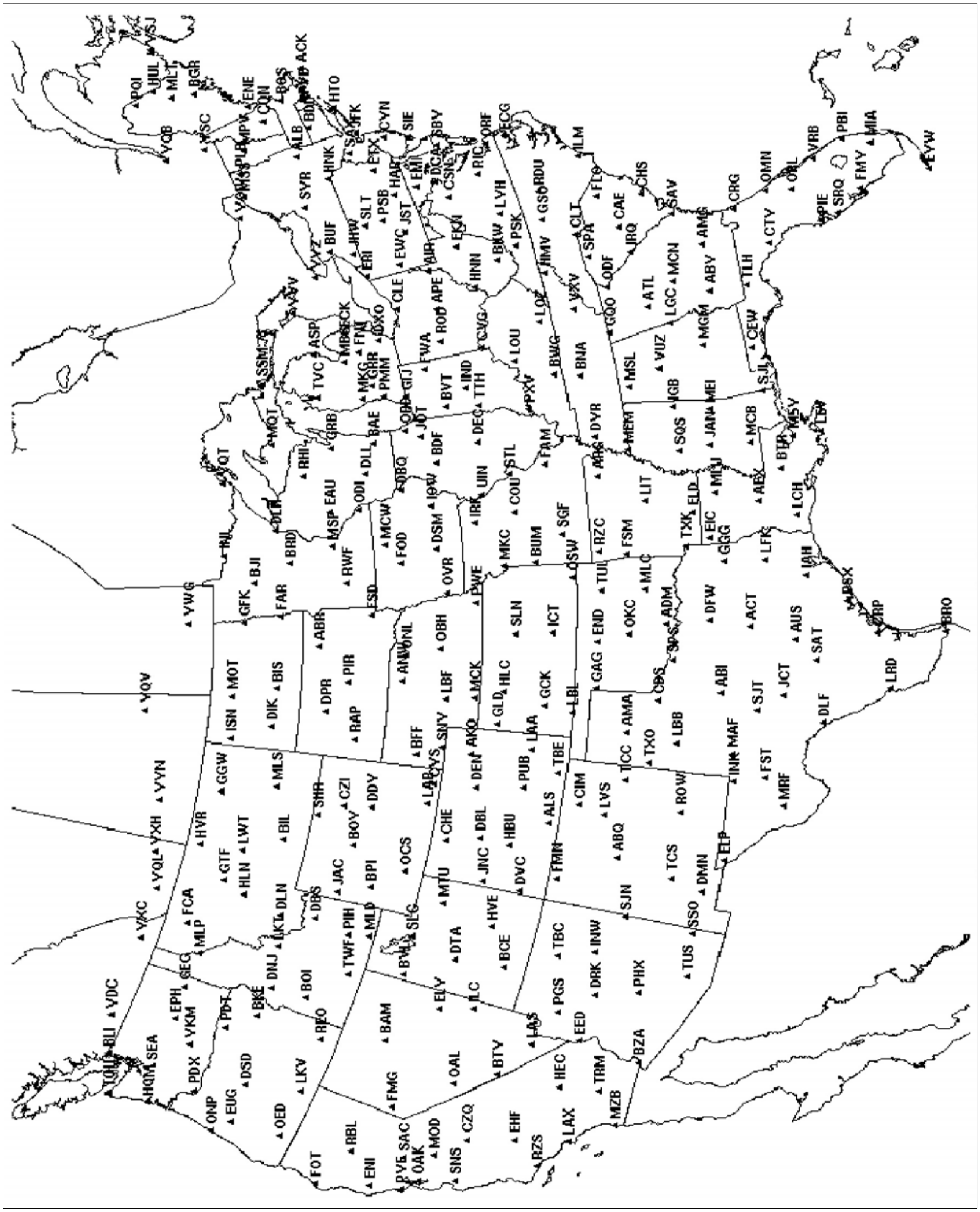


FIG GEN 3.5-4

Geographical Areas and Terrain Features

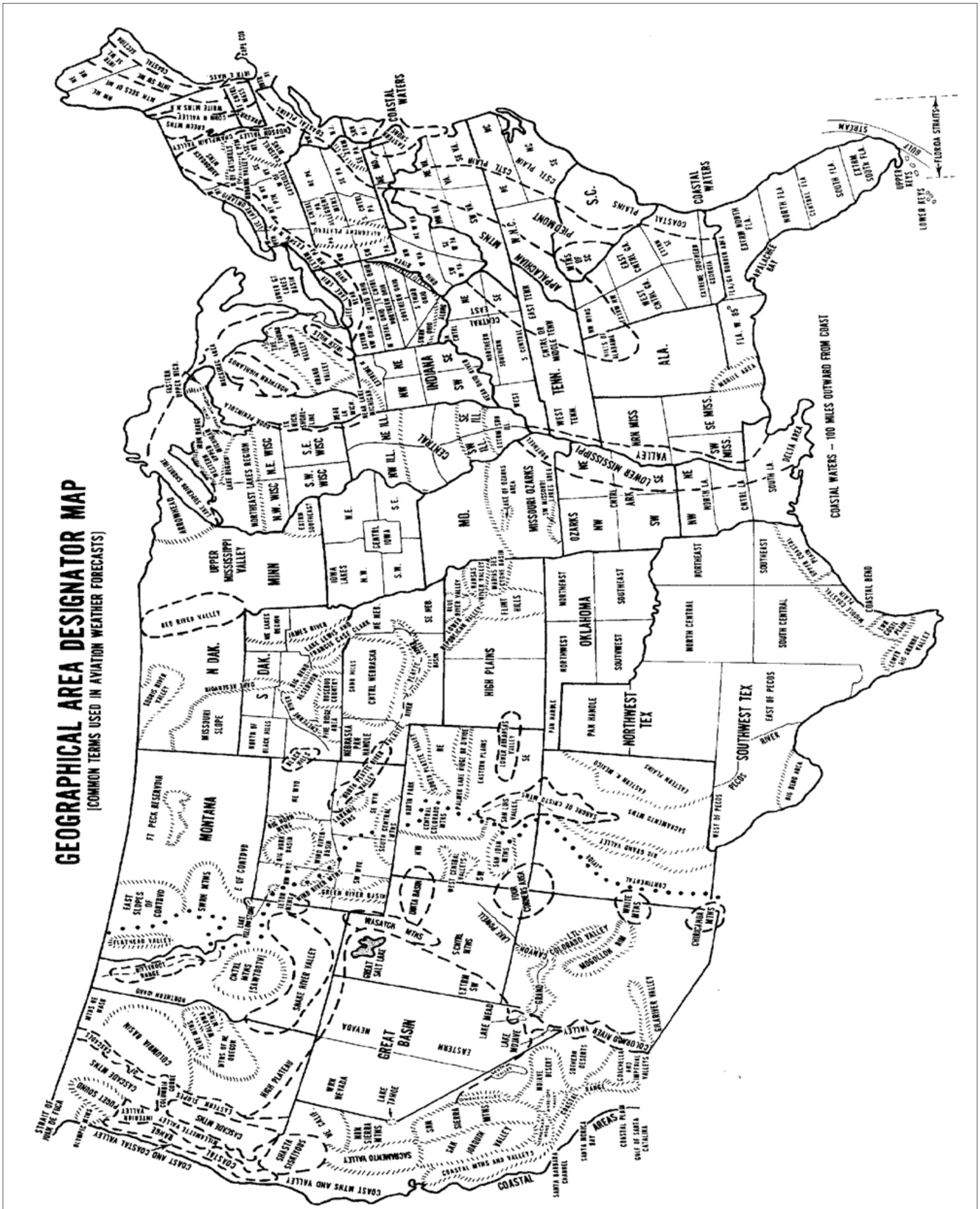


FIG GEN 3.5-5

Aviation Area Forecasts
FA Locations - Contiguous United States

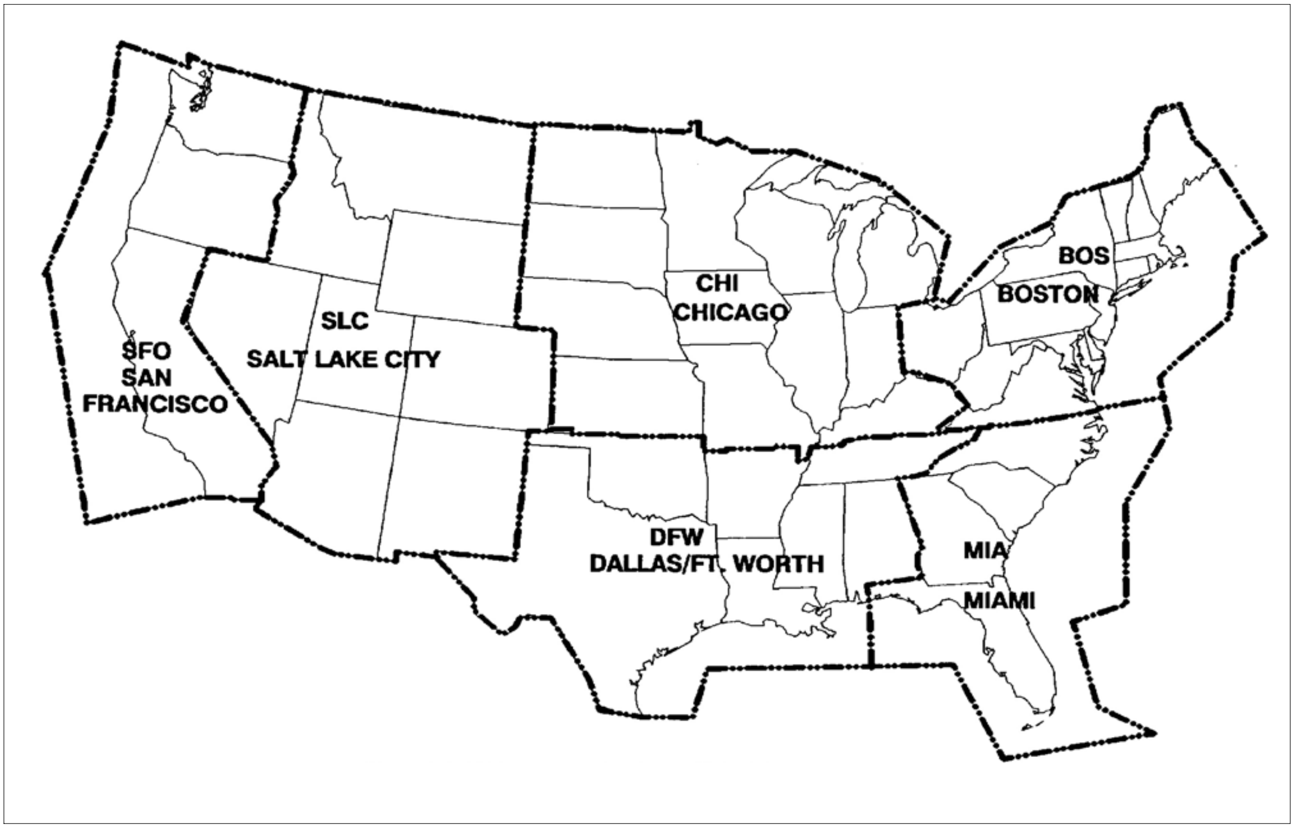


FIG GEN 3.5-6

Alaska Area Forecast Sectors

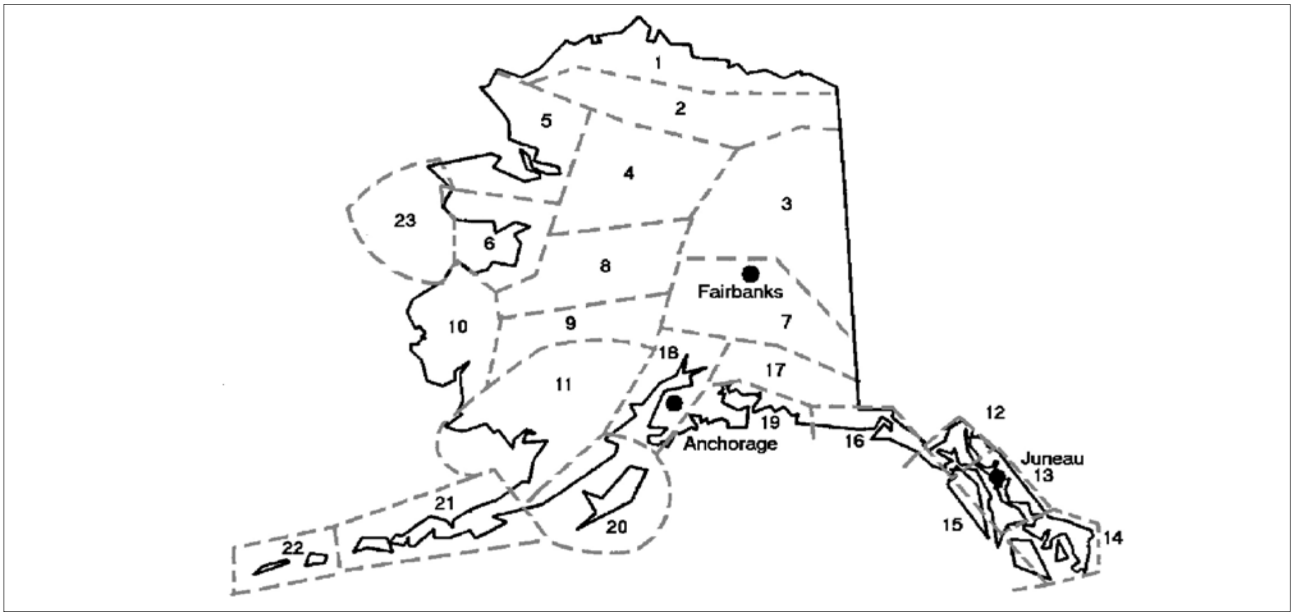
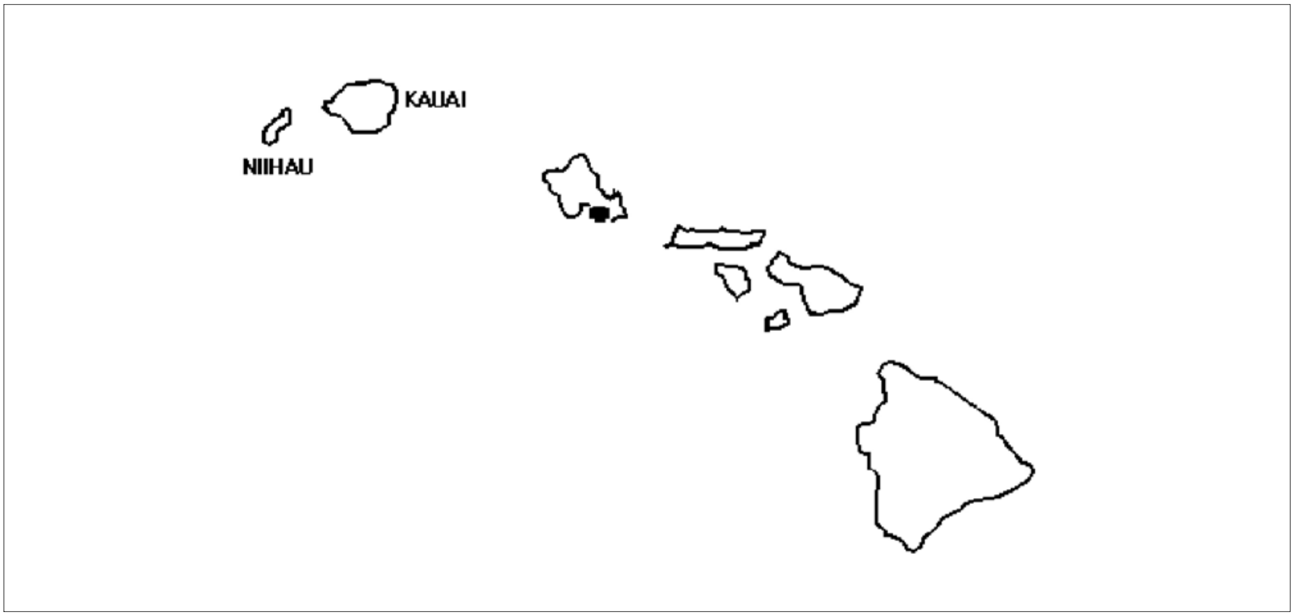


FIG GEN 3.5-7

Hawaii Area Forecast Locations



3.9.3 SIGMET (WS)

3.9.3.1 A SIGMET advises of nonconvective weather that is potentially hazardous to all aircraft. SIGMETs are unscheduled products that are valid for 4 hours. However, conditions that are associated with hurricanes are valid for 6 hours. Unscheduled updates and corrections are issued as necessary. In the conterminous U.S., SIGMETs are issued when the following phenomena occur or are expected to occur:

a) Severe icing not associated with thunderstorms.

b) Severe or extreme turbulence or clear air turbulence (CAT) not associated with thunderstorms.

c) Dust storms or sandstorms lowering surface or inflight visibilities to below 3 miles.

d) Volcanic ash.

3.9.3.2 In Alaska and Hawaii, SIGMETs are also issued for:

a) Tornadoes.

b) Lines of thunderstorms.

c) Embedded thunderstorms.

d) Hail greater than or equal to $^{3}/_{4}$ inch in diameter.

3.9.3.3 SIGMETs are identified by an alphabetic designator from November through Yankee excluding Sierra and Tango. (Sierra, Tango, and Zulu are reserved for AIRMETs.) The first issuance of a SIGMET will be labeled as UWS (Urgent Weather SIGMET). Subsequent issuances are at the forecasters discretion. Issuance for the same phenomenon will be sequentially numbered, using the original designator until the phenomenon ends. For example, the first issuance in the Chicago (CHI) FA area for phenomenon moving from the Salt Lake City (SLC) FA area will be SIGMET Papa 3, if the previous two issuances, Papa 1 and Papa 2, had been in the SLC FA area. Note that no two different phenomena across the country can have the same alphabetic designator at the same time.

EXAMPLE-
Example of a SIGMET:
BOSR WS 050600
SIGMET ROMEO 2 VALID UNTIL 051000
ME NH VT
FROM CAR TO YSJ TO CON TO MPV TO CAR
MOD TO OCNL SEV TURB BLW 080 EXP DUE TO STG
NWLY FLOW. CONDS CONTG BYD
1000Z.

3.9.3.4 Convective SIGMET (WST)

a) Convective SIGMETs are issued in the conterminous U.S. for any of the following:

1) Severe thunderstorm due to:

(a) Surface winds greater than or equal to 50 knots.

(b) Hail at the surface greater than or equal to $^3/_4$ inches in diameter.

(c) Tornadoes.

2) Embedded thunderstorms.

3) A line of thunderstorms.

4) Thunderstorms producing precipitation greater than or equal to heavy precipitation affecting 40 percent or more of an area at least 3,000 square miles.

b) Any convective SIGMET implies severe or greater turbulence, severe icing, and low-level wind shear. A convective SIGMET may be issued for any convective situation that the forecaster feels is hazardous to all categories of aircraft.

c) Convective SIGMET bulletins are issued for the western (W), central (C), and eastern (E) United States. (Convective SIGMETs are not issued for Alaska or Hawaii.) The areas are separated at 87 and 107 degrees west longitude with sufficient overlap to cover most cases when the phenomenon crosses the boundaries. Bulletins are issued hourly at H+55. Special bulletins are issued at any time as required and updated at H+55. If no criteria meeting convective SIGMET requirements are observed or forecasted, the message "CONVECTIVE SIGMET... NONE" will be issued for each area at H+55. Individual convective SIGMETs for each area (W, C, E) are numbered sequentially from number one each day, beginning at 00Z. A convective SIGMET for a continuing phenomenon will be reissued every hour at H+55 with a new number. The text of the bulletin consists of either an observation and a forecast or just a forecast. The forecast is valid for up to 2 hours.

EXAMPLE-
Example of a Convective SIGMET:
MKCC WST 251655
CONVECTIVE SIGMET 54C
VALID UNTIL 1855Z
WI IL
FROM 30E MSN-40ESE DBQ
DMSHG LINE TS 15 NM WIDE MOV FROM 30025KT. TOPS TO FL450. WIND GUSTS TO 50 KT POSS.
CONVECTIVE SIGMET 55C
VALID UNTIL 1855Z
WI IA
FROM 30NNW MSN-30SSE MCW
DVLPG LINE TS 10 NM WIDE MOV FROM 30015KT. TOPS TO FL300.
CONVECTIVE SIGMET 56C
VALID UNTIL 1855Z
MT ND SD MN IA MI
LINE TS 15 NM WIDE MOV FROM 27020KT. TOPS TO FL380.
OUTLOOK VALID 151855-252255
FROM 60NW ISN-INL-TVC-SBN-BRL-FSD-BIL-60N W ISN

IR STLT IMGRY SHOWS CNVTV CLD TOP TEMPS OVER SRN WI HAVE BEEN WARMING STEADILY INDCG A WKNG TREND. THIS ALSO REFLECTED BY LTST RADAR AND LTNG DATA. WKNG TREND OF PRESENT LN MAY CONT...HWVR NEW DVLPMT IS PSBL ALG OUTFLOW BDRY AND/OR OVR NE IA/SW WI BHD CURRENT ACT.
A SCND TS IS CONTG TO MOV EWD THRU ERN MT WITH NEW DVLPMT OCRG OVR CNTRL ND. MT ACT IS MOVG TWD MORE FVRBL AMS OVR THE WRN DAKS WHERE DWPTS ARE IN THE UPR 60S WITH LIFTED INDEX VALUES TO MS 6. TS EXPD TO INCR IN COVERAGE AND INTSTY DURG AFTN HRS.
WST ISSUANCES EXPD TO BE RQRD THRUT AFTN HRS WITH INCRG PTNTL FOR STGR CELLS TO CONTAIN LRG HAIL AND PSBLY DMGG SFC WNDS.

3.9.3.5 International SIGMET

a) Some NWS offices have been designated by the ICAO as Meteorological Watch Offices (MWOs). These offices are responsible for issuing International SIGMETs for designated areas that include Alaska, Hawaii, portions of the Atlantic and Pacific Oceans, and the Gulf of Mexico.

b) The offices which issue International SIGMETs are:

1) The AWC in Kansas City, Missouri.

2) The AAWU in Anchorage, Alaska.

3) The WFO in Honolulu, Hawaii.

4) The WFO on Guam Island in the Pacific Ocean.

c) These SIGMETs are considered "widespread" because they must be either affecting or be forecasted to affect an area of at least 3,000 square miles at any one time. The International SIGMET is issued for 12 hours for volcanic ash events, 6 hours for hurricanes and tropical storms, and 4 hours for all other events. Like the domestic SIGMETs, International SIGMETs are also identified by an alphabetic designator from Alpha through Mike and are numbered sequentially until that weather phenomenon ends. The criteria for an International SIGMET are:

1) Thunderstorms occurring in lines, embedded in clouds, or in large areas producing tornadoes or large hail.

2) Tropical cyclones.

3) Severe icing.

4) Severe or extreme turbulence.

5) Dust storms and sandstorms lowering visibilities to less than 3 miles.

6) Volcanic ash.

EXAMPLE-
Example of an International SIGMET:
WSNT06 KKCI 022014
SIGA0F
KZMA KZNY TJZS SIGMET FOXTROT 3 VALID 022015/030015 KKCI- MIAMI OCEANIC FIR NEW YORK OCEANIC FIR SAN JUAN FIR FRQ TS WI AREA BOUNDED BY 2711N6807W 2156N6654W 2220N7040W 2602N7208W 2711N6807W. TOPS TO FL470. MOV NE 15KT. WKN. BASED ON SAT AND LTG OBS.
MOSHER

3.9.3.6 AIRMET (WA)

a) AIRMETs (WAs) are advisories of significant weather phenomena but describe conditions at intensities lower than those which require the issuance of SIGMETs. AIRMETs are intended for dissemination to all pilots in the preflight and en route phase of flight to enhance safety. AIRMET Bulletins are issued on a scheduled basis every 6 hours beginning at 0145 UTC during Central Daylight Time and at 0245 UTC during Central Standard Time. Unscheduled updates and corrections are issued as necessary. Each AIRMET Bulletin contains any current AIRMETs in effect and an outlook for conditions expected after the AIRMET valid period. AIRMETs contain details about IFR, extensive mountain obscuration, turbulence, strong surface winds, icing, and freezing levels.

b) There are three AIRMETs: Sierra, Tango, and Zulu. After the first issuance each day, scheduled or unscheduled bulletins are numbered sequentially for easier identification.

1) AIRMET Sierra describes IFR conditions and/or extensive mountain obscurations.

2) AIRMET Tango describes moderate turbulence, sustained surface winds of 30 knots or greater, and/or nonconvective low-level wind shear.

3) AIRMET Zulu describes moderate icing and provides freezing level heights.

EXAMPLE-
Example of AIRMET Sierra issued for the Chicago FA area:
CHIS WA 121345
AIRMET SIERRA UPDT 3 FOR IFR AND MTN OBSCN VALID UNTIL 122000.
AIRMET IFR...SD NE MN IA MO WI LM MI IL IN KY
FROM 70NW RAP TO 50W RWF TO 50W MSN TO GRB TO MBS TO FWA TO CVG TO HNN TO TRI TO ARG TO 40SSW BRL TO OMA TO BFF TO 70NW RAP
OCNL CIG BLW 010/VIS BLW 3SM FG/BR. CONDS ENDG 15Z-17Z.

AIRMET MTN OBSCN...KY TN
FROM HNN TO TRI TO CHA TO LOZ TO HNN
MTNS OCNL OBSC CLDS/PCPN/BR. CONDS ENDG TN PTN AREA 18Z- 20Z..CONTG KY BYD 20Z..ENDG 02Z.

EXAMPLE-
Example of AIRMET Tango issued for the Salt Lake City FA area:
SLCT WA 121345
AIRMET TANGO UPDT 2 FOR TURB VALID UNTIL 122000.
AIRMET TURB...NV UT CO AZ NM
FROM LKV TO CHE TO ELP TO 60S TUS TO YUM TO EED TO RNO TO LKV OCNL MOD TURB BLW FL180 DUE TO MOD SWLY/WLY WNDS. CONDS CONTG BYD 20Z THRU 02Z.

AIRMET TURB...NV WA OR CA CSTL WTRS
FROM BLI TO REO TO BTY TO DAG TO SBA TO 120W FOT TO 120W TOU TO BLI
OCNL MOD TURB BTWN FL180 AND FL400 DUE TO WNDSHR ASSOCD WITH JTSTR. CONDS CONTG BYD 20Z THRU 02Z.

EXAMPLE-
Example of AIRMET Zulu issued for the San Francisco FA area:
SFOZ WA 121345
AIRMET ZULU UPDT 2 FOR ICE AND FRZLVL VALID UNTIL 122000.
AIRMET ICE...WA OR ID MT NV UT
FROM YQL TO SLC TO WMC TO LKV TO PDT TO YDC TO YQL
LGT OCNL MOD RIME/MXD ICGICIP BTWN FRZLVL AND FL220. FRZLVL 080-120. CONDS CONTG BYD 20Z THRU 02Z.

AIRMET ICE...WA OR
FROM YDC TO PDT TO LKV TO 80W MFR TO ONP TO TOU TO YDC
LGT OCNL MOD RIME/MXD ICGICIP BTWN FRZLVL AND FL180. FRZLVL 060-080. CONDS CONTG BYD 20Z THRU 02Z.

FRZLVL...WA...060 CSTLN SLPG 100 XTRM E.
OR...060-070 CASCDS WWD. 070-095 RMNDR.
NRN CA...060-100 N OF A 30N FOT-40N RNO LN SLPG 100-110 RMNDR.

3.9.3.7 Severe Weather Watch Bulletins (WWs) and Alert Messages (AWWs)

a) WWs define areas of possible severe thunderstorms or tornado activity. The bulletins are issued by the Storm Prediction Center (SPC) in Norman, OK. WWs are unscheduled and are issued as required.

b) A severe thunderstorm watch describes areas of expected severe thunderstorms. (Severe thunderstorm criteria are $^{3}/_{4}$-inch hail or larger and/or wind gusts of 50 knots [58 mph] or greater.)

c) A tornado watch describes areas where the threat of tornadoes exists.

d) In order to alert the WFOs, CWSUs, FSSs, and other users, a preliminary notification of a watch called the Alert Severe Weather Watch bulletin (AWW) is sent before the WW. (WFOs know this product as a SAW).

EXAMPLE-
Example of an AWW:
MKC AWW 011734
WW 75 TORNADO TX OK AR 011800Z-020000Z
AXIS..80 STATUTE MILES EAST AND WEST OF A LINE..60ESE DAL/DALLAS TX/ - 30 NW ARG/ WALNUT RIDGE AR/
..AVIATION COORDS.. 70NM E/W /58W GGG - 25NW ARG/
HAIL SURFACE AND ALOFT..1 $^{3}/_{4}$ INCHES. WIND GUSTS..70 KNOTS. MAX TOPS TO 450. MEAN WIND VECTOR 24045.

e) Soon after the AWW goes out, the actual watch bulletin itself is issued. A WW is in the following format:

1) Type of severe weather watch, watch area, valid time period, type of severe weather possible, watch axis, meaning of a watch, and a statement that persons should be on the lookout for severe weather.

2) Other watch information; i.e., references to previous watches.

3) Phenomena, intensities, hail size, wind speed (knots), maximum cumulonimbus (CB) tops, and estimated cell movement (mean wind vector).

4) Cause of severe weather.

5) Information on updating Convective Outlook (AC) products.

EXAMPLE-
Example of a WW:
BULLETIN - IMMEDIATE BROADCAST REQUESTED
TORNADO WATCH NUMBER 381
STORM PREDICTION CENTER NORMAN OK
556 PM CDT MON JUN 2 1997
THE STORM PREDICTON CENTER HAS ISSUED A TORNADO WATCH FOR PORTIONS OF NORTHEAST NEW MEXICO TEXAS PANHANDLE
EFFECTIVE THIS MONDAY NIGHT AND TUESDAY MORNING FROM 630 PM UNTIL MIDNIGHT CDT.
TORNADOES...HAIL TO 2 $^{3}/_{4}$ INCHES IN DIAMETER...THUNDERSTORM WIND GUSTS TO 80 MPH...AND DANGEROUS LIGHTNING ARE POSSIBLE IN THESE AREAS.
THE TORNADO WATCH AREA IS ALONG AND 60 STATUTE MILES NORTH AND SOUTH OF A LINE FROM 50 MILES SOUTHWEST OF RATON NEW MEXICO TO 50 MILES EAST OF AMARILLO TEXAS.
REMEMBER...A TORNADO WATCH MEANS CONDITIONS ARE FAVORABLE FOR TORNADOES AND SEVERE THUNDERSTORMS IN AND CLOSE TO THE WATCH AREA. PERSONS IN THESE AREAS SHOULD BE ON THE LOOKOUT FOR THREATENING WEATHER CONDITIONS AND LISTEN FOR LATER STATEMENTS AND POSSIBLE WARNINGS.
OTHER WATCH INFORMATION...CONTINUE... WW 378...WW 379...WW 380
DISCUSSION...THUNDERSTORMS ARE INCREASING OVER NE NM IN MOIST SOUTHEASTERLY UPSLOPE FLOW. OUTFLOW BOUNDARY EXTENDS EASTWARD INTO THE TEXAS PANHANDLE AND EXPECT STORMS TO MOVE ESE ALONG AND NORTH OF THE BOUNDARY ON THE N EDGE OF THE CAP. VEERING WINDS WITH HEIGHT ALONG WITH INCREASGING

MID LVL FLOW INDICATE A THREAT FOR SUPERCELLS.

AVIATION...TORNADOES AND A FEW SEVERE THUNDERSTORMS WITH HAIL SURFACE AND ALOFT TO 2 3/4 INCHES. EXTREME TURBULENCE AND SURFACE WIND GUSTS TO 70 KNOTS. A FEW CUMULONIMBI WITH MAXIMUM TOPS TO 550. MEAN STORM MOTION VECTOR 28025.

f) Status reports are issued as needed to show progress of storms and to delineate areas no longer under the threat of severe storm activity. Cancellation bulletins are issued when it becomes evident that no severe weather will develop or that storms have subsided and are no longer severe.

g) When tornadoes or severe thunderstorms have developed, the local WFO office will issue the warnings covering those areas.

3.9.3.8 Center Weather Advisories (CWAs)

a) CWAs are unscheduled inflight, flow control, air traffic, and air crew advisory. By nature of its short lead time, the CWA is not a flight planning product. It is generally a nowcast for conditions beginning within the next two hours. CWAs will be issued:

1) As a supplement to an existing SIGMET, Convective SIGMET or AIRMET.

2) When an Inflight Advisory has not been issued but observed or expected weather conditions meet SIGMET/AIRMET criteria based on current pilot reports and reinforced by other sources of information about existing meteorological conditions.

3) When observed or developing weather conditions do not meet SIGMET, Convective SIGMET, or AIRMET criteria; e.g., in terms of intensity or area coverage, but current pilot reports or other weather information sources indicate that existing or anticipated meteorological phenomena will adversely affect the safe flow of air traffic within the ARTCC area of responsibility.

b) The following example is a CWA issued from the Kansas City, Missouri, ARTCC. The "3" after ZKC in the first line denotes this CWA has been issued for the third weather phenomena to occur for the day. The "301" in the second line denotes the phenomena number again (3) and the issuance number (01) for this phenomena. The CWA was issued at 2140Z and is valid until 2340Z.

EXAMPLE-
ZKC3 CWA 032140
ZKC CWA 301 VALID UNTIL 032340
ISOLD SVR TSTM over KCOU MOVG SWWD 10 KTS ETC.

4. Categorical Outlooks

4.1 Categorical outlook terms describing general ceiling and visibility conditions for advance planning purposes are used only in area forecasts. They are defined as follows:

4.1.1 LIFR (Low IFR) - Ceiling less than 500 feet and/or visibility less than 1 mile.

4.1.2 IFR - Ceiling 500 to less than 1,000 feet and/or visibility 1 to less than 3 miles.

4.1.3 MVFR (Marginal VFR) - Ceiling 1,000 or 3,000 feet and/or visibility 3 to 5 miles inclusive.

4.1.4 VFR - Ceiling greater than 3,000 feet and visibility greater than 5 miles; includes sky clear.

4.2 The cause of LIFR, IFR, or MVFR is indicated by either ceiling or visibility restrictions or both. The contraction "CIG" and/or weather and obstruction to vision symbols are used. If winds or gusts of 25 knots or greater are forecast for the outlook period, the word "WIND" is also included for all categories, including VFR.

EXAMPLE-
LIFR CIG-low IFR due to low ceiling.

IFR FG-IFR due to visibility restricted by fog.

MVFR CIG HZ FU-marginal VFR due both to ceiling and to visibility restricted by haze and smoke.

IFR CIG RA WIND-IFR due both to low ceiling and to visibility restricted by rain; wind expected to be 25 knots or greater.

5. Telephone Information Briefing Service (TIBS)

5.1 TIBS, provided by automated flight service stations (AFSSs), is a continuous recording of meteorological and aeronautical information, available by telephone. Each AFSS provides at least four route and/or area briefings. In addition, airspace procedures and special announcements (if applicable) concerning aviation interests are also available. Depending upon user demand, other items may be provided; i.e., METAR observations, terminal airport forecasts, winds aloft, and temperatures aloft forecasts.

6. Inflight Weather Broadcasts

6.1 Weather Advisory Broadcasts. ARTCCs' broadcast a Severe Weather Forecast Alert (AWW), Convective SIGMET, or CWA alert once on all frequencies, except emergency, when any part of the area described is within 150 miles of the airspace under their jurisdiction. These broadcasts contain SIGMET or CWA identification and a brief description of the weather activity and general area affected.

EXAMPLE−
Attention all aircraft, SIGMET Delta Three, from Myton to Tuba City to Milford, severe turbulence and severe clear icing below one zero thousand feet. Expected to continue beyond zero three zero zero zulu.

EXAMPLE−
Attention all aircraft, Convective SIGMET Two Seven Eastern. From the vicinity of Elmira to Phillipsburg. Scattered embedded thunderstorms moving east at one zero knots. A few intense level five cells, maximum tops four five zero.

EXAMPLE−
Attention all aircraft, Kansas City Center weather advisory one zero three. Numerous reports of moderate to severe icing from eight to niner thousand feet in a three zero mile radius of St. Louis. Light or negative icing reported from four thousand to one two thousand feet remainder of Kansas City Center area.

NOTE−
Terminal control facilities have the option to limit the AWW, Convective SIGMET, SIGMET, or CWA broadcast as follows: local control and approach control positions may opt to broadcast SIGMET or CWA alerts only when any part of the area described is within 50 miles of the airspace under their jurisdiction.

6.2 Hazardous Inflight Weather Advisory Service (HIWAS). This is a continuous broadcast of inflight weather advisories including summarized AWWs, SIGMETs, Convective SIGMETs, CWAs, AIRMETs, and urgent PIREPs. HIWAS has been adopted as a national program and will be implemented throughout the conterminous U.S. as resources permit. In those areas where HIWAS is commissioned, ARTCC, Terminal ATC, and AFSS/FSS facilities have discontinued the broadcast of inflight advisories. HIWAS is an additional source of hazardous weather information which makes these data available on a continuous basis. It is not, however, a replacement for preflight or inflight briefings or real−time weather updates from Flight Watch (EFAS). As HIWAS is implemented in individual center areas, the commissioning will be advertised in the Notices to Airmen publication.

6.2.1 Where HIWAS has been implemented, a HIWAS alert will be broadcast on all except emergency frequencies once upon receipt by ARTCC and terminal facilities which will include an alert announcement, frequency instruction, number, and type of advisory updated; e.g., AWW, SIGMET, Convective SIGMET, or CWA.

EXAMPLE−
Attention all aircraft. Hazardous weather information (SIGMET, Convective SIGMET, AIRMET, urgent pilot weather report (UUA), or Center Weather Advisory (CWA)), (number or numbers) for (geographical area) available on HIWAS, flight watch, or flight service frequencies.

6.2.2 In HIWAS ARTCC areas, AFSSs/FSSs will broadcast a HIWAS update announcement once on all except emergency frequencies upon completion of recording an update to the HIWAS broadcast. Included in the broadcast will be the type of advisory update; e.g., AWW, SIGMET, Convective SIGMET, or CWA.

EXAMPLE−
Attention all aircraft. Hazardous weather information for (geographical area) available from flight watch or flight service.

6.2.3 HIWAS availability is shown on IFR En Route Low Altitude Charts and VFR Sectional Charts. The symbol depiction is identified in the chart legend.

7. Flight Information Services (FIS)

7.1 FIS. Aviation weather and other operational information may be displayed in the cockpit through the use of FIS. FIS systems are of two basic types: Broadcast only systems (called FIS-B) and two-way request/reply systems. Broadcast system components include a ground- or space-based transmitter, an aircraft receiver, and a portable or installed cockpit display device. Two-way systems utilize transmitter/receivers at both the ground- or space-based site and the aircraft.

7.1.1 Broadcast FIS (i.e., FIS-B) allows the pilot to passively collect weather and other operational data and to display that data at the appropriate time. In addition to textual weather products such as Aviation Routine Weather Reports (METARs)/Aviation Selected Special Weather Reports (SPECIs) and Terminal Area Forecasts (TAFs), graphical weather products such as radar composite/mosaic images, temporary flight restricted airspace and other NOTAMs may be provided to the cockpit. Two-way FIS services permit the pilot to make specific weather and other operational information requests for cockpit display. A FIS service provider will then prepare a reply in response to that specific request and transmit the product to that specific aircraft.

7.1.2 FIS services are available from four types of service providers:

7.1.2.1 A private sector FIS provider operating under service agreement with the FAA using broadcast data link over VHF aeronautical spectrum and whose products have been reviewed and accepted by the FAA prior to transmission. (Products and services are defined under subparagraph 7.3.)

7.1.2.2 Through an FAA operated service using a broadcast data link on the ADS-B UAT network. (Products and services are defined under subparagraph 7.4.)

7.1.2.3 Private sector FIS providers operating under customer contracts using aeronautical spectrum.

7.1.2.4 Private sector FIS providers operating under customer contract using methods other than aeronautical spectrum, including Internet data-to-the-cockpit service providers.

7.1.3 FIS is a method of receiving aviation weather and other operational data in the cockpit that augments traditional pilot voice communication with FAA's Flight Service Stations (FSSs), ATC facilities, or Airline Operations Control Centers (AOCCs). FIS is not intended to replace traditional pilot and controller/flight service specialist/aircraft dispatcher pre-flight briefings or inflight voice communications. FIS; however, can provide textual and graphical background information that can help abbreviate and improve the usefulness of such communications. FIS enhances pilot situational awareness and improves safety.

7.1.4 To ensure airman compliance with Federal Aviation Regulations, manufacturer's operating manuals should remind airmen to contact ATC controllers, FSS specialists, operator dispatchers, or airline operations control centers for general and mission critical aviation weather information and/or NAS status conditions (such as NOTAMs, Special Use Airspace status, and other government flight information). If FIS products are systemically modified (for example, are displayed as abbreviated plain text and/or graphical depictions), the modification process and limitations of the resultant product should be clearly described in the vendor's user guidance.

7.2 Operational Use of FIS. Regardless of the type of FIS system being used, several factors must be considered when using FIS:

7.2.1 Before using FIS for inflight operations, pilots and other flight crewmembers should become familiar with the operation of the FIS system to be used, the airborne equipment to be used, including its system architecture, airborne system components, coverage service volume and other limitations of the particular system, modes of operation and indications of various system failures. Users should also be familiar with the specific content and format of the services available from the FIS provider(s). Sources of information that may provide this specific guidance include manufacturer's manuals, training programs and reference guides.

7.2.2 FIS should not serve as the sole source of aviation weather and other operational information. ATC, AFSSs and, if applicable, AOCC VHF/HF voice remain as a redundant method of communicating aviation weather, NOTAMs, and other operational information to aircraft in flight. FIS augments these traditional ATC/FSS/AOCC services and, for some products, offers the advantage of being displayed as graphical information. By using FIS for orientation, the usefulness of information received from conventional means may be enhanced. For example, FIS may alert the pilot to specific areas of concern that will more accurately focus requests made to FSS or AOCC for inflight updates or similar queries made to ATC.

7.2.3 The airspace and aeronautical environment is constantly changing. These changes occur quickly and without warning. Critical operational decisions should be based on use of the most current and appropriate data available. When differences exist between FIS and information obtained by voice communication with ATC, FSS, and/or AOCC (if applicable), pilots are cautioned to use the most recent data from the most authoritative source.

7.2.4 FIS aviation weather products (e.g., graphical ground-based radar precipitation depictions) are not appropriate for tactical avoidance of severe weather such as negotiating a path through a weather hazard area. FIS supports strategic weather decision making such as route selection to avoid a weather hazard area in its entirety. The misuse of information beyond its applicability may place the pilot and aircraft in jeopardy. In addition, FIS should never be used in lieu of an individual pre-flight weather and flight planning briefing.

7.2.5 FIS NOTAM products, including Temporary Flight Restriction (TFR) information, are advisory-use information and are intended for situational awareness purposes only. Cockpit displays of this information are not appropriate for tactical navigation - pilots should stay clear of any geographic area displayed as a TFR NOTAM. Pilots should contact FSSs and/or ATC while en route to obtain updated information and to verify the cockpit display of NOTAM information.

7.2.6 FIS supports better pilot decision making by increasing situational awareness. Better decision-making is based on using information from a variety of sources. In addition to FIS, pilots should take advantage of other weather/NAS status sources, including, briefings from Flight Service Stations, FAA's en route "Flight Watch" service, data from other air traffic control facilities, airline operation control centers, pilot reports, as well as their own observations.

7.3 FAA FISDL (VHF) Service. The FAA's FISDL (VHF datalink) system is a VHF Data Link (VDL) Mode 2 implementation that provides pilots and flight crews of properly equipped aircraft with a cockpit display of certain aviation weather and flight operational information. This information may be displayed in both textual and graphical formats. The system is operated under a service agreement with the FAA, using broadcast data link on VHF aeronautical spectrum on two 25 KHz spaced frequencies (136.450 and 136.475 MHz). The FAA FISDL (VHF) service is designed to provide coverage throughout the continental U.S. from 5,000 feet AGL to 17,500 feet MSL, except in areas where this is not feasible due to mountainous terrain. Aircraft operating near transmitter sites may receive useable FISDL signals at altitudes lower than 5,000 feet AGL, including on the surface in some locations, depending on transmitter/aircraft line of sight geometry. Aircraft operating above 17,500 feet MSL may also receive useable FISDL signals under certain circumstances.

7.3.1 FAA FISDL (VHF) service provides, free of charge, the following basic text products:

7.3.1.1 Aviation Routine Weather Reports (METARs).

7.3.1.2 Aviation Selected Special Weather Reports (SPECIs).

7.3.1.3 Terminal Area Forecasts (TAFs), and their amendments.

7.3.1.4 Significant Meteorological Information (SIGMETs).

7.3.1.5 Convective SIGMETs.

7.3.1.6 Airman's Meteorological Information (AIRMETs).

7.3.1.7 Pilot Reports (both urgent and routine) (PIREPs); and,

7.3.1.8 Severe Weather Forecast Alerts and Warnings (AWWs/WW) issued by the NOAA Storm Prediction Center (SPC).

7.3.2 The format and coding of these text products are described in Advisory Circular AC-00-45, Aviation Weather Services, and FIG GEN 3.5-23 and FIG GEN 3.5-24, Key to Aerodrome Forecast (TAF) and Aviation Routine Weather Report (METAR).

7.3.3 Additional products, called "Value-Added Products," are also available from the vendor on a paid subscription basis. Details concerning the content, format, symbology and cost of these products may be obtained from the vendor.

7.4 FAA's Flight Information Service-Broadcast (FIS-B) Service. FIS-B is a ground broadcast service provided through the FAA's Universal Access Transceiver (UAT) "ADS-B Broadcast Services" network. The UAT network is an ADS-B data link that operates on 978 MHz. The FAA FIS-B system provides pilots and flight crews of properly equipped aircraft with a cockpit display of certain aviation weather and flight operational information. The FAA's FIS-B service is being introduced in certain regional implementations within the NAS (e.g., in Alaska and in other areas of implementation).

7.4.1 FAA's UAT FIS-B provides the initial products listed below with additional products planned for future implementation. FIS-B reception is line of sight and can be expected within 200 NM (nominal range) of each ground transmitting site. The following services are provided free of charge.

7.4.1.1 Text: Aviation Routine Weather Reports (METARs).

7.4.1.2 Text: Special Aviation Reports (SPECIs).

7.4.1.3 Text: Terminal Area Forecasts (TAFs), and their amendments.

7.4.1.4 Graphic: NEXRAD precipitation maps.

7.4.2 The format and coding of the above text weather-related products are described in Advisory Circular AC-00-45, Aviation Weather Services, and FIG GEN 3.5-23 and FIG GEN 3.5-24, Key to Aerodrome Forecast (TAF) and Aviation Routine Weather Report (METAR).

7.4.3 Details concerning the content, format, and symbology of the various data link products provided may be obtained from the specific avionics manufacturer.

7.5 Non-FAA FISDL Systems. Several commercial vendors also provide customers with FIS data over both the aeronautical spectrum and on other frequencies using a variety of data link protocols. In some cases, the vendors provide only the communications system that carries customer messages, such as the Aircraft Communications Addressing and Reporting System (ACARS) used by many air carrier and other operators.

7.5.1 Operators using non-FAA FIS data for inflight weather and other operational information should ensure that the products used conform to FAA/NWS standards. Specifically, aviation weather and NAS status information should meet the following criteria:

7.5.1.1 The products should be either FAA/NWS "accepted" aviation weather reports or products, or based on FAA/NWS accepted aviation weather reports or products. If products are used which do not meet this criteria, they should be so identified. The operator must determine the applicability of such products to their particular flight operations.

7.5.1.2 In the case of a weather product which is the result of the application of a process which alters the form, function or content of the base FAA/NWS accepted weather product(s), that process, and any limitations to the application of the resultant product, should be described in the vendor's user guidance material.

7.5.2 An example would be a NEXRAD radar composite/mosaic map, which has been modified by changing the scaling resolution. The methodology of assigning reflectivity values to the resultant image components should be described in the vendor's guidance material to ensure that the user can accurately interpret the displayed data.

8. Weather Observing Programs

8.1 Manual Observations. Aviation Routine Weather Reports (METAR) are taken at more than 600 locations in the U.S. With only a few exceptions, these stations are located at airport sites and most are staffed by FAA or NWS personnel who manually observe, perform calculations, and enter the observation into the distribution system. The format and coding of these observations are contained in FIG GEN 3.5-23.

8.2 Automated Weather Observing System (AWOS)

8.2.1 Automated weather reporting systems are increasingly being installed at airports. These systems consist of various sensors, a processor, a computer-generated voice subsystem, and a transmitter to broadcast local, minute-by-minute weather data directly to the pilot.

NOTE-
When the barometric pressure exceeds 31.00 inches Hg., see Section ENR 1.7, Altimeter Setting Procedures.

8.2.2 The AWOS observations will include the prefix "AUTO" to indicate that the data are derived from an automated system. Some AWOS locations will be augmented by certified observers who will provide weather and obstruction to vision information in the remarks of the report when the reported visibility is less than 3 miles. These sites, along with the hours of augmentation, are published in the Airport/Facility Directory. Augmentation is identified in the observation as "OBSERVER WEATHER." The AWOS wind speed, direction and gusts, temperature, dew point, and altimeter setting are exactly the same as for manual observations. The AWOS will also report density altitude when it exceeds the field elevation by more than 1,000 feet. The reported visibility is derived from a sensor near the touchdown of the primary instrument runway. The visibility sensor output is converted to a visibility value using a 10-minute harmonic average. The reported sky condition/ceiling is derived from the ceilometer located next to the visibility sensor. The AWOS algorithm integrates the last 30 minutes of ceilometer data to derive cloud layers and heights. This output may also differ from the observer sky condition in that the AWOS is totally dependent upon the cloud advection over the sensor site.

8.2.3 Referred to as AWOS, these real-time systems are operationally classified into four basic levels:

8.2.3.1 AWOS-A: only reports altimeter setting.

NOTE-
Any other information is advisory only.

8.2.3.2 AWOS-l: usually reports altimeter setting, wind data, temperature, dew point, and density altitude.

8.2.3.3 AWOS-2 provides the information provided by AWOS-l, plus visibility.

8.2.3.4 AWOS-3 provides the information provided by AWOS-2, plus cloud/ceiling data.

8.2.4 The information is transmitted over a discrete VHF radio frequency or the voice portion of a local NAVAID. AWOS transmissions on a discrete VHF radio frequency are engineered to be receivable to a maximum of 25 NM from the AWOS site and a maximum altitude of 10,000 feet AGL. At many locations, AWOS signals may be received on the surface of the airport, but local conditions may limit the maximum AWOS reception distance and/or altitude. The system transmits a 20- to 30-second weather message updated each minute. Pilots should monitor the designated frequency for the automated weather broadcast. A description of the broadcast is contained in paragraph 8.3, Automated Weather Observing System (AWOS) Broadcasts. There is no two-way communication capability. Most AWOS sites also have a dial-up capability so that the minute-by-minute weather messages can be accessed via telephone.

8.2.5 AWOS information (system level, frequency, phone number) concerning specific locations is published, as the systems become operational, in the Airport/Facility Directory and, where applicable, on published Instrument Approach Procedure (IAP) charts. Selected individual systems may be incorporated into nationwide data collection and dissemination networks in the future.

8.3 Automated Weather Observing System (AWOS) Broadcasts. Computer-generated voice is used in AWOS to automate the broadcast of the minute-by-minute weather observations. In addition, some systems are configured to permit the addition of an operator-generated voice message; e.g., weather remarks, following the automated parameters. The phraseology used generally follows that used for other weather broadcasts. Following are explanations and examples of the exceptions.

8.3.1 Location and Time. The location/name and the phrase "AUTOMATED WEATHER OBSERVATION" followed by the time are announced.

8.3.1.1 If the airport's specific location is included in the airport's name, the airport's name is announced.

EXAMPLE-
"Bremerton National Airport automated weather observation one four five six zulu."

"Ravenswood Jackson County Airport automated weather observation one four five six zulu."

8.3.1.2 If the airport's specific location is not included in the airport's name, the location is announced followed by the airport's name.

EXAMPLE-
"Sault Ste. Marie, Chippewa County International Airport automated weather observation."

"Sandusky, Cowley Field automated weather observation."

8.3.1.3 The word "TEST" is added following "OBSERVATION" when the system is not in commissioned status.

EXAMPLE-
"Bremerton National Airport automated weather observation test one four five six zulu."

8.3.1.4 The phrase "TEMPORARILY INOPERATIVE" is added when the system is inoperative.

EXAMPLE-
"Bremerton National Airport automated weather observing system temporarily inoperative."

8.3.2 Ceiling and Sky Cover

8.3.2.1 Ceiling is announced as either "CEILING" or "INDEFINITE CEILING." The phrases "MEASURED CEILING" and "ESTIMATED CEILING" are not used. With the exception of indefinite ceilings, all automated ceiling heights are measured.

EXAMPLE-
"Bremerton National Airport automated weather observation one four five six zulu, ceiling two thousand overcast."

"Bremerton National Airport automated weather observation one four five six zulu, indefinite ceiling two hundred."

8.3.2.2 The word "CLEAR" is not used in AWOS due to limitations in the height ranges of the sensors. No clouds detected is announced as, "No clouds below XXX" or, in newer systems as, "Clear below XXX" (where XXX is the range limit of the sensor).

EXAMPLE-
"No clouds below one two thousand."

"Clear below one two thousand."

8.3.2.3 A sensor for determining ceiling and sky cover is not included in some AWOS. In these systems, ceiling and sky cover are not announced. "SKY CONDITION MISSING" is announced only if the system is configured with a ceilometer, and the ceiling and sky cover information is not available.

8.3.3 Visibility

8.3.3.1 The lowest reportable visibility value in AWOS is "less than $^1/_4$." It is announced as "VISIBILITY LESS THAN ONE QUARTER."

8.3.3.2 A sensor for determining visibility is not included in some AWOSs. In these systems, visibility is not announced. "VISIBILITY MISSING" is announced only if the system is configured with a visibility sensor and visibility information is not available.

8.3.4 Weather. In the future, some AWOSs are to be configured to determine the occurrence of precipitation. However, the type and intensity may not always be determined. In these systems, the word "PRECIPITATION" will be announced if precipitation is occurring, but the type and intensity are not determined.

8.3.5 Remarks. If remarks are included in the observation, the word "REMARKS" is announced following the altimeter setting. Remarks are announced in the following order of priority:

8.3.5.1 Automated "remarks."

a) Variable visibility.

b) Density altitude.

8.3.5.2 Manual input remarks. Manual input remarks are prefaced with the phrase "OBSERVER WEATHER." As a general rule the manual remarks are limited to:

a) Type and intensity of precipitation.

b) Thunderstorms, intensity (if applicable), and direction.

c) Obstructions to vision when the visibility is less than 7 miles.

EXAMPLE-
"Remarks...density altitude, two thousand five hundred...visibility variable between one and two...wind direction variable between two four zero and three one zero...observed weather...thunderstorm moderate rain showers and mist...thunderstorm overhead."

8.3.5.3 If an automated parameter is "missing" and no manual input for that parameter is available, the parameter is announced as "MISSING." For example, a report with the dew point "missing," and no manual input available, would be announced as follows:

EXAMPLE-
"Ceiling one thousand overcast, visibility three, precipitation, temperature three zero, dew point missing, wind calm, altimeter three zero zero one."

8.3.5.4 "REMARKS" are announced in the following order of priority:

a) Automated "REMARKS":

1) Variable visibility.

2) Density altitude.

b) Manual Input "REMARKS." As a general rule, the remarks are announced in the same order as the parameters appear in the basic text of the observation.

EXAMPLE-
"Remarks, density altitude, two thousand five hundred, visibility variable between one and two, wind direction variable between two four zero and three one zero, observer ceiling estimated two thousand broken, observer temperature two, dew point minus five."

8.4 Automated Surface Observing System (ASOS)/Automated Weather Sensor System (AWSS)

8.4.1 The ASOS/AWSS is the primary surface weather observing system of the U.S. The program to install and operate these systems throughout the U.S. is a joint effort of the NWS, the FAA and the Department of Defense. AWSS is a follow-on program that provides identical data as ASOS. ASOS/AWSS is designed to support aviation operations and weather forecast activities. The ASOS/AWSS will provide continuous minute-by-minute observations and perform the basic observing functions necessary to generate an aviation routine weather report (METAR) and other aviation weather information. The information may be transmitted over a discrete VHF radio frequency or the voice portion of a local NAVAID. ASOS/AWSS transmissions on a discrete VHF radio frequency are engineered to be receivable to a maximum of 25 NM from the ASOS/AWSS site and a maximum altitude of 10,000 feet AGL. At many locations, ASOS/AWSS signals may be received on the surface of the airport, but local conditions may limit the maximum reception distance and/or altitude. While the automated system and the human may differ in their methods of data collection and interpretation, both produce an observation quite similar in form and content. For the "objective" elements such as pressure, ambient temperature, dew point temperature, wind, and precipitation accumulation, both the automated system and the observer use a fixed location and time-averaging technique. The quantitative differences between the observer and the automated observation of these elements are negligible. For the "subjective" elements, however, observers use a fixed time, spatial averaging technique to describe the visual elements (sky condition, visibility and present weather), while the automated systems use a fixed location, time averaging technique. Although this is a fundamental change, the manual and automated techniques yield remarkably similar results within the limits of their respective capabilities. (See FIG GEN 3.5-25 and FIG GEN 3.5-26, Key to Decode an ASOS/AWSS (METAR) Observation.

8.4.2 System Description

8.4.2.1 The ASOS/AWSS at each airport location consists of four main components:

a) Individual weather sensors.

b) Data collection and processing units.

c) Peripherals and displays.

8.4.2.2 The ASOS/AWSS sensors perform the basic function of data acquisition. They continuously sample and measure the ambient environment, derive raw sensor data and make them available to the collection and processing units.

8.4.3 Every ASOS/AWSS will contain the following basic set of sensors.

8.4.3.1 Cloud height indicator (one or possibly three).

8.4.3.2 Visibility sensor (one or possibly three).

8.4.3.3 Precipitation identification sensor.

8.4.3.4 Freezing rain sensor.

8.4.3.5 Pressure sensors (two sensors at small airports; three sensors at large airports).

8.4.3.6 Ambient temperature/dew point temperature sensor.

8.4.3.7 Anemometer (wind direction and speed sensor).

8.4.3.8 Rainfall accumulation sensor.

8.4.4 The ASOS/AWSS data outlets include:

8.4.4.1 Those necessary for on-site airport users.

8.4.4.2 National communications networks.

8.4.4.3 Computer-generated voice (available through FAA radio broadcast to pilots and dial-in telephone line).

NOTE-
Wind direction broadcast over FAA radios is in reference to magnetic north.

8.5 A comparison of weather observing programs and the elements observed by each are in TBL GEN 3.5-2, Weather Observing Programs.

8.6 Service Standards. During 1995, a government/industry team worked to comprehensively reassess the requirements for surface observations at the nation's airports. That work resulted in agreement on a set of service standards and the FAA and NWS ASOS sites to which the standards would apply. The term "Service Standards" refers to the level of detail in the weather observation. The service standards consist of four different levels of service (A, B, C, and D) as described below. Specific observational elements included in each service level are listed in TBL GEN 3.5-3, Weather Observation Service Standards.

8.6.1 Service Level D defines the minimum acceptable level of service. It is a completely automated service in which the ASOS observation will constitute the entire observation; i.e., no additional weather information is added by a human observer. This service is referred to as a stand alone D site.

8.6.2 Service Level C is a service in which the human observer, usually an air traffic controller, augments or adds information to the automated observation. Service Level C also includes backup of ASOS elements in the event of an ASOS malfunction or an unrepresentative ASOS report.

8.6.3 In backup, the human observer inserts the correct or missing value for the automated ASOS elements. This service is provided by air traffic controllers under the Limited Aviation Weather Reporting Station (LAWRS) process, FSS and NWS observers, and, at selected sites, Non-Federal Observation Program observers.

Two categories of airports require detail beyond Service Level C in order to enhance air traffic control efficiency and increase system capacity. Services at these airports are typically provided by contract weather observers, NWS observers, and, at some locations, FSS observers.

8.6.4 Service Level B is a service in which weather observations consist of all elements provided under Service Level C, plus augmentation of additional data beyond the capability of the ASOS. This category of airports includes smaller hubs or airports special in other ways that have worse than average bad weather operations for thunderstorms and/or freezing/frozen precipitation, and/or that are remote airports.

8.6.5 Service Level A, the highest and most demanding category, includes all the data reported in Service Standard B, plus additional requirements as specified. Service Level A covers major aviation hubs and/or high volume traffic airports with average or worse weather.

TBL GEN 3.5-2

Weather Observing Programs

Element Reported	AWOS-A	AWOS-1	AWOS-2	AWOS-3	ASOS	MANUAL
Altimeter	X	X	X	X	X	X
Wind		X	X	X	X	X
Temperature/Dew point		X	X	X	X	X
Density altitude		X	X	X	X	
Visibility			X	X	X	X
Clouds/Ceiling				X	X	X
Precipitation					X	X
Remarks					X	X

TBL GEN 3.5-3

Weather Observation Service Standards

SERVICE LEVEL A	
Service Level A consists of all the elements of Service Levels B, C and D plus the elements listed to the right, if observed.	10 minute longline RVR at precedented sites or additional visibility increments of 1/8, 1/16 and 0 Sector visibility Variable sky condition Cloud layers above 12,000 feet and cloud types Widespread dust, sand and other obscurations Volcanic eruptions
SERVICE LEVEL B	
Service Level B consists of all the elements of Service Levels C and D plus the elements listed to the right, if observed.	Longline RVR at precedented sites (may be instantaneous readout) Freezing drizzle versus freezing rain Ice pellets Snow depth & snow increasing rapidly remarks Thunderstorm and lightning location remarks Observed significant weather not at the station remarks
SERVICE LEVEL C	
Service Level C consists of all the elements of Service Level D plus augmentation and backup by a human observer or an air traffic control specialist on location nearby. Backup consists of inserting the correct value if the system malfunctions or is unrepresentative. Augmentation consists of adding the elements listed to the right, if observed. During hours that the observing facility is closed, the site reverts to Service Level D.	Thunderstorms Tornadoes Hail Virga Volcanic ash Tower visibility Operationally significant remarks as deemed appropriate by the observer
SERVICE LEVEL D	
This level of service consists of an ASOS continually measuring the atmosphere at a point near the runway. The ASOS senses and measures the weather parameters listed to the right.	Wind Visibility Precipitation/Obstruction to vision Cloud height Sky cover Temperature Dew point Altimeter

9. Weather Radar Services

9.1 The National Weather Service operates a network of radar sites for detecting coverage, intensity, and movement of precipitation. The network is supplemented by FAA and DOD radar sites in the western sections of the country. Local warning radars augment the network by operating on an as needed basis to support warning and forecast programs.

9.2 Scheduled radar observations are taken hourly and transmitted in alpha−numeric format on weather telecommunications circuits for flight planning purposes. Under certain conditions special radar reports are issued in addition to the hourly transmittals. Data contained in the reports is also collected by the National Meteorological Center and used to prepare hourly national radar summary charts for dissemination on facsimile circuits.

9.3 All En route Flight Advisory Service facilities and many Automated Flight Service Stations have equipment to directly access the radar displays from the individual weather radar sites. Specialists at these locations are trained to interpret the display for pilot briefing and inflight advisory services. The Center Weather Service Units located in the ARTCCs also have access to weather radar displays and provide support to all air traffic facilities within their center's area.

9.4 A clear radar display (no echoes) does not mean that there is no significant weather within the coverage of the radar site. Clouds and fog are not detected by the radar. However, when echoes are present, turbulence can be implied by the intensity of the precipitation, and icing is implied by the presence of the precipitation at temperatures at or below zero degrees Celsius. Used in conjunction with other weather products, radar provides invaluable information for weather avoidance and flight planning.

9.5 Additional information on weather radar products and services can be found in FAA Advisory Circular 00−45, "Aviation Weather Services."

REFERENCE−
Pilot/Controller Glossary Term− Precipitation Radar Weather Descriptions.
AIP, Thunderstorms, GEN 3.5, Paragraph 27.
Airport/Facility Directory, Charts, NWS Upper Air Observing Stations and Weather Network for the location of specific radar sites.

10. ATC Inflight Weather Avoidance Assistance

10.1 ATC Radar Weather Display

10.1.1 ATC radars are able to display areas of precipitation by sending out a beam of radio energy that is reflected back to the radar antenna when it strikes an object or moisture which may be in the form of rain drops, hail, or snow. The larger the object is, or the more dense its reflective surface, the stronger the return will be presented. Radar weather processors indicate the intensity of reflective returns in terms of decibels (dBZ). ATC systems cannot detect the presence or absence of clouds. The ATC systems can often determine the intensity of a precipitation area, but the specific character of that area (snow, rain, hail, VIRGA, etc.) cannot be determined. For this reason, ATC refers to all weather areas displayed on ATC radar scopes as "precipitation."

10.1.2 All ATC facilities using radar weather processors with the ability to determine precipitation intensity, will describe the intensity to pilots as:

10.1.2.1 "LIGHT" (< 30 dBZ)

10.1.2.2 "MODERATE" (30 to 40 dBZ)

10.1.2.3 "HEAVY" (> 40 to 50 dBZ)

10.1.2.4 "EXTREME" (> 50 dBZ)

10.1.3 ATC facilities that, due to equipment limitations, cannot display the intensity levels of precipitation, will describe the location of the precipitation area by geographic position, or position relative to the aircraft. Since the intensity level is not available, the controller will state "INTENSITY UNKNOWN."

10.1.4 ARTCC facilities normally use a Weather and Radar Processor (WARP) to display a mosaic of data obtained from multiple NEXRAD sites. There is a time delay between actual conditions and those displayed to the controller. For example, the precipitation data on the ARTCC controller's display could be up to 6 minutes old. When the WARP is not available, a second system, the narrowband Air Route Surveillance Radar (ARSR) can display two distinct levels of precipitation intensity that will be described to pilots as "MODERATE" (30 to 40 dBZ) and "HEAVY TO EXTREME" (> 40 dBZ). The WARP processor is only used in ARTCC facilities.

10.1.5 *ATC radar is not able to detect turbulence.* Generally, turbulence can be expected to occur as the rate of rainfall or intensity of precipitation increases. Turbulence associated with greater rates of rainfall/ precipitation will normally be more severe than any associated with lesser rates of rainfall/precipitation. Turbulence should be expected to occur near convective activity, even in clear air. Thunderstorms are a form of convective activity that imply severe or greater turbulence. Operation within 20 miles of thunderstorms should be approached with great caution, as the severity of turbulence can be markedly greater than the precipitation intensity might indicate.

10.2 Weather Avoidance Assistance

10.2.1 To the extent possible, controllers will issue pertinent information of weather or chaff areas and assist pilots in avoiding such areas if requested. Pilots should respond to a weather advisory by either acknowledging the advisory or by acknowledging the advisory and requesting an alternative course of action as follows:

10.2.1.1 Request to deviate off course by stating the number of miles and the direction of the requested deviation. In this case, when the requested deviation is approved the pilot is expected to provide his/her own navigation, to maintain the altitude assigned by ATC, and to remain within the specified mileage of his/her original course.

10.2.1.2 Request a new route to avoid the affected area.

10.2.1.3 Request a change of altitude.

10.2.1.4 Request radar vectors around the affected areas.

10.2.2 For obvious reasons of safety, an IFR pilot must not deviate from the course or altitude/flight level without a proper ATC clearance. When weather conditions encountered are so severe that an immediate deviation is determined to be necessary and time will not permit approval by ATC, the pilot's emergency authority may be exercised.

10.2.3 When the pilot requests clearance for a route deviation or for an ATC radar vector, the controller must evaluate the air traffic picture in the affected area and coordinate with other controllers (if ATC jurisdictional boundaries may be crossed) before replying to the request.

10.2.4 It should be remembered that the controller's primary function is to provide safe separation between aircraft. Any additional service, such as weather avoidance assistance, can only be provided to the extent that it does not derogate the primary function. It is also worth noting that the separation workload is generally greater than normal when weather disrupts the usual flow of traffic. ATC radar limitations and frequency congestion may also be factors in limiting the controller's capability to provide additional service.

10.2.5 It is very important that the request for deviation or radar vector be forwarded to ATC as far in advance as possible. Delay in submitting it may delay or even preclude ATC approval or require that additional restrictions be placed on the clearance. Insofar as possible, the following information should be furnished to ATC when requesting clearance to detour around weather activity:

10.2.5.1 Proposed point where detour will commence.

10.2.5.2 Proposed route and extent of detour (direction and distance).

10.2.5.3 Point where original route will be resumed.

10.2.5.4 Flight conditions (IFR or VFR).

10.2.5.5 Any further deviation that may become necessary as the flight progresses.

10.2.5.6 Advise if the aircraft is equipped with functioning airborne radar.

10.2.6 To a large degree, the assistance that might be rendered by ATC will depend upon the weather information available to controllers. Due to the extremely transitory nature of severe weather situations, the controller's weather information may be of only limited value if based on weather observed on radar only. Frequent updates by pilots giving specific information as to the area affected, altitudes, intensity, and nature of the severe weather can be of considerable value. Such reports are relayed by radio or phone to other pilots and controllers, and they also receive widespread teletypewriter dissemination.

10.2.7 Obtaining IFR clearance or an ATC radar vector to circumnavigate severe weather can often be accommodated more readily in the en route areas away from terminals because there is usually less congestion and, therefore, greater freedom of action. In terminal areas, the problem is more acute because of traffic density, ATC coordination requirements, complex departure and arrival routes, and adjacent airports. As a consequence, controllers are less likely to be able to accommodate all requests for weather detours in a terminal area or be in a position to volunteer such routes to the pilot. Nevertheless, pilots should not hesitate to advise controllers of any observed severe weather and should specifically advise controllers if they desire circumnavigation of observed weather.

10.3 ATC Severe Weather Avoidance Plans

10.3.1 Air Route Traffic Control Centers and some Terminal Radar Control facilities utilize plans for severe weather avoidance within their control areas. Aviation−oriented meteorologists provide weather information. Preplanned alternate route packages developed by the facilities are used in conjunction with flow restrictions to ensure a more orderly flow of traffic during periods of severe or adverse weather conditions.

10.3.2 During these periods, pilots may expect to receive alternative route clearances. These routes are predicated upon the forecasts of the meteorologist and coordination between the Air Traffic Control System Command Center and the other centers. The routes are utilized as necessary in order to allow as many aircraft as possible to operate in any given area, and frequently they will deviate from the normal preferred routes. With user cooperation, this plan may significantly reduce delays.

10.4 Procedures for Weather Deviations and Other Contingencies in Oceanic Controlled Airspace

10.4.1 When the pilot initiates communications with ATC, rapid response may be obtained by stating "WEATHER DEVIATION REQUIRED" to indicate priority is desired on the frequency and for ATC response.

10.4.2 The pilot still retains the option of initiating the communications using the urgency call "PAN−PAN" three times to alert all listening parties of a special handling condition which will receive ATC priority for issuance of a clearance or assistance.

10.4.3 ATC will:

10.4.3.1 Approve the deviation, or

10.4.3.2 Provide vertical separation and then approve the deviation, or

10.4.3.3 If ATC is unable to establish vertical separation, ATC shall advise the pilot that standard separation cannot be applied; provide essential traffic information for all affected aircraft, to the extent practicable; and if possible, suggest a course of action. ATC may suggest that the pilot climb or descend to a contingency altitude (1,000 feet above or below that assigned if operating above FL 290; 500 feet above or below that assigned if operating at or below FL 290).

PHRASEOLOGY−
STANDARD SEPARATION NOT AVAILABLE; DEVIATE AT PILOT'S DISCRETION; SUGGEST CLIMB (or descent) TO (appropriate altitude); TRAFFIC (position and altitude); REPORT DEVIATION COMPLETE.

10.4.4 The pilot will follow the ATC advisory altitude when approximately 10 NM from track as well as execute the procedures detailed in paragraph 10.4.5.

10.4.5 If contact cannot be established or a revised ATC clearance or advisory is not available and deviation from track is required, the pilot shall take the following actions:

10.4.5.1 If possible, deviate away from an organized track or route system.

10.4.5.2 Broadcast aircraft position and intentions on the frequency in use, as well as on frequency 121.5 MHz at suitable intervals stating: flight identification (operator call sign), flight level, track code or ATS route designator, and extent of deviation expected.

10.4.5.3 Watch for conflicting traffic both visually and by reference to the Traffic Alert and Collision Avoidance System (TCAS), if equipped.

10.4.5.4 Turn on aircraft exterior lights.

10.4.5.5 Deviations of less than 10 NM or operations within COMPOSITE (NOPAC and CEPAC) Airspace, should REMAIN at ASSIGNED altitude. Otherwise, when the aircraft is approximately 10 NM from track, initiate an altitude change based upon the following criteria:

TBL GEN 3.5-4

Route Centerline/Track	Deviations >10 NM	Altitude Change
East 000 - 179°M	Left Right	Descend 300 Feet Climb 300 Feet
West 180-359°M	Left Right	Climb 300 Feet Descend 300 Feet
Pilot Memory Slogan: ***"East right up, West right down."***		

10.4.5.6 When returning to track, be at the assigned flight level when the aircraft is within approximately 10 NM of centerline.

10.4.5.7 If contact was not established prior to deviating, continue to attempt to contact ATC to obtain a clearance. If contact was established, continue to keep ATC advised of intentions and obtain essential traffic information.

11. Notifications Required From Operators

11.1 Preflight briefing and flight documentation services provided by AFSSs do not require prior notification.

11.2 Preflight briefing and flight documentation services provided by a National Weather Service Office (or contract office) are available upon request for long-range international flights for which meteorological data packages are prepared for the pilot-in-command. Briefing times should be coordinated between the local representative and the local meteorological office.

11.3 Flight Service Stations do not normally have the capability to prepare meteorological data packages for a preflight briefing.

12. Weather Observing Systems and Operating Procedures

For surface wind readings, most meteorological reporting stations have a direct reading, 3-cup anemometer wind system for which a 1-minute mean wind speed and direction (based on true north) is taken. Some stations also have a continuous wind speed recorder which is used in determining the gustiness of the wind.

13. Runway Visual Range (RVR)

There are currently two configurations of the RVR, commonly identified as Taskers and New Generation RVR. The Taskers use transmissometer technology. The New Generation RVRs use forward scatter technology and are currently being deployed to replace the existing Taskers.

13.1 RVR values are measured by transmissometers mounted on 14-foot towers along the runway. A full RVR system consists of:

13.1.1 A transmissometer projector and related items.

13.1.2 A transmissometer receiver (detector) and related items.

13.1.3 An analogue recorder.

13.1.4 A signal data converter and related items.

13.1.5 A remote digital or remote display programmer.

13.2 The transmissometer projector and receiver are mounted on towers 250 feet apart. A known intensity of light is emitted from the projector and is measured by the receiver. Any obscuring matter, such as rain, snow, dust, fog, haze, or smoke, reduces the light intensity arriving at the receiver. The resultant intensity measurement is then converted to an RVR value by the signal data converter. These values are displayed by readout equipment in the associated air traffic facility and updated approximately once every minute for controller issuance to pilots.

13.3 The signal data converter receives information on the high-intensity runway edge light setting in use (step 3, 4, or 5), transmission values from the transmissometer, and the sensing of day or night conditions. From the three data sources, the system will compute appropriate RVR values.

13.4 An RVR transmissometer established on a 250-foot baseline provides digital readouts to a minimum of 600 feet, which are displayed in 200-foot increments to 3,000 feet, and in 500-foot increments from 3,000 feet to a maximum value of 6,000 feet.

13.5 RVR values for Category IIIa operations extend down to 700-foot RVR; however, only 600 and 800 feet are reportable RVR increments. The 800 RVR reportable value covers a range of 701 feet to 900 feet and is therefore a valid minimum indication of Category IIIa operations.

13.6 Approach categories with the corresponding minimum RVR values are listed in TBL GEN 3.5-5.

TBL GEN 3.5-5

Approach Category/Minimum RVR Table

Category	Visibility (RVR)
Nonprecision	2,400 feet
Category I	1,800 feet
Category II	1,200 feet
Category IIIa	700 feet
Category IIIb	150 feet
Category IIIc	0 feet

13.7 Ten-minute maximum and minimum RVR values for the designated RVR runway are reported in the body of the aviation weather report when the prevailing visibility is less than 1 mile and/or the RVR is 6,000 feet or less. ATCTs report RVR when the prevailing visibility is 1 mile or less and/or the RVR is 6,000 feet or less.

13.8 Details on the requirements for the operational use of RVR are contained in FAA Advisory Circular 97-1, "Runway Visual Range (RVR)." Pilots are responsible for compliance with minimums prescribed for their class of operations in appropriate Federal Aviation Regulations and/or operations specifications.

13.8.1 RVR values are also measured by forward scatter meters mounted on 14-foot frangible fiberglass poles. A full RVR system consists of:

13.8.1.1 Forward scatter meter with a transmitter, receiver and associated items.

13.8.1.2 A runway light intensity monitor (RLIM).

13.8.1.3 An ambient light sensor (ALS).

13.8.1.4 A data processor unit (DPU).

13.8.1.5 A controller display (CD).

13.8.2 The forward scatter meter is mounted on a 14-foot frangible pole. Infrared light is emitted from the transmitter and received by the receiver. Any obscuring matter such as rain, snow, dust, fog, haze, or smoke increases the amount of scattered light reaching the receiver. The resulting measurement along with inputs from the runway light intensity monitor and the ambient light sensor are forwarded to the DPU which calculates the proper RVR value. The RVR values are displayed locally and remotely on controller displays.

13.8.3 The runway light intensity monitors both the runway edge and centerline light step settings (steps 1 through 5). Centerline light step settings are used for CAT IIIb operations. Edge light step settings are used for CAT I, II, and IIIa operations.

13.8.4 New Generation RVRs can measure and display RVR values down to the lowest limits of Category IIIb operations (150 foot RVR). RVR values are displayed in 100-foot increments and are reported as follows:

13.8.4.1 100-foot increments for products below 800 feet.

13.8.4.2 200-foot increments for products between 800 feet and 3,000 feet.

13.8.4.3 500-foot increments for products between 3,000 feet and 6,500 feet.

13.8.4.4 25-meter increments for products below 150 meters.

13.8.4.5 50-meter increments for products between 150 meters and 800 meters.

13.8.4.6 100-meter increments for products between 800 meters and 1,200 meters.

13.8.4.7 200-meter increments for products between 1,200 meters and 2,000 meters.

14. Reporting of Cloud Heights

14.1 Ceiling, by definition in Federal Aviation Regulations, and as used in Aviation Weather Reports and Forecasts, is the height above ground (or water) level of the lowest layer of clouds or obscuring phenomenon that is reported as "broken," "overcast," or "the vertical visibility into an obscuration." For example, an aerodrome forecast which reads "BKN030" refers to heights above ground level (AGL). An area forecast which reads "BKN030" states that the height is above mean sea level (MSL). See FIG GEN 3.5-23 for the Key to Routine Aviation Weather Reports and Forecasts for the definition of "broken," "overcast," and "obscuration."

14.2 Information on cloud base height is obtained by use of ceilometers (rotating or fixed beam), ceiling lights, ceiling balloons, pilot reports, and observer estimations. The systems in use by most reporting stations are either the observer estimation or the rotating beam ceilometer.

14.3 Pilots usually report height values above mean sea level, since they determine heights by the altimeter. This is taken into account when disseminating and otherwise applying information received from pilots. ("Ceiling" heights are always above ground level.) In reports disseminated as pilot reports, height references are given the same as received from pilots; that is, above mean sea level.

14.4 In area forecasts or inflight Advisories, ceilings are denoted by the contraction "CIG" when used with sky cover symbols as in "LWRG TO CIG OVC005," or the contraction "AGL" after the forecast cloud height value. When the cloud base is given in height above mean sea level, it is so indicated by the contraction "MSL" or "ASL" following the height value. The heights of cloud tops, freezing level, icing, and turbulence are always given in heights above mean sea level (ASL or MSL).

15. Reporting Prevailing Visibility

15.1 Surface (horizontal) visibility is reported in METAR reports in terms of statute miles and increments thereof; e.g., $^{1}/_{16}$, $^{1}/_{8}$, $^{3}/_{16}$, $^{1}/_{4}$, $^{5}/_{16}$, $^{3}/_{8}$, $^{1}/_{2}$, $^{5}/_{8}$, $^{3}/_{4}$, $^{7}/_{8}$, 1, 1 $^{1}/_{8}$, etc. (Visibility reported by an unaugmented automated site is reported differently than in a manual report; i.e., ASOS: 0, $^{1}/_{16}$, $^{1}/_{8}$, $^{1}/_{4}$, $^{1}/_{2}$, $^{3}/_{4}$, 1, 1 $^{1}/_{4}$, 1 $^{1}/_{2}$, 1 $^{3}/_{4}$, 2, 2 $^{1}/_{2}$, 3, 4, 5, etc., AWOS: M$^{1}/_{4}$, $^{1}/_{4}$, $^{1}/_{2}$, $^{3}/_{4}$, 1, 1 $^{1}/_{4}$, 1 $^{1}/_{2}$, 1 $^{3}/_{4}$, 2, 2 $^{1}/_{2}$, 3, 4, 5, etc.) Visibility is determined through the ability to see and identify preselected and prominent objects at a known distance from the usual point of observation. Visibilities which are determined to be less than 7 miles, identify the obscuring atmospheric condition; e.g., fog, haze, smoke, etc., or combinations thereof.

15.2 Prevailing visibility is the greatest visibility equalled or exceeded throughout at least one−half the horizon circle, not necessarily contiguous. Segments of the horizon circle which may have a significantly different visibility may be reported in the remarks section of the weather report; i.e., the southeastern quadrant of the horizon circle may be determined to be 2 miles in mist while the remaining quadrants are determined to be 3 miles in mist.

15.3 When the prevailing visibility at the usual point of observation, or at the tower level, is less than 4 miles, certificated tower personnel will take visibility observations in addition to those taken at the usual point of observation. The lower of these two values will be used as the prevailing visibility for aircraft operations.

16. Estimating Intensity of Rain and Ice Pellets

16.1 Rain

16.1.1 Light. From scattered drops that, regardless of duration, do not completely wet an exposed surface up to a condition where individual drops are easily seen.

16.1.2 Moderate. Individual drops are not clearly identifiable; spray is observable just above pavements and other hard surfaces.

16.1.3 Heavy. Rain seemingly falls in sheets; individual drops are not identifiable; heavy spray to a height of several inches is observed over hard surfaces.

16.2 Ice Pellets

16.2.1 Light. Scattered pellets that do not completely cover an exposed surface regardless of duration. Visibility is not affected.

16.2.2 Moderate. Slow accumulation on the ground. Visibility is reduced by ice pellets to less than 7 statute miles.

16.2.3 Heavy. Rapid accumulation on the ground. Visibility is reduced by ice pellets to less than 3 statute miles.

17. Estimating the Intensity of Snow or Drizzle (Based on Visibility)

17.1 Light. Visibility more than $^{1}/_{2}$ statute mile.

17.2 Moderate. Visibility from more than $^{1}/_{4}$ statute mile to $^{1}/_{2}$ statute mile.

17.3 Heavy. Visibility $^{1}/_{4}$ statute mile or less.

18. Pilot Weather Reports (PIREPs)

18.1 FAA air traffic facilities are required to solicit PIREPs when the following conditions are reported or forecast: ceilings at or below 5,000 feet, visibility at or below 5 miles (surface or aloft), thunderstorms and related phenomena, icing of a light degree or greater, turbulence of a moderate degree or greater, wind shear, and reported or forecast volcanic ash clouds.

18.2 Pilots are urged to cooperate and promptly volunteer reports of these conditions and other atmospheric data, such as cloud bases, tops and layers, flight visibility, precipitation, visibility restrictions (haze, smoke, and dust), wind at altitude, and temperature aloft.

18.3 PIREPs should be given to the ground facility with which communications are established; i.e., EFAS, AFSS/FSS, ARTCC, or terminal ATC. Radio call "FLIGHT WATCH," which serves as a collection point for the exchange of PIREPs with en route aircraft, is one of the primary duties of EFAS facilities.

18.4 If pilots do not make PIREPs by radio, it is helpful if, upon landing, they report to the nearest AFSS/FSS or Weather Forecast Office the inflight conditions which they encountered. Some of the uses made of the reports are:

18.4.1 The ATCT uses the reports to expedite the flow of air traffic in the vicinity of the field and for hazardous weather avoidance procedures.

18.4.2 The AFSS/FSS uses the reports to brief other pilots, to provide inflight advisories and weather avoidance information to en route aircraft.

18.4.3 The ARTCC uses the reports to expedite the flow of en route traffic, to determine most favorable altitudes, and to issue hazardous weather information within the center's area.

18.4.4 The NWS uses the reports to verify or amend conditions contained in aviation forecasts and advisories; (In some cases, pilot reports of hazardous conditions are the triggering mechanism for the issuance of advisories.)

18.4.5 The NWS, other government organizations, the military, and private industry groups use PIREPs for research activities in the study of meteorological phenomena.

18.4.6 All air traffic facilities and the NWS forward the reports received from pilots into the weather distribution system to assure the information is made available to all pilots and other interested parties.

18.5 The FAA, NWS, and other organizations that enter PIREPs into the weather reporting system use the format listed in TBL GEN 3.5-6, PIREP Element Code Chart. Items 1 through 6 are included in all transmitted PIREPs along with one or more of items 7 through 13. Although the PIREP should be as complete and concise as possible, pilots should not be overly concerned with strict format or phraseology. The important thing is that the information is relayed so other pilots may benefit from your observation. If a portion of the report needs clarification, the ground station will request the information.

18.6 Completed PIREPs will be transmitted to weather circuits as in the following examples:

EXAMPLE-
KCMH UA/OV APE 230010/TM 1516/FL085/TP BE20/SK BKN065/WX FV03SM HZ FU/TA 20/TB LGT.

Translation: one zero miles southwest of Appleton VOR; time 1516 UTC; altitude eight thousand five hundred; aircraft type BE20; base of the broken cloud layer is six thousand five hundred; flight visibility 3 miles with haze and smoke; air temperature 20 degrees Celsius; light turbulence.

EXAMPLE-
KCRW UA/OV KBKW 360015-KCRW/TM 1815/ FL120/TP BE99/SK IMC/WX RA-/TA M08/WV 290030/TB LGT-MDT/IC LGT RIME/RM MDT MXD ICG DURC KROA NWBND FL080-100 1750Z.

Translation: from 15 miles north of Beckley VOR to Charleston VOR; time 1815 UTC; altitude 12,000 feet; type aircraft, BE-99; in clouds; rain; temperature minus 8 Celsius; wind 290 degrees magnetic at 30 knots; light to moderate turbulence; light rime icing during climb northwestbound from Roanoke, VA, between 8,000 and 10,000 feet at 1750 UTC.

TBL GEN 3.5−6

PIREP Element Code Chart

	PIREP ELEMENT	PIREP CODE	CONTENTS
1.	3−letter station identifier	XXX	Nearest weather reporting location to the reported phenomenon
2.	Report type	UA or UUA	Routine or urgent PIREP
3.	Location	/OV	In relation to a VOR
4.	Time	/TM	Coordinated Universal Time
5.	Altitude	/FL	Essential for turbulence and icing reports
6.	Type aircraft	/TP	Essential for turbulence and icing reports
7.	Sky cover	/SK	Cloud height and coverage (sky clear, few, scattered, broken, or overcast)
8.	Weather	/WX	Flight visibility, precipitation, restrictions to visibility, etc.
9.	Temperature	/TA	Degrees Celsius
10.	Wind	/WV	Direction in degrees magnetic north and speed in knots
11.	Turbulence	/TB	See paragraph 22
12.	Icing	/IC	See paragraph 20
13.	Remarks	/RM	For reporting elements not included or to clarify previously reported items

19. Mandatory MET Points

19.1 Within the ICAO CAR/SAM Regions and within the U.S. area of responsibility, several mandatory MET reporting points have been established. These points are located within the Houston, Miami, and San Juan Flight Information Regions (FIR). These points have been established for flights between the South American and Caribbean Regions and Europe, Canada and the U.S.

19.2 Mandatory MET Reporting Points Within the Houston FIR

Point	For Flights Between
ABBOT	Acapulco and Montreal, New York, Toronto, Mexico City and New Orleans.
ALARD	New Orleans and Belize, Guatemala, San Pedro Sula, Mexico City and Miami, Tampa.
ARGUS	Toronto and Guadalajara, Mexico City, New Orleans and Mexico City.
SWORD	Dallas-Fort Worth, New Orleans, Chicago and Cancun, Cozumel, and Central America.

19.3 Mandatory MET Reporting Points Within the Miami FIR

Point	For Flights Between
Grand Turk	New York and Aruba, Curacao, Kingston, Miami and Belem, St. Thomas, Rio de Janeiro, San Paulo, St. Croix, Kingston and Bermuda.
GRATX	Madrid and Miami, Havana.
MAPYL	New York and Guayaquil, Montego Bay, Panama, Lima, Atlanta and San Juan.
RESIN	New Orleans and San Juan.
SLAPP	New York and Aruba, Curacao, Kingston, Port-au-Prince. Bermuda and Freeport, Nassau. New York and Barranquilla, Bogota, Santo Domingo, Washington and Santo Domingo, Atlanta and San Juan.

19.4 Mandatory MET Reporting Points Within the San Juan FIR

Point	For Flights Between
GRANN	Toronto and Barbados, New York and Fort de France. At intersection of routes A321, A523, G432.
KRAFT	San Juan and Buenos Aires, Caracas, St. Thomas, St. Croix, St. Maarten, San Juan, Kingston and Bermuda.
PISAX	New York and Barbados, Fort de France, Bermuda and Antigua, Barbados.

TBL GEN 3.5−7

Intensity	Ice Accumulation
Trace	Ice becomes perceptible. Rate of accumulation slightly greater than rate of sublimation. Deicing/anti−icing equipment is not utilized unless encountered for an extended period of time (over 1 hour).
Light	The rate of accumulation may create a problem if flight is prolonged in this environment (over 1 hour). Occasional use of deicing/anti−icing equipment removes/prevents accumulation. It does not present a problem if the deicing/anti−icing equipment is used.
Moderate	The rate of accumulation is such that even short encounters become potentially hazardous and use of deicing/anti−icing equipment or diversion is necessary.
Severe	The rate of accumulation is such that deicing/anti−icing equipment fails to reduce or control the hazard. Immediate diversion is necessary.
Pilot Report: Aircraft Identification, Location, Time (UTC), Intensity of Type[1], Altitude/FL, Aircraft Type, Indicated Air Speed (IAS), and Outside Air Temperature (OAT)[2].	
[1]Rime or Clear Ice: Rime ice is a rough, milky, opaque ice formed by the instantaneous freezing of small supercooled water droplets. Clear ice is a glossy, clear, or translucent ice formed by the relatively slow freezing of large supercooled water droplets.	
[2]The Outside Air Temperature (OAT) should be requested by the AFSS/FSS or ATC if not included in the PIREP.	

20. PIREPs Relating to Airframe Icing

20.1 The effects of ice accretion on aircraft are: cumulative−thrust is reduced, drag increases, lift lessens, weight increases. The results are an increase in stall speed and a deterioration of aircraft performance. In extreme cases, 2 to 3 inches of ice can form on the leading edge of the airfoil in less than 5 minutes. It takes but $^1/_2$ inch of ice to reduce the lifting power of some aircraft by 50 percent and to increase the frictional drag by an equal percentage.

20.2 A pilot can expect icing when flying in visible precipitation, such as rain or cloud droplets, and the temperature is between +02 and −10 degrees Celsius. When icing is detected, a pilot should do one of two things (particularly if the aircraft is not equipped with deicing equipment). The pilot should get out of the area of precipitation or go to an altitude where the temperature is above freezing. This "warmer" altitude may not always be a lower altitude. Proper preflight action includes obtaining information on the freezing level and the above−freezing levels in precipitation areas. Report the icing to an ATC or FSS facility, and if operating IFR, request new routing or altitude if icing will be a hazard. Be sure to give the type of aircraft to ATC when reporting icing. TBL GEN 3.5−7, describes how to report icing conditions.

21. Definitions of Inflight Icing Terms

See TBL GEN 3.5−8, Icing Types, and TBL GEN 3.5−9, Icing Conditions.

TBL GEN 3.5−8

Icing Types

Clear Ice	See Glaze Ice.
Glaze Ice	Ice, sometimes clear and smooth, but usually containing some air pockets, which results in a lumpy translucent appearance. Glaze ice results from supercooled drops/droplets striking a surface but not freezing rapidly on contact. Glaze ice is denser, harder, and sometimes more transparent than rime ice. Factors, which favor glaze formation, are those that favor slow dissipation of the heat of fusion (i.e., slight supercooling and rapid accretion). With larger accretions, the ice shape typically includes "horns" protruding from unprotected leading edge surfaces. It is the ice shape, rather than the clarity or color of the ice, which is most likely to be accurately assessed from the cockpit. The terms "clear" and "glaze" have been used for essentially the same type of ice accretion, although some reserve "clear" for thinner accretions which lack horns and conform to the airfoil.
Intercycle Ice	Ice which accumulates on a protected surface between actuation cycles of a deicing system.
Known or Observed or Detected Ice Accretion	Actual ice observed visually to be on the aircraft by the flight crew or identified by on−board sensors.
Mixed Ice	Simultaneous appearance or a combination of rime and glaze ice characteristics. Since the clarity, color, and shape of the ice will be a mixture of rime and glaze characteristics, accurate identification of mixed ice from the cockpit may be difficult.
Residual Ice	Ice which remains on a protected surface immediately after the actuation of a deicing system.
Rime Ice	A rough, milky, opaque ice formed by the rapid freezing of supercooled drops/droplets after they strike the aircraft. The rapid freezing results in air being trapped, giving the ice its opaque appearance and making it porous and brittle. Rime ice typically accretes along the stagnation line of an airfoil and is more regular in shape and conformal to the airfoil than glaze ice. It is the ice shape, rather than the clarity or color of the ice, which is most likely to be accurately assessed from the cockpit.
Runback Ice	Ice which forms from the freezing or refreezing of water leaving protected surfaces and running back to unprotected surfaces.
Note− *Ice types are difficult for the pilot to discern and have uncertain effects on an airplane in flight. Ice type definitions will be included in the AIP for use in the "Remarks" section of the PIREP and for use in forecasting.*	

TBL GEN 3.5-9

Icing Conditions

Appendix C Icing Conditions	Appendix C (14 CFR, Part 25 and 29) is the certification icing condition standard for approving ice protection provisions on aircraft. The conditions are specified in terms of altitude, temperature, liquid water content (LWC), representative droplet size (mean effective drop diameter [MED]), and cloud horizontal extent.
Forecast Icing Conditions	Environmental conditions expected by a National Weather Service or an FAA-approved weather provider to be conducive to the formation of inflight icing on aircraft.
Freezing Drizzle (FZDZ)	Drizzle is precipitation at ground level or aloft in the form of liquid water drops which have diameters less than 0.5 mm and greater than 0.05 mm. Freezing drizzle is drizzle that exists at air temperatures less than 0°C (supercooled), remains in liquid form, and freezes upon contact with objects on the surface or airborne.
Freezing Precipitation	Freezing precipitation is freezing rain or freezing drizzle falling through or outside of visible cloud.
Freezing Rain (FZRA)	Rain is precipitation at ground level or aloft in the form of liquid water drops which have diameters greater than 0.5 mm. Freezing rain is rain that exists at air temperatures less than 0°C (supercooled), remains in liquid form, and freezes upon contact with objects on the ground or in the air.
Icing in Cloud	Icing occurring within visible cloud. Cloud droplets (diameter < 0.05 mm) will be present; freezing drizzle and/or freezing rain may or may not be present.
Icing in Precipitation	Icing occurring from an encounter with freezing precipitation, that is, supercooled drops with diameters exceeding 0.05 mm, within or outside of visible cloud.
Known Icing Conditions	Atmospheric conditions in which the formation of ice is observed or detected in flight. ***Note-*** *Because of the variability in space and time of atmospheric conditions, the existence of a report of observed icing does not assure the presence or intensity of icing conditions at a later time, nor can a report of no icing assure the absence of icing conditions at a later time.*
Potential Icing Conditions	Atmospheric icing conditions that are typically defined by airframe manufacturers relative to temperature and visible moisture that may result in aircraft ice accretion on the ground or in flight. The potential icing conditions are typically defined in the Airplane Flight Manual or in the Airplane Operation Manual.
Supercooled Drizzle Drops (SCDD)	Synonymous with freezing drizzle aloft.
Supercooled Drops or /Droplets	Water drops/droplets which remain unfrozen at temperatures below 0 °C. Supercooled drops are found in clouds, freezing drizzle, and freezing rain in the atmosphere. These drops may impinge and freeze after contact on aircraft surfaces.
Supercooled Large Drops (SLD)	Liquid droplets with diameters greater than 0.05 mm at temperatures less than 0°C, i.e., freezing rain or freezing drizzle.

22. PIREPs Relating to Turbulence

22.1 When encountering turbulence, pilots are urgently requested to report such conditions to ATC as soon as practicable. PIREPs relating to turbulence should state:

22.1.1 Aircraft location.

22.1.2 Time of occurrence in UTC.

22.1.3 Turbulence intensity.

22.1.4 Whether the turbulence occurred in or near clouds.

22.1.5 Aircraft altitude, or flight level.

22.1.6 Type of aircraft.

22.1.7 Duration of turbulence.

EXAMPLE–

1. *Over Omaha, 1232Z, moderate turbulence in clouds at Flight Level three one zero, Boeing 707.*

2. *From five zero miles south of Albuquerque to three zero miles north of Phoenix, 1250Z, occasional moderate chop at Flight Level three three zero, DC8.*

22.2 Duration and classification of intensity should be made using TBL GEN 3.5-10, Turbulence Reporting Criteria Table.

TBL GEN 3.5-10

Turbulence Reporting Criteria Table

Intensity	Aircraft Reaction	Reaction inside Aircraft	Reporting Term-Definition
Light	Turbulence that momentarily causes slight, erratic changes in altitude and/or attitude (pitch, roll, yaw). Report as **Light Turbulence;** [1] or Turbulence that causes slight, rapid and somewhat rhythmic bumpiness without appreciable changes in altitude or attitude. Report as **Light Chop.**	Occupants may feel a slight strain against seat belts or shoulder straps. Unsecured objects may be displaced slightly. Food service may be conducted, and little or no difficulty is encountered in walking.	Occasional-Less than $^{1}/_{3}$ of the time. Intermittent-$^{1}/_{3}$ to $^{2}/_{3}$. Continuous-More than $^{2}/_{3}$.
Moderate	Turbulence that is similar to Light Turbulence but of greater intensity. Changes in altitude and/or attitude occur, but the aircraft remains in positive control at all times. It usually causes variations in indicated airspeed. Report as **Moderate Turbulence;** [1] or Turbulence that is similar to Light Chop but of greater intensity. It causes rapid bumps or jolts without appreciable changes in aircraft altitude or attitude. Report as **Moderate Chop.** [1]	Occupants feel definite strains against seat belts or shoulder straps. Unsecured objects are dislodged. Food service and walking are difficult.	**NOTE** 1. Pilots should report location(s), time (UTC), intensity, whether in or near clouds, altitude, type of aircraft and, when applicable, duration of turbulence. 2. Duration may be based on time between two locations or over a single location. All locations should be readily identifiable.
Severe	Turbulence that causes large, abrupt changes in altitude and/or attitude. It usually causes large variations in indicated airspeed. Aircraft may be momentarily out of control. Report as **Severe Turbulence.**[1]	Occupants are forced violently against seat belts or shoulder straps. Unsecured objects are tossed about. Food service and walking are impossible.	**EXAMPLES:** a. Over Omaha. 1232Z, Moderate Turbulence, in cloud, Flight Level 310, B707.
Extreme	Turbulence in which the aircraft is violently tossed about and is practically impossible to control. It may cause structural damage. Report as **Extreme Turbulence.** [1]		b. From 50 miles south of Albuquerque to 30 miles north of Phoenix, 1210Z to 1250Z, occasional Moderate Chop, Flight Level 330, DC8.

[1] High level turbulence (normally above 15,000 feet ASL) not associated with cumuliform cloudiness, including thunderstorms, should be reported as clear air turbulence (CAT) preceded by the appropriate intensity, or light or moderate chop.

23. Wind Shear PIREPs

23.1 Because unexpected changes in wind speed and direction can be hazardous to aircraft operations at low altitudes on approach to and departing from airports, pilots are urged to promptly volunteer reports to controllers of wind shear conditions they encounter. An advance warning of this information will assist other pilots in avoiding or coping with a wind shear on approach or departure.

23.2 When describing conditions, the use of the terms "negative" or "positive" wind shear should be avoided. PIREPs of negative wind shear on final, intended to describe loss of airspeed and lift, have been interpreted to mean that no wind shear was encountered. The recommended method for wind shear reporting is to state the loss/gain of airspeed and the altitude(s) at which it was encountered.

EXAMPLE-
1. *Denver Tower, Cessna 1234 encountered wind shear, loss of 20 knots at 400.*
2. *Tulsa Tower, American 721 encountered wind shear on final, gained 25 knots between 600 and 400 feet followed by loss of 40 knots between 400 feet and surface.*

Pilots using Inertial Navigation Systems should report the wind and altitude both above and below the shear layer.

EXAMPLE-
Miami Tower, Gulfstream 403 Charlie encountered an abrupt wind shear at 800 feet on final, max thrust required.

Pilots who are not able to report wind shear in these specific terms are encouraged to make reports in terms of the effect upon their aircraft.

24. Clear Air Turbulence (CAT) PIREPs

24.1 Clear air turbulence (CAT) has become a very serious operational factor to flight operations at all levels and especially to jet traffic flying in excess of 15,000 feet. The best available information on this phenomenon must come from pilots via the PIREP procedures. All pilots encountering CAT conditions are urgently requested to report time, location, and intensity (light, moderate, severe, or extreme) of the element to the FAA facility with which they are maintaining radio contact. If time and conditions permit, elements should be reported according to the standards for other PIREPs and position reports. See TBL GEN 3.5-10, Turbulence Reporting Criteria Table.

25. Microbursts

25.1 Relatively recent meteorological studies have confirmed the existence of microburst phenomena. Microbursts are small-scale intense downdrafts which, on reaching the surface, spread outward in all directions from the downdraft center. This causes the presence of both vertical and horizontal wind shears that can be extremely hazardous to all types and categories of aircraft, especially at low altitudes. Due to their small size, short life-span, and the fact that they can occur over areas without surface precipitation, microbursts are not easily detectable using conventional weather radar or wind shear alert systems.

25.2 Parent clouds producing microburst activity can be any of the low or middle layer convective cloud types. Note however, that microbursts commonly occur within the heavy rain portion of thunderstorms, and in much weaker, benign-appearing convective cells that have little or no precipitation reaching the ground.

25.3 The life cycle of a microburst as it descends in a convective rain shaft is seen in FIG GEN 3.5-8, Evolution of a Microburst. An important consideration for pilots is the fact that the microburst intensifies for about 5 minutes after it strikes the ground.

25.4 Characteristics of microbursts include:

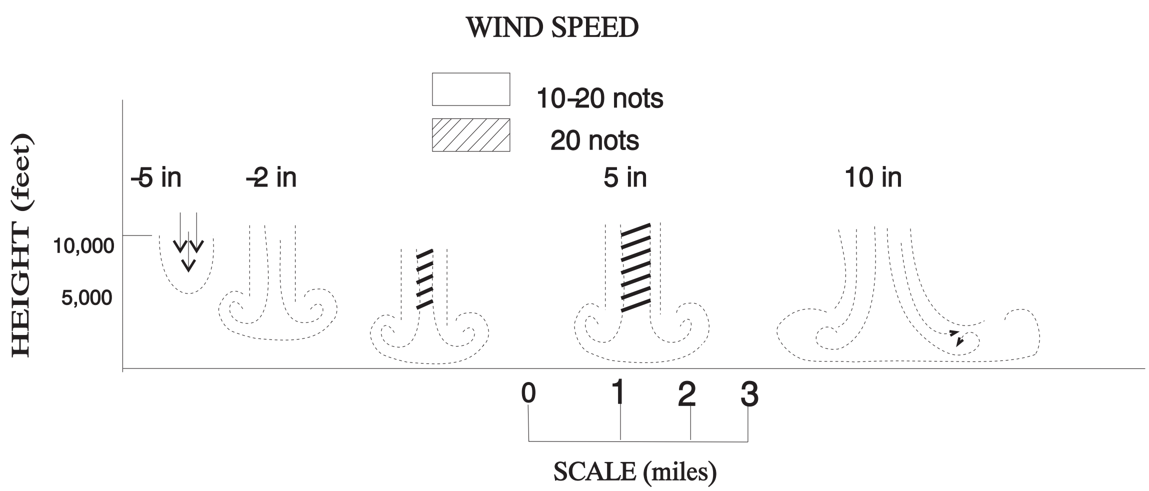
25.4.1 Size. The microburst downdraft is typically less than 1 mile in diameter as it descends from the cloud base to about 1,000-3,000 feet above the ground. In the transition zone near the ground, the downdraft changes to a horizontal outflow that can extend to approximately 2 $^{1}/_{2}$ miles in diameter.

25.4.2 Intensity. The downdrafts can be as strong as 6,000 feet per minute. Horizontal winds near the surface can be as strong as 45 knots resulting in a 90-knot shear (headwind to tailwind change for a traversing aircraft) across the microburst. These strong horizontal winds occur within a few hundred feet of the ground.

25.4.3 Visual Signs. Microbursts can be found almost anywhere that there is convective activity. They may be embedded in heavy rain associated with a thunderstorm or in light rain in benign- appearing virga. When there is little or no precipitation at the surface accompanying the microburst, a ring of blowing dust may be the only visual clue of its existence.

FIG GEN 3.5-8

Evolution of a Microburst

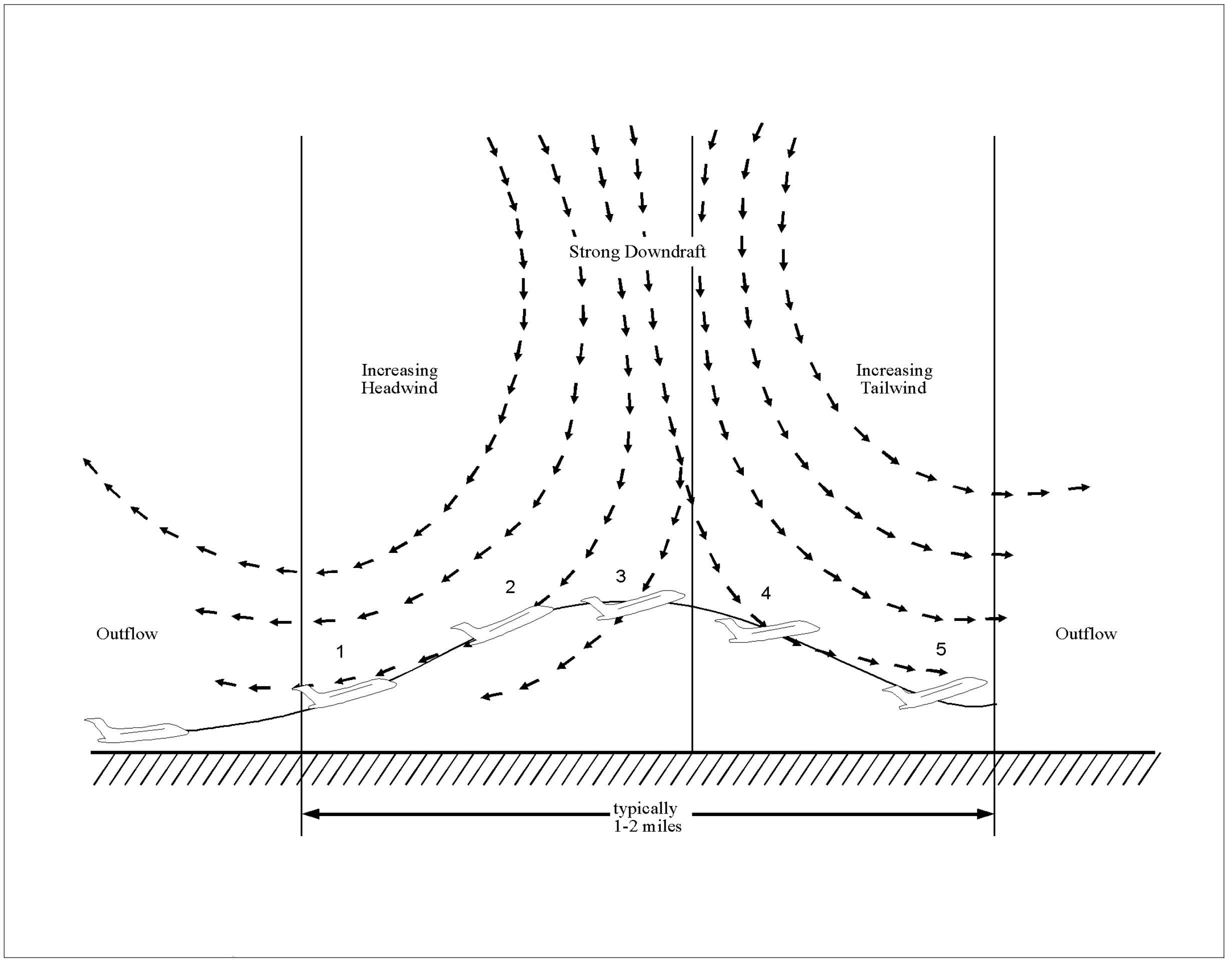


Vertical cross section of the evolution of a microburst wind field. T is the time of initial divergence at the surface. The shading refers to the vector wind speeds. Figure adapted from Wilson et al., 1984, Microburst Wind Structure and Evaluation of Doppler Radar for Wind Shear Detection, DOT/FAA Report No. DOT/FAA/PM-84/29, National Technical Information Service, Springfield, VA 37 pp.

25.4.4 Duration. An individual microburst will seldom last longer than 15 minutes from the time it strikes the ground until dissipation. The horizontal winds continue to increase during the first 5 minutes with the maximum intensity winds lasting approximately 2-4 minutes. Sometimes microbursts are concentrated into a line structure and, under these conditions, activity may continue for as long as 1 hour. Once microburst activity starts, multiple microbursts in the same general area are not uncommon and should be expected.

FIG GEN 3.5-9

Microburst Encounter During Takeoff

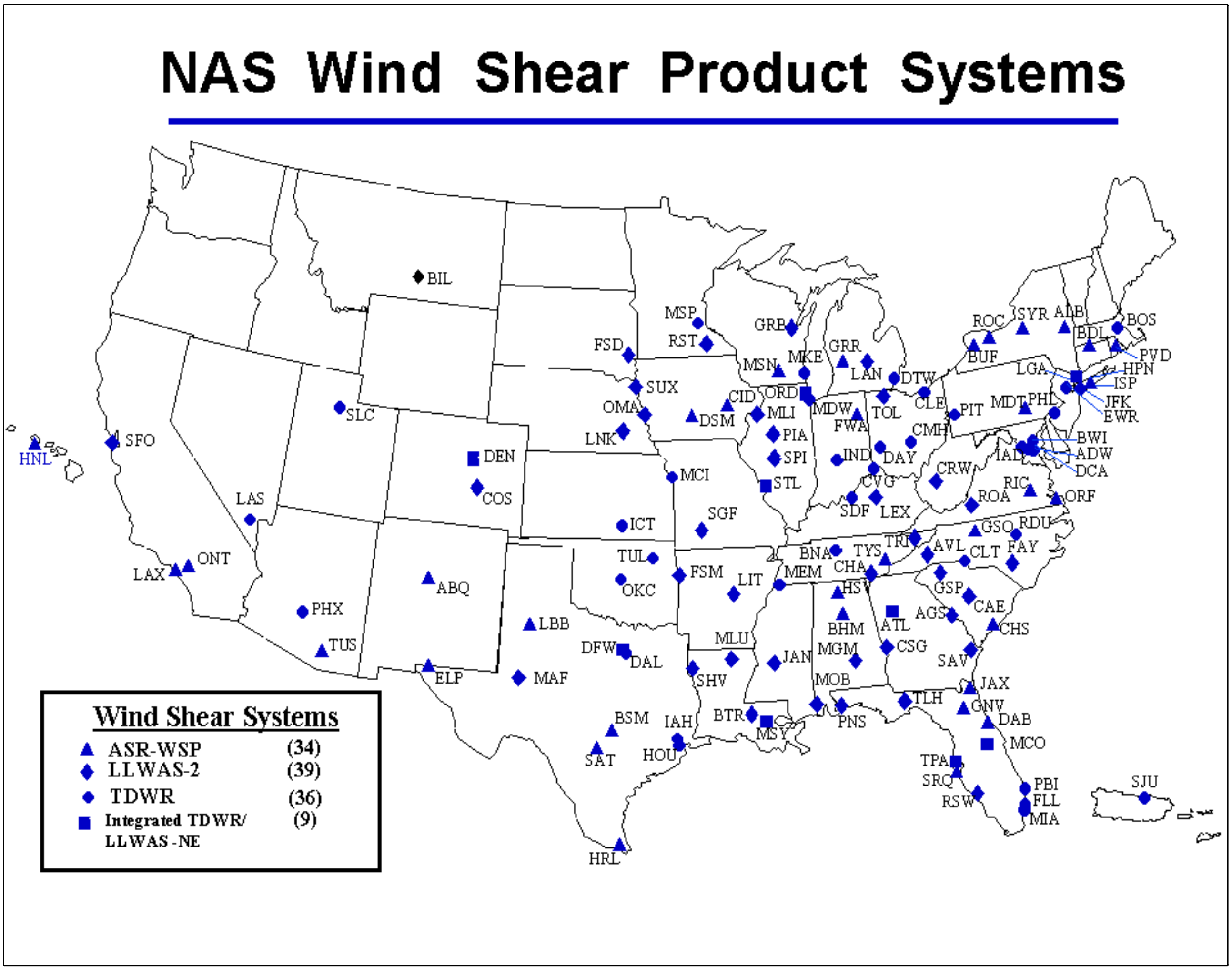


NOTE-

A microburst encounter during takeoff. The airplane first encounters a headwind and experiences increasing performance (1), this is followed in short succession by a decreasing headwind component (2), a downdraft (3), and finally a strong tailwind (4), where 2 through 5 all result in decreasing performance of the airplane. Position (5) represents an extreme situation just prior to impact. Figure courtesy of Walter Frost, FWG Associates, Inc., Tullahoma, Tennessee.

25.5 Microburst wind shear may create a severe hazard for aircraft within 1,000 feet of the ground, particularly during the approach to landing and landing and take-off phases. The impact of a microburst on aircraft which have the unfortunate experience of penetrating one is characterized in FIG GEN 3.5-9. The aircraft may encounter a headwind (performance increasing), followed by a downdraft and a tailwind (both performance decreasing), possibly resulting in terrain impact.

FIG GEN 3.5-10



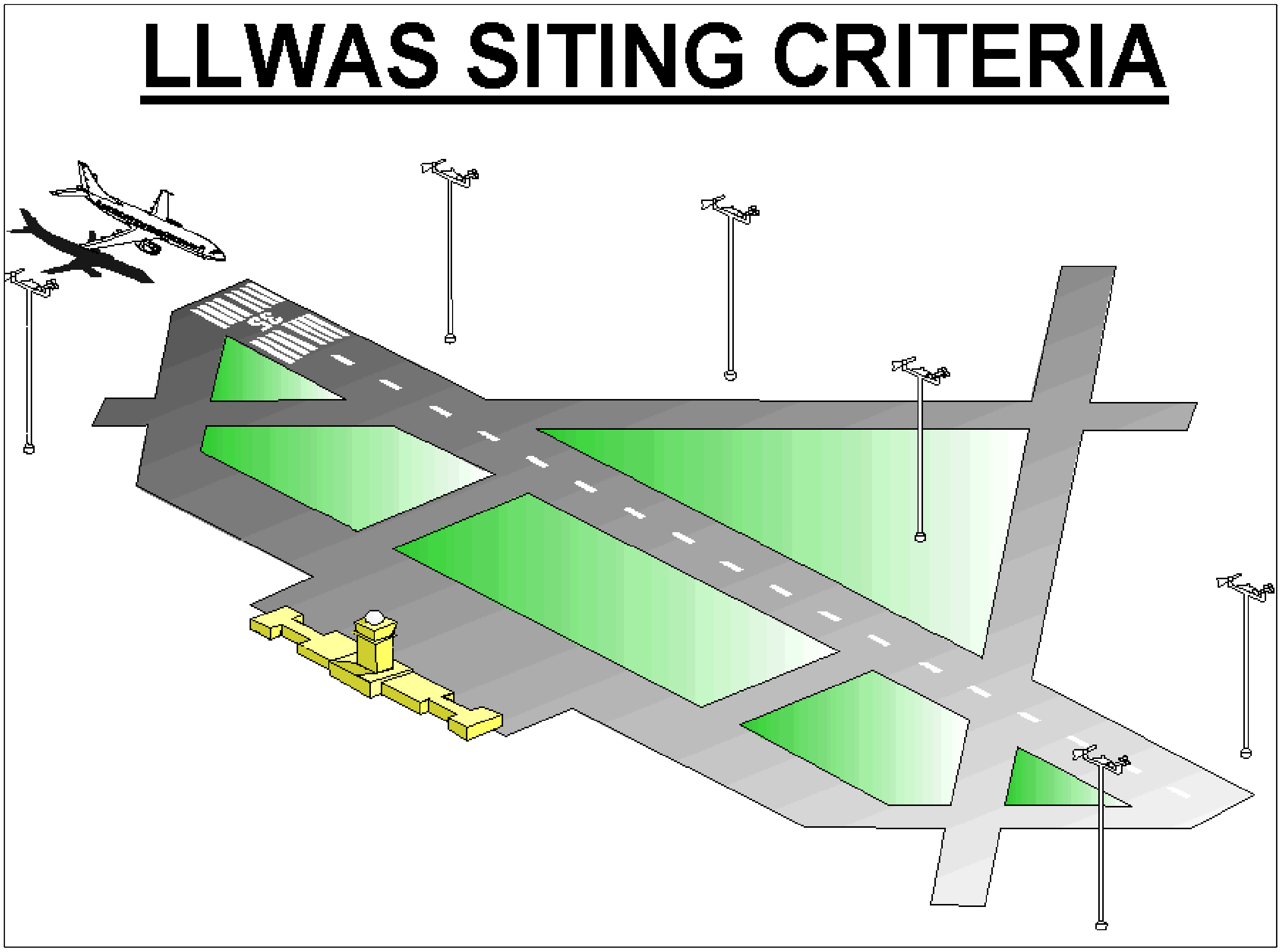
25.6 Detection of Microbursts, Wind Shear, and Gust Fronts

25.6.1 FAA's Integrated Wind Shear Detection Plan

25.6.1.1 The FAA currently employs an integrated plan for wind shear detection that will significantly improve both the safety and capacity of the majority of the airports currently served by the air carriers. This plan integrates several programs, such as the Integrated Terminal Weather System (ITWS), Terminal Doppler Weather Radar (TDWR), Weather System Processor (WSP), and Low Level Wind Shear Alert Systems (LLWAS) into a single strategic concept that significantly improves the aviation weather information in the terminal area. (See FIG GEN 3.5-10.)

25.6.1.2 The wind shear/microburst information and warnings are displayed on the ribbon display terminal (RBDT) located in the tower cabs. They are identical (and standardized) to those in the LLWAS, TDWR and WSP systems, and designed so that the controller does not need to interpret the data, but simply read the displayed information to the pilot. The RBDTs are constantly monitored by the controller to ensure the rapid and timely dissemination of any hazardous event(s) to the pilot.

FIG GEN 3.5-11



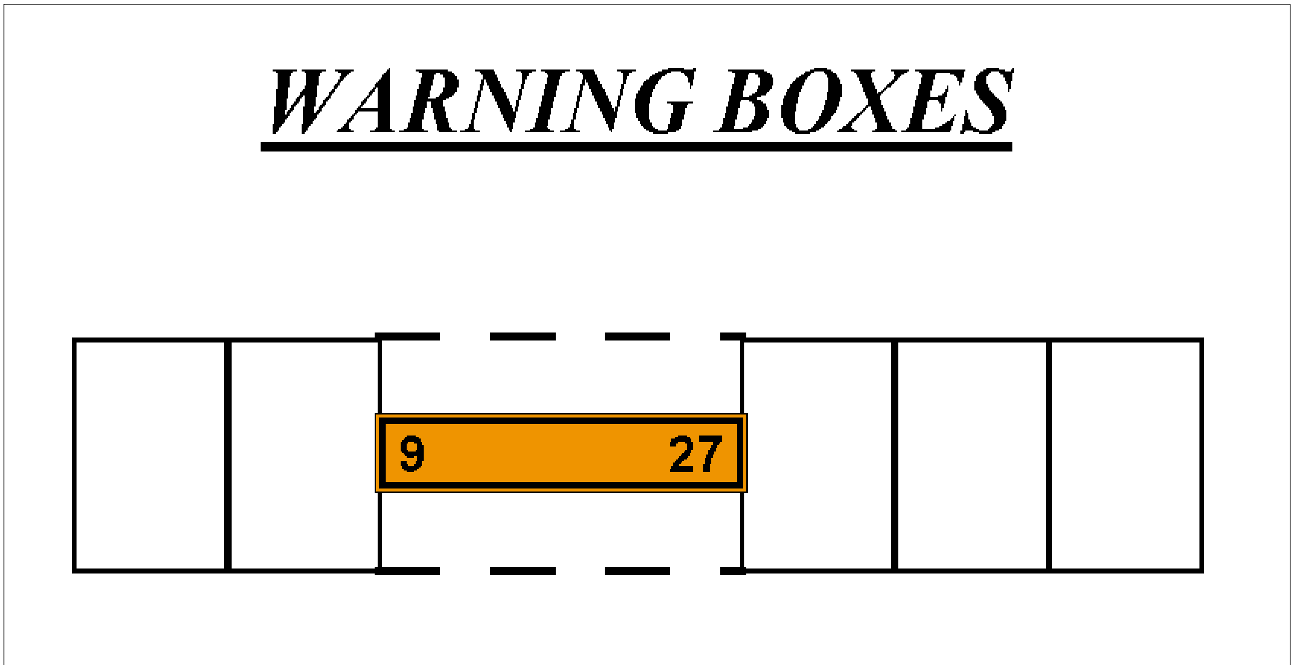
25.6.1.3 The early detection of a wind shear/microburst event, and the subsequent warning(s) issued to an aircraft on approach or departure, will alert the pilot/crew to the potential of, and to be prepared for, a situation that could become very dangerous! Without these warnings, the aircraft may NOT be able to climb out of or safely transition the event, resulting in a catastrophe. The air carriers, working with the FAA, have developed specialized training programs using their simulators to train and prepare their pilots on the demanding aircraft procedures required to escape these very dangerous wind shear and/or microburst encounters.

25.6.1.4 Low Level Wind Shear Alert System (LLWAS)

a) The LLWAS provides wind data and software processes to detect the presence of hazardous wind shear and microbursts in the vicinity of an airport. Wind sensors, mounted on poles sometimes as high as 150 feet, are (ideally) located 2,000 - 3,500 feet, but not more than 5,000 feet, from the centerline of the runway. (See FIG GEN 3.5-11.)

b) The LLWAS was fielded in 1988 at 110 airports across the nation. Many of these systems have been replaced by new terminal doppler weather radar (TDWR) and weather systems processor (WSP) technology. Eventually all LLWAS systems will be phased out; however, 39 airports will be upgraded to the LLWAS-NE (Network Expansion) system, which employs the very latest software and sensor technology. The new LLWAS-NE systems will not only provide the controller with wind shear warnings and alerts, including wind shear/microburst detection at the airport wind sensor location, but will also provide the location of the hazards relative to the airport runway(s). It will also have the flexibility and capability to grow with the airport as new runways are built. As many as 32 sensors, strategically located around the airport and in relationship to its runway configuration, can be accommodated by the LLWAS-NE network.

FIG GEN 3.5-12



25.6.1.5 Terminal Doppler Weather Radar (TDWR)

a) TDWRs are being deployed at 45 locations across the U.S. Optimum locations for TDWRs are 8 to 12 miles from the airport proper, and designed to look at the airspace around and over the airport to detect microbursts, gust fronts, wind shifts, and precipitation intensities. TDWR products advise the controller of wind shear and microburst events impacting all runways and the areas $^1/_2$ mile on either side of the extended centerline of the runways and to a distance of 3 miles on final approach and 2 miles on departure. FIG GEN 3.5-12 is a theoretical view of the runway and the warning boxes that the software uses to determine the location(s) of wind shear or microbursts. These warnings are displayed (as depicted in the examples in subparagraph e) on the ribbon display terminal located in the tower cabs.

b) It is very important to understand what TDWR DOES NOT DO:

1) It **DOES NOT** warn of wind shear outside of the alert boxes (on the arrival and departure ends of the runways).

2) It **DOES NOT** detect wind shear that is NOT a microburst or a gust front.

3) It **DOES NOT** detect gusty or cross wind conditions.

4) It **DOES NOT** detect turbulence.

However, research and development is continuing on these systems. Future improvements may include such areas as storm motion (movement), improved gust front detection, storm growth and decay, microburst prediction, and turbulence detection.

c) TDWR also provides a geographical situation display (GSD) for supervisors and traffic management specialists for planning purposes. The GSD displays (in color) 6 levels of weather (precipitation), gust fronts and predicted storm movement(s). This data is used by the tower supervisor(s), traffic management specialists, and controllers to plan for runway changes and arrival/departure route changes in order to reduce aircraft delays and increase airport capacity.

25.6.1.6 Weather Systems Processor (WSP)

a) The WSP provides the controller, supervisor, traffic management specialist, and ultimately the pilot, with the same products as the terminal doppler weather radar at a fraction of the cost. This is accomplished by utilizing new technologies to access the weather channel capabilities of the existing ASR-9 radar located on or near the airport, thus eliminating the requirements for a separate radar location, land acquisition, support facilities, and the associated communication landlines and expenses.

b) The WSP utilizes the same RBDT display as the TDWR and LLWAS, and, like the TDWR, has a GSD for planning purposes by supervisors, traffic management specialists, and controllers. The WSP GSD emulates the TDWR display; i.e., it also depicts 6 levels of precipitation, gust fronts and predicted storm movement, and like the TDWR, GSD is used to plan for runway changes and arrival/departure route changes in order to reduce aircraft delays and to increase airport capacity.

c) This system is currently under development and is operating in a developmental test status at the Albuquerque, New Mexico, airport. When fielded, the WSP is expected to be installed at 34 airports across the nation, substantially increasing the safety of flying.

25.6.1.7 Operational Aspects of LLWAS, TDWR, and WSP

To demonstrate how this data is used by both the controller and the pilot, 3 ribbon display examples and their explanations are presented:

a) MICROBURST ALERTS

EXAMPLE-
This is what the controller sees on his/her ribbon display in the tower cab.

27A MBA 35K- 2MF 250 20

NOTE-
(See FIG GEN 3.5-13 to see how the TDWR/WSP determines the microburst location).

This is what the controller will say when issuing the alert.

PHRASEOLOGY-
RUNWAY 27 ARRIVAL, MICROBURST ALERT, 35 KT LOSS 2 MILE FINAL, THRESHOLD WINDS 250 AT 20.

In plain language, the controller is telling the pilot that on approach to runway 27, there is a microburst alert on the approach lane to the runway, and to anticipate or expect a 35-knot loss of airspeed at approximately 2 miles out on final approach (where the aircraft will first encounter the phenomena). With that information, the aircrew is forewarned, and should be prepared to apply wind shear/microburst escape procedures should they decide to continue the approach. Additionally, the surface winds at the airport for landing runway 27 are reported as 250 degrees at 20 knots.

NOTE-
Threshold wind is at pilot's request or as deemed appropriate by the controller.

b) WIND SHEAR ALERTS

EXAMPLE-
This is what the controller sees on his/her ribbon display in the tower cab.

27A WSA 20K- 3MF 200 15

NOTE-
(See FIG GEN 3.5-14 to see how the TDWR/WSP determines the wind shear location).

This is what the controller will say when issuing the alert.

PHRASEOLOGY-
RUNWAY 27 ARRIVAL, WIND SHEAR ALERT, 20 KT LOSS 3 MILE FINAL, THRESHOLD WINDS 200 AT 15.

In plain language, the controller is advising the aircraft arriving on runway 27 that at 3 miles out the pilot should expect to encounter a wind shear condition that will decrease airspeed by 20 knots and possibly the aircraft will encounter turbulence. Additionally, the airport surface winds for landing runway 27 are reported as 200 degrees at 15 knots.

NOTE-
Threshold wind is at pilot's request or as deemed appropriate by the controller.

FIG GEN 3.5-13

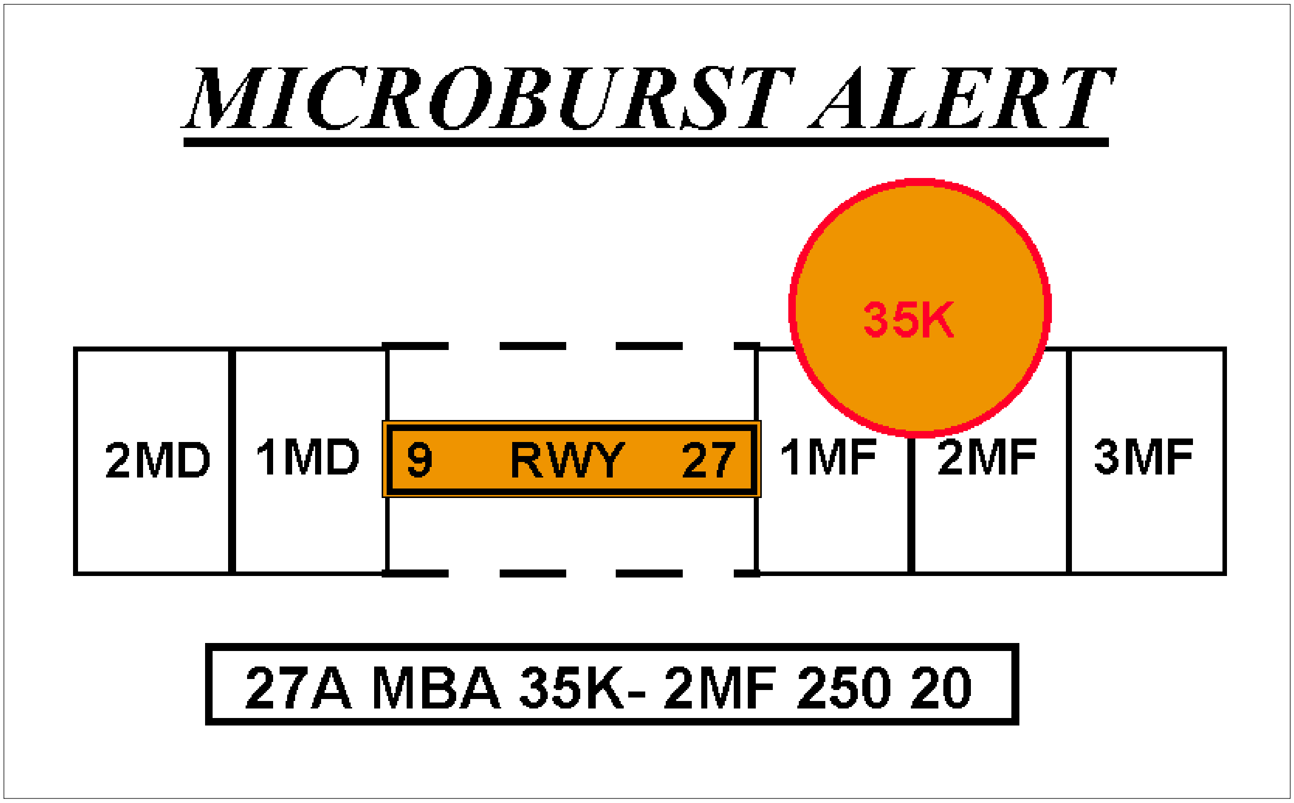


FIG GEN 3.5-14

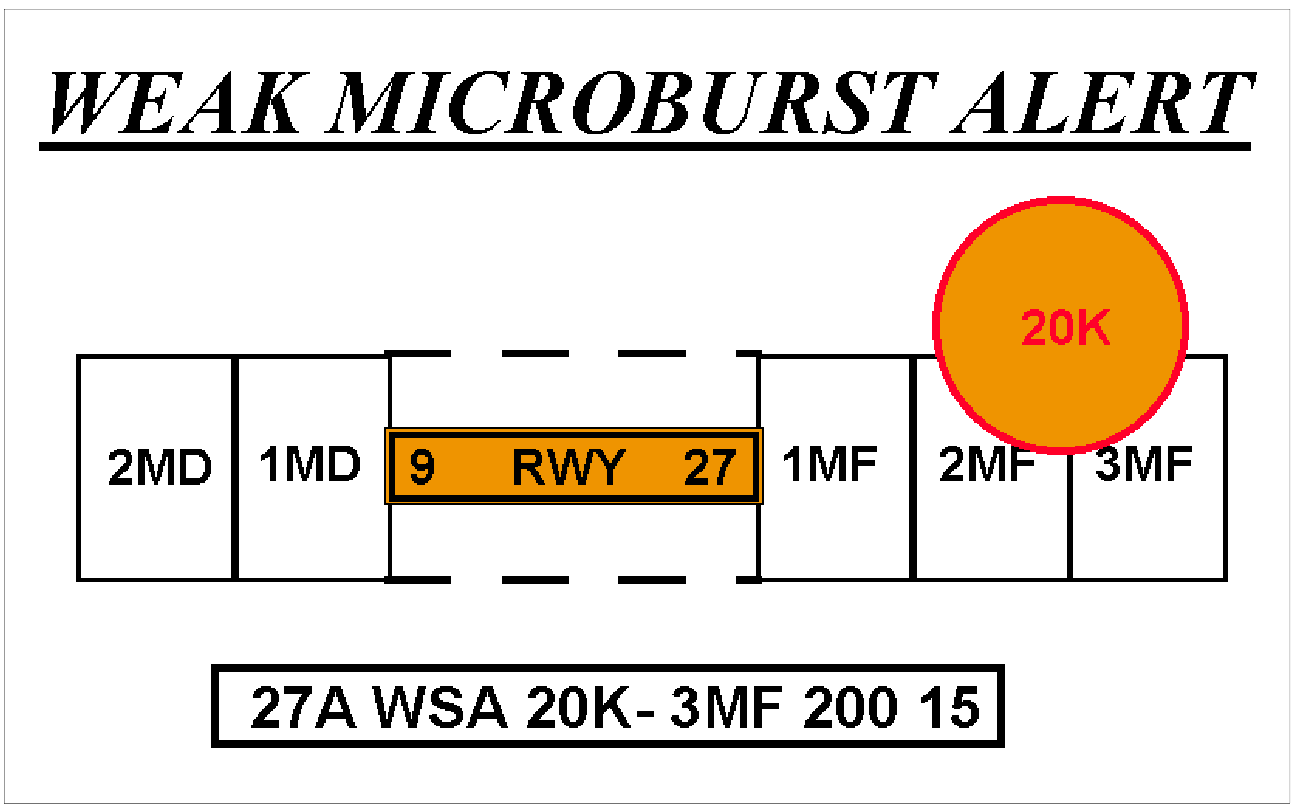
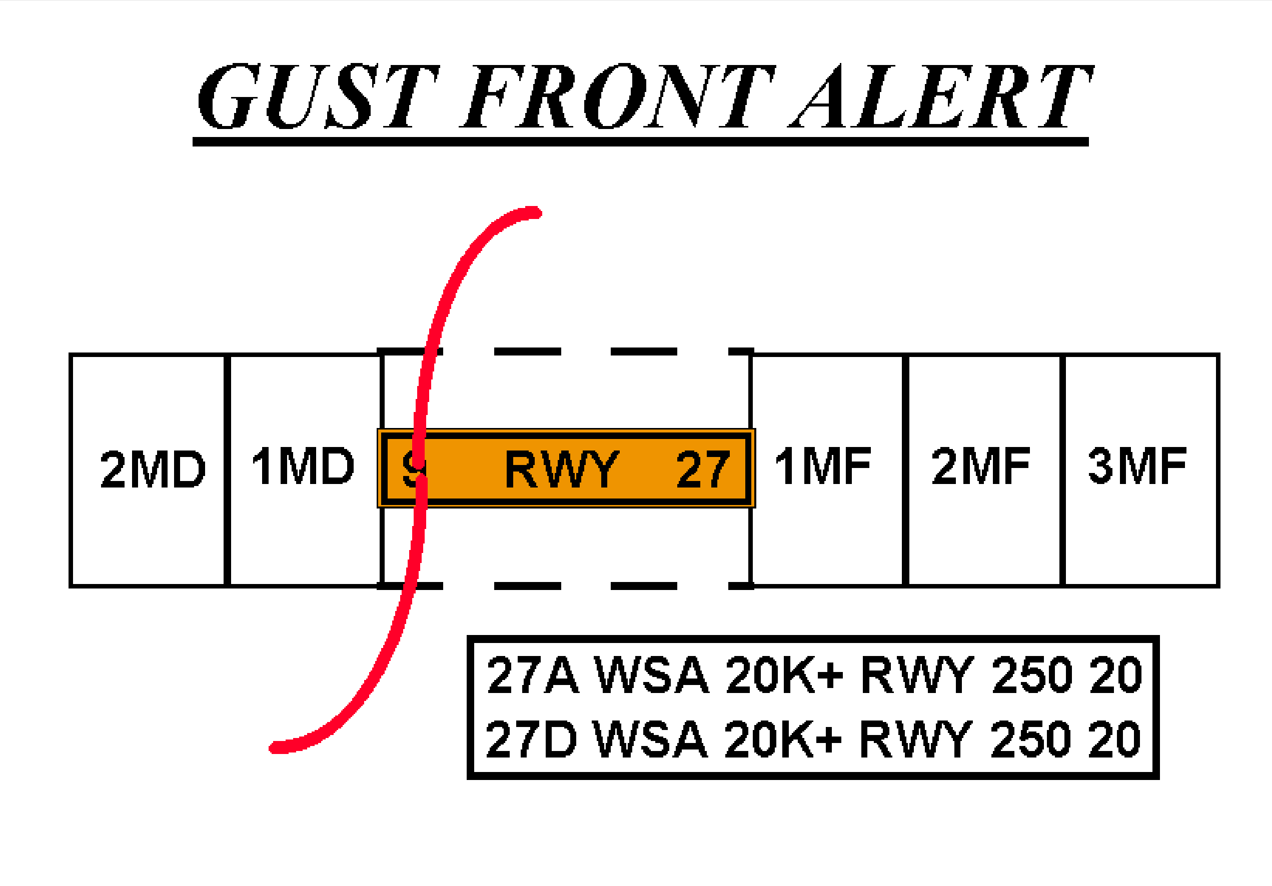


FIG GEN 3.5-15



c) **MULTIPLE WIND SHEAR ALERTS**

EXAMPLE-
This is what the controller sees on his/her ribbon display in the tower cab.

27A WSA 20K+ RWY	250 20
27D WSA 20K+ RWY	250 20

NOTE-
(See FIG GEN 3.5-15 to see how the TDWR/WSP determines the gust front/wind shear location).

This is what the controller will say when issuing the alert.

PHRASEOLOGY-
MULTIPLE WIND SHEAR ALERTS.
RUNWAY 27 ARRIVAL, WIND SHEAR ALERT, 20 KT GAIN ON RUNWAY;
RUNWAY 27 DEPARTURE, WIND SHEAR ALERT, 20 KT GAIN ON RUNWAY, WINDS 250 AT 20.

EXAMPLE-
In this example, the controller is advising arriving and departing aircraft that they could encounter a wind shear condition right on the runway due to a gust front (significant change of wind direction) with the possibility of a 20 knot gain in airspeed associated with the gust front. Additionally, the airport surface winds (for the runway in use) are reported as 250 degrees at 20 knots.

25.6.1.8 The Terminal Weather Information for Pilots System (TWIP)

a) With the increase in the quantity and quality of terminal weather information available through TDWR, the next step is to provide this information directly to pilots rather than relying on voice communications from ATC. The National Airspace System has long been in need of a means of delivering terminal weather information to the cockpit more efficiently in terms of both speed and accuracy to enhance pilot awareness of weather hazards and to reduce air traffic controller workload. With the TWIP capability, terminal weather information, both alphanumerically and graphically, is now available directly to the cockpit on a test basis at 9 locations.

b) TWIP products are generated using weather data from the TDWR or the Integrated Terminal Weather System (ITWS) testbed. TWIP products are generated and stored in the form of text and character graphic messages. Software has been developed to allow TDWR or ITWS to format the data and send the TWIP products to a database resident at Aeronautical Radio, Inc. (ARINC). These products can then be accessed by pilots using the ARINC Aircraft Communications Addressing and Reporting System (ACARS) data link services. Airline dispatchers can also access this database and send messages to specific aircraft whenever wind shear activity begins or ends at an airport.

c) TWIP products include descriptions and character graphics of microburst alerts, wind shear alerts, significant precipitation, convective activity within 30 NM surrounding the terminal area, and expected weather that will impact airport operations. During inclement weather; i.e., whenever a predetermined level of precipitation or wind shear is detected within 15 miles of the terminal area, TWIP products are updated once each minute for text messages and once every 5 minutes for character graphic messages. During good weather (below the predetermined precipitation or wind shear parameters) each message is updated every 10 minutes. These products are intended to improve the situational awareness of the pilot/flight crew, and to aid in flight planning prior to arriving or departing the terminal area. It is important to understand that, in the context of TWIP, the predetermined levels for inclement versus good weather has nothing to do with the criteria for VFR/MVFR/IFR/LIFR; it only deals with precipitation, wind shears, and microbursts.

26. PIREPs Relating to Volcanic Ash Activity

26.1 Volcanic eruptions which send ash into the upper atmosphere occur somewhere around the world several times each year. Flying into a volcanic ash cloud can be exceedingly dangerous. At least two B747s have lost all power in all four engines after such an encounter. Regardless of the type aircraft, some damage is almost certain to ensue after an encounter with a volcanic ash cloud.

26.2 While some volcanoes in the U.S. are monitored, many in remote areas are not. These unmonitored volcanoes may erupt without prior warning to the aviation community. A pilot observing a volcanic eruption who has not had previous notification of it may be the only witness to the eruption. Pilots are strongly encouraged to transmit a PIREP regarding volcanic eruptions and any observed volcanic ash clouds.

26.3 Pilots should submit PIREPs regarding volcanic activity using the Volcanic Activity Reporting form (VAR) as illustrated in FIG GEN 3.5-30. (If a VAR form is not immediately available, relay enough information to identify the position and type of volcanic activity.)

26.4 Pilots should verbally transmit the data required in items 1 through 8 of the VAR as soon as possible. The data required in items 9 through 16 of the VAR should be relayed after landing, if possible.

27. Thunderstorms

27.1 Turbulence, hail, rain, snow, lightning, sustained updrafts and downdrafts, and icing conditions are all present in thunderstorms. While there is some evidence that maximum turbulence exists at the middle level of a thunderstorm, recent studies show little variation of turbulence intensity with altitude.

27.2 There is no useful correlation between the external visual appearance of thunderstorms and the severity or amount of turbulence or hail within them. Also, the visible thunderstorm cloud is only a portion of a turbulent system whose updrafts and downdrafts often extend far beyond the visible storm cloud. Severe turbulence can be expected up to 20 miles from severe thunderstorms. This distance decreases to about 10 miles in less severe storms. These turbulent areas may appear as a well-defined echo on weather radar.

27.3 Weather radar, airborne or ground-based, will normally reflect the areas of moderate to heavy precipitation. (Radar does not detect turbulence.) The frequency and severity of turbulence generally increases with the areas of highest liquid water content of the storm. NO FLIGHT PATH THROUGH AN AREA OF STRONG OR VERY STRONG RADAR ECHOES SEPARATED BY 20-30 MILES OR LESS MAY BE CONSIDERED FREE OF SEVERE TURBULENCE.

27.4 Turbulence beneath a thunderstorm should not be minimized. This is especially true when the relative humidity is low in any layer between the surface and 15,000 feet. Then the lower altitudes may be characterized by strong out-flowing winds and severe turbulence.

27.5 The probability of lightning strikes occurring to aircraft is greatest when operating at altitudes where temperatures are between -5 C and +5 C. Lightning can strike aircraft flying in the clear in the vicinity of a thunderstorm.

27.6 Current weather radar systems are able to objectively determine precipitation intensity. These precipitation intensity areas are described as "light," "moderate," "heavy," and "extreme."

REFERENCE-
Pilot/Controller Glossary Term- Precipitation Radar Weather Descriptions.

EXAMPLE-
Alert provided by an ATC facility to an aircraft:
(aircraft identification) EXTREME precipitation between ten o'clock and two o'clock, one five miles. Precipitation area is two five miles in diameter.

EXAMPLE-
Alert provided by an AFSS/FSS:
(aircraft identification) EXTREME precipitation two zero miles west of Atlanta V-O-R, two five miles wide, moving east at two zero knots, tops flight level three niner zero.

28. Thunderstorm Flying

28.1 Above all, remember this: never regard any thunderstorm lightly, even when radar observers report the echoes are of light intensity. Avoiding thunderstorms is the best policy. Following are some Do's and Don'ts of thunderstorm avoidance:

28.1.1 Don't land or takeoff in the face of an approaching thunderstorm. A sudden gust front of low-level turbulence could cause loss of control.

28.1.2 Don't attempt to fly under a thunderstorm even if you can see through to the other side. Turbulence and wind shear under the storm could be disastrous.

28.1.3 Don't fly without airborne radar into a cloud mass containing scattered embedded thunderstorms. Scattered thunderstorms not embedded usually can be visually circumnavigated.

28.1.4 Don't trust the visual appearance to be a reliable indicator of the turbulence inside a thunderstorm.

28.1.5 Do avoid by at least 20 miles any thunderstorm identified as severe or giving an intense radar echo. This is especially true under the anvil of a large cumulonimbus.

28.1.6 Do clear the top of a known or suspected severe thunderstorm by at least 1,000 feet altitude for each 10 knots of wind speed at the cloud top. However, the altitude capability of most aircraft make it unlikely that the aircraft will be able to clear the storm top.

28.1.7 Do circumnavigate the entire area if the area has 6/10 thunderstorm coverage.

28.1.8 Do remember that vivid and frequent lightning indicates the probability of a severe thunderstorm.

28.1.9 Do regard as extremely hazardous any thunderstorm that tops 35,000 feet or higher whether the top is visually sighted or determined by radar.

28.2 If you cannot avoid penetrating a thunderstorm, before entering the storm, you should do the following:

28.2.1 Tighten your safety belt, put on your shoulder harness if you have one, and secure all loose objects.

28.2.2 Plan and hold your course to take you through the storm in a minimum time.

28.2.3 To avoid the most critical icing, establish a penetration altitude below the freezing level or above the level of -15 C.

28.2.4 Verify that pitot heat is on and turn on carburetor heat or jet engine anti-ice. Icing can be rapid at any altitude and cause almost instantaneous power failure and/or loss of airspeed indication.

28.2.5 Establish power settings for turbulence penetration airspeed recommended in your aircraft manual.

28.2.6 Turn up cockpit lights to highest intensity to lessen danger of temporary blindness from lightning.

28.2.7 If using automatic pilot, disengage altitude hold mode and speed hold mode. The automatic altitude and speed controls will increase maneuvers of the aircraft thus increasing structural stresses.

28.2.8 If using airborne radar, tilt the antenna up and down occasionally. This will permit you to detect other thunderstorm activity at altitudes other than the one being flown.

28.3 Following are some Do's and Don'ts during the thunderstorm penetration:

28.3.1 Do keep your eyes on your instruments. Looking outside the cockpit can increase danger of temporary blindness from lightning.

28.3.2 Don't change power settings; maintain settings for the recommended turbulence penetration airspeed.

28.3.3 Don't attempt to maintain constant altitude; let the aircraft "ride the waves."

28.3.4 Don't turn back once you are in the thunderstorm. A straight course through the storm most likely will get you out of the hazards more quickly. In addition, turning maneuvers increase stress on the aircraft.

29. Wake Turbulence

29.1 General

29.1.1 Every aircraft generates a wake while in flight. Initially, when pilots encountered this wake in flight, the disturbance was attributed to "prop wash." It is known, however, that this disturbance is caused by a pair of counterrotating vortices trailing from the wing tips. The vortices from larger aircraft pose problems to encountering aircraft. For instance, the wake of these aircraft can impose rolling moments exceeding the roll control authority of the encountering aircraft. Further, turbulence generated within the vortices can damage aircraft components and equipment if encountered at close range. The pilot must learn to envision the location of the vortex wake generated by larger (transport category) aircraft and adjust the flight path accordingly.

29.1.2 During ground operations and during takeoff, jet engine blast (thrust stream turbulence) can cause damage and upsets if encountered at close range. Exhaust velocity versus distance studies at various thrust levels have shown a need for light aircraft to maintain an adequate separation behind large turbojet aircraft. Pilots of larger aircraft should be particularly careful to consider the effects of their "jet blast" on other aircraft, vehicles, and maintenance equipment during ground operations.

29.2 Vortex Generation

29.2.1 Lift is generated by the creation of a pressure differential over the wing surface. The lowest pressure occurs over the upper wing surface and the highest pressure under the wing. This pressure differential triggers the roll up of the airflow aft of the wing resulting in swirling air masses trailing downstream of the wing tips. After the roll up is completed, the wake consists of two counter rotating cylindrical vortices. Most of the energy is within a few feet of the center of each vortex, but pilots should avoid a region within about 100 feet of the vortex core. (See FIG GEN 3.5-16.)

29.3 Vortex Strength

29.3.1 The strength of the vortex is governed by the weight, speed, and shape of the wing of the generating aircraft. The vortex characteristics of any given aircraft can also be changed by extension of flaps or other wing configuring devices as well as by change in speed. However, as the basic factor is weight, the vortex strength increases proportionately. Peak vortex tangential speeds up to almost 300 feet per second have been recorded. The greatest vortex strength occurs when the generating aircraft is HEAVY, CLEAN, and SLOW.

29.3.2 Induced Roll

29.3.2.1 In rare instances, a wake encounter could cause inflight structural damage of catastrophic proportions. However, the usual hazard is associated with induced rolling moments which can exceed the roll control authority of the encountering aircraft. In flight experiments, aircraft have been intentionally flown directly up trailing vortex cores of larger aircraft. It was shown that the capability of an aircraft to counteract the roll imposed by the wake vortex primarily depends on the wing span and counter-control responsiveness of the encountering aircraft.

29.3.2.2 Counter-control is usually effective and induced roll minimal in cases where the wing span and ailerons of the encountering aircraft extend beyond the rotational flow field of the vortex. It is more difficult for aircraft with short wing span (relative to the generating aircraft) to counter the imposed roll induced by vortex flow. Pilots of short-span aircraft, even of the high-performance type, must be especially alert to vortex encounters. (See FIG GEN 3.5-17.)

29.3.2.3 The wake of larger aircraft requires the respect of all pilots.

29.4 Vortex Behavior

29.4.1 Trailing vortices have certain behavioral characteristics which can help a pilot visualize the wake location and thereby take avoidance precautions.

29.4.1.1 Vortices are generated from the moment aircraft leave the ground, since trailing vortices are a by-product of wing lift. Prior to takeoff or touchdown pilots should note the rotation or touchdown point of the preceding aircraft. (See FIG GEN 3.5-18.)

29.4.1.2 The vortex circulation is outward, upward and around the wing tips when viewed from either ahead or behind the aircraft. Tests with large aircraft have shown that the vortices remain spaced a bit less than a wing span apart, drifting with the wind, at altitudes greater than a wing span from the ground. In view of this, if persistent vortex turbulence is encountered, a slight change of altitude and lateral position (preferably upwind) will provide a flight path clear of the turbulence.

29.4.1.3 Flight tests have shown that the vortices from larger (transport category) aircraft sink at a rate of several hundred feet per minute, slowing their descent and diminishing in strength with time and distance behind the generating aircraft. Atmospheric turbulence hastens breakup. Pilots should fly at or above the preceding aircraft's flight path, altering course as necessary to avoid the area behind and below the generating aircraft. However, vertical separation of 1,000 feet may be considered safe. (See FIG GEN 3.5-19.)

FIG GEN 3.5-16

Wake Vortex Generation

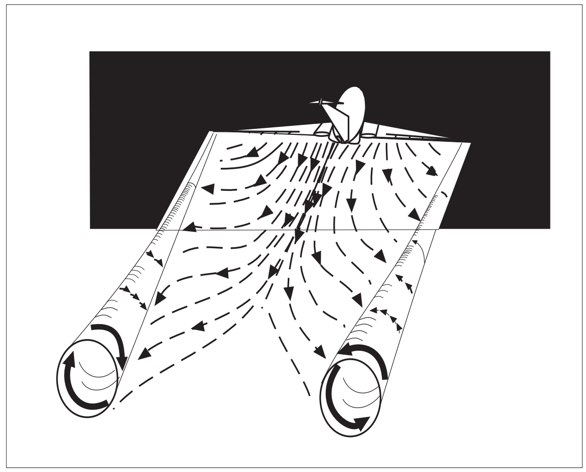


FIG GEN 3.5-17

Wake Encounter Counter Control

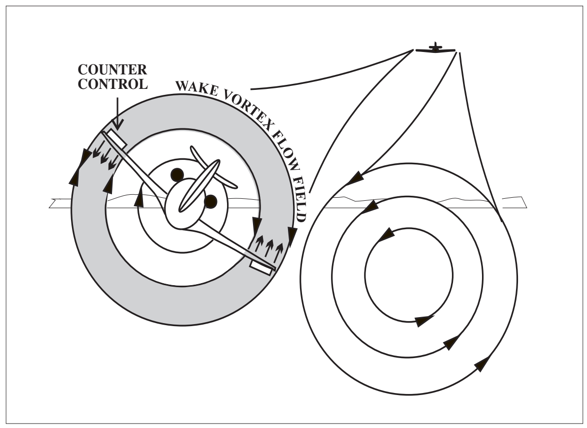


FIG GEN 3.5-18

Wake Ends/Wake Begins

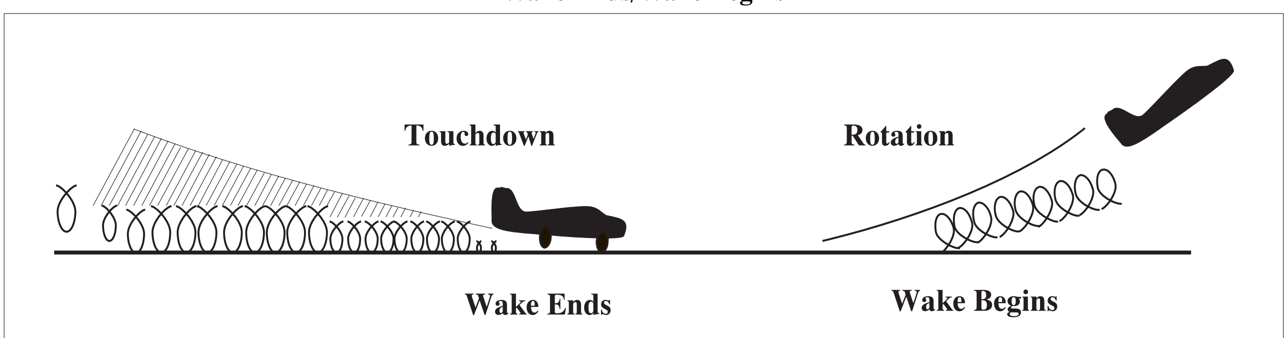


FIG GEN 3.5-19
Vortex Flow Field

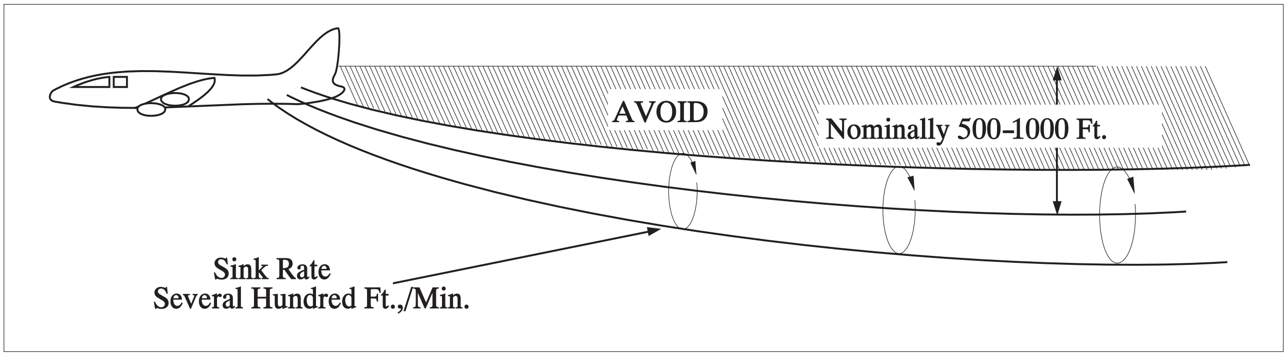
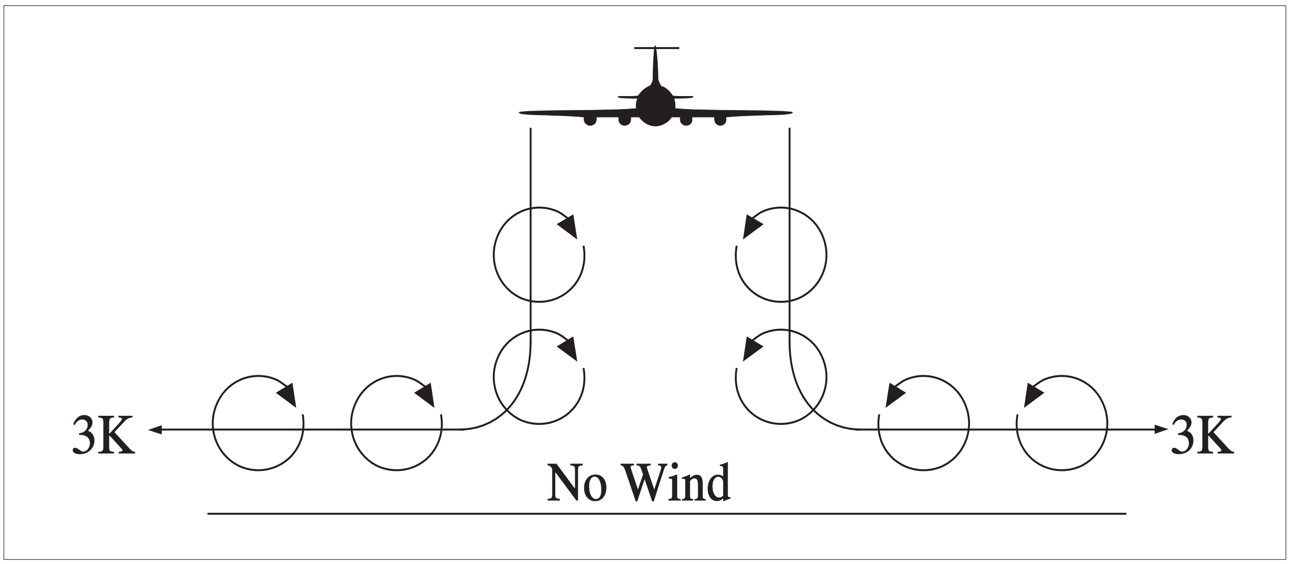


FIG GEN 3.5-20
Vortex Movement Near Ground - No Wind



29.4.1.4 When the vortices of larger aircraft sink close to the ground (within 100 to 200 feet), they tend to move laterally over the ground at a speed of 2 or 3 knots. (See FIG GEN 3.5-20.)

29.4.1.5 There is a small segment of the aviation community that have become convinced that wake vortices may "bounce" up to twice their nominal steady state height. With a 200-foot span aircraft, the "bounce" height could reach approximately 200 feet AGL. This conviction is based on a single unsubstantiated report of an apparent coherent vortical flow that was seen in the volume scan of a research sensor. No one can say what conditions cause vortex bouncing, how high they bounce, at what angle they bounce, or how many times a vortex may bounce. On the other hand, no one can say for certain that vortices never "bounce." Test data have shown that vortices can rise with the air mass in which they are embedded. Wind shear, particularly, can cause vortex flow field "tilting." Also, ambient thermal lifting and orographic effects (rising terrain or tree lines) can cause a vortex flow field to rise. Notwithstanding the foregoing, pilots are reminded that they should be alert at all times for possible wake vortex encounters when conducting approach and landing operations. The pilot has the ultimate responsibility for ensuring appropriate separations and positioning of the aircraft in the terminal area to avoid the wake turbulence created by a preceding aircraft.

FIG GEN 3.5-21

Vortex Movement Near Ground - with Cross Winds

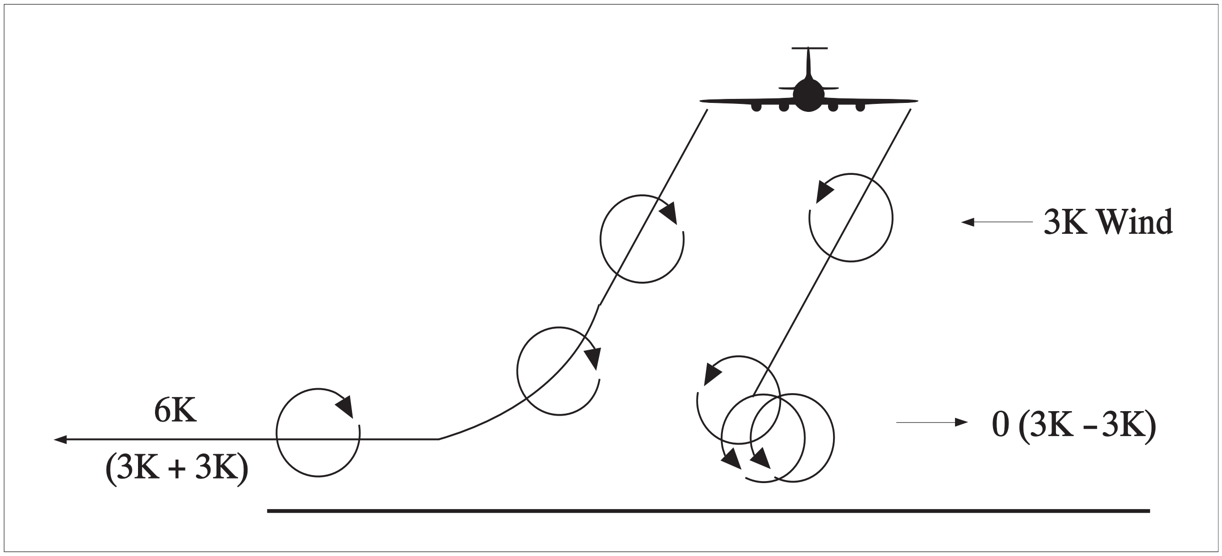
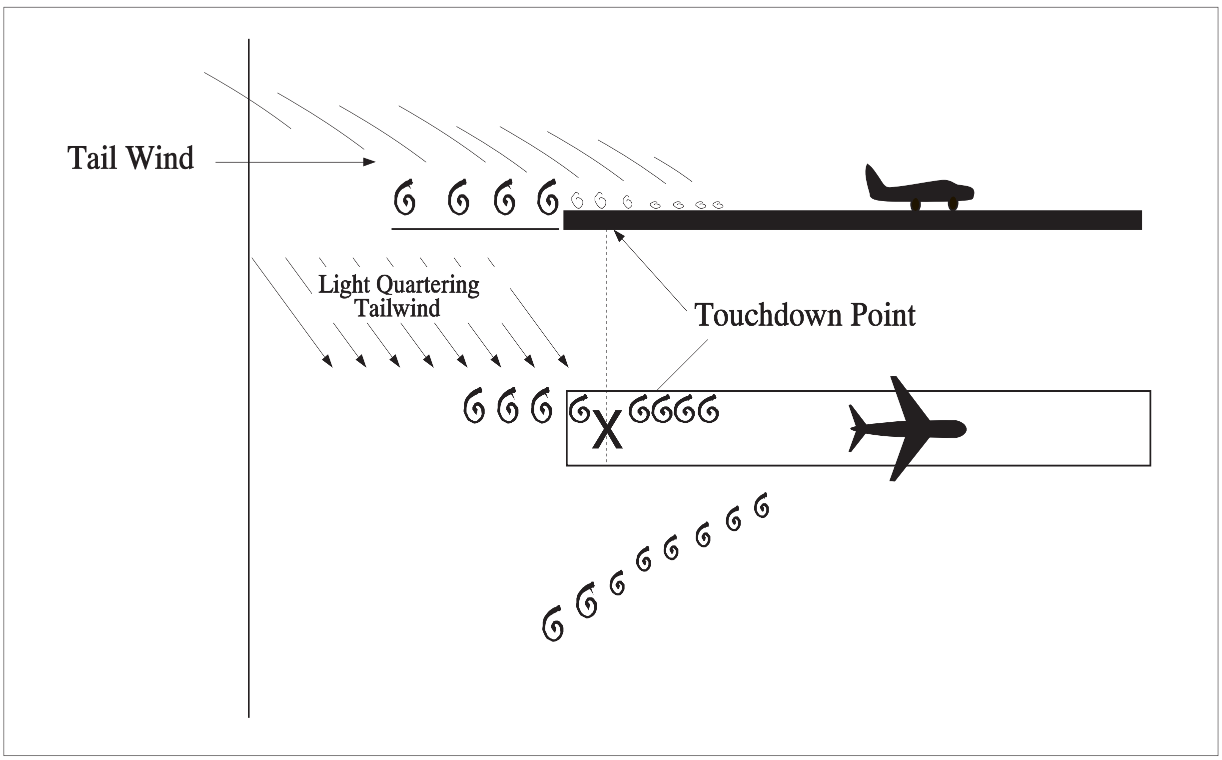


FIG GEN 3.5-22

Vortex Movement in Ground Effect - Tailwind



29.4.2 A crosswind will decrease the lateral movement of the upwind vortex and increase the movement of the downwind vortex. Thus a light wind with a cross-runway component of 1 to 5 knots could result in the upwind vortex remaining in the touchdown zone for a period of time and hasten the drift of the downwind vortex toward another runway. (See FIG GEN 3.5-21.) Similarly, a tailwind condition can move the vortices of the preceding aircraft forward into the touchdown zone. THE LIGHT QUARTERING TAILWIND REQUIRES MAXIMUM CAUTION. Pilots should be alert to larger aircraft upwind from their approach and takeoff flight paths. (See FIG GEN 3.5-22.)

29.5 Operations Problem Areas

29.5.1 A wake encounter can be catastrophic. In 1972 at Fort Worth, Texas, a DC-9 got too close to a DC-10 (two miles back), rolled, caught a wingtip, and cartwheeled coming to rest in an inverted position on the runway. All aboard were killed. Serious and even fatal general aviation accidents induced by wake vortices are not uncommon. However, a wake encounter is not necessarily hazardous. It can be one or more jolts with varying severity depending upon the direction of the encounter, weight of the generating aircraft, size of the encountering aircraft, distance from the generating aircraft, and point of vortex encounter. The probability of induced roll increases when the encountering aircraft's heading is generally aligned with the flight path of the generating aircraft.

29.5.2 AVOID THE AREA BELOW AND BEHIND THE GENERATING AIRCRAFT, ESPECIALLY AT LOW ALTITUDE WHERE EVEN A MOMENTARY WAKE ENCOUNTER COULD BE HAZARDOUS. This is not easy to do. Some accidents have occurred even though the pilot of the trailing aircraft had carefully noted that the aircraft in front was at a considerably lower altitude. Unfortunately, this does not ensure that the flight path of the lead aircraft will be below that of the trailing aircraft.

29.5.3 Pilots should be particularly alert in calm wind conditions and situations where the vortices could:

29.5.3.1 Remain in the touchdown area.

29.5.3.2 Drift from aircraft operating on a nearby runway.

29.5.3.3 Sink into the takeoff or landing path from a crossing runway.

29.5.3.4 Sink into the traffic pattern from other airport operations.

29.5.3.5 Sink into the flight path of VFR aircraft operating on the hemispheric altitude 500 feet below.

29.5.4 Pilots of all aircraft should visualize the location of the vortex trail behind larger aircraft and use proper vortex avoidance procedures to achieve safe operation. It is equally important that pilots of larger aircraft plan or adjust their flight paths to minimize vortex exposure to other aircraft.

29.6 Vortex Avoidance Procedures

29.6.1 Under certain conditions, airport traffic controllers apply procedures for separating IFR aircraft. If a pilot accepts a clearance to visually follow a preceding aircraft, the pilot accepts responsibility for separation and wake turbulence avoidance. The controllers will also provide to VFR aircraft, with whom they are in communication and which in the tower's opinion may be adversely affected by wake turbulence from a larger aircraft, the position, altitude and direction of flight of larger aircraft followed by the phrase "CAUTION - WAKE TURBULENCE." After issuing the caution for wake turbulence, the airport traffic controllers generally do not provide additional information to the following aircraft unless the airport traffic controllers know the following aircraft is overtaking the preceding aircraft. WHETHER OR NOT A WARNING OR INFORMATION HAS BEEN GIVEN, HOWEVER, THE PILOT IS EXPECTED TO ADJUST AIRCRAFT OPERATIONS AND FLIGHT PATH AS NECESSARY TO PRECLUDE SERIOUS WAKE ENCOUNTERS. When any doubt exists about maintaining safe separation distances between aircraft during approaches, pilots should ask the control tower for updates on separation distance and aircraft groundspeed.

29.6.2 The following vortex avoidance procedures are recommended for the various situations:

29.6.2.1 Landing Behind a Larger Aircraft - Same Runway. Stay at or above the larger aircraft's final approach flight path - note its touchdown point - land beyond it.

29.6.2.2 Landing Behind a Larger Aircraft - When a Parallel Runway is Closer Than 2,500 Feet. Consider possible drift to your runway. Stay at or above the larger aircraft's final approach flight path - note its touchdown point.

29.6.2.3 Landing Behind a Larger Aircraft - Crossing Runway. Cross above the larger aircraft's flight path.

29.6.2.4 Landing Behind a Departing Larger Aircraft - Same Runway. Note the larger aircraft's rotation point - land well prior to rotation point.

29.6.2.5 Landing Behind a Departing Larger Aircraft - Crossing Runway. Note the larger aircraft's rotation point - if past the intersection - continue the approach - land prior to the intersection. If larger aircraft rotates prior to the intersection, avoid flight below the larger aircraft's flight path. Abandon the approach unless a landing is ensured well before reaching the intersection.

29.6.2.6 Departing Behind a Larger Aircraft. Note the larger aircraft's rotation point - rotate prior to larger aircraft's rotation point - continue climb above the larger aircraft's climb path until turning clear of the larger aircraft's wake. Avoid subsequent headings which will cross below and behind a larger aircraft. Be alert for any critical takeoff situation which could lead to a vortex encounter.

29.6.2.7 Intersection Takeoffs - Same Runway. Be alert to adjacent larger aircraft operations, particularly upwind of your runway. If intersection takeoff clearance is received, avoid subsequent headings which will cross below a larger aircraft's path.

29.6.2.8 Departing or Landing After a Larger Aircraft Executing a Low Approach, Missed Approach, Or Touch-and-go Landing. Because vortices settle and move laterally near the ground, the vortex hazard may exist along the runway and in your flight path after a larger aircraft has executed a low approach, missed approach, or a touch-and-go landing, particular in light quartering wind conditions. You should ensure that an interval of at least 2 minutes has elapsed before your takeoff or landing.

29.6.2.9 En Route VFR (Thousand-foot Altitude Plus 500 Feet). Avoid flight below and behind a large aircraft's path. If a larger aircraft is observed above on the same track (meeting or overtaking) adjust your position laterally, preferably upwind.

29.7 Helicopters

29.7.1 In a slow hover-taxi or stationary hover near the surface, helicopter main rotor(s) generate downwash producing high velocity outwash vortices to a distance approximately three times the diameter of the rotor. When rotor downwash hits the surface, the resulting outwash vortices have behavioral characteristics similar to wing tip vortices produced by fixed-wing aircraft. However, the vortex circulation is outward, upward, around, and away from the main rotor(s) in all directions. Pilots of small aircraft should avoid operating within three rotor diameters of any helicopter in a slow hover-taxi or stationary hover. In forward flight, departing or landing helicopters produce a pair of strong, high-speed trailing vortices similar to wing tip vortices of larger fixed-wing aircraft. Pilots of small aircraft should use caution when operating behind or crossing behind landing and departing helicopters.

29.8 Pilot Responsibility

29.8.1 Government and industry groups are making concerted efforts to minimize or eliminate the hazards of trailing vortices. However, the flight disciplines necessary to ensure vortex avoidance during VFR operations must be exercised by the pilot. Vortex visualization and avoidance procedures should be exercised by the pilot using the same degree for concern as in collision avoidance.

29.8.2 Wake turbulence may be encountered by aircraft in flight as well as when operating on the airport movement area.

29.8.3 Pilots are reminded that in operations conducted behind all aircraft, acceptance of instructions from ATC in the following situations is an acknowledgment that the pilot will ensure safe takeoff and landing intervals and accepts the responsibility of providing his/her own wake turbulence separation:

29.8.3.1 Traffic information.

29.8.3.2 Instructions to follow an aircraft.

29.8.3.3 The acceptance of a visual approach clearance.

29.8.4 For operations conducted behind heavy aircraft, ATC will specify the word "heavy" when this information is known. Pilots of heavy aircraft should always use the word "heavy" in radio communications.

29.8.5 Heavy and large jet aircraft operators should use the following procedures during an approach to landing. These procedures establish a dependable baseline from which pilots of in-trail, lighter aircraft may reasonably expect to make effective flight path adjustments to avoid serious wake vortex turbulence.

29.8.5.1 Pilots of aircraft that produce strong wake vortices should make every attempt to fly on the established glidepath, not above it; or, if glidepath guidance is not available, to fly as closely as possible to a "3-1" glidepath, not above it.

EXAMPLE-
Fly 3,000 feet at 10 miles from touchdown, 1,500 feet at 5 miles, 1,200 feet at 4 miles, and so on to touchdown.

29.8.5.2 Pilots of aircraft that produce strong wake vortices should fly as closely as possible to the approach course centerline or to the extended centerline of the runway of intended landing as appropriate to conditions.

29.8.6 Pilots operating lighter aircraft on visual approaches in-trail to aircraft producing strong wake vortices should use the following procedures to assist in avoiding wake turbulence. These procedures apply only to those aircraft that are on visual approaches.

29.8.6.1 Pilots of lighter aircraft should fly on or above the glidepath. Glidepath reference may be furnished by an ILS, by a visual approach slope system, by other ground-based approach slope guidance systems, or by other means. In the absence of visible glidepath guidance, pilots may very nearly duplicate a 3-degree glideslope by adhering to the "3 to 1" glidepath principle.

EXAMPLE-
Fly 3,000 feet at 10 miles from touchdown, 1,500 feet at 5 miles, 1,200 feet at 4 miles, and so on to touchdown.

29.8.6.2 If the pilot of the lighter following aircraft has visual contact with the preceding heavier aircraft and also with the runway, the pilot may further adjust for possible wake vortex turbulence by the following practices:

a) Pick a point of landing no less than 1,000 feet from the arrival end of the runway.

b) Establish a line-of-sight to that landing point that is above and in front of the heavier preceding aircraft.

c) When possible, note the point of landing of the heavier preceding aircraft and adjust point of intended landing as necessary.

EXAMPLE-
A puff of smoke may appear at the 1,000-foot markings of the runway, showing that touchdown was at that point; therefore, adjust point of intended landing to the 1,500-foot markings.

d) Maintain the line-of-sight to the point of intended landing above and ahead of the heavier preceding aircraft; maintain it to touchdown.

e) Land beyond the point of landing of the preceding heavier aircraft.

29.8.7 During visual approaches pilots may ask ATC for updates on separation and groundspeed with respect to heavier preceding aircraft, especially when there is any question of safe separation from wake turbulence.

29.9 Air Traffic Wake Turbulence Separations

29.9.1 Because of the possible effects of wake turbulence, controllers are required to apply no less than specified minimum separation for aircraft operating behind a heavy jet and, in certain instances, behind large nonheavy aircraft; i.e., B757 aircraft.

29.9.1.1 Separation is applied to aircraft operating directly behind a heavy and/or B757 jet at the same altitude or less than 1,000 feet below:

a) Heavy jet behind heavy jet-4 miles.

b) Large/heavy behind B757 - 4 miles.

c) Small behind B757-5 miles.

d) Small/large aircraft behind heavy jet - 5 miles.

29.9.1.2 Also, separation, measured at the time the preceding aircraft is over the landing threshold, is provided to small aircraft:

a) Small aircraft landing behind heavy jet - 6 miles.

b) Small aircraft landing behind B757 - 5 miles.

c) Small aircraft landing behind large aircraft - 4 miles.

NOTE-
Aircraft classes are listed in the Pilot/Controller Glossary in the Aeronautical Information Manual.

29.9.1.3 Additionally, appropriate time or distance intervals are provided to departing aircraft. Two minutes or the appropriate 4 or 5 mile radar separation when takeoff behind a heavy/B757 jet will be:

a) From the same threshold.

b) On a crossing runway and projected flight paths will cross.

c) From the threshold of a parallel runway when staggered ahead of that of the adjacent runway by less than 500 feet and when the runways are separated by less than 2,500 feet.

NOTE-
Controllers may not reduce or waive these intervals.

29.9.2 A 3-minute interval will be provided for a small aircraft taking off:

29.9.2.1 From an intersection on the same runway (same or opposite direction) behind a departing large aircraft.

29.9.2.2 In the opposite direction on the same runway behind a large aircraft takeoff or low/missed approach.

NOTE-
This 3-minute interval may be waived upon specific pilot request.

29.9.3 A 3-minute interval will be provided for all aircraft taking off when the operations are as described in paragraph 29.9.2 above, the preceding aircraft is a heavy and/or a B757 jet, and the operations are on either the same runway or parallel runways separated by less than 2,500 feet. Controllers may not reduce or waive this interval.

29.9.4 Pilots may request additional separation; i.e., 2 minutes instead of 4 or 5 miles for wake turbulence avoidance. This request should be made as soon as practical on ground control and at least before taxiing onto the runway.

NOTE-
Federal Aviation Administration Regulations state: "The pilot in command of an aircraft is directly responsible for and is the final authority as to the operation of that aircraft."

29.9.5 Controllers may anticipate separation and need not withhold a takeoff clearance for an aircraft departing behind a large/heavy aircraft if there is reasonable assurance the required separation will exist when the departing aircraft starts takeoff roll.

30. International Civil Aviation Organization (ICAO) Weather Formats

30.1 The U.S. uses the ICAO world standard for aviation weather reporting and forecasting. The utilization of terminal forecasts affirms U.S. commitment to a single global format for aviation weather. The World Meteorological Organization's (WMO) publication No. 782, "Aerodrome Reports and Forecasts," contains the base METAR and TAF code as adopted by the WMO member countries.

30.2 Although the METAR code is adopted worldwide, each country is allowed to make modifications or exceptions to the code for use in their particular country; e.g., the U.S. will continue to use statute miles for visibility, feet for RVR values, knots for wind speed, inches of mercury for altimetry, and will continue reporting prevailing visibility rather than lowest sector visibility. A METAR report contains the following sequence of elements in the following order:

30.2.1 Type of report.

30.2.2 ICAO station identifier.

30.2.3 Date and time of report.

30.2.4 Modifier (as required).

30.2.5 Wind.

30.2.6 Visibility.

30.2.7 Runway Visual Range (RVR).

30.2.8 Weather phenomena.

30.2.9 Sky conditions.

30.2.10 Temperature/Dew point group.

30.2.11 Altimeter.

30.2.12 Remarks (RMK).

30.3 The following paragraphs describe the elements in a METAR report.

30.3.1 Type of Report. There are two types of reports:

30.3.1.1 The METAR, an aviation routine weather report.

30.3.1.2 The SPECI, a nonroutine (special) aviation weather report.

The type of report (METAR or SPECI) will always appear as the lead element of the report.

30.3.2 ICAO Station Identifier. The METAR code uses ICAO 4-letter station identifiers. In the contiguous 48 states, the 3-letter domestic station identifier is prefixed with a "K"; i.e., the domestic identifier for Seattle is SEA while the ICAO identifier is KSEA. For Alaska, all station identifiers start with "PA"; for Hawaii, all station identifiers start with "PH." The identifier for the eastern Caribbean is "T" followed by the individual country's letter; i.e., Puerto Rico is "TJ." For a complete worldwide listing see ICAO Document 7910, "Location Indicators."

30.3.3 Date and Time of Report. The date and time the observation is taken are transmitted as a six-digit date/time group appended with Z to denote Coordinated Universal Time (UTC). The first two digits are the date followed with two digits for hour and two digits for minutes.

EXAMPLE-
172345Z (the 17th day of the month at 2345Z)

30.3.4 Modifier (As Required). "AUTO" identifies a METAR/SPECI report as an automated weather report with no human intervention. If "AUTO" is shown in the body of the report, the type of sensor equipment used at the station will be encoded in the remarks section of the report. The absence of "AUTO" indicates that a report was made manually by an observer or that an automated report had human augmentation/backup. The modifier "COR" indicates a corrected report that is sent out to replace an earlier report with an error.

NOTE-
There are two types of automated stations, AO1 for automated weather reporting stations without a precipitation discriminator, and AO2 for automated stations with a precipitation discriminator. (A precipitation discriminator can determine the difference between liquid and frozen/freezing precipitation). This information appears in the remarks section of an automated report.

30.3.5 Wind. The wind is reported as a five digit group (six digits if speed is over 99 knots). The first three digits are the direction from which the wind is blowing, in tens of degrees referenced to true north, or "VRB" if the direction is variable. The next two digits is the wind speed in knots, or if over 99 knots, the next three digits. If the wind is gusty, it is reported as a "G" after the speed followed by the highest gust reported. The abbreviation "KT" is appended to denote the use of knots for wind speed.

EXAMPLE-
13008KT - wind from 130 degrees at 8 knots

08032G45KT - wind from 080 degrees at 32 knots with gusts to 45 knots

VRB04KT - wind variable in direction at 4 knots

00000KT - wind calm

210103G130KT - wind from 210 degrees at 103 knots with gusts to 130 knots

If the wind direction is variable by 60 degrees or more and the speed is greater than 6 knots, a variable group consisting of the extremes of the wind direction separated by a "V" will follow the prevailing wind group.

32012G22KT 280V350

30.3.5.1 Peak Wind. Whenever the peak wind exceeds 25 knots, "PK WND" will be included in Remarks; e.g., PK WND 280045/1955 "Peak wind two eight zero at four five occurred at one niner five five." If the hour can be inferred from the report time, only the minutes will be appended; e.g., PK WND 34050/38 "Peak wind three four zero at five zero occurred at three eight past the hour."

30.3.5.2 Wind Shift. Whenever a wind shift occurs, "WSHFT" will be included in remarks followed by the time the wind shift began; e.g., WSHFT 30 FROPA "Wind shift at three zero due to frontal passage."

30.3.6 Visibility. Prevailing visibility is reported in statute miles with "SM" appended to it.

EXAMPLE-
7SM . . . . seven statute miles
15SM . . . . fifteen statute miles
$^1/_2$SM . . . . one-half statute mile

30.3.6.1 Tower/Surface Visibility. If either tower or surface visibility is below 4 statute miles, the lesser of the 2 will be reported in the body of the report; the greater will be reported in remarks.

30.3.6.2 Automated Visibility. ASOS visibility stations will show visibility ten or greater than ten miles as "10SM." AWOS visibility stations will show visibility less than $^1/_4$ statute mile as "M$^1/_4$SM" and visibility ten or greater than ten miles as "10SM."

30.3.6.3 Variable Visibility. Variable visibility is shown in remarks when rapid increase or decrease by $^1/_2$ statute mile or more and the average prevailing visibility is less than 3 statute miles; e.g., VIS 1V2 means "visibility variable between 1 and 2 statute miles."

30.3.6.4 Sector Visibility. Sector visibility is shown in remarks when it differs from the prevailing visibility, and either the prevailing or sector visibility is less than 3 statute miles.

EXAMPLE-
VIS N2 . . . . visibility north two

30.3.7 Runway Visual Range (when reported). "R" identifies the group followed by the runway heading (and parallel runway designator, if needed) "/" and the visual range in feet (meters in other countries) followed with "FT." ("Feet" is not spoken.)

30.3.7.1 Variability Values. When RVR varies by more than on reportable value, the lowest and highest values are shown with "V" between them.

30.3.7.2 Maximum/Minimum Range. "P" indicates an observed RVR is above the maximum value for this system (spoken as "more than"). "M" indicates an observed RVR is below the minimum value which can be determined by the system (spoken as "less than").

EXAMPLE-

R32L/1200FT - Runway Three Two Left R-V-R one thousand two hundred

R27R/M1000V4000FT - Runway Two Seven Right R-V-R variable from less than one thousand to four thousand.

30.3.8 Weather Phenomena. In METAR, weather is reported in the format:

Intensity / Proximity / Descriptor / Precipitation / Obstruction to Visibility / Other

NOTE-

The "/" above and in the following descriptions (except as the separator between the temperature and dew point) are for separation purposes in this publication and do not appear in the actual METARs.

30.3.8.1 Intensity applies only to the first type of precipitation reported. A "-" denotes light, no symbol denotes moderate, and a "+" denotes heavy.

30.3.8.2 Proximity applies to and is reported only for weather occurring in the vicinity of the airport (between 5 and 10 miles of the point(s) of observation). It is denoted by the letters "VC." (Intensity and "VC" will not appear together in the weather group.)

30.3.8.3 Descriptor. These eight descriptors apply to the precipitation or obstructions to visibility:

TS	thunderstorm
DR	low drifting
SH	showers
MI	shallow
FZ	freezing
BC	patches
BL	blowing
PR	partial

NOTE-

Although "TS" and "SH" are used with precipitation and may be preceded with an intensity symbol, the intensity still applies to the precipitation not the descriptor.

30.3.8.4 Precipitation. There are nine types of precipitation in the METAR code:

RA	rain
DZ	drizzle
SN	snow
GR	hail ($^1/_4''$ or greater)
GS	small hail/snow pellets
PL	ice pellets
SG	snow grains
IC	ice crystals
UP	unknown precipitation (automated stations only)

EXAMPLE-

TSRA	thunderstorm with moderate rain
+SN	heavy snow
-RA FG	light rain and fog
BRHZ	mist and haze (visibility $^5/_8$ mile or greater)
FZDZ	freezing drizzle
VCSH	rain shower in the vicinity
+SHRASNPL	heavy rain showers, snow, ice pellets (Intensity indicator refers to the predominant rain.)

30.3.8.5 Obstructions to Visibility. Obscurations are any phenomena in the atmosphere, other than precipitation, that reduce horizontal visibility. There are eight types of obscuration phenomena in the METAR code:

FG	fog (visibility less than $^5/_8$ mile)
HZ	haze
FU	smoke
PY	spray
BR	mist (visibility $^5/_8$-6 miles)
SA	sand
DU	dust
VA	volcanic ash

NOTE-
Fog (FG) is observed or forecast only when the visibility is less than $^5/_8$ mile. Otherwise, mist (BR) is observed or forecast.

30.3.8.6 Other. There are five categories of other weather phenomena which are reported when they occur:

SQ	squall
SS	sandstorm
DS	duststorm
PO	dust/sand whirls
FC +FC	funnel cloud tornado/waterspout

30.3.9 Sky Condition. In METAR, sky condition is reported in the format:

Amount / Height / (Type) or Indefinite Ceiling / Height

30.3.9.1 Amount. The amount of sky cover is reported in eighths of sky cover, using contractions:

SKC	clear (no clouds)
FEW	>$^0/_8$ to $^2/_8$ cloud cover
SCT	scattered ($^3/_8$ to $^4/_8$ cloud cover)
BKN	broken ($^5/_8$ to $^7/_8$ cloud cover)
OVC	overcast ($^8/_8$ cloud cover)
CB	cumulonimbus when present
TCU	towering cumulus when present

NOTE-
1. *"SKC" will be reported at manual stations. "CLR" will be used at automated stations when no clouds below 12,000 feet are reported.*
2. *A ceiling layer is not designated in the METAR code. For aviation purposes, the ceiling is the lowest broken or overcast layer, or vertical visibility into obscuration. Also, there is no provision for reporting thin layers in the METAR code. When clouds are thin, that layer shall be reported as if it were opaque.*

30.3.9.2 Height. Cloud bases are reported with three digits in hundreds of feet. (Clouds above 12,000 feet cannot be reported by an automated station.)

30.3.9.3 Type. If towering cumulus clouds (TCU) or cumulonimbus clouds (CB) are present, they are reported after the height which represents their base.

EXAMPLE-
SCT025TCU BKN080 BKN250 - "two thousand five hundred scattered towering cumulus, ceiling eight thousand broken, two five thousand broken."

SCT008 OVC012CB - "eight hundred scattered ceiling one thousand two hundred overcast cumulonimbus clouds."

30.3.9.4 Vertical Visibility (indefinite ceiling height). The height into an indefinite ceiling is preceded by "VV" and followed by three digits indicating the vertical visibility in hundreds of feet. This layer indicates total obscuration.

EXAMPLE-
$^1/_8$ SM FG VV006 - visibility one eighth, fog, indefinite ceiling six hundred.

30.3.9.5 Obscurations are reported when the sky is partially obscured by a ground-based phenomena by indicating the amount of obscuration as FEW, SCT, BKN followed by three zeros (000). In remarks, the obscuring phenomenon precedes the amount of obscuration and three zeros.

EXAMPLE-
BKN000 (IN BODY) - "sky partially obscured."

FU BKN000 (IN REMARKS) - "smoke obscuring five- to seven-eighths of the sky."

30.3.9.6 When sky conditions include a layer aloft other than clouds, such as smoke or haze, the type of phenomena, sky cover, and height are shown in remarks.

EXAMPLE-
BKN020 (IN BODY) - "ceiling two thousand broken."
RMK FU BKN020 - "broken layer of smoke aloft, based at two thousand."

30.3.9.7 Variable Ceiling. When a ceiling is below three thousand and is variable, the remark "CIG" will be shown followed with the lowest and highest ceiling heights separated by a "V."

EXAMPLE-
CIG 005V010 - "ceiling variable between five hundred and one thousand."

30.3.9.8 Second Site Sensor. When an automated station uses meteorological discontinuity sensors, remarks will be shown to identify site specific sky conditions which differ and are lower than conditions reported in the body.

EXAMPLE-
CIG 020 RY11 - "ceiling two thousand at Runway One One."

30.3.9.9 Variable Cloud Layer. When a layer is varying in sky cover, remarks will show the variability range. If there is more than one cloud layer, the variable layer will be identified by including the layer height.

EXAMPLE-
SCT V BKN - "scattered layer variable to broken."

BKN025 V OVC - "broken layer at two thousand five hundred variable to overcast."

30.3.9.10 Significant Clouds. When significant clouds are observed, they are shown in remarks, along with the specified information as shown below:

a) Cumulonimbus (CB), or Cumulonimbus Mammatus (CBMAM), distance (if known), direction from the station, and direction of movement, if known. If the clouds are beyond 10 miles from the airport, DSNT will indicate distance.

EXAMPLE-
CB W MOV E - "cumulonimbus west moving east."

CBMAM DSNT S - "cumulonimbus mammatus distant south."

b) Towering Cumulus (TCU), location, (if known), or direction from the station.

EXAMPLE-
TCU OHD - "towering cumulus overhead."

TCU W - "towering cumulus west."

c) Altocumulus Castellanus (ACC), Stratocumulus Standing Lenticular (SCSL), Altocumulus Standing Lenticular (ACSL), Cirrocumulus Standing Lenticular (CCSL) or rotor clouds, describing the clouds (if needed), and the direction from the station.

ACC W	"altocumulus castellanus west"
ACSL SW-S	"standing lenticular altocumulus southwest through south"
APRNT ROTOR CLD S	"apparent rotor cloud south"
CCSL OVR E	"standing lenticular cirrocumulus over the east"

30.3.10 Temperature/Dew Point. Temperature and dew point are reported in two, two-digit groups in degrees Celsius, separated by a solidus (/). Temperatures below zero are prefixed with an "M." If the temperature is available but the dew point is missing, the temperature is shown followed by a solidus. If the temperature is missing, the group is omitted from the report.

EXAMPLE-
15/08 . . . . "temperature one five, dew point 8"
00/M02 . . . . "temperature zero, dew point minus 2"
M05/ . . . . "temperature minus five, dew point missing"

30.3.11 Altimeter. Altimeter settings are reported in a four-digit format in inches of mercury prefixed with an "A" to denote the units of pressure.

EXAMPLE-
A2995 . . . . "altimeter two niner niner five"

30.3.12 Remarks. Remarks will be included in all observations, when appropriate. The contraction "RMK" denotes the start of the remarks section of a METAR report.

Location of a phenomena within 5 statute miles of the point of observation will be reported as at the station. Phenomena between 5 and 10 statute miles will be reported in the vicinity, "VC." Phenomena beyond 10 statute miles will be shown as distant, "DSNT." Distances are in statute miles except for automated lightning remarks which are in nautical miles. Movement of clouds or weather will be indicated by the direction toward which the phenomena is moving.

There are two categories of remarks: Automated, Manual, and Plain Language; and Additive and Automated Maintenance Data.

30.3.12.1 Automated, Manual, and Plain Language Remarks. This group of remarks may be generated from either manual or automated weather reporting stations and generally elaborates on parameters reported in the body of the report. Plain language remarks are only provided by manual stations.

1) Volcanic Eruptions
2) Tornado, Funnel Cloud, Waterspout
3) Type of Automated Station (AO1 or AO2)
4) Peak Wind
5) Wind Shift
6) Tower or Surface Visibility
7) Variable Prevailing Visibility
8) Sector Visibility
9) Visibility at Second Location
10) Dispatch Visual Range
11) Lightning (freq) LTG (type) (loc)
12) Beginning/Ending Time of Precipitation
13) Beginning/Ending Time of Thunderstorms
14) Thunderstorm Location; Movement Direction
15) Hailstone Size
16) Virga
17) Variable Ceiling
18) Obscurations
19) Variable Sky Condition
20) Significant Cloud Types
21) Ceiling Height at Second Location
22) Pressure Rising or Falling Rapidly
23) Sea-Level Pressure
24) Aircraft Mishap (not transmitted)
25) No SPECI Reports Taken
26) Snow Increasing Rapidly
27) Other Significant Information

30.3.12.2 Additive and Automated Maintenance Data Remarks.

1) Hourly Precipitation
2) Precipitation Amount
3) 24-Hour Precipitation
4) Snow Depth on Ground
5) Water Equivalent of Snow on Ground
6) Cloud Types
7) Duration of Sunshine
8) Hourly Temperature and Dew Point (Tenths)
9) 6-Hour Maximum Temperature
10) 6-Hour Minimum Temperature
11) 24-Hour Maximum/Minimum Temperatures
12) Pressure Tendency
13) Sensor Status:
WINO
ZRANO
SNO
VRNO
PNO
VISNO

EXAMPLE-
METAR report and explanation:

METAR KSFO 041453Z AUTO VRB02KT 3SM BR CLR 15/12 A3012 RMK AO2

METAR	Type of report (aviation routine weather report)
KSFO	Station identifier (San Francisco, CA)
041453Z	Date/Time (4th day of month; time 1453 UTC)
AUTO	Fully automated; no human intervention
VRB02KT	Wind (wind variable at two)
3SM	Visibility (visibility three statute miles)
BR	Visibility obscured by mist
CLR	No clouds below one two thousand
15/12	Temperature one five; dew point one two
A3012	Altimeter three zero one two
RMK	Remarks
AO2	This automated station has a weather discriminator (for precipitation).

EXAMPLE-
METAR report and explanation:

METAR KBNA 281250Z 33018KT 290V360 1/2SM R31/2700FT SN BLSN FG VV008 00/M03 A2991 RMK RAE42SNB42

METAR	Aviation routine weather report
KBNA	Nashville, TN
281250Z	28th day of month; time 1250 UTC
(no modifier)	This is a manually generated report, due to the absence of "AUTO" and "AO1 or AO2" in remarks.
33018KT	Wind three three zero at one eight
290V360	Wind variable between two nine zero and three six zero
$^{1}/_{2}$SM	Visibility one half statute mile
R31/2700FT	Runway three one RVR two thousand seven hundred feet
SN	Moderate snow
BLSN FG	Visibility obscured by blowing snow and fog
VV008	Indefinite ceiling eight hundred
00/M03	Temperature zero; dew point minus three
A2991	Altimeter two niner niner one
RMK	Remarks
RAE36	Rain ended at three six
SNB42	Snow began at four two

EXAMPLE-
SPECI report and explanation:

SPECI KCVG 152224Z 28024G36KT 3/4SM +TSRA BKN008 OVC020CB 28/23 A3000 RMK TSRAB24 TS W MOV E.

SPECI	Nonroutine aviation special weather report
KCVG	Cincinnati, OH
152224Z	15th day of month; time 2224 UTC
(no modifier)	This is a manually generated report due to the absence of "AUTO" and "AO1 or AO2" in remarks.
28024G36KT	Wind two eight zero at two four gusts three six
3/4SM	Visibility three fourths statute mile
+TSRA	Thunderstorms, heavy rain
BKN008	Ceiling eight hundred broken
OVC020CB	Two thousand overcast cumulonimbus clouds
28/23	Temperature two eight; dew point two three
A3000	Altimeter three zero zero zero
RMK	Remarks
TSRAB24	Thunderstorm and rain began at two four
TS W MOV E	Thunderstorm west moving east

30.4 Aerodrome Forecast (TAF). A concise statement of the expected meteorological conditions at an airport during a specified period (usually 24 hours). TAFs use the same codes as METAR weather reports. They are scheduled four times daily for 24-hour periods beginning at 0000Z, 0600Z, 1200Z, and 1800Z. TAFs are issued in the following format:

Type of Report / ICAO Station Identifier / Date and Time of Origin / Valid Period Date and Time / Forecast Meteorological Conditions

NOTE-
The "/" above and in the following descriptions are for separation purposes in this publication and do not appear in the actual TAFs.

30.4.1 Explanation of TAF elements

30.4.1.1 Type of Report. There are two types of TAF issuances, a routine forecast issuance (TAF) and an amended forecast (TAF AMD). An amended TAF is issued when the current TAF no longer adequately describes the on-going weather or the forecaster feels the TAF is not representative of the current or expected weather. Corrected (COR) or delayed (RTD) TAFs are identified only in the communications header which precedes the actual forecasts.

30.4.1.2 ICAO Station Identifier. The TAF code uses ICAO 4-letter location identifiers as described in the METAR section.

30.4.1.3 Date and Time of Origin. This element is the date and time the forecast is actually prepared. The format is a two-digit date and four-digit time followed, without a space, by the letter "Z."

30.4.1.4 Valid Period Date and Time. The UTC valid period of the forecast is a two-digit date followed by the two-digit beginning hour and two-digit ending hour. In the case of an amended forecast, or a forecast which is corrected or delayed, the valid period may be for less than 24 hours. Where an airport or terminal operates on a part-time basis (less than 24 hours/day), the TAFs issued for those locations will have the abbreviated statement "NIL AMD SKED AFT (closing time) Z" added to the end of the forecasts. For the TAFs issued while these locations are closed, the word "NIL" will appear in place of the forecast text. A delayed (RTD) forecast will then be issued for these locations after two complete observations are received.

30.4.1.5 Forecast Meteorological Conditions. This is the body of the TAF. The basic format is:

Wind / Visibility / Weather / Sky Condition / Optional Data (Wind Shear)

The wind, visibility, and sky condition elements are always included in the initial time group of the forecast. Weather is included only if significant to aviation. If a significant, lasting change in any of the elements is expected during the valid period, a new time period with the changes is included. It should be noted that with the exception of an "FM" group, the new time period will include only those elements which are expected to change; i.e., if a lowering of the visibility is expected but the wind is expected to remain the same, the new time period reflecting the lower visibility would not include a forecast wind. The forecast wind would remain the same as in the previous time period.

Any temporary conditions expected during a specific time period are included with that time period. The following describes the elements in the above format.

a) Wind. This five (or six) digit group includes the expected wind direction (first 3 digits) and speed (last 2 digits or 3 digits if 100 knots or greater). The contraction "KT" follows to denote the units of wind speed. Wind gusts are noted by the letter "G" appended to the wind speed followed by the highest expected gust.

NOTE-
A variable wind direction is noted by "VRB" where the three digit direction usually appears. A calm wind (3 knots or less) is forecast as "00000KT."

EXAMPLE-
18010KT - wind one eight zero at one zero (wind is blowing from 180 at 10 knots).

35012G20KT - wind three five zero at one two gust two zero

b) Visibility. The expected prevailing visibility up to and including 6 miles is forecast in statute miles, including fractions of miles, followed by "SM" to note the units of measure. Expected visibilities greater than 6 miles are forecast as P6SM (Plus six statute miles).

EXAMPLE-
1/2SM . . . . visibility one-half
4SM . . . . visibility four
P6SM . . . . visibility more than six

c) Weather. The expected weather phenomena is coded in TAF reports using the same format, qualifiers, and phenomena contractions as METAR reports (except UP).

Obscurations to vision will be forecast whenever the prevailing visibility is forecast to be 6 statute miles or less.

If no significant weather is expected to occur during a specific time period in the forecast, the weather group is omitted for that time period. If, after a time period in which significant weather has been forecast, a change to a forecast of no significant weather occurs, the contraction NSW (no significant weather) will appear as the weather group in the new time period. (NSW is included only in becoming (BECMG) or temporary (TEMPO) groups.)

d) Sky Condition. TAF sky condition forecasts use the METAR format described in the METAR section. Cumulonimbus clouds (CB) are the only cloud type forecast in TAFs.

When clear skies are forecast, the contraction "SKC" will always be used. The contraction "CLR" is never used in the aerodrome forecast (TAF).

When the sky is obscured due to a surface-based phenomenon, vertical visibility (VV) into the obscuration is forecast. The format for vertical visibility is "VV" followed by a three-digit height in hundreds of feet.

NOTE-
As in METAR, ceiling layers are not designated in the TAF code. For aviation purposes, the ceiling is the lowest broken or overcast layer or vertical visibility into a complete obscuration.

SKC	"sky clear"
SCT005 BKN025CB	"five hundred scattered, ceiling two thousand five hundred broken cumulonimbus clouds"
VV008	"indefinite ceiling eight hundred"

e) Optional Data (Wind Shear). Wind Shear is the forecast of non-convective, low-level winds (up to 2,000 feet). The forecast includes the letters "WS" followed by the height of the wind shear, the wind direction and wind speed at the indicated height and the ending letters "KT" (knots). Height is given in hundreds of feet (AGL) up to and including 2,000 feet. Wind shear is encoded with the contraction "WS" followed by a three-digit height, slant character "/" and winds at the height indicated in the same format as surface winds. The wind shear element is omitted if not expected to occur.

WS010/18040KT	"low level wind shear at one thousand, wind one eight zero at four zero"

30.5 Probability Forecast. The probability or chance of thunderstorms or other precipitation events occurring, along with associated weather conditions (wind, visibility, and sky conditions).

The PROB30 group is used when the occurrence of thunderstorms or precipitation is 30-39 percent and the PROB40 group is used when the occurrence of thunderstorms or precipitation is 40-49 percent. This is followed by a four-digit group giving the beginning hour and ending hour of the time period during which the thunderstorms or precipitation are expected.

NOTE-
Neither PROB30 nor PROB40 will be shown during the first six hours of a forecast.

EXAMPLE-
PROB40 2102 1/2SM +TSRA - "chance between 2100Z and 0200Z of visibility one-half thunderstorm, heavy rain."

PROB30 1014 1SM RASN - "chance between 1000Z and 1400Z of visibility one rain and snow."

30.6 Forecast Change Indicators. The following change indicators are used when either a rapid, gradual, or temporary change is expected in some or all of the forecast meteorological conditions. Each change indicator marks a time group within the TAF report.

30.6.1 From (FM) Group. The FM Group is used when a rapid change, usually occurring in less than one hour, in prevailing conditions is expected. Typically, a rapid change of prevailing conditions to more or less a completely new set of prevailing conditions is associated with a synoptic feature passing through the terminal area (cold or warm frontal passage). Appended to the "FM" indicator is the four-digit hour and minute the change is expected to begin and continues until the next change group or until the end of the current forecast.

An "FM" group marks the beginning of a new line in a TAF report (indented 5 spaces). Each "FM" group contains all the required elements-wind, visibility, weather, and sky condition. Weather is omitted in "FM" groups when it is not significant to aviation. FM groups do not include the contraction NSW.

EXAMPLE-

FM0100 14010KT P6SM SKC - "after 0100Z, wind one four zero at one zero, visibility more than six, sky clear."

30.6.2 Becoming (BECMG) Group. The BECMG group is used when a gradual change in conditions is expected over a longer time period, usually two hours. The time period when the change is expected is a four-digit group with the beginning hour and ending hour of the change period which follows the BECMG indicator. The gradual change will occur at an unspecified time within this time period. Only the changing forecast meteorological conditions are included in BECMG groups. The omitted conditions are carried over from the previous time group.

EXAMPLE-

OVC012 BECMG 1416 BKN020 - "ceiling one thousand two hundred overcast. Then a gradual change to ceiling two thousand broken between 1400Z and 1600Z."

30.6.3 Temporary (TEMPO) Group. The TEMPO group is used for any conditions in wind, visibility, weather, or sky condition which are expected to last for generally less than an hour at a time (occasional), and are expected to occur during less than half the time period. The TEMPO indicator is followed by a four-digit group giving the beginning hour and ending hour of the time period during which the temporary conditions are expected. Only the changing forecast meteorological conditions are included in TEMPO groups. The omitted conditions are carried over from the previous time group.

EXAMPLE-

1. *SCT030 TEMPO 1923 BKN030 - "three thousand scattered with occasional ceilings three thousand broken between 1900Z and 2300Z."*

2. *4SM HZ TEMPO 0006 2SM BR HZ - "visibility four in haze with occasional visibility two in mist and haze between 0000Z and 0600Z."*

FIG GEN 3.5-23

U.S. Department of Transportation
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KEY to AERODROME FORECAST (TAF) and AVIATION ROUTINE WEATHER REPORT (METAR) (FRONT)

TAF KPIT 091730Z 091818 15005KT 5SM HZ FEW020 WS010/31022KT
FM 1930 30015G25KT 3SM SHRA OVC015 TEMPO 2022 1/2SM +TSRA
OVC008CB
FM0100 27008KT 5SM SHRA BKN020 OVC040 PROB40 0407 1SM -RA BR
FM1015 18005KT 6SM -SHRA OVC020 BECMG 1315 P6SM NSW SKC

METAR KPIT 091955Z COR 22015G25KT 3/4SM R28L/2600FT TSRA OVC010CB
18/16 A2992 RMK SLP045 T01820159

FORECAST	EXPLANATION	REPORT
TAF	Message type : TAF-routine or TAF AMD-amended forecast, METAR-hourly, SPECI-special or TESTM-non-commissioned ASOS report	**METAR**
KPIT	ICAO location indicator	**KPIT**
091730Z	Issuance time: ALL times in UTC "Z", 2-digit date, 4-digit time	**091955z**
091818	Valid period: 2-digit date, 2-digit beginning, 2-digit ending times	
	In U.S. **METAR**: CORrected of; or AUTOmated ob for automated report with no human intervention; omitted when observer logs on	**COR**
15005KT	Wind: 3 digit true-north direction , nearest 10 degrees (or VaRiaBle); next 2-3 digits for speed and unit, KT (KMH or MPS); as needed, Gust and maximum speed; 00000KT for calm; for **METAR,** if direction varies 60 degrees or more, Variability appended, e.g. 180V260	**22015G25KT**
5SM	Prevailing visibility; in U.S., Statute Miles & fractions; above 6 miles in **TAF** Plus6SM. (Or, 4-digit minimum visibility in meters and as required, lowest value with direction)	**3/4SM**
	Runway Visual Range: R; 2-digit runway designator Left, Center, or Right as needed; "/", Minus or Plus in U.S., 4-digit value, FeeT in U.S., (usually meters elsewhere); 4-digit value Variability 4-digit value (and tendency Down, Up or No change)	**R28L/2600FT**
HZ	Significant present, forecast and recent weather: see table (on back)	**TSRA**
FEW020	Cloud amount, height and type: Sky Clear 0/8, FEW >0/8-2/8, SCaTtered 3/8-4/8, BroKeN 5/8-7/8, OVerCast 8/8; 3-digit height in hundreds of ft; Towering Cumulus or CumulonimBus in **METAR**; in **TAF**, only CB. Vertical Visibility for obscured sky and height "VV004". More than 1 layer may be reported or forecast. In automated **METAR** reports only, CLeaR for "clear below 12,000 feet"	**OVC 010CB**
	Temperature: degrees Celsius; first 2 digits, temperature "/" last 2 digits, dew-point temperature; Minus for below zero, e.g., M06	**18/16**
	Altimeter setting: indicator and 4 digits; in U.S., A-inches and hundredths; (Q-hectoPascals, e.g. Q1013)	**A2992**

FIG GEN 3.5-24

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KEY to AERODROME FORECAST (TAF) and AVIATION ROUTINE WEATHER REPORT (METAR) (BACK)

FORECAST	EXPLANATION	REPORT
WS010/31022KT	In U.S. **TAF**, non-convective low-level (≤ 2,000 ft) Wind Shear; 3-digit height (hundreds of ft); "/"; 3-digit wind direction and 2-3 digit wind speed above the indicated height, and unit, KT	
	In **METAR**, ReMarK indicator & remarks. For example: Sea-Level Pressure in hectoPascals & tenths, as shown: 1004.5 hPa; Temp/dew-point in tenths °C, as shown: temp. 18.2°C, dew-point 15.9°C	**RMK** **SLP045** **T01820159**
FM1930	FroM and 2-digit hour and 2-digit minute **beginning** time: indicates significant change. Each FM starts on a new line, indented 5 spaces	
TEMPO 2022	TEMPOrary: changes expected for <1 hour and in total, < half of 2-digit hour **beginning** and 2-digit hour **ending** time period	
PROB40 0407	PROBability and 2-digit percent (30 or 40): probable condition during 2-digit hour **beginning** and 2-digit hour **ending** time period	
BECMG 1315	BECoMinG: change expected during 2-digit hour **beginning** and 2-digit hour **ending** time period	

Table of Significant Present, Forecast and Recent Weather- Grouped in categories and used in the order listed below; or as needed in TAF, No Significant Weather.

QUALIFIER

INTENSITY OR PROXIMITY

'-' Light "no sign" Moderate '+' Heavy

VC Vicinity: but not at aerodrome; in U.S. **METAR**, between 5 and 10SM of the point(s) of observation; in U.S. **TAF,** 5 to 10SM from center of runway complex (elsewhere within 8000m)

DESCRIPTOR

MI	Shallow	BC	Patches	PR	Partial	TS	Thunderstorm
BL	Blowing	SH	Showers	DR	Drifting	FZ	Freezing

WEATHER PHENOMENA

PRECIPITATION

DZ	Drizzle	RA	Rain	SN	Snow	SG	Snow grains
IC	Ice Crystals	PL	Ice Pellets	GR	Hail	GS	Small hail/snow pellets
UP	Unknown precipitation in automated observations						

OBSCURATION

BR	Mist (≥5/8SM)	FG	Fog (<5/8SM)	FU	Smoke	VA	Volcanic ash
SA	Sand	HZ	Haze	PY	Spray	DU	Widespread dust

OTHER

SQ	Squall	SS	Sandstorm	DU	Duststorm	PO	Well developed dust/sand whirls
FC	Funnel cloud	+FC	tornado/waterspout				

-Explanations in parentheses "( )" indicate different worldwide practices.
- Ceiling is not specified; defined as the lowest broken or overcast layer, or the vertical visibility.
- NWS **TAFs** exclude turbulence, icing & temperature forecasts; NWS **METARs** exclude trend forecasts

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Aviation Weather Directorate

Department of Transportation
FEDERAL AVIATION ADMINISTRATION

31. Meteorological Broadcasts (ATIS, VHF and LF)

31.1 Continuous Transcribed Weather Broadcasts (TWEB)

31.1.1 Weather broadcasts are made continuously over selected navigational aids. These broadcasts contain the general weather forecasts and winds up to 12,000 feet within a 250-mile radius of the radio. In some cases the forecasts are for route of flight rather than the general area. They also broadcast pilot reports, radar reports, and hourly weather reports of selected locations within a 400-mile radius of the broadcast station.

31.2 Automatic Terminal Information Service (ATIS) Broadcasts

31.2.1 These broadcasts are made continuously and include as weather information only the ceiling, visibility, wind, and altimeter setting of the aerodrome at which they are located.

31.3 Scheduled Weather Broadcasts (SWB)

31.3.1 Scheduled broadcasts are made only in Alaska at 15 minutes past the hour over en route navigational aids not used for TWEB or ATIS. These broadcasts contain hourly weather reports of selected locations within 150 miles of the station and weather advisories, pilot weather reports, radar weather reports, and Notices to Airmen (NOTAMs).

31.4 Navigational Aids Providing Broadcast Services

31.4.1 A compilation of navigational aids over which weather broadcasts are transmitted is not available for this publication. Complete information concerning all navigational aids providing this service is contained in the Airport/Facility directory. Similar information for the Pacific and Alaskan areas is contained in the Pacific and Alaska Supplements.

31.5 Hazardous Inflight Weather Advisory Service (HIWAS)

31.5.1 A 24-hour continuous broadcast of hazardous inflight weather is available on selected navigational outlets. Broadcasts include: severe weather forecast alerts (AWW), airman's meteorological information (AIRMET), significant meteorological information (SIGMET), Convective SIGMET (WST), urgent pilot weather reports (UUA), hazardous portions of the domestic area forecasts (FA), and center weather advisories (CWA). HIWAS broadcast outlets are identified on en route/sectional charts and in airport facility directories. For further details, contact your nearest FSS.

TBL GEN 3.5-11

Meteorological Broadcasts (VOLMET)

Name	Call Sign	Frequency	Broadcast	Form	Contents	Emission	Remarks
Honolulu	Honolulu Radio	2863, 6679, 8828, 13282 kHz	H00-05 and H30-35	Forecasts	PHNL Honolulu PHTO Hilo PGUM Guam	Voice	Plain language English
				SIGMET	Oakland FIR		
				Hourly Reports	PHNL Honolulu PHTO Hilo PHOG Kahului PGUM Guam		
			E05-10 and E35-40	Hourly Reports	KSFO San Francisco KSEA Seattle KLAX Los Angeles KPDX Portland KSMF Sacramento KONT Ontario KLAS Las Vegas		
				SIGMET	Oakland FIR		
				Aerodrome Forecasts	KSFO San Francisco KSEA Seattle KLAX Los Angeles		
			E25-30 and E55-00	Hourly Reports	PANC Anchorage PAED ElmendorfAFB PAFA Fairbanks PACD Cold Bay PAKN King Salmon CYVR Vancouver		
				SIGMET	Oakland FIR		
				Forecasts	PANC Anchorage PAFA Fairbanks PACD Cold Bay CYVR Vancouver		
New York	New York Radio	3485, 6604, 10051, 13270 kHz	H00-05	Aerodrome Forecasts	KDTW Detroit KCLE Cleveland KCVG Cincinnati	Voice	Plain language English
				Hourly Reports	KDTW Detroit KCLE Cleveland KCVG Cincinnati KIND Indianapolis KPIT Pittsburgh		
			H05-10	SIGMET	Oceanic - New York FIR		
				Aerodrome Forecasts	KBGR Bangor KBDL Windsor Locks KCLT Charlotte		
				Hourly Reports	KBGR Bangor KBDL Windsor Locks KORF Norfolk KCLT Charlotte		
			H10-15	Aerodrome Forecasts	KJFK New York KEWR Newark KBOS Boston		
				Hourly Reports	KJFK New York KEWR Newark KBOS Boston KBAL Baltimore KIAD Washington		

Meteorological Broadcasts (VOLMET) - continued							
Name	**Call Sign**	**Frequency**	**Broadcast**	**Form**	**Contents**	**Emission**	**Remarks**
			H15-20	SIGMET	Oceanic - Miami FIR/San Juan FIR		
				Aerodrome Forecasts	MXKF Bermuda KMIA Miami KATL Atlanta		
				Hourly Reports	MXKF Bermuda KMIA Miami MYNN Nassau KMCO Orlando KATL Atlanta		
			H30-35	Aerodrome Forecasts	KORD Chicago KMKE Milwaukee KMSP Minneapolis		
				Hourly Reports	KORD Chicago KMKE Milwaukee KMSP Minneapolis KDTW Detroit KBOS Boston		
			E35-40	SIGMET	Oceanic - New York FIR		
				Aerodrome Forecasts	KIND Indianapolis KSTL St. Louis KPIT Pittsburgh		
				Hourly Reports	KIND Indianapolis KSTL St. Louis KPIT Pittsburgh KACY Atlantic City		
			E40-45	Aerodrome Forecasts	KBAL Baltimore KPHL Philadelphia KIAD Washington		
				Hourly Reports	KBAL Baltimore KPHL Philadelphia KIAD Washington KJFK New York KEWR Newark		
			E45-50	SIGMET	Oceanic - Miami FIR/San Juan FIR		
				Aerodrome Forecasts	MYNN Nassau KMCO Orlando		
				Hourly Reports	MXKF Bermuda KMIA Miami MYNN Nassau KMCO Orlando KATL Atlanta KTPA Tampa KPBI West Palm Beach		
All stations operate on A3 emission H24.							
All broadcasts are made 24 hours daily, seven days a week.							

FIG GEN 3.5-25

Key to Decode an ASOS/AWSS (METAR) Observation (Front)

METAR KABC 121755Z AUTO 21016G24KT 180V240 1SM R11/P6000FT -RA BR BKN015 OVC025 06/04 A2990
RMK A02 PK WND 20032/25 WSHFT 1715 VIS 3/4V1 1/2 VIS 3/4 RWY11 RAB07 CIG 013V017 CIG 017 RWY11 PRESFR
SLP125 P0003 6009 T00640036 10066 21012 58033 TSNO $

TYPE OF REPORT	METAR: hourly (scheduled report; SPECI: special (unscheduled) report.	METAR
STATION IDENTIFIER	Four alphabetic characters; ICAO location identifiers.	KABC
DATE/TIME	All dates and times in UTC using a 24-hour clock; two-digit date and four-digit time; always appended with Z to indicate UTC.	121755Z
REPORT MODIFIER	Fully automated report, no human intervention; removed when observer signed-on.	AUTO
WIND DIRECTION AND SPEED	Direction in tens of degrees from true north (first three digits); next two digits: speed in whole knots; as needed Gusts (character) followed by maximum observed speed; always appended with KT to indicate knots; 00000KT for calm; if direction varies by 60° or more a Variable wind direction group is reported.	21016G24KT 108V240
VISIBILITY	Prevailing visibility in statute miles and fractions (space between whole miles and fractions); always appended with SM to indicate statute miles.	1SM
RUNWAY VISUAL RANGE	10-minute RVR value in hundreds of feet; reported if prevailing visibility is ≤ one mile or RVR ≤6000 feet; always appended with FT to indicate feet; value prefixed with M or P to indicate value is lower or higher than the reportable RVR value.	R11/P6000FT
WEATHER PHENOMENA	RA: liquid precipitation that does not freeze; SN: frozen precipitation other than hail; UP: precipitation of unknown type; intensity prefixed to precipitation: light (-), moderate (no sign), heavy (+); FG: fog; FZFG: freezing fog (temperature below 0°C); BR: mist; HZ: haze; SQ: squall; maximum of three groups reported; augmented by observer: FC (funnel cloud/tornado/waterspout); TS(thunderstorm); GR (hail); GS (small hail; <1/4 inch); FZRA (intensity; freezing rain); VA (volcanic ash).	-RA BR
SKY CONDITION	Cloud amount and height: CLR (no clouds detected below 12000 feet); FEW (few); SCT (scattered); BKN (broken); OVC (overcast); followed by 3-digit height in hundreds of feet; or vertical visibility (VV) followed by height for indefinite ceiling.	BKN015 OVC025
TEMPERATURE/DEW POINT	Each is reported in whole degrees Celsius using two digits; values are separated by a solidus; sub-zero values are prefixed with an M (minus).	06/04
ALTIMETER	Altimeter always prefixed with an A indicating inches of mercury; reported using four digits: tens, units, tenths, and hundredths.	A2990

FIG GEN 3.5-26

Key to Decode an ASOS/AWSS (METAR) Observation (Back)

REMARKS IDENTIFIER: RMK	RMK
TORNADIC ACTIVITY: Augmented; report should include TORNADO, FUNNEL CLOUD, or WATERSPOUT, time begin/end, location, movement; e.;g., TORNADO B25 N MOV E.	
TYPE OF AUTOMATED STATION: AO2; automated station with precipitation discriminator.	AO2
PEAK WIND: PK WND dddff(f)/(hh)mm; direction in tens of degrees, speed in whole knots, and time.	PK WND 20032/25
WIND SHIFT: WSHFT (hh)mm	WSHFT 1715
TOWER OR SURFACE VISIBILITY: TWR VIS vvvvv: visibility reported by tower personnel, e.g., TWR VIS 2; SFC VIS vvvvv: visibility reported by ASOS, e.g., SFC VIS 2.	
VARIABLE PREVAILING VISIBILITY: VIS v_n v_n v_n v_n v_nV$v_x v_x v_x v_x v_x$; reported if prevailing visibility is <3 miles and variable.	VIS 3/4V1 1/2
VISIBILITY AT SECOND LOCATION: VIS vvvvv [LOC]; reported if different than the reported prevailing visibility in body of report.	VIS 3/4 RWY11
LIGHTNING: [FREQ] LTG [LOC]; when detected the frequency and location is reported, e.g., FRQ LTG NE.	
BEGINNING AND ENDING OF PRECIPITATION AND THUNDERSTORMS: w'w'B(hh)mmE(hh)mm; TSB(hh)mmE(hh)mm	RAB07
VIRGA: Augmented; precipitation not reaching the ground, e.g., VIRGA.	
VARIABLE CEILING HEIGHT: CIG h_n h_n h_nV$h_x h_x h_x$; reported if ceiling in body of report is <3000 feet and variable.	CIG 013V017
CEILING HEIGHT AT SECOND LOCATION: CIG hhh [LOC]; Ceiling height reported if secondary ceilometer site is different than the ceiling height in the body of the report.	CIG 017 RWY11
PRESSURE RISING OR FALLING RAPIDLY: PRESRR or PRESFR; pressure rising or falling rapidly at time of observation.	PRESFR
SEA-LEVEL PRESSURE: SLPppp; tens, units, and tenths of SLP in hPa.	SLP125
HOURLY PRECIPITATION AMOUNT: Prrrr; in .01 inches since last METAR; a trace is P0000.	P0003
3- AND 6-HOUR PRECIPITATION AMOUNT: 6RRRR; precipitation amount in .01 inches for past 6 hours reported in 00, 06, 12, and 18 UTC observations and for past 3 hours in 03, 09, 15, and 21 UTC observations; a trace is 60000.	60009
24-HOUR PRECIPITATION AMOUNT: $7R_{24} R_{24} R_{24} R_{24}$; precipitation amount in .01 inches for past 24 hours reported in 12 UTC observation, e.g., 70015.	
HOURLY TEMPERATURE AND DEW POINT: $Ts_nT_aT_aT_as_nT'_aT'_aT'_a$; tenth of degree Celsius; s_n: 1 if temperature below 0° C and 0 if temperature 0°C or higher.	T00640036
6-HOUR MAXIMUM TEMPERATURE: $1s_nT_xT_xT_x$; tenth of degree Celsius; 00, 06, 12, 18 UTC; s_n: 1 if temperature below 0°C and 0 if temperature 0°C or higher.	10066
6-HOUR MINIMUM TEMPERATURE: $2s_nT_nT_nT_n$; tenth of degree Celsius; 00, 06, 12, 18 UTC; s_n: 1 if temperature below 0°C and 0 if temperature 0°C or higher.	21012
24-HOUR MAXIMUM AND MINIMUM TEMPERATURE: $4s_nT_xT_xT_xs_nT_nT_nT_n$; tenth of degree Celsius; reported at midnight local standard time; 1 if temperature below 0°C and 0 if temperature 0°C or higher, e.g., 400461006.	
PRESSURE TENDENCY: 5appp; the character (a) and change in pressure (ppp; tenths of hPa) the past 3 hours.	58033
SENSOR STATUS INDICATORS: RVRNO: RVR missing; PWINO: precipitation identifier information not available; PNO: precipitation amount not available; FZRANO: freezing rain information not available; TSNO: thunderstorm information not available; VISNO [LOC]: visibility at secondary location not available, e.g., VISNO RWY06; CHINO [LOC]: (cloud-height-indicator) sky condition at secondary location not available, e.g., CHINO RWY06.	TSNO
MAINTENANCE CHECK INDICATOR: Maintenance needed on the system.	$
If an element or phenomena does not occur, is missing, or cannot be observed, the corresponding group and space are omitted (body and/or remarks) from that particular report, except for Sea-Level Pressure (SLPppp). SLPNO shall be reported in a METAR when the SLP is not available.	

U.S. DEPARTMENT OF TRANSPORTATION • FEDERAL AVIATION ADMINISTRATION • Aviation Weather Directorate, 400 7TH Street, SW, Rooms 8200-8326, Washington, D.C 20591

FIG GEN 3.5-27
NEXRAD Coverage

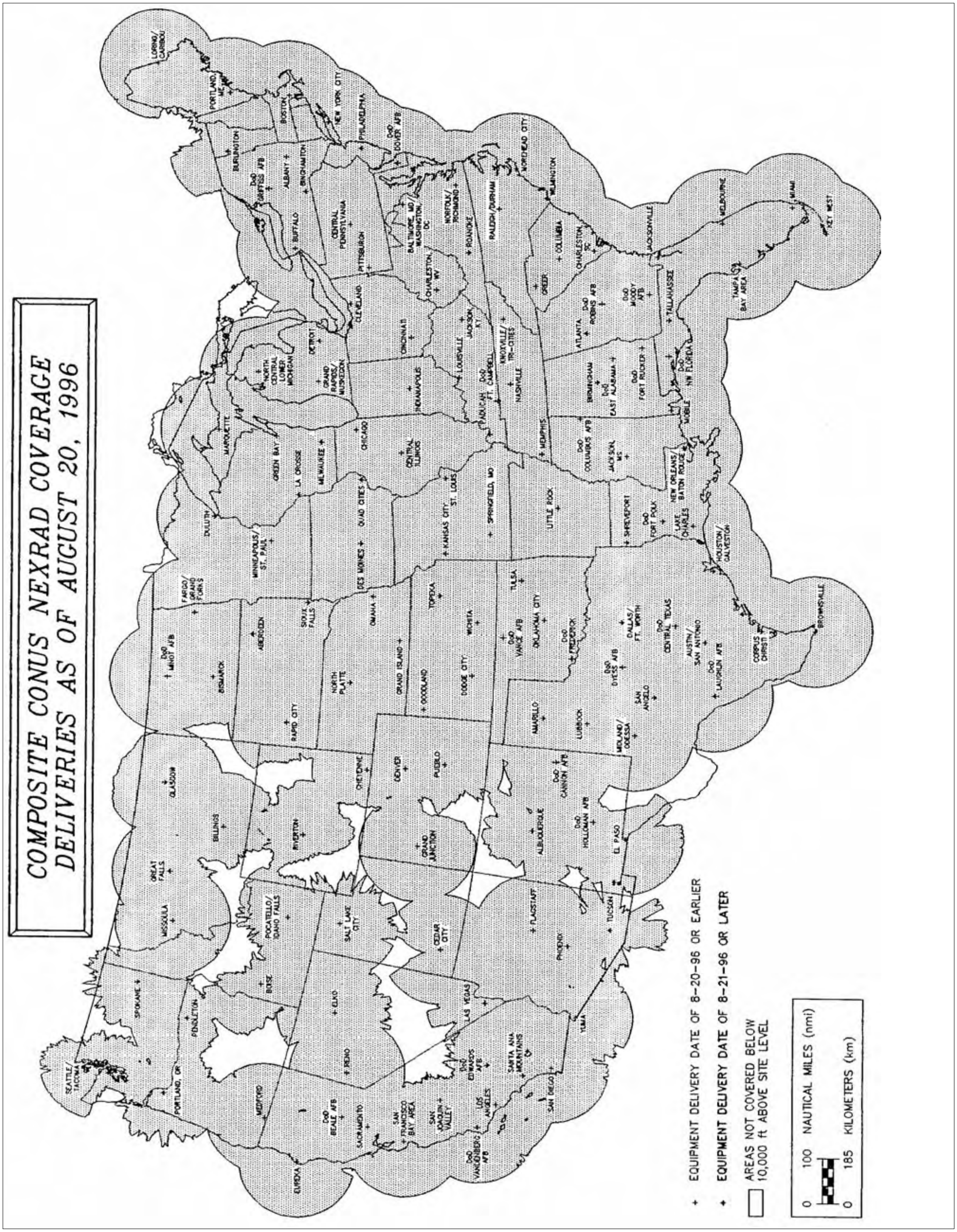


FIG GEN 3.5-28

NEXRAD Coverage

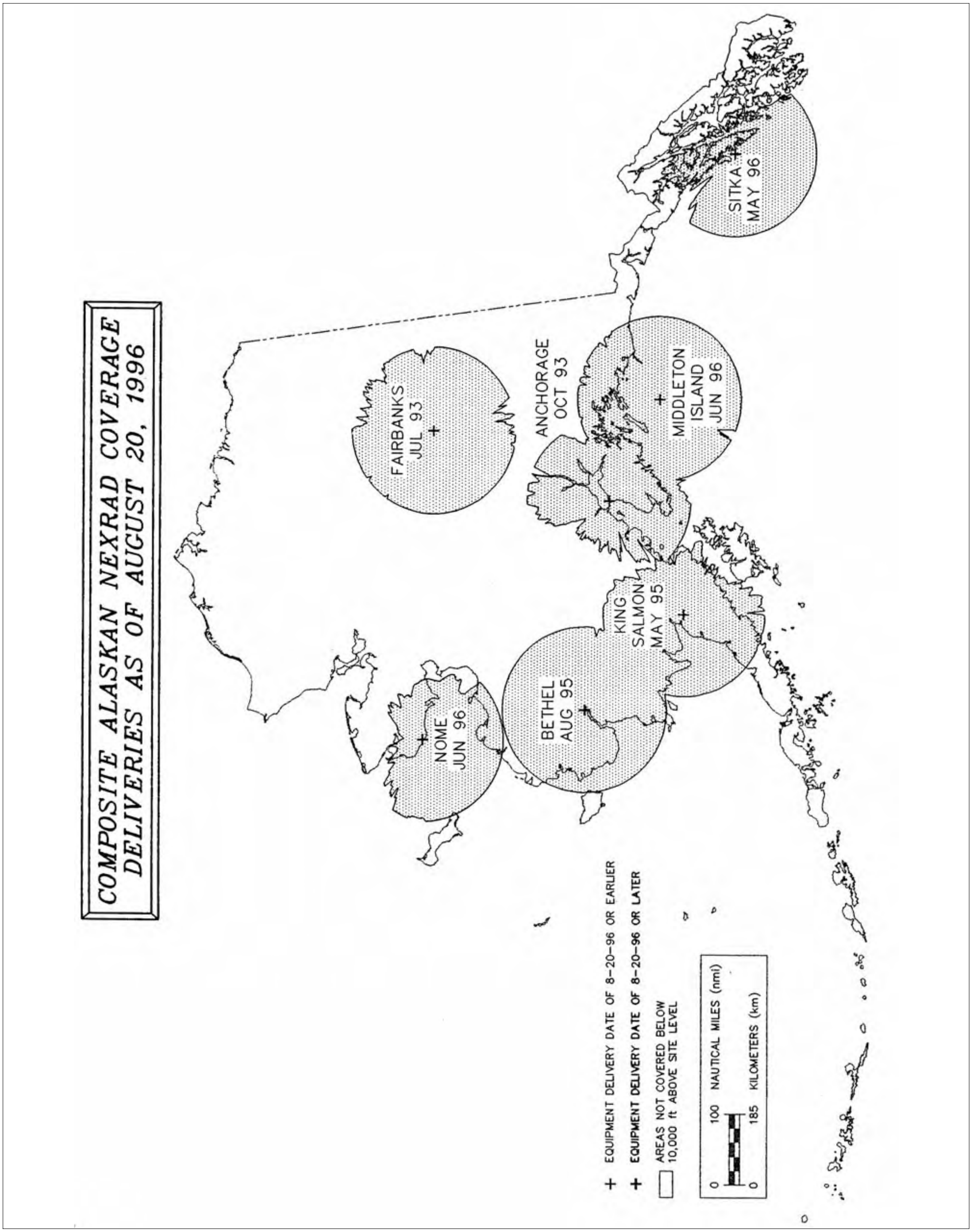


FIG GEN 3.5-29
NEXRAD Coverage

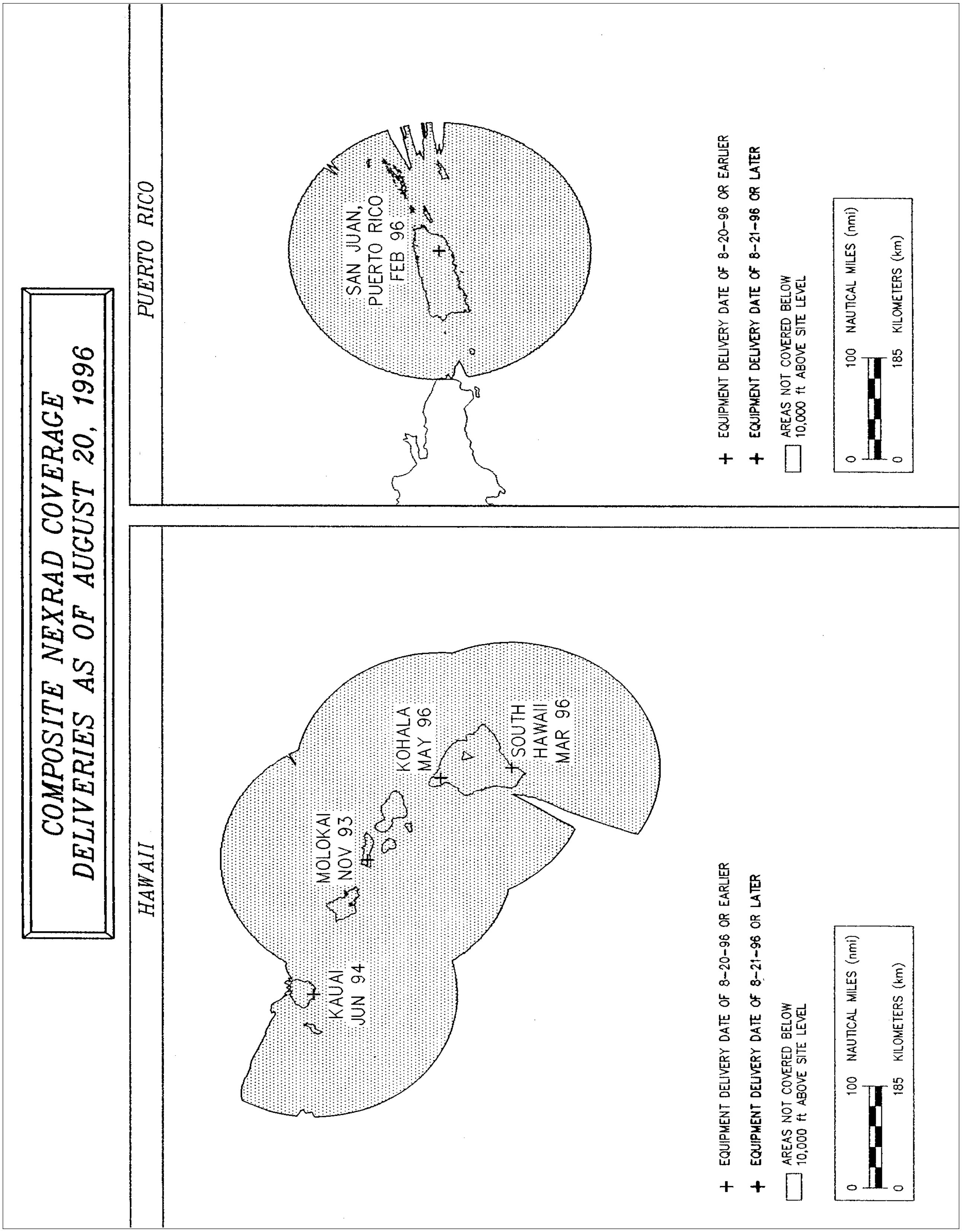


FIG GEN 3.5-30

Volcanic Activity Reporting Form (VAR)

Date ________________

SECTION 1 - Transmit to ATC via radio

1. Aircraft Identification	
2. Position	
3. Time (UTC)	
4. Flight level or altitude	
5. Position/location of volcanic activity or ash cloud	
6. Air temperature	
7. Wind	
8. Supplementary Information (Brief description of activity including vertical and lateral extent of the ash cloud, horizontal movement, rate of growth, etc., as available.)	

SECTION 2 - Complete and forward as directed

Mark the appropriate box(s)			
9. *Density of ash cloud*	☐ wispy	☐ moderately dense	☐ very dense
10. *Color of ash*	☐ white ☐ black	☐ light gray	☐ dark gray
11. *Eruption*	☐ continuous	☐ intermittent	☐ not visible
12. *Position of activity*	☐ summit ☐ multiple	☐ side ☐ not observed	☐ single
13. *Other observed features of eruption*	☐ lightning ☐ ash fallout	☐ glow ☐ mushroom cloud	☐ large rocks ☐ none
14. *Effect on aircraft*	☐ communications ☐ pitot static ☐ none	☐ navigation system ☐ windscreen	☐ engines ☐ other windows
15. *Other effects*	☐ turbulence ☐ ash deposits	☐ St. Elmo's fire	☐ fumes
16. *Other information deemed useful*			

Forward completed form via mail to:
Global Volcanism Program
NHB-119
Smithsonian Institution
Washington, DC 20560

Or Fax to:
Global Volcanism Program
(202) 357-2476

GEN 3.6 Search and Rescue

1. Responsible Authority

1.1 The Search and Rescue (SAR) service in the U.S. and its area of jurisdiction is organized in accordance with the Standards and Recommended Practices of ICAO Annex 12 by the Federal Aviation Administration with the collaboration of the U.S. Coast Guard and the U.S. Air Force. The Coast Guard and the Air Force are the responsible SAR authorities and have the responsibility for making the necessary facilities available. Postal and telegraphic addresses for the Federal Aviation Administration are given in GEN 3.1. The appropriate addresses for Coast Guard and Air Force offices are:

Air Force
Postal Address:
Inland SAR Coordinator
Commander ARRS
USAF RCC
Tyndall AFB, FL
Telegraphic Address: None.
Telex: None.
Telephone: 1-800-851-3051,
Commercial: 850-283-5955, or
Defense Switching Network: 523-5955.

Coast Guard
Postal Address:
United States Coast Guard
Search and Rescue Division (GOSR/73)
400 7th Street, S.W.
Washington, D.C. 20590
Telegraphic Address: None.
Telex: 89 2427

2. Types of Service

2.1 Details of the Rescue Coordination Centers (RCCs) and related rescue units are given in this section. In addition, various elements of state and local police organizations are available for search and rescue missions when required. The aeronautical, maritime and public telecommunication services are available to the search and rescue organizations.

2.2 Aircraft, both land and amphibious based, are used, as well as land and seagoing vessels, when required, and carry survival equipment. Airborne survival equipment, capable of being dropped, consists of inflatable rubber dinghies equipped with medical supplies, emergency rations and survival radio equipment. Aircraft and marine craft are equipped to communicate on 121.5, 123.1, 243.0, 500 kHz, 2182 kHz, and 8364 kHz. Ground rescue teams are equipped to communicate on 121.5 MHz, 500 kHz, and 8364 kHz. SAR aircraft and marine craft are equipped with direction finding equipment and radar.

3. SAR Agreements

3.1 Bilateral agreements exist between the U.S. and the following neighboring States of the NAM region: Canada and Mexico.

3.1.1 There are two agreements with Canada. One provides for public aircraft of either country which are engaged in air search and rescue operations to enter or leave either country without being subjected to immigration or customs formalities normally required. The other permits vessels and wrecking appliances of either country to render aid and assistance on specified border waters and on the shores and in the waters of the other country along the Atlantic and Pacific Coasts within a distance of 30 miles from the international boundary on those coasts. A post operations report is required.

3.1.2 The agreement with Mexico applies to territorial waters and shores of each country within 200 miles of the border on the Gulf Coast and within 270 miles of the border on the Pacific Coast. It permits the vessels and aircraft of either country to proceed to the assistance of a distressed vessel or aircraft of their own registry upon notification of entry and of departure of the applicable waters and shores.

3.2 In situations not falling under the above agreements, requests from States to participate in a SAR operation within the U.S. for aircraft of their own registry may be addressed to the nearest RCC. The RCC would reply, and issue appropriate instructions.

4. General Conditions of Availability

4.1 The SAR service and facilities in the U.S. are available to the neighboring States within the NAM, NAT, CAR, PAC Regions upon request to the appropriate RCC at all times when they are not engaged in search and rescue activity in their home territory. All facilities are specialized in SAR techniques and functions.

5. Applicable ICAO Documents

Annex 12	Search and Rescue
Annex 13	Aircraft Accident Inquiry
Doc 7030	Regional Supplementary Procedures for Alerting and Search and Rescue Services applicable to the NAM, NAT, CAR, PAC Regions.

6. Differences from ICAO Standards, Recommended Practices and Procedures

6.1 Differences from ICAO Standards, Recommended Practices and Procedures are listed in GEN 1.7.

7. Emergency Locator Transmitters

7.1 General

7.1.1 ELTs are required for most General Aviation airplanes.

REFERENCE-
14 CFR SECTION 91.207.

7.1.2 ELTs of various types were developed as a means of locating downed aircraft. These electronic, battery operated transmitters operate on one of three frequencies. These operating frequencies are 121.5 MHz, 243.0 MHz, and the newer 406 MHz. ELTs operating on 121.5 MHz and 243.0 MHz are analog devices. The newer 406 MHz ELT is a digital transmitter that can be encoded with the owner's contact information or aircraft data. The latest 406 MHz ELT models can also be encoded with the aircraft's position data which can help SAR forces locate the aircraft much more quickly after a crash. The 406 MHz ELTs also transmits a stronger signal when activated than the older 121.5 MHz ELTs.

7.1.2.1 The Federal Communications Commission (FCC) requires 406 MHz ELTs be registered with the National Oceanic and Atmospheric Administration (NOAA) as outlined in the ELT's documentation. The FAA's 406 MHz ELT Technical Standard Order (TSO) TSO-C126 also requires that each 406 MHz ELT be registered with NOAA. The reason is NOAA maintains the owner registration database for U.S. registered 406 MHz alerting devices, which includes ELTs. NOAA also operates the United States' portion of the Cospas-Sarsat satellite distress alerting system designed to detect activated ELTs and other distress alerting devices.

7.1.2.2 In the event that a properly registered 406 MHz ELT activates, the Cospas-Sarsat satellite system can decode the owner's information and provide that data to the appropriate search and rescue (SAR) center. In the United States, NOAA provides the alert data to the appropriate U.S. Air Force Rescue Coordination Center (RCC) or U.S. Coast Guard Rescue Coordination Center. That RCC can then telephone or contact the owner to verify the status of the aircraft. If the aircraft is safely secured in a hangar, a costly ground or airborne search is avoided. In the case of an inadvertent 406 MHz ELT activation, the owner can deactivate the 406 MHz ELT. If the 406 MHz ELT equipped aircraft is being flown, the RCC can quickly activate a search. 406 MHz ELTs permit the Cospas-Sarsat satellite system to narrow the search area to a more confined area compared to that of a 121.5 MHz or 243.0 MHz ELT. 406 MHz ELTs also include a low-power 121.5 MHz homing transmitter to aid searchers in finding the aircraft in the terminal search phase.

7.1.2.3 Each analog ELT emits a distinctive downward swept audio tone on 121.5 MHz and 243.0 MHz.

7.1.2.4 If "armed" and when subject to crash-generated forces, ELTs are designed to automatically activate and continuously emit their respective signals, analog or digital. The transmitters will operate continuously for at least 48 hours over a wide temperature range. A properly installed, maintained, and functioning ELT can expedite search and rescue operations and save lives if it survives the crash and is activated.

7.1.2.5 Pilots and their passengers should know how to activate the aircraft's ELT if manual activation is required. They should also be able to verify the aircraft's ELT is functioning and transmitting an alert after a crash or manual activation.

7.1.2.6 Because of the large number of 121.5 MHz ELT false alerts and the lack of a quick means of verifying the actual status of an activated 121.5 MHz or 243.0 MHz analog ELT through an owner registration database, U.S. SAR forces do not respond as quickly to initial 121.5/243.0 MHz ELT alerts as the SAR forces do to 406 MHz ELT alerts. Compared to the almost instantaneous detection of a 406 MHz ELT, SAR forces' normal practice is to wait for either a confirmation of a 121.5/243.0 MHz alert by additional satellite passes or through confirmation of an overdue aircraft or similar notification. In some cases, this confirmation process can take hours. SAR forces can initiate a response to 406 MHz alerts in minutes compared to the potential delay of hours for a 121.5/243.0 MHz ELT.

7.1.3 The Cospas-Sarsat system has announced the termination of satellite monitoring and reception of the 121.5 MHz and 243.0 MHz frequencies in 2009. The Cospas-Sarsat system will continue to monitor the 406 MHz frequency. What this means for pilots is that after the termination date, those aircraft with only 121.5 MHz or 243.0 MHz ELTs onboard will have to depend upon either a nearby Air Traffic Control facility receiving the alert signal or an overflying aircraft monitoring 121.5 MHz or 243.0 MHz detecting the alert. To ensure adequate monitoring of these frequencies and timely alerts after 2009, all airborne pilots should periodically monitor these frequencies to try and detect an activated 121.5/243.0 MHz ELT.

7.2 ELT Testing

7.2.1 ELTs should be tested in accordance with the manufacturer's instructions, preferably in a shielded or screened room or specially designed test container to prevent the broadcast of signals which could trigger a false alert.

7.2.2 When this cannot be done, aircraft operational testing is authorized as follows:

7.2.2.1 Analog 121.5/243 MHz ELTs should only be tested during the first 5 minutes after any hour. If operational tests must be made outside of this period, they should be coordinated with the nearest FAA Control Tower or FSS. Tests should be no longer than three audible sweeps. If the antenna is removable, a dummy load should be substituted during test procedures.

7.2.2.2 Digital 406 MHz ELTs should only be tested in accordance with the unit's manufacturer's instructions.

7.2.2.3 Airborne tests are not authorized.

7.3 False Alarms

7.3.1 Caution should be exercised to prevent the inadvertent activation of ELTs in the air or while they are being handled on the ground. Accidental or unauthorized activation will generate an emergency signal that cannot be distinguished from the real thing, leading to expensive and frustrating searches. A false ELT signal could also interfere with genuine emergency transmissions and hinder or prevent the timely location of crash sites. Frequent false alarms could also result in complacency and decrease the vigorous reaction that must be attached to all ELT signals.

7.3.2 Numerous cases of inadvertent activation have occurred as a result of aerobatics, hard landings, movement by ground crews and aircraft maintenance. These false alarms can be minimized by monitoring 121.5 MHz and/or 243.0 MHz as follows:

7.3.2.1 In flight when a receiver is available.

7.3.2.2 Before engine shut down at the end of each flight.

7.3.2.3 When the ELT is handled during installation or maintenance.

7.3.2.4 When maintenance is being performed near the ELT.

7.3.2.5 When a ground crew moves the aircraft.

7.3.2.6 If an ELT signal is heard, turn off the aircraft's ELT to determine if it is transmitting. If it has been activated, maintenance might be required before the unit is returned to the "ARMED" position. You should contact the nearest Air Traffic facility and notify it of the inadvertent activation.

7.4 Inflight Monitoring and Reporting

7.4.1 Pilots are encouraged to monitor 121.5 MHz and/or 243.0 MHz while in flight to assist in identifying possible emergency ELT transmissions. On receiving a signal, report the following information to the nearest air traffic facility:

7.4.1.1 Your position at the time the signal was first heard.

7.4.1.2 Your position at the time the signal was last heard.

7.4.1.3 Your position at maximum signal strength.

7.4.1.4 Your flight altitudes and frequency on which the emergency signal was heard: 121.5 MHz or 243.0 MHz. If possible, positions should be given relative to a navigation aid. If the aircraft has homing equipment, provide the bearing to the emergency signal with each reported position.

8. National Search and Rescue Plan

8.1 By federal interagency agreement, the National Search and Rescue Plan provides for the effective use of all available facilities in all types of SAR missions. These facilities include aircraft, vessels, pararescue and ground rescue teams, and emergency radio fixing. Under the Plan, the U.S. Coast Guard is responsible for the coordination of SAR in the Maritime Region, and the U.S. Air Force is responsible in the Inland Region. To carry out these responsibilities, the Coast Guard and the Air Force have established RCCs to direct SAR activities within their regions. For aircraft emergencies, distress and urgency information normally will be passed to the appropriate RCC through an air route traffic control center (ARTCC) or flight service station (FSS).

TBL GEN 3.6-1

8.2 Coast Guard Rescue Coordination Centers

Coast Guard Rescue Coordination Centers	
Alameda, CA 510-437-3701	Miami, FL 305-415-6800
Boston, MA 617-223-8555	New Orleans, LA 504-589-6225
Cleveland, OH 216-902-6117	Portsmouth, VA 757-398-6390
Honolulu, HI 808-541-2500	Seattle, WA 206-220-7001
Juneau, AK 907-463-2000	San Juan, PR 787-289-2042

8.3 Coast Guard Rescue Coordination Centers are served by major radio stations which guard 2182 kHz (VOICE). In addition, Coast Guard units along the seacoasts of the U.S. and shores of the Great Lakes guard 2182 kHz. The call "COAST GUARD" will alert all Coast Guard Radio Stations within range. 2182 kHz is also guarded by most commercial coast stations and some ships and boats.

8.4 Air Force Rescue Coordination Centers

TBL GEN 3.6-2

Air Force Rescue Coordination Center	
Tyndall AFB, Florida	**Phone**
Commercial	850-283-5955
WATS	800-851-3051
DSN	523-5955

TBL GEN 3.6-3

Air Command Rescue Coordination Center Alaska

Alaskan Air Command Rescue Coordination Center	
Fort Richardson, 11th RCC, Alaska	**Phone**
Commercial	907-428-7230 or 800-420-7230
DSN	317-384-6726

8.5 Joint Rescue Coordination Center Hawaii

TBL GEN 3.6-4

Honolulu Joint Rescue Coordination Center	
HQ 14th CG District Honolulu	**Phone**
Commercial	808-541-2500
DSN	448-0301

PART 2 – EN ROUTE (ENR)

ENR 0.

ENR 0.1 Preface – Not applicable

ENR 0.2 Record of AIP Amendments – See GEN 0.2–1

ENR 0.3 Record of AIP Supplements – Not applicable

ENR 0.4 Checklist of Pages

ENR 0.5 List of Hand Amendments to the AIP - Not applicable

42.13 VFR-on-top

42.13.1 Pilot

42.13.1.1 This clearance must be requested by the pilot on an IFR flight plan, and if approved, allows the pilot the choice to select (subject to any ATC restrictions) an altitude or flight level in lieu of an assigned altitude.

NOTE-
1. *VFR-on-top is not permitted in certain airspace areas, such as Class A airspace, certain restricted areas, etc. Consequently, IFR flights operating VFR-on-top will avoid such airspace.*

2. *See paragraph 32 of this section, IFR Separation Standards; GEN 3.3 paragraph 6, Position Reporting; and GEN 3.3 paragraph 7, Additional Reports.*

42.13.1.2 By requesting a VFR-on-top clearance, the pilot assumes the sole responsibility to be vigilant so as to see and avoid other aircraft and to:

a) Fly at the appropriate VFR altitude as prescribed in 14 CFR Section 91.159.

b) Comply with the VFR visibility and distance from clouds criteria in 14 CFR Section 91.155 (Basic VFR Weather Minimums).

c) Comply with instrument flight rules that are applicable to this flight; i.e., minimum IFR altitudes, position reporting, radio communications, course to be flown, adherence to ATC clearance, etc.

d) Advise ATC prior to any altitude change to ensure the exchange of accurate traffic information.

42.13.2 Controller

42.13.2.1 May clear an aircraft to maintain VFR-on-top if the pilot of an aircraft on an IFR flight plan requests the clearance.

42.13.2.2 Informs the pilot of an aircraft cleared to climb to VFR-on-top the reported height of the tops or that no top report is available; issues an alternate clearance if necessary; and once the aircraft reports reaching VFR-on-top, reclears the aircraft to maintain VFR-on-top.

42.13.2.3 Before issuing clearance, ascertains that the aircraft is not in or will not enter Class A airspace.

42.14 Instrument Departures

42.14.1 Pilot

42.14.1.1 Prior to departure, considers the type of terrain and other obstructions on or in the vicinity of the departure airport.

42.14.1.2 Determines if obstruction avoidance can be maintained visually or that the departure procedure should be followed.

42.14.1.3 Determines whether a departure procedure and/or instrument departure procedure (DP) is available for obstruction avoidance.

42.14.1.4 At airports where instrument approach procedures have not been published, hence no published departure procedure, determines what action will be necessary and takes such action that will assure a safe departure.

42.14.2 Controller

42.14.2.1 At locations with airport traffic control service, when necessary, specifies direction of takeoff/turn or initial heading to be flown after takeoff.

42.14.2.2 At locations without airport traffic control service but within Class E surface area, when necessary to specify direction of takeoff/turn or initial heading to be flown, obtains pilot's concurrence that the procedure will allow him/her to comply with local traffic patterns, terrain, and obstruction avoidance.

42.14.2.3 Includes established departure procedures as part of the air traffic control clearance when pilot compliance is necessary to ensure separation.

42.15 Minimum Fuel Advisory

42.15.1 Pilot

42.15.1.1 Advises ATC of your "minimum fuel" status when your fuel supply has reached a state where, upon reaching destination, you cannot accept any undue delay.

42.15.1.2 Be aware that this is not an emergency situation but merely an advisory that indicates an emergency situation is possible should any undue delay occur.

42.15.1.3 On initial contact the term "minimum fuel" should be used after stating call sign.

EXAMPLE-
Salt Lake Approach, United 621, "minimum fuel."

42.15.1.4 Be aware a minimum fuel advisory does not imply a need for traffic priority.

42.15.1.5 If the remaining usable fuel supply suggests the need for traffic priority to ensure a safe landing, you should declare an emergency due to low fuel, and report the fuel remaining in minutes.

42.15.2 Controller

42.15.2.1 When an aircraft declares a state of "minimum fuel," relay this information to the facility to whom control jurisdiction is transferred.

42.15.2.2 Be alert for any occurrence which might delay the aircraft.

43. Traffic Alert and Collision Avoidance System (TCAS I & II)

43.1 TCAS I provides proximity warning only, to assist the pilot in the visual acquisition of intruder aircraft. No recommended avoidance maneuvers are provided nor authorized as a direct result of a TCAS I warning. It is intended for use by smaller commuter aircraft holding 10 to 30 passenger seats, and general aviation aircraft.

43.2 TCAS II provides traffic advisories (TAs) and resolution advisories (RAs). RAs provide recommended maneuvers in a vertical direction (climb or descend only) to avoid conflicting traffic. Airline aircraft, and larger commuter and business aircraft holding 31 passenger seats or more, use TCAS II equipment.

43.3 Each pilot who deviates from an ATC clearance in response to a TCAS II RA shall notify ATC of that deviation as soon as practicable and expeditiously return to the current ATC clearance when the traffic conflict is resolved.

43.4 Deviations from rules, policies, or clearances should be kept to the minimum necessary to satisfy a TCAS II RA.

43.5 The serving IFR air traffic facility is not responsible for providing approved standard IFR separation to an aircraft after a TCAS II RA maneuver until one of the following conditions exists:

43.5.1 The aircraft has returned to its assigned altitude and course.

43.5.2 Alternate ATC instructions have been issued.

43.6 TCAS does not alter or diminish the pilot's basic authority and responsibility to ensure safe flight. Since TCAS does not respond to aircraft which are not transponder equipped or aircraft with a transponder failure, TCAS alone does not ensure safe separation in every case.

43.7 At this time, no air traffic service nor handling is predicated on the availability of TCAS equipment in the aircraft.

44. Heavy Traffic Around Military Fields

44.1 Pilots are advised to exercise vigilance when in close proximity to most military airports. These airports may have jet aircraft traffic patterns extending up to 2,500 feet above the surface. In addition, they may have an unusually heavy concentration of jet aircraft operating within a 25-nautical mile radius and from the surface to all altitudes. The precautionary note also applies to the larger civil airports.

45. Traffic Information Service (TIS)

45.1 Introduction

The Traffic Information Service (TIS) provides information to the cockpit via data link, that is similar to VFR radar traffic advisories normally received over voice radio. Among the first FAA-provided data services, TIS is intended to improve the safety and efficiency of "see and avoid" flight through an automatic display that informs the pilot of nearby traffic and potential conflict situations. This traffic display is intended to assist the pilot in visual acquisition of these aircraft. TIS employs an enhanced capability of the terminal Mode S radar system, which contains the surveillance data, as well as the data link required to "uplink" this information to suitably-equipped aircraft (known as a TIS "client"). TIS provides estimated position, altitude, altitude trend, and ground track information for up to 8 intruder aircraft within 7 NM horizontally, +3,500 and -3,000 feet vertically of the client aircraft (see FIG ENR 1.1-27, TIS Proximity Coverage Volume). The range of a target reported at a distance greater than 7 NM only indicates that this target will be a threat within 34 seconds and does not display a precise distance. TIS will alert the pilot to aircraft (under surveillance of the Mode S radar) that are estimated to be within 34 seconds of potential collision, regardless of distance of altitude. TIS surveillance data is derived from the same radar used by ATC; this data is uplinked to the client aircraft on each radar scan (nominally every 5 seconds).

45.2 Requirements

45.2.1 In order to use TIS, the client and any intruder aircraft must be equipped with the appropriate cockpit equipment and fly within the radar coverage of a Mode S radar capable of providing TIS. Typically, this will be within 55 NM of the sites depicted in FIG ENR 1.1-28, Terminal Mode S Radar Sites. ATC communication is not a requirement to receive TIS, although it may be required by the particular airspace or flight operations in which TIS is being used.

FIG ENR 1.1-27

TIS Proximity Coverage Volume

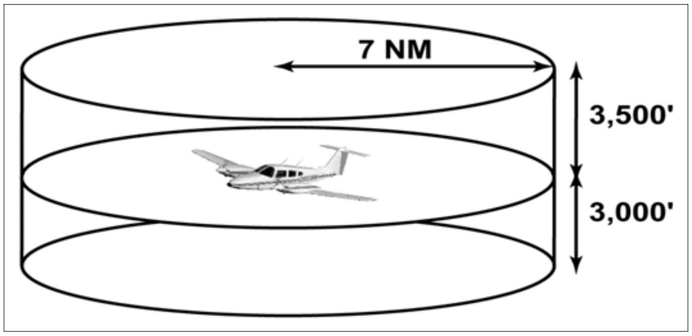


FIG ENR 1.1-28

Terminal Mode S Radar Sites

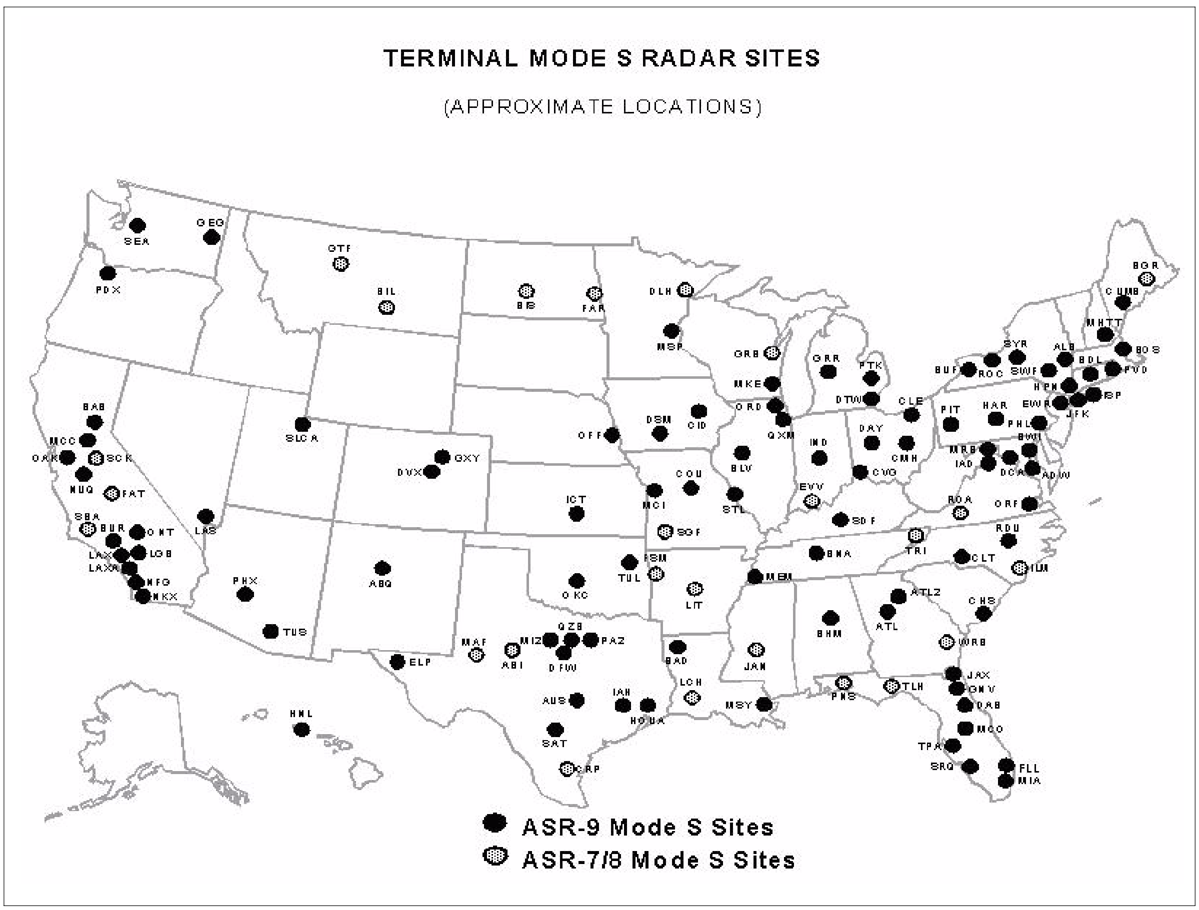
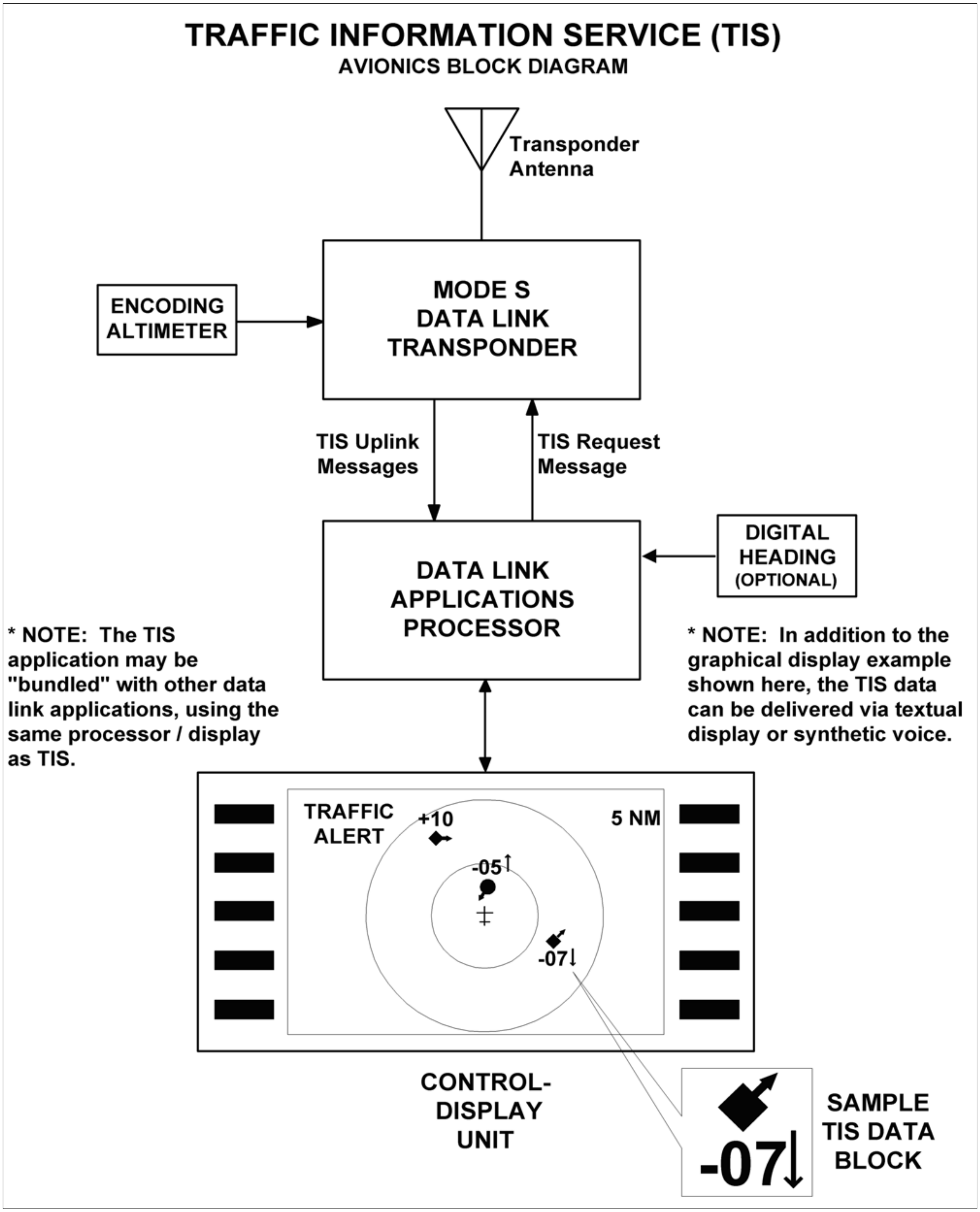


FIG ENR 1.1-29

**Traffic Information Service (TIS)
Avionics Block Diagram**



45.2.2 The cockpit equipment functionality required by a TIS client aircraft to receive the service consists of the following (refer to FIG ENR 1.1-29):

45.2.2.1 Mode S data link transponder with altitude encoder.

45.2.2.2 Data link applications processor with TIS software installed.

45.2.2.3 Control-display unit.

45.2.2.4 Optional equipment includes a digital heading source to correct display errors caused by "crab angle" and turning maneuvers.

NOTE-
Some of the above functions will likely be combined into single pieces of avionics, such as subparagraphs 45.2.2.1 and 45.2.2.2.

45.2.3 To be visible to the TIS client, the intruder aircraft must, at a minimum, have an operating transponder (Mode A, C or S). All altitude information provided by TIS from intruder aircraft is derived from Mode C reports, if appropriately equipped.

45.2.4 TIS will initially be provided by the terminal Mode S systems that are paired with ASR-9 digital primary radars. These systems are in locations with the greatest traffic densities, thus will provide the greatest initial benefit. The remaining terminal Mode S sensors, which are paired with ASR-7 or ASR-8 analog primary radars, will provide TIS pending modification or relocation of these sites. See FIG ENR 1.1-28, Terminal Mode S Radar Sites, for site locations. There is no mechanism in place, such as NOTAMs, to provide status update on individual radar sites since TIS is a nonessential, supplemental information service.

The FAA also operates en route Mode S radars (not illustrated) that rotate once every 12 seconds. These sites will require additional development of TIS before any possible implementation. There are no plans to implement TIS in the en route Mode S radars at the present time.

45.3 Capabilities

45.3.1 TIS provides ground-based surveillance information over the Mode S data link to properly equipped client aircraft to aid in visual acquisition of proximate air traffic. The actual avionics capability of each installation will vary and the supplemental handbook material must be consulted prior to using TIS. A maximum of eight (8) intruder aircraft may be displayed; if more than eight aircraft match intruder parameters, the eight "most significant" intruders are uplinked. These "most significant" intruders are usually the ones in closest proximity and/or the greatest threat to the TIS client.

45.3.2 TIS, through the Mode S ground sensor, provides the following data on each intruder aircraft:

45.3.2.1 Relative bearing information in 6-degree increments.

45.3.2.2 Relative range information in 1/8 NM to 1 NM increments (depending on range).

45.3.2.3 Relative altitude in 100-foot increments (within 1,000 feet) or 500-foot increments (from 1,000-3,500 feet) if the intruder aircraft has operating altitude reporting capability.

45.3.2.4 Estimated intruder ground track in 45-degree increments.

45.3.2.5 Altitude trend data (level within 500 fpm or climbing/descending >500 fpm) if the intruder aircraft has operating altitude reporting capability.

45.3.2.6 Intruder priority as either a "traffic advisory" or "proximate" intruder.

45.3.3 When flying from surveillance coverage of one Mode S sensor to another, the transfer of TIS is an automatic function of the avionics system and requires no action from the pilot.

45.3.4 There are a variety of status messages that are provided by either the airborne system or ground equipment to alert the pilot of high priority intruders and data link system status. These messages include the following:

45.3.4.1 Alert. Identifies a potential collision hazard within 34 seconds. This alert may be visual and/or audible, such as a flashing display symbol or a headset tone. A target is a threat if the time to the closest approach in vertical and horizontal coordinates is less than 30 seconds and the closest approach is expected to be within 500 feet vertically and 0.5 nautical miles laterally.

45.3.4.2 TIS Traffic. TIS traffic data is displayed.

45.3.4.3 Coasting. The TIS display is more than 6 seconds old. This indicates a missing uplink from the ground system. When the TIS display information is more than 12 seconds old, the "No Traffic" status will be indicated.

45.3.4.4 No Traffic. No intruders meet proximate or alert criteria. This condition may exist when the TIS system is fully functional or may indicate "coasting" between 12 and 59 seconds old (see paragraph 45.3.4.3 above).

45.3.4.5 TIS Unavailable. The pilot has requested TIS, but no ground system is available. This condition will also be displayed when TIS uplinks are missing for 60 seconds or more.

45.3.4.6 TIS Disabled. The pilot has not requested TIS or has disconnected from TIS.

45.3.4.7 Good-bye. The client aircraft has flown outside of TIS coverage.

NOTE-
Depending on the avionics manufacturer implementation, it is possible that some of these messages will not be directly available to the pilot.

45.3.5 Depending on avionics system design, TIS may be presented to the pilot in a variety of different displays, including text and/or graphics. Voice annunciation may also be used, either alone or in combination with a visual display. FIG ENR 1.1-29, Traffic Information Service (TIS), Avionics Block Diagram, shows an example of a TIS display using symbology similar to the Traffic Alert and Collision Avoidance System (TCAS) installed on most passenger air carrier/commuter aircraft in the U.S. The small symbol in the center represents the client aircraft and the display is oriented "track up," with the 12 o'clock position at the top. The range rings indicate 2 and 5 NM. Each intruder is depicted by a symbol positioned at the approximate relative bearing and range from the client aircraft. The circular symbol near the center indicates an "alert" intruder and the diamond symbols indicate "proximate" intruders.

45.3.6 The inset in the lower right corner of FIG ENR 1.1-29, Traffic Information Service (TIS), Avionics Block Diagram, shows a possible TIS data block display. The following information is contained in this data block:

45.3.6.1 The intruder, located approximately four o'clock, three miles, is a "proximate" aircraft and currently not a collision threat to the client aircraft. This is indicated by the diamond symbol used in this example.

45.3.6.2 The intruder ground track diverges to the right of the client aircraft, indicated by the small arrow.

45.3.6.3 The intruder altitude is 700 feet less than or below the client aircraft, indicated by the "-07" located under the symbol.

45.3.6.4 The intruder is descending >500 fpm, indicated by the downward arrow next to the "-07" relative altitude information. The absence of this arrow when an altitude tag is present indicates level flight or a climb/descent rate less than 500 fpm.

NOTE-
If the intruder did not have an operating altitude encoder (Mode C), the altitude and altitude trend "tags" would have been omitted.

45.4 Limitations

45.4.1 TIS is **NOT** intended to be used as a collision avoidance system and does not relieve the pilot responsibility to "see and avoid" other aircraft (see paragraph 42.10, See and Avoid). TIS shall not be for avoidance maneuvers during IMC or other times when there is no visual contact with the intruder aircraft. TIS provides proximity warning only, to assist the pilot in the visual acquisition of intruder aircraft. It is intended for use by aircraft in which TCAS is not required. **No recommended avoidance maneuvers are provided for, nor authorized, as a direct result of a TIS intruder display or TIS alert.**

45.4.2 TIS does not alter or diminish the pilot's basic authority and responsibility to ensure safe flight. Since TIS does not respond to aircraft which are not transponder equipped, aircraft with a transponder failure, or aircraft out of radar coverage, TIS alone does not ensure safe separation in every case.

45.4.3 At this time, no air traffic service nor handling is predicated on the availability of TIS equipment in the aircraft.

45.4.4 While TIS is a useful aid to visual traffic avoidance, it has some system limitations that must be fully understood to ensure proper use. Many of these limitations are inherent in secondary radar surveillance. In other words, the information provided by TIS will be no better than that provided to ATC. Other limitations and anomalies are associated with the TIS predictive algorithm.

45.4.4.1 Intruder Display Limitations. TIS will only display aircraft with operating transponders installed. TIS relies on surveillance of the Mode S radar, which is a "secondary surveillance" radar similar to the ATCRBS described in paragraph 37.2, Air Traffic Control Radar Beacon System (ATCRBS).

45.4.4.2 TIS Client Altitude Reporting Requirement. Altitude reporting is required by the TIS client aircraft in order to receive TIS. If the altitude encoder is inoperative or disabled, TIS will be unavailable, as TIS requests will not be honored by the ground system. As such, TIS requires altitude reporting to determine the Proximity Coverage Volume as indicated in FIG ENR 1.1-27. TIS users must be alert to altitude encoder malfunctions, as TIS has no mechanism to determine if client altitude reporting is correct. A failure of this nature will cause erroneous and possibly unpredictable TIS operation. If this malfunction is suspected, confirmation of altitude reporting with ATC is suggested.

45.4.4.3 Intruder Altitude Reporting. Intruders without altitude reporting capability will be displayed without the accompanying altitude tag. Additionally, nonaltitude reporting intruders are assumed to be at the same altitude as the TIS client for alert computations. This helps to ensure that the pilot will be alerted to all traffic under radar coverage, but the actual altitude difference may be substantial. Therefore, visual acquisition may be difficult in this instance.

45.4.4.4 Coverage Limitations. Since TIS is provided by ground-based, secondary surveillance radar, it is subject to all limitations of that radar. If an aircraft is not detected by the radar, it cannot be displayed on TIS. Examples of these limitations are as follows:

45.4.4.4.1 TIS will typically be provided within 55 NM of the radars depicted in FIG ENR 1.1-28, Terminal Mode S Radar Sites. This maximum range can vary by radar site and is always subject to "line of sight" limitations; the radar and data link signals will be blocked by obstructions, terrain, and curvature of the earth.

45.4.4.4.2 TIS will be unavailable at low altitudes in many areas of the country, particularly in mountainous regions. Also, when flying near the "floor" of radar coverage in a particular area, intruders below the client aircraft may not be detected by TIS.

45.4.4.4.3 TIS will be temporarily disrupted when flying directly over the radar site providing coverage if no adjacent site assumes the service. A ground-based radar, like a VOR or NDB, has a zenith cone, sometimes referred to as the cone of confusion or cone of silence. This is the area of ambiguity directly above the station where bearing information is unreliable. The zenith cone setting for TIS is 34 degrees: any aircraft above that angle with respect to the radar horizon will lose TIS coverage from that radar until it is below this 34 degree angle. The aircraft may not actually lose service in areas of multiple radar coverage since an adjacent radar will provide TIS. If no other TIS-capable radar is available, the "Good-bye" message will be received and TIS terminated until coverage is resumed.

45.4.4.5 Intermittent Operations. TIS operation may be intermittent during turns or other maneuvering, particularly if the transponder system does not include antenna diversity (antenna mounted on the top and bottom of the aircraft). As in subparagraph 45.4.4.4 above, TIS is dependent on two-way, "line of sight" communications between the aircraft and the Mode S radar. Whenever the structure of the client aircraft comes between the transponder antenna (usually located on the underside of the aircraft) and the ground-based radar antenna, the signal may be temporarily interrupted.

45.4.4.6 TIS Predictive Algorithm. TIS information is collected one radar scan prior to the scan during which the uplink occurs. Therefore, the surveillance information is approximately 5 seconds old. In order to present the intruders in a "real time" position, TIS uses a "predictive algorithm" in its tracking software. This algorithm uses track history data to extrapolate intruders to their expected positions consistent with the time of display in the cockpit. Occasionally, aircraft maneuvering will cause this algorithm to induce errors in the TIS display. These errors primarily affect relative bearing information; intruder distance and altitude will remain relatively accurate and may be used to assist in "see and avoid." Some of the more common examples of these errors are as follows:

45.4.4.6.1 When client or intruder aircraft maneuver excessively or abruptly, the tracking algorithm will report incorrect horizontal position until the maneuvering aircraft stabilizes.

45.4.4.6.2 When a rapidly closing intruder is on a course that crosses the client at a shallow angle (either overtaking or head on) and either aircraft abruptly changes course within ¿ NM, TIS will display the intruder on the opposite side of the client than it actually is.

These are relatively rare occurrences and will be corrected in a few radar scans once the course has stabilized.

45.4.4.7 Heading/Course Reference. Not all TIS aircraft installations will have onboard heading reference information. In these installations, aircraft course reference to the TIS display is provided by the Mode S radar. The radar only determines ground track information and has no indication of the client aircraft heading. In these installations, all intruder bearing information is referenced to ground track and does not account for wind correction. Additionally, since ground-based radar will require several scans to determine aircraft course following a course change, a lag in TIS display orientation (intruder aircraft bearing) will occur. As in subparagraph 45.4.4.6 above, intruder distance and altitude are still usable.

45.4.4.8 Closely-Spaced Intruder Errors. When operating more than 30 NM from the Mode S sensor, TIS forces any intruder within 3/8 NM of the TIS client to appear at the same horizontal position as the client aircraft. Without this feature, TIS could display intruders in a manner confusing to the pilot in critical situations (e.g., a closely-spaced intruder that is actually to the right of the client may appear on the TIS display to the left). At longer distances from the radar, TIS cannot accurately determine relative bearing/distance information on intruder aircraft that are in close proximity to the client.

Because TIS uses a ground-based, rotating radar for surveillance information, the accuracy of TIS data is dependent on the distance from the sensor (radar) providing the service. This is much the same phenomenon as experienced with ground-based navigational aids, such as VOR or NDB. As distance from the radar increases, the accuracy of surveillance decreases. Since TIS does not inform the pilot of distance from the Mode S radar, the pilot must assume that any intruder appearing at the same position as the client aircraft may actually be up to 3/8 NM away in any direction. Consistent with the operation of TIS, an alert on the display (regardless of distance from the radar) should stimulate an outside visual scan, intruder acquisition, and traffic avoidance based on outside reference.

45.5 Reports of TIS Malfunctions

45.5.1 Users of TIS can render valuable assistance in the early correction of malfunctions by reporting their observations of undesirable performance. Reporters should identify the time of observation, location, type and identity of aircraft, and describe the condition observed; the type of transponder processor, and software in use can also be useful information. Since TIS performance is monitored by maintenance personnel rather than ATC, it is suggested that malfunctions be reported in the following ways:

45.5.1.1 By radio or telephone to the nearest Flight Service Station (FSS) facility.

45.5.1.2 By FAA Form 8000-7, Safety Improvement Report, a postage-paid card designed for this purpose. These cards may be obtained at FAA FSSs, General Aviation District Offices, Flight Standards District Offices, and General Aviation Fixed Based Operations.

46. Automatic Dependent Surveillance-Broadcast (ADS-B) Services

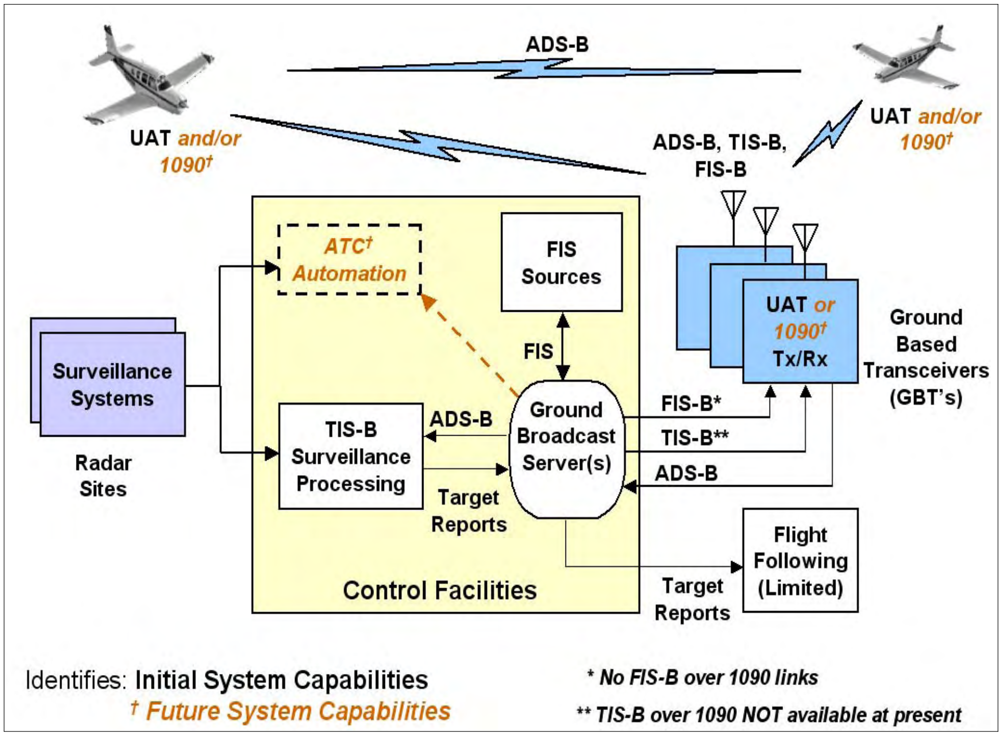
46.1 Introduction

46.1.1 Automatic Dependent Surveillance-Broadcast (ADS-B) is a surveillance technology being deployed in selected areas of the NAS (see FIG ENR 1.1-30). ADS-B broadcasts a radio transmission approximately once per second containing the aircraft's position, velocity, identification, and other information. ADS-B can also receive reports from other suitably equipped aircraft within reception range. Additionally, these broadcasts can be received by Ground Based Transceivers (GBTs) and used to provide surveillance services, along with fleet operator monitoring of aircraft. No ground infrastructure is necessary for ADS-B equipped aircraft to detect each other.

46.1.2 In the U.S., two different data links have been adopted for use with ADS-B: 1090 MHz Extended Squitter (1090 ES) and the Universal Access Transceiver (UAT). The 1090 ES link is intended for aircraft that primarily operate at FL 180 and above, whereas the UAT link is intended for use by aircraft that primarily operate at 18,000 feet and below. From a pilot's standpoint, the two links operate similarly and support ADS-B and Traffic Information Service-Broadcast (TIS-B), see paragraph 45. The UAT link additionally supports Flight Information Services-Broadcast (FIS-B), subparagraph GEN 3.5, 7.4.

FIG ENR 1.1-30

**ADS-B, TIS-B, and FIS-B:
Broadcast Services Architecture**



46.2 ADS-B Certification and Performance Requirements

ADS-B equipment may be certified as an air-to-air system for enhancing situational awareness and as a surveillance source for air traffic services. Refer to the aircraft's flight manual supplement for the specific aircraft installation.

46.3 ADS-B Capabilities

46.3.1 ADS-B enables improved surveillance services, both air-to-air and air-to-ground, especially in areas where radar is ineffective due to terrain or where it is impractical or cost prohibitive. Initial NAS applications of air-to-air ADS-B are for "advisory," use only, enhancing a pilot's visual acquisition of other nearby equipped aircraft either when airborne or on the airport surface. Additionally, ADS-B will enable ATC and fleet operators to monitor aircraft throughout the available ground station coverage area. Other applications of ADS-B may include enhanced search and rescue operations and advanced air-to-air applications such as spacing, sequencing, and merging.

46.3.2 ADS-B avionics typically allow pilots to enter the aircraft's call sign and Air Traffic Control (ATC)-assigned transponder code, which will be transmitted to other aircraft and ground receivers. Pilots are cautioned to use care when selecting and entering the aircraft's identification and transponder code. Some ADS-B avionics panels are not interconnected to the transponder. Therefore, it is **extremely important to ensure that the transponder code is identical in the ADS-B and transponder panel**. Additionally, UAT systems provide a VFR "privacy" mode switch position that may be used by pilots when not wanting to receive air traffic services. This feature will broadcast a "VFR" ID to other aircraft and ground receivers, similar to the "1200" transponder code.

46.3.3 ADS-B is intended to be used in-flight and on the airport surface. ADS-B systems should be turned "on" -- and remain "on" -- whenever operating in the air and on the airport surface, thus reducing the likelihood of runway incursions. Civil and military Mode A/C transponders and ADS-B systems should be adjusted to the "on" or normal operating position as soon as practical, unless the change to "standby" has been accomplished previously at the request of ATC. Mode S transponders should be left on whenever power is applied to the aircraft.

46.4 ATC Surveillance Services using ADS-B - Procedures and Recommended Phraseology - For Use In Alaska Only

Radar procedures, with the exceptions found in this paragraph, are identical to those procedures prescribed for radar in the AIP.

46.4.1 Preflight:

If a request for ATC services is predicated on ADS-B and such services are anticipated when either a VFR or IFR flight plan is filed, the aircraft's "N" number or call-sign as filed in "Block 2" of the Flight Plan shall be entered in the ADS-B avionics as the aircraft's flight ID.

46.4.2 Inflight:

When requesting ADS-B services while airborne, pilots should ensure that their ADS-B equipment is transmitting their aircraft's "N" number or call sign prior to contacting ATC. To accomplish this, the pilot must select the ADS-B "broadcast flight ID" function.

NOTE-
The broadcast "VFR" or "Standby" mode built into some ADS-B systems will not provide ATC with the appropriate aircraft identification information. This function should first be disabled before contacting ATC.

46.4.3 Aircraft with an Inoperative/Malfunctioning ADS-B Transmitter or in the Event of an Inoperative Ground Broadcast Transceiver (GBT).

46.4.3.1 ATC will inform the flight crew when the aircraft's ADS-B transmitter appears to be inoperative or malfunctioning:

PHRASEOLOGY-
YOUR ADS-B TRANSMITTER APPEARS TO BE INOPERATIVE/MALFUNCTIONING. STOP ADS-B TRANSMISSIONS.

46.4.3.2 ATC will inform the flight crew when the GBT transceiver becomes inoperative or malfunctioning, as follows:

PHRASEOLOGY-
(Name of facility) GROUND BASED TRANSCEIVER INOPERATIVE/MALFUNCTIONING.
(And if appropriate) RADAR CONTACT LOST.

NOTE-
An inoperative or malfunctioning GBT may also cause a loss of ATC surveillance services.

46.4.3.3 ATC will inform the flight crew if it becomes necessary to turn off the aircraft's ADS-B transmitter.

PHRASEOLOGY-
STOP ADS-B TRANSMISSIONS.

46.4.3.4 Other malfunctions and considerations: Loss of automatic altitude reporting capabilities (encoder failure) will result in loss of ATC altitude advisory services.

46.5 ADS-B Limitations

46.5.1 The ADS-B cockpit display of traffic is NOT intended to be used as a collision avoidance system and does not relieve the pilot's responsibility to "see and avoid" other aircraft. (See paragraph 42.10, See and Avoid). ADS-B provides proximity warning only to assist the pilot in the visual acquisition of other aircraft. ADS-B shall not be used for avoidance maneuvers during IMC or other times when there is no visual contact with the intruder aircraft. ADS-B is intended only to assist in visual acquisition of other aircraft. No avoidance maneuvers are provided nor authorized, as a direct result of an ADS-B display or an ADS-B alert.

46.5.2 ADS-B does not alter or diminish the pilot's basic authority and responsibility to ensure safe flight. ADS-B only displays aircraft that are ADS-B equipped; therefore, aircraft that are not ADS-B equipped or aircraft that are experiencing an ADS-B failure will not be displayed. ADS-B alone does not ensure safe separation.

46.5.3 Presently, no air traffic services or handling is predicated on the availability of an ADS-B cockpit display. A "traffic-in-sight" reply to ATC must be based on seeing an aircraft out-the-window, NOT on the cockpit display.

46.5.4 Use of ADS-B radar services is limited to the service volume of the GBT.

NOTE-
The coverage volume of GBTs are limited to line-of-sight.

46.6 Reports of ADS-B Malfunctions

Users of ADS-B can provide valuable assistance in the correction of malfunctions by reporting instances of undesirable system performance. Reporters should identify the time of observation, location, type and identity of aircraft, and describe the condition observed; the type of avionics system and its software version in use should also be included. Since ADS-B performance is monitored by maintenance personnel rather than ATC, it is suggested that malfunctions be reported in any one of the following ways:

46.6.1 By radio or telephone to the nearest Flight Service Station (FSS) facility.

46.6.2 By FAA Form 8000-7, Safety Improvement Report, a postage-paid card is designed for this purpose. These cards may be obtained from FAA FSSs, Flight Standards District Offices, and general aviation fixed-based operators.

46.6.3 By reporting the failure directly to the FAA Safe Flight 21 program at 1-877-FLYADSB or **http://www.adsb.gov**.

47. Traffic Information Service-Broadcast (TIS-B)

47.1 Introduction

Traffic Information Service-Broadcast (TIS-B) is the broadcast of traffic information to ADS-B equipped aircraft from ADS-B ground stations. The source of this traffic information is derived from ground-based air traffic surveillance sensors, typically radar. TIS-B service is becoming available in selected locations where there are both adequate surveillance coverage from ground sensors and adequate broadcast coverage from Ground Based Transceivers (GBTs). The quality level of traffic information provided by TIS-B is dependent upon the number and type of ground sensors available as TIS-B sources and the timeliness of the reported data.

47.2 TIS-B Requirements

In order to receive TIS-B service, the following conditions must exist:

47.2.1 The host aircraft must be equipped with a UAT ADS-B transmitter/receiver or transceiver, and a cockpit display of traffic information (CDTI). As the ground system evolves, the ADS-B data link may be either UAT or 1090 ES, or both.

47.2.2 The host aircraft must fly within the coverage volume of a compatible GBT that is configured for TIS-B uplinks. (Not all GBTs provide TIS-B due to a lack of radar coverage or because a radar feed is not available).

47.2.3 The target aircraft must be within the coverage of, and detected by, at least one of the ATC radars serving the GBT in use.

47.3 TIS-B Capabilities

47.3.1 TIS-B is the broadcast of traffic information to ADS-B equipped aircraft. The source of this traffic information is derived from ground-based air traffic radars. TIS-B is intended to provide ADS-B equipped aircraft with a more complete traffic picture in situations where not all nearby aircraft are equipped with ADS-B. The advisory-only application will enhance a pilot's visual acquisition of other traffic.

47.3.2 Only transponder-equipped targets (i.e., Mode A/C or Mode S transponders) are detected. Current radar citing may result in limited radar surveillance coverage at lower altitudes near some general aviation airports, with subsequently limited TIS-B service volume coverage. If there is no radar coverage in a given area, then there will be no TIS-B coverage in that area.

47.4 TIS-B Limitations

47.4.1 TIS-B is NOT intended to be used as a collision avoidance system and does not relieve the pilot's responsibility to "see and avoid" other aircraft. (See paragraph 42.10, See and Avoid). TIS-B provides traffic information to assist the pilot in the visual acquisition of other aircraft. TIS-B shall not be used for avoidance maneuvers during times when there is no visual contact with the intruder aircraft. TIS-B is intended only to assist in the visual acquisition of other aircraft. No avoidance maneuvers are provided for nor authorized as a direct result of a TIS-B display or TIS-B alert.

47.4.2 TIS-B does not alter or diminish the pilot's basic authority and responsibility to ensure safe flight. TIS-B only displays aircraft with a functioning transponder; therefore, aircraft that are not transponder equipped, or aircraft that are experiencing a transponder failure, or aircraft out of radar coverage will not be displayed. TIS-B alone does not ensure safe separation.

47.4.3 Presently, no air traffic services or handling is predicated on the availability of TIS-B equipment in aircraft. A "traffic-in-sight" reply to ATC must be based on seeing an aircraft out-the-window, NOT on the cockpit display.

47.4.4 While TIS-B is a useful aid to visual traffic avoidance, its inherent system limitations must be understood to ensure proper use.

47.4.4.1 A pilot may receive an intermittent TIS-B target of themselves, typically when maneuvering (e.g., climbing turn) due to the radar not tracking the aircraft as quickly as ADS-B.

47.4.4.2 The ADS-B-to-radar association process within the ground system may at times have difficulty correlating an ADS-B report with corresponding radar returns from the same aircraft. When this happens the pilot will see duplicate traffic symbols (i.e., "TIS-B shadows") on the cockpit display.

47.4.4.3 Updates of TIS-B traffic reports will occur less often than ADS-B traffic updates. (TIS-B position updates will occur approximately once every 3-13 seconds depending on the radar coverage. In comparison, the update rate for ADS-B is nominally once per second).

47.4.4.4 The TIS-B system only detects and uplinks data pertaining to transponder equipped aircraft. Aircraft without a transponder will not be displayed as a TIS-B target.

47.4.4.5 There is no indication provided when any aircraft is operating inside (or outside) the TIS-B service volume, therefore it is difficult to know if one is receiving uplinked TIS-B traffic information. Assume that not all aircraft are displayed as TIS-B targets.

47.4.5 Pilots and operators are reminded that the airborne equipment that displays TIS-B targets is for pilot situational awareness **only** and is not approved as a collision avoidance tool. Unless there is an imminent emergency requiring immediate action, any deviation from an air traffic control clearance based on TIS-B displayed cockpit information must be approved beforehand by the controlling ATC facility prior to commencing the maneuver. Uncoordinated deviations may place an aircraft in close proximity to other aircraft under ATC control not seen on the airborne equipment, and may result in a pilot deviation.

47.5 Reports of TIS-B Malfunctions

Users of TIS-B can provide valuable assistance in the correction of malfunctions by reporting instances of undesirable system performance. Reporters should identify the time of observation, location, type and identity of the aircraft, and describe the condition observed; the type of avionics system and its software version used. Since TIS-B performance is monitored by maintenance personnel rather than ATC, it is suggested that malfunctions be reported in any one of the following ways:

47.5.1 By radio or telephone to the nearest Flight Service Station (FSS) facility.

47.5.2 By FAA Form 8000-7, Safety Improvement Report, a postage-paid card is designed for this purpose. These cards may be obtained from FAA FSSs, Flight Standards District Offices, and general aviation fixed-based operators.

47.5.3 By reporting the failure directly to the FAA Safe Flight 21 program at 1-877-FLYADSB or **http://www.adsb.gov**.

3.1.2.2 Pilots cleared for vertical navigation using the phraseology "DESCEND VIA" shall inform ATC upon initial contact with a new frequency.

EXAMPLE-
"Delta One Twenty One leaving FL 240, descending via the Civit One arrival."

3.1.2.3 Pilots of IFR aircraft destined to locations for which STARs have been published may be issued a clearance containing a STAR whenever ATC deems it appropriate.

3.2 Use of STARs requires pilot possession of at least the approved chart. RNAV STARs must be retrievable by the procedure name from the aircraft database and conform to charted procedure. As with any ATC clearance or portion thereof, it is the responsibility of each pilot to accept or refuse an issued STAR. Pilots should notify ATC if they do not wish to use a STAR by placing "NO STAR" in the remarks section of the flight plan or by the less desirable method of verbally stating the same to ATC.

3.3 STAR charts are published in the Terminal Procedures Publication (TPP) and are available on subscription from the National Aeronautical Charting Office.

3.4 RNAV STAR.

3.4.1 All public RNAV STARs are RNAV1. These procedures require system performance currently met by GPS or DME/DME/IRU RNAV systems that satisfy the criteria discussed in AC 90-100A, U.S. Terminal and En Route Area Navigation (RNAV) Operations. RNAV1 procedures require the aircraft's total system error remain bounded by ±1 NM for 95% of the total flight time.

3.4.1.1 Type A. These procedures require system performance currently met by GPS, DME/DME, or DME/DME/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 the aircraft's track keeping accuracy remain bounded by ±2 NM for 95% of the total flight time.

NOTE-
If not equipped with GPS (or for multi-sensor systems with GPS which 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 STARs.

3.4.1.2 Type B. 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 may require the aircraft's track keeping accuracy remain bounded by ±1 NM for 95% of the total flight time.

NOTE-
If not equipped with GPS (or for multi-sensor systems with GPS which do not alert upon loss of GPS), aircraft must be capable of navigation system updating using DME/DME/IRU for Type B STARs.

3.4.2 For procedures requiring GPS, if the navigation system does not automatically alert the flight crew of a loss of GPS, the operator must develop procedures to verify correct GPS operation.

4. Local Flow Traffic Management Program

4.1 This program is a continuing effort by the FAA to enhance safety, minimize the impact of aircraft noise, and conserve aviation fuel. The enhancement of safety and reduction of noise are achieved in this program by minimizing low altitude maneuvering of arriving turbojet and turboprop aircraft weighing more that 12,500 pounds and, by permitting departure aircraft to climb to high altitudes sooner, as arrivals are operating at higher altitudes at the points where their flight paths cross. The application of these procedures also reduces exposure time between controlled aircraft and uncontrolled aircraft at the lower altitudes in and around the terminal environment. Fuel conservation is accomplished by absorbing any necessary arrival delays for aircraft included in this program operating at the higher and more fuel efficient altitudes.

4.2 A fuel efficient descent is basically an uninterrupted descent (except where level flight is required for speed adjustment) from cruising altitude to the point when level flight is necessary for the pilot to stabilize the aircraft on final approach. The procedure for a fuel efficient descent is based on an altitude loss which is most efficient for the majority of aircraft being served. This will generally result in a descent gradient window of 250-350 feet per nautical mile.

4.3 When crossing altitudes and speed restrictions are issued verbally or are depicted on a chart, ATC will expect the pilot to descend first to the crossing altitude and then reduce speed. Verbal clearances for descent will normally permit an uninterrupted descent in accordance with the procedure as described in paragraph 4.2 above. Acceptance of a charted fuel efficient descent (Runway Profile Descent) clearance requires the pilot to adhere to the altitudes, speeds, and headings depicted on the charts unless otherwise instructed by ATC. PILOTS RECEIVING A CLEARANCE FOR A FUEL EFFICIENT DESCENT ARE EXPECTED TO ADVISE ATC IF THEY DO NOT HAVE RUNWAY PROFILE DESCENT CHARTS PUBLISHED FOR THAT AIRPORT OR ARE UNABLE TO COMPLY WITH THE CLEARANCE.

5. Advance Information on Instrument Approaches

5.1 When landing at airports with approach control services and where two or more instrument approach procedures are published, pilots will be provided in advance of their arrival with the type of approach to expect or that they may be vectored for a visual approach. This information will be broadcast either by a controller or on ATIS. It will not be furnished when the visibility is three miles or better and the ceiling is at or above the highest initial approach altitude established for any low altitude instrument approach procedure for the airport.

5.2 The purpose of this information is to aid the pilot in planning arrival actions; however, it is not an ATC clearance or commitment and is subject to change. Pilots should bear in mind that fluctuating weather, shifting winds, blocked runway, etc., are conditions which may result in changes to approach information previously received. It is important that pilots advise ATC immediately if they are unable to execute the approach ATC advised will be used, or if they prefer another type of approach.

5.3 Aircraft destined to uncontrolled airports which have automated weather data with broadcast capability should monitor the ASOS/AWOS frequency to ascertain the current weather for the airport. The pilot shall advise ATC when he/she has received the broadcast weather and state his/her intentions.

NOTE-
1. *ASOS/AWOS should be set to provide one-minute broadcast weather updates at uncontrolled airports that are without weather broadcast capability by a human observer.*

2. *Controllers will consider the long line disseminated weather from an automated weather system at an uncontrolled airport as trend and planning information only and will rely on the pilot for current weather information for the airport. If the pilot is unable to receive the current broadcast weather, the last long-line disseminated weather will be issued to the pilot. When receiving IFR services, the pilot/aircraft operator is responsible for determining if weather/visibility is adequate for approach/landing.*

5.4 When making an IFR approach to an airport not served by a tower or FSS, after the ATC controller advises "CHANGE TO ADVISORY FREQUENCY APPROVED," you should broadcast your intentions, including the type of approach being executed, your position, and when over the final approach fix inbound (nonprecision approach) or when over the outer marker or the fix used in lieu of the outer marker inbound (precision approach). Continue to monitor the appropriate frequency (UNICOM, etc.) for reports from other pilots.

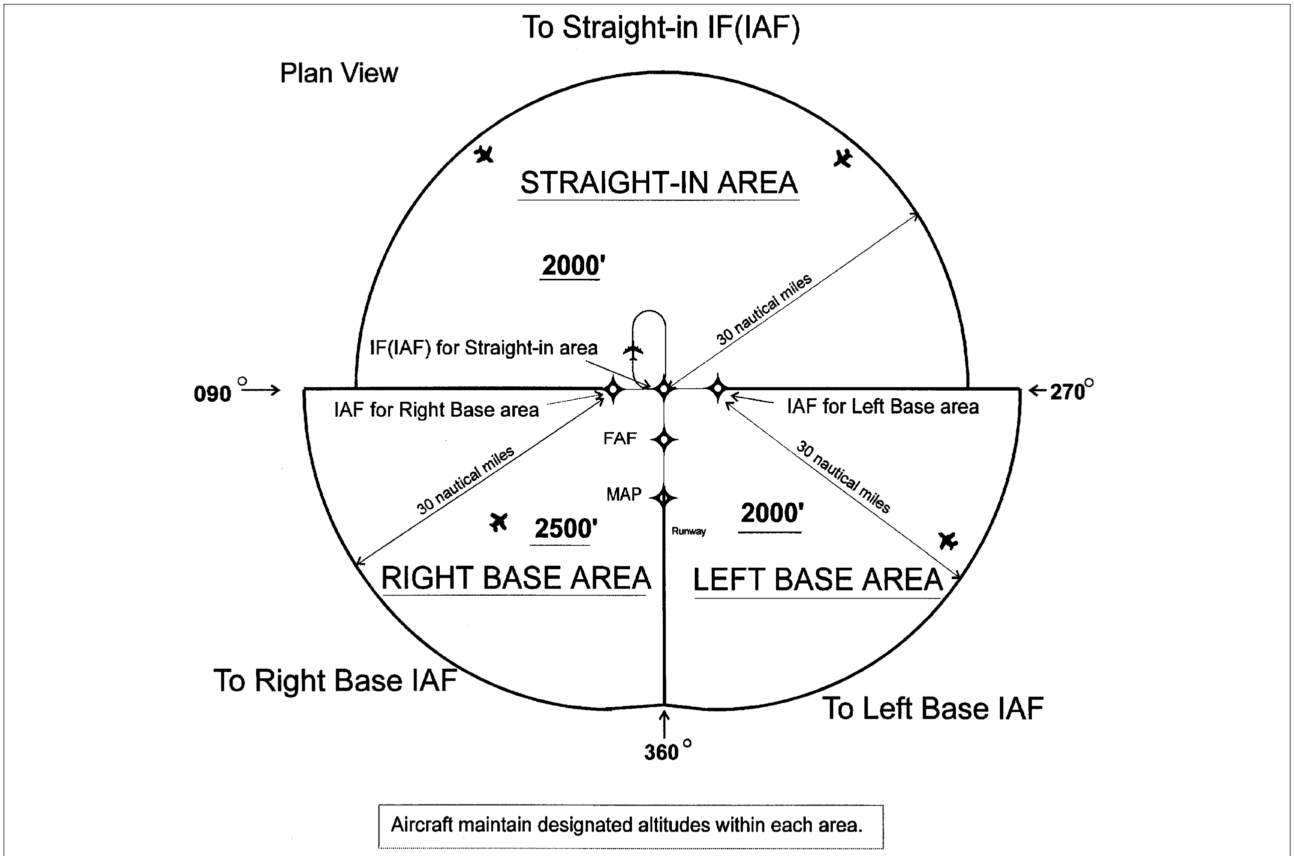
6. Approach Clearance

6.1 An aircraft which has been cleared to a holding fix and subsequently "cleared . . . approach" has not received new routing. Even though clearance for the approach may have been issued prior to the aircraft reaching the holding fix, ATC would expect the pilot to proceed via the holding fix (the last assigned route), and the feeder route associated with that fix (if a feeder route is published on the approach chart) to the initial approach fix (IAF) to commence the approach. WHEN CLEARED FOR THE APPROACH, THE PUBLISHED OFF AIRWAY (FEEDER) ROUTES THAT LEAD FROM THE EN ROUTE STRUCTURE TO THE IAF ARE PART OF THE APPROACH CLEARANCE.

6.2 If a feeder route to an IAF begins at a fix located along the route of flight prior to reaching the holding fix, and clearance for an approach is issued, a pilot should commence the approach via the published feeder route; i.e., the aircraft would not be expected to overfly the feeder route and return to it. The pilot is expected to commence the approach in a similar manner at the IAF, if the IAF for the procedure is located along the route of flight to the holding fix.

6.3 If a route of flight directly to the initial approach fix is desired, it should be so stated by the controller with phraseology to include the words "direct . . . ," "proceed direct" or a similar phrase which the pilot can interpret without question. If a pilot is uncertain of the clearance, immediately query ATC as to what route of flight is desired.

FIG ENR 1.5-18
TAA Area

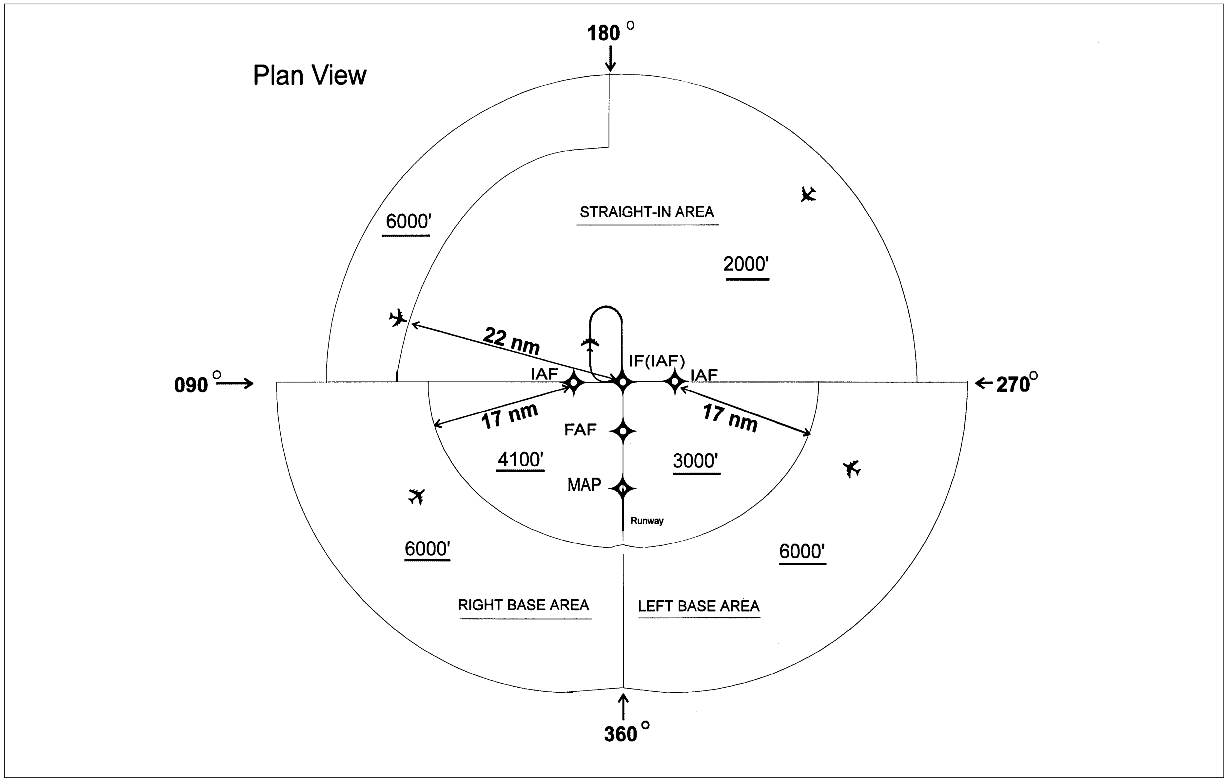


12.4.5 The standard TAA consists of three areas defined by the extension of the IAF legs and the intermediate segment course. These areas are called the straight-in, left-base, and right-base areas. (See FIG ENR 1.5-18). TAA area lateral boundaries are identified by magnetic courses TO the IF (IAF). The straight-in area can be further divided into pie-shaped sectors with the boundaries identified by magnetic courses TO the IF (IAF), and may contain stepdown sections defined by arcs based on RNAV distances (DME or ATD) from the IF (IAF). The right/left-base areas can only be subdivided using arcs based on RNAV distances from the IAFs for those areas. Minimum MSL altitudes are charted within each of these defined areas/subdivisions that provide at least 1,000 feet of obstacle clearance, or more as necessary in mountainous areas.

12.4.5.1 Prior to arriving at the TAA boundary, the pilot can determine which area of the TAA the aircraft will enter by selecting the IF (IAF) to determine the magnetic bearing TO the center IF (IAF). That bearing should then be compared with the published bearings that define the lateral boundaries of the TAA areas. Using the end IAFs may give a false indication of which area the aircraft will enter. This is critical when approaching the TAA near the extended boundary between the left and right-base areas, especially where these areas contain different minimum altitude requirements.

12.4.5.2 Pilots entering the TAA and cleared by air traffic control, are expected to proceed directly to the IAF associated with that area of the TAA at the altitude depicted, unless otherwise cleared by air traffic control. Cleared direct to an Initial Approach Fix (IAF) without a clearance for the procedure does not authorize a pilot to descend to a lower TAA altitude. If a pilot desires a lower altitude without an approach clearance, request the lower TAA altitude. If a pilot is not sure of what they are authorized or expected to do by air traffic, they should ask air traffic or request a specific clearance. Pilots entering the TAA with two-way radio communications failure (14 CFR Section 91.185, IFR Operations: Two-way Radio Communications Failure), must maintain the highest altitude prescribed by Section 91.185(c)(2) until arriving at the appropriate IAF.

FIG ENR 1.5-19
Sectored TAA Areas



12.4.5.3 Depiction of the TAA on U.S. Government charts will be through the use of icons located in the plan view outside the depiction of the actual approach procedure. (See FIG ENR 1.5-20). Use of icons is necessary to avoid obscuring any portion of the "T" procedure (altitudes, courses, minimum altitudes, etc.). The icon for each TAA area will be located and oriented on the plan view with respect to the direction of arrival to the approach procedure, and will show all TAA minimum altitudes and sector/radius subdivisions for that area. The IAF for each area of the TAA is included on the icon where it appears on the approach, to help the pilot orient the icon to the approach procedure. The IAF name and the distance of the TAA area boundary from the IAF are included on the outside arc of the TAA area icon. Examples here are shown with the TAA around the approach to aid pilots in visualizing how the TAA corresponds to the approach and should not be confused with the actual approach chart depiction.

12.4.5.4 Each waypoint on the "T", except the missed approach waypoint, is assigned a pronounceable 5-character name used in air traffic control communications, and which is found in the RNAV databases for the procedure. The missed approach waypoint is assigned a pronounceable name when it is not located at the runway threshold.

12.4.6 Once cleared to fly the TAA, pilots are expected to obey minimum altitudes depicted within the TAA icons, unless instructed otherwise by air traffic control. In FIG ENR 1.5-19, pilots within the left or right-base areas are expected to maintain a minimum altitude of 6,000 feet until within 17 NM of the associated IAF. After crossing the 17 NM arc, descent is authorized to the lower charted altitudes. Pilots approaching from the northwest are expected to maintain a minimum altitude of 6,000 feet, and when within 22 NM of the IF (IAF), descend to a minimum altitude of 2,000 feet MSL until reaching the IF (IAF).

of a portion of the routing or that the IFR clearance has been received.

28.1.2.6 If a pilot cannot establish contact on clearance delivery frequency or has not received an IFR clearance before ready to taxi, the pilot should contact ground control and inform the controller accordingly.

29. Pre-departure Clearance Procedures

29.1 Many airports in the National Airspace System are equipped with the Tower Data Link System (TDLS) that includes the Pre-departure Clearance (PDC) function. The PDC function automates the Clearance Delivery operations in the ATCT for participating users. The PDC function displays IFR clearances from the ARTCC to the ATCT. The Clearance Delivery controller in the ATCT can append local departure information and transmit the clearance via data link to participating airline/service provider computers. The airline/service provider will then deliver the clearance via the Aircraft Communications Addressing and Reporting System (ACARS) or a similar data link system or, for nondata link equipped aircraft, via a printer located at the departure gate. PDC reduces frequency congestion, controller workload and is intended to mitigate delivery/readback errors. Also, information from participating users indicates a reduction in pilot workload.

29.2 PDC is available only to participating aircraft that have subscribed to the service through an approved service provider.

29.3 Due to technical reasons, the following limitations currently exist in the PDC program:

29.3.1 Aircraft filing multiple flight plans are limited to one PDC clearance per departure airport within a 24-hour period. Additional clearances will be delivered verbally.

29.3.2 If the clearance is revised or modified prior to delivery, it will be rejected from PDC and the clearance will need to be delivered verbally.

29.4 No acknowledgment of receipt or readback is required for a PDC.

29.5 In all situations, the pilot is encouraged to contact clearance delivery if a question or concern exists regarding an automated clearance.

30. Taxi Clearance

30.1 Pilots on IFR flight plans should communicate with the control tower on the appropriate ground control/clearance delivery frequency prior to starting engines to receive engine start time, taxi, and/or clearance information.

31. Taxi into Position and Hold (TIPH)

31.1 Taxi into position and hold is an air traffic control (ATC) procedure designed to position an aircraft onto the runway for an imminent departure. The ATC instruction "POSITION AND HOLD" is used to instruct a pilot to taxi onto the departure runway in takeoff position and hold.

EXAMPLE-
Tower: "N234AR Runway 24L, position and hold."

31.2 This ATC instruction is not an authorization to takeoff. In instances where the pilot has been instructed to "position and hold" and has been advised of a reason/condition (wake turbulence, traffic on an intersecting runway, etc.) or the reason/condition is clearly visible (another aircraft that has landed on or is taking off on the same runway), and the reason/condition is satisfied, the pilot should expect an imminent takeoff clearance, unless advised of a delay. If you are uncertain about any ATC instruction or clearance, contact ATC immediately.

31.3 If a takeoff clearance is not received within a reasonable amount of time after clearance to position and hold, ATC should be contacted.

EXAMPLE-
Aircraft: Cessna 234AR holding in position Runway 24L.

Aircraft: Cessna 234AR holding in position Runway 24L at Bravo.

NOTE-
FAA analysis of accidents and incidents involving aircraft holding in position indicate that two minutes or more elapsed between the time the instruction was issued to "position and hold" and the resulting event (e.g., landover or go-around). Pilots should consider the length of time that they have been holding in position whenever they HAVE NOT been advised of any expected delay to determine when it is appropriate to query the controller.

REFERENCE-
Advisory Circulars 91-73A, Part 91 and Part 135 Single-Pilot Procedures during Taxi Operations, and 120-74A, Parts 91, 121, 125, and 135 Flightcrew Procedures during Taxi Operations.

31.4 Situational awareness during position and hold operations is enhanced by monitoring ATC instructions/clearances issued to other aircraft. Pilots should listen carefully if another aircraft is on frequency that has a similar call sign and pay close attention to communications between ATC and other aircraft. If you are uncertain of an ATC instruction or clearance, query ATC immediately. Care should be taken to not inadvertently execute a clearance/ instruction for another aircraft.

31.5 Pilots should be especially vigilant when conducting "position and hold" operations at night or during reduced visibility conditions. They should scan the full length of the runway and look for aircraft on final approach or landing roll out when taxiing onto a runway. ATC should be contacted anytime there is a concern about a potential conflict.

31.6 When two or more runways are active, aircraft may be instructed to "POSITION AND HOLD" on two or more runways. When multiple runway operations are being conducted, it is important to listen closely for your call sign and runway. Be alert for similar sounding call signs and acknowledge all instructions with your call sign. When you are holding in position and are not sure if the takeoff clearance was for you, ask ATC before you begin takeoff roll. ATC prefers that you confirm a takeoff clearance rather than mistake another aircraft's clearance for your own.

31.7 When ATC issues intersection "position and hold" and takeoff clearances, the intersection designator will be used. If ATC omits the intersection designator, call ATC for clarification.

EXAMPLE–
Aircraft: "Cherokee 234AR, Runway 24L at November 4, position and hold."

31.8 If landing traffic is a factor during position and hold operations, ATC will inform the aircraft in position of the closest traffic that has requested a full–stop, touch–and–go, stop–and–go, or an unrestricted low approach to the same runway. Pilots should take care to note the position of landing traffic. ATC will also advise the landing traffic when an aircraft is authorized to "position and hold" on the same runway.

EXAMPLE–
Tower: "Cessna 234AR, Runway 24L, position and hold. Traffic a Boeing 737, six mile final."

Tower: "Delta 1011, continue, traffic a Cessna 210 position and hold Runway 24L."

NOTE–
ATC will normally withhold landing clearance to arrival aircraft when another aircraft is in position and holding on the runway.

31.9 Never land on a runway that is occupied by another aircraft, even if a landing clearance was issued. Do not hesitate to ask the controller about the traffic on the runway and be prepared to execute a go–around.

NOTE–
Always clarify any misunderstanding or confusion concerning ATC instructions or clearances. ATC should be advised immediately if there is any uncertainty about the ability to comply with any of their instructions.

32. Departure Restrictions, Clearance Void Times, Hold for Release, and Release Times

32.1 ATC may assign departure restrictions, clearance void times, hold for release, and release times, when necessary, to separate departures from other traffic or to restrict or regulate the departure flow.

32.1.1 Clearance Void Times. A pilot may receive a clearance, when operating from an airport without a control tower, which contains a provision for the clearance to be void if not airborne by a specific time. A pilot who does not depart prior to the clearance void time must advise ATC as soon as possible of his or her intentions. ATC will normally advise the pilot of the time allotted to notify ATC that the aircraft did not depart prior to the clearance void time. This time cannot exceed 30 minutes. Failure of an aircraft to contact ATC within 30 minutes after the clearance void time will result in the aircraft being considered overdue and search and rescue procedures initiated.

NOTE–
1. *Other IFR traffic for the airport where the clearance is issued is suspended until the aircraft has contacted ATC or until 30 minutes after the clearance void time or 30 minutes after the clearance release time if no clearance void time is issued.*

2. *Pilots who depart at or after their clearance void time are not afforded IFR separation and may be in violation of 14 CFR Section 91.173 which requires that pilots receive an appropriate ATC clearance before operating IFR in Class A, B, C, D, and E airspace.*

EXAMPLE–
Clearance void if not off by (clearance void time) and, if required, if not off by (clearance void time) advise (facility) not later than (time) of intentions.

32.1.2 Hold for Release. ATC may issue "hold for release" instructions in a clearance to delay an aircrafts departure for traffic management reasons (i.e., weather, traffic volume, etc.). When ATC states in the clearance, "hold for release," the pilot may not depart utilizing that IFR clearance until a release time or additional instructions are issued by ATC. This does not preclude the pilot from cancelling the IFR clearance with ATC and departing under VFR; but an IFR clearance may not be available after departure. In addition, ATC will include departure delay information in conjunction with "hold for release" instructions.

EXAMPLE-
(Aircraft identification) cleared to (destination) airport as filed, maintain (altitude), and, if required (additional instructions or information), hold for release, expect (time in hours and/or minutes) departure delay.

32.1.3 Release Times. A "release time" is a departure restriction issued to a pilot by ATC, specifying the earliest time an aircraft may depart. ATC will use "release times" in conjunction with traffic management procedures and/or to separate a departing aircraft from other traffic.

EXAMPLE-
(Aircraft identification) released for departure at (time in hours and/or minutes).

32.1.4 Expect Departure Clearance Time (EDCT). The EDCT is the runway release time assigned to an aircraft included in traffic management programs. Aircraft are expected to depart no earlier than 5 minutes before, and no later than 5 minutes after the EDCT.

32.2 If practical, pilots departing uncontrolled airports should obtain IFR clearances prior to becoming airborne when two-way communication with the controlling ATC facility is available.

33. Departure Control

33.1 Departure Control is an approach control function responsible for ensuring separation between departures. So as to expedite the handling of departures, Departure Control may suggest a takeoff direction other than that which may normally have been used under VFR handling. Many times it is preferred to offer the pilot a runway that will require the fewest turns after takeoff to place the pilot on course or selected departure route as quickly as possible. At many locations particular attention is paid to the use of preferential runways for local noise abatement programs, and route departures away from congested areas.

33.2 Departure Control utilizing radar will normally clear aircraft out of the terminal area using instrument departure procedures (DPs) via radio navigation aids. When a departure is to be vectored immediately following takeoff, the pilot will be advised prior to takeoff of the initial heading to be flown but may not be advised of the purpose of the heading. Pilots operating in a radar environment are expected to associate departure headings with vectors to their planned route of flight. When given a vector taking the aircraft off a previously assigned nonradar route, the pilot will be advised briefly what the vector is to achieve. Thereafter, radar service will be provided until the aircraft has been reestablished "on-course" using an appropriate navigation aid and the pilot has been advised of the aircraft's position; or, a handoff is made to another radar controller with further surveillance capabilities.

33.3 Controllers will inform pilots of the departure control frequencies and, if appropriate, the transponder code before takeoff. Pilots should not operate their transponder until ready to start the takeoff roll, except at ASDE-X facilities where transponders should be transmitting "on" with altitude reporting continuously while operating on the airport surface if so equipped. Pilots should not change to the departure control frequency until requested. Controllers may omit the departure control frequency if a DP has or will be assigned and the departure control frequency is published on the DP.

34. Abbreviated IFR Departure Clearance (Cleared . . . as Filed) Procedures

34.1 ATC facilities will issue an abbreviated IFR departure clearance based on the ROUTE of flight filed in the IFR flight plan, provided the filed route can be approved with little or no revision. These abbreviated clearance procedures are based on the following conditions:

34.1.1 The aircraft is on the ground or it has departed VFR and the pilot is requesting IFR clearance while airborne.

34.1.2 That a pilot will not accept an abbreviated clearance if the route or destination of a flight plan filed with ATC has been changed by him/her or the company or the operations officer before departure.

34.1.3 That it is the responsibility of the company or operations office to inform the pilot when they make a change to the filed flight plan.

34.1.4 That it is the responsibility of the pilot to inform ATC in the initial call-up (for clearance) when the filed flight plan has been either:

34.1.4.1 Amended.

34.1.4.2 Canceled and replaced with a new filed flight plan.

NOTE-
The facility issuing a clearance may not have received the revised route or the revised flight plan by the time a pilot requests clearance.

34.2 Controllers will issue a detailed clearance when they know that the original filed flight plan has been changed or when the pilot requests a full route clearance.

34.3 The clearance as issued will include the destination airport filed in the flight plan.

34.4 ATC procedures now require the controller to state the DP name, the current number and the DP Transition name after the phrase "Cleared to (destination) airport," and prior to the phrase, "then as filed," for ALL departure clearances when the DP or DP Transition is to be flown. The procedure applies whether or not the DP is filed in the flight plan.

34.5 Standard Terminal Arrivals (STARs), when filed in a flight plan, are considered a part of the filed route of flight and will not normally be stated in an initial departure clearance. If the ARTCC's jurisdictional airspace includes both the departure airport and the fix where a STAR or STAR Transition begins, the STAR name, the current number, and the STAR Transition name MAY be stated in the initial clearance.

34.6 "Cleared to (destination) airport as filed" does NOT include the en route altitude filed in a flight plan. An en route altitude will be stated in the clearance or the pilot will be advised to expect an assigned/filed altitude within a given time frame or at a certain point after departure. This may be done verbally in the departure instructions or stated in the DP.

34.7 In a radar and a nonradar environment, the controller will state "Cleared to (destination) airport as filed" or:

34.7.1 If a DP or DP Transition is to be flown, specify the DP name, the current DP number, the DP Transition name, the assigned altitude/flight level, and any additional instructions (departure control frequency, beacon code assignment, etc.) necessary to clear a departing aircraft via the DP/DP Transition and the route filed.

EXAMPLE-
National Seven Twenty cleared to Miami Airport Intercontinental one departure, Lake Charles transition then as filed, maintain Flight Level two seven zero.

34.7.2 When there is no DP or when the pilot cannot accept a DP, specify the assigned altitude/flight level, and any additional instructions necessary to clear a departing aircraft via an appropriate departure routing and the route filed.

NOTE-
A detailed departure route description or a radar vector may be used to achieve the desired departure routing.

34.7.3 If necessary to make a minor revision to the filed route, specify the assigned DP/DP Transition (or departure routing), the revision to the filed route, the assigned altitude/flight level, and any additional instructions necessary to clear a departing aircraft.

EXAMPLE-
Jet Star One Four Two Four cleared to Atlanta Airport, South Boston two departure then as filed except change route to read South Boston Victor 20 Greensboro, maintain one seven thousand.

34.7.4 Additionally, in a nonradar environment, specify one or more fixes as necessary to identify the initial route of flight.

EXAMPLE-
Cessna Three One Six Zero Foxtrot cleared to Charlotte Airport as filed via Brooke, maintain seven thousand.

34.8 To ensure success of the program, pilots should:

34.8.1 Avoid making changes to a filed flight plan just prior to departure.

34.8.2 State the following information in the initial call-up to the facility when no change has been made to the filed flight plan: Aircraft call sign, location, type operation (IFR), and the name of the airport (or fix) to which you expect clearance.

EXAMPLE-
"Washington clearance delivery (or ground control if appropriate) American Seventy Six at gate one, IFR Los Angeles."

34.8.3 If the flight plan has been changed, state the change and request a full route clearance.

EXAMPLE-
"Washington clearance delivery, American Seventy Six at gate one. IFR San Francisco. My flight plan route has been amended (or destination changed). Request full route clearance."

34.8.4 Request verification or clarification from ATC if ANY portion of the clearance is not clearly understood.

34.8.5 When requesting clearance for the IFR portion of a VFR-IFR flight, request such clearance prior to the fix where IFR operation is proposed to commence in sufficient time to avoid delay. Use the following phraseology:

EXAMPLE-
"Los Angeles center, Apache Six One Papa, VFR estimating Paso Robles VOR at three two, one thousand five hundred, request IFR to Bakersfield."

35. Instrument Departure Procedures (DP) - Obstacle Departure Procedures (ODP) and Standard Instrument Departures (SID)

35.1 Instrument departure procedures are preplanned instrument flight rule (IFR) procedures which provide obstruction clearance from the terminal area to the appropriate en route structure. There are two types of DPs, Obstacle Departure Procedures (ODPs), printed either textually or graphically, and Standard Instrument Departures (SIDs), always printed graphically. All DPs, either textual or graphic may be designed using either conventional or RNAV criteria. RNAV procedures will have RNAV printed in the title, e.g., SHEAD TWO DEPARTURE (RNAV). ODPs provide obstruction clearance via the least onerous route from the terminal area to the appropriate en route structure. ODPs are recommended for obstruction clearance and may be flown without ATC clearance unless an alternate departure procedure (SID or radar vector) has been specifically assigned by ATC. Graphic ODPs will have (OBSTACLE) printed in the procedure title, e.g., GEYSR THREE DEPARTURE (OBSTACLE), or, CROWN ONE DEPARTURE (RNAV)(OBSTACLE). Standard Instrument Departures are air traffic control (ATC) procedures printed for pilot/controller use in graphic form to provide obstruction clearance and a transition from the terminal area to the appropriate en route structure. SIDs are primarily designed for system enhancement and to reduce pilot/controller workload. ATC clearance must be received prior to flying a SID. All DPs provide the pilot with a way to depart the airport and transition to the en route structure safely. Pilots operating under 14 CFR Part 91 are strongly encouraged to file and fly a DP at night, during marginal Visual Meteorological Conditions (VMC) and Instrument Meteorological Conditions (IMC), when one is available. The following paragraphs will provide an overview of the DP program, why DPs are developed, what criteria are used, where to find them, how they are to be flown, and finally pilot and ATC responsibilities.

35.2 Why are DPs necessary? The primary reason is to provide obstacle clearance protection information to pilots. A secondary reason, at busier airports, is to increase efficiency and reduce communications and departure delays through the use of SIDs. When an instrument approach is initially developed for an airport, the need for DPs is assessed. The procedure designer conducts an obstacle analysis to support departure operations. If an aircraft may turn in any direction from a runway, and remain clear of obstacles, that runway passes what is called a diverse departure assessment and no ODP will be published. A SID may be published if needed for air traffic control purposes. However, if an obstacle penetrates what is called the 40:1 obstacle identification surface, then the procedure designer chooses whether to:

35.2.1 Establish a steeper than normal climb gradient; or

35.2.2 Establish a steeper than normal climb gradient with an alternative that increases takeoff minima to allow the pilot to visually remain clear of the obstacle(s); or

35.2.3 Design and publish a specific departure route; or

35.2.4 A combination or all of the above.

35.3 What criteria is used to provide obstruction clearance during departure?

35.3.1 Unless specified otherwise, required obstacle clearance for all departures, including diverse, is based on the pilot crossing the departure end of the runway at least 35 feet above the departure end of runway elevation, climbing to 400 feet above the departure end of runway elevation before making the initial turn, and maintaining a minimum climb gradient of 200 feet per nautical mile (FPNM), unless required to level off by a crossing restriction, until the minimum IFR altitude. A greater climb gradient may be specified in the DP to clear obstacles or to achieve an ATC crossing restriction. If an initial turn higher than 400 feet above the departure end of runway elevation is specified in the DP, the turn should be commenced at the higher altitude. If a turn is specified at a fix, the turn must be made at that fix. Fixes may have minimum and/or maximum crossing altitudes that must be adhered to prior to passing the fix. In rare instances, obstacles that exist on the extended runway centerline may make an "early turn" more desirable than proceeding straight ahead. In these cases, the published departure instructions will include the language "turn left(right) as soon as practicable." These departures will also include a ceiling and visibility minimum of at least 300 and 1. Pilots encountering one of these DPs should preplan the climb out to gain altitude and begin the turn as quickly as possible within the bounds of safe operating practices and operating limitations. This type of departure procedure is being phased out.

NOTE-
"Practical" or "feasible" may exist in some existing departure text instead of "practicable."

35.3.2 The 40:1 obstacle identification surface begins at the departure end of the runway and slopes upward at 152 FPNM until reaching the minimum IFR altitude or entering the en route structure.

35.3.3 Climb gradients greater than 200 FPNM are specified when required for obstacle clearance and/or ATC required crossing restrictions.

EXAMPLE-
"Cross ALPHA intersection at or below 4000; maintain 6000." The pilot climbs at least 200 FPNM to 6000. If 4000 is reached before ALPHA, the pilot levels off at 4000 until passing ALPHA; then immediately resumes at least 200 FPNM climb.

35.3.4 Climb gradients may be specified only to an altitude/fix, above which the normal gradient applies.

EXAMPLE-
"Minimum climb 340 FPNM to ALPHA." The pilot climbs at least 340 FPNM to ALPHA, then at least 200 FPNM to MIA.

35.3.5 Some DPs established solely for obstacle avoidance require a climb in visual conditions to cross the airport or an on-airport NAVAID in a specified direction, at or above a specified altitude. These procedures are called Visual Climb Over the Airport (VCOA).

EXAMPLE-
"Climb in visual conditions so as to cross the McElory Airport southbound, at or above 6000, then climb via Keemmling radial zero three three to Keemmling VORTAC."

35.4 Who is responsible for obstacle clearance? DPs are designed so that adherence to the procedure by the pilot will ensure obstacle protection. Additionally:

35.4.1 Obstacle clearance responsibility also rests with the pilot when he/she chooses to climb in visual conditions in lieu of flying a DP and/or depart under increased takeoff minima rather than fly the climb gradient. Standard takeoff minima are one statute mile for aircraft having two engines or less and one-half statute mile for aircraft having more than two engines. Specified ceiling and visibility minima (VCOA or increased takeoff minima) will allow visual avoidance of obstacles until the pilot enters the standard obstacle protection area. Obstacle avoidance is not guaranteed if the pilot maneuvers farther from the airport than the specified visibility minimum prior to reaching the specified altitude. DPs may also contain what are called Low Close in Obstacles. These obstacles are less than 200 feet above the departure end of runway elevation and within one NM of the runway end, and do not require increased takeoff minimums. These obstacles are identified on the SID chart or in the Take-off Minimums and (Obstacle) Departure Procedures section of the U. S. Terminal Procedure booklet. These obstacles are especially critical to aircraft that do not lift off until close to the departure end of the runway or which climb at the minimum rate. Pilots should also consider drift following lift-off to ensure sufficient clearance from these obstacles. That segment of the procedure that requires the pilot to see and avoid obstacles ends when the aircraft crosses the specified point at the required altitude. In all cases continued obstacle clearance is based on having climbed a minimum of 200 feet per nautical mile to the specified point and then continuing to climb at least 200 foot per nautical mile during the departure until reaching the minimum enroute altitude, unless specified otherwise.

35.4.2 ATC may assume responsibility for obstacle clearance by vectoring the aircraft prior to reaching the minimum vectoring altitude by using a Diverse Vector Area (DVA). The DVA has been assessed for departures which do not follow a specific ground track. ATC may also vector an aircraft off a previously assigned DP. In all cases, the 200 FPNM climb gradient is assumed and obstacle clearance is not provided by ATC until the controller begins to provide navigational guidance in the form of radar vectors.

NOTE-
When used by the controller during departure, the term "radar contact" should not be interpreted as relieving pilots of their responsibility to maintain appropriate terrain and obstruction clearance which may include flying the obstacle DP.

35.4.3 When missed approach or departure procedure climb gradients exceed 200 ft/NM, pilots must preplan that the aircraft can meet the ft/NM climb gradient requirement prescribed by the procedure.

35.5 Where are DPs located? DPs will be listed by airport in the IFR Takeoff Minimums and (Obstacle) Departure Procedures Section, Section C, of the Terminal Procedures Publications (TPPs). If the DP is textual, it will be described in TPP Section C. SIDs and complex ODPs will be published graphically and named. The name will be listed by airport name and runway in Section C. Graphic ODPs will also have the term "(OBSTACLE)" printed in the charted procedure title, differentiating them from SIDs.

35.5.1 An ODP that has been developed solely for obstacle avoidance will be indicated with the symbol "T" on appropriate Instrument Approach Procedure (IAP) charts and DP charts for that airport. The "T" symbol will continue to refer users to TPP Section C. In the case of a graphic ODP, the TPP Section C will only contain the name of the ODP. Since there may be both a textual and a graphic DP, Section C should still be checked for additional information. The nonstandard minimums and minimum climb gradients found in TPP Section C also apply to charted DPs and radar vector departures unless different minimums are specified on the charted DP. Takeoff minimums and departure procedures apply to all runways unless otherwise specified. New graphic DPs will have all the information printed on the graphic depiction. As a general rule, ATC will only assign an ODP from a nontowered airport when compliance with the ODP is necessary for aircraft to aircraft separation. Pilots may use the ODP to help ensure separation from terrain and obstacles.

35.6 Responsibilities

35.6.1 Each pilot, prior to departing an airport on an IFR flight should consider the type of terrain and other obstacles on or in the vicinity of the departure airport; and:

35.6.2 Determine whether an ODP is available; and

35.6.3 Determine if obstacle avoidance can be maintained visually or if the ODP should be flown; and

35.6.4 Consider the effect of degraded climb performance and the actions to take in the event of an engine loss during the departure.

35.6.5 After an aircraft is established on an ODP/SID and subsequently vectored or cleared off of the ODP or SID transition, pilots shall consider the ODP/SID canceled, unless the controller adds "expect to resume ODP/SID."

35.6.6 Aircraft instructed to resume a procedure which contains restrictions, such as a DP, shall be issued/reissued all applicable restrictions or shall be advised to comply with those restrictions.

35.6.7 If an altitude to "maintain" is restated, whether prior to departure or while airborne, previously issued altitude restrictions are canceled, including any DP altitude restrictions if any.

35.6.8 Pilots of civil aircraft operating from locations where SIDs are established may expect ATC clearances containing a SID. Use of a DP requires pilot possession of the textual description or graphic depiction of the approved current DP, as appropriate. RNAV SIDs must be retrievable by the procedure name from the aircraft database and conform to charted procedure. ATC must be immediately advised if the pilot does not possess the assigned SID, or the aircraft is not capable of flying the SID. Notification may be accomplished by filing "NO SID" in the remarks section of the filed flight plan or by the less desirable method of verbally advising ATC. Adherence to all restrictions on the DP is required unless clearance to deviate is received.

35.6.9 Controllers may omit the departure control frequency if a SID clearance is issued and the departure control frequency is published on the SID.

35.7 RNAV Departure Procedures

35.7.1 All public RNAV SIDs and graphic ODPs are RNAV 1. These procedures generally start with an initial RNAV or heading leg near the departure runway end. In addition, these procedures require system performance currently met by GPS or DME/DME/IRU RNAV systems that satisfy the criteria discussed in AC 90-100A, U.S. Terminal and En Route Area Navigation (RNAV) Operations. RNAV 1 procedures require the aircraft's total system error remain bounded by ±1 NM for 95% of the total flight time.

5.1.3 When filing an IFR flight plan, identify the equipment capability by adding a suffix, preceded by a slant, to the AIRCRAFT TYPE, as shown in TBL ENR 1.10−1, Aircraft Suffixes.

NOTE−

1. *ATC issues clearances based on filed suffixes. Pilots should determine the appropriate suffix based upon desired services and/or routing. For example, if a desired route/procedure requires GPS, a pilot should file /G even if the aircraft also qualifies for other suffixes.*

2. *For procedures requiring GPS, if the navigation system does not automatically alert the flight crew of a loss of GPS, the operator must develop procedures to verify correct GPS operation.*

3. *The suffix is not to be added to the aircraft identification or be transmitted by radio as part of the aircraft identification.*

5.1.4 It is recommended that pilots file the maximum transponder or navigation capability of their aircraft in the equipment suffix. This will provide ATC with the necessary information to utilize all facets of navigational equipment and transponder capabilities available.

5.2 Airways/Jet Routes Depiction on Flight Plan

5.2.1 It is vitally important that the route of flight be accurately and completely described in the flight plan. To simplify definition of the proposed route, and to facilitate air traffic control, pilots are requested to file via airways or jet routes established for use at the altitude or flight level planned.

5.2.2 If flight is to be conducted via designated airways or jet routes, describe the route by indicating the type and number designators of the airway(s) or jet route(s) requested. If more than one airway or jet route is to be used, clearly indicate points of transition. If the transition is made at an unnamed intersection, show the next succeeding NAVAID or named intersection on the intended route and the complete route from that point. Reporting points should be identified by using authorized name/code as depicted on appropriate aeronautical charts. The following two examples illustrate the need to specify the transition point when two routes share more than one transition fix.

EXAMPLE−

1. *ALB J37 BUMPY J14 BHM*
Spelled out: from Albany, New York, via Jet Route 37 transitioning to Jet Route 14 at BUMPY intersection, thence via Jet Route 14 to Birmingham, Alabama.

2. *ALB J37 ENO J14 BHM*
Spelled out: from Albany, New York, via Jet Route 37 transitioning to Jet Route 14 at Smyrna VORTAC (ENO) thence via Jet Route 14 to Birmingham, Alabama.

5.2.3 The route of flight may also be described by naming the reporting points or NAVAIDs over which the flight will pass, provided the points named are established for use at the altitude or flight level planned.

EXAMPLE−

BWI V44 SWANN V433 DQO
Spelled out: from Baltimore-Washington International, via Victor 44 to Swann intersection, transitioning to Victor 433 at Swann, thence via Victor 433 to Dupont.

5.2.4 When the route of flight is defined by named reporting points, whether alone or in combination with airways or jet routes, and the navigational aids (VOR, VORTAC, TACAN, LF, RBN) to be used for the flight are a combination of different types of aids, enough information should be included to clearly indicate the route requested.

EXAMPLE−

LAX J5 LKV J3 GEG YXC FL 330 J500 VLR J515 YWG
Spelled out: from Los Angeles International via Jet Route 5 Lakeview, Jet Route 3 Spokane, direct Cranbrook, British Columbia VOR/DME, Flight Level 330 Jet Route 500 to Langruth, Manitoba VORTAC, Jet Route 515 to Winnepeg, Manitoba.

5.2.5 When filing IFR, it is to the pilot's advantage to file a "preferred route."

NOTE−

Preferred IFR routes are described and tabulated in the Airport/Facility Directory.

5.2.6 ATC may issue a SID or a STAR as appropriate (See ENR 1.5, paragraph 3).

NOTE−

Pilots not desiring a SID or STAR should so indicate in the remarks section of the flight plan as "no SID" or "no STAR."

5.3 Direct Flights

5.3.1 All or any portions of the route which will not be flown on the radials or courses of established airways or routes, such as direct route flights, must be defined by indicating the radio fixes over which the flight will pass. Fixes selected to define the route shall be those over which the position of the aircraft can be accurately determined. Such fixes automatically become compulsory reporting points for the flight, unless advised otherwise by ATC. Only those navigational aids established for use in a particular structure; i.e., in the low or high structures, may be used to define the en route phase of a direct flight within that structure.

5.3.2 The azimuth feature of VOR aids and the azimuth and distance (DME) features of VORTAC and TACAN aids are assigned certain frequency protected areas of airspace which are intended for application to established airway and route use, and to provide guidance for planning flights outside of established airways or routes. These areas of airspace are expressed in terms of cylindrical service volumes of specified dimensions called "class limits" or "categories."

5.3.3 An operational service volume has been established for each class in which adequate signal coverage and frequency protection can be assured. To facilitate use of VOR, VORTAC, or TACAN aids, consistent with their operational service volume limits, pilot use of such aids for defining a direct route of flight in Class A, B, C, D, and E airspace should not exceed the following:

5.3.3.1 Operations above Flight Level 450. Use aids not more than 200 nautical miles apart. These aids are depicted on En Route High Altitude Charts.

5.3.3.2 Operation off established routes from 18,000 feet MSL to Flight Level 450. Use aids not more than 260 nautical miles apart. These aids are depicted on En Route High Altitude Charts.

5.3.3.3 Operation off established airways below 18,000 feet MSL. Use aids not more than 80 nautical miles apart. These aids are depicted on En Route Low Altitude Charts.

5.3.3.4 Operation off established airways between 14,500 feet MSL and 17,999 feet MSL in the conterminous United States. (H) facilities not more than 200 NM apart may be used.

5.3.4 Increasing use of self-contained airborne navigational systems which do not rely on the VOR/VORTAC/TACAN system has resulted in pilot requests for direct routes which exceed NAVAID service volume limits. These direct route requests will be approved only in a radar environment, with approval based on pilot responsibility for navigation on the authorized direct route. "Radar flight following" will be provided by ATC for air traffic control purposes.

5.3.5 At times, ATC will initiate a direct route in a radar environment which exceeds NAVAID service volume limits. In such cases ATC will provide radar monitoring and navigational assistance as necessary.

5.3.6 Airway or jet route numbers, appropriate to the stratum in which operation will be conducted, may also be included to describe portions of the route to be flown.

EXAMPLE-
MDW V262 BDF V10 BRL STJ SLN GCK
Spelled out: from Chicago Midway Airport via Victor 262 to Bradford, Victor 10 to Burlington, Iowa, direct St. Joseph, Missouri, direct Salina, Kansas, direct Garden City, Kansas.

NOTE-
When route of flight is described by radio fixes, the pilot will be expected to fly a direct course between the points named.

5.3.7 Pilots are reminded that they are responsible for adhering to obstruction clearance requirements on those segments of direct routes that are outside of Class A, B, C, D, and E airspace. The MEAs and other altitudes shown on Low Altitude IFR En Route Charts pertain to those route segments within Class A, B, C, D, and E airspace, and those altitudes may not meet obstruction clearance criteria when operating off those routes.

5.4 Area Navigation (RNAV)

5.4.1 Random RNAV routes can only be approved in a radar environment. Factors that will be considered by ATC in approving random RNAV routes include the capability to provide radar monitoring and compatibility with traffic volume and flow. ATC will radar monitor each flight; however, navigation on the random RNAV route is the responsibility of the pilot.

5.4.2 Pilots of aircraft equipped with approved area navigation equipment may file for RNAV routes throughout the National Airspace System and may be filed for in accordance with the following procedures.

ENR 3.3 Area Navigation (RNAV) Routes

1. RNAV Routes

1.1 Published RNAV routes, including Q-Routes and T-Routes, can be flight planned for use by aircraft with RNAV capability, subject to any limitations or requirements noted on en route charts, in applicable Advisory Circulars, or by NOTAM. RNAV routes are depicted in blue on aeronautical charts and are identified by the letter "Q" or "T" followed by the airway number (e.g., Q-13, T-205). Published RNAV routes are RNAV-2 except when specifically charted as RNAV-1. These routes require system performance currently met by GPS or DME/DME/IRU RNAV systems that satisfy the criteria discussed in AC 90-100A, U.S. Terminal and En Route Area Navigation (RNAV) Operations.

NOTE-
AC 90-100A does not apply to over water RNAV routes (reference 14 CFR Section 91.511, including the Q-routes in the Gulf of Mexico and the Atlantic routes) or Alaska VOR/DME RNAV routes ("JxxxR"). The AC does not apply to off-route RNAV operations, Alaska GPS routes or Caribbean routes.

1.1.1 Q-routes are available for use by RNAV equipped aircraft between 18,000 feet MSL and FL 450 inclusive. Q-routes are depicted on Enroute High Altitude Charts.

1.1.2 T-routes are available for use by RNAV equipped aircraft from 1,200 feet above the surface (or in some instances higher) up to but not including 18,000 feet MSL. T-routes are depicted on Enroute Low Altitude Charts.

1.2 Unpublished RNAV routes are direct routes, based on area navigation capability, between waypoints defined in terms of latitude/longitude coordinates, degree-distance fixes, or offsets from established routes/airways at a specified distance and direction. Radar monitoring by ATC is required on all unpublished RNAV routes.

approved above flight level 180, UAs are operated under instrument flight rules, are in communication with ATC, and are equipped with a transponder.

5.3 There are several things a pilot should consider regarding UA activity in an effort to reduce potential flight hazards. Pilots are urged to exercise increased vigilance when operating in the vicinity of restricted or other special use airspace, military operations areas, and any military installation. Since the size of a UA can be very small, they may be difficult to see and track. If a UA is encountered during flight, don't assume that the pilot or crew of the UA can see you, maintain increased vigilance with the UA. Always check NOTAMs for potential UA activity along the intended route of flight and exercise increased vigilance in areas specified in the NOTAM.

6. Mountain Flying

6.1 Your first experience of flying over mountainous terrain (particularly if most of your flight time has been over the flatlands of the midwest) could be a *never-to-be-forgotten nightmare* if proper planning is not done and if you are not aware of the potential hazards awaiting. Those familiar section lines are not present in the mountains; those flat, level fields for forced landings are practically nonexistent; abrupt changes in wind direction and velocity occur; severe updrafts and downdrafts are common, particularly near or above abrupt changes of terrain such as cliffs or rugged areas; even the clouds look different and can build up with startling rapidity. Mountain flying need not be hazardous if you follow the recommendations below:

6.1.1 File a Flight Plan. Plan your route to avoid topography which would prevent a safe forced landing. The route should be over populated areas and well known mountain passes. Sufficient altitude should be maintained to permit gliding to a safe landing in the event of engine failure.

6.1.2 Don't fly a light aircraft when the winds aloft, at your proposed altitude, exceed 35 miles per hour. Expect the winds to be of much greater velocity over mountain passes than reported a few miles from them. Approach mountain passes with as much altitude as possible. Downdrafts of from 1,500 to 2,000 feet per minute are not uncommon on the leeward side.

6.1.3 Don't fly near or above abrupt changes in terrain. Severe turbulence can be expected, especially in high wind conditions.

6.1.4 Understand Mountain Obscuration. The term Mountain Obscuration (MTOS) is used to describe a visibility condition that is distinguished from IFR because ceilings, by definition, are described as "above ground level" (AGL). In mountainous terrain clouds can form at altitudes significantly higher than the weather reporting station and at the same time nearby mountaintops may be obscured by low visibility. In these areas the ground level can also vary greatly over a small area. Beware if operating VFR-on-top. You could be operating closer to the terrain than you think because the tops of mountains are hidden in a cloud deck below. MTOS areas are identified daily on The Aviation Weather Center located at:
http://www.aviationweather.gov.

6.2 Some canyons run into a dead end. Don't fly so far up a canyon that you get trapped. ALWAYS BE ABLE TO MAKE A 180 DEGREE TURN.

6.3 VFR flight operations may be conducted at night in mountainous terrain with the application of sound judgment and common sense. Proper pre-flight planning, giving ample consideration to winds and weather, knowledge of the terrain and pilot experience in mountain flying are prerequisites for safety of flight. Continuous visual contact with the surface and obstructions is a major concern and flight operations under an overcast or in the vicinity of clouds should be approached with extreme caution.

6.4 When landing at a high altitude field, the same indicated airspeed should be used as at low elevation fields. Remember: that due to the less dense air at altitude, this same indicated airspeed actually results in a higher true airspeed, a faster landing speed, and more important, a longer landing distance. During gusty wind conditions which often prevail at high altitude fields, a power approach and power landing is recommended. Additionally, due to the faster groundspeed, your takeoff distance will increase considerably over that required at low altitudes.

6.5 Effects of Density Altitude. Performance figures in the aircraft owner's handbook for length of takeoff run, horsepower, rate of climb, etc., are generally based on standard atmosphere conditions (59°F, pressure 29.92 inches of mercury) at sea level. However, inexperienced pilots as well as experienced pilots may run into trouble when they encounter an altogether different set of conditions. This is particularly true in hot weather and at higher elevations. Aircraft operations at altitudes above sea level and at higher than standard temperatures are commonplace in mountainous area. Such operations quite often result in a drastic reduction of aircraft performance capabilities because of the changing air density. Density altitude is a measure of air density. It is not to be confused with pressure altitude − true altitude or absolute altitude. It is not to be used as a height reference, but as a determining criteria in the performance capability of an aircraft. Air density decreases with altitude. As air density decreases, density altitude increases. The further effects of high temperature and high humidity are cumulative, resulting in an increasing high density altitude condition. High density altitude reduces all aircraft performance parameters. To the pilot, this means that the normal horsepower output is reduced, propeller efficiency is reduced and a higher true airspeed is required to sustain the aircraft throughout its operating parameters. It means an increase in runway length requirements for takeoff and landings, and a decreased rate of climb. An average small airplane, for example, requiring 1,000 feet for takeoff at sea level under standard atmospheric conditions will require a takeoff run of approximately 2,000 at an operational altitude of 5,000 feet.

NOTE−
A turbo−charged aircraft engine provides some slight advantage in that it provides sea level horsepower up to a specified altitude above sea level.

6.6 Density Altitude Advisories. At airports with elevations of 2,000 feet and higher, control towers and FSSs will broadcast the advisory "Check Density Altitude" when the temperature reaches a predetermined level. These advisories will be broadcast on appropriate tower frequencies or, where available, ATIS. FSSs will broadcast these advisories as a part of Airport Advisory Service, and on TWEB.

6.6.1 These advisories are provided by air traffic facilities, as a reminder to pilots that high temperatures and high field elevations will cause significant changes in aircraft characteristics. The pilot retains the responsibility to compute density altitude, when appropriate, as a part of preflight duties.

NOTE−
All FSSs will compute the current density altitude upon request.

7. Use of Runway Half−way Signs at Unimproved Airports

7.1 When installed, runway half−way signs provide the pilot with a reference point to judge takeoff acceleration trends. Assuming that the runway length is appropriate for takeoff (considering runway condition and slope, elevation, aircraft weight, wind, and temperature), typical takeoff acceleration should allow the airplane to reach 70 percent of lift−off airspeed by the midpoint of the runway. The "rule of thumb" is that should airplane acceleration not allow the airspeed to reach this value by the midpoint, the takeoff should be aborted, as it may not be possible to liftoff in the remaining runway.

7.2 Several points are important when considering using this "rule of thumb":

7.2.1 Airspeed indicators in small airplanes are not required to be evaluated at speeds below stalling, and may not be usable at 70 percent of liftoff airspeed.

7.2.2 This "rule of thumb" is based on a uniform surface condition. Puddles, soft spots, areas of tall and/or wet grass, loose gravel, etc., may impede acceleration or even cause deceleration. Even if the airplane achieves 70 percent of liftoff airspeed by the midpoint, the condition of the remainder of the runway may not allow further acceleration. The entire length of the runway should be inspected prior to takeoff to ensure a usable surface.

7.2.3 This "rule of thumb" applies only to runway required for actual liftoff. In the event that obstacles affect the takeoff climb path, appropriate distance must be available after liftoff to accelerate to best angle of climb speed and to clear the obstacles. This will, in effect, require the airplane to accelerate to a higher speed by midpoint, particularly if the obstacles are close to the end of the runway. In addition, this technique does not take into account the effects of upslope or tailwinds on takeoff performance. These factors will also require greater acceleration than normal and, under some circumstances, prevent takeoff entirely.

7.2.4 Use of this "rule of thumb" does not alleviate the pilot's responsibility to comply with applicable Federal Aviation Regulations, the limitations and performance data provided in the FAA approved

Airplane Flight Manual (AFM), or, in the absence of an FAA approved AFM, other data provided by the aircraft manufacturer.

7.3 In addition to their use during takeoff, runway half-way signs offer the pilot increased awareness of his or her position along the runway during landing operations.

NOTE-
No FAA standard exists for the appearance of the runway half-way sign. FIG ENR 5.7-1 shows a graphical depiction of a typical runway half-way sign.

FIG ENR 5.7-1
Typical Runway Half-way Sign

8. Mountain Wave

8.1 Many pilots go all their lives without understanding what a mountain wave is. Quite a few have lost their lives because of this lack of understanding. One need not be a licensed meteorologist to understand the mountain wave phenomenon.

8.2 Mountain waves occur when air is being blown over a mountain range or even the ridge of a sharp bluff area. As the air hits the upwind side of the range, it starts to climb, thus creating what is generally a smooth updraft which turns into a turbulent downdraft as the air passes the crest of the ridge. From this point, for many miles downwind, there will be a series of downdrafts and updrafts. Satellite photos of the Rockies have shown mountain waves extending as far as 700 miles downwind of the range. Along the east coast area, such photos of the Appalachian chain have picked up the mountain wave phenomenon over a hundred miles eastward. All it takes to form a mountain wave is wind blowing across the range at 15 knots or better at an intersection angle of not less than 30 degrees.

8.3 Pilots from flatland areas should understand a few things about mountain waves in order to stay out of trouble. Approaching a mountain range from the upwind side (generally the west), there will usually be a smooth updraft; therefore, it is not quite as dangerous an area as the lee of the range. From the leeward side, it is always a good idea to add an extra thousand feet or so of altitude because downdrafts can exceed the climb capability of the aircraft. Never expect an updraft when approaching a mountain chain from the leeward. Always be prepared to cope with a downdraft and turbulence.

8.4 When approaching a mountain ridge from the downwind side, it is recommended that the ridge be approached at approximately a 45° angle to the horizontal direction of the ridge. This permits a safer retreat from the ridge with less stress on the aircraft should severe turbulence and downdraft be experienced. If severe turbulence is encountered, simultaneously reduce power and adjust pitch until aircraft approaches maneuvering speed, then adjust power and trim to maintain maneuvering speed and fly away from the turbulent area.

9. Seaplane Safety

9.1 Acquiring a seaplane class rating affords access to many areas not available to landplane pilots. Adding a seaplane class rating to your pilot certificate can be relatively uncomplicated and inexpensive. However, more effort is required to become a safe, efficient, competent "bush" pilot. The natural hazards of the backwoods have given way to modern man-made hazards. Except for the far north, the available bodies of water are no longer the exclusive domain of the airman. Seaplane pilots must be vigilant for hazards such as electric power lines, power, sail and rowboats, rafts, mooring lines, water skiers, swimmers, etc.

9.2 Seaplane pilots must have a thorough understanding of the right-of-way rules as they apply to aircraft versus other vessels. Seaplane pilots are expected to know and adhere to both the United States Coast Guard's (USCG) Navigation Rules, International-Inland, and Title 14 Code of Federal Regulations (CFR) Section 91.115, Right of Way Rules; Water Operations. The navigation rules of the road are a set of collision avoidance rules as they apply to aircraft on the water. A seaplane is considered a vessel when on the water for the purposes of these collision avoidance rules. In general, a seaplane on the water shall keep well clear of all vessels and avoid impeding their navigation. The CFR requires, in part, that aircraft operating on the water ". . . shall, insofar as possible, keep clear of all vessels and avoid impeding their navigation and shall give way to any vessel or other aircraft that is given the right of way . . . ." This means that a seaplane should avoid boats and commercial shipping when on the water. If on a collision course, the seaplane should slow, stop, or maneuver to the right, away from the bow of the oncoming vessel. Also, while on the surface with an engine running, an aircraft must give way to all nonpowered vessels. Since a seaplane in the water may not be as maneuverable as one in the air, the aircraft on the water has right-of-way over one in the air, and one taking off has right-of-way over one landing. A seaplane is exempt from the USCG safety equipment requirements, including the requirements for Personal Floatation Devices (PFD). Requiring seaplanes on the water to comply with USCG equipment requirements in addition to the FAA equipment requirements would be an unnecessary burden on seaplane owners and operators.

9.3 Unless they are under Federal jurisdiction, navigable bodies of water are under the jurisdiction of the state, or in a few cases, privately owned. Unless they are specifically restricted, aircraft have as much right to operate on these bodies of water as other vessels. To avoid problems, check with Federal or local officials in advance of operating on unfamiliar waters. In addition to the agencies listed in TBL ENR 5.7-1, the nearest Flight Standards District Office can usually offer some practical suggestions as well as regulatory information. If you land on a restricted body of water because of an inflight emergency, or in ignorance of the restrictions you have violated, report as quickly as practical to the nearest local official having jurisdiction and explain your situation.

TBL ENR 5.7-1

Jurisdictions Controlling Navigable Bodies of Water

AUTHORITY TO CONSULT FOR USE OF A BODY OF WATER		
Location	**Authority**	**Contact**
Wilderness Area	U.S. Department of Agriculture, Forest Service	Local forest ranger
National Forest	USDA Forest Service	Local forest ranger
National Park	U.S. Department of the Interior, National Park Service	Local park ranger
Indian Reservation	USDI, Bureau of Indian Affairs	Local Bureau office
State Park	State government or state forestry or park service	Local state aviation office for further information
Canadian National and Provincial Parks	Supervised and restricted on an individual basis from province to province and by different departments of the Canadian government; consult Canadian Flight Information Manual and/or Water Aerodrome Supplement	Park Superintendent in an emergency

9.4 When operating a seaplane over or into remote areas, appropriate attention should be given to survival gear. Minimum kits are recommended for summer and winter, and are required by law for flight into sparsely settled areas of Canada and Alaska. Alaska State Department of Transportation and Canadian Ministry of Transport officials can provide specific information on survival gear requirements. The kit should be assembled in one container and be easily reachable and preferably floatable.

9.5 The FAA recommends that each seaplane owner or operator provide flotation gear for occupants any time a seaplane operates on or near water. 14 CFR Section 91.205(b)(12) requires approved flotation gear for aircraft operated for hire over water and beyond power-off gliding distance from shore. FAA-approved gear differs from that required for navigable waterways under USCG rules. FAA-approved life vests are inflatable designs as compared to the USCG's noninflatable PFDs that may consist of solid, bulky material. Such USCG PFDs are impractical for seaplanes and other aircraft because they may block passage through the relatively narrow exits available to pilots and passengers. Life vests approved under Technical Standard Order (TSO) C-13E contain fully inflatable compartments. The wearer inflates the compartments (AFTER exiting the aircraft) primarily by independent CO_2 cartridges, with an oral inflation tube as a backup. The flotation gear also contains a water-activated, self-illuminating signal light. The fact that pilots and passengers can easily don and wear inflatable life vests (when not inflated) provides maximum effectiveness and allows for unrestricted movement. It is imperative that passengers are briefed on the location and proper use of available PFDs prior to leaving the dock.

9.6 The FAA recommends that seaplane owners and operators obtain Advisory Circular (AC) 91-69, Seaplane Safety for 14 CFR Part 91 Operations, free from:

U.S. Department of Transportation
Subsequent Distribution Office, SVC-121.23
Ardmore East Business Center
3341 Q 75th Avenue
Landover, MD 20785
FAX: (301) 386-5394

The USCG Navigation Rules International-Inland (COMDTINST M16672.2B) is available for a fee from the Government Printing Office by facsimile request to (202) 512-2250. It can be ordered using Mastercard or Visa.

10. Flight Operations in Volcanic Ash

10.1 Severe volcanic eruptions which send ash into the upper atmosphere occur somewhere around the world several times each year. Flying into a volcanic ash cloud can be exceedingly dangerous. A B747-200 lost all four engines after such an encounter, and a B747-400 had the same nearly catastrophic experience. Piston-powered aircraft are less likely to lose power but severe damage is almost certain to ensue after an encounter with a volcanic ash cloud which is only a few hours old.

10.2 Most important is to avoid any encounter with volcanic ash. The ash plume may not be visible, especially in instrument conditions or at night; and even if visible, it is difficult to distinguish visually between an ash cloud and an ordinary weather cloud. Volcanic ash clouds are not displayed on airborne or ATC radar. The pilot must rely on reports from air traffic controllers and other pilots to determine the location of the ash cloud and use that information to remain well clear of the area. Every attempt should be made to remain on the upwind side of the volcano.

10.3 It is recommended that pilots encountering an ash cloud should immediately reduce thrust to idle (altitude permitting), and reverse course in order to escape from the cloud. Ash clouds may extend for hundreds of miles, and pilots should not attempt to fly through or climb out of the cloud. In addition, the following procedures are recommended:

10.3.1 Disengage the autothrottle if engaged. This will prevent the autothrottle from increasing engine thrust.

10.3.2 Turn on continuous ignition.

10.3.3 Turn on all accessory airbleeds including all air conditioning packs, nacelles, and wing anti-ice. This will provide an additional engine stall margin by reducing engine pressure.

10.4 The following has been reported by flight crews who have experienced encounters with volcanic dust clouds.

10.4.1 Smoke or dust appearing in the cockpit.

10.4.2 An acrid odor similar to electrical smoke.

10.4.3 Multiple engine malfunctions, such as compressor stalls, increasing EGT, torching from tailpipe, and flameouts.

10.4.4 At night, St. Elmo's fire or other static discharges accompanied by a bright orange glow in the engine inlets.

10.4.5 A fire warning in the forward cargo area.

10.5 It may become necessary to shut down and then restart engines to prevent exceeding EGT limits. Volcanic ash may block the pitot system and result in unreliable airspeed indications.

10.6 If you see a volcanic eruption and have not been previously notified of it, you may have been the first person to observe it. In this case, immediately contact ATC and alert them to the existence of the eruption. If possible, use the Volcanic Activity Reporting Form (VAR) depicted at the end of GEN 3.5. Items 1 through 8 of the VAR should be transmitted immediately. The information requested in items 9 through 16 should be passed after landing. If a VAR form is not immediately available, relay enough information to identify the position and nature of the volcanic activity. Do not become unnecessarily alarmed if there is merely steam or very low-level eruptions of ash.

10.7 When landing at airports where volcanic ash has been deposited on the runway, be aware that even a thin layer of dry ash can be detrimental to braking action. Wet ash on the runway may also reduce effectiveness of braking. It is recommended that reverse thrust be limited to a minimum practical to reduce the possibility of reduced visibility and engine ingestion of airborne ash.

10.8 When departing from airports where volcanic ash has been deposited it is recommended that pilots avoid operating in visible airborne ash. Allow ash to settle before initiating takeoff roll. It is also recommended that flap extension be delayed until initiating the takeoff checklist and that a rolling takeoff be executed to avoid blowing ash back into the air.

11. Emergency Airborne Inspection of Other Aircraft

11.1 Providing airborne assistance to another aircraft may involve flying in very close proximity to that aircraft. Most pilots receive little, if any, formal training or instruction in this type of flying activity. Close proximity flying without sufficient time to plan (i.e., in an emergency situation), coupled with the stress involved in a perceived emergency can be hazardous.

11.2 The pilot in the best position to assess the situation should take the responsibility of coordinating the airborne intercept and inspection, taking into account the unique flight characteristics and differences of the category(s) of aircraft involved.

11.3 Some of the safety considerations are:

11.3.1 Area, direction, and speed of the intercept.

11.3.2 Aerodynamic effects (i.e., rotorcraft downwash) which may also affect.

11.3.3 Minimum safe separation distances.

11.3.4 Communications requirements, lost communications procedures, coordination with ATC.

11.3.5 Suitability of diverting the distressed aircraft to the nearest safe airport.

11.3.6 Emergency actions to terminate the intercept.

11.4 Close proximity, inflight inspection of another aircraft is uniquely hazardous. The pilot in command of the aircraft experiencing the problem/emergency must not relinquish his/her control of the situation and jeopardize the safety of his/her aircraft. The maneuver must be accomplished with minimum risk to both aircraft.

12. Precipitation Static

12.1 Precipitation static is caused by aircraft in flight coming in contact with uncharged particles. These particles can be rain, snow, fog, sleet, hail, volcanic ash, dust, any solid or liquid particles. When the aircraft strikes these neutral particles, the positive element of the particle is reflected away from the aircraft and the negative particle adheres to the skin of the aircraft. In a very short period of time a substantial negative charge will develop on the skin of the aircraft. If the aircraft is not equipped with static dischargers, or has an ineffective static discharger system, when a sufficient negative voltage level is reached, the aircraft may go into "CORONA." That is, it will discharge the static electricity from the extremities of the aircraft, such as the wing tips, horizontal stabilizer, vertical stabilizer, antenna, propeller tips, etc. This discharge of static electricity is what you will hear in your headphones and is what we call P-static.

12.2 A review of pilot reports often shows different symptoms with each problem that is encountered. The following list of problems is a summary of many pilot reports from many different aircraft. Each problem was caused by P-static:

12.2.1 Complete loss of VHF communications.

12.2.2 Erroneous magnetic compass readings (30% in error).

12.2.3 High pitched squeal on audio.

12.2.4 Motor boat sound on audio.

12.2.5 Loss of all avionics in clouds.

12.2.6 VLF navigation system inoperative most of the time.

12.2.7 Erratic instrument readouts.

12.2.8 Weak transmissions and poor receptivity of radios.

12.2.9 "St. Elmo's Fire" on windshield.

12.3 Each of these symptoms is caused by one general problem on the airframe. This problem is the inability of the accumulated charge to flow easily to the wing tips and tail of the airframe, and properly discharge to the airstream.

12.4 Static dischargers work on the principle of creating a relatively easy path for discharging negative charges that develop on the aircraft by using a discharger with fine metal points, carbon coated rods, or carbon wicks rather than wait until a large charge is developed and discharged off the trailing edges of the aircraft that will interfere with avionics equipment. This process offers approximately 50 decibels (dB) static noise reduction which is adequate in most cases to be below the threshold of noise that would cause interference in avionics equipment.

12.5 It is important to remember that precipitation static problems can only be corrected with the proper number of quality static dischargers, properly installed on a properly bonded aircraft. P-static is indeed a problem in the all weather operation of the aircraft, but there are effective ways to combat it. All possible methods of reducing the effects of P-static should be considered so as to provide the best possible performance in the flight environment.

12.6 A wide variety of discharger designs is available on the commercial market. The inclusion of well-designed dischargers may be expected to improve airframe noise in P-static conditions by as much as 50 dB. Essentially, the discharger provides a path by which accumulated charge may leave the airframe quietly. This is generally accomplished by providing a group of tiny corona points to permit onset of corona-current flow at a low aircraft potential. Additionally, aerodynamic design of dischargers to permit corona to occur at the lowest possible atmospheric pressure also lowers the corona threshold. In addition to permitting a low potential discharge, the discharger will minimize the radiation of radio frequency (RF) energy which accompanies the corona discharge, in order to minimize effects of RF components at communications and navigation frequencies on avionics performance. These effects are reduced through resistive attachment of the corona point(s) to the airframe, preserving direct current connection but attenuating the higher frequency components of the discharge.

12.7 Each manufacturer of static dischargers offers information concerning appropriate discharger location on specific airframes. Such locations emphasize the trailing outboard surfaces of wings and horizontal tail surfaces, plus the tip of the vertical stabilizer, where charge tends to accumulate on the airframe. Sufficient dischargers must be provided to allow for current carrying capacity which will maintain airframe potential below the corona threshold of the trailing edges.

12.8 In order to achieve full performance of avionic equipment, the static discharge system will require periodic maintenance. A pilot's knowledge of P-static causes and effects is an important element in assuring optimum performance by early recognition of these types of problems.

13. Light Amplification by Stimulated Emission of Radiation (Laser) Operations and Reporting Illumination of Aircraft

13.1 Lasers have many applications. Of concern to users of the National Airspace System are those laser events that may affect pilots; e.g., outdoor laser light shows or demonstrations for entertainment and advertisement at special events and theme parks. Generally, the beams from these events appear as bright blue-green in color; however, they may be red, yellow, or white. Some laser systems produce light which is invisible to the human eye.

13.2 FAA regulations prohibit the disruption of aviation activity by any person on the ground or in the air. The FAA and the Food and Drug Administration (the Federal agency that has the responsibility to enforce compliance with Federal requirements for laser systems and laser light show products) are working together to ensure that operators of these devices do not pose a hazard to aircraft operators.

13.3 Pilots should be aware that illuminations from these laser operations is able to create temporary vision impairment miles from the actual location. In addition, these operations can produce permanent eye damage. Pilots should make themselves aware of where laser activities are being conducted and avoid the areas if possible.

13.4 Recent and increasing incidents of unauthorized illumination of aircraft by lasers, as well as the proliferation and increasing sophistication of laser devices available to the general public, dictates that the FAA, in coordination with other government agencies, take action to safeguard flights from these unauthorized illuminations.

13.5 Pilots should report laser illumination activity to the controlling Air Traffic Control facilities, Federal Contract Towers or Flight Service Stations as soon as possible after the event. The following information should be included:

13.5.1 UTC Date and Time of Event.

13.5.2 Call Sign or Aircraft Registration Number.

13.5.3 Type Aircraft.

13.5.4 Nearest Major City.

13.5.5 Altitude.

13.5.6 Location of Event (Latitude/Longitude and/or Fixed Radial Distance (FRD)).

13.5.7 Brief Description of the Event and any other Pertinent Information.

13.6 Pilots are also encouraged to complete the Laser Beam Exposure Questionnaire (See FIG 5-7-1), and fax it to the Washington Operations Center Complex (WOCC) as soon as possible after landing.

13.7 When a laser event is reported to an air traffic facility, a general caution warning will be broadcasted on all appropriate frequencies every five minutes for 20 minutes and broadcasted on the ATIS for one hour following the report.

PHRASEOLOGY-
UNAUTHORIZED LASER ILLUMINATION EVENT, (UTC time), (location), (altitude), (color), (direction).

EXAMPLE-
"Unauthorized laser illumination event, at 0100z, 8 mile final runway 18R at 3,000 feet, green laser from the southwest."

13.8 When laser activities become known to the FAA, Notices to Airmen (NOTAM) are issued to inform the aviation community of the events. Pilots should consult NOTAMs or the Special Notices Section of the Airport/Facility Directory for information regarding laser activities.

14. Flying in Flat Light and White Out Conditions

14.1 Flat Light. Flat light is an optical illusion, also known as "**sector or partial white out**." It is not as severe as "white out" but the condition causes pilots to lose their depth-of-field and contrast in vision. Flat light conditions are usually accompanied by overcast skies inhibiting any visual clues. Such conditions can occur anywhere in the world, primarily in snow covered areas but can occur in dust, sand, mud flats, or on glassy water. Flat light can completely obscure features of the terrain, creating an inability to distinguish distances and closure rates. As a result of this reflected light, it can give pilots the illusion that they are ascending or descending when they may actually be flying level. However, with good judgment and proper training and planning, it is possible to safely operate an aircraft in flat light conditions.

14.2 White Out. As defined in meteorological terms, white out occurs when a person becomes engulfed in a uniformly white glow. The glow is a result of being surrounded by blowing snow, dust, sand, mud or water. There are no shadows, no horizon or clouds and all depth-of-field and orientation are lost. A white out situation is severe in that there are no visual references. Flying is not recommended in any white out situation. Flat light conditions can lead to a white out environment quite rapidly, and both atmospheric conditions are insidious; they sneak up on you as your visual references slowly begin to disappear. White out has been the cause of several aviation accidents.

14.3 Self Induced White Out. This effect typically occurs when a helicopter takes off or lands on a snow-covered area. The rotor down wash picks up particles and re-circulates them through the rotor down wash. The effect can vary in intensity depending upon the amount of light on the surface. This can happen on the sunniest, brightest day with good contrast everywhere. However, when it happens, there can be a complete loss of visual clues. If the pilot has not prepared for this immediate loss of visibility, the results can be disastrous. Good planning does not prevent one from encountering flat light or white out conditions.

14.4 Never take off in a white out situation.

14.4.1 Realize that in flat light conditions it may be possible to depart but not to return to that site. During takeoff, make sure you have a reference point. Do not lose sight of it until you have a departure reference point in view. Be prepared to return to the takeoff reference if the departure reference does not come into view.

14.4.2 Flat light is common to snow skiers. One way to compensate for the lack of visual contrast and depth-of-field loss is by wearing amber tinted lenses (also known as blue blockers). Special note of caution: Eyewear is not ideal for every pilot. Take into consideration personal factors - age, light sensitivity, and ambient lighting conditions.

14.4.3 So what should a pilot do when all visual references are lost?

14.4.3.1 Trust the cockpit instruments.

14.4.3.2 Execute a 180 degree turnaround and start looking for outside references.

14.4.3.3 Above all - fly the aircraft.

14.4.4 Landing in Low Light Conditions. When landing in a low light condition - use extreme caution. Look for intermediate reference points, in addition to checkpoints along each leg of the route for course confirmation and timing. The lower the ambient light becomes, the more reference points a pilot should use.

14.4.5 Airport Landings.

14.4.5.1 Look for features around the airport or approach path that can be used in determining depth perception. Buildings, towers, vehicles or other aircraft serve well for this measurement. Use something that will provide you with a sense of height above the ground, in addition to orienting you to the runway.

14.4.5.2 Be cautious of snowdrifts and snow banks - anything that can distinguish the edge of the runway. Look for subtle changes in snow texture or shading to identify ridges or changes in snow depth.

14.4.6 Off-Airport Landings.

14.4.6.1 In the event of an off-airport landing, pilots have used a number of different visual cues to gain reference. Use whatever you must to create the contrast you need. Natural references seem to work best (trees, rocks, snow ribs, etc.)

a) Over flight.

b) Use of markers.

c) Weighted flags.

d) Smoke bombs.

e) Any colored rags.

f) Dye markers.

g) Kool-aid.

h) Trees or tree branches.

14.4.6.2 It is difficult to determine the depth of snow in areas that are level. Dropping items from the aircraft to use as reference points should be used as a visual aid only and not as a primary landing reference. Unless your marker is biodegradable, be sure to retrieve it after landing. Never put yourself in a position where no visual references exist.

14.4.6.3 Abort landing if blowing snow obscures your reference. Make your decisions early. Don't assume you can pick up a lost reference point when you get closer.

14.4.6.4 Exercise extreme caution when flying from sunlight into shade. Physical awareness may tell you that you are flying straight but you may actually be in a spiral dive with centrifugal force pressing against you. Having no visual references enhances this illusion. Just because you have a good visual reference does not mean that it's safe to continue. There may be snow-covered terrain not visible in the direction that you are traveling. Getting caught in a no visual reference situation can be fatal.

14.4.7 Flying Around a Lake.

14.4.7.1 When flying along lakeshores, use them as a reference point. Even if you can see the other side, realize that your depth perception may be poor. It is easy to fly into the surface. If you must cross the lake, check the altimeter frequently and maintain a safe altitude while you still have a good reference. Don't descend below that altitude.

14.4.7.2 The same rules apply to seemingly flat areas of snow. If you don't have good references, avoid going there.

14.4.8 Other Traffic. Be on the look out for other traffic in the area. Other aircraft may be using your same reference point. Chances are greater of colliding with someone traveling in the same direction as you, than someone flying in the opposite direction.

14.4.9 Ceilings. Low ceilings have caught many pilots off guard. Clouds do not always form parallel to the surface, or at the same altitude. Pilots may try to compensate for this by flying with a slight bank and thus creating a descending turn.

14.4.10 Glaciers. Be conscious of your altitude when flying over glaciers. The glaciers may be rising faster than you are climbing.

15. Operations in Ground Icing Conditions

15.1 The presence of aircraft airframe icing during takeoff, typically caused by improper or no deicing of the aircraft being accomplished prior to flight has contributed to many recent accidents in turbine aircraft. The General Aviation Joint Steering Committee (GAJSC) is the primary vehicle for government-industry cooperation, communication, and coordination on GA accident mitigation. The Turbine Aircraft Operations Subgroup (TAOS) works to mitigate accidents in turbine accident aviation. While there is sufficient information and guidance currently available regarding the effects of icing on aircraft and methods for deicing, the TAOS has developed a list of recommended actions to further assist pilots and operators in this area.

15.1.1 While the efforts of the TAOS specifically focus on turbine aircraft, it is recognized that their recommendations are applicable to and can be adapted for the pilot of a small, piston powered aircraft too.

15.2 The following recommendations are offered:

15.2.1 Ensure that your aircraft's lift-generating surfaces are COMPLETELY free of contamination before flight through a tactile (hands on) check of the critical surfaces when feasible. Even when otherwise permitted, operators should avoid smooth or polished frost on lift-generating surfaces as an acceptable preflight condition.

15.2.2 Review and refresh your cold weather standard operating procedures.

15.2.3 Review and be familiar with the Airplane Flight Manual (AFM) limitations and procedures necessary to deal with icing conditions prior to flight, as well as in flight.

15.2.4 Protect your aircraft while on the ground, if possible, from sleet and freezing rain by taking advantage of aircraft hangars.

15.2.5 Take full advantage of the opportunities available at airports for deicing. Do not refuse deicing services simply because of cost.

15.2.6 Always consider canceling or delaying a flight if weather conditions do not support a safe operation.

15.3 If you haven't already developed a set of Standard Operating Procedures for cold weather operations, they should include:

15.3.1 Procedures based on information that is applicable to the aircraft operated, such as AFM limitations and procedures;

15.3.2 Concise and easy to understand guidance that outlines best operational practices;

15.3.3 A systematic procedure for recognizing, evaluating and addressing the associated icing risk, and offer clear guidance to mitigate this risk;

15.3.4 An aid (such as a checklist or reference cards) that is readily available during normal day-to-day aircraft operations.

15.4 There are several sources for guidance relating to airframe icing, including:

http://aircrafticing.grc.nasa.gov/index.html

http://www.ibac.org/is-bao/isbao.htm

http://www.natasafety1st.org/bus_deice.htm

15.4.1 Advisory Circular (AC) 91-74, Pilot Guide, Flight in Icing Conditions.

15.4.2 AC 135-17, Pilot Guide Small Aircraft Ground Deicing.

15.4.3 AC 135-9, FAR Part 135 Icing Limitations.

15.4.4 AC 120-60, Ground Deicing and Anti-icing Program.

15.4.5 AC 135-16, Ground Deicing and Anti-icing Training and Checking.

15.5 The FAA Approved Deicing Program Updates is published annually as a Flight Standards Information Bulletin for Air Transportation and contains detailed information on deicing and anti-icing procedures and holdover times. It may be accessed at the following web site by selecting the current year's information bulletins:

http://www.faa.gov/library/manuals/examiners_inspectors/8400/fsat

PART 3 – AERODROMES (AD)

AD 0.

AD 0.1 Preface – Not applicable

AD 0.2 Record of AIP Amendments – See GEN 0.2-1

AD 0.3 Record of AIP Supplements – Not applicable

AD 0.4 Checklist of Pages

AD 0.5 List of Hand Amendments to the AIP - Not applicable

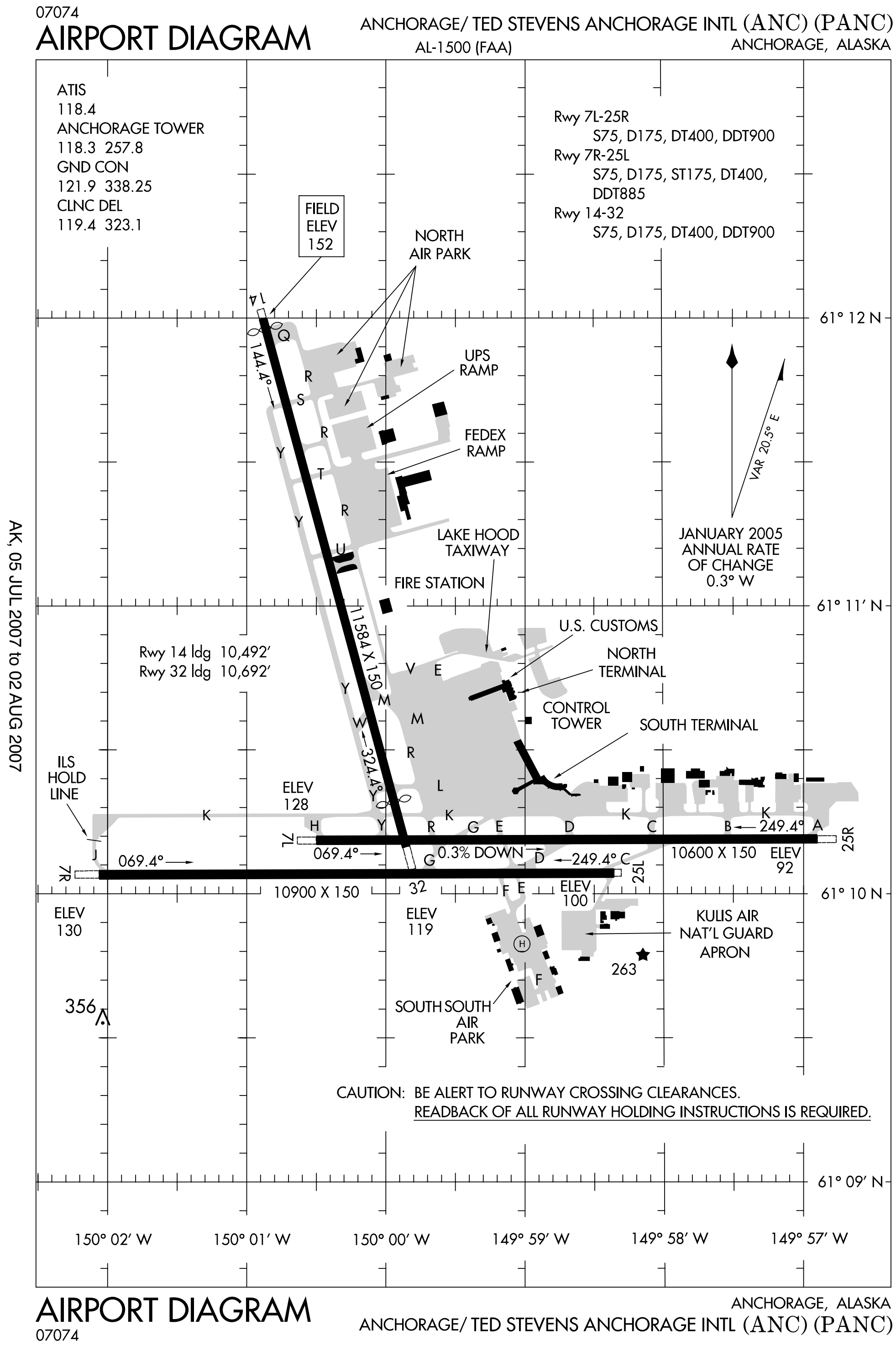
ICAO ID	Location	Airport Name	Designation
Tennessee			
KMEM	Memphis	Memphis International	Regular
KBNA	Nashville	Nashville International	Regular
Texas			
KDFW	Dallas	Dallas-Fort Worth International	Regular
KELP	El Paso	El Paso International	Regular
KIAH	Houston	George Bush Intercontinental/ Houston	Regular
KLRD	Laredo	Laredo International	Regular
KSAT	San Antonio	San Antonio International	Regular
Utah			
KSLC	Salt Lake City	Salt Lake City International	Regular
Virgin Islands			
TIST	Charlotte Amalie St. Thomas	Cyril E. King	Regular
TISX	Christiansted St. Croix	Henry E Rohlsen	Regular

ICAO ID	Location	Airport Name	Designation
Washington			
KPAE	Everett	Snohomish County (Paine Field)	Alternate
KSEA	Seattle	Seattle-Tacoma International	Regular
KGEG	Spokane	Spokane International	Alternate
Wisconsin			
KMKE	Milwaukee	General Mitchell International	Regular

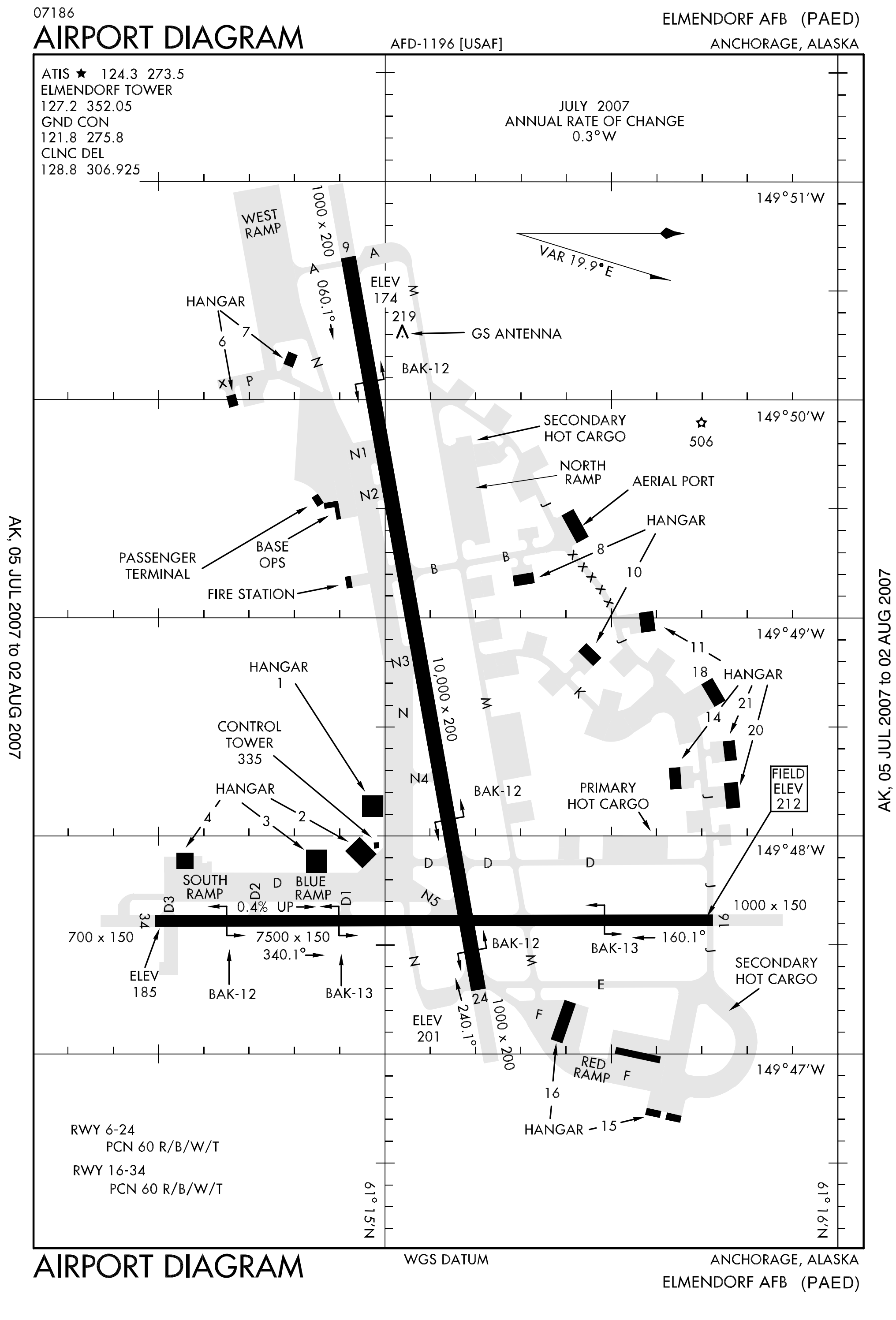
1.1 Diagrams of these airports, arranged alphabetically by state and in the order listed above, are on the pages following. The most up-to-date diagrams of these and other U.S. airports are in the Terminal Procedures Publication (TPP). For additional information on these airports, see the U.S. Airport/ Facility Directory (A/FD).

1.2 Both the A/FD and TPP may be purchased from:
National Aeronautical Charting Office (NACO)
Distribution Division,
Federal Aviation Administration
6303 Ivy Lane, Suite 400
Greenbelt, MD 20770
Telephone: 301-436-8301/6990
301-436-6829 (FAX)
e-mail: 9-AMC-Chartsales@faa.gov

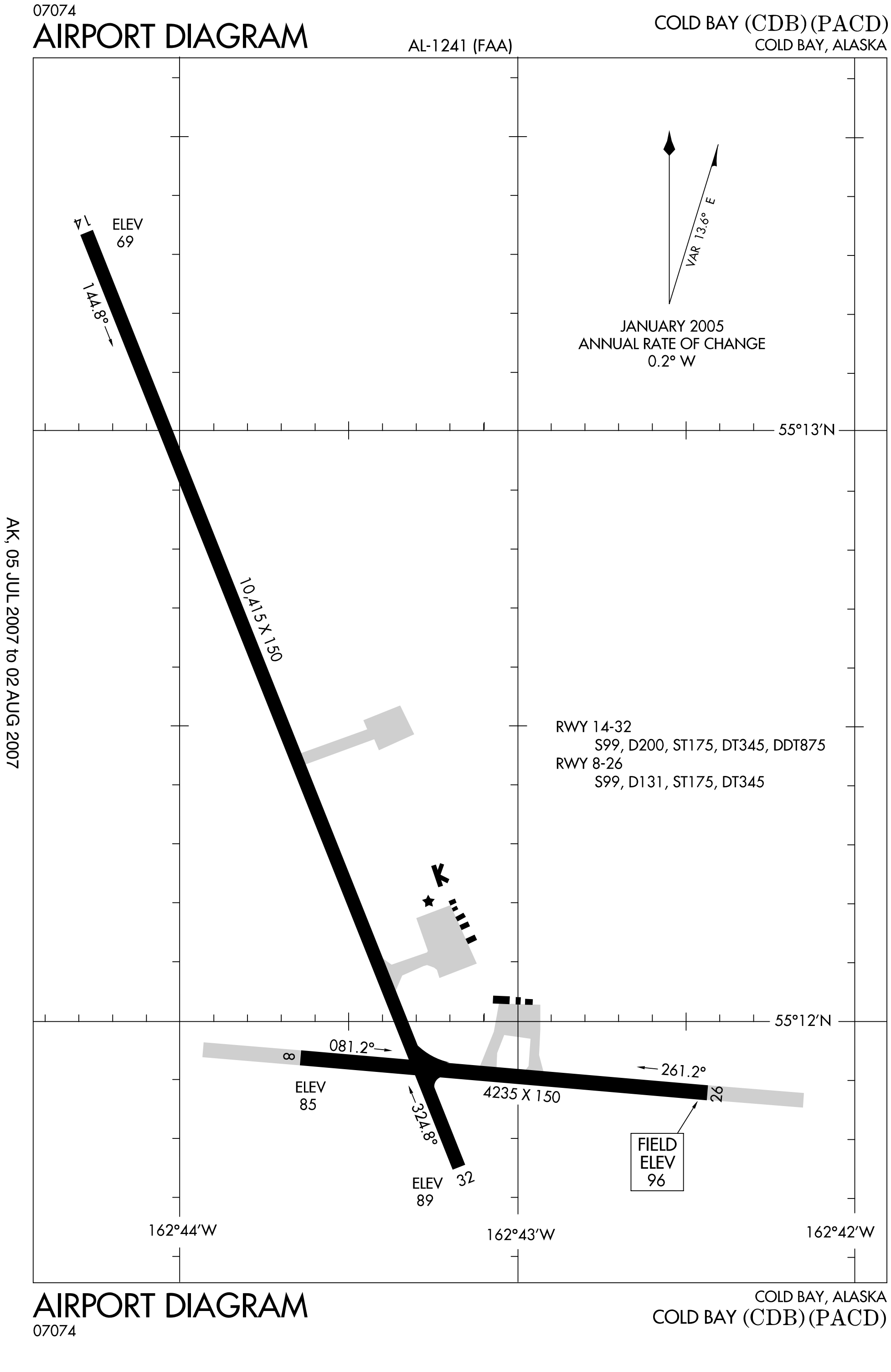
Anchorage, Alaska
Ted Stevens Anchorage International
ICAO Identifier PANC



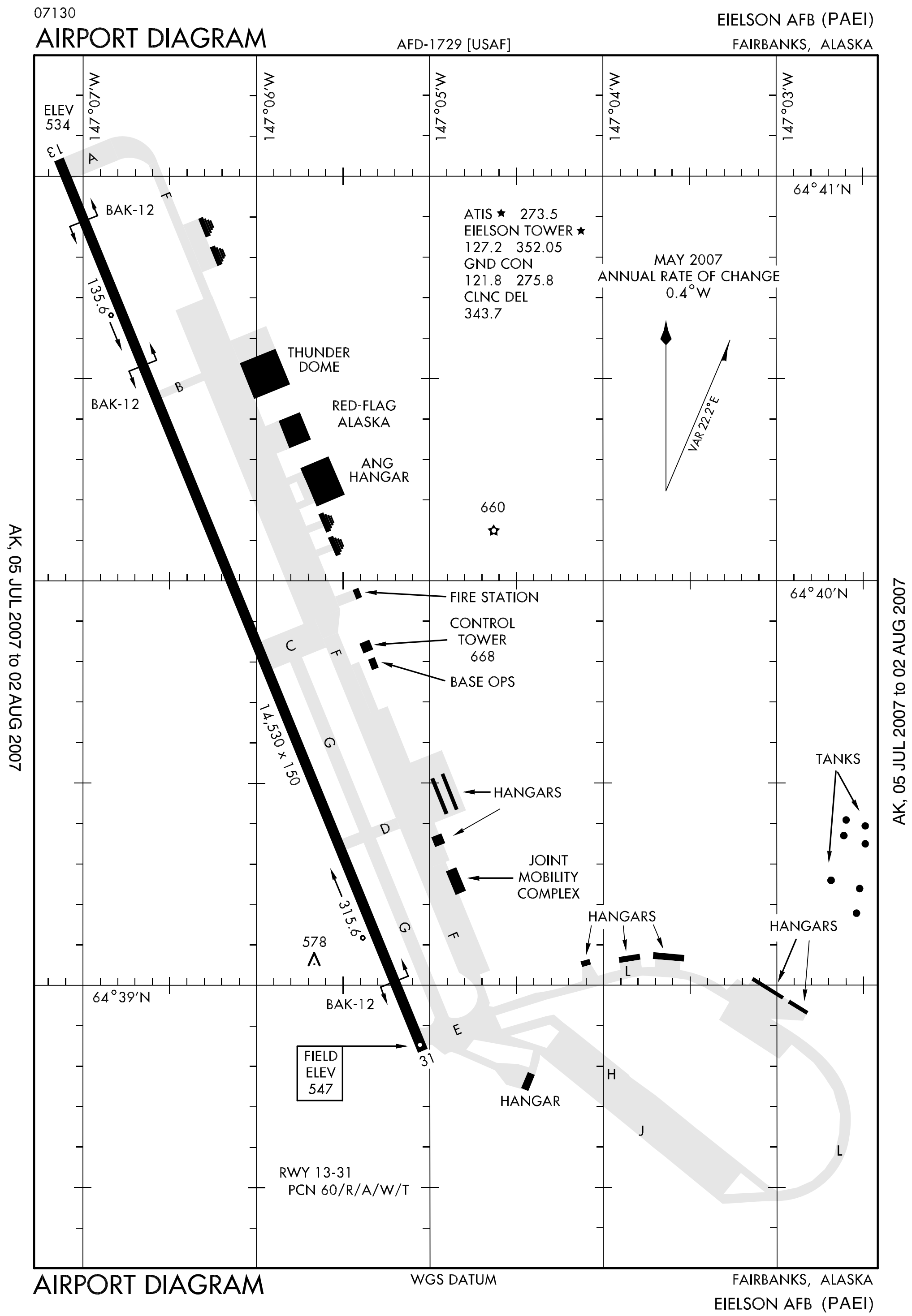
Anchorage, Alaska
Elmendorf AFB
ICAO Identifier PAED



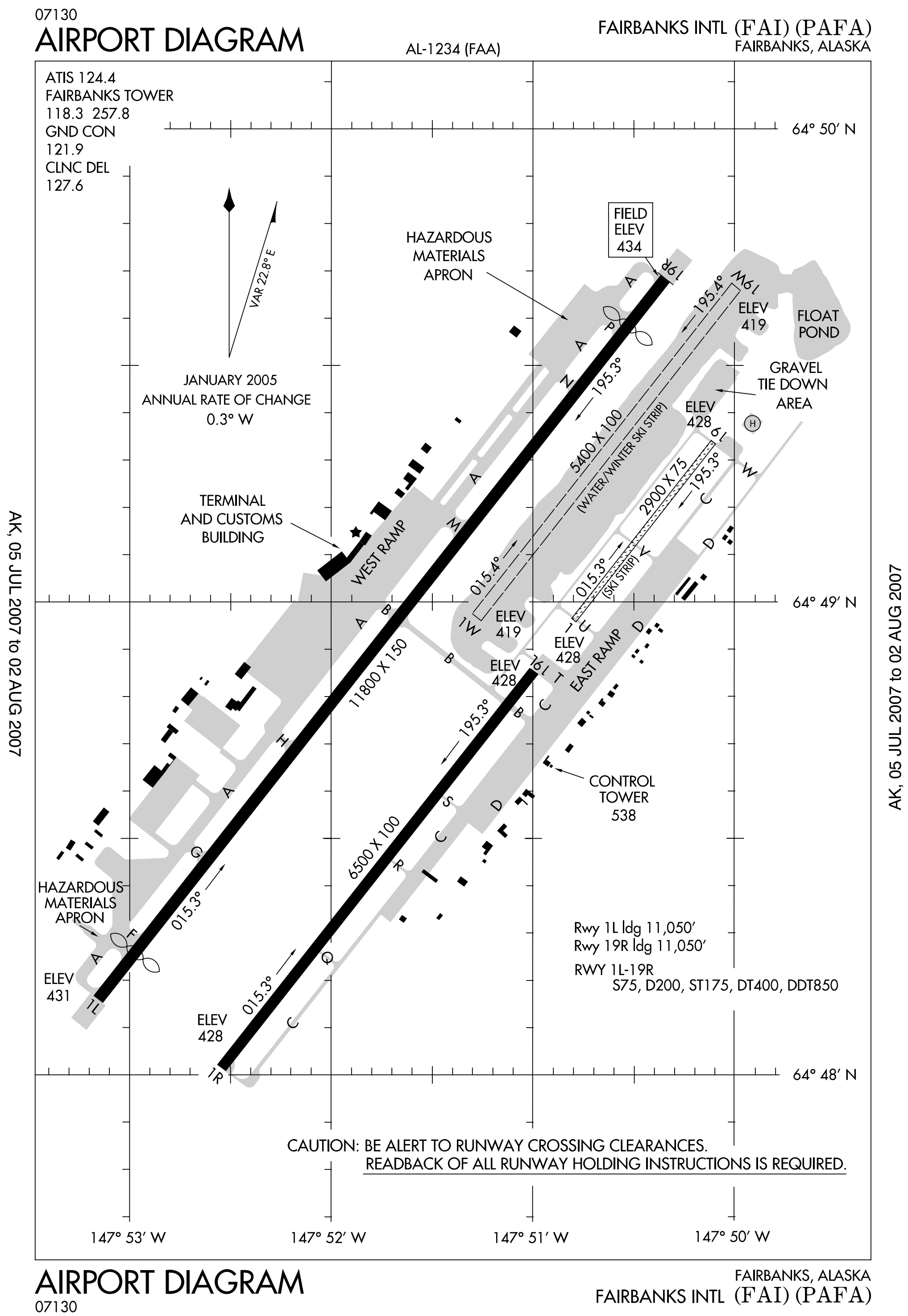
Cold Bay, Alaska
Cold Bay
ICAO Identifier PACD



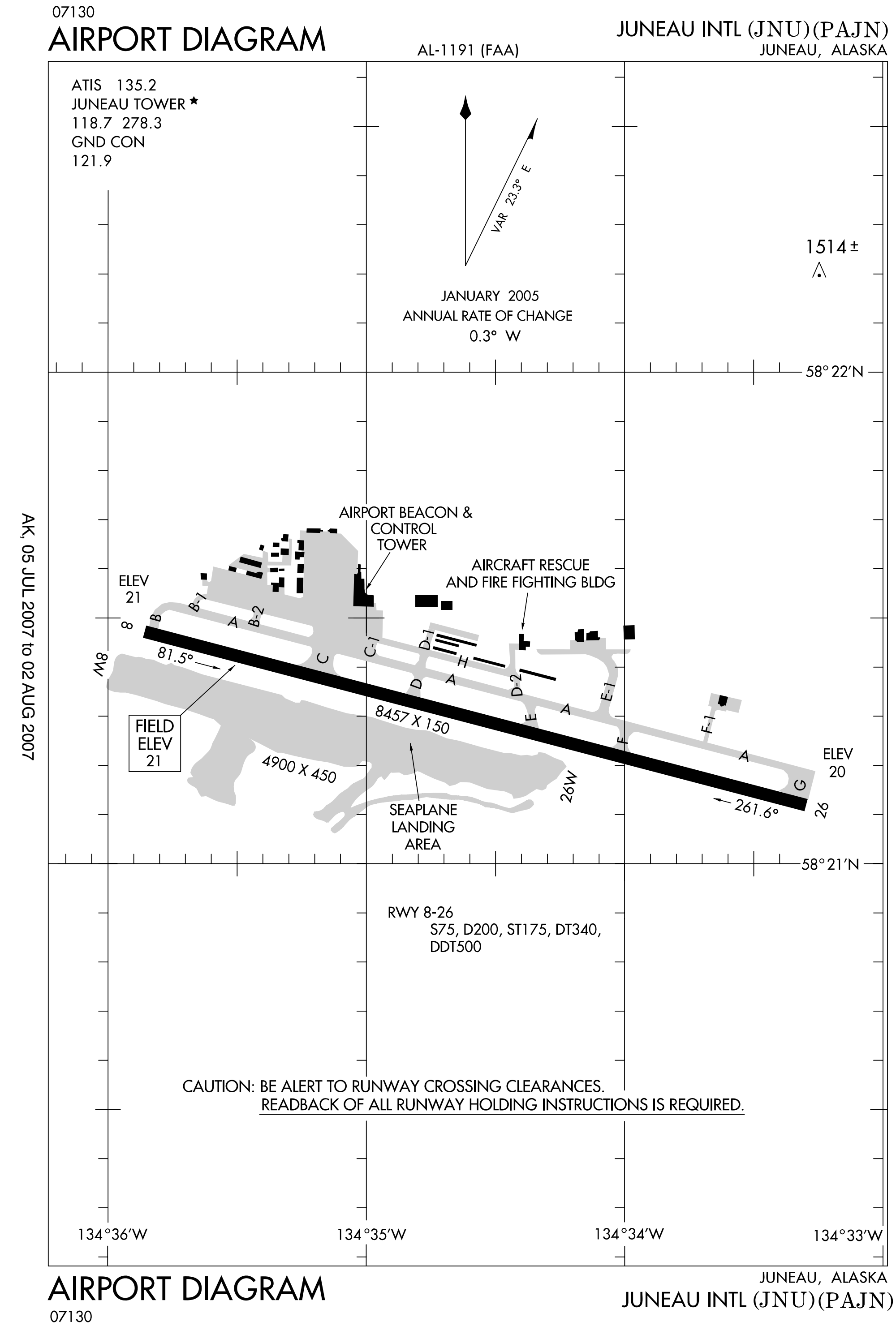
Fairbanks, Alaska
Eielson AFB
ICAO Identifier PAEI



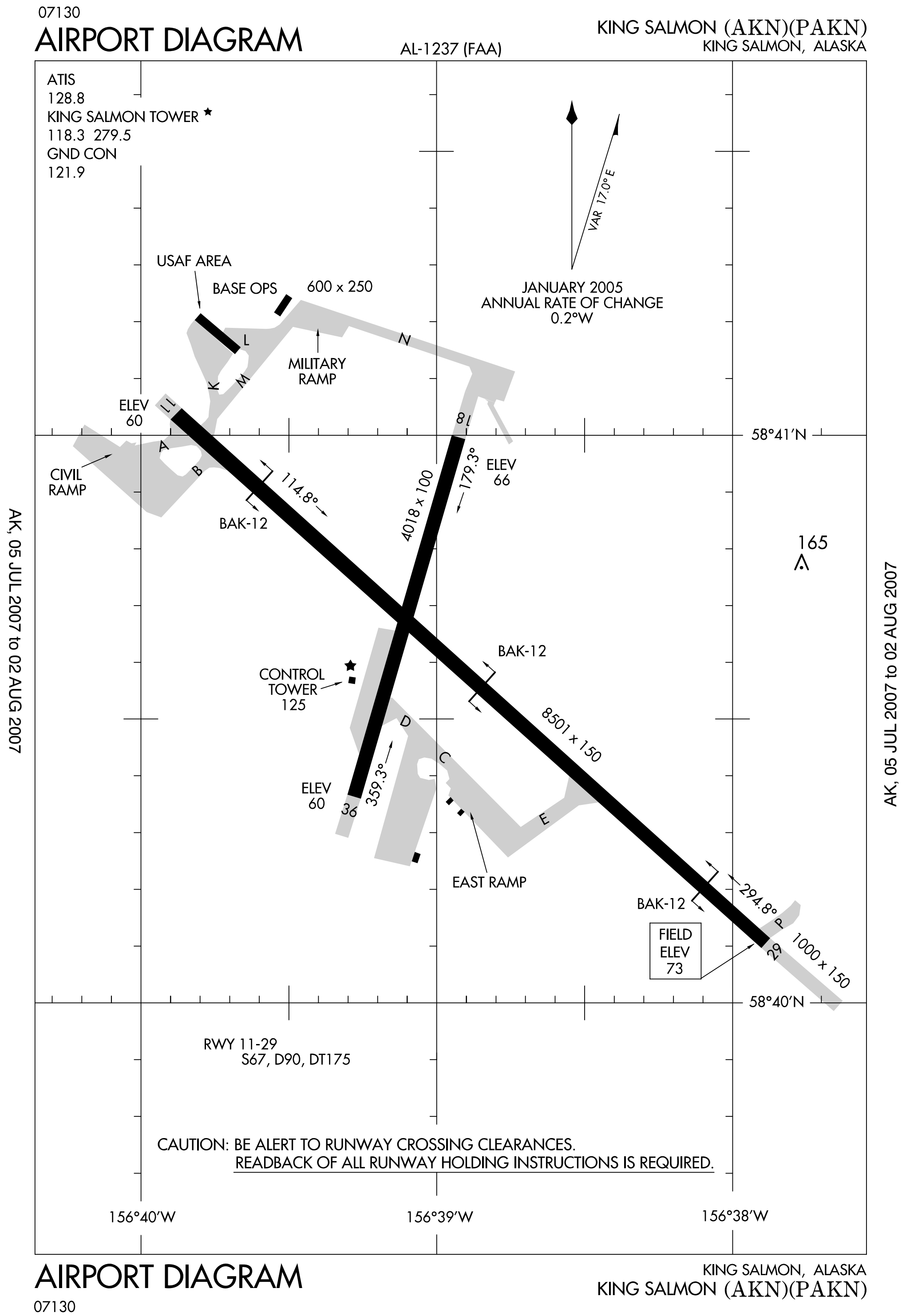
Fairbanks, Alaska
Fairbanks International
ICAO Identifier PAFA



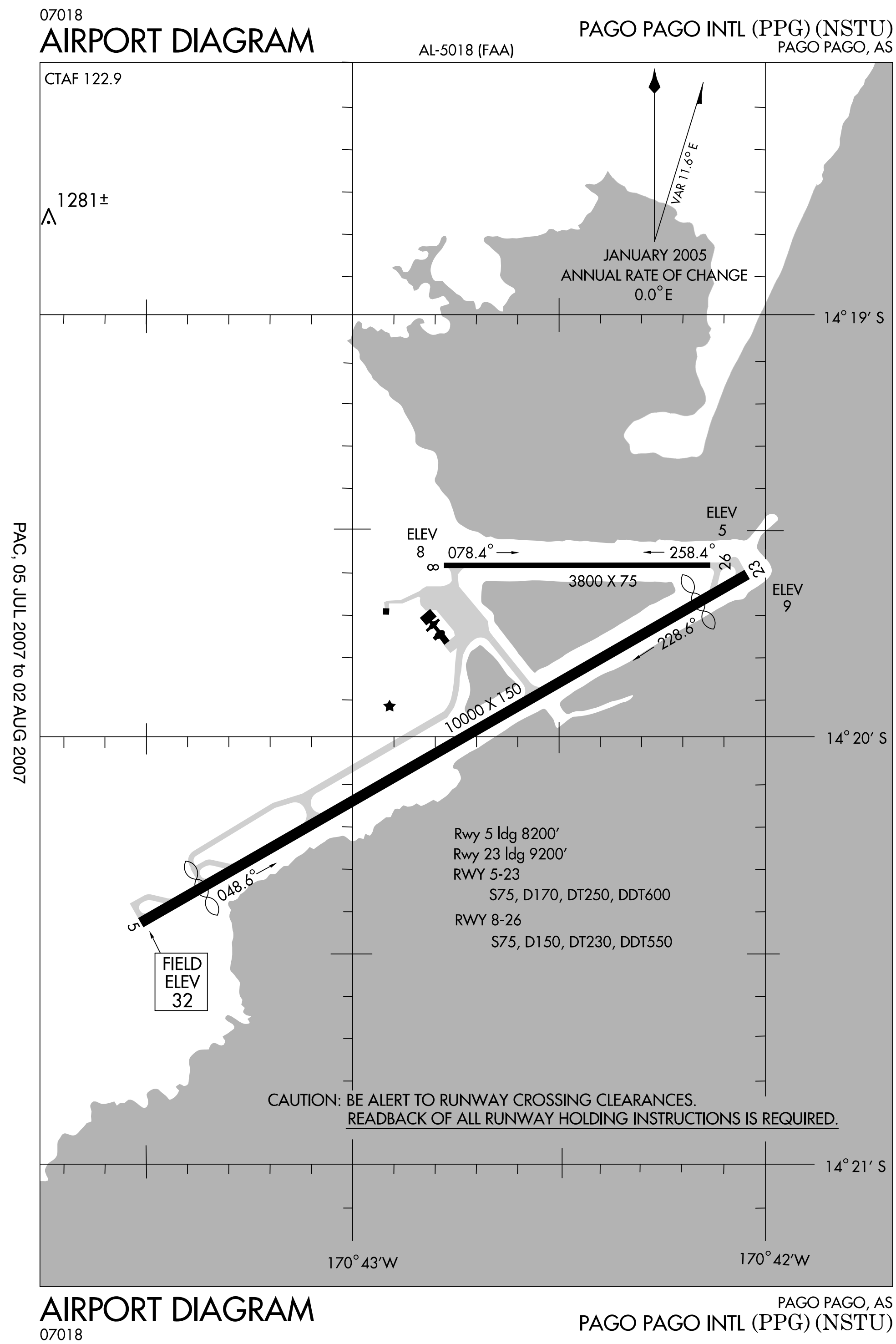
Juneau, Alaska
Juneau International
ICAO Identifier PAJN



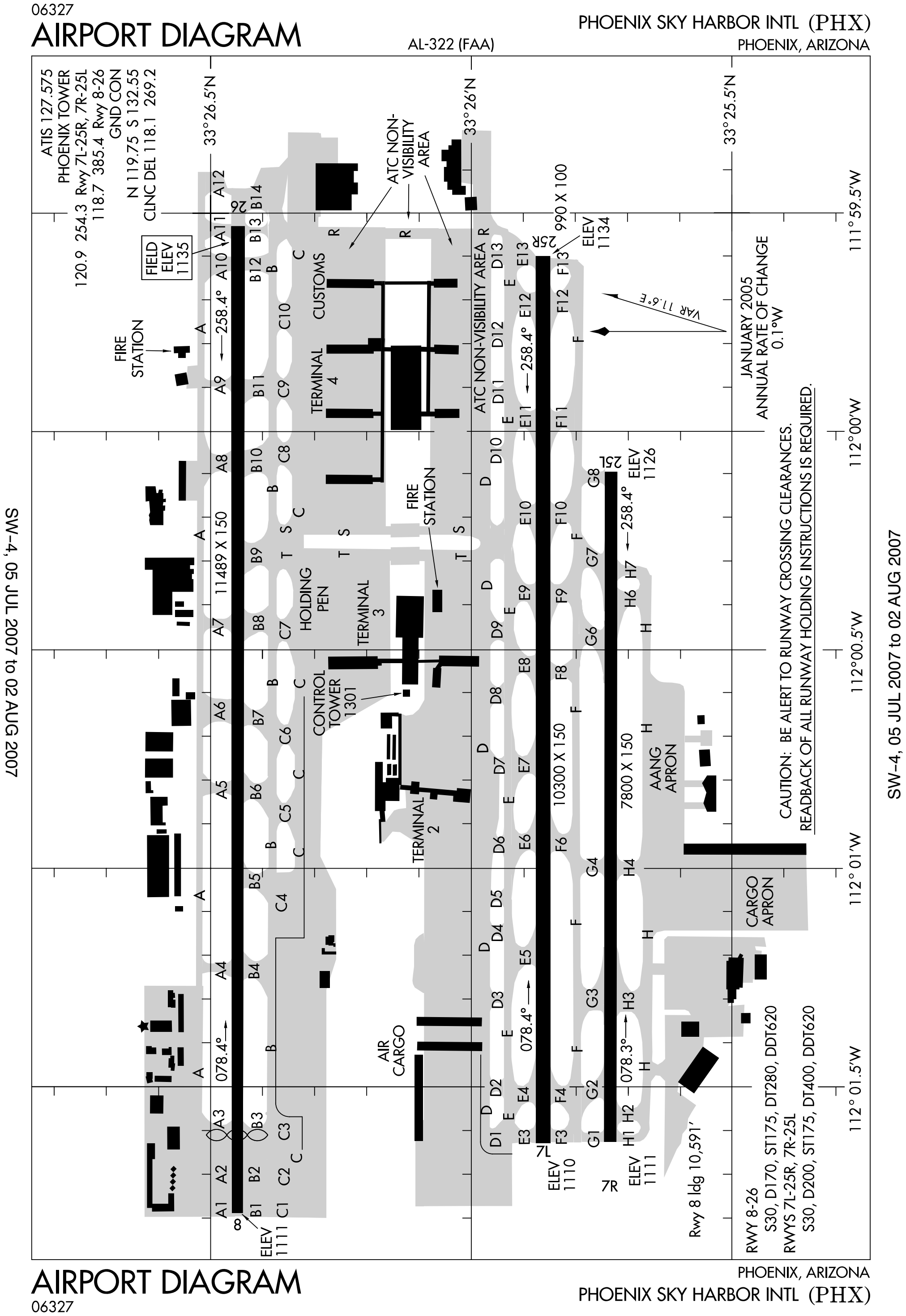
King Salmon, Alaska
King Salmon
ICAO Identifier PAKN



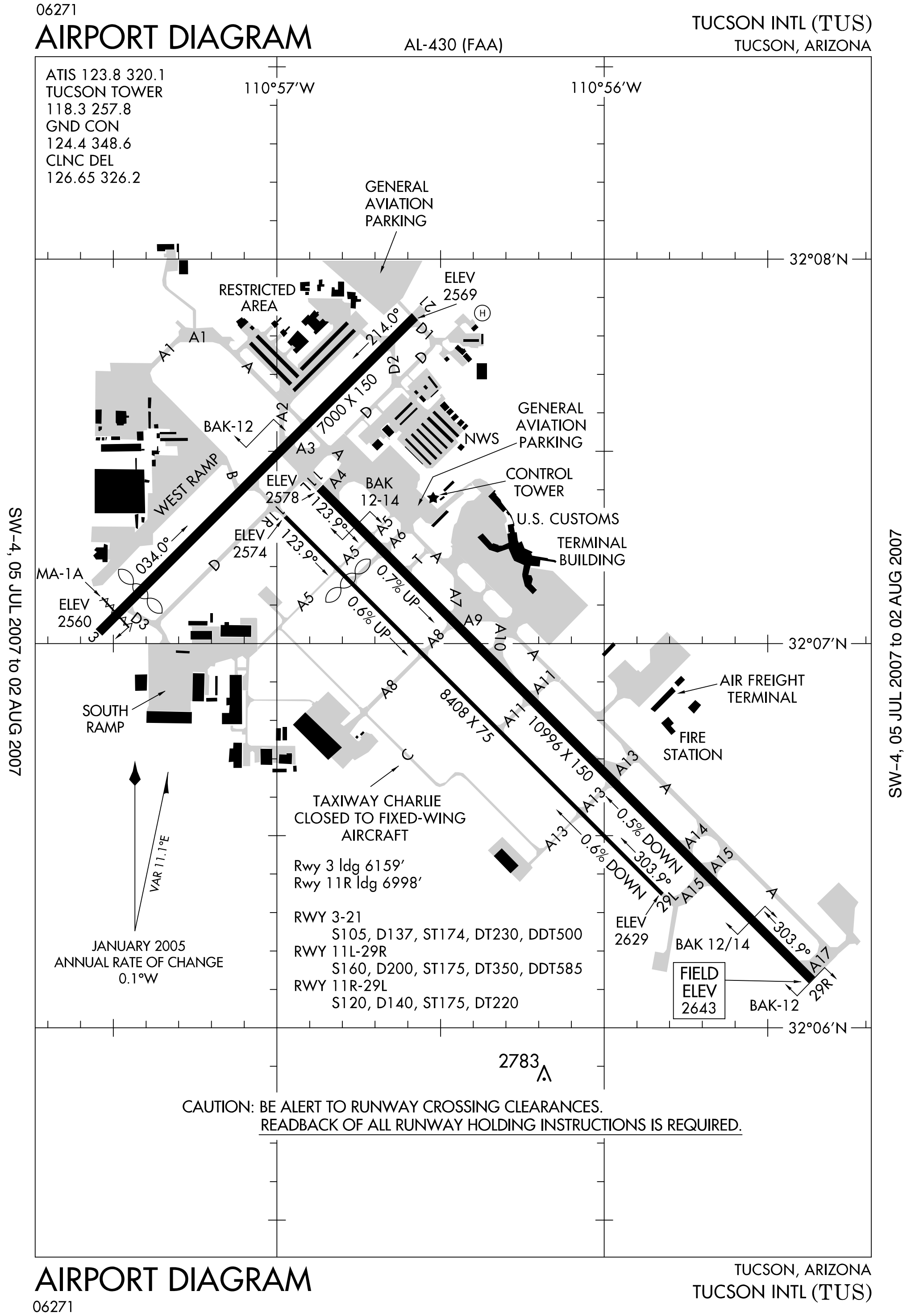
Pago Pago, American Samoa
Pago Pago/International
ICAO Identifier NSTU



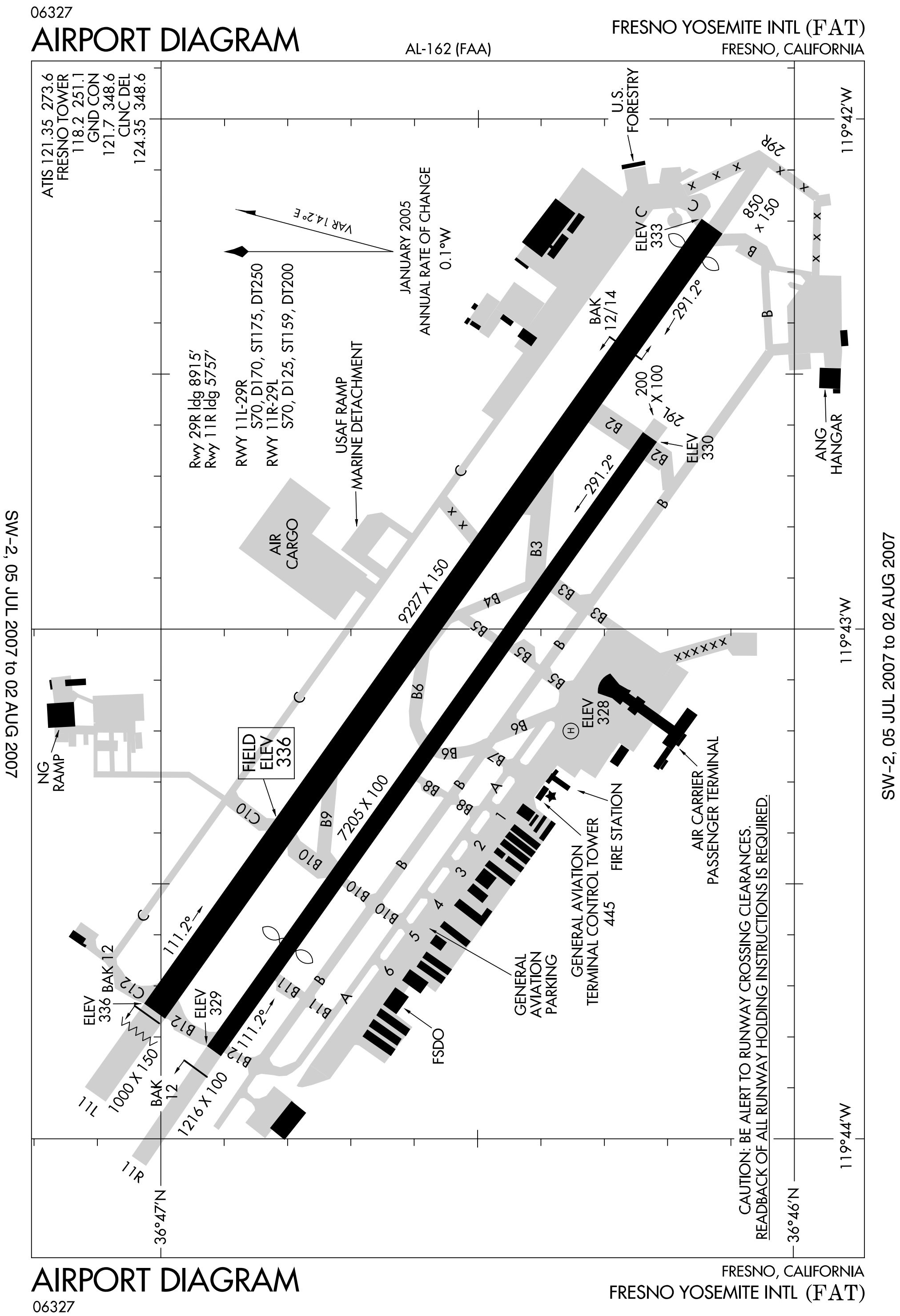
Phoenix, Arizona
Phoenix Sky Harbor International
ICAO Identifier KPHX



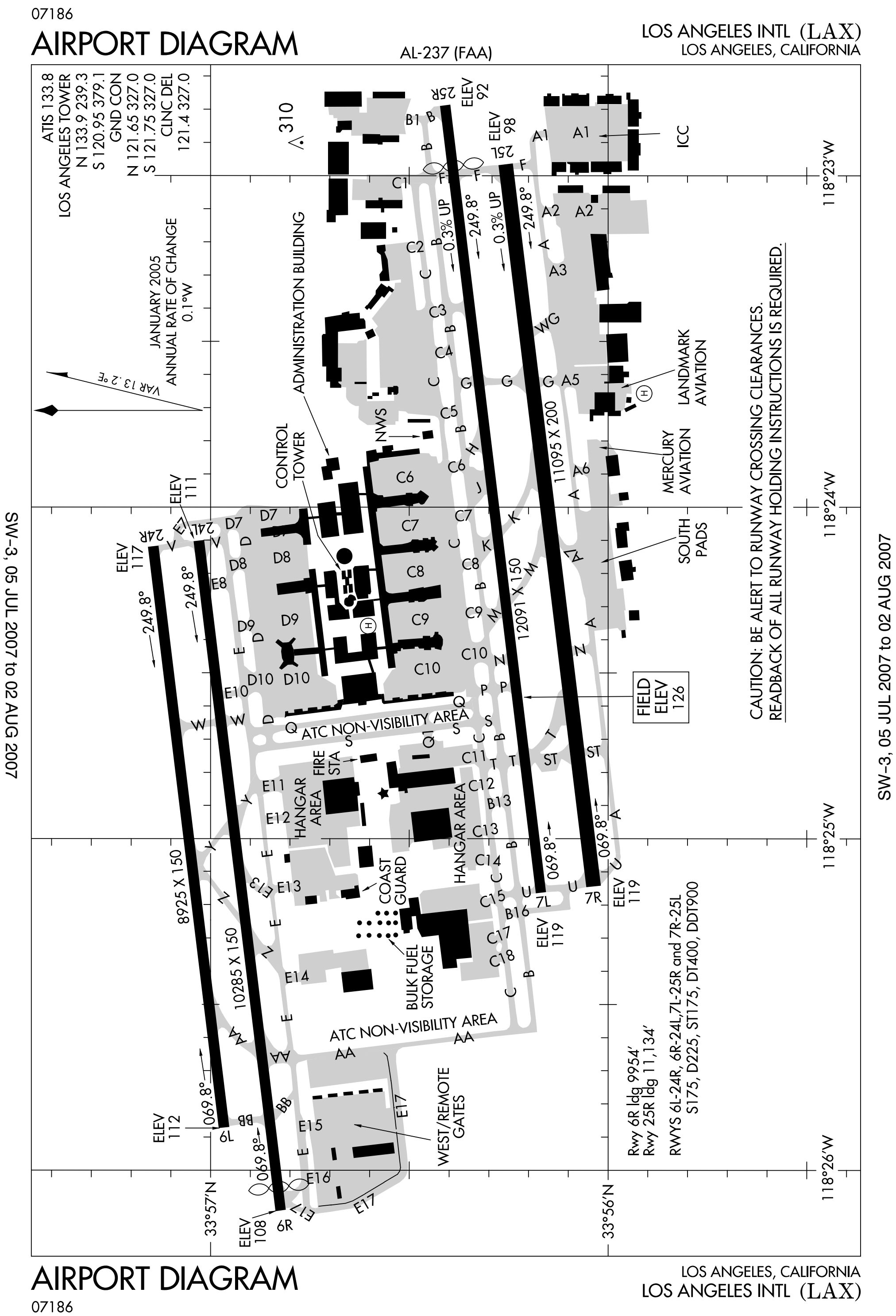
Tucson, Arizona
Tucson International
ICAO Identifier KTUS



Fresno, California
Fresno Yosemite International
ICAO Identifier KFAT



Los Angeles, California
Los Angeles International
ICAO Identifier KLAX



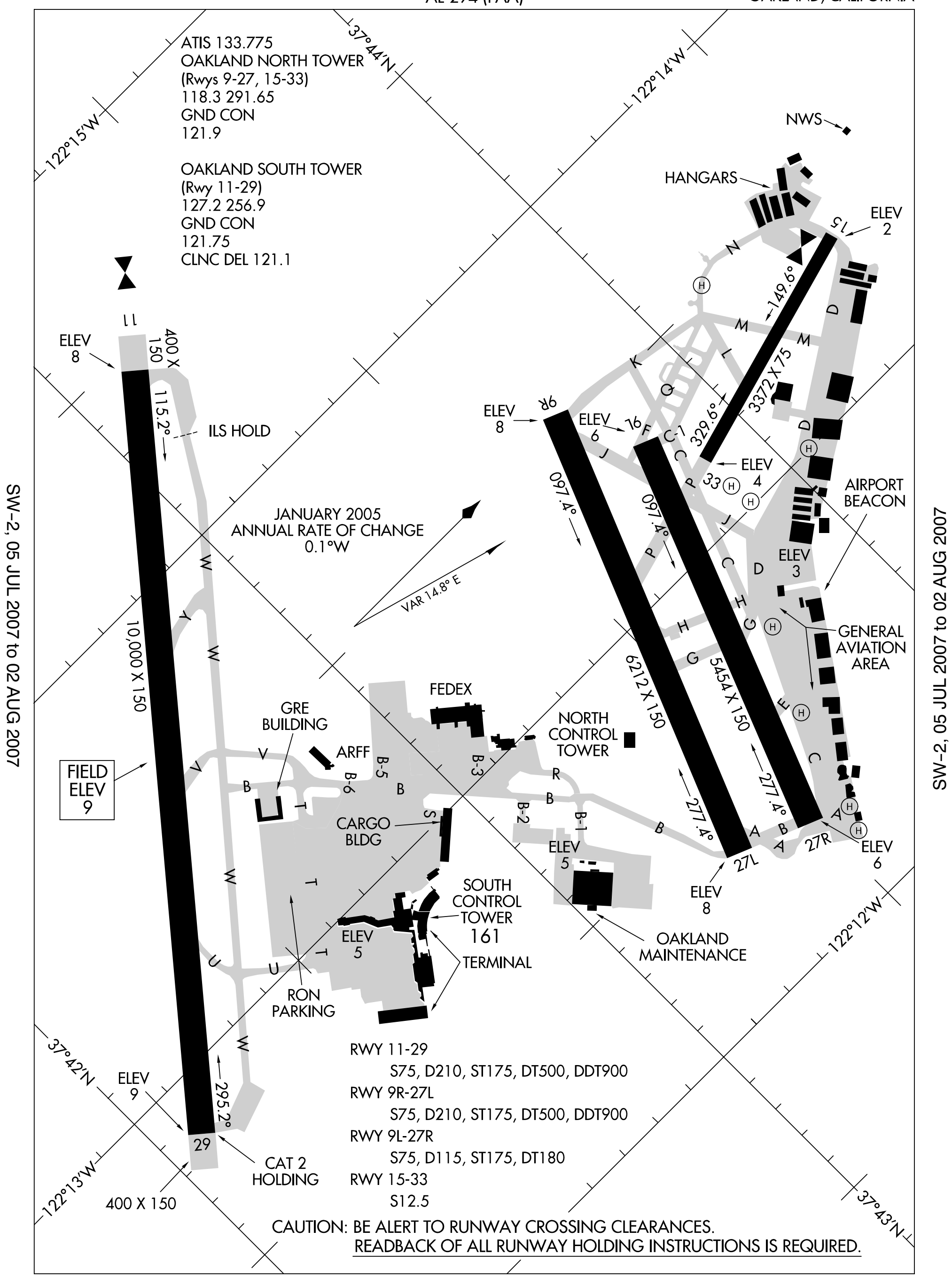
Oakland, California
Metropolitan Oakland International
ICAO Identifier KOAK

07186

AIRPORT DIAGRAM

AL-294 (FAA)

OAKLAND/METROPOLITAN OAKLAND INTL (OAK)
OAKLAND, CALIFORNIA

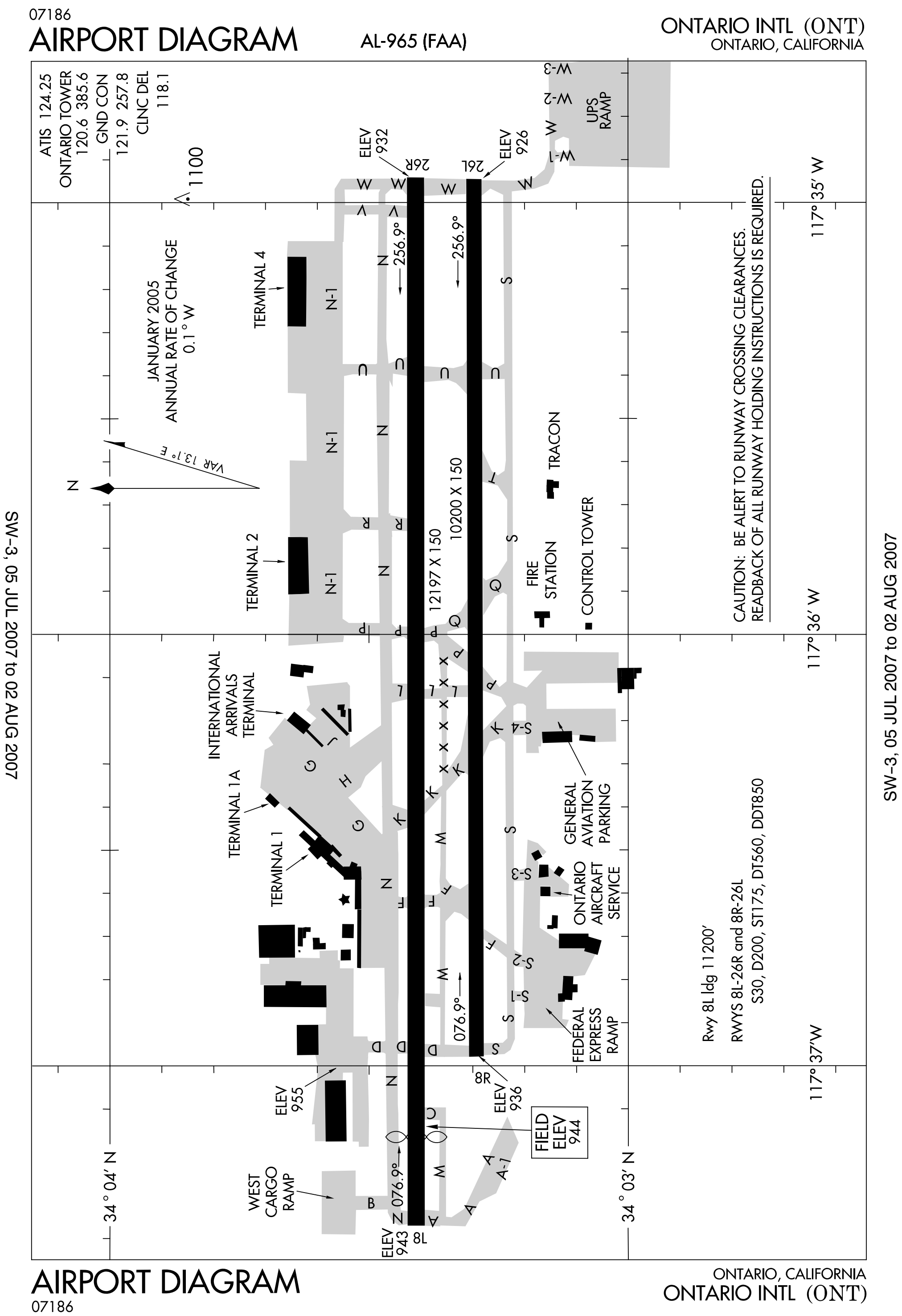


AIRPORT DIAGRAM

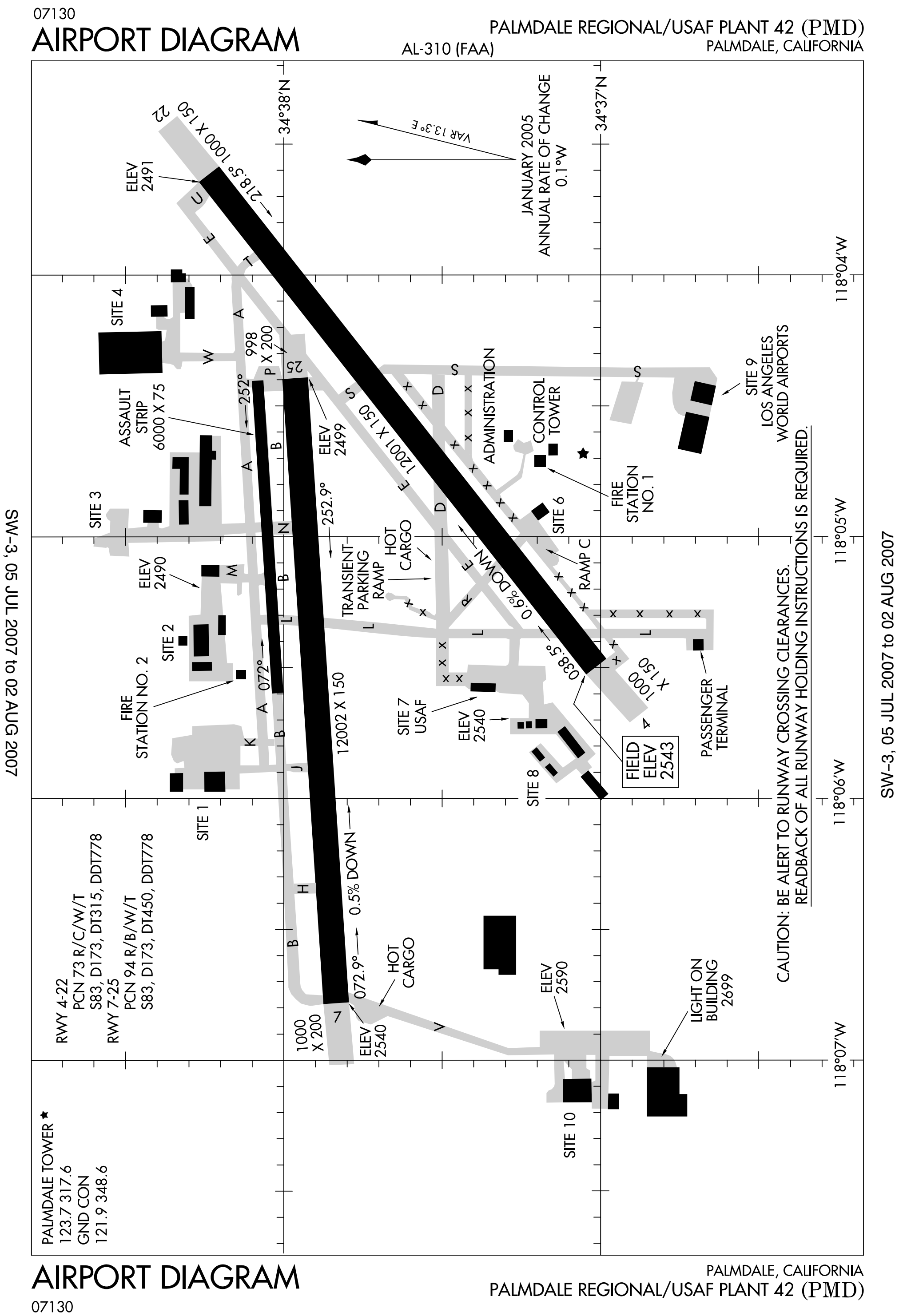
OAKLAND, CALIFORNIA
OAKLAND/METROPOLITAN OAKLAND INTL (OAK)

07186

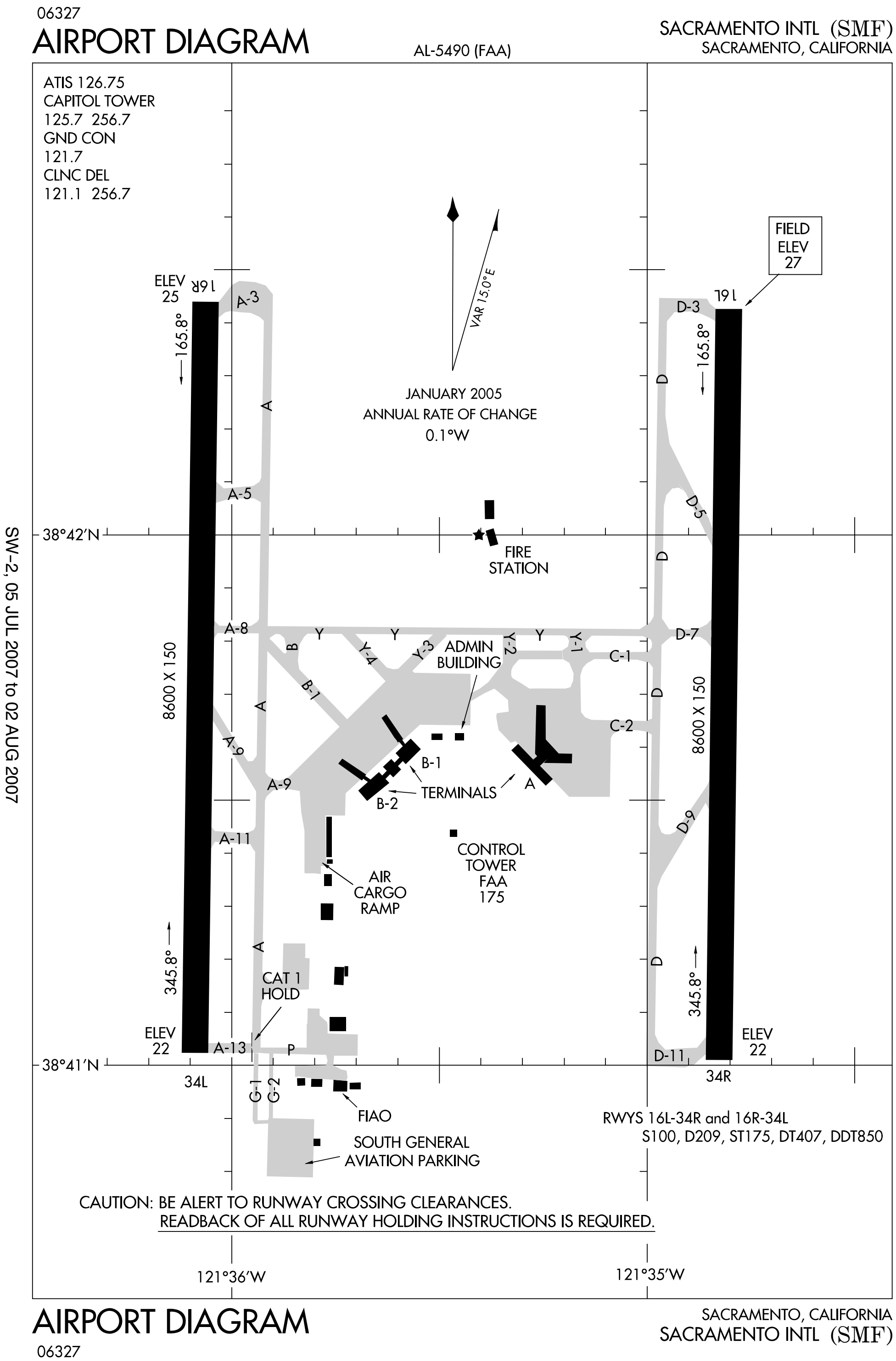
Ontario, California
Ontario International
ICAO Identifier KONT



Palmdale, California
Palmdale Production Flight/Test Installation
AF Plant #42
ICAO Identifier KPMD

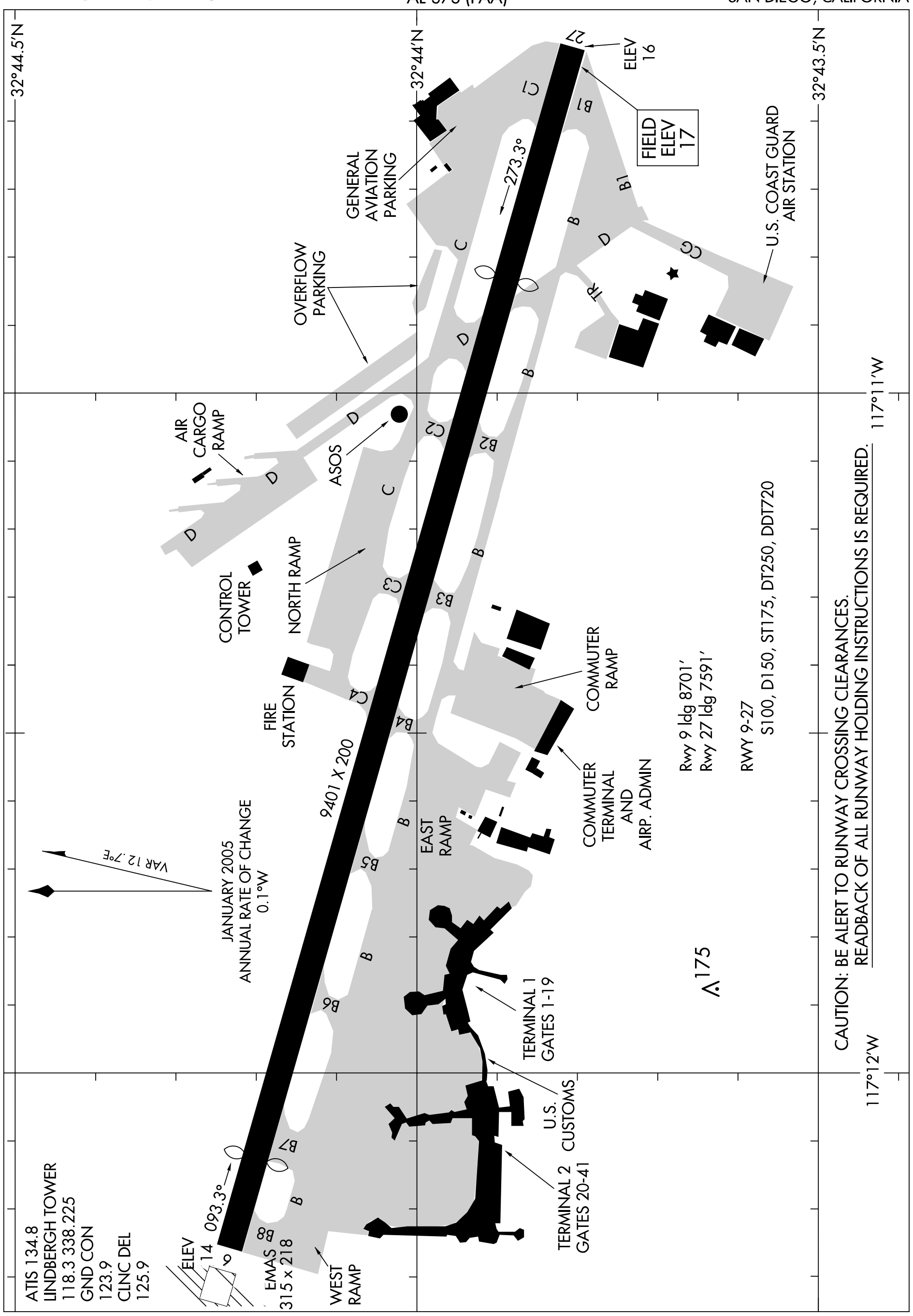


Sacramento, California
Sacramento International
ICAO Identifier KSMF



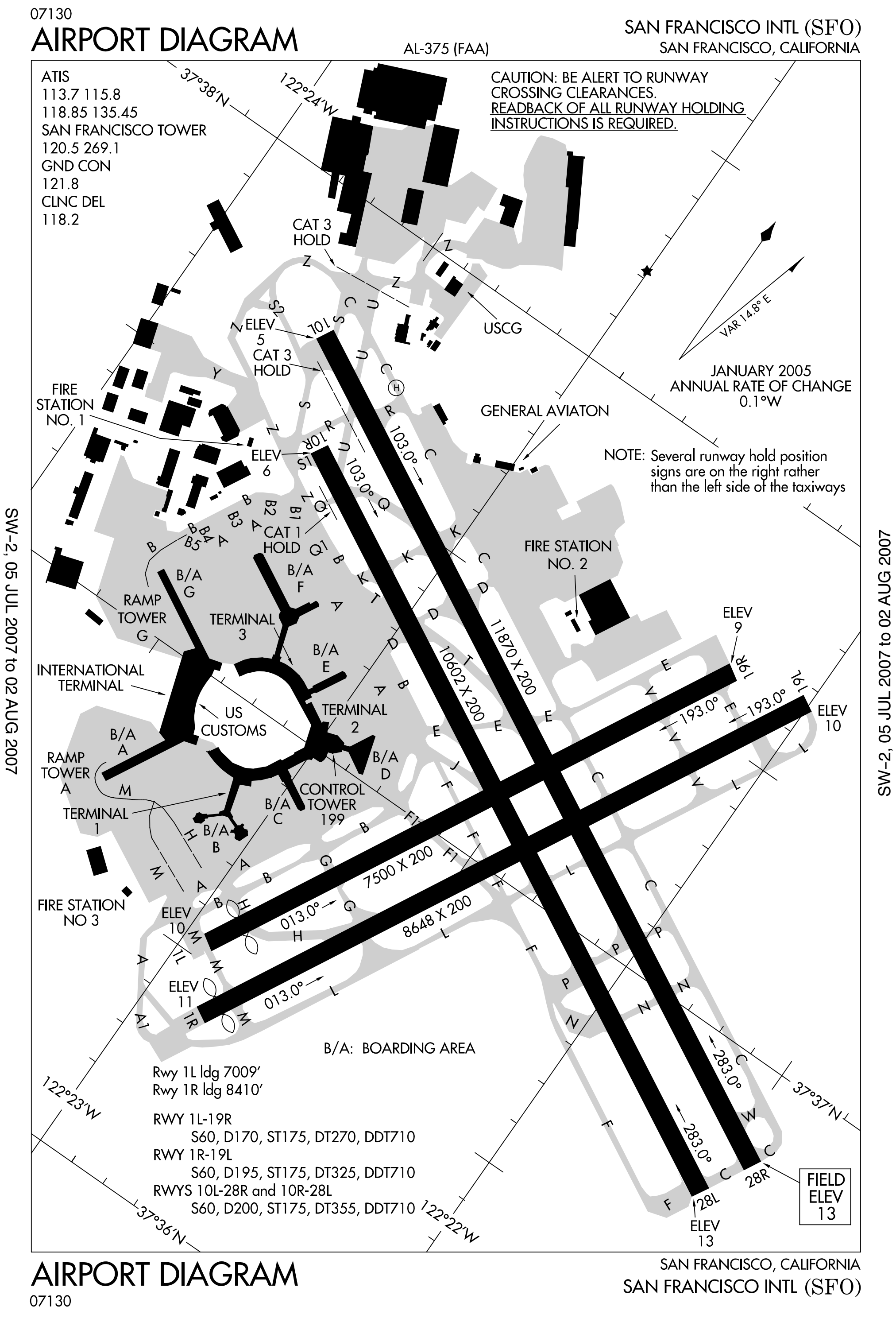
San Diego, California
San Diego International
ICAO Identifier KSAN

07186
AIRPORT DIAGRAM
AL-373 (FAA)
SAN DIEGO INTL (SAN)
SAN DIEGO, CALIFORNIA

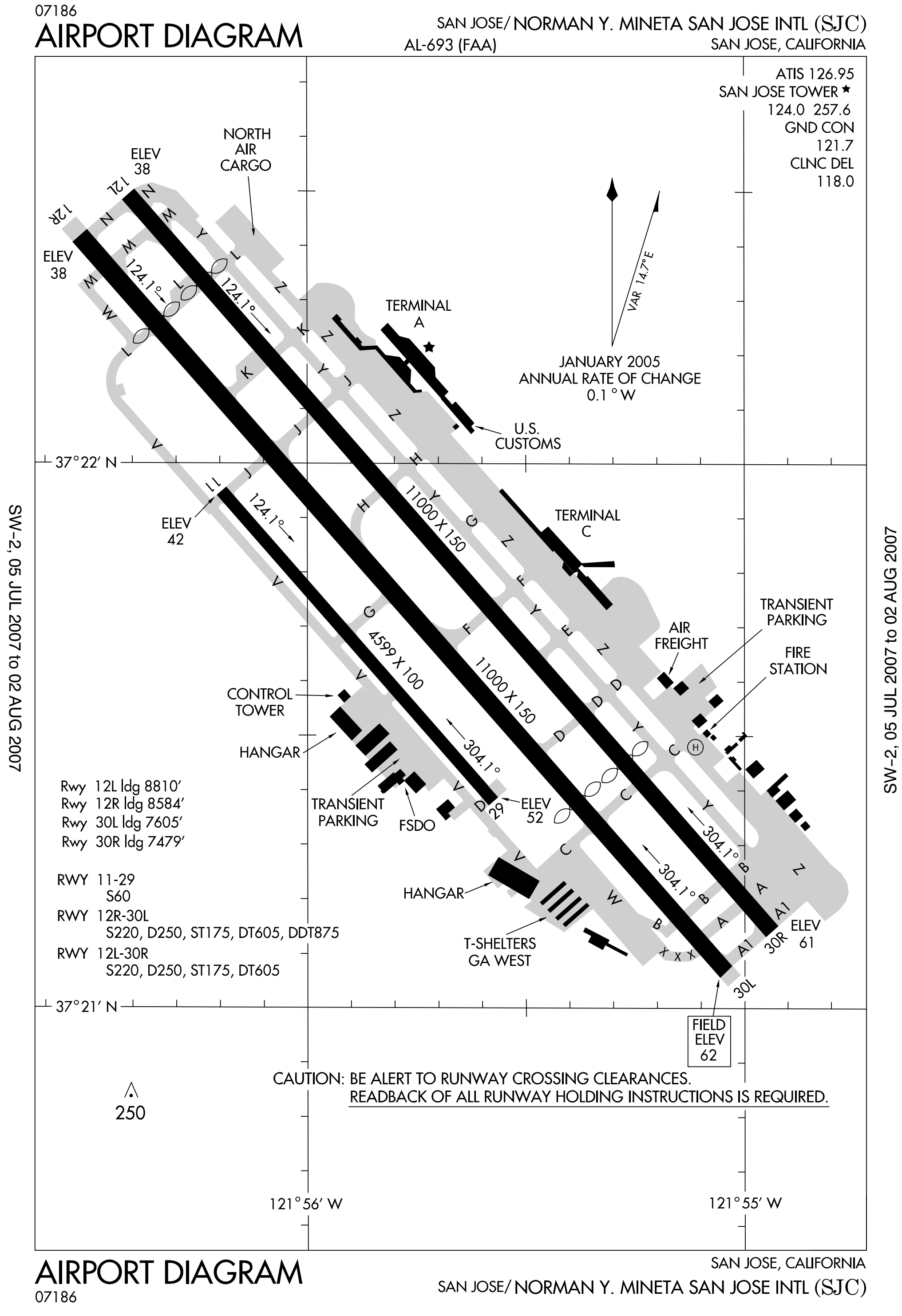


AIRPORT DIAGRAM
07186
SAN DIEGO, CALIFORNIA
SAN DIEGO INTL (SAN)

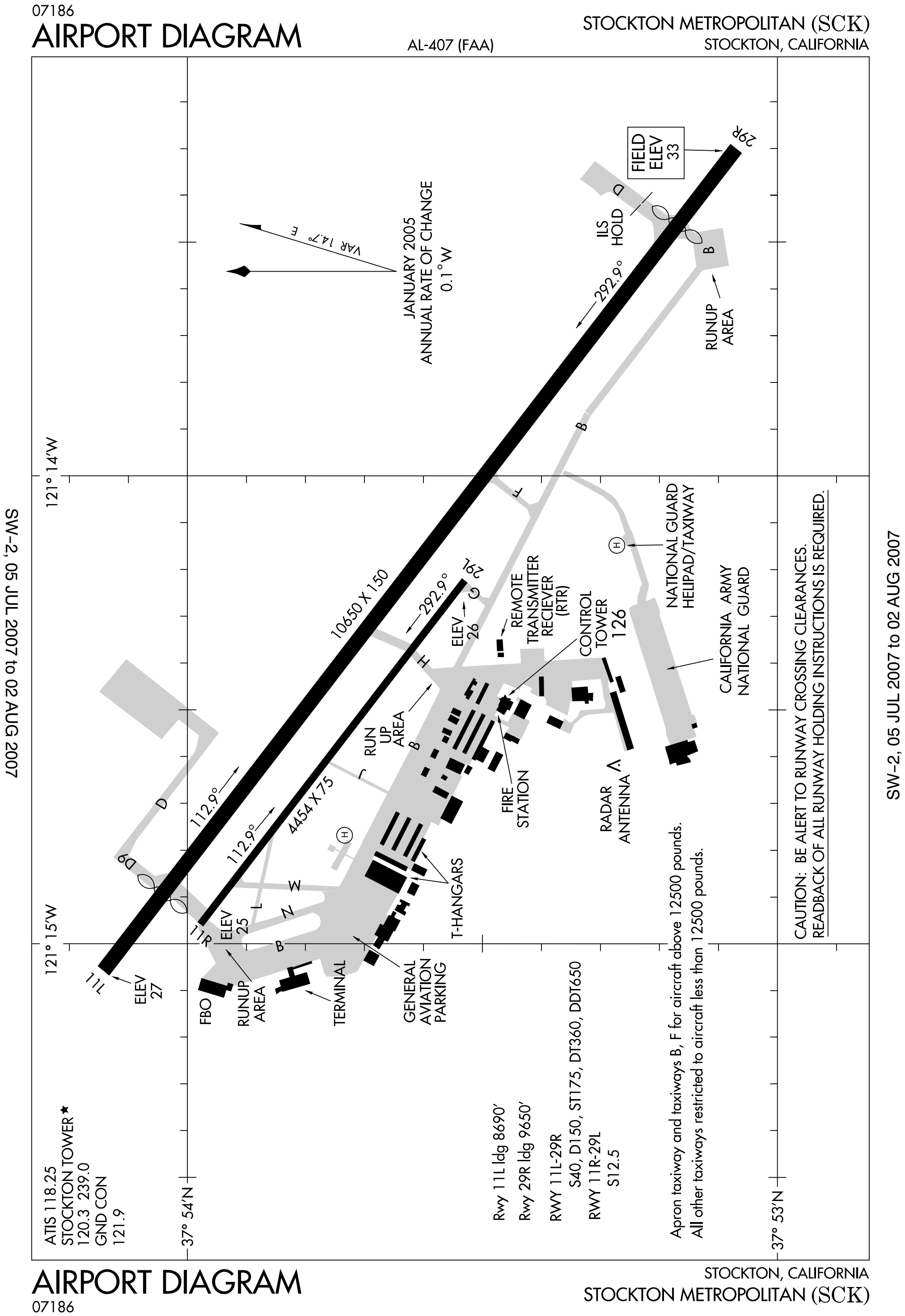
San Francisco, California
San Francisco International
ICAO Identifier KSFO



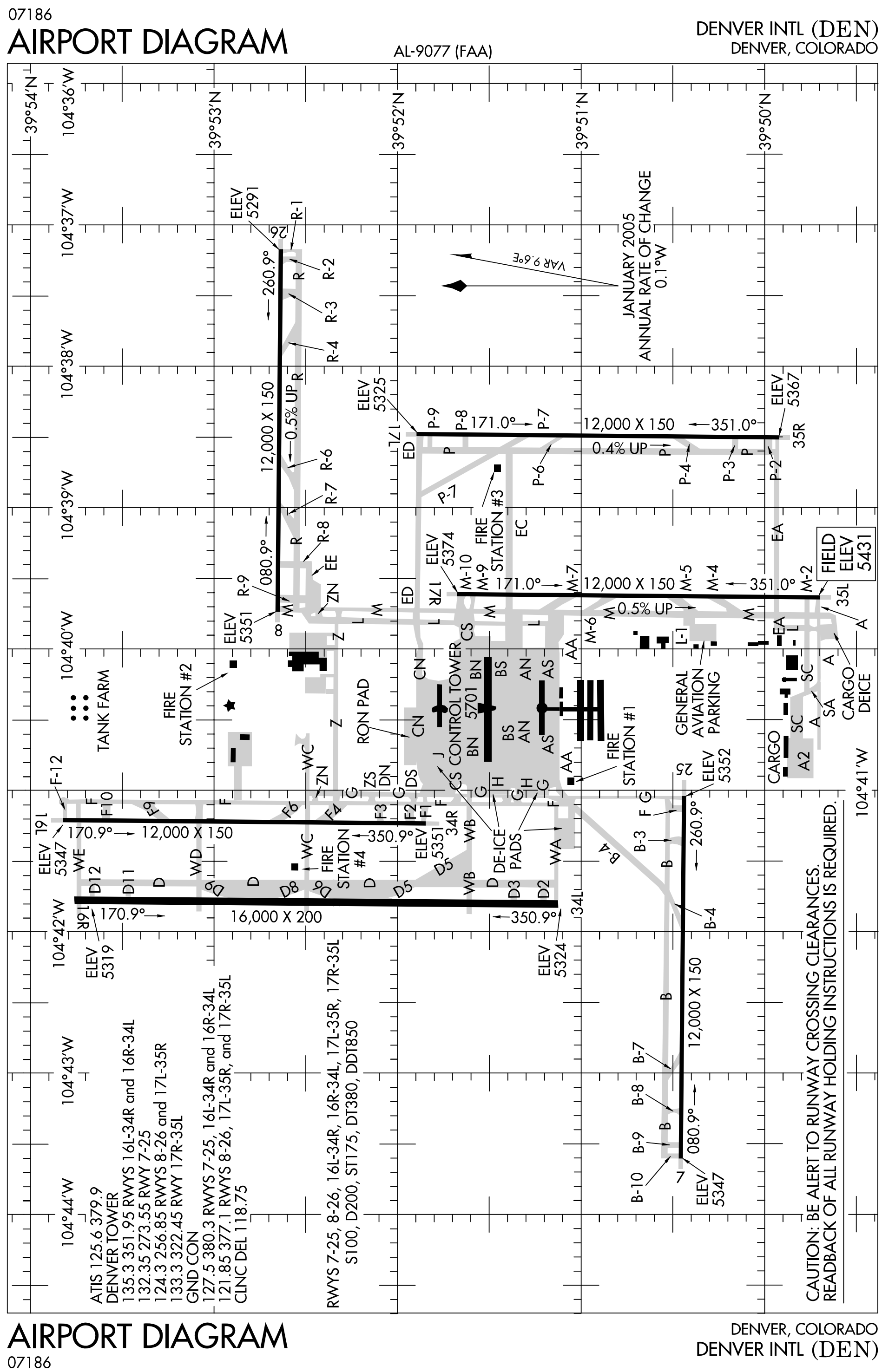
San Jose, California
Norman Y. Mineta San Jose International
ICAO Identifier KSJC



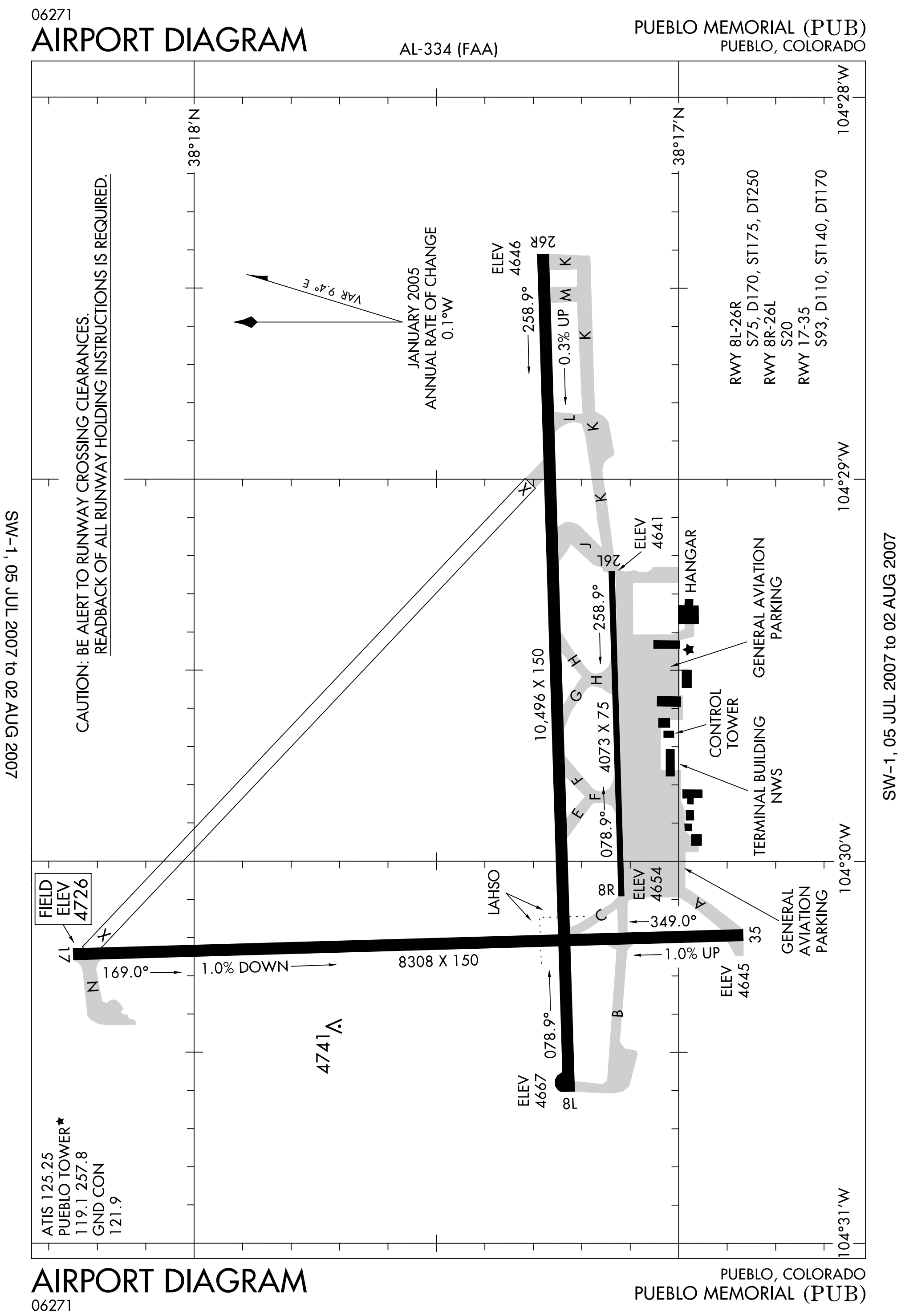
Stockton, California
Stockton Metropolitan
ICAO Identifier KSCK



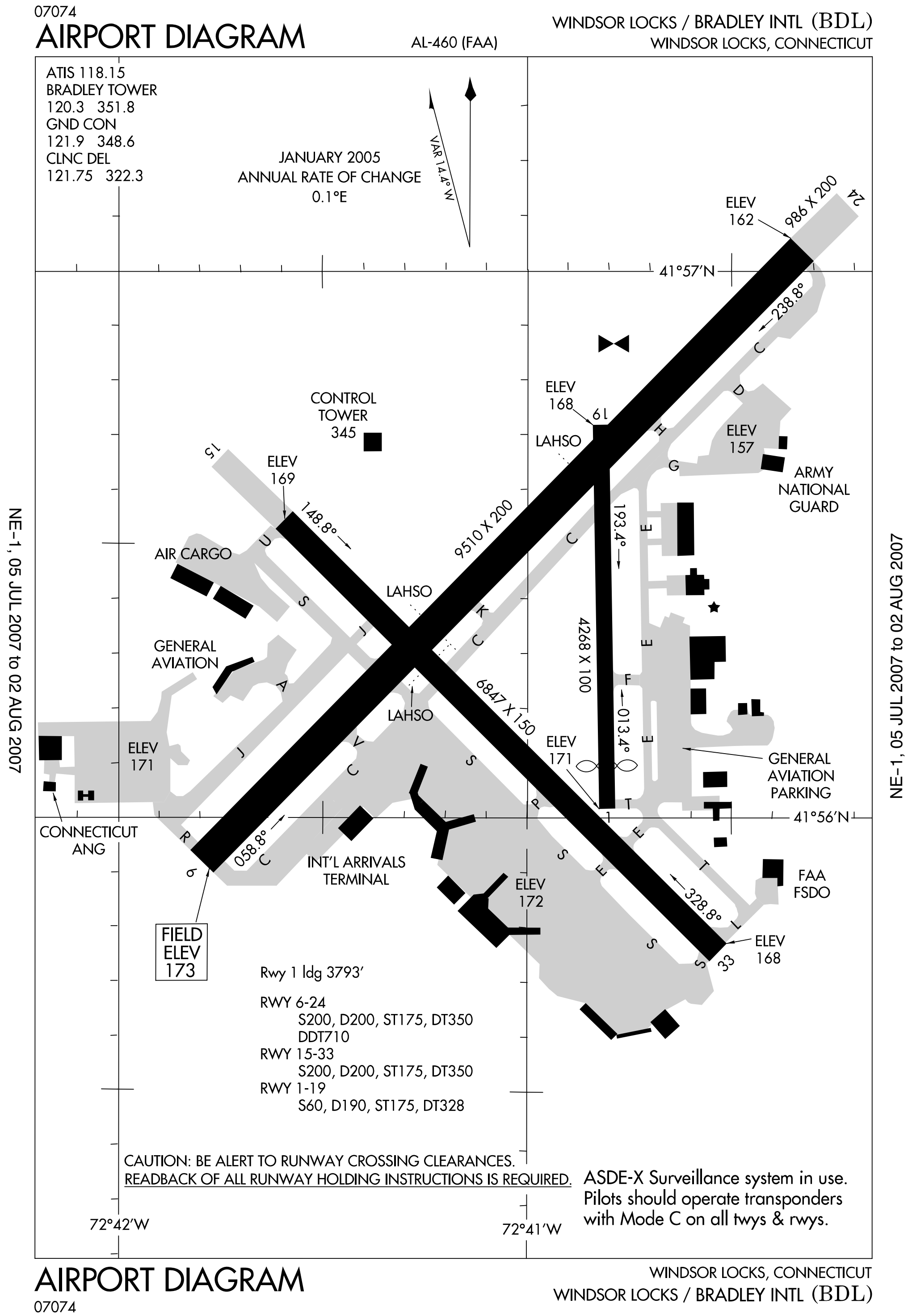
Denver, Colorado
Denver International
ICAO Identifier KDEN



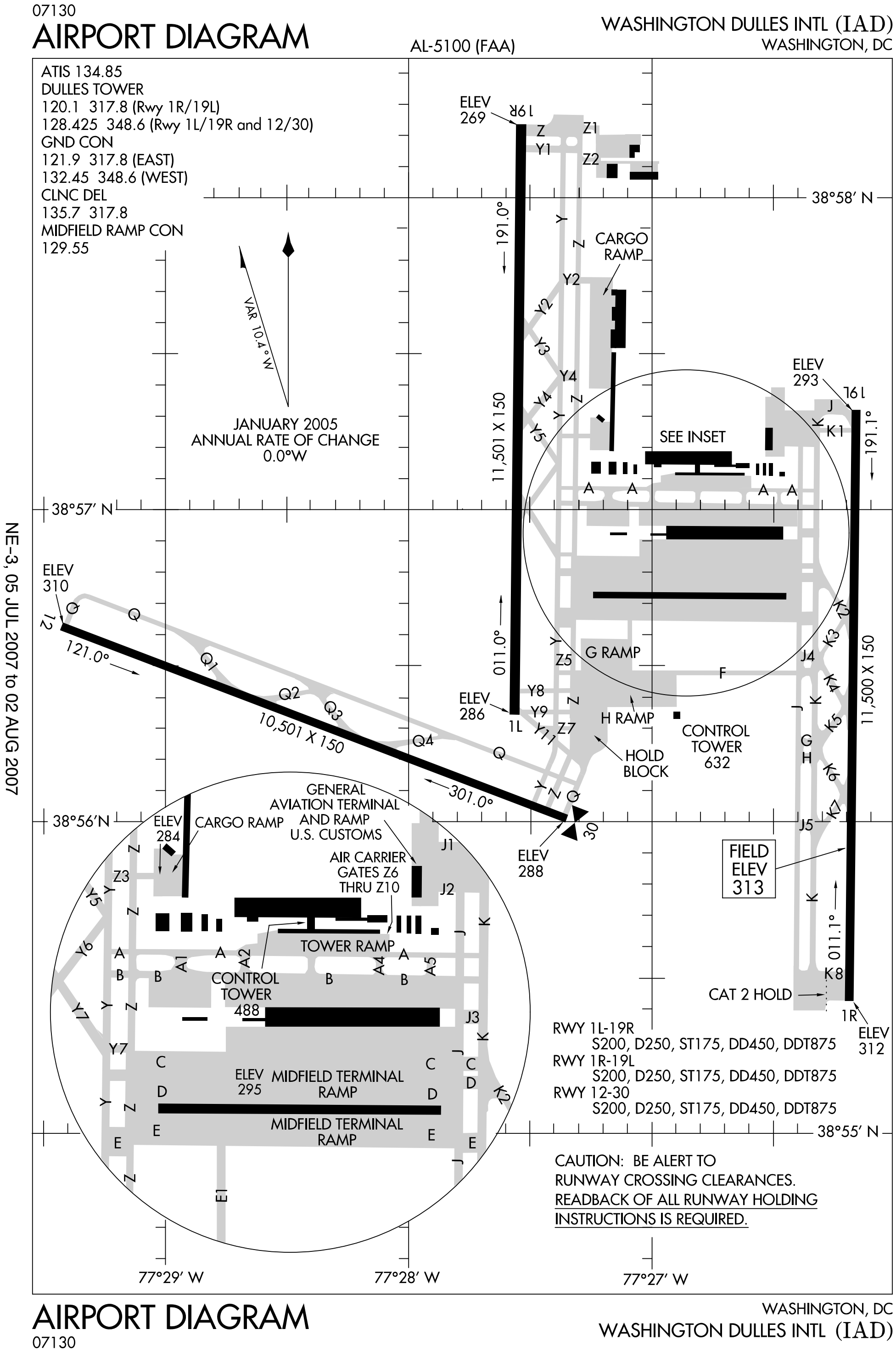
Pueblo, Colorado
Pueblo Memorial
ICAO Identifier KPUB



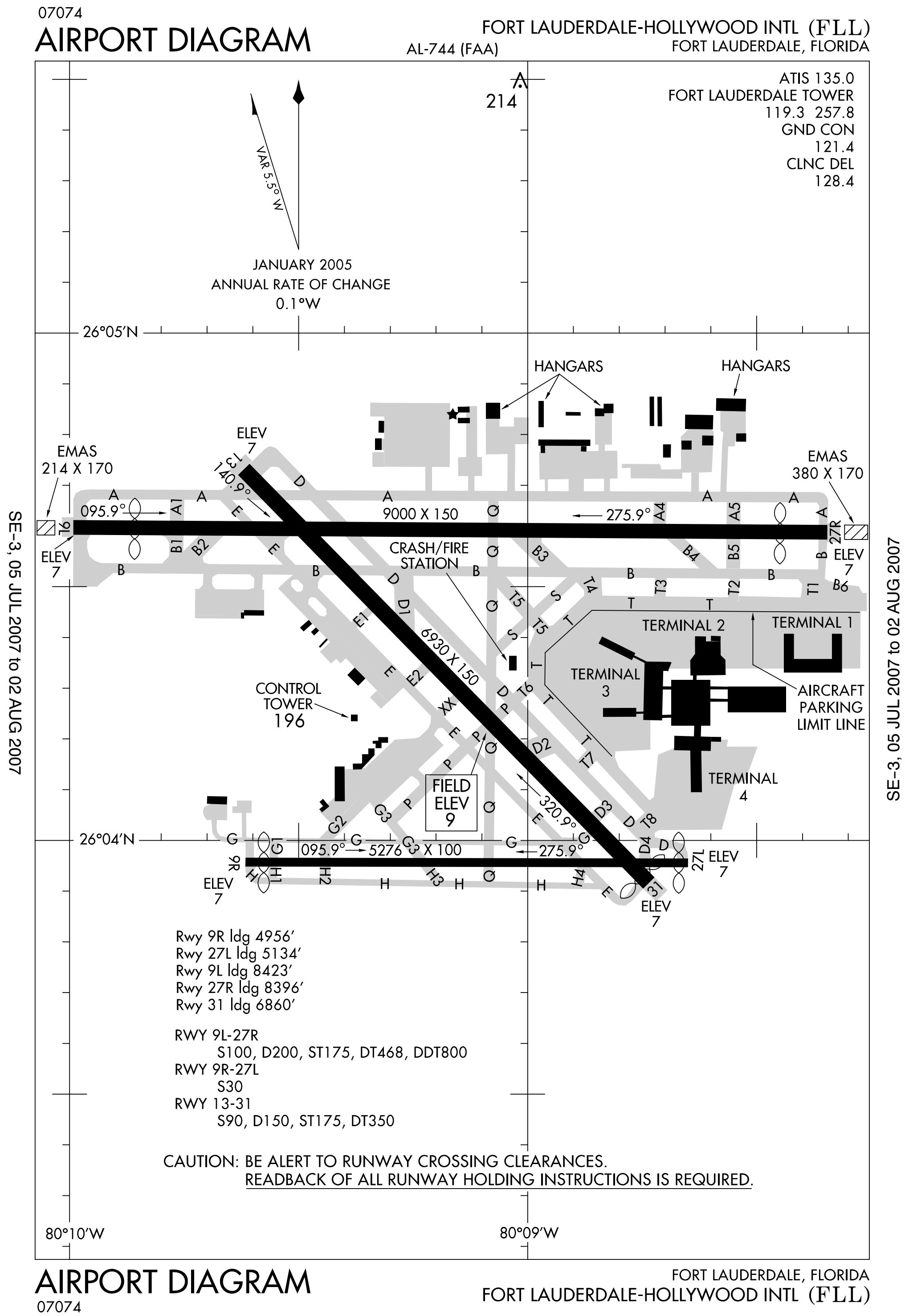
Windsor Locks, Connecticut
Bradley International
ICAO Identifier KBDL



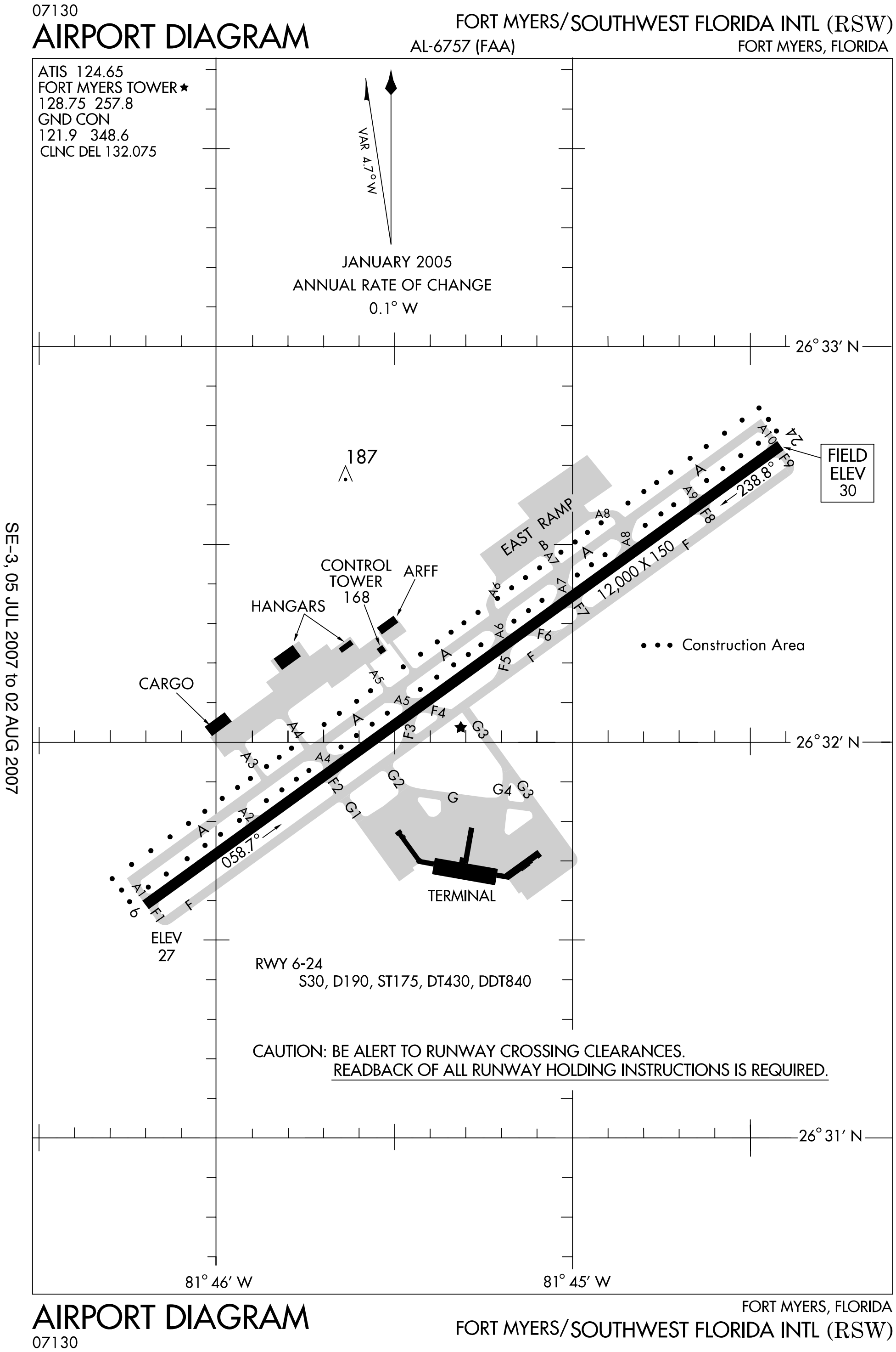
Washington, District of Columbia
Washington Dulles International
ICAO Identifier KIAD



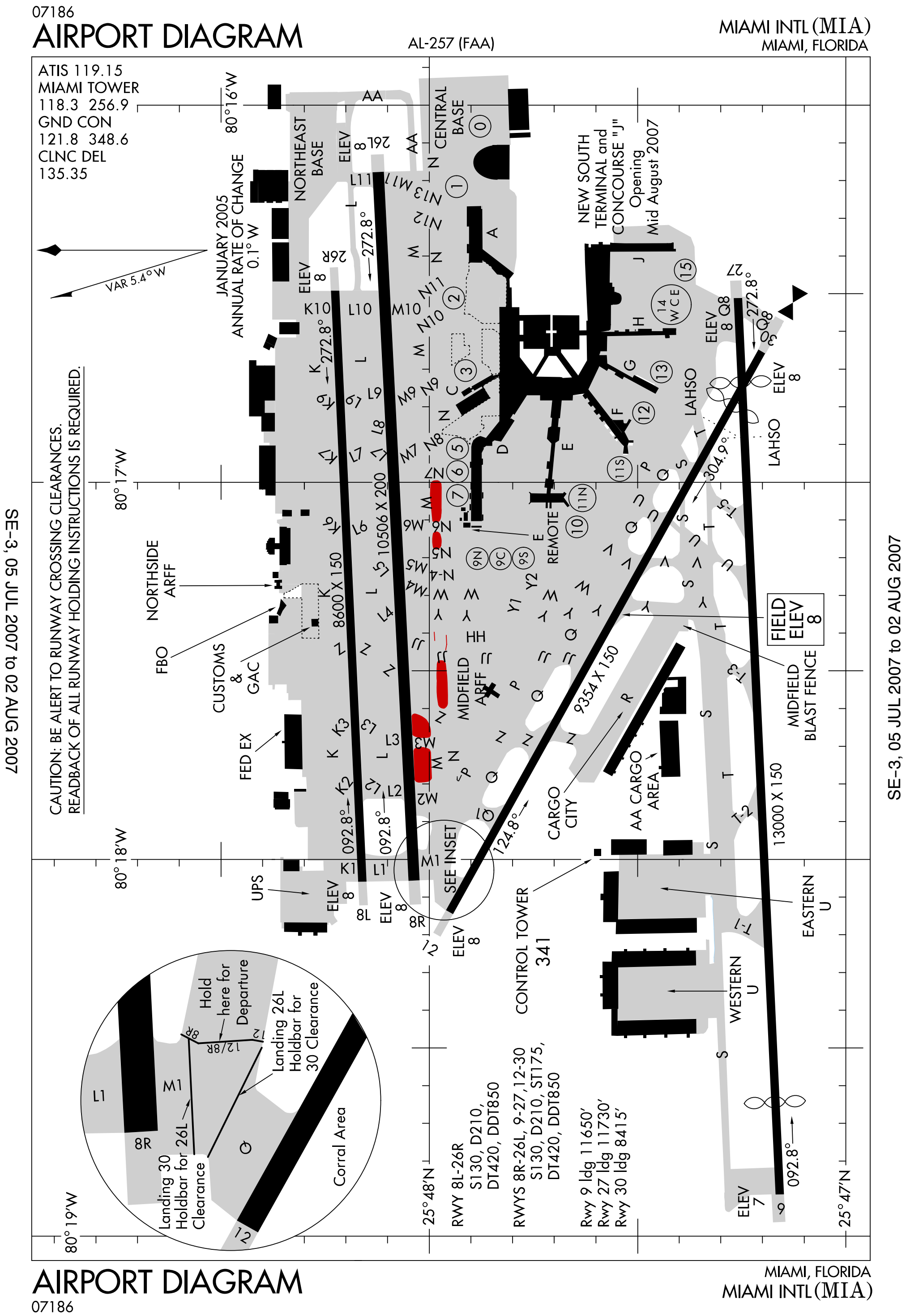
Fort Lauderdale, Florida
Fort Lauderdale/Hollywood International
ICAO Identifier KFLL



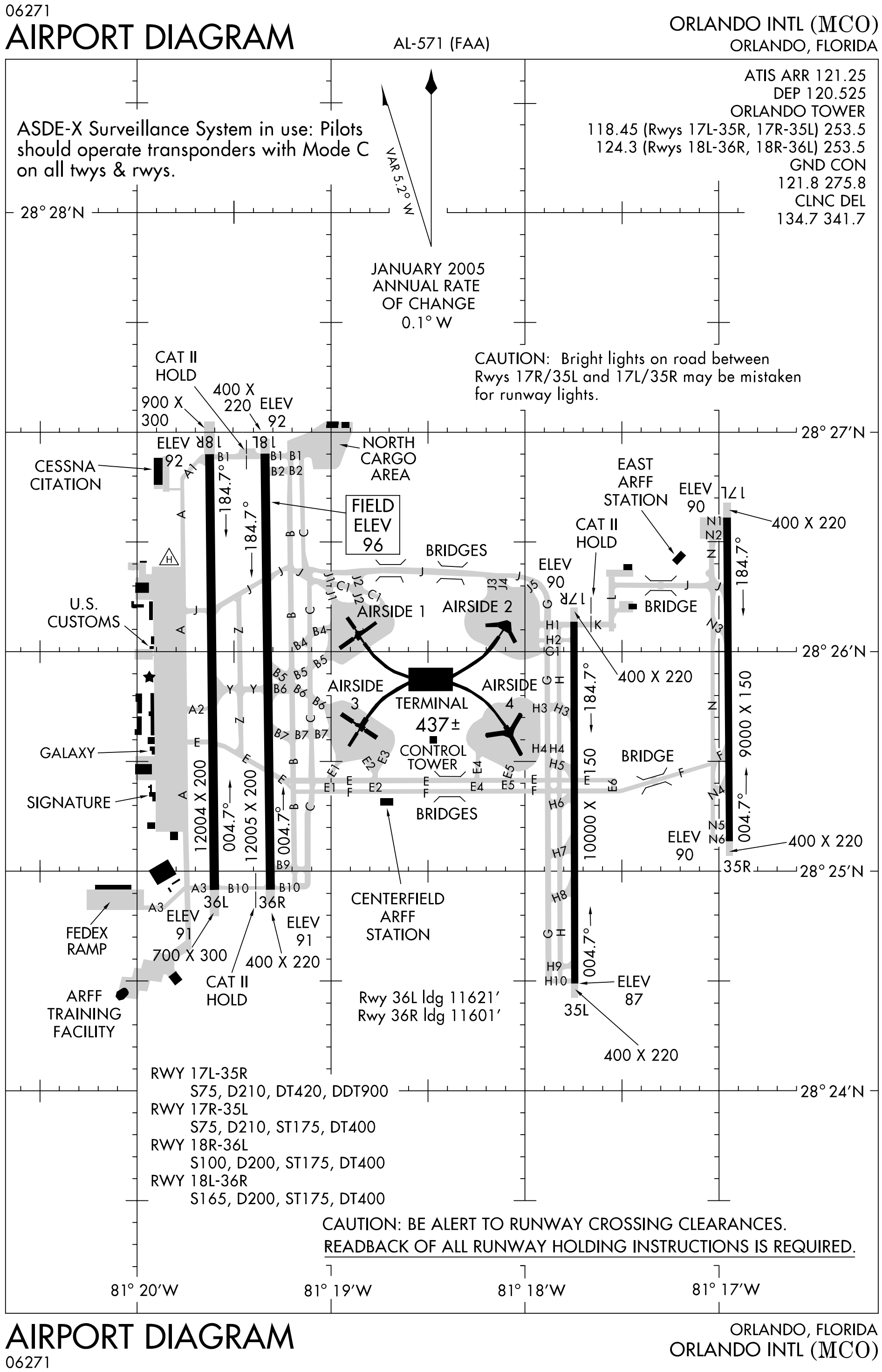
Fort Myers, Florida
Southwest Florida International
ICAO Identifier KRSW



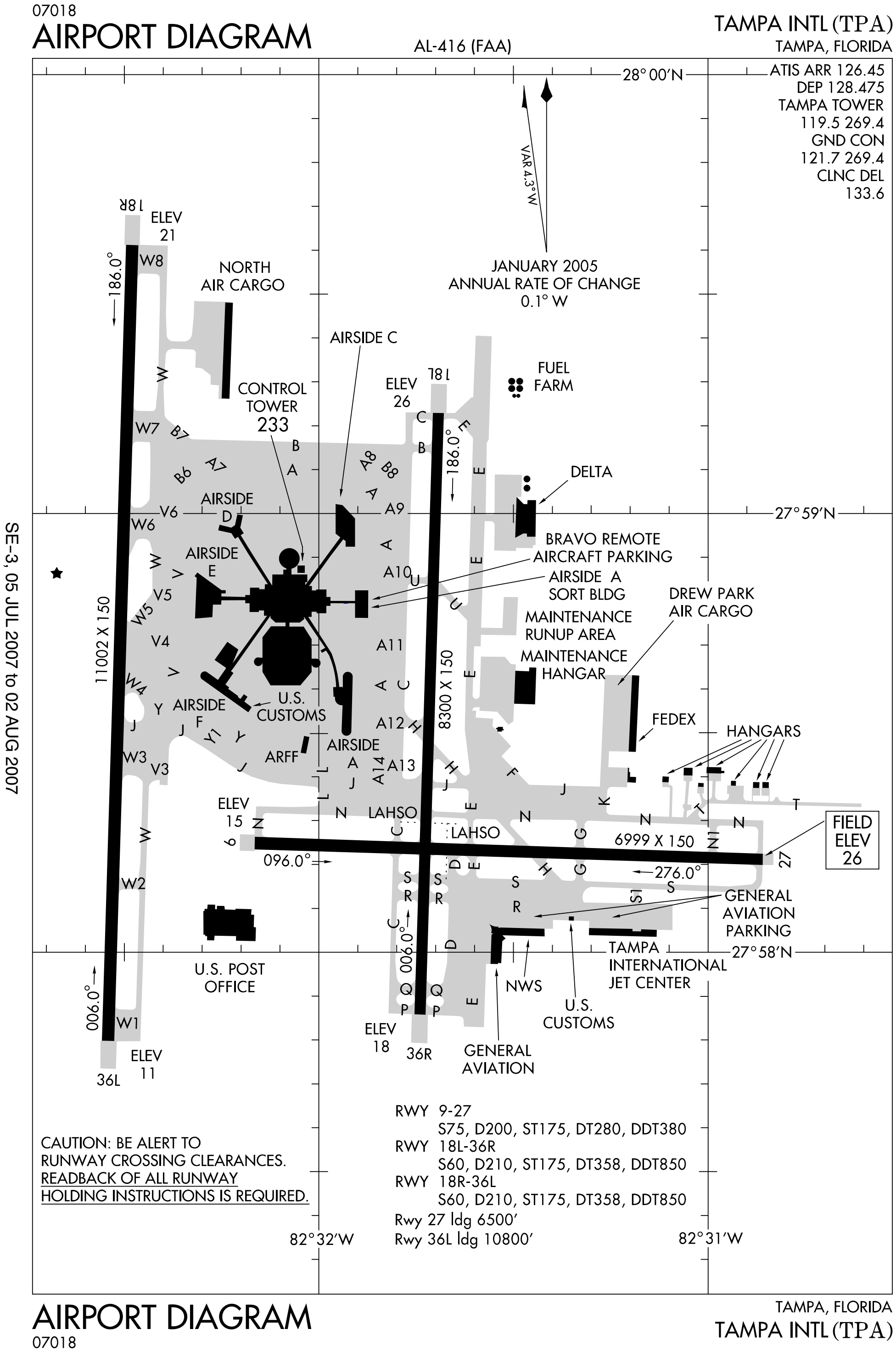
Miami, Florida
Miami International
ICAO Identifier KMIA



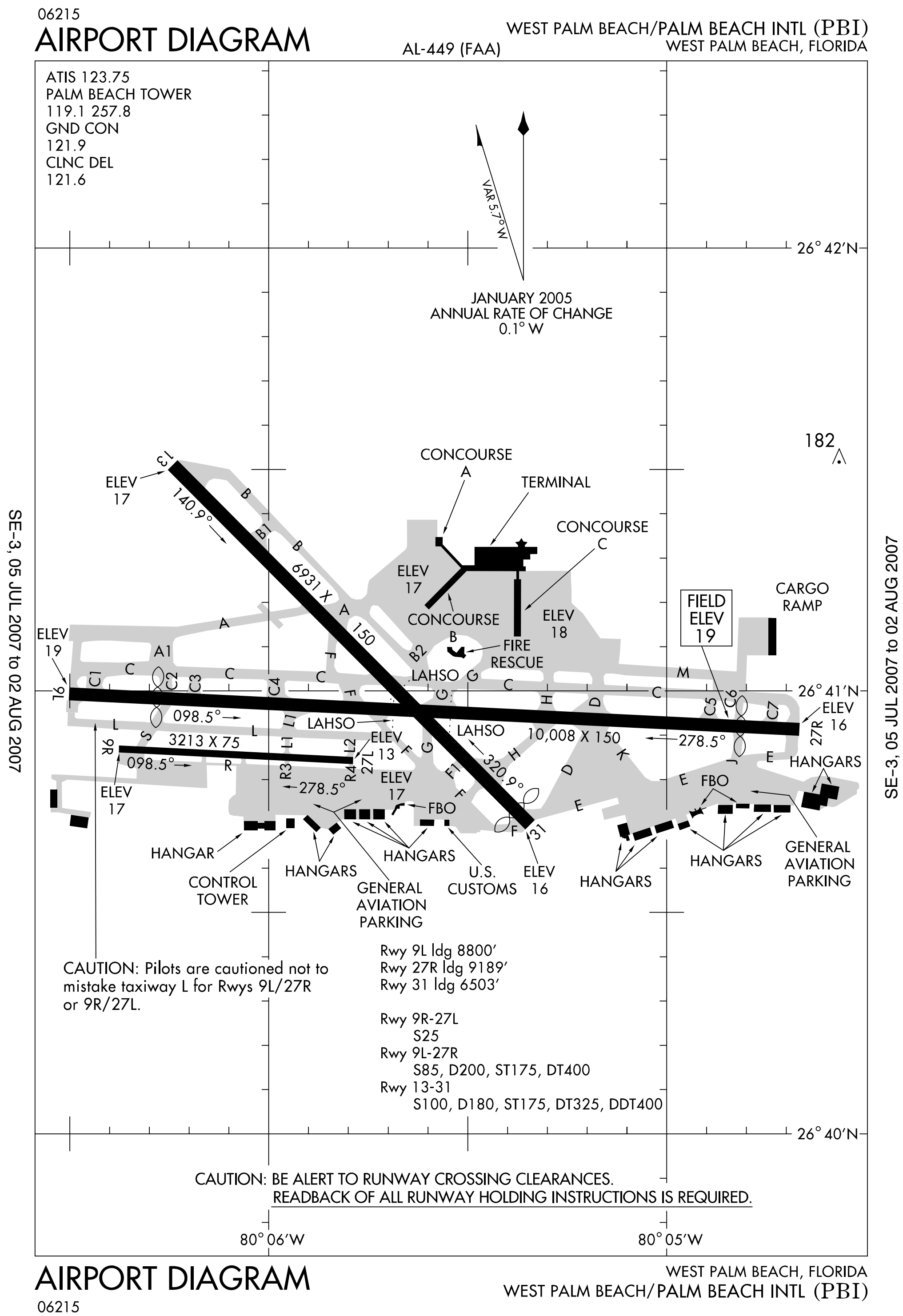
Orlando, Florida
Orlando International
ICAO Identifier KMCO



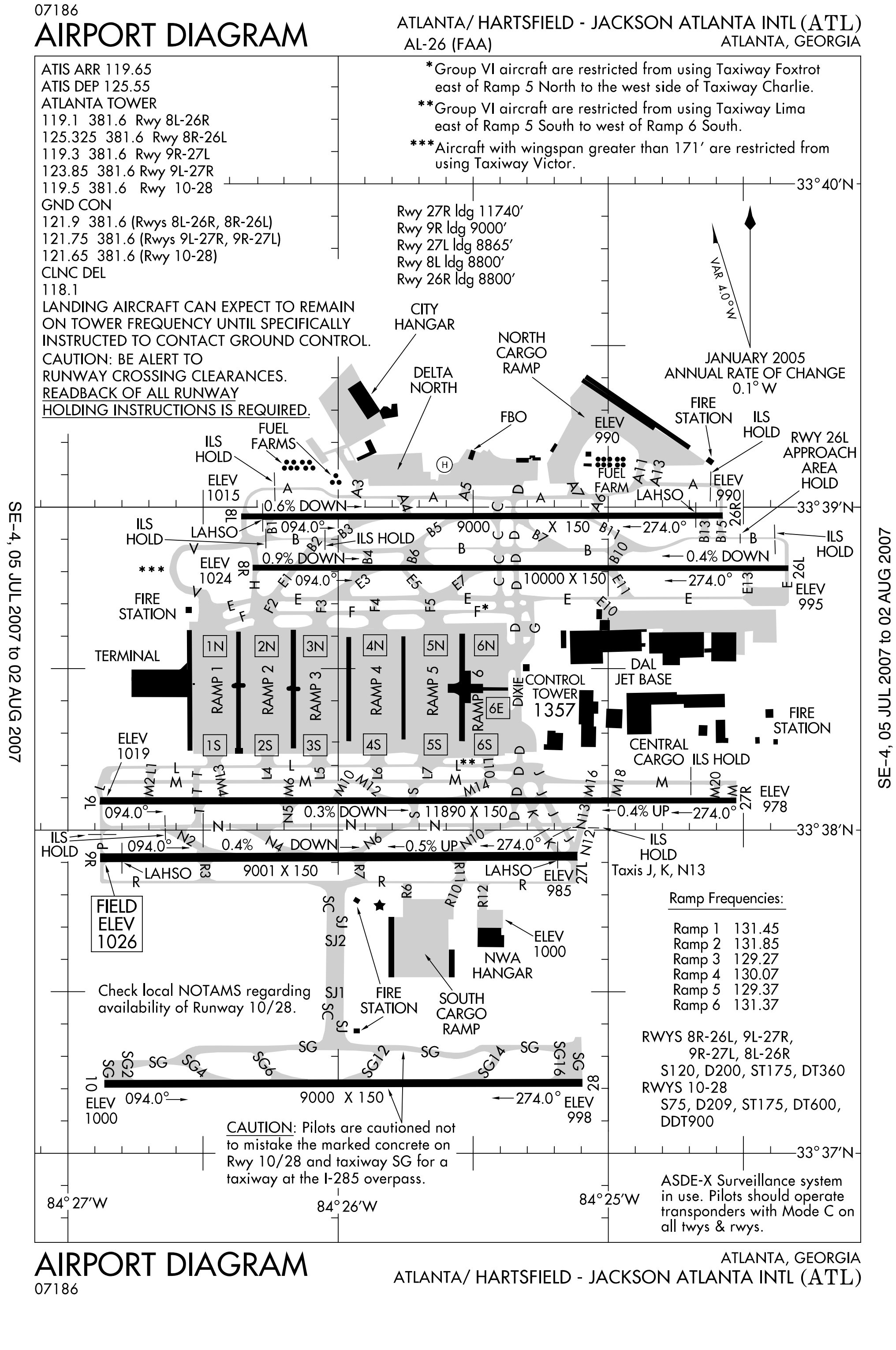
Tampa, Florida
Tampa International
ICAO Identifier KTPA



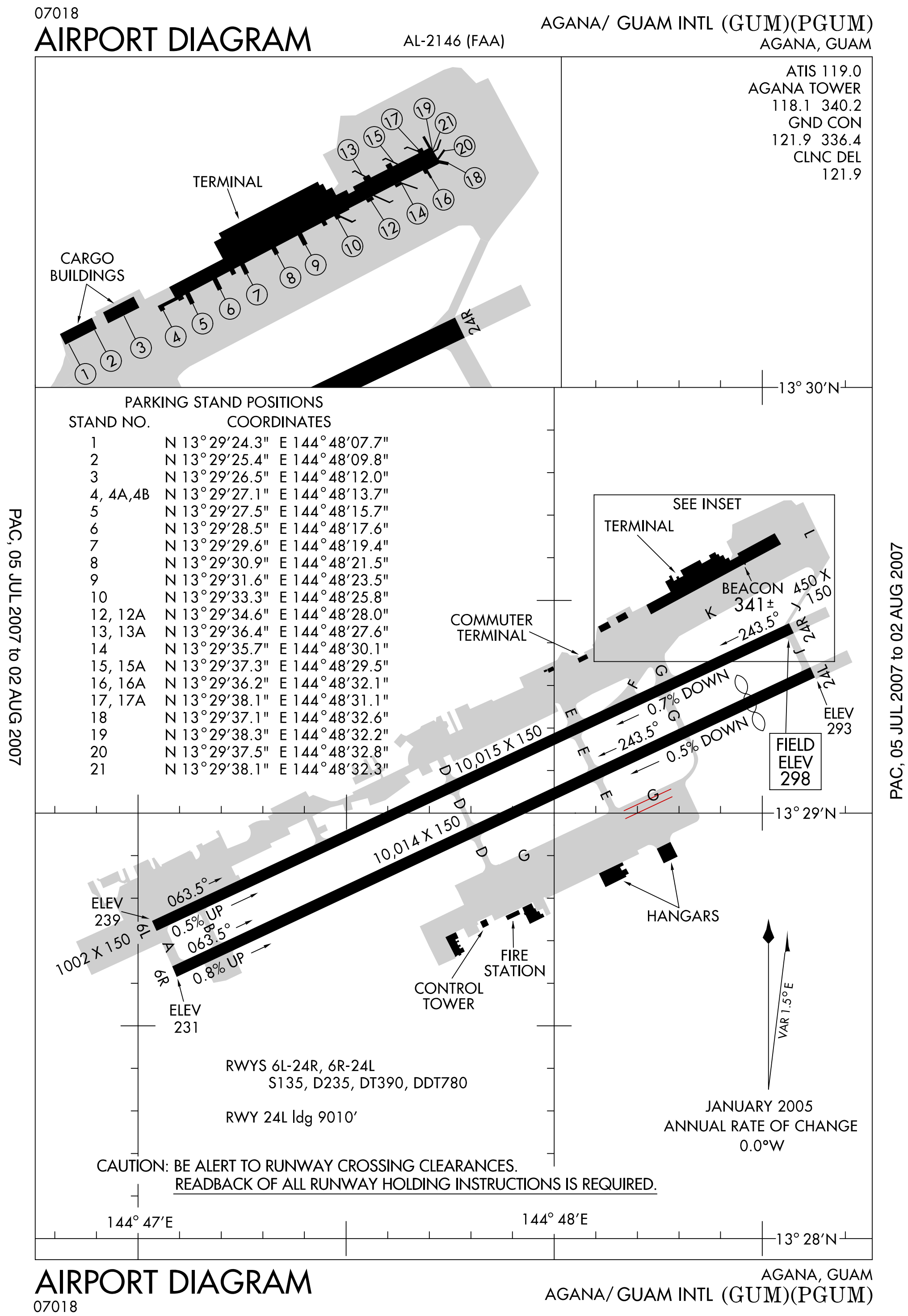
West Palm Beach, Florida
Palm Beach International
ICAO Identifier KPBI



Atlanta, Georgia
Hartsfield-Jackson Atlanta International
ICAO Identifier KATL



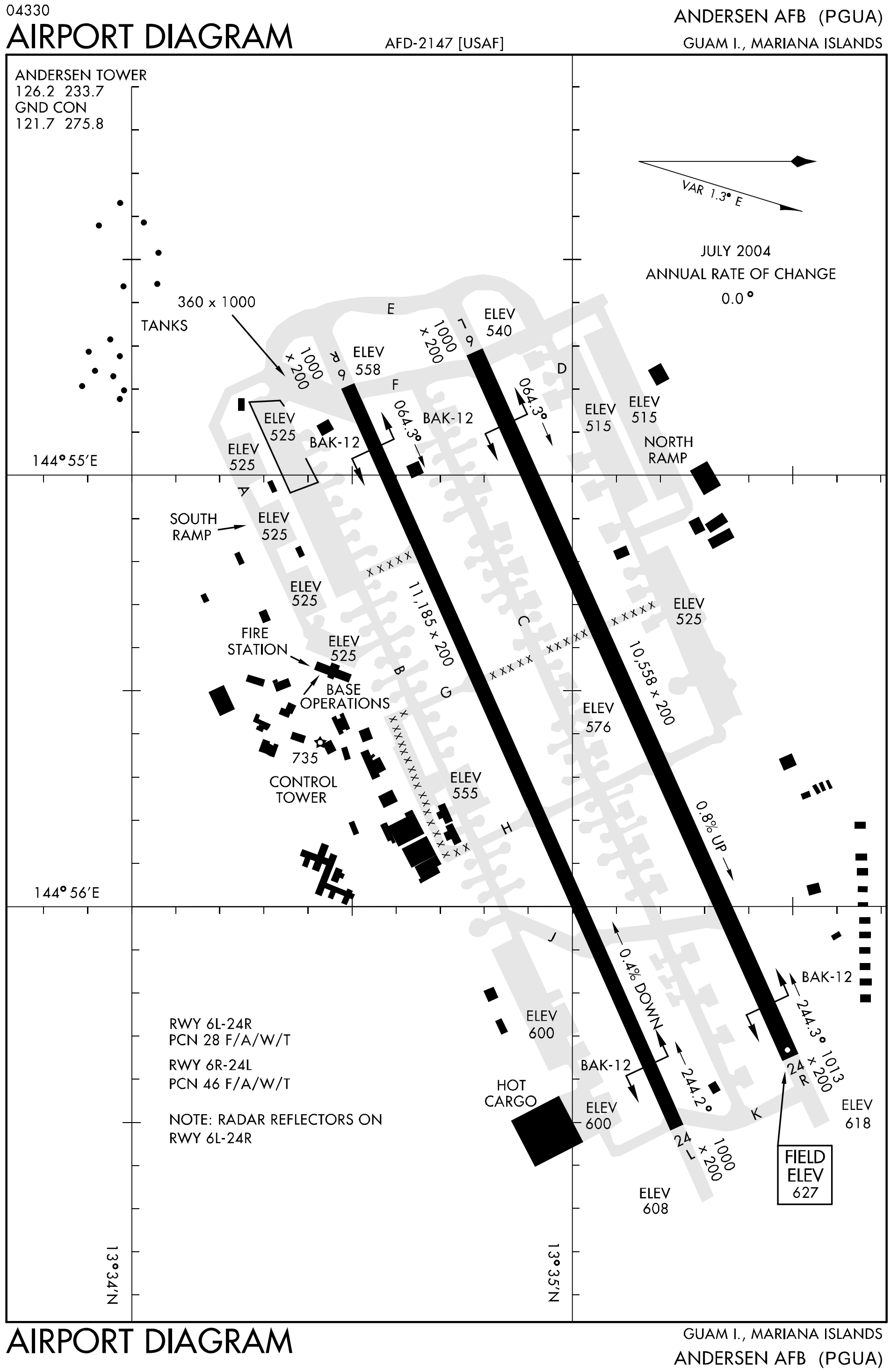
Agana, Guam
Guam International
ICAO Identifier PGUM



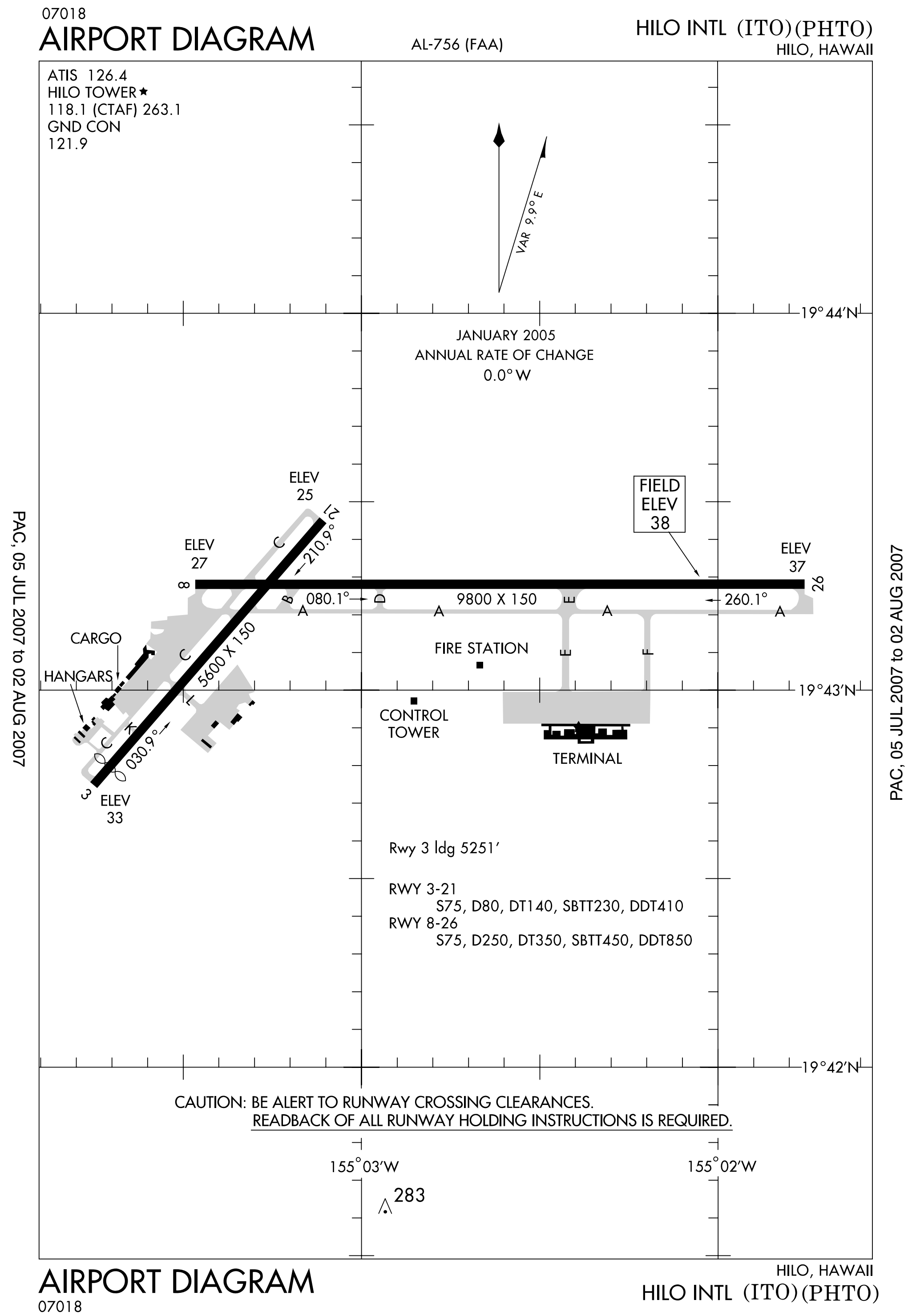
PARKING STAND POSITIONS

STAND NO.	COORDINATES
1	N 13°29'24.3" E 144°48'07.7"
2	N 13°29'25.4" E 144°48'09.8"
3	N 13°29'26.5" E 144°48'12.0"
4, 4A,4B	N 13°29'27.1" E 144°48'13.7"
5	N 13°29'27.5" E 144°48'15.7"
6	N 13°29'28.5" E 144°48'17.6"
7	N 13°29'29.6" E 144°48'19.4"
8	N 13°29'30.9" E 144°48'21.5"
9	N 13°29'31.6" E 144°48'23.5"
10	N 13°29'33.3" E 144°48'25.8"
12, 12A	N 13°29'34.6" E 144°48'28.0"
13, 13A	N 13°29'36.4" E 144°48'27.6"
14	N 13°29'35.7" E 144°48'30.1"
15, 15A	N 13°29'37.3" E 144°48'29.5"
16, 16A	N 13°29'36.2" E 144°48'32.1"
17, 17A	N 13°29'38.1" E 144°48'31.1"
18	N 13°29'37.1" E 144°48'32.6"
19	N 13°29'38.3" E 144°48'32.2"
20	N 13°29'37.5" E 144°48'32.8"
21	N 13°29'38.1" E 144°48'32.3"

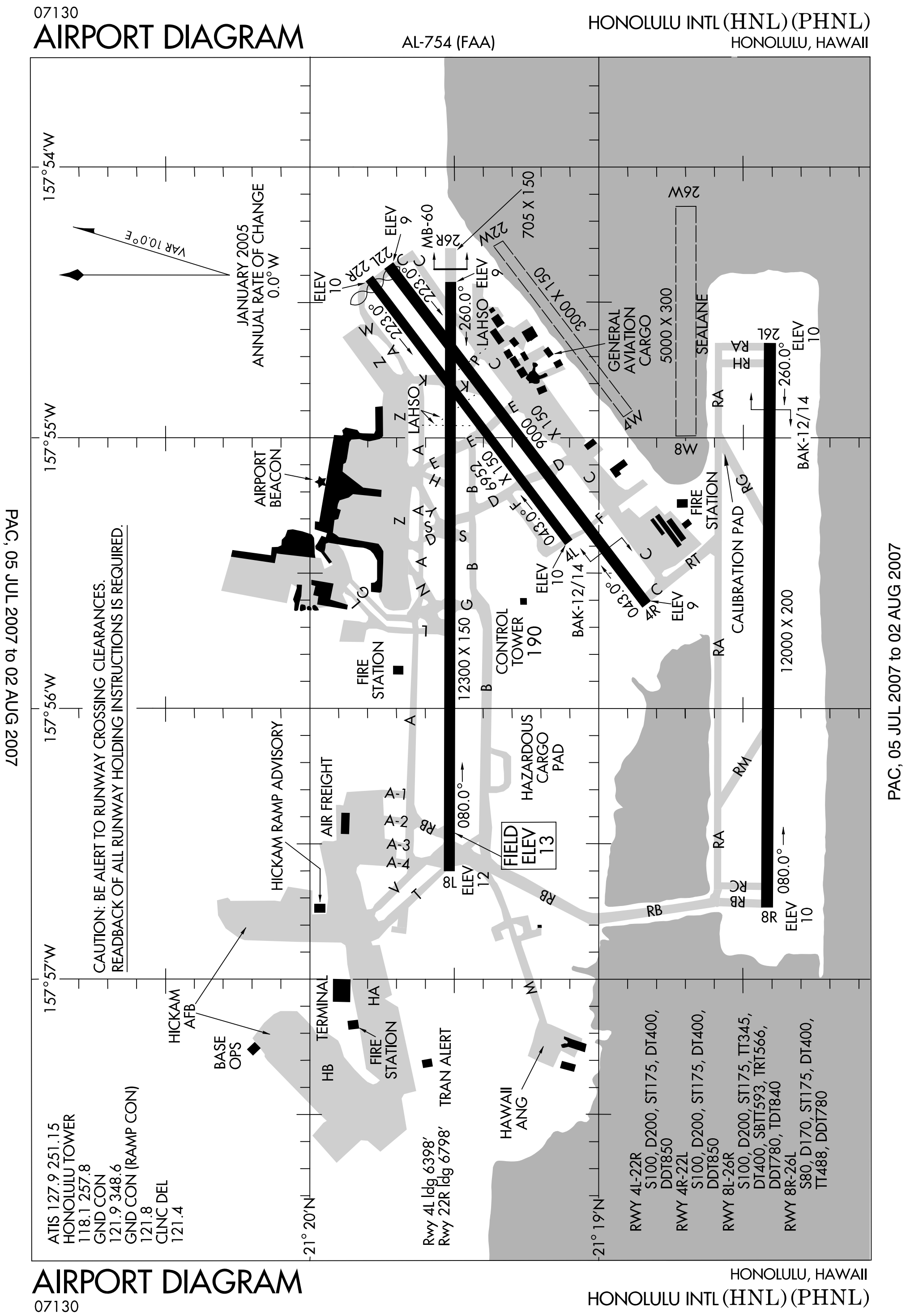
Guam Island, Guam
Andersen Air Force Base
ICAO Identifier PGUA



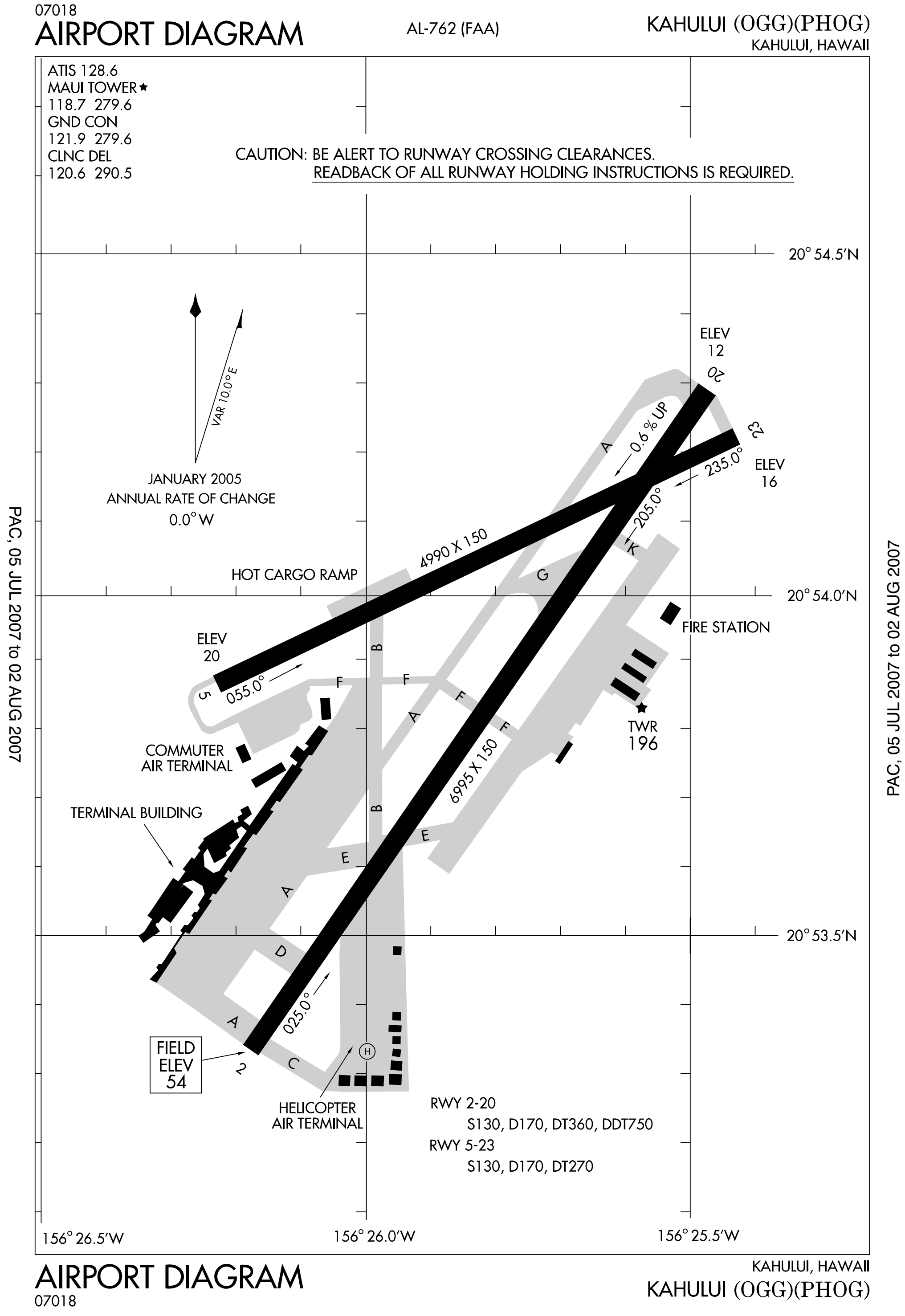
Hilo, Hawaii
Hilo International
ICAO Identifier PHTO



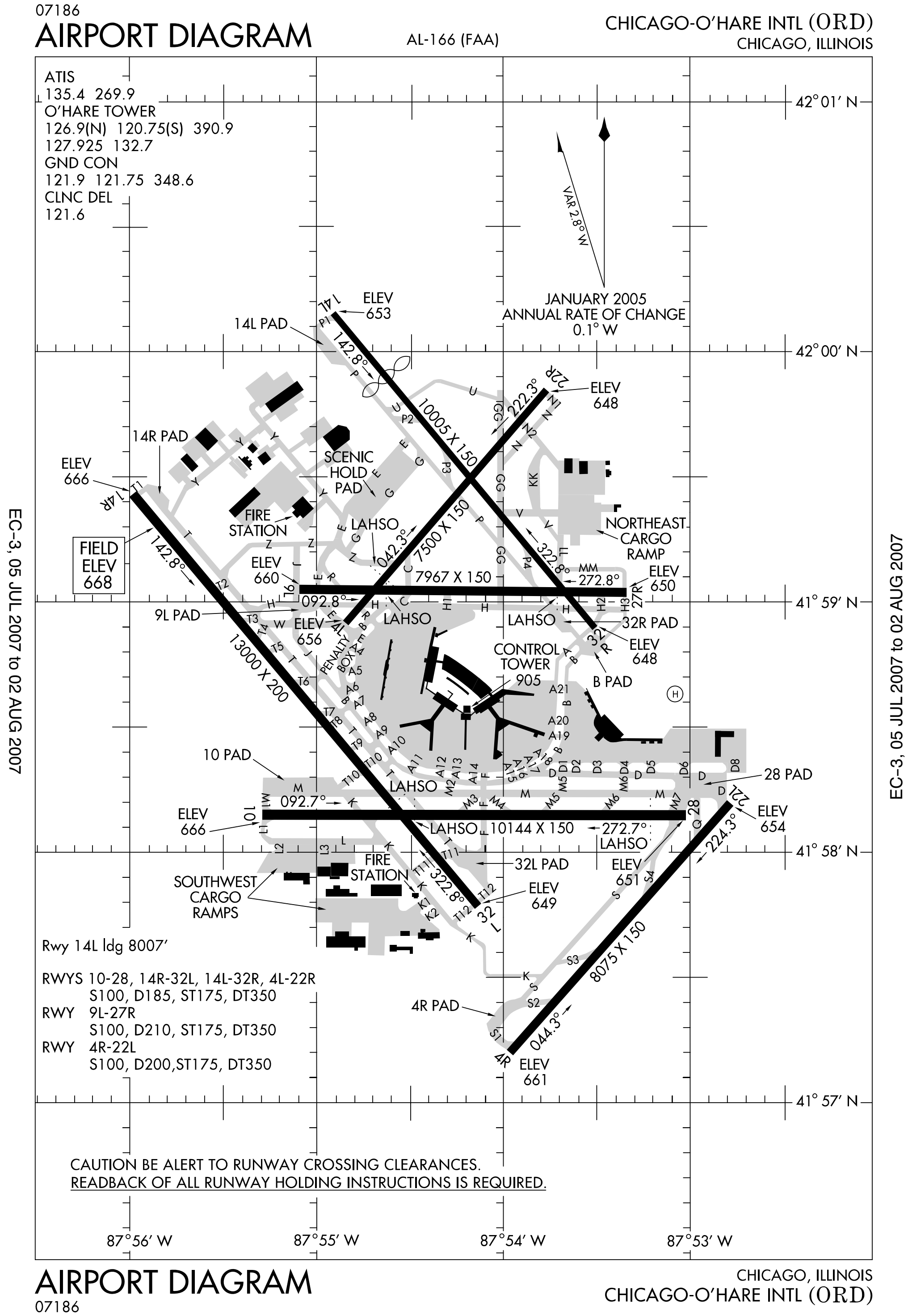
Honolulu, Hawaii
Honolulu International
ICAO Identifier PHNL



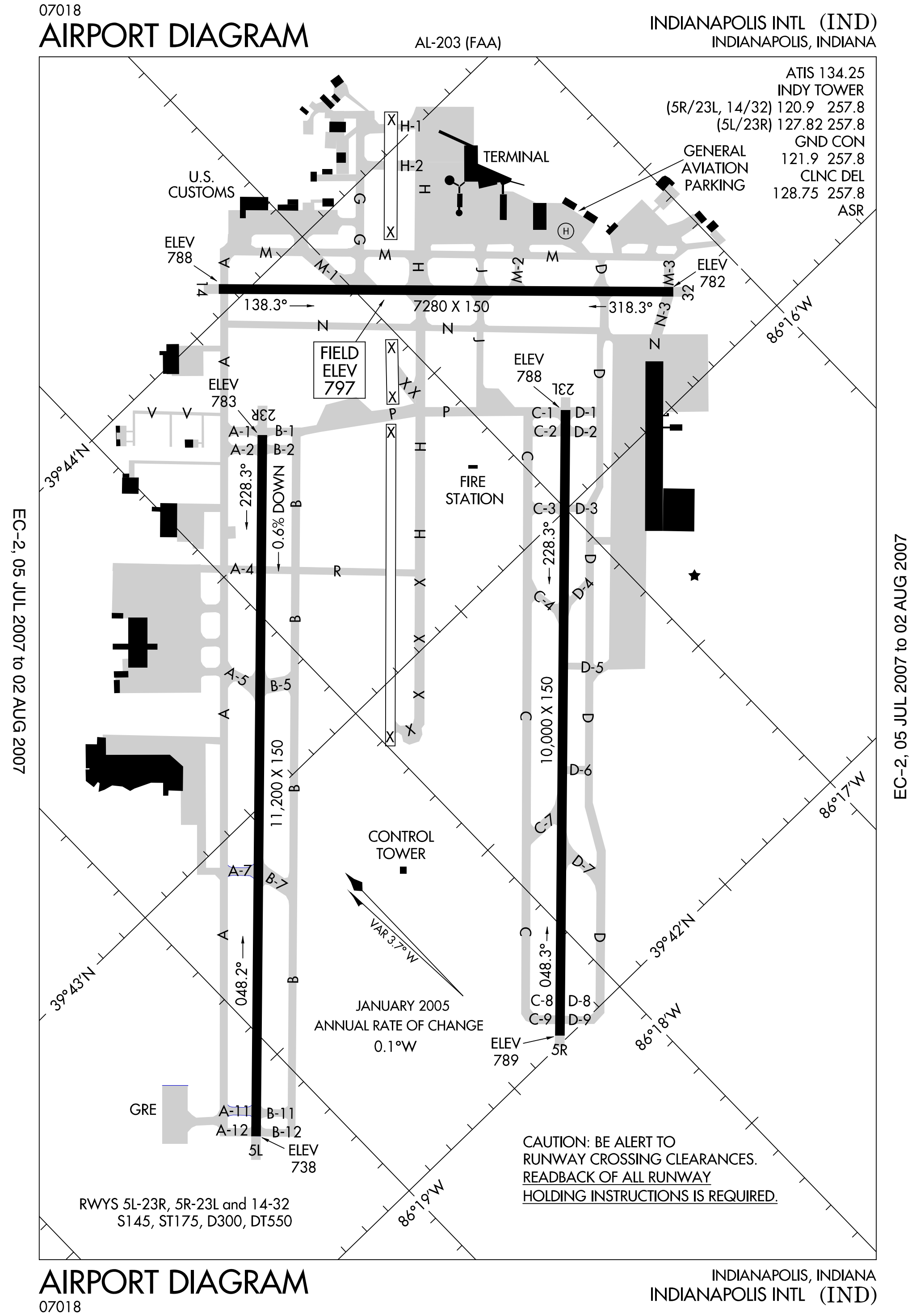
Kahului, Hawaii
Kahului
ICAO Identifier PHOG



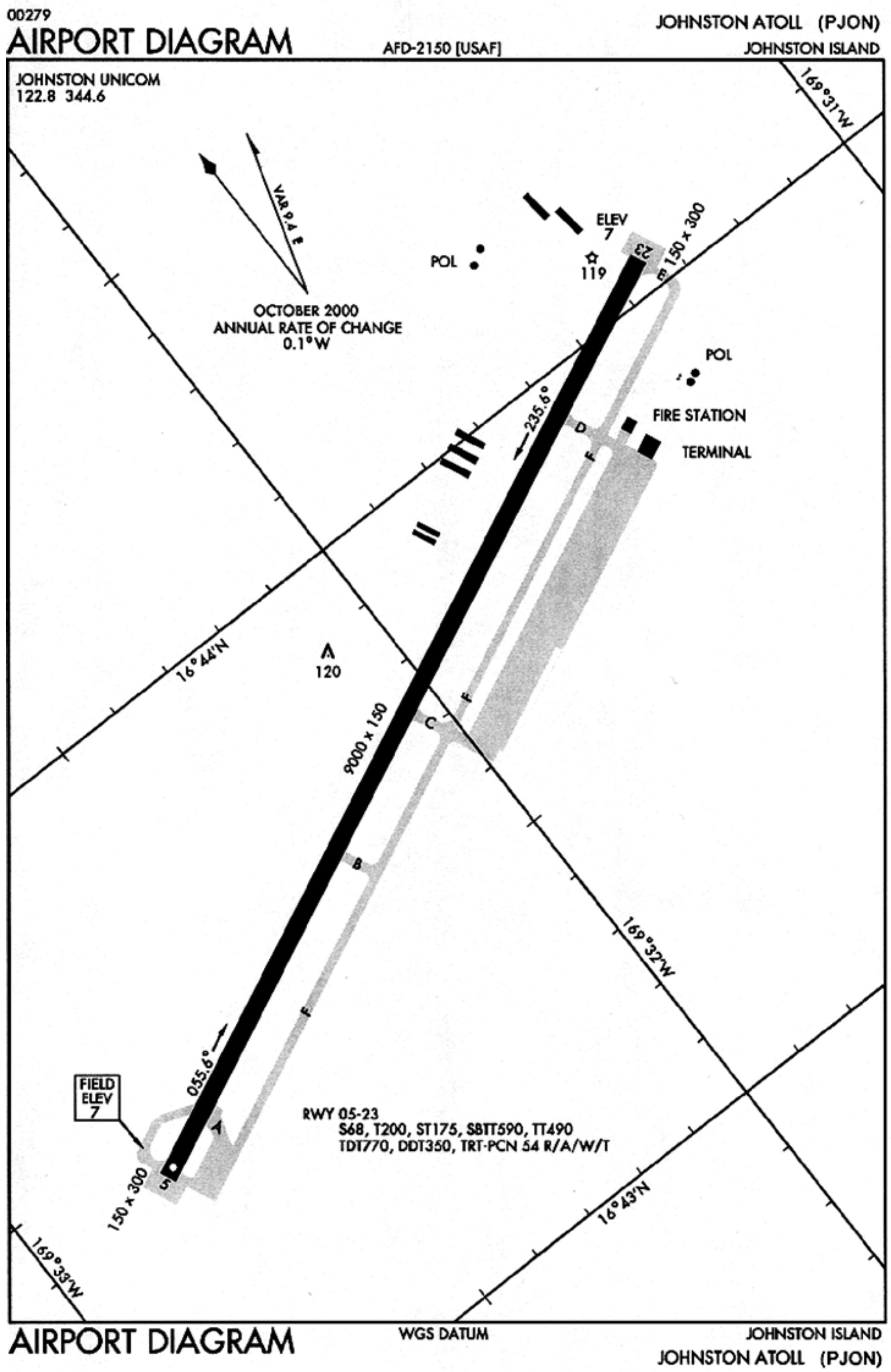
Chicago, Illinois
Chicago-O'Hare International
ICAO Identifier KORD



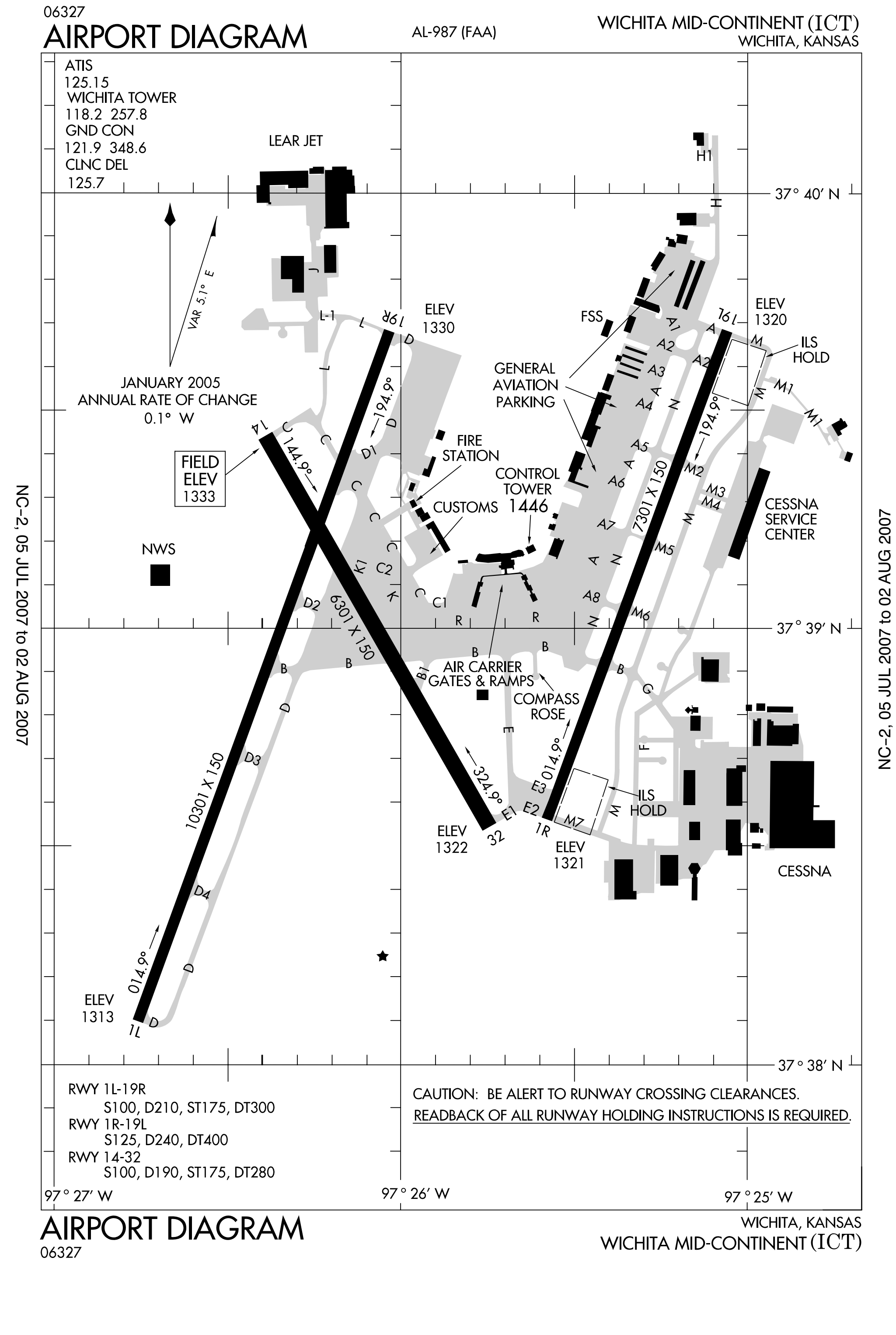
Indianapolis, Indiana
Indianapolis International
ICAO Identifier KIND



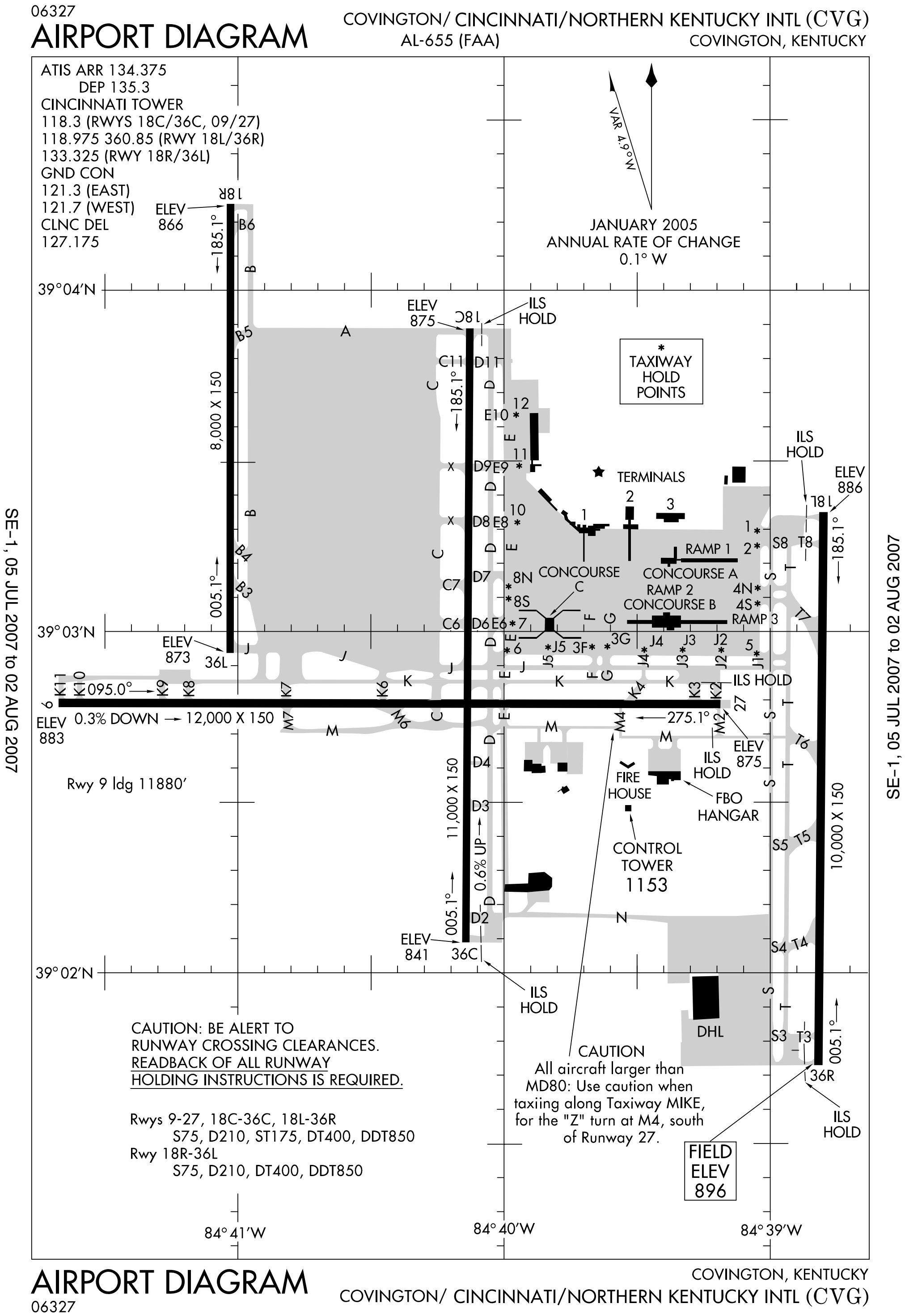
Johnston Island
Johnston Atoll
ICAO Identifier PJON



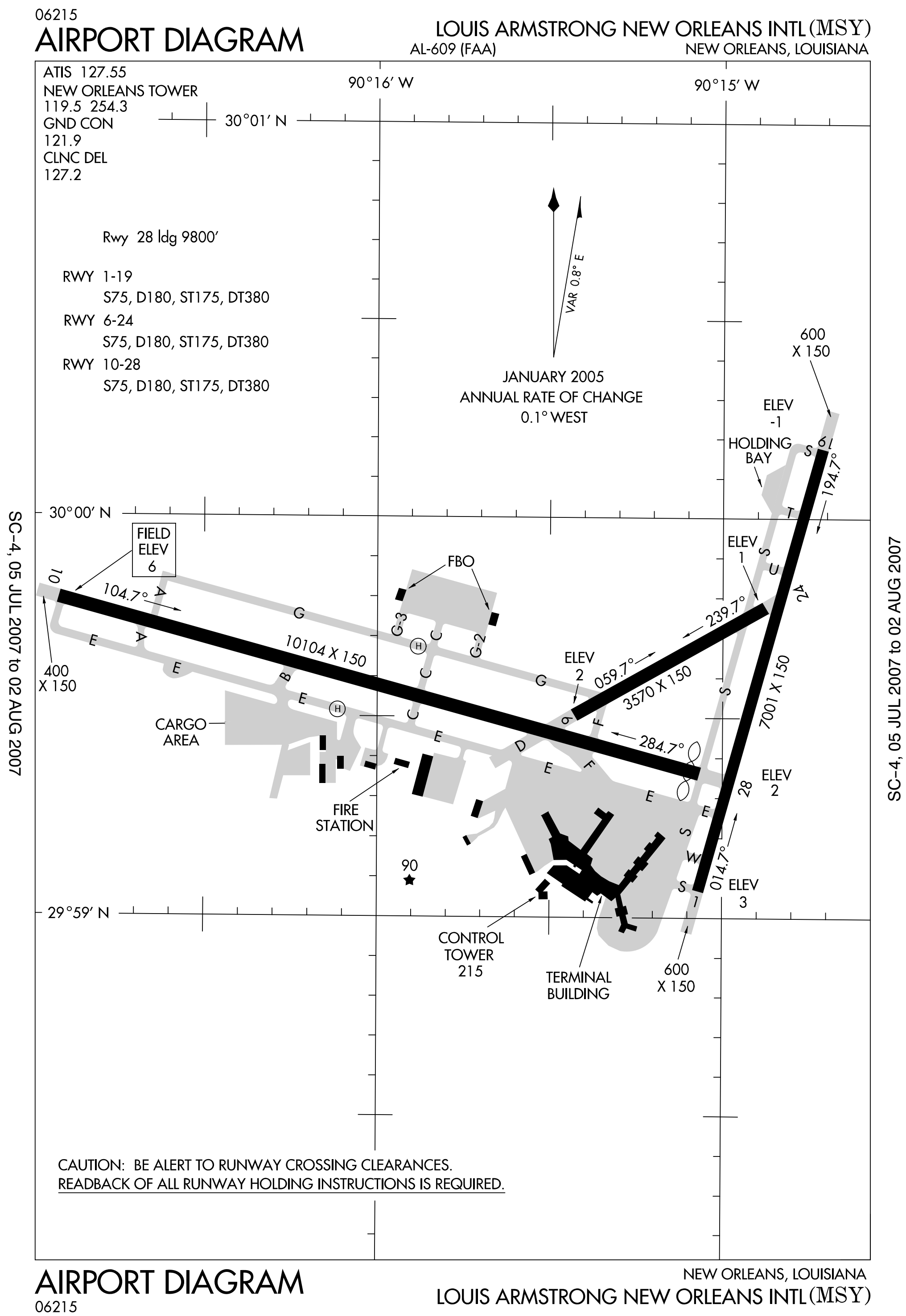
Wichita, Kansas
Wichita Mid-Continent
ICAO Identifier KICT



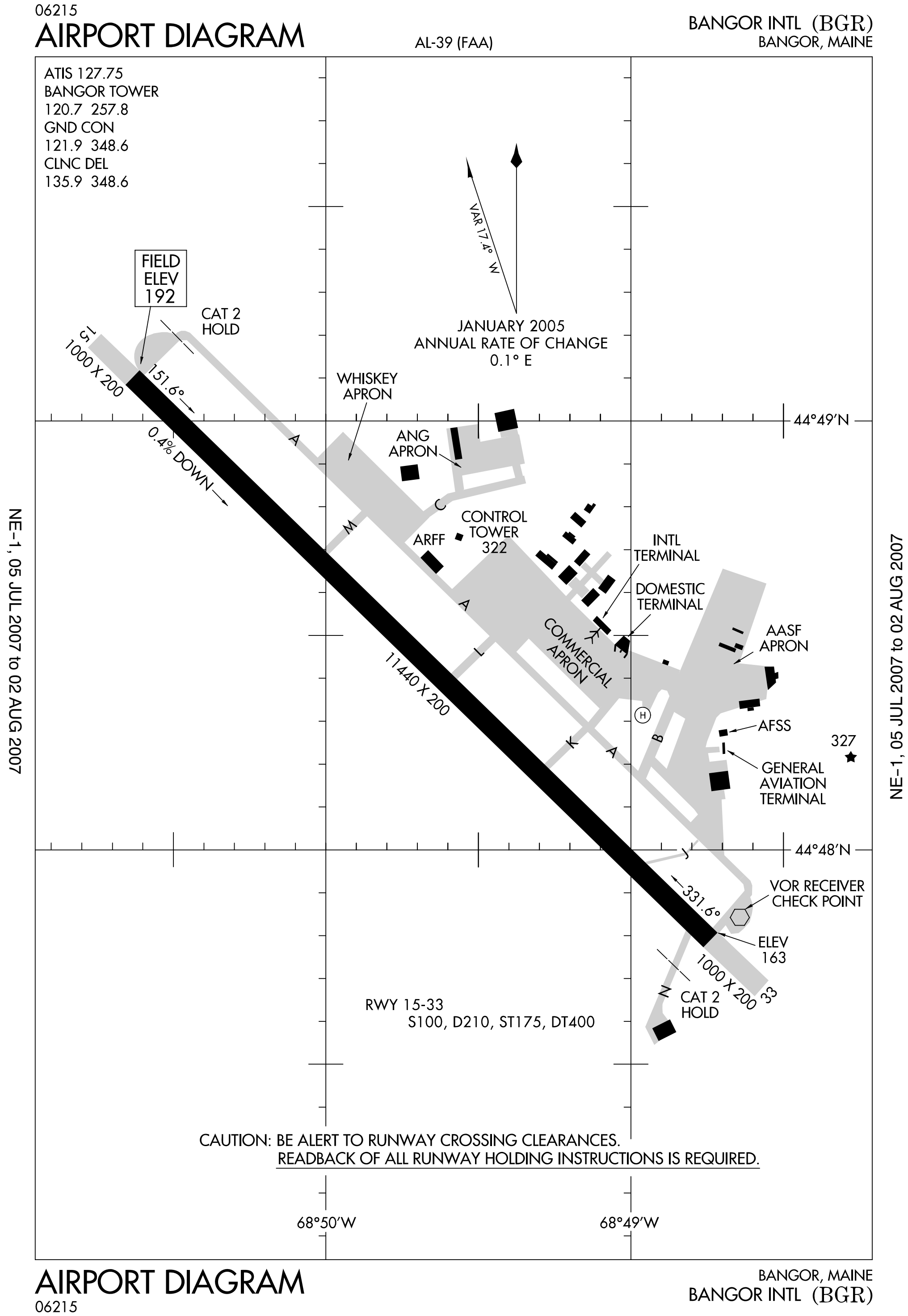
Covington, Kentucky
Cincinnati/Northern Kentucky International
ICAO Identifier KCVG



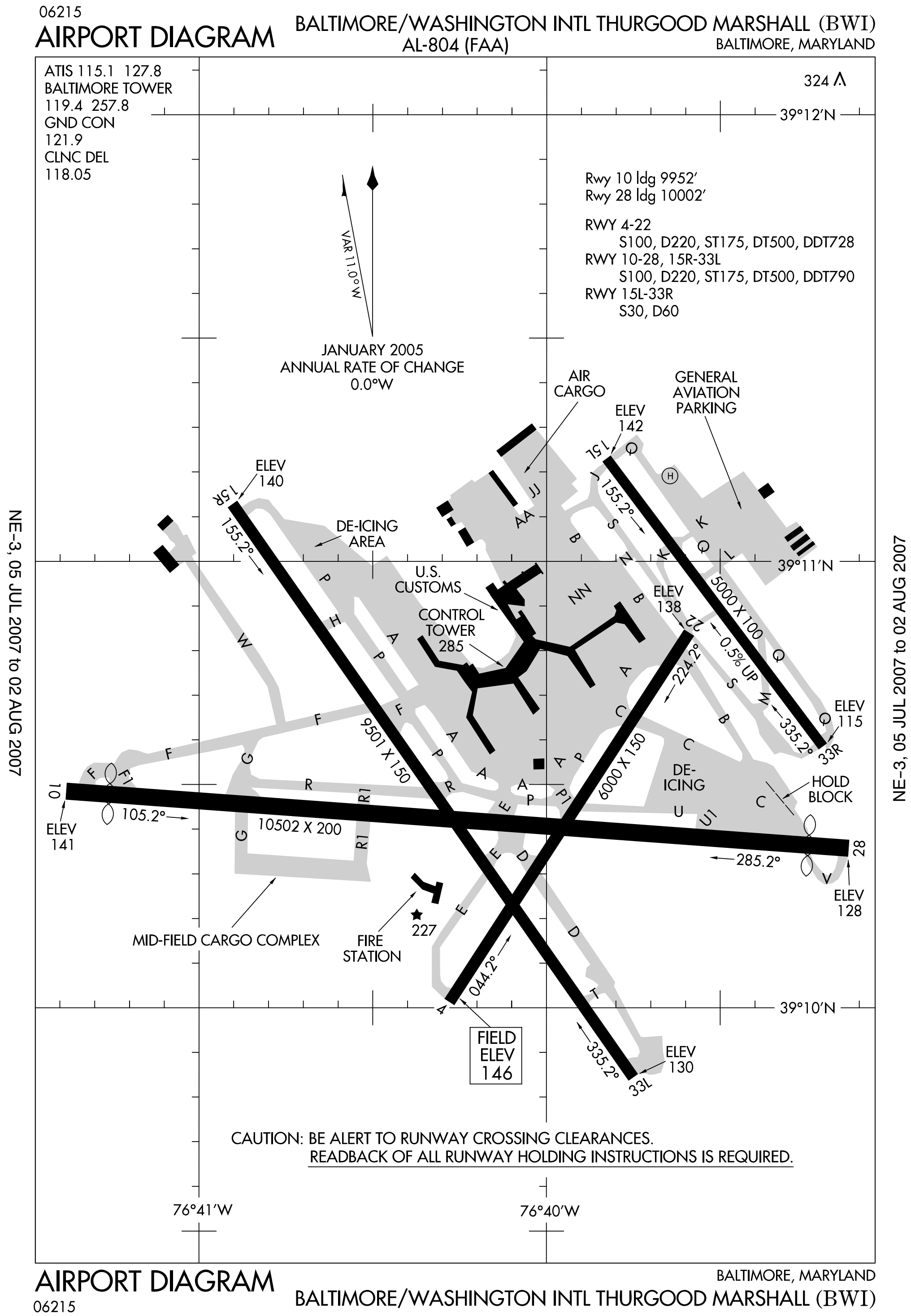
New Orleans, Louisana
Louis Armstrong New Orleans International
ICAO Identifier KMSY



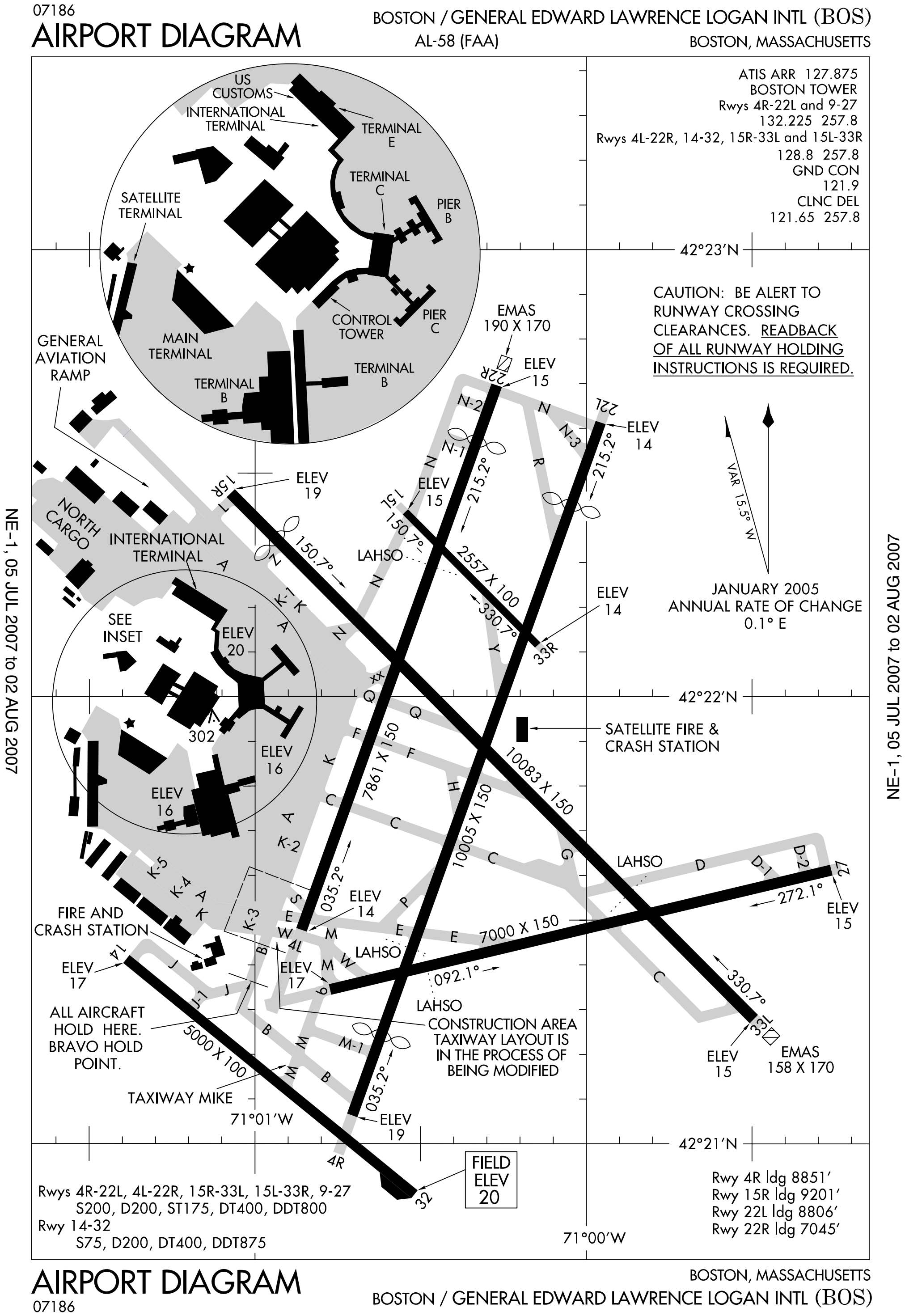
Bangor, Maine
Bangor International
ICAO Identifier KBGR



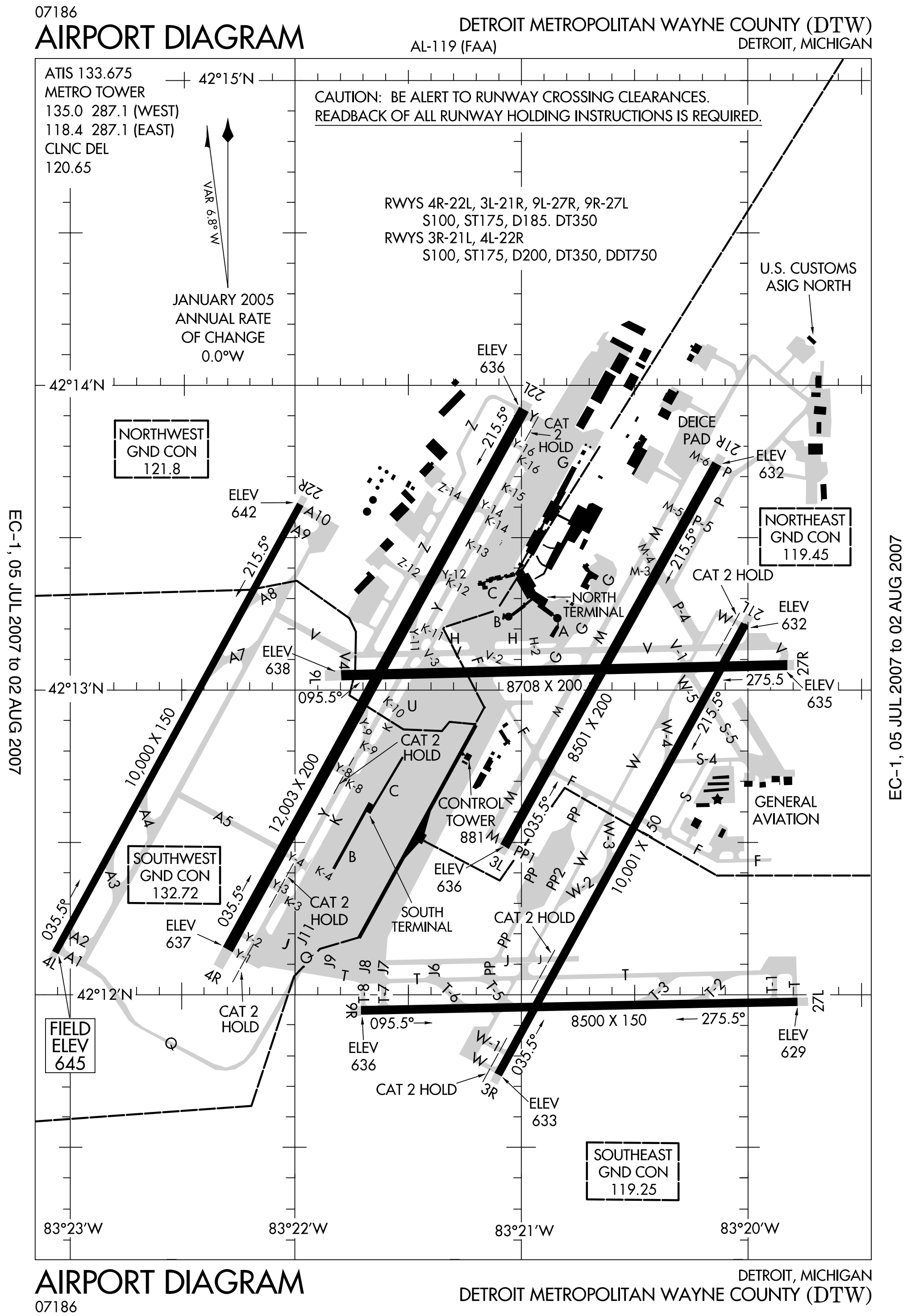
Baltimore, Maryland
Baltimore-Washington International Thurgood Marshall
ICAO Identifier KBWI



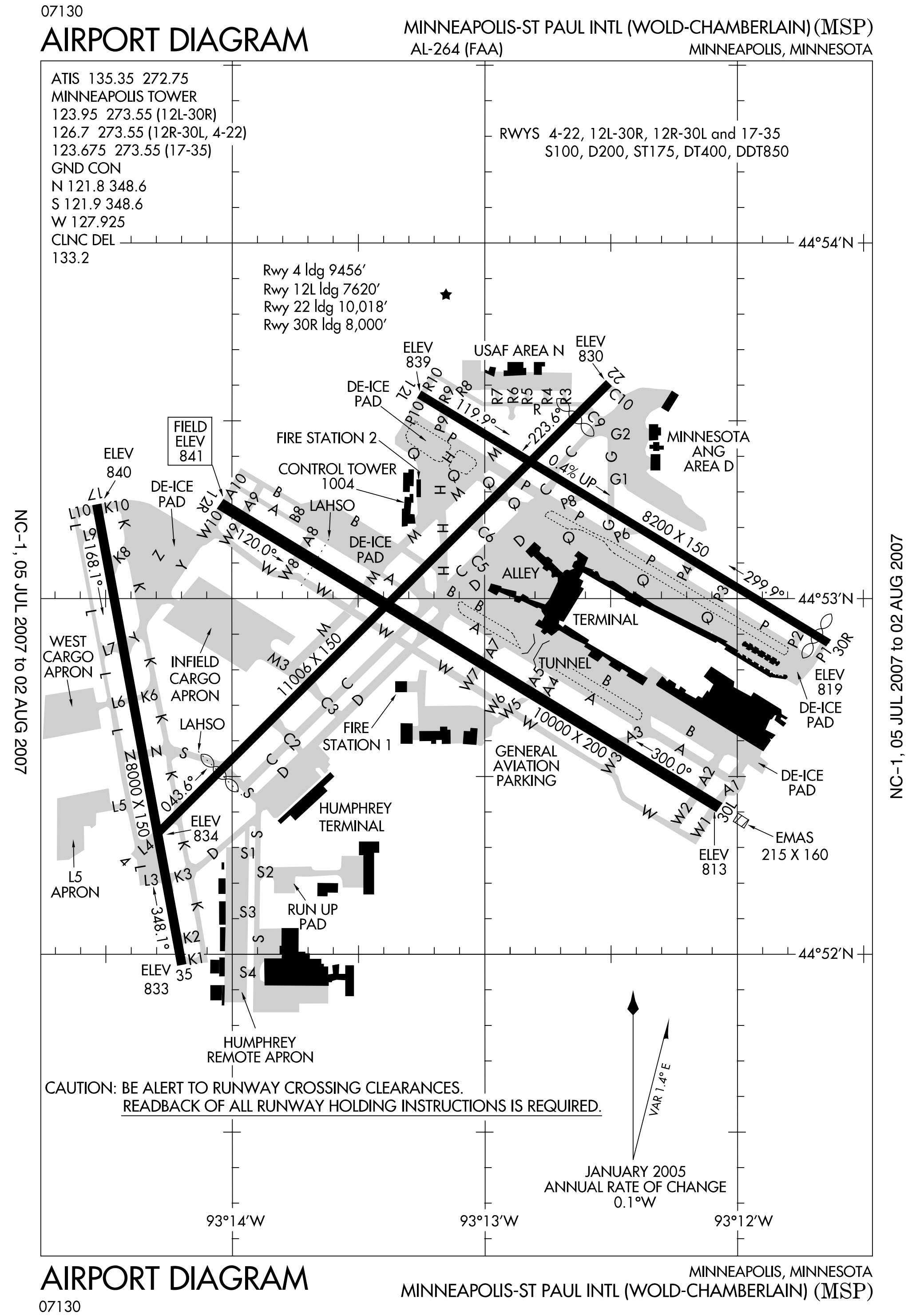
Boston, Massachusetts
General Edward Lawrence Logan International
ICAO Identifier KBOS



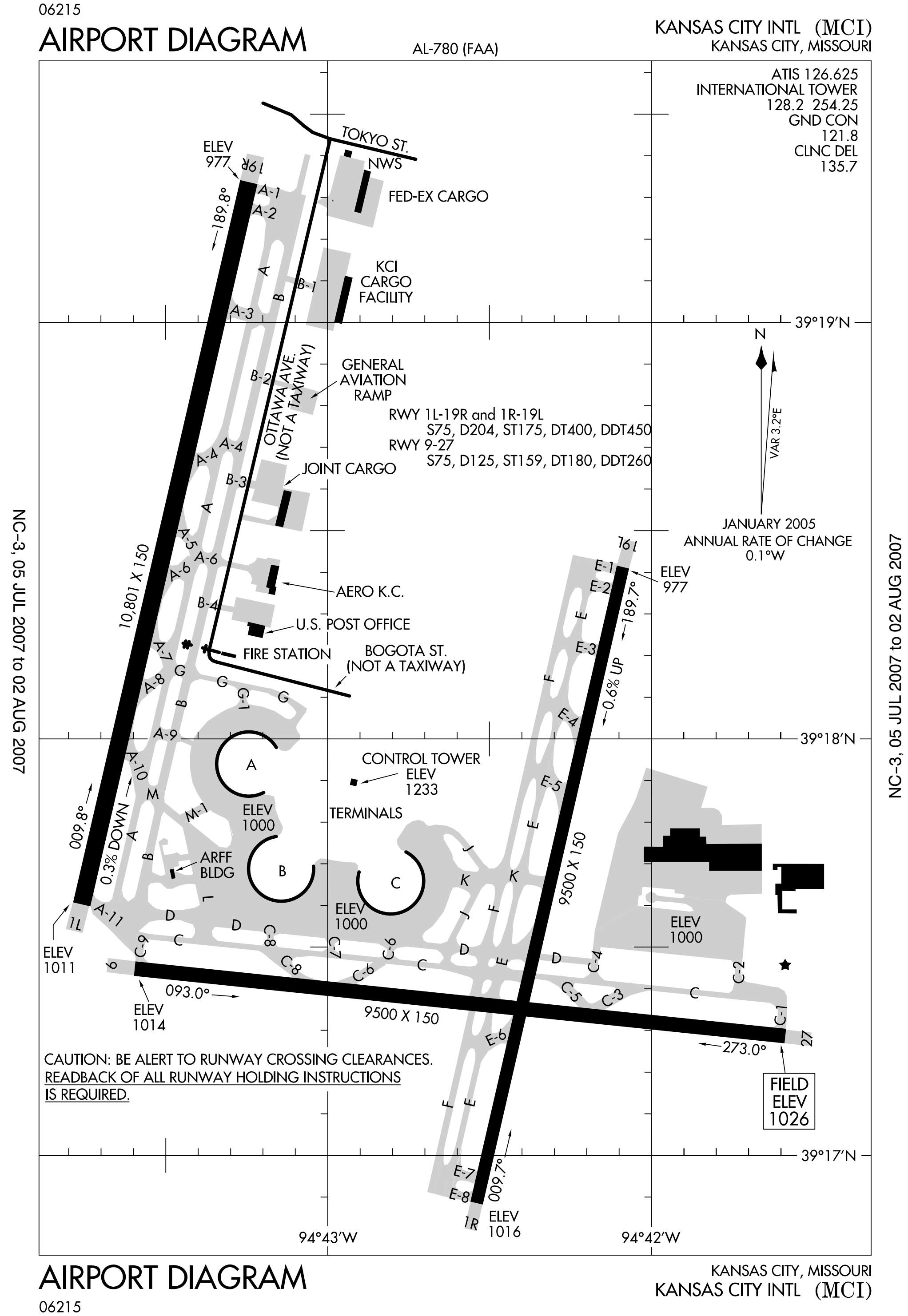
Detroit, Michigan
Detroit Metropolitan Wayne County
ICAO Identifier KDTW



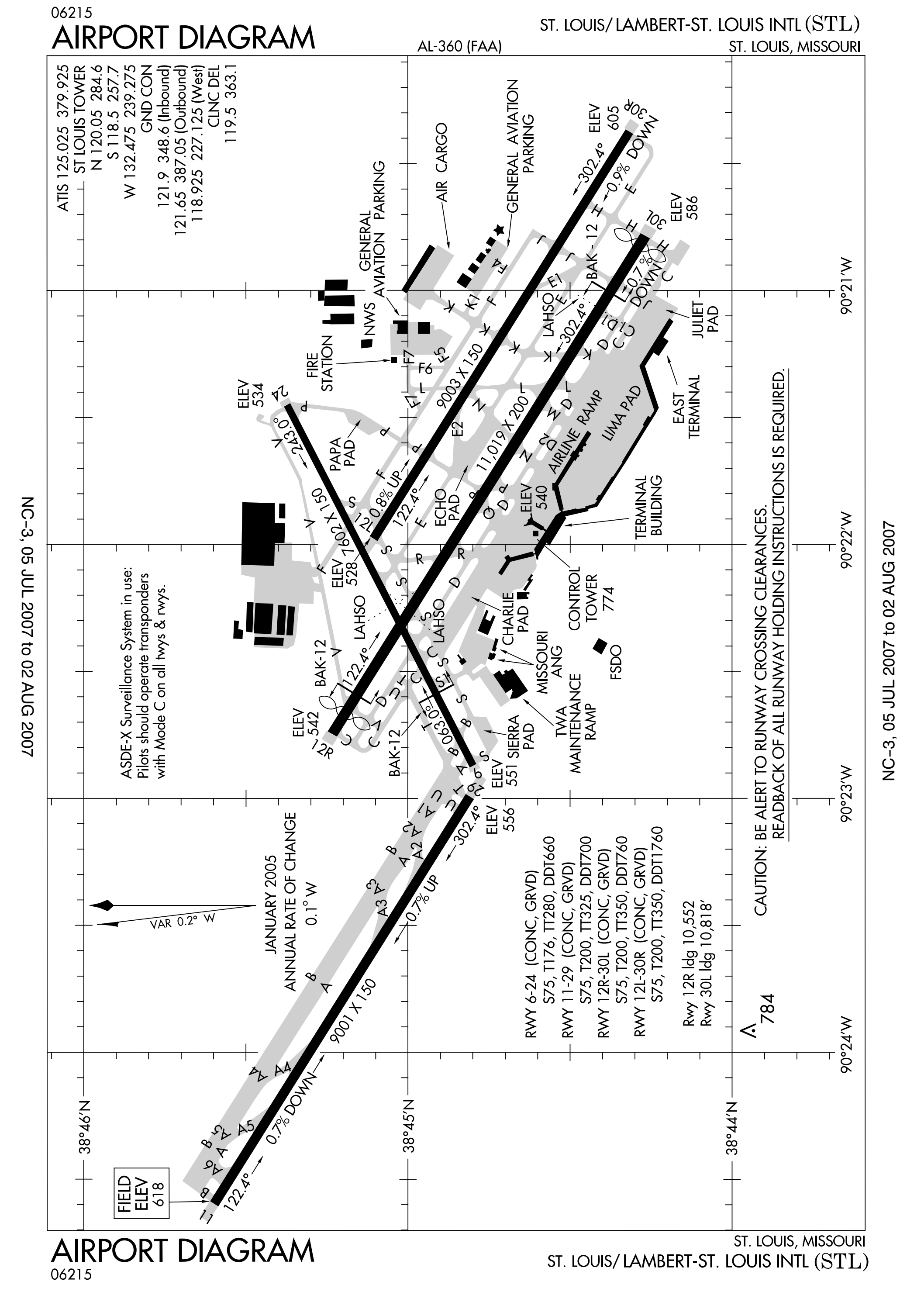
Minneapolis, Minnesota
Minneapolis-St. Paul International
(Wold-Chamberlain)
ICAO Identifier KMSP



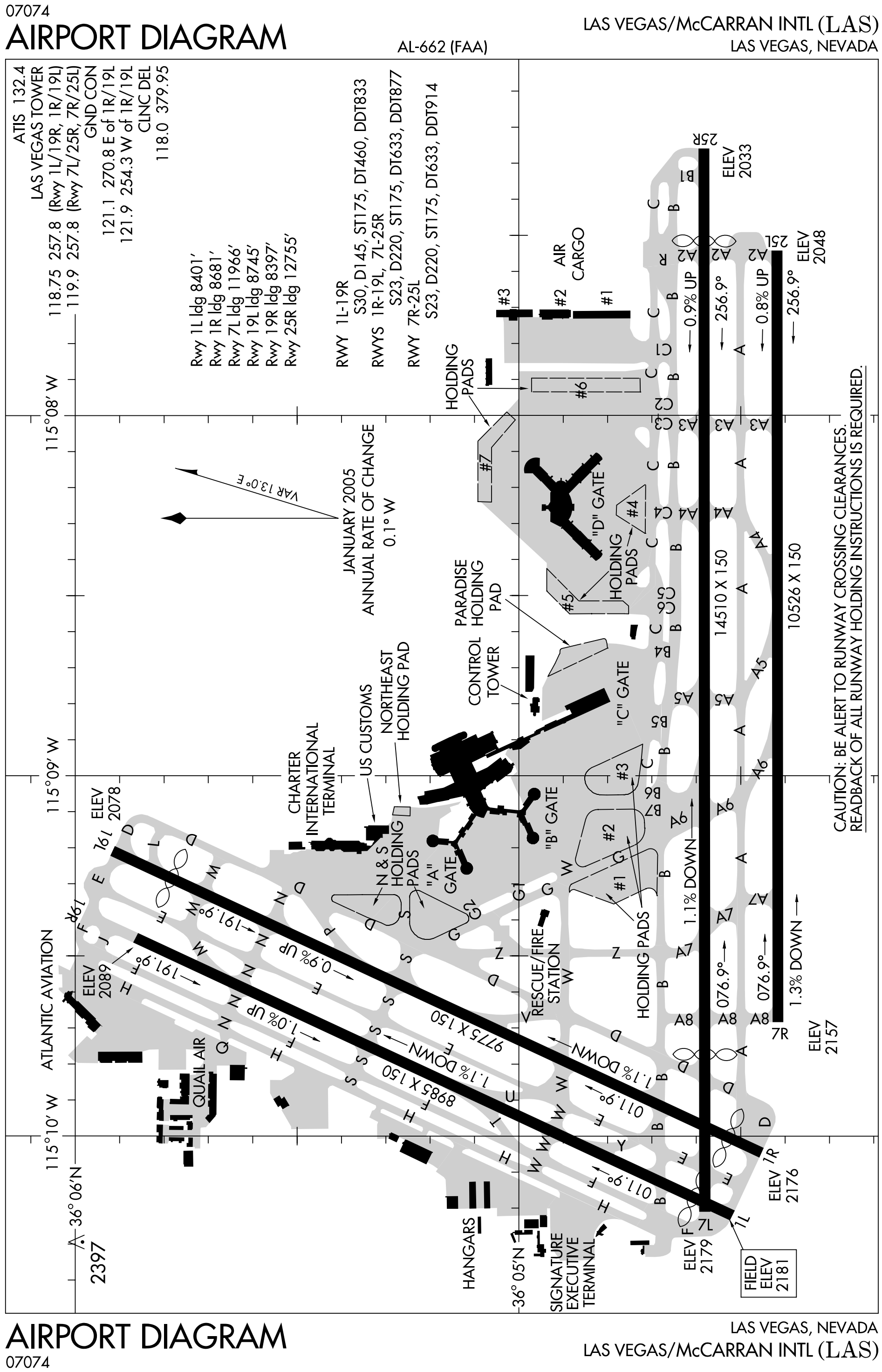
Kansas City, Missouri
Kansas City International
ICAO Identifier KMCI



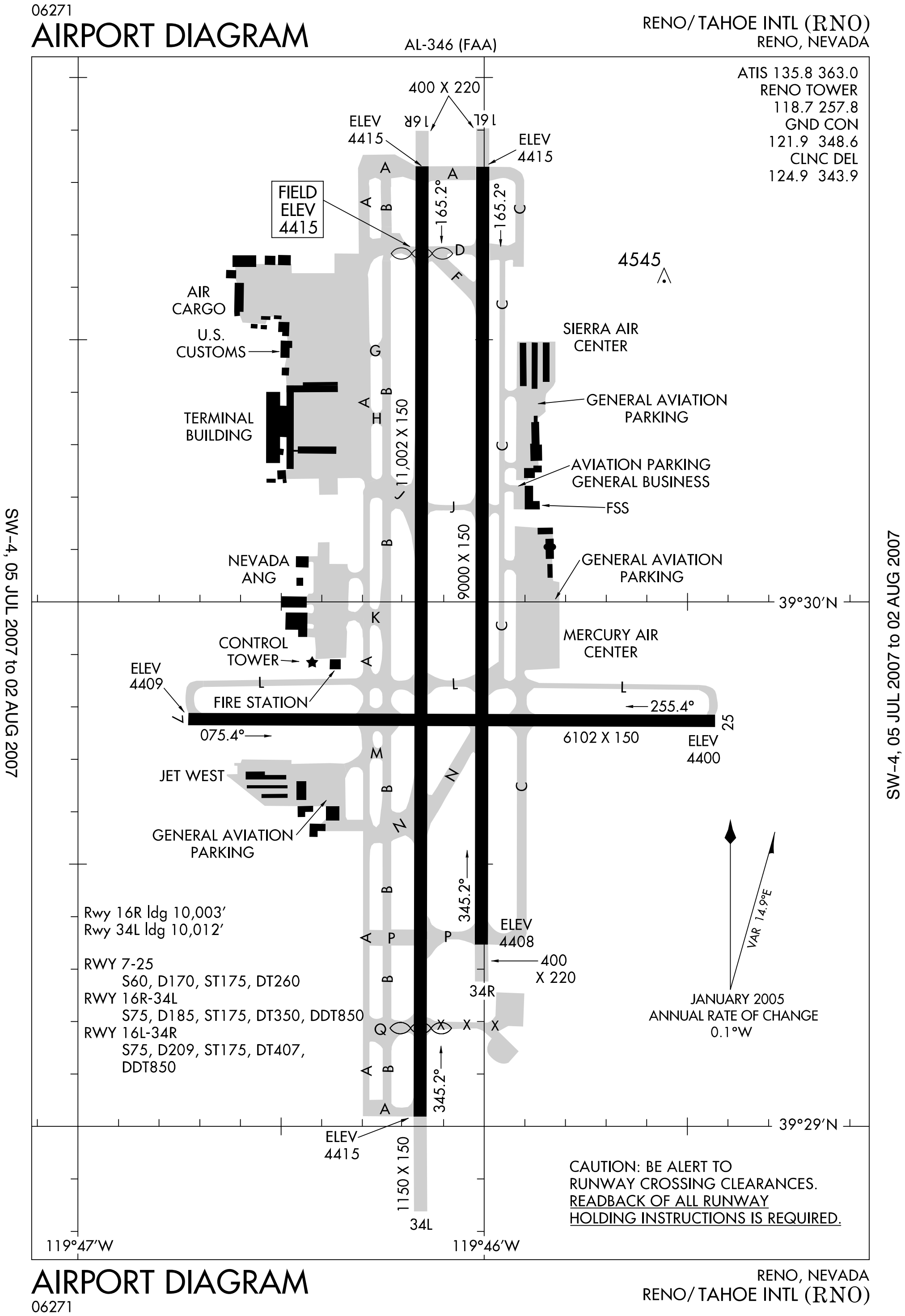
St. Louis, Missouri
Lambert-St. Louis International
ICAO Identifier KSTL



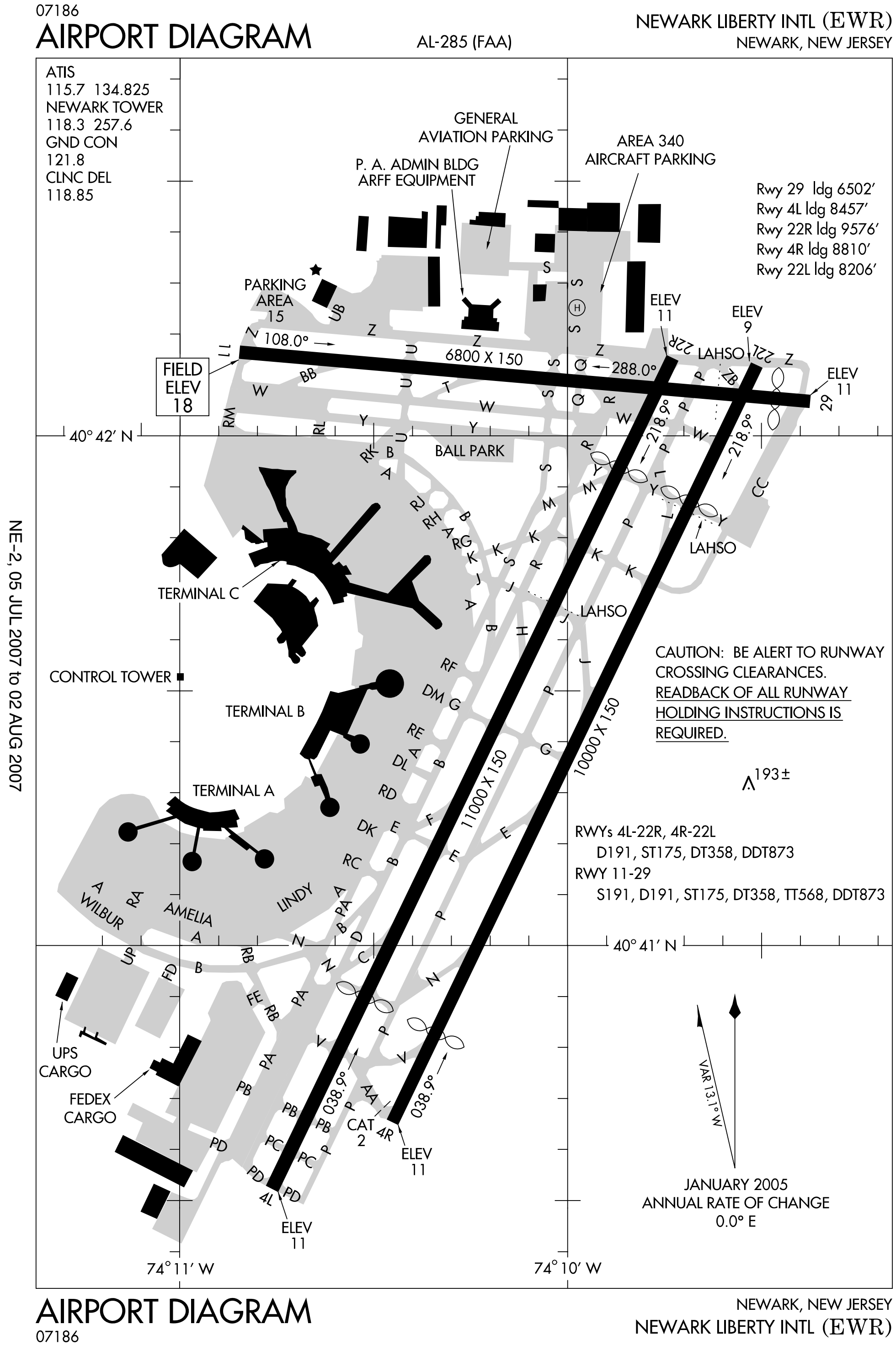
Las Vegas, Nevada
McCarren International
ICAO Identifier KLAS



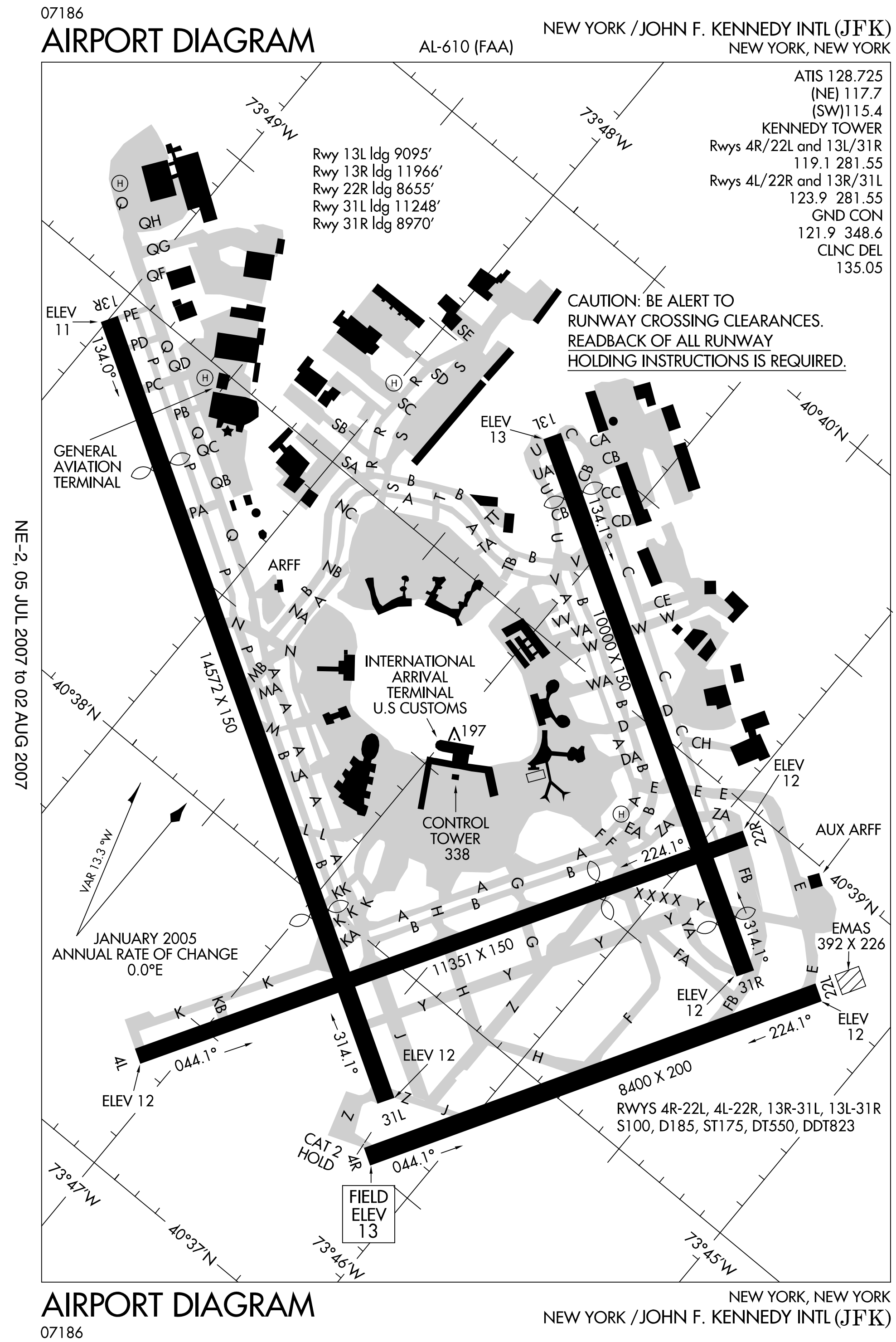
Reno, Nevada
Reno/Tahoe International
ICAO Identifier KRNO



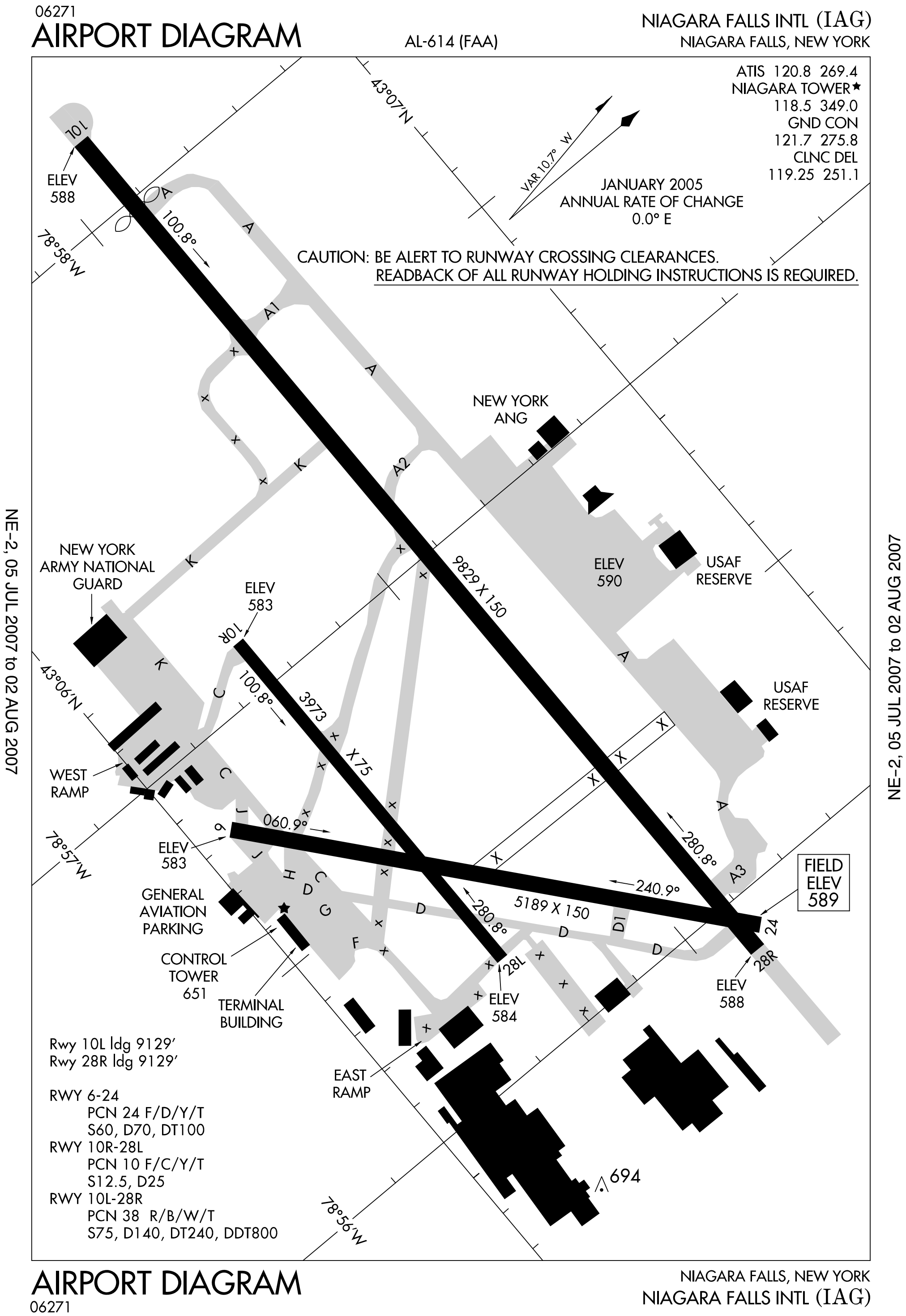
Newark, New Jersey
Newark Liberty International
ICAO Identifier KEWR



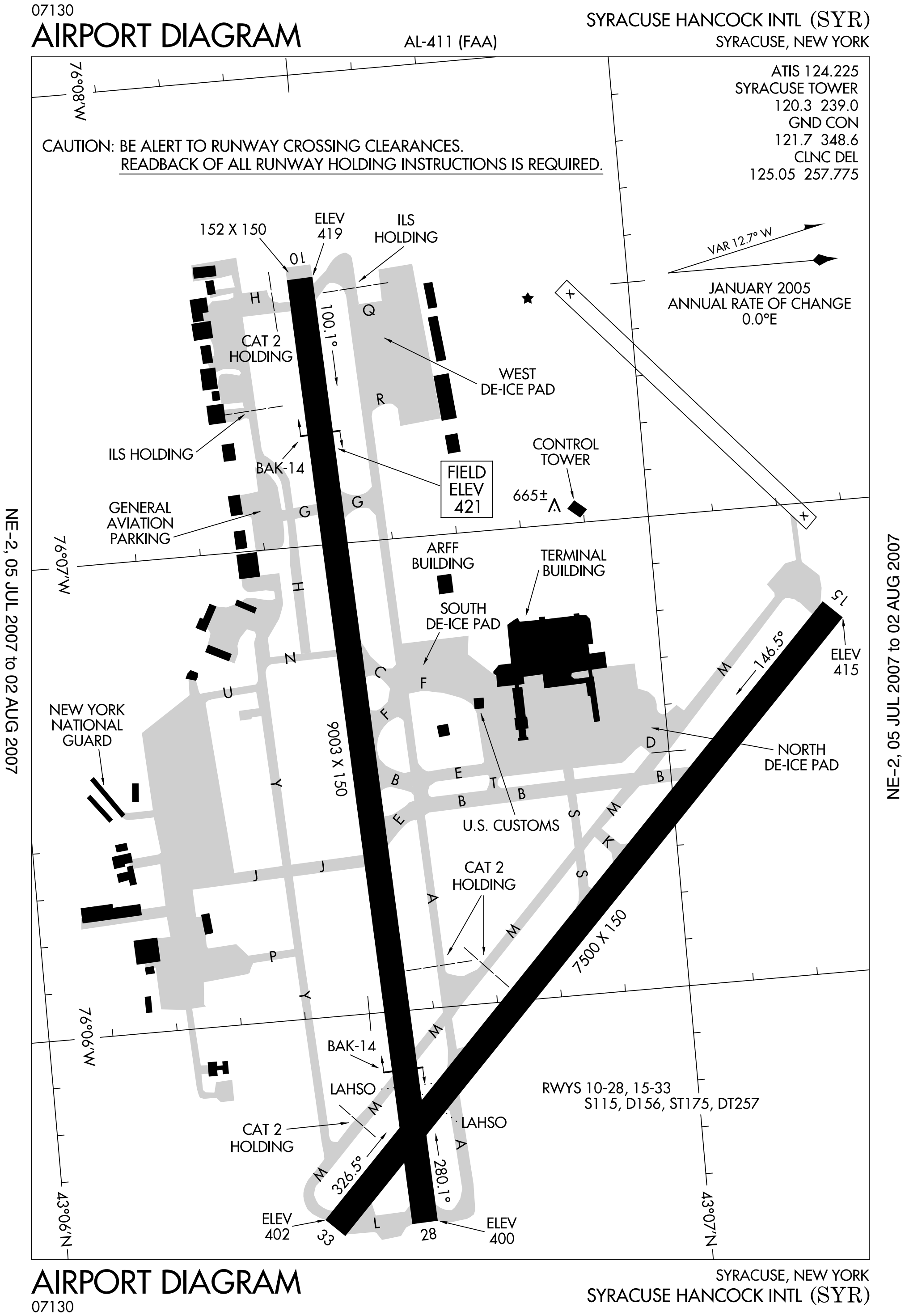
New York, New York
John F. Kennedy International
ICAO Identifier KJFK



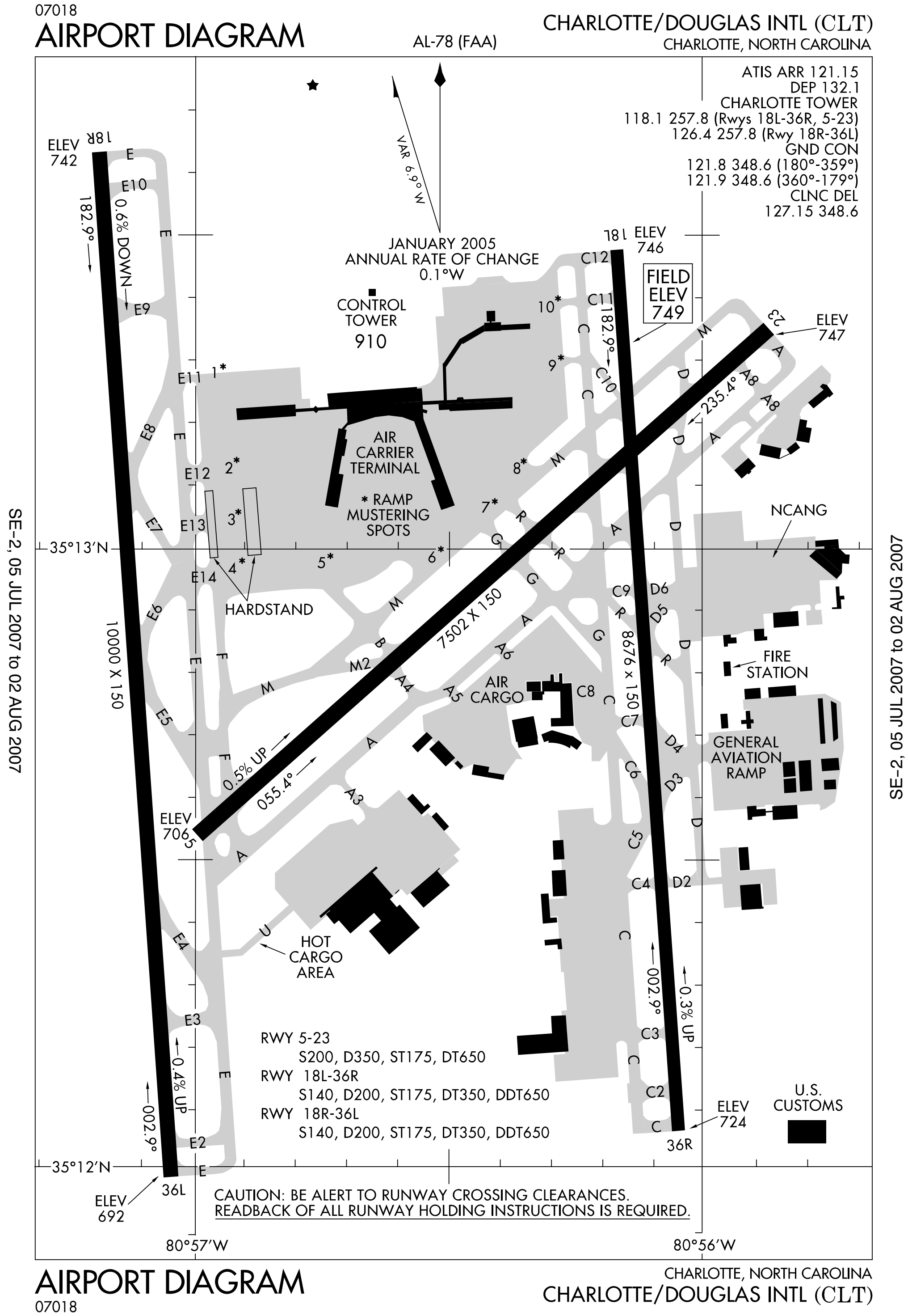
Niagara Falls, New York
Niagara Falls International
ICAO Identifier KIAG



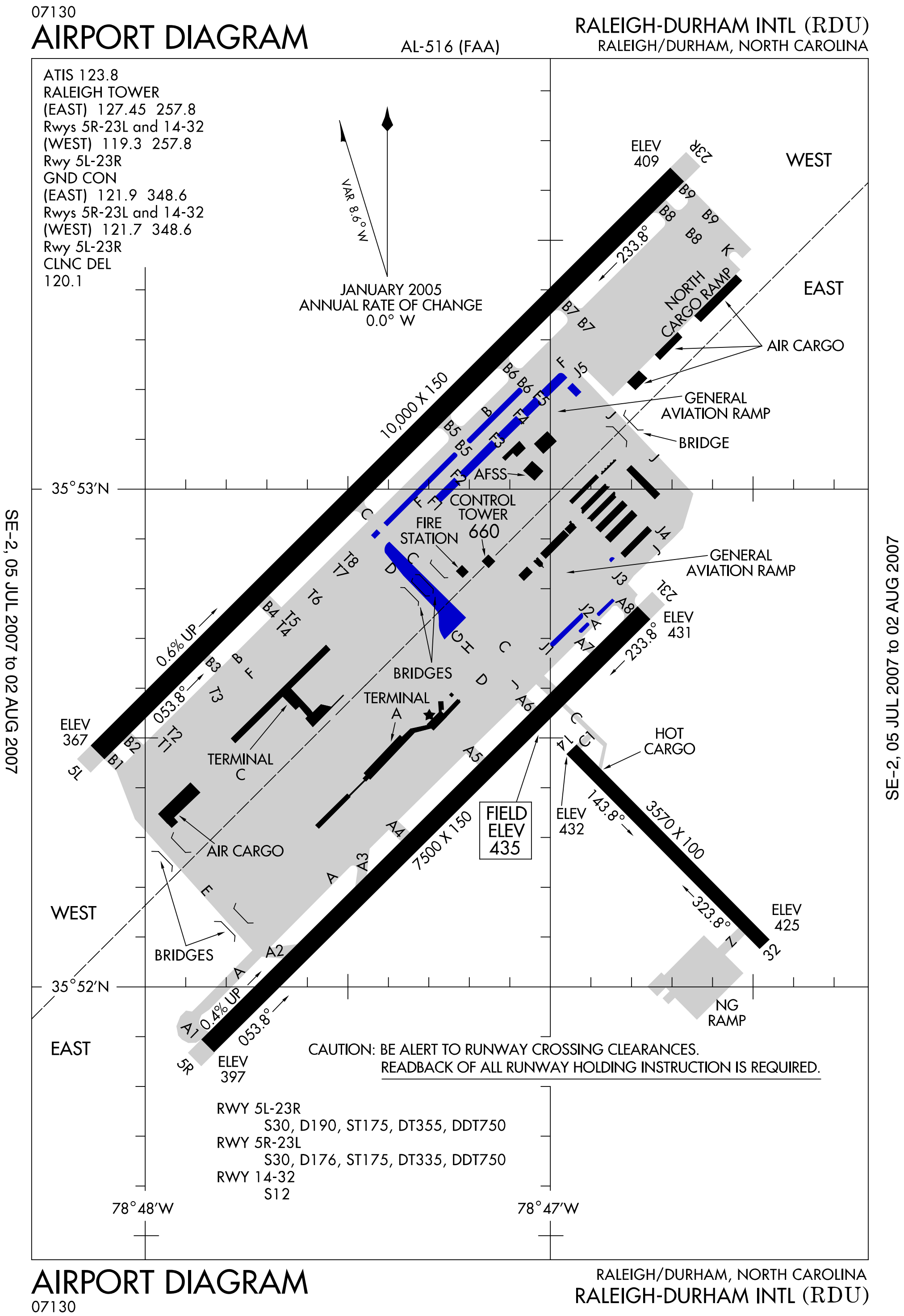
Syracuse, New York
Syracuse Hancock International
ICAO Identifier KSYR



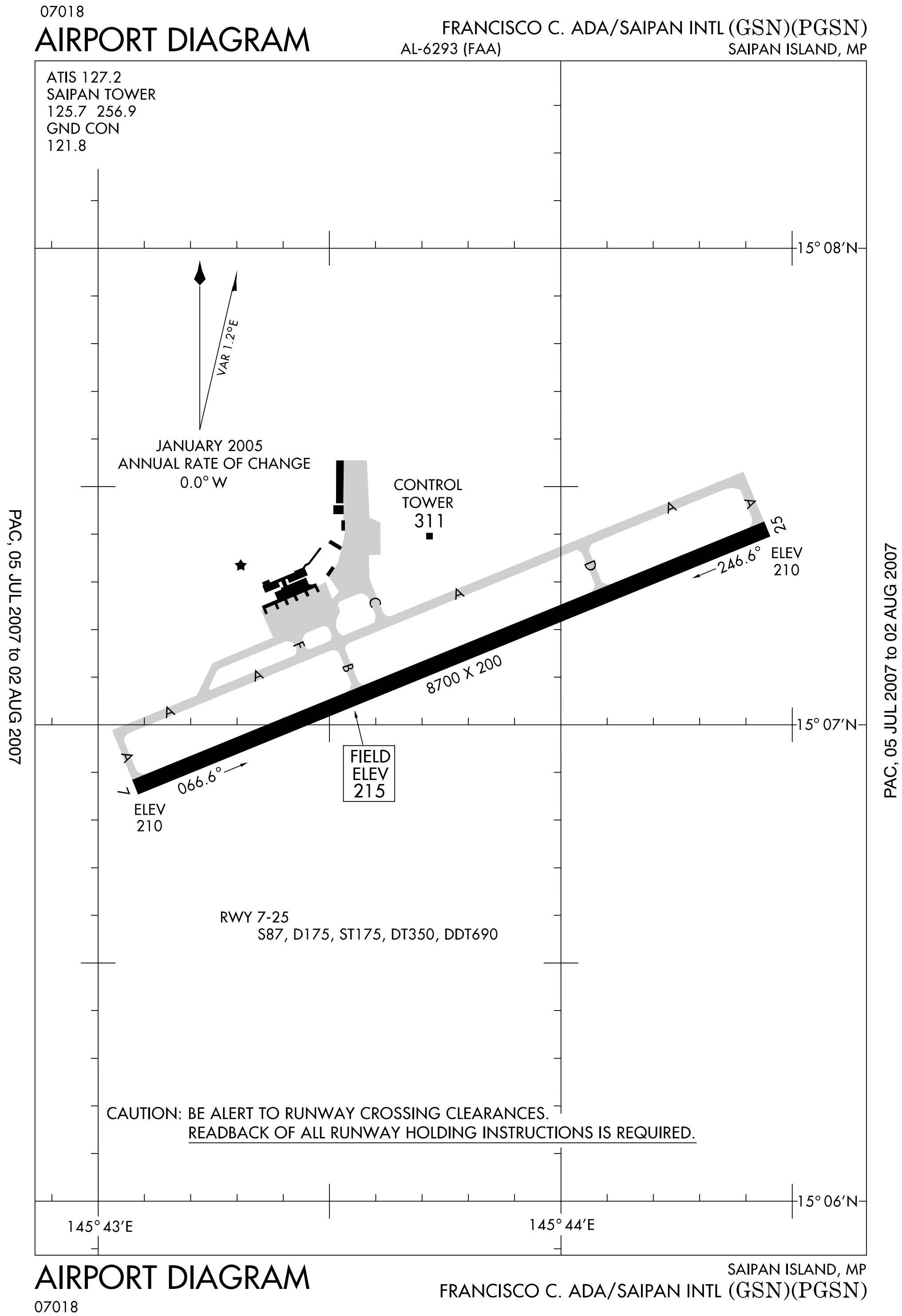
Charlotte, North Carolina
Charlotte/Douglas International
ICAO Identifier KCLT



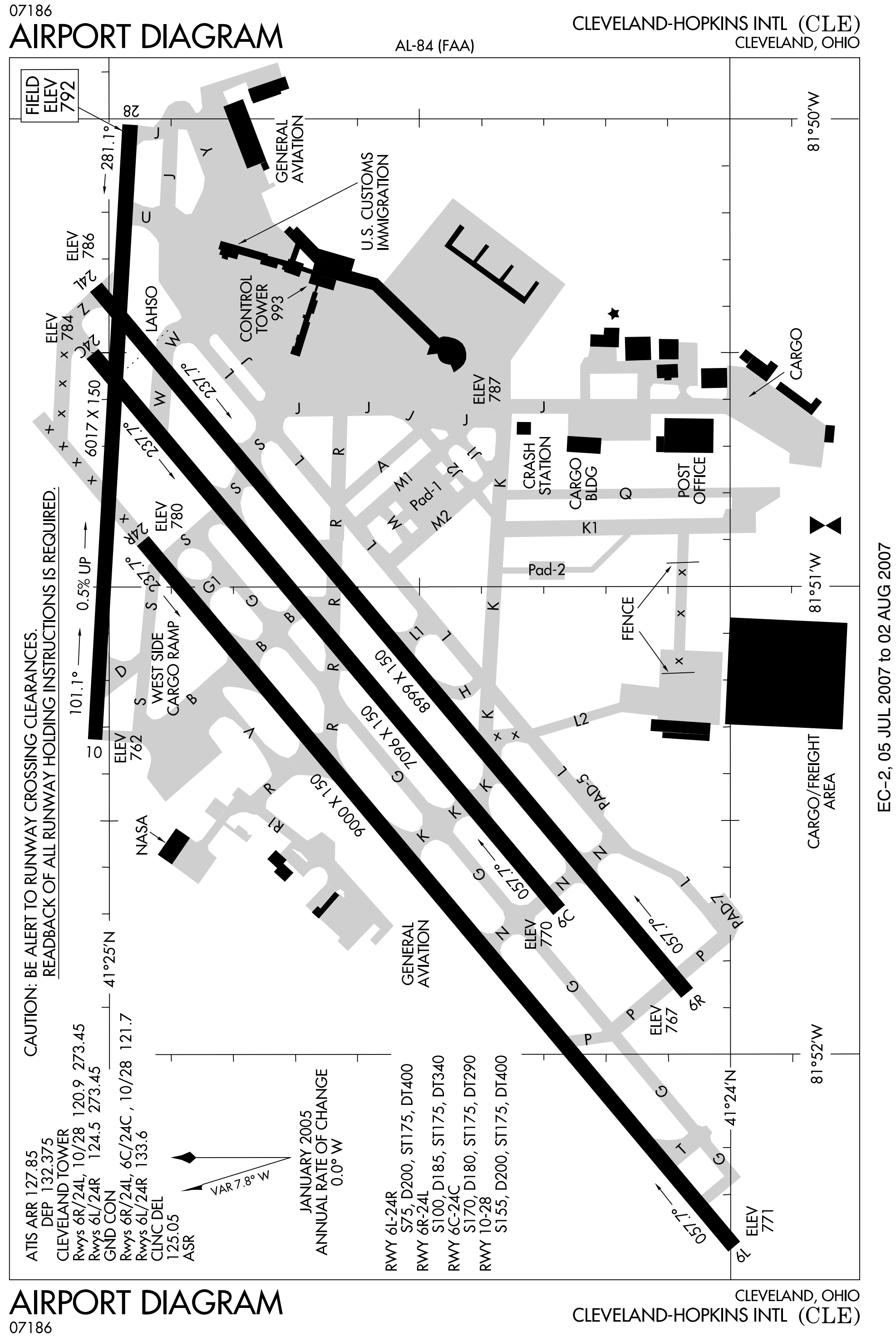
Raleigh-Durham, North Carolina
Raleigh-Durham International
ICAO Identifier KRDU



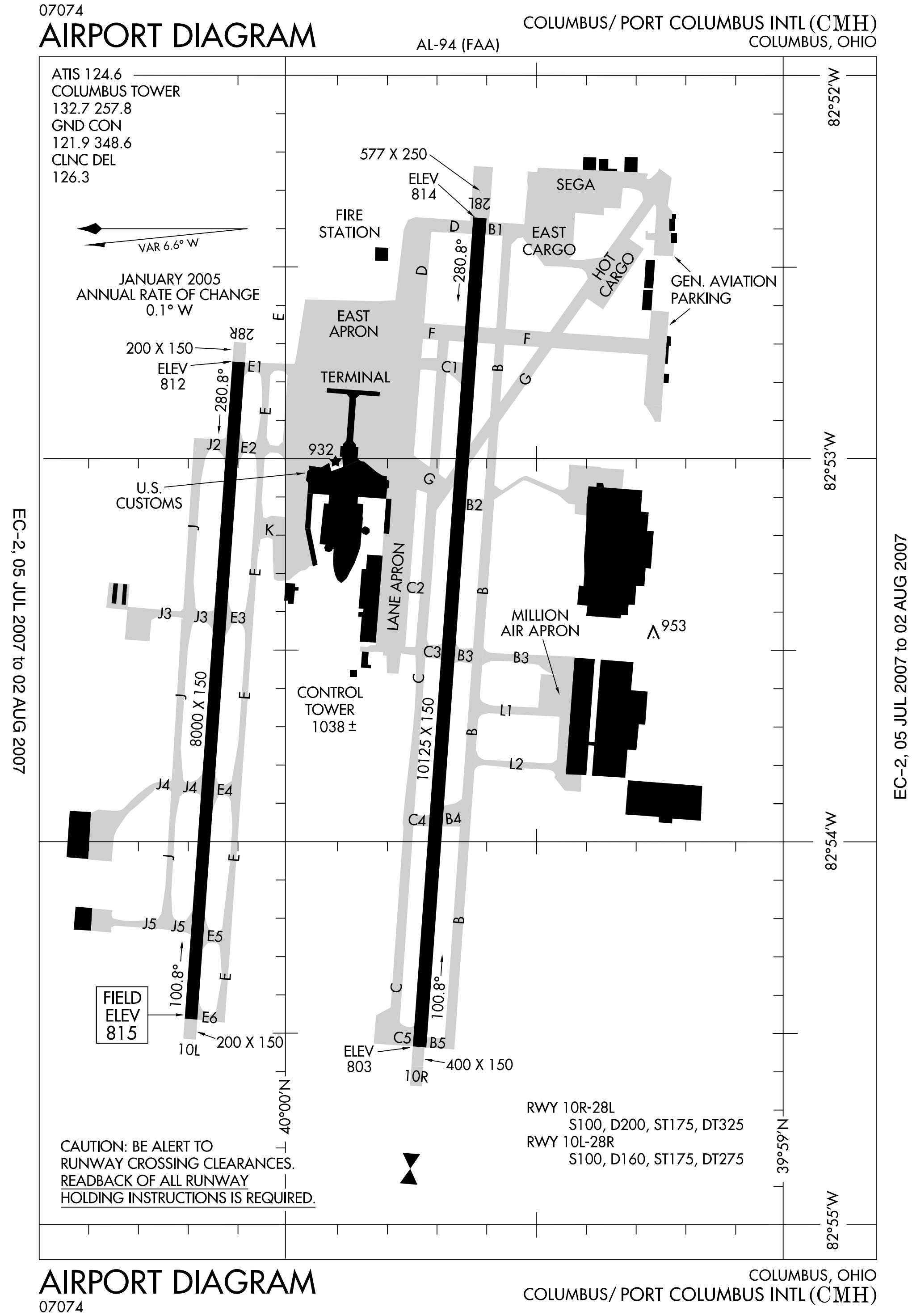
North Mariana Islands
Saipan Island
Francisco C. Ada/Saipan International
ICAO Identifier PGSN



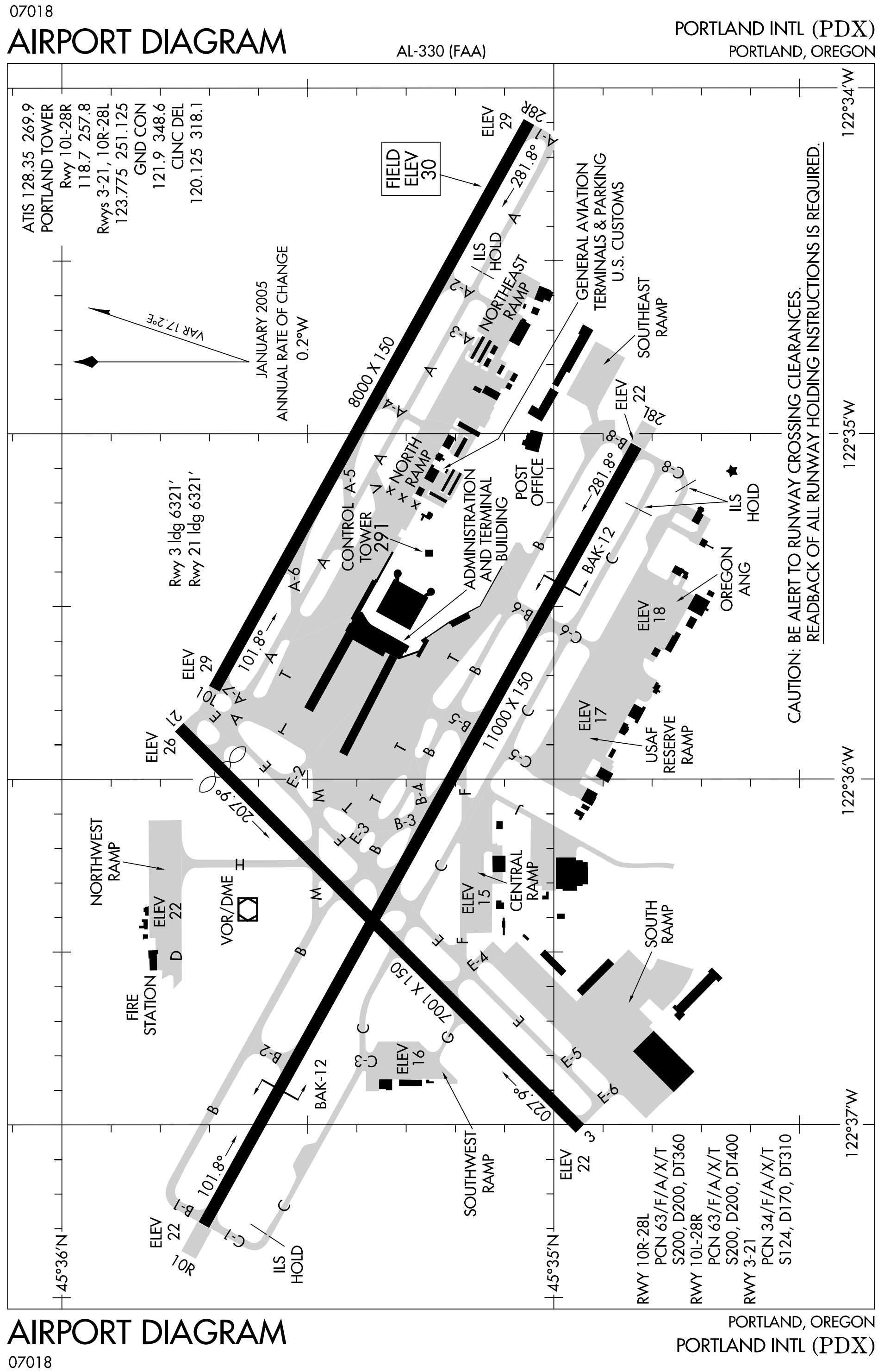
Cleveland, Ohio
Cleveland-Hopkins International
ICAO Identifier KCLE



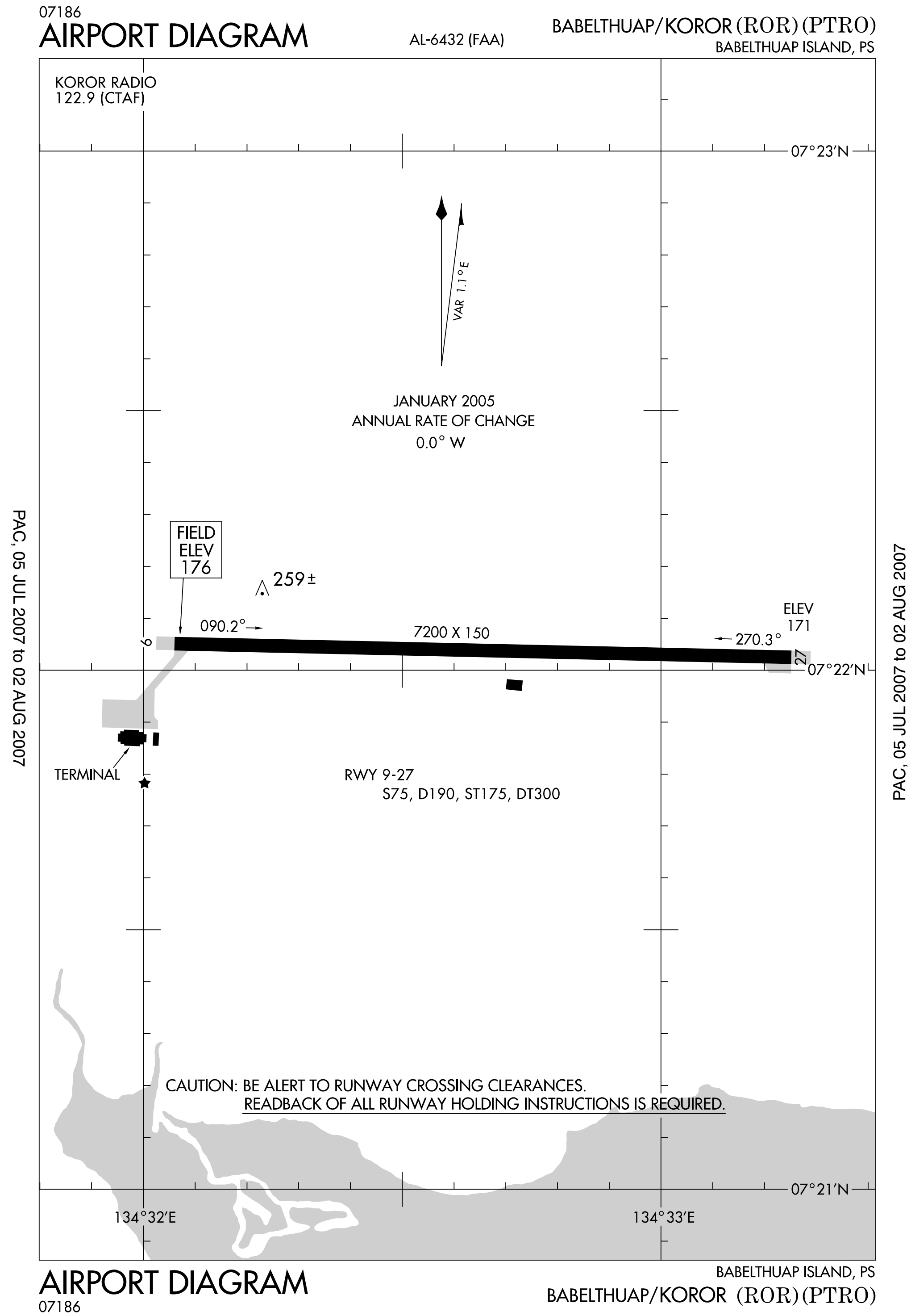
Columbus, Ohio
Port Columbus International
ICAO Identifier KCMH



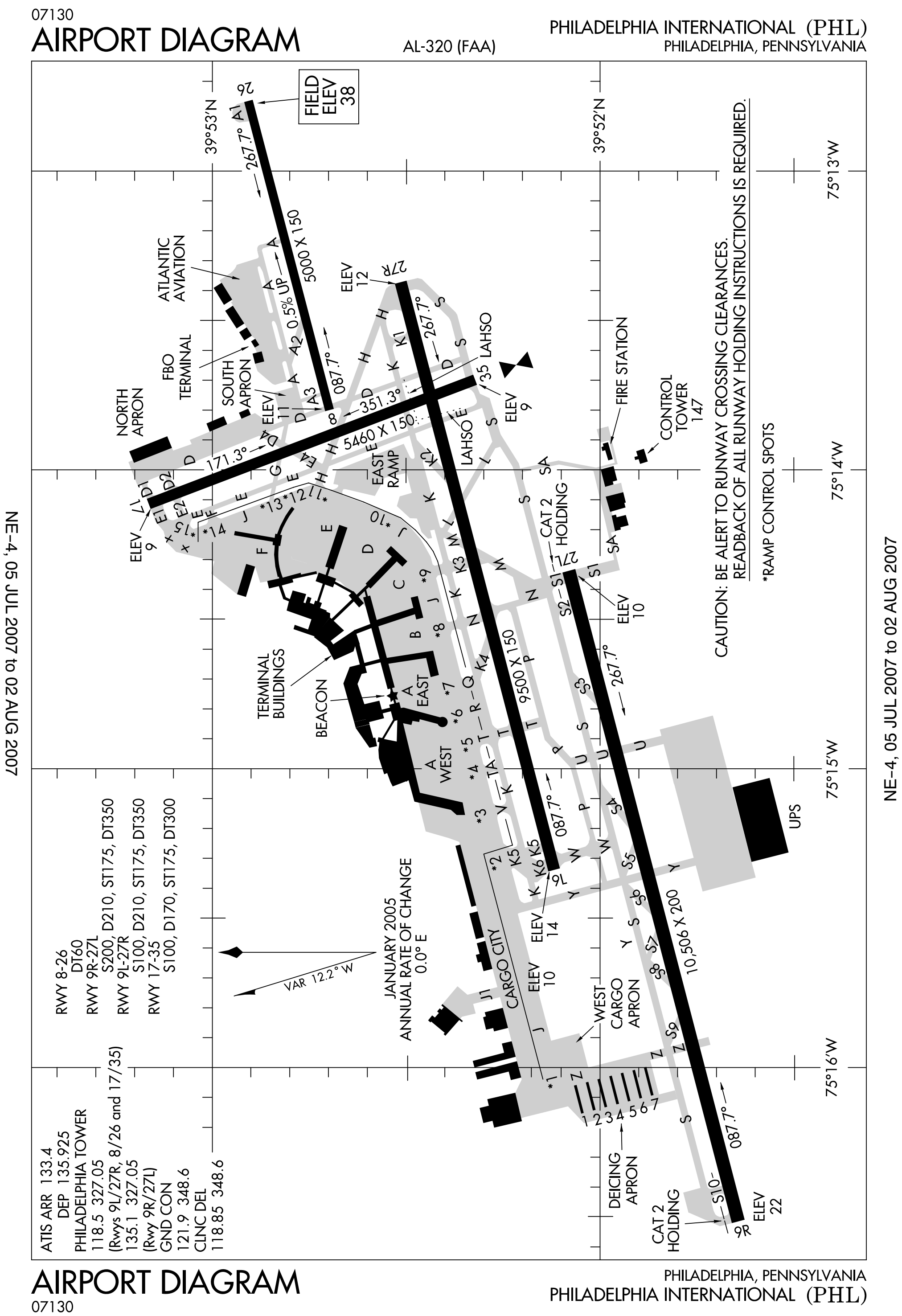
Portland, Oregon
Portland International
ICAO Identifier KPDX



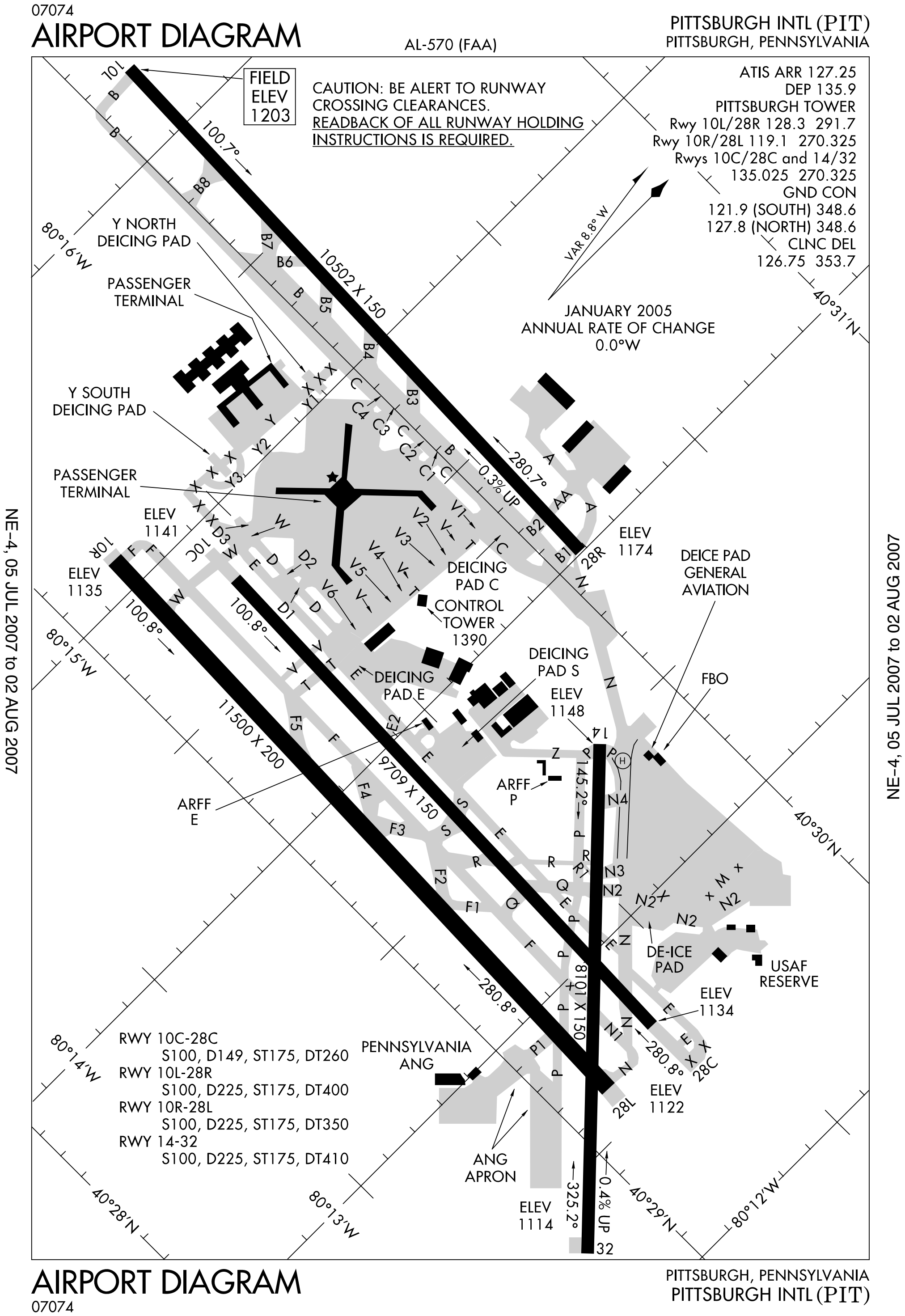
Babelthuap Island
Babelthuap/Koror
ICAO Identifier PTRO



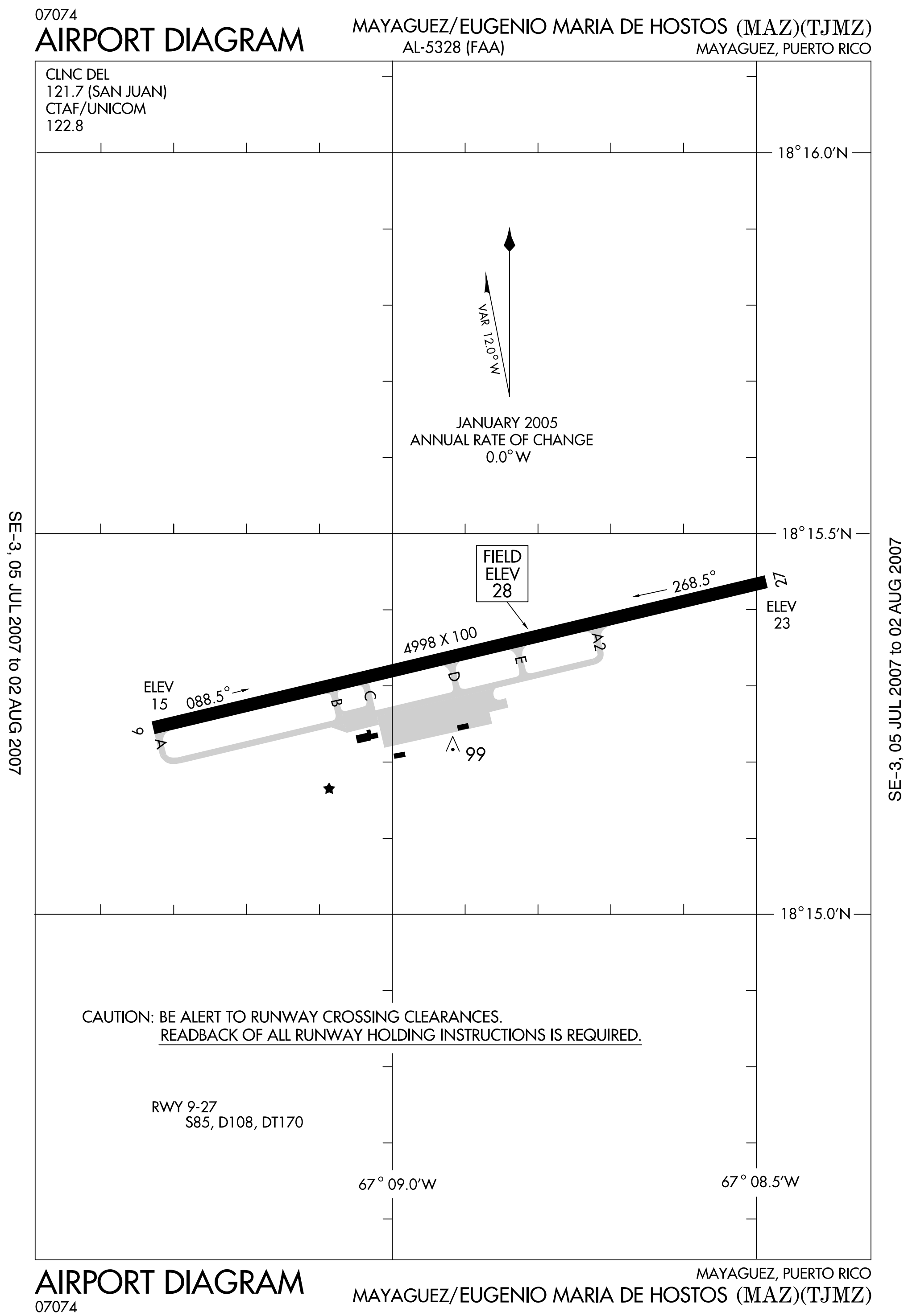
Philadelphia, Pennsylvania
Philadelphia International
ICAO Identifier KPHL



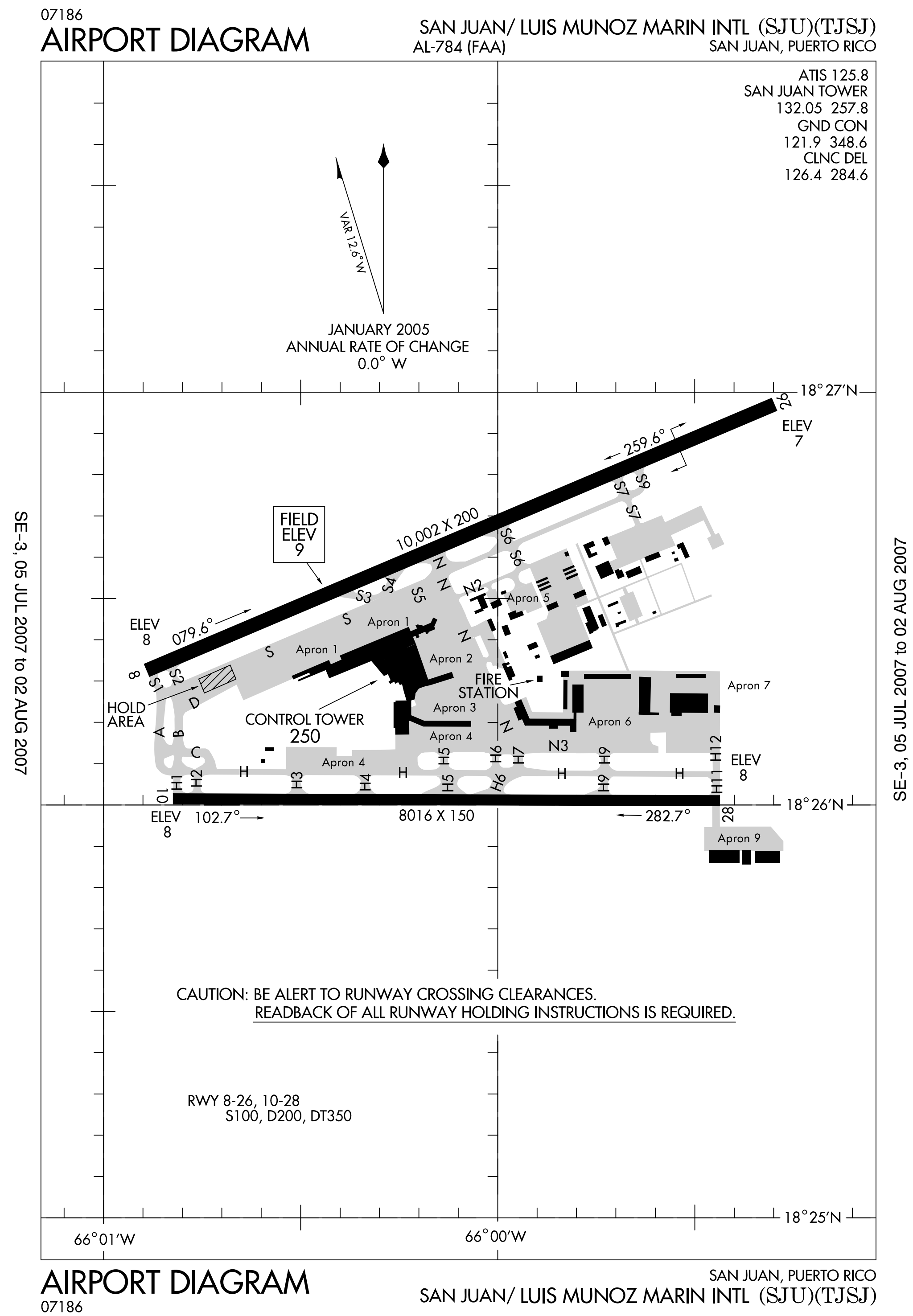
Pittsburgh, Pennsylvania
Pittsburgh International
ICAO Identifier KPIT



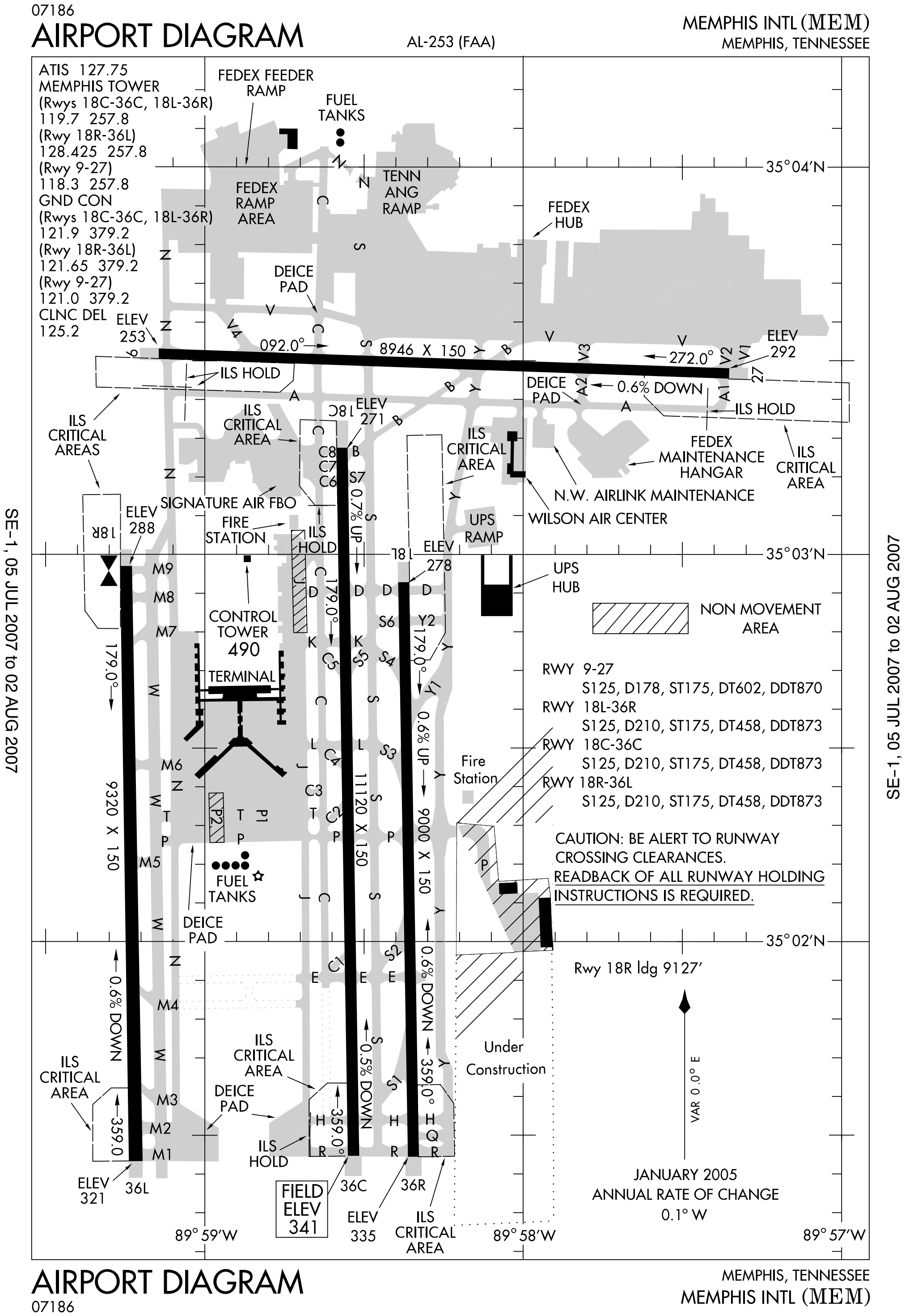
Mayaguez, Puerto Rico
Eugenio Maria De Hostos
ICAO Identifier TJMZ



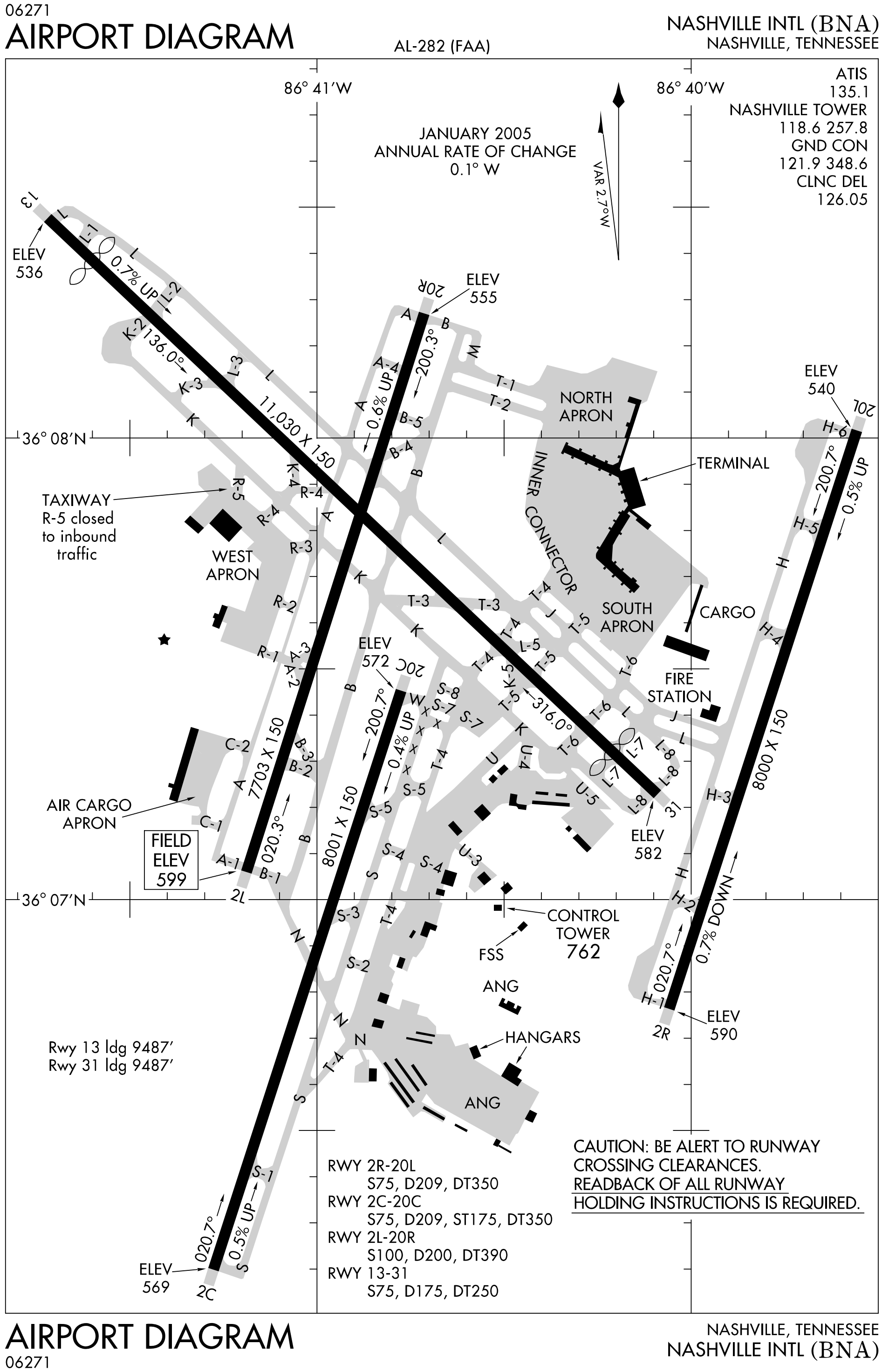
San Juan, Puerto Rico
Luis Munoz Marin International
ICAO Identifier TJSJ



Memphis, Tennessee
Memphis International
ICAO Identifier KMEM



Nashville, Tennessee
Nashville International
ICAO Identifier KBNA



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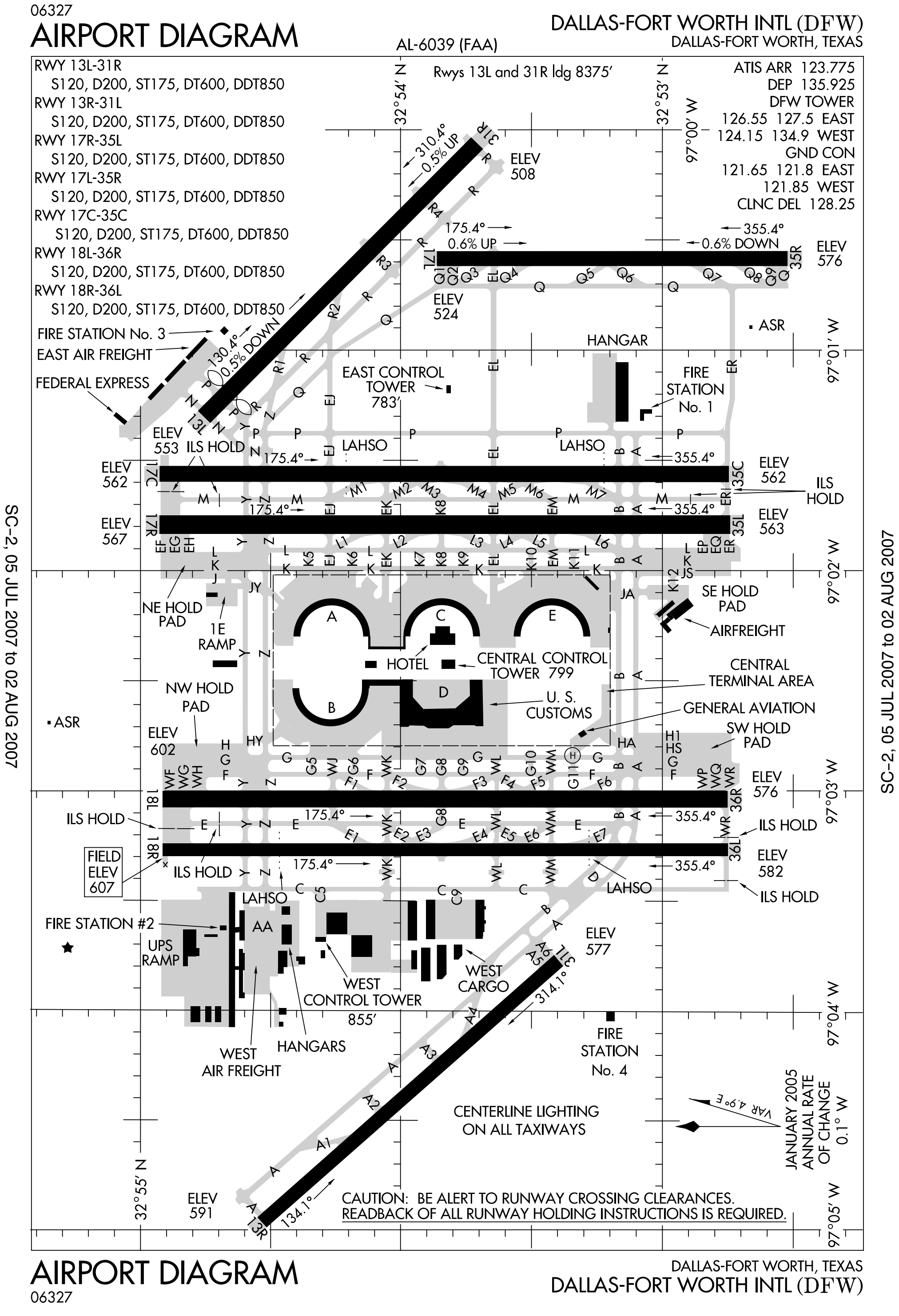
Dallas-Fort Worth International
ICAO Identifier KDFW



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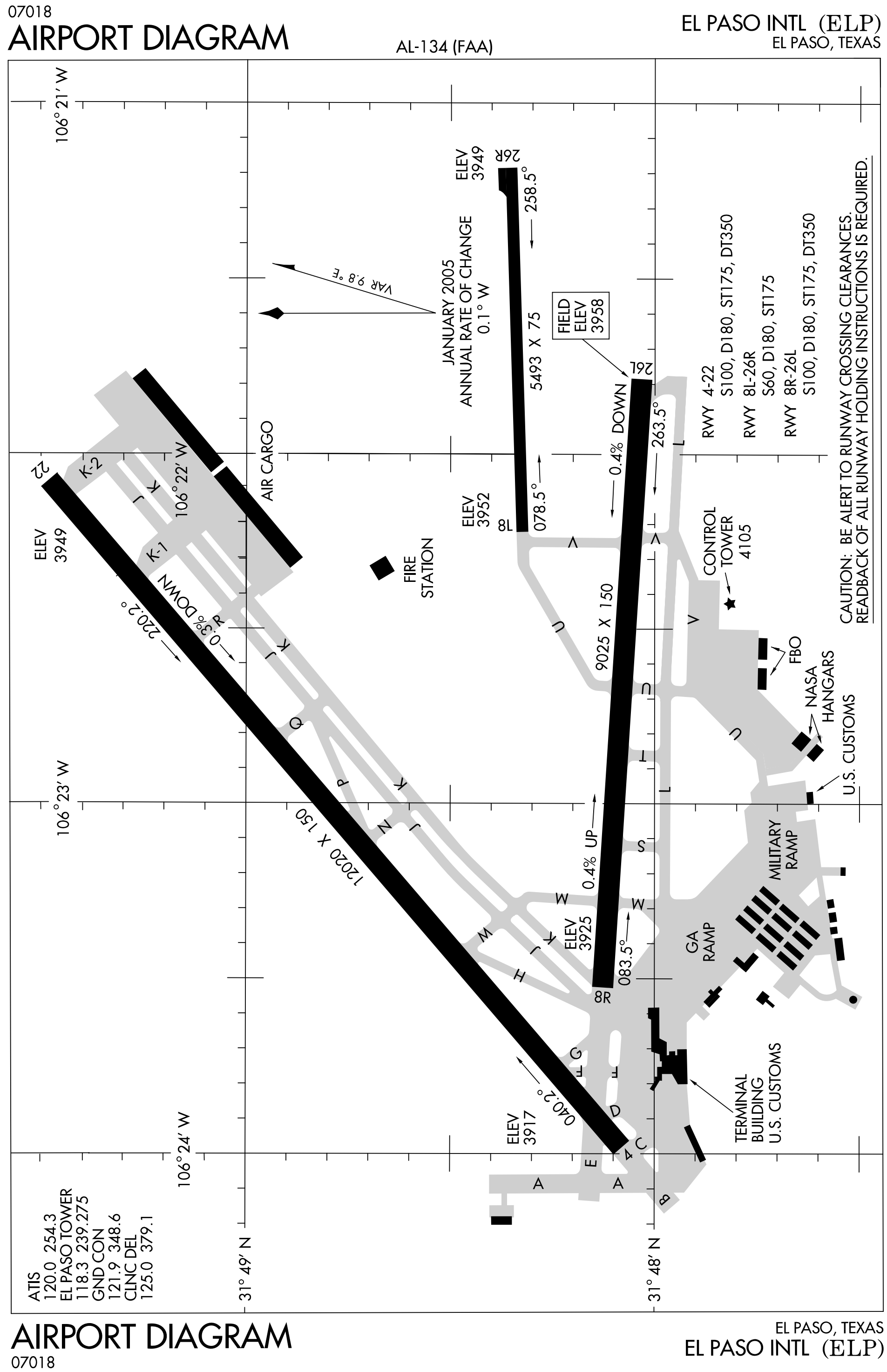
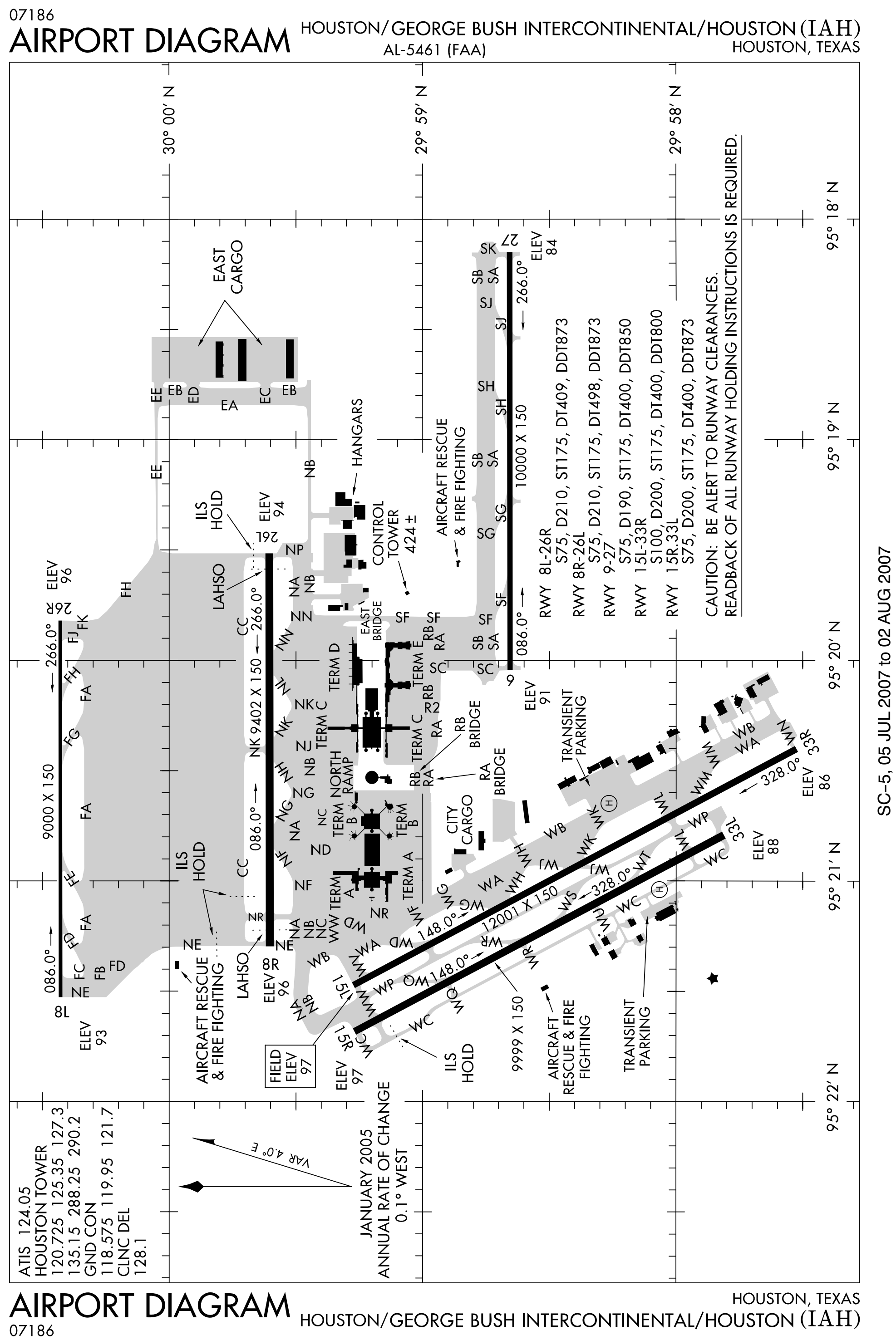
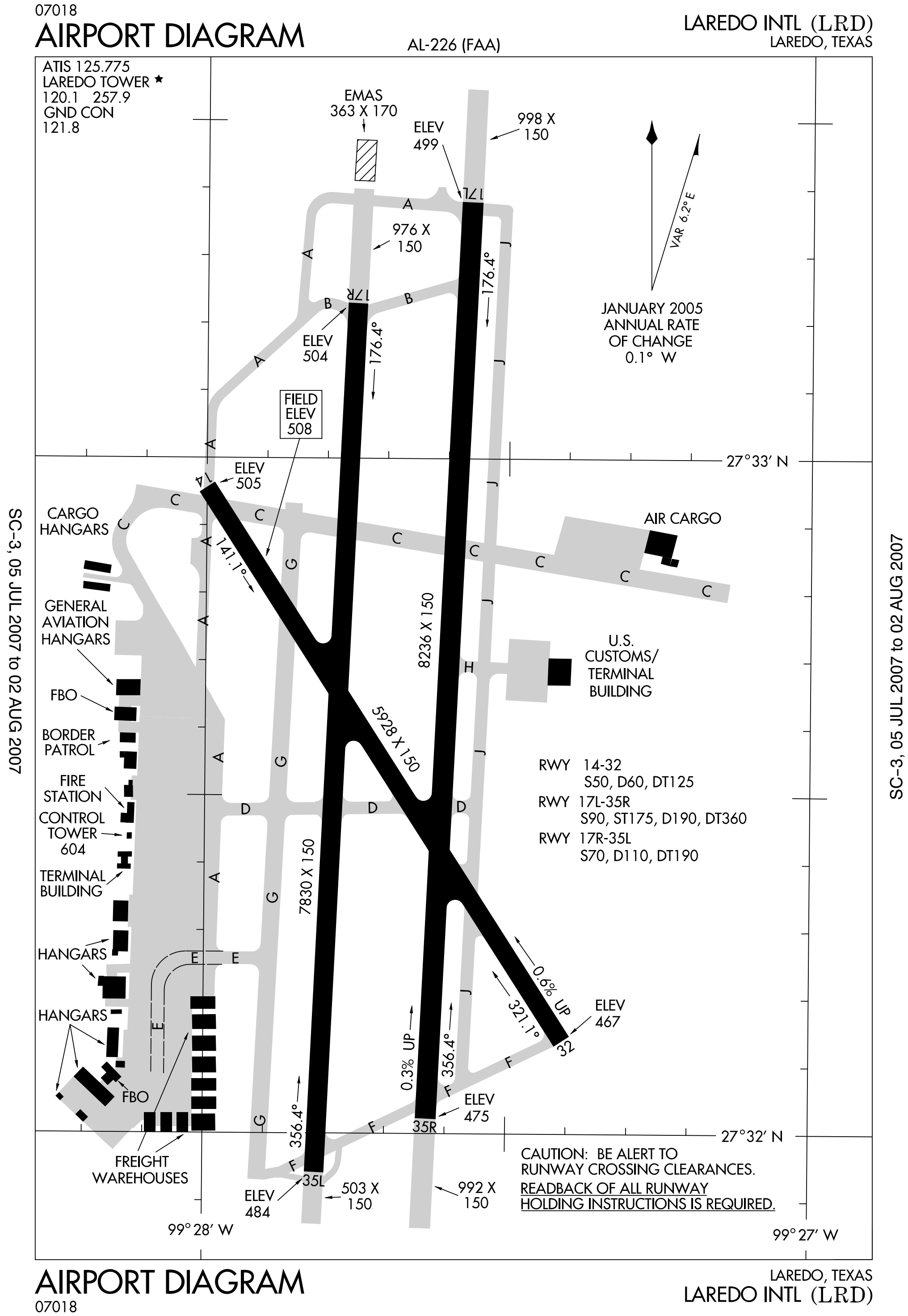
El Paso International
ICAO Identifier KELP



Houston, Texas
George Bush Intercontinental/Houston
ICAO Identifier KIAH



Laredo, Texas
Laredo International
ICAO Identifier KLRD



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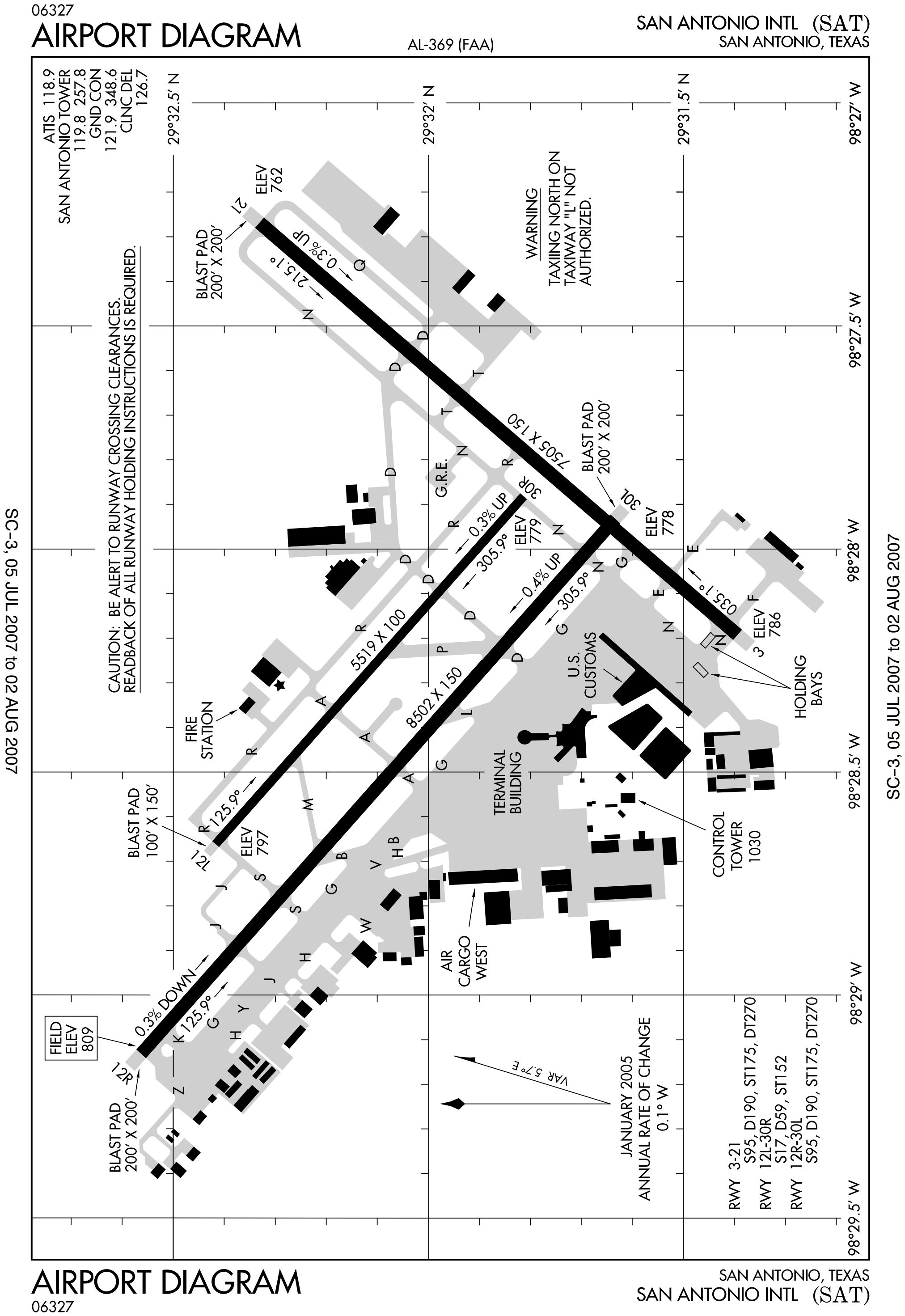
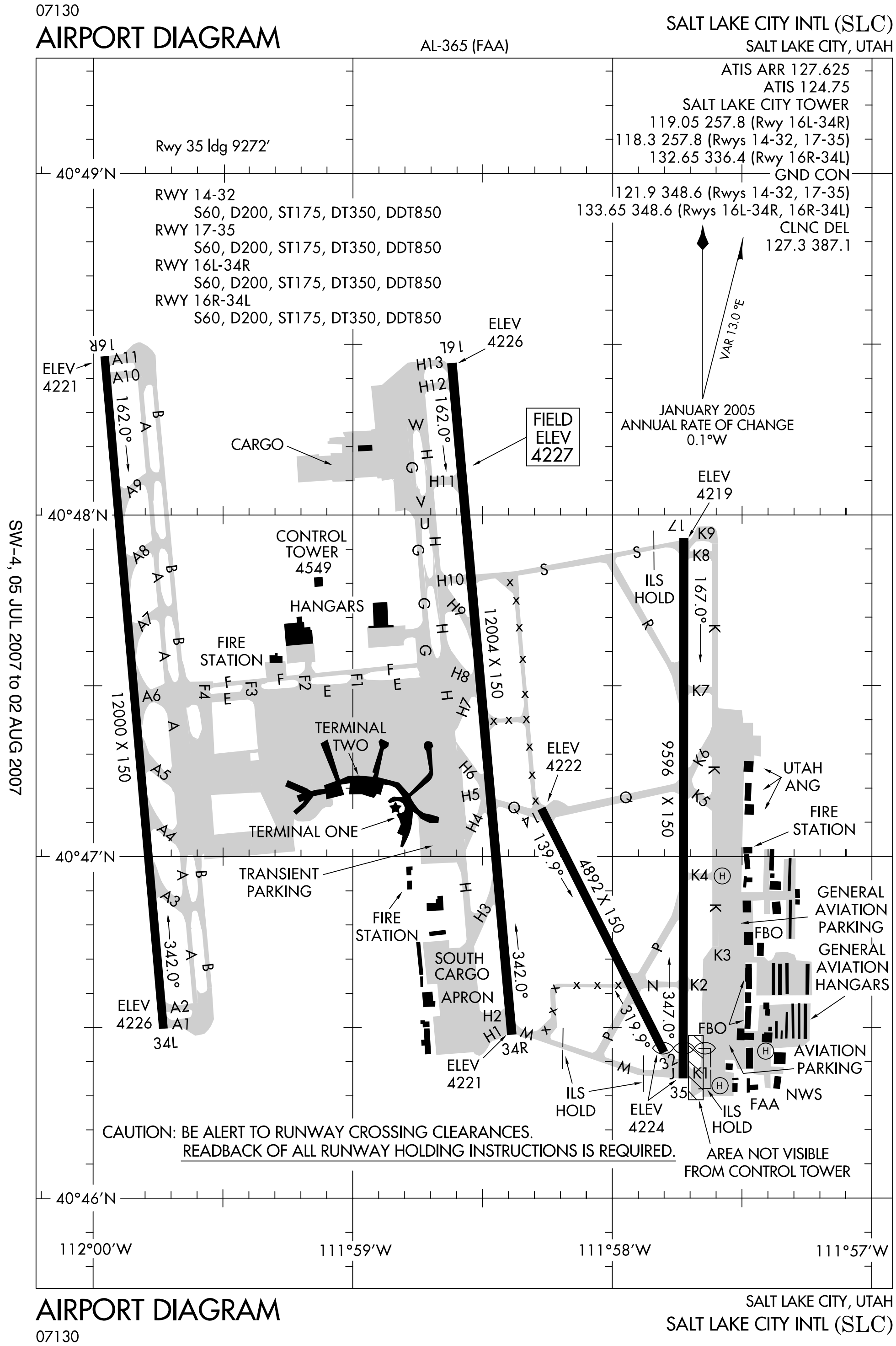
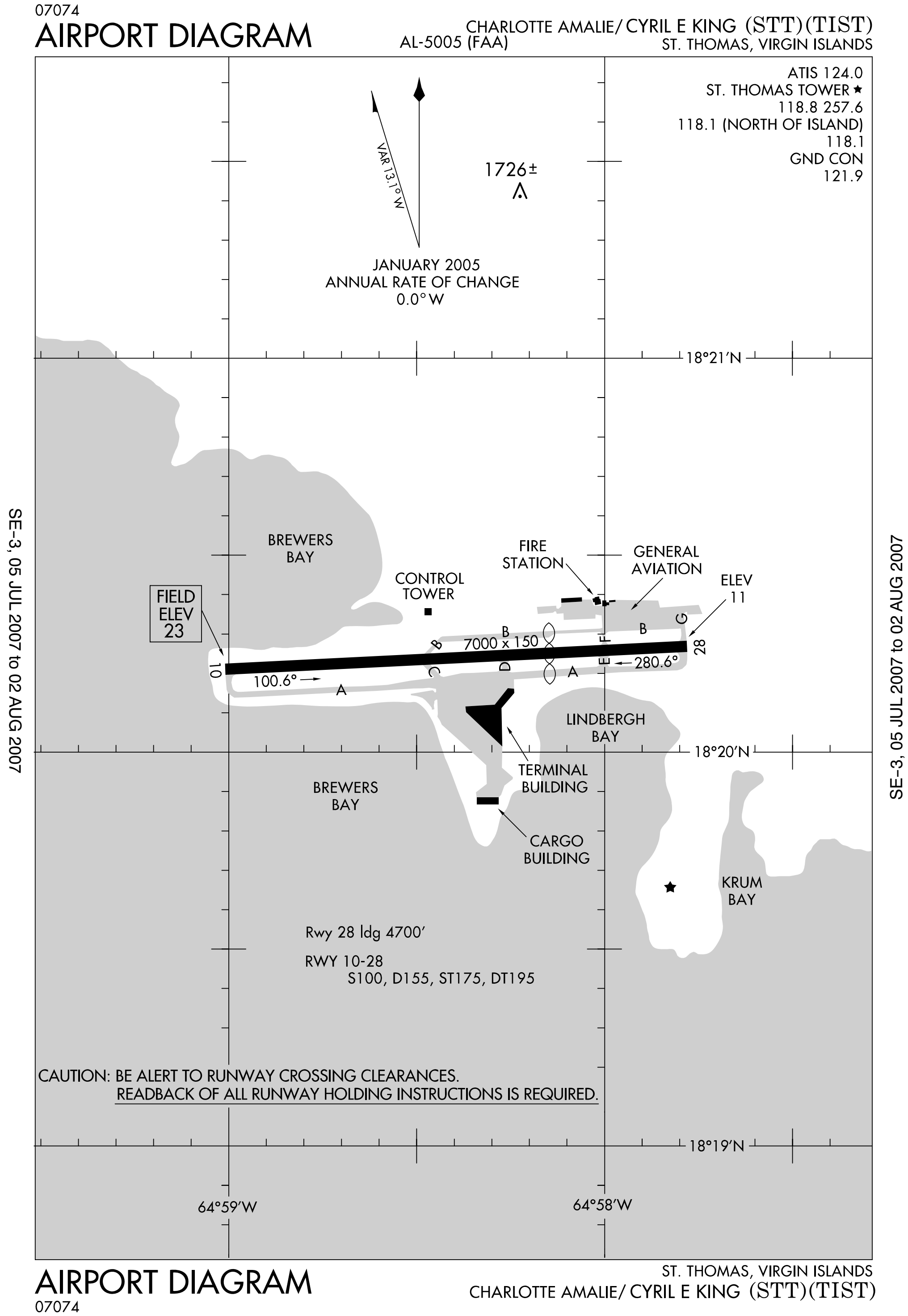
San Antonio International
ICAO Identifier KSAT



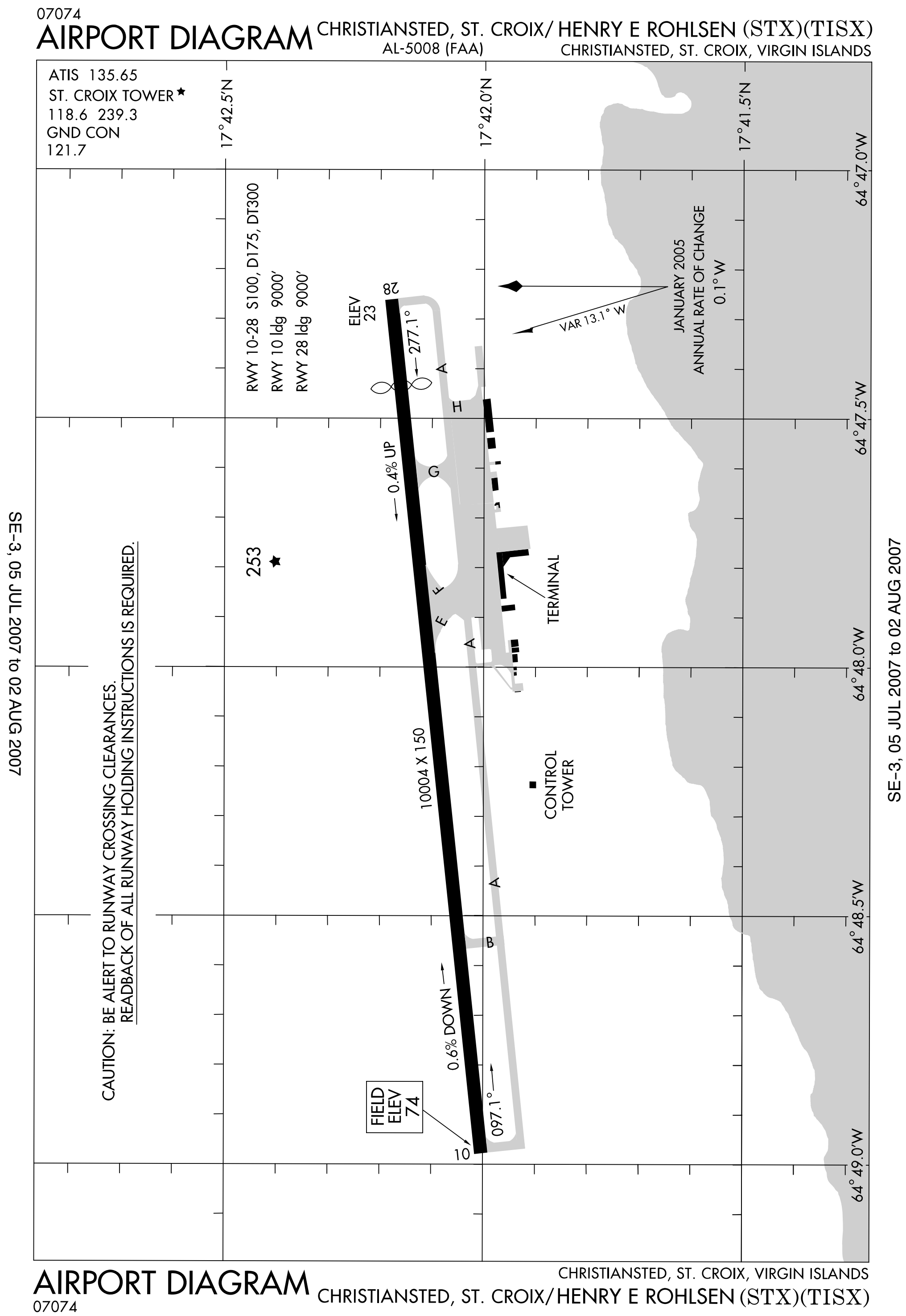
Salt Lake City, Utah
Salt Lake City International
ICAO Identifier KSLC



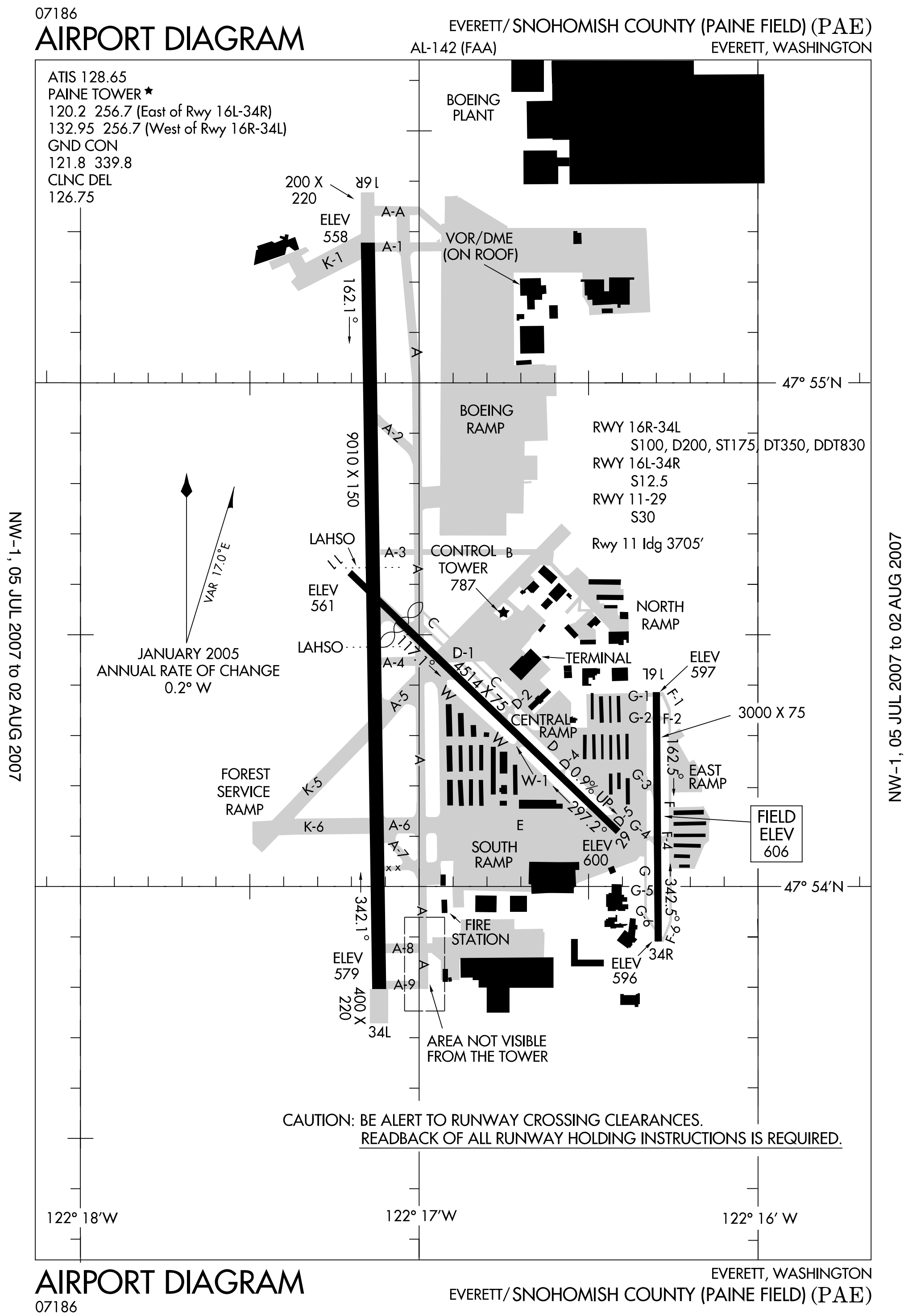
Charlotte Amalie St. Thomas, Virgin Islands
Cyril E. King
ICAO Identifier TIST



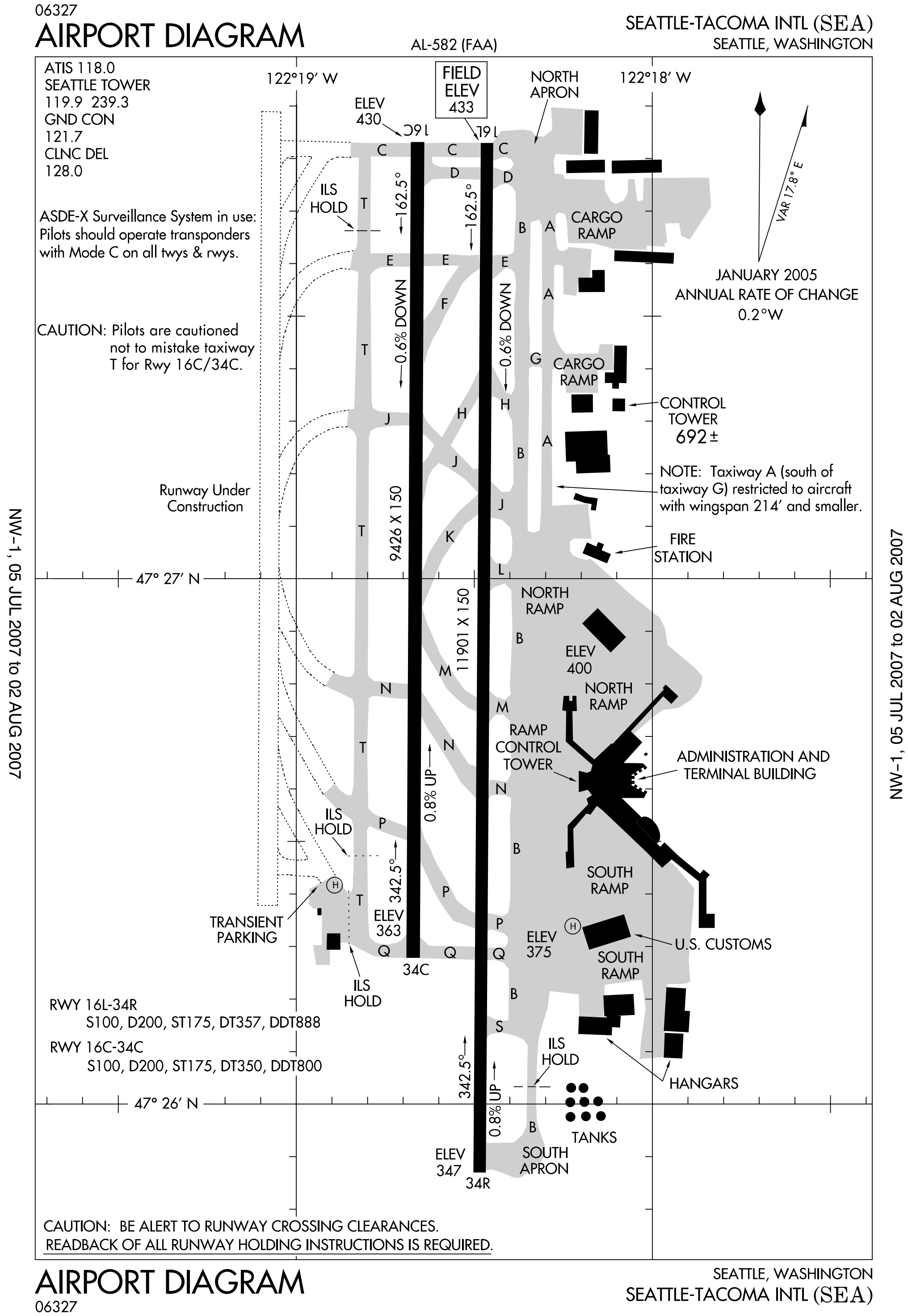
Christiansted St. Croix
Henry E Rohlsen
ICAO Identifier TISX



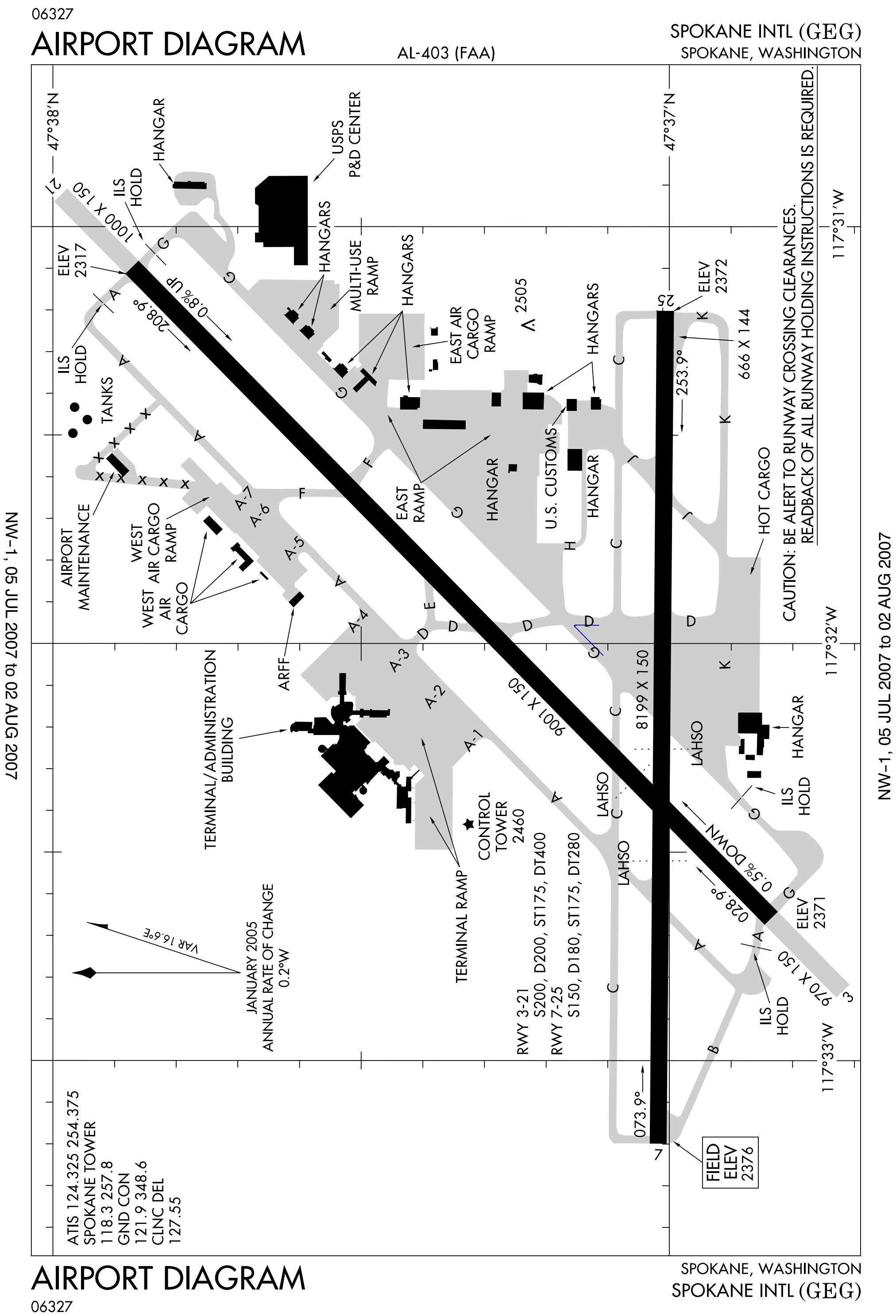
Everett, Washington
Snohomish County (Paine Field)
ICAO Identifier KPAE



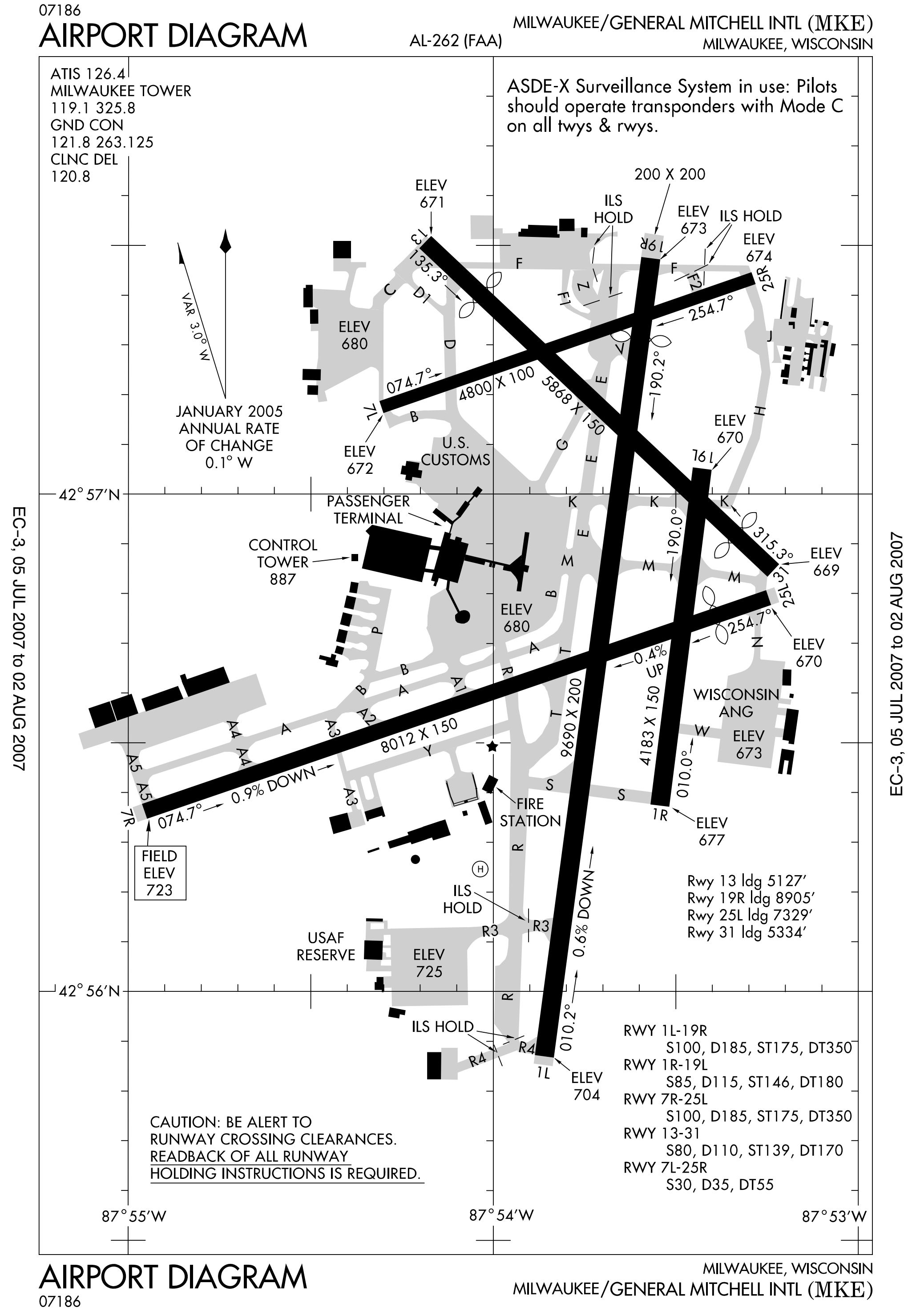
Seattle, Washington
Seattle-Tacoma International
ICAO Identifier KSEA



Spokane, Washington
Spokane International
ICAO Identifier KGEG



Milwaukee, Wisconsin
General Mitchell International
ICAO Identifier KMKE



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