



U.S. Department  
of Transportation

**Federal Aviation  
Administration**

# *AERONAUTICAL INFORMATION MANUAL*

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*Change 3  
December 31, 2020*

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**DO NOT DESTROY  
BASIC DATED  
AUGUST 15, 2019**



# Aeronautical Information Manual

## Explanation of Changes

**Effective: December 31, 2020**

### **a. 1-1-8. NAVIGATIONAL AID (NAVAID) SERVICE VOLUMES**

This paragraph has been completely rewritten. Significant changes include an updated explanation of Standard Service Volumes (SSVs) and how they are used in a PBN NAS, revised tables that incorporate new classes of VOR and DME, and new graphics depicting the new SSVs have been placed appropriately with corresponding text.

### **b. 1-1-9. INSTRUMENT LANDING SYSTEM (ILS)**

#### **4-1-3. FLIGHT SERVICE STATIONS**

#### **7-1-2. FAA WEATHER SERVICES**

#### **7-1-5. PREFLIGHT BRIEFING**

### **7-1-8. TELEPHONE INFORMATION BRIEFING SERVICES (TIBS)**

### **7-1-9. TRANSCRIBED WEATHER BROADCAST (TWEB) (ALASKA ONLY)**

#### **7-5-6. MOUNTAIN FLYING**

### **APPENDIX 3. ABBREVIATIONS/ACRONYMS**

This change removes references to TIBS and TWEB as these services are no longer provided by Flight Service.

### **c. 1-1-18. WIDE AREA AUGMENTATION SYSTEM (WAAS)**

### **5-1-9. INTERNATIONAL FLIGHT PLAN (FAA FORM 7233-4) IFR FLIGHTS (FOR DOMESTIC OR INTERNATIONAL FLIGHTS)**

#### **5-3-1. ARTCC COMMUNICATIONS**

This change removes references to Multi-Function Transport Satellite (MTSAT).

### **d. 2-1-6. RUNWAY STATUS LIGHT (RWSL) SYSTEM**

### **2-1-7. STAND-ALONE FINAL APPROACH RUNWAY OCCUPANCY SIGNAL**

This change deletes verbiage to Final Approach Runway Occupancy Signal (FAROS) and Runway Intersection Light (RIL) systems content, including revision of figures representing their removal.

### **e. 5-4-13. SIMULTANEOUS APPROACHES TO PARALLEL RUNWAYS**

### **5-4-16. SIMULTANEOUS CLOSE PARALLEL PRM APPROACHES AND SIMULTANEOUS OFFSET INSTRUMENT APPROACHES (SOIA)**

The minimum distance between parallel runways that permits simultaneous independent approaches has been reduced from 3000 feet to 2500 feet, along with the need for high update rate surveillance. Figures that address this issue have been updated to reflect this change. This revision will update FIG 5-4-20 and FIG 5-4-23.

### **f. 6-1-1. PILOT RESPONSIBILITY AND AUTHORITY**

Because these systems are programmed to make decisions that would normally fall upon the pilot-in-command and deviate as necessary to save lives and property, this change is to make the controller aware that an emergency autoland system or an emergency descent mode system may be in control of the aircraft.

### **g. 7-1-14. PROCEDURES FOR WEATHER DEVIATIONS AND OTHER CONTINGENCIES IN OCEANIC CONTROLLED AIRSPACE**

This change deletes inflight contingency procedures which will be out of date in subparagraph 7-1-14 c. The procedures will be updated in the AIP, where they belong.

### **h. Editorial Changes**

Editorial changes include the removal of a reference to a canceled Advisory Circular in paragraph 4-1-10. Another editorial change updates U.S. State Department contact information in paragraph 5-6-8. An editorial change removes an unnecessary “is” in paragraph 4-5-7. Finally, a reference to “56 weeks” in paragraph 9-1-4 was corrected to “56 days.”

**i. Entire Publication**

Additional editorial/format changes were made where necessary. Revision bars were not used because of the insignificant nature of these changes.

**AIM Change 3**  
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## Comments/Corrections

The office of primary responsibility (OPR) for this manual is:

FAA Headquarters, Mission Support Services  
Policy Directorate (AJV-P)  
600 Independence Avenue, SW.  
Washington, DC 20597

Proposed changes must be submitted electronically, using the following format, to the Policy Directorate Correspondence Mailbox at [9-AJV-P-HQ-Correspondence@faa.gov](mailto:9-AJV-P-HQ-Correspondence@faa.gov).

### Notice to Editor

The following comments/corrections are submitted concerning the information contained in:

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### 1-1-6. VHF Omni-directional Range/Tactical Air Navigation (VORTAC)

a. A VORTAC is a facility consisting of two components, VOR and TACAN, which provides three individual services: VOR azimuth, TACAN azimuth and TACAN distance (DME) at one site. Although consisting of more than one component, incorporating more than one operating frequency, and using more than one antenna system, a VORTAC is considered to be a unified navigational aid. Both components of a VORTAC are envisioned as operating simultaneously and providing the three services at all times.

b. Transmitted signals of VOR and TACAN are each identified by three-letter code transmission and are interlocked so that pilots using VOR azimuth with TACAN distance can be assured that both signals being received are definitely from the same ground station. The frequency channels of the VOR and the TACAN at each VORTAC facility are “paired” in accordance with a national plan to simplify airborne operation.

### 1-1-7. Distance Measuring Equipment (DME)

a. In the operation of DME, paired pulses at a specific spacing are sent out from the aircraft (this is the interrogation) and are received at the ground station. The ground station (transponder) then transmits paired pulses back to the aircraft at the same pulse spacing but on a different frequency. The time required for the round trip of this signal exchange is measured in the airborne DME unit and is translated into distance (nautical miles) from the aircraft to the ground station.

b. Operating on the line-of-sight principle, DME furnishes distance information with a very high degree of accuracy. Reliable signals may be received at distances up to 199 NM at line-of-sight altitude with an accuracy of better than  $\frac{1}{2}$  mile or 3 percent of the distance, whichever is greater. Distance information received from DME equipment is SLANT RANGE distance and not actual horizontal distance.

c. Operating frequency range of a DME according to ICAO Annex 10 is from 960 MHz to 1215 MHz. Aircraft equipped with TACAN equipment will receive distance information from a VORTAC

automatically, while aircraft equipped with VOR must have a separate DME airborne unit.

d. VOR/DME, VORTAC, Instrument Landing System (ILS)/DME, and localizer (LOC)/DME navigation facilities established by the FAA provide course and distance information from collocated components under a frequency pairing plan. Aircraft receiving equipment which provides for automatic DME selection assures reception of azimuth and distance information from a common source when designated VOR/DME, VORTAC, ILS/DME, and LOC/DME are selected.

e. Due to the limited number of available frequencies, assignment of paired frequencies is required for certain military noncollocated VOR and TACAN facilities which serve the same area but which may be separated by distances up to a few miles.

f. VOR/DME, VORTAC, ILS/DME, and LOC/DME facilities are identified by synchronized identifications which are transmitted on a time share basis. The VOR or localizer portion of the facility is identified by a coded tone modulated at 1020 Hz or a combination of code and voice. The TACAN or DME is identified by a coded tone modulated at 1350 Hz. The DME or TACAN coded identification is transmitted one time for each three or four times that the VOR or localizer coded identification is transmitted. When either the VOR or the DME is inoperative, it is important to recognize which identifier is retained for the operative facility. A single coded identification with a repetition interval of approximately 30 seconds indicates that the DME is operative.

g. Aircraft equipment which provides for automatic DME selection assures reception of azimuth and distance information from a common source when designated VOR/DME, VORTAC and ILS/DME navigation facilities are selected. Pilots are cautioned to disregard any distance displays from automatically selected DME equipment when VOR or ILS facilities, which do not have the DME feature installed, are being used for position determination.

### 1-1-8. NAVAID Service Volumes

a. The FAA publishes Standard Service Volumes (SSVs) for most NAVAIDs. The SSV is a three-dimensional volume within which the FAA ensures that a signal can be received with adequate

signal strength and course quality, and is free from interference from other NAVAIDs on similar frequencies (e.g., co-channel or adjacent-channel interference). However, the SSV signal protection does not include potential blockage from terrain or obstructions. The SSV is principally intended for off-route navigation, such as proceeding direct to or from a VOR when not on a published instrument procedure or route. Navigation on published instrument procedures (e.g., approaches or departures) or routes (e.g., Victor routes) may use NAVAIDs outside of the SSV, when Extended Service Volume (ESV) is approved, since adequate signal strength, course quality, and freedom from interference are verified by the FAA prior to the publishing of the instrument procedure or route.

**NOTE-**

*A conical area directly above the NAVAID is generally not usable for navigation.*

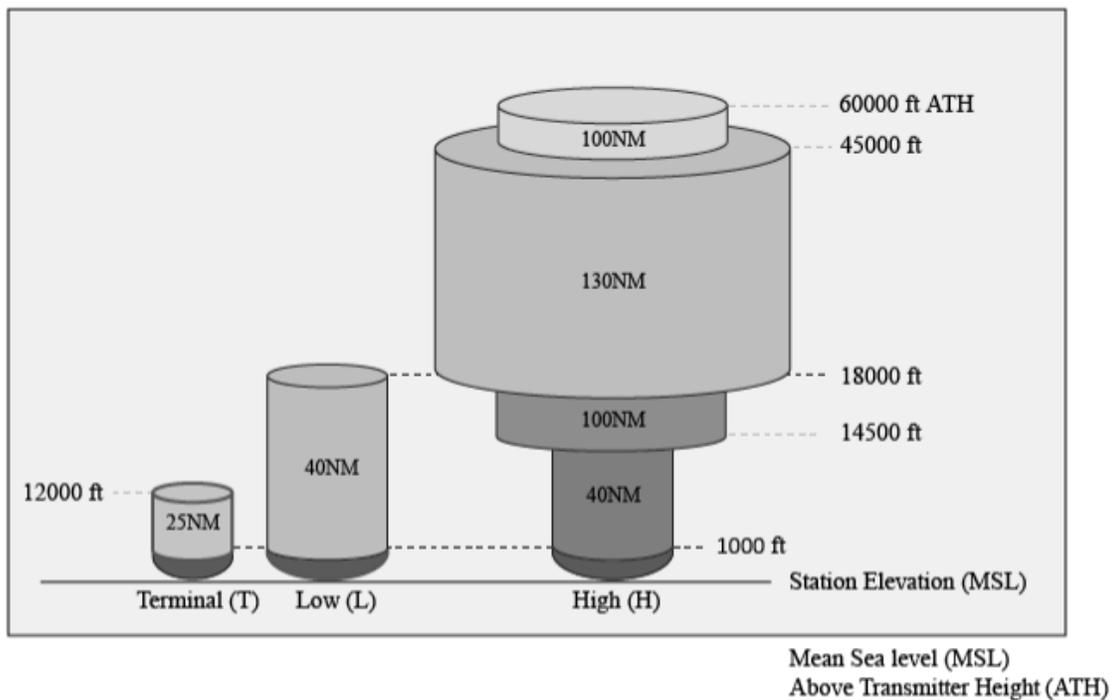
b. A NAVAID will have service volume restric-

tions if it does not conform to signal strength and course quality standards throughout the published SSV. Service volume restrictions are first published in Notices to Airmen (NOTAMs) and then with the alphabetical listing of the NAVAIDs in the Chart Supplement. Service volume restrictions do not generally apply to published instrument procedures or routes unless published in NOTAMs for the affected instrument procedure or route.

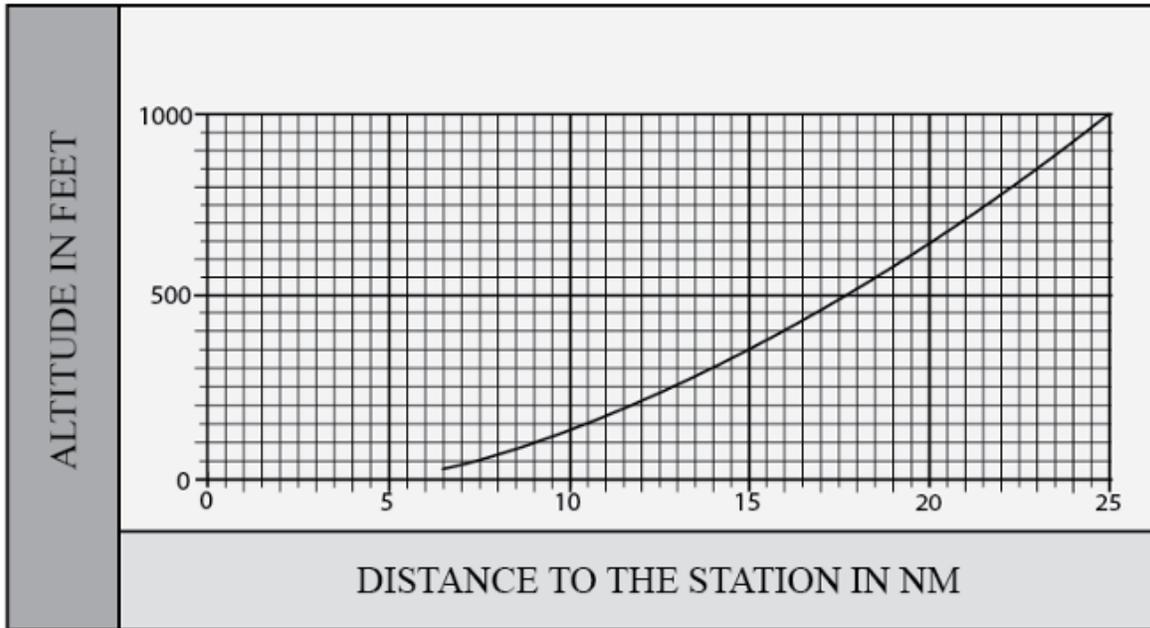
c. VOR/DME/TACAN Standard Service Volumes (SSV).

1. The three original SSVs are shown in FIG 1-1-1 and are designated with three classes of NAVAIDs: Terminal (T), Low (L), and High (H). The usable distance of the NAVAID depends on the altitude Above the Transmitter Height (ATH) for each class. The lower edge of the usable distance when below 1,000 feet ATH is shown in FIG 1-1-2 for Terminal NAVAIDs and in FIG 1-1-3 for Low and High NAVAIDs.

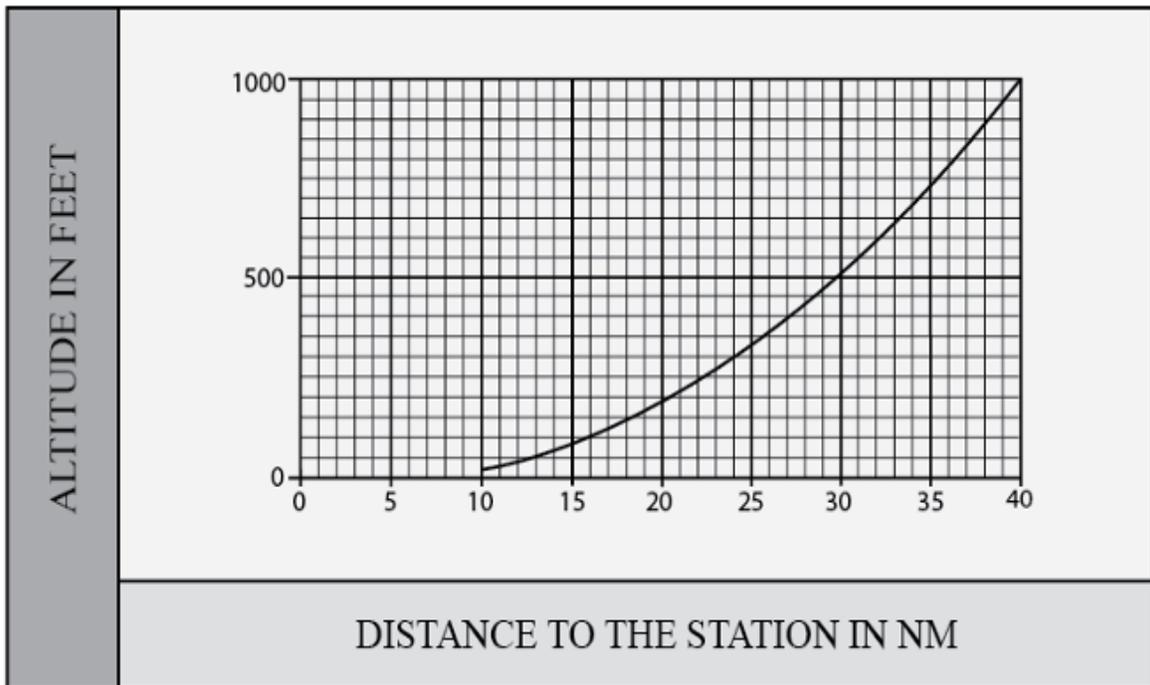
**FIG 1-1-1  
Original Standard Service Volumes**



*FIG 1-1-2*  
**Lower Edge of the Terminal Service Volume (in altitude ATH)**



*FIG 1-1-3*  
**Lower Edge of Low and High Service Volumes (in altitude ATH)**



2. With the progression of navigation capabilities to Performance Based Navigation (PBN), additional capabilities for off-route navigation are necessary. For example, the VOR MON (See paragraph 1-1-3 f.) requires the use of VORs at 5,000 feet AGL, which is beyond the original SSV ranges. Additionally, PBN procedures using DME require extended ranges. As a result, the FAA created four additional SSVs. Two of the new SSVs are associated with VORs: VOR Low (VL) and VOR High (VH), as

shown in FIG 1-1-4. The other two new SSVs are associated with DME: DME Low (DL) and DME High (DH), as shown in FIG 1-1-5. The SSV at altitudes below 1,000 feet for the VL and VH are the same as FIG 1-1-3. The SSVs at altitudes below 12,900 feet for the DL and DH SSVs correspond to a conservative estimate of the DME radio line of sight (RLOS) coverage at each altitude (not including possible terrain blockage).

FIG 1-1-4  
New VOR Service Volumes

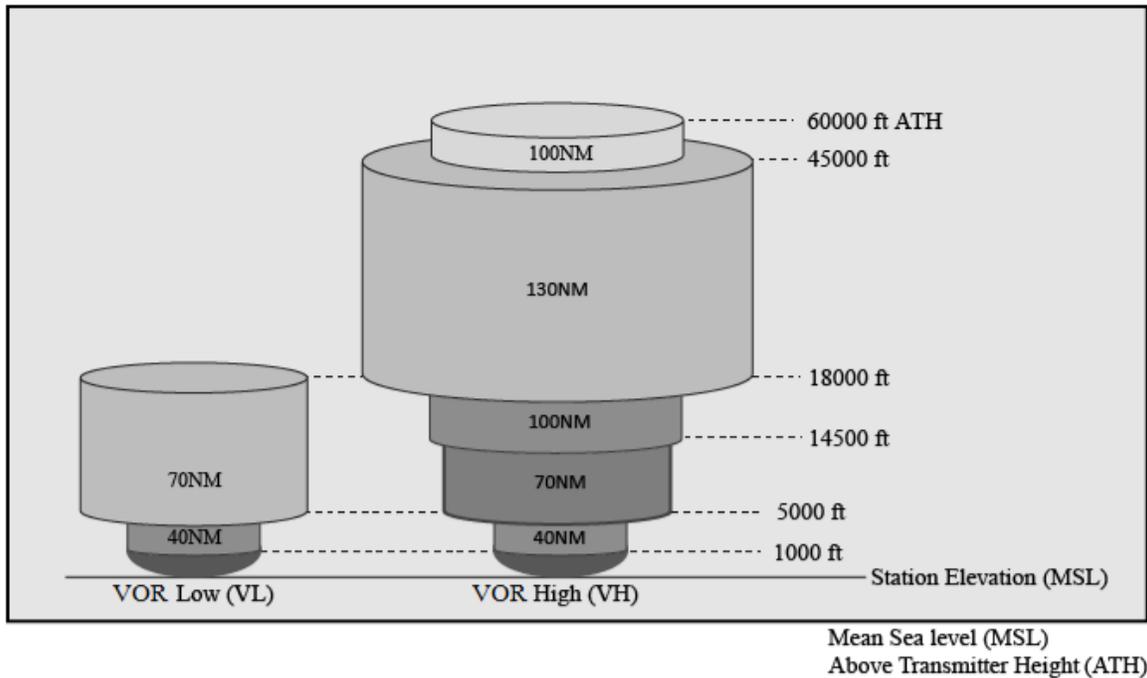
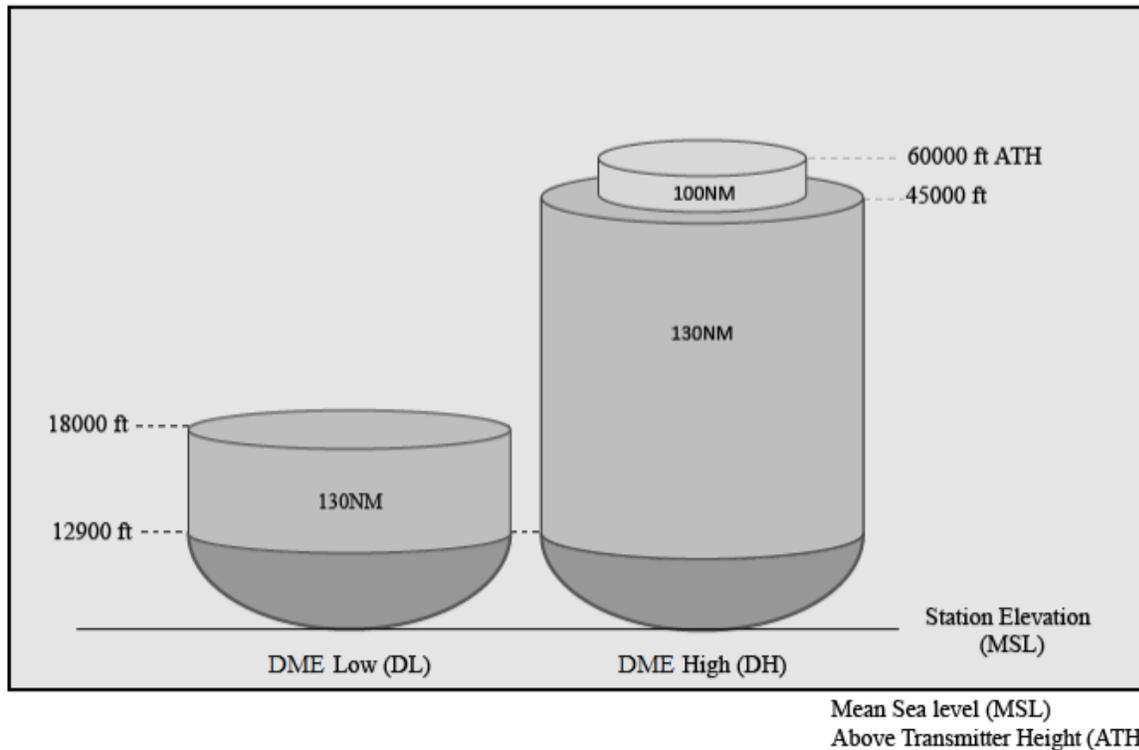


FIG 1-1-5  
New DME Service Volumes



**NOTE-**

1. In the past, NAVAIDs at one location typically all had the same SSV. For example, a VORTAC typically had a High (H) SSV for the VOR, the TACAN azimuth, and the TACAN DME, or a Low (L) or Terminal (T) SSV for all three. A VOR/DME typically had a High (H), Low (L), or Terminal (T) for both the VOR and the DME. A common SSV may no longer be the case at all locations. A VOR/DME, for example, could have an SSV of VL for the VOR and DH for the DME, or other combinations.
2. The TACAN azimuth will only be classified as T, L, or H.

3. TBL 1-1-1 is a tabular summary of the VOR, DME, and TACAN NAVAID SSVs, not including altitudes below 1,000 feet ATH for VOR and TACAN Azimuth, and not including ranges for altitudes below 12,900 feet for TACAN and DME.

**TBL 1-1-1**  
**VOR/DME/TACAN Standard Service Volumes**

SSV Designator	Altitude and Range Boundaries
T (Terminal)	From 1,000 feet ATH up to and including 12,000 feet ATH at radial distances out to 25 NM.
L (Low Altitude)	From 1,000 feet ATH up to and including 18,000 feet ATH at radial distances out to 40 NM.
H (High Altitude)	From 1,000 feet ATH up to and including 14,500 feet ATH at radial distances out to 40 NM. From 14,500 ATH up to and including 60,000 feet at radial distances out to 100 NM. From 18,000 feet ATH up to and including 45,000 feet ATH at radial distances out to 130 NM.
VL (VOR Low)	From 1,000 feet ATH up to but not including 5,000 feet ATH at radial distances out to 40 NM. From 5,000 feet ATH up to but not including 18,000 feet ATH at radial distances out to 70 NM.
VH (VOR High)	From 1,000 feet ATH up to but not including 5,000 feet ATH at radial distances out to 40 NM. From 5,000 feet ATH up to but not including 14,500 feet ATH at radial distances out to 70 NM. From 14,500 ATH up to and including 60,000 feet at radial distances out to 100 NM. From 18,000 feet ATH up to and including 45,000 feet ATH at radial distances out to 130 NM.
DL (DME Low)	For altitudes up to 12,900 feet ATH at a radial distance corresponding to the LOS to the NAVAID. From 12,900 feet ATH up to but not including 18,000 feet ATH at radial distances out to 130 NM
DH (DME High)	For altitudes up to 12,900 feet ATH at a radial distance corresponding to the LOS to the NAVAID. From 12,900 ATH up to and including 60,000 feet at radial distances out to 100 NM. From 12,900 feet ATH up to and including 45,000 feet ATH at radial distances out to 130 NM.

d. Nondirectional Radio Beacon (NDB) SSVs. NDBs are classified according to their intended use. The ranges of NDB service volumes are shown in

TBL 1-1-2. The distance (radius) is the same at all altitudes for each class.

**TBL 1-1-2**  
**NDB Service Volumes**

Class	Distance (Radius) (NM)
Compass Locator	15
MH	25
H	50*
HH	75

*\*Service ranges of individual facilities may be less than 50 nautical miles (NM). Restrictions to service volumes are first published as a Notice to Airmen and then with the alphabetical listing of the NAVAID in the Chart Supplement U.S.*

### 1-1-9. Instrument Landing System (ILS)

#### a. General

1. The ILS is designed to provide an approach path for exact alignment and descent of an aircraft on final approach to a runway.

2. The basic components of an ILS are the localizer, glide slope, and Outer Marker (OM) and, when installed for use with Category II or Category III instrument approach procedures, an Inner Marker (IM).

3. The system may be divided functionally into three parts:

(a) **Guidance information:** localizer, glide slope.

(b) **Range information:** marker beacon, DME.

(c) **Visual information:** approach lights, touchdown and centerline lights, runway lights.

4. The following means may be used to substitute for the OM:

(a) Compass locator; or

(b) Precision Approach Radar (PAR); or

(c) Airport Surveillance Radar (ASR); or

(d) Distance Measuring Equipment (DME), Very High Frequency Omni-directional Range (VOR), or Nondirectional beacon fixes authorized in the Standard Instrument Approach Procedure; or

(e) Very High Frequency Omni-directional Radio Range (VOR); or

(f) Nondirectional beacon fixes authorized in the Standard Instrument Approach Procedure; or

(g) A suitable RNAV system with Global Positioning System (GPS), capable of fix identification on a Standard Instrument Approach Procedure.

5. Where a complete ILS system is installed on each end of a runway; (i.e., the approach end of Runway 4 and the approach end of Runway 22) the ILS systems are not in service simultaneously.

### b. Localizer

1. The localizer transmitter operates on one of 40 ILS channels within the frequency range of 108.10 to 111.95 MHz. Signals provide the pilot with course guidance to the runway centerline.

2. The approach course of the localizer is called the front course and is used with other functional parts, e.g., glide slope, marker beacons, etc. The localizer signal is transmitted at the far end of the runway. It is adjusted for a course width of (full scale fly-left to a full scale fly-right) of 700 feet at the runway threshold.

3. The course line along the extended centerline of a runway, in the opposite direction to the front course is called the back course.

### CAUTION-

*Unless the aircraft's ILS equipment includes reverse sensing capability, when flying inbound on the back course it is necessary to steer the aircraft in the direction opposite the needle deflection when making corrections from off-course to on-course. This "flying away from the needle" is also required when flying outbound on the front course of the localizer. Do not use back course signals for approach unless a back course approach procedure is published for that particular runway and the approach is authorized by ATC.*

4. Identification is in International Morse Code and consists of a three-letter identifier preceded by the letter I (•••) transmitted on the localizer frequency.

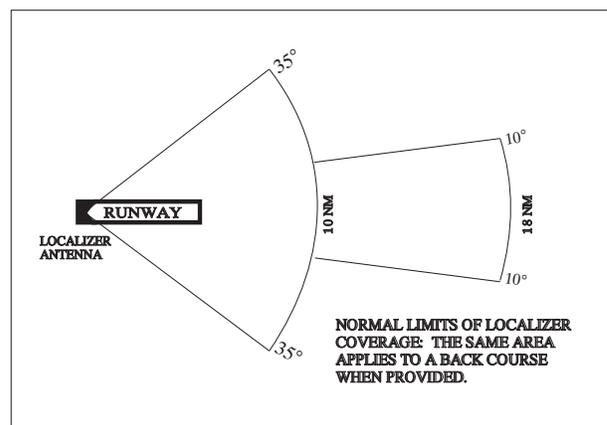
### EXAMPLE- I-DIA

5. The localizer provides course guidance throughout the descent path to the runway threshold from a distance of 18 NM from the antenna between an altitude of 1,000 feet above the highest terrain along the course line and 4,500 feet above the elevation of the antenna site. Proper off-course indications are provided throughout the following angular areas of the operational service volume:

(a) To 10 degrees either side of the course along a radius of 18 NM from the antenna; and

(b) From 10 to 35 degrees either side of the course along a radius of 10 NM. (See FIG 1-1-6.)

FIG 1-1-6  
Limits of Localizer Coverage



6. Unreliable signals may be received outside these areas.

7. The areas described in paragraph 1-1-9 b.5 and depicted in FIG 1-1-6 represent a Standard

Service Volume (SSV) localizer. All charted procedures with localizer coverage beyond the 18 NM SSV have been through the approval process for Expanded Service Volume (ESV), and have been validated by flight inspection.

### c. Localizer Type Directional Aid (LDA)

1. The LDA is of comparable use and accuracy to a localizer but is not part of a complete ILS. The LDA course usually provides a more precise approach course than the similar Simplified Directional Facility (SDF) installation, which may have a course width of 6 or 12 degrees.

2. The LDA is not aligned with the runway. Straight-in minimums may be published where alignment does not exceed 30 degrees between the course and runway. Circling minimums only are published where this alignment exceeds 30 degrees.

3. A very limited number of LDA approaches also incorporate a glideslope. These are annotated in the plan view of the instrument approach chart with a note, "LDA/Glideslope." These procedures fall under a newly defined category of approaches called Approach with Vertical Guidance (APV) described in paragraph 5-4-5, Instrument Approach Procedure Charts, subparagraph a7(b), Approach with Vertical Guidance (APV). LDA minima for with and without glideslope is provided and annotated on the minima lines of the approach chart as S-LDA/GS and S-LDA. Because the final approach course is not aligned with the runway centerline, additional maneuvering will be required compared to an ILS approach.

### d. Glide Slope/Glide Path

1. The UHF glide slope transmitter, operating on one of the 40 ILS channels within the frequency range 329.15 MHz, to 335.00 MHz radiates its signals in the direction of the localizer front course. The term "glide path" means that portion of the glide slope that intersects the localizer.

#### **CAUTION-**

*False glide slope signals may exist in the area of the localizer back course approach which can cause the glide slope flag alarm to disappear and present unreliable glide slope information. Disregard all glide slope signal indications when making a localizer back course approach unless a glide slope is specified on the approach and landing chart.*

2. The glide slope transmitter is located between 750 feet and 1,250 feet from the approach end of the runway (down the runway) and offset 250 to 650 feet from the runway centerline. It transmits a glide path beam 1.4 degrees wide (vertically). The signal provides descent information for navigation down to the lowest authorized decision height (DH) specified in the approved ILS approach procedure. The glidepath may not be suitable for navigation below the lowest authorized DH and any reference to glidepath indications below that height must be supplemented by visual reference to the runway environment. Glidepaths with no published DH are usable to runway threshold.

3. The glide path projection angle is normally adjusted to 3 degrees above horizontal so that it intersects the MM at about 200 feet and the OM at about 1,400 feet above the runway elevation. The glide slope is normally usable to the distance of 10 NM. However, at some locations, the glide slope has been certified for an extended service volume which exceeds 10 NM.

4. Pilots must be alert when approaching the glidepath interception. False courses and reverse sensing will occur at angles considerably greater than the published path.

5. Make every effort to remain on the indicated glide path.

#### **CAUTION-**

*Avoid flying below the glide path to assure obstacle/terrain clearance is maintained.*

6. The published glide slope threshold crossing height (TCH) DOES NOT represent the height of the actual glide path on-course indication above the runway threshold. It is used as a reference for planning purposes which represents the height above the runway threshold that an aircraft's glide slope antenna should be, if that aircraft remains on a trajectory formed by the four-mile-to-middle marker glidepath segment.

7. Pilots must be aware of the vertical height between the aircraft's glide slope antenna and the main gear in the landing configuration and, at the DH, plan to adjust the descent angle accordingly if the published TCH indicates the wheel crossing height over the runway threshold may not be satisfactory. Tests indicate a comfortable wheel crossing height is approximately 20 to 30 feet, depending on the type of aircraft.

**NOTE—**

The TCH for a runway is established based on several factors including the largest aircraft category that normally uses the runway, how airport layout affects the glide slope antenna placement, and terrain. A higher than optimum TCH, with the same glide path angle, may cause the aircraft to touch down further from the threshold if the trajectory of the approach is maintained until the flare. Pilots should consider the effect of a high TCH on the runway available for stopping the aircraft.

**e. Distance Measuring Equipment (DME)**

1. When installed with the ILS and specified in the approach procedure, DME may be used:

- (a) In lieu of the OM;
- (b) As a back course (BC) final approach fix (FAF); and
- (c) To establish other fixes on the localizer course.

2. In some cases, DME from a separate facility may be used within Terminal Instrument Procedures (TERPS) limitations:

- (a) To provide ARC initial approach segments;
- (b) As a FAF for BC approaches; and
- (c) As a substitute for the OM.

**f. Marker Beacon**

1. ILS marker beacons have a rated power output of 3 watts or less and an antenna array designed to produce an elliptical pattern with dimensions, at 1,000 feet above the antenna, of approximately 2,400 feet in width and 4,200 feet in length. Airborne marker beacon receivers with a selective sensitivity feature should always be operated in the “low” sensitivity position for proper reception of ILS marker beacons.

2. ILS systems may have an associated OM. An MM is no longer required. Locations with a Category II ILS also have an Inner Marker (IM). Due to advances in both ground navigation equipment and airborne avionics, as well as the numerous means that may be used as a substitute for a marker beacon, the current requirements for the use of marker beacons are:

- (a) An OM or suitable substitute identifies the Final Approach Fix (FAF) for nonprecision approach (NPA) operations (for example, localizer only); and

(b) The MM indicates a position approximately 3,500 feet from the landing threshold. This is also the position where an aircraft on the glide path will be at an altitude of approximately 200 feet above the elevation of the touchdown zone. A MM is no longer operationally required. There are some MMs still in use, but there are no MMs being installed at new ILS sites by the FAA; and

(c) An IM, where installed, indicates the point at which an aircraft is at decision height on the glide path during a Category II ILS approach. An IM is only required for CAT II operations that do not have a published radio altitude (RA) minimum.

TBL 1-1-3

**Marker Passage Indications**

Marker	Code	Light
OM	— — —	BLUE
MM	• — • —	AMBER
IM	• • • •	WHITE
BC	• • • •	WHITE

3. A back course marker normally indicates the ILS back course final approach fix where approach descent is commenced.

**g. Compass Locator**

1. Compass locator transmitters are often situated at the MM and OM sites. The transmitters have a power of less than 25 watts, a range of at least 15 miles and operate between 190 and 535 kHz. At some locations, higher powered radio beacons, up to 400 watts, are used as OM compass locators.

2. Compass locators transmit two letter identification groups. The outer locator transmits the first two letters of the localizer identification group, and the middle locator transmits the last two letters of the localizer identification group.

**h. ILS Frequency (See TBL 1-1-4.)**

TBL 1-1-4

**Frequency Pairs Allocated for ILS**

Localizer MHz	Glide Slope
108.10	334.70
108.15	334.55
108.3	334.10
108.35	333.95
108.5	329.90
108.55	329.75
108.7	330.50

Localizer MHz	Glide Slope
108.75	330.35
108.9	329.30
108.95	329.15
109.1	331.40
109.15	331.25
109.3	332.00
109.35	331.85
109.50	332.60
109.55	332.45
109.70	333.20
109.75	333.05
109.90	333.80
109.95	333.65
110.1	334.40
110.15	334.25
110.3	335.00
110.35	334.85
110.5	329.60
110.55	329.45
110.70	330.20
110.75	330.05
110.90	330.80
110.95	330.65
111.10	331.70
111.15	331.55
111.30	332.30
111.35	332.15
111.50	332.9
111.55	332.75
111.70	333.5
111.75	333.35
111.90	331.1
111.95	330.95

**i. ILS Minimums**

1. The lowest authorized ILS minimums, with all required ground and airborne systems components operative, are:

(a) **Category I.** Decision Height (DH) 200 feet and Runway Visual Range (RVR) 2,400 feet (with touchdown zone and centerline lighting, RVR 1,800 feet), or (with Autopilot or FD or HUD, RVR 1,800 feet);

(b) **Special Authorization Category I.** DH 150 feet and Runway Visual Range (RVR) 1,400 feet, HUD to DH;

(c) **Category II.** DH 100 feet and RVR 1,200 feet (with autoland or HUD to touchdown and noted on authorization, RVR 1,000 feet);

(d) **Special Authorization Category II with Reduced Lighting.** DH 100 feet and RVR 1,200 feet with autoland or HUD to touchdown and noted on authorization (touchdown zone, centerline lighting, and ALSF-2 are not required);

(e) **Category IIIa.** No DH or DH below 100 feet and RVR not less than 700 feet;

(f) **Category IIIb.** No DH or DH below 50 feet and RVR less than 700 feet but not less than 150 feet; and

(g) **Category IIIc.** No DH and no RVR limitation.

**NOTE-**

*Special authorization and equipment required for Categories II and III.*

**j. Inoperative ILS Components**

1. **Inoperative localizer.** When the localizer fails, an ILS approach is not authorized.

2. **Inoperative glide slope.** When the glide slope fails, the ILS reverts to a non-precision localizer approach.

**REFERENCE-**

*See the inoperative component table in the U.S. Government Terminal Procedures Publication (TPP), for adjustments to minimums due to inoperative airborne or ground system equipment.*

**k. ILS Course Distortion**

1. All pilots should be aware that disturbances to ILS localizer and glide slope courses may occur when surface vehicles or aircraft are operated near the localizer or glide slope antennas. Most ILS installations are subject to signal interference by either surface vehicles, aircraft or both. ILS CRITICAL AREAS are established near each localizer and glide slope antenna.

2. ATC issues control instructions to avoid interfering operations within ILS critical areas at controlled airports during the hours the Airport Traffic Control Tower (ATCT) is in operation as follows:

(a) **Weather Conditions.** Official weather observation is a ceiling of less than 800 feet and/or visibility 2 miles.

(1) **Localizer Critical Area.** Except for aircraft that land, exit a runway, depart, or execute a

missed approach, vehicles and aircraft are not authorized in or over the critical area when an arriving aircraft is inside the outer marker (OM) or the fix used in lieu of the OM. Additionally, whenever the official weather observation is a ceiling of less than 200 feet or RVR less than 2,000 feet, do not authorize vehicles or aircraft operations in or over the area when an arriving aircraft is inside the MM, or in the absence of a MM, ½ mile final.

**(2) Glide Slope Critical Area.** Do not authorize vehicles or aircraft operations in or over the area when an arriving aircraft is inside the ILS outer marker (OM), or the fix used in lieu of the OM, unless the arriving aircraft has reported the runway in sight and is circling or side-stepping to land on another runway.

**(b) Weather Conditions.** At or above ceiling 800 feet and/or visibility 2 miles.

**(1)** No critical area protective action is provided under these conditions.

**(2)** A flight crew, under these conditions, should advise the tower that it will conduct an AUTOLAND or COUPLED approach.

**EXAMPLE-**

*Denver Tower, United 1153, Request Autoland/Coupled Approach (runway)*

*ATC replies with:*

*United 1153, Denver Tower, Roger, Critical Areas not protected.*

**3.** Aircraft holding below 5,000 feet between the outer marker and the airport may cause localizer signal variations for aircraft conducting the ILS approach. Accordingly, such holding is not authorized when weather or visibility conditions are less than ceiling 800 feet and/or visibility 2 miles.

**4.** Pilots are cautioned that vehicular traffic not subject to ATC may cause momentary deviation to ILS course or glide slope signals. Also, critical areas are not protected at uncontrolled airports or at airports with an operating control tower when weather or visibility conditions are above those requiring protective measures. Aircraft conducting coupled or autoland operations should be especially alert in monitoring automatic flight control systems. (See FIG 1-1-7.)

**NOTE-**

*Unless otherwise coordinated through Flight Standards, ILS signals to Category I runways are not flight inspected below the point that is 100 feet less than the decision altitude (DA). Guidance signal anomalies may be encountered below this altitude.*

**1-1-10. Simplified Directional Facility (SDF)**

**a.** The SDF provides a final approach course similar to that of the ILS localizer. It does not provide glide slope information. A clear understanding of the ILS localizer and the additional factors listed below completely describe the operational characteristics and use of the SDF.

**b.** The SDF transmits signals within the range of 108.10 to 111.95 MHz.

**c.** The approach techniques and procedures used in an SDF instrument approach are essentially the same as those employed in executing a standard localizer approach except the SDF course may not be aligned with the runway and the course may be wider, resulting in less precision.

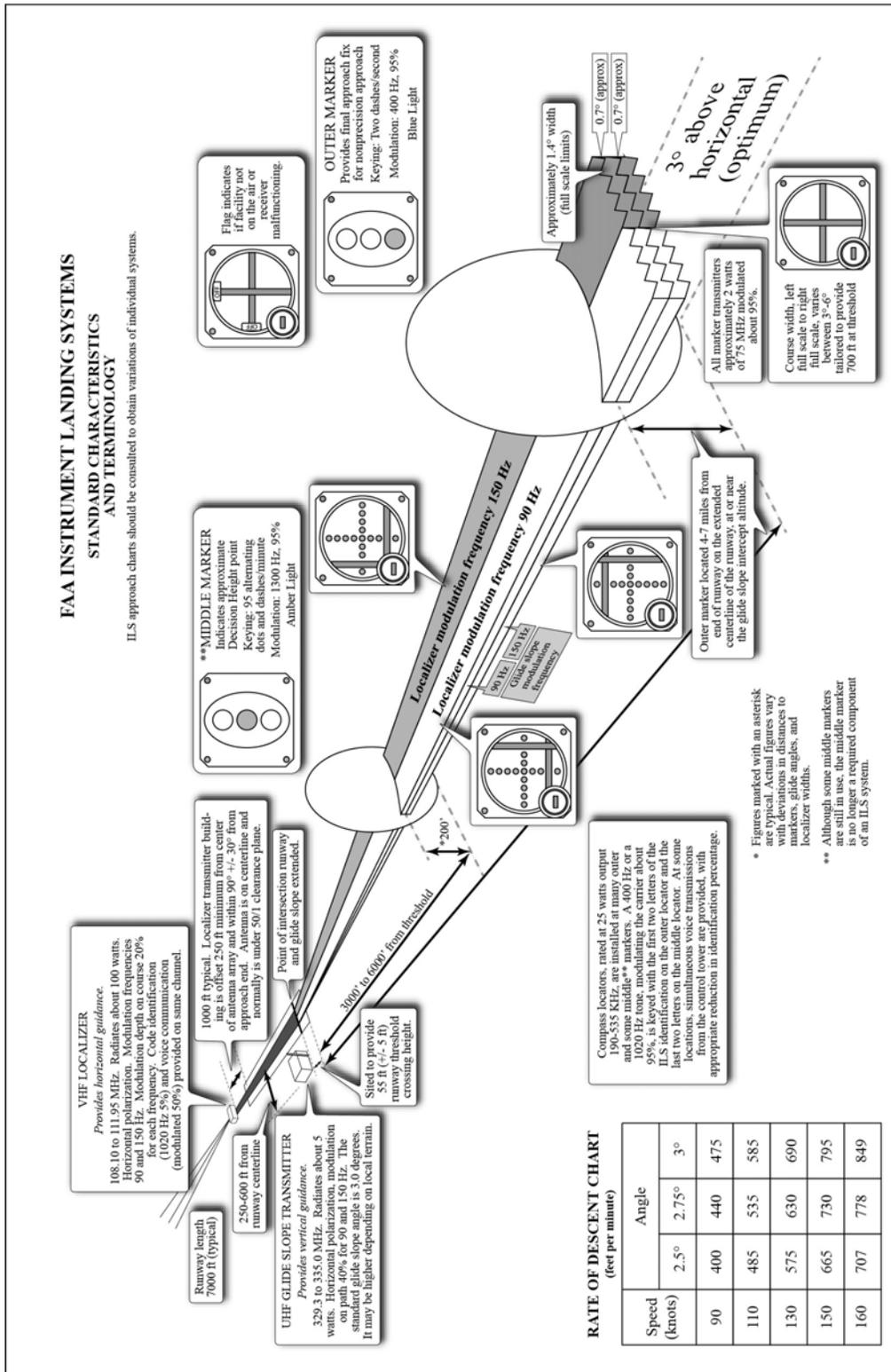
**d.** Usable off-course indications are limited to 35 degrees either side of the course centerline. Instrument indications received beyond 35 degrees should be disregarded.

**e.** The SDF antenna may be offset from the runway centerline. Because of this, the angle of convergence between the final approach course and the runway bearing should be determined by reference to the instrument approach procedure chart. This angle is generally not more than 3 degrees. However, it should be noted that inasmuch as the approach course originates at the antenna site, an approach which is continued beyond the runway threshold will lead the aircraft to the SDF offset position rather than along the runway centerline.

**f.** The SDF signal is fixed at either 6 degrees or 12 degrees as necessary to provide maximum flyability and optimum course quality.

**g.** Identification consists of a three-letter identifier transmitted in Morse Code on the SDF frequency. The appropriate instrument approach chart will indicate the identifier used at a particular airport.

FIG 1-1-7  
**FAA Instrument Landing Systems**



### 1-1-11. NAVAID Identifier Removal During Maintenance

During periods of routine or emergency maintenance, coded identification (or code and voice, where applicable) is removed from certain FAA NAVAIDs. Removal of identification serves as a warning to pilots that the facility is officially off the air for tune-up or repair and may be unreliable even though intermittent or constant signals are received.

**NOTE-**

*During periods of maintenance VHF ranges may radiate a T-E-S-T code (- ● ● ● ● -).*

**NOTE-**

*DO NOT attempt to fly a procedure that is NOTAMed out of service even if the identification is present. In certain cases, the identification may be transmitted for short periods as part of the testing.*

### 1-1-12. NAVAIDs with Voice

a. Voice equipped en route radio navigational aids are under the operational control of either a Flight Service Station (FSS) or an approach control facility. Facilities with two-way voice communication available are indicated in the Chart Supplement U.S. and aeronautical charts.

b. Unless otherwise noted on the chart, all radio navigation aids operate continuously except during shutdowns for maintenance. Hours of operation of facilities not operating continuously are annotated on charts and in the Chart Supplement U.S.

### 1-1-13. User Reports Requested on NAVAID or Global Navigation Satellite System (GNSS) Performance or Interference

a. Users of the National Airspace System (NAS) can render valuable assistance in the early correction of NAVAID malfunctions or GNSS problems and are encouraged to report their observations of undesirable avionics performance. Although NAVAIDs are monitored by electronic detectors, adverse effects of electronic interference, new obstructions, or changes in terrain near the NAVAID can exist without detection by the ground monitors. Some of the characteristics of malfunction or deteriorating performance which should be reported are: erratic course or bearing indications; intermittent, or full, flag alarm; garbled, missing or obviously improper

coded identification; poor quality communications reception; or, in the case of frequency interference, an audible hum or tone accompanying radio communications or NAVAID identification. GNSS problems are often characterized by navigation degradation or service loss indications. For instance, pilots conducting operations in areas where there is GNSS interference may be unable to use GPS for navigation, and ADS-B may be unavailable for surveillance. Radio frequency interference may affect both navigation for the pilot and surveillance by the air traffic controller. Depending on the equipment and integration, either an advisory light or message may alert the pilot. Air traffic controllers monitoring ADS-B reports may stop receiving ADS-B position messages and associated aircraft tracks.

In addition, malfunctioning, faulty, inappropriately installed, operated, or modified GPS re-radiator systems, intended to be used for aircraft maintenance activities, have resulted in unintentional disruption of aviation GNSS receivers. This type of disruption could result in un-flagged, erroneous position information output to primary flight displays/indicators and to other aircraft and air traffic control systems. Since receiver autonomous integrity monitoring (RAIM) is only partially effective against this type of disruption (effectively a “signal spoofing”), the pilot may not be aware of any erroneous navigation indications; ATC may be the only means available for identification of these disruptions and detect unexpected aircraft position while monitoring aircraft for IFR separation.

b. Pilots reporting potential interference should identify the NAVAID (for example, VOR) malfunction or GNSS problem, location of the aircraft (that is, latitude, longitude or bearing/distance from a reference NAVAID), magnetic heading, altitude, date and time of the observation, type of aircraft (make/model/call sign), and description of the condition observed, and the type of receivers in use (that is, make/model/software revision). Reports should be made in any of the following ways:

1. Immediately, by voice radio communication to the controlling ATC facility or FSS.

2. By telephone to the nearest ATC facility controlling the airspace where the disruption was experienced.

3. Additionally, GNSS problems should be reported by Internet via the GPS Anomaly Reporting

Form at [http://www.faa.gov/air\\_traffic/nas/gps\\_reports/](http://www.faa.gov/air_traffic/nas/gps_reports/).

c. In aircraft equipped with more than one avionics receiver, there are many combinations of potential interference between units that could cause erroneous navigation indications, or complete or partial blanking out of the display.

**NOTE–**

*GPS interference or outages associated with known testing NOTAMs should not be reported to ATC.*

### 1–1–14. LORAN

**NOTE–**

*In accordance with the 2010 DHS Appropriations Act, the U.S. Coast Guard (USCG) terminated the transmission of all U.S. LORAN–C signals on 08 Feb 2010. The USCG also terminated the transmission of the Russian American signals on 01 Aug 2010, and the Canadian LORAN–C signals on 03 Aug 2010. For more information, visit <http://www.navcen.uscg.gov>. Operators should also note that TSO–C60b, AIRBORNE AREA NAVIGATION EQUIPMENT USING LORAN–C INPUTS, has been canceled by the FAA.*

### 1–1–15. Inertial Reference Unit (IRU), Inertial Navigation System (INS), and Attitude Heading Reference System (AHRS)

a. IRUs are self-contained systems comprised of gyros and accelerometers that provide aircraft attitude (pitch, roll, and heading), position, and velocity information in response to signals resulting from inertial effects on system components. Once aligned with a known position, IRUs continuously calculate position and velocity. IRU position accuracy decays with time. This degradation is known as “drift.”

b. INSs combine the components of an IRU with an internal navigation computer. By programming a series of waypoints, these systems will navigate along a predetermined track.

c. AHRSs are electronic devices that provide attitude information to aircraft systems such as weather radar and autopilot, but do not directly compute position information.

d. Aircraft equipped with slaved compass systems may be susceptible to heading errors caused by exposure to magnetic field disturbances (flux fields) found in materials that are commonly located on the

surface or buried under taxiways and ramps. These materials generate a magnetic flux field that can be sensed by the aircraft’s compass system flux detector or “gate”, which can cause the aircraft’s system to align with the material’s magnetic field rather than the earth’s natural magnetic field. The system’s erroneous heading may not self-correct. Prior to take off pilots should be aware that a heading misalignment may have occurred during taxi. Pilots are encouraged to follow the manufacturer’s or other appropriate procedures to correct possible heading misalignment before take off is commenced.

### 1–1–16. Doppler Radar

Doppler Radar is a semiautomatic self-contained dead reckoning navigation system (radar sensor plus computer) which is not continuously dependent on information derived from ground based or external aids. The system employs radar signals to detect and measure ground speed and drift angle, using the aircraft compass system as its directional reference. Doppler is less accurate than INS, however, and the use of an external reference is required for periodic updates if acceptable position accuracy is to be achieved on long range flights.

### 1–1–17. Global Positioning System (GPS)

#### a. System Overview

1. System Description. The Global Positioning System is a space-based radio navigation system used to determine precise position anywhere in the world. The 24 satellite constellation is designed to ensure at least five satellites are always visible to a user worldwide. A minimum of four satellites is necessary for receivers to establish an accurate three-dimensional position. The receiver uses data from satellites above the mask angle (the lowest angle above the horizon at which a receiver can use a satellite). The Department of Defense (DOD) is responsible for operating the GPS satellite constellation and monitors the GPS satellites to ensure proper operation. Each satellite’s orbital parameters (ephemeris data) are sent to each satellite for broadcast as part of the data message embedded in the GPS signal. The GPS coordinate system is the Cartesian earth-centered, earth-fixed coordinates as specified in the World Geodetic System 1984 (WGS–84).

#### 2. System Availability and Reliability.

(a) The status of GPS satellites is broadcast as part of the data message transmitted by the GPS

satellites. GPS status information is also available by means of the U.S. Coast Guard navigation information service: (703) 313-5907, Internet: <http://www.navcen.uscg.gov/>. Additionally, satellite status is available through the Notice to Airmen (NOTAM) system.

(b) GNSS operational status depends on the type of equipment being used. For GPS-only equipment TSO-C129 or TSO-C196(), the operational status of non-precision approach capability for flight planning purposes is provided through a prediction program that is embedded in the receiver or provided separately.

**3. Receiver Autonomous Integrity Monitoring (RAIM).** RAIM is the capability of a GPS receiver to perform integrity monitoring on itself by ensuring available satellite signals meet the integrity requirements for a given phase of flight. Without RAIM, the pilot has no assurance of the GPS position integrity. RAIM provides immediate feedback to the pilot. This fault detection is critical for performance-based navigation (PBN)(see Paragraph 1-2-1, Performance-Based Navigation (PBN) and Area Navigation (RNAV), for an introduction to PBN), because delays of up to two hours can occur before an erroneous satellite transmission is detected and corrected by the satellite control segment.

(a) In order for RAIM to determine if a satellite is providing corrupted information, at least one satellite, in addition to those required for navigation, must be in view for the receiver to perform the RAIM function. RAIM requires a minimum of 5 satellites, or 4 satellites and barometric altimeter input (baro-aiding), to detect an integrity anomaly. Baro-aiding is a method of augmenting the GPS integrity solution by using a non-satellite input source in lieu of the fifth satellite. Some GPS receivers also have a RAIM capability, called fault detection and exclusion (FDE), that excludes a failed satellite from the position solution; GPS receivers capable of FDE require 6 satellites or 5 satellites with baro-aiding. This allows the GPS receiver to isolate the corrupt satellite signal, remove it from the position solution, and still provide an integrity-assured position. To ensure that baro-aiding is available, enter the current altimeter setting into the receiver as described in the operating manual. Do not use the GPS derived altitude due to the large GPS

vertical errors that will make the integrity monitoring function invalid.

(b) There are generally two types of RAIM fault messages. The first type of message indicates that there are not enough satellites available to provide RAIM integrity monitoring. The GPS navigation solution may be acceptable, but the integrity of the solution cannot be determined. The second type indicates that the RAIM integrity monitor has detected a potential error and that there is an inconsistency in the navigation solution for the given phase of flight. Without RAIM capability, the pilot has no assurance of the accuracy of the GPS position.

**4. Selective Availability.** Selective Availability (SA) is a method by which the accuracy of GPS is intentionally degraded. This feature was designed to deny hostile use of precise GPS positioning data. SA was discontinued on May 1, 2000, but many GPS receivers are designed to assume that SA is still active. New receivers may take advantage of the discontinuance of SA based on the performance values in ICAO Annex 10.

**b. Operational Use of GPS.** U.S. civil operators may use approved GPS equipment in oceanic airspace, certain remote areas, the National Airspace System and other States as authorized (please consult the applicable Aeronautical Information Publication). Equipage other than GPS may be required for the desired operation. GPS navigation is used for both Visual Flight Rules (VFR) and Instrument Flight Rules (IFR) operations.

### 1. VFR Operations

(a) GPS navigation has become an asset to VFR pilots by providing increased navigational capabilities and enhanced situational awareness. Although GPS has provided many benefits to the VFR pilot, care must be exercised to ensure that system capabilities are not exceeded. VFR pilots should integrate GPS navigation with electronic navigation (when possible), as well as pilotage and dead reckoning.

(b) GPS receivers used for VFR navigation vary from fully integrated IFR/VFR installation used to support VFR operations to hand-held devices. Pilots must understand the limitations of the receivers prior to using in flight to avoid misusing navigation information. (See TBL 1-1-6.) Most receivers are not intuitive. The pilot must learn the various

keystrokes, knob functions, and displays that are used in the operation of the receiver. Some manufacturers provide computer-based tutorials or simulations of their receivers that pilots can use to become familiar with operating the equipment.

(c) When using GPS for VFR operations, RAIM capability, database currency, and antenna location are critical areas of concern.

(1) **RAIM Capability.** VFR GPS panel mount receivers and hand-held units have no RAIM alerting capability. This prevents the pilot from being alerted to the loss of the required number of satellites in view, or the detection of a position error. Pilots should use a systematic cross-check with other navigation techniques to verify position. Be suspicious of the GPS position if a disagreement exists between the two positions.

(2) **Database Currency.** Check the currency of the database. Databases must be updated for IFR operations and should be updated for all other operations. However, there is no requirement for databases to be updated for VFR navigation. It is not recommended to use a moving map with an outdated database in and around critical airspace. Pilots using an outdated database should verify waypoints using current aeronautical products; for example, Chart Supplement U.S., Sectional Chart, or En Route Chart.

(3) **Antenna Location.** The antenna location for GPS receivers used for IFR and VFR operations may differ. VFR antennae are typically placed for convenience more than performance, while IFR installations ensure a clear view is provided with the satellites. Antennae not providing a clear view have a greater opportunity to lose the satellite navigational signal. This is especially true in the case of hand-held GPS receivers. Typically, suction cups are used to place the GPS antennas on the inside of cockpit windows. While this method has great utility, the antenna location is limited to the cockpit or cabin which rarely provides a clear view of all available satellites. Consequently, signal losses may occur due to aircraft structure blocking satellite signals, causing a loss of navigation capability. These losses, coupled with a lack of RAIM capability, could present erroneous position and navigation information with no warning to the pilot. While the use of a hand-held GPS for VFR operations is not limited by regulation, modification of the aircraft, such as

installing a panel- or yoke-mounted holder, is governed by 14 CFR Part 43. Consult with your mechanic to ensure compliance with the regulation and safe installation.

(d) Do not solely rely on GPS for VFR navigation. No design standard of accuracy or integrity is used for a VFR GPS receiver. VFR GPS receivers should be used in conjunction with other forms of navigation during VFR operations to ensure a correct route of flight is maintained. Minimize head-down time in the aircraft by being familiar with your GPS receiver's operation and by keeping eyes outside scanning for traffic, terrain, and obstacles.

#### (e) **VFR Waypoints**

(1) VFR waypoints provide VFR pilots with a supplementary tool to assist with position awareness while navigating visually in aircraft equipped with area navigation receivers. VFR waypoints should be used as a tool to supplement current navigation procedures. The uses of VFR waypoints include providing navigational aids for pilots unfamiliar with an area, waypoint definition of existing reporting points, enhanced navigation in and around Class B and Class C airspace, and enhanced navigation around Special Use Airspace. VFR pilots should rely on appropriate and current aeronautical charts published specifically for visual navigation. If operating in a terminal area, pilots should take advantage of the Terminal Area Chart available for that area, if published. The use of VFR waypoints does not relieve the pilot of any responsibility to comply with the operational requirements of 14 CFR Part 91.

(2) VFR waypoint names (for computer-entry and flight plans) consist of five letters beginning with the letters "VP" and are retrievable from navigation databases. The VFR waypoint names are not intended to be pronounceable, and they are not for use in ATC communications. On VFR charts, stand-alone VFR waypoints will be portrayed using the same four-point star symbol used for IFR waypoints. VFR waypoints collocated with visual check points on the chart will be identified by small magenta flag symbols. VFR waypoints collocated with visual check points will be pronounceable based on the name of the visual check point and may be used for ATC communications. Each VFR waypoint name will appear in parentheses adjacent to the geographic location on the chart. Latitude/longitude data for all

established VFR waypoints may be found in the appropriate regional Chart Supplement U.S.

(3) VFR waypoints may not be used on IFR flight plans. VFR waypoints are not recognized by the IFR system and will be rejected for IFR routing purposes.

(4) Pilots may use the five-letter identifier as a waypoint in the route of flight section on a VFR flight plan. Pilots may use the VFR waypoints only when operating under VFR conditions. The point may represent an intended course change or describe the planned route of flight. This VFR filing would be similar to how a VOR would be used in a route of flight.

(5) VFR waypoints intended for use during flight should be loaded into the receiver while on the ground. Once airborne, pilots should avoid programming routes or VFR waypoint chains into their receivers.

(6) Pilots should be vigilant to see and avoid other traffic when near VFR waypoints. With the increased use of GPS navigation and accuracy, expect increased traffic near VFR waypoints. Regardless of the class of airspace, monitor the available ATC frequency for traffic information on other aircraft operating in the vicinity. See Paragraph 7-6-2, VFR in Congested Areas, for more information.

## 2. IFR Use of GPS

(a) **General Requirements.** Authorization to conduct any GPS operation under IFR requires:

(1) GPS navigation equipment used for IFR operations must be approved in accordance with the requirements specified in Technical Standard Order (TSO) TSO-C129(), TSO-C196(), TSO-C145(), or TSO-C146(), and the installation must be done in accordance with Advisory Circular AC 20-138, Airworthiness Approval of Positioning and Navigation Systems. Equipment approved in accordance with TSO-C115a does not meet the requirements of TSO-C129. Visual flight rules (VFR) and hand-held GPS systems are not authorized for IFR navigation, instrument approaches, or as a principal instrument flight reference.

(2) Aircraft using un-augmented GPS (TSO-C129() or TSO-C196()) for navigation under IFR must be equipped with an alternate approved and

operational means of navigation suitable for navigating the proposed route of flight. (Examples of alternate navigation equipment include VOR or DME/DME/IRU capability). Active monitoring of alternative navigation equipment is not required when RAIM is available for integrity monitoring. Active monitoring of an alternate means of navigation is required when the GPS RAIM capability is lost.

(3) Procedures must be established for use in the event that the loss of RAIM capability is predicted to occur. In situations where RAIM is predicted to be unavailable, the flight must rely on other approved navigation equipment, re-route to where RAIM is available, delay departure, or cancel the flight.

(4) The GPS operation must be conducted in accordance with the FAA-approved aircraft flight manual (AFM) or flight manual supplement. Flight crew members must be thoroughly familiar with the particular GPS equipment installed in the aircraft, the receiver operation manual, and the AFM or flight manual supplement. Operation, receiver presentation and capabilities of GPS equipment vary. Due to these differences, operation of GPS receivers of different brands, or even models of the same brand, under IFR should not be attempted without thorough operational knowledge. Most receivers have a built-in simulator mode, which allows the pilot to become familiar with operation prior to attempting operation in the aircraft.

(5) Aircraft navigating by IFR-approved GPS are considered to be performance-based navigation (PBN) aircraft and have special equipment suffixes. File the appropriate equipment suffix in accordance with TBL 5-1-3 on the ATC flight plan. If GPS avionics become inoperative, the pilot should advise ATC and amend the equipment suffix.

(6) Prior to any GPS IFR operation, the pilot must review appropriate NOTAMs and aeronautical information. (See GPS NOTAMs/Aeronautical Information).

(b) **Database Requirements.** The onboard navigation data must be current and appropriate for the region of intended operation and should include the navigation aids, waypoints, and relevant coded terminal airspace procedures for the departure, arrival, and alternate airfields.

(1) Further database guidance for terminal and en route requirements may be found in AC 90-100, U.S. Terminal and En Route Area Navigation (RNAV) Operations.

(2) Further database guidance on Required Navigation Performance (RNP) instrument approach operations, RNP terminal, and RNP en route requirements may be found in AC 90-105, Approval Guidance for RNP Operations and Barometric Vertical Navigation in the U.S. National Airspace System.

(3) All approach procedures to be flown must be retrievable from the current airborne navigation database supplied by the equipment manufacturer or other FAA-approved source. The system must be able to retrieve the procedure by name from the aircraft navigation database, not just as a manually entered series of waypoints. Manual entry of waypoints using latitude/longitude or place/bearing is not permitted for approach procedures.

(4) Prior to using a procedure or waypoint retrieved from the airborne navigation database, the pilot should verify the validity of the database. This verification should include the following preflight and inflight steps:

**[a] Preflight:**

[1] Determine the date of database issuance, and verify that the date/time of proposed use is before the expiration date/time.

[2] Verify that the database provider has not published a notice limiting the use of the specific waypoint or procedure.

**[b] Inflight:**

[1] Determine that the waypoints and transition names coincide with names found on the procedure chart. Do not use waypoints which do not exactly match the spelling shown on published procedure charts.

[2] Determine that the waypoints are logical in location, in the correct order, and their orientation to each other is as found on the procedure chart, both laterally and vertically.

**NOTE—**

*There is no specific requirement to check each waypoint latitude and longitude, type of waypoint and/or altitude constraint, only the general relationship of waypoints in*

*the procedure, or the logic of an individual waypoint's location.*

[3] If the cursory check of procedure logic or individual waypoint location, specified in [b] above, indicates a potential error, do not use the retrieved procedure or waypoint until a verification of latitude and longitude, waypoint type, and altitude constraints indicate full conformity with the published data.

(5) Air carrier and commercial operators must meet the appropriate provisions of their approved operations specifications.

[a] During domestic operations for commerce or for hire, operators must have a second navigation system capable of reversion or contingency operations.

[b] Operators must have two independent navigation systems appropriate to the route to be flown, or one system that is suitable and a second, independent backup capability that allows the operator to proceed safely and land at a different airport, and the aircraft must have sufficient fuel (reference 14 CFR 121.349, 125.203, 129.17, and 135.165). These rules ensure the safety of the operation by preventing a single point of failure.

**NOTE—**

*An aircraft approved for multi-sensor navigation and equipped with a single navigation system must maintain an ability to navigate or proceed safely in the event that any one component of the navigation system fails, including the flight management system (FMS). Retaining a FMS-independent VOR capability would satisfy this requirement.*

[c] The requirements for a second system apply to the entire set of equipment needed to achieve the navigation capability, not just the individual components of the system such as the radio navigation receiver. For example, to use two RNAV systems (e.g., GPS and DME/DME/IRU) to comply with the requirements, the aircraft must be equipped with two independent radio navigation receivers and two independent navigation computers (e.g., flight management systems (FMS)). Alternatively, to comply with the requirements using a single RNAV system with an installed and operable VOR capability, the VOR capability must be independent of the FMS.

[d] To satisfy the requirement for two independent navigation systems, if the primary navigation system is GPS-based, the second system

must be independent of GPS (for example, VOR or DME/DME/IRU). This allows continued navigation in case of failure of the GPS or WAAS services. Recognizing that GPS interference and test events resulting in the loss of GPS services have become more common, the FAA requires operators conducting IFR operations under 14 CFR 121.349, 125.203, 129.17 and 135.65 to retain a non-GPS navigation capability consisting of either DME/DME, IRU, or VOR for en route and terminal operations, and VOR and ILS for final approach. Since this system is to be used as a reversionary capability, single equipage is sufficient.

### 3. Oceanic, Domestic, En Route, and Terminal Area Operations

(a) Conduct GPS IFR operations in oceanic areas only when approved avionics systems are installed. TSO-C196() users and TSO-C129() GPS users authorized for Class A1, A2, B1, B2, C1, or C2 operations may use GPS in place of another approved means of long-range navigation, such as dual INS. (See TBL 1-1-5 and TBL 1-1-6.) Aircraft with a single installation GPS, meeting the above specifications, are authorized to operate on short oceanic routes requiring one means of long-range navigation (reference AC 20-138, Appendix 1).

(b) Conduct GPS domestic, en route, and terminal IFR operations only when approved avionics systems are installed. Pilots may use GPS via TSO-C129() authorized for Class A1, B1, B3, C1, or C3 operations GPS via TSO-C196(); or GPS/WAAS with either TSO-C145() or TSO-C146(). When using TSO-C129() or TSO-C196() receivers, the avionics necessary to receive all of the ground-based facilities appropriate for the route to the destination airport and any required alternate airport must be installed and operational. Ground-based facilities necessary for these routes must be operational.

(1) GPS en route IFR operations may be conducted in Alaska outside the operational service volume of ground-based navigation aids when a TSO-C145() or TSO-C146() GPS/wide area augmentation system (WAAS) system is installed and operating. WAAS is the U.S. version of a satellite-based augmentation system (SBAS).

[a] In Alaska, aircraft may operate on GNSS Q-routes with GPS (TSO-C129 () or

TSO-C196 ()) equipment while the aircraft remains in Air Traffic Control (ATC) radar surveillance or with GPS/WAAS (TSO-C145 () or TSO-C146 ()) which does not require ATC radar surveillance.

[b] In Alaska, aircraft may only operate on GNSS T-routes with GPS/WAAS (TSO-C145 () or TSO-C146 ()) equipment.

(2) Ground-based navigation equipment is not required to be installed and operating for en route IFR operations when using GPS/WAAS navigation systems. All operators should ensure that an alternate means of navigation is available in the unlikely event the GPS/WAAS navigation system becomes inoperative.

(3) Q-routes and T-routes outside Alaska. Q-routes require system performance currently met by GPS, GPS/WAAS, 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. T-routes require GPS or GPS/WAAS equipment.

#### REFERENCE-

*AIM, Paragraph 5-3-4, Airways and Route Systems*

(c) GPS IFR approach/departure operations can be conducted when approved avionics systems are installed and the following requirements are met:

(1) The aircraft is TSO-C145() or TSO-C146() or TSO-C196() or TSO-C129() in Class A1, B1, B3, C1, or C3; and

(2) The approach/departure must be retrievable from the current airborne navigation database in the navigation computer. The system must be able to retrieve the procedure by name from the aircraft navigation database. Manual entry of waypoints using latitude/longitude or place/bearing is not permitted for approach procedures.

(3) The authorization to fly instrument approaches/departures with GPS is limited to U.S. airspace.

(4) The use of GPS in any other airspace must be expressly authorized by the FAA Administrator.

(5) GPS instrument approach/departure operations outside the U.S. must be authorized by the appropriate sovereign authority.

### 4. Departures and Instrument Departure Procedures (DPs)

The GPS receiver must be set to terminal ( $\pm 1$  NM) CDI sensitivity and the navigation routes contained in the database in order to fly published IFR charted departures and DPs. Terminal RAIM should be automatically provided by the receiver. (Terminal RAIM for departure may not be available unless the waypoints are part of the active flight plan rather than proceeding direct to the first destination.) Certain segments of a DP may require some manual intervention by the pilot, especially when radar vectored to a course or required to intercept a specific course to a waypoint. The database may not contain all of the transitions or departures from all runways and some GPS receivers do not contain DPs in the database. It is necessary that helicopter procedures be flown at 70 knots or less since helicopter departure procedures and missed approaches use a 20:1 obstacle clearance surface (OCS), which is double the fixed-wing OCS, and turning areas are based on this speed as well.

### 5. GPS Instrument Approach Procedures

(a) GPS overlay approaches are designated non-precision instrument approach procedures that pilots are authorized to fly using GPS avionics. Localizer (LOC), localizer type directional aid (LDA), and simplified directional facility (SDF) procedures are not authorized. Overlay procedures are identified by the “name of the procedure” and “or GPS” (e.g., VOR/DME or GPS RWY 15) in the title. Authorized procedures must be retrievable from a current onboard navigation database. The navigation database may also enhance position orientation by displaying a map containing information on conventional NAVAID approaches. This approach information should not be confused with a GPS overlay approach (see the receiver operating manual, AFM, or AFM Supplement for details on how to identify these approaches in the navigation database).

#### **NOTE-**

*Overlay approaches do not adhere to the design criteria described in Paragraph 5-4-5m, Area Navigation (RNAV) Instrument Approach Charts, for stand-alone GPS approaches. Overlay approach criteria is based on the design criteria used for ground-based NAVAID approaches.*

(b) Stand-alone approach procedures specifically designed for GPS systems have replaced many of the original overlay approaches. All approaches that contain “GPS” in the title (e.g.,

“VOR or GPS RWY 24,” “GPS RWY 24,” or “RNAV (GPS) RWY 24”) can be flown using GPS. GPS-equipped aircraft do not need underlying ground-based NAVAIDs or associated aircraft avionics to fly the approach. Monitoring the underlying approach with ground-based NAVAIDs is suggested when able. Existing overlay approaches may be requested using the GPS title; for example, the VOR or GPS RWY 24 may be requested as “GPS RWY 24.” Some GPS procedures have a Terminal Arrival Area (TAA) with an underlining RNAV approach.

(c) For flight planning purposes, TSO-C129() and TSO-C196()-equipped users (GPS users) whose navigation systems have fault detection and exclusion (FDE) capability, who perform a preflight RAIM prediction for the approach integrity at the airport where the RNAV (GPS) approach will be flown, and have proper knowledge and any required training and/or approval to conduct a GPS-based IAP, may file based on a GPS-based IAP at either the destination or the alternate airport, but not at both locations. At the alternate airport, pilots may plan for:

(1) Lateral navigation (LNAV) or circling minimum descent altitude (MDA);

(2) LNAV/vertical navigation (LNAV/VNAV) DA, if equipped with and using approved barometric vertical navigation (baro-VNAV) equipment;

(3) RNP 0.3 DA on an RNAV (RNP) IAP, if they are specifically authorized users using approved baro-VNAV equipment and the pilot has verified required navigation performance (RNP) availability through an approved prediction program.

(d) If the above conditions cannot be met, any required alternate airport must have an approved instrument approach procedure other than GPS-based that is anticipated to be operational and available at the estimated time of arrival, and which the aircraft is equipped to fly.

#### **(e) Procedures for Accomplishing GPS Approaches**

(1) An RNAV (GPS) procedure may be associated with a Terminal Arrival Area (TAA). The basic design of the RNAV procedure is the “T” design or a modification of the “T” (See Paragraph 5-4-5d, Terminal Arrival Area (TAA), for complete information).

(2) Pilots cleared by ATC for an RNAV (GPS) approach should fly the full approach from an Initial Approach Waypoint (IAWP) or feeder fix. Randomly joining an approach at an intermediate fix does not assure terrain clearance.

(3) When an approach has been loaded in the navigation system, GPS receivers will give an “arm” annunciation 30 NM straight line distance from the airport/heliport reference point. Pilots should arm the approach mode at this time if not already armed (some receivers arm automatically). Without arming, the receiver will not change from en route CDI and RAIM sensitivity of  $\pm 5$  NM either side of centerline to  $\pm 1$  NM terminal sensitivity. Where the IAWP is inside this 30 mile point, a CDI sensitivity change will occur once the approach mode is armed and the aircraft is inside 30 NM. Where the IAWP is beyond 30 NM from the airport/heliport reference point and the approach is armed, the CDI sensitivity will not change until the aircraft is within 30 miles of the airport/heliport reference point. Feeder route obstacle clearance is predicated on the receiver being in terminal ( $\pm 1$  NM) CDI sensitivity and RAIM within 30 NM of the airport/heliport reference point; therefore, the receiver should always be armed (if required) not later than the 30 NM annunciation.

(4) The pilot must be aware of what bank angle/turn rate the particular receiver uses to compute turn anticipation, and whether wind and airspeed are included in the receiver’s calculations. This information should be in the receiver operating manual. Over or under banking the turn onto the final approach course may significantly delay getting on course and may result in high descent rates to achieve the next segment altitude.

(5) When within 2 NM of the Final Approach Waypoint (FAWP) with the approach mode armed, the approach mode will switch to active, which results in RAIM and CDI changing to approach sensitivity. Beginning 2 NM prior to the FAWP, the full scale CDI sensitivity will smoothly change from  $\pm 1$  NM to  $\pm 0.3$  NM at the FAWP. As sensitivity changes from  $\pm 1$  NM to  $\pm 0.3$  NM approaching the FAWP, with the CDI not centered, the corresponding increase in CDI displacement may give the impression that the aircraft is moving further away from the intended course even though it is on an acceptable intercept heading. Referencing the

digital track displacement information (cross track error), if it is available in the approach mode, may help the pilot remain position oriented in this situation. Being established on the final approach course prior to the beginning of the sensitivity change at 2 NM will help prevent problems in interpreting the CDI display during ramp down. Therefore, requesting or accepting vectors which will cause the aircraft to intercept the final approach course within 2 NM of the FAWP is not recommended.

(6) When receiving vectors to final, most receiver operating manuals suggest placing the receiver in the non-sequencing mode on the FAWP and manually setting the course. This provides an extended final approach course in cases where the aircraft is vectored onto the final approach course outside of any existing segment which is aligned with the runway. Assigned altitudes must be maintained until established on a published segment of the approach. Required altitudes at waypoints outside the FAWP or stepdown fixes must be considered. Calculating the distance to the FAWP may be required in order to descend at the proper location.

(7) Overriding an automatically selected sensitivity during an approach will cancel the approach mode annunciation. If the approach mode is not armed by 2 NM prior to the FAWP, the approach mode will not become active at 2 NM prior to the FAWP, and the equipment will flag. In these conditions, the RAIM and CDI sensitivity will not ramp down, and the pilot should not descend to MDA, but fly to the MAWP and execute a missed approach. The approach active annunciator and/or the receiver should be checked to ensure the approach mode is active prior to the FAWP.

(8) Do not attempt to fly an approach unless the procedure in the onboard database is current and identified as “GPS” on the approach chart. The navigation database may contain information about non-overlay approach procedures that enhances position orientation generally by providing a map, while flying these approaches using conventional NAVAIDs. This approach information should not be confused with a GPS overlay approach (see the receiver operating manual, AFM, or AFM Supplement for details on how to identify these procedures in the navigation database). Flying point to point on the approach does not assure compliance with the published approach procedure. The proper RAIM sensitivity will not be available and the CDI

sensitivity will not automatically change to  $\pm 0.3$  NM. Manually setting CDI sensitivity does not automatically change the RAIM sensitivity on some receivers. Some existing non-precision approach procedures cannot be coded for use with GPS and will not be available as overlays.

(9) Pilots should pay particular attention to the exact operation of their GPS receivers for performing holding patterns and in the case of overlay approaches, operations such as procedure turns. These procedures may require manual intervention by the pilot to stop the sequencing of waypoints by the receiver and to resume automatic GPS navigation sequencing once the maneuver is complete. The same waypoint may appear in the route of flight more than once consecutively (for example, IAWP, FAWP, MAHWP on a procedure turn). Care must be exercised to ensure that the receiver is sequenced to the appropriate waypoint for the segment of the procedure being flown, especially if one or more fly-overs are skipped (for example, FAWP rather than IAWP if the procedure turn is not flown). The pilot may have to sequence past one or more fly-overs of the same waypoint in order to start GPS automatic sequencing at the proper place in the sequence of waypoints.

(10) Incorrect inputs into the GPS receiver are especially critical during approaches. In some cases, an incorrect entry can cause the receiver to leave the approach mode.

(11) A fix on an overlay approach identified by a DME fix will not be in the waypoint sequence on the GPS receiver unless there is a published name assigned to it. When a name is assigned, the along track distance (ATD) to the waypoint may be zero rather than the DME stated on the approach chart. The pilot should be alert for this on any overlay procedure where the original approach used DME.

(12) If a visual descent point (VDP) is published, it will not be included in the sequence of waypoints. Pilots are expected to use normal piloting techniques for beginning the visual descent, such as ATD.

(13) Unnamed stepdown fixes in the final approach segment may or may not be coded in the waypoint sequence of the aircraft's navigation database and must be identified using ATD.

Stepdown fixes in the final approach segment of RNAV (GPS) approaches are being named, in addition to being identified by ATD. However, GPS avionics may or may not accommodate waypoints between the FAF and MAP. Pilots must know the capabilities of their GPS equipment and continue to identify stepdown fixes using ATD when necessary.

#### (f) Missed Approach

(1) A GPS missed approach requires pilot action to sequence the receiver past the MAWP to the missed approach portion of the procedure. The pilot must be thoroughly familiar with the activation procedure for the particular GPS receiver installed in the aircraft and must initiate appropriate action after the MAWP. Activating the missed approach prior to the MAWP will cause CDI sensitivity to immediately change to terminal ( $\pm 1$  NM) sensitivity and the receiver will continue to navigate to the MAWP. The receiver will not sequence past the MAWP. Turns should not begin prior to the MAWP. If the missed approach is not activated, the GPS receiver will display an extension of the inbound final approach course and the ATD will increase from the MAWP until it is manually sequenced after crossing the MAWP.

(2) Missed approach routings in which the first track is via a course rather than direct to the next waypoint require additional action by the pilot to set the course. Being familiar with all of the inputs required is especially critical during this phase of flight.

#### (g) GPS NOTAMs/Aeronautical Information

(1) GPS satellite outages are issued as GPS NOTAMs both domestically and internationally. However, the effect of an outage on the intended operation cannot be determined unless the pilot has a RAIM availability prediction program which allows excluding a satellite which is predicted to be out of service based on the NOTAM information.

(2) The terms UNRELIABLE and MAY NOT BE AVAILABLE are used in conjunction with GPS NOTAMs. Both UNRELIABLE and MAY NOT BE AVAILABLE are advisories to pilots indicating the expected level of service may not be available. UNRELIABLE does not mean there is a problem with GPS signal integrity. If GPS service is available, pilots may continue operations. If the LNAV or LNAV/VNAV service is available, pilots may use the

displayed level of service to fly the approach. GPS operation may be NOTAMed UNRELIABLE or MAY NOT BE AVAILABLE due to testing or anomalies. (Pilots are encouraged to report GPS anomalies, including degraded operation and/or loss of service, as soon as possible, reference paragraph 1–1–13.) When GPS testing NOTAMS are published and testing is actually occurring, Air Traffic Control will advise pilots requesting or cleared for a GPS or RNAV (GPS) approach that GPS may not be available and request intentions. If pilots have reported GPS anomalies, Air Traffic Control will request the pilot's intentions and/or clear the pilot for an alternate approach, if available and operational.

**EXAMPLE–**

*The following is an example of a GPS testing NOTAM:  
!GPS 06/001 ZAB NAV GPS (INCLUDING WAAS, GBAS, AND ADS-B) MAY NOT BE AVAILABLE WITHIN A 468NM RADIUS CENTERED AT 330702N1062540W (TCS 093044) FL400-UNL DECREASING IN AREA WITH A DECREASE IN ALTITUDE DEFINED AS: 425NM RADIUS AT FL250, 360NM RADIUS AT 10000FT, 354NM RADIUS AT 4000FT AGL, 327NM RADIUS AT 50FT AGL. 1406070300-1406071200.*

(3) Civilian pilots may obtain GPS RAIM availability information for non–precision approach procedures by using a manufacturer-supplied RAIM prediction tool, or using the Service Availability Prediction Tool (SAPT) on the FAA en route and terminal RAIM prediction website. Pilots can also request GPS RAIM aeronautical information from a flight service station during preflight briefings. GPS RAIM aeronautical information can be obtained for a period of 3 hours (for example, if you are scheduled to arrive at 1215 hours, then the GPS RAIM information is available from 1100 to 1400 hours) or a 24–hour timeframe at a particular airport. FAA briefers will provide RAIM information for a period of 1 hour before to 1 hour after the ETA hour, unless a specific timeframe is requested by the pilot. If flying a published GPS departure, a RAIM prediction should also be requested for the departure airport.

(4) The military provides airfield specific GPS RAIM NOTAMs for non–precision approach procedures at military airfields. The RAIM outages are issued as M–series NOTAMs and may be obtained for up to 24 hours from the time of request.

(5) Receiver manufacturers and/or database suppliers may supply “NOTAM” type information concerning database errors. Pilots

should check these sources, when available, to ensure that they have the most current information concerning their electronic database.

**(h) Receiver Autonomous Integrity Monitoring (RAIM)**

(1) RAIM outages may occur due to an insufficient number of satellites or due to unsuitable satellite geometry which causes the error in the position solution to become too large. Loss of satellite reception and RAIM warnings may occur due to aircraft dynamics (changes in pitch or bank angle). Antenna location on the aircraft, satellite position relative to the horizon, and aircraft attitude may affect reception of one or more satellites. Since the relative positions of the satellites are constantly changing, prior experience with the airport does not guarantee reception at all times, and RAIM availability should always be checked.

(2) If RAIM is not available, use another type of navigation and approach system, select another route or destination, or delay the trip until RAIM is predicted to be available on arrival. On longer flights, pilots should consider rechecking the RAIM prediction for the destination during the flight. This may provide an early indication that an unscheduled satellite outage has occurred since takeoff.

(3) If a RAIM failure/status annunciation occurs prior to the final approach waypoint (FAWP), the approach should not be completed since GPS no longer provides the required integrity. The receiver performs a RAIM prediction by 2 NM prior to the FAWP to ensure that RAIM is available as a condition for entering the approach mode. The pilot should ensure the receiver has sequenced from “Armed” to “Approach” prior to the FAWP (normally occurs 2 NM prior). Failure to sequence may be an indication of the detection of a satellite anomaly, failure to arm the receiver (if required), or other problems which preclude flying the approach.

(4) If the receiver does not sequence into the approach mode or a RAIM failure/status annunciation occurs prior to the FAWP, the pilot must not initiate the approach or descend, but instead proceed to the missed approach waypoint (MAWP) via the FAWP, perform a missed approach, and contact ATC as soon as practical. The GPS receiver may continue to operate after a RAIM flag/status annunciation appears, but the navigation information

should be considered advisory only. Refer to the receiver operating manual for specific indications and instructions associated with loss of RAIM prior to the FAF.

(5) If the RAIM flag/status annunciation appears after the FAWP, the pilot should initiate a climb and execute the missed approach. The GPS receiver may continue to operate after a RAIM flag/status annunciation appears, but the navigation information should be considered advisory only. Refer to the receiver operating manual for operating mode information during a RAIM annunciation.

#### (i) Waypoints

(1) GPS receivers navigate from one defined point to another retrieved from the aircraft's onboard navigational database. These points are waypoints (5-letter pronounceable name), existing VHF intersections, DME fixes with 5-letter pronounceable names and 3-letter NAVAID IDs. Each waypoint is a geographical location defined by a latitude/longitude geographic coordinate. These 5-letter waypoints, VHF intersections, 5-letter pronounceable DME fixes and 3-letter NAVAID IDs are published on various FAA aeronautical navigation products (IFR Enroute Charts, VFR Charts, Terminal Procedures Publications, etc.).

(2) A Computer Navigation Fix (CNF) is also a point defined by a latitude/longitude coordinate and is required to support Performance-Based Navigation (PBN) operations. The GPS receiver uses CNFs in conjunction with waypoints to navigate from point to point. However, CNFs are not recognized by ATC. ATC does not maintain CNFs in their database and they do not use CNFs for any air traffic control purpose. CNFs may or may not be charted on FAA aeronautical navigation products, are listed in the chart legends, and are for advisory purposes only. Pilots are not to use CNFs for point to point navigation (proceed direct), filing a flight plan, or in aircraft/ATC communications. CNFs that do appear on aeronautical charts allow pilots increased situational awareness by identifying points in the aircraft database route of flight with points on the aeronautical chart. CNFs are random five-letter identifiers, not pronounceable like waypoints and placed in parenthesis. Eventually, all CNFs will begin with the letters "CF" followed by three consonants (for example, CFWBG). This five-letter identifier will be found next to an "x" on enroute charts and

possibly on an approach chart. On instrument approach procedures (charts) in the terminal procedures publication, CNFs may represent unnamed DME fixes, beginning and ending points of DME arcs, and sensor (ground-based signal i.e., VOR, NDB, ILS) final approach fixes on GPS overlay approaches. These CNFs provide the GPS with points on the procedure that allow the overlay approach to mirror the ground-based sensor approach. These points should only be used by the GPS system for navigation and should not be used by pilots for any other purpose on the approach. The CNF concept has not been adopted or recognized by the International Civil Aviation Organization (ICAO).

(3) GPS approaches use fly-over and fly-by waypoints to join route segments on an approach. Fly-by waypoints connect the two segments by allowing the aircraft to turn prior to the current waypoint in order to roll out on course to the next waypoint. This is known as turn anticipation and is compensated for in the airspace and terrain clearances. The MAWP and the missed approach holding waypoint (MAHWP) are normally the only two waypoints on the approach that are not fly-by waypoints. Fly-over waypoints are used when the aircraft must overfly the waypoint prior to starting a turn to the new course. The symbol for a fly-over waypoint is a circled waypoint. Some waypoints may have dual use; for example, as a fly-by waypoint when used as an IF for a NoPT route and as a fly-over waypoint when the same waypoint is also used as an IAF/IF hold-in-lieu of PT. When this occurs, the less restrictive (fly-by) symbology will be charted. Overlay approach charts and some early stand-alone GPS approach charts may not reflect this convention.

(4) Unnamed waypoints for each airport will be uniquely identified in the database. Although the identifier may be used at different airports (for example, RW36 will be the identifier at each airport with a runway 36), the actual point, at each airport, is defined by a specific latitude/longitude coordinate.

(5) The runway threshold waypoint, normally the MAWP, may have a five-letter identifier (for example, SNEEZ) or be coded as RW## (for example, RW36, RW36L). MAWPs located at the runway threshold are being changed to the RW## identifier, while MAWPs not located at the threshold will have a five-letter identifier. This may cause the approach chart to differ from the aircraft database

until all changes are complete. The runway threshold waypoint is also used as the center of the Minimum Safe Altitude (MSA) on most GPS approaches.

**(j) Position Orientation.**

Pilots should pay particular attention to position orientation while using GPS. Distance and track information are provided to the next active waypoint, not to a fixed navigation aid. Receivers may sequence when the pilot is not flying along an active route, such as when being vectored or deviating for weather, due to the proximity to another waypoint in the route. This can be prevented by placing the receiver in the non-sequencing mode. When the receiver is in the non-sequencing mode, bearing and distance are provided to the selected waypoint and the receiver will not sequence to the next waypoint in the route until placed back in the auto sequence mode or the pilot selects a different waypoint. The pilot may have to compute the ATD to stepdown fixes and other points on overlay approaches, due to the receiver showing ATD to the next waypoint rather than DME to the VOR or ILS ground station.

**(k) Impact of Magnetic Variation on PBN Systems**

(1) Differences may exist between PBN systems and the charted magnetic courses on ground-based NAVAID instrument flight procedures (IFP), enroute charts, approach charts, and Standard Instrument Departure/Standard Terminal Arrival (SID/STAR) charts. These differences are due to the magnetic variance used to calculate the magnetic course. Every leg of an instrument procedure is first computed along a desired ground track with reference to true north. A magnetic variation correction is then applied to the true course in order to calculate a magnetic course for publication. The type of procedure will determine what magnetic variation value is added to the true course. A ground-based NAVAID IFP applies the facility magnetic variation of record to the true course to get the charted magnetic course. Magnetic courses on PBN procedures are calculated two different ways. SID/STAR procedures use the airport magnetic variation of record, while IFR enroute charts use magnetic reference bearing. PBN systems make a correction to true north by adding a magnetic variation calculated with an algorithm based on aircraft position, or by adding the magnetic variation coded in their navigational

database. This may result in the PBN system and the procedure designer using a different magnetic variation, which causes the magnetic course *displayed* by the PBN system and the magnetic course *charted* on the IFP plate to be different. It is important to understand, however, that PBN systems, (with the exception of VOR/DME RNAV equipment) navigate by reference to true north and display magnetic course only for pilot reference. As such, a *properly functioning* PBN system, containing a *current and accurate navigational database*, should fly the correct ground track for any loaded instrument procedure, despite differences in displayed magnetic course that may be attributed to magnetic variation application. Should significant differences between the approach chart and the PBN system avionics' application of the navigation database arise, the published approach chart, supplemented by NOT-AMs, holds precedence.

(2) The course into a waypoint may not always be 180 degrees different from the course leaving the previous waypoint, due to the PBN system avionics' computation of geodesic paths, distance between waypoints, and differences in magnetic variation application. Variations in distances may also occur since PBN system distance-to-waypoint values are ATDs computed to the next waypoint and the DME values published on underlying procedures are slant-range distances measured to the station. This difference increases with aircraft altitude and proximity to the NAVAID.

**(l) GPS Familiarization**

Pilots should practice GPS approaches in visual meteorological conditions (VMC) until thoroughly proficient with all aspects of their equipment (receiver and installation) prior to attempting flight in instrument meteorological conditions (IMC). Pilots should be proficient in the following areas:

- (1) Using the receiver autonomous integrity monitoring (RAIM) prediction function;
- (2) Inserting a DP into the flight plan, including setting terminal CDI sensitivity, if required, and the conditions under which terminal RAIM is available for departure;
- (3) Programming the destination airport;
- (4) Programming and flying the approaches (especially procedure turns and arcs);

(5) Changing to another approach after selecting an approach;

(6) Programming and flying “direct” missed approaches;

(7) Programming and flying “routed” missed approaches;

(8) Entering, flying, and exiting holding patterns, particularly on approaches with a second waypoint in the holding pattern;

(9) Programming and flying a “route” from a holding pattern;

(10) Programming and flying an approach with radar vectors to the intermediate segment;

(11) Indication of the actions required for RAIM failure both before and after the FAWP; and

(12) Programming a radial and distance from a VOR (often used in departure instructions).

*TBL 1-1-5*  
**GPS IFR Equipment Classes/Categories**

<b>TSO-C129</b>						
<b>Equipment Class</b>	<b>RAIM</b>	<b>Int. Nav. Sys. to Prov. RAIM Equiv.</b>	<b>Oceanic</b>	<b>En Route</b>	<b>Terminal</b>	<b>Non-precision Approach Capable</b>
<b>Class A</b> – GPS sensor and navigation capability.						
A1	yes		yes	yes	yes	yes
A2	yes		yes	yes	yes	no
<b>Class B</b> – GPS sensor data to an integrated navigation system (i.e., FMS, multi-sensor navigation system, etc.).						
B1	yes		yes	yes	yes	yes
B2	yes		yes	yes	yes	no
B3		yes	yes	yes	yes	yes
B4		yes	yes	yes	yes	no
<b>Class C</b> – GPS sensor data to an integrated navigation system (as in Class B) which provides enhanced guidance to an autopilot, or flight director, to reduce flight tech. errors. Limited to 14 CFR Part 121 or equivalent criteria.						
C1	yes		yes	yes	yes	yes
C2	yes		yes	yes	yes	no
C3		yes	yes	yes	yes	yes
C4		yes	yes	yes	yes	no

*TBL 1-1-6*  
**GPS Approval Required/Authorized Use**

Equipment Type <sup>1</sup>	Installation Approval Required	Operational Approval Required	IFR En Route <sup>2</sup>	IFR Terminal <sup>2</sup>	IFR Approach <sup>3</sup>	Oceanic Remote	In Lieu of ADF and/or DME <sup>3</sup>
Hand held <sup>4</sup>	X <sup>5</sup>						
VFR Panel Mount <sup>4</sup>	X						
IFR En Route and Terminal	X	X	X	X			X
IFR Oceanic/Remote	X	X	X	X		X	X
IFR En Route, Terminal, and Approach	X	X	X	X	X		X

**NOTE-**

- <sup>1</sup>To determine equipment approvals and limitations, refer to the AFM, AFM supplements, or pilot guides.
- <sup>2</sup>Requires verification of data for correctness if database is expired.
- <sup>3</sup>Requires current database or verification that the procedure has not been amended since the expiration of the database.
- <sup>4</sup>VFR and hand-held GPS systems are not authorized for IFR navigation, instrument approaches, or as a primary instrument flight reference. During IFR operations they may be considered only an aid to situational awareness.
- <sup>5</sup>Hand-held receivers require no approval. However, any aircraft modification to support the hand-held receiver; i.e., installation of an external antenna or a permanent mounting bracket, does require approval.

**1-1-18. Wide Area Augmentation System (WAAS)**

**a. General**

1. The FAA developed the WAAS to improve the accuracy, integrity and availability of GPS signals. WAAS will allow GPS to be used, as the aviation navigation system, from takeoff through approach when it is complete. WAAS is a critical component of the FAA’s strategic objective for a seamless satellite navigation system for civil aviation, improving capacity and safety.

2. The International Civil Aviation Organization (ICAO) has defined Standards and Recommended Practices (SARPs) for satellite-based augmentation systems (SBAS) such as WAAS. India and Europe are building similar systems: EGNOS, the European Geostationary Navigation Overlay System; and India’s GPS and Geo-Augmented Navigation (GAGAN) system. The merging of these systems will create an expansive navigation capability similar to GPS, but with greater accuracy, availability, and integrity.

3. Unlike traditional ground-based navigation aids, WAAS will cover a more extensive service area. Precisely surveyed wide-area reference stations

(WRS) are linked to form the U.S. WAAS network. Signals from the GPS satellites are monitored by these WRSs to determine satellite clock and ephemeris corrections and to model the propagation effects of the ionosphere. Each station in the network relays the data to a wide-area master station (WMS) where the correction information is computed. A correction message is prepared and uplinked to a geostationary earth orbit satellite (GEO) via a GEO uplink subsystem (GUS) which is located at the ground earth station (GES). The message is then broadcast on the same frequency as GPS (L1, 1575.42 MHz) to WAAS receivers within the broadcast coverage area of the WAAS GEO.

4. In addition to providing the correction signal, the WAAS GEO provides an additional pseudorange measurement to the aircraft receiver, improving the availability of GPS by providing, in effect, an additional GPS satellite in view. The integrity of GPS is improved through real-time monitoring, and the accuracy is improved by providing differential corrections to reduce errors. The performance improvement is sufficient to enable approach procedures with GPS/WAAS glide paths (vertical guidance).

5. The FAA has completed installation of 3 GEO satellite links, 38 WRSs, 3 WMSs, 6 GES, and the required terrestrial communications to support the WAAS network including 2 operational control centers. Prior to the commissioning of the WAAS for public use, the FAA conducted a series of test and validation activities. Future dual frequency operations are planned.

6. GNSS navigation, including GPS and WAAS, is referenced to the WGS-84 coordinate system. It should only be used where the Aeronautical Information Publications (including electronic data and aeronautical charts) conform to WGS-84 or equivalent. Other countries' civil aviation authorities may impose additional limitations on the use of their SBAS systems.

#### **b. Instrument Approach Capabilities**

1. A class of approach procedures which provide vertical guidance, but which do not meet the ICAO Annex 10 requirements for precision approaches has been developed to support satellite navigation use for aviation applications worldwide. These procedures are not precision and are referred to as Approach with Vertical Guidance (APV), are defined in ICAO Annex 6, and include approaches such as the LNAV/VNAV and localizer performance with vertical guidance (LPV). These approaches provide vertical guidance, but do not meet the more stringent standards of a precision approach. Properly certified WAAS receivers will be able to fly to LPV minima and LNAV/VNAV minima, using a WAAS electronic glide path, which eliminates the errors that can be introduced by using Barometric altimetry.

2. LPV minima takes advantage of the high accuracy guidance and increased integrity provided by WAAS. This WAAS generated angular guidance allows the use of the same TERPS approach criteria used for ILS approaches. LPV minima may have a decision altitude as low as 200 feet height above touchdown with visibility minimums as low as  $\frac{1}{2}$  mile, when the terrain and airport infrastructure support the lowest minima. LPV minima is published on the RNAV (GPS) approach charts (see Paragraph 5-4-5, Instrument Approach Procedure Charts).

3. A different WAAS-based line of minima, called Localizer Performance (LP) is being added in locations where the terrain or obstructions do not allow publication of vertically guided LPV minima.

LP takes advantage of the angular lateral guidance and smaller position errors provided by WAAS to provide a lateral only procedure similar to an ILS Localizer. LP procedures may provide lower minima than a LNAV procedure due to the narrower obstacle clearance surface.

#### **NOTE-**

*WAAS receivers certified prior to TSO-C145b and TSO-C146b, even if they have LPV capability, do not contain LP capability unless the receiver has been upgraded. Receivers capable of flying LP procedures must contain a statement in the Aircraft Flight Manual (AFM), AFM Supplement, or Approved Supplemental Flight Manual stating that the receiver has LP capability, as well as the capability for the other WAAS and GPS approach procedure types.*

4. WAAS provides a level of service that supports all phases of flight, including RNAV (GPS) approaches to LNAV, LP, LNAV/VNAV, and LPV lines of minima, within system coverage. Some locations close to the edge of the coverage may have a lower availability of vertical guidance.

#### **c. General Requirements**

1. WAAS avionics must be certified in accordance with Technical Standard Order (TSO) TSO-C145(), Airborne Navigation Sensors Using the (GPS) Augmented by the Wide Area Augmentation System (WAAS); or TSO-C146(), Stand-Alone Airborne Navigation Equipment Using the Global Positioning System (GPS) Augmented by the Wide Area Augmentation System (WAAS), and installed in accordance with AC 20-138, Airworthiness Approval of Positioning and Navigation Systems.

2. GPS/WAAS operation must be conducted in accordance with the FAA-approved aircraft flight manual (AFM) and flight manual supplements. Flight manual supplements will state the level of approach procedure that the receiver supports. IFR approved WAAS receivers support all GPS only operations as long as lateral capability at the appropriate level is functional. WAAS monitors both GPS and WAAS satellites and provides integrity.

3. GPS/WAAS equipment is inherently capable of supporting oceanic and remote operations if the operator obtains a fault detection and exclusion (FDE) prediction program.

4. Air carrier and commercial operators must meet the appropriate provisions of their approved operations specifications.

5. Prior to GPS/WAAS IFR operation, the pilot must review appropriate Notices to Airmen (NOTAMs) and aeronautical information. This information is available on request from a Flight Service Station. The FAA will provide NOTAMs to advise pilots of the status of the WAAS and level of service available.

(a) The term MAY NOT BE AVBL is used in conjunction with WAAS NOTAMs and indicates that due to ionospheric conditions, lateral guidance may still be available when vertical guidance is unavailable. Under certain conditions, both lateral and vertical guidance may be unavailable. This NOTAM language is an advisory to pilots indicating the expected level of WAAS service (LNAV/VNAV, LPV, LP) may not be available.

**EXAMPLE-**

*!FDC FDC NAV WAAS VNAV/LPV/LP MINIMA MAY NOT BE AVBL 1306111330-1306141930EST*

or

*!FDC FDC NAV WAAS VNAV/LPV MINIMA NOT AVBL, WAAS LP MINIMA MAY NOT BE AVBL 1306021200-1306031200EST*

WAAS MAY NOT BE AVBL NOTAMs are predictive in nature and published for flight planning purposes. Upon commencing an approach at locations NOTAMED WAAS MAY NOT BE AVBL, if the WAAS avionics indicate LNAV/VNAV or LPV service is available, then vertical guidance may be used to complete the approach using the displayed level of service. Should an outage occur during the approach, reversion to LNAV minima or an alternate instrument approach procedure may be required. When GPS testing NOTAMS are published and testing is actually occurring, Air Traffic Control will advise pilots requesting or cleared for a GPS or RNAV (GPS) approach that GPS may not be available and request intentions. If pilots have reported GPS anomalies, Air Traffic Control will request the pilot's intentions and/or clear the pilot for an alternate approach, if available and operational.

(b) WAAS area-wide NOTAMs are originated when WAAS assets are out of service and impact the service area. Area-wide WAAS NOT AVAILABLE (AVBL) NOTAMs indicate loss or malfunction of the WAAS system. In flight, Air Traffic Control will advise pilots requesting a GPS or RNAV (GPS) approach of WAAS NOT AVBL NOTAMs if not contained in the ATIS broadcast.

**EXAMPLE-**

*For unscheduled loss of signal or service, an example NOTAM is: !FDC FDC NAV WAAS NOT AVBL 1311160600- 1311191200EST.*

*For scheduled loss of signal or service, an example NOTAM is: !FDC FDC NAV WAAS NOT AVBL 1312041015- 1312082000EST.*

(c) Site-specific WAAS MAY NOT BE AVBL NOTAMs indicate an expected level of service; for example, LNAV/VNAV, LP, or LPV may not be available. Pilots must request site-specific WAAS NOTAMs during flight planning. In flight, Air Traffic Control will not advise pilots of WAAS MAY NOT BE AVBL NOTAMs.

**NOTE-**

*Though currently unavailable, the FAA is updating its prediction tool software to provide this site-service in the future.*

(d) Most of North America has redundant coverage by two or more geostationary satellites. One exception is the northern slope of Alaska. If there is a problem with the satellite providing coverage to this area, a NOTAM similar to the following example will be issued:

**EXAMPLE-**

*!FDC 4/3406 (PAZA A0173/14) ZAN NAV WAAS SIGNAL MAY NOT BE AVBL NORTH OF LINE FROM 7000N150000W TO 6400N16400W. RMK WAAS USERS SHOULD CONFIRM RAIM AVAILABILITY FOR IFR OPERATIONS IN THIS AREA. T-ROUTES IN THIS SECTOR NOT AVBL. ANY REQUIRED ALTERNATE AIRPORT IN THIS AREA MUST HAVE AN APPROVED INSTRUMENT APPROACH PROCEDURE OTHER THAN GPS THAT IS ANTICIPATED TO BE OPERATIONAL AND AVAILABLE AT THE ESTIMATED TIME OF ARRIVAL AND WHICH THE AIRCRAFT IS EQUIPPED TO FLY. 1406030812-1406050812EST.*

6. When GPS-testing NOTAMS are published and testing is actually occurring, Air Traffic Control will advise pilots requesting or cleared for a GPS or RNAV (GPS) approach that GPS may not be available and request intentions. If pilots have reported GPS anomalies, Air Traffic Control will request the pilot's intentions and/or clear the pilot for an alternate approach, if available and operational.

**EXAMPLE-**

*Here is an example of a GPS testing NOTAM:  
!GPS 06/001 ZAB NAV GPS (INCLUDING WAAS, GBAS, AND ADS-B) MAY NOT BE AVAILABLE WITHIN A 468NM RADIUS CENTERED AT 330702N1062540W (TCS 093044) FL400-UNL DECREASING IN AREA WITH A DECREASE IN ALTITUDE DEFINED AS:*

425NM RADIUS AT FL250, 360NM RADIUS AT 10000FT, 354NM RADIUS AT 4000FT AGL, 327NM RADIUS AT 50FT AGL. 1406070300-1406071200.

7. When the approach chart is annotated with the **W** symbol, site-specific WAAS MAY NOT BE AVBL NOTAMS or Air Traffic advisories are not provided for outages in WAAS LNAV/VNAV and LPV vertical service. Vertical outages may occur daily at these locations due to being close to the edge of WAAS system coverage. Use LNAV or circling minima for flight planning at these locations, whether as a destination or alternate. For flight operations at these locations, when the WAAS avionics indicate that LNAV/VNAV or LPV service is available, then the vertical guidance may be used to complete the approach using the displayed level of service. Should an outage occur during the procedure, reversion to LNAV minima may be required.

**NOTE-**

*Area-wide WAAS NOT AVBL NOTAMS apply to all airports in the WAAS NOT AVBL area designated in the NOTAM, including approaches at airports where an approach chart is annotated with the **W** symbol.*

8. GPS/WAAS was developed to be used within GEO coverage over North America without the need for other radio navigation equipment appropriate to the route of flight to be flown. Outside the WAAS coverage or in the event of a WAAS failure, GPS/WAAS equipment reverts to GPS-only operation and satisfies the requirements for basic GPS equipment. (See paragraph 1-1-17 for these requirements).

9. Unlike TSO-C129 avionics, which were certified as a supplement to other means of navigation, WAAS avionics are evaluated without reliance on other navigation systems. As such, installation of WAAS avionics does not require the aircraft to have other equipment appropriate to the route to be flown. (See paragraph 1-1-17 d for more information on equipment requirements.)

(a) Pilots with WAAS receivers may flight plan to use any instrument approach procedure authorized for use with their WAAS avionics as the planned approach at a required alternate, with the following restrictions. When using WAAS at an alternate airport, flight planning must be based on flying the RNAV (GPS) LNAV or circling minima line, or minima on a GPS approach procedure, or

conventional approach procedure with “or GPS” in the title. Code of Federal Regulation (CFR) Part 91 non-precision weather requirements must be used for planning. Upon arrival at an alternate, when the WAAS navigation system indicates that LNAV/VNAV or LPV service is available, then vertical guidance may be used to complete the approach using the displayed level of service. The FAA has begun removing the **△ NA** (Alternate Minimums Not Authorized) symbol from select RNAV (GPS) and GPS approach procedures so they may be used by approach approved WAAS receivers at alternate airports. Some approach procedures will still require the **△ NA** for other reasons, such as no weather reporting, so it cannot be removed from all procedures. Since every procedure must be individually evaluated, removal of the **△ NA** from RNAV (GPS) and GPS procedures will take some time.

**NOTE-**

*Properly trained and approved, as required, TSO-C145() and TSO-C146() equipped users (WAAS users) with and using approved baro-VNAV equipment may plan for LNAV/VNAV DA at an alternate airport. Specifically authorized WAAS users with and using approved baro-VNAV equipment may also plan for RNP 0.3 DA at the alternate airport as long as the pilot has verified RNP availability through an approved prediction program.*

**d. Flying Procedures with WAAS**

1. WAAS receivers support all basic GPS approach functions and provide additional capabilities. One of the major improvements is the ability to generate glide path guidance, independent of ground equipment or barometric aiding. This eliminates several problems such as hot and cold temperature effects, incorrect altimeter setting, or lack of a local altimeter source. It also allows approach procedures to be built without the cost of installing ground stations at each airport or runway. Some approach certified receivers may only generate a glide path with performance similar to Baro-VNAV and are only approved to fly the LNAV/VNAV line of minima on the RNAV (GPS) approach charts. Receivers with additional capability (including faster update rates and smaller integrity limits) are approved to fly the LPV line of minima. The lateral integrity changes dramatically from the 0.3 NM (556 meter) limit for GPS, LNAV, and LNAV/VNAV approach mode, to 40 meters for LPV. It also provides vertical integrity monitoring, which bounds the vertical error to 50

meters for LNAV/VNAV and LPVs with minima of 250' or above, and bounds the vertical error to 35 meters for LPVs with minima below 250'.

2. When an approach procedure is selected and active, the receiver will notify the pilot of the most accurate level of service supported by the combination of the WAAS signal, the receiver, and the selected approach, using the naming conventions on the minima lines of the selected approach procedure. For example, if an approach is published with LPV minima and the receiver is only certified for LNAV/VNAV, the equipment would indicate "LNAV/VNAV available," even though the WAAS signal would support LPV. If flying an existing LNAV/VNAV procedure with no LPV minima, the receiver will notify the pilot "LNAV/VNAV available," even if the receiver is certified for LPV and the signal supports LPV. If the signal does not support vertical guidance on procedures with LPV and/or LNAV/VNAV minima, the receiver annunciation will read "LNAV available." On lateral only procedures with LP and LNAV minima the receiver will indicate "LP available" or "LNAV available" based on the level of lateral service available. Once the level of service notification has been given, the receiver will operate in this mode for the duration of the approach procedure, unless that level of service becomes unavailable. The receiver cannot change back to a more accurate level of service until the next time an approach is activated.

**NOTE—**

*Receivers do not "fail down" to lower levels of service once the approach has been activated. If only the vertical off flag appears, the pilot may elect to use the LNAV minima if the rules under which the flight is operating allow changing the type of approach being flown after commencing the procedure. If the lateral integrity limit is exceeded on an LP approach, a missed approach will be necessary since there is no way to reset the lateral alarm limit while the approach is active.*

3. Another additional feature of WAAS receivers is the ability to exclude a bad GPS signal and continue operating normally. This is normally accomplished by the WAAS correction information. Outside WAAS coverage or when WAAS is not available, it is accomplished through a receiver algorithm called FDE. In most cases this operation will be invisible to the pilot since the receiver will continue to operate with other available satellites

after excluding the "bad" signal. This capability increases the reliability of navigation.

4. Both lateral and vertical scaling for the LNAV/VNAV and LPV approach procedures are different than the linear scaling of basic GPS. When the complete published procedure is flown,  $\pm 1$  NM linear scaling is provided until two (2) NM prior to the FAF, where the sensitivity increases to be similar to the angular scaling of an ILS. There are two differences in the WAAS scaling and ILS: 1) on long final approach segments, the initial scaling will be  $\pm 0.3$  NM to achieve equivalent performance to GPS (and better than ILS, which is less sensitive far from the runway); 2) close to the runway threshold, the scaling changes to linear instead of continuing to become more sensitive. The width of the final approach course is tailored so that the total width is usually 700 feet at the runway threshold. Since the origin point of the lateral splay for the angular portion of the final is not fixed due to antenna placement like localizer, the splay angle can remain fixed, making a consistent width of final for aircraft being vectored onto the final approach course on different length runways. When the complete published procedure is not flown, and instead the aircraft needs to capture the extended final approach course similar to ILS, the vector to final (VTF) mode is used. Under VTF, the scaling is linear at  $\pm 1$  NM until the point where the ILS angular splay reaches a width of  $\pm 1$  NM regardless of the distance from the FAWP.

5. The WAAS scaling is also different than GPS TSO-C129() in the initial portion of the missed approach. Two differences occur here. First, the scaling abruptly changes from the approach scaling to the missed approach scaling, at approximately the departure end of the runway or when the pilot selects missed approach guidance rather than ramping as GPS does. Second, when the first leg of the missed approach is a Track to Fix (TF) leg aligned within 3 degrees of the inbound course, the receiver will change to 0.3 NM linear sensitivity until the turn initiation point for the first waypoint in the missed approach procedure, at which time it will abruptly change to terminal ( $\pm 1$  NM) sensitivity. This allows the elimination of close in obstacles in the early part of the missed approach that may otherwise cause the DA to be raised.

6. There are two ways to select the final approach segment of an instrument approach. Most receivers use menus where the pilot selects the

airport, the runway, the specific approach procedure and finally the IAF, there is also a channel number selection method. The pilot enters a unique 5-digit number provided on the approach chart, and the receiver recalls the matching final approach segment from the aircraft database. A list of information including the available IAFs is displayed and the pilot selects the appropriate IAF. The pilot should confirm that the correct final approach segment was loaded by cross checking the Approach ID, which is also provided on the approach chart.

7. The Along-Track Distance (ATD) during the final approach segment of an LNAV procedure (with a minimum descent altitude) will be to the MAWP. On LNAV/VNAV and LPV approaches to a decision altitude, there is no missed approach waypoint so the along-track distance is displayed to a point normally located at the runway threshold. In most cases, the MAWP for the LNAV approach is located on the runway threshold at the centerline, so these distances will be the same. This distance will always vary slightly from any ILS DME that may be present, since the ILS DME is located further down the runway. Initiation of the missed approach on the LNAV/VNAV and LPV approaches is still based on reaching the decision altitude without any of the items listed in 14 CFR Section 91.175 being visible, and must not be delayed while waiting for the ATD to reach zero. The WAAS receiver, unlike a GPS receiver, will automatically sequence past the MAWP if the missed approach procedure has been designed for RNAV. The pilot may also select missed approach prior to the MAWP; however, navigation will continue to the MAWP prior to waypoint sequencing taking place.

## 1-1-19. Ground Based Augmentation System (GBAS) Landing System (GLS)

### a. General

1. The GLS provides precision navigation guidance for exact alignment and descent of aircraft on approach to a runway. GBAS equipment provides localized differential augmentation to the Global Positioning System (GPS).

#### NOTE-

*To remain consistent with international terminology, the FAA will use the term GBAS in place of the former term Local Area Augmentation System (LAAS).*

2. GLS displays three-dimension vertical and horizontal navigation guidance to the pilot much like

ILS. GLS navigation is based on GPS signals augmented by position correction, integrity parameters, and approach path definition information transmitted over VHF from the local GBAS ground station. One GBAS station can support multiple GLS precision approaches to nearby runways within the GBAS's maximum use distance.

3. GLS provides guidance similar to ILS approaches for the final approach segment, though the approach service volume has different dimensions (see FIG 1-1-8). The GLS approach is constructed using the RNP approach (RNP APCH) navigation specification, and may include vertically-guided turn(s) after the IAF or on the missed approach procedure. Portions of the approach prior to an IAF and after the final approach segment may also require Area Navigation (RNAV) typically using the Required Navigation Performance 1 (RNP 1) navigation specification. See paragraph 1-2-1 for more information on navigation specifications.

4. GLS consists of a GBAS Ground Facility (GGF), at least four ground reference stations, a corrections processor, a VHF Data Broadcast (VDB) uplink antenna, an aircraft GBAS receiver, and a charted instrument approach procedure.

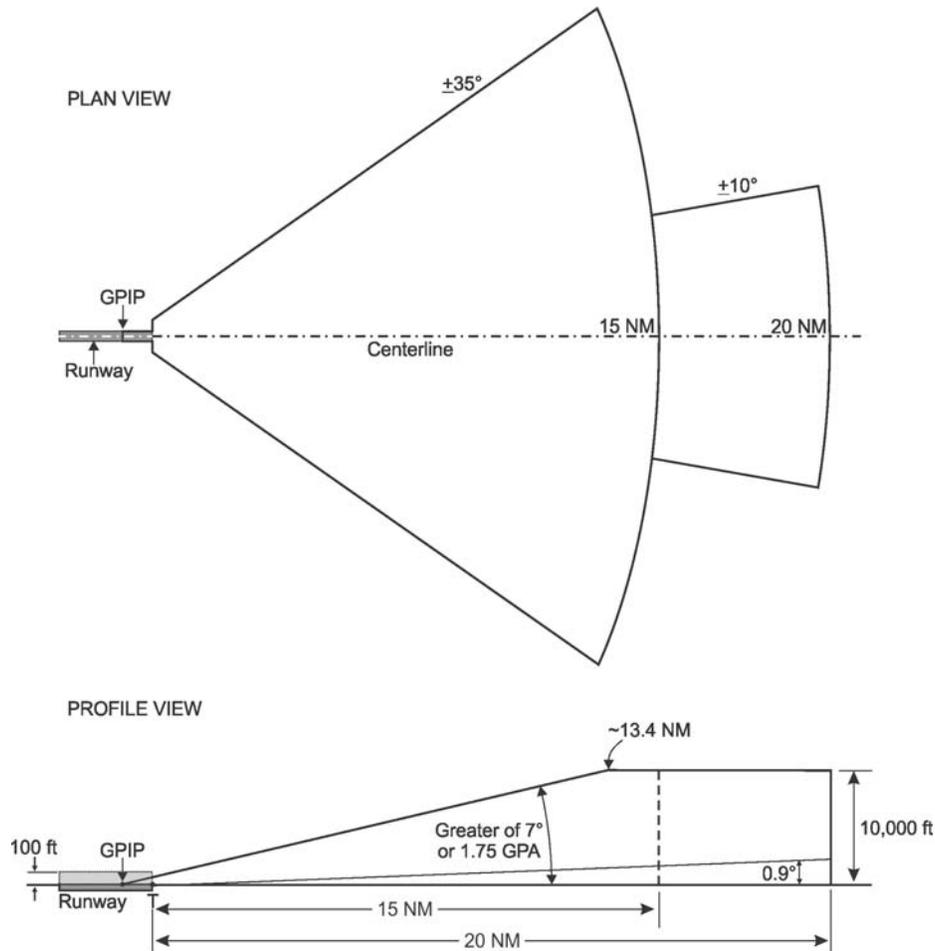
### b. Procedure

1. Pilots will select the five digit GBAS channel number of the associated GLS approach within the Flight Management System (FMS) menu or manually select the five digits (system dependent). Selection of the GBAS channel number also tunes the VDB.

2. Following procedure selection, confirmation that the correct GLS procedure is loaded can be accomplished by cross checking the charted Reference Path Indicator (RPI) or approach ID with the cockpit displayed RPI or audio identification of the RPI with Morse Code (for some systems). Distance to the runway threshold will be displayed to the pilot once the aircraft is inside the approach service volume.

3. The pilot will fly the GLS approach using many of the same techniques as ILS including using a heading or lateral steering mode to intercept the GLS final approach course and then switching to the appropriate approach navigation mode once the aircraft is within the approach service volume and prior to the glide path intercept point. See also the Instrument Procedures Handbook for more information on GLS.

FIG 1-1-8  
GLS Standard Approach Service Volume



## 1-1-20. Precision Approach Systems other than ILS and GLS

### a. General

Approval and use of precision approach systems other than ILS and GLS require the issuance of special instrument approach procedures.

### b. Special Instrument Approach Procedure

1. Special instrument approach procedures must be issued to the aircraft operator if pilot training, aircraft equipment, and/or aircraft performance is different than published procedures. Special instrument approach procedures are not distributed for general public use. These procedures are issued to an aircraft operator when the conditions for operations approval are satisfied.

2. General aviation operators requesting approval for special procedures should contact the local Flight Standards District Office to obtain a letter of authorization. Air carrier operators requesting approval for use of special procedures should contact their Certificate Holding District Office for authorization through their Operations Specification.

### c. Transponder Landing System (TLS)

1. The TLS is designed to provide approach guidance utilizing existing airborne ILS localizer, glide slope, and transponder equipment.

2. Ground equipment consists of a transponder interrogator, sensor arrays to detect lateral and vertical position, and ILS frequency transmitters. The TLS detects the aircraft's position by interrogating its transponder. It then broadcasts ILS frequency signals to guide the aircraft along the desired approach path.

**3.** TLS instrument approach procedures are designated Special Instrument Approach Procedures. Special aircrew training is required. TLS ground equipment provides approach guidance for only one aircraft at a time. Even though the TLS signal is received using the ILS receiver, no fixed course or glidepath is generated. The concept of operation is very similar to an air traffic controller providing radar vectors, and just as with radar vectors, the guidance is valid only for the intended aircraft. The TLS ground equipment tracks one aircraft, based on its transponder code, and provides correction signals to course and glidepath based on the position of the tracked aircraft. Flying the TLS corrections computed for another aircraft will not provide guidance relative to the approach; therefore, aircrews must not use the TLS signal for navigation unless they have received approach clearance and completed the required coordination with the TLS ground equipment operator. Navigation fixes based on conventional NAVAIDs or GPS are provided in the

special instrument approach procedure to allow aircrews to verify the TLS guidance.

**d. Special Category I Differential GPS (SCAT-I DGPS)**

**1.** The SCAT-I DGPS is designed to provide approach guidance by broadcasting differential correction to GPS.

**2.** SCAT-I DGPS procedures require aircraft equipment and pilot training.

**3.** Ground equipment consists of GPS receivers and a VHF digital radio transmitter. The SCAT-I DGPS detects the position of GPS satellites relative to GPS receiver equipment and broadcasts differential corrections over the VHF digital radio.

**4.** Category I Ground Based Augmentation System (GBAS) will displace SCAT-I DGPS as the public use service.

**REFERENCE-**

*AIM, Paragraph 5-4-7j, Instrument Approach Procedures*

**REFERENCE-**

AIM, Paragraph 4-3-11, *Pilot Responsibilities When Conducting Land and Hold Short Operations (LAHSO)*

## **2-1-6. Runway Status Light (RWSL) System**

### **a. Introduction.**

RWSL is a fully automated system that provides runway status information to pilots and surface vehicle operators to clearly indicate when it is unsafe to enter, cross, takeoff from, or land on a runway. The RWSL system processes information from surveillance systems and activates Runway Entrance Lights (REL) and Takeoff Hold Lights (THL), in accordance with the position and velocity of the detected surface traffic and approach traffic. REL and THL are in-pavement light fixtures that are directly visible to pilots and surface vehicle operators. RWSL is an independent safety enhancement that does not substitute for or convey an ATC clearance. Clearance to enter, cross, takeoff from, land on, or operate on a runway must still be received from ATC. Although ATC has limited control over the system, personnel do not directly use and may not be able to view light fixture activations and deactivations during the conduct of daily ATC operations.

**b. Runway Entrance Lights (REL):** The REL system is composed of flush mounted, in-pavement, unidirectional light fixtures that are parallel to and focused along the taxiway centerline and directed toward the pilot at the hold line. An array of REL lights include the first light at the hold line followed by a series of evenly spaced lights to the runway edge; one additional light at the runway centerline is in line with the last two lights before the runway edge (see FIG 2-1-9 and FIG 2-1-10). When activated, the red lights indicate that there is high speed traffic on the runway or there is an aircraft on final approach within the activation area.

### **1. REL Operating Characteristics – Departing Aircraft:**

When a departing aircraft reaches a site adaptable speed of approximately 30 knots, all taxiway intersections with REL arrays along the runway ahead of the aircraft will illuminate (see FIG 2-1-9).

As the aircraft approaches an REL equipped taxiway intersection, the lights at that intersection extinguish approximately 3 to 4 seconds before the aircraft reaches it. This allows controllers to apply “anticipated separation” to permit ATC to move traffic more expeditiously without compromising safety. After the aircraft is declared “airborne” by the system, all REL lights associated with this runway will extinguish.

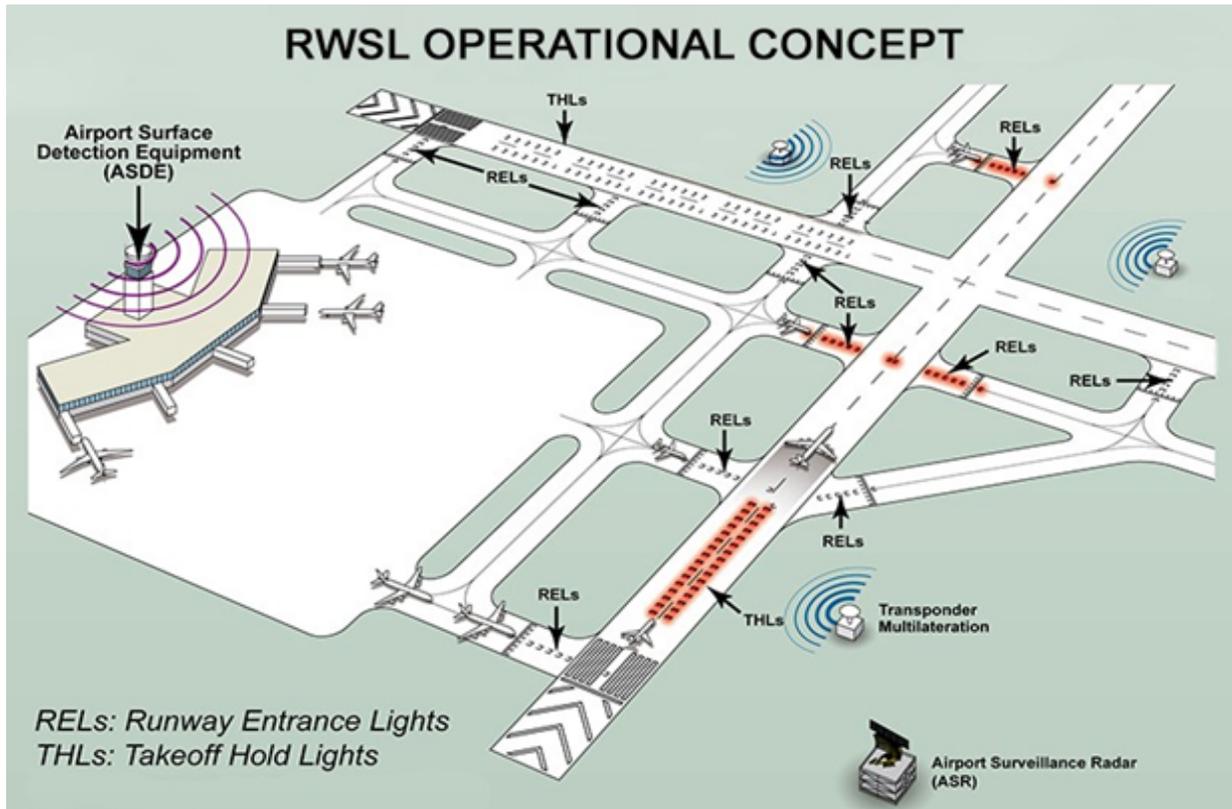
### **2. REL Operating Characteristics – Arriving Aircraft:**

When an aircraft on final approach is approximately 1 mile from the runway threshold, all sets of taxiway REL light arrays that intersect the runway illuminate. The distance is adjustable and can be configured for specific operations at particular airports. Lights extinguish at each equipped taxiway intersection approximately 3 to 4 seconds before the aircraft reaches it to apply anticipated separation until the aircraft has slowed to approximately 80 knots (site adjustable parameter). Below 80 knots, all arrays that are not within 30 seconds of the aircraft’s forward path are extinguished. Once the arriving aircraft slows to approximately 34 knots (site adjustable parameter), it is declared to be in a taxi state, and all lights extinguish.

**3. What a pilot would observe:** A pilot at or approaching the hold line to a runway will observe RELs illuminate and extinguish in reaction to an aircraft or vehicle operating on the runway, or an arriving aircraft operating less than 1 mile from the runway threshold.

**4. When a pilot observes the red lights of the REL,** that pilot will stop at the hold line or remain stopped. The pilot will then contact ATC for resolution if the clearance is in conflict with the lights. Should pilots note illuminated lights under circumstances when remaining clear of the runway is impractical for safety reasons (for example, aircraft is already on the runway), the crew should proceed according to their best judgment while understanding the illuminated lights indicate the runway is unsafe to enter or cross. Contact ATC at the earliest possible opportunity.

FIG 2-1-9  
Runway Status Light System



c. **Takeoff Hold Lights (THL)** : The THL system is composed of flush mounted, in-pavement, unidirectional light fixtures in a double longitudinal row aligned either side of the runway centerline lighting. Fixtures are focused toward the arrival end of the runway at the “line up and wait” point. THLs extend for 1,500 feet in front of the holding aircraft starting at a point 375 feet from the departure threshold (see FIG 2-1-11). Illuminated red lights provide a signal, to an aircraft in position for takeoff or rolling, that it is unsafe to takeoff because the runway is occupied or about to be occupied by another aircraft or ground vehicle. Two aircraft, or a surface vehicle and an aircraft, are required for the lights to illuminate. The departing aircraft must be in position for takeoff or beginning takeoff roll. Another aircraft or a surface vehicle must be on or about to cross the runway.

**1. THL Operating Characteristics – Departing Aircraft:**

THLs will illuminate for an aircraft in position for departure or departing when there is another aircraft or vehicle on the runway or about to enter the runway

(see FIG 2-1-9.) Once that aircraft or vehicle exits the runway, the THLs extinguish. A pilot may notice lights extinguish prior to the downfield aircraft or vehicle being completely clear of the runway but still moving. Like RELs, THLs have an “anticipated separation” feature.

**NOTE-**

*When the THLs extinguish, this is not clearance to begin a takeoff roll. All takeoff clearances will be issued by ATC.*

**2.** What a pilot would observe: A pilot in position to depart from a runway, or has begun takeoff roll, will observe THLs illuminate in reaction to an aircraft or vehicle on the runway or entering or crossing it. Lights will extinguish when the runway is clear. A pilot may observe several cycles of illumination and extinguishing depending on the amount of crossing traffic.

**3.** When a pilot observes the red light of the THLs, the pilot should safely stop if it’s feasible or remain stopped. The pilot must contact ATC for resolution if any clearance is in conflict with the lights. Should pilots note illuminated lights while in takeoff roll and under circumstances when stopping

is impractical for safety reasons, the crew should proceed according to their best judgment while understanding the illuminated lights indicate that continuing the takeoff is unsafe. Contact ATC at the earliest possible opportunity.

**d. Pilot Actions:**

**1.** When operating at airports with RWSL, pilots will operate with the transponder/ADS-B “On” when departing the gate or parking area until it is shut down upon arrival at the gate or parking area. This ensures interaction with the FAA surveillance systems such as ASDE-X/Airport Surface Surveillance Capability (ASSC) which provide information to the RWSL system.

**2.** Pilots must always inform the ATCT when they have stopped due to an RWSL indication that is in conflict with ATC instructions. Pilots must request clarification of the taxi or takeoff clearance.

**3.** Never cross over illuminated red lights. Under normal circumstances, RWSL will confirm the pilot’s taxi or takeoff clearance previously issued by ATC. If RWSL indicates that it is unsafe to takeoff from, land on, cross, or enter a runway, immediately notify ATC of the conflict and re-confirm the clearance.

**4.** Do not proceed when lights have extinguished without an ATC clearance. RWSL verifies an ATC clearance; it does not substitute for an ATC clearance.

**5.** Never land if PAPI continues to flash. Execute a go around and notify ATC.

**e. ATC Control of RWSL System:**

**1.** Controllers can set in-pavement lights to one of five (5) brightness levels to assure maximum conspicuity under all visibility and lighting condi-

tions. REL and THL subsystems may be independently set.

**2.** System lights can be disabled should RWSL operations impact the efficient movement of air traffic or contribute, in the opinion of the assigned ATC Manager, to unsafe operations. REL and THL light fixtures may be disabled separately. Whenever the system or a component is disabled, a NOTAM must be issued, and the Automatic Terminal Information System (ATIS) must be updated.

## **2-1-7. Control of Lighting Systems**

**a.** Operation of approach light systems and runway lighting is controlled by the control tower (ATCT). At some locations the FSS may control the lights where there is no control tower in operation.

**b.** Pilots may request that lights be turned on or off. Runway edge lights, in-pavement lights and approach lights also have intensity controls which may be varied to meet the pilots request. Sequenced flashing lights (SFL) may be turned on and off. Some sequenced flashing light systems also have intensity control.

## **2-1-8. Pilot Control of Airport Lighting**

Radio control of lighting is available at selected airports to provide airborne control of lights by keying the aircraft’s microphone. Control of lighting systems is often available at locations without specified hours for lighting and where there is no control tower or FSS or when the tower or FSS is closed (locations with a part-time tower or FSS) or specified hours. All lighting systems which are radio controlled at an airport, whether on a single runway or multiple runways, operate on the same radio frequency. (See TBL 2-1-1 and TBL 2-1-2.)

*FIG 2-1-10*  
**Runway Entrance Lights**



*FIG 2-1-11*  
**Takeoff Hold Lights**



**FIG 2-1-12**  
**Taxiway Lead-On Light Configuration**



**TBL 2-1-1**  
**Runways With Approach Lights**

Lighting System	No. of Int. Steps	Status During Nonuse Period	Intensity Step Selected Per No. of Mike Clicks		
			3 Clicks	5 Clicks	7 Clicks
Approach Lights (Med. Int.)	2	Off	Low	Low	High
Approach Lights (Med. Int.)	3	Off	Low	Med	High
MIRL	3	Off or Low	◆	◆	◆
HIRL	5	Off or Low	◆	◆	◆
VASI	2	Off	☆	☆	☆

**NOTES:** ◆ Predetermined intensity step.  
☆ Low intensity for night use. High intensity for day use as determined by photocell control.

**TBL 2-1-2**  
**Runways Without Approach Lights**

Lighting System	No. of Int. Steps	Status During Nonuse Period	Intensity Step Selected Per No. of Mike Clicks		
			3 Clicks	5 Clicks	7 Clicks
MIRL	3	Off or Low	Low	Med.	High
HIRL	5	Off or Low	Step 1 or 2	Step 3	Step 5
LIRL	1	Off	On	On	On
VASI☆	2	Off	◆	◆	◆
REIL☆	1	Off	Off	On/Off	On
REIL☆	3	Off	Low	Med.	High

**NOTES:** ◆ Low intensity for night use. High intensity for day use as determined by photocell control.  
☆ The control of VASI and/or REIL may be independent of other lighting systems.

a. With FAA approved systems, various combinations of medium intensity approach lights, runway lights, taxiway lights, VASI and/or REIL may be activated by radio control. On runways with both approach lighting and runway lighting (runway edge lights, taxiway lights, etc.) systems, the approach lighting system takes precedence for air-to-ground radio control over the runway lighting system which is set at a predetermined intensity step, based on expected visibility conditions. Runways without approach lighting may provide radio controlled intensity adjustments of runway edge lights. Other lighting systems, including VASI, REIL, and taxiway lights may be either controlled with the runway edge lights or controlled independently of the runway edge lights.

b. The control system consists of a 3-step control responsive to 7, 5, and/or 3 microphone clicks. This 3-step control will turn on lighting facilities capable of either 3-step, 2-step or 1-step operation. The 3-step and 2-step lighting facilities can be altered in intensity, while the 1-step cannot. All lighting is illuminated for a period of 15 minutes from the most recent time of activation and may not be extinguished prior to end of the 15 minute period (except for 1-step and 2-step REILs which may be turned off when desired by keying the mike 5 or 3 times respectively).

c. Suggested use is to always initially key the mike 7 times; this assures that all controlled lights are turned on to the maximum available intensity. If desired, adjustment can then be made, where the capability is provided, to a lower intensity (or the REIL turned off) by keying 5 and/or 3 times. Due to the close proximity of airports using the same frequency, radio controlled lighting receivers may be set at a low sensitivity requiring the aircraft to be relatively close to activate the system. Consequently, even when lights are on, always key mike as directed when overflying an airport of intended landing or just prior to entering the final segment of an approach. This will assure the aircraft is close enough to activate the system and a full 15 minutes lighting duration is available. Approved lighting systems may be activated by keying the mike (within 5 seconds) as indicated in TBL 2-1-3.

*TBL 2-1-3*  
**Radio Control System**

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

d. For all public use airports with FAA standard systems the Chart Supplement U.S. contains the types of lighting, runway and the frequency that is used to activate the system. Airports with IAPs include data on the approach chart identifying the light system, the runway on which they are installed, and the frequency that is used to activate the system.

**NOTE-**

*Although the CTAF is used to activate the lights at many airports, other frequencies may also be used. The appropriate frequency for activating the lights on the airport is provided in the Chart Supplement U.S. and the standard instrument approach procedures publications. It is not identified on the sectional charts.*

e. Where the airport is not served by an IAP, it may have either the standard FAA approved control system or an independent type system of different specification installed by the airport sponsor. The Chart Supplement U.S. contains descriptions of pilot controlled lighting systems for each airport having other than FAA approved systems, and explains the type lights, method of control, and operating frequency in clear text.

**2-1-9. Airport/Heliport Beacons**

a. Airport and heliport beacons have a vertical light distribution to make them most effective from one to ten degrees above the horizon; however, they can be seen well above and below this peak spread. The beacon may be an omnidirectional capacitor-discharge device, or it may rotate at a constant speed which produces the visual effect of flashes at regular intervals. Flashes may be one or two colors alternately. The total number of flashes are:

1. 24 to 30 per minute for beacons marking airports, landmarks, and points on Federal airways.
2. 30 to 45 per minute for beacons marking heliports.

**b.** The colors and color combinations of beacons are:

1. White and Green– Lighted land airport.
2. \*Green alone– Lighted land airport.
3. White and Yellow– Lighted water airport.
4. \*Yellow alone– Lighted water airport.
5. Green, Yellow, and White– Lighted heliport.

**NOTE–**

*\*Green alone or yellow alone is used only in connection with a white-and-green or white-and-yellow beacon display, respectively.*

**c.** Military airport beacons flash alternately white and green, but are differentiated from civil beacons by dualpeaked (two quick) white flashes between the green flashes.

**d.** In Class B, Class C, Class D and Class E surface areas, operation of the airport beacon during the hours of daylight often indicates that the ground visibility is less than 3 miles and/or the ceiling is less than 1,000 feet. ATC clearance in accordance with 14 CFR Part 91 is required for landing, takeoff and flight in the traffic pattern. Pilots should not rely solely on the operation of the airport beacon to indicate if weather conditions are IFR or VFR. At some locations with operating control towers, ATC personnel turn the beacon on or off when controls are in the tower. At many airports the airport beacon is turned on by a photoelectric cell or time clocks and ATC personnel cannot control them. There is no regulatory requirement for daylight operation and it is the pilot's responsibility to comply with proper preflight planning as required by 14 CFR Section 91.103.

## 2-1-10. Taxiway Lights

**a. Taxiway Edge Lights.** Taxiway edge lights are used to outline the edges of taxiways during periods of darkness or restricted visibility conditions. These fixtures emit blue light.

**NOTE–**

*At most major airports these lights have variable intensity settings and may be adjusted at pilot request or when deemed necessary by the controller.*

**b. Taxiway Centerline Lights.** Taxiway centerline lights are used to facilitate ground traffic under low visibility conditions. They are located along the taxiway centerline in a straight line on straight

portions, on the centerline of curved portions, and along designated taxiing paths in portions of runways, ramp, and apron areas. Taxiway centerline lights are steady burning and emit green light.

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

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

**NOTE–**

*Some airports may have a row of three or five in-pavement yellow lights installed at taxiway/runway intersections. They should not be confused with clearance bar lights described in paragraph 2-1-10 c, Clearance Bar Lights.*

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

**CAUTION–**

*Pilots should never cross a red illuminated stop bar, even if an ATC clearance has been given to proceed onto or across the runway.*

**NOTE–**

*If after crossing a stop bar, the taxiway centerline lead-on lights inadvertently extinguish, pilots should hold their position and contact ATC for further instructions.*

# Chapter 4. Air Traffic Control

## Section 1. Services Available to Pilots

### 4-1-1. Air Route Traffic Control Centers

Centers are established primarily to provide air traffic service to aircraft operating on IFR flight plans within controlled airspace, and principally during the en route phase of flight.

### 4-1-2. Control Towers

Towers have been established to provide for a safe, orderly and expeditious flow of traffic on and in the vicinity of an airport. When the responsibility has been so delegated, towers also provide for the separation of IFR aircraft in the terminal areas.

**REFERENCE-**

*AIM, Paragraph 5-4-3, Approach Control.*

### 4-1-3. Flight Service Stations

Flight Service Stations (FSSs) are air traffic facilities that provide pilot briefings, flight plan processing, en route flight advisories, search and rescue services, and assistance to lost aircraft and aircraft in emergency situations. FSSs also relay ATC clearances, process Notices to Airmen, and broadcast aviation weather and aeronautical information. In Alaska, designated FSSs also take weather observations, and provide Airport Advisory Services (AAS).

### 4-1-4. Recording and Monitoring

a. Calls to air traffic control (ATC) facilities (ARTCCs, Towers, FSSs, Central Flow, and Operations Centers) over radio and ATC operational telephone lines (lines used for operational purposes such as controller instructions, briefings, opening and closing flight plans, issuance of IFR clearances and amendments, counter hijacking activities, etc.) may be monitored and recorded for operational uses such as accident investigations, accident prevention, search and rescue purposes, specialist training and evaluation, and technical evaluation and repair of control and communications systems.

b. Where the public access telephone is recorded, a beeper tone is not required. In place of the “beep” tone the FCC has substituted a mandatory require-

ment that persons to be recorded be given notice they are to be recorded and give consent. Notice is given by this entry, consent to record is assumed by the individual placing a call to the operational facility.

### 4-1-5. Communications Release of IFR Aircraft Landing at an Airport Without an Operating Control Tower

Aircraft operating on an IFR flight plan, landing at an airport without an operating control tower will be advised to change to the airport advisory frequency when direct communications with ATC are no longer required. Towers and centers do not have nontower airport traffic and runway in use information. The instrument approach may not be aligned with the runway in use; therefore, if the information has not already been obtained, pilots should make an expeditious change to the airport advisory frequency when authorized.

**REFERENCE-**

*AIM, Paragraph 5-4-4, Advance Information on Instrument Approach*

### 4-1-6. Pilot Visits to Air Traffic Facilities

Pilots are encouraged to participate in local pilot/air traffic control outreach activities. However, due to security and workload concerns, requests for air traffic facility visits may not always be approved. Therefore, visit requests should be submitted through the air traffic facility as early as possible. Pilots should contact the facility and advise them of the number of persons in the group, the time and date of the proposed visit, and the primary interest of the group. The air traffic facility will provide further instructions if a request can be approved.

**REFERENCE-**

*FAA Order 1600.69, FAA Facility Security Management Program*

### 4-1-7. Operation Rain Check

Operation Rain Check is a program designed and managed by local air traffic control facility management. Its purpose is to familiarize pilots and aspiring pilots with the ATC system, its functions, responsibilities and benefits.

**REFERENCE-**

*FAA Order JO 7210.3, Paragraph 4-2-2, Pilot Education  
FAA Order 1600.69, FAA Facility Security Management Program*

#### 4-1-8. Approach Control Service for VFR Arriving Aircraft

a. Numerous approach control facilities have established programs for arriving VFR aircraft to contact approach control for landing information. This information includes: wind, runway, and altimeter setting at the airport of intended landing. This information may be omitted if contained in the Automatic Terminal Information Service (ATIS) broadcast and the pilot states the appropriate ATIS code.

**NOTE-**

*Pilot use of “have numbers” does not indicate receipt of the ATIS broadcast. In addition, the controller will provide traffic advisories on a workload permitting basis.*

b. Such information will be furnished upon initial contact with concerned approach control facility. The pilot will be requested to change to the *tower* frequency at a predetermined time or point, to receive further landing information.

c. Where available, use of this procedure will not hinder the operation of VFR flights by requiring excessive spacing between aircraft or devious routing.

d. Compliance with this procedure is not mandatory but pilot participation is encouraged.

**REFERENCE-**

*AIM, Paragraph 4-1-18, Terminal Radar Services for VFR Aircraft*

**NOTE-**

*Approach control services for VFR aircraft are normally dependent on ATC radar. These services are not available during periods of a radar outage. Approach control services for VFR aircraft are limited when CENRAP is in use.*

#### 4-1-9. Traffic Advisory Practices at Airports Without Operating Control Towers

(See TBL 4-1-1.)

##### a. Airport Operations Without Operating Control Tower

1. There is no substitute for alertness while in the vicinity of an airport. It is essential that pilots be alert and look for other traffic and exchange traffic information when approaching or departing an airport without an operating control tower. This is of particular importance since other aircraft may not

have communication capability or, in some cases, pilots may not communicate their presence or intentions when operating into or out of such airports. To achieve the greatest degree of safety, it is essential that:

(a) All radio-equipped aircraft transmit/receive on a common frequency identified for the purpose of airport advisories; and

(b) Pilots use the correct airport name, as identified in appropriate aeronautical publications, to reduce the risk of confusion when communicating their position, intentions, and/or exchanging traffic information.

2. An airport may have a full or part-time tower or FSS located on the airport, a full or part-time UNICOM station or no aeronautical station at all. There are three ways for pilots to communicate their intention and obtain airport/traffic information when operating at an airport that does not have an operating tower: by communicating with an FSS, a UNICOM operator, or by making a self-announce broadcast.

**NOTE-**

*FSS airport advisories are available only in Alaska.*

3. Many airports are now providing completely automated weather, radio check capability and airport advisory information on an automated UNICOM system. These systems offer a variety of features, typically selectable by microphone clicks, on the UNICOM frequency. Availability of the automated UNICOM will be published in the Chart Supplement U.S. and approach charts.

##### b. Communicating on a Common Frequency

1. The key to communicating at an airport without an operating control tower is selection of the correct common frequency. The acronym CTAF which stands for Common Traffic Advisory Frequency, is synonymous with this program. A CTAF is a frequency designated for the purpose of carrying out airport advisory practices while operating to or from an airport without an operating control tower. The CTAF may be a UNICOM, MULTICOM, FSS, or tower frequency and is identified in appropriate aeronautical publications.

**NOTE-**

*FSS frequencies are available only in Alaska.*

self-announce procedure should also be used if a pilot is unable to communicate with the FSS on the designated CTAF. Pilots stating, “Traffic in the area, please advise” is not a recognized Self-Announce Position and/or Intention phrase and should not be used under any condition.

2. If an airport has a tower and it is temporarily closed, or operated on a part-time basis and there is no FSS on the airport or the FSS is closed, use the CTAF to self-announce your position or intentions.

3. Where there is no tower, FSS, or UNICOM station on the airport, use MULTICOM frequency 122.9 for self-announce procedures. Such airports will be identified in appropriate aeronautical information publications.

4. **Practice Approaches.** Pilots conducting practice instrument approaches should be particularly alert for other aircraft that may be departing in the opposite direction. When conducting any practice approach, regardless of its direction relative to other airport operations, pilots should make announcements on the CTAF as follows:

(a) Departing the final approach fix, inbound (nonprecision approach) or departing the outer marker or fix used in lieu of the outer marker, inbound (precision approach);

(b) Established on the final approach segment or immediately upon being released by ATC;

(c) Upon completion or termination of the approach; and

(d) Upon executing the missed approach procedure.

5. Departing aircraft should always be alert for arrival aircraft coming from the opposite direction.

6. Recommended self-announce phraseologies: It should be noted that aircraft operating to or from another nearby airport may be making self-announce broadcasts on the same UNICOM or MULTICOM frequency. To help identify one airport from another, the airport name should be spoken at the beginning and end of each self-announce transmission.

(a) Inbound

**EXAMPLE–**

*Strawn traffic, Apache Two Two Five Zulu, (position), (altitude), (descending) or entering downwind/base/final (as appropriate) runway one seven full stop, touch-and–*

*go, Strawn.*

*Strawn traffic Apache Two Two Five Zulu clear of runway one seven Strawn.*

(b) Outbound

**EXAMPLE–**

*Strawn traffic, Queen Air Seven One Five Five Bravo (location on airport) taxiing to runway two six Strawn.*

*Strawn traffic, Queen Air Seven One Five Five Bravo departing runway two six. Departing the pattern to the (direction), climbing to (altitude) Strawn.*

(c) Practice Instrument Approach

**EXAMPLE–**

*Strawn traffic, Cessna Two One Four Three Quebec (position from airport) inbound descending through (altitude) practice (name of approach) approach runway three five Strawn.*

*Strawn traffic, Cessna Two One Four Three Quebec practice (type) approach completed or terminated runway three five Strawn.*

**h. UNICOM Communications Procedures**

1. In communicating with a UNICOM station, the following practices will help reduce frequency congestion, facilitate a better understanding of pilot intentions, help identify the location of aircraft in the traffic pattern, and enhance safety of flight:

(a) Select the correct UNICOM frequency.

(b) State the identification of the UNICOM station you are calling in each transmission.

(c) Speak slowly and distinctly.

(d) Report approximately 10 miles from the airport, reporting altitude, and state your aircraft type, aircraft identification, location relative to the airport, state whether landing or overflight, and request wind information and runway in use.

(e) Report on downwind, base, and final approach.

(f) Report leaving the runway.

2. Recommended UNICOM phraseologies:

(a) Inbound

**PHRASEOLOGY–**

*FREDERICK UNICOM CESSNA EIGHT ZERO ONE TANGO FOXTROT 10 MILES SOUTHEAST DESCENDING THROUGH (altitude) LANDING FREDERICK, REQUEST WIND AND RUNWAY INFORMATION FREDERICK.*

*FREDERICK TRAFFIC CESSNA EIGHT ZERO ONE TANGO FOXTROT ENTERING DOWNWIND/BASE/*

*FINAL (as appropriate) FOR RUNWAY ONE NINER (full stop/touch-and-go) FREDERICK.  
 FREDERICK TRAFFIC CESSNA EIGHT ZERO ONE TANGO FOXTROT CLEAR OF RUNWAY ONE NINER FREDERICK.*

**(b) Outbound**

**PHRASEOLOGY-**

*FREDERICK UNICOM CESSNA EIGHT ZERO ONE TANGO FOXTROT (location on airport) TAXIING TO RUNWAY ONE NINER, REQUEST WIND AND TRAFFIC INFORMATION FREDERICK.*

*FREDERICK TRAFFIC CESSNA EIGHT ZERO ONE TANGO FOXTROT DEPARTING RUNWAY ONE NINER. "REMAINING IN THE PATTERN" OR "DEPARTING THE PATTERN TO THE (direction) (as appropriate)" FREDERICK.*

**4-1-10. IFR Approaches/Ground Vehicle Operations**

**a. IFR Approaches.** When operating in accordance with an IFR clearance and ATC approves a change to the advisory frequency, make an expeditious change to the CTAF and employ the recommended traffic advisory procedures.

**b. Ground Vehicle Operation.** Airport ground vehicles equipped with radios should monitor the CTAF frequency when operating on the airport movement area and remain clear of runways/taxiways being used by aircraft. Radio transmissions from ground vehicles should be confined to safety-related matters.

**c. Radio Control of Airport Lighting Systems.** Whenever possible, the CTAF will be used to control airport lighting systems at airports without operating control towers. This eliminates the need for pilots to change frequencies to turn the lights on and allows a continuous listening watch on a single frequency. The CTAF is published on the instrument approach chart and in other appropriate aeronautical information publications.

**4-1-11. Designated UNICOM/MULTICOM Frequencies**

**Frequency use**

**a.** The following listing depicts UNICOM and MULTICOM frequency uses as designated by the Federal Communications Commission (FCC). (See TBL 4-1-2.)

*TBL 4-1-2  
 Unicom/Multicom Frequency Usage*

Use	Frequency
Airports without an operating control tower.	122.700
	122.725
	122.800
	122.975
	123.000
	123.050
(MULTICOM FREQUENCY) Activities of a temporary, seasonal, emergency nature or search and rescue, as well as, airports with no tower, FSS, or UNICOM.	122.900
(MULTICOM FREQUENCY) Forestry management and fire suppression, fish and game management and protection, and environmental monitoring and protection.	122.925
Airports with a control tower or FSS on airport.	122.950

**NOTE-**

**1.** *In some areas of the country, frequency interference may be encountered from nearby airports using the same UNICOM frequency. Where there is a problem, UNICOM operators are encouraged to develop a "least interference" frequency assignment plan for airports concerned using the frequencies designated for airports without operating control towers. UNICOM licensees are encouraged to apply for UNICOM 25 kHz spaced channel frequencies. Due to the extremely limited number of frequencies with 50 kHz channel spacing, 25 kHz channel spacing should be implemented. UNICOM licensees may then request FCC to assign frequencies in accordance with the plan, which FCC will review and consider for approval.*

**2.** *Wind direction and runway information may not be available on UNICOM frequency 122.950.*

**b.** The following listing depicts other frequency uses as designated by the Federal Communications Commission (FCC). (See TBL 4-1-3.)

#### 4-3-7. Low Level Wind Shear/Microburst Detection Systems

Low Level Wind Shear Alert System (LLWAS), Terminal Doppler Weather Radar (TDWR), Weather System Processor (WSP), and Integrated Terminal Weather System (ITWS) display information on hazardous wind shear and microburst activity in the vicinity of an airport to air traffic controllers who relay this information to pilots.

a. LLWAS provides wind shear alert and gust front information but does not provide microburst alerts. The LLWAS is designed to detect low level wind shear conditions around the periphery of an airport. It does not detect wind shear beyond that limitation. Controllers will provide this information to pilots by giving the pilot the airport wind followed by the boundary wind.

**EXAMPLE-**

*Wind shear alert, airport wind 230 at 8, south boundary wind 170 at 20.*

b. LLWAS “network expansion,” (LLWAS NE) and LLWAS Relocation/Sustainment (LLWAS-RS) are systems integrated with TDWR. These systems provide the capability of detecting microburst alerts and wind shear alerts. Controllers will issue the appropriate wind shear alerts or microburst alerts. In some of these systems controllers also have the ability to issue wind information oriented to the threshold or departure end of the runway.

**EXAMPLE-**

*Runway 17 arrival microburst alert, 40 knot loss 3 mile final.*

**REFERENCE-**

AIM, Para 7-1-24, Microbursts.

c. More advanced systems are in the field or being developed such as ITWS. ITWS provides alerts for microbursts, wind shear, and significant thunderstorm activity. ITWS displays wind information oriented to the threshold or departure end of the runway.

d. The WSP provides weather processor enhancements to selected Airport Surveillance Radar (ASR)-9 facilities. The WSP provides Air Traffic with detection and alerting of hazardous weather such as wind shear, microbursts, and significant thunderstorm activity. The WSP displays terminal area 6 level weather, storm cell locations and movement, as well as the location and predicted future position

and intensity of wind shifts that may affect airport operations. Controllers will receive and issue alerts based on Areas Noted for Attention (ARENA). An ARENA extends on the runway center line from a 3 mile final to the runway to a 2 mile departure.

e. An airport equipped with the LLWAS, ITWS, or WSP is so indicated in the Chart Supplement U.S. under Weather Data Sources for that particular airport.

#### 4-3-8. Braking Action Reports and Advisories

a. When available, ATC furnishes pilots the quality of braking action received from pilots. The quality of braking action is described by the terms “good,” “good to medium,” “medium,” “medium to poor,” “poor,” and “nil.” When pilots report the quality of braking action by using the terms noted above, they should use descriptive terms that are easily understood, such as, “braking action poor the first/last half of the runway,” together with the particular type of aircraft.

b. FICON NOTAMs will provide contaminant measurements for paved runways; however, a FICON NOTAM for braking action will only be used for non-paved runway surfaces, taxiways, and aprons. These NOTAMs are classified according to the most critical term (“good to medium,” “medium,” “medium to poor,” and “poor”).

1. FICON NOTAM reporting of a braking condition for paved runway surfaces is not permissible by Federally Obligated Airports or those airports certificated under 14 CFR Part 139.

2. A “NIL” braking condition at these airports must be mitigated by closure of the affected surface. Do not include the type of vehicle in the FICON NOTAM.

c. When tower controllers receive runway braking action reports which include the terms medium, poor, or nil, or whenever weather conditions are conducive to deteriorating or rapidly changing runway braking conditions, the tower will include on the ATIS broadcast the statement, “**BRAKING ACTION ADVISORIES ARE IN EFFECT.**”

d. During the time that braking action advisories are in effect, ATC will issue the most recent braking action report for the runway in use to each arriving and departing aircraft. Pilots should be prepared for

deteriorating braking conditions and should request current runway condition information if not issued by controllers. Pilots should also be prepared to provide a descriptive runway condition report to controllers after landing.

#### 4-3-9. Runway Condition Reports

**a.** Aircraft braking coefficient is dependent upon the surface friction between the tires on the aircraft wheels and the pavement surface. Less friction means less aircraft braking coefficient and less aircraft braking response.

**b.** Runway condition code (RwyCC) values range from 1 (poor) to 6 (dry). For frozen contaminants on runway surfaces, a runway condition code reading of 4 indicates the level when braking deceleration or directional control is between good and medium.

**NOTE-**

*A RwyCC of “0” is used to delineate a braking action report of NIL and is prohibited from being reported in a FICON NOTAM.*

**c.** Airport management should conduct runway condition assessments on wet runways or runways covered with compacted snow and/or ice.

**1.** Numerical readings may be obtained by using the Runway Condition Assessment Matrix (RCAM). The RCAM provides the airport operator with data to complete the report that includes the following:

- (a) Runway(s) in use
- (b) Time of the assessment
- (c) Runway condition codes for each zone (touchdown, mid-point, roll-out)

(d) Pilot-reported braking action report (if available)

(e) The contaminant (for example, wet snow, dry snow, slush, ice, etc.)

**2.** Assessments for each zone (see 4-3-9c1(c)) will be issued in the direction of takeoff and landing on the runway, ranging from “1” to “6” to describe contaminated surfaces.

**NOTE-**

*A RwyCC of “0” is used to delineate a braking action report of NIL and is prohibited from being reported in a FICON NOTAM.*

**3.** When any 1 or more runway condition codes are reported as less than 6, airport management must notify ATC for dissemination to pilots.

**4.** Controllers will not issue runway condition codes when all 3 segments of a runway are reporting values of 6.

**d.** When runway condition code reports are provided by airport management, the ATC facility providing approach control or local airport advisory must provide the report to all pilots.

**e.** Pilots should use runway condition code information with other knowledge including aircraft performance characteristics, type, and weight, previous experience, wind conditions, and aircraft tire type (such as bias ply vs. radial constructed) to determine runway suitability.

**f.** The Runway Condition Assessment Matrix identifies the descriptive terms “good,” “good to medium,” “medium,” “medium to poor,” “poor,” and “nil” used in braking action reports.

**REFERENCE-**

*Advisory Circular AC 91-79A (Revision 1), Mitigating the Risks of a Runway Overrun Upon Landing, Appendix 1*

surface traffic. They will be addressed at two levels; operations less than 1,200 feet RVR to 500 feet RVR and operations less than 500 feet RVR.

**NOTE–**

*Specific lighting systems and surface markings may be found in Paragraph 2–1–10, Taxiway Lights, and Paragraph 2–3–4, Taxiway Markings.*

d. When low visibility conditions exist, pilots should focus their entire attention on the safe operation of the aircraft while it is moving. Checklists and nonessential communication should be withheld until the aircraft is stopped and the brakes set.

#### **4–3–20. Exiting the Runway After Landing**

The following procedures must be followed after landing and reaching taxi speed.

a. Exit the runway without delay at the first available taxiway or on a taxiway as instructed by ATC. Pilots must not exit the landing runway onto another runway unless authorized by ATC. At airports with an operating control tower, pilots should not stop or reverse course on the runway without first obtaining ATC approval.

b. Taxi clear of the runway unless otherwise directed by ATC. An aircraft is considered clear of the runway when all parts of the aircraft are past the runway edge and there are no restrictions to its continued movement beyond the runway holding position markings. In the absence of ATC instructions, the pilot is expected to taxi clear of the landing runway by taxiing beyond the runway holding position markings associated with the landing runway, even if that requires the aircraft to protrude into or cross another taxiway or ramp area. Once all parts of the aircraft have crossed the runway holding position markings, the pilot must hold unless further instructions have been issued by ATC.

**NOTE–**

1. *The tower will issue the pilot instructions which will permit the aircraft to enter another taxiway, runway, or ramp area when required.*

2. *Guidance contained in subparagraphs a and b above is considered an integral part of the landing clearance and satisfies the requirement of 14 CFR Section 91.129.*

c. Immediately change to ground control frequency when advised by the tower and obtain a taxi clearance.

**NOTE–**

1. *The tower will issue instructions required to resolve any potential conflicts with other ground traffic prior to advising the pilot to contact ground control.*

2. *Ground control will issue taxi clearance to parking. That clearance does not authorize the aircraft to “enter” or “cross” any runways. Pilots not familiar with the taxi route should request specific taxi instructions from ATC.*

#### **4–3–21. Practice Instrument Approaches**

a. Various air traffic incidents have indicated the necessity for adoption of measures to achieve more organized and controlled operations where practice instrument approaches are conducted. Practice instrument approaches are considered to be instrument approaches made by either a VFR aircraft not on an IFR flight plan or an aircraft on an IFR flight plan. To achieve this and thereby enhance air safety, it is Air Traffic’s policy to provide for separation of such operations at locations where approach control facilities are located and, as resources permit, at certain other locations served by ARTCCs or parent approach control facilities. Pilot requests to practice instrument approaches may be approved by ATC subject to traffic and workload conditions. Pilots should anticipate that in some instances the controller may find it necessary to deny approval or withdraw previous approval when traffic conditions warrant. It must be clearly understood, however, that even though the controller may be providing separation, pilots on VFR flight plans are required to comply with basic VFR weather minimums (14 CFR Section 91.155). Application of ATC procedures or any action taken by the controller to avoid traffic conflicts does not relieve IFR and VFR pilots of their responsibility to see-and-avoid other traffic while operating in VFR conditions (14 CFR Section 91.113). In addition to the normal IFR separation minimums (which includes visual separation) during VFR conditions, 500 feet vertical separation may be applied between VFR aircraft and between a VFR aircraft and the IFR aircraft. Pilots not on IFR flight plans desiring practice instrument approaches should always state ‘practice’ when making requests to ATC. Controllers will instruct VFR aircraft requesting an instrument approach to maintain VFR. This is to preclude misunderstandings between the pilot and controller as to the status of the aircraft. If pilots wish to proceed in accordance with instrument flight rules, they must specifically request and obtain, an IFR clearance.

**b.** Before practicing an instrument approach, pilots should inform the approach control facility or the tower of the type of practice approach they desire to make and how they intend to terminate it, i.e., full-stop landing, touch-and-go, or missed or low approach maneuver. This information may be furnished progressively when conducting a series of approaches. Pilots on an IFR flight plan, who have made a series of instrument approaches to full stop landings should inform ATC when they make their final landing. The controller will control flights practicing instrument approaches so as to ensure that they do not disrupt the flow of arriving and departing itinerant IFR or VFR aircraft. The priority afforded itinerant aircraft over practice instrument approaches is not intended to be so rigidly applied that it causes grossly inefficient application of services. A minimum delay to itinerant traffic may be appropriate to allow an aircraft practicing an approach to complete that approach.

**NOTE-**

*A clearance to land means that appropriate separation on the landing runway will be ensured. A landing clearance does not relieve the pilot from compliance with any previously issued restriction.*

**c.** At airports without a tower, pilots wishing to make practice instrument approaches should notify the facility having control jurisdiction of the desired approach as indicated on the approach chart. All approach control facilities and ARTCCs are required to publish a Letter to Airmen depicting those airports where they provide standard separation to both VFR and IFR aircraft conducting practice instrument approaches.

**d.** The controller will provide approved separation between both VFR and IFR aircraft when authorization is granted to make practice approaches to airports where an approach control facility is located and to certain other airports served by approach control or an ARTCC. Controller responsibility for separation of VFR aircraft begins at the point where the approach clearance becomes effective, or when the aircraft enters Class B or Class C airspace, or a TRSA, whichever comes first.

**e.** VFR aircraft practicing instrument approaches are not automatically authorized to execute the missed approach procedure. This authorization must be specifically requested by the pilot and approved by the controller. Where ATC procedures require

application of IFR separation to VFR aircraft practicing instrument approaches, separation will be provided throughout the procedure including the missed approach. Where no separation services are provided during the practice approach, no separation services will be provided during the missed approach.

**f.** Except in an emergency, aircraft cleared to practice instrument approaches must not deviate from the approved procedure until cleared to do so by the controller.

**g.** At radar approach control locations when a full approach procedure (procedure turn, etc.) cannot be approved, pilots should expect to be vectored to a final approach course for a practice instrument approach which is compatible with the general direction of traffic at that airport.

**h.** When granting approval for a practice instrument approach, the controller will usually ask the pilot to report to the tower prior to or over the final approach fix inbound (nonprecision approaches) or over the outer marker or fix used in lieu of the outer marker inbound (precision approaches).

**i.** When authorization is granted to conduct practice instrument approaches to an airport with a tower, but where approved standard separation is not provided to aircraft conducting practice instrument approaches, the tower will approve the practice approach, instruct the aircraft to maintain VFR and issue traffic information, as required.

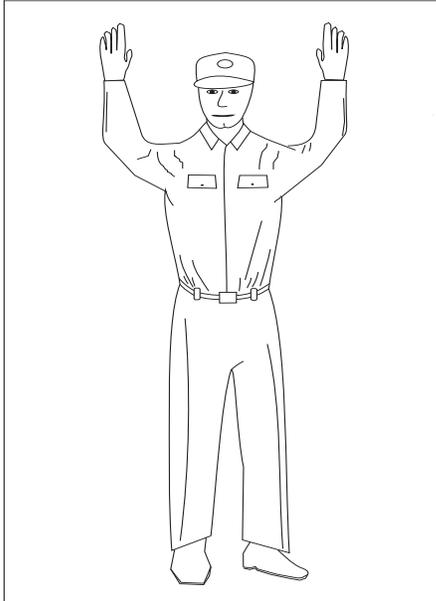
**j.** When an aircraft notifies a FSS providing Local Airport Advisory to the airport concerned of the intent to conduct a practice instrument approach and whether or not separation is to be provided, the pilot will be instructed to contact the appropriate facility on a specified frequency prior to initiating the approach. At airports where separation is not provided, the FSS will acknowledge the message and issue known traffic information but will neither approve or disapprove the approach.

**k.** Pilots conducting practice instrument approaches should be particularly alert for other aircraft operating in the local traffic pattern or in proximity to the airport.

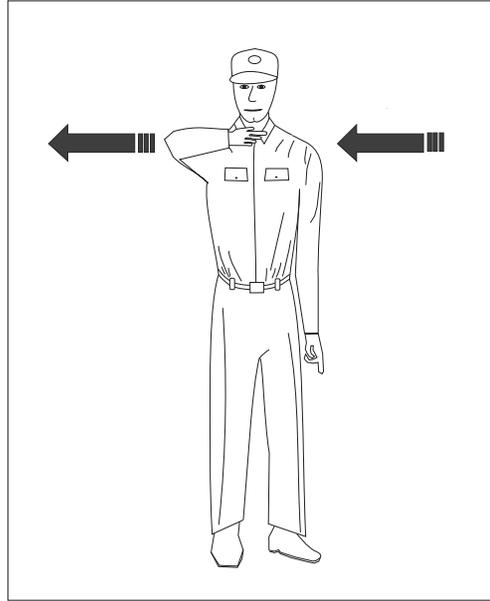
#### **4-3-22. Option Approach**

The “Cleared for the Option” procedure will permit an instructor, flight examiner or pilot the option to make a touch-and-go, low approach, missed

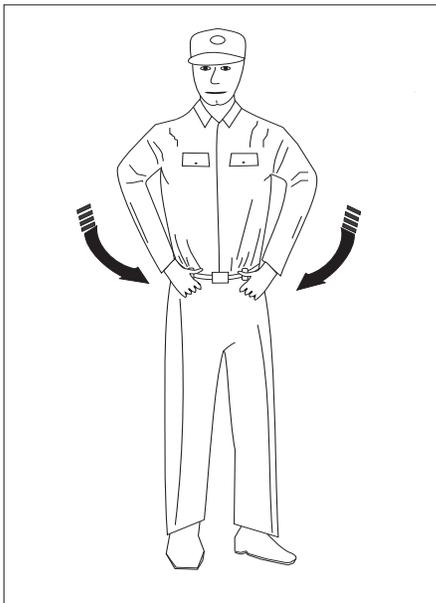
**FIG 4-3-20**  
**Flagman Directs Pilot**



**FIG 4-3-22**  
**Cut Engines**



**FIG 4-3-21**  
**Insert Chocks**



**FIG 4-3-23**  
**Night Operation**

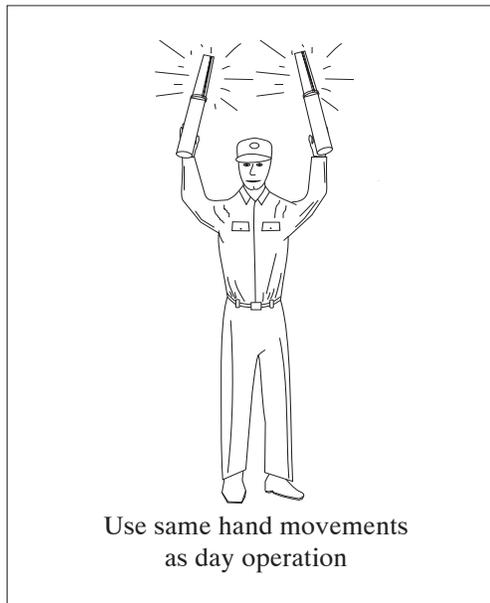
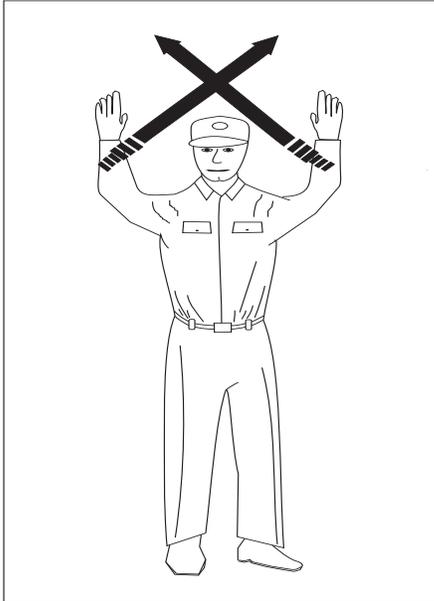


FIG 4-3-24  
Stop



#### 4-3-26. Operations at Uncontrolled Airports With Automated Surface Observing System (ASOS)/Automated Weather Observing System (AWOS)

a. Many airports throughout the National Airspace System are equipped with either ASOS or AWOS. At most airports with an operating control tower or human observer, the weather will be available to you in an Aviation Routine Weather Report (METAR) hourly or special observation format on the Automatic Terminal Information Service (ATIS) or directly transmitted from the controller/observer.

b. At uncontrolled airports that are equipped with ASOS/AWOS with ground-to-air broadcast capability, the one-minute updated airport weather should be available to you within approximately 25 NM of the airport below 10,000 feet. The frequency for the weather broadcast will be published on sectional charts and in the Chart Supplement U.S. Some part-time towered airports may also broadcast the automated weather on their ATIS frequency during the hours that the tower is closed.

c. Controllers issue SVFR or IFR clearances based on pilot request, known traffic and reported weather, i.e., METAR/Nonroutine (Special) Aviation Weather Report (SPECI) observations, when they are available. Pilots have access to more current weather at uncontrolled ASOS/AWOS airports than do the controllers who may be located several miles away. Controllers will rely on the pilot to determine the current airport weather from the ASOS/AWOS. All aircraft arriving or departing an ASOS/AWOS equipped uncontrolled airport should monitor the airport weather frequency to ascertain the status of the airspace. Pilots in Class E airspace must be alert for changing weather conditions which may affect the status of the airspace from IFR/VFR. If ATC service is required for IFR/SVFR approach/departure or requested for VFR service, the pilot should advise the controller that he/she has received the one-minute weather and state his/her intentions.

#### EXAMPLE-

*"I have the (airport) one-minute weather, request an ILS Runway 14 approach."*

#### REFERENCE-

*AIM, Para 7-1-10, Weather Observing Programs.*

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.

**(c) 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.

**(d) 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:

**(1)** TIS will typically be provided within 55 NM of the radars depicted in FIG 4-5-5, 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.

**(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.

**(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, similar to 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.

**(e) 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 (d) 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.

**(f) 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:

**(1)** When client or intruder aircraft maneuver excessively or abruptly, the tracking algorithm will report incorrect horizontal position until the maneuvering aircraft stabilizes.

**(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  $\frac{1}{4}$  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.

**(g) 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 (f) above, intruder distance and altitude are still usable.

**(h) 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 (for example, 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 a VOR. 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.

**e. Reports of TIS Malfunctions.**

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 by radio or telephone to the nearest Flight Service Station (FSS) facility.

**NOTE-**

*TIS operates at only those terminal Mode S radar sites depicted in FIG 4-5-5. Though similar in some ways, TIS is not related to TIS-B (Traffic Information Service-Broadcast).*

**4-5-7. Automatic Dependent Surveillance-Broadcast (ADS-B) Services**

**a. Introduction.**

1. Automatic Dependent Surveillance-Broadcast (ADS-B) is a surveillance technology deployed throughout the NAS (see FIG 4-5-7). The ADS-B system is composed of aircraft avionics and a ground infrastructure. Onboard avionics determine the position of the aircraft by using the GNSS and transmit its position along with additional information about the aircraft to ground stations for use by ATC and other ADS-B services. This information is transmitted at a rate of approximately once per second. (See FIG 4-5-8 and FIG 4-5-9.)

2. In the United States, ADS-B equipped aircraft exchange information on one of two frequencies: 978 or 1090 MHz. The 1090 MHz frequency is also associated with Mode A, C, and S transponder operations. 1090 MHz transponders with integrated ADS-B functionality extend the transponder message sets with additional ADS-B information. This additional information is known as an “extended squitter” message and is referred to as 1090ES. ADS-B equipment operating on 978 MHz is known as the Universal Access Transceiver (UAT).

3. ADS-B avionics can have the ability to both transmit and receive information. The transmission of ADS-B information from an aircraft is known as ADS-B Out. The receipt of ADS-B information by an aircraft is known as ADS-B In. All aircraft operating within the airspace defined in 14 CFR § 91.225 are required to transmit the information defined in § 91.227 using ADS-B Out avionics.

4. In general, operators flying at 18,000 feet and above (Class A airspace) are required to have 1090ES equipment. Those that do not fly above 18,000 may use either UAT or 1090ES equipment. (Refer to 14 CFR §§ 91.225 and 91.227.) While the regulations do not require it, operators equipped with ADS-B In will realize additional benefits from ADS-B broadcast

performance is monitored by maintenance personnel rather than ATC, report malfunctions to the nearest Flight Service Station (FSS) facility by radio or telephone, or by sending an email to the ADS-B help desk at [adsb@faa.gov](mailto:adsb@faa.gov). Reports should include:

1. Condition observed;
2. Date and time of observation;
3. Altitude and location of observation;
4. Type and call sign of the aircraft; and
5. Type and software version of avionics system.

#### 4-5-8. Traffic Information Service-Broadcast (TIS-B)

##### a. Introduction

TIS-B is the broadcast of ATC derived traffic information to ADS-B equipped (1090ES or UAT) aircraft from ground radio stations. The source of this traffic information is derived from ground-based air traffic surveillance sensors. TIS-B service will be available throughout the NAS where there are both adequate surveillance coverage from ground sensors and adequate broadcast coverage from ADS-B ground radio stations. 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. (See FIG 4-5-8 and FIG 4-5-9.)

##### b. TIS-B Requirements.

In order to receive TIS-B service, the following conditions must exist:

1. Aircraft must be equipped with an ADS-B transmitter/receiver or transceiver, and a cockpit display of traffic information (CDTI).
2. Aircraft must fly within the coverage volume of a compatible ground radio station that is configured for TIS-B uplinks. (Not all ground radio stations provide TIS-B due to a lack of radar coverage or because a radar feed is not available).
3. Aircraft must be within the coverage of and detected by at least one ATC radar serving the ground radio station in use.

##### c. TIS-B Capabilities.

1. 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 Out. This advisory-only application is intended to enhance a pilot's visual acquisition of other traffic.

2. Only transponder-equipped targets (i.e., Mode A/C or Mode S transponders) are transmitted through the ATC ground system architecture. Current radar siting may result in limited radar surveillance coverage at lower altitudes near some 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.

##### d. TIS-B Limitations.

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, in accordance with 14CFR §91.113b. TIS-B must 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.

##### *NOTE-*

*No aircraft avoidance maneuvers are authorized as a direct result of a TIS-B target being displayed in the cockpit.*

2. While TIS-B is a useful aid to visual traffic avoidance, its inherent system limitations must be understood to ensure proper use.

- (a) A pilot may receive an intermittent TIS-B target of themselves, typically when maneuvering (e.g., climbing turns) due to the radar not tracking the aircraft as quickly as ADS-B.

- (b) 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 may see duplicate traffic symbols (i.e., "TIS-B shadows") on the cockpit display.

- (c) 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 type of radar system in use within the coverage area. In comparison, the update rate for ADS-B is nominally once per second.

(d) The TIS-B system only uplinks data pertaining to transponder-equipped aircraft. Aircraft without a transponder will not be displayed as TIS-B traffic.

(e) 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.

3. 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 in response to perceived converging traffic appearing on a TIS-B display must be approved by the controlling ATC facility before commencing the maneuver, except as permitted under certain conditions in 14CFR §91.123. 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 or other incident.

#### e. 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. Since TIS-B performance is monitored by maintenance personnel rather than ATC, report malfunctions to the nearest Flight Service Station (FSS) facility by radio or telephone, or by sending an email to the ADS-B help desk at [adsb@faa.gov](mailto:adsb@faa.gov). Reports should include:

1. Condition observed;
2. Date and time of observation;
3. Altitude and location of observation;
4. Type and call sign of the aircraft; and
5. Type and software version of avionics system.

### 4-5-9. Flight Information Service-Broadcast (FIS-B)

#### a. Introduction.

FIS-B is a ground broadcast service provided through the ADS-B Services network over the 978 MHz UAT data link. The FAA FIS-B system provides pilots and flight crews of properly equipped aircraft with a cockpit display of certain aviation weather and aeronautical information. FIS-B reception is line-of-sight within the service volume of the ground infrastructure. (See FIG 4-5-8 and FIG 4-5-9.)

#### b. Weather Products.

FIS-B does not replace a preflight weather briefing from a source listed in Paragraph 7-1-2, FAA Weather Services, or inflight updates from an FSS or ATC. FIS-B information may be used by the pilot for the safe conduct of flight and aircraft movement; however, the information should not be the only source of weather or aeronautical information. A pilot should be particularly alert and understand the limitations and quality assurance issues associated with individual products. This includes graphical representation of next generation weather radar (NEXRAD) imagery and Notices to Airmen (NOTAM)/temporary flight restrictions (TFR).

#### REFERENCE-

AIM, Para 7-1-9, *Flight Information Services (FIS)*.  
Advisory Circular (AC) 00-63, "Use of Cockpit Displays of Digital Weather and Aeronautical Information"

#### c. Reports of FIS-B Malfunctions.

Users of FIS-B can provide valuable assistance in the correction of malfunctions by reporting instances of undesirable system performance. Since FIS-B performance is monitored by maintenance personnel rather than ATC, report malfunctions to the nearest Flight Service Station (FSS) facility by radio or telephone, or by sending an email to the ADS-B help desk at [adsb@faa.gov](mailto:adsb@faa.gov). Reports should include:

1. Condition observed;
2. Date and time of observation;
3. Altitude and location of observation;
4. Type and call sign of the aircraft; and
5. Type and software version of avionics system.

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 5-1-3, 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.

4. It is recommended that pilots file the maximum transponder/ADS-B and 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. When filing an IFR flight plan via telephone or radio, it is highly recommended that the departure airport be clearly identified by stating the city name and state and/or airport location identifier. With cell phone use and flight service specialists covering larger areas of the country, clearly identifying the departure airport can prevent confusing your airport of departure with those of identical or similar names in other states.

**TBL 5-1-3  
Aircraft Equipment Suffixes**

	Navigation Capability	Transponder Capability	Suffix
<b>RVSM</b>	No GNSS, No RNAV	Transponder with Mode C	/W
	RNAV, No GNSS	Transponder with Mode C	/Z
	GNSS	Transponder with Mode C	/L
<b>No RVSM</b>	No DME	No Transponder	/X
		Transponder with no Mode C	/T
		Transponder with Mode C	/U
	DME	No Transponder	/D
		Transponder with no Mode C	/B
		Transponder with Mode C	/A
	TACAN	No Transponder	/M
		Transponder with no Mode C	/N
		Transponder with Mode C	/P
	RNAV, no GNSS	No Transponder	/Y
		Transponder with no Mode C	/C
		Transponder with Mode C	/I
	GNSS	No Transponder	/V
		Transponder with no Mode C	/S
		Transponder with Mode C	/G

## **b. Airways and Jet Routes Depiction on Flight Plan**

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 ATC, pilots are requested to file via airways or jet routes established for use at the altitude or flight level planned.

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 may 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.*

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.*

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, NDB) 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 Winnipeg, Manitoba.*

5. When filing IFR, it is to the pilot's advantage to file a preferred route.

### **REFERENCE–**

*Preferred IFR Routes are described and tabulated in the Chart Supplement U.S.*

6. ATC may issue a SID or a STAR, as appropriate.

### **REFERENCE–**

*AIM, Paragraph 5–2–9, Instrument Departure Procedures (DP) – Obstacle Departure Procedures (ODP) and Standard Instrument Departures (SID)*

*AIM, Paragraph 5–4–1, Standard Terminal Arrival (STAR) Procedures*

### **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.”*

## **c. Direct Flights**

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 must 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 altitude structure.

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.”

### **REFERENCE–**

*AIM, Para 1–1–8, NAVAID Service Volumes.*

**Pre-Flight Pilot Checklist**

Aircraft Identification			Time of Briefing			
Weather <small>(Destination) (Alternate)</small>	<input type="checkbox"/> Present	Remarks	<b>Report Weather Conditions Aloft</b>			
	<input type="checkbox"/> Forecast		<i>Report immediately weather conditions encountered--particularly cloud tops, upper cloud layers, thunderstorms, ice, turbulence, winds and temperature</i>			
			Position	Altitude	Time	Weather Conditions
Weather <small>(En Route)</small>	<input type="checkbox"/> Present					
	<input type="checkbox"/> Forecast					
	<input type="checkbox"/> Pireps					
Winds Aloft	Best Crzg. Alt.					
Nav. Aid & Comm. Status.	<input type="checkbox"/> Destination					
	<input type="checkbox"/> En Route					
Airport Conditions	<input type="checkbox"/> Destination					
	<input type="checkbox"/> Alternate					
ADIZ	<input type="checkbox"/> Airspace Restrictions					
<b>Civil Aircraft Pilots</b>						
<p>FAR Part 91 states that each person operating a civil aircraft of U.S. registry over the high seas shall comply with Annex 2 to the <u>Convention of International Civil Aviation, International Standards - Rules of the Air</u>. Annex 2 requires the submission of a flight plan containing items 1-19 prior to operating any flight across international waters. Failure to file could result in a civil penalty not to exceed \$1,000 for each violation (Section 901 of the Federal Aviation Act of 1958, as amended).</p>						
<i>International briefing information may not be current or complete. Data should be secured, at the first opportunity, from the country in whose airspace the flight will be conducted.</i>						
<p><b>Paperwork Reduction Act Statement:</b> Flight Plan information is collected for the protection and identification of aircraft and property and persons on the ground. Air Traffic uses the information to provide control services and search and rescue services. An individual respondent would require about 2.5 minutes to provide the information. FAR Part 91 requires an Instrument Flight Rules (IFR) flight plan to operate under IFR in controlled airspace. Filing a Visual Flight Rules flight plan is recommended but not mandatory. It is FAA policy to make factual information available to persons properly and directly concerned except information held confidential for good cause, i.e., pilot's address/telephone number. All flight plan data is destroyed when 15 days old except for data retained due to an accident/incident investigation. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. The OMB control number associated with this collection is 2120-0026. Comments concerning the accuracy of this burden and suggestions for reducing the burden should be directed to the FAA at: 800 Independence Ave SW, Washington, DC 20591, Attn: Information Collection Clearance Officer, ABA-20</p>						

*TBL 5-1-4*  
**Aircraft COM, NAV, and Approach Equipment Qualifiers**

INSERT one letter as follows:  
 N if no COM/NAV/approach aid equipment for the route to be flown is carried, or the equipment is unserviceable,  
 (OR)  
 S if standard COM/NAV/approach aid equipment for the route to be flown is carried and serviceable (see Note 1),  
 (AND/OR)  
 INSERT one or more of the following letters to indicate the COM/NAV/approach aid equipment available and serviceable:  
**NOTE-**  
*The capabilities described below comprise the following elements:*  
*a. Presence of relevant serviceable equipment on board the aircraft.*  
*b. Equipment and capabilities commensurate with flight crew qualifications.*  
*c. Where applicable, authorization from the appropriate authority.*

A	GBAS landing system	L	ILS
B	LPV (APV with SBAS)	M1	ATC RTF SATCOM (INMARSAT)
C	LORAN C	M2	Reserved
D	DME	M3	ATC RTF (Iridium)
E1	FMC WPR ACARS	O	VOR
E2	D-FIS ACARS	P1	CPDLC RCP 400 (See Note 7.)
E3	PDC ACARS	P2	CPDLC RCP 240 (See Note 7.)
F	ADF	P3	SATVOICE RCP 400 (See Note 7.)
G	(GNSS) (See Note 2.)	P4- P9	Reserved for RCP
H	HF RTF	R	PBN approved (See Note 4.)
I	Inertial navigation	T	TACAN
J1	CPDLC ATN VDL Mode 2 (See Note 3.)	U	UHF RTF
J2	CPDLC FANS 1/A HFDL	V	VHF RTF
J3	CPDLC FANS 1/A VDL Mode 4	W	RVSM approved
J4	CPDLC FANS 1/A VDL Mode 2	X	MNPS approved/North Atlantic (NAT) High Level Airspace (HLA) approved
J5	CPDLC FANS 1/A SATCOM (INMARSAT)	Y	VHF with 8.33 kHz channel spacing capability
J6	Reserved	Z	Other equipment carried or other capabilities (See Note 5.)
J7	CPDLC FANS 1/A SATCOM (Iridium)		

**NOTE-**

1. If the letter S is used, standard equipment is considered to be VHF RTF, VOR, and ILS within U.S. domestic airspace.
2. If the letter G is used, the types of external GNSS augmentation, if any, are specified in Item 18 following the indicator NAV/ and separated by a space.
3. See RTCA/EUROCAE Interoperability Requirements Standard For ATN Baseline 1 (ATN B1 INTEROP Standard – DO-280B/ED-110B) for data link services air traffic control clearance and information/air traffic control communications management/air traffic control microphone check.
4. If the letter R is used, the performance-based navigation levels that are authorized must be specified in Item 18 following the indicator PBN/. For further details, see Paragraph 5-1-9 b 8, Item 18 (c) and (d).

2. The following phraseology should be utilized by pilots for establishing contact with the designated facility:

(a) When operating in a radar environment: On initial contact, the pilot should inform the controller of the aircraft's assigned altitude preceded by the words "level," or "climbing to," or "descending to," as appropriate; and the aircraft's present vacating altitude, if applicable.

**EXAMPLE-**

1. (Name) CENTER, (aircraft identification), LEVEL (altitude or flight level).

2. (Name) CENTER, (aircraft identification), LEAVING (exact altitude or flight level), CLIMBING TO OR DESCENDING TO (altitude of flight level).

**NOTE-**

Exact altitude or flight level means to the nearest 100 foot increment. Exact altitude or flight level reports on initial contact provide ATC with information required prior to using Mode C altitude information for separation purposes.

(b) When operating in a nonradar environment:

(1) On initial contact, the pilot should inform the controller of the aircraft's present position, altitude and time estimate for the next reporting point.

**EXAMPLE-**

(Name) CENTER, (aircraft identification), (position), (altitude), ESTIMATING (reporting point) AT (time).

(2) After initial contact, when a position report will be made, the pilot should give the controller a complete position report.

**EXAMPLE-**

(Name) CENTER, (aircraft identification), (position), (time), (altitude), (type of flight plan), (ETA and name of next reporting point), (the name of the next succeeding reporting point), AND (remarks).

**REFERENCE-**

AIM, Paragraph 5-3-2, Position Reporting

3. At times controllers will ask pilots to verify that they are at a particular altitude. The phraseology used will be: "VERIFY AT (altitude)." In climbing or descending situations, controllers may ask pilots to "VERIFY ASSIGNED ALTITUDE AS (altitude)." Pilots should confirm that they are at the altitude stated by the controller or that the assigned altitude is correct as stated. If this is not the case, they should inform the controller of the actual altitude being maintained or the different assigned altitude.

**CAUTION-**

*Pilots should not take action to change their actual altitude or different assigned altitude to the altitude stated in the controllers verification request unless the controller specifically authorizes a change.*

c. **ARTCC Radio Frequency Outage.** ARTCCs normally have at least one back-up radio receiver and transmitter system for each frequency, which can usually be placed into service quickly with little or no disruption of ATC service. Occasionally, technical problems may cause a delay but switchover seldom takes more than 60 seconds. When it appears that the outage will not be quickly remedied, the ARTCC will usually request a nearby aircraft, if there is one, to switch to the affected frequency to broadcast communications instructions. It is important, therefore, that the pilot wait at least 1 minute before deciding that the ARTCC has actually experienced a radio frequency failure. When such an outage does occur, the pilot should, if workload and equipment capability permit, maintain a listening watch on the affected frequency while attempting to comply with the following recommended communications procedures:

1. If two-way communications cannot be established with the ARTCC after changing frequencies, a pilot should attempt to recontact the transferring controller for the assignment of an alternative frequency or other instructions.

2. When an ARTCC radio frequency failure occurs after two-way communications have been established, the pilot should attempt to reestablish contact with the center on any other known ARTCC frequency, preferably that of the next responsible sector when practicable, and ask for instructions. However, when the next normal frequency change along the route is known to involve another ATC facility, the pilot should contact that facility, if feasible, for instructions. If communications cannot be reestablished by either method, the pilot is expected to request communications instructions from the FSS appropriate to the route of flight.

**NOTE-**

*The exchange of information between an aircraft and an ARTCC through an FSS is quicker than relay via company radio because the FSS has direct interphone lines to the responsible ARTCC sector. Accordingly, when circumstances dictate a choice between the two, during an ARTCC frequency outage, relay via FSS radio is recommended.*

**d. Oakland Oceanic FIR.** The use of CPDLC and ADS-C in the Oakland Oceanic FIR (KZAK) is only permitted by Inmarsat and Iridium customers. All other forms of data link connectivity are not authorized. Users must ensure that the proper data link code is filed in Item 10a of the ICAO FPL in order to indicate which satellite medium(s) the aircraft is equipped with. The identifier for Inmarsat is J5 and the identifier for Iridium is J7. If J5 or J7 is not included in the ICAO FPL, then the LOGON will be rejected by KZAK and the aircraft will not be able to connect.

**e. New York Oceanic FIR.** The use of CPDLC and ADS-C in the New York Oceanic FIR (KZNY) is only permitted by Inmarsat and Iridium customers. All other forms of data link connectivity are not authorized. Users must ensure that the proper data link code is filed in Item 10a of the ICAO FPL in order to indicate which satellite medium(s) the aircraft is equipped with. The identifier for Inmarsat is J5 and the identifier for Iridium is J7. If J5 or J7 is not included in the ICAO FPL, then the LOGON will be rejected by KZNY and the aircraft will not be able to connect.

### 5-3-2. Position Reporting

The safety and effectiveness of traffic control depends to a large extent on accurate position reporting. In order to provide the proper separation and expedite aircraft movements, ATC must be able to make accurate estimates of the progress of every aircraft operating on an IFR flight plan.

#### a. Position Identification.

1. When a position report is to be made passing a VOR radio facility, the time reported should be the time at which the first complete reversal of the “to/from” indicator is accomplished.

2. When a position report is made passing a facility by means of an airborne ADF, the time reported should be the time at which the indicator makes a complete reversal.

3. When an aural or a light panel indication is used to determine the time passing a reporting point, such as a fan marker, Z marker, cone of silence or intersection of range courses, the time should be noted when the signal is first received and again when it ceases. The mean of these two times should then be taken as the actual time over the fix.

4. If a position is given with respect to distance and direction from a reporting point, the distance and direction should be computed as accurately as possible.

5. Except for terminal area transition purposes, position reports or navigation with reference to aids not established for use in the structure in which flight is being conducted will not normally be required by ATC.

**b. Position Reporting Points.** CFRs require pilots to maintain a listening watch on the appropriate frequency and, unless operating under the provisions of subparagraph c, to furnish position reports passing certain reporting points. Reporting points are indicated by symbols on en route charts. The designated compulsory reporting point symbol is a solid triangle  and the “on request” reporting point symbol is the open triangle . Reports passing an “on request” reporting point are only necessary when requested by ATC.

#### c. Position Reporting Requirements.

**1. Flights Along Airways or Routes.** A position report is required by all flights regardless of altitude, including those operating in accordance with an ATC clearance specifying “*VFR-on-top*,” over each designated compulsory reporting point along the route being flown.

**2. Flights Along a Direct Route.** Regardless of the altitude or flight level being flown, including flights operating in accordance with an ATC clearance specifying “*VFR-on-top*,” pilots must report over each reporting point used in the flight plan to define the route of flight.

**3. Flights in a Radar Environment.** When informed by ATC that their aircraft are in “Radar Contact,” pilots should discontinue position reports over designated reporting points. They should resume normal position reporting when ATC advises “*RADAR CONTACT LOST*” or “*RADAR SERVICE TERMINATED*.”

**4. Flights in an Oceanic (Non-radar) Environment.** Pilots must report over each point used in the flight plan to define the route of flight, even if the point is depicted on aeronautical charts as an “on request” (non-compulsory) reporting point. For aircraft providing automatic position reporting via an Automatic Dependent Surveillance-Contract

(ADS-C) logon, pilots should discontinue voice position reports.

**NOTE—**

*ATC will inform pilots that they are in “radar contact”:*

*(a) when their aircraft is initially identified in the ATC system; and*

*(b) when radar identification is reestablished after radar service has been terminated or radar contact lost. Subsequent to being advised that the controller has established radar contact, this fact will not be repeated to the pilot when handed off to another controller. At times, the aircraft identity will be confirmed by the receiving controller; however, this should not be construed to mean that radar contact has been lost. The identity of transponder equipped aircraft will be confirmed by asking the pilot to “ident,” “squawk standby,” or to change codes. Aircraft without transponders will be advised of their position to confirm identity. In this case, the pilot is expected to advise the controller if in disagreement with the position given. Any pilot who cannot confirm the accuracy of the position given because of not being tuned to the NAVAID referenced by the controller, should ask for another radar position relative to the tuned in NAVAID.*

**d. Position Report Items:**

**1. Position reports should include the following items:**

- (a) Identification;
- (b) Position;
- (c) Time;
- (d) Altitude or flight level (include actual altitude or flight level when operating on a clearance specifying VFR-on-top);
- (e) Type of flight plan (not required in IFR position reports made directly to ARTCCs or approach control);
- (f) ETA and name of next reporting point;
- (g) The name only of the next succeeding reporting point along the route of flight; and
- (h) Pertinent remarks.

**5-3-3. Additional Reports**

**a. The following reports should be made to ATC or FSS facilities without a specific ATC request:**

**1. At all times.**

(a) When vacating any previously assigned altitude or flight level for a newly assigned altitude or flight level.

(b) When an altitude change will be made if operating on a clearance specifying VFR-on-top.

(c) When unable to climb/descend at a rate of a least 500 feet per minute.

(d) When approach has been missed. (Request clearance for specific action; i.e., to alternative airport, another approach, etc.)

(e) Change in the average true airspeed (at cruising altitude) when it varies by 5 percent or 10 knots (whichever is greater) from that filed in the flight plan.

(f) The time and altitude or flight level upon reaching a holding fix or point to which cleared.

(g) When leaving any assigned holding fix or point.

**NOTE—**

*The reports in subparagraphs (f) and (g) may be omitted by pilots of aircraft involved in instrument training at military terminal area facilities when radar service is being provided.*

(h) Any loss, in controlled airspace, of VOR, TACAN, ADF, low frequency navigation receiver capability, GPS anomalies while using installed IFR-certified GPS/GNSS receivers, complete or partial loss of ILS receiver capability or impairment of air/ground communications capability. Reports should include aircraft identification, equipment affected, degree to which the capability to operate under IFR in the ATC system is impaired, and the nature and extent of assistance desired from ATC.

**NOTE—**

**1.** *Other equipment installed in an aircraft may effectively impair safety and/or the ability to operate under IFR. If such equipment (e.g., airborne weather radar) malfunctions and in the pilot’s judgment either safety or IFR capabilities are affected, reports should be made as above.*

**2.** *When reporting GPS anomalies, include the location and altitude of the anomaly. Be specific when describing the location and include duration of the anomaly if necessary.*

(i) Any information relating to the safety of flight.

**2. When not in radar contact.**

(a) When leaving final approach fix inbound on final approach (nonprecision approach) or when

leaving the outer marker or fix used in lieu of the outer marker inbound on final approach (precision approach).

(b) A corrected estimate at anytime it becomes apparent that an estimate as previously submitted is in error in excess of 2 minutes. For flights in the North Atlantic (NAT), a revised estimate is required if the error is 3 minutes or more.

b. Pilots encountering weather conditions which have not been forecast, or hazardous conditions which have been forecast, are expected to forward a report of such weather to ATC.

**REFERENCE-**

AIM, Para 7-1-18, Pilot Weather Reports (PIREPs).  
14 CFR Section 91.183(B) and (C).

### 5-3-4. Airways and Route Systems

a. Three fixed route systems are established for air navigation purposes. They are the Federal airway system (consisting of VOR and L/MF routes), the jet route system, and the RNAV route system. To the extent possible, these route systems are aligned in an overlying manner to facilitate transition between each.

1. The VOR and L/MF (nondirectional radio beacons) Airway System consists of airways designated from 1,200 feet above the surface (or in some instances higher) up to but not including 18,000 feet MSL. These airways are depicted on IFR Enroute Low Altitude Charts.

**NOTE-**

*The altitude limits of a victor airway should not be exceeded except to effect transition within or between route structures.*

(a) Except in Alaska, the VOR airways are: predicated solely on VOR or VORTAC navigation aids; depicted in black on aeronautical charts; and identified by a "V" (Victor) followed by the airway number (for example, V12).

**NOTE-**

*Segments of VOR airways in Alaska are based on L/MF navigation aids and charted in brown instead of black on en route charts.*

(1) A segment of an airway which is common to two or more routes carries the numbers of all the airways which coincide for that segment. When such is the case, pilots filing a flight plan need to indicate only that airway number for the route filed.

**NOTE-**

*A pilot who intends to make an airway flight, using VOR facilities, will simply specify the appropriate "victor" airway(s) in the flight plan. For example, if a flight is to be made from Chicago to New Orleans at 8,000 feet, using omniranges only, the route may be indicated as "departing from Chicago-Midway, cruising 8,000 feet via Victor 9 to Moisant International." If flight is to be conducted in part by means of L/MF navigation aids and in part on omniranges, specifications of the appropriate airways in the flight plan will indicate which types of facilities will be used along the described routes, and, for IFR flight, permit ATC to issue a traffic clearance accordingly. A route may also be described by specifying the station over which the flight will pass, but in this case since many VORs and L/MF aids have the same name, the pilot must be careful to indicate which aid will be used at a particular location. This will be indicated in the route of flight portion of the flight plan by specifying the type of facility to be used after the location name in the following manner: Newark L/MF, Allentown VOR.*

(2) With respect to position reporting, reporting points are designated for VOR Airway Systems. Flights using Victor Airways will report over these points unless advised otherwise by ATC.

(b) The L/MF airways (colored airways) are predicated solely on L/MF navigation aids and are depicted in brown on aeronautical charts and are identified by color name and number (e.g., Amber One). Green and Red airways are plotted east and west. Amber and Blue airways are plotted north and south.

**NOTE-**

*Except for G13 in North Carolina, the colored airway system exists only in the state of Alaska. All other such airways formerly so designated in the conterminous U.S. have been rescinded.*

(c) The use of TSO-C145 (as revised) or TSO-C146 (as revised) GPS/WAAS navigation systems is allowed in Alaska as the only means of navigation on published air traffic service (ATS) routes, including those Victor, T-Routes, and colored airway segments designated with a second minimum en route altitude (MEA) depicted in blue and followed by the letter G at those lower altitudes. The altitudes so depicted are below the minimum reception altitude (MRA) of the land-based navigation facility defining the route segment, and guarantee standard en route obstacle clearance and two-way communications. Air carrier operators requiring operations specifications are authorized to

conduct operations on those routes in accordance with FAA operations specifications.

2. The jet route system consists of jet routes established from 18,000 feet MSL to FL 450 inclusive.

(a) These routes are depicted on Enroute High Altitude Charts. Jet routes are depicted in black on aeronautical charts and are identified by a “J” (Jet) followed by the airway number (e.g., J12). Jet routes, as VOR airways, are predicated solely on VOR or VORTAC navigation facilities (except in Alaska).

**NOTE–**

*Segments of jet routes in Alaska are based on L/MF navigation aids and are charted in brown color instead of black on en route charts.*

(b) With respect to position reporting, reporting points are designated for jet route systems. Flights using jet routes will report over these points unless otherwise advised by ATC.

**3. Area Navigation (RNAV) Routes.**

(a) 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 (for example, 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, GPS/WAAS, 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.

(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.

**NOTE–**

*Aircraft in Alaska may only operate on GNSS Q-routes with GPS (TSO-C129 (as revised) or TSO-C196 (as revised)) equipment while the aircraft remains in Air Traffic Control (ATC) radar surveillance or with GPS/WAAS which does not require ATC radar surveillance.*

(2) T-routes are available for use by GPS or GPS/WAAS 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.

**NOTE–**

*Aircraft in Alaska may only operate on GNSS T-routes with GPS/WAAS (TSO-C145 (as revised) or TSO-C146 (as revised)) equipment.*

(b) 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, except for GNSS-equipped aircraft cleared via filed published waypoints recallable from the aircraft’s navigation database.

(c) Magnetic Reference Bearing (MRB) is the published bearing between two waypoints on an RNAV/GPS/GNSS route. The MRB is calculated by applying magnetic variation at the waypoint to the calculated true course between two waypoints. The MRB enhances situational awareness by indicating a reference bearing (no-wind heading) that a pilot should see on the compass/HSI/RMI, etc., when turning prior to/over a waypoint en route to another waypoint. Pilots should use this bearing as a reference only, because their RNAV/GPS/GNSS navigation system will fly the true course between the waypoints.

b. Operation above FL 450 may be conducted on a point-to-point basis. Navigational guidance is provided on an area basis utilizing those facilities depicted on the enroute high altitude charts.

c. **Radar Vectors.** Controllers may vector aircraft within controlled airspace for separation purposes, noise abatement considerations, when an operational advantage will be realized by the pilot or the controller, or when requested by the pilot. Vectors outside of controlled airspace will be provided only on pilot request. Pilots will be advised as to what the vector is to achieve when the vector is controller initiated and will take the aircraft off a previously assigned nonradar route. To the extent possible, aircraft operating on RNAV routes will be allowed to remain on their own navigation.

d. When flying in Canadian airspace, pilots are cautioned to review Canadian Air Regulations.

1. Special attention should be given to the parts which differ from U.S. CFRs.

(a) The Canadian Airways Class B airspace restriction is an example. Class B airspace is all controlled low level airspace above 12,500 feet MSL or the MEA, whichever is higher, within which only IFR and controlled VFR flights are permitted. (Low level airspace means an airspace designated and defined as such in the Designated Airspace Handbook.)

(b) Unless issued a VFR flight clearance by ATC, regardless of the weather conditions or the

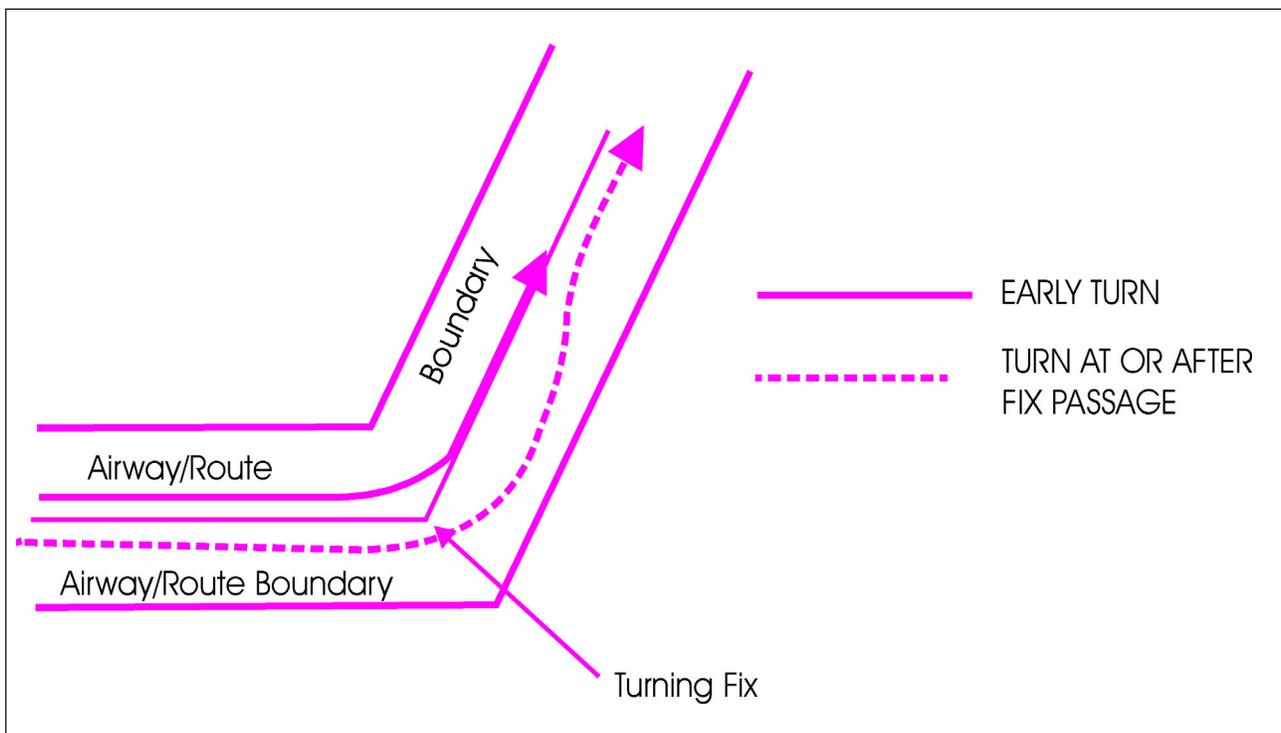
height of the terrain, no person may operate an aircraft under VMC within Class B airspace.

(c) The requirement for entry into Class B airspace is a student pilot permit (under the guidance or control of a flight instructor).

(d) VFR flight requires visual contact with the ground or water at all times.

2. Segments of VOR airways and high level routes in Canada are based on L/MF navigation aids and are charted in brown color instead of blue on en route charts.

FIG 5-3-1  
Adhering to Airways or Routes



### 5-3-5. Airway or Route Course Changes

a. Pilots of aircraft are required to adhere to airways or routes being flown. Special attention must be given to this requirement during course changes. Each course change consists of variables that make the technique applicable in each case a matter only the pilot can resolve. Some variables which must be considered are turn radius, wind effect, airspeed, degree of turn, and cockpit instrumentation. An early turn, as illustrated below, is one method of adhering to airways or routes. The use of any available cockpit

instrumentation, such as Distance Measuring Equipment, may be used by the pilot to lead the turn when making course changes. This *is consistent* with the intent of 14 CFR Section 91.181, which requires pilots to operate along the centerline of an airway and along the direct course between navigational aids or fixes.

b. Turns which begin at or after fix passage may exceed airway or route boundaries. FIG 5-3-1 contains an example flight track depicting this, together with an example of an early turn.

c. Without such actions as leading a turn, aircraft operating in excess of 290 knots true air speed (TAS) can exceed the normal airway or route boundaries depending on the amount of course change required, wind direction and velocity, the character of the turn fix (DME, overhead navigation aid, or intersection), and the pilot's technique in making a course change. For example, a flight operating at 17,000 feet MSL with a TAS of 400 knots, a 25 degree bank, and a course change of more than 40 degrees would exceed the width of the airway or route; i.e., 4 nautical miles each side of centerline. However, in the airspace below 18,000 feet MSL, operations in excess of 290 knots TAS are not prevalent and the provision of additional IFR separation in all course change situations for the occasional aircraft making a turn in excess of 290 knots TAS creates an unacceptable waste of airspace and imposes a penalty upon the preponderance of traffic which operate at low speeds. Consequently, the FAA expects pilots to lead turns and take other actions they consider necessary during course changes to adhere as closely as possible to the airways or route being flown.

### 5-3-6. Changeover Points (COPs)

a. COPs are prescribed for Federal airways, jet routes, area navigation routes, or other direct routes for which an MEA is designated under 14 CFR Part 95. The COP is a point along the route or airway segment between two adjacent navigation facilities or waypoints where changeover in navigation guidance should occur. At this point, the pilot should change navigation receiver frequency from the station behind the aircraft to the station ahead.

b. The COP is normally located midway between the navigation facilities for straight route segments, or at the intersection of radials or courses forming a dogleg in the case of dogleg route segments. When the COP is NOT located at the midway point, aeronautical charts will depict the COP location and give the mileage to the radio aids.

c. COPs are established for the purpose of preventing loss of navigation guidance, to prevent frequency interference from other facilities, and to prevent use of different facilities by different aircraft in the same airspace. Pilots are urged to observe COPs to the fullest extent.

### 5-3-7. Minimum Turning Altitude (MTA)

Due to increased airspeeds at 10,000 ft MSL or above, the published minimum enroute altitude (MEA) may not be sufficient for obstacle clearance when a turn is required over a fix, NAVAID, or waypoint. In these instances, an expanded area in the vicinity of the turn point is examined to determine whether the published MEA is sufficient for obstacle clearance. In some locations (normally mountainous), terrain/obstacles in the expanded search area may necessitate a higher minimum altitude while conducting the turning maneuver. Turning fixes requiring a higher minimum turning altitude (MTA) will be denoted on government charts by the minimum crossing altitude (MCA) icon ("x" flag) and an accompanying note describing the MTA restriction. An MTA restriction will normally consist of the air traffic service (ATS) route leading to the turn point, the ATS route leading from the turn point, and the required altitude; e.g., MTA V330 E TO V520 W 16000. When an MTA is applicable for the intended route of flight, pilots must ensure they are at or above the charted MTA not later than the turn point and maintain at or above the MTA until joining the centerline of the ATS route following the turn point. Once established on the centerline following the turning fix, the MEA/MOCA determines the minimum altitude available for assignment. An MTA may also preclude the use of a specific altitude or a range of altitudes during a turn. For example, the MTA may restrict the use of 10,000 through 11,000 ft MSL. In this case, any altitude greater than 11,000 ft MSL is unrestricted, as are altitudes less than 10,000 ft MSL provided MEA/MOCA requirements are satisfied.

### 5-3-8. Holding

a. Whenever an aircraft is cleared to a fix other than the destination airport and delay is expected, it is the responsibility of ATC to issue complete holding instructions (unless the pattern is charted), an EFC time and best estimate of any additional en route/terminal delay.

#### **NOTE-**

*Only those holding patterns depicted on U.S. government or commercially produced (meeting FAA requirements) low/high altitude en route, and area or STAR charts should be used.*

b. If the holding pattern is charted and the controller doesn't issue complete holding instructions, the pilot is expected to hold as depicted on the

**b.** If the holding pattern is charted and the controller doesn't issue complete holding instructions, the pilot is expected to hold as depicted on the appropriate chart. When the pattern is charted on the assigned procedure or route being flown, ATC may omit all holding instructions except the charted holding direction and the statement *AS PUBLISHED*; for example, *HOLD EAST AS PUBLISHED*. ATC must always issue complete holding instructions when pilots request them.

**c.** If no holding pattern is charted and holding instructions have not been issued, the pilot should ask ATC for holding instructions prior to reaching the fix. This procedure will eliminate the possibility of an aircraft entering a holding pattern other than that desired by ATC. If unable to obtain holding instructions prior to reaching the fix (due to frequency congestion, stuck microphone, etc.), then enter a standard pattern on the course on which the aircraft approached the fix and request further clearance as soon as possible. In this event, the altitude/flight level of the aircraft at the clearance limit will be protected so that separation will be provided as required.

**d.** When an aircraft is 3 minutes or less from a clearance limit and a clearance beyond the fix has not been received, the pilot is expected to start a speed reduction so that the aircraft will cross the fix, initially, at or below the maximum holding airspeed.

**e.** When no delay is expected, the controller should issue a clearance beyond the fix as soon as possible and, whenever possible, at least 5 minutes before the aircraft reaches the clearance limit.

**f.** Pilots should report to ATC the time and altitude/flight level at which the aircraft reaches the clearance limit and report leaving the clearance limit.

**NOTE-**

*In the event of two-way communications failure, pilots are required to comply with 14 CFR Section 91.185.*

**g.** When holding at a VOR station, pilots should begin the turn to the outbound leg at the time of the first complete reversal of the to/from indicator.

**h.** Patterns at the most generally used holding fixes are depicted (charted) on U.S. Government or commercially produced (meeting FAA requirements) Low or High Altitude En Route, Area, Departure Procedure, and STAR Charts. Pilots are expected to hold in the pattern depicted unless specifically advised otherwise by ATC.

**NOTE-**

*Holding patterns that protect for a maximum holding airspeed other than the standard may be depicted by an icon, unless otherwise depicted. The icon is a standard holding pattern symbol (racetrack) with the airspeed restriction shown in the center. In other cases, the airspeed restriction will be depicted next to the standard holding pattern symbol.*

**REFERENCE-**

*AIM, Paragraph 5-3-8j2, Holding*

**i.** An ATC clearance requiring an aircraft to hold at a fix where the pattern is not charted will include the following information: (See FIG 5-3-2.)

**1.** Direction of holding from the fix in terms of the eight cardinal compass points (i.e., N, NE, E, SE, etc.).

**2.** Holding fix (the fix may be omitted if included at the beginning of the transmission as the clearance limit).

**3.** Radial, course, bearing, airway or route on which the aircraft is to hold.

**4.** Leg length in miles if DME or RNAV is to be used (leg length will be specified in minutes on pilot request or if the controller considers it necessary).

**5.** Direction of turn if left turns are to be made, the pilot requests, or the controller considers it necessary.

**6.** Time to expect further clearance and any pertinent additional delay information.

airport or heliport in sight or, for a helicopter point-in-space approach, the prescribed visual reference with the surface is established. Also, if, at any time during the approach the controller considers that safe guidance for the remainder of the approach cannot be provided, the controller will terminate guidance and instruct the pilot to execute a missed approach. Similarly, guidance termination and missed approach will be effected upon pilot request and, for civil aircraft only, controllers may terminate guidance when the pilot reports the runway, airport/heliport or visual surface route (point-in-space approach) in sight or otherwise indicates that continued guidance is not required. Radar service is automatically terminated at the completion of a radar approach.

**NOTE—**

1. *The published MDA for straight-in approaches will be issued to the pilot before beginning descent. When a surveillance approach will terminate in a circle-to-land maneuver, the pilot must furnish the aircraft approach category to the controller. The controller will then provide the pilot with the appropriate MDA.*

2. **ASR APPROACHES ARE NOT AVAILABLE WHEN AN ATC FACILITY IS USING CENRAP.**

3. **NO-GYRO Approach.** This approach is available to a pilot under radar control who experiences circumstances wherein the directional gyro or other stabilized compass is inoperative or inaccurate. When this occurs, the pilot should so advise ATC and request a No-Gyro vector or approach. Pilots of aircraft not equipped with a directional gyro or other stabilized compass who desire radar handling may also request a No-Gyro vector or approach. The pilot should make all turns at standard rate and should execute the turn immediately upon receipt of instructions. For example, “TURN RIGHT,” “STOP TURN.” When a surveillance or precision approach is made, the pilot will be advised after the aircraft has been turned onto final approach to make turns at half standard rate.

## 5-4-12. Radar Monitoring of Instrument Approaches

a. PAR facilities operated by the FAA and the military services at some joint-use (civil and

military) and military installations monitor aircraft on instrument approaches and issue radar advisories to the pilot when weather is below VFR minimums (1,000 and 3), at night, or when requested by a pilot. This service is provided only when the PAR Final Approach Course coincides with the final approach of the navigational aid and only during the operational hours of the PAR. The radar advisories serve only as a secondary aid since the pilot has selected the navigational aid as the primary aid for the approach.

b. Prior to starting final approach, the pilot will be advised of the frequency on which the advisories will be transmitted. If, for any reason, radar advisories cannot be furnished, the pilot will be so advised.

c. Advisory information, derived from radar observations, includes information on:

1. Passing the final approach fix inbound (nonprecision approach) or passing the outer marker or fix used in lieu of the outer marker inbound (precision approach).

**NOTE—**

*At this point, the pilot may be requested to report sighting the approach lights or the runway.*

2. Trend advisories with respect to elevation and/or azimuth radar position and movement will be provided.

**NOTE—**

*Whenever the aircraft nears the PAR safety limit, the pilot will be advised that the aircraft is well above or below the glidepath or well left or right of course. Glidepath information is given only to those aircraft executing a precision approach, such as ILS. Altitude information is not transmitted to aircraft executing other than precision approaches because the descent portions of these approaches generally do not coincide with the depicted PAR glidepath.*

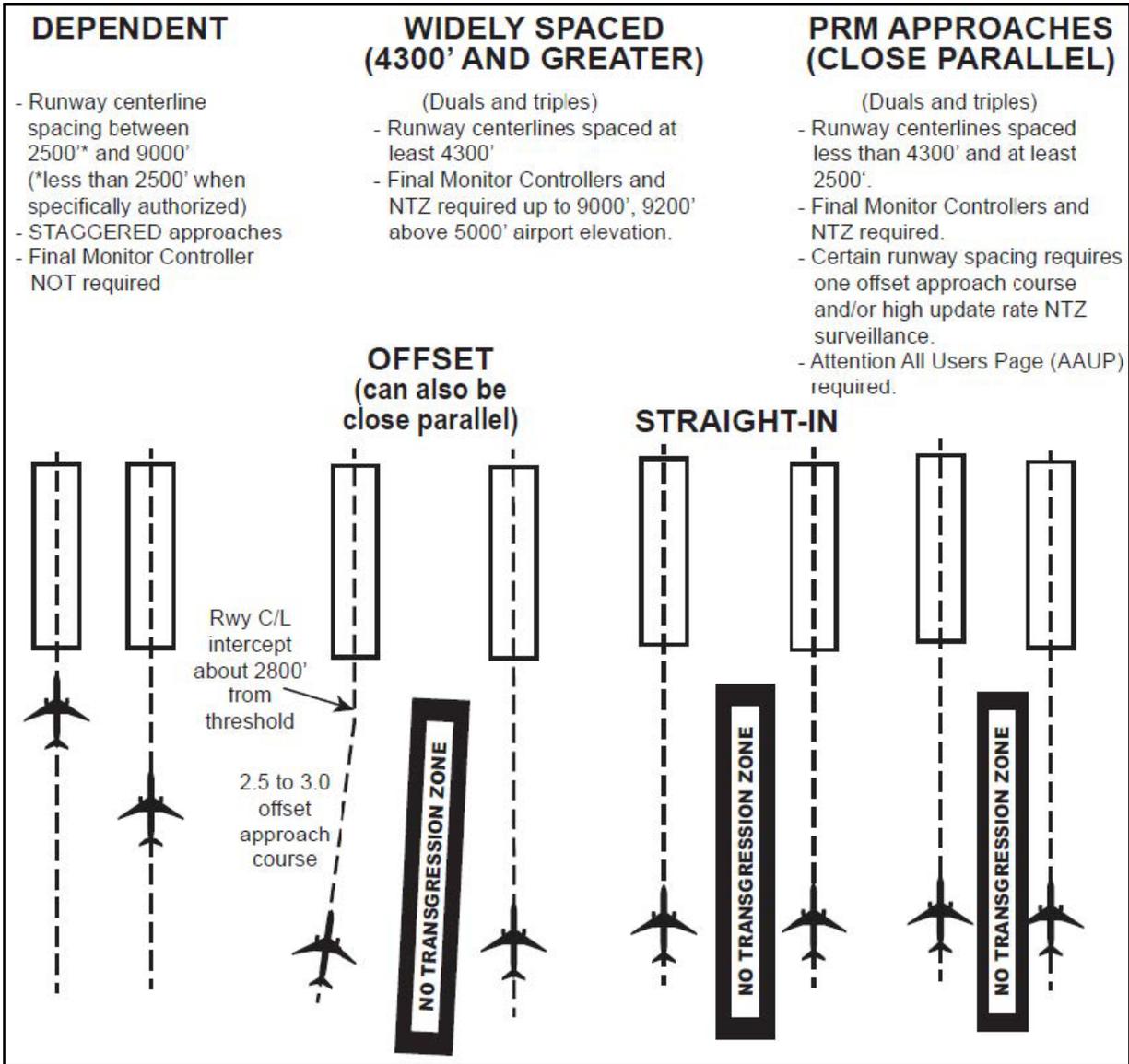
3. If, after repeated advisories, the aircraft proceeds outside the PAR safety limit or if a radical deviation is observed, the pilot will be advised to execute a missed approach unless the prescribed visual reference with the surface is established.

d. Radar service is automatically terminated upon completion of the approach.

### 5-4-13. Simultaneous Approaches to Parallel Runways

FIG 5-4-20

#### Simultaneous Approaches (Approach Courses Parallel and Offset between 2.5 and 3.0 degrees)



**b. Radar Services.** These services are provided for each simultaneous independent approach.

**1.** During turn on to parallel final approach, aircraft are normally provided 3 miles radar separation or a minimum of 1,000 feet vertical separation. The assigned altitude must be maintained until intercepting the glidepath, unless cleared otherwise by ATC. Aircraft will not be vectored to intercept the final approach course at an angle greater than thirty degrees.

**NOTE–**

*Some simultaneous operations permit the aircraft to track an RNAV course beginning on downwind and continuing in a turn to intercept the final approach course. In this case, separation with the aircraft on the adjacent final approach course is provided by the monitor controller with reference to an NTZ.*

**2.** The final monitor controller will have the capability of overriding the tower controller on the tower frequency.

**3.** Pilots will be instructed to contact the tower frequency prior to the point where NTZ monitoring begins.

**4.** Aircraft observed to overshoot the turn-on or to continue on a track which will penetrate the NTZ will be instructed to return to the correct final approach course immediately. The final monitor controller may cancel the approach clearance, and issue missed approach or other instructions to the deviating aircraft.

**PHRASEOLOGY–**

*“(Aircraft call sign) YOU HAVE CROSSED THE FINAL APPROACH COURSE. TURN (left/right) IMMEDIATELY AND RETURN TO THE FINAL APPROACH COURSE,”*

*or*

*“(aircraft call sign) TURN (left/right) AND RETURN TO THE FINAL APPROACH COURSE.”*

**5.** If a deviating aircraft fails to respond to such instructions or is observed penetrating the NTZ, the aircraft on the adjacent final approach course (if threatened), will be issued a breakout instruction.

**PHRASEOLOGY–**

*“TRAFFIC ALERT (aircraft call sign) TURN (left/right) IMMEDIATELY HEADING (degrees), (climb/descend) AND MAINTAIN (altitude).”*

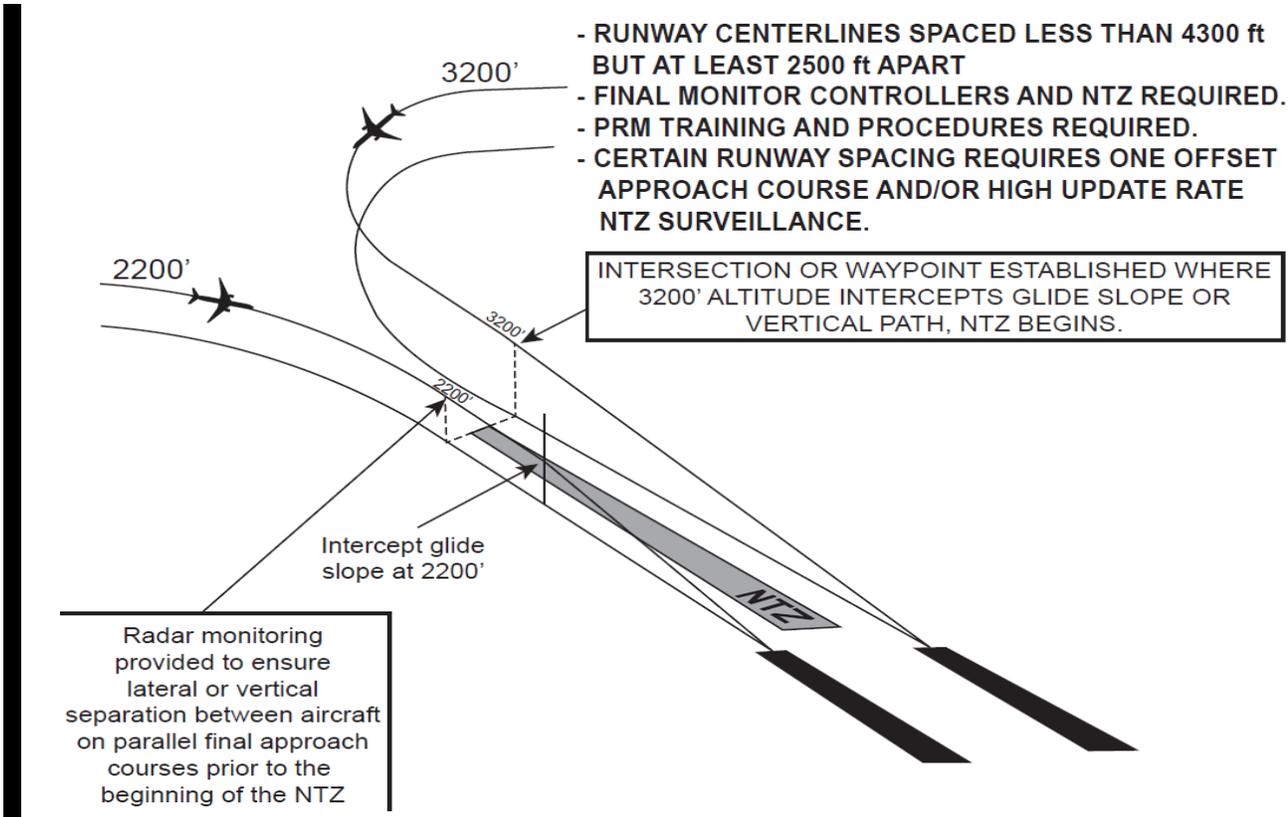
**6.** Radar monitoring will automatically be terminated when visual separation is applied, the aircraft reports the approach lights or runway in sight, or the aircraft is 1 NM or less from the runway threshold. Final monitor controllers will not advise pilots when radar monitoring is terminated.

**NOTE–**

*Simultaneous independent approaches conducted to runways spaced greater than 9,000 feet (or 9,200’ at airports above 5,000’) do not require an NTZ. However, from a pilot’s perspective, the same alerts relative to deviating aircraft will be provided by ATC as are provided when an NTZ is being monitored. Pilots may not be aware as to whether or not an NTZ is being monitored.*

**5-4-16. Simultaneous Close Parallel PRM Approaches and Simultaneous Offset Instrument Approaches (SOIA)**

*FIG 5-4-23*  
**PRM Approaches**  
**Simultaneous Close Parallel**



**a. System.**

1. PRM is an acronym for the high update rate Precision Runway Monitor surveillance system which is required to monitor the No Transgression Zone (NTZ) for specific parallel runway separations used to conduct simultaneous close parallel approaches. PRM is also published in the title as part of the approach name for IAPs used to conduct Simultaneous Close Parallel approaches. “PRM” alerts pilots that specific airborne equipment, training, and procedures are applicable.

Because Simultaneous Close Parallel PRM approaches are independent, the NTZ and normal operating zone (NOZ) airspace between the final approach courses is monitored by two monitor controllers, one for each approach course. The NTZ monitoring system (final monitor aid) consists of a high resolution ATC radar display with automated tracking software which provides monitor controllers with aircraft identification, position, speed, and a

ten-second projected position, as well as visual and aural NTZ penetration alerts. A PRM high update rate surveillance sensor is a component of this system only for specific runway spacing. Additional procedures for simultaneous independent approaches are described in Paragraph 5-4-15, Simultaneous Independent ILS/RNAV/GLS Approaches.

2. Simultaneous Close Parallel PRM approaches, whether conducted utilizing a high update rate PRM surveillance sensor or not, must meet all of the following requirements: pilot training, PRM in the approach title, NTZ monitoring utilizing a final monitor aid, radar display, publication of an AAUP, and use of a secondary PRM communications frequency. PRM approaches are depicted on a separate IAP titled (Procedure type) PRM Rwy XXX (Simultaneous Close Parallel or Close Parallel).

**NOTE-**  
 ATC does not use the word “independent” when advertising these operations on the ATIS.

(c) Only crewmembers are permitted onboard the aircraft; and

(d) “Maintenance Flight” is included in the remarks section of the flight plan.

### **5–6–7. Civil Aircraft Operations Transiting U.S. Territorial Airspace**

a. Civil aircraft (except those operating in accordance with subparagraphs 5–6–7b, 5–6–7c, 5–6–7d, and 5–6–7e) are authorized to transit U.S. territorial airspace if in compliance with all of the following conditions:

1. File and are on an active flight plan (IFR, VFR, or DVFR);

2. Equipped with an operational transponder with altitude reporting capability and continuously squawk an ATC assigned transponder code;

3. Equipped with an operational ADS–B Out when operating in airspace specified in 14 CFR 91.225;

4. Maintain two–way radio communications with ATC;

5. Comply with all other applicable ADIZ requirements described in paragraph 5–6–4 and any other national security requirements in paragraph 5–6–2;

6. Are operating under an approved TSA aviation security program (see paragraph 5–6–10 for TSA aviation security program information) or are operating with and in accordance with an FAA/TSA airspace waiver (see paragraph 5–6–9 for FAA/TSA airspace waiver information), if:

(a) The aircraft is not registered in the U.S.; or

(b) The aircraft is registered in the U.S. and its maximum takeoff gross weight is greater than 100,309 pounds (45,500 kgs);

7. Are in receipt of, and are operating in accordance with, an FAA routing authorization if the aircraft is registered in a U.S. State Department–designated special interest country or is operating with the ICAO 3LD of a company in a country listed as a U.S. State Department–designated special interest country, unless the operator holds valid FAA Part 129 operations specifications. VFR and DVFR flight operations are prohibited for any aircraft requiring an

FAA routing authorization. (See paragraph 5–6–11 for FAA routing authorization information.)

b. Civil aircraft registered in Canada or Mexico, and engaged in operations for the purposes of air ambulance, firefighting, law enforcement, search and rescue, or emergency evacuation are authorized to transit U.S. territorial airspace within 50 NM of their respective borders with the U.S., with or without an active flight plan, provided they have received and continuously transmit an ATC–assigned transponder code.

c. Civil aircraft registered in Canada, Mexico, Bahamas, Bermuda, Cayman Islands, or the British Virgin Islands with a maximum certificated takeoff gross weight of 100,309 pounds (45,500 kgs) or less are authorized to transit U.S. territorial airspace if in compliance with all of the following conditions:

1. File and are on an active flight plan (IFR, VFR, or DVFR) that enters U.S. territorial airspace directly from any of the countries listed in this subparagraph 5–6–7c. Flights that include a stop in a non–listed country prior to entering U.S. territorial airspace must comply with the requirements prescribed by subparagraph 5–6–7a above, including operating under an approved TSA aviation security program (see paragraph 5–6–10 for TSA aviation security program information) or operating with, and in accordance with, an FAA/TSA airspace waiver (see paragraph 5–6–9 for FAA/TSA airspace waiver information).

2. Equipped with an operational transponder with altitude reporting capability and continuously squawk an ATC assigned transponder code;

3. Equipped with an operational ADS–B Out when operating in airspace specified in 14 CFR 91.225;

4. Maintain two–way radio communications with ATC; and

5. Comply with all other applicable ADIZ requirements described in paragraph 5–6–4 and any other national security requirements in paragraph 5–6–2.

d. Civil aircraft registered in Canada, Mexico, Bahamas, Bermuda, Cayman Islands, or the British Virgin Islands with a maximum certificated takeoff gross weight greater than 100,309 pounds (45,500 kgs) must comply with the requirements subparagraph 5–6–7a, including operating under an

approved TSA aviation security program (see paragraph 5-6-10 for TSA aviation program information) or operating with, and in accordance with, an FAA/TSA airspace waiver (see paragraph 5-6-9 for FAA/TSA airspace waiver information).

**e.** Civil aircraft registered in the U.S., Canada, or Mexico with a maximum certificated takeoff gross weight of 100,309 pounds (45,500 kgs) or less that are operating without an operational transponder and/or the ability to maintain two-way radio communications with ATC, are authorized to transit U.S. territorial airspace over Alaska if in compliance with all of the following conditions:

1. Enter and exit U.S. territorial airspace over Alaska north of the fifty-fourth parallel;
2. File and are on an active flight plan;
3. Squawk 1200 if VFR and equipped with a transponder.
4. Comply with all other applicable ADIZ requirements described in paragraph 5-6-4 and any other national security requirements in paragraph 5-6-2.

### 5-6-8. Foreign State Aircraft Operations

**a.** Foreign state aircraft are authorized to operate in U.S. territorial airspace if in compliance with all of the following conditions:

1. File and are on an active IFR flight plan;
2. Equipped with an operational transponder with altitude reporting capability and continuously squawk an ATC assigned transponder code;
3. Equipped with an operational ADS-B Out when operating in airspace specified in 14 CFR 91.225;
4. Maintain two-way radio communications with ATC; and
5. Comply with all other applicable ADIZ requirements described in paragraph 5-6-4 and any other national security requirements in paragraph 5-6-2.

**b. Diplomatic Clearances.** Foreign state aircraft may operate to or from, within, or in transit of U.S. territorial airspace only when authorized by the U.S. State Department by means of a diplomatic

clearance, except as described in subparagraph 5-6-8h below.

**1.** Information about diplomatic clearances is available at the U.S. State Department website <https://www.state.gov/diplomatic-aircraft-clearance-procedures-for-foreign-state-aircraft-to-operate-in-united-states-national-airspace/> (lower case only).

**2.** A diplomatic clearance may be initiated by contacting the U.S. State Department via email at [DCAS@state.gov](mailto:DCAS@state.gov) or via phone at (202) 453-8390.

**NOTE-**

*A diplomatic clearance is not required for foreign state aircraft operations that transit U.S. controlled oceanic airspace but do not enter U.S. territorial airspace. (See subparagraph 5-6-8d for flight plan information.)*

**c.** An FAA routing authorization for state aircraft operations of special interest countries listed in subparagraph 5-6-11b. is required before the U.S. State Department will issue a diplomatic clearance for such operations. (See subparagraph 5-6-11 for FAA routing authorizations information).

**d.** Foreign state aircraft operating with a diplomatic clearance must navigate U.S. territorial airspace on an active IFR flight plan, unless specifically approved for VFR flight operations by the U.S. State Department in the diplomatic clearance.

**NOTE-**

*Foreign state aircraft operations to or from, within, or transiting U.S. territorial airspace; or transiting any U.S. controlled oceanic airspace, should enter ICAO code M in Item 8 of the flight plan to assist in identification of the aircraft as a state aircraft.*

**e.** A foreign aircraft that operates to or from, within, or in transit of U.S. territorial airspace while conducting a state aircraft operation is not authorized to change its status as a state aircraft during any portion of the approved, diplomatically cleared itinerary.

**f.** A foreign aircraft described in subparagraph 5-6-8e above may operate from or within U.S. territorial airspace as a civil aircraft operation, once it has completed its approved, diplomatically cleared itinerary, if the aircraft operator is:

1. A foreign air carrier that holds valid FAA Part 129 operations specifications; and
2. Is in compliance with all other requirements applied to foreign civil aircraft operations from or

within U.S. territorial airspace. (See paragraphs 5-6-5 and 5-6-6.)

**g.** Foreign state aircraft operations are not authorized to or from Ronald Reagan Washington National Airport (KDCA).

**h. Diplomatic Clearance Exceptions.** State aircraft operations on behalf of the governments of Canada and Mexico conducted for the purposes of air ambulance, firefighting, law enforcement, search and rescue, or emergency evacuation are authorized to transit U.S. territorial airspace within 50 NM of their respective borders with the U.S., with or without an active flight plan, provided they have received and continuously transmit an ATC assigned transponder code. State aircraft operations on behalf of the governments of Canada and Mexico conducted under this subparagraph 5-6-8h are not required to obtain a diplomatic clearance from the U.S. State Department.

#### **5-6-9. FAA/TSA Airspace Waivers**

**a.** Operators may submit requests for FAA/TSA airspace waivers at <https://waivers.faa.gov> by selecting “international” as the waiver type.

**b.** Information regarding FAA/TSA airspace waivers can be found at: <http://www.tsa.gov/for-industry/general-aviation> or can be obtained by contacting TSA at (571) 227-2071.

**c.** All existing FAA/TSA waivers issued under previous FDC NOTAMS remain valid until the expiration date specified in the waiver, unless sooner superseded or rescinded.

#### **5-6-10. TSA Aviation Security Programs**

**a.** Applicants for U.S. air operator certificates will be provided contact information for TSA aviation security programs by the U.S. Department of Transportation during the certification process.

**b.** For information about applicable TSA security programs:

**1.** U.S. air carriers and commercial operators must contact their TSA Principal Security Specialist (PSS); and

**2.** Foreign air carriers must contact their International Industry Representative (IIR).

#### **5-6-11. FAA Flight Routing Authorizations**

**a.** Information about FAA routing authorizations for U.S. State Department–designated special interest country flight operations to or from, within, or transiting U.S. territorial airspace is available by country at:

**1.** FAA website [http://www.faa.gov/air\\_traffic/publications/us\\_restrictions/](http://www.faa.gov/air_traffic/publications/us_restrictions/); or

**2.** Phone by contacting the FAA System Operations Support Center (SOSC) at (202) 267-8115.

**b. Special Interest Countries.** The U.S. State Department–designated special interest countries are Cuba, Iran, The Democratic People’s Republic of Korea (North Korea), The People’s Republic of China, The Russian Federation, Sudan, and Syria.

#### **NOTE–**

*FAA flight routing authorizations are not required for aircraft registered in Hong Kong, Taiwan, or Macau.*

**c.** Aircraft operating with the ICAO 3LD assigned to a company or entity from a country listed as a State Department–designated special interest country and holding valid FAA Part 129 operations specifications do not require FAA flight routing authorization.

**d.** FAA routing authorizations will only be granted for IFR operations. VFR and DVFR flight operations are prohibited for any aircraft requiring an FAA routing authorization.

#### **5-6-12. Emergency Security Control of Air Traffic (ESCAT)**

**a.** During defense emergency or air defense emergency conditions, additional special security instructions may be issued in accordance with 32 CFR Part 245, *Plan for the Emergency Security Control of Air Traffic (ESCAT)*.

**b.** Under the provisions of 32 CFR Part 245, the military will direct the action to be taken in regard to landing, grounding, diversion, or dispersal of aircraft in the defense of the U.S. during emergency conditions.

**c.** At the time a portion or all of ESCAT is implemented, ATC facilities will broadcast appropriate instructions received from the Air Traffic Control System Command Center (ATCSCC) over available ATC frequencies. Depending on instructions received from the ATCSCC, VFR flights may be

directed to land at the nearest available airport, and IFR flights will be expected to proceed as directed by ATC.

**d.** Pilots on the ground may be required to file a flight plan and obtain an approval (through FAA) prior to conducting flight operation.

### **5-6-13. Interception Procedures**

#### **a. General.**

**1.** In conjunction with the FAA, Air Defense Sectors monitor air traffic and could order an intercept in the interest of national security or defense. Intercepts during peacetime operations are vastly different than those conducted under increased states of readiness. The interceptors may be fighters or rotary wing aircraft. The reasons for aircraft intercept include, but are not limited to:

- (a) Identify an aircraft;
- (b) Track an aircraft;
- (c) Inspect an aircraft;
- (d) Divert an aircraft;
- (e) Establish communications with an aircraft.

**2.** When specific information is required (i.e., markings, serial numbers, etc.) the interceptor pilot(s) will respond only if, in their judgment, the request can be conducted in a safe manner. Intercept procedures are described in some detail in the paragraphs below. In all situations, the interceptor pilot will consider safety of flight for all concerned throughout the intercept procedure. The interceptor pilot(s) will use caution to avoid startling the intercepted crew or passengers and understand that maneuvers considered normal for interceptor aircraft may be considered hazardous to other aircraft.

**3.** All aircraft operating in US national airspace are highly encouraged to maintain a listening watch on VHF/UHF guard frequencies (121.5 or 243.0 MHz). If subjected to a military intercept, it is incumbent on civilian aviators to understand their responsibilities and to comply with ICAO standard signals relayed from the intercepting aircraft. Specifically, aviators are expected to contact air traffic control without delay (if able) on the local operating frequency or on VHF/UHF guard. Noncompliance may result in the use of force.

#### **b. Fighter intercept phases (See FIG 5-6-1).**

##### **1. Approach Phase.**

As standard procedure, intercepted aircraft are approached from behind. Typically, interceptor aircraft will be employed in pairs, however, it is not uncommon for a single aircraft to perform the intercept operation. Safe separation between interceptors and intercepted aircraft is the responsibility of the intercepting aircraft and will be maintained at all times.

##### **2. Identification Phase.**

Interceptor aircraft will initiate a controlled closure toward the aircraft of interest, holding at a distance no closer than deemed necessary to establish positive identification and to gather the necessary information. The interceptor may also fly past the intercepted aircraft while gathering data at a distance considered safe based on aircraft performance characteristics.

##### **3. Post Intercept Phase.**

An interceptor may attempt to establish communications via standard ICAO signals. In time-critical situations where the interceptor is seeking an immediate response from the intercepted aircraft or if the intercepted aircraft remains non-compliant to instruction, the interceptor pilot may initiate a divert maneuver. In this maneuver, the interceptor flies across the intercepted aircraft's flight path (minimum 500 feet separation and commencing from slightly below the intercepted aircraft altitude) in the general direction the intercepted aircraft is expected to turn. The interceptor will rock its wings (daytime) or flash external lights/select afterburners (night) while crossing the intercepted aircraft's flight path. The interceptor will roll out in the direction the intercepted aircraft is expected to turn before returning to verify the aircraft of interest is complying. The intercepted aircraft is expected to execute an immediate turn to the direction of the intercepting aircraft. If the aircraft of interest does not comply, the interceptor may conduct a second climbing turn across the intercepted aircraft's flight path (minimum 500 feet separation and commencing from slightly below the intercepted aircraft altitude) while expending flares as a warning signal to the intercepted aircraft to comply immediately and to turn in the direction indicated and to leave the area. The interceptor is responsible to maintain safe separation during these and all intercept maneuvers. Flight safety is paramount.



# Chapter 6. Emergency Procedures

## Section 1. General

### 6-1-1. Pilot Responsibility and Authority

a. The pilot-in-command of an aircraft is directly responsible for and is the final authority as to the operation of that aircraft. In an emergency requiring immediate action, the pilot-in-command may deviate from any rule in 14 CFR Part 91, Subpart A, General, and Subpart B, Flight Rules, to the extent required to meet that emergency.

#### NOTE-

*In the event of a pilot incapacitation, an Emergency Autoland system or an emergency descent system may assume operation of the aircraft and deviate to meet that emergency.*

#### REFERENCE-

*14 CFR Section 91.3(b).*

b. If the emergency authority of 14 CFR Section 91.3(b) is used to deviate from the provisions of an ATC clearance, the pilot-in-command must notify ATC as soon as possible and obtain an amended clearance.

c. Unless deviation is necessary under the emergency authority of 14 CFR Section 91.3, pilots of IFR flights experiencing two-way radio communications failure are expected to adhere to the procedures prescribed under “IFR operations, two-way radio communications failure.”

#### REFERENCE-

*14 CFR Section 91.185.*

### 6-1-2. Emergency Condition- Request Assistance Immediately

a. An emergency can be either a *distress* or *urgency* condition as defined in the Pilot/Controller Glossary. Pilots do not hesitate to declare an emergency when they are faced with *distress* conditions such as fire, mechanical failure, or structural damage. However, some are reluctant to report an *urgency* condition when they encounter situations which may not be immediately perilous, but are potentially catastrophic. An aircraft is in at least an *urgency* condition the moment the pilot becomes doubtful about position, fuel endurance, weather, or any other condition that could adversely affect flight safety. This is the time to ask for help, not after the situation has developed into a *distress* condition.

b. Pilots who become apprehensive for their safety for any reason should *request assistance immediately*. Ready and willing help is available in the form of radio, radar, direction finding stations and other aircraft. Delay has caused accidents and cost lives. *Safety is not a luxury! Take action!*



# Chapter 7. Safety of Flight

## Section 1. Meteorology

### 7-1-1. National Weather Service Aviation Weather Service Program

**a.** Weather service to aviation is a joint effort of the National Oceanic and Atmospheric Administration (NOAA), the National Weather Service (NWS), the Federal Aviation Administration (FAA), Department of Defense, and various private sector aviation weather service providers. Requirements for all aviation weather products originate from the FAA, which is the Meteorological Authority for the U.S.

**b.** NWS meteorologists are assigned to all air route traffic control centers (ARTCC) as part of the Center Weather Service Units (CWSU) as well as the Air Traffic Control System Command Center (ATCSCC). These meteorologists provide specialized briefings as well as tailored forecasts to support the needs of the FAA and other users of the NAS.

#### **c.** Aviation Products

**1.** The NWS maintains an extensive surface, upper air, and radar weather observing program; and a nationwide aviation weather forecasting service.

**2.** Airport observations (METAR and SPECI) supported by the NWS are provided by automated observing systems.

**3.** Terminal Aerodrome Forecasts (TAF) are prepared by 123 NWS Weather Forecast Offices (WFOs) for over 700 airports. These forecasts are valid for 24 or 30 hours and amended as required.

**4.** Inflight aviation advisories (for example, Significant Meteorological Information (SIGMETs) and Airmen's Meteorological Information (AIRMETs)) are issued by three NWS Meteorological Watch Offices; the Aviation Weather Center (AWC) in Kansas City, MO, the Alaska Aviation Weather Unit (AAWU) in Anchorage, AK, and the WFO in Honolulu, HI. Both the AWC and the AAWU issue area forecasts (FA) for selected areas. In addition, NWS meteorologists assigned to most ARTCCs as part of the Center Weather Service Unit (CWSU) provide Center Weather Advisories (CWAs) and

gather weather information to support the needs of the FAA and other users of the system.

**5.** Several NWS National Centers for Environmental Prediction (NCEP) provide aviation specific weather forecasts, or select public forecasts which are of interest to pilots and operators.

**(a)** The Aviation Weather Center (AWC) displays a variety of domestic and international aviation forecast products over the Internet at [aviationweather.gov](http://aviationweather.gov).

**(b)** The NCEP Central Operations (NCO) is responsible for the operation of many numerical weather prediction models, including those which produce the many wind and temperature aloft forecasts.

**(c)** The Storm Prediction Center (SPC) issues tornado and severe weather watches along with other guidance forecasts.

**(d)** The National Hurricane Center (NHC) issues forecasts on tropical weather systems (for example, hurricanes).

**(e)** The Space Weather Prediction Center (SWPC) provides alerts, watches, warnings and forecasts for space weather events (for example, solar storms) affecting or expected to affect Earth's environment.

**(f)** The Weather Prediction Center (WPC) provides analysis and forecast products on a national scale including surface pressure and frontal analyses.

**6.** NOAA operates two Volcanic Ash Advisory Centers (VAAC) which issue forecasts of ash clouds following a volcanic eruption in their area of responsibility.

**7.** Details on the products provided by the above listed offices and centers is available in FAA Advisory Circular 00-45, Aviation Weather Services.

**d.** Weather element values may be expressed by using different measurement systems depending on several factors, such as whether the weather products will be used by the general public, aviation interests, international services, or a combination of these

users. FIG 7-1-1 provides conversion tables for the most used weather elements that will be encountered by pilots.

### 7-1-2. FAA Weather Services

**a.** The FAA provides the Flight Service program, which serves the weather needs of pilots through its flight service stations (FSS) (both government and contract via 1-800-WX-BRIEF) and via the Internet, through Leidos Flight Service.

**b.** The FAA maintains an extensive surface weather observing program. Airport observations (METAR and SPECI) in the U.S. are provided by automated observing systems. Various levels of human oversight of the METAR and SPECI reports and augmentation may be provided at select larger airports by either government or contract personnel qualified to report specified weather elements that cannot be detected by the automated observing system.

#### **c. Other Sources of Weather Information**

**1.** Weather and aeronautical information are 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.

**2.** Pilots can access Leidos Flight Services via the Internet. Pilots can receive preflight weather data and file domestic VFR and IFR flight plans. The following is the FAA contract vendor:

Leidos Flight Service  
Internet Access: <http://www.1800wxbrief.com>  
For customer service: 1-800-WXBRIEF

### 7-1-3. Use of Aviation Weather Products

**a.** Air carriers and operators certificated under the provisions of 14 CFR Part 119 are required to use the

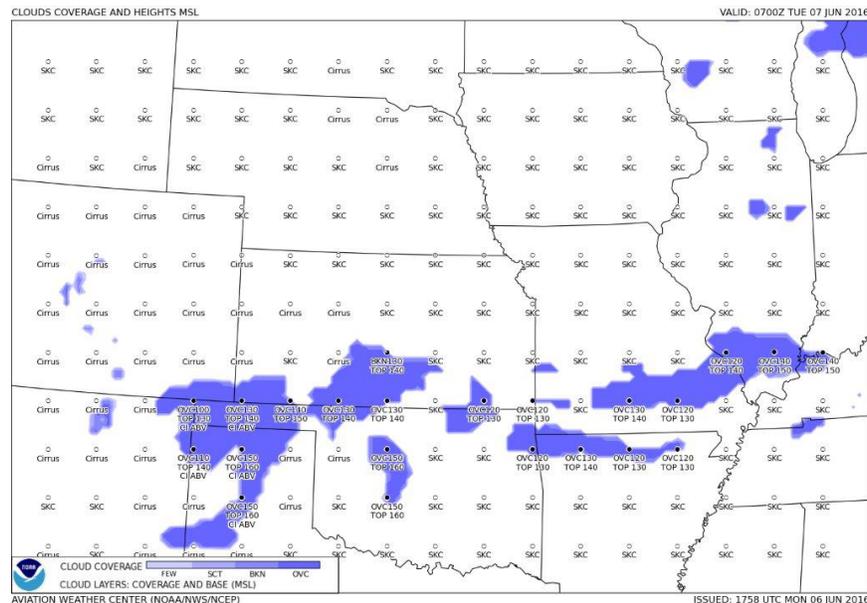
aeronautical weather information systems defined in the Operations Specifications issued to that certificate holder by the FAA. These systems may utilize basic FAA/National Weather Service (NWS) weather services, contractor- or operator-proprietary weather services and/or Enhanced Weather Information 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.

**b.** Operators not certificated under the provisions of 14 CFR Part 119 are encouraged to use FAA/NWS products through Flight Service Stations, Leidos Flight Service, and/or Flight Information Services-Broadcast (FIS-B).

**c.** 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 various weather research laboratories and corporations under contract to the Government, develop and implement new aviation weather product types. The FAA's NextGen Aviation Weather Research Program (AWRP) facilitates collaboration between the NWS, the FAA, and various industry and research representatives. This collaboration ensures that user needs and technical readiness requirements are met before experimental products mature to operational application.

**d.** The AWRP manages the transfer of aviation weather R&D to operational use through technical review panels and conducting safety assessments to ensure that newly developed aviation weather products meet regulatory requirements and enhance safety.

FIG 7-1-3  
Aviation Cloud Forecast



### 7-1-5. Preflight Briefing

a. Flight Service Stations (FSS) are the primary sources for obtaining preflight briefings and to file flight plans by phone or the Internet. Flight Service Specialists are qualified and certified as Pilot Weather Briefers by the FAA. They are not authorized to make original forecasts, but are authorized to translate and interpret available forecasts and reports directly into terms describing the weather conditions which can be expected along the flight route and at the destination. Three basic types of preflight briefings (Standard, Abbreviated, and Outlook) are available to serve the pilot's specific needs. Pilots should specify to the briefer the type of briefing they want, along with their appropriate background information. This will enable the briefer to tailor the information to the pilot's intended flight. The following paragraphs describe the types of briefings available and the information provided in each briefing.

#### REFERENCE-

- AIM, Para 5-1-1, Preflight Preparation, for items that are required.

b. **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. 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.

**1. Adverse Conditions.** Significant meteorological and/or aeronautical information that might influence the pilot to alter or cancel the proposed flight; for example, hazardous weather conditions, airport closures, air traffic delays, etc. Pilots should be especially alert for current or forecast weather that could reduce flight minimums below VFR or IFR conditions. Pilots should also be alert for any reported or forecast icing if the aircraft is not certified for operating in icing conditions. Flying into areas of icing or weather below minimums could have disastrous results.

**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 VFR doubtful, the briefer will describe the conditions, describe the 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. Upon receiving a “VFR flight not recommended” statement, the non-IFR rated pilot will need to make a “go or no go” decision. This decision should be based on weighing the current and forecast weather conditions against the pilot’s experience and ratings. The aircraft’s equipment, capabilities and limitations should also be considered.

**NOTE–**

*Pilots flying into areas of minimal VFR weather could encounter unforecasted lowering conditions that place the aircraft outside the pilot’s ratings and experience level. This could result in spatial disorientation and/or loss of control of the aircraft.*

**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–**

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

**4. Current Conditions.** Reported weather conditions applicable to the flight will be summarized from all available sources; e.g., METARs/ SPECIS, PIREPs, RAREPs. This element will be omitted if the proposed time of departure is beyond 2 hours, unless the information is specifically requested by the pilot.

**5. En Route Forecast.** Forecast en route conditions for the proposed route are summarized in logical order; i.e., departure/climbout, en route, and descent. (Heights are MSL, unless the contractions “AGL” or “CIG” are denoted indicating that heights are above ground.)

**6. Destination Forecast.** The destination forecast for the planned ETA. Any significant changes within 1 hour before and after the planned arrival are included.

**7. Winds Aloft.** Forecast winds aloft 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. (Heights are MSL.) Temperature information will be provided on request.

**8. Notices to Airmen (NOTAMs).**

(a) Available NOTAM (D) information pertinent to the proposed flight, including special use airspace (SUA) NOTAMs for restricted areas, aerial refueling, and night vision goggles (NVG).

**NOTE–**

*Other SUA NOTAMs (D), such as military operations area (MOA), military training route (MTR), and warning area NOTAMs, are considered “upon request” briefing items as indicated in paragraph 7–1–4b10(a).*

(b) Prohibited Areas P–40, P–49, P–56, and the special flight rules area (SFRA) for Washington, DC.

(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–**

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

**2.** *Airway NOTAMs, procedural NOTAMs, and NOTAMs that are general in nature and not tied to a specific airport/facility (for example, flight advisories and restrictions, open duration special security instructions, and special flight rules areas) are briefed solely by pilot request. For complete flight information, pilots are urged to review the Domestic Notices and International Notices found in the External Links section of the Federal NOTAM System (FNS) NOTAM Search System and the Chart Supplement U.S. In addition to obtaining a briefing.*

**9. ATC Delays.** Any known ATC delays and flow control advisories which might affect the proposed flight.

**10. Pilots may obtain the following from flight service station briefers upon request:**

(a) Information on SUA and SUA-related airspace, except those listed in paragraph 7–1–4b8.

**NOTE–**

**1.** *For the purpose of this paragraph, SUA and related airspace includes the following types of airspace: alert area, military operations area (MOA), warning area, and air traffic control assigned airspace (ATCAA). MTR data includes the following types of airspace: IFR training routes (IR), VFR training routes (VR), and slow training routes (SR).*

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

b. 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–**

1. *LIFR CIG–low IFR due to low ceiling.*
2. *IFR FG–IFR due to visibility restricted by fog.*
3. *MVFR CIG HZ FU–marginal VFR due to both ceiling and visibility restricted by haze and smoke.*
4. *IFR CIG RA WIND–IFR due to both low ceiling and visibility restricted by rain; wind expected to be 25 knots or greater.*

### **7–1–8. Inflight Weather Advisory Broadcasts**

a. ARTCCs broadcast a Severe Weather Forecast Alert (AWW), Convective SIGMET, SIGMET, AIRMET, Urgent Pilot Report, 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 advise

pilots of the availability of hazardous weather advisories and to contact the nearest Flight Service facility for additional details.

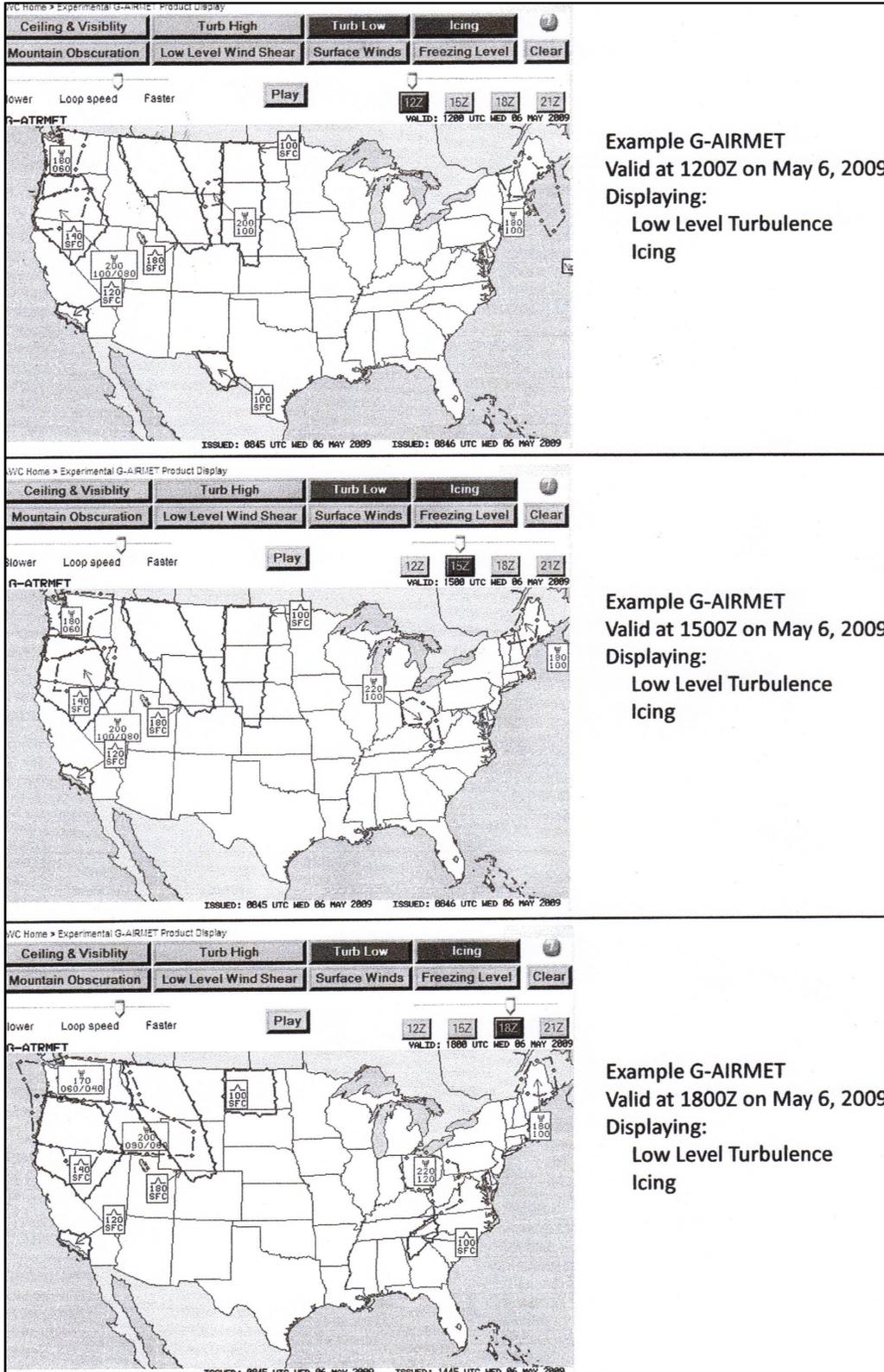
**EXAMPLE–**

1. *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.*
2. *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.*
3. *Attention all aircraft, Kansas City Center weather advisory one zero three. Numerous reports of moderate to severe icing from eight to nine 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.*

FIG 7-1-6  
G-AIRMET Graphical Product



## 7-1-9. Flight Information Services (FIS)

FIS is a method of disseminating meteorological (MET) and aeronautical information (AI) to displays in the cockpit in order to enhance pilot situational awareness, provide decision support tools, and improve safety. FIS augments traditional pilot voice communication with 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 preflight briefings or inflight voice communications. FIS, however, can provide textual and graphical information that can help abbreviate and improve the usefulness of such communications. FIS enhances pilot situational awareness and improves safety.

**a. Data link Service Providers (DSPs).** DSPs deploy and maintain airborne, ground-based, and, in some cases, space-based infrastructure that supports the transmission of AI/MET information over one or more physical links. A DSP may provide a free of charge or a for-fee service that permits end users to uplink and downlink AI/MET and other information. The following are examples of DSPs:

**1. FAA FIS-B.** A ground-based broadcast service provided through the ADS-B Universal Access Transceiver (UAT) network. The service provides users with a 978 MHz data link capability when operating within range and line-of-sight of a transmitting ground station. FIS-B enables users of properly equipped aircraft to receive and display a suite of broadcast weather and aeronautical information products.

**2. Non-FAA FIS Systems.** Several commercial vendors provide customers with FIS data over both the aeronautical spectrum and on other frequencies using a variety of data link protocols. Services available from these providers vary greatly and may include tier based subscriptions. Advancements in bandwidth technology permits preflight as well as inflight access to the same MET and AI information available on the ground. Pilots and operators using non-FAA FIS for MET and AI information should be knowledgeable regarding the weather services being provided as some commercial vendors may be repackaging NWS sourced weather, while other commercial vendors may alter the weather information to produce vendor-tailored or vendor-specific weather reports and forecasts.

**b. Three Data Link Modes.** There are three data link modes that may be used for transmitting AI and MET information to aircraft. The intended use of the AI and/or MET information will determine the most appropriate data link service.

**1. Broadcast Mode:** A one-way interaction in which AI and/or MET updates or changes applicable to a designated geographic area are continuously transmitted (or transmitted at repeated periodic intervals) to all aircraft capable of receiving the broadcast within the service volume defined by the system network architecture.

**2. Contract/Demand Mode:** A two-way interaction in which AI and/or MET information is transmitted to an aircraft in response to a specific request.

**3. Contract/Update Mode:** A two-way interaction that is an extension of the Demand Mode. Initial AI and/or MET report(s) are sent to an aircraft and subsequent updates or changes to the AI and/or MET information that meet the contract criteria are automatically or manually sent to an aircraft.

**c. 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.

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

**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.

2. FIS should not serve as the sole source of aviation weather and other operational information. ATC, FSSs, 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.

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.

4. FIS aviation weather products (for example, graphical ground-based radar precipitation depictions) are not appropriate for tactical (typical timeframe of less than 3 minutes) avoidance of severe weather such as negotiating a path through a weather hazard area. FIS supports strategic (typical timeframe of 20 minutes or more) 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 preflight weather and flight planning briefing.

5. DSPs offer numerous MET and AI products with information that can be layered on top of each other. Pilots need to be aware that too much information can have a negative effect on their cognitive work load. Pilots need to manage the amount of information to a level that offers the most pertinent information to that specific flight without creating a cockpit distraction. Pilots may need to adjust the amount of information based on numerous

factors including, but not limited to, the phase of flight, single pilot operation, autopilot availability, class of airspace, and the weather conditions encountered.

6. 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. 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, data from other air traffic control facilities, airline operation control centers, pilot reports, as well as their own observations.

e. FAA's Flight Information Service–Broadcast (FIS–B).

1. FIS–B is a ground-based broadcast service provided through the FAA's Automatic Dependent Surveillance–Broadcast (ADS–B) Services Universal Access Transceiver (UAT) network. The service provides users with a 978 MHz data link capability when operating within range and line-of-sight of a transmitting ground station. FIS–B enables users of properly-equipped aircraft to receive and display a suite of broadcast weather and aeronautical information products.

2. TBL 7–1–1 lists the text and graphical products available through FIS–B and provided free-of-charge. Detailed information concerning FIS–B meteorological products can be found in Advisory Circular 00–45, Aviation Weather Services, and AC 00–63, Use of Cockpit Displays of Digital Weather and Aeronautical Information. Information on Special Use Airspace (SUA), Temporary Flight Restriction (TFR), and Notice to Airmen (NOTAM) products can be found in Chapters 3, 4 and 5 of this manual.

3. Users of FIS–B should familiarize themselves with the operational characteristics and limitations of the system, including: system architec-

**NOTE–**

1. Details concerning the content, format, and symbols of the various data link products provided should be obtained from the specific avionics manufacturer.

2. NOTAM–D and NOTAM–FDC products broadcast via FIS–B are limited to those issued or effective within the past 30 days.

**TBL 7-1-2  
Product Parameters for Low/Medium/High Altitude Tier Radios**

Product	Surface Radios	Low Altitude Tier	Medium Altitude Tier	High Altitude Tier
CONUS NEXRAD	N/A	CONUS NEXRAD not provided	CONUS NEXRAD imagery	CONUS NEXRAD imagery
Winds & Temps Aloft	500 NM look-ahead range	500 NM look-ahead range	750 NM look-ahead range	1,000 NM look-ahead range
METAR	100 NM look-ahead range	250 NM look-ahead range	375 NM look-ahead range	CONUS: CONUS Class B & C airport METARs and 500 NM look-ahead range  Outside of CONUS: 500 NM look-ahead range
TAF	100 NM look-ahead range	250 NM look-ahead range	375 NM look-ahead range	CONUS: CONUS Class B & C airport TAFs and 500 NM look-ahead range  Outside of CONUS: 500 NM look-ahead range
AIRMET, SIGMET, PIREP, and SUA/SAA	100 NM look-ahead range. PIREP/SUA/SAA is N/A.	250 NM look-ahead range	375 NM look-ahead range	500 NM look-ahead range
Regional NEXRAD	150 NM look-ahead range	150 NM look-ahead range	200 NM look-ahead range	250 NM look-ahead range
NOTAMs D, FDC, and TFR	100 NM look-ahead range	100 NM look-ahead range	100 NM look-ahead range	100 NM look-ahead range

**7-1-10. Weather Observing Programs**

a. **Manual Observations.** With only a few exceptions, these reports are from airport locations staffed by FAA personnel who manually observe, perform calculations, and enter these observations into the (WMSCR) communication system. The format and coding of these observations are contained in Paragraph 7-1-28, Key to Aviation Routine Weather Report (METAR) and Aerodrome Forecasts (TAF).

b. **Automated Weather Observing System (AWOS).**

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 AIM, Para 7-2-3, Altimeter Errors.

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 7 miles. These sites, along with the hours of augmentation, are to be published in the Chart Supplement U.S. 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.

**3.** These real-time systems are operationally classified into nine basic levels:

(a) **AWOS–A** only reports altimeter setting;

**NOTE–**

*Any other information is advisory only.*

(b) **AWOS–AV** reports altimeter and visibility;

**NOTE–**

*Any other information is advisory only.*

(c) **AWOS–I** usually reports altimeter setting, wind data, temperature, dew point, and density altitude;

(d) **AWOS–2** provides the information provided by AWOS–1 plus visibility; and

(e) **AWOS–3** provides the information provided by AWOS–2 plus cloud/ceiling data.

(f) **AWOS–3P** provides reports the same as the AWOS 3 system, plus a precipitation identification sensor.

(g) **AWOS–3PT** reports the same as the AWOS 3P System, plus thunderstorm/lightning reporting capability.

(h) **AWOS–3T** reports the same as AWOS 3 system and includes a thunderstorm/lightning reporting capability.

(i) **AWOS–4** reports the same as the AWOS 3 system, plus precipitation occurrence, type and accumulation, freezing rain, thunderstorm, and runway surface sensors.

**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 subparagraph c. 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.

**5.** AWOS information (system level, frequency, phone number, etc.) concerning specific locations is published, as the systems become operational, in the Chart Supplement U.S., and where applicable, on published Instrument Approach Procedures. Selected individual systems may be incorporated into nationwide data collection and dissemination networks in the future.

**c. 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.

**1. Location and Time.** The location/name and the phrase “AUTOMATED WEATHER OBSERVATION,” followed by the time are announced.

(a) If the airport’s specific location is included in the airport’s name, the airport’s name is announced.

(g) Anemometer (wind direction and speed sensor).

(h) Rainfall accumulation sensor.

(i) Automated Lightning Detection and Reporting System (ALDARS) (excluding Alaska and Pacific Island sites).

**3. The ASOS/AWOS data outlets include:**

(a) Those necessary for on-site airport users.

(b) National communications networks.

(c) 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.*

**4.** An ASOS/AWOS report without human intervention will contain only that weather data

capable of being reported automatically. The modifier for this METAR report is “AUTO.” When an observer augments or backs-up an ASOS/AWOS site, the “AUTO” modifier disappears.

**5.** 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. As appropriate, “AO1” and “AO2” must appear in remarks. (A precipitation discriminator can determine the difference between liquid and frozen/freezing precipitation).

**NOTE—**

*To decode an ASOS/AWOS report, refer to FIG 7-1-7 and FIG 7-1-8.*

**REFERENCE—**

*A complete explanation of METAR terminology is located in AIM, Para 7-1-28, Key to Aerodrome Forecast (TAF) and Aviation Routine Weather Report (METAR).* ■

FIG 7-1-7

Key to Decode an ASOS/AWOS (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 \$

<b>TYPE OF REPORT</b>	METAR: hourly (scheduled report); SPECI: special (unscheduled) report.	METAR
<b>STATION IDENTIFIER</b>	Four alphabetic characters; ICAO location identifiers.	KABC
<b>DATE/TIME</b>	All dates and times in UTC using a 24-hour clock; two-digit date and four-digit time; always appended with <u>Z</u> to indicate UTC.	121755Z
<b>REPORT MODIFIER</b>	Fully automated report, no human intervention; removed when observer signed-on.	AUTO
<b>WIND DIRECTION AND SPEED</b>	Direction in tens of degrees from true north (first three digits); next two digits: speed in whole knots; as needed <u>G</u> usts (character) followed by maximum observed speed; always appended with <u>K</u> T to indicate knots; 0000KT for calm; if direction varies by 60° or more a <u>V</u> ariable wind direction group is reported.	21016G24KT 108V240
<b>VISIBILITY</b>	Prevailing visibility in statute miles and fractions (space between whole miles and fractions); always appended with <u>S</u> M to indicate statute miles.	1SM
<b>RUNWAY VISUAL RANGE</b>	10-minute RVR value in hundreds of feet; reported if prevailing visibility is ≤ one mile or RVR ≤ 6000 feet; always appended with <u>FT</u> to indicate feet; value prefixed with <u>M</u> or <u>P</u> to indicate value is lower or higher than the reportable RVR value.	R11/P6000FT
<b>WEATHER PHENOMENA</b>	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
<b>SKY CONDITION</b>	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 ( <u>VV</u> ) followed by height for indefinite ceiling.	BKN015 OVC025
<b>TEMPERATURE/DEW POINT</b>	Each is reported in whole degrees Celsius using two digits; values are separated by a solidus; sub-zero values are prefixed with an <u>M</u> (minus).	06/04
<b>ALTIMETER</b>	Altimeter always prefixed with an <u>A</u> indicating inches of mercury; reported using four digits: tens, units, tenths, and hundredths.	A2990

TBL 7-1-4

<b>SERVICE LEVEL A</b>	
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
<b>SERVICE LEVEL B</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
<b>SERVICE LEVEL C</b>	
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
<b>SERVICE LEVEL D</b>	
This level of service consists of an ASOS or AWOS continually measuring the atmosphere at a point near the runway. The ASOS or AWOS senses and measures the weather parameters listed to the right.	Wind Visibility Precipitation/Obstruction to vision Cloud height Sky cover Temperature Dew point Altimeter

### 7-1-11. Weather Radar Services

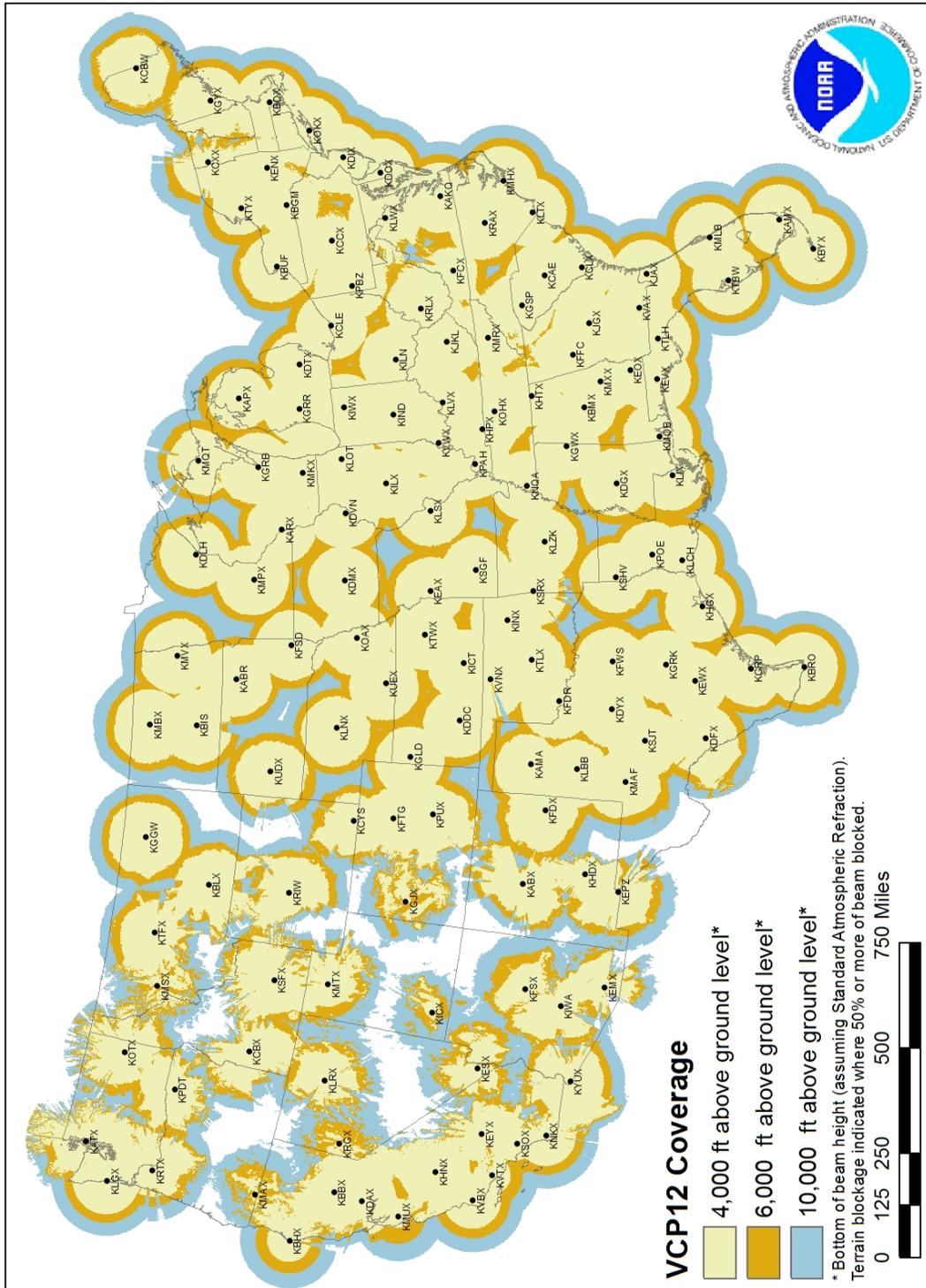
a. The National Weather Service operates a network of radar sites for detecting coverage, intensity, and movement of precipitation. The network is supplemented by FAA and DOD radar sites in the western sections of the country. Local warning radar sites augment the network by operating on an as needed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

b. 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 are also collected by the National Center for Environmental Prediction and used to prepare national radar summary charts for dissemination on facsimile circuits.

c. 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.

FIG 7-1-9  
NEXRAD Coverage



**d.** All En Route Flight Advisory Service facilities and FSSs 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 ARTCCs also have access to weather radar displays and provide support to all air traffic facilities within their center's area.

**e.** Additional information on weather radar products and services can be found in AC 00-45, Aviation Weather Services.

**REFERENCE-**

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

*AIM, Para 7-1-26, Thunderstorms.*

*Chart Supplement U.S., Charts, NWS Upper Air Observing Stations and Weather Network for the location of specific radar sites.*

## **7-1-12. ATC Inflight Weather Avoidance Assistance**

### **a. ATC Radar Weather Display.**

**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."

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

- (a) "LIGHT" (< 26 dBZ)
- (b) "MODERATE" (26 to 40 dBZ)
- (c) "HEAVY" (> 40 to 50 dBZ)
- (d) "EXTREME" (> 50 dBZ)

**NOTE-**

*En route ATC radar's Weather and Radar Processor (WARP) does not display light precipitation intensity.*

**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."

**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.

**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.

### **b. Weather Avoidance Assistance.**

**1.** To the extent possible, controllers will issue pertinent information on weather or chaff areas and assist pilots in avoiding such areas when 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:

(a) Request to deviate off course by stating a heading or degrees, direction of deviation, and approximate number of miles. In this case, when the requested deviation is approved, navigation is at the pilot's prerogative, but must maintain the altitude assigned, and remain within the lateral restrictions issued by ATC.

(b) An approval for lateral deviation authorizes the pilot to maneuver left or right within the limits specified in the clearance.

**NOTE—**

1. It is often necessary for ATC to restrict the amount of lateral deviation (“twenty degrees right,” “up to fifteen degrees left,” “up to ten degrees left or right of course”).

2. The term “when able, proceed direct,” in an ATC weather deviation clearance, refers to the pilot’s ability to remain clear of the weather when returning to course/route.

(c) Request a new route to avoid the affected area.

(d) Request a change of altitude.

(e) Request radar vectors around the affected areas.

2. For obvious reasons of safety, an IFR pilot must not deviate from the course or altitude or 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.

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.

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’s 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 a factor in limiting the controller’s capability to provide additional service.

5. It is very important, therefore, 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:

(a) Proposed point where detour will commence.

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

(c) Point where original route will be resumed.

(d) Flight conditions (IFR or VFR).

(e) Any further deviation that may become necessary as the flight progresses.

(f) Advise if the aircraft is equipped with functioning airborne radar.

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 also receive widespread teletypewriter dissemination.

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, offer greater freedom of action. In terminal areas, the problem is more acute because of traffic density, ATC coordination requirements, complex departure and arrival routes, adjacent airports, etc. 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 routing 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.

### 7-1-13. Runway Visual Range (RVR)

There are currently two configurations of RVR in the NAS commonly identified as Taskers and New Generation RVR. The Taskers are the existing configuration which uses transmissometer

technology. The New Generation RVRs were deployed in November 1994 and use forward scatter technology. The New Generation RVRs are currently being deployed in the NAS to replace the existing Taskers.

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

1. Transmissometer projector and related items.
2. Transmissometer receiver (detector) and related items.
3. Analog
4. recorder.
5. Signal data converter and related items.
6. Remote digital or remote display programmer.

**b.** 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.

**c.** 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.

**d.** 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.

**e.** RVR values for Category IIIa operations extend down to 700 feet 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.

**f.** Approach categories with the corresponding minimum RVR values. (See TBL 7-1-5.)

*TBL 7-1-5*  
**Approach Category/Minimum RVR Table**

Category	Visibility (RVR)
Nonprecision	2,400 feet
Category I	1,800 feet*
Category II	1,000 feet
Category IIIa	700 feet
Category IIIb	150 feet
Category IIIc	0 feet

\* 1,400 feet with special equipment and authorization

**g.** 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 one 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.

**h.** Details on the requirements for the operational use of RVR are contained in FAA AC 97-1, Runway Visual Range (RVR). Pilots are responsible for compliance with minimums prescribed for their class of operations in the appropriate CFRs and/or operations specifications.

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

1. Forward scatter meter with a transmitter, receiver and associated items.
2. A runway light intensity monitor (RLIM).
3. An ambient light sensor (ALS).
4. A data processor unit (DPU).
5. Controller display (CD).

**j.** 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.

**k.** 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.

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

1. 100–foot increments for products below 800 feet.
2. 200–foot increments for products between 800 feet and 3,000 feet.
3. 500–foot increments for products between 3,000 feet and 6,500 feet.
4. 25–meter increments for products below 150 meters.
5. 50–meter increments for products between 150 meters and 800 meters.
6. 100–meter increments for products between 800 meters and 1,200 meters.
7. 200–meter increments for products between 1,200 meters and 2,000 meters.

#### 7–1–14. Reporting of Cloud Heights

**a.** Ceiling, by definition in the CFRs 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 “obscuration,” e.g., an aerodrome forecast (TAF) which reads “BKN030” refers to height above ground level. An area forecast which reads “BKN030” indicates that the height is above mean sea level.

##### REFERENCE–

*AIM, Paragraph 7–1–28, Key to Aerodrome Forecast (TAF) and Aviation Routine Weather Report (METAR), defines “broken,” “overcast,” and “obscuration.”*

**b.** Pilots usually report height values above MSL, since they determine heights by the altimeter. This is taken in account when disseminating and otherwise applying information received from pilots. (“Ceiling” heights are always above ground level.) In reports disseminated as PIREPs, height references are given the same as received from pilots, that is, above MSL.

**c.** 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 MSL, it is so indicated by the contraction “MSL” or “ASL” following the height value. The heights of clouds tops, freezing level, icing, and turbulence are always given in heights above ASL or MSL.

#### 7–1–15. Reporting Prevailing Visibility

**a.** Surface (horizontal) visibility is reported in METAR reports in terms of statute miles and increments thereof; e.g.,  $\frac{1}{16}$ ,  $\frac{1}{8}$ ,  $\frac{3}{16}$ ,  $\frac{1}{4}$ ,  $\frac{5}{16}$ ,  $\frac{3}{8}$ ,  $\frac{1}{2}$ ,  $\frac{5}{8}$ ,  $\frac{3}{4}$ ,  $\frac{7}{8}$ , 1,  $1\frac{1}{8}$ , etc. (Visibility reported by an unaugmented automated site is reported differently than in a manual report, i.e., ASOS/AWOS: 0,  $\frac{1}{16}$ ,  $\frac{1}{8}$ ,  $\frac{1}{4}$ ,  $\frac{3}{8}$ ,  $\frac{1}{2}$ ,  $1\frac{1}{4}$ ,  $1\frac{1}{2}$ ,  $1\frac{3}{4}$ , 2,  $2\frac{1}{2}$ , 3, 4, 5, etc., AWOS:  $M\frac{1}{4}$ ,  $\frac{1}{4}$ ,  $\frac{1}{2}$ ,  $\frac{3}{4}$ , 1,  $1\frac{1}{4}$ ,  $1\frac{1}{2}$ ,  $1\frac{3}{4}$ , 2,  $2\frac{1}{2}$ , 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.

**b.** Prevailing visibility is the greatest visibility equaled or exceeded throughout at least one half of 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.

**c.** 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.

#### 7–1–16. Estimating Intensity of Rain and Ice Pellets

##### a. Rain

**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.

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

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

**b. Ice Pellets**

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

**2. Moderate.** Slow accumulation on ground. Visibility reduced by ice pellets to less than 7 statute miles.

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

**7-1-17. Estimating Intensity of Snow or Drizzle (Based on Visibility)**

**a. Light.** Visibility more than  $\frac{1}{2}$  statute mile.

**b. Moderate.** Visibility from more than  $\frac{1}{4}$  statute mile to  $\frac{1}{2}$  statute mile.

**c. Heavy.** Visibility  $\frac{1}{4}$  statute mile or less.

**7-1-18. Pilot Weather Reports (PIREPs)**

**a.** 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 light degree or greater; turbulence of moderate degree or greater; wind shear and reported or forecast volcanic ash clouds.

**b.** 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 such as haze, smoke and dust; wind at altitude; and temperature aloft.

**c.** PIREPs should be given to the ground facility with which communications are established; i.e.,

FSS, ARTCC, or terminal ATC. One of the primary duties of the Inflight position is to serve as a collection point for the exchange of PIREPs with en route aircraft.

**d.** If pilots are not able to make PIREPs by radio, reporting upon landing of the inflight conditions encountered to the nearest FSS or Weather Forecast Office will be helpful. Some of the uses made of the reports are:

**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.

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

**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.

**4.** The NWS uses the reports to verify or amend conditions contained in aviation forecast and advisories. In some cases, pilot reports of hazardous conditions are the triggering mechanism for the issuance of advisories. They also use the reports for pilot weather briefings.

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

**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.

**e.** The FAA, NWS, and other organizations that enter PIREPs into the weather reporting system use the format listed in TBL 7-1-6. 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. Completed PIREPs will be transmitted to weather circuits as in the following examples:

**EXAMPLE-**

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

**NOTE-**

1. *One zero miles southwest of Appleton VOR; time 1516 UTC; altitude eight thousand five hundred; aircraft type BE200; bases 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-**

2. *KCRW UV /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*

**NOTE-**

2. *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.*

f. For more detailed information on PIREPS, users can refer to the current version of AC 00-45, Aviation Weather Services.

**TBL 7-1-6  
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 AIM paragraph 7-1-21
12.	Icing	/IC	See AIM paragraph 7-1-19
13.	Remarks	/RM	For reporting elements not included or to clarify previously reported items

**7-1-19. PIREPs Relating to Airframe Icing**

a. The effects of ice on aircraft are cumulative-thrust is reduced, drag increases, lift lessens, and 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 increases the frictional drag by an equal percentage.

b. 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; 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 icing to ATC, 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. The following describes how to report icing conditions.

1. **Trace.** Ice becomes noticeable. The rate of accumulation is slightly greater than the rate of

sublimation. A representative accretion rate for reference purposes is less than ¼ inch (6 mm) per hour on the outer wing. The pilot should consider exiting the icing conditions before they become worse.

**2. Light.** The rate of ice accumulation requires occasional cycling of manual deicing systems to minimize ice accretions on the airframe. A representative accretion rate for reference purposes is ¼ inch to 1 inch (0.6 to 2.5 cm) per hour on the unprotected part of the outer wing. The pilot should consider exiting the icing condition.

**3. Moderate.** The rate of ice accumulation requires frequent cycling of manual deicing systems to minimize ice accretions on the airframe. A representative accretion rate for reference purposes is 1 to 3 inches (2.5 to 7.5 cm) per hour on the unprotected part of the outer wing. The pilot should consider exiting the icing condition as soon as possible.

**4. Severe.** The rate of ice accumulation is such that ice protection systems fail to remove the accumulation of ice and ice accumulates in locations not normally prone to icing, such as areas aft of protected surfaces and any other areas identified by the manufacturer. A representative accretion rate for

reference purposes is more than 3 inches (7.5 cm) per hour on the unprotected part of the outer wing. By regulation, immediate exit is required.

**NOTE–**

*Severe icing is aircraft dependent, as are the other categories of icing intensity. Severe icing may occur at any ice accumulation rate when the icing rate or ice accumulations exceed the tolerance of the aircraft.*

**EXAMPLE–**

*Pilot report: give aircraft identification, location, time (UTC), intensity of type, altitude/FL, aircraft type, indicated air speed (IAS), and outside air temperature (OAT).*

**NOTE–**

- 1. Rime ice.** *Rough, milky, opaque ice formed by the instantaneous freezing of small supercooled water droplets.*
- 2. Clear ice.** *A glossy, clear, or translucent ice formed by the relatively slow freezing of large supercooled water droplets.*
- 3.** *The OAT should be requested by the FSS or ATC if not included in the PIREP.*

## **7–1–20. Definitions of Inflight Icing Terms**

See TBL 7–1–7, Icing Types, and TBL 7–1–8, Icing Conditions.

*TBL 7-1-7*  
**Icing Types**

<b>Clear Ice</b>	See Glaze Ice.
<b>Glaze Ice</b>	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.
<b>Intercycle Ice</b>	Ice which accumulates on a protected surface between actuation cycles of a deicing system.
<b>Known or Observed or Detected Ice Accretion</b>	Actual ice observed visually to be on the aircraft by the flight crew or identified by on-board sensors.
<b>Mixed Ice</b>	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.
<b>Residual Ice</b>	Ice which remains on a protected surface immediately after the actuation of a deicing system.
<b>Rime Ice</b>	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.
<b>Runback Ice</b>	Ice which forms from the freezing or refreezing of water leaving protected surfaces and running back to unprotected surfaces.
<i>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 AIM for use in the “Remarks” section of the PIREP and for use in forecasting.</i>	

*TBL 7-1-8*  
**Icing Conditions**

<b>Appendix C Icing Conditions</b>	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.
<b>Forecast Icing Conditions</b>	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.
<b>Freezing Drizzle (FZDZ)</b>	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.
<b>Freezing Precipitation</b>	Freezing precipitation is freezing rain or freezing drizzle falling through or outside of visible cloud.
<b>Freezing Rain (FZRA)</b>	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.
<b>Icing in Cloud</b>	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.
<b>Icing in Precipitation</b>	Icing occurring from an encounter with freezing precipitation, that is, supercooled drops with diameters exceeding 0.05 mm, within or outside of visible cloud.
<b>Known Icing Conditions</b>	Atmospheric conditions in which the formation of ice is observed or detected in flight. <i>Note—</i> <i>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.</i>
<b>Potential Icing Conditions</b>	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.
<b>Supercooled Drizzle Drops (SCDD)</b>	Synonymous with freezing drizzle aloft.
<b>Supercooled Drops or /Droplets</b>	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.
<b>Supercooled Large Drops (SLD)</b>	Liquid droplets with diameters greater than 0.05 mm at temperatures less than 0°C, i.e., freezing rain or freezing drizzle.

**7-1-21. PIREPs Relating to Turbulence**

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

1. Aircraft location.
2. Time of occurrence in UTC.
3. Turbulence intensity.
4. Whether the turbulence occurred in or near clouds.

5. Aircraft altitude or flight level.

6. Type of aircraft.

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.*

b. Duration and classification of intensity should be made using TBL 7-1-9.

*TBL 7-1-9*

**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 <b>Light Turbulence</b> ; <sup>1</sup> or Turbulence that causes slight, rapid and somewhat rhythmic bumpiness without appreciable changes in altitude or attitude. Report as <b>Light Chop</b> .	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 <b>Moderate Turbulence</b> ; <sup>1</sup> 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 <b>Moderate Chop</b> . <sup>1</sup>	Occupants feel definite strains against seat belts or shoulder straps. Unsecured objects are dislodged. Food service and walking are difficult.	<p style="text-align: center;"><b>NOTE</b></p> <p>1. Pilots should report location(s), time (UTC), intensity, whether in or near clouds, altitude, type of aircraft and, when applicable, duration of turbulence.</p> <p>2. Duration may be based on time between two locations or over a single location. All locations should be readily identifiable.</p>
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 <b>Severe Turbulence</b> . <sup>1</sup>	Occupants are forced violently against seat belts or shoulder straps. Unsecured objects are tossed about. Food Service and walking are impossible.	
Extreme	Turbulence in which the aircraft is violently tossed about and is practically impossible to control. It may cause structural damage. Report as <b>Extreme Turbulence</b> . <sup>1</sup>		<p style="text-align: center;"><b>EXAMPLES:</b></p> <p>a. Over Omaha, 1232Z, Moderate Turbulence, in cloud, Flight Level 310, B707.</p> <p>b. From 50 miles south of Albuquerque to 30 miles north of Phoenix, 1210Z to 1250Z, occasional Moderate Chop, Flight Level 330, DC8.</p>
<p><sup>1</sup> High level turbulence (normally above 15,000 feet ASL) not associated with cumuliform cloudiness, including thunderstorms, should be reported as CAT (clear air turbulence) preceded by the appropriate intensity, or light or moderate chop.</p>			

## 7-1-22. Wind Shear PIREPs

a. 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.

b. When describing conditions, 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 or gain of airspeed and the altitudes 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.*

1. 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.

### EXAMPLE-

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

2. Pilots using Inertial Navigation Systems (INSs) should report the wind and altitude both above and below the shear level.

## c. Wind Shear Escape

1. Pilots should report to ATC when they are performing a wind shear escape maneuver. This report should be made as soon as practicable, but not until aircraft safety and control is assured, which may not be satisfied until the aircraft is clear of the wind shear or microburst. ATC should provide safety alerts and traffic advisories, as appropriate.

### EXAMPLE-

*“Denver Tower, United 1154, wind shear escape.”*

2. Once the pilot initiates a wind shear escape maneuver, ATC is not responsible for providing approved separation between the aircraft and any other aircraft, airspace, terrain, or obstacle until the

pilot reports that the escape procedure is complete and approved separation has been re-established. Pilots should advise ATC that they are resuming the previously assigned clearance or should request an alternate clearance.

### EXAMPLE-

*“Denver Tower, United 1154, wind shear escape complete, resuming last assigned heading/(name) DP/clearance.”*

or

*“Denver Tower, United 1154, wind shear escape complete, request further instructions.”*

## 7-1-23. Clear Air Turbulence (CAT) PIREPs

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 reporting 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.

### REFERENCE-

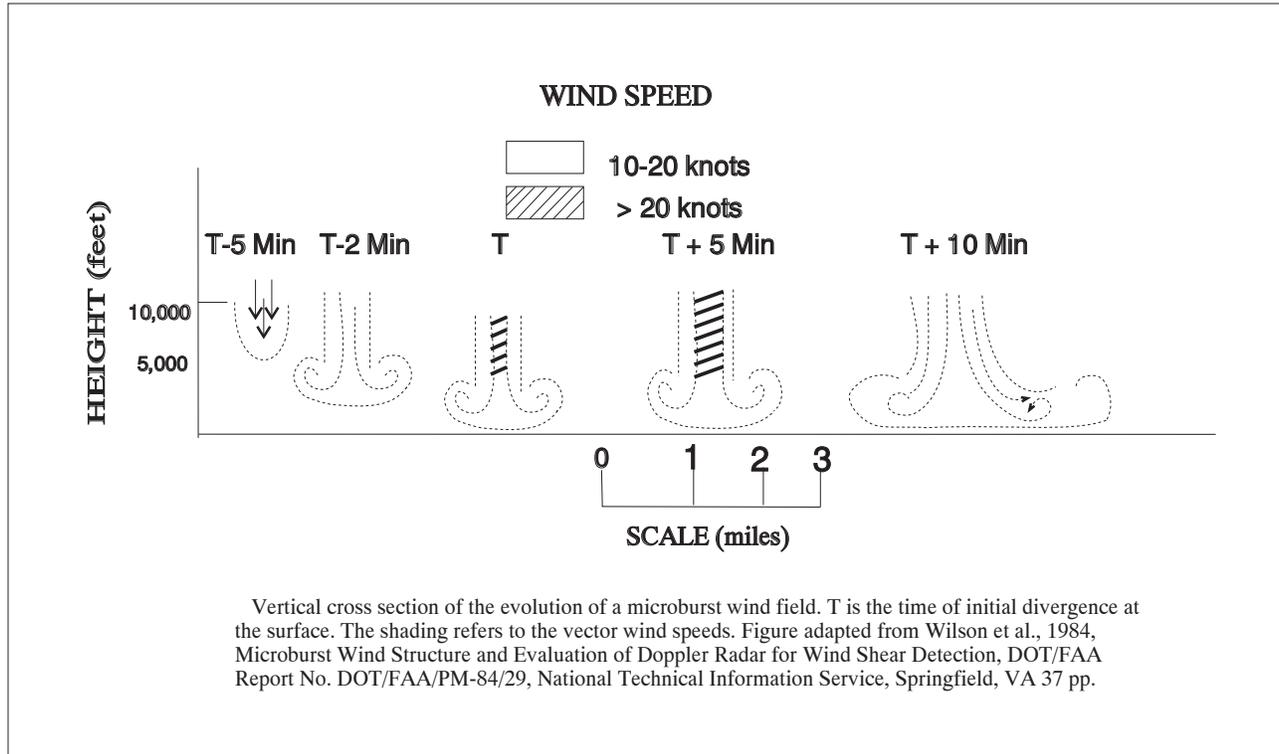
*AIM, Para 7-1-21, PIREPs Relating to Turbulence.*

## 7-1-24. Microbursts

a. Relatively recent meteorological studies have confirmed the existence of microburst phenomenon. 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.

b. 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.

FIG 7-1-12  
Evolution of a Microburst



c. The life cycle of a microburst as it descends in a convective rain shaft is seen in FIG 7-1-12. An important consideration for pilots is the fact that the microburst intensifies for about 5 minutes after it strikes the ground.

**d. Characteristics of microbursts include:**

**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.

**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.

**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.

**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 an hour. Once microburst activity starts, multiple microbursts in the same general area are not uncommon and should be expected.

### 6. 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 reduce air traffic controller workload. With the TWIP capability, terminal weather information, both alphanumerically and graphically, is now available directly to the cockpit at 43 airports in the U.S. NAS. (See FIG 7-1-20.)

FIG 7-1-20

**TWIP Image of Convective Weather at MCO International**

WEATHER SITUATION	TWIP TEXT MESSAGE
	<p>MCO 1800                      TERMINAL WEATHER                      -STORM(S)                      3NM N-E MOD PRECIP                      4NM NE HVY PRECIP                      MOVG W AT 15KT                      .EXPECTED MOD PRECIP                      BEGIN 1805</p>
	<p>MCO 1810                      TERMINAL WEATHER                      *MODERATE PRECIP                      BEGAN 1805                      -STORM(S)                      ARPT ALQDS MOD PRECIP                      1NM N-E HVY PRECIP                      MOVG W AT 15KT                      .EXPECTED HVY PRECIP                      BEGIN 1815</p>

(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 five 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.

TBL 7-1-10

**TWIP-Equipped Airports**

Airport	Identifier
Andrews AFB, MD	KADW
Hartsfield-Jackson Atlanta Intl Airport	KATL
Nashville Intl Airport	KBNA
Logan Intl Airport	KBOS
Baltimore/Washington Intl Airport	KBWI
Hopkins Intl Airport	KCLE
Charlotte/Douglas Intl Airport	KCLT
Port Columbus Intl Airport	KCMH
Cincinnati/Northern Kentucky Intl Airport	KCVG
Dallas Love Field Airport	KDAL
James M. Cox Intl Airport	KDAY
Ronald Reagan Washington National Airport	KDCA
Denver Intl Airport	KDEN
Dallas-Fort Worth Intl Airport	KDFW
Detroit Metro Wayne County Airport	KDTW
Newark Liberty Intl Airport	KEWR
Fort Lauderdale-Hollywood Intl Airport	KFLL
William P. Hobby Airport	KHOU
Washington Dulles Intl Airport	KIAD
George Bush Intercontinental Airport	KIAH
Wichita Mid-Continent Airport	KICT
Indianapolis Intl Airport	KIND

<b>Airport</b>	<b>Identifier</b>
John F. Kennedy Intl Airport	KJFK
LaGuardia Airport	KLGA
Kansas City Intl Airport	KMCI
Orlando Intl Airport	KMCO
Midway Intl Airport	KMDW
Memphis Intl Airport	KMEM
Miami Intl Airport	KMIA
General Mitchell Intl Airport	KMKE
Minneapolis St. Paul Intl Airport	KMSP
Louis Armstrong New Orleans Intl Airport	KMSY
Will Rogers World Airport	KOKC
O'Hare Intl Airport	KORD
Palm Beach Intl Airport	KPBI
Philadelphia Intl Airport	KPHL
Pittsburgh Intl Airport	KPIT
Raleigh-Durham Intl Airport	KRDU
Louisville Intl Airport	KSDF
Salt Lake City Intl Airport	KSLC
Lambert-St. Louis Intl Airport	KSTL
Tampa Intl Airport	KTPA
Tulsa Intl Airport	KTUL

**7-1-25. PIREPs Relating to Volcanic Ash Activity**

a. 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 extremely 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. Additionally, studies have shown that volcanic eruptions are the only significant source of large quantities of sulphur dioxide (SO<sub>2</sub>) gas at jet-cruising altitudes. Therefore, the detection and subsequent reporting of SO<sub>2</sub> is of significant importance. Although SO<sub>2</sub> is colorless, its presence in the atmosphere should be suspected when a sulphur-like or rotten egg odor is present throughout the cabin.

b. 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 or detection of sulphur dioxide (SO<sub>2</sub>) gas associated with volcanic activity.

c. Pilots should submit PIREPs regarding volcanic activity using the Volcanic Activity Reporting (VAR) form as illustrated in Appendix 2. If a VAR form is not immediately available, relay enough information to identify the position and type of volcanic activity.

d. 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.

**7-1-26. Thunderstorms**

a. Turbulence, hail, rain, snow, lightning, sustained updrafts and downdrafts, icing conditions—are 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.

b. There is no useful correlation between the external visual appearance of thunderstorms and the severity or amount of turbulence or hail within them. 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.

c. 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 radar reflectivity which is closely associated 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.**

d. 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.

**e.** The probability of lightning strikes occurring to aircraft is greatest when operating at altitudes where temperatures are between minus 5 degrees Celsius and plus 5 degrees Celsius. Lightning can strike aircraft flying in the clear in the vicinity of a thunderstorm.

**f.** METAR reports do not include a descriptor for severe thunderstorms. However, by understanding severe thunderstorm criteria, i.e., 50 knot winds or  $\frac{3}{4}$  inch hail, the information is available in the report to know that one is occurring.

**g.** 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– Precipitation Radar Weather Descriptions*

#### EXAMPLE–

**1.** 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.

**2.** Alert provided by an 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.

## ■ 7–1–27. Thunderstorm Flying

**a.** Thunderstorm Avoidance. Never regard any thunderstorm lightly, even when radar echoes are of light intensity. Avoiding thunderstorms is the best policy. Following are some Do's and Don'ts of thunderstorm avoidance:

**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.

**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 hazardous.

**3.** Don't attempt to fly under the anvil of a thunderstorm. There is a potential for severe and extreme clear air turbulence.

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

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

**6.** Don't assume that ATC will offer radar navigation guidance or deviations around thunderstorms.

**7.** Don't use data-linked weather next generation weather radar (NEXRAD) mosaic imagery as the sole means for negotiating a path through a thunderstorm area (tactical maneuvering).

**8.** Do remember that the data-linked NEXRAD mosaic imagery shows where the weather was, not where the weather is. The weather conditions depicted may be 15 to 20 minutes older than indicated on the display.

**9.** Do listen to chatter on the ATC frequency for Pilot Weather Reports (PIREP) and other aircraft requesting to deviate or divert.

**10.** Do ask ATC for radar navigation guidance or to approve deviations around thunderstorms, if needed.

**11.** Do use data-linked weather NEXRAD mosaic imagery (for example, Flight Information Service-Broadcast (FIS-B)) for route selection to avoid thunderstorms entirely (strategic maneuvering).

**12.** Do advise ATC, when switched to another controller, that you are deviating for thunderstorms before accepting to rejoin the original route.

**13.** Do ensure that after an authorized weather deviation, before accepting to rejoin the original route, that the route of flight is clear of thunderstorms.

**14.** 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.

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

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

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

**18.** Do give a PIREP for the flight conditions.

**19.** Do divert and wait out the thunderstorms on the ground if unable to navigate around an area of thunderstorms.

**20.** Do contact Flight Service for assistance in avoiding thunderstorms. Flight Service specialists have NEXRAD mosaic radar imagery and NEXRAD single site radar with unique features such as base and composite reflectivity, echo tops, and VAD wind profiles.

**b.** If you cannot avoid penetrating a thunderstorm, following are some Do's before entering the storm:

**1.** Tighten your safety belt, put on your shoulder harness (if installed), if and secure all loose objects.

**2.** Plan and hold the course to take the aircraft through the storm in a minimum time.

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

**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.

**5.** Establish power settings for turbulence penetration airspeed recommended in the aircraft manual.

**6.** Turn up cockpit lights to highest intensity to lessen temporary blindness from lightning.

**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 stress.

**8.** If using airborne radar, tilt the antenna up and down occasionally. This will permit the detection of other thunderstorm activity at altitudes other than the one being flown.

**c.** Following are some Do's and Don'ts during the thunderstorm penetration:

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

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

**3.** Do maintain constant attitude. Allow the altitude and airspeed to fluctuate.

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

7-1-28. Key to Aerodrome Forecast (TAF) and Aviation Routine Weather Report (METAR)

FIG 7-1-21

Key to Aerodrome Forecast (TAF) and Aviation Routine Weather Report (METAR) (Front)



**Key to Aerodrome Forecast (TAF) and Aviation Routine Weather Report (METAR) (Front)**



<b>TAF</b>	KPIT 091730Z 0918/1024 15005KT 5SM HZ FEW020 WS010/31022KT FM091930 30015G25KT 3SM SHRA OVC015 TEMPO 0920/0922 1/2SM +TSRA OVC008CB FM100100 27008KT 5SM SHRA BKN020 OVC040 PROB30 1004/1007 1SM -RA BR FM101015 18005KT 6SM -SHRA OVC020 BECMG 1013/1015 P6SM NSW SKC
<b>NOTE:</b> Users are cautioned to confirm <i>DATE</i> and <i>TIME</i> of the TAF. For example FM100000 is 0000Z on the <b>10th</b> . Do not confuse with <b>1000Z!</b>	
<b>METAR</b>	KPIT 091955Z COR 22015G25KT 3/4SM R28L/2600FT TSRA OVC010CB 18/16 A2992 RMK SLP045 T01820159

Forecast	Explanation	Report
<b>TAF</b>	Message type: <u>TAF</u> -routine or <u>TAF AMD</u> -amended forecast, <u>METAR</u> -hourly, <u>SPECI</u> -special or <u>TESTM</u> -non-commissioned ASOS report	<b>METAR</b>
<b>KPIT</b>	ICAO location indicator	<b>KPIT</b>
<b>091730Z</b>	Issuance time: ALL times in UTC “Z”, 2-digit date, 4-digit time	<b>091955Z</b>
<b>0918/1024</b>	Valid period, either 24 hours or 30 hours. The first two digits of EACH four digit number indicate the date of the valid period, the final two digits indicate the time (valid from 18Z on the 9 <sup>th</sup> to 24Z on the 10 <sup>th</sup> ). In U.S. METAR: <u>COR</u> rected ob; or <u>AUTOM</u> ated ob for automated report with no human intervention; omitted when observer logs on.	<b>COR</b>
<b>15005KT</b>	Wind: 3 digit true-north direction, nearest 10 degrees (or <u>VaRiAbLe</u> ); next 2-3 digits for speed and unit, <u>KT</u> (KMH or MPS); as needed, <u>G</u> ust and maximum speed; 00000KT for calm; for METAR, if direction varies 60 degrees or more, <u>Variability</u> appended, e.g., 180V260	<b>22015G25KT</b>
<b>5SM</b>	Prevailing visibility; in U.S., Statute <u>Miles</u> & fractions; above 6 miles in TAF <u>Plus6SM</u> . (Or, 4-digit minimum visibility in meters and as required, lowest value with direction)	<b>3/4SM</b>
	Runway Visual Range: <u>R</u> ; 2-digit runway designator <u>L</u> eft, <u>C</u> enter, or <u>R</u> ight as needed; “ <u>L</u> ”, Minus or Plus in U.S., 4-digit value, <u>F</u> eeT in U.S., (usually meters elsewhere); 4-digit value <u>V</u> ariability 4-digit value (and tendency <u>D</u> own, <u>U</u> p or <u>N</u> o change)	<b>R28L/2600FT</b>
<b>HZ</b>	Significant present, forecast and recent weather: see table (on back)	<b>TSRA</b>
<b>FEW020</b>	Cloud amount, height and type: <u>Sky Clear</u> 0/8, <u>FEW</u> >0/8-2/8, <u>ScAT</u> tered 3/8-4/8, <u>BroKeN</u> 5/8-7/8, <u>OverCast</u> 8/8; 3-digit height in hundreds of ft; <u>T</u> owering <u>C</u> umulus or <u>C</u> umuloni <u>m</u> Bus in <u>METAR</u> ; in <u>TAF</u> , only <u>CB</u> . <u>V</u> ertical <u>V</u> isibility for obscured sky and height “VV004”. More than 1 layer may be reported or forecast. In automated <u>METAR</u> reports only, <u>CleaR</u> for “clear below 12,000 feet”	<b>OVC 010CB</b>
	Temperature: degrees Celsius; first 2 digits, temperature “ <u>L</u> ” last 2 digits, dew-point temperature; <u>M</u> inus for below zero, e.g., M06	<b>18/16</b>
	Altimeter setting: indicator and 4 digits; in U.S., <u>A</u> -inches and hundredths; ( <u>Q</u> -hectoPascals, e.g., Q1013)	<b>A2992</b>
<b>WS010/31022KT</b>	In U.S. <u>TAF</u> , non-convective low-level (<u>2,000 ft) <u>W</u> ind <u>S</u> hear; 3-digit height (hundreds of ft); “ <u>L</u> ”; 3-digit wind direction and 2-3 digit wind speed above the indicated height, and unit, <u>KT</u>	

FIG 7-1-22

**Key to Aerodrome Forecast (TAF) and Aviation Routine Weather Report (METAR) (Back)**



**Key to Aerodrome Forecast (TAF) and Aviation Routine Weather Report (METAR) (Back)**



	In <b>METAR</b> , <u>ReMarK</u> indicator & remarks. For example: <u>Sea- Level Pressure</u> in hectoPascals & tenths, as shown: 1004.5 hPa; <u>Temp/dew-point</u> in tenths °C, as shown: temp. 18.2°C, dew-point 15.9°C	<b>RMK SLP045 T01820159</b>
<b>FM091930</b>	<u>FroM</u> : changes are expected at: 2-digit date, 2-digit hour, and 2-digit minute beginning time: indicates significant change. Each FM starts on a new line, indented 5 spaces	
<b>TEMPO 0920/0922</b>	<u>TEMPO</u> rary: changes expected for <1 hour and in total, < half of the period between the 2-digit date and 2-digit hour beginning, and 2-digit date and 2-digit hour ending time	
<b>PROB30 1004/1007</b>	<u>PROB</u> ability and 2-digit percent (30 or 40): probable condition in the period between the 2-digit date & 2-digit hour beginning time, and the 2-digit date and 2-digit hour ending time	
<b>BECMG 1013/1015</b>	<u>BECO</u> MinG: change expected in the period between the 2-digit date and 2-digit hour beginning time, and the 2-digit date and 2-digit hour ending time	

<b>Table of Significant Present, Forecast and Recent Weather - Grouped in categories and used in the order listed below; or as needed in TAF, <u>No Significant Weather</u>.</b>			
<b>Qualifiers</b>			
<b>Intensity or Proximity</b>			
“-” = Light		No sign = Moderate	“+” = Heavy
“VC” = Vicinity, but not at aerodrome. In the US METAR, 5 to 10 SM from the point of observation. In the US TAF, 5 to 10 SM from the center of the runway complex. Elsewhere, within 8000m.			
<b>Descriptor</b>			
<b>BC</b> – Patches	<b>BL</b> – Blowing	<b>DR</b> – Drifting	<b>FZ</b> – Freezing
<b>MI</b> – Shallow	<b>PR</b> – Partial	<b>SH</b> – Showers	<b>TS</b> – Thunderstorm
<b>Weather Phenomena</b>			
<b>Precipitation</b>			
<b>DZ</b> – Drizzle	<b>GR</b> – Hail	<b>GS</b> – Small Hail/Snow Pellets	
<b>IC</b> – Ice Crystals	<b>PL</b> – Ice Pellets	<b>RA</b> – Rain	<b>SG</b> – Snow Grains
<b>SN</b> – Snow	<b>UP</b> – Unknown Precipitation in automated observations		
<b>Obscuration</b>			
<b>BR</b> – Mist (≥5/8SM)	<b>DU</b> – Widespread Dust	<b>FG</b> – Fog (<5/8SM)	<b>FU</b> – Smoke
<b>HZ</b> – Haze	<b>PY</b> – Spray	<b>SA</b> – Sand	<b>VA</b> – Volcanic Ash
<b>Other</b>			
<b>DS</b> – Dust Storm	<b>FC</b> – Funnel Cloud	<b>+FC</b> – Tornado or Waterspout	
<b>PO</b> – Well developed dust or sand whirls		<b>SQ</b> – Squall	<b>SS</b> – Sandstorm
<ul style="list-style-type: none"> <li>- Explanations in parentheses “()” indicate different worldwide practices.</li> <li>- Ceiling is not specified; defined as the lowest broken or overcast layer, or the vertical visibility.</li> <li>- NWS TAFs exclude BECMG groups and temperature forecasts, NWS TAFS do not use PROB in the first 9 hours of a TAF; NWS METARs exclude trend forecasts. US Military TAFs include Turbulence and Icing groups.</li> </ul>			

## 7-1-29. International Civil Aviation Organization (ICAO) Weather Formats

The U.S. uses the ICAO world standard for aviation weather reporting and forecasting. 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.

a. 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, and inches of mercury for altimetry. However, temperature and dew point will be reported in degrees Celsius. The U.S. reports prevailing visibility rather than lowest sector visibility. The elements in the body of a METAR report are separated with a space. The only exceptions are RVR, temperature, and dew point which are separated with a solidus (/). When an element does not occur, or cannot be observed, the preceding space and that element are omitted from that particular report. A METAR report contains the following sequence of elements in the following order:

1. Type of report.
2. ICAO Station Identifier.
3. Date and time of report.
4. Modifier (as required).
5. Wind.
6. Visibility.
7. Runway Visual Range (RVR).
8. Weather phenomena.
9. Sky conditions.
10. Temperature/dew point group.
11. Altimeter.
12. Remarks (RMK).

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

1. **Type of report.** There are two types of report:

(a) Aviation Routine Weather Report (METAR); and

(b) Nonroutine (Special) Aviation Weather Report (SPECI).

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

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. Elsewhere, the first two letters of the ICAO identifier indicate what region of the world and country (or state) the station is in. For Alaska, all station identifiers start with "PA;" for Hawaii, all station identifiers start with "PH." Canadian station identifiers start with "CU," "CW," "CY," and "CZ." Mexican station identifiers start with "MM." The identifier for the western Caribbean is "M" followed by the individual country's letter; i.e., Cuba is "MU;" Dominican Republic "MD;" the Bahamas "MY." 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.

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 17<sup>th</sup> day of the month at 2345Z)

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.

**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 the wind is blowing from, 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*

**(a) Peak Wind.** Whenever the peak wind exceeds 25 knots “PK WND” will be included in Remarks, e.g., PK WND 28045/1955 “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.”

**(b) 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.”

**6. Visibility.** Prevailing visibility is reported in statute miles with “SM” appended to it.

**EXAMPLE–**

*7SM – seven statute miles*

*15SM – fifteen statute miles*

*1/2SM – one-half statute mile*

**(a) Tower/surface visibility.** If either visibility (tower or surface) is below four statute miles,

the lesser of the two will be reported in the body of the report; the greater will be reported in remarks.

**(b) Automated visibility.** ASOS/AWOS visibility stations will show visibility 10 or greater than 10 miles as “10SM.” AWOS visibility stations will show visibility less than 1/4 statute mile as “M<sup>1/4</sup>SM” and visibility 10 or greater than 10 miles as “10SM.”

**NOTE–**

*Automated sites that are augmented by human observer to meet service level requirements can report 0, 1/16 SM, and 1/8 SM visibility increments.*

**(c) 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 three miles) e.g., VIS 1V2 “visibility variable between one and two.”

**(d) 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 three miles.

**EXAMPLE–**

*VIS N2 – visibility north two*

**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).

**(a) Variability Values.** When RVR varies (by more than on reportable value), the lowest and highest values are shown with “V” between them.

**(b) 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.*

are operated under instrument flight rules, are in communication with ATC, and are appropriately equipped).

c. UAS operations may be approved at either controlled or uncontrolled airports and are typically disseminated by NOTAM. In all cases, approved UAS operations must comply with all applicable regulations and/or special provisions specified in the COA or in the operating limitations of the special airworthiness certificate. At uncontrolled airports, UAS operations are advised to operate well clear of all known manned aircraft operations. Pilots of manned aircraft are advised to follow normal operating procedures and are urged to monitor the CTAF for any potential UAS activity. At controlled airports, local ATC procedures may be in place to handle UAS operations and should not require any special procedures from manned aircraft entering or departing the traffic pattern or operating in the vicinity of the airport.

d. In addition to approved UAS operations described above, a recently approved agreement between the FAA and the Department of Defense authorizes small UAS operations wholly contained within Class G airspace, and in no instance, greater than 1200 feet AGL over military owned or leased property. These operations do not require any special authorization as long as the UA remains within the lateral boundaries of the military installation as well as other provisions including the issuance of a NOTAM. Unlike special use airspace, these areas may not be depicted on an aeronautical chart.

e. There are several factors a pilot should consider regarding UAS 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. Areas with a preponderance of UAS activity are typically noted on sectional charts advising pilots of this activity. 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, as with manned aircraft, never assume that the pilot or crew of the UAS can see you, maintain increased vigilance with the UA and always be prepared for evasive action if necessary. Always check NOTAMs for potential UAS activity along the intended route of flight and exercise increased vigilance in areas specified in the NOTAM.

## 7-6-6. Mountain Flying

a. 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.

b. **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.

c. 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.

d. Don't fly near or above abrupt changes in terrain. Severe turbulence can be expected, especially in high wind conditions.

e. **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>**

**f.** 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!**

**g.** 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.

**h.** 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 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.

**i. 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 degrees Fahrenheit (15 degrees Celsius), 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 areas. 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 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 feet at an operational altitude of 5,000 feet.

**NOTE-**

*A turbo-charged aircraft engine provides a slight advantage in that it provides sea level horsepower up to a specified altitude above sea level.*

**1. 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 Local Airport Advisory.

**2.** 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.*

**j. Mountain Wave.** 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.

1. 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.

2. Pilots from flatland areas should understand a few things about mountain waves in order to stay out of trouble. When 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.

3. When approaching a mountain ridge from the downwind side, it is recommended that the ridge be approached at approximately a 45 degree 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.

### **7-6-7. Use of Runway Half-way Signs at Unimproved Airports**

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.

Several points are important when considering using this “rule of thumb”:

a. 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.

b. 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.

c. 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.

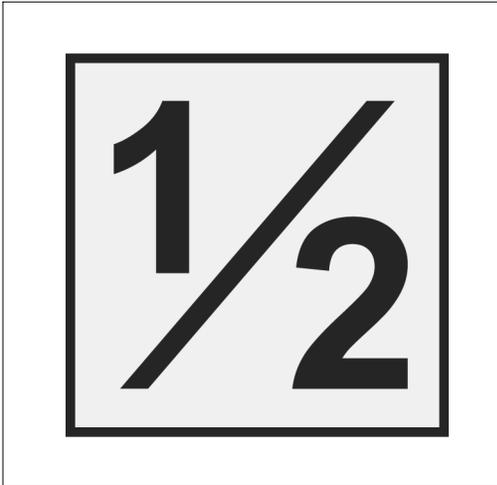
d. Use of this “rule of thumb” does not alleviate the pilot’s responsibility to comply with applicable Federal Aviation Regulations, the limitations and performance data provided in the FAA approved Airplane Flight Manual (AFM), or, in the absence of an FAA approved AFM, other data provided by the aircraft manufacturer.

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 7-6-1 shows a graphical depiction of a typical runway half-way sign.

FIG 7-6-1  
Typical Runway Half-way Sign



### 7-6-8. Seaplane Safety

a. 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.

b. 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 U.S. Coast Guard’s (USCG) Navigation Rules, International-Inland, and 14 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 must 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 Flotation 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.

c. 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 7-6-1, 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.

d. 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.

**1. Glaciers.** Be conscious of your altitude when flying over glaciers. The glaciers may be rising faster than you are climbing.

## 7-6-14. Operations in Ground Icing Conditions

**a.** 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.

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.

**b.** The following recommendations are offered:

- 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.

- 2.** Review and refresh your cold weather standard operating procedures.

- 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.

- 4.** Protect your aircraft while on the ground, if possible, from sleet and freezing rain by taking advantage of aircraft hangars.

- 5.** Take full advantage of the opportunities available at airports for deicing. Do not refuse deicing services simply because of cost.

- 6.** Always consider canceling or delaying a flight if weather conditions do not support a safe operation.

**c.** If you haven’t already developed a set of Standard Operating Procedures for cold weather operations, they should include:

- 1.** Procedures based on information that is applicable to the aircraft operated, such as AFM limitations and procedures;

- 2.** Concise and easy to understand guidance that outlines best operational practices;

- 3.** A systematic procedure for recognizing, evaluating and addressing the associated icing risk, and offer clear guidance to mitigate this risk;

- 4.** An aid (such as a checklist or reference cards) that is readily available during normal day–to–day aircraft operations.

**d.** There are several sources for guidance relating to airframe icing, including:

- 1.** <http://aircrafticing.grc.nasa.gov/index.html>

- 2.** <http://www.ibac.org/is-bao/isbao.htm>

- 3.** [http://www.natasafety1st.org/bus\\_deice.htm](http://www.natasafety1st.org/bus_deice.htm)

- 4.** Advisory Circular (AC) 91–74, Pilot Guide, Flight in Icing Conditions.

- 5.** AC 135–17, Pilot Guide Small Aircraft Ground Deicing.

- 6.** AC 135–9, FAR Part 135 Icing Limitations.

- 7.** AC 120–60, Ground Deicing and Anti–icing Program.

- 8.** AC 135–16, Ground Deicing and Anti–icing Training and Checking.

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 website by selecting the current year’s information bulletins:

**[http://www.faa.gov/library/manuals/examiners\\_inspectors/8400/fsat](http://www.faa.gov/library/manuals/examiners_inspectors/8400/fsat)**

**7-6-15. Avoid Flight in the Vicinity of Exhaust Plumes (Smoke Stacks and Cooling Towers)**

**a. Flight Hazards Exist Around Exhaust Plumes.** Exhaust plumes are defined as visible or invisible emissions from power plants, industrial production facilities, or other industrial systems that release large amounts of vertically directed unstable gases (effluent). High temperature exhaust plumes can cause significant air disturbances such as turbulence and vertical shear. Other identified potential hazards include, but are not necessarily limited to: reduced visibility, oxygen depletion, engine particulate contamination, exposure to gaseous oxides, and/or icing. Results of encountering a plume may include airframe damage, aircraft upset, and/or engine damage/failure. These hazards are most critical during low altitude flight in calm and cold air, especially in and around approach and departure corridors or airport traffic areas.

Whether plumes are visible or invisible, the total extent of their turbulent affect is difficult to predict. Some studies do predict that the significant turbulent effects of an exhaust plume can extend to heights of over 1,000 feet above the height of the top of the stack or cooling tower. Any effects will be more pronounced in calm stable air where the plume is very hot and the surrounding area is still and cold. Fortunately, studies also predict that any amount of crosswind will help to dissipate the effects. However, the size of the tower or stack is not a good indicator of the predicted effect the plume may produce. The major effects are related to the heat or size of the

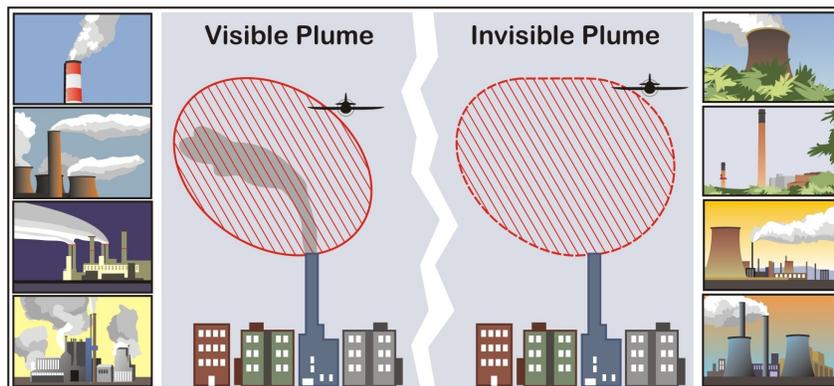
plume effluent, the ambient air temperature, and the wind speed affecting the plume. Smaller aircraft can expect to feel an effect at a higher altitude than heavier aircraft.

**b. When able, a pilot should steer clear of exhaust plumes by flying on the upwind side of smokestacks or cooling towers.** When a plume is visible via smoke or a condensation cloud, remain clear and realize a plume may have both visible and invisible characteristics. Exhaust stacks without visible plumes may still be in full operation, and airspace in the vicinity should be treated with caution. As with mountain wave turbulence or clear air turbulence, an invisible plume may be encountered unexpectedly. Cooling towers, power plant stacks, exhaust fans, and other similar structures are depicted in FIG 7-6-2.

Pilots are encouraged to exercise caution when flying in the vicinity of exhaust plumes. Pilots are also encouraged to reference the Chart Supplement U.S. where amplifying notes may caution pilots and identify the location of structure(s) emitting exhaust plumes.

The best available information on this phenomenon must come from pilots via the PIREP reporting procedures. All pilots encountering hazardous plume 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 (AIM Paragraph 7-1-21, PIREPS Relating to Turbulence).

**FIG 7-6-2  
Plumes**



**3. U.S. Terminal Procedures Publication (TPP).** TPPs are published in 24 loose-leaf or perfect bound volumes covering the conterminous U.S., Puerto Rico and the Virgin Islands. A Change Notice is published at the midpoint between revisions in bound volume format and is available on the internet for free download at the AIS website. (See FIG 9-1-15.) The TPPs include:

**(a) Instrument Approach Procedure (IAP)**

**Charts.** IAP charts portray the aeronautical data that is required to execute instrument approaches to airports. Each chart depicts the IAP, all related navigation data, communications information, and an airport sketch. Each procedure is designated for use with a specific electronic navigational aid, such as ILS, VOR, NDB, RNAV, etc.

**(b) Instrument Departure Procedure (DP)**

**Charts.** DP charts are designed to expedite clearance delivery and to facilitate transition between takeoff and en route operations. They furnish pilots' departure routing clearance information in graphic and textual form.

**(c) Standard Terminal Arrival (STAR)**

**Charts.** STAR charts are designed to expedite ATC arrival procedures and to facilitate transition between en route and instrument approach operations. They depict preplanned IFR ATC arrival procedures in graphic and textual form. Each STAR procedure is presented as a separate chart and may serve either a single airport or more than one airport in a given geographic area.

**(d) Airport Diagrams.** Full page airport diagrams are designed to assist in the movement of ground traffic at locations with complex runway/taxiway configurations and provide information for updating geodetic position navigational systems aboard aircraft. Airport diagrams are available for free download at the AIS website.

**4. Alaska Terminal Procedures Publication.**

This publication contains all terminal flight procedures for civil and military aviation in Alaska.

Included are IAP charts, DP charts, STAR charts, airport diagrams, radar minimums, and supplementary support data such as IFR alternate minimums, take-off minimums, rate of descent tables, rate of climb tables and inoperative components tables. Volume is 5-3/8 x 8-1/4 inch top bound. Publication revised every 56 days with provisions for a Terminal Change Notice, as required.

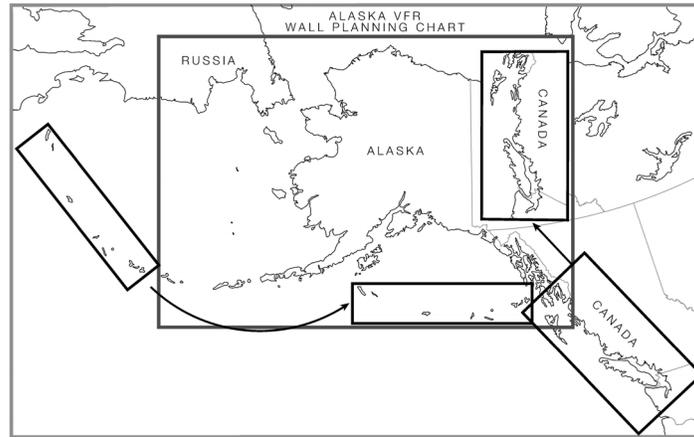
**c. Planning Charts.**

**1. U.S. IFR/VFR Low Altitude Planning Chart.** This chart is designed for preflight and en route flight planning for IFR/VFR flights. Depiction includes low altitude airways and mileage, NAVAIDs, airports, special use airspace, cities, times zones, major drainage, a directory of airports with their airspace classification, and a mileage table showing great circle distances between major airports. Scale 1 inch = 47nm/1:3,400,000. Chart revised annually, and is available either folded or unfolded for wall mounting. (See FIG 9-1-10.)

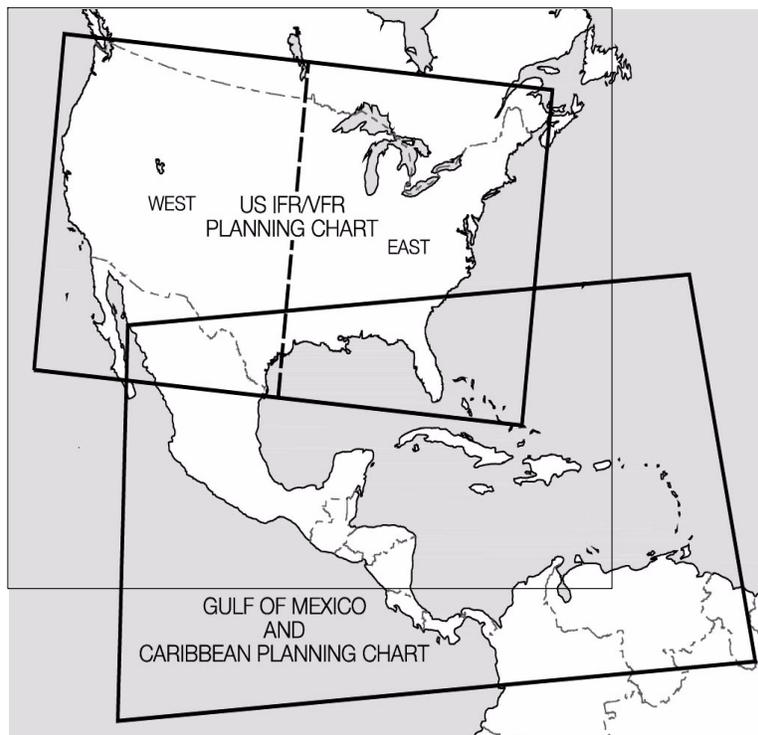
**2. Gulf of Mexico and Caribbean Planning Chart.** This is a VFR planning chart on the reverse side of the *Puerto Rico - Virgin Islands VFR Terminal Area Chart*. Information shown includes mileage between airports of entry, a selection of special use airspace and a directory of airports with their available services. Scale 1 inch = 85nm/1:6,192,178. 60 x 20 inches folded to 5 x 10 inches. Chart revised annually. (See FIG 9-1-10.)

**3. Alaska VFR Wall Planning Chart.** This chart is designed for VFR preflight planning and chart selection. It includes aeronautical and topographic information of the state of Alaska. The aeronautical information includes public and military airports; radio aids to navigation; and Class B, Class C, TRSA and special-use airspace. The topographic information includes city tint, populated places, principal roads, and shaded relief. Scale 1 inch = 27.4 nm/1:2,000,000. The one sided chart is 58.5 x 40.75 inches and is designed for wall mounting. Chart is revised biennially. (See FIG 9-1-9.)

**FIG 9-1-9**  
**Alaska VFR Wall Planning Chart**



**FIG 9-1-10**  
**Planning Charts**



**4. U.S. VFR Wall Planning Chart.** This chart is designed for VFR preflight planning and chart selection. It includes aeronautical and topographic information of the conterminous U.S. The aeronautical information includes airports, radio aids to navigation, Class B airspace and special use airspace. The topographic information includes city tint, populated places, principal roads, drainage patterns, and shaded relief. Scale 1 inch = 43 nm/ 1:3,100,000. The one-sided chart is 59 x 36 inches and ships unfolded for wall mounting. Chart is revised biennially. (See FIG 9-1-11.)

FIG 9-1-11  
U.S. VFR Wall Planning Chart



**5. Charted VFR Flyway Planning Charts.** This chart is printed on the reverse side of selected TAC charts. The coverage is the same as the associated TAC. Flyway planning charts depict flight paths and altitudes recommended for use to bypass high traffic areas. Ground references are provided as a guide for visual orientation. Flyway planning charts are designed for use in conjunction with TACs and sectional charts and are not to be used for navigation. Chart scale 1 inch = 3.43 nm/1:250,000.

**d. Supplementary Charts and Publications.**

**1. Chart Supplement U.S.** This 7-volume booklet series contains data on airports, seaplane bases, heliports, NAVAIDs, communications data, weather data sources, airspace, special notices, and operational procedures. Coverage includes the conterminous U.S., Puerto Rico, and the Virgin

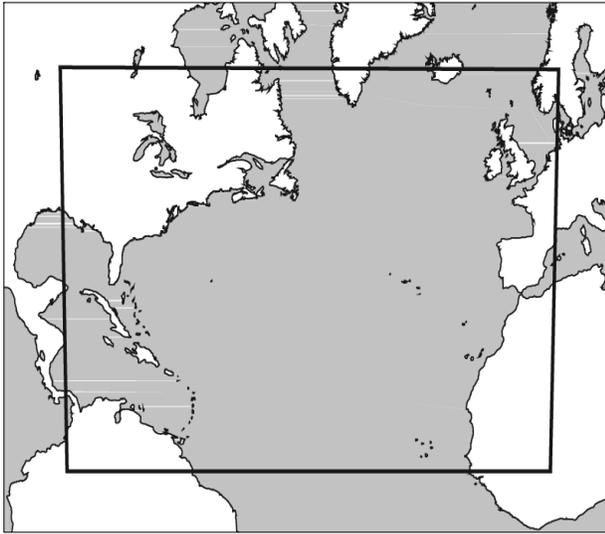
Islands. The Chart Supplement U.S. shows data that cannot be readily depicted in graphic form; for example, airport hours of operations, types of fuel available, runway widths, lighting codes, etc. The Chart Supplement U.S. also provides a means for pilots to update visual charts between edition dates (The Chart Supplement U.S. is published every 56 days while Sectional Aeronautical and VFR Terminal Area Charts are generally revised every six months). The Aeronautical Chart Bulletins (VFR Chart Update Bulletins) are available for free download at the AIS website. Volumes are side-bound 5-3/8 x 8-1/4 inches. (See FIG 9-1-14.)

**2. Chart Supplement Alaska.** This is a civil/military flight information publication issued by FAA every 56 days. It is a single volume booklet designed for use with appropriate IFR or VFR charts. The Chart Supplement Alaska contains airport sketches, communications data, weather data sources, airspace, listing of navigational facilities, and special notices and procedures. Volume is side-bound 5-3/8 x 8-1/4 inches.

**3. Chart Supplement Pacific.** This supplement is designed for use with appropriate VFR or IFR en route charts. Included in this one-volume booklet are the chart supplement, communications data, weather data sources, airspace, navigational facilities, special notices, and Pacific area procedures. IAP charts, DP charts, STAR charts, airport diagrams, radar minimums, and supporting data for the Hawaiian and Pacific Islands are included. The manual is published every 56 days. Volume is side-bound 5-3/8 x 8-1/4 inches.

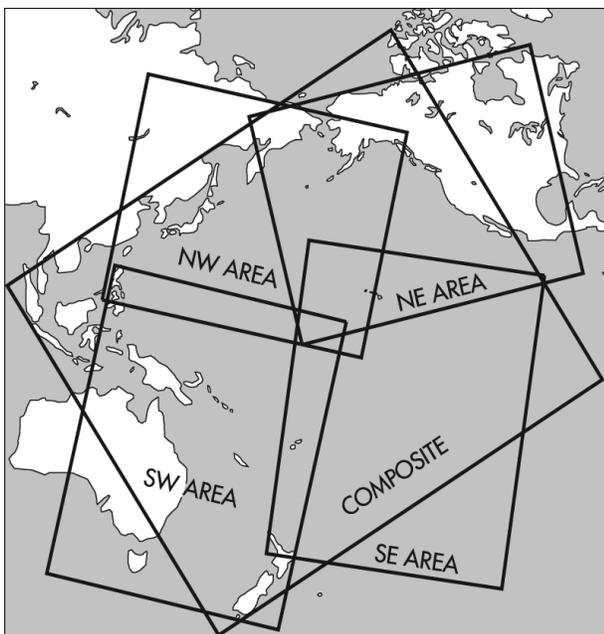
**4. North Atlantic Route Chart.** Designed for FAA controllers to monitor transatlantic flights, this 5-color chart shows oceanic control areas, coastal navigation aids, oceanic reporting points, and NAVAID geographic coordinates. Full Size Chart: Scale 1 inch = 113.1 nm/1:8,250,000. Chart is shipped flat only. Half Size Chart: Scale 1 inch = 150.8 nm/1:11,000,000. Chart is 29-3/4 x 20-1/2 inches, shipped folded to 5 x 10 inches only. Chart revised every 56 days. (See FIG 9-1-12.)

FIG 9-1-12  
North Atlantic Route Charts



**5. North Pacific Route Charts.** These charts are designed for FAA controllers to monitor transoceanic flights. They show established intercontinental air routes, including reporting points with geographic positions. Composite Chart: Scale 1 inch = 164 nm/1:12,000,000. 48 x 41-1/2 inches. Area Charts: Scale 1 inch = 95.9 nm/1:7,000,000. 52 x 40-1/2 inches. All charts shipped unfolded. Charts revised every 56 days. (See FIG 9-1-13.)

FIG 9-1-13  
North Pacific Oceanic Route Charts



**6. Airport Obstruction Charts (OC).** The OC is a 1:12,000 scale graphic depicting 14 CFR Part 77, Objects Affecting Navigable Airspace, surfaces, a representation of objects that penetrate these surfaces, aircraft movement and apron areas, navigational aids, prominent airport buildings, and a selection of roads and other planimetric detail in the airport vicinity. Also included are tabulations of runway and other operational data.

**7. FAA Aeronautical Chart User's Guide.** A booklet designed to be used as a teaching aid and reference document. It describes the substantial amount of information provided on FAA's aeronautical charts and publications. It includes explanations and illustrations of chart terms and symbols organized by chart type. The users guide is available for free download at the AIS website.

**e. Digital Products.**

**1. The Digital Aeronautical Information CD (DAICD).** The DAICD is a combination of the NAVAID Digital Data File, the Digital Chart Supplement, and the Digital Obstacle File on one Compact Disk. These three digital products are no longer sold separately. The files are updated every 56 days and are available by subscription only.

**(a) The NAVAID Digital Data File.** This file contains a current listing of NAVAIDs that are compatible with the National Airspace System. This file contains all NAVAIDs including ILS and its components, in the U.S., Puerto Rico, and the Virgin Islands plus bordering facilities in Canada, Mexico, and the Atlantic and Pacific areas.

**(b) The Digital Obstacle File.** This file describes all obstacles of interest to aviation users in the U.S., with limited coverage of the Pacific, Caribbean, Canada, and Mexico. The obstacles are assigned unique numerical identifiers, accuracy codes, and listed in order of ascending latitude within each state or area.

**2. The Coded Instrument Flight Procedures (CIFP) (ARINC 424 [Ver 13 & 15]).** The CIFP is a basic digital dataset, modeled to an international standard, which can be used as a basis to support GPS navigation. Initial data elements included are: Airport and Helicopter Records, VHF and NDB Navigation aids, en route waypoints and airways. Additional data elements will be added in subsequent releases to include: departure procedures, standard terminal arrivals, and GPS/RNAV instrument approach

## Appendix 3. Abbreviations/Acronyms

As used in this manual, the following abbreviations/acronyms have the meanings indicated.

Abbreviation/ Acronym	Meaning
AAWU . . . . .	Alaskan Aviation Weather Unit
AAS . . . . .	Airport Advisory Service
AC . . . . .	Advisory Circular
ACAR . . . . .	Aircraft Communications Addressing and Reporting System
ADCUS . . . . .	Advise Customs
ADDS . . . . .	Aviation Digital Data Service
ADF . . . . .	Automatic Direction Finder
ADIZ . . . . .	Air Defense Identification Zone
ADS-B . . . . .	Automatic Dependent Surveillance-Broadcast
AFB . . . . .	Air Force Base
AFCS . . . . .	Automatic Flight Control System
AFIS . . . . .	Automatic Flight Information Service
AFM . . . . .	Aircraft Flight Manual
AGL . . . . .	Above Ground Level
AHRS . . . . .	Attitude Heading Reference System
AIM . . . . .	Aeronautical Information Manual
AIRMET . . . . .	Airmen's Meteorological Information
AIS . . . . .	Aeronautical Information Services
ALD . . . . .	Available Landing Distance
ALDARS . . . . .	Automated Lightning Detection and Reporting System
ALS . . . . .	Approach Light Systems
AMSL . . . . .	Above Mean Sea Level
ANP . . . . .	Actual Navigation Performance
AOCC . . . . .	Airline Operations Control Center
AP . . . . .	Autopilot System
APV . . . . .	Approach with Vertical Guidance
AR . . . . .	Authorization Required
ARENA . . . . .	Areas Noted for Attention
ARFF IC . . . . .	Aircraft Rescue and Fire Fighting Incident Commander
ARINC . . . . .	Aeronautical Radio Incorporated
ARO . . . . .	Airport Reservations Office
ARSA . . . . .	Airport Radar Service Area
ARSR . . . . .	Air Route Surveillance Radar
ARTCC . . . . .	Air Route Traffic Control Center
ARTS . . . . .	Automated Radar Terminal System
ASDE-X . . . . .	Airport Surface Detection Equipment – Model X
ASOS . . . . .	Automated Surface Observing System
ASR . . . . .	Airport Surveillance Radar

Abbreviation/ Acronym	Meaning
ASRS . . . . .	Aviation Safety Reporting System
ASSC . . . . .	Airport Surface Surveillance Capability
ATC . . . . .	Air Traffic Control
ATCRBS . . . . .	Air Traffic Control Radar Beacon System
ATCSCC . . . . .	Air Traffic Control System Command Center
ATCT . . . . .	Airport Traffic Control Tower
ATD . . . . .	Along-Track Distance
ATIS . . . . .	Automatic Terminal Information Service
ATT . . . . .	Attitude Retention System
AWC . . . . .	Aviation Weather Center
AWOS . . . . .	Automated Weather Observing System
AWTT . . . . .	Aviation Weather Technology Transfer
AWW . . . . .	Severe Weather Forecast Alert
BAASS . . . . .	Bigelow Aerospace Advanced Space Studies
BBS . . . . .	Bulletin Board System
BC . . . . .	Back Course
BECMG . . . . .	Becoming group
C/A . . . . .	Coarse Acquisition
CARTS . . . . .	Common Automated Radar Terminal System (ARTS) (to include ARTS IIIIE and ARTS IIE)
CAT . . . . .	Clear Air Turbulence
CD . . . . .	Controller Display
CDI . . . . .	Course Deviation Indicator
CDR . . . . .	Coded Departure Route
CERAP . . . . .	Combined Center/RAPCON
CFA . . . . .	Controlled Firing Area
CFIT . . . . .	Controlled Flight into Terrain
CFR . . . . .	Code of Federal Regulations
COA . . . . .	Certificate of Waiver or Authorization
CPDLC . . . . .	Controller Pilot Data Link Communications
CTAF . . . . .	Common Traffic Advisory Frequency
CVFP . . . . .	Chartered Visual Flight Procedure
CVRS . . . . .	Computerized Voice Reservation System
CWA . . . . .	Center Weather Advisory
CWSU . . . . .	Center Weather Service Unit
DA . . . . .	Decision Altitude
DCA . . . . .	Ronald Reagan Washington National Airport
DCP . . . . .	Data Collection Package
DER . . . . .	Departure End of Runway
DH . . . . .	Decision Height

Abbreviation/ Acronym	Meaning
DME . . . . .	Distance Measuring Equipment
DME/N . . . . .	Standard DME
DME/P . . . . .	Precision DME
DOD . . . . .	Department of Defense
DP . . . . .	Instrument Departure Procedure
DPU . . . . .	Data Processor Unit
DRT . . . . .	Diversion Recovery Tool
DRVSM . . . . .	Domestic Reduced Vertical Separation Minimum
DVA . . . . .	Diverse Vector Area
DVFR . . . . .	Defense Visual Flight Rules
DVRSN . . . . .	Diversion
EDCT . . . . .	Expect Departure Clearance Time
EFAS . . . . .	En Route Flight Advisory Service
EFV . . . . .	Enhanced Flight Visibility
EFVS . . . . .	Enhanced Flight Vision System
ELT . . . . .	Emergency Locator Transmitter
EMAS . . . . .	Engineered Materials Arresting System
EPE . . . . .	Estimate of Position Error
ESV . . . . .	Expanded Service Volume
ETA . . . . .	Estimated Time of Arrival
ETD . . . . .	Estimated Time of Departure
ETE . . . . .	Estimated Time En Route
EWINS . . . . .	Enhanced Weather Information System
EWR . . . . .	Newark International Airport
FA . . . . .	Area Forecast
FAA . . . . .	Federal Aviation Administration
FAF . . . . .	Final Approach Fix
FAWP . . . . .	Final Approach Waypoint
FB . . . . .	Fly-by
FCC . . . . .	Federal Communications Commission
FD . . . . .	Flight Director System
FDC . . . . .	Flight Data Center
FDE . . . . .	Fault Detection and Exclusion
FIR . . . . .	Flight Information Region
FIS . . . . .	Flight Information Service
FISDL . . . . .	Flight Information Services Data Link
FLIP . . . . .	Flight Information Publication
FMS . . . . .	Flight Management System
FO . . . . .	Fly-over
FPA . . . . .	Flight Path Angle
FPV . . . . .	Flight Path Vector
FPNM . . . . .	Feet Per Nautical Mile
FSDO . . . . .	Flight Standards District Office
FSS . . . . .	Flight Service Station
GBAS . . . . .	Ground Based Augmentation System
GEO . . . . .	Geostationary Satellite

Abbreviation/ Acronym	Meaning
GLS . . . . .	GBAS Landing System
GNSS . . . . .	Global Navigation Satellite System
GNSSP . . . . .	Global Navigation Satellite System Panel
GPS . . . . .	Global Positioning System
GRI . . . . .	Group Repetition Interval
GSD . . . . .	Geographical Situation Display
GUS . . . . .	Ground Uplink Station
HAT . . . . .	Height Above Touchdown
HDTA . . . . .	High Density Traffic Airports
HEMS . . . . .	Helicopter Emergency Medical Services
HIRL . . . . .	High Intensity Runway Lights
HRR . . . . .	Helicopter Rapid Refueling Procedures
HUD . . . . .	Head-Up Display
Hz . . . . .	Hertz
IAF . . . . .	Initial Approach Fix
IAP . . . . .	Instrument Approach Procedure
IAS . . . . .	Indicated Air Speed
IAWP . . . . .	Initial Approach Waypoint
ICAO . . . . .	International Civil Aviation Organization
IF . . . . .	Intermediate Fix
IFR . . . . .	Instrument Flight Rules
ILS . . . . .	Instrument Landing System
ILS/PRM . . . . .	Instrument Landing System/Precision Runway Monitor
IM . . . . .	Inner Marker
IMC . . . . .	Instrument Meteorological Conditions
InFO . . . . .	Information For Operators
INS . . . . .	Inertial Navigation System
IOC . . . . .	Initial Operational Capability
IR . . . . .	IFR Military Training Route
IRU . . . . .	Inertial Reference Unit
ITWS . . . . .	Integrated Terminal Weather System
JFK . . . . .	John F. Kennedy International Airport
kHz . . . . .	Kilohertz
LAA . . . . .	Local Airport Advisory
LAAS . . . . .	Local Area Augmentation System
LAHSO . . . . .	Land and Hold Short Operations
LAWRS . . . . .	Limited Aviation Weather Reporting Station
LDA . . . . .	Localizer Type Directional Aid
LDA/PRM . . . . .	Localizer Type Directional Aid/Precision Runway Monitor
LGA . . . . .	LaGuardia Airport
LIRL . . . . .	Low Intensity Runway Lights
LLWAS . . . . .	Low Level Wind Shear Alert System
LLWAS NE . . . . .	Low Level Wind Shear Alert System Network Expansion

<b>Abbreviation/ Acronym</b>	<b>Meaning</b>
LLWAS-RS .	Low Level Wind Shear Alert System Relocation/Sustainment
LNAV . . . . .	Lateral Navigation
LOC . . . . .	Localizer
LOP . . . . .	Line-of-position
LORAN . . . .	Long Range Navigation System
LP . . . . .	Localizer Performance
LPV . . . . .	Localizer Performance with Vertical Guidance
LUAW . . . . .	Line Up and Wait
LZ . . . . .	Landing Zone
MAHWP . . .	Missed Approach Holding Waypoint
MAP . . . . .	Missed Approach Point
MAWP . . . . .	Missed Approach Waypoint
MDA . . . . .	Minimum Descent Altitude
MEA . . . . .	Minimum En Route Altitude
MEARTS . . .	Micro En Route Automated Radar Tracking System
METAR . . . .	Aviation Routine Weather Report
MHz . . . . .	Megahertz
MIRL . . . . .	Medium Intensity Runway Lights
MM . . . . .	Middle Marker
MOA . . . . .	Military Operations Area
MOCA . . . . .	Minimum Obstruction Clearance Altitude
MRA . . . . .	Minimum Reception Altitude
MRB . . . . .	Magnetic Reference Bearing
MSA . . . . .	Minimum Safe Altitude
MSAW . . . . .	Minimum Safe Altitude Warning
MSL . . . . .	Mean Sea Level
MTI . . . . .	Moving Target Indicator
MTOS . . . . .	Mountain Obscuration
MTR . . . . .	Military Training Route
MVA . . . . .	Minimum Vectoring Altitude
MWA . . . . .	Mountain Wave Activity
MWO . . . . .	Meteorological Watch Office
NAS . . . . .	National Airspace System
NASA . . . . .	National Aeronautics and Space Administration
NAVAID . . . .	Navigational Aid
NAVCEN . . .	Coast Guard Navigation Center
NCWF . . . . .	National Convective Weather Forecast
NDB . . . . .	Nondirectional Radio Beacon
NEXRAD . . .	Next Generation Weather Radar
NFDC . . . . .	National Flight Data Center
NGA . . . . .	National Geospatial-Intelligence Agency
NM . . . . .	Nautical Mile
NMAC . . . . .	Near Midair Collision

<b>Abbreviation/ Acronym</b>	<b>Meaning</b>
NOAA . . . . .	National Oceanic and Atmospheric Administration
NOPAC . . . .	North Pacific
NoPT . . . . .	No Procedure Turn Required
NPA . . . . .	Nonprecision Approach
NRS . . . . .	Navigation Reference System
NSA . . . . .	National Security Area
NSW . . . . .	No Significant Weather
NTSB . . . . .	National Transportation Safety Board
NTZ . . . . .	No Transgression Zone
NWS . . . . .	National Weather Service
OAT . . . . .	Outside Air Temperature
OBS . . . . .	Omni-bearing Selector
ODP . . . . .	Obstacle Departure Procedure
OIS . . . . .	Operational Information System
OIS . . . . .	Obstacle Identification Surface
OM . . . . .	Outer Marker
ORD . . . . .	Chicago O'Hare International Airport
PA . . . . .	Precision Approach
PAPI . . . . .	Precision Approach Path Indicator
PAR . . . . .	Precision Approach Radar
PAR . . . . .	Preferred Arrival Route
PC . . . . .	Personal Computer
P/CG . . . . .	Pilot/Controller Glossary
PDC . . . . .	Pre-departure Clearance
PFD . . . . .	Personal Flotation Device
PinS . . . . .	Point-in-Space
PIREP . . . . .	Pilot Weather Report
POB . . . . .	Persons on Board
POFZ . . . . .	Precision Obstacle Free Zone
POI . . . . .	Principal Operations Inspector
PPS . . . . .	Precise Positioning Service
PRM . . . . .	Precision Runway Monitor
PT . . . . .	Procedure Turn
QICP . . . . .	Qualified Internet Communications Provider
RA . . . . .	Resolution Advisory
RAA . . . . .	Remote Advisory Airport
RAIM . . . . .	Receiver Autonomous Integrity Monitoring
RAIS . . . . .	Remote Airport Information Service
RBDT . . . . .	Ribbon Display Terminals
RCAG . . . . .	Remote Center Air/Ground
RCC . . . . .	Rescue Coordination Center
RCLS . . . . .	Runway Centerline Lighting System
RCO . . . . .	Remote Communications Outlet
TAF . . . . .	Aerodrome Forecast
RD . . . . .	Rotor Diameter

Abbreviation/ Acronym	Meaning
REIL . . . . .	Runway End Identifier Lights
REL . . . . .	Runway Entrance Lights
RFM . . . . .	Rotorcraft Flight Manual
RLIM . . . . .	Runway Light Intensity Monitor
RMI . . . . .	Radio Magnetic Indicator
RNAV . . . . .	Area Navigation
RNP . . . . .	Required Navigation Performance
ROC . . . . .	Required Obstacle Clearance
RPAT . . . . .	RNP Parallel Approach Runway Transitions
RVR . . . . .	Runway Visual Range
RVSM . . . . .	Reduced Vertical Separation Minimum
RWSL . . . . .	Runway Status Light
SAFO . . . . .	Safety Alerts For Operators
SAM . . . . .	System Area Monitor
SAR . . . . .	Search and Rescue
SAS . . . . .	Stability Augmentation System
SATR . . . . .	Special Air Traffic Rules
SBAS . . . . .	Satellite-based Augmentation System
SCAT-1 DGPS . . . . .	Special Category I Differential GPS
SDF . . . . .	Simplified Directional Facility
SFL . . . . .	Sequenced Flashing Lights
SFR . . . . .	Special Flight Rules
SFRA . . . . .	Special Flight Rules Area
SIAP . . . . .	Standard Instrument Approach Procedure
SID . . . . .	Standard Instrument Departure
SIGMET . . . . .	Significant Meteorological Information
SM . . . . .	Statute Mile
SMGCS . . . . .	Surface Movement Guidance Control System
SNR . . . . .	Signal-to-noise Ratio
SOIA . . . . .	Simultaneous Offset Instrument Approaches
SOP . . . . .	Standard Operating Procedure
SPC . . . . .	Storm Prediction Center
SPS . . . . .	Standard Positioning Service
STAR . . . . .	Standard Terminal Arrival
STARS . . . . .	Standard Terminal Automation Replacement System
STMP . . . . .	Special Traffic Management Program
TA . . . . .	Traffic Advisory
TAA . . . . .	Terminal Arrival Area
TAC . . . . .	Terminal Area Chart
TACAN . . . . .	Tactical Air Navigation
TAS . . . . .	True Air Speed
TCAS . . . . .	Traffic Alert and Collision Avoidance System
TCH . . . . .	Threshold Crossing Height

Abbreviation/ Acronym	Meaning
TD . . . . .	Time Difference
TDLS . . . . .	Tower Data Link System
TDWR . . . . .	Terminal Doppler Weather Radar
TDZ . . . . .	Touchdown Zone
TDZE . . . . .	Touchdown Zone Elevation
TDZL . . . . .	Touchdown Zone Lights
TEC . . . . .	Tower En Route Control
THL . . . . .	Takeoff Hold Lights
TIS . . . . .	Traffic Information Service
TIS-B . . . . .	Traffic Information Service-Broadcast
TLS . . . . .	Transponder Landing System
TPP . . . . .	Terminal Procedures Publications
TRSA . . . . .	Terminal Radar Service Area
TSO . . . . .	Technical Standard Order
TWIB . . . . .	Terminal Weather Information for Pilots System
UA . . . . .	Unmanned Aircraft
UAS . . . . .	Unmanned Aircraft System
UAV . . . . .	Unmanned Aerial Vehicle
UFO . . . . .	Unidentified Flying Object
UHF . . . . .	Ultrahigh Frequency
U.S. . . . .	United States
USCG . . . . .	United States Coast Guard
UTC . . . . .	Coordinated Universal Time
UWS . . . . .	Urgent Weather SIGMET
VAR . . . . .	Volcanic Activity Reporting
VASI . . . . .	Visual Approach Slope Indicator
VCOA . . . . .	Visual Climb Over the Airport
VDA . . . . .	Vertical Descent Angle
VDP . . . . .	Visual Descent Point
VFR . . . . .	Visual Flight Rules
VGSI . . . . .	Visual Glide Slope Indicator
VHF . . . . .	Very High Frequency
VIP . . . . .	Video Integrator Processor
VMC . . . . .	Visual Meteorological Conditions
V <sub>MINI</sub> . . . . .	Instrument flight minimum speed, utilized in complying with minimum limit speed requirements for instrument flight
VNAV . . . . .	Vertical Navigation
V <sub>NE</sub> . . . . .	Never exceed speed
V <sub>NEI</sub> . . . . .	Instrument flight never exceed speed, utilized instead of V <sub>NE</sub> for compliance with maximum limit speed requirements for instrument flight
VOR . . . . .	Very High Frequency Omni-directional Range
VORTAC . . . . .	VHF Omni-directional Range/Tactical Air Navigation
VOT . . . . .	VOR Test Facility

<b>Abbreviation/ Acronym</b>	<b>Meaning</b>
VR . . . . .	VFR Military Training Route
V <sub>REF</sub> . . . . .	The reference landing approach speed, usually about 1.3 times V <sub>SO</sub> plus 50 percent of the wind gust speed in excess of the mean wind speed.
V <sub>SO</sub> . . . . .	The stalling speed or the minimum steady flight speed in the landing configuration at maximum weight.
VTF . . . . .	Vector to Final
VV . . . . .	Vertical Visibility
VVI . . . . .	Vertical Velocity Indicator
V <sub>Y</sub> . . . . .	Speed for best rate of climb
V <sub>YI</sub> . . . . .	Instrument climb speed, utilized instead of V <sub>Y</sub> for compliance with the climb requirements for instrument flight
WA . . . . .	AIRMET
WAAS . . . . .	Wide Area Augmentation System

<b>Abbreviation/ Acronym</b>	<b>Meaning</b>
WFO . . . . .	Weather Forecast Office
WGS-84 . . . . .	World Geodetic System of 1984
WMO . . . . .	World Meteorological Organization
WMS . . . . .	Wide-Area Master Station
WMSC . . . . .	Weather Message Switching Center
WMSCR . . . . .	Weather Message Switching Center Replacement
WP . . . . .	Waypoint
WRA . . . . .	Weather Reconnaissance Area
WRS . . . . .	Wide-Area Ground Reference Station
WS . . . . .	SIGMET
WSO . . . . .	Weather Service Office
WSP . . . . .	Weather System Processor
WST . . . . .	Convective Significant Meteorological Information
WW . . . . .	Severe Weather Watch Bulletin



# PILOT/CONTROLLER GLOSSARY

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## PURPOSE

a. This Glossary was compiled to promote a common understanding of the terms used in the Air Traffic Control system. It includes those terms which are intended for pilot/controller communications. Those terms most frequently used in pilot/controller communications are printed in *bold italics*. The definitions are primarily defined in an operational sense applicable to both users and operators of the National Airspace System. Use of the Glossary will preclude any misunderstandings concerning the system's design, function, and purpose.

b. Because of the international nature of flying, terms used in the Lexicon, published by the International Civil Aviation Organization (ICAO), are included when they differ from FAA definitions. These terms are followed by "[ICAO]." For the reader's convenience, there are also cross references to related terms in other parts of the Glossary and to other documents, such as the Code of Federal Regulations (CFR) and the Aeronautical Information Manual (AIM).

c. This Glossary will be revised, as necessary, to maintain a common understanding of the system.

## EXPLANATION OF CHANGES

d. Terms Added:

AUTOMATED EMERGENCY DESCENT  
EMERGENCY AUTOLAND SYSTEM  
EMERGENCY DESCENT MODE  
STNR ALT RESERVATION

e. Terms Deleted:

TELEPHONE INFORMATION BRIEFING SERVICE  
TIBS  
TRANSCRIBED WEATHER BROADCAST (TWEB)  
TWEB

f. Terms Modified:

GROSS NAVIGATION ERROR (GNE)  
GROUND COMMUNICATION OUTLET (GCO)  
STATIONARY RESERVATIONS

g. Editorial/format changes were made where necessary. Revision bars were not used due to the insignificant nature of the changes.



# A

**AAI-**

(See ARRIVAL AIRCRAFT INTERVAL.)

**AAR-**

(See AIRPORT ARRIVAL RATE.)

**ABBREVIATED IFR FLIGHT PLANS-** An authorization by ATC requiring pilots to submit only that information needed for the purpose of ATC. It includes only a small portion of the usual IFR flight plan information. In certain instances, this may be only aircraft identification, location, and pilot request. Other information may be requested if needed by ATC for separation/control purposes. It is frequently used by aircraft which are airborne and desire an instrument approach or by aircraft which are on the ground and desire a climb to VFR-on-top.

(See VFR-ON-TOP.)

(Refer to AIM.)

**ABEAM-** An aircraft is “abeam” a fix, point, or object when that fix, point, or object is approximately 90 degrees to the right or left of the aircraft track. Abeam indicates a general position rather than a precise point.

**ABORT-** To terminate a preplanned aircraft maneuver; e.g., an aborted takeoff.

**ACC [ICAO]-**

(See ICAO term AREA CONTROL CENTER.)

**ACCELERATE-STOP DISTANCE AVAILABLE-**

The runway plus stopway length declared available and suitable for the acceleration and deceleration of an airplane aborting a takeoff.

**ACCELERATE-STOP DISTANCE AVAILABLE**

[ICAO]- The length of the take-off run available plus the length of the stopway if provided.

**ACDO-**

(See AIR CARRIER DISTRICT OFFICE.)

**ACKNOWLEDGE-** Let me know that you have received and understood this message.

**ACL-**

(See AIRCRAFT LIST.)

**ACLS-**

(See AUTOMATIC CARRIER LANDING SYSTEM.)

**ACLT-**

(See ACTUAL CALCULATED LANDING TIME.)

**ACROBATIC FLIGHT-** An intentional maneuver involving an abrupt change in an aircraft’s attitude, an abnormal attitude, or abnormal acceleration not necessary for normal flight.

(See ICAO term ACROBATIC FLIGHT.)

(Refer to 14 CFR Part 91.)

**ACROBATIC FLIGHT [ICAO]-** Maneuvers intentionally performed by an aircraft involving an abrupt change in its attitude, an abnormal attitude, or an abnormal variation in speed.

**ACTIVE RUNWAY-**

(See RUNWAY IN USE/ACTIVE RUNWAY/DUTY RUNWAY.)

**ACTUAL CALCULATED LANDING TIME-**

ACLT is a flight’s frozen calculated landing time. An actual time determined at freeze calculated landing time (FCLT) or meter list display interval (MLDI) for the adapted vertex for each arrival aircraft based upon runway configuration, airport acceptance rate, airport arrival delay period, and other metered arrival aircraft. This time is either the vertex time of arrival (VTA) of the aircraft or the tentative calculated landing time (TCLT)/ACLT of the previous aircraft plus the arrival aircraft interval (AAI), whichever is later. This time will not be updated in response to the aircraft’s progress.

**ACTUAL NAVIGATION PERFORMANCE (ANP)-**

(See REQUIRED NAVIGATION PERFORMANCE.)

**ADDITIONAL SERVICES-** Advisory information provided by ATC which includes but is not limited to the following:

a. Traffic advisories.

b. Vectors, when requested by the pilot, to assist aircraft receiving traffic advisories to avoid observed traffic.

c. Altitude deviation information of 300 feet or more from an assigned altitude as observed on a verified (reading correctly) automatic altitude readout (Mode C).

d. Advisories that traffic is no longer a factor.

- e. Weather and chaff information.
- f. Weather assistance.
- g. Bird activity information.
- h. Holding pattern surveillance. Additional services are provided to the extent possible contingent only upon the controller's capability to fit them into the performance of higher priority duties and on the basis of limitations of the radar, volume of traffic, frequency congestion, and controller workload. The controller has complete discretion for determining if he/she is able to provide or continue to provide a service in a particular case. The controller's reason not to provide or continue to provide a service in a particular case is not subject to question by the pilot and need not be made known to him/her.

(See TRAFFIC ADVISORIES.)

(Refer to AIM.)

ADF-

(See AUTOMATIC DIRECTION FINDER.)

ADIZ-

(See AIR DEFENSE IDENTIFICATION ZONE.)

ADLY-

(See ARRIVAL DELAY.)

**ADMINISTRATOR**- The Federal Aviation Administrator or any person to whom he/she has delegated his/her authority in the matter concerned.

ADR-

(See AIRPORT DEPARTURE RATE.)

ADS [ICAO]-

(See ICAO term AUTOMATIC DEPENDENT SURVEILLANCE.)

ADS-B-

(See AUTOMATIC DEPENDENT SURVEILLANCE-BROADCAST.)

ADS-C-

(See AUTOMATIC DEPENDENT SURVEILLANCE-CONTRACT.)

**ADVISE INTENTIONS**- Tell me what you plan to do.

**ADVISORY**- Advice and information provided to assist pilots in the safe conduct of flight and aircraft movement.

(See ADVISORY SERVICE.)

**ADVISORY FREQUENCY**- The appropriate frequency to be used for Airport Advisory Service.

(See LOCAL AIRPORT ADVISORY.)

(See UNICOM.)

(Refer to ADVISORY CIRCULAR NO. 90-66.)

(Refer to AIM.)

**ADVISORY SERVICE**- Advice and information provided by a facility to assist pilots in the safe conduct of flight and aircraft movement.

(See ADDITIONAL SERVICES.)

(See LOCAL AIRPORT ADVISORY.)

(See RADAR ADVISORY.)

(See SAFETY ALERT.)

(See TRAFFIC ADVISORIES.)

(Refer to AIM.)

**AERIAL REFUELING**- A procedure used by the military to transfer fuel from one aircraft to another during flight.

(Refer to VFR/IFR Wall Planning Charts.)

**AERODROME**- A defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure, and movement of aircraft.

**AERODROME BEACON [ICAO]**- Aeronautical beacon used to indicate the location of an aerodrome from the air.

**AERODROME CONTROL SERVICE [ICAO]**- Air traffic control service for aerodrome traffic.

**AERODROME CONTROL TOWER [ICAO]**- A unit established to provide air traffic control service to aerodrome traffic.

**AERODROME ELEVATION [ICAO]**- The elevation of the highest point of the landing area.

**AERODROME TRAFFIC CIRCUIT [ICAO]**- The specified path to be flown by aircraft operating in the vicinity of an aerodrome.

**AERONAUTICAL BEACON**- A visual NAVAID displaying flashes of white and/or colored light to indicate the location of an airport, a heliport, a landmark, a certain point of a Federal airway in mountainous terrain, or an obstruction.

(See AIRPORT ROTATING BEACON.)

(Refer to AIM.)

**AERONAUTICAL CHART**- A map used in air navigation containing all or part of the following: topographic features, hazards and obstructions,

clearance and other pertinent information is provided in the approach clearance when required.

(See CLEARED APPROACH.)

(See INSTRUMENT APPROACH PROCEDURE.)

(Refer to AIM.)

(Refer to 14 CFR Part 91.)

**APPROACH CONTROL FACILITY**– A terminal ATC facility that provides approach control service in a terminal area.

(See APPROACH CONTROL SERVICE.)

(See RADAR APPROACH CONTROL FACILITY.)

**APPROACH CONTROL SERVICE**– Air traffic control service provided by an approach control facility for arriving and departing VFR/IFR aircraft and, on occasion, en route aircraft. At some airports not served by an approach control facility, the ARTCC provides limited approach control service.

(See ICAO term APPROACH CONTROL SERVICE.)

(Refer to AIM.)

**APPROACH CONTROL SERVICE [ICAO]**– Air traffic control service for arriving or departing controlled flights.

**APPROACH GATE**– An imaginary point used within ATC as a basis for vectoring aircraft to the final approach course. The gate will be established along the final approach course 1 mile from the final approach fix on the side away from the airport and will be no closer than 5 miles from the landing threshold.

**APPROACH/DEPARTURE HOLD AREA**– The locations on taxiways in the approach or departure areas of a runway designated to protect landing or departing aircraft. These locations are identified by signs and markings.

**APPROACH LIGHT SYSTEM**–

(See AIRPORT LIGHTING.)

**APPROACH SEQUENCE**– The order in which aircraft are positioned while on approach or awaiting approach clearance.

(See LANDING SEQUENCE.)

(See ICAO term APPROACH SEQUENCE.)

**APPROACH SEQUENCE [ICAO]**– The order in which two or more aircraft are cleared to approach to land at the aerodrome.

**APPROACH SPEED**– The recommended speed contained in aircraft manuals used by pilots when making an approach to landing. This speed will vary for different segments of an approach as well as for aircraft weight and configuration.

**APPROACH WITH VERTICAL GUIDANCE (APV)**– A term used to describe RNAV approach procedures that provide lateral and vertical guidance but do not meet the requirements to be considered a precision approach.

**APPROPRIATE ATS AUTHORITY [ICAO]**– The relevant authority designated by the State responsible for providing air traffic services in the airspace concerned. In the United States, the “appropriate ATS authority” is the Program Director for Air Traffic Planning and Procedures, ATP-1.

**APPROPRIATE AUTHORITY**–

a. Regarding flight over the high seas: the relevant authority is the State of Registry.

b. Regarding flight over other than the high seas: the relevant authority is the State having sovereignty over the territory being overflown.

**APPROPRIATE OBSTACLE CLEARANCE MINIMUM ALTITUDE**– Any of the following:

(See MINIMUM EN ROUTE IFR ALTITUDE.)

(See MINIMUM IFR ALTITUDE.)

(See MINIMUM OBSTRUCTION CLEARANCE ALTITUDE.)

(See MINIMUM VECTORING ALTITUDE.)

**APPROPRIATE TERRAIN CLEARANCE MINIMUM ALTITUDE**– Any of the following:

(See MINIMUM EN ROUTE IFR ALTITUDE.)

(See MINIMUM IFR ALTITUDE.)

(See MINIMUM OBSTRUCTION CLEARANCE ALTITUDE.)

(See MINIMUM VECTORING ALTITUDE.)

**APRON**– A defined area on an airport or heliport intended to accommodate aircraft for purposes of loading or unloading passengers or cargo, refueling, parking, or maintenance. With regard to seaplanes, a ramp is used for access to the apron from the water.

(See ICAO term APRON.)

**APRON [ICAO]**– A defined area, on a land aerodrome, intended to accommodate aircraft for purposes of loading or unloading passengers, mail or cargo, refueling, parking or maintenance.

**ARC**– The track over the ground of an aircraft flying at a constant distance from a navigational aid by reference to distance measuring equipment (DME).

**AREA CONTROL CENTER [ICAO]**– An air traffic control facility primarily responsible for ATC services being provided IFR aircraft during the en route phase of flight. The U.S. equivalent facility is an air route traffic control center (ARTCC).

**AREA NAVIGATION (RNAV)**– A method of navigation which permits aircraft operation on any desired flight path within the coverage of ground- or space-based navigation aids or within the limits of the capability of self-contained aids, or a combination of these.

Note: Area navigation includes performance-based navigation as well as other operations that do not meet the definition of performance-based navigation.

**AREA NAVIGATION (RNAV) APPROACH CONFIGURATION:**

**a. STANDARD T**– An RNAV approach whose design allows direct flight to any one of three initial approach fixes (IAF) and eliminates the need for procedure turns. The standard design is to align the procedure on the extended centerline with the missed approach point (MAP) at the runway threshold, the final approach fix (FAF), and the initial approach/intermediate fix (IAF/IF). The other two IAFs will be established perpendicular to the IF.

**b. MODIFIED T**– An RNAV approach design for single or multiple runways where terrain or operational constraints do not allow for the standard T. The “T” may be modified by increasing or decreasing the angle from the corner IAF(s) to the IF or by eliminating one or both corner IAFs.

**c. STANDARD I**– An RNAV approach design for a single runway with both corner IAFs eliminated. Course reversal or radar vectoring may be required at busy terminals with multiple runways.

**d. TERMINAL ARRIVAL AREA (TAA)**– The TAA is controlled airspace established in conjunction with the Standard or Modified T and I RNAV approach configurations. In the standard TAA, there are three areas: straight-in, left base, and right base. The arc boundaries of the three areas of the TAA are published portions of the approach and allow aircraft to transition from the en route structure direct to the nearest IAF. TAAs will also eliminate or reduce feeder routes, departure extensions, and procedure turns or course reversal.

**1. STRAIGHT-IN AREA**– A 30 NM arc centered on the IF bounded by a straight line extending through the IF perpendicular to the intermediate course.

**2. LEFT BASE AREA**– A 30 NM arc centered on the right corner IAF. The area shares a boundary with the straight-in area except that it extends out for 30 NM from the IAF and is bounded on the other side by a line extending from the IF through the FAF to the arc.

**3. RIGHT BASE AREA**– A 30 NM arc centered on the left corner IAF. The area shares a boundary with the straight-in area except that it extends out for 30 NM from the IAF and is bounded on the other side by a line extending from the IF through the FAF to the arc.

**AREA NAVIGATION (RNAV) GLOBAL POSITIONING SYSTEM (GPS) PRECISION RUNWAY MONITORING (PRM) APPROACH**–

A GPS approach, which requires vertical guidance, used in lieu of another type of PRM approach to conduct approaches to parallel runways whose extended centerlines are separated by less than 4,300 feet and at least 3,000 feet, where simultaneous close parallel approaches are permitted. Also used in lieu of an ILS PRM and/or LDA PRM approach to conduct Simultaneous Offset Instrument Approach (SOIA) operations.

**ARINC**– An acronym for Aeronautical Radio, Inc., a corporation largely owned by a group of airlines. ARINC is licensed by the FCC as an aeronautical station and contracted by the FAA to provide communications support for air traffic control and meteorological services in portions of international airspace.

**ARMY AVIATION FLIGHT INFORMATION BULLETIN**– A bulletin that provides air operation data covering Army, National Guard, and Army Reserve aviation activities.

**ARO**–

(See AIRPORT RESERVATION OFFICE.)

**ARRESTING SYSTEM**– A safety device consisting of two major components, namely, engaging or catching devices and energy absorption devices for the purpose of arresting both tailhook and/or nontailhook-equipped aircraft. It is used to prevent aircraft from overrunning runways when the aircraft cannot be stopped after landing or during aborted

takeoff. Arresting systems have various names; e.g., arresting gear, hook device, wire barrier cable.

(See ABORT.)

(Refer to AIM.)

**ARRIVAL AIRCRAFT INTERVAL**– An internally generated program in hundredths of minutes based upon the AAR. AAI is the desired optimum interval between successive arrival aircraft over the vertex.

**ARRIVAL CENTER**– The ARTCC having jurisdiction for the impacted airport.

**ARRIVAL DELAY**– A parameter which specifies a period of time in which no aircraft will be metered for arrival at the specified airport.

**ARRIVAL SECTOR**– An operational control sector containing one or more meter fixes.

**ARRIVAL SECTOR ADVISORY LIST**– An ordered list of data on arrivals displayed at the PVD/MDM of the sector which controls the meter fix.

**ARRIVAL SEQUENCING PROGRAM**– The automated program designed to assist in sequencing aircraft destined for the same airport.

**ARRIVAL TIME**– The time an aircraft touches down on arrival.

**ARSR**–

(See AIR ROUTE SURVEILLANCE RADAR.)

**ARTCC**–

(See AIR ROUTE TRAFFIC CONTROL CENTER.)

**ASDA**–

(See ACCELERATE-STOP DISTANCE AVAILABLE.)

**ASDA [ICAO]**–

(See ICAO Term ACCELERATE-STOP DISTANCE AVAILABLE.)

**ASDE**–

(See AIRPORT SURFACE DETECTION EQUIPMENT.)

**ASF**–

(See AIRPORT STREAM FILTER.)

**ASLAR**–

(See AIRCRAFT SURGE LAUNCH AND RECOVERY.)

**ASP**–

(See ARRIVAL SEQUENCING PROGRAM.)

**ASR**–

(See AIRPORT SURVEILLANCE RADAR.)

**ASR APPROACH**–

(See SURVEILLANCE APPROACH.)

**ASSOCIATED**– A radar target displaying a data block with flight identification and altitude information.

(See UNASSOCIATED.)

**ATC**–

(See AIR TRAFFIC CONTROL.)

**ATC ADVISES**– Used to prefix a message of noncontrol information when it is relayed to an aircraft by other than an air traffic controller.

(See ADVISORY.)

**ATC ASSIGNED AIRSPACE**– Airspace of defined vertical/lateral limits, assigned by ATC, for the purpose of providing air traffic segregation between the specified activities being conducted within the assigned airspace and other IFR air traffic.

(See SPECIAL USE AIRSPACE.)

**ATC CLEARANCE**–

(See AIR TRAFFIC CLEARANCE.)

**ATC CLEARS**– Used to prefix an ATC clearance when it is relayed to an aircraft by other than an air traffic controller.

**ATC INSTRUCTIONS**– Directives issued by air traffic control for the purpose of requiring a pilot to take specific actions; e.g., “Turn left heading two five zero,” “Go around,” “Clear the runway.”

(Refer to 14 CFR Part 91.)

**ATC PREFERRED ROUTE NOTIFICATION**– EDST notification to the appropriate controller of the need to determine if an ATC preferred route needs to be applied, based on destination airport.

(See ROUTE ACTION NOTIFICATION.)

(See EN ROUTE DECISION SUPPORT TOOL.)

**ATC PREFERRED ROUTES**– Preferred routes that are not automatically applied by Host.

**ATC REQUESTS**– Used to prefix an ATC request when it is relayed to an aircraft by other than an air traffic controller.

**ATC SECURITY SERVICES**– Communications and security tracking provided by an ATC facility in

support of the DHS, the DOD, or other Federal security elements in the interest of national security. Such security services are only applicable within designated areas. ATC security services do not include ATC basic radar services or flight following.

**ATC SECURITY SERVICES POSITION**– The position responsible for providing ATC security services as defined. This position does not provide ATC, IFR separation, or VFR flight following services, but is responsible for providing security services in an area comprising airspace assigned to one or more ATC operating sectors. This position may be combined with control positions.

**ATC SECURITY TRACKING**– The continuous tracking of aircraft movement by an ATC facility in support of the DHS, the DOD, or other security elements for national security using radar (i.e., radar tracking) or other means (e.g., manual tracking) without providing basic radar services (including traffic advisories) or other ATC services not defined in this section.

**ATS SURVEILLANCE SERVICE [ICAO]**– A term used to indicate a service provided directly by means of an ATS surveillance system.

**ATC SURVEILLANCE SOURCE**– Used by ATC for establishing identification, control and separation using a target depicted on an air traffic control facility’s video display that has met the relevant safety standards for operational use and received from one, or a combination, of the following surveillance sources:

- a. Radar (See RADAR.)
- b. ADS-B (See AUTOMATIC DEPENDENT SURVEILLANCE–BROADCAST.)
- c. WAM (See WIDE AREA MULTILATERATION.)  
(See INTERROGATOR.)  
(See TRANSPONDER.)  
(See ICAO term RADAR.)  
(Refer to AIM.)

**ATS SURVEILLANCE SYSTEM [ICAO]**– A generic term meaning variously, ADS–B, PSR, SSR or any comparable ground–based system that enables the identification of aircraft.

**Note:** A comparable ground–based system is one that has been demonstrated, by comparative assessment or other methodology, to have a level of safety and performance equal to or better than monopulse SSR.

**ATCAA**–  
(See ATC ASSIGNED AIRSPACE.)

**ATCRBS**–  
(See RADAR.)

**ATCSCC**–  
(See AIR TRAFFIC CONTROL SYSTEM COMMAND CENTER.)

**ATCT**–  
(See TOWER.)

**ATD**–  
(See ALONG–TRACK DISTANCE.)

**ATIS**–  
(See AUTOMATIC TERMINAL INFORMATION SERVICE.)

**ATIS [ICAO]**–  
(See ICAO Term AUTOMATIC TERMINAL INFORMATION SERVICE.)

**ATS ROUTE [ICAO]**– A specified route designed for channeling the flow of traffic as necessary for the provision of air traffic services.

**Note:** The term “ATS Route” is used to mean variously, airway, advisory route, controlled or uncontrolled route, arrival or departure, etc.

**ATTENTION ALL USERS PAGE (AAUP)**– The AAUP provides the pilot with additional information relative to conducting a specific operation, for example, PRM approaches and RNAV departures.

**AUTOLAND APPROACH**–An autoland system aids by providing control of aircraft systems during a precision instrument approach to at least decision altitude and possibly all the way to touchdown, as well as in some cases, through the landing rollout. The autoland system is a sub-system of the autopilot system from which control surface management occurs. The aircraft autopilot sends instructions to the autoland system and monitors the autoland system performance and integrity during its execution.

**AUTOMATED EMERGENCY DESCENT**–  
(See EMERGENCY DESCENT MODE.)

**AUTOMATED INFORMATION TRANSFER (AIT)**– A precoordinated process, specifically defined in facility directives, during which a transfer of altitude control and/or radar identification is accomplished without verbal coordination between controllers using information communicated in a full data block.

**AUTOMATED MUTUAL-ASSISTANCE VESSEL RESCUE SYSTEM**– A facility which can deliver, in a matter of minutes, a surface picture (SURPIC) of vessels in the area of a potential or actual search and rescue incident, including their predicted positions and their characteristics.

(See FAA Order JO 7110.65, Para 10–6–4, INFLIGHT CONTINGENCIES.)

**AUTOMATED PROBLEM DETECTION (APD)**– An Automation Processing capability that compares trajectories in order to predict conflicts.

**AUTOMATED PROBLEM DETECTION BOUNDARY (APB)**– The adapted distance beyond a facilities boundary defining the airspace within which EDST performs conflict detection.

(See EN ROUTE DECISION SUPPORT TOOL.)

**AUTOMATED PROBLEM DETECTION INHIBITED AREA (APDIA)**– Airspace surrounding a terminal area within which APD is inhibited for all flights within that airspace.

**AUTOMATED WEATHER SYSTEM**– Any of the automated weather sensor platforms that collect weather data at airports and disseminate the weather information via radio and/or landline. The systems currently consist of the Automated Surface Observing System (ASOS) and Automated Weather Observation System (AWOS).

**AUTOMATED UNICOM**– Provides completely automated weather, radio check capability and airport advisory information on an Automated UNICOM system. These systems offer a variety of features, typically selectable by microphone clicks, on the UNICOM frequency. Availability will be published in the Chart Supplement U.S. and approach charts.

**AUTOMATIC ALTITUDE REPORT**–

(See ALTITUDE READOUT.)

**AUTOMATIC ALTITUDE REPORTING**– That function of a transponder which responds to Mode C interrogations by transmitting the aircraft's altitude in 100-foot increments.

**AUTOMATIC CARRIER LANDING SYSTEM**– U.S. Navy final approach equipment consisting of precision tracking radar coupled to a computer data link to provide continuous information to the aircraft, monitoring capability to the pilot, and a backup approach system.

**AUTOMATIC DEPENDENT SURVEILLANCE (ADS) [ICAO]**– A surveillance technique in which aircraft automatically provide, via a data link, data derived from on-board navigation and position fixing systems, including aircraft identification, four dimensional position and additional data as appropriate.

**AUTOMATIC DEPENDENT SURVEILLANCE–BROADCAST (ADS-B)**– A surveillance system in which an aircraft or vehicle to be detected is fitted with cooperative equipment in the form of a data link transmitter. The aircraft or vehicle periodically broadcasts its GNSS-derived position and other required information such as identity and velocity, which is then received by a ground-based or space-based receiver for processing and display at an air traffic control facility, as well as by suitably equipped aircraft.

(See AUTOMATIC DEPENDENT SURVEILLANCE–BROADCAST IN.)

(See AUTOMATIC DEPENDENT SURVEILLANCE–BROADCAST OUT.)

(See COOPERATIVE SURVEILLANCE.)

(See GLOBAL POSITIONING SYSTEM.)

(See SPACE–BASED ADS–B.)

**AUTOMATIC DEPENDENT SURVEILLANCE–BROADCAST IN (ADS–B In)**– Aircraft avionics capable of receiving ADS–B Out transmissions directly from other aircraft, as well as traffic or weather information transmitted from ground stations.

(See AUTOMATIC DEPENDENT SURVEILLANCE–BROADCAST OUT.)

(See AUTOMATIC DEPENDENT SURVEILLANCE–REBROADCAST.)

(See FLIGHT INFORMATION SERVICE–BROADCAST.)

(See TRAFFIC INFORMATION SERVICE–BROADCAST.)

**AUTOMATIC DEPENDENT SURVEILLANCE–BROADCAST OUT (ADS–B Out)**– The transmitter onboard an aircraft or ground vehicle that periodically broadcasts its GNSS-derived position along with other required information, such as identity, altitude, and velocity.

(See AUTOMATIC DEPENDENT SURVEILLANCE–BROADCAST.)

(See AUTOMATIC DEPENDENT SURVEILLANCE–BROADCAST IN.)

**AUTOMATIC DEPENDENT SURVEILLANCE-CONTRACT (ADS-C)**– A data link position reporting system, controlled by a ground station, that establishes contracts with an aircraft’s avionics that occur automatically whenever specific events occur, or specific time intervals are reached.

**AUTOMATIC DEPENDENT SURVEILLANCE-REBROADCAST (ADS-R)**– A datalink translation function of the ADS-B ground system required to accommodate the two separate operating frequencies (978 MHz and 1090 MHz). The ADS-B system receives the ADS-B messages transmitted on one frequency and ADS-R translates and reformats the information for rebroadcast and use on the other frequency. This allows ADS-B In equipped aircraft to see nearby ADS-B Out traffic regardless of the operating link of the other aircraft. Aircraft operating on the same ADS-B frequency exchange information directly and do not require the ADS-R translation function.

**AUTOMATIC DIRECTION FINDER**– An aircraft radio navigation system which senses and indicates the direction to a L/MF nondirectional radio beacon (NDB) ground transmitter. Direction is indicated to the pilot as a magnetic bearing or as a relative bearing to the longitudinal axis of the aircraft depending on the type of indicator installed in the aircraft. In certain applications, such as military, ADF operations may be based on airborne and ground transmitters in the VHF/UHF frequency spectrum.

(See BEARING.)

(See NONDIRECTIONAL BEACON.)

**AUTOMATIC FLIGHT INFORMATION SERVICE (AFIS) – ALASKA FSSs ONLY**– The continuous broadcast of recorded non-control information at airports in Alaska where a FSS provides local airport advisory service. The AFIS broadcast automates the repetitive transmission of essential but routine information such as weather, wind, altimeter, favored runway, braking action, airport NOTAMs, and other applicable information. The information is continuously broadcast over a discrete VHF radio frequency (usually the ASOS/AWOS frequency).

**AUTOMATIC TERMINAL INFORMATION SERVICE**– The continuous broadcast of recorded noncontrol information in selected terminal areas. Its purpose is to improve controller effectiveness and to

relieve frequency congestion by automating the repetitive transmission of essential but routine information; e.g., “Los Angeles information Alfa. One three zero zero Coordinated Universal Time. Weather, measured ceiling two thousand overcast, visibility three, haze, smoke, temperature seven one, dew point five seven, wind two five zero at five, altimeter two niner niner six. I-L-S Runway Two Five Left approach in use, Runway Two Five Right closed, advise you have Alfa.”

(See ICAO term AUTOMATIC TERMINAL INFORMATION SERVICE.)

(Refer to AIM.)

**AUTOMATIC TERMINAL INFORMATION SERVICE [ICAO]**– The provision of current, routine information to arriving and departing aircraft by means of continuous and repetitive broadcasts throughout the day or a specified portion of the day.

**AUTOROTATION**– A rotorcraft flight condition in which the lifting rotor is driven entirely by action of the air when the rotorcraft is in motion.

**a. Autorotative Landing/Touchdown Autorotation.** Used by a pilot to indicate that the landing will be made without applying power to the rotor.

**b. Low Level Autorotation.** Commences at an altitude well below the traffic pattern, usually below 100 feet AGL and is used primarily for tactical military training.

**c. 180 degrees Autorotation.** Initiated from a downwind heading and is commenced well inside the normal traffic pattern. “Go around” may not be possible during the latter part of this maneuver.

**AVAILABLE LANDING DISTANCE (ALD)**– The portion of a runway available for landing and roll-out for aircraft cleared for LAHSO. This distance is measured from the landing threshold to the hold-short point.

**AVIATION WEATHER SERVICE**– A service provided by the National Weather Service (NWS) and FAA which collects and disseminates pertinent weather information for pilots, aircraft operators, and ATC. Available aviation weather reports and forecasts are displayed at each NWS office and FAA FSS.

(See TRANSCRIBED WEATHER BROADCAST.)

(See WEATHER ADVISORY.)

(Refer to AIM.)

AWW-  
(See SEVERE WEATHER FORECAST  
ALERTS.)



# B

**BACK-TAXI**– A term used by air traffic controllers to taxi an aircraft on the runway opposite to the traffic flow. The aircraft may be instructed to back-taxi to the beginning of the runway or at some point before reaching the runway end for the purpose of departure or to exit the runway.

**BASE LEG**–

(See TRAFFIC PATTERN.)

**BEACON**–

(See AERONAUTICAL BEACON.)

(See AIRPORT ROTATING BEACON.)

(See AIRWAY BEACON.)

(See MARKER BEACON.)

(See NONDIRECTIONAL BEACON.)

(See RADAR.)

**BEARING**– The horizontal direction to or from any point, usually measured clockwise from true north, magnetic north, or some other reference point through 360 degrees.

(See NONDIRECTIONAL BEACON.)

**BELOW MINIMUMS**– Weather conditions below the minimums prescribed by regulation for the particular action involved; e.g., landing minimums, takeoff minimums.

**BLAST FENCE**– A barrier that is used to divert or dissipate jet or propeller blast.

**BLAST PAD**– A surface adjacent to the ends of a runway provided to reduce the erosive effect of jet blast and propeller wash.

**BLIND SPEED**– The rate of departure or closing of a target relative to the radar antenna at which cancellation of the primary radar target by moving target indicator (MTI) circuits in the radar equipment causes a reduction or complete loss of signal.

(See ICAO term BLIND VELOCITY.)

**BLIND SPOT**– An area from which radio transmissions and/or radar echoes cannot be received. The term is also used to describe portions of the airport not visible from the control tower.

**BLIND TRANSMISSION**–

(See TRANSMITTING IN THE BLIND.)

**BLIND VELOCITY [ICAO]**– The radial velocity of a moving target such that the target is not seen on primary radars fitted with certain forms of fixed echo suppression.

**BLIND ZONE**–

(See BLIND SPOT.)

**BLOCKED**– Phraseology used to indicate that a radio transmission has been distorted or interrupted due to multiple simultaneous radio transmissions.

**BOTTOM ALTITUDE**– In reference to published altitude restrictions on a STAR or STAR runway transition, the lowest altitude authorized.

**BOUNDARY LIGHTS**–

(See AIRPORT LIGHTING.)

**BRAKING ACTION (GOOD, GOOD TO MEDIUM, MEDIUM, MEDIUM TO POOR, POOR, OR NIL)**– A report of conditions on the airport movement area providing a pilot with a degree/quality of braking to expect. Braking action is reported in terms of good, good to medium, medium, medium to poor, poor, or nil.

(See RUNWAY CONDITION READING.)

(See RUNWAY CONDITION REPORT.)

(See RUNWAY CONDITION CODES.)

**BRAKING ACTION ADVISORIES**– When tower controllers receive runway braking action reports which include the terms “medium,” “poor,” or “nil,” or whenever weather conditions are conducive to deteriorating or rapidly changing runway braking conditions, the tower will include on the ATIS broadcast the statement, “Braking Action Advisories are in Effect.” During the time braking action advisories are in effect, ATC will issue the most current braking action report for the runway in use to each arriving and departing aircraft. Pilots should be prepared for deteriorating braking conditions and should request current runway condition information if not issued by controllers. Pilots should also be prepared to provide a descriptive runway condition report to controllers after landing.

**BREAKOUT**– A technique to direct aircraft out of the approach stream. In the context of simultaneous (independent) parallel operations, a breakout is used to direct threatened aircraft away from a deviating aircraft.

**BROADCAST**– Transmission of information for which an acknowledgement is not expected.

(See ICAO term **BROADCAST**.)

**BROADCAST [ICAO]**– A transmission of information relating to air navigation that is not addressed to a specific station or stations.

**BUFFER AREA**– As applied to an MVA or MIA chart, a depicted 3 NM or 5 NM radius MVA/MIA sector isolating a displayed obstacle for which the sector is established. A portion of a buffer area can also be inclusive of a MVA/MIA sector polygon boundary.

**COMMON ROUTE**– Typically the portion of a RNAV STAR between the en route transition end point and the runway transition start point; however, the common route may only consist of a single point that joins the en route and runway transitions.

**COMMON TRAFFIC ADVISORY FREQUENCY (CTAF)**– A frequency designed for the purpose of carrying out airport advisory practices while operating to or from an airport without an operating control tower. The CTAF may be a UNICOM, Multicom, FSS, or tower frequency and is identified in appropriate aeronautical publications.

(See DESIGNATED COMMON TRAFFIC ADVISORY FREQUENCY (CTAF) AREA.)

(Refer to AC 90-66, Non-Towered Airport Flight Operations.)

**COMPASS LOCATOR**– A low power, low or medium frequency (L/MF) radio beacon installed at the site of the outer or middle marker of an instrument landing system (ILS). It can be used for navigation at distances of approximately 15 miles or as authorized in the approach procedure.

**a. Outer Compass Locator (LOM)**– A compass locator installed at the site of the outer marker of an instrument landing system.

(See OUTER MARKER.)

**b. Middle Compass Locator (LMM)**– A compass locator installed at the site of the middle marker of an instrument landing system.

(See MIDDLE MARKER.)

(See ICAO term LOCATOR.)

**COMPASS ROSE**– A circle, graduated in degrees, printed on some charts or marked on the ground at an airport. It is used as a reference to either true or magnetic direction.

**COMPLY WITH RESTRICTIONS**– An ATC instruction that requires an aircraft being vectored back onto an arrival or departure procedure to comply with all altitude and/or speed restrictions depicted on the procedure. This term may be used in lieu of repeating each remaining restriction that appears on the procedure.

**COMPOSITE FLIGHT PLAN**– A flight plan which specifies VFR operation for one portion of flight and IFR for another portion. It is used primarily in military operations.

(Refer to AIM.)

**COMPULSORY REPORTING POINTS**– Reporting points which must be reported to ATC. They are designated on aeronautical charts by solid triangles or filed in a flight plan as fixes selected to define direct routes. These points are geographical locations which are defined by navigation aids/fixes. Pilots should discontinue position reporting over compulsory reporting points when informed by ATC that their aircraft is in “radar contact.”

**COMPUTER NAVIGATION FIX (CNF)**– A Computer Navigation Fix is a point defined by a latitude/longitude coordinate and is required to support Performance-Based Navigation (PBN) operations. A five-letter identifier denoting a CNF can be found next to an “x” on en route charts and on some approach charts. Eventually, all CNFs will be labeled and begin with the letters “CF” followed by three consonants (e.g., ‘CFWBG’). CNFs are not recognized by ATC, are not contained in ATC fix or automation databases, and are not used for ATC purposes. Pilots should not use CNFs for point-to-point navigation (e.g., proceed direct), filing a flight plan, or in aircraft/ATC communications. Use of CNFs has not been adopted or recognized by the International Civil Aviation Organization (ICAO).

(REFER to AIM 1-1-17b5(i)(2), Global Positioning System (GPS).)

**CONDITIONS NOT MONITORED**– When an airport operator cannot monitor the condition of the movement area or airfield surface area, this information is issued as a NOTAM. Usually necessitated due to staffing, operating hours or other mitigating factors associated with airport operations.

**CONFIDENCE MANEUVER**– A confidence maneuver consists of one or more turns, a climb or descent, or other maneuver to determine if the pilot in command (PIC) is able to receive and comply with ATC instructions.

**CONFLICT ALERT**– A function of certain air traffic control automated systems designed to alert radar controllers to existing or pending situations between tracked targets (known IFR or VFR aircraft) that require his/her immediate attention/action.

(See MODE C INTRUDER ALERT.)

**CONFLICT RESOLUTION**– The resolution of potential conflicts between aircraft that are radar identified and in communication with ATC by ensuring that radar targets do not touch. Pertinent

traffic advisories shall be issued when this procedure is applied.

**Note:** This procedure shall not be provided utilizing mosaic radar systems.

**CONFORMANCE**– The condition established when an aircraft’s actual position is within the conformance region constructed around that aircraft at its position, according to the trajectory associated with the aircraft’s Current Plan.

**CONFORMANCE REGION**– A volume, bounded laterally, vertically, and longitudinally, within which an aircraft must be at a given time in order to be in conformance with the Current Plan Trajectory for that aircraft. At a given time, the conformance region is determined by the simultaneous application of the lateral, vertical, and longitudinal conformance bounds for the aircraft at the position defined by time and aircraft’s trajectory.

**CONSOLAN**– A low frequency, long-distance NAVAID used principally for transoceanic navigations.

**CONTACT**–

**a.** Establish communication with (followed by the name of the facility and, if appropriate, the frequency to be used).

**b.** A flight condition wherein the pilot ascertains the attitude of his/her aircraft and navigates by visual reference to the surface.

(See CONTACT APPROACH.)

(See RADAR CONTACT.)

**CONTACT APPROACH**– An approach wherein an aircraft on an IFR flight plan, having an air traffic control authorization, operating clear of clouds with at least 1 mile flight visibility and a reasonable expectation of continuing to the destination airport in those conditions, may deviate from the instrument approach procedure and proceed to the destination airport by visual reference to the surface. This approach will only be authorized when requested by the pilot and the reported ground visibility at the destination airport is at least 1 statute mile.

(Refer to AIM.)

**CONTAMINATED RUNWAY**– A runway is considered contaminated whenever standing water, ice, snow, slush, frost in any form, heavy rubber, or other substances are present. A runway is contaminated with respect to rubber deposits or other

friction-degrading substances when the average friction value for any 500-foot segment of the runway within the ALD fails below the recommended minimum friction level and the average friction value in the adjacent 500-foot segments falls below the maintenance planning friction level.

**CONTERMINOUS U.S.**– The 48 adjoining States and the District of Columbia.

**CONTINENTAL UNITED STATES**– The 49 States located on the continent of North America and the District of Columbia.

**CONTINGENCY HAZARD AREA (CHA)**– Used by ATC. Areas of airspace that are defined and distributed in advance of a launch or reentry operation and are activated in response to a failure.

(See AIRCRAFT HAZARD AREA.)

(See REFINED HAZARD AREA.)

(See TRANSITIONAL HAZARD AREA.)

**CONTINUE**– When used as a control instruction should be followed by another word or words clarifying what is expected of the pilot. Example: “continue taxi,” “continue descent,” “continue inbound,” etc.

**CONTROL AREA [ICAO]**– A controlled airspace extending upwards from a specified limit above the earth.

**CONTROL SECTOR**– An airspace area of defined horizontal and vertical dimensions for which a controller or group of controllers has air traffic control responsibility, normally within an air route traffic control center or an approach control facility. Sectors are established based on predominant traffic flows, altitude strata, and controller workload. Pilot communications during operations within a sector are normally maintained on discrete frequencies assigned to the sector.

(See DISCRETE FREQUENCY.)

**CONTROL SLASH**– A radar beacon slash representing the actual position of the associated aircraft. Normally, the control slash is the one closest to the interrogating radar beacon site. When ARTCC radar is operating in narrowband (digitized) mode, the control slash is converted to a target symbol.

**CONTROLLED AIRSPACE**– An airspace of defined dimensions within which air traffic control service is provided to IFR flights and to VFR flights in accordance with the airspace classification.

**a.** Controlled airspace is a generic term that covers Class A, Class B, Class C, Class D, and Class E airspace.

**b.** Controlled airspace is also that airspace within which all aircraft operators are subject to certain pilot qualifications, operating rules, and equipment requirements in 14 CFR Part 91 (for specific operating requirements, please refer to 14 CFR Part 91). For IFR operations in any class of controlled airspace, a pilot must file an IFR flight plan and receive an appropriate ATC clearance. Each Class B, Class C, and Class D airspace area designated for an airport contains at least one primary airport around which the airspace is designated (for specific designations and descriptions of the airspace classes, please refer to 14 CFR Part 71).

**c.** Controlled airspace in the United States is designated as follows:

**1. CLASS A–** Generally, that airspace from 18,000 feet MSL up to and including FL 600, including the airspace overlying the waters within 12 nautical miles of the coast of the 48 contiguous States and Alaska. Unless otherwise authorized, all persons must operate their aircraft under IFR.

**2. CLASS B–** Generally, that airspace from the surface to 10,000 feet MSL surrounding the nation’s busiest airports in terms of airport operations or passenger enplanements. The configuration of each Class B airspace area is individually tailored and consists of a surface area and two or more layers (some Class B airspace areas resemble upside-down wedding cakes), and is designed to contain all published instrument procedures once an aircraft enters the airspace. An ATC clearance is required for all aircraft to operate in the area, and all aircraft that are so cleared receive separation services within the airspace. The cloud clearance requirement for VFR operations is “clear of clouds.”

**3. CLASS C–** Generally, that airspace from the surface to 4,000 feet above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower, are serviced by a radar approach control, and that have a certain number of IFR operations or passenger enplanements. Although the configuration of each Class C area is individually tailored, the airspace usually consists of a surface area with a 5 NM radius, a circle with a 10 NM radius that extends no lower than 1,200

feet up to 4,000 feet above the airport elevation, and an outer area that is not charted. Each person must establish two-way radio communications with the ATC facility providing air traffic services prior to entering the airspace and thereafter maintain those communications while within the airspace. VFR aircraft are only separated from IFR aircraft within the airspace.

(See OUTER AREA.)

**4. CLASS D–** Generally, that airspace from the surface to 2,500 feet above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower. The configuration of each Class D airspace area is individually tailored and when instrument procedures are published, the airspace will normally be designed to contain the procedures. Arrival extensions for instrument approach procedures may be Class D or Class E airspace. Unless otherwise authorized, each person must establish two-way radio communications with the ATC facility providing air traffic services prior to entering the airspace and thereafter maintain those communications while in the airspace. No separation services are provided to VFR aircraft.

**5. CLASS E–** Generally, if the airspace is not Class A, Class B, Class C, or Class D, and it is controlled airspace, it is Class E airspace. Class E airspace extends upward from either the surface or a designated altitude to the overlying or adjacent controlled airspace. When designated as a surface area, the airspace will be configured to contain all instrument procedures. Also in this class are Federal airways, airspace beginning at either 700 or 1,200 feet AGL used to transition to/from the terminal or en route environment, en route domestic, and offshore airspace areas designated below 18,000 feet MSL. Unless designated at a lower altitude, Class E airspace begins at 14,500 MSL over the United States, including that airspace overlying the waters within 12 nautical miles of the coast of the 48 contiguous States and Alaska, up to, but not including 18,000 feet MSL, and the airspace above FL 600.

**CONTROLLED AIRSPACE [ICAO]–** An airspace of defined dimensions within which air traffic control service is provided to IFR flights and to VFR flights in accordance with the airspace classification.

**Note:** Controlled airspace is a generic term which covers ATS airspace Classes A, B, C, D, and E.

**CONTROLLED TIME OF ARRIVAL**– Arrival time assigned during a Traffic Management Program. This time may be modified due to adjustments or user options.

**CONTROLLER**–

(See **AIR TRAFFIC CONTROL SPECIALIST**.)

**CONTROLLER [ICAO]**– A person authorized to provide air traffic control services.

**CONTROLLER PILOT DATA LINK COMMUNICATIONS (CPDLC)**– A two-way digital communications system that conveys textual air traffic control messages between controllers and pilots using ground or satellite-based radio relay stations.

**CONVECTIVE SIGMET**– A weather advisory concerning convective weather significant to the safety of all aircraft. Convective SIGMETs are issued for tornadoes, lines of thunderstorms, embedded thunderstorms of any intensity level, areas of thunderstorms greater than or equal to VIP level 4 with an area coverage of  $\frac{4}{10}$  (40%) or more, and hail  $\frac{3}{4}$  inch or greater.

(See **AIRMET**.)

(See **AWW**.)

(See **CWA**.)

(See **SIGMET**.)

(Refer to **AIM**.)

**CONVECTIVE SIGNIFICANT METEOROLOGICAL INFORMATION**–

(See **CONVECTIVE SIGMET**.)

**COOPERATIVE SURVEILLANCE**– Any surveillance system, such as secondary surveillance radar (SSR), wide-area multilateration (WAM), or ADS-B, that is dependent upon the presence of certain equipment onboard the aircraft or vehicle to be detected.

(See **AUTOMATIC DEPENDENT SURVEILLANCE-BROADCAST**.)

(See **NON-COOPERATIVE SURVEILLANCE**.)

(See **RADAR**.)

(See **WIDE AREA MULTILATERATION**.)

**COORDINATES**– The intersection of lines of reference, usually expressed in degrees/minutes/seconds of latitude and longitude, used to determine position or location.

**COORDINATION FIX**– The fix in relation to which facilities will handoff, transfer control of an aircraft,

or coordinate flight progress data. For terminal facilities, it may also serve as a clearance for arriving aircraft.

**COPTER**–

(See **HELICOPTER**.)

**CORRECTION**– An error has been made in the transmission and the correct version follows.

**COUPLED APPROACH**– An instrument approach performed by the aircraft autopilot, and/or visually depicted on the flight director, which is receiving position information and/or steering commands from onboard navigational equipment. In general, coupled non-precision approaches must be flown manually (autopilot disengaged) at altitudes lower than 50 feet AGL below the minimum descent altitude, and coupled precision approaches must be flown manually (autopilot disengaged) below 50 feet AGL unless authorized to conduct autoland operations. Coupled instrument approaches are commonly flown to the allowable IFR weather minima established by the operator or PIC, or flown VFR for training and safety.

**COURSE**–

a. The intended direction of flight in the horizontal plane measured in degrees from north.

b. The ILS localizer signal pattern usually specified as the front course or the back course.

(See **BEARING**.)

(See **INSTRUMENT LANDING SYSTEM**.)

(See **RADIAL**.)

**CPDLC**–

(See **CONTROLLER PILOT DATA LINK COMMUNICATIONS**.)

**CPL [ICAO]**–

(See ICAO term **CURRENT FLIGHT PLAN**.)

**CRITICAL ENGINE**– The engine which, upon failure, would most adversely affect the performance or handling qualities of an aircraft.

**CROSS (FIX) AT (ALTITUDE)**– Used by ATC when a specific altitude restriction at a specified fix is required.

**CROSS (FIX) AT OR ABOVE (ALTITUDE)**– Used by ATC when an altitude restriction at a specified fix is required. It does not prohibit the aircraft from crossing the fix at a higher altitude than specified; however, the higher altitude may not be one that will

# E

## EAS–

(See EN ROUTE AUTOMATION SYSTEM.)

## EDCT–

(See EXPECT DEPARTURE CLEARANCE TIME.)

## EDST–

(See EN ROUTE DECISION SUPPORT TOOL)

## EFC–

(See EXPECT FURTHER CLEARANCE (TIME).)

## ELT–

(See EMERGENCY LOCATOR TRANSMITTER.)

**EMERGENCY–** A distress or an urgency condition.

**EMERGENCY AUTOLAND SYSTEM–** This system, if activated, will determine an optimal airport, plot a course, broadcast the aircraft's intentions, fly to the airport, land, and (depending on the model) shut down the engines. Though the system will broadcast the aircraft's intentions, the controller should assume that transmissions to the aircraft will not be acknowledged.

**EMERGENCY DESCENT MODE–** This automated system senses conditions conducive to hypoxia (cabin depressurization). If an aircraft is equipped and the system is activated, it is designed to turn the aircraft up to 90 degrees, then descend to a lower altitude and level off, giving the pilot(s) time to recover.

**EMERGENCY LOCATOR TRANSMITTER (ELT)–** A radio transmitter attached to the aircraft structure which operates from its own power source on 121.5 MHz and 243.0 MHz. It aids in locating downed aircraft by radiating a downward sweeping audio tone, 2-4 times per second. It is designed to function without human action after an accident.

(Refer to 14 CFR Part 91.)

(Refer to AIM.)

## E-MSAW–

(See EN ROUTE MINIMUM SAFE ALTITUDE WARNING.)

**ENHANCED FLIGHT VISION SYSTEM (EFVS)–** An EFVS is an installed aircraft system which uses

an electronic means to provide a display of the forward external scene topography (the natural or man-made features of a place or region especially in a way to show their relative positions and elevation) through the use of imaging sensors, including but not limited to forward-looking infrared, millimeter wave radiometry, millimeter wave radar, or low-light level image intensification. An EFVS includes the display element, sensors, computers and power supplies, indications, and controls. An operator's authorization to conduct an EFVS operation may have provisions which allow pilots to conduct IAPs when the reported weather is below minimums prescribed on the IAP to be flown.

**EN ROUTE AIR TRAFFIC CONTROL SERVICES–** Air traffic control service provided aircraft on IFR flight plans, generally by centers, when these aircraft are operating between departure and destination terminal areas. When equipment, capabilities, and controller workload permit, certain advisory/assistance services may be provided to VFR aircraft.

(See AIR ROUTE TRAFFIC CONTROL CENTER.)

(Refer to AIM.)

**EN ROUTE AUTOMATION SYSTEM (EAS)–** The complex integrated environment consisting of situation display systems, surveillance systems and flight data processing, remote devices, decision support tools, and the related communications equipment that form the heart of the automated IFR air traffic control system. It interfaces with automated terminal systems and is used in the control of en route IFR aircraft.

(Refer to AIM.)

## EN ROUTE CHARTS–

(See AERONAUTICAL CHART.)

**EN ROUTE DECISION SUPPORT TOOL (EDST)–** An automated tool provided at each Radar Associate position in selected En Route facilities. This tool utilizes flight and radar data to determine present and future trajectories for all active and proposal aircraft and provides enhanced automated flight data management.

**EN ROUTE DESCENT**– Descent from the en route cruising altitude which takes place along the route of flight.

**EN ROUTE HIGH ALTITUDE CHARTS**–  
(See AERONAUTICAL CHART.)

**EN ROUTE LOW ALTITUDE CHARTS**–  
(See AERONAUTICAL CHART.)

**EN ROUTE MINIMUM SAFE ALTITUDE WARNING (E-MSAW)**– A function of the EAS that aids the controller by providing an alert when a tracked aircraft is below or predicted by the computer to go below a predetermined minimum IFR altitude (MIA).

**EN ROUTE SPACING PROGRAM (ESP)**– A program designed to assist the exit sector in achieving the required in-trail spacing.

**EN ROUTE TRANSITION**–

a. Conventional STARs/SIDs. The portion of a SID/STAR that connects to one or more en route airway/jet route.

b. RNAV STARs/SIDs. The portion of a STAR preceding the common route or point, or for a SID the portion following, that is coded for a specific en route fix, airway or jet route.

**ESP**–

(See EN ROUTE SPACING PROGRAM.)

**EST**–

(See ESTIMATED.)

**ESTABLISHED**– To be stable or fixed at an altitude or on a course, route, route segment, heading, instrument approach or departure procedure, etc.

**ESTABLISHED ON RNP (EoR) CONCEPT**– A system of authorized instrument approaches, ATC procedures, surveillance, and communication requirements that allow aircraft operations to be safely conducted with approved reduced separation criteria once aircraft are established on a PBN segment of a published instrument flight procedure.

**ESTIMATED (EST)**–When used in NOTAMs “EST” is a contraction that is used by the issuing authority only when the condition is expected to return to service prior to the expiration time. Using “EST” lets the user know that this NOTAM has the possibility of returning to service earlier than the

expiration time. Any NOTAM which includes an “EST” will be auto-expired at the designated expiration time.

**ESTIMATED ELAPSED TIME [ICAO]**– The estimated time required to proceed from one significant point to another.

(See ICAO Term TOTAL ESTIMATED ELAPSED TIME.)

**ESTIMATED OFF-BLOCK TIME [ICAO]**– The estimated time at which the aircraft will commence movement associated with departure.

**ESTIMATED POSITION ERROR (EPE)**–

(See Required Navigation Performance)

**ESTIMATED TIME OF ARRIVAL**– The time the flight is estimated to arrive at the gate (scheduled operators) or the actual runway on times for nonscheduled operators.

**ESTIMATED TIME EN ROUTE**– The estimated flying time from departure point to destination (lift-off to touchdown).

**ETA**–

(See ESTIMATED TIME OF ARRIVAL.)

**ETE**–

(See ESTIMATED TIME EN ROUTE.)

**EXECUTE MISSED APPROACH**– Instructions issued to a pilot making an instrument approach which means continue inbound to the missed approach point and execute the missed approach procedure as described on the Instrument Approach Procedure Chart or as previously assigned by ATC. The pilot may climb immediately to the altitude specified in the missed approach procedure upon making a missed approach. No turns should be initiated prior to reaching the missed approach point. When conducting an ASR or PAR approach, execute the assigned missed approach procedure immediately upon receiving instructions to “execute missed approach.”

(Refer to AIM.)

**EXPECT (ALTITUDE) AT (TIME) or (FIX)**– Used under certain conditions to provide a pilot with an altitude to be used in the event of two-way communications failure. It also provides altitude information to assist the pilot in planning.

(Refer to AIM.)

**EXPECT DEPARTURE CLEARANCE TIME (EDCT)**– The runway release time assigned to an aircraft in a traffic management program and shown on the flight progress strip as an EDCT.

(See GROUND DELAY PROGRAM.)

***EXPECT FURTHER CLEARANCE (TIME)***– The time a pilot can expect to receive clearance beyond a clearance limit.

***EXPECT FURTHER CLEARANCE VIA (AIRWAYS, ROUTES OR FIXES)***– Used to inform a

pilot of the routing he/she can expect if any part of the route beyond a short range clearance limit differs from that filed.

***EXPEDITE***– Used by ATC when prompt compliance is required to avoid the development of an imminent situation. Expedite climb/descent normally indicates to a pilot that the approximate best rate of climb/descent should be used without requiring an exceptional change in aircraft handling characteristics.



# G

**GATE HOLD PROCEDURES**– Procedures at selected airports to hold aircraft at the gate or other ground location whenever departure delays exceed or are anticipated to exceed 15 minutes. The sequence for departure will be maintained in accordance with initial call-up unless modified by flow control restrictions. Pilots should monitor the ground control/clearance delivery frequency for engine start/taxi advisories or new proposed start/taxi time if the delay changes.

**GCA**–

(See **GROUND CONTROLLED APPROACH**.)

**GDP**–

(See **GROUND DELAY PROGRAM**.)

**GENERAL AVIATION**– That portion of civil aviation that does not include scheduled or unscheduled air carriers or commercial space operations.

(See ICAO term **GENERAL AVIATION**.)

**GENERAL AVIATION [ICAO]**– All civil aviation operations other than scheduled air services and nonscheduled air transport operations for remuneration or hire.

**GEO MAP**– The digitized map markings associated with the ASR-9 Radar System.

**GLIDEPATH**–

(See **GLIDESLOPE**.)

**GLIDEPATH [ICAO]**– A descent profile determined for vertical guidance during a final approach.

**GLIDEPATH INTERCEPT ALTITUDE**–

(See **GLIDESLOPE INTERCEPT ALTITUDE**.)

**GLIDESLOPE**– Provides vertical guidance for aircraft during approach and landing. The glideslope/glidepath is based on the following:

**a.** Electronic components emitting signals which provide vertical guidance by reference to airborne instruments during instrument approaches such as ILS; or,

**b.** Visual ground aids, such as VASI, which provide vertical guidance for a VFR approach or for

the visual portion of an instrument approach and landing.

**c. PAR.** Used by ATC to inform an aircraft making a PAR approach of its vertical position (elevation) relative to the descent profile.

(See ICAO term **GLIDEPATH**.)

**GLIDESLOPE INTERCEPT ALTITUDE**– The published minimum altitude to intercept the glideslope in the intermediate segment of an instrument approach. Government charts use the lightning bolt symbol to identify this intercept point. This intersection is called the Precise Final Approach fix (PFAF). ATC directs a higher altitude, the resultant intercept becomes the PFAF.

(See **FINAL APPROACH FIX**.)

(See **SEGMENTS OF AN INSTRUMENT APPROACH PROCEDURE**.)

**GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)**– GNSS refers collectively to the worldwide positioning, navigation, and timing determination capability available from one or more satellite constellations. A GNSS constellation may be augmented by ground stations and/or geostationary satellites to improve integrity and position accuracy.

(See **GROUND-BASED AUGMENTATION SYSTEM**.)

(See **SATELLITE-BASED AUGMENTATION SYSTEM**.)

**GLOBAL NAVIGATION SATELLITE SYSTEM MINIMUM EN ROUTE IFR ALTITUDE (GNSS MEA)**– The minimum en route IFR altitude on a published ATS route or route segment which assures acceptable Global Navigation Satellite System reception and meets obstacle clearance requirements. (Refer to 14 CFR Part 91.) (Refer to 14 CFR Part 95.)

**GLOBAL POSITIONING SYSTEM (GPS)**– GPS refers to the worldwide positioning, navigation and timing determination capability available from the U.S. satellite constellation. The service provided by GPS for civil use is defined in the GPS Standard Positioning System Performance Standard. GPS is composed of space, control, and user elements.

**GNSS [ICAO]–**

(See GLOBAL NAVIGATION SATELLITE SYSTEM.)

**GNSS MEA–**

(See GLOBAL NAVIGATION SATELLITE SYSTEM MINIMUM EN ROUTE IFR ALTITUDE.)

**GO AHEAD–** Proceed with your message. Not to be used for any other purpose.

**GO AROUND–** Instructions for a pilot to abandon his/her approach to landing. Additional instructions may follow. Unless otherwise advised by ATC, a VFR aircraft or an aircraft conducting visual approach should overfly the runway while climbing to traffic pattern altitude and enter the traffic pattern via the crosswind leg. A pilot on an IFR flight plan making an instrument approach should execute the published missed approach procedure or proceed as instructed by ATC; e.g., “Go around” (additional instructions if required).

(See LOW APPROACH.)

(See MISSED APPROACH.)

**GPD–**

(See GRAPHIC PLAN DISPLAY.)

**GPS–**

(See GLOBAL POSITIONING SYSTEM.)

**GRAPHIC PLAN DISPLAY (GPD)–** A view available with EDST that provides a graphic display of aircraft, traffic, and notification of predicted conflicts. Graphic routes for Current Plans and Trial Plans are displayed upon controller request.

(See EN ROUTE DECISION SUPPORT TOOL.)

**GROSS NAVIGATION ERROR (GNE) –** A lateral deviation of 10 NM or more from the aircraft’s cleared route.

**GROUND BASED AUGMENTATION SYSTEM (GBAS)–** A ground based GNSS station which provides local differential corrections, integrity parameters and approach data via VHF data broadcast to GNSS users to meet real-time performance requirements for CAT I precision approaches. The aircraft applies the broadcast data to improve the accuracy and integrity of its GNSS signals and computes the deviations to the selected approach. A single ground station can serve multiple runway ends up to an approximate radius of 23 NM.

**GROUND BASED AUGMENTATION SYSTEM (GBAS) LANDING SYSTEM (GLS)–** A type of precision IAP based on local augmentation of GNSS data using a single GBAS station to transmit locally corrected GNSS data, integrity parameters and approach information. This improves the accuracy of aircraft GNSS receivers’ signal in space, enabling the pilot to fly a precision approach with much greater flexibility, reliability and complexity. The GLS procedure is published on standard IAP charts, features the title GLS with the designated runway and minima as low as 200 feet DA. Future plans are expected to support Cat II and CAT III operations.

**GROUND CLUTTER–** A pattern produced on the radar scope by ground returns which may degrade other radar returns in the affected area. The effect of ground clutter is minimized by the use of moving target indicator (MTI) circuits in the radar equipment resulting in a radar presentation which displays only targets which are in motion.

(See CLUTTER.)

**GROUND COMMUNICATION OUTLET (GCO)–** An unstaffed, remotely controlled, ground/ground communications facility. Pilots at uncontrolled airports may contact ATC and FSS via VHF radio to a telephone connection. If the connection goes to ATC, the pilot can obtain an IFR clearance or close an IFR flight plan. If the connection goes to Flight Service, the pilot can open or close a VFR flight plan; obtain an updated weather briefing prior to takeoff; close an IFR flight plan; or, for Alaska or MEDEVAC only, obtain an IFR clearance. Pilots will use four “key clicks” on the VHF radio to contact the appropriate ATC facility or six “key clicks” to contact the FSS. The GCO system is intended to be used only on the ground.

**GROUND CONTROLLED APPROACH–** A radar approach system operated from the ground by air traffic control personnel transmitting instructions to the pilot by radio. The approach may be conducted with surveillance radar (ASR) only or with both surveillance and precision approach radar (PAR). Usage of the term “GCA” by pilots is discouraged except when referring to a GCA facility. Pilots should specifically request a “PAR” approach when a precision radar approach is desired or request an “ASR” or “surveillance” approach when a nonprecision radar approach is desired.

(See RADAR APPROACH.)

**INCERFA (Uncertainty Phase) [ICAO]**– A situation wherein uncertainty exists as to the safety of an aircraft and its occupants.

**INCREASED SEPARATION REQUIRED (ISR)**– Indicates the confidence level of the track requires 5 NM separation, 3 NM separation, 1 ½ NM separation, and target resolution cannot be used.

***INCREASE SPEED TO (SPEED)***–  
(See **SPEED ADJUSTMENT**.)

**INERTIAL NAVIGATION SYSTEM (INS)**– An RNAV system which is a form of self-contained navigation.

(See **Area Navigation/RNAV**.)

**INFLIGHT REFUELING**–

(See **AERIAL REFUELING**.)

**INFLIGHT WEATHER ADVISORY**–

(See **WEATHER ADVISORY**.)

**INFORMATION REQUEST (INREQ)**– A request originated by an FSS for information concerning an overdue VFR aircraft.

**INITIAL APPROACH FIX (IAF)**– The fixes depicted on instrument approach procedure charts that identify the beginning of the initial approach segment(s).

(See **FIX**.)

(See **SEGMENTS OF AN INSTRUMENT APPROACH PROCEDURE**.)

**INITIAL APPROACH SEGMENT**–

(See **SEGMENTS OF AN INSTRUMENT APPROACH PROCEDURE**.)

**INITIAL APPROACH SEGMENT [ICAO]**– That segment of an instrument approach procedure between the initial approach fix and the intermediate approach fix or, where applicable, the final approach fix or point.

**INLAND NAVIGATION FACILITY**– A navigation aid on a North American Route at which the common route and/or the noncommon route begins or ends.

**INNER MARKER**– A marker beacon used with an ILS (CAT II) precision approach located between the middle marker and the end of the ILS runway, transmitting a radiation pattern keyed at six dots per second and indicating to the pilot, both aurally and visually, that he/she is at the designated decision height (DH), normally 100 feet above the touchdown

zone elevation, on the ILS CAT II approach. It also marks progress during a CAT III approach.

(See **INSTRUMENT LANDING SYSTEM**.)

(Refer to **AIM**.)

**INNER MARKER BEACON**–

(See **INNER MARKER**.)

**INREQ**–

(See **INFORMATION REQUEST**.)

**INS**–

(See **INERTIAL NAVIGATION SYSTEM**.)

**INSTRUMENT APPROACH**–

(See **INSTRUMENT APPROACH PROCEDURE**.)

**INSTRUMENT APPROACH OPERATIONS [ICAO]**– An approach and landing using instruments for navigation guidance based on an instrument approach procedure. There are two methods for executing instrument approach operations:

**a.** A two-dimensional (2D) instrument approach operation, using lateral navigation guidance only; and

**b.** A three-dimensional (3D) instrument approach operation, using both lateral and vertical navigation guidance.

Note: Lateral and vertical navigation guidance refers to the guidance provided either by:

a) a ground-based radio navigation aid; or

b) computer-generated navigation data from ground-based, space-based, self-contained navigation aids or a combination of these.

(See **ICAO term INSTRUMENT APPROACH PROCEDURE**.)

**INSTRUMENT APPROACH PROCEDURE**– A series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a landing or to a point from which a landing may be made visually. It is prescribed and approved for a specific airport by competent authority.

(See **SEGMENTS OF AN INSTRUMENT APPROACH PROCEDURE**.)

(Refer to **14 CFR Part 91**.)

(Refer to **AIM**.)

**a.** U.S. civil standard instrument approach procedures are approved by the FAA as prescribed under **14 CFR Part 97** and are available for public use.

**b.** U.S. military standard instrument approach procedures are approved and published by the Department of Defense.

**c.** Special instrument approach procedures are approved by the FAA for individual operators but are not published in 14 CFR Part 97 for public use.

(See ICAO term INSTRUMENT APPROACH PROCEDURE.)

**INSTRUMENT APPROACH PROCEDURE [ICAO]**– A series of predetermined maneuvers by reference to flight instruments with specified protection from obstacles from the initial approach fix, or where applicable, from the beginning of a defined arrival route to a point from which a landing can be completed and thereafter, if a landing is not completed, to a position at which holding or en route obstacle clearance criteria apply.

(See ICAO term INSTRUMENT APPROACH OPERATIONS)

**INSTRUMENT APPROACH PROCEDURE CHARTS**–

(See AERONAUTICAL CHART.)

**INSTRUMENT DEPARTURE PROCEDURE (DP)**– A preplanned instrument flight rule (IFR) departure procedure published for pilot use, in graphic or textual format, that provides obstruction clearance from the terminal area to the appropriate en route structure. There are two types of DP, Obstacle Departure Procedure (ODP), printed either textually or graphically, and, Standard Instrument Departure (SID), which is always printed graphically.

(See IFR TAKEOFF MINIMUMS AND DEPARTURE PROCEDURES.)

(See OBSTACLE DEPARTURE PROCEDURES.)

(See STANDARD INSTRUMENT DEPARTURES.)

(Refer to AIM.)

**INSTRUMENT DEPARTURE PROCEDURE (DP) CHARTS**–

(See AERONAUTICAL CHART.)

**INSTRUMENT FLIGHT RULES (IFR)**– Rules governing the procedures for conducting instrument

flight. Also a term used by pilots and controllers to indicate type of flight plan.

(See INSTRUMENT METEOROLOGICAL CONDITIONS.)

(See VISUAL FLIGHT RULES.)

(See VISUAL METEOROLOGICAL CONDITIONS.)

(See ICAO term INSTRUMENT FLIGHT RULES.)

(Refer to AIM.)

**INSTRUMENT FLIGHT RULES [ICAO]**– A set of rules governing the conduct of flight under instrument meteorological conditions.

**INSTRUMENT LANDING SYSTEM (ILS)**– A precision instrument approach system which normally consists of the following electronic components and visual aids:

**a.** Localizer.

(See LOCALIZER.)

**b.** Glideslope.

(See GLIDESLOPE.)

**c.** Outer Marker.

(See OUTER MARKER.)

**d.** Middle Marker.

(See MIDDLE MARKER.)

**e.** Approach Lights.

(See AIRPORT LIGHTING.)

(Refer to 14 CFR Part 91.)

(Refer to AIM.)

**INSTRUMENT METEOROLOGICAL CONDITIONS (IMC)**– Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling less than the minima specified for visual meteorological conditions.

(See INSTRUMENT FLIGHT RULES.)

(See VISUAL FLIGHT RULES.)

(See VISUAL METEOROLOGICAL CONDITIONS.)

**INSTRUMENT RUNWAY**– A runway equipped with electronic and visual navigation aids for which a precision or nonprecision approach procedure having straight-in landing minimums has been approved.

(See ICAO term INSTRUMENT RUNWAY.)

**INSTRUMENT RUNWAY [ICAO]**– One of the following types of runways intended for the operation of aircraft using instrument approach procedures:

Approaches (SOIA) to parallel runways whose centerlines are separated by less than 3,000 feet and at least 750 feet. NTZ monitoring is required to conduct these approaches.

(See SIMULTANEOUS OFFSET INSTRUMENT APPROACH (SOIA).)

(Refer to AIM.)

**LOCALIZER USABLE DISTANCE**– The maximum distance from the localizer transmitter at a specified altitude, as verified by flight inspection, at which reliable course information is continuously received.

(Refer to AIM.)

**LOCATOR [ICAO]**– An LM/MF NDB used as an aid to final approach.

Note: A locator usually has an average radius of rated coverage of between 18.5 and 46.3 km (10 and 25 NM).

**LONG RANGE NAVIGATION**–

(See LORAN.)

**LONGITUDINAL SEPARATION**– The longitudinal spacing of aircraft at the same altitude by a minimum distance expressed in units of time or miles.

(See SEPARATION.)

(Refer to AIM.)

**LORAN**– An electronic navigational system by which hyperbolic lines of position are determined by measuring the difference in the time of reception of synchronized pulse signals from two fixed transmitters. Loran A operates in the 1750-1950 kHz frequency band. Loran C and D operate in the 100-110 kHz frequency band. In 2010, the U.S. Coast Guard terminated all U.S. LORAN-C transmissions.

(Refer to AIM.)

**LOST COMMUNICATIONS**– Loss of the ability to communicate by radio. Aircraft are sometimes referred to as NORDO (No Radio). Standard pilot procedures are specified in 14 CFR Part 91. Radar controllers issue procedures for pilots to follow in the event of lost communications during a radar approach when weather reports indicate that an aircraft will likely encounter IFR weather conditions during the approach.

(Refer to 14 CFR Part 91.)

(Refer to AIM.)

**LOST LINK (LL)**– An interruption or loss of the control link, or when the pilot is unable to effect control of the aircraft and, as a result, the UA will perform a predictable or planned maneuver. Loss of command and control link between the Control Station and the aircraft. There are two types of links:

a. An uplink which transmits command instructions to the aircraft, and

b. A downlink which transmits the status of the aircraft and provides situational awareness to the pilot.

**LOST LINK PROCEDURE**– Preprogrammed or predetermined mitigations to ensure the continued safe operation of the UA in the event of a lost link (LL). In the event positive link cannot be established, flight termination must be implemented.

**LOW ALTITUDE AIRWAY STRUCTURE**– The network of airways serving aircraft operations up to but not including 18,000 feet MSL.

(See AIRWAY.)

(Refer to AIM.)

***LOW ALTITUDE ALERT, CHECK YOUR ALTITUDE IMMEDIATELY***–

(See SAFETY ALERT.)

**LOW APPROACH**– An approach over an airport or runway following an instrument approach or a VFR approach including the go-around maneuver where the pilot intentionally does not make contact with the runway.

(Refer to AIM.)

**LOW FREQUENCY (LF)**– The frequency band between 30 and 300 kHz.

(Refer to AIM.)

**LOCALIZER PERFORMANCE WITH VERTICAL GUIDANCE (LPV)**– A type of approach with vertical guidance (APV) based on WAAS, published on RNAV (GPS) approach charts. This procedure takes advantage of the precise lateral guidance available from WAAS. The minima is published as a decision altitude (DA).

**LUAW**–

(See LINE UP AND WAIT.)



terminates at the approach gate or where the glideslope or other appropriate minimum altitude is intercepted.

**PROGRESS REPORT–**

(See POSITION REPORT.)

**PROGRESSIVE TAXI–** Precise taxi instructions given to a pilot unfamiliar with the airport or issued in stages as the aircraft proceeds along the taxi route.

**PROHIBITED AREA–**

(See SPECIAL USE AIRSPACE.)

(See ICAO term PROHIBITED AREA.)

**PROHIBITED AREA [ICAO]–** An airspace of defined dimensions, above the land areas or territorial waters of a State, within which the flight of aircraft is prohibited.

**PROMINENT OBSTACLE–** An obstacle that meets one or more of the following conditions:

**a.** An obstacle which stands out beyond the adjacent surface of surrounding terrain and immediately projects a noticeable hazard to aircraft in flight.

**b.** An obstacle, not characterized as low and close in, whose height is no less than 300 feet above the departure end of takeoff runway (DER) elevation, is within 10 NM from the DER, and that penetrates that airport/heliport's diverse departure obstacle clearance surface (OCS).

**c.** An obstacle beyond 10 NM from an airport/heliport that requires an obstacle departure procedure (ODP) to ensure obstacle avoidance.

(See OBSTACLE.)

(See OBSTRUCTION.)

**PROPELLER (PROP) WASH (PROP BLAST)–** The disturbed mass of air generated by the motion of a propeller.

**PROPOSED BOUNDARY CROSSING TIME–** Each center has a PBCT parameter for each internal airport. Proposed internal flight plans are transmitted

to the adjacent center if the flight time along the proposed route from the departure airport to the center boundary is less than or equal to the value of PBCT or if airport adaptation specifies transmission regardless of PBCT.

**PROPOSED DEPARTURE TIME–** The time that the aircraft expects to become airborne.

**PROTECTED AIRSPACE–** The airspace on either side of an oceanic route/track that is equal to one-half the lateral separation minimum except where reduction of protected airspace has been authorized.

**PROTECTED SEGMENT–** The protected segment is a segment on the amended TFM route that is to be inhibited from automatic adapted route alteration by ERAM.

**PT–**

(See PROCEDURE TURN.)

**PTP–**

(See POINT-TO-POINT.)

**PTS–**

(See POLAR TRACK STRUCTURE.)

**PUBLISHED INSTRUMENT APPROACH PROCEDURE VISUAL SEGMENT–** A segment on an IAP chart annotated as "Fly Visual to Airport" or "Fly Visual." A dashed arrow will indicate the visual flight path on the profile and plan view with an associated note on the approximate heading and distance. The visual segment should be flown as a dead reckoning course while maintaining visual conditions.

**PUBLISHED ROUTE–** A route for which an IFR altitude has been established and published; e.g., Federal Airways, Jet Routes, Area Navigation Routes, Specified Direct Routes.

**PWS–**

(See PREDICTIVE WIND SHEAR ALERT SYSTEM.)



b. “Increase/reduce speed to (speed in knots)” or “Increase/reduce speed (number of knots) knots.”

**SPEED BRAKES**– Moveable aerodynamic devices on aircraft that reduce airspeed during descent and landing.

**SPEED SEGMENTS**– Portions of the arrival route between the transition point and the vertex along the optimum flight path for which speeds and altitudes are specified. There is one set of arrival speed segments adapted from each transition point to each vertex. Each set may contain up to six segments.

**SPOOFING**– Denotes emissions of GNSS-like signals that may be acquired and tracked in combination with or instead of the intended signals by civil receivers. The onset of spoofing effects can be instantaneous or delayed, and effects can persist after the spoofing has ended. Spoofing can result in false and potentially confusing, or hazardously misleading, position, navigation, and/or date/time information in addition to loss of GNSS use.

**SQUAWK (Mode, Code, Function)**– Used by ATC to instruct a pilot to activate the aircraft transponder and ADS-B Out with altitude reporting enabled, or (military) to activate only specific modes, codes, or functions. Examples: “Squawk five seven zero seven;” “Squawk three/alpha, two one zero five.”

(See TRANSPONDER.)

**STA**–

(See SCHEDULED TIME OF ARRIVAL.)

**STAGING/QUEUING**– The placement, integration, and segregation of departure aircraft in designated movement areas of an airport by departure fix, EDCT, and/or restriction.

**STAND BY**– Means the controller or pilot must pause for a few seconds, usually to attend to other duties of a higher priority. Also means to wait as in “stand by for clearance.” The caller should reestablish contact if a delay is lengthy. “Stand by” is not an approval or denial.

**STANDARD INSTRUMENT APPROACH PROCEDURE (SIAP)**–

(See INSTRUMENT APPROACH PROCEDURE.)

**STANDARD INSTRUMENT DEPARTURE (SID)**– A preplanned instrument flight rule (IFR) air traffic control (ATC) departure procedure printed for pilot/controller use in graphic form to provide

obstacle clearance and a transition from the terminal area to the appropriate en route structure. SIDs are primarily designed for system enhancement to expedite traffic flow and to reduce pilot/controller workload. ATC clearance must always be received prior to flying a SID.

(See IFR TAKEOFF MINIMUMS AND DEPARTURE PROCEDURES.)

(See OBSTACLE DEPARTURE PROCEDURE.)

(Refer to AIM.)

**STANDARD RATE TURN**– A turn of three degrees per second.

**STANDARD TERMINAL ARRIVAL (STAR)**– A preplanned instrument flight rule (IFR) air traffic control arrival procedure published for pilot use in graphic and/or textual form. STARs provide transition from the en route structure to an outer fix or an instrument approach fix/arrival waypoint in the terminal area.

**STANDARD TERMINAL ARRIVAL CHARTS**–  
(See AERONAUTICAL CHART.)

**STANDARD TERMINAL AUTOMATION REPLACEMENT SYSTEM (STARS)**–

(See DTAS.)

**STAR**–

(See STANDARD TERMINAL ARRIVAL.)

**STATE AIRCRAFT**– Aircraft used in military, customs and police service, in the exclusive service of any government or of any political subdivision thereof, including the government of any state, territory, or possession of the United States or the District of Columbia, but not including any government-owned aircraft engaged in carrying persons or property for commercial purposes.

**STATIC RESTRICTIONS**– Those restrictions that are usually not subject to change, fixed, in place, and/or published.

**STATIONARY ALTITUDE RESERVATION (STATIONARY ALTRV)**– An altitude reservation which encompasses activities in a fixed area. Stationary ALTRVs may include activities such as special tests of weapons systems or equipment; certain U.S. Navy carrier, fleet, and anti-submarine operations; rocket, missile, and drone operations; and certain aerial refueling or similar operations.

**STEP TAXI**– To taxi a float plane at full power or high RPM.

**STEP TURN**– A maneuver used to put a float plane in a planing configuration prior to entering an active sea lane for takeoff. The STEP TURN maneuver should only be used upon pilot request.

**STEPDOWN FIX**– A fix permitting additional descent within a segment of an instrument approach procedure by identifying a point at which a controlling obstacle has been safely overflown.

**STEREO ROUTE**– A routinely used route of flight established by users and ARTCCs identified by a coded name; e.g., ALPHA 2. These routes minimize flight plan handling and communications.

**STNR ALT RESERVATION**– An abbreviation for Stationary Altitude Reservation commonly used in NOTAMs.

(See STATIONARY ALTITUDE RESERVATION.)

**STOL AIRCRAFT**–

(See SHORT TAKEOFF AND LANDING AIRCRAFT.)

**STOP ALTITUDE SQUAWK**– Used by ATC to instruct a pilot to turn off the automatic altitude reporting feature of the aircraft transponder and ADS–B Out. It is issued when a verbally reported altitude varies by 300 feet or more from the automatic altitude report.

(See ALTITUDE READOUT.)

(See TRANSPONDER.)

**STOP AND GO**– A procedure wherein an aircraft will land, make a complete stop on the runway, and then commence a takeoff from that point.

(See LOW APPROACH.)

(See OPTION APPROACH.)

**STOP BURST**–

(See STOP STREAM.)

**STOP BUZZER**–

(See STOP STREAM.)

**STOP SQUAWK (Mode or Code)**– Used by ATC to instruct a pilot to stop transponder and ADS–B transmissions, or to turn off only specified functions of the aircraft transponder (military).

(See STOP ALTITUDE SQUAWK.)

(See TRANSPONDER.)

**STOP STREAM**– Used by ATC to request a pilot to suspend electronic attack activity.

(See JAMMING.)

**STOPOVER FLIGHT PLAN**– A flight plan format which permits in a single submission the filing of a sequence of flight plans through interim full-stop destinations to a final destination.

**STOPWAY**– An area beyond the takeoff runway no less wide than the runway and centered upon the extended centerline of the runway, able to support the airplane during an aborted takeoff, without causing structural damage to the airplane, and designated by the airport authorities for use in decelerating the airplane during an aborted takeoff.

**STRAIGHT-IN APPROACH IFR**– An instrument approach wherein final approach is begun without first having executed a procedure turn, not necessarily completed with a straight-in landing or made to straight-in landing minimums.

(See LANDING MINIMUMS.)

(See STRAIGHT-IN APPROACH VFR.)

(See STRAIGHT-IN LANDING.)

**STRAIGHT-IN APPROACH VFR**– Entry into the traffic pattern by interception of the extended runway centerline (final approach course) without executing any other portion of the traffic pattern.

(See TRAFFIC PATTERN.)

**STRAIGHT-IN LANDING**– A landing made on a runway aligned within 30° of the final approach course following completion of an instrument approach.

(See STRAIGHT-IN APPROACH IFR.)

**STRAIGHT-IN LANDING MINIMUMS**–

(See LANDING MINIMUMS.)

**STRAIGHT-IN MINIMUMS**–

(See STRAIGHT-IN LANDING MINIMUMS.)

**STRATEGIC PLANNING**– Planning whereby solutions are sought to resolve potential conflicts.

**SUBSTITUTE ROUTE**– A route assigned to pilots when any part of an airway or route is unusable because of NAVAID status. These routes consist of:

a. Substitute routes which are shown on U.S. Government charts.

b. Routes defined by ATC as specific NAVAID radials or courses.

c. Routes defined by ATC as direct to or between NAVAIDs.

**SUNSET AND SUNRISE**– The mean solar times of sunset and sunrise as published in the Nautical Almanac, converted to local standard time for the locality concerned. Within Alaska, the end of evening civil twilight and the beginning of morning civil twilight, as defined for each locality.

**SUPPLEMENTAL WEATHER SERVICE LOCATION**– Airport facilities staffed with contract personnel who take weather observations and provide current local weather to pilots via telephone or radio. (All other services are provided by the parent FSS.)

**SUPPS**– Refers to ICAO Document 7030 Regional Supplementary Procedures. SUPPS contain procedures for each ICAO Region which are unique to that Region and are not covered in the worldwide provisions identified in the ICAO Air Navigation Plan. Procedures contained in Chapter 8 are based in part on those published in SUPPS.

**SURFACE AREA**– The airspace contained by the lateral boundary of the Class B, C, D, or E airspace designated for an airport that begins at the surface and extends upward.

**SURPIC**– A description of surface vessels in the area of a Search and Rescue incident including their predicted positions and their characteristics.

(Refer to FAA Order JO 7110.65, Para 10–6–4, INFLIGHT CONTINGENCIES.)

**SURVEILLANCE APPROACH**– An instrument approach wherein the air traffic controller issues instructions, for pilot compliance, based on aircraft position in relation to the final approach course (azimuth), and the distance (range) from the end of the runway as displayed on the controller’s radar scope. The controller will provide recommended altitudes on final approach if requested by the pilot.

(Refer to AIM.)

**SWAP**–

(See SEVERE WEATHER AVOIDANCE PLAN.)

**SWSL**–

(See SUPPLEMENTAL WEATHER SERVICE LOCATION.)

**SYSTEM STRATEGIC NAVIGATION**– Military activity accomplished by navigating along a preplanned route using internal aircraft systems to maintain a desired track. This activity normally requires a lateral route width of 10 NM and altitude range of 1,000 feet to 6,000 feet AGL with some route segments that permit terrain following.



# T

## TACAN–

(See TACTICAL AIR NAVIGATION.)

**TACAN-ONLY AIRCRAFT**– An aircraft, normally military, possessing TACAN with DME but no VOR navigational system capability. Clearances must specify TACAN or VORTAC fixes and approaches.

**TACTICAL AIR NAVIGATION (TCAN)**– An ultra-high frequency electronic rho-theta air navigation aid which provides suitably equipped aircraft a continuous indication of bearing and distance to the TACAN station.

(See VORTAC.)

(Refer to AIM.)

**TAILWIND**– Any wind more than 90 degrees to the longitudinal axis of the runway. The magnetic direction of the runway shall be used as the basis for determining the longitudinal axis.

## TAKEOFF AREA–

(See LANDING AREA.)

**TAKEOFF DISTANCE AVAILABLE (TODA)**– The takeoff run available plus the length of any remaining runway or clearway beyond the far end of the takeoff run available.

(See ICAO term TAKEOFF DISTANCE AVAILABLE.)

**TAKEOFF DISTANCE AVAILABLE [ICAO]**– The length of the takeoff run available plus the length of the clearway, if provided.

**TAKEOFF HOLD LIGHTS (THL)**– The THL system is composed of in-pavement lighting in a double, longitudinal row of lights aligned either side of the runway centerline. The lights are focused toward the arrival end of the runway at the “line up and wait” point, and they extend for 1,500 feet in front of the holding aircraft. Illuminated red lights indicate to an aircraft in position for takeoff or rolling that it is unsafe to takeoff because the runway is occupied or about to be occupied by an aircraft or vehicle.

**TAKEOFF ROLL** – The process whereby an aircraft is aligned with the runway centerline and the aircraft is moving with the intent to take off. For helicopters,

this pertains to the act of becoming airborne after departing a takeoff area.

**TAKEOFF RUN AVAILABLE (TORA)** – The runway length declared available and suitable for the ground run of an airplane taking off.

(See ICAO term TAKEOFF RUN AVAILABLE.)

**TAKEOFF RUN AVAILABLE [ICAO]**– The length of runway declared available and suitable for the ground run of an aeroplane take-off.

**TARGET**– The indication shown on a display resulting from a primary radar return, a radar beacon reply, or an ADS–B report. The specific target symbol presented to ATC may vary based on the surveillance source and automation platform.

(See ASSOCIATED.)

(See DIGITAL TARGET.)

(See DIGITIZED RADAR TARGET.)

(See FUSED TARGET.)

(See PRIMARY RADAR TARGET.)

(See RADAR.)

(See SECONDARY RADAR TARGET.)

(See ICAO term TARGET.)

(See UNASSOCIATED.)

**TARGET [ICAO]**– In radar:

a. Generally, any discrete object which reflects or retransmits energy back to the radar equipment.

b. Specifically, an object of radar search or surveillance.

**TARGET RESOLUTION**– A process to ensure that correlated radar targets do not touch. Target resolution must be applied as follows:

a. Between the edges of two primary targets or the edges of the ASR-9/11 primary target symbol.

b. Between the end of the beacon control slash and the edge of a primary target.

c. Between the ends of two beacon control slashes.

Note 1: Mandatory traffic advisories and safety alerts must be issued when this procedure is used.

Note 2: This procedure must not be used when utilizing mosaic radar systems or multi-sensor mode.

## TARGET SYMBOL–

(See TARGET.)

(See ICAO term TARGET.)

**TARMAC DELAY**– The holding of an aircraft on the ground either before departure or after landing with no opportunity for its passengers to deplane.

**TARMAC DELAY AIRCRAFT**– An aircraft whose pilot-in-command has requested to taxi to the ramp, gate, or alternate deplaning area to comply with the Three-hour Tarmac Rule.

**TARMAC DELAY REQUEST**– A request by the pilot-in-command to taxi to the ramp, gate, or alternate deplaning location to comply with the Three-hour Tarmac Rule.

**TAS**–

(See **TERMINAL AUTOMATION SYSTEMS**.)

**TAWS**–

(See **TERRAIN AWARENESS WARNING SYSTEM**.)

**TAXI**– The movement of an airplane under its own power on the surface of an airport (14 CFR Section 135.100 [Note]). Also, it describes the surface movement of helicopters equipped with wheels.

(See **AIR TAXI**.)

(See **HOVER TAXI**.)

(Refer to 14 CFR Section 135.100.)

(Refer to **AIM**.)

**TAXI PATTERNS**– Patterns established to illustrate the desired flow of ground traffic for the different runways or airport areas available for use.

**TCAS**–

(See **TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM**.)

**TCH**–

(See **THRESHOLD CROSSING HEIGHT**.)

**TCLT**–

(See **TENTATIVE CALCULATED LANDING TIME**.)

**TDLS**–

(See **TERMINAL DATA LINK SYSTEM**.)

**TDZE**–

(See **TOUCHDOWN ZONE ELEVATION**.)

**TEMPORARY FLIGHT RESTRICTION (TFR)**– A TFR is a regulatory action issued by the FAA via the U.S. NOTAM System, under the authority of United States Code, Title 49. TFRs are issued within the sovereign airspace of the United States and its

territories to restrict certain aircraft from operating within a defined area on a temporary basis to protect persons or property in the air or on the ground. While not all inclusive, TFRs may be issued for disaster or hazard situations such as: toxic gas leaks or spills, fumes from flammable agents, aircraft accident/incident sites, aviation or ground resources engaged in wildfire suppression, or aircraft relief activities following a disaster. TFRs may also be issued in support of VIP movements, for reasons of national security; or when determined necessary for the management of air traffic in the vicinity of aerial demonstrations or major sporting events. NAS users or other interested parties should contact a FSS for TFR information. Additionally, TFR information can be found in automated briefings, NOTAM publications, and on the internet at <http://www.faa.gov>. The FAA also distributes TFR information to aviation user groups for further dissemination.

**TENTATIVE CALCULATED LANDING TIME (TCLT)**– A projected time calculated for adapted vertex for each arrival aircraft based upon runway configuration, airport acceptance rate, airport arrival delay period, and other metered arrival aircraft. This time is either the VTA of the aircraft or the TCLT/ACLT of the previous aircraft plus the AAI, whichever is later. This time will be updated in response to an aircraft's progress and its current relationship to other arrivals.

**TERMINAL AREA**– A general term used to describe airspace in which approach control service or airport traffic control service is provided.

**TERMINAL AREA FACILITY**– A facility providing air traffic control service for arriving and departing IFR, VFR, Special VFR, and on occasion en route aircraft.

(See **APPROACH CONTROL FACILITY**.)

(See **TOWER**.)

**TERMINAL AUTOMATION SYSTEMS (TAS)**– TAS is used to identify the numerous automated tracking systems including STARS and MEARTS.

**TERMINAL DATA LINK SYSTEM (TDLS)**– A system that provides Digital Automatic Terminal Information Service (D-ATIS) both on a specified radio frequency and also, for subscribers, in a text message via data link to the cockpit or to a gate printer. TDLS also provides Pre-departure Clearances (PDC), at selected airports, to subscribers, through a service provider, in text to the cockpit or to

a gate printer. In addition, TDLS will emulate the Flight Data Input/Output (FDIO) information within the control tower.

**TERMINAL RADAR SERVICE AREA**– Airspace surrounding designated airports wherein ATC provides radar vectoring, sequencing, and separation on a full-time basis for all IFR and participating VFR aircraft. The AIM contains an explanation of TRSA. TRSAs are depicted on VFR aeronautical charts. Pilot participation is urged but is not mandatory.

**TERMINAL VFR RADAR SERVICE**– A national program instituted to extend the terminal radar services provided instrument flight rules (IFR) aircraft to visual flight rules (VFR) aircraft. The program is divided into four types service referred to as basic radar service, terminal radar service area (TRSA) service, Class B service and Class C service. The type of service provided at a particular location is contained in the Chart Supplement U.S.

**a. Basic Radar Service**– These services are provided for VFR aircraft by all commissioned terminal radar facilities. Basic radar service includes safety alerts, traffic advisories, limited radar vectoring when requested by the pilot, and sequencing at locations where procedures have been established for this purpose and/or when covered by a letter of agreement. The purpose of this service is to adjust the flow of arriving IFR and VFR aircraft into the traffic pattern in a safe and orderly manner and to provide traffic advisories to departing VFR aircraft.

**b. TRSA Service**– This service provides, in addition to basic radar service, sequencing of all IFR and participating VFR aircraft to the primary airport and separation between all participating VFR aircraft. The purpose of this service is to provide separation between all participating VFR aircraft and all IFR aircraft operating within the area defined as a TRSA.

**c. Class C Service**– This service provides, in addition to basic radar service, approved separation between IFR and VFR aircraft, and sequencing of VFR aircraft, and sequencing of VFR arrivals to the primary airport.

**d. Class B Service**– This service provides, in addition to basic radar service, approved separation

of aircraft based on IFR, VFR, and/or weight, and sequencing of VFR arrivals to the primary airport(s).

(See CONTROLLED AIRSPACE.)

(See TERMINAL RADAR SERVICE AREA.)

(Refer to AIM.)

(Refer to CHART SUPPLEMENT U.S.)

**TERMINAL-VERY HIGH FREQUENCY OMNI-DIRECTIONAL RANGE STATION (TVOR)**– A very high frequency terminal omnirange station located on or near an airport and used as an approach aid.

(See NAVIGATIONAL AID.)

(See VOR.)

**TERRAIN AWARENESS WARNING SYSTEM (TAWS)**– An on-board, terrain proximity alerting system providing the aircrew ‘Low Altitude warnings’ to allow immediate pilot action.

**TERRAIN FOLLOWING**– The flight of a military aircraft maintaining a constant AGL altitude above the terrain or the highest obstruction. The altitude of the aircraft will constantly change with the varying terrain and/or obstruction.

**TETRAHEDRON**– A device normally located on uncontrolled airports and used as a landing direction indicator. The small end of a tetrahedron points in the direction of landing. At controlled airports, the tetrahedron, if installed, should be disregarded because tower instructions supersede the indicator.

(See SEGMENTED CIRCLE.)

(Refer to AIM.)

**TF**–

(See TERRAIN FOLLOWING.)

**THAT IS CORRECT**– The understanding you have is right.

**THA**–

(See TRANSITIONAL HAZARD AREA.)

**THREE-HOUR TARMAC RULE**– Rule that relates to Department of Transportation (DOT) requirements placed on airlines when tarmac delays are anticipated to reach 3 hours.

**360 OVERHEAD**–

(See OVERHEAD MANEUVER.)

**THRESHOLD**– The beginning of that portion of the runway usable for landing.

(See AIRPORT LIGHTING.)

(See DISPLACED THRESHOLD.)

**THRESHOLD CROSSING HEIGHT**– The theoretical height above the runway threshold at which the aircraft’s glideslope antenna would be if the aircraft maintains the trajectory established by the mean ILS glideslope or the altitude at which the calculated glidepath of an RNAV or GPS approaches.

(See GLIDESLOPE.)

(See THRESHOLD.)

**THRESHOLD LIGHTS**–

(See AIRPORT LIGHTING.)

**TIE-IN FACILITY**– The FSS primarily responsible for providing FSS services, including telecommunications services for landing facilities or navigational aids located within the boundaries of a flight plan area (FPA). Three-letter identifiers are assigned to each FSS/FPA and are annotated as tie-in facilities in the Chart Supplement U.S., the Alaska Supplement, the Pacific Supplement, and FAA Order JO 7350.9, Location Identifiers. Large consolidated FSS facilities may have many tie-in facilities or FSS sectors within one facility.

(See FLIGHT PLAN AREA.)

(See FLIGHT SERVICE STATION.)

**TIME-BASED FLOW MANAGEMENT (TBFM)**– The hardware, software, methods, processes, and initiatives to manage air traffic flows based on time to balance air traffic demand with system capacity, and support the management of PBN. This includes, but not limited to, Adjacent Center Metering (ACM), En Route Departure Capability (EDC), Ground-based Interval Management-Spacing (GIM-S), Integrated Departure/Arrival Capability (IDAC), Single Center Metering (SCM), Time-Based Metering (TBM), Time-Based Scheduling (TBS), and Extended/Coupled Metering.

**TIME GROUP**– Four digits representing the hour and minutes from the Coordinated Universal Time (UTC) clock. FAA uses UTC for all operations. The term “ZULU” may be used to denote UTC. The word “local” or the time zone equivalent shall be used to denote local when local time is given during radio and telephone communications. When written, a time zone designator is used to indicate local time; e.g., “0205M” (Mountain). The local time may be based on the 24-hour clock system. The day begins at 0000 and ends at 2359.

**TIS-B**–

(See TRAFFIC INFORMATION SERVICE–BROADCAST.)

**TMPA**–

(See TRAFFIC MANAGEMENT PROGRAM ALERT.)

**TMU**–

(See TRAFFIC MANAGEMENT UNIT.)

**TODA**–

(See TAKEOFF DISTANCE AVAILABLE.)

(See ICAO term TAKEOFF DISTANCE AVAILABLE.)

**TOI**–

(See TRACK OF INTEREST.)

**TOP ALTITUDE**– In reference to SID published altitude restrictions, the charted “maintain” altitude contained in the procedure description or assigned by ATC.

**TORA**–

(See TAKEOFF RUN AVAILABLE.)

(See ICAO term TAKEOFF RUN AVAILABLE.)

**TORCHING**– The burning of fuel at the end of an exhaust pipe or stack of a reciprocating aircraft engine, the result of an excessive richness in the fuel air mixture.

**TOS**–

(See TRAJECTORY OPTIONS SET)

**TOTAL ESTIMATED ELAPSED TIME [ICAO]**– For IFR flights, the estimated time required from takeoff to arrive over that designated point, defined by reference to navigation aids, from which it is intended that an instrument approach procedure will be commenced, or, if no navigation aid is associated with the destination aerodrome, to arrive over the destination aerodrome. For VFR flights, the estimated time required from takeoff to arrive over the destination aerodrome.

(See ICAO term ESTIMATED ELAPSED TIME.)

**TOUCH-AND-GO**– An operation by an aircraft that lands and departs on a runway without stopping or exiting the runway.

**TOUCH-AND-GO LANDING**–

(See TOUCH-AND-GO.)

**TOUCHDOWN**–

a. The point at which an aircraft first makes contact with the landing surface.

**b.** Concerning a precision radar approach (PAR), it is the point where the glide path intercepts the landing surface.

(See ICAO term TOUCHDOWN.)

**TOUCHDOWN [ICAO]**– The point where the nominal glide path intercepts the runway.

Note: Touchdown as defined above is only a datum and is not necessarily the actual point at which the aircraft will touch the runway.

**TOUCHDOWN RVR**–

(See VISIBILITY.)

**TOUCHDOWN ZONE**– The first 3,000 feet of the runway beginning at the threshold. The area is used for determination of Touchdown Zone Elevation in the development of straight-in landing minimums for instrument approaches.

(See ICAO term TOUCHDOWN ZONE.)

**TOUCHDOWN ZONE [ICAO]**– The portion of a runway, beyond the threshold, where it is intended landing aircraft first contact the runway.

**TOUCHDOWN ZONE ELEVATION**– The highest elevation in the first 3,000 feet of the landing surface. TDZE is indicated on the instrument approach procedure chart when straight-in landing minimums are authorized.

(See TOUCHDOWN ZONE.)

**TOUCHDOWN ZONE LIGHTING**–

(See AIRPORT LIGHTING.)

**TOWER**– A terminal facility that uses air/ground communications, visual signaling, and other devices to provide ATC services to aircraft operating in the vicinity of an airport or on the movement area. Authorizes aircraft to land or takeoff at the airport controlled by the tower or to transit the Class D airspace area regardless of flight plan or weather conditions (IFR or VFR). A tower may also provide approach control services (radar or nonradar).

(See AIRPORT TRAFFIC CONTROL SERVICE.)

(See APPROACH CONTROL FACILITY.)

(See APPROACH CONTROL SERVICE.)

(See MOVEMENT AREA.)

(See TOWER EN ROUTE CONTROL SERVICE.)

(See ICAO term AERODROME CONTROL TOWER.)

(Refer to AIM.)

**TOWER EN ROUTE CONTROL SERVICE**– The control of IFR en route traffic within delegated airspace between two or more adjacent approach control facilities. This service is designed to expedite traffic and reduce control and pilot communication requirements.

**TOWER TO TOWER**–

(See TOWER EN ROUTE CONTROL SERVICE.)

**TRACEABLE PRESSURE STANDARD**– The facility station pressure instrument, with certification/calibration traceable to the National Institute of Standards and Technology. Traceable pressure standards may be mercurial barometers, commissioned ASOS or dual transducer AWOS, or portable pressure standards or DASI.

**TRACK**– The actual flight path of an aircraft over the surface of the earth.

(See COURSE.)

(See FLIGHT PATH.)

(See ROUTE.)

(See ICAO term TRACK.)

**TRACK [ICAO]**– The projection on the earth's surface of the path of an aircraft, the direction of which path at any point is usually expressed in degrees from North (True, Magnetic, or Grid).

**TRACK OF INTEREST (TOI)**– Displayed data representing an airborne object that threatens or has the potential to threaten North America or National Security. Indicators may include, but are not limited to: noncompliance with air traffic control instructions or aviation regulations; extended loss of communications; unusual transmissions or unusual flight behavior; unauthorized intrusion into controlled airspace or an ADIZ; noncompliance with issued flight restrictions/security procedures; or unlawful interference with airborne flight crews, up to and including hijack. In certain circumstances, an object may become a TOI based on specific and credible intelligence pertaining to that particular aircraft/object, its passengers, or its cargo.

**TRACK OF INTEREST RESOLUTION**– A TOI will normally be considered resolved when: the aircraft/object is no longer airborne; the aircraft complies with air traffic control instructions, aviation regulations, and/or issued flight restrictions/security procedures; radio contact is re-established and authorized control of the aircraft is verified; the aircraft is intercepted and intent is verified to be

nonthreatening/nonhostile; TOI was identified based on specific and credible intelligence that was later determined to be invalid or unreliable; or displayed data is identified and characterized as invalid.

**TRAFFIC-**

**a.** A term used by a controller to transfer radar identification of an aircraft to another controller for the purpose of coordinating separation action. Traffic is normally issued:

1. In response to a handoff or point out,
2. In anticipation of a handoff or point out, or
3. In conjunction with a request for control of an aircraft.

**b.** A term used by ATC to refer to one or more aircraft.

**TRAFFIC ADVISORIES-** Advisories issued to alert pilots to other known or observed air traffic which may be in such proximity to the position or intended route of flight of their aircraft to warrant their attention. Such advisories may be based on:

- a.** Visual observation.
- b.** Observation of radar identified and nonidentified aircraft targets on an ATC radar display, or
- c.** Verbal reports from pilots or other facilities.

Note 1: The word "traffic" followed by additional information, if known, is used to provide such advisories; e.g., "Traffic, 2 o'clock, one zero miles, southbound, eight thousand."

Note 2: Traffic advisory service will be provided to the extent possible depending on higher priority duties of the controller or other limitations; e.g., radar limitations, volume of traffic, frequency congestion, or controller workload. Radar/nonradar traffic advisories do not relieve the pilot of his/her responsibility to see and avoid other aircraft. Pilots are cautioned that there are many times when the controller is not able to give traffic advisories concerning all traffic in the aircraft's proximity; in other words, when a pilot requests or is receiving traffic advisories, he/she should not assume that all traffic will be issued.

(Refer to AIM.)

**TRAFFIC ALERT (aircraft call sign), TURN (left/right) IMMEDIATELY, (climb/descend) AND MAINTAIN (altitude).**

(See SAFETY ALERT.)

**TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS)-** An airborne collision

avoidance system based on radar beacon signals which operates independent of ground-based equipment. TCAS-I generates traffic advisories only. TCAS-II generates traffic advisories, and resolution (collision avoidance) advisories in the vertical plane.

**TRAFFIC INFORMATION-**

(See TRAFFIC ADVISORIES.)

**TRAFFIC INFORMATION SERVICE-BROADCAST (TIS-B)-** The broadcast of ATC derived traffic information to ADS-B equipped (1090ES or UAT) aircraft. The source of this traffic information is derived from ground-based air traffic surveillance sensors, typically from radar targets. TIS-B service will be available throughout the NAS where there are both adequate surveillance coverage (radar) and adequate broadcast coverage from ADS-B ground stations. Loss of TIS-B will occur when an aircraft enters an area not covered by the GBT network. If this occurs in an area with adequate surveillance coverage (radar), nearby aircraft that remain within the adequate broadcast coverage (ADS-B) area will view the first aircraft. TIS-B may continue when an aircraft enters an area with inadequate surveillance coverage (radar); nearby aircraft that remain within the adequate broadcast coverage (ADS-B) area will not view the first aircraft.

**TRAFFIC IN SIGHT-** Used by pilots to inform a controller that previously issued traffic is in sight.

(See NEGATIVE CONTACT.)

(See TRAFFIC ADVISORIES.)

**TRAFFIC MANAGEMENT PROGRAM ALERT-**

A term used in a Notice to Airmen (NOTAM) issued in conjunction with a special traffic management program to alert pilots to the existence of the program and to refer them to a special traffic management program advisory message for program details. The contraction TMPA is used in NOTAM text.

**TRAFFIC MANAGEMENT UNIT-** The entity in ARTCCs and designated terminals directly involved in the active management of facility traffic. Usually under the direct supervision of an assistant manager for traffic management.

**TRAFFIC NO FACTOR-** Indicates that the traffic described in a previously issued traffic advisory is no factor.

**TRAFFIC NO LONGER OBSERVED-** Indicates that the traffic described in a previously issued traffic advisory is no longer depicted on radar, but may still be a factor.

**TRAFFIC PATTERN**– The traffic flow that is prescribed for aircraft landing at, taxiing on, or taking off from an airport. The components of a typical traffic pattern are upwind leg, crosswind leg, downwind leg, base leg, and final approach.

**a. Upwind Leg**– A flight path parallel to the landing runway in the direction of landing.

**b. Crosswind Leg**– A flight path at right angles to the landing runway off its upwind end.

**c. Downwind Leg**– A flight path parallel to the landing runway in the direction opposite to landing. The downwind leg normally extends between the crosswind leg and the base leg.

**d. Base Leg**– A flight path at right angles to the landing runway off its approach end. The base leg normally extends from the downwind leg to the intersection of the extended runway centerline.

**e. Final Approach**– A flight path in the direction of landing along the extended runway centerline. The final approach normally extends from the base leg to the runway. An aircraft making a straight-in approach VFR is also considered to be on final approach.

(See STRAIGHT-IN APPROACH VFR.)

(See TAXI PATTERNS.)

(See ICAO term AERODROME TRAFFIC CIRCUIT.)

(Refer to 14 CFR Part 91.)

(Refer to AIM.)

**TRAFFIC SITUATION DISPLAY (TSD)**– TSD is a computer system that receives radar track data from all 20 CONUS ARTCCs, organizes this data into a mosaic display, and presents it on a computer screen. The display allows the traffic management coordinator multiple methods of selection and highlighting of individual aircraft or groups of aircraft. The user has the option of superimposing these aircraft positions over any number of background displays. These background options include ARTCC boundaries, any stratum of en route sector boundaries, fixes, airways, military and other special use airspace, airports, and geopolitical boundaries. By using the TSD, a coordinator can monitor any number of traffic situations or the entire systemwide traffic flows.

**TRAJECTORY**– A EDST representation of the path an aircraft is predicted to fly based upon a Current Plan or Trial Plan.

(See EN ROUTE DECISION SUPPORT TOOL.)

**TRAJECTORY MODELING**– The automated process of calculating a trajectory.

**TRAJECTORY OPTIONS SET (TOS)**– A TOS is an electronic message, submitted by the operator, that is used by the Collaborative Trajectory Options Program (CTOP) to manage the airspace captured in the traffic management program. The TOS will allow the operator to express the route and delay trade-off options that they are willing to accept.

**TRANSFER OF CONTROL**– That action whereby the responsibility for the separation of an aircraft is transferred from one controller to another.

(See ICAO term TRANSFER OF CONTROL.)

**TRANSFER OF CONTROL [ICAO]**– Transfer of responsibility for providing air traffic control service.

**TRANSFERRING CONTROLLER**– A controller/facility transferring control of an aircraft to another controller/facility.

(See ICAO term TRANSFERRING UNIT/CONTROLLER.)

**TRANSFERRING FACILITY**–

(See TRANSFERRING CONTROLLER.)

**TRANSFERRING UNIT/CONTROLLER [ICAO]**– Air traffic control unit/air traffic controller in the process of transferring the responsibility for providing air traffic control service to an aircraft to the next air traffic control unit/air traffic controller along the route of flight.

Note: See definition of accepting unit/controller.

**TRANSITION**–

**a.** The general term that describes the change from one phase of flight or flight condition to another; e.g., transition from en route flight to the approach or transition from instrument flight to visual flight.

**b.** A published procedure (DP Transition) used to connect the basic DP to one of several en route airways/jet routes, or a published procedure (STAR Transition) used to connect one of several en route airways/jet routes to the basic STAR.

(Refer to DP/STAR Charts.)

**TRANSITION POINT**– A point at an adapted number of miles from the vertex at which an arrival aircraft would normally commence descent from its en route altitude. This is the first fix adapted on the arrival speed segments.

**TRANSITION WAYPOINT**– The waypoint that defines the beginning of a runway or en route transition on an RNAV SID or STAR.

**TRANSITIONAL AIRSPACE**– That portion of controlled airspace wherein aircraft change from one phase of flight or flight condition to another.

**TRANSITIONAL HAZARD AREA (THA)**– Used by ATC. Airspace normally associated with an Aircraft Hazard Area within which the flight of aircraft is subject to restrictions.

(See AIRCRAFT HAZARD AREA.)

(See CONTINGENCY HAZARD AREA.)

(See REFINED HAZARD AREA.)

**TRANSMISSOMETER**– An apparatus used to determine visibility by measuring the transmission of light through the atmosphere. It is the measurement source for determining runway visual range (RVR).

(See VISIBILITY.)

**TRANSMITTING IN THE BLIND**– A transmission from one station to other stations in circumstances where two-way communication cannot be established, but where it is believed that the called stations may be able to receive the transmission.

**TRANSPONDER**– The airborne radar beacon receiver/transmitter portion of the Air Traffic Control Radar Beacon System (ATCRBS) which automatically receives radio signals from interrogators on the ground, and selectively replies with a specific reply pulse or pulse group only to those interrogations being received on the mode to which it is set to respond.

(See INTERROGATOR.)

(See ICAO term TRANSPONDER.)

(Refer to AIM.)

**TRANSPONDER [ICAO]**– A receiver/transmitter which will generate a reply signal upon proper interrogation; the interrogation and reply being on different frequencies.

**TRANSPONDER CODES**–

(See CODES.)

**TRANSPONDER OBSERVED** – Phraseology used to inform a VFR pilot the aircraft's assigned beacon code and position have been observed. Specifically, this term conveys to a VFR pilot the transponder

reply has been observed and its position correlated for transit through the designated area.

**TRIAL PLAN**– A proposed amendment which utilizes automation to analyze and display potential conflicts along the predicted trajectory of the selected aircraft.

**TRSA**–

(See TERMINAL RADAR SERVICE AREA.)

**TSD**–

(See TRAFFIC SITUATION DISPLAY.)

**TURBOJET AIRCRAFT**– An aircraft having a jet engine in which the energy of the jet operates a turbine which in turn operates the air compressor.

**TURBOPROP AIRCRAFT**– An aircraft having a jet engine in which the energy of the jet operates a turbine which drives the propeller.

**TURBULENCE**– An atmospheric phenomenon that causes changes in aircraft altitude, attitude, and or airspeed with aircraft reaction depending on intensity. Pilots report turbulence intensity according to aircraft's reaction as follows:

**a. Light** – Causes slight, erratic changes in altitude and or attitude (pitch, roll, or yaw).

**b. Moderate**– Similar to Light 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.

**c. Severe**– Causes large, abrupt changes in altitude and or attitude. It usually causes large variations in indicated airspeed. Aircraft may be momentarily out of control.

**d. Extreme**– The aircraft is violently tossed about and is practically impossible to control. It may cause structural damage.

(See CHOP.)

(Refer to AIM.)

**TURN ANTICIPATION**– (maneuver anticipation).

**TVOR**–

(See TERMINAL-VERY HIGH FREQUENCY OMNIDIRECTIONAL RANGE STATION.)

**TWO-WAY RADIO COMMUNICATIONS FAILURE**–

(See LOST COMMUNICATIONS.)

# U

## UHF-

(See ULTRAHIGH FREQUENCY.)

**ULTRAHIGH FREQUENCY (UHF)**– The frequency band between 300 and 3,000 MHz. The bank of radio frequencies used for military air/ground voice communications. In some instances this may go as low as 225 MHz and still be referred to as UHF.

**ULTRALIGHT VEHICLE**– A single-occupant aeronautical vehicle operated for sport or recreational purposes which does not require FAA registration, an airworthiness certificate, or pilot certification. Operation of an ultralight vehicle in certain airspace requires authorization from ATC.

(Refer to 14 CFR Part 103.)

**UNABLE**– Indicates inability to comply with a specific instruction, request, or clearance.

**UNASSOCIATED**– A radar target that does not display a data block with flight identification and altitude information.

(See ASSOCIATED.)

**UNCONTROLLED AIRSPACE**– Airspace in which aircraft are not subject to controlled airspace (Class A, B, C, D, or E) separation criteria.

**UNDER THE HOOD**– Indicates that the pilot is using a hood to restrict visibility outside the cockpit while simulating instrument flight. An appropriately rated pilot is required in the other control seat while this operation is being conducted.

(Refer to 14 CFR Part 91.)

**UNFROZEN**– The Scheduled Time of Arrival (STA) tags, which are still being rescheduled by the time-based flow management (TBFM) calculations. The aircraft will remain unfrozen until the time the corresponding estimated time of arrival (ETA) tag passes the preset freeze horizon for that aircraft's stream class. At this point the automatic rescheduling will stop, and the STA becomes "frozen."

**UNICOM**– A nongovernment communication facility which may provide airport information at certain airports. Locations and frequencies of UNICOMs are shown on aeronautical charts and publications.

(See CHART SUPPLEMENT U.S.)

(Refer to AIM.)

**UNMANNED AIRCRAFT (UA)**– A device used or intended to be used for flight that has no onboard pilot. This device can be any type of airplane, helicopter, airship, or powered-lift aircraft. Unmanned free balloons, moored balloons, tethered aircraft, gliders, and unmanned rockets are not considered to be a UA.

**UNMANNED AIRCRAFT SYSTEM (UAS)**– An unmanned aircraft and its associated elements related to safe operations, which may include control stations (ground, ship, or air based), control links, support equipment, payloads, flight termination systems, and launch/recovery equipment. It consists of three elements: unmanned aircraft, control station, and data link.

**UNPUBLISHED ROUTE**– A route for which no minimum altitude is published or charted for pilot use. It may include a direct route between NAVAIDs, a radial, a radar vector, or a final approach course beyond the segments of an instrument approach procedure.

(See PUBLISHED ROUTE.)

(See ROUTE.)

**UNRELIABLE (GPS/WAAS)**– An advisory to pilots indicating the expected level of service of the GPS and/or WAAS may not be available. Pilots must then determine the adequacy of the signal for desired use.

## UNSERVICEABLE (U/S)

(See OUT OF SERVICE/UNSERVICEABLE.)

## UPWIND LEG-

(See TRAFFIC PATTERN.)

**URGENCY**– A condition of being concerned about safety and of requiring timely but not immediate assistance; a potential distress condition.

(See ICAO term URGENCY.)

**URGENCY [ICAO]**– A condition concerning the safety of an aircraft or other vehicle, or of person on board or in sight, but which does not require immediate assistance.

## USAFIB-

(See ARMY AVIATION FLIGHT INFORMATION BULLETIN.)



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