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GENERAL

AIRWAY MANUAL

Issue Date 1 JUL 21

Content covered in the E-AWM General coverage is:

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NAVDATA
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Effective February 12, 2021

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This Manual is designed for use by experienced pilots who must be thoroughly familiar and competent with the navigation of aircraft. Airway Manual is for use by instrument-rated pilots and VFR Manual is for use by pilots flying under visual flight rules. The user of this Manual should also be thoroughly familiar with the introduction and legend materials which are contained in and/or available for this Manual.

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In addition, this Manual contains a wide variety of information useful to pilots which Jeppesen has obtained from many outside sources. Jeppesen has edited this source material, and has arranged and published it in a convenient, easy-to-use format.

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Preface

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Preface

Briefing Bulletins

NICOSIA FIR/UIR IATA COMMUNICATIONS/CONTROL PROCEDURES

JEP 06 01

(extract from IATA Information Bulletin)

This Bulletin is compiled from information contained in various official documents and from observations of practical operations. Contents **MUST** be regarded as provisional pending improvement of the airspace organization and of the ATS and COM services by the authorities concerned.

a. **General**

Authority for Air Traffic Control within Nicosia FIR/UIR, rests solely with Nicosia ACC. Boundary between Ankara - Nicosia FIRs/UIRs, runs from N3605 E03000 to N3558 E03230 to N3555 E03333 to N3555 E03540. ATC instructions must **ONLY** be accepted from Nicosia ACC, including allocation of SSR codes.

Most of the northern part of Nicosia FIR/UIR, inclusive of a wide area of the high seas, has been identified by Ercan Control, a station based in northern Cyprus, falling under Turkish Cypriot administration, as a zone under its control. The authority of Ercan Control over this zone for Air Traffic Control purposes is **NOT** recognized by ICAO.

Contrary to ICAO requirements, no contact is effected between Ankara and Nicosia ACCs. Nicosia ACC requires that aircraft approaching Nicosia FIR/UIR from Ankara FIR make pre-entry contact **at least 10 minutes before the FIR boundary**. It is essential that crews comply with this requirement: **only then will Nicosia ACC be in a position to assume control and provide appropriate traffic separation**.

b. **Southbound Procedures**

While in Ankara FIR comply with control instructions issued by Ankara ACC (either directly or by relay through any other station designated by Ankara, e.g. **Ercan Control** on **126.70** MHZ) up to point VESAR (B/UB545, L/UL620) or point TOMBI (A/UA16, M/UM855) or point DOREN (A/UA28). Establish contact with Nicosia ACC **at least 10 minutes before FIR BDY**. Once contact established and flight details including Flight Level (FL) information passed, **avoid making requests to Ankara ACC for FL changes for the rest of the flight through Ankara FIR**, unless climbing from or descending to aerodromes in the immediate vicinity of the FIR boundary. If for any reason, it becomes absolutely necessary to make such level changes after initial contact with Nicosia while still in Ankara FIR, it is important for safety reasons that Nicosia ACC be advised at once of the change.

At VESAR or TOMBI, flights will come under the sole control of Nicosia, change automatically to Nicosia ACC. Although no formal transfer of control procedures is affected between Ankara and Nicosia ACCs and no changeover instructions are issued on crossing the FIR boundary, flights should thereafter **ONLY** accept control instructions issued by Nicosia ACC until hand over to the next ATC Unit or FIR/UIR. Any invitation to change to another station (e.g. Ercan control) should be politely acknowledged but disregarded. In case of insistence a check should be made with Nicosia ACC.

For aircraft planning to continue the flight into Damascus FIR, additional communications requirements exist. Refer to para. d.) below, under **“Eastbound / Westbound Procedures”**.

On completion of ATC formalities with Nicosia ACC after entry into the FIR and of position reporting requirements for Damascus FIR, establish communications with Ercan Control and pass on relevant flight details. This should be regarded as a purely courtesy call - **under NO circumstances should any ATC instruction be accepted from Ercan**.

c. **Northbound Procedures**

Due to lack of contact between the two centers, advance flight information can **ONLY** be provided to Ankara by relay. Provide flight information **at least 10 minutes prior to entering Ankara FIR**, along L/UL619, W/UW10, B/UB15, A/UA16, L/UL620, M/UM855 or A/UA28 to Ercan Control on 126.70 for relay to Ankara. Control authority of Nicosia ACC remains absolute up to the point of entry into Ankara FIR.

d. **Eastbound / Westbound Procedures**

Eastbound aircraft entering Damascus FIR via routes L/UL619, W/UW10, R/UR78 or M/UM978 are required to establish contact with Damascus ACC 5 minutes before ETA position NIKAS. If for any reason this is not possible, aircraft **must** provide, a position report to **Latakia Radio**, a relay station for Damascus ACC, at position VESAR, ALSUS or BALMA for relay to Damascus, and maintain continuous listening watch.

Even if a position report and flight details have been communicated to Latakia Radio two-way Radio Communications with Damascus ACC must be completed as early as possible before passing Banias NDB.

Nicosia ACC remains primary station for listening watch until NIKAS, where change to Damascus shall be effected.

Westbound aircraft from Damascus FIR establish communications with Nicosia ACC at the FIR BDRY (NIKAS), unless requested by Damascus ACC to call Nicosia earlier. A courtesy call may be made to Ercan Control. If flight continues into Ankara FIR, provide advance flight information to Ankara ACC via Ercan Control **at least 10 minutes before passing the Nicosia/Ankara FIR boundary**.

Control authority rests firmly with Nicosia ACC until the FIR BDY (VESAR); thereafter it changes to Ankara. Further calls to Ercan may be made as requested to the extent other commitments permit.

SPECIAL COMMUNICATIONS AND CONTROL PROCEDURES APPLYING TO AIRCRAFT ENROUTE MUT - VESAR - NIKAS - BANIAS OR VICE VERSA

a. **SOUTHBOUND, continuing eastward into Damascus FIR**

1. **10 minutes before ETA VESAR:**
    (a) Primary station is Ankara ACC.
    (b) Call Nicosia ACC and communicate essential flight details [FL, ETA FIR (VESAR), ROUTE, etc.].

NICOSIA FIR/UIR IATA COMMUNICATIONS/CONTROL PROCEDURES

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*NOTE: Avoid Flight Level changes from this point until FIR boundary and control transferred to Nicosia ACC. If change absolutely necessary, obtain clearance from Ankara ACC and **keep Nicosia ACC informed**.*

2. **VESAR:**

   (a) Transfer control to Nicosia ACC. Do **NOT** accept ATC clearances from any other station. From now on until next FIR BDRY, primary listening watch must remain with Nicosia ACC, which is also the authority for SSR codes.

   (b) Establish contact with Damascus ACC. If no contact, call Latakia Radio, transmit essential flight details for relay to Damascus ACC.

   (c) Ercan, pass essential flight details (ATO VESAR, FL, ETA NIKAS).

3. **Before Banias:**

   Continue to contact Damascus ACC if communications have not been established yet, because it is a requirement to establish contact well before passing Banias.

4. **At NIKAS:**

   Transfer control to Damascus ACC.

b. **WESTBOUND, continuing northwards into Ankara FIR**

1. **In Damascus FIR, before passing NIKAS:**

   Primary station is Damascus ACC. No need for advance call to Nicosia FIR unless request to that effect received from Damascus ACC.

2. **At NIKAS:**

   (a) Transfer control to Nicosia ACC. Control authority remains with Nicosia ACC until point VESAR.

   (b) Call Ercan on 126.70, pass essential flight details for relay to Ankara ACC.

   NOTE: Any Flight Level changes made thereafter under instructions from Nicosia ACC must be communicated at once to Ercan Control for relay to Ankara ACC.

3. **At VESAR:**

   Transfer to Ankara ACC.

MULTIPLE APPROACH PROCEDURE INDICATORS

Which procedure is included in your database when multiple approach procedures using the same sensor are published to a single runway end?

GENERAL

Civil aviation authorities occasionally create more than one approach procedure of the same type to a single runway. This is done to accommodate many operations, including different missed approach procedures and missed approach climb gradients, different approach transitions, and other considerations such as WAAS and RNP.

Previously, when more than one procedure of the same type to the same runway existed, only one of the procedures could be captured in the database. Where there were multiple RNAV (GPS) procedures to the same runway in the U.S., the note “Procedure Not in Database” would be shown on the charts for procedures that were not coded in the database.

Since a database is required to fly RNAV (GPS) or RNAV (GNSS) procedures, regulators such as the FAA have mandated that all published RNAV (GPS/GNSS) procedures must be retrievable from a database. Additionally, more instances of multiple approaches were being encountered worldwide, including ILS, LOC (only), VOR, VORDME or VORTAC, NDB, and TACAN. This necessitated a change to ARINC 424 in order to establish a suffix in the procedure identifier record for multiple approach procedures.

However, even though Jeppesen now has the capability to output multiple versions of an approach type to a given runway, many avionics units cannot accept the suffix in the procedure identifier record that was designed to differentiate between multiple versions of these procedures. The units allow for only a four character approach procedure identifier.

OPTIONS

In order for all FMS and GPS avionics to contain at least one of the approaches when multiple procedures have been published, it is necessary to determine which version of the procedure should be included in *all* FMS and GPS avionics. Jeppesen uses the term “predominant procedure” for the one that is always included.

Multiple approach procedures without a suffix

Where the source does not include a suffix to provide uniqueness Jeppesen will include the approach that is believed to be predominant procedure that is issued in ATC clearances.

Where multiple approach procedures are issued yet only one of them includes a suffix, Jeppesen will code the procedure that was supplied *without* the suffix in order to provide at least one procedure that can be included in *all* FMS and GPS avionics.

Guidelines for Designating the Selected Procedure

While many of the FMS and GPS systems that our customers use have the ability to handle multiple versions of approaches with the same procedure identifier, it was determined that the equipment that cannot handle this information should not be penalized by losing any existing procedures based on this limitation. As a result, Jeppesen developed various delivery options for Multiple Approach Procedures to minimize the impact for all equipment. Avionics manufacturers were directed to select which of four options they would implement for their end-user customers.

To understand how Jeppesen designates the Selected Procedure, it is important to understand how the various source providers publish Multiple Approach Procedures. Source providers may deliver these procedures using a variety of suffixes after the procedure title or, in a few cases, without suffixes. The following list explains these different source cases:

a. Letters of the alphabet, starting with Z and moving backwards (Z, Y, X, W, etc.)
b. Numbers (1, 2, 3, etc.)
c. Words beginning with letters of the phonetic alphabet, such as Papa, Sierra, Tango, etc. (as found in Italy)
d. The phonetic alphabet (Alpha, Bravo, Charlie, etc.) starting at the beginning of the alphabet and moving forward
e. Letters or numbers with one procedure missing a multiple approach suffix; for example, VOR Rwy 36, VOR Rwy 36-1, VOR Rwy 36-2)
f. No suffix to distinguish between multiple procedures of the same type to the same runway (as found on ILS procedures in Tunis, Tunisia (DTTA))

When either the letters or numbers are used as shown in items a. or b. above, Jeppesen will use the source-supplied letters or numbers as a suffix in compliance with the ARINC 424 specifications. When words are used as depicted in items c. and d., Jeppesen will code the first letter of the word.

Given the possible source situations, Jeppesen will designate the Selected Procedure according to the following rules:

For Source Case:	**Selected Procedure Will Be:**
Z, Y, X, designations	Z[1] (or the letter closest to the end of the alphabet)
1, 2, 3 designations	1 (or lowest number)
Papa, Sierra, Tango	Papa (or word that starts with the letter closest to the start of the alphabet. Papa = primary, Sierra = secondary, Tango = tertiary)
Alpha, Bravo, Charlie	Alpha (or word that starts with the letter closest to the start of the alphabet)
Blank for one procedure (e.g., VOR Rwy 36, VOR Rwy 36-1, VOR Rwy 36-2)	Blank (procedure without a suffix)
No designation	First procedure in chart sequence

[1] see RNAV (RNP) and “LPV Only” minimums exceptions

RNAV (RNP) and “LPV Only” minimum exceptions

RNAV (RNP) approaches are defined as Special Aircraft and Aircrew Authorization Required (SAAAR) procedures which restrict their use to a small group of customers (see RNAV (RNP) Y Rwy 31 at KSUN for an example). Also, RNAV (GPS) procedures with “LPV Only” minimums are currently used by a limited group of customers (see RNAV (GPS) Z Rwy 21 at KAOO). In order to deliver a procedure that most customers are able to fly, in these cases Jeppesen will select the alternate procedure which is closest to the end of the alphabet to be included in your NavData file. In other words, the –W procedure at KSUN and the –Y procedure at KAOO.

There are some avionics manufacturers that take all multiple approach indicator procedures offered by Jeppesen and they have their own rules for determining which single procedure will be included in their legacy equipment. For those boxes, Jeppesen rules do not apply.

Procedures that qualify as the exception as stated above will be posted on Jeppesen’s website www.jeppesen.com under Aviation Resources, Online Publications, NavData Alerts/Notices.

UNITED STATES LOWER THAN STANDARD TAKE-OFF MINIMUMS – CHANGES TO JEPPESEN CHARTS

BACKGROUND

As a result of efforts to harmonize the criteria for lower than standard take-off minimums with ICAO, the FAA published Notice N 8900.38: **Revised Guidance and Authorizations for IFR Lower Than Standard Takeoff Minima Airplane Operations – All Airports (C078 and C079)**. The Notice provides guidance to 14 CFR Part 121, 125, 135, and 91 subpart K operators regarding the authorization of lower than standard take-off minimums at airports in the U.S.

This Briefing Bulletin outlines the changes to the depiction of lower than standard take-off minimums as they will appear on Jeppesen charts beginning in the 30 MAY 08 revision. Due to the volume of changes, all affected charts will be updated to reflect the new criteria over the course of several charting cycles.

The FAA maintains a website containing a list of all runways that are authorized for lower than standard take-off minimums of 300, 500 or 1000 RVR (RVR 3, RVR 5, RVR 10) at:

http://www.faa.gov/about/office_org/headquarters_offices/avs/offices/afs/afs400/afs410/status_lists/

For the complete Notice N 8900.38, refer to the FAA's website at:

http://fsims.faa.gov/home.aspx

CHANGES TO CRITERIA

Major changes in FAA Notice N 8900.38 include the following:

- Only two RVR reports are required for lower than standard take-off operations.
- RVR 5 is now the lowest authorized take-off minimum based upon outside visual references.
- High intensity runway lighting (HIRL) is required for take-off operations less than RVR 10.

The following requirements and restrictions apply to the use of RVR values below RVR 16:

a. Where only two RVR sensors are installed, the TDZ and Rollout RVR sensor reports are both required and controlling.

b. Where three RVR sensors are installed on the runway to be used:

    1. The TDZ, Mid and Rollout RVR reports are controlling for all operations.
    2. The failure of any one RVR will not affect operations provided the remaining two RVR sensors are reporting values at or above the appropriate minimums.

NOTE: Extremely long runways (e.g., DEN 16R-34L) utilize four RVR sensors (i.e., TDZ, Mid, Rollout, and Far-End). When a fourth Far-End RVR value is reported, it is not controlling and is not to be used as one of the two required operative RVR systems.

CHANGES TO CHART FORMAT

Jeppesen's depiction of lower than standard take-off minimums at U.S. airports has been modified to include all pertinent equipment requirements. These include

- notations for the number of RVR reports below RVR 16,

UNITED STATES LOWER THAN STANDARD TAKE-OFF MINIMUMS – CHANGES TO JEPPESEN CHARTS

- specific runway lighting and runway centerline markings required for each level of RVR, and
- the term HUD (approved Head-Up Display take-off guidance system) in place of the phrase “Approved Guidance System” for RVR 3 authorization.

The configuration of RVR sensors on each runway – TDZ, Mid (where installed) and Rollout – remains the same, and the take-off minimums will still reflect the number of available RVR reports on each runway.

The lowest available take-off RVR values for each runway or group of runways are shown to the left. Moving to the right, the RVR values increase depending on the availability of centerline (CL) and high intensity runway lights (HIRL) as well as runway centerline markings (RCLM). Where lower than standard take-off minimums are shown, the aircraft engine requirements for Standard take-off minimums are now depicted as column headings (i.e., 3 & 4 Eng, 1 & 2 Eng).

NOTE: Jeppesen charts depict the lowest authorized take-off minimums as defined by the criteria. However, principal operations inspectors may issue OpSpecs authorizations with higher take-off minimums to individual operators.

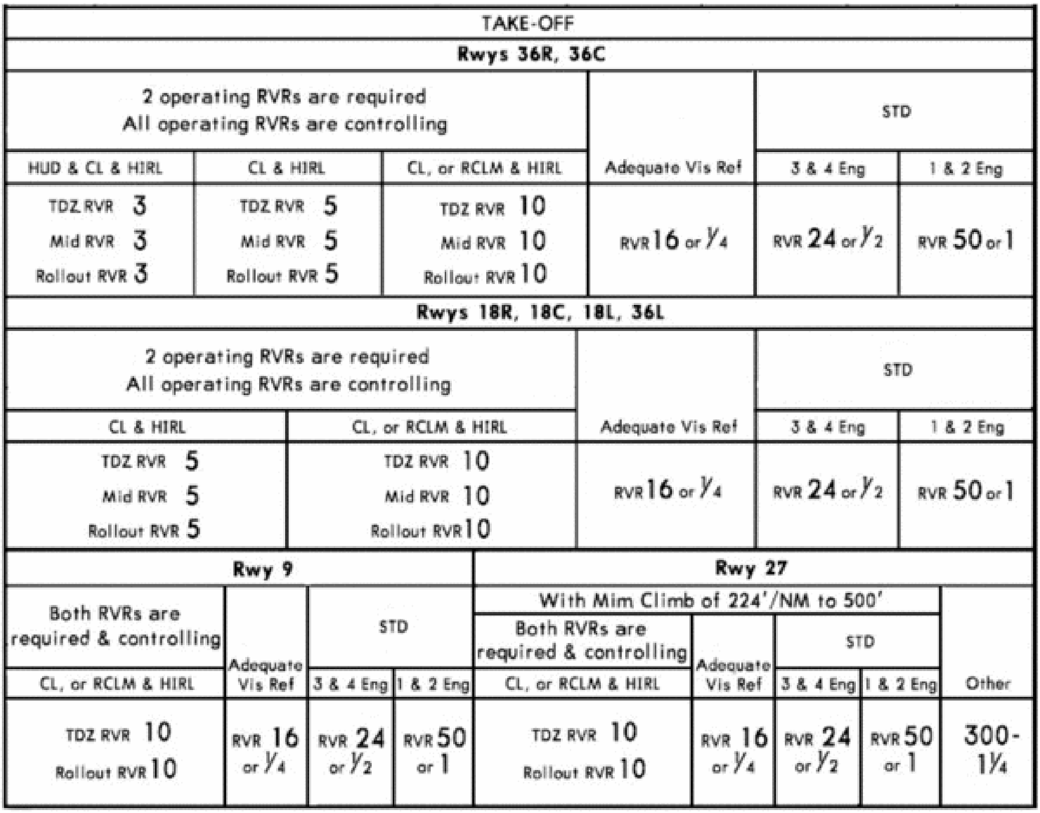
CHART SAMPLE

Depending on the authorized lower than standard take-off minimums, the number of RVR sensors, and any additional climb requirements for each runway, it may be necessary to depict the take-off minimums in more than one band.

In this example, most runways have three RVR sensor reports. Two of the runways depict the requirement for HUD (as well as CL & HIRL) for RVR 3. And two of the runways have only two RVR reports, with RVR 10 being the lowest authorized take-off minimum. Even though these runways share the same basic take-off minimums, they are shown separately due to one runway having a minimum climb requirement.

UNITED STATES LOWER THAN STANDARD TAKE-OFF MINIMUMS – CHANGES TO JEPPESEN CHARTS

Example of an airport's take-off minimums with multiple authorizations and equipment requirements for lower than standard take-off operations



<table>
<tr><th colspan="12">TAKE-OFF</th></tr>
<tr><th colspan="12">Rwys 36R, 36C</th></tr>
<tr><td colspan="6">2 operating RVRs are required
All operating RVRs are controlling</td><td colspan="2" rowspan="2">Adequate Vis Ref</td><td colspan="4">STD</td></tr>
<tr><td colspan="2">HUD & CL & HIRL</td><td colspan="2">CL & HIRL</td><td colspan="2">CL, or RCLM & HIRL</td><td colspan="2">3 & 4 Eng</td><td colspan="2">1 & 2 Eng</td></tr>
<tr><td colspan="2">TDZ RVR 3
Mid RVR 3
Rollout RVR 3</td><td colspan="2">TDZ RVR 5
Mid RVR 5
Rollout RVR 5</td><td colspan="2">TDZ RVR 10
Mid RVR 10
Rollout RVR 10</td><td colspan="2">RVR 16 or ¼</td><td colspan="2">RVR 24 or ½</td><td colspan="2">RVR 50 or 1</td></tr>
<tr><th colspan="12">Rwys 18R, 18C, 18L, 36L</th></tr>
<tr><td colspan="6">2 operating RVRs are required
All operating RVRs are controlling</td><td colspan="2" rowspan="2">Adequate Vis Ref</td><td colspan="4">STD</td></tr>
<tr><td colspan="3">CL & HIRL</td><td colspan="3">CL, or RCLM & HIRL</td><td colspan="2">3 & 4 Eng</td><td colspan="2">1 & 2 Eng</td></tr>
<tr><td colspan="3">TDZ RVR 5
Mid RVR 5
Rollout RVR 5</td><td colspan="3">TDZ RVR 10
Mid RVR 10
Rollout RVR 10</td><td colspan="2">RVR 16 or ¼</td><td colspan="2">RVR 24 or ½</td><td colspan="2">RVR 50 or 1</td></tr>
<tr><th colspan="5">Rwy 9</th><th colspan="7">Rwy 27</th></tr>
<tr><td colspan="2" rowspan="2">Both RVRs are required & controlling</td><td rowspan="3">Adequate Vis Ref</td><td colspan="2" rowspan="2">STD</td><td colspan="5">With Mim Climb of 224′/NM to 500′</td><td colspan="2" rowspan="3">Other</td></tr>
<tr><td colspan="2">Both RVRs are required & controlling</td><td rowspan="2">Adequate Vis Ref</td><td colspan="2">STD</td></tr>
<tr><td colspan="2">CL, or RCLM & HIRL</td><td>3 & 4 Eng</td><td>1 & 2 Eng</td><td colspan="2">CL, or RCLM & HIRL</td><td>3 & 4 Eng</td><td>1 & 2 Eng</td></tr>
<tr><td colspan="2">TDZ RVR 10
Rollout RVR 10</td><td>RVR 16 or ¼</td><td>RVR 24 or ½</td><td>RVR 50 or 1</td><td colspan="2">TDZ RVR 10
Rollout RVR 10</td><td>RVR 16 or ¼</td><td>RVR 24 or ½</td><td>RVR 50 or 1</td><td colspan="2">300-1¼</td></tr>
</table>

APPLICATION OF STATE NOTAMS TO JEPPESEN AERONAUTICAL CHARTS AND DATABASE

GENERAL

The purpose of this bulletin is to convey to our valued customers our current policy regarding the applications of chart and database changes based on state issued NOTAMs. The following is a summary of that policy and is specific to the processing of state issued NOTAMs only.

BACKGROUND

The “Notice to Airmen” (NOTAM) has been an integral part of the system for disseminating critical aeronautical information world wide for a very long time. Typically, NOTAMs publicize aeronautical information that is time-critical as well as temporary in nature. NOTAMs are also used when the information is not known sufficiently in advance to allow for chart publication and/or database extraction.

NOTAMs communicate aeronautical information that has a direct impact on a pilot's flight preparation. It is for this reason that all pilots are required by regulation to review all available NOTAMs applicable to their particular flight. The following policy regarding the application of NOTAM information to Jeppesen products is based on that fundamental principal.

NOTAM POLICY

All Permanent or “P” NOTAMs are analyzed when received and applied to the Jeppesen charts and/or database as appropriate, based on normal Jeppesen workflow and process criteria.

Temporary NOTAMs published without an active duration, or those published with an active duration of 90 days or less, are not analyzed for possible application due to their short life span and volatility. It would be part of a pilot's normal flight preparation to familiarize themselves with this type of NOTAM.

Temporary NOTAMs published with an active duration of more than 90 days will be analyzed and may be applied to the charts and/or database after considering its overall applicability. Not all temporary NOTAMs with an active duration of more than 90 days are applied to the charts and/or database. The decision regarding when to apply a temporary NOTAM to the charts and/or database is based on a wide range of factors, and is done on a case by case basis. Again, based on a normal pre flight process, pilots would access these NOTAMs prior to flight.

NOTE: Jeppesen scans all Temporary NOTAMs upon receipt to assess a basic level of impact. Special consideration is given to Temporary NOTAMs that have a direct effect on permanent source documents.

We continue striving to supply you, our valued customers, with highly accurate, on time flight information. The above policy helps us meet that lofty goal. We look forward to fulfilling your aeronautical charting and database needs now and in the future.

AIRLINE CHART ENHANCEMENT

MSA Depiction on Approach Chart Plan View

Dear valued customer,

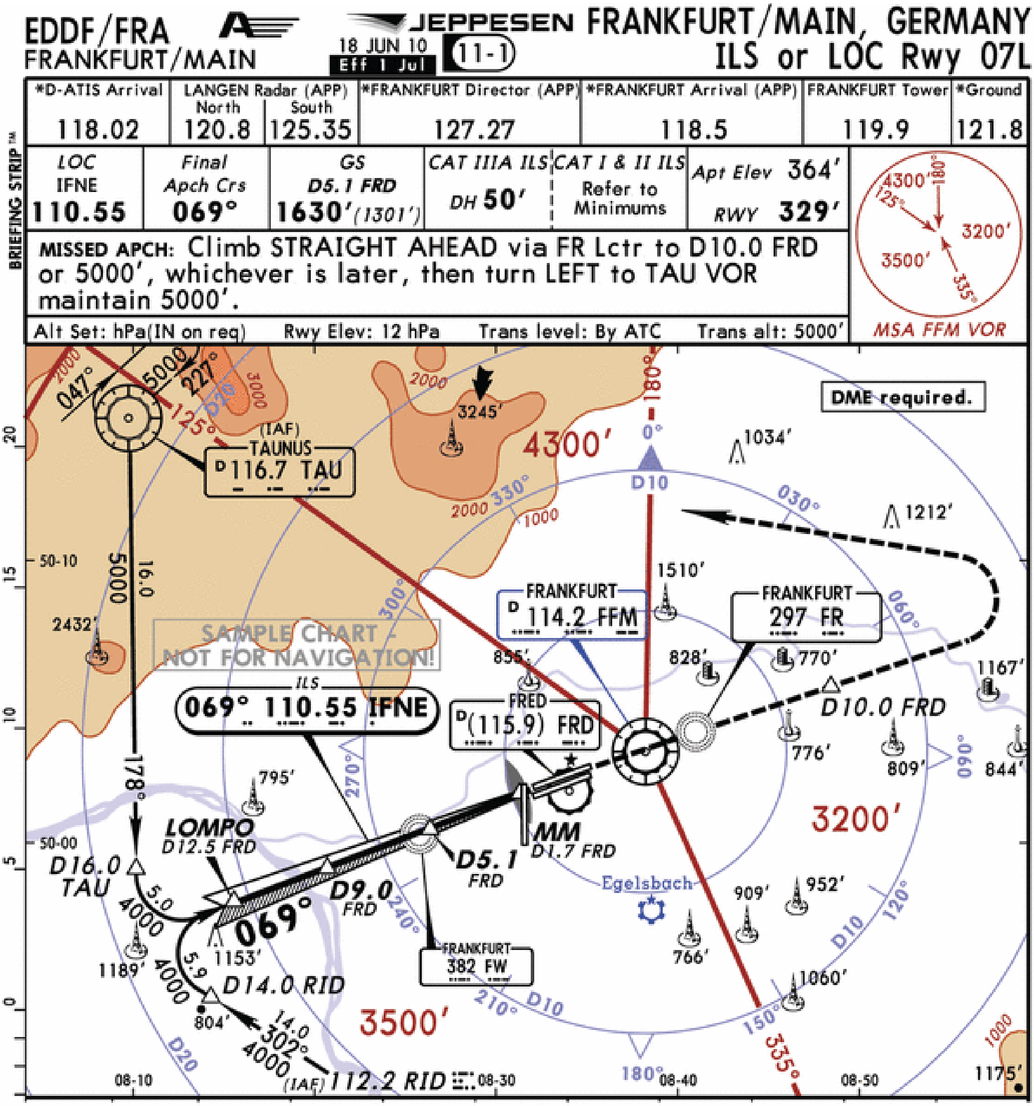
Over the past year, Jeppesen has been actively performing market research capturing the Voice of the Customer specifically in relation to the CAO Airline Approach Charts. As a result of the customer comments, suggestions and direct feedback, Jeppesen is pleased to announce an enhancement to the Airline Approach Chart.

Beginning with 26 November 2010 Revision Jeppesen Airline Approach Charts will depict the Minimum Sector Altitude (MSA) in the Plan View. This enhancement will deliver the following benefits:

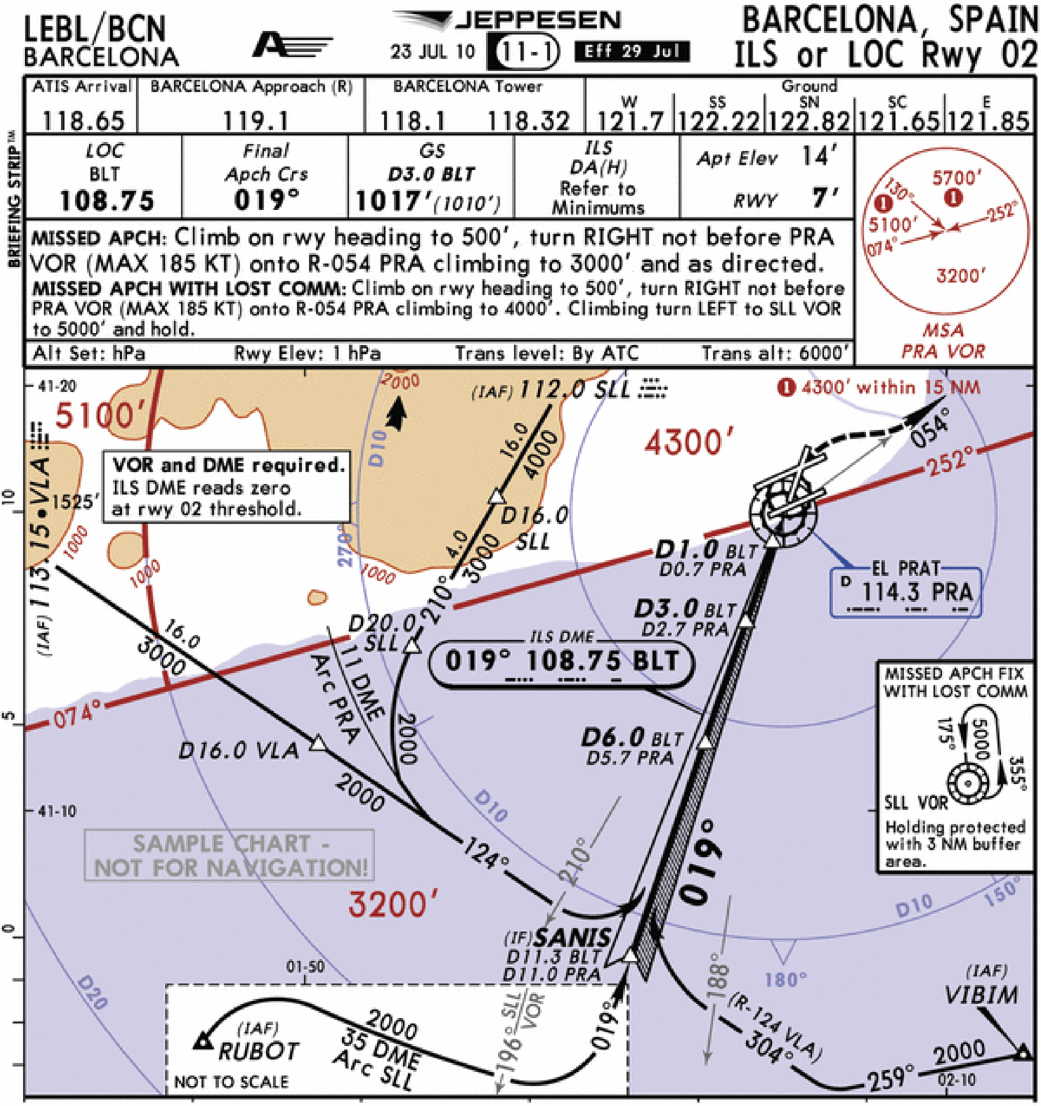
- MSA depicted to-scale in the Plan View for better situational awareness
- Keeping the MSA in the Briefing Strip for familiarity and to accommodate complex MSA’s
- MSA’s in the Briefing Strip and Plan View are depicted in the same color

Airline Approach Charts will be updated with this enhancement on a routinely basis.

AIRLINE CHART ENHANCEMENT



Unlike the Briefing Strip MSA view, which shows the complete MSA coverage, the Plan View will only contain the MSA information affecting the charted area:


LEBL/BCN
BARCELONA
JEPPESEN
23 JUL 10 (11-1) Eff 29 Jul
BARCELONA, SPAIN
ILS or LOC Rwy 02
ATIS Arrival 118.65
BARCELONA Approach (R) 119.1
BARCELONA Tower 118.1 118.32
Ground W 121.7 SS 122.22 SN 122.82 SC 121.65 E 121.85
BRIEFING STRIP™
LOC BLT 108.75
Final Apch Crs 019°
GS D3.0 BLT 1017′(1010′)
ILS DA(H) Refer to Minimums
Apt Elev 14′
RWY 7′
MISSED APCH: Climb on rwy heading to 500′, turn RIGHT not before PRA VOR (MAX 185 KT) onto R-054 PRA climbing to 3000′ and as directed.
MISSED APCH WITH LOST COMM: Climb on rwy heading to 500′, turn RIGHT not before PRA VOR (MAX 185 KT) onto R-054 PRA climbing to 4000′. Climbing turn LEFT to SLL VOR to 5000′ and hold.
Alt Set: hPa
Rwy Elev: 1 hPa
Trans level: By ATC
Trans alt: 6000′
5700′
130°
252°
5100′
074°
3200′
MSA PRA VOR
❶ 4300′ within 15 NM
41-20
5100′
VOR and DME required.
ILS DME reads zero at rwy 02 threshold.
(IAF) 112.0 SLL
16.0
4000
D16.0 SLL
4.0
3000
4300′
054°
252°
D1.0 BLT
D0.7 PRA
EL PRAT
D 114.3 PRA
D3.0 BLT
D2.7 PRA
ILS DME
019° 108.75 BLT
(IAF) 113.15 VLA
1525′
1000
2000
D10
270°
210°
D20.0 SLL
11 DME Arc PRA
2000
16.0
3000
074°
D16.0 VLA
2000
124°
D6.0 BLT
D5.7 PRA
019°
MISSED APCH FIX WITH LOST COMM
175°
5000
355°
SLL VOR
Holding protected with 3 NM buffer area.
41-10
SAMPLE CHART - NOT FOR NAVIGATION!
3200′
210°
(IF) SANIS
D11.3 BLT
D11.0 PRA
188°
180°
D10
150°
(R-124 VLA)
304°
(IAF) VIBIM
2000
259°
02-10
01-50
(IAF) RUBOT
2000
35 DME Arc SLL
196°
SLL VOR
019°
NOT TO SCALE
D20
10
5
0

IMPLEMENTATION OF NEW CIRCLING CRITERIA BASED ON TERPS 8260.3B CHANGE 21

Background

The FAA has modified the criteria for circling approach areas via TERPS 8260.3B Change 21. The circling approach area has been expanded to provide improved obstacle protection. As a result, circling minima at certain airports may increase significantly.

Standard Circling Approach Maneuvering Radius

Circling approach areas developed prior to 2011 used the radius distances (in NM) as depicted in the following table. The distances are dependent on the aircraft approach category.

Circling MDA in feet MSL	Approach Category and Circling Radius (NM)				
	CAT A	CAT B	CAT C	CAT D	CAT E
All altitudes	1.3	1.5	1.7	2.3	4.5

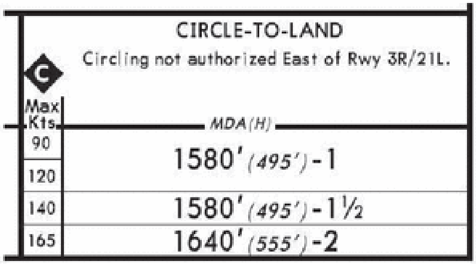
Expanded Circling Maneuvering Airspace Radius

Circling approach areas for approach procedures developed beginning in 2013 use the radius distances (in NM) as depicted in the following table. These distances, dependent on aircraft category, are also based on the circling altitude which accounts for the true airspeed increase with altitude.

Circling MDA in feet MSL	Approach Category and Circling Radius (NM)				
	CAT A	CAT B	CAT C	CAT D	CAT E
1000 or less	1.3	1.7	2.7	3.6	4.5
1001 – 3000	1.3	1.8	2.8	3.7	4.6
3001 – 5000	1.3	1.8	2.9	3.8	4.8
5001 – 7000	1.3	1.9	3.0	4.0	5.0
7001 – 9000	1.4	2.0	3.2	4.2	5.3
9001 and above	1.4	2.1	3.3	4.4	5.5

Affect on Jeppesen Charts

Charts where these criteria have been applied can be identified by the symbol C in the CIRCLE-TO-LAND minima box.



CIRCLE-TO-LAND

Circling not authorized East of Rwy 3R/21L.

C Max Kts	MDA(H)
90	1580′(495′)-1
120	
140	1580′(495′)-1½
165	1640′(555′)-2

The new minima will be published on approach procedure charts on an as-revised basis as the new criteria are applied by the FAA and issued via their source documents.

CHART DESIGN ENHANCEMENTS FOR SIDS, STARS, DEPARTURES, AND ARRIVALS

PURPOSE

The purpose of this Bulletin is to announce significant enhancements to the graphical depiction of Jeppesen SID, STAR, Departure, and Arrival charts. In the past, Jeppesen has used a Not-To-Scale depiction for the graphical section of SID, STAR, Departure, and Arrival charts. Moving forward, the graphic portion of Jeppesen SID, STAR, Departure, and Arrival charts will now be shown either completely or partially To-Scale. In addition, several other major enhancements will be applied which are geared toward continually improving the overall usability of Jeppesen charts. These enhancements are a direct result of feedback received from you, the customer, which Jeppesen greatly appreciates.

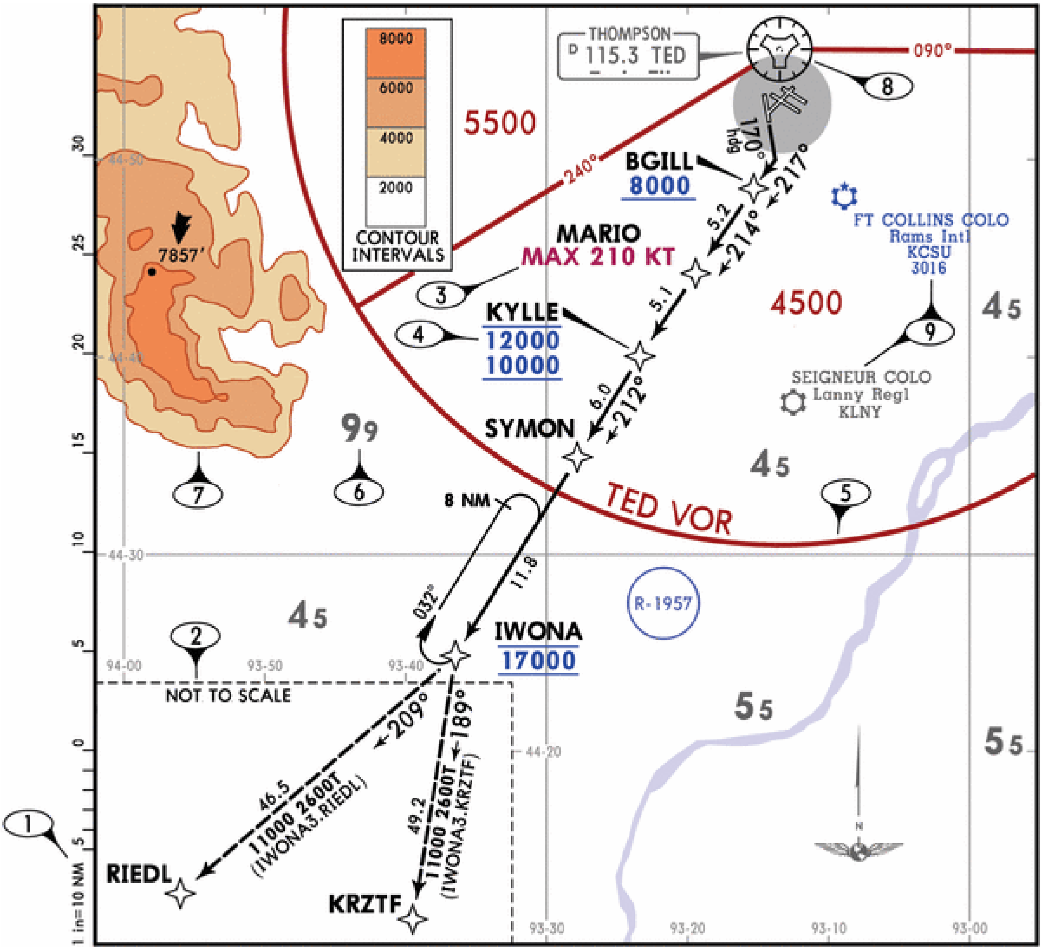
PHILOSOPHY

To enhance terrain/situational awareness during low level operations, the area in and around the departure/arrival airport will be depicted To-Scale. At times a complete To-Scale depiction will not be practical, in which case Enroute transition segments will be shown Not-to-Scale and will be clearly indicated as such. By using a To-Scale depiction around the departure/arrival airport, Jeppesen SID, STAR, Departure, and Arrival charts will provide enhanced terrain, airspace, and relative distance information.

ENHANCEMENTS

The sample procedure graphic below depicts the major enhancements being applied to Jeppesen SID, STAR, Departure, and Arrival procedure charts. A brief description of each major improvement is shown after the graphic.

CHART DESIGN ENHANCEMENTS FOR SIDS, STARS, DEPARTURES, AND ARRIVALS



1. Charting scales are applied, similar to what are used for approach charts, which allow a To-Scale depiction of the immediate area around the departure/arrival airport. The scale used is indicated along the lower left side of the procedure graphic. The normal orientation will be north towards the top of the chart, but other orientations will be used when chart readability can be enhanced. All procedure text will be oriented the same as the procedure graphic.

2. Normally all departure/arrival tracks will be shown within the To-Scale portion of the procedure graphic. At times, transitions to and from the enroute structure will be shown within Not-To-Scale areas. These Not-To-Scale areas will be indicated by a dashed line and clearly marked. It will be fairly common for transition tracks to crossover between To-Scale and Not-To-Scale areas and vice versa.

3. All speed restrictions will now be shown using bold text and a magenta color so as to be easily located. General speed restrictions that apply to the entire procedure will continue to be shown directly below the procedure identifier. Speed restrictions that apply to a specific navaid, intersection/waypoint, or track segment, will be placed next to, or tied to the element as appropriate.
4. The depiction of altitude restrictions has been enhanced two ways. All altitude restrictions will be shown in bold text and will be blue in color to make them easy to locate. In addition, a “Line Above” and “Line Below” depiction will be used to indicate the type of restriction using the ICAO recommendation for the depiction of altitude restrictions.
5. An MSA will be shown in graphical form within the Plan View of the chart indicating the outer limits, all associated sectors, and applicable sector altitudes. The radius of the MSA will be indicated when other than the standard 25 NM. The MSA information will be brown in color for easy identification.
6. Grid MORAs will be charted for the To-Scale areas of the procedure graphic. Values will be shown using a grey color.
7. Generalized terrain contours will be depicted within the To-Scale sections of the procedure graphic to portray areas of higher or rising terrain.
8. The navaid symbols used will be those that are consistent with Jeppesen enroute charts.
9. Airports that are served by the procedure, known as “Also Serves” airports, are depicted using a blue color to distinguish them from other secondary airports. All secondary airports, those not served by the procedure, are depicted using a grey color.

IMPLEMENTATION PLAN

Jeppesen SID, STAR, Departure, and Arrival charts will be converted using the enhanced charting specifications beginning in December 2016.

Conversion will take place airport-by-airport with all procedures for a given airport released at the same time.

Pilot Training Material is available at www.jeppesen.com/chart-enhancements. This website also provides an Operational Risk Assessment (ORA) for your information.

Inquiries related to this Bulletin may be submitted through established customer support channels or your account representative.

FOR USERS OF THE COMMERCIAL AIRLINE FORMAT CHART (CAO) ONLY — LPV MINIMUMS ADDED TO RNAV APPROACH PROCEDURES

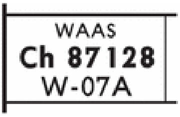
PURPOSE

The purpose of this Bulletin is to announce an enhancement to the Landing Minimums on Jeppesen Commercial Airline Format (CAO) RNAV Approach Procedure charts. Moving forward Landing Minimums associated with Localizer Performance with Vertical Guidance (LPV) type RNAV approach procedures will be provided. These minimums are being provided based on future increases of WAAS/EGNOS capable commercial aircraft.

ENHANCEMENTS

As stated above, when provided by the State Authority as a function of an RNAV instrument approach procedure, LPV landing minimums will now be depicted on Jeppesen CAO charts. Along with the LPV minimums, all of the supporting Wide Area Augmentation System (WAAS) or European Geostationary Navigation Overlay Service (EGNOS) information related to the approach procedure will also be depicted. This WAAS/EGNOS information is placed throughout the chart, an overview of these enhancements are listed below:

- WAAS/EGNOS reception information will be shown within the Briefing Strip in the Primary Navaid Box

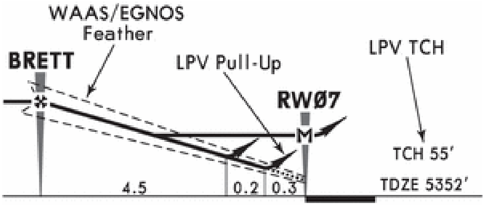


- When LPV landing minimums are available for an RNAV approach procedure the DA(H) will be shown within the Briefing Strip in the Landing DA/MDA Box.

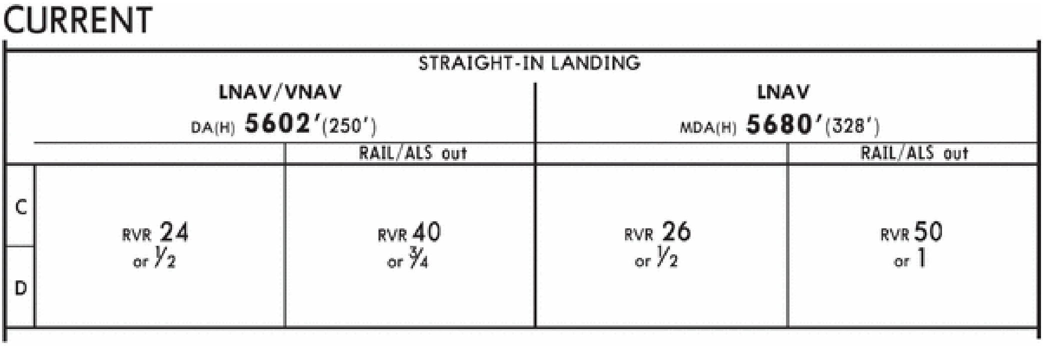
- Within the procedure plan-view, WAAS/EGNOS information will be depicted within the Primary Navaid Box which is tied to the Final Approach Course.

- Several LPV related items will be added to the profile view of the chart. These include, the WAAS/EGNOS “feather” along the final approach, the pull-up arrow associated with the LPV DA(H), and the LPV TCH.

FOR USERS OF THE COMMERCIAL AIRLINE FORMAT CHART (CAO) ONLY — LPV MINIMUMS ADDED TO RNAV APPROACH PROCEDURES

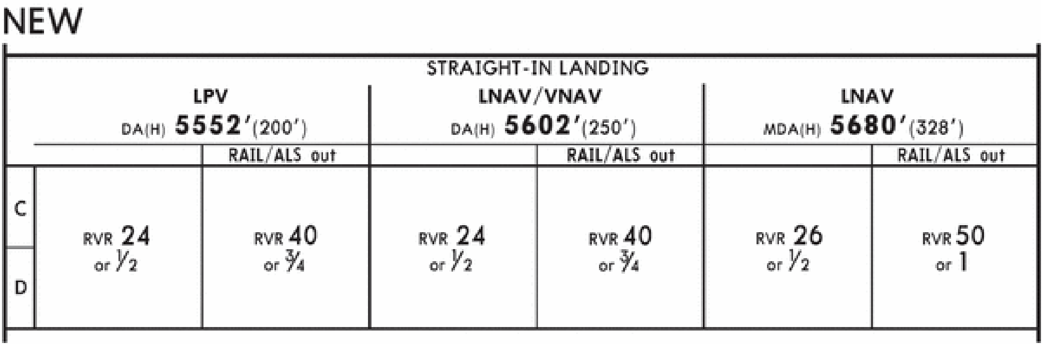


- Any applicable LPV related information will be added to the Ground Speed box.
- LPV landing minimums will be added to the landing minimums band. See the before and after sample below:



CURRENT

	STRAIGHT-IN LANDING			
	LNAV/VNAV DA(H) **5602'**(250')		LNAV MDA(H) **5680'**(328')	
		RAIL/ALS out		RAIL/ALS out
C D	RVR 24 or ½	RVR 40 or ¾	RVR 26 or ½	RVR 50 or 1



NEW

	STRAIGHT-IN LANDING					
	LPV DA(H) **5552'**(200')		LNAV/VNAV DA(H) **5602'**(250')		LNAV MDA(H) **5680'**(328')	
		RAIL/ALS out		RAIL/ALS out		RAIL/ALS out
C D	RVR 24 or ½	RVR 40 or ¾	RVR 24 or ½	RVR 40 or ¾	RVR 26 or ½	RVR 50 or 1

IMPLEMENTATION

The addition of LPV landing minimums will begin starting in the 5 May 2017 revision. Conversion will take place on an as revised basis.

Inquiries related to this Bulletin may be submitted through established customer support channels or your account representative.

CHART DESIGN ENHANCEMENTS OF TAXI CHARTS FOR CODE F AIRCRAFT

PURPOSE

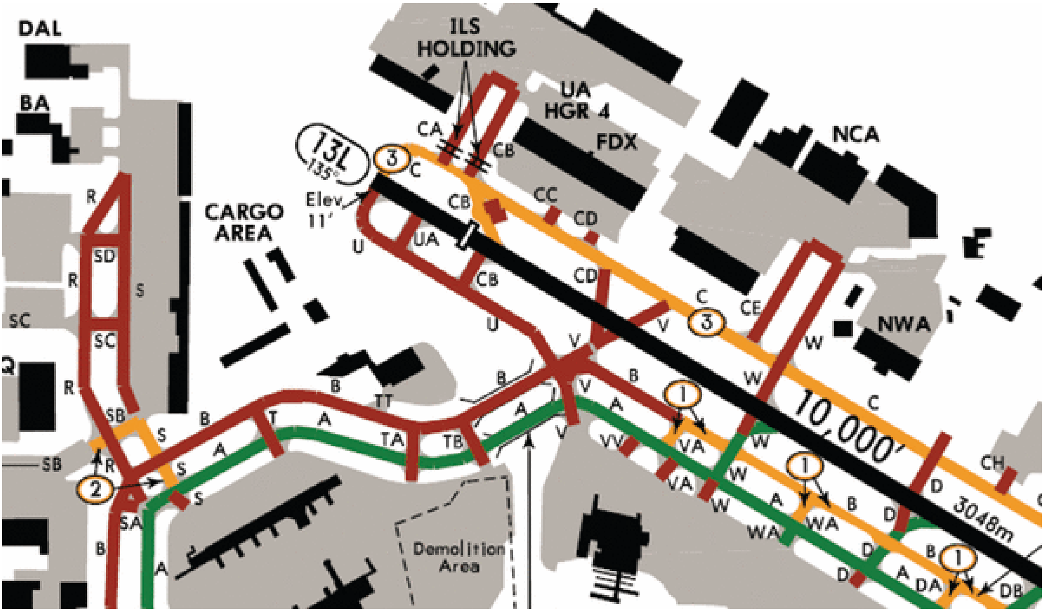
The purpose of this Bulletin is to announce enhancements to the graphical depiction of Jeppesen taxi charts for Code F aircraft when a source provider has provided Jeppesen with the relevant information regarding Code F taxi procedures at an aerodrome. Code F aircraft are aircraft with a wingspan between 214ft (65m) and 263ft (80m) and outer main gear wheel span between 46ft (14m) and 53ft (16m).

Moving forward, several enhancements will be applied which are intended to improve the overall usability of Jeppesen taxi charts. These enhancements are a direct result of feedback received from you, the customer, which Jeppesen greatly appreciates.

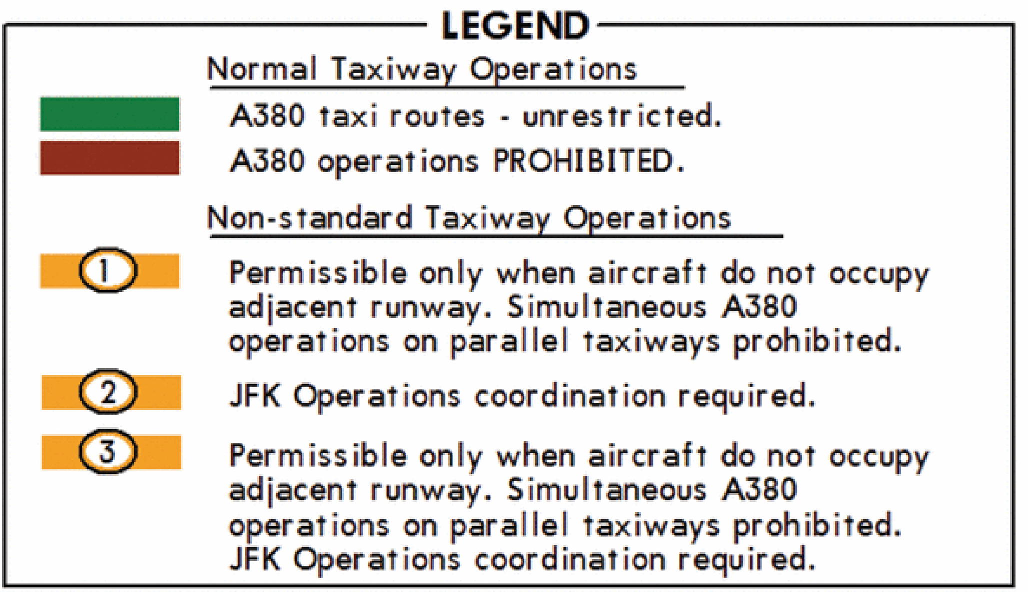
ENHANCEMENTS

The sample graphic below depicts the enhancements being applied to Jeppesen Code F taxi charts. A brief description of each major improvement is shown after the graphic.

Sample Plan View:



Sample Legend:



LEGEND

Normal Taxiway Operations

🟩 A380 taxi routes - unrestricted.

🟥 A380 operations PROHIBITED.

Non-standard Taxiway Operations

① Permissible only when aircraft do not occupy adjacent runway. Simultaneous A380 operations on parallel taxiways prohibited.

② JFK Operations coordination required.

③ Permissible only when aircraft do not occupy adjacent runway. Simultaneous A380 operations on parallel taxiways prohibited. JFK Operations coordination required.

a. Colors have been changed to allow for a quicker and easier understanding of the aerodrome.
   - Green indicates an approved taxiway.
   - Yellow indicates restrictions apply.
   - Red indicates the taxiway is prohibited for use.

b. In the case multiple restrictions apply, a new ball flag type has been created to more easily identify the restrictions.

c. A legend with appropriate information will be present on each chart to assist in further defining what each color and ball flag signifies.

d. Communications information, runway threshold information, and runway length will be shown to reduce the need to switch between the standard airport diagrams.

IMPLEMENTATION PLAN

Jeppesen Code F taxi charts will be converted using the enhanced charting specifications beginning with the 1 JUN 2018 revision.

Conversion will take place on an as-revised basis.

Inquiries related to this Bulletin may be submitted through established customer support channels or your account representative.

CHART DESIGN ENHANCEMENTS OF TAXI CHARTS FOR CODE F AIRCRAFT

THIS BULLETIN IS FOR INFORMATION ONLY. RETAIN OR DESTROY AT YOUR DISCRETION.

GLOBAL APPLICATION OF NEW AERODROME OPERATING MINIMUMS (AOM) CONCEPT

PURPOSE

The purpose of this Bulletin is to announce the new Standard AOM concept and provide a general description of the forthcoming changes concerning the way in which Jeppesen determines and applies Aerodrome Operating Minimums (AOM) for landing and take-off to its worldwide library of the Instrument Approach Procedures (IAP) and Airport charts in the Jeppesen Airway Manual.

BACKGROUND

Jeppesen has a long history as a global provider of aeronautical charts, navigation data and related services. Among these essential services has been the uniform publication of Aerodrome Operating Minimums on Airway Manual charts.

Jeppesen's policy to recognize and respect the authority of individual State Aviation Authorities is a fundamental principle past, present, and future.

The original Jeppesen Standard for AOM is known as the "Explanation of Common Airport Operating Minimum Specifications", or ECOMS. This standard was significantly influenced by U.S. FAA TERPS visibility tables which were widely accepted when ECOMS was originally created in the late 1970s.

Over the years Jeppesen has been involved in initiatives to develop new, harmonized global AOM concepts. These industry efforts led to the development of Joint Aviation Authorities JAR-OPS, then EASA AIR OPS and in 2017 to the publication of the 4th edition of ICAO's Doc 9365 Manual of All-Weather Operations (AWOM). This was the genesis of the decision to replace the aged ECOMS with a new Jeppesen AOM concept which is aligned with the new ICAO AWOM.

OBJECTIVES

The implementation of the new Standard AOM is intended to adopt accepted ICAO standards and to better serve developments in aviation (such as Continuous Descent Final Approach flight technique, Approaches with Vertical Guidance, Enhanced Vision Systems, Performance Based Navigation, etc.). It also leads to the presentation of the lowest possible visibility minimums which are authorized by the State of the aerodrome.

The **Jeppesen Standard AOM Policy** for the depiction of operating minimums is:

a. **State-provided AOM will always be depicted as published by the State**.

State-provided visibilities may be lower than the visibilities determined according to ICAO's AWOM. The determination of lower values by the State is not precluded by ICAO if such values result in an acceptable level of safety. **Therefore, the State-provided visibilities will not being raised to match the visibilities from the tables in ICAO AWOM**.

If the State does not provide AOM for "ALS out" condition, ALS out visibility values will be determined according to the rules and tables in ICAO's AWOM, but not below any State-provided visibilities for operational approach lights.

"Provided by State" means either, minimum visibilities are published on procedure source, within the Aeronautical Information Publication (AIP), or a specific AOM concept has to be applied within this State.

b. **Where a State does not provide any AOM, Jeppesen will determine visibility values according to the rules and tables in ICAO's AWOM.**

c. **Operators with tailored AOM concepts** will continue to be accommodated in accordance with the established processes.

SCOPE

The systematic conversion from ECOMS to the new Standard AOM will affect operators differently depending on the nature of their operations; domestic or international, country of origin, etc.

Operators, especially those who operate internationally, are encouraged to become familiar with ICAO Doc 9365 AWOM with respect to possible implications. FAA and EASA approved operators might be less affected because of the harmonization with ICAO.

The effects of replacing ECOMS-based visibility values with the new ICAO-based visibilities will vary by State or by region.

In States where complete AOM are provided (such as United States), minimum visibility will typically remain the same. If the charted visibility was raised because of a higher ECOMS table value, it is now being replaced by the lower State-provided visibility value.

In States that provide no or incomplete AOM, significant changes will apply on instrument approach procedures charts. The new visibilities might be higher or lower than the charted ones.

OVERVIEW OF NEW JEPPESEN STANDARD AOM

MINIMUMS BOX LABEL

In the future, the new Std label will apply to Jeppesen charts to indicate that the charted minimums are determined according to the rules of the new Jeppesen AOM concept.

The current Standard label on existing charts, which indicates the AOM are according to EU-OPS/EASA AIR OPS, will be replaced by Std/State.

Minimums with the Std/State label are determined according to a State Regulation which provides rules **similar** to the ICAO AWOM. Deviations from ICAO AWOM will be described in ATC State pages in the Airway Manual.

If the minimums are determined according to another AOM concept which is **not** similar to ICAO AWOM, the State Regulation will be indicated by a different label:

TERPS	minimums based on TERPS
State	State simply provides minimums, regulation/rules might be unknown
JAR-OPS	minimums based on JAR-OPS
Military	minimums supplied with Military procedures

SCENARIOS INVOLVING THE AVAILABILITY OF STATE-PROVIDED AOM FOR LANDING

Descent Limit

The procedure source may include the following information to determine the descent limit for the specific approach procedure:

a. DA, DH, DA(H) or MDA, MDH, MDA(H) or similar information;

b. OCA, OCH or OCA(H);

c. DA(H) or MDA(H) together with the procedure design OCA(H).

Guidelines for the determination of applicable Descent Limit values for landing minimums are outlined below.

Approach Type/ Condition	Source Provides	Descent Limit in Minimums Box labelled as	Notes
Precision (ILS, MLS, PAR, GLS, LPV200, etc.)	DA, DH, DA(H)	DA(H)	Adjustments may be made for rounded source values.
APV (LPV, LNAV/VNAV)			
Precision (ILS, MLS, PAR, GLS, LPV200, etc.)	OCA, OCH, OCA(H)	DA(H)	The DA(H) is determined according to the rules described in ICAO AWOM. Adjustments may be made for rounded source values.
APV (LPV, LNAV/VNAV)			
Non-precision (LNAV, LP, LOC, VOR, NDB, VDF, SRA, etc.)	MDA, MDH, MDA(H)	MDA(H)	**Depiction of MDA(H) as descent limit is independent from using the CDFA or non-CDFA flight technique.** Adjustments may be made for rounded source values.

Approach Type/ Condition	Source Provides	Descent Limit in Minimums Box labelled as	Notes
Non-precision (LNAV, LP, LOC, VOR, NDB, VDF, SRA, etc.)	DA, DH, DA(H)	DA(H)	**It is assumed that a height loss adjustment is applied by the State.** Adjustments may be made for rounded source values.
Non-precision CDFA flight technique/ continuous descent profile (LNAV, LP, LOC, VOR, NDB, VDF, SRA, etc.)	OCA, OCH, OCA(H)	DA/MDA(H)	The DA/MDA(H) is determined according to the rules described in ICAO AWOM and **does not include a height loss adjustment.** Adjustments may be made for rounded source values.
Non-precision non-CDFA flight technique/stepped descent profile (LNAV, LP, LOC, VOR, NDB, VDF, SRA, etc.)	OCA, OCH, OCA(H)	MDA(H)	The MDA(H) is determined according to the rules described in ICAO AWOM. Adjustments may be made for rounded source values.

HEIGHT LOSS ADJUSTMENT NOTES – APPLICABLE TO DA(H) MANEUVER ON NPA

Wherever a State authority has clearly prescribed, provided, or otherwise specified that a non-precision instrument approach procedure has to be flown using the CDFA flight technique, **and** the corresponding descent limit value is published by source as a DA(H), Jeppesen will assume the State-provided DA(H) value includes a height loss adjustment. Only in this case the descent limit would be charted as a DA(H) on a non-precision approach procedure.

IMPORTANT NOTES:

Jeppesen will not add any Height Loss Adjustment to any charted DA/MDA(H) or MDA(H) Descent Limit values unless specified by the State.

When using the CDFA flight technique and using a DA(H) in lieu of MDA(H), operators must determine and apply an appropriate Height Loss Adjustment applicable to the aircraft, landing configuration and/or operating requirements.

If it cannot be determined if the State has incorporated a Height Loss Adjustment, the ball note below will be shown on applicable Non-Precision IAP approach charts. It is the operator's responsibility to provide necessary guidance to pilots.

"VNAV DA(H) in lieu of MDA(H) depends on operator policy."

States may prescribe specific DA(H) height loss adjustment procedures for use when non-precision IAPs are flown using CDFA and DA(H) techniques. Such situations will be noted accordingly. A note will be added to the straight-in landing minimums referencing any State-provided height loss adjustment value or requirement.

IMPORTANT NOTE:

CDFA is a flight technique. It is not a procedure design criterion. Depending on varying regulatory operational requirements, for some operators the use of CDFA for NPAs may be mandatory; for others it may be optional.

Visibility

States may not always provide visibilities for landing. The table below shows the rules which are applied to determine the landing visibility:

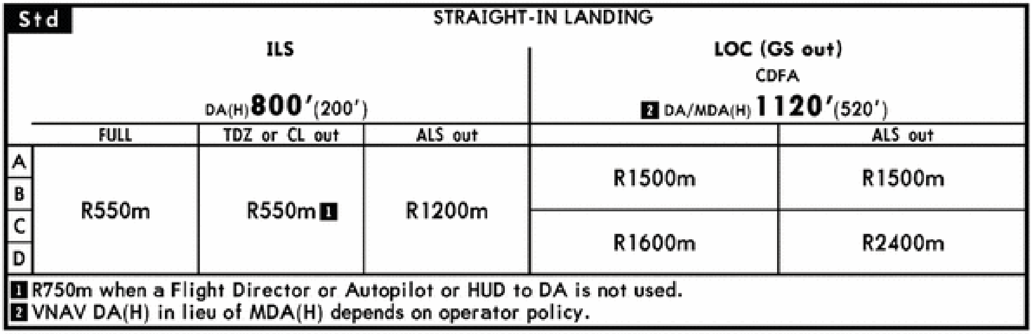
Scenario	Rules
States provide visibilities for with and without lights	– State-provided visibilities will be charted.
States provide visibilities for with approach lights only (approach lights are available and operational)	– State-provided visibilities will be charted. – Visibilities for "ALS out" will be determined according to ICAO AWOM, but not below the State-provided values for operational lights.

GLOBAL APPLICATION OF NEW AERODROME OPERATING MINIMUMS (AOM) CONCEPT

Scenario	Rules
States provide visibilities without lights only (approach lights are not available or not operational at all)	– State-provided visibilities will be charted.
States provide no visibilities at all	– Visibilities will be determined according to ICAO AWOM.

Visibilities will always be labelled as R (= RVR), V (= VIS), C (= CMV) or as R/V (= RVR and/or VIS).

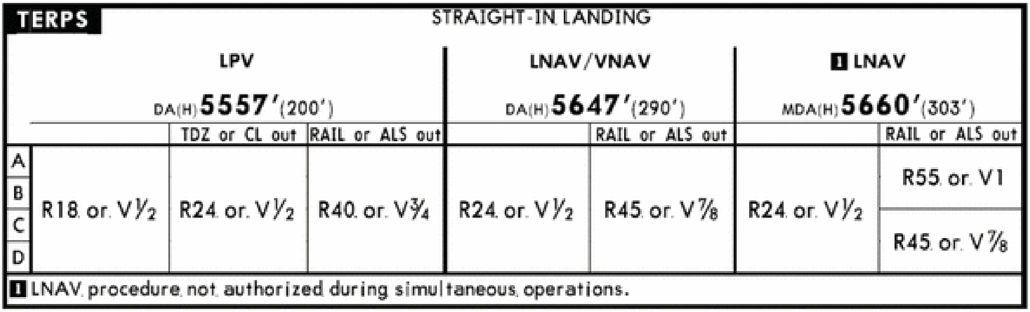
Samples



Std	STRAIGHT-IN LANDING				
	ILS DA(H) 800'(200')			LOC (GS out) CDFA [2] DA/MDA(H) 1120'(520')	
	FULL	TDZ or CL out	ALS out		ALS out
A B	R550m	R550m [1]	R1200m	R1500m	R1500m
C D				R1600m	R2400m

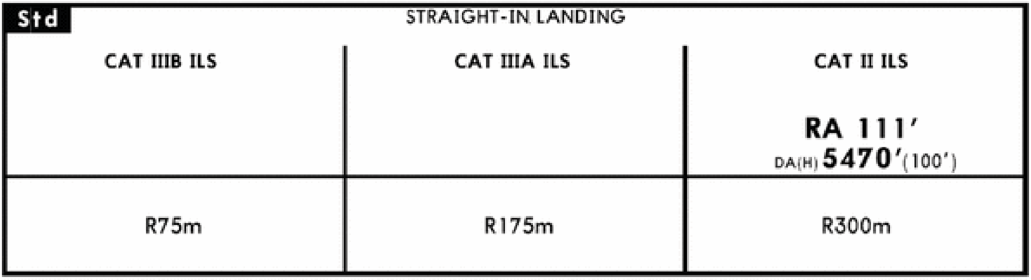
[1] R750m when a Flight Director or Autopilot or HUD to DA is not used.

[2] VNAV DA(H) in lieu of MDA(H) depends on operator policy.



TERPS	STRAIGHT-IN LANDING						
	LPV DA(H) 5557'(200')			LNAV/VNAV DA(H) 5647'(290')		[1] LNAV MDA(H) 5660'(303')	
		TDZ or CL out	RAIL or ALS out		RAIL or ALS out		RAIL or ALS out
A B	R18 or V½	R24 or V½	R40 or V¾	R24 or V½	R45 or V⅞	R24 or V½	R55 or V1
C D							R45 or V⅞

[1] LNAV procedure not authorized during simultaneous operations.



Std	STRAIGHT-IN LANDING	
CAT IIIB ILS	CAT IIIA ILS	CAT II ILS RA 111' DA(H) 5470'(100')
R75m	R175m	R300m

SCENARIOS INVOLVING THE AVAILABILITY OF STATE-PROVIDED AOM FOR TAKE-OFF

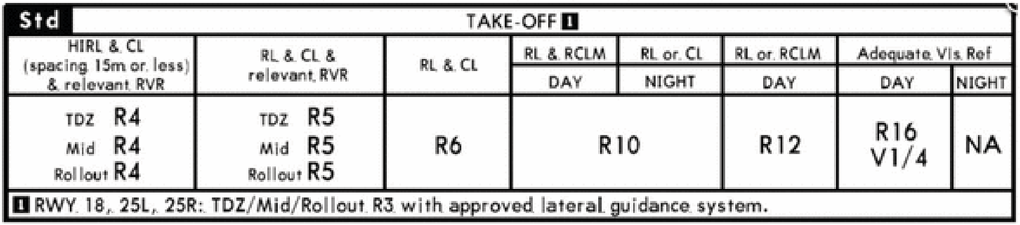
States may provide visibility minimums for take-off or not. The table below shows the rules which are applied to determine the take-off visibilities:

Scenario	Rules
States provide visibilities for with and without operational runway lights *(depending on lighting conditions, like HIRL + CL, CL, RCLM, etc.)*	– State-provided visibilities will be charted.
States provide visibilities for operational runway lights *(lowest possible visibilities for best lights, no visibilities for other conditions)*	
States provide visibilities without lights	
States do not provide any visibilities for take-off	– Visibilities will be determined according to ICAO AWOM.

Visibilities will always be labelled as R (= RVR), V (= VIS), C (= CMV) or as R/V (= RVR and/or VIS).

Samples

Std	TAKE-OFF 1						
HIRL & CL (spacing 15m or less) & relevant RVR	RL & CL & relevant RVR	RL & CL	RL & RCLM	RL or CL	RL or RCLM	Adequate Vis Ref	
			DAY	NIGHT	DAY	DAY	NIGHT
TDZ R125m Mid R125m Rollout R125m	TDZ R150m Mid R150m Rollout R150m	R200m	R300m		R400m	R/V500m	NA
1 RWY 18, 25L, 25R: TDZ/Mid/Rollout R75m with approved lateral guidance system.							



Std	TAKE-OFF 1						
HIRL & CL (spacing 15m or less) & relevant RVR	RL & CL & relevant RVR	RL & CL	RL & RCLM	RL or CL	RL or RCLM	Adequate Vis Ref	
			DAY	NIGHT	DAY	DAY	NIGHT
TDZ R4 Mid R4 Rollout R4	TDZ R5 Mid R5 Rollout R5	R6	R10		R12	R16 V1/4	NA
1 RWY 18, 25L, 25R: TDZ/Mid/Rollout R3 with approved lateral guidance system.							

CEILING

A Ceiling will only be charted for straight-in landing, circle-to-land or take-off minimums if prescribed by the State authority as a parameter of the AOM they provide.

SUPPLEMENTAL AOM TEXT PAGE LISTINGS

At certain airports, supplemental AOM text page listings (like 10-9S pages) have been published in order to accommodate the needs of operators who require operating minimums that differ from the AOM as depicted on the Standard Airway Manual charts.

With the implementation of the new Standard AOM concept most of these supplemental minimums pages might become obsolete and will be removed accordingly.

However, the supplemental AOM text pages might still be required for airports where the State-published minimums are lower than the AOM concept which is used by a specific operator.

An operator, who still needs supplemental AOM text pages, has to define the affected airports and has to provide the AOM rules, same as for the current procedure.

IMPLEMENTATION PLAN

ICAO Annex 6 requires that the operator establishes airport operating minimums for each airport to be used. This method needs to be approved by the State of the operator.

The publication of this Briefing Bulletin and the description of the new Standard AOM concept allows you to become familiar with the changes and to analyze the impact on the operations before the new concept is applied to the Airway Manual.

Jeppesen plans to start the publication of the new Standard AOM in **January 2020**.

All charts of an airport will be converted to the new concept at the same time. The conversion will be done together with regular revision activities.

For customized charts we continue to determine the minimums according to the minimums specifications which are agreed by the customer, only the depiction of the minimums box will be changed to the new format.

Airports will be converted according to the priorities below:

a. Airports with pure ECOMS minimums where no State-provided minimums are available.

   Existing 10-9S charts will be deleted during conversion.

b. Airports where ECOMS and State-provided minimums are charted.

   Minimums will be converted to “State” and existing 10-9S pages will be updated to show the higher of State and EASA AIR OPS.

c. Airports where “Standard”, “Standard/DGCA”, “TERPS” or “JAR-OPS” minimums are charted.

   These airports see almost no changes to the minimums, except the change to the new format.

DOCUMENTATION

A detailed description of take-off and landing minimums based on the rules from ICAO AWOM and their application on Jeppesen charts will be added into the Airway Manual (AWM) and to our web site www.jeppesen.com/aom.

GLOBAL APPLICATION OF NEW AERODROME OPERATING MINIMUMS (AOM) CONCEPT

The following documents are available with revision 23 AUG 19:

- Briefing Bulletin JEP 19-A;
- Jeppesen ATC-Chapter “Aerodrome Operating Minimums - Jeppesen” describing the rules and tables for the new concept;
- Table comparing ICAO Doc 9365 AOM rules against EASA AIR OPS, Indian CAR, TERPS and EU-OPS/CAR-OPS as part of the Jeppesen ATC chapter as mentioned above.

The following documents will be made available before January 2020:

- AOM scenarios and expected changes when converting to the new AOM concept (web site);
- State overview table to indicate which minimums concept will be applied for which State (web site);
- Airport & Approach Chart Legend for take-off and landing minimums (Airway Manual and web site).

Inquiries related to this Bulletin may be submitted through established customer support channels.

CHINA HIGH/LOW ALTITUDE ENROUTE CHART SERIES REDRAW

Jeppesen is pleased to announce the redesign of the China High/Low Enroute Chart Series. The redesign of these Enroute charts provides improved chart legibility and usability.

The new series of High/Low Altitude Enroute charts for China are planned for introduction in June of 2020.

Improvements include:

– Improved chart scales (for new chart coverages, refer to graphic below):

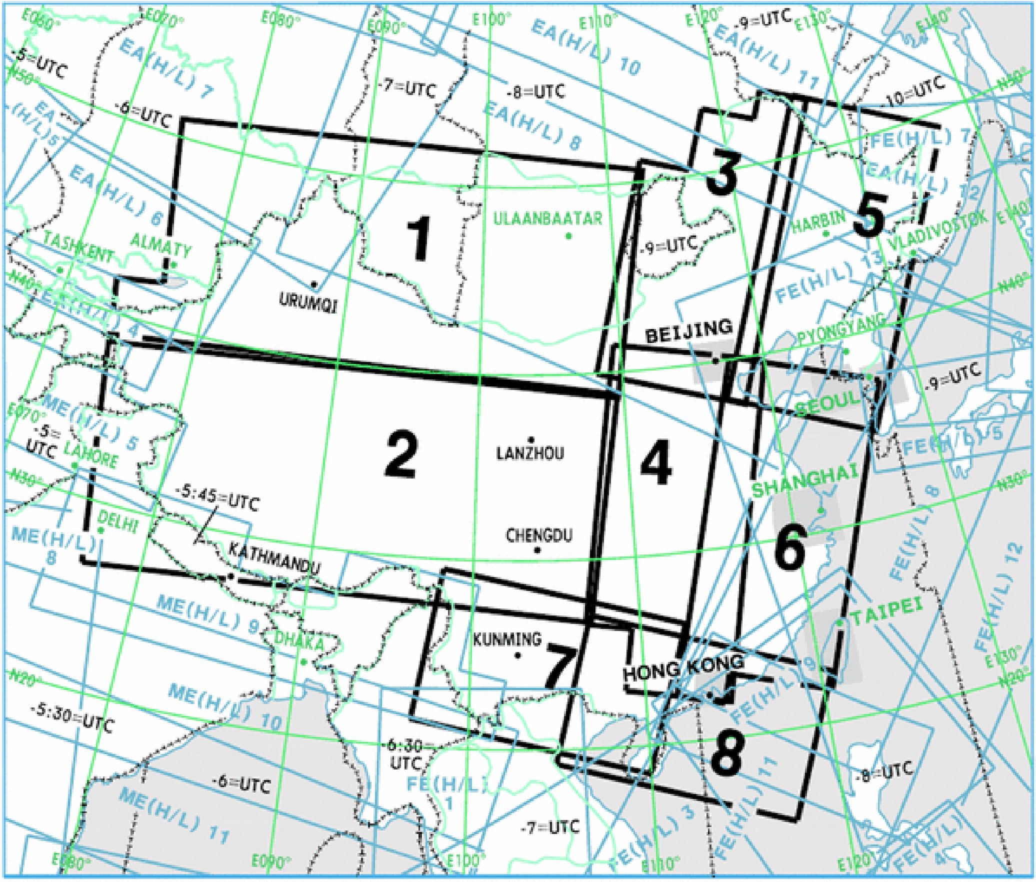
  - CH(H/L)1/2 — 1” = 30 NM, designed to accommodate flights in the north western and south western regions of China.
  - CH(H/L)3/4 — 1” = 20 NM, designed to accommodate flights towards the eastern regions of China mainly for north/south direction.
  - CH(H/L)5/6 — 1” = 20 NM, designed to accommodate flights along the eastern shores of China mainly for north/south direction.
  - CH(H/L)7/8 — 1” = 20 NM, designed to accommodate flights in the southern regions of China.

– Improved chart scales will result in a cleaner depiction in areas of heavy congestion.

– Elimination of multiple chart insets to reduce the need for cross-referencing.

– Implementation of the Enroute chart enhancements which were announced with Bulletin Jep 17-A.

CHINA HIGH/LOW ALTITUDE ENROUTE CHART SERIES REDRAW



To ease transition, Jeppesen will automatically replace charts in existing standard and tailored chart coverages as follows:

– CH(H/L) 1/2 (old) replaced by CH(H/L) 1/2, 3/4, 7/8

– CH(H/L) 3/4 (old) replaced by CH(H/L) 3/4, 5/6, 7/8

Customers with tailored coverages are asked to review these chart coverage transitions and if any changes are desired in their tailored coverage, please contact your Jeppesen Account Representative no later than 15 MAY 20 to make appropriate changes. After 15 MAY 20 the standard chart transitions listed above will be implemented to ensure complete coverage of aeronautical information.

EXPLANATION OF AIRPORT MOVING MAP & AIRWAY MANUAL AIRPORT/TAXI CHART PUBLICATION CYCLES

Data extract cycles coincide with the AIRAC 28-day cycles used by Civil Aviation Authorities worldwide. This includes Jeppesen's Airport Mapping Database (AMDB) extracts that support Airport Moving Map (AMM) displays. All airport-related changes applicable to AMDB (additions, changes and deletions) to be effective on a given AIRAC cycle date are included in the data extract. Examples include physical changes to runways, taxiways, ramps, parking gates, as well as changes to runway, taxiway, or gate markings.

Also included are interim changes based on NOTAMs or other official means that span at least one AIRAC cycle. In certain cases, NOTAM changes that do not cover an entire AIRAC cycle but terminate close to the cycle end date may be applied.

Jeppesen's pre-composed Airway Manual chart customers can choose between 14- and 7-day chart revision updates. As a result, certain chart-related interim changes may be issued more quickly rather than the next 28-day cycle of the AMM. Additionally, Airport and Taxi charts are updated for other items besides surface features. Examples include modifications to ATC communication frequencies, approach and runway lighting details, declared distances, take-off and alternate minima, textual departure procedures, cultural features, and airport-related notes.

In some cases Airport/Taxi charts may not be revised immediately for minor changes and these changes will be communicated via a Chart Change Notice. Even though there are situations that may result in AMM displaying more up-to-date information, the pre-composed charts – in addition to the relevant Chart Change Notices – should always be used as primary reference given the completeness of the information. The AMM display should be used as a supplement to the Airport/Taxi charts which is particularly useful in improving situational awareness during ground operations.

In regards to the features depicted on the AMM display such as NOTAMs which may not be available on the pre-composed chart due to the dynamic nature of the data, it is recommended to refer to the AMM display and NOTAMs provided by your operations or via an official government authority. For further details pertaining to the application of NOTAMs to pre-composed charts, refer to Briefing Bulletin JEP 09-B dated 10 JUL 09. The bulletin is available within standard Jeppesen Airway Manual.

Should a discrepancy occur between Jeppesen products and official approved sources, the nature of the discrepancy, including the impact on operations, is analyzed by Standards department. The decision to issue an AMM Alert is made in accordance with established Alert criteria. In certain cases, minor issues do not qualify the discrepancy as an Alert and will not be published as an AMM Alert.

Jeppesen continues to work toward unification and synchronization between both products' process criteria in order to provide consistent updates regardless of the service demanded by the customer.

CHART DESIGN ENHANCEMENTS FOR MILITARY CHARTS

PURPOSE

The purpose of the bulletin is to announce enhancements to Jeppesen charts at military and joint use locations. The description below shall enable the user to familiarize with the upcoming changes.

BACKGROUND

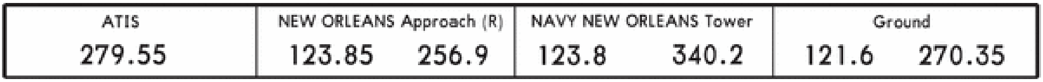
In the past, Jeppesen procedure charts were primarily designed for the use by civil aviation operators. Going forward, the depiction of military procedures at military and joint use civil/military airports will put increased focus on the needs of military pilots. With the introduction of several additional features and specification changes, this chart enhancement initiative will improve the usability of Jeppesen charts for military operators.

The new chart specifications outlined below will first be released at DoD procedure charts being added to the Jeppesen chart library starting in September. Existing military procedure charts will be transitioned to the new specifications over time as part of the revision process.

ENHANCEMENTS

UHF COMMUNICATIONS

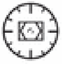
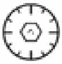
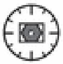
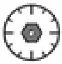
Ultra High Frequency (UHF) communications added at sole military and joint use, civil/military, locations.



ATIS	NEW ORLEANS Approach (R)	NAVY NEW ORLEANS Tower	Ground
279.55	123.85 256.9	123.8 340.2	121.6 270.35

NAVAID SYMBOLS

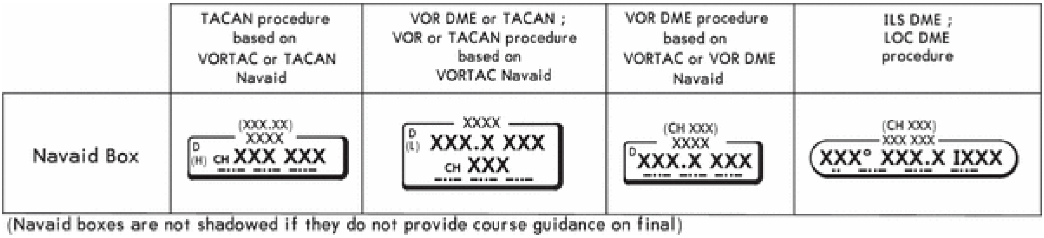
Navaid symbols used will be those that are consistent with ICAO recommended symbols.

Type	TACAN	VORTAC	VOR DME	VOR	DME	NDB
Non Compulsory						
Compulsory						

NAVAID BOXES

- Navaid boxes enhanced to include channel information and VHF frequency.
- Frequency/channel in the navaid box provides course guidance or formation radials.
- Frequency pairings designated in parenthesis.

CHART DESIGN ENHANCEMENTS FOR MILITARY CHARTS



	TACAN procedure based on VORTAC or TACAN Navaid	VOR DME or TACAN ; VOR or TACAN procedure based on VORTAC Navaid	VOR DME procedure based on VORTAC or VOR DME Navaid	ILS DME ; LOC DME procedure
Navaid Box	(XXX.XX) XXXX D (H) CH XXX XXX	XXXX D (L) XXX.X XXX CH XXX	(CH XXX) XXXX D XXX.X XXX	(CH XXX) XXX XXX XXX° XXX.X IXXX

(Navaid boxes are not shadowed if they do not provide course guidance on final)

OFF CHART NAVAID DEPICTION

- Navaid type identified.
- Frequency/channel *not* in parenthesis provides course guidance or radial formation information.
- Frequency pairing designated in parenthesis.

CROSSING ALTITUDES IN THE CHART PLANVIEW

Altitude restrictions in the planview of charts will be enhanced in the following manner:

- Altitude crossing restrictions shown blue in color.
- Over-bar/under bars used to indicate the type of altitude restriction, following ICAO guidance.
- Between Altitudes/Flight Levels

$\overline{10000}$ $\overline{\text{FL100}}$

$\underline{8000}$ $\underline{\text{FL80}}$

- Minimum Altitude/Flight Level

$\underline{8000}$ $\underline{\text{FL80}}$

- Maximum Altitude/Flight Level

- Mandatory or At Altitude/FL

- Altitude/FL indicated by state source as recommended will be charted without over-bar and under-bars

SPEED RESTRICTIONS IN THE CHART PLANVIEW

Speed restrictions in the planview on charts at military locations and joint use locations shown using magenta color.

- Speed restrictions that apply to a specific navaid, intersection/waypoint; track segment, will be placed next to, or tied to the element.

INSTRUMENT PROCEDURE DESIGN INDICATOR

In addition to indicating TERPS, PANS-OPS and MIPS, a NATL Procedure Design Indicator label will be added to applicable procedures.

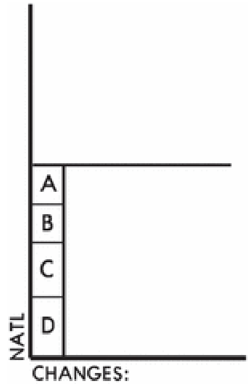
A NATL label represents a procedure designed according to ICAO (8168 guidance), PANS OPS criteria, but the state has filed an exception to the design criteria for one of the following: Final approach segment, missed approach segment or the circling area.

Example: Final; missed approach based on PANS OPS and the circling area has an exception filed to the PANS OPS criteria. Therefore, the chart would indicate a NATL label.

Additionally, if the procedure AIP indicates the procedure design was based on mixed criteria, TERPs and PANS OPS, the chart would indicate a NATL label.

NOTE: If a procedure has a NATL label, the AIP should be reviewed to determine the exception the state has filed to the design criteria.

CHART DESIGN ENHANCEMENTS FOR MILITARY CHARTS



OPR (OFFICE OF PRIMARY RESPONSIBILITY) LABEL

An OPR label will be included on *all* military procedure charts:

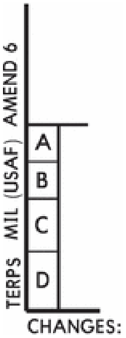
MIL (USAF) – procedures designed by the United States Air Force

MIL (USN) – procedures designed by the United States Navy

MIL (USA) – procedures designed by the United States Army

MIL – Any procedure based on a Host Nation military AIP

NOTE: If a procedure does not include an OPR label, the Host Nation has designed the procedure.

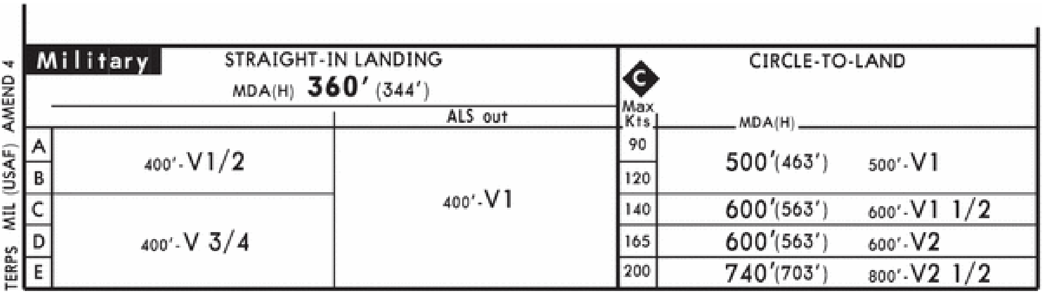


MINIMUMS

- CAT E or HPMA minimums depicted when provided by source.
- Minimums depicted in the new Aerodrome Operating Minimums Format (AOM), refer to briefing bulletin JEP 19-A dated August 23, 2019 on Jeppesen.com publications for additional information.

CHART DESIGN ENHANCEMENTS FOR MILITARY CHARTS

NOTE: Ceilings depicted on charts with a USAF, USN or USA OPR label apply only to military operators. Military pilots should refer to appropriate regulations.



TERPS MIL (USAF) AMEND 4

Military

	STRAIGHT-IN LANDING MDA(H) 360′ (344′)	ALS out	Ⓒ CIRCLE-TO-LAND Max Kts	MDA(H)	
A	400′-V1/2	400′-V1	90	500′(463′)	500′-V1
B			120		
C	400′-V 3/4		140	600′(563′)	600′-V1 1/2
D			165	600′(563′)	600′-V2
E			200	740′(703′)	800′-V2 1/2

IMPLEMENTATION PLAN

- – Jeppesen will begin adding approach procedures in the enhanced format and specifications beginning September 2020.
- – Existing approach charts at military and joint use civil and military locations will be updated over time as part of the revision process.

CONTACT INFORMATION

- – Inquiries related to this Bulletin may be submitted through established customer support channels or your account representative.
- – Questions concerning the Jeppesen chart, or Electronic Chart Images, please contact Chart Support:

+01 (303) 328-6776 (Western Hemisphere)

+49 (6102) 50-8174 (Eastern Hemisphere)

U.S. Toll Free: 1-800-353-2107

E-mail: ChartSupport@jeppesen.com

JEPPESEN®
A BOEING COMPANY

Preface

Customer Service Bulletins

JEPPESEN ALERTS, NOTICES AND BULLETINS; DISSEMINATION OF PRODUCT-RELATED INFORMATION

Jeppesen is committed to delivering the highest quality and most advanced products and services in the industry. Our ongoing commitment to quality includes using various communication channels to disseminate the latest information that affects the Jeppesen products and services you rely upon.

Updates are posted online at jeppesen.com under “Notices & Alerts.” Here you will also find RSS feeds, which are an efficient way to monitor the latest information from Jeppesen. All Notices and Alerts mentioned in this service bulletin can be subscribed to using RSS feed technology. Issues related to our products or services are communicated using one or more standard notification methods. The method we use depends on the product or service as well as the criticality of the communication. The following is a brief description of our notification types:

NavData Alert [1]

NavData Alerts are used to inform commercial NavData subscribers, including airlines, avionics equipment companies, and aviation service providers, of changes and issues related to databases distributed by Jeppesen. Alerts are intended to supplement the NavData Change Notices by disseminating time-critical information that could have a significant affect on flight operations. Alerts contain safety-of-flight or operationally significant information including but not limited to incorrect turn directions, altitudes, bearing changes, etc. This information typically affects Jeppesen's master database; however, each change or issue can be isolated to specific avionics equipment. To determine whether the change or issue affects your database, you should check with your individual avionics equipment manufacturer.

Chart Alert [1]

Chart Alerts are used to quickly disseminate flight critical information that affects Jeppesen's Standard paper or electronic (JeppView) Airway Manual products. Occasionally, changes cannot be issued to customers through our normal paper or electronic production schedules prior to effectivity. Chart Alerts allow Jeppesen to immediately address these changes through either RSS or our website as soon as they come to our attention.

Airport Moving Map (AMM) Alert [1]

Airport Moving Map Alerts are published to advise users of significant issues in Jeppesen Airport Moving Map data that may affect aircraft ground operations. AMM Alerts allow Jeppesen to immediately address these changes through either RSS or our website as soon as they come to our attention.

Obstacle and Terrain Alerts [1]

Obstacle and Terrain Alerts are published to advise users of significant issues in Jeppesen Obstacle or Terrain datasets. Obstacle and Terrain Alerts allow Jeppesen to immediately address these issues through either RSS or our website as soon as they come to our attention.

Issues with obstacles and/or terrain that are displayed in individual products will be distributed in a product-specific alert. For example, an issue with obstacle or terrain data on an approach chart will be distributed in a Chart Alert and may not be distributed in an Obstacle and/or Terrain Alert.

NavData Change Notice [2]

JEPPESEN ALERTS, NOTICES AND BULLETINS; DISSEMINATION OF PRODUCT-RELATED INFORMATION

NavData Change Notices are directed at customers who receive Jeppesen NavData for use in avionics equipment and flight planning systems, airline operations, and other systems that provide aviation information. They are published weekly on jeppesen.com under “Notices & Alerts” and in RSS feeds. They include updates and corrections to data and procedures that are not yet reflected in Jeppesen’s navigation databases. NavData Change Notices contain narrative explanations of the changes that affect the data coded in Jeppesen’s current NavData cycle. Customers who receive an Internet update service from Jeppesen will also receive NavData Change Notices as part of their service.

Chart Change Notice [2]

Chart Change Notices are directed at customers who receive Jeppesen Terminal and Enroute charts. They are included in the revision updates that are mailed to customers and are also posted on jeppesen.com under “Notices & Alerts” and RSS feed. Each notice contains a narrative explanation of changes affecting the current Jeppesen chart. Jeppesen Chart Change Notices highlight only significant changes affecting Jeppesen Charts. A Graphic Chart Change Notice may be issued to depict a more significant change to a Jeppesen Enroute or Area chart. A Chart Change Notice will remain in effect until the chart is to be reissued.

On-Demand Change Notice [2]

On-Demand Change Notices are available on jeppesen.com in the Main page and under the Notices and Alerts page. They contain the same content that both NavData and Chart Change Notices contain. However, unlike NavData and Chart Change notices, On-Demand Change Notices are updated when our Change Notices Database is updated (near real-time). On-Demand Change Notices also allows the user the ability to search Change Notices for a single Airport or FIR.

NavData Notice

NavData Notices are issued to airframe and avionics equipment manufacturers to announce additional database capabilities or new datasets that will affect the output of navigational data. NavData Notices are intended for Jeppesen's Original Equipment Manufacturer (OEM) partners only. Jeppesen’s Product Management department may also issue notices highlighting any changes made to Jeppesen Internet update services, such as data content, modifications to data card sizing, or system-specific information issued by an avionics equipment manufacturer. End users of the data may contact their avionics equipment providers with questions regarding the availability of data in their specific units.

Briefing Bulletin

Briefing Bulletins provide you with explanations of modifications to Jeppesen products that are being implemented in response to changes suggested by customers or required by governing authorities. In particular, Briefing Bulletins explain how changes will affect Jeppesen's products.

Customer Service Bulletin

Customer Service Bulletins contain information that educates you on the content of our products and services. Additionally, Customer Service Bulletins may be issued to inform customers about

JEPPESEN ALERTS, NOTICES AND BULLETINS; DISSEMINATION OF PRODUCT-RELATED INFORMATION

major events where significant short-term changes or restrictions to flight operations will be in effect.

1 Beginning November 2012, Alerts will only be distributed to our customers through RSS Feeds. To learn more about this subject, please see our 03 Aug 2012 Customer Service Bulletin.

2 When Charts and/or NavData are intentionally omitted from Jeppesen Airway Manual or NavData respectively, Change Notices will include that information along with the respective revision/cycle that the information will be included.

Please note that the Customer Notification Services defined above only refer to Jeppesen products and do not replace State-published NOTAMs.

All communication channels listed above are posted on jeppesen.com under the “Notices & Alerts” section.

We hope this bulletin clarifies the various product and service updates you may receive from Jeppesen. If you have any questions please contact your account representative or customer service at:

The Americas	**Europe & Asia**
800.621.5377 E-mail: captain@jeppesen.com	+49 6102 5070 E-mail: fra-services@jeppesen.com
United Kingdom, Middle East & Africa	**Australia**
+44 1293 842404 0800 085 5377 (UK & Ireland) E-mail: uk-services@jeppesen.com	+61 2 6120 2999 E-mail: customerservice@jeppesen.com.au

Sincerely,

Jeppesen Corporate Technical Standards and Product Management

CHANGE IN RSS FEED FOR JEPPESEN NOTICES & ALERTS

Jeppesen distributes notices related to our products and services using several standard notification methods. One of these methods includes issuing time-critical information using Jeppesen Notices & Alerts through https://www.jeppesen.com. Here you'll find Notices & Alerts that can impact your flight or operations. In addition to our Notices & Alerts page, we also distribute alerts using RSS (Really Simple Syndication) feeds, which is an alternate way to monitor the latest Jeppesen product & charting information.

Beginning January 17, 2020, Jeppesen will transition to a new Notices & Alerts page. If you monitor Notices & Alerts via an RSS feed, please note that you may need to resubscribe to continue receiving RSS notifications by reinstalling a compatible RSS plug-in application. This will ensure you continue to receive the broadcasting of any new Alert notifications from Jeppesen's website.

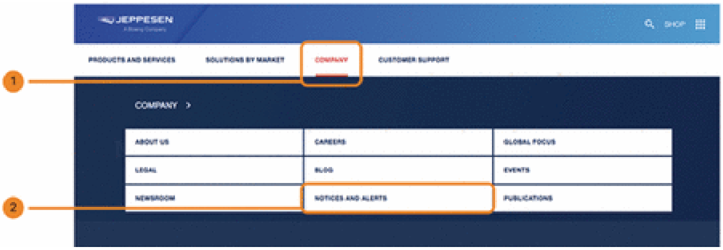
In addition to online Alerts, RSS feeds can be used to automatically customize the broadcasting of Alerts by region applicable to a designated geographic location.

To subscribe to RSS feeds, simply download a compatible RSS viewer (e.g., Feedly & RSSOlw) of your choice, then follow the steps below.

Go to https://www.jeppesen.com

1 Select “Company”

2 Select “Notices And Alerts” at the top of the home page.



On the left side of the page, you'll have the option of selecting a single region, or filtering down to a sub-region and the Category of the alert type.

Follow these steps, if you would like to subscribe to a specific region:

CHANGE IN RSS FEED FOR JEPPESEN NOTICES & ALERTS

3 Click on the “Region” dropdown and select a Region from the list.

4 Select a “Sub-Region” from the drop down.

5 Choose the “Category” of Alert you are interested in subscribing to:

6 Once the preferred Region and Subregion is selected, click the RSS link, as shown in step 6. You should see a prompt from your preferred RSS application. Follow the suggested RSS application steps as suggested by your selected RSS application.

NOTE: (To subscribe to multiple subregions, you’ll need to repeat steps 1 through 6.)

That’s it! Now the RSS feed will automatically show you any new Notices and Alerts so you’ll always have the latest information. It will be customized so that you only get the information that is relevant to you.

We hope this bulletin clarifies the steps necessary to set up the new RSS Feeds. If you have any questions, please go to Jeppesen.com/Contact Us (https://www.jeppesen.com/contact-us/) or by calling:

Jeppesen Support:

Tel: Toll-Free: 1-800-732-2800
Direct: 1-303-328-4587

Sincerely,

Jeppesen Aviation Technical and Regulatory Standards

JEPPESEN®
A BOEING COMPANY

Introduction

JEPPESEN®
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Introduction

Definitions and Abbreviations

AIRPORT QUALIFICATION PAGES

U.S. Federal Aviation Regulations (FAR) Part 121.445 specifies pilot in command special airport qualifications. The (FAA) Administrator may determine that certain airports (due to items such as surrounding terrain, obstructions, or complex approach or departure procedures) are special airports requiring special airport qualifications. These requirements do not apply when an entry to that airport (including a takeoff or a landing) is being made if the ceiling at that airport is at least 1,000 feet above the lowest MEA or MOCA, or initial approach altitude prescribed for the instrument approach procedure for that airport, and the visibility at that airport is at least 3 miles.

At other times, no certificate holder may use any person, nor may any person serve, as pilot in command to or from an airport determined to require special airport qualifications unless, within the preceding 12 calendar months:

a. The pilot in command or second in command has made an entry to that airport (including a takeoff and landing) while serving as a pilot flight crewmember; or

b. The pilot in command has qualified by using pictorial means acceptable to the Administrator for that airport.

Airport qualification pages, when approved by the certificate holder’s Principal Operations Inspector (POI), provide an acceptable means of complying with the above requirement.

The list of special airports is found in the Handbook Bulletin for Air Transportation (HBAT) 03-07. The list is also accessible through the following web site:

http://www.opspecs.com/ops/SpecialPICAirports/

AIRPORT FAMILIARIZATION PAGES

Airport familiarization pages are similar to qualification pages, except the familiarization airports are not currently considered a special airport under FAR 121.445. However as with qualification pages, familiarization pages depict airports that are also unique due to items such as surrounding terrain, obstructions, or complex approach or departure procedures.

ICAO

DOC 7300, Annex 6 specifies that a pilot in command must be currently qualified to be used on a route or route segment. Each such pilot shall demonstrate to the operator an adequate knowledge of aerodromes which are to be used including such things as knowledge of terrain, minimum safe altitudes, and seasonal meteorological conditions. In another provision, an operator may qualify a pilot in command to land at an aerodrome by means of an adequate pictorial presentation.

According to the state authority's recommendation or on the operator's individual decision, both airport qualification and airport familiarization pages can be used for professional familiarization of specific airports.

DESCRIPTION OF SERVICE

The front side of the overview page provides an aerial image of the airport. The overview image will include key areas of interest surrounding the airport, such as obstructions that could affect flight operations. Below the image is a graphic presentation of the airport and surrounding area.

The graphic portion includes airways, navigation aids, general terrain contours, water, roads and city patterns. The graphic also includes an overview arrow that indicates the direction from which the image is viewed.

The reverse side of the overview page provides a textual description of the airport and its surrounding area. The textual description points out key items of interest about the airport, as well as the surrounding area. An annual weather table is also provided on the second half of the page. This table is based on seasonal data and represents average monthly values.

Runway pages portray the airport's primary runways. The top portion of the page provides a view of the approach end of the runway, as seen during the landing phase of flight. Below is a narrative that provides specific information and unique features relating to the runway. The reverse side of the page provides the same type of information for the opposite end of the runway.

All airport pages are updated as significant changes dictate. In addition, Airport Qualification locations are reissued every 24 months.

JEPPESEN AIRWAY MANUAL VERSUS EASA AIR OPS ANNEX III PART-ORO

The following table helps to identify the sections of the Jeppesen Airway Manual which comply with EASA Acceptable Means of Compliance (AMC) and Guidance Material (GM) to Part-ORO.

For further details, please refer to AMC3 ORO.MLR.100 Part C: Route/Role/Area and Aerodrome/Operating Site Instructions and Information.

EASA Operations Manual Part C	Jeppesen Airway Manual
a) Minimum flight level/Minimum flight altitude	a. Enroute-, Area-, SID/STAR charts. b. INTRODUCTION section, Enroute Chart Legend.
b) Operating minima for departure-, destination- and alternate aerodromes	a. Approach-, Airport charts b. 10-9S type pages (EASA AIR OPS Minimums) c. ATC section "AERODROME OPERATING MINIMUMS - EASA AIR OPERATIONS"
c) Communication facilities and navigation aids	a. RADIO AIDS section b. Approach-, Airport charts c. Enroute-, Area-, SID/STAR charts
d) Runway/final approach and take-off area (FATO) data and aerodrome/operating site facilities	a. AIRPORT DIRECTORY section b. Airport charts
e) Approach, missed approach and departure procedures including noise abatement procedures	a. Airport Briefing Pages b. Approach charts c. SIDs & STARs d. Noise pages e. ATC section: State pages
f) COM-failure procedures	a. EMERGENCY section b. Airport Briefing Pages c. Approach charts d. SIDs & STARs
g) Search and rescue facilities in the area over which the aircraft is to be flown	a. EMERGENCY section, Search and Rescue b. AIRPORT DIRECTORY

EASA Operations Manual Part C	Jeppesen Airway Manual
h) A description of the aeronautical charts that should be carried on board in relation to the type of flight and the route to be flown, including the method to check their validity.	a. INTRODUCTION section 1. Chart Legends 2. EASA AIR OPS/Revision Service
i) Availability of aeronautical information and MET services	a. METEOROLOGY section b. Enroute charts c. AIRPORT DIRECTORY
j) Enroute COM/NAV procedures	a. ATC section, State pages b. ENROUTE section c. Enroute-, Area charts
k) Aerodrome/operating site categorization for flight crew competence qualification	This is not part of the Standard Airway Manual as it is operator specific. However it can be part of a Tailored Route Manual. Special Jeppesen service is the Airport Familiarization/Qualification program
l) Special aerodrome limitations (performance limitations and operating procedures)	Cannot be part of the Standard Airway Manual, as it is aircraft/performance specific. However, Jeppesen is providing its OpsData Service for these purposes

Jeppesen CHART CHANGE NOTICES provide flight crews with temporary and permanent changes between revision of charts. They are issued for each Airway Manual coverage with every revision.

Jeppesen NAVDATA CHANGE NOTICES are issued for each Navigation Data Base geographic area. They provide flight crews with temporary changes affecting their FMCS or Navigation Computer Systems. They also provide permanent changes effective between the 28 day AIRAC cycle.

Both services do not replace AIS NOTAM Services in any manner.

REVISION SERVICE

Aeronautical Chart Services are available either as the Standard Airway Manual Service or the customer defined Tailored Route Manual Service.

Depending on geographical coverage, customer defined requirements or other reasons both types of Aeronautical Chart Services may be set up for weekly, bi-weekly or four-weekly revisions to be kept current. Bi-weekly and four-weekly revisions may be supplemented by weekly revisions if it is required to get important changes as soon as possible to our customers. Each revision is accompanied by a revision letter which indicates the necessary actions to keep the Chart Service current. The Record of Revisions page in front of the Manual needs to be signed after the completion of each revision. A consecutive revision numbering assures that the customer can see that all published revisions for this particular Chart Service are received. The first revision letter in a calendar year also indicates which was the last revision for this Chart Service of the past year.

Handwritten amendments and revisions are not permitted, except in situations requiring immediate amendment or revision in the interest of safety.

Annotations of changes in the text section are marked with a change bar for revised or added lines and changes on charts and tables are indicated as Change Note.

Temporary information is printed on white stock with yellow stripes on both sides, there is an information box in the center of the chart to indicate that this is a temporary procedure and furthermore the chart title contains the abbreviation “TEMP” in brackets (e.g. CAT II/II ILS RWY 31R (TEMP). It is used to alert pilots to Airport Construction and temporary SID/STAR and Approach Procedures.

An ICAO developed AIRAC (Aeronautical Information Regulation and Control) system (Annex 15, Chapter 6-1 and Doc 8126, Chapter 2-6) assures that all significant changes are made available prior the effective date. Governing authorities are required to make defined significant changes effective only on certain Thursdays in intervals of 28 days, the so-called AIRAC dates. Furthermore are the governing authorities required to publish any changes under the AIRAC system with defined lead times allowing the commercial aeronautical chart providers to update and distribute their products in advance of the effective date. Charts without effective date should be used as soon as received.

Not all Aeronautical Chart Services must get regular updates as this also depends if there are charts to be revised per the Jeppesen revision criteria which have been developed over decades in cooperation with our customers.

Whenever charts cannot be revised, e.g. information not received early enough or clarifications to the governing authorities must be resolved prior publication, respective information is distributed by the means of Chart Change Notices which are also available on-line to all customers via our website.

Chart Alerts are used to quickly disseminate flight critical information that affects Jeppesen's Standard paper or electronic Airway Manual products. Occasionally changes cannot be issued to customers through our normal paper or electronic production schedules prior to effectivity. Chart Alerts allow Jeppesen to immediateley address these changes through either RSS or our website as soon as they come to our attention.

CHECKLISTS

Checklists are issued at regular intervals to enable all Manual Service holders to check the up-to-date status and the completeness on the material subscribed to. Anytime, an updated copy of the checklist can be requested. Furthermore are on-line and off-line electronic Chart Services available which can be used to check the paper based Chart Service currency against.

A comprehensive list of enroute, plotting and area charts worldwide with latest revision and effective dates is available via our website.

GLOSSARY

This glossary provides definitions that are unique and abbreviations commonly used in Jeppesen publications. No attempt has been made to list all the terms of basic aeronautical nomenclature.

Because of the international nature of flying, terms used by the FAA (USA) are included when they differ from International Civil Aviation Organization (ICAO) definitions. A vertical bar, that is omitted on all new pages, tables of contents, tabular listings and graphics, indicates changes.

DEFINITIONS

ACCELERATE STOP DISTANCE AVAILABLE (ASDA) — The length of the take-off run available plus the length of the stopway, if provided.

ACROBATIC FLIGHT — Manoeuvres intentionally performed by an aircraft involving an abrupt change in its attitude, an abnormal attitude, or an abnormal variation in speed.

ADEQUATE VIS REF (Adequate Visual Reference) — Runway markings or runway lighting that provides the pilot with adequate visual reference to continuously identify the take-off surface and maintain directional control throughout the take-off run.

ADS AGREEMENT — An ADS reporting plan which establishes the conditions of ADS data reporting (i.e., data required by the air traffic services unit and frequency of ADS reports which have to be agreed to prior to the provision of the ADS services).

NOTE: The terms of the agreement will be exchanged between the ground system and the aircraft by means of a contract, or a series of contracts.

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 GPS-derived position and other information such as velocity over the data link, which is received by a ground-based transmitter/receiver (transceiver) for processing and display at an air traffic control facility.

ADS-C AGREEMENT — A reporting plan which establishes the conditions of ADS-C data reporting (i.e. data required by the air traffic services unit and frequency of ADS-C reports which have to be agreed to prior to using ADS-C in the provision of air traffic services).

NOTE: The terms of the agreement will be exchanged between the ground system and the aircraft by means of a contract, or a series of contracts.

ADS CONTRACT — A means by which the terms of an ADS agreement will be exchanged between the ground system and the aircraft, specifying under what conditions ADS reports would be initiated, and what data would be contained in the reports.

NOTE: The term “ADS contract” is a generic term meaning variously, ADS event contract, ADS demand contract, ADS periodic contract or an emergency mode. Ground forwarding of ADS reports may be implemented between ground systems.

ADVISORY AIRSPACE — An airspace of defined dimensions, or designated route, within which air traffic advisory service is available.

ADVISORY ROUTE (ADR) — A designated route along which air traffic advisory service is available.

NOTE: Air traffic control service provides a much more complete service than air traffic advisory service; advisory areas and routes are therefore not established within controlled airspace, but air traffic advisory service may be provided below and above control areas.

ADVISORY SERVICE — Advice and information provided by a facility to assist pilots in the safe conduct of flight and aircraft movement.

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 surface movement of aircraft.

NOTE: The term “aerodrome” where used in the provisions relating to flight plans and ATS messages is intended to cover also sites other than aerodromes which may be used by certain types of aircraft; e.g., helicopters or balloons.

AERODROME CLIMATOLOGICAL SUMMARY — Concise summary of specified meteorological elements at an aerodrome, based on statistical data.

AERODROME CLIMATOLOGICAL TABLE — Table providing statistical data on the observed occurrence of one or more meteorological elements at an aerodrome.

AERODROME CONTROL SERVICE — Air traffic control service for aerodrome traffic.

AERODROME CONTROL TOWER — A unit established to provide air traffic control service to aerodrome traffic.

AERODROME ELEVATION — The elevation of the highest point of the landing area.

AERODROME FLIGHT INFORMATION SERVICE (AFIS) — A directed traffic information and operational information service provided within an aerodrome flight information zone, to all radio equipped aircraft, to assist in the safe and efficient conduct of flight.

AERODROME METEOROLOGICAL OFFICE — An office, located at an aerodrome, designated to provide meteorological service for international air navigation.

AERODROME REFERENCE CODE — A simple method for interrelating the numerous specifications concerning the characteristics of aerodromes so as to provide a series of aerodromes facilities that are suitable for the aeroplanes that are intended to operate at the aerodrome. The aerodrome reference code — code number and letter, which are selected for aerodrome planning purposes, have the meanings assigned to them as indicated in the table below:

Code Element 1		**Code Element 2**		
Code Number	**Aeroplane Reference Field Length**	**Code Letter**	**Wing Span**	**Outer Main Gear Wheel Span** a)
(1)	**(2)**	**(3)**	**(4)**	**(5)**
1	Less than **800m**	A	Up to but not including **15m**	Up to but not including **4.5m**
2	**800m** up to but not including **1200m**	B	**15m** up to but not including **24m**	**4.5m** up to but not including **6m**
3	**1200m** up to but not including **1800m**	C	**24m** up to but not including **36m**	**6m** up to but not including **9m**
4	**1800m** and over	D	**36m** up to but not including **52m**	**9m** up to but not including **14m**
		E	**52m** up to but not including **65m**	**9m** up to but not including **14m**
		F	**65m** up to but not including **80m**	**14m** up to but not including **16m**

a) Distance between the outside edges of the main gear wheels.

NOTE: Guidance on planning for aeroplanes with wing spans greater than 80m is given in the ICAO Doc. 9157 "Aerodrome Design Manual," Parts 1 and 2.

AERODROME TRAFFIC — All traffic on the manoeuvring area of an aerodrome and all aircraft flying in the vicinity of an aerodrome.

NOTE: An aircraft is in the vicinity of an aerodrome when it is in, entering or leaving an aerodrome traffic circuit.

AERODROME TRAFFIC CIRCUIT — The specified path to be flown by aircraft operating in the vicinity of an aerodrome.

AERODROME TRAFFIC FREQUENCY (ATF) — A frequency designated at an uncontrolled airport. An ATF is used to ensure all radio equipped aircraft operating within the area, normally within a 5NM radius of the airport, are listening on a common frequency. The ATF is normally the ground station frequency. Where a ground station does not exist, a common frequency is designated. Radio call sign is that of the ground station, or where no ground station exists, a broadcast is made with the call sign "Traffic Advisory." Jeppesen charts list the frequency and the area of use when other than the standard 5NM.

AERODROME TRAFFIC ZONE (ATZ) — An airspace of detailed dimensions established around an aerodrome for the protection of aerodrome traffic.

AERONAUTICAL FIXED SERVICE (AFS) — A telecommunication service between specified fixed points provided primarily for the safety of air navigation and for the regular, efficient and economical operation of air services.

AERONAUTICAL FIXED STATION — A station in the aeronautical fixed service.

AERONAUTICAL FIXED TELECOMMUNICATION NETWORK (AFTN) — A world-wide system of aeronautical fixed circuits provided, as part of the aeronautical fixed service, for the exchange of messages and/or digital data between aeronautical fixed stations having the same or compatible communications characteristics.

AERONAUTICAL GROUND LIGHT — Any light specially provided as an aid to air navigation, other than a light displayed on an aircraft.

AERONAUTICAL INFORMATION PUBLICATION (AIP) — A publication issued by or with the authority of a State and containing aeronautical information of a lasting character essential to air navigation.

AERONAUTICAL METEOROLOGICAL STATION — A station designated to make observations and meteorological reports for use in international air navigation.

AERONAUTICAL MOBILE SERVICE — A mobile service between aeronautical stations and aircraft stations, or between aircraft stations, in which survival craft stations may participate; emergency position-indicating radio beacon stations may also participate in this service on designated distress and emergency frequencies.

AERONAUTICAL RADIO, INCORPORATED (ARINC) — An international radio network providing air-to-ground communications available on a subscription (fee) basis.

AERONAUTICAL STATION — A land station in the aeronautical mobile service. In certain instances, an aeronautical station may be located, for example, on board ship or on a platform at sea.

AERONAUTICAL TELECOMMUNICATION SERVICE — A telecommunication service provided for any aeronautical purpose.

AERONAUTICAL TELECOMMUNICATION STATION — A station in the aeronautical telecommunication service.

AIRBORNE COLLISION AVOIDANCE SYSTEM (ACAS) — An aircraft system based on secondary surveillance radar (SSR) transponder signals which operates independently of ground-based equipment to provide advice to the pilot on potential conflicting aircraft that are equipped with SSR transponders.

AIRCRAFT — Any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth’s surface.

AIRCRAFT ADDRESS — A unique combination of 24 bits available for assignment to an aircraft for the purpose of air-ground communications, navigation and surveillance.

AIRCRAFT APPROACH CATEGORY (USA TERPS) — A grouping of aircraft based on a speed of Vref, if specified, or if Vref is not specified, 1.3 V_{S0} at the maximum certificated landing weight.

Vref, V_{S0}, and the maximum certificated landing weight are those values as established for the aircraft by the certification authority of the country of registry. An aircraft shall fit in only one category. If it is necessary to maneuver at speeds in excess of the upper limit of a speed range for a category, the minimums for the next higher category must be used. For example, an aircraft which falls in Category A, but is circling to land at a speed in excess of 91 knots, should use the approach Category B minimums when circling to land. The categories are as follows:

Category A	Speed less than 91KT.
Category B	Speed 91KT or more but less than 121KT.
Category C	Speed 121KT or more but less than 141KT.
Category D	Speed 141KT or more but less than 166KT.
Category E	Speed 166KT or more.

AIRCRAFT APPROACH CATEGORY (ICAO) — The ICAO table, depicted in the ATC section “Flight Procedures (DOC 8168) Arrival and Approach Procedures”, indicates the specified range of handling speeds (IAS in Knots) for each category of aircraft to perform the maneuvers specified. These speed ranges have been assumed for use in calculating airspace and obstacle clearance for each procedure.

AIRCRAFT IDENTIFICATION — A group of letters, figures or combination thereof which is either identical to, or the coded equivalent of, the aircraft call sign to be used in air-ground communications, and which is used to identify the aircraft in ground-ground air traffic services communications.

AIRCRAFT – LARGE AIRCRAFT (LACFT) — Term used when referring to ICAO aircraft category DL standard dimensions:

- wing span – more than 65m/213ft (max 80m/262ft); and/or
- vertical distance between the flight paths of the wheels and the glide path antenna – more than 7m/23ft (max 8m/26ft).

For precision approach procedures, the dimensions of the aircraft are also a factor for the calculation of the OCH.

For category DL aircraft, additional OCA/H is provided, when necessary.

AIRCRAFT OBSERVATION — The evaluation of one or more meteorological elements made from an aircraft in flight.

AIRCRAFT PROXIMITY — A situation in which, in the opinion of a pilot or air traffic services personnel, the distance between aircraft as well as their relative positions and speed have been such that the safety of the aircraft involved may have been compromised. An aircraft proximity is classified as follows:

Risk of Collision — The risk classification of an aircraft proximity in which serious risk of collision has existed.

Safety not Assured — The risk classification of an aircraft proximity in which the safety of the aircraft may have been compromised.

No Risk of Collision — The risk classification of an aircraft proximity in which no risk of collision has existed.

Risk not Determined — The risk classification of an aircraft proximity in which insufficient information was available to determine the risk involved, or inconclusive or conflicting evidence precluded such determination.

AIRCRAFT STATION — A mobile station in the aeronautical mobile service, other than a survival craft station, located on board an aircraft.

AIR DEFENSE IDENTIFICATION ZONE (ADIZ) — The area of airspace over land or water, extending upward from the surface, within which the ready identification, the location, and the control of aircraft are required in the interest of national security.

AIR-GROUND COMMUNICATION — Two-way communication between aircraft and stations or locations on the surface of the earth.

AIR-GROUND CONTROL RADIO STATION — An aeronautical telecommunication station having primary responsibility for handling communications pertaining to the operation and control of aircraft in a given area.

AIRMET INFORMATION — Information issued by a meteorological watch office concerning the occurrence or expected occurrence of specified en route weather phenomena which may affect the safety of low-level aircraft operations and which was not already included in the forecast issued for low-level flights in the flight information region concerned or sub-area thereof.

AIRPORT — An area on land or water that is used or intended to be used for the landing and take-off of aircraft and includes its buildings and facilities, if any.

AIRPORT ELEVATION/FIELD ELEVATION — The highest point of an airports usable runways measured in feet from mean sea level. In a few countries, the airport elevation is determined at the airport reference point.

AIRPORT REFERENCE POINT (ARP) — A point on the airport designated as the official airport location.

AIRPORT SURFACE DETECTION EQUIPMENT - MODEL X (ASDE-X) — A surveillance system using radar, aircraft transponders, satellites, and multilateration to track surface movements of aircraft and vehicles.

AIRCRAFT SURFACE SURVEILLANCE CAPABILITY (ASSC) — A surveillance system using multilateration and ADS-B aircraft information to track surface movements of aircraft and vehicles.

AIRPORT SURVEILLANCE RADAR (ASR) — Approach control radar used to detect and display an aircraft’s position in the terminal area. ASR provides range and azimuth information but does not provide elevation data. Coverage of the ASR can extend up to 60 miles.

AIRPROX — The code word used in an air traffic incident report to designate aircraft proximity.

AIR-REPORT — A report from an aircraft in flight prepared in conformity with requirements for position and operational and/or meteorological reporting.

NOTE: Details of the AIREP form are given in PANSATM (Doc 4444) and ATC section.

AIR-TAXIING — Movement of a helicopter/VTOL above the surface of an aerodrome, normally in ground effect and at a ground speed normally less than 20KT (37kmh).

NOTE: The actual height may vary, and some helicopters may require air-taxiing above 25ft (8m) AGL to reduce ground effect turbulence or provide clearance for cargo slingloads.

AIR-TO-GROUND COMMUNICATION — One-way communication from aircraft to stations or locations on the surface of the earth.

AIR TRAFFIC — All aircraft in flight or operating on the manoeuvring area of an aerodrome.

AIR TRAFFIC ADVISORY SERVICE — A service provided within advisory airspace to ensure separation, in so far as practical, between aircraft which are operating on IFR flight plans.

AIR TRAFFIC CONTROL ASSIGNED AIRSPACE (ATCAA) — 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.

AIR TRAFFIC CONTROL CLEARANCE — Authorization for an aircraft to proceed under conditions specified by an air traffic control unit.

NOTE 1: For convenience, the term "air traffic control clearance" is frequently abbreviated to "clearance" when used in appropriate contexts.

NOTE 2: The abbreviated term "clearance" may be prefixed by the words "taxi," "take-off," "departure," "en route," "approach" or "landing" to indicate the particular portion of flight to which the air traffic control clearance relates.

AIR TRAFFIC CONTROL INSTRUCTION — Directives issued by air traffic control for the purpose of requiring a pilot to take a specific action.

AIR TRAFFIC CONTROL SERVICE — A service provided for the purpose of:

a. preventing collisions:
    1. between aircraft; and
    2. on the manoeuvring area between aircraft and obstructions; and

b. expediting and maintaining an orderly flow of air traffic.

AIR TRAFFIC CONTROL UNIT — A generic term meaning variously, area control centre, approach control office or aerodrome control tower.

AIR TRAFFIC SERVICE (ATS) — A generic term meaning variously, flight information service, alerting service, air traffic advisory service, air traffic control service (area control service, approach control service or aerodrome control service).

AIR TRAFFIC SERVICES AIRSPACES — Airspaces of defined dimensions, alphabetically designated, within which specific types of flights may operate and for which air traffic services and rules of operation are specified.

NOTE: ATS airspaces are classified as Class "A" to "G."

AIR TRAFFIC SERVICES REPORTING OFFICE — A unit established for the purpose of receiving reports concerning air traffic services and flight plans submitted before departure.

NOTE: An air traffic services reporting office may be established as a separate unit or combined with an existing unit, such as another air traffic services unit, or a unit of the aeronautical information service.

AIR TRAFFIC SERVICES (ATS) ROUTE — A specified route designated for channeling the flow of traffic as necessary for 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 route, etc.

AIR TRAFFIC SERVICES (ATS) ROUTE (USA) — A generic term that includes 'VOR Federal airways', 'colored Federal airways', 'jet routes', 'Military Training Routes', 'named routes', and 'RNAV routes.'

AIR TRAFFIC SERVICES UNIT — A generic term meaning variously, air traffic control unit, flight information centre or air traffic services reporting office.

AIRWAY (ICAO) — A control area or portion thereof established in the form of a corridor equipped with radio navigation aids.

AIRWAY (USA) — A Class "E" airspace area established in the form of a corridor, the centerline of which is defined by radio navigational aids.

ALERFA — The code word used to designate an alert phase.

ALERT AREA (USA) — [see SPECIAL USE AIRSPACE (SUA)].

ALERTING SERVICE — A service provided to notify appropriate organizations regarding aircraft in need of search and rescue aid, and assist such organizations as required.

ALERT PHASE — A situation wherein apprehension exists as to the safety of an aircraft and its occupants.

ALLOCATION, ALLOCATE — Distribution of frequencies, SSR Codes, etc. to a State, unit or service, Distribution of 24-bit aircraft addresses to a State or common mark registering authority.

ALONG TRACK DISTANCE — The distance measured from a point-in-space by systems using area navigation reference capabilities that are not subject to slant range errors.

ALPHANUMERIC CHARACTERS (Alphanumerics) — A collective term for letters and figures (digits).

ALTERNATE AERODROME (ICAO) — An aerodrome to which an aircraft may proceed when it becomes either impossible or inadvisable to proceed to or to land at the aerodrome of intended landing. Alternate aerodromes include the following:

Take-Off Alternate — An alternate aerodrome at which an aircraft can land should this become necessary shortly after take-off and it is not possible to use the aerodrome of departure.

En Route Alternate — An aerodrome at which an aircraft would be able to land after experiencing an abnormal or emergency condition while en route.

Destination Alternate — An alternate aerodrome to which an aircraft may proceed should it become impossible or inadvisable to land at the aerodrome of intended landing.

NOTE: The aerodrome from which a flight departs may also be an en route or a destination alternate aerodrome for that flight.

ETOPS En Route Alternate — A suitable and appropriate alternate aerodrome at which an aeroplane would be able to land after experiencing an engine shutdown or other abnormal or emergency condition while en route in an ETOPS operation.

ALTERNATE AIRPORT (USA) — An airport at which an aircraft may land if a landing at the intended airport becomes inadvisable.

ALTIMETER SETTING — The barometric pressure reading used to adjust a pressure altimeter for variations in existing atmospheric pressure or to the standard altimeter setting (29.92 inches of mercury, 1013.2 hectopascals or 1013.2 millibars).

QFE — The atmospheric pressure setting which, when set in the aircraft's altimeter, will cause the altimeter to read zero when at the reference datum of the airfield.

QNE — The constant atmospheric pressure related to a reference datum of 29.92 inches of mercury or 1013.25 hectopascals or 1013.25 millibars, used for expressing flight levels.

QNH — The atmospheric pressure setting which, when set in the aircraft's altimeter, will cause the altimeter to read altitudes referenced to mean sea level.

ALTITUDE (ICAO) — The vertical distance of a level, a point, or an object considered as a point, measured from Mean Sea Level (MSL).

ALTITUDE (USA) — The height of a level, point or object measured in feet Above Ground Level (AGL) or from Mean Sea Level (MSL).

a. AGL Altitude — Altitude expressed in feet measured above ground level (QFE).

b. MSL Altitude — Altitude expressed in feet measured from mean sea level (QNH).

c. Indicated Altitude — The Altitude as shown by an altimeter. On a pressure barometric altimeter it is altitude as shown uncorrected for instrument error and uncompensated for variation from standard atmospheric conditions.

APPROACH BAN — An approach procedure, for which continuation is prohibited beyond a specific point, and or specified height, if the reported visibility or RVR is below the minimum specified for that approach.

APPROACH CONTROL OFFICE — A unit established to provide air traffic control service to controlled flights arriving at, or departing from, one or more aerodromes.

APPROACH CONTROL SERVICE — Air traffic control service for arriving or departing controlled flights.

APPROACH CONTROL UNIT — A unit established to provide air traffic control service to controlled flights arriving at, or departing from, one or more aerodromes.

APPROACH FUNNEL — A specified airspace around a nominal approach path within which an aircraft approaching to land is considered to be making a normal approach.

APPROACH PROCEDURE WITH VERTICAL GUIDANCE (APV) — [see INSTRUMENT APPROACH PROCEDURE (IAP)].

APPROACH SEQUENCE — The order in which two or more aircraft are cleared to approach to land at the aerodrome.

APPROPRIATE ATS AUTHORITY — The relevant authority designated by the State responsible for providing air traffic services in the airspace concerned.

APPROPRIATE AUTHORITY —

a. **Regarding flight over the high seas:** The relevant authority of the State of Registry.
b. **Regarding flight other than over the high seas:** The relevant authority of the State having sovereignty over the territory being overflown.

APRON — A defined area, on a land aerodrome, intended to accommodate aircraft for purposes of loading or unloading passengers, mail or cargo, fueling, parking or maintenance.

AREA CONTROL CENTRE — A unit established to provide air traffic control service to controlled flights in control areas under its jurisdiction.

AREA CONTROL SERVICE — Air traffic control service for controlled flights in control areas.

AREA MINIMUM ALTITUDE (AMA) — The minimum altitude to be used under instrument meteorological conditions (IMC), that provides a minimum obstacle clearance within a specified area, normally formed by parallels and meridians.

AREA NAVIGATION/RNAV — A method of navigation which permits aircraft operation on any desired flight path within the coverage of the station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these.

AREA NAVIGATION ROUTE — An ATS route established for the use of aircraft capable of employing area navigation.

ARRIVAL ROUTES — Routes on an instrument approach procedure by which aircraft may proceed from the enroute phase of flight to the initial approach fix.

ASSIGNMENT, ASSIGN — Distribution of frequencies to stations. Distribution of SSR Codes or 24-bit addresses to aircraft.

ATIS — ASOS INTERFACE — A switch that allows ASOS weather observations to be appended to the ATIS broadcast, making weather information available on the same (ATIS) frequency H24. When the tower is open, ATIS information and the hourly weather will be broadcast. When the tower is closed, one-minute weather information updates are broadcast, and the controller can add overnight ATIS information to the ASOS automated voice weather message.

ATS ROUTE — A specified route designed for channeling the flow of traffic as necessary for the provision of air traffic services.

NOTE 1: The term “ATS route” is used to mean variously, airway, advisory route, controlled or uncontrolled route, arrival or departure route, etc.

NOTE 2: An ATS route is defined by route specifications which include an ATS route designator, the track to or from significant points (way-points), distance between significant points, reporting requirements and, as determined by the appropriate ATS authority, the lowest safe altitude.

ATS SURVEILLANCE SERVICE — A term used to indicate a service provided directly by means of an ATS surveillance system.

ATS SURVEILLANCE SYSTEM — 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.

AUTOMATIC DEPENDENT SURVEILLANCE (ADS) — 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 means by which aircraft, aerodrome vehicles and other objects can automatically transmit and/or receive data such as identification, position and additional data, as appropriate, in a broadcast mode via a data link.

AUTOMATIC DEPENDENT SURVEILLANCE — CONTRACT (ADS-C) — A means by which the terms of an ADS-C agreement will be exchanged between the ground system and the aircraft, via a data link, specifying under what conditions ADS-C reports would be initiated, and what data would be contained in the reports.

NOTE: The abbreviated term “ADS” contract is commonly used to refer to ADS event contract, ADS demand contract or an emergency mode.

AUTOMATIC TERMINAL INFORMATION SERVICE (ATIS) — The automatic provision of current, routine information to arriving and departing aircraft throughout 24 hours or a specified portion thereof:

- Data link-automatic terminal information service (D-ATIS). The provision of ATIS via data link.
- Voice-automatic terminal information service (Voice-ATIS). The provision of ATIS by means of continuous and repetitive voice broadcasts.

AUTOMATED SURFACE OBSERVATION SYSTEM (ASOS) — The Automated Surface Observation System, in the United States, is a surface weather observing system implemented by the

National Weather Service, the Federal Aviation Administration and the Department of Defense. It is designed to support aviation operations and weather forecast activities. The ASOS provides continuous minute-by-minute observations and performs the basic observing functions necessary to generate an aviation routine weather report (METAR) and other aviation weather information. ASOS information may be transmitted over a discrete VHF radio frequency or the voice portion of a local navaid.

AUTOMATED WEATHER OBSERVING SYSTEM (AWOS) — An automated weather reporting system which transmits local real-time weather data directly to the pilot.

AWOS-A	Only reports altimeter setting.
AWOS-A/V	Reports altimeter setting plus visibility.
AWOS-1	Usually reports altimeter setting, wind data, temperature, dewpoint and density altitude.
AWOS-2	Reports same as AWOS-1 plus visibility.
AWOS-3	Reports the same as AWOS-2 plus cloud/ceiling data.

AUTOMATED WEATHER SENSOR SYSTEM (AWSS) — A surface weather observing system similar to AWOS and ASOS, providing all the weather information furnished by ASOS systems. The AWSS sensor suite automatically collects, measures, processes, and broadcasts surface weather data including altimeter setting, temperature and dew point, cloud height and coverage, visibility, present weather (rain, drizzle, snow), rain accumulation, freezing rain, thunderstorms, fog, mist, haze, freezing fog, as well as wind speed, direction, and gusts.

BALKED LANDING — A landing manoeuvre that is unexpectedly discontinued below DA(H)/MDA(H) or beyond MAP.

BASE TURN — A turn executed by the aircraft during the initial approach between the end of the outbound track and the beginning of the intermediate or final approach track. The tracks are not reciprocal.

NOTE: Base turns may be designated as being made either in level flight or while descending, according to the circumstances of each individual procedure.

BLIND TRANSMISSION — A transmission from one station to another station in circumstances where two-way communication cannot be established but where it is believed that the called station is able to receive the transmission.

BRAKING ACTION (GOOD, FAIR, POOR, NIL) — A report of conditions on the airport movement area providing a pilot with a degree/quality of braking that might be expected. Braking action is reported in terms of good, fair, poor, or nil.

BRIEFING — Oral commentary on existing and/or expected conditions.

BROADCAST — A transmission of information relating to air navigation that is not addressed to a specific station or stations.

CARDINAL ALTITUDES OR FLIGHT LEVELS — “Odd” or “Even” thousand-foot altitudes or flight levels; e.g., 5000, 6000, 7000, FL60, FL250, FL260, FL270.

CATCH POINT — A fix/waypoint that serves as a transition point from the high altitude waypoint navigation structure to the low altitude structure or an arrival procedure (STAR).

CEILING (ICAO) — The height above the ground or water of the base of the lowest layer of cloud below 6000m (20,000ft) covering more than half the sky.

CEILING (USA) — The height above the earth's surface of the lowest layer of clouds or obscuring phenomena that is reported as “broken”, “overcast”, or “obscuration”, and not classified as “thin”, or “partial”.

CHANGE-OVER POINT — The point at which an aircraft navigating on an ATS route segment defined by reference to very high frequency omnidirectional radio ranges is expected to transfer its primary navigational reference from the facility behind the aircraft to the next facility ahead of the aircraft.

NOTE: Change-over points are established to provide the optimum balance in respect of signal strength and quality between facilities at all levels to be used and to ensure a common source of azimuth guidance for all aircraft operating along the same portion of a route segment.

CHART CHANGE NOTICES — Jeppesen Chart Change Notices include significant information changes affecting Enroute, Area, and Terminal charts. Entries are published until the temporary condition no longer exists, or until the permanent change appears on revised charts. Enroute chart numbers/panel numbers/letters and area chart identifiers are included for each entry in the enroute portion of the Chart Change Notices. To avoid duplication of information in combined Enroute and Terminal Chart Change Notices, navaid conditions, except for ILS components, are listed only in the Enroute portion of the Chart Change Notices. All times are local unless otherwise indicated. Vertical bars indicate new or revised information. Chart Change Notices are only an *abbreviated* service. Always ask for pertinent NOTAMs prior to flight.

CIRCLING APPROACH / CIRCLE-TO-LAND MANEUVER — An extension of an instrument approach procedure which provides for visual circling of the aerodrome prior to landing.

CLEARANCE LIMIT — The point to which an aircraft is granted an air traffic control clearance.

CLEARWAY — An area beyond the take-off runway under the control of airport authorities within which terrain or fixed obstacles may not extend above specified limits. These areas may be required for certain turbine-powered operations and the size and upward slope of the clearway will differ depending on when the aircraft was certified.

CLOUD OF OPERATIONAL SIGNIFICANCE — A cloud with the height of cloud base below 5000ft (1500m) or below the highest minimum sector altitude, whichever is greater, or a cumulonimbus cloud or a towering cumulus cloud at any height.

CODE (SSR CODE) — The number assigned to a particular multiple pulse reply signal transmitted by a transponder in Mode A or Mode C.

COMMON TRAFFIC ADVISORY FREQUENCY (CTAF) (USA) — A frequency designed for the purpose of carrying out airport advisory practices while operating to or from an uncontrolled airport. The CTAF may be a UNICOM, Multicom, FSS, or tower frequency.

COMMUNITY AERODROME RADIO STATION (CARS) — An aerodrome radio that provides weather, field conditions, accepts flight plans and position reports.

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 — A device which performs sequences of arithmetical and logical steps upon data without human intervention.

NOTE: When the word "computer" is used in this document it may denote a computer complex, which includes one or more computers and peripheral equipment.

CONDITIONAL ROUTES (CDR) (Europe) —

Category 1,2,3.

Category 1:	Permanently plannable CDR during designated times.
Category 2:	Plannable only during times designated in the Conditional Route Availability Message (CRAM) published at 1500 for the 24 hour period starting at 0600 the next day.
Category 3:	Not plannable. Usable only when directed by ATC.

CONTROL AREA (ICAO) — A controlled airspace extending upwards from a specified limit above the earth.

CONTROLLED AERODROME — An aerodrome at which air traffic control service is provided to aerodrome traffic.

NOTE: The term "controlled aerodrome" indicates that air traffic control service is provided to aerodrome traffic but does not necessarily imply that a control zone exists.

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.

NOTE: Controlled airspace is a generic term which covers ATS airspace Classes "A", "B", "C", "D", and "E".

CONTROLLED FIRING AREA (USA) — [see SPECIAL USE AIRSPACE (SUA)].

CONTROLLED FLIGHT — Any flight which is subject to an air traffic control clearance.

CONTROLLER-PILOT DATA LINK COMMUNICATIONS (CPDLC) — A means of communication between controller and pilot, using data link for ATC communications.

CONTROL ZONE (CTR) (ICAO) — A controlled airspace extending upwards from the surface of the earth to a specified upper limit.

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 front course or back course.

c. The intended track along a straight, curved, or segmented MLS path.

CRITICAL HEIGHT — Lowest height in relation to an aerodrome specified level below which an approach procedure cannot be continued in a safe manner solely by the aid of instruments.

CRUISE CLIMB — An aeroplane cruising technique resulting in a net increase in altitude as the aeroplane mass decreases.

CRUISING LEVEL — A level maintained during a significant portion of a flight.

CURRENT FLIGHT PLAN (CPL) — The flight plan, including changes, if any, brought about by subsequent clearances.

DANGER AREA (ICAO) — [see SPECIAL USE AIRSPACE (SUA)].

DATA CONVENTION — An agreed set of rules governing the manner or sequence in which a set of data may be combined into a meaningful communication.

DATA LINK COMMUNICATIONS — A form of communication intended for the exchange of messages via a data link.

DATA LINK INITIATION CAPABILITY (DLIC) — A data link application that provides the ability to exchange addresses, names and version numbers necessary to initiate data link applications.

DEAD RECKONING (DR) NAVIGATION — The estimating or determining of position by advancing an earlier known position by the application of direction, time and speed data.

DECISION ALTITUDE (DA) or DECISION HEIGHT (DH) (ICAO) — A specified altitude or height in the precision approach or approach with vertical guidance at which a missed approach must be initiated if the required visual reference to continue the approach has not been established.

NOTE:

a. Decision altitude (DA) is referenced to mean sea level (MSL) and decision height (DH) is referenced to the threshold elevation.

b. The required visual reference means that section of the visual aids or of the approach area which should have been in view for sufficient time for the pilot to have made an assessment of the aircraft position and rate of change of position, in relation to the desired flight path. In Category III operations with a decision height the required visual reference is that specified for the particular procedure and operation.

c. For convenience where both expressions are used they may be written in the form "decision altitude/height" and abbreviated "DA/H."

DECISION ALTITUDE/HEIGHT (DA/H) (FAA) — Is a specified altitude/height in an instrument approach procedure at which the pilot must decide whether to initiate an immediate missed approach if the pilot does not see the required visual reference, or to continue the approach. Decision altitude/height is expressed in feet above mean sea level/ground level.

NOTE: Jeppesen approach charts use the abbreviation DA(H). The decision altitude "DA" is referenced to mean sea level (MSL) and the parenthetical decision height (DH) is referenced to the TDZE or threshold elevation. A DA(H) of 1440ft (200ft is a Decision Altitude of 1440ft and a Decision Height of 200ft.

DEPARTURE CLEARANCE VIA DATA LINK (DCL) — Provides assistance for requesting and delivering information and clearance, with the objective of reducing aircrew and controller workload. The DCL service shall be initiated by the aircrew at a suitable time between Ti and Tt where:

Ti – the earliest time at which a DCL service can be initiated;

Tt – the latest time after which an aircrew, having not completed the DCL service, is still able to receive by voice procedures and in due time, the vocal departure clearance.

The third time parameter of the DCL acknowledge procedure is T1 where:

T1 – timer implemented in the ATS ground system between the sending by ATS ground system of the DCL clearance message and the reception by it of the read-back of DCL clearance message.

DEPENDENT PARALLEL APPROACHES — Simultaneous approaches to parallel or near-parallel instrument runways where radar separation minima between aircraft on adjacent extended runway centre lines are prescribed.

DETRESFA — The code word used to designate a distress phase.

DIRECT ROUTE - D — A requested route published on a Jeppesen Enroute or Area chart to assist pilots who have previous knowledge of acceptance of these routes by ATC. Use of a Direct route may require prior ATC approval and may not provide ATC or Advisory services, or be acceptable in flight plans.

DISCRETE CODE — A four-digit SSR Code with the last two digits not being "00."

DISPLACED THRESHOLD — A threshold that is located at a point on the runway other than the designated beginning of the runway.

DISTRESS — A condition of being threatened by serious and/or imminent danger and of requiring immediate assistance.

DISTRESS PHASE — A situation wherein there is a reasonable certainty that an aircraft and its occupants are threatened by grave and imminent danger or require immediate assistance.

DME DISTANCE — The line of sight distance (slant range) from the source of a DME signal to the receiving antenna.

EFFECTIVE DATE/TIME —

FAA and Canada: Aeronautical information in the U.S. and its territories is generally effective on the designated effective date at 09:01 Coordinated Universal Time (UTC). The effective time applies to airspace, airways and flight procedures. It allows for implementation between 01:00 and 06:00 local standard time in the U.S. Local authorities may change the date or time of implementation due to local operational considerations. Check NOTAMs and contact local ATC for information.

International: The International Civil Aviation Organization (ICAO) guidance specifies that aeronautical information should be effective on the designated effective date at 00:00 Coordinated Universal Time (UTC). However national and local authorities often change the effective time to allow for implementation during the local night or at other times due to local operational considerations. When an effective time other than 00:00 UTC is used, ICAO requires that it be published in the official Aeronautical Information Publication (AIP) of the country. Check NOTAMs and contact local ATC for information.

ELEVATION — The vertical distance of a point or a level, on or affixed to the surface of the earth, measured from mean sea level.

EMERGENCY PHASE — A generic term meaning, as the case may be, uncertainty phase, alert phase or distress phase.

ENGINEERED MATERIALS ARRESTING SYSTEM (EMAS) — High-energy-absorbing material located in the runway overrun that is designed to crush under the weight of an aircraft as the material exerts deceleration forces on the aircraft landing gear.

ENROUTE FLIGHT ADVISORY SERVICE (FLIGHT WATCH) — A service specifically designed to provide, upon pilot request, timely weather information pertinent to the type of flight, intended route of flight, and altitude. The FSSs providing this service are indicated on Jeppesen Enroute and Area charts.

ESTIMATED ELAPSED TIME — The estimated time required to proceed from one significant point to another.

ESTIMATED OFF-BLOCK TIME — The estimated time at which the aircraft will commence movement associated with departure.

ESTIMATED TIME OF ARRIVAL — For IFR flights, the time at which it is estimated that the aircraft will 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 aerodrome, the time at which the aircraft will arrive over the aerodrome. For VFR flights, the time at which it is estimated that the aircraft will arrive over the aerodrome.

EXPECTED APPROACH TIME — The time at which ATC expects that an arriving aircraft, following a delay, will leave the holding point to complete its approach for a landing.

NOTE: The actual time of leaving the holding point will depend upon the approach clearance.

EXTENDED OPERATION (ETOPS) — Any flight by an aeroplane with two turbine power-units where the flight time at the one power-unit inoperative cruise speed (in ISA and still air conditions), from a point on the route to an adequate alternate aerodrome, is greater than the threshold time approved by the State of the Operator.

FAA AIR CARRIER OPERATIONS SPECIFICATIONS — Document issued to users operating under Federal Aviation Administration Regulations (FAR) Parts 121, 125, 127, 129, and 135. Operations Specifications are established and formalized by FARs. The primary purpose of FAA Air Carrier Operations Specifications is to provide a legally enforceable means of prescribing an authorization, limitation and/or procedures for a specific operator. Operations Specifications are subject to expeditious changes. These changes are usually too time critical to adopt through the regulatory process.

FEEDER FIX — The fix depicted on instrument approach procedure charts which establishes the starting point of the feeder route.

FEEDER ROUTE — Routes depicted on instrument approach procedure charts to designate routes for aircraft to proceed from the enroute structure to the initial approach fix (IAF).

FILED FLIGHT PLAN (FPL) — The flight plan as filed with an ATS unit by the pilot or a designated representative, without any subsequent changes.

FINAL APPROACH COURSE — A bearing/radial/track of an instrument approach leading to a runway or an extended runway centerline all without regard to distance.

FINAL APPROACH (ICAO) — That part of an instrument approach procedure which commences at the specified final approach fix or point, or where such a fix or point is not specified,

a. at the end of the last procedure turn, base turn or inbound turn of a racetrack procedure, if specified; or
b. at the point of interception of the last track specified in the approach procedure; and ends at a point in the vicinity of an aerodrome from which:
    1. a landing can be made; or
    2. a missed approach procedure is initiated.

FINAL APPROACH AND TAKE-OFF AREA (FATO) — A defined area over which the final phase of the approach manoeuvre to hover or landing is completed and from which the take-off manoeuvre is commenced. Where the FATO is to be used by performance Class 1 helicopters, the defined area includes the rejected take-off area available.

FINAL APPROACH FIX (FAF) — The fix from which the final approach (IFR) to an airport is executed and which identifies the beginning of the final approach segment. It is designated in the profile view of Jeppesen Terminal charts by the Maltese Cross symbol for non-precision approaches and by the glide slope/path intercept point on precision approaches. The glide slope/path symbol starts at the FAF. When ATC directs a lower-than-published Glide Slope/Path Intercept Altitude, it is the resultant actual point of the glide slope/path intercept.

FINAL APPROACH FIX (FAF) (AUSTRALIA) — A specified point on a non-precision approach which identifies the commencement of the final segment. The FAF is designated in the profile view of Jeppesen Terminal charts by the Maltese Cross symbol.

FINAL APPROACH FIX (FAF) OR POINT (FAP) (ICAO) — That fix or point of an instrument approach procedure where the final approach segment commences.

FINAL APPROACH — IFR (USA) — The flight path of an aircraft which is inbound to an airport on a final instrument approach course, beginning at the final approach fix or point and extending to the airport or the point where a circling approach/circle-to-land maneuver or a missed approach is executed.

FINAL APPROACH POINT (FAP) (USA) — The point, applicable only to a non-precision approach with no depicted FAF (such as an on-airport VOR), where the aircraft is established inbound on the final approach course from the procedure turn and where the final approach descent may be commenced. The FAP serves as the FAF and identifies the beginning of the final approach segment.

FINAL APPROACH POINT (FAP) (AUSTRALIA) — A specified point on the glide path of a precision instrument approach which identifies the commencement of the final segment.

NOTE: The FAP is co-incident with the FAF of a localizer-based non-precision approach.

FINAL APPROACH SEGMENT (FAS) — That segment of an instrument approach procedure in which alignment and descent for landing are accomplished.

FLIGHT CREW MEMBER — A licensed crew member charged with duties essential to the operation of an aircraft during flight time.

FLIGHT DOCUMENTATION — Written or printed documents, including charts or forms, containing meteorological information for a flight.

FLIGHT INFORMATION CENTRE — A unit established to provide flight information service and alerting service.

FLIGHT INFORMATION REGION (FIR, UIR) — An airspace of defined dimensions within which Flight Information Service and Alerting Service are provided.

FLIGHT INFORMATION SERVICE (FIS) — A service provided for the purpose of giving advice and information useful for the safe and efficient conduct of flights.

FLIGHT LEVEL (FL) — A surface of constant atmospheric pressure which is related to a specific pressure datum, 1013.2 hectopascals (hPa), and is separated from other such surfaces by specific pressure intervals.

NOTE 1: A pressure type altimeter calibrated in accordance with the Standard Atmosphere:

a. when set to a QNH altimeter setting, will indicate altitude;

b. when set to a QFE altimeter setting, will indicate height above the QFE reference datum;

c. when set to a pressure of 1013.2 hectopascals (hPa), may be used to indicate flight levels.

NOTE 2: The terms “height” and “altitude,” used in NOTE 1 above, indicate altimetric rather than geometric heights and altitudes.

FLIGHT PATH MONITORING — The use of ATS surveillance systems for the purpose of providing aircraft with information and advice relative to significant deviations from nominal flight path, including deviations from the terms of their air traffic control clearances.

NOTE: Some applications may require a specific technology, e.g. radar, to support the function of flight path monitoring.

FLIGHT PLAN — Specified information provided to air traffic services units, relative to an intended flight or portion of a flight of an aircraft.

NOTE: Specifications for flight plans are contained in ICAO Rules of the Air, Annex 2. A Model Flight Form is contained in ICAO Rules of the Air and Air Traffic Services, PANS-RAC (Doc 4444), Appendix 2 and ATC section.

FLIGHT VISIBILITY — The visibility forward from the cockpit of an aircraft in flight.

FLIGHT WATCH (USA) — A shortened term for use in air-ground contacts to identify the flight service station providing Enroute Flight Advisory Service; e.g., “Oakland Flight Watch.”

FLOW CONTROL — Measures designed to adjust the flow of traffic into a given airspace, along a given route, or bound for a given aerodrome, so as to ensure the most effective utilization of the airspace.

FORECAST — A statement of expected meteorological conditions for a specified time or period, and for a specified area or portion of airspace.

GAMET AREA FORECAST — An area forecast in abbreviated plain language for low-level flights for a flight information region or sub-area thereof, prepared by the meteorological office designated by the meteorological authority concerned and exchanged with meteorological offices in adjacent flight information regions, as agreed between the meteorological authorities concerned.

GBAS-LANDING SYSTEM (GLS) — A system for Approach and Landing operations utilizing GNSS, augmented by a Ground-Based Augmentation System (GBAS), as the primary navigational reference.

GLIDE PATH (GP) (ICAO) — A descent profile determined for vertical guidance during a final approach.

GLIDE SLOPE (GS) (USA) — Provides vertical guidance for aircraft during approach and landing. The glide slope/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/MLS; 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.

GLIDE SLOPE/GLIDE PATH INTERCEPT ALTITUDE — The minimum altitude to intercept the glide slope/path on a precision approach. The intersection of the published intercept altitude with the glide slope/path, designated on Jeppesen Terminal charts by the start of the glide slope/path symbol, is the precision FAF; however, when ATC directs a lower altitude, the resultant lower intercept position is then the FAF.

GLOBAL NAVIGATION SATELLITE SYSTEMS (GNSS) — An “umbrella” term adopted by the International Civil Aviation Organization (ICAO) to encompass any independent satellite navigation system used by a pilot to perform onboard position determinations from the satellite data.

GLOBAL POSITIONING SYSTEM (GPS) — A space-based radio positioning, navigation, and time-transfer system. The system provides highly accurate position and velocity information, and precise time, on a continuous global basis, to an unlimited number of properly equipped users. The system is unaffected by weather, and provides a worldwide common grid reference system. The GPS concept is predicated upon accurate and continuous knowledge of the spatial position of each satellite in the system with respect to time and distance from a transmitting satellite to the user. The GPS receiver automatically selects appropriate signals from the satellites in view and translates these into a three-dimensional position, velocity, and time. System accuracy for civil users is normally 100 meters horizontally.

GRID MINIMUM OFF-ROUTE ALTITUDE (Grid MORA) — An altitude derived by Jeppesen or provided by State Authorities. The Grid MORA altitude provides terrain and man-made structure clearance within the section outlined by latitude and longitude lines. MORA does not provide for navaid signal coverage or communication coverage.

a. Grid MORA values derived by Jeppesen clear all terrain and man-made structures by 1000ft in areas where the highest elevations are 5000ft MSL or lower. MORA values clear all terrain and man-made structures by 2000ft in areas where the highest elevations are 5001ft MSL or higher. When a Grid MORA is shown as “Unsurveyed” it is due to incomplete or insufficient information. Grid MORA values followed by a +/- denote doubtful accuracy, but are believed to provide sufficient reference point clearance.

b. Grid MORA (State) altitude supplied by the State Authority provides 2000ft clearance in mountainous areas and 1000ft in non-mountainous areas.

GRID POINT DATA IN DIGITAL FORM — Computer processed meteorological data for a set of regularly spaced points on a chart, for transmission from a meteorological computer to another computer in a code form suitable for automated use.

NOTE: In most cases such data are transmitted on medium or high speed telecommunications channels.

GRIP-FLEX MICRO-SURFACING — A thermoplastic compound that uses highly refined, environmentally safe coal tar derivative for anti-oxidation and fuel-resistance qualities to create a stable wearing surface for pavements.

GROUND COMMUNICATIONS OUTLET (GCO) (USA) — An unstaffed, remotely controlled ground / ground communications facility. Pilots at uncontrolled airports may contact ATC and FSS via VHF to a telephone connection to obtain an instrument clearance or close a VFR or IFR flight plan. They may also get an updated weather briefing prior to take-off. Pilots will use four “key clicks” on the VHF radio to contact the appropriate ATC facility, or six “key clicks” to contact FSS. The GCO system is intended to be used only on the ground.

GLOSSARY

GROUND EFFECT — A condition of improved performance (lift) due to the interference of the surface with the airflow pattern of the rotor system when a helicopter or other VTOL aircraft is operating near the ground.

NOTE: Rotor efficiency is increased by ground effect to a height of about one rotor diameter for most helicopters.

GROUND VISIBILITY — The visibility at an aerodrome, as reported by an accredited observer.

HEADING — The direction in which the longitudinal axis of an aircraft is pointed, usually expressed in degrees from North (true, magnetic, compass or grid).

HEIGHT — The vertical distance of a level, a point or an object considered as a point, measured from a specified datum.

HEIGHT ABOVE AIRPORT (HAA) — The height of the Minimum Descent Altitude (MDA) above the published airport elevation. This is published in conjunction with circling minimums.

HEIGHT ABOVE TOUCHDOWN (HAT) — The height of the Decision Height or Minimum Descent Altitude above the highest runway elevation in the touchdown zone of the runway. HAT is published on instrument approach charts in conjunction with all straight-in minimums.

HIGH FREQUENCY COMMUNICATIONS — High radio frequencies (HF) between 3 and 30MHz used for air-to-ground voice communication in overseas operations.

HIGH SPEED TAXIWAY / TURNOFF (HST) — A long radius taxiway designed and provided with lighting or marking to define the path of an aircraft, traveling at high speed (up to 60KT), from the runway center to a point on the center of a taxiway. Also referred to as long radius exit or turnoff taxiway. The high speed taxiway is designed to expedite aircraft turning off the runway after landing, thus reducing runway occupancy time.

HOLDING FIX, HOLDING POINT — A specified location, identified by visual or other means, in the vicinity of which the position of an aircraft in flight is maintained in accordance with air traffic control clearances.

HOLD / HOLDING PROCEDURE — A predetermined maneuver which keeps aircraft within a specified airspace while awaiting further clearance from air traffic control. Also used during ground operations to keep aircraft within a specified area or at a specified point while awaiting further clearance from air traffic control.

HOT SPOT — A location on an aerodrome movement area with a history or potential risk of collision or runway incursion, and where heightened attention by pilots/drivers is necessary.

HUMAN FACTORS PRINCIPLES — Principles which apply to aeronautical design, certification, training, operations and maintenance and which seek safe interface between the human and other system components by proper consideration to human performance.

HUMAN PERFORMANCE — Human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations.

IFR FLIGHT — A flight conducted in accordance with the instrument flight rules.

ILS CATEGORIES (ICAO) —

a. ILS Category I — An ILS approach procedure which provides for an approach to a decision height not lower than 60m (200ft) and a visibility not less than 800m (2400ft) or a runway visual range not less than 550m (1800ft).

b. ILS Category II (Special authorization required) — An ILS approach procedure which provides for an approach to a decision height lower than 60m (200ft) but not lower than 30m (100ft) and a runway visual range not less than 300m (1000ft) for aircraft categories A, B, C (D with auto landing), and not less than 350m (1200ft) for aircraft category D without auto landing.

c. ILS Category III (Special authorization required) —

   1. IIIA — An ILS approach procedure which provides for approach with either a decision height lower than 30m (100ft) or with no decision height and with a runway visual range of not less than 175m (574ft).

   2. IIIB — An ILS approach procedure which provides for approach with either a decision height lower than 15m (50ft) or with no decision height and with a runway visual range of less than 175m (574ft) but not less than 50m (150ft).

   3. IIIC — An ILS approach procedure which provides for approach with no decision height and no runway visual range limitations.

d. Some areas require special authorization for ILS Category I approaches. In these areas, an additional category of approach called ILS is available without special authorization. These ILS approaches have minimums higher than a decision height of 200ft and a runway visual range value of 2600ft. Jeppesen approach charts, at these locations, will have a notation in the chart heading or in the minimum box titles.

ILS CATEGORIES (USA) —

a. ILS Category I — An ILS approach procedure which provides for approach to a height above touchdown of not less than 200ft and with runway visual range of not less than 1800ft.

b. ILS Category II — An ILS approach procedure which provides for approach to a height above touchdown of not less than 100ft and with runway visual range of not less than 1200ft.

c. ILS Category III —

   1. IIIA — An ILS approach procedure which provides for approach without a decision height minimum and with runway visual range of not less than 700ft.

   2. IIIB — An ILS approach procedure which provides for approach without a decision height minimum and with runway visual range of not less than 150ft.

   3. IIIC — An ILS approach procedure which provides for approach without a decision height minimum and without runway visual range minimum.

INCERFA — The code word used to designate an uncertainty phase.

INDEPENDENT PARALLEL APPROACHES — Simultaneous approaches to parallel or near-parallel instrument runways where radar separation minima between aircraft on adjacent extended runway centre lines are not prescribed.

INDEPENDENT PARALLEL DEPARTURES — Simultaneous departures from parallel or near-parallel instrument runways.

INITIAL APPROACH FIX (IAF) — A fix that marks the beginning of the initial segment and the end of the arrival segment, if applicable. In RNAV applications this fix is normally defined by a fly-by waypoint.

INITIAL APPROACH SEGMENT — 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.

INSTRUMENT APPROACH PROCEDURE (IAP) — A series of predetermined manoeuvres 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. Instrument approach procedures are classified as follows:

- Non-precision approach (NPA) procedure. An instrument approach procedure which utilizes lateral guidance but does not utilize vertical guidance.
- Approach procedure with vertical guidance (APV). An instrument approach based on a navigation system that is not required to meet the precision approach standards of ICAO Annex 10 but provides course and glide path deviation information (sometimes referred to as “semi-precision”). Baro-VNAV, LDA with glide path, LNAV/VNAV and LPV are examples of APV approaches.
- Precision approach (PA) procedure. An instrument approach procedure using precision lateral and vertical guidance with minima as determined by the category of operation.

  NOTE: Lateral and vertical guidance refers to the guidance provided either by:

  a. a ground-based navigation aid; or

  b. computer-generated navigation data.

INSTRUMENT DEPARTURE PROCEDURE (DP) (USA) — A preplanned instrument flight rule (IFR) air traffic control departure procedure printed for pilot use in graphic and/or textual form. DPs provide transition from the terminal to the appropriate enroute structure.

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.

NOTE 1: The specified minima for visual meteorological conditions are contained in ICAO Rules of the Air, Annex 2, Chapter 4.

NOTE 2: In a control zone, a VFR flight may proceed under instrument meteorological conditions if and as authorized by air traffic control.

INTERMEDIATE APPROACH SEGMENT — That segment of an instrument approach procedure between either the intermediate approach fix and the final approach fix or point, or between the end of a reversal, racetrack or dead reckoning track procedure and the final approach fix or point, as appropriate.

INTERMEDIATE FIX (IF) — A fix that marks the end of an initial segment and the beginning of the intermediate segment. In RNAV applications this fix is normally defined by a fly-by waypoint.

INTERNATIONAL AIRPORT (ICAO) — Any airport designated by the Contracting State in whose territory it is situated as an airport of entry and departure for international air traffic, where the formalities incident to customs, immigration, public health, animal and plant quarantine and similar procedures are carried out.

INTERNATIONAL AIRPORT (USA) — Relating to international flight, it means:

a. An airport of entry which has been designated by the Secretary of Treasury or Commissioner of Customs as an international airport for customs service.

b. A landing rights airport at which specific permission to land must be obtained from customs authorities in advance of contemplated use.

c. Airports designated under the Convention on International Civil Aviation as an airport for use by international air transport and/or international general aviation.

INTERNATIONAL AIRWAYS VOLCANO WATCH (IAVW) — International arrangements for monitoring and providing warnings to aircraft of volcanic ash in the atmosphere.

NOTE: The IAVW is based on the co-operation of aviation and non-aviation operational units using information derived from observing sources and networks that are provided by States. The watch is coordinated by ICAO with the co-operation of other concerned international organizations.

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO) — A specialized agency of the United Nations whose objective is to develop the principles and techniques of international air navigation and to foster planning and development of international civil air transport.

LAND AND HOLD SHORT OPERATIONS (LAHSO) — Operations which include simultaneous take-offs and landings and/or simultaneous landings when a landing aircraft is able and is instructed by the controller to hold short of the intersecting runway / taxiway or designated hold short point. Pilots are expected to promptly inform the controller if the hold short clearance cannot be accepted.

LANDING AREA — That part of a movement area intended for the landing or take-off of aircraft.

LANDING DISTANCE AVAILABLE (LDA) (ICAO) — The length of runway which is declared available and suitable for the ground run of an airplane landing.

LATERAL NAVIGATION (LNAV) — Provides the same level of service as the present GPS stand-alone approaches. LNAV minimums support the following navigation systems: WAAS, when the navigation solution will not support vertical navigation; and, GPS navigation systems which are presently authorized to conduct GPS/GNSS approaches.

LATERAL NAVIGATION / VERTICAL NAVIGATION (LNAV/VNAV) — Identifies APV minimums developed to accommodate an RNAV IAP with vertical guidance, usually provided by approach certified Baro-VNAV, but with lateral and vertical integrity limits larger than a precision approach or LPV. LNAV stands for Lateral Navigation; VNAV stands for Vertical Navigation. These minimums can be flown by aircraft with a statement in the Aircraft Flight Manual (AFM) that the installed equipment supports GPS approaches and has an approach-approved barometric VNAV, or if the aircraft has been demonstrated to support LNAV/VNAV approaches. This includes Class 2, 3 and 4 TSO-C146 WAAS equipment. Aircraft using LNAV/VNAV minimums will descend to landing via an internally generated descent path based on satellite or other approach approved VNAV systems. WAAS equipment may revert to this mode of operation when the signal does not support “precision” or LPV integrity.

LEVEL — A generic term relating to the vertical position of an aircraft in flight and meaning variously, height, altitude or flight level.

LOCAL AIRPORT ADVISORY (LAA) — A service provided by flight service stations or the military at airports not serviced by an operating control tower. This service consists of providing information to arriving and departing aircraft concerning wind direction and speed, favored runway, altimeter setting, pertinent known traffic, pertinent known field conditions, airport taxi routes and traffic patterns, and authorized instrument approach procedures. This information is advisory in nature and does not constitute an ATC clearance.

LOCALIZER PERFORMANCE WITH VERTICAL GUIDANCE (LPV) — Identifies the APV minimums that incorporate electronic lateral and vertical guidance. The lateral guidance is equivalent to localizer, and the protected area is considerably smaller than the protected area for the present LNAV and LNAV/VNAV lateral protection. Aircraft can fly these minimums with a statement in the Aircraft Flight Manual (AFM) that the installed equipment supports LPV approaches. This includes Class 3 and 4 TSO-C146 WAAS equipment, and future LAAS equipment. The label LPV denotes minima lines associated with APV-I or APV-II performance on approach charts.

LOCATION INDICATOR — A four-letter code group formulated in accordance with rules prescribed by ICAO and assigned to the location of an aeronautical fixed station.

LOW ALTITUDE AIRWAY STRUCTURE / FEDERAL AIRWAYS (USA) — The network of airways serving aircraft operations up to but not including 18,000ft MSL.

LOW FREQUENCY (LF) — The frequency band between 30 and 300kHz.

MAGNETIC VARIATION (VAR) — The orientation of a horizontal magnetic compass with respect to true north. Because there is a continuous small change of direction of lines of magnetic force over the surface of the earth, magnetic variation at most locations is not constant over long periods of time.

MANDATORY ALTITUDE — An altitude depicted on an instrument approach procedure chart requiring the aircraft to maintain altitude at the depicted value.

MANDATORY FREQUENCY (MF) — A frequency designated at selected airports that are uncontrolled during certain hours only. Aircraft operating within the designated MF Area, normally 5NM radius of the airport, must be equipped with a functioning radio capable of maintaining two-way communications. Jeppesen charts list the MF frequency and the area when other than the standard 5NM.

MANOEUVRING AREA — That part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, excluding aprons.

MAXIMUM AUTHORIZED ALTITUDE (MAA) — A published altitude representing the maximum usable altitude or flight level for an airspace structure or route segment.

MEDIUM FREQUENCY (MF) — The frequencies between 300kHz and 3MHz.

METEOROLOGICAL AUTHORITY — The authority providing or arranging for the provision of meteorological service for international air navigation on behalf of a Contracting State.

METEOROLOGICAL BULLETIN — A text comprising meteorological information preceded by an appropriate heading.

METEOROLOGICAL INFORMATION — Meteorological report, analysis, forecast, and any other statement relating to existing or expected meteorological conditions.

METEOROLOGICAL OFFICE — An office designated to provide meteorological service for international air navigation.

METEOROLOGICAL REPORT — A statement of observed meteorological conditions related to a specified time and location.

METEOROLOGICAL SATELLITE — An artificial earth satellite making meteorological observations and transmitting these observations to earth.

MILITARY OPERATIONS AREA (MOA) (USA) — [see SPECIAL USE AIRSPACE (SUA)].

MINIMUM CROSSING ALTITUDE (MCA) — The lowest altitude at certain fixes at which an aircraft must cross when proceeding in the direction of a higher minimum enroute IFR altitude (MEA).

MINIMUM DESCENT ALTITUDE (MDA) (FAA) — Is the lowest altitude specified in an instrument approach procedure, expressed in feet above mean sea level, to which descent is authorized on final approach or during circle-to-land maneuvering until the pilot sees the required visual references for the heliport or runway of intended landing.

MINIMUM DESCENT ALTITUDE (MDA) OR MINIMUM DESCENT HEIGHT (MDH) (ICAO) — A specified altitude or height in a non-precision approach or circling approach below which descent must not be made without the required visual reference.

NOTE 1: Minimum descent altitude (MDA) is referenced to mean sea level and minimum descent height (MDH) is referenced to the aerodrome elevation or to the threshold elevation if that is more than 2m (7ft) below the aerodrome elevation. A minimum descent height for a circling approach is referenced to the aerodrome elevation.

NOTE 2: The required visual reference means that section of the visual aids or of the approach area which should have been in view for sufficient time for the pilot to have made an assessment of the aircraft position and rate of change of position, in relation to the desired flight path. In the case of a circling approach the required visual reference is the runway environment.

NOTE 3: For convenience when both expressions are used they may be written in the form "minimum descent altitude/height" abbreviated "MDA/H."

MINIMUM ENROUTE IFR ALTITUDE (MEA) — The lowest published altitude between radio fixes that meets obstacle clearance requirements between those fixes and in many countries assures acceptable navigational signal coverage. The MEA applies to the entire width of the airway, segment, or route between the radio fixes defining the airway, segment, or route.

MINIMUM FUEL — The term used to describe a situation in which an aircraft's fuel supply has reached a state where little or no delay can be accepted.

NOTE: This is not an emergency situation but merely indicates that an emergency situation is possible, should any undue delay occur.

MINIMUM IFR ALTITUDES (USA) — Minimum altitudes for IFR operations are published on aeronautical charts for airways, routes, and for standard instrument approach procedures. Within the USA, if no applicable minimum altitude is prescribed the following minimum IFR altitudes apply.

a. In designated mountainous areas, 2000ft above the highest obstacle within a horizontal distance of 4NM from the course to be flown; or

b. Other than mountainous areas, 1000ft above the highest obstacle within a horizontal distance of 4NM from the course to be flown; or

c. As otherwise authorized by the Administrator or assigned by ATC.

MINIMUM OBSTRUCTION CLEARANCE ALTITUDE (MOCA) — The lowest published altitude in effect between radio fixes on VOR airways, off airway routes, or route segments which meets obstacle clearance requirements for the entire route segment and in the USA assures acceptable navigational signal coverage only within 22NM of a VOR.

MINIMUM OFF-ROUTE ALTITUDE (MORA) — This is an altitude derived by Jeppesen. The MORA provides known obstruction clearance 10NM either side of the route centerline including a 10NM radius beyond the radio fix reporting or mileage break defining the route segment. For terrain and man-made structure clearance refer to Grid MORA.

MINIMUM RECEPTION ALTITUDE (MRA) — The lowest altitude at which an intersection can be determined.

MINIMUM SAFE/SECTOR ALTITUDE (MSA) (FAA) — Altitude depicted on an instrument chart and identified as the minimum safe altitude which provides 1000ft of obstacle clearance within a 25NM radius from the navigational facility upon which the MSA is predicated. If the radius limit is other than 25NM, it is stated. This altitude is for EMERGENCY USE ONLY and does not necessarily guarantee navaid reception. When the MSA is divided into sectors, with each sector a different altitude, the altitudes in these sectors are referred to as "minimum sector altitudes".

MINIMUM SECTOR ALTITUDE (MSA) (ICAO) — The lowest altitude which may be used which will provide a minimum clearance of 300m (1000ft) above all objects located in an area contained within a sector of a circle of 46km (25NM) radius centered on a radio aid to navigation.

MINIMUM STABILIZATION DISTANCE (MSD) — The minimum distance to complete a turn manoeuvre and after which a new manoeuvre can be initiated. The minimum stabilization distance is used to compute the minimum distance between waypoints.

MINIMUM VECTORING ALTITUDE (MVA) — The lowest MSL altitude at which an IFR aircraft will be vectored by a radar controller, except as otherwise authorized for radar approaches, departures and missed approaches. The altitude meets IFR obstacle clearance criteria. It may be lower than the published MEA along an airway of J-route segment. It may be utilized for radar vectoring only upon the controller's determination that an adequate radar return is being received from the aircraft being controlled.

MISSED APPROACH —

a. A maneuver conducted by a pilot when an instrument approach cannot be completed to a landing. The route of flight and altitude are shown on instrument approach procedure charts. A pilot executing a missed approach prior to the Missed Approach Point (MAP) must continue along the final approach to the MAP. The pilot may climb immediately to the altitude specified in the missed approach procedure.

b. A term used by the pilot to inform ATC that he/she is executing the missed approach.

c. At locations where ATC radar service is provided the pilot should conform to radar vectors, when provided by ATC, in lieu of the published missed approach procedure.

MISSED APPROACH HOLDING FIX (MAHF) — A fix used in RNAV applications that marks the end of the missed approach segment and the centre point for the missed approach holding.

MISSED APPROACH POINT (MAP) (ICAO) — That point in an instrument approach procedure at or before which the prescribed missed approach procedure must be initiated in order to ensure that the minimum obstacle clearance is not infringed.

MISSED APPROACH POINT (MAP) (USA) — A point prescribed in each instrument approach procedure at which a missed approach procedure shall be executed if the required visual reference does not exist.

MISSED APPROACH PROCEDURE — The procedure to be followed if the approach cannot be continued.

MODE (SSR) — The conventional identifier related to specific functions of the interrogation signals transmitted by an SSR interrogator. There are four modes specified in ICAO Annex 10 (not published herein): A, C, S and intermode.

MOUNTAINOUS AREA (ICAO) — An area of changing terrain profile where the changes of terrain elevation exceed 900m (3000ft) within a distance of 10NM.

MOVEMENT AREA — That part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, consisting of the manoeuvring area and the apron(s).

NEAR-PARALLEL RUNWAYS — Non-intersecting runways whose extended centre lines have an angle of convergence/divergence of 15 degrees or less.

NON PRECISION APPROACH (NPA) PROCEDURE — [see INSTRUMENT APPROACH PROCEDURE (IAP)]

NO PROCEDURE TURN (NoPT) — No procedure turn is required nor authorized.

NORMAL OPERATING ZONE (NOZ) — Airspace of defined dimensions extending to either side of an ILS localizer course and/or MLS final approach track. Only the inner half of the normal operating zone is taken into account in independent parallel approaches.

NOTAM (ICAO) — A notice distributed by means of telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations.

NO-TRANSGRESSION ZONE (NTZ) — In the context of independent parallel approaches, a corridor of airspace of defined dimensions located centrally between the two extended runway centre lines, where a penetration by an aircraft requires a controller intervention to manoeuvre any threatened aircraft on the adjacent approach.

OBSERVATION (METEOROLOGICAL) — The evaluation of one or more meteorological elements.

OBSTACLE ASSESSMENT SURFACE (OAS) — A defined surface intended for the purpose of determining those obstacles to be considered in the calculation of obstacle clearance altitude/height for a specific APV or precision approach procedure.

OBSTACLE CLEARANCE ALTITUDE (OCA) OR OBSTACLE CLEARANCE HEIGHT (OCH) — The lowest altitude or the lowest height above the elevation of the relevant runway threshold or the aerodrome elevation as applicable, used in establishing compliance with appropriate obstacle clearance criteria.

NOTE 1: Obstacle clearance altitude is referenced to mean sea level and obstacle clearance height is referenced to the threshold elevation or in the case of non-precision approaches to the aerodrome elevation or the threshold elevation if that is more than 7ft (2m) below the aerodrome elevation. An obstacle clearance height for a circling approach is referenced to the aerodrome elevation.

NOTE 2: For convenience when both expressions are used they may be written in the form “obstacle clearance altitude/height” and abbreviated “OCA/H.”

OBSTACLE FREE ZONE (OFZ) (ICAO) — The airspace above the inner approach surface, inner transitional surfaces, and balked landing surface and that portion of the strip bounded by these surfaces, which is not penetrated by any fixed obstacle other than a low-mass and frangibly mounted one required for air navigation purposes.

OBSTRUCTION CLEARANCE LIMIT (OCL) — The height above aerodrome elevation below which the minimum prescribed vertical clearance cannot be maintained either on approach or in the event of a missed approach.

OPERATIONAL CONTROL — The exercise of authority over the initiation, continuation, diversion or termination of a flight in the interest of the safety of the aircraft and the regularity and efficiency of the flight.

OPERATOR — A person, organization or enterprise engaged in or offering to engage in an aircraft operation.

PILOT CONTROLLED LIGHTING (PCL) (USA) — (For other states see Air Traffic Control Rules and Procedures.)

Radio control of lighting is available at selected airports to provide airborne control of lights by keying the aircraft's microphone. The control system consists of a 3-step control responsive to 7, 5, and/or 3 microphone clicks. The 3-step and 2-step lighting facilities can be altered in intensity. All lighting is illuminated for a period of 15min (except for 1-step and 2-step REILs which may be turned off by keying the mike 5 or 3 times, respectively).

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 the mike 5 and/or three times. Approved lighting systems may be activated by keying the mike as indicated below:

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)

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 15min lighting duration is available.

PILOT-IN-COMMAND (PIC) — The pilot responsible for the operation and safety of the aircraft during flight time.

PITCH POINT — A fix/waypoint that serves as a transition point from a departure procedure or the low altitude ground-based navigation structure into the high altitude waypoint system.

POINT-IN-SPACE APPROACH (PinS) — The point-in-space approach is based on a basic GNSS non-precision approach procedure designed for helicopters only. It is aligned with a reference point located to permit subsequent flight manoeuvring or approach and landing using visual manoeuvring in adequate visual conditions to see and avoid obstacles.

POINT-IN-SPACE REFERENCE POINT (PRP) — Reference point for the point-in-space approach as identified by the latitude and longitude of the MAPt.

PRECISION APPROACH (PA) PROCEDURE — [see INSTRUMENT APPROACH PROCEDURE (IAP)].

PRECISION APPROACH RADAR (PAR) — Primary radar equipment used to determine the position of an aircraft during final approach, in terms of lateral and vertical deviations relative to a nominal approach path, and in range relative to touchdown.

NOTE: Precision approach radars are designated to enable pilots of aircraft to be given guidance by radio communication during the final stages of the approach to land.

PRECISION OBJECT FREE ZONE (POFZ) (FAA) — A volume of airspace above an area beginning at the runway threshold, at the threshold elevation, and entered on the extended runway centerline. The standard POFZ is 200ft (60m) long and 800ft (240m) wide. The POFZ must be kept clear when an aircraft on a vertically guided final approach is within two nautical miles (NM) of the runway threshold and the reported ceiling is below 250ft and/or visibility less than ¾ statute miles (SM) (or runway visual range below 4000ft). The POFZ is considered clear even if the wing of the aircraft holding on a taxiway waiting for runway clearance penetrates the POFZ; however, neither the fuselage nor the tail may infringe on the POFZ. For approaching aircraft, in the event that a taxiing/parked aircraft or vehicle is not clear of the POFZ, air traffic control will provide advisories to the approaching aircraft regarding the position of the offending aircraft/vehicle. In this case the pilot of the approaching aircraft must decide to continue or abort the approach. When the reported ceiling is below 800ft or visibility less than 2SM, departing aircraft must do the following. When there is an air traffic control tower (ATCT) in operation, plan to hold at the ILS hold line and hold as directed by air traffic control. When there is no operating ATCT, honor the ILS hold line and do not taxi into position and take-off if there is an approaching aircraft within 2NM of the runway threshold.

PRE-DEPARTURE CLEARANCE (PDC) — An automated Clearance Delivery system relaying ATC departure clearances from the FAA to the user network computer for subsequent delivery to the cockpit via ACARS (Airline/Aviation VHF data link) where aircraft are appropriately equipped, or to gate printers for pilot pickup.

PRESSURE ALTITUDE — An atmospheric pressure expressed in terms of altitude which corresponds to that pressure in the Standard Atmosphere.

PREVAILING VISIBILITY — The greatest visibility value, observed in accordance with the definition “visibility”, which is reached within at least half the horizon circle or within at least half of the surface of the aerodrome. These areas could comprise contiguous or non-contiguous sectors.

NOTE: This value may be assessed by human observation and/or instrumented systems. When instruments are installed, they are used to obtain the best estimate of the prevailing visibility.

PRIMARY AREA — A defined area symmetrically disposed about the nominal flight track in which full obstacle clearance is provided. (See also **SECONDARY AREA**.)

PRIMARY RADAR — A radar system which uses reflected radio signals.

PRIMARY SURVEILLANCE RADAR (PSR) — A surveillance radar system which uses reflected radio signals.

PROCEDURE ALTITUDE/HEIGHT — Are recommended altitudes/heights developed in coordination with Air Traffic Control requirements flown operationally at or above the minimum altitude/height and established to accommodate a stabilized descent at a prescribed descent gradient/

angle in the intermediate/final approach segment. Procedure altitudes/heights are never below the Segment Minimum Altitude (SMA) or Segment Minimum Safe Altitude (SMSA).

PROCEDURE TURN (PT) (ICAO) — A maneuver in which a turn is made away from a designated track followed by a turn in the opposite direction to permit the aircraft to intercept and proceed along the reciprocal of the designated track.

NOTE 1: Procedure turns are designated “left” or “right” according to the direction of the initial turn.

NOTE 2: Procedure turns may be designated as being made either in level flight or while descending, according to the circumstances of each individual procedure.

PROCEDURE TURN (PT) (USA) — The maneuver prescribed when it is necessary to reverse direction to establish an aircraft on the intermediate approach segment or final approach course. The outbound course, direction of turn, distance within which the turn must be completed, and minimum altitude are specified in the procedure. However, unless otherwise restricted, the point at which the turn may be commenced and the type and rate of turn are at the discretion of the pilot.

PROCEDURE TURN INBOUND — That point of a procedure turn maneuver where course reversal has been completed and an aircraft is established inbound on the intermediate approach segment or final approach course. A report of “procedure turn inbound” is normally used by ATC as a position report for separation purposes.

PROFILE — The orthogonal projection of a flight path or portion thereof on the vertical surface containing the nominal track.

PROGNOSTIC CHART — A forecast of a specified meteorological element(s) for a specified time or period and a specified surface or portion of airspace, depicted graphically on a chart.

PROHIBITED AREA (ICAO) (USA) — [see SPECIAL USE AIRSPACE (SUA)].

QFE — [see ALTIMETER SETTING]

QNE — [see ALTIMETER SETTING]

QNH — [see ALTIMETER SETTING]

RACETRACK PROCEDURE (ICAO) — A procedure designed to enable the aircraft to reduce altitude during the initial approach segment and/or establish the aircraft inbound when the entry into a reversal procedure is not practical.

RADAR — A radio detection device which provides information on range, azimuth and/or elevation of objects.

RADAR APPROACH — An approach, executed by an aircraft, under the direction of a radar controller.

RADAR CONTACT — The situation which exists when the radar position of a particular aircraft is seen and identified on a radar display.

RADAR SEPARATION — The separation used when aircraft position information is derived from radar sources.

RADAR WEATHER ECHO INTENSITY LEVELS — Existing radar systems cannot detect turbulence. However, there is a direct correlation between the degree of turbulence and other weather features associated with thunderstorms and the radar weather echo intensity. The National Weather Service has categorized radar weather echo intensity for precipitation into six levels. These levels are sometimes expressed during communications as "VIP LEVEL" 1 through 6 (derived from the component of the radar that produces the information — Video Integrator and Processor). The following list gives the "VIP LEVELS" in relation to the precipitation intensity within a thunderstorm:

Level 1.	WEAK
Level 2.	MODERATE
Level 3.	STRONG
Level 4.	VERY STRONG
Level 5.	INTENSE
Level 6.	EXTREME

RADIO ALTIMETER / RADAR ALTIMETER — Aircraft equipment which makes use of the reflection of radio waves from the ground to determine the height of the aircraft above the surface.

RADIOTELEPHONY — A form of radio communication primarily intended for the exchange of information in the form of speech.

RADIOTELEPHONY NETWORK — A group of radiotelephony aeronautical stations which operate on and guard frequencies from the same family and which support each other in a defined manner to ensure maximum dependability of air-ground communications and dissemination of air-ground traffic.

REDUCED VERTICAL SEPARATION MINIMUMS (RVSM) — A reduction in the vertical separation between FL290 – FL410 from 2000ft to 1000ft.

REGIONAL AIR NAVIGATION AGREEMENT — Agreement approved by the Council of ICAO normally on the advice of a regional air navigation meeting.

REPETITIVE FLIGHT PLAN (RPL) — A flight plan related to a series of frequently recurring, regularly operated individual flights with identical basic features, submitted by an operator for retention and repetitive use by ATS units.

REPORTING POINT — A specified geographical location in relation to which the position of an aircraft can be reported.

REQUIRED NAVIGATION PERFORMANCE (RNP) — A statement of navigation position accuracy necessary for operation within a defined airspace. RNP is performance-based and not dependent on a specific piece of equipment. RNP includes a descriptive number, the value being an indicator of the size of the containment area (e.g., RNP-0.3, RNP-1, RNP-3, etc.). The different values are assigned to terminal, departure, and enroute operations. Some aircraft have RNP approval in their AFM without a GPS sensor. The lowest level of sensors that the FAA will support for RNP service is DME/DME. However, necessary DME signal may not be available at the airport of intended operations. For those locations having an RNAV chart published with LNAV/VNAV minimums, a procedure note may be provided such as "DME/DME RNP-0.3 NA." This means that RNP aircraft dependent on DME/DME to achieve RNP-0.3 are not authorized to conduct this approach. Where DME facility availability is a factor, the note may read "DME/DME RNP-0.3 authorized; ABC and XYZ required." This means that ABC and XYZ facilities have been determined by flight inspection to be required in the navigation solution to assure RNP-0.3. VOR/DME updating must not be used for approach procedures.

RESCUE COORDINATION CENTER — A unit responsible for promoting efficient organization of search and rescue service and for coordinating the conduct of search and rescue operations within a search and rescue region.

RESCUE UNIT — A unit composed of trained personnel and provided with equipment suitable for the expeditious conduct of search and rescue.

RESTRICTED AREA (ICAO) (USA) — [see SPECIAL USE AIRSPACE (SUA)].

REVERSAL PROCEDURE — A procedure designed to enable aircraft to reverse direction during the initial approach segment of an instrument approach procedure. The sequence may include procedure turns or base turns.

REVISION DATE — Charts revisions are issued on Fridays. Charts are considered effective (usable) upon receipt. With regard to the coverages, charts are issued weekly or bi-weekly.

RNAV APPROACH — An instrument approach procedure which relies on aircraft area navigation equipment for navigation guidance.

RNP TYPE — A containment value expressed as a distance in nautical miles from the intended position within which flights would be for at least 95 percent of the total flying time.

EXAMPLE: RNP 4 represents a navigation accuracy of plus or minus 7.4km (4NM) on a 95 percent containment basis.

ROUTE MINIMUM OFF-ROUTE ALTITUDE (Route MORA) — This is an altitude derived by Jeppesen. The Route MORA altitude provides reference point clearance within 10NM of the route centerline (regardless of the route width) and end fixes. Route MORA values clear all reference points by 1000ft in areas where the highest reference points are 5000ft MSL or lower. Route MORA values clear all reference points by 2000ft in areas where the highest reference points are 5001ft MSL or higher. When a Route MORA is shown along a route as “unknown” it is due to incomplete or insufficient information.

RUNWAY — A defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft.

RUNWAY EDGE LIGHTS (ICAO) — Are provided for a runway intended for use at night or for a precision approach runway intended for use by day or night. Runway edge lights shall be fixed lights showing variable white, except that:

a. in the case of a displaced threshold, the lights between the beginning of the runway and the displaced threshold shall show red in the approach direction; and

b. a section of the lights 600m or one-third of the runway length, whichever is the less, at the remote end of the runway from the end at which the take-off run is started, may show yellow.

RUNWAY EDGE LIGHTS (USA) — Lights used to outline the edges of runways during periods of darkness or restricted visibility conditions. The light systems are classified according to the intensity or brightness they are capable of producing: they are the High Intensity Runway Lights (HIRL), Medium Intensity Runway Lights (MIRL), and the Low Intensity Runway Lights (RL). The HIRL and MIRL systems have variable intensity controls, where the RLs normally have one intensity setting.

a. The runway edge lights are white, except on instrument runways amber replaces white on the last 2000ft or half of the runway length, whichever is less, to form a caution zone for landings.

b. The lights marking the ends of the runway emit red light toward the runway to indicate the end of runway to a departing aircraft and emit green outward from the runway end to indicate the threshold to landing aircraft.

RUNWAY HOLDING POSITION — A designated position intended to protect a runway, an obstacle limitation surface, or an ILS/MLS critical/sensitive area at which taxiing aircraft and vehicles shall stop and hold, unless otherwise authorized by the aerodrome control tower.

NOTE: In radiotelephony phraseologies, the expression “holding point” is used to designate the runway holding position.

RUNWAY INCURSION — Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take-off of aircraft.

RUNWAY MARKINGS —

a. Basic marking — Markings on runways used for operations under visual flight rules consisting of centerline markings and runway direction numbers and, if required, letters.

b. Instrument marking — Markings on runways served by nonvisual navigation aids and intended for landings under instrument weather conditions, consisting of basic marking plus threshold markings.

c. All-weather (precision instrument) marking — Marking on runways served by nonvisual precision approach aids and on runways having special operational requirements, consisting of instrument markings plus landing zone markings and side strips.

RUNWAY STRIP — A defined area including the runway and stopway, if provided, intended:

a. to reduce the risk of damage to aircraft running off a runway; and

b. to protect aircraft flying over it during take-off or landing operations.

RUNWAY VISUAL RANGE (RVR) — The range over which the pilot of an aircraft on the centre line of a runway can see the runway surface markings or the lights delineating the runway or identifying its centre line.

SAFETY-SENSITIVE PERSONNEL — Persons who might endanger aviation safety if they perform their duties and functions improperly including, but not limited to, crew members, aircraft maintenance personnel and air traffic controllers.

SEARCH AND RESCUE SERVICES UNIT — A generic term meaning, as the case may be, rescue coordination center, rescue subcenter or alerting post.

SECONDARY AREA — A defined area on each side of the primary area located along the nominal flight track in which decreasing obstacle clearance is provided. (See also **PRIMARY AREA**).

SECONDARY RADAR — A radar system wherein a radio signal transmitted from a radar station initiates the transmission of a radio signal from another station.

SECONDARY SURVEILLANCE RADAR (SSR) — A surveillance radar system which uses transmitters/receivers (interrogators) and transponders.

SEGMENT MINIMUM ALTITUDE (SMA), or SEGMENT MINIMUM SAFE ALTITUDE (SMSA) — An altitude that provides minimum obstacle clearance in each segment of a non-precision approach. Segment minimum (safe) altitudes can be considered “do not descend below” altitudes and can be lower than *procedure* altitudes which are specifically developed to facilitate a constant rate or stabilized descent.

SEGMENTS OF AN INSTRUMENT APPROACH PROCEDURE — An instrument approach procedure may have as many as four separate segments depending on how the approach procedure is structured.

ICAO —

a. Initial Approach — 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.

b. Intermediate Approach — That segment of an instrument approach procedure between either the intermediate approach fix and the final approach fix or point, or between the end of a reversal, race track or dead reckoning track procedure and the final approach fix or point, as appropriate.

c. Final Approach — That segment of an instrument approach procedure in which alignment and descent for landing are accomplished.

d. Missed Approach Procedure — The procedure to be followed if the approach cannot be continued.

USA —

a. Initial Approach — The segment between the initial approach fix and the intermediate fix or the point where the aircraft is established on the intermediate course or final course.

b. Intermediate Approach — The segment between the intermediate fix or point and the final approach fix.

c. Final Approach — The segment between the final approach fix or point and the runway, airport or missed approach point.

d. Missed Approach — The segment between the missed approach point, or point of arrival at decision height, and the missed approach fix at the prescribed altitude.

SEGREGATED PARALLEL OPERATIONS — Simultaneous operations on parallel or near-parallel instrument runways in which one runway is used exclusively for approaches and the other runway is used exclusively for departures.

SELECTIVE CALL SYSTEM (SELCAL) — A system which permits the selective calling of individual aircraft over radiotelephone channels linking a ground station with the aircraft.

SHORELINE — A line following the general contour of the shore, except that in cases of inlets or bays less than 30NM in width, the line shall pass directly across the inlet or bay to intersect the general contour on the opposite side.

SIDESTEP MANEUVER — A visual maneuver accomplished by a pilot at the completion of an instrument approach to permit a straight-in landing on a parallel runway not more than 1200ft to either side of the runway to which the instrument approach was conducted.

SIGMET INFORMATION — Information issued by a meteorological watch office concerning the occurrence or expected occurrence of specified en route weather phenomena which may affect the safety of aircraft operations.

SIGNAL AREA — An area on an aerodrome used for the display of ground signals.

SIGNIFICANT POINT — A specified geographical location used in defining an ATS route or the flight path of an aircraft and for other navigation and ATS purposes.

NOTE: There are three categories of significant points: ground-based navigation aid, intersection and waypoint. In the context of this definition, intersection is a significant point expressed as radials, bearings and/or distances from ground-based navigation aids.

SLUSH — Water-saturated snow which with a heel-and-toe slap-down motion against the ground will be displaced with a splatter; specific gravity: 0.5 up to 0.8.

NOTE: Combinations of ice, snow and/or standing water may, especially when rain, rain and snow, or snow is falling, produce substances with specific gravities in excess of 0.8. These substances, due to their high water/ice content, will have a transparent rather than a cloudy appearance and, at the higher specific gravities, will be readily distinguishable from slush.

SNOW (on the ground) —

a. Dry snow. Snow which can be blown if loose or, if compacted by hand, will fall apart upon release; specific gravity: up to but not including 0.35.

b. Wet snow. Snow which, if compacted by hand, will stick together and tend to or form a snowball; specific gravity: 0.35 up to but not including 0.5.

c. Compacted snow. Snow which has been compressed into a solid mass that resists further compression and will hold together or break up into lumps if picked up; specific gravity: 0.5 and over.

SPECIAL USE AIRSPACE — Airspace of defined dimensions identified by an area on the surface of the earth wherein activities must be confined because of their nature and/or wherein limitations may be imposed upon aircraft operations that are not a part of those activities. Types of special use airspace are:

a. Alert Area (USA) — Airspace which may contain a high volume of pilot training activities or an unusual type of aerial activity, neither of which is hazardous to aircraft. Alert Areas are depicted on aeronautical charts for the information of nonparticipating pilots. All activities within an Alert Area are conducted in accordance with Federal Aviation Regulations, and pilots of participating aircraft as well as pilots transiting the area are equally responsible for collision avoidance.

b. Controlled Firing Area (USA) — Airspace wherein activities are conducted under conditions so controlled as to eliminate hazards to non participating aircraft and to ensure the safety of persons and property on the ground.

c. Danger Area (ICAO) — An airspace of defined dimensions within which activities dangerous to the flight of aircraft may exist at specified times.

d. Military Operations Area (MOA) (USA) — A MOA is airspace established outside of a Class “A” airspace area to separate or segregate certain nonhazardous military activities from IFR traffic and to identify for VFR traffic where these activities are conducted.

e. 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.

Prohibited Area (USA) — Airspace designated under FAR Part 73 within which no person may operate an aircraft without the permission of the using agency.

f. Restricted Area (ICAO) — An airspace of defined dimensions, above the land areas or territorial waters of a State, within which the flight of aircraft is restricted in accordance with certain specified conditions.

Restricted Area (USA) — Airspace designated under Part 73, within which the flight of aircraft, while not wholly prohibited, is subject to restriction. Most restricted areas are designated joint use and IFR/VFR operations in the area may be authorized by the controlling ATC facility when it is not being utilized by the using agency. Restricted areas are depicted on enroute charts. Where joint use is authorized, the name of the ATC controlling facility is also shown.

g. Warning Area (USA) — A warning area is airspace of defined dimensions from 3NM outward from the coast of the United States, that contains activity that may be hazardous to nonparticipating aircraft. The purpose of such warning areas is to warn nonparticipating pilots of the potential danger. A warning area may be located over domestic or international waters or both.

SPECIAL VFR FLIGHT — A VFR flight cleared by air traffic control to operate within a control zone in meteorological conditions below VMC.

STANDARD INSTRUMENT ARRIVAL (STAR) (ICAO) — A designated instrument flight rule (IFR) arrival route linking a significant point, normally on an ATS route, with a point from which a published instrument approach procedure can be commenced.

STANDARD INSTRUMENT DEPARTURE (SID) (ICAO) — A designated instrument flight rule (IFR) departure route linking the aerodrome or a specified runway of the aerodrome with a specified point, normally on a designated ATS route, at which the enroute phase of a flight commences.

STANDARD INSTRUMENT DEPARTURE (SID) (USA) — A preplanned instrument flight rule (IFR) air traffic control departure procedure printed for pilot use in graphic and/or textual form. SIDs provide transition from the terminal to the appropriate enroute structure.

STANDARD ISOBARIC SURFACE — An isobaric surface used on a world-wide basis for representing and analyzing the conditions in the atmosphere.

STANDARD TERMINAL ARRIVAL ROUTE (STAR) (USA) — 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 enroute structure to an outer fix or an instrument approach fix/arrival waypoint in the terminal area.

STATION DECLINATION — The orientation with respect to true north of VHF transmitted signals. The orientation is originally made to agree with the magnetic variation (an uncontrollable global phenomenon) at the site. Hence station declination (fixed by man) may differ from changed magnetic variation until the station is reoriented.

STOPWAY — A defined rectangular area on the ground at the end of take-off run available prepared as a suitable area in which an aircraft can be stopped in the case of an abandoned take-off.

SUBSTITUTE ROUTE — A route assigned to pilots when any part of an airway or route is unusable because of navaid status.

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.

SURFACE MOVEMENT GUIDANCE AND CONTROL SYSTEM (SMGCS) (USA) — Provisions for guidance and control or regulation for facilities, information, and advice necessary for pilots of aircraft and drivers of ground vehicles to find their way on the airport during low visibility operations and to keep the aircraft or vehicles on the surfaces or within the areas intended for their use. Low visibility operations for this system means reported conditions of RVR 1200 or less.

SURVEILLANCE APPROACH (ASR) — 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.

SURVEILLANCE RADAR — Radar equipment used to determine the position of an aircraft in range and azimuth.

TAKE-OFF DISTANCE AVAILABLE (TODA) (ICAO) — The length of the take-off run available plus the length of the clearway, if provided.

TAKE-OFF RUN AVAILABLE (TORA) (ICAO) — The length of runway declared available and suitable for the ground run of an airplane taking off.

TAXIING — Movement of an aircraft on the surface of an aerodrome under its own power, excluding take-off and landing.

TAXIWAY — A defined path on a land aerodrome established for the taxiing of aircraft and intended to provide a link between one part of the aerodrome and another, including:

Aircraft Stand Taxilane — A portion of an apron designated as a taxiway and intended to provide access to aircraft stands only.

Apron Taxiway — A portion of a taxiway system located on an apron and intended to provide a through taxi route across the apron.

Rapid Exit Taxiway — A taxiway connected to a runway at an acute angle and designed to allow landing aeroplanes to turn off at higher speeds than are achieved on other exit taxi-ways and thereby minimizing runway occupancy times.

TERMINAL CONTROL AREA (ICAO) — A control area normally established at the confluence of ATS routes in the vicinity of one or more major aerodromes.

TERMINAL ARRIVAL AREA (FAA) / TERMINAL AREA ALTITUDE (TAA) (ICAO) — Provides a seamless and efficient transition from the enroute structure to the terminal environment to an underlying RNAV instrument approach procedure for FMS and/or GPS equipped aircraft. Minimum altitudes depict standard obstacle clearances compatible with the associated instrument approach procedure. TAAs will not be found on all RNAV procedures, particularly in areas with a heavy concentration of air traffic. When the TAA is published, it replaces the MSA for that approach procedure. A standard racetrack holding pattern may be provided at the center IAF, and if present may be necessary for course reversal and for altitude adjustment for entry into the procedure. In the latter case, the pattern provides an extended distance for the descent as required by the procedure. The published procedure will be annotated to indicate when the course reversal is not necessary when flying within a particular TAA (e.g., "NoPT"). Otherwise, the pilot is expected to execute the course reversal under the provisions of 14 CFR Section 91.175 (USA). The pilot may elect to use the course reversal pattern when it is not required by the procedure, but must inform air traffic control and receive clearance to do so.

TERMINAL VFR RADAR SERVICE (USA) — 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 of service referred to as basic radar service, terminal radar service area (TRSA) service, Class “B” service and Class “C” service.

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 “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).

d. 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.

TERMINAL RADAR SERVICE AREA (TRSA) (USA) — Airspace surrounding designated airports wherein ATC provides radar vectoring, sequencing and separation on a full-time basis for all IFR and participating VFR aircraft. Service provided in a TRSA is called Stage III Service. Pilots’ participation is urged but is not mandatory.

THRESHOLD (THR) — The beginning of that portion of the runway usable for landing.

THRESHOLD CROSSING HEIGHT (TCH) — The theoretical height above the runway threshold at which the aircraft's glide slope antenna (or equivalent position) would be if the aircraft maintains the trajectory of the ILS glide slope, MLS glide path or charted descent angle.

TOTAL ESTIMATED ELAPSED TIME — For IFR flights, the estimated time required from take-off 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 take-off to arrive over the destination aerodrome.

TOUCHDOWN — 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 ZONE ELEVATION (TDZE) — The highest elevation in the first 3000ft of the landing surface.

TRACK — 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).

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 advisory only;

TCAS-II generates traffic advisories, and resolution (collision avoidance) advisories in the vertical plane.

TRAFFIC AVOIDANCE ADVICE — Advice provided by an air traffic services unit specifying manoeuvres to assist a pilot to avoid a collision.

TRAFFIC INFORMATION — Information issued by an air traffic services unit to alert a pilot to other known or observed air traffic which may be in proximity to the position or intended route of flight and to help the pilot avoid a collision.

TRANSITION ALTITUDE (TA) — The altitude in the vicinity of an airport at or below which the vertical position of an aircraft is controlled by reference to altitudes (MSL).

TRANSITION HEIGHT — The height in the vicinity of an airport at or below which the vertical position of an aircraft is expressed in height above the airport reference datum.

TRANSITION LAYER — The airspace between the transition altitude and the transition level. Aircraft descending through the transition layer will use altimeters set to local station pressure, while departing aircraft climbing through the layer will be using standard altimeter setting (QNE) of 29.92 inches of Mercury, 1013.2 millibars, or 1013.2 hectopascals.

TRANSITION LEVEL (TL) — The lowest flight level available for use above the transition altitude.

TROPICAL CYCLONE — Generic term for a non-frontal synoptic-scale cyclone originating over tropical or sub-tropical waters with organized convection and definite cyclonic surface wind circulation.

TROPICAL CYCLONE ADVISORY CENTRE (TCAC) — A meteorological centre designated by regional air navigation agreement to provide advisory information to meteorological watch offices, world area forecast centres and international OPMET databanks regarding the position, forecast direction and speed of movement, central pressure and maximum surface wind of tropical cyclones.

TURN ANTICIPATION — Turning maneuver initiated prior to reaching the actual airspace fix or turn point that is intended to keep the aircraft within established airway or route boundaries.

UNCERTAINTY PHASE — A situation wherein uncertainty exists as to the safety of an aircraft and its occupants.

UNMANNED FREE BALLOON — A non-powerdriven, unmanned, lighter-than-air aircraft in free flight.

NOTE: Unmanned free balloons are classified as heavy, medium or light in accordance with specifications contained in ICAO Rules of the Air, Annex 2, Appendix 4.

UPPER-AIR CHART — A meteorological chart relating to a specified upper-air surface or layer of the atmosphere.

URGENCY — A condition concerning the safety of an aircraft or other vehicle, or of some person on board or within sight, but which does not require immediate assistance.

VECTORING — Provision of navigational guidance to aircraft in the form of specific headings, based on the use of an ATS surveillance system.

GLOSSARY

VERTICAL NAVIGATION (VNAV) — That function of RNAV equipment which provides guidance in the vertical plane.

VERTICAL PATH ANGLE (VPA) (ICAO) — Angle of the published final approach descent in Baro-VNAV procedures.

VERTICAL PATH ANGLE (VPA) (USA) — The descent angle shown on some non-precision approaches describing the geometric descent path from the Final approach fix (FAF), or on occasion from an intervening stepdown fix, to the Threshold Crossing Height (TCH). This angle may or may not coincide with the angle projected by a Visual Glide Slope Indicator (VASI, PAPI, PLASI, etc.)

VERY HIGH FREQUENCY (VHF) — The frequencies between 30MHz and 300MHz (200MHz – 3GHz is considered as UHF in the Aviation).

VFR FLIGHT — A flight conducted in accordance with the visual flight rules.

VIBAL — (Visibilité Balise) Is the method whereby a human observer (or pilot in take-off position) determines the RVR by counting specific markers adjacent to the runway or by counting runway edge lights.

VISIBILITY (ICAO) — The ability, as determined by atmospheric conditions and expressed in units of distance, to see and identify prominent unlighted objects by day and prominent lighted objects by night.

a. Flight Visibility — The visibility forward from the cockpit of an aircraft in flight.

b. Ground Visibility — The visibility at an aerodrome as reported by an accredited observer.

c. Runway Visual Range (RVR) — The range over which the pilot of an aircraft on the centerline of a runway can see the runway surface markings or the lights delineating the runway or identifying its centerline.

VISIBILITY (USA) — The ability, as determined by atmospheric conditions and expressed in units of distance, to see and identify prominent unlighted objects by day and prominent lighted objects by night. Visibility is reported as statute or nautical miles, hundreds of feet or meters.

a. Flight Visibility — The average forward horizontal distance, from the cockpit of an aircraft in flight, at which prominent unlighted objects may be seen and identified by day and prominent lighted objects may be seen and identified by night.

b. Ground Visibility — Prevailing horizontal visibility near the earth’s surface as reported by the United States National Weather Service or an accredited observer.

c. Prevailing Visibility — The greatest horizontal visibility equaled or exceeded throughout at least half the horizon circle which need not necessarily be continuous.

d. Runway Visibility Value (RVV) — The visibility determined for a particular runway by a transmissometer. A meter provides a continuous indication of the visibility (reported in miles or fractions of miles) for the runway. RVV is used in lieu of prevailing visibility in determining minimums for a particular runway.

e. Runway Visual Range (RVR) — An instrumentally derived value, based on standard calibrations, that represents the horizontal distance a pilot will see down the runway from the approach end; it is based on the sighting of either high intensity runway lights or on the visual contrast of other targets whichever yields the greater visual range. RVR, in contrast to prevailing or runway visibility, is based on what a pilot in a moving aircraft should see looking down the runway. RVR is horizontal visual range, not slant visual range. It is based on the measurement of a transmissometer made near the touchdown point of the instrument runway and is reported in hundreds of feet. RVR is used in lieu of RVV and/or prevailing visibility in determining minimums for a particular runway.

   1. Touchdown RVR — The RVR visibility readout values obtained from RVR equipment serving the runway touchdown zone.
   2. Mid-RVR — The RVR readout values obtained from RVR equipment located midfield of the runway.
   3. Rollout RVR — The RVR readout values obtained from RVR equipment located nearest the rollout end of the runway.

VISUAL APPROACH (ICAO) — An approach by an IFR flight when either part or all of an instrument approach procedure is not completed and the approach is executed in visual reference to terrain.

VISUAL APPROACH (USA) — An approach conducted on an instrument flight rules (IFR) flight plan which authorizes the pilot to proceed visually and clear of clouds to the airport. The pilot must, at all times, have either the airport or the preceding aircraft in sight. This approach must be authorized and under the control of the appropriate air traffic control facility. Reported weather at the airport must be ceiling at or above 1000ft and visibility of 3 miles or greater.

VISUAL DESCENT POINT (VDP) — A defined point on the final approach course of a non-precision straight-in approach procedure from which normal descent from the MDA to the runway touchdown point may be commenced, provided the approach threshold of that runway, or approach lights, or other markings identifiable with the approach end of that runway are clearly visible to the pilot.

VISUAL MANOEUVRING (CIRCLING) AREA — The area in which obstacle clearance should be taken into consideration for aircraft carrying out a circling approach.

VISUAL METEOROLOGICAL CONDITIONS (VMC) — Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling equal to or better than specified minima.

NOTE: The specified minima are contained in ICAO Rules of the Air, Annex 2, Chapter 4.

VOLMET BROADCAST — Routine broadcast of meteorological information for aircraft in flight.

VOLCANIC ASH ADVISORY CENTRE (VAAC) — A meteorological centre designated by regional air navigation agreement to provide advisory information to meteorological watch offices, area control centres, flight information centres, world area forecast centres, relevant regional area forecast centres and international OPMET data banks regarding the lateral and vertical extent and forecast movement of volcanic ash in the atmosphere following volcanic eruptions.

VOLMET BROADCAST — Provision of current aerodrome meteorological reports (METAR) and special meteorological reports (SPECI), aerodrome forecasts (TAF), SIGMET by means of continuous and repetitive voice broadcasts for aircraft in flight.

VOLMET DATA LINK SERVICE (D-VOLMET) — Provision of current METAR, SPECI, TAF, SIGMET, special air-reports not covered by SIGMET and, where available, AIRMET via data link.

WARNING AREA (USA) — [see SPECIAL USE AIRSPACE (SUA)].

WAYPOINT — A specified geographical location used to define an area navigation route or the flight path of an aircraft employing area navigation. Waypoints are identified as either:

Fly-by waypoint — A fly-by waypoint requires the use of turn anticipation to avoid overshoot of the next flight segment; or

Fly-over waypoint — A fly-over waypoint precludes any turn until the waypoint is overflown and is followed by an intercept maneuver of the next flight segment.

WEATHER SYSTEMS PROCESSOR (WSP) — An add-on weather processor to selected Airport Surveillance Radar (ASR)-9 facilities that adds Doppler weather radar capability and provides wind shear and microburst warnings. The system gives controllers timely and accurate warnings for relaying to pilots via radio communications. The WSP also provides controllers with thunderstorm cell locations and movement as well as the predicted future position and intensity of wind shifts that may affect airport operations. The system can also process precipitation data to reduce false severe weather reports caused by anomalous propagation.

WIDE AREA AUGMENTATION SYSTEM (WAAS) — WAAS is a navigation system developed for civil aviation that provides extremely accurate horizontal and vertical navigation for all classes of aircraft in all phases of flight - including enroute navigation, airport departures, and airport arrivals. This includes vertically-guided landing approaches in instrument meteorological conditions at all qualified locations.

WORLD AREA FORECAST CENTRE (WAFC) — A meteorological centre designated to prepare and issue significant weather forecasts and upper-air forecasts in digital and/or pictorial form on a global basis direct States by appropriate means as part of the aeronautical fixed service.

WORLD AREA FORECAST SYSTEM (WAFS) — A world-wide system by which world area forecast centres provide aeronautical meteorological en-route forecasts in uniform standardized formats.

DEFINITIONS

A/A	Air to Air
AAF	Army Air Field
AAIM	Aircraft Autonomous Integrity Monitoring
AAIS	Automated Aerodrome Information Service
AAL	Above Aerodrome Level
AAS	Airport Advisory Service
AAU	Authorized Approach UNICOM
AB	Air Base
ABM	Abeam
ABN	Aerodrome Beacon
AC	Air Carrier
ACA	Arctic Control Area
ACA	Approach Control Area
ACAS	Airborne Collision Avoidance System
ACARS	Airborne Communications Addressing and Reporting System
ACC	Area Control Center
ACFT	Aircraft
ACN	Aircraft Classification Number
AD	Aerodrome
ADA	Advisory Area
ADF	Automatic Direction Finding
ADIZ	Air Defense Identification Zone
ADNL	Additional
ADR	Advisory Route
ADS	Automatic Dependent Surveillance
ADS-B	Automatic Dependent Surveillance-Broadcast
ADV	Advisory Area
AEIS	Aeronautical Enroute Information Service
AER	Approach End of Runway
AERADIO	Air Radio

ABBREVIATIONS USED IN AIRWAY MANUAL

AERO	Aerodrome
AF Aux	Air Force Auxiliary Field
AFB	Air Force Base
AFIS	Aerodrome Flight Information Service
AFIS	Automatic Flight Information Services (FAA)
AFLD	Airfield
AFN	American Forces Network
AFRS	Armed Forces Radio Stations
AFRU	Aerodrome Frequency Response Unit
AFS	Air Force Station
AFSS	Automated Flight Service Station
A/G	Air-to-Ground
AGL	Above Ground Level
AGNIS	Azimuth Guidance Nose-in-Stand
AH	Alert Height
AHP	Army Heliport
AIRAC	Aeronautical Information Regulation and Control
AIREP	Air-Report
AIS	Aeronautical Information Services
ALA	Aircraft Landing Area
ALF	Auxiliary Landing Field
ALS	Approach Light System
ALS	Low Intensity Approach Lights
ALT	Altitude
ALTN	Alternate
AMA	Area Minimum Altitude
AMSL	Above Mean Sea Level
ANGB	Air National Guard Base
AOC	Aircraft Operator Certificate
AOE	Airport/Aerodrome of Entry
AOM	Airport Operating Minimums

ABBREVIATIONS USED IN AIRWAY MANUAL

AOR	Area of Responsibility
APAPI	Abbreviated Precision Approach Path Indicator
APC	Area Positive Control
APCH	Approach
APP	Approach Control
APT	Airport
APV	Approach Procedure with Vertical Guidance
AR	Authorization Required
ARB	Air Reserve Base
ARINC	Aeronautical Radio, Inc.
ARO	Aerodrome Reporting Officer
ARP	Airport Reference Point
ARR	Arrival
ARTCC	Air Route Traffic Control Center
ASDA	Accelerate Stop Distance Available
ASDE-X	Airport Surface Detection Equipment - Model X
ASMGCS	Advanced Surface Movement Guidance and Control System
ASOS	Automated Surface Observing System
ASR	Airport Surveillance Radar
ASSC	Airport Surface Surveillance Capability
ATA	Actual Time of Arrival
ATCAA	Air Traffic Control Assigned Airspace
ATCC	Air Traffic Control Center
ATCT	Air Traffic Control Tower
ATD	Actual Time of Departure
ATF	Aerodrome Traffic Frequency
ATFM	Air Traffic Flow Management
ATIS	Automatic Terminal Information Service
ATND SKD	Attended Scheduled Hours
ATS	Air Traffic Service
ATZ	Aerodrome Traffic Zone

ABBREVIATIONS USED IN AIRWAY MANUAL

AU	Approach UNICOM
AUP	Airspace Utilization Plane
AUTH	Authorized
AUW	All-Up Weight
AUX	Auxiliary
AVBL	Available
AWIB	Aerodrome Weather Information Broadcast
AWIS	Aerodrome Weather Information Service
AWOS	Automated Weather Observing System
AWSS	Aviation Weather Sensor System
AWY	Airway
AZM	Azimuth
Baro VNAV	Barometric Vertical Navigation
BC	Back Course
BCM	Back Course Marker
BCN	Beacon
BCOB	Broken Clouds or Better
BCST	Broadcast
BDRY	Boundary
BLDG	Building
BM	Back Marker
BRG	Bearing
B-RNAV	Basic RNAV
BS	Broadcast Station (Commercial)
C	ATC IFR Flight Plan Clearance Delivery Frequency
C	Converted Met Visibility
CADIZ	Canadian Air Defense Identification Zone
CAE	Control Area Extension
CA/GRS	Certified Air/Ground Radio Service
CANPA	Constant Angle Non-Precision Approach
CARS	Community Aerodrome Radio Station

ABBREVIATIONS USED IN AIRWAY MANUAL

CAT	Category
CBA	Cross Border Area
CCN	Chart Change Notices
CDFA	Continuous Descent Final Approach
CDI	Course Deviation Indicator
CDR	Conditional Route
CDT	Central Daylight Time
CEIL	Ceiling
CERAP	Combined Center/Radar Approach Control
CFIT	Controlled Flight Into Terrain
CGAS	Coast Guard Air Station
CGL	Circling Guidance Lights
CH	Channel
CH	Critical Height
CHGD	Changed
CL	Centerline Lights
CMNPS	Canadian Minimum Navigation Performance Specification
CMV	Converted Met Visibility
CNF	Computer Navigation Fix
CO	County
COMLO	Compass Locator
COMMS	Communications
CONT	Continuous
CONTD	Continued
COORDS	Coordinates
COP	Change Over Point
CORR	Corridor
CP	Command Post
CPDLC	Controller Pilot Data Link Communications
Cpt	Clearance (Pre-Taxi Procedure)
CRC	Cyclical Redundancy Check

ABBREVIATIONS USED IN AIRWAY MANUAL

CRP	Compulsory Reporting Point
CRS	Course
CST	Central Standard Time
CTA	Control Area
CTAF	Common Traffic Advisory Frequency
CTL	Control
CTOT	Calculated Take-off Time
CTR	Control Zone
CVFP	Charted Visual Flight Procedure
CVFR	Controlled VFR
D	Day
DA	Decision Altitude
DA (H)	Decision Altitude (Height)
D-ATIS	Digital ATIS
DCL	Data Link Departure Clearance Service
DCT	Direct
DECMSND	Decommissioned
DEG	Degree
DEP	Departure Control/Departure Procedures
DER	Departure End of Runway
DEWIZ	Distance Early Warning Identification Zone
DF	Direction Finder
DISPL THRESH	Displaced Threshold
DIST	Distance
DME	Distance-Measuring Equipment
DOD	Department of Defense
DOM	Domestic
DP	Obstacle Departure Procedure
DRCO	Dial-up Remote Communications Outlet
E	East or Eastern
EAT	Expected Approach Time

ABBREVIATIONS USED IN AIRWAY MANUAL

ECOMS	Jeppesen Explanation of Common Minimum Specifications
EDT	Eastern Daylight Time
EET	Estimated Elapsed Time
EFAS	Enroute Flight Advisory Service
EFF	Effective
EFVS	Enhanced Flight Vision System
EGNOS	European Geostationary Navigation Overlay Services
EH	Eastern Hemisphere
ELEV	Elevation
EMAS	Engineered Materials Arresting System
EMERG	Emergency
ENG	Engine
EOBT	Estimated Off Block Time
EST	Eastern Standard Time
EST	Estimated
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
ETE	Estimated Time Enroute
ETOPS	Extended Range Operation with two-engine airplanes
EVS	Enhanced Vision System
FAA	Federal Aviation Administration
FACF	Final Approach Course Fix
FAF	Final Approach Fix
FAIL	Failure
FANS	Future Air Navigation System
FAP	Final Approach Point
FAR	Federal Aviation Regulation
FAS DB	Final Approach Segment Datablock
FAT	Final Approach Track
FATO	Final Approach and Take-off Area
FBL	Light (to qualify icing, turbulence, etc.)

ABBREVIATIONS USED IN AIRWAY MANUAL

FBO	Fixed Based Operator
FCP	Final Control Point
FIA	Flight Information Area
FIC	Flight Information Center
FIR	Flight Information Region
FIS	Flight Information Service
FL	Flight Level (Altitude)
FLARES	Flare Pots or Goosenecks
FLD	Field
FLG	Flashing
FLT	Flight
FM	Fan Marker
FMC	Flight Management Computer
FMS	Flight Management System
FOD	Foreign Object Damage
FOM	Flight Operation Manual
FPM	Feet Per Minute
FPR	Flight Planning Requirements
FRA	Free Route Airspace
FREQ	Frequency
FSS	Flight Service Station
FT	Feet
FTS	Flexible Track System
G	Guards only (radio frequencies)
GA	General Aviation
GBAS	Ground-Based Augmentation System
GCA	Ground Controlled Approach (radar)
GCO	Ground Communication Outlet
GEN	General
GLONASS	Global Orbiting Navigation Satellite System
GLS	Ground Based Augmentation System [GBAS] Landing System

ABBREVIATIONS USED IN AIRWAY MANUAL

GMT	Greenwich Mean Time
GND	Ground Control
GND	Surface of the Earth (either land or water)
GNSS	Global Navigation Satellite System
GP	Glidepath
GPA	Glidepath Angle
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
GS	Glide Slope
G/S	Ground Speed
GWT	Gross Weight
H	Non-Directional Radio Beacon or High Altitude
H24	24 Hour Service
HAA	Height Above Airport
HALS	High Approach Landing System
HAS	Height Above Site
HAT	Height Above Touchdown
HC	Critical Height
HDG	Heading
HF	High Frequency (3-30 MHz)
HGS	Head-up Guidance System
HI	High (altitude)
HI	High Intensity (lights)
HIALS	High Intensity Approach Light System
HIRL	High Intensity Runway Edge Lights
HIRO	High Intensity Runway Operations
HIWAS	Hazardous Inflight Weather Advisory Service
HJ	Sunrise to Sunset
HN	Sunset to Sunrise
HO	By Operational Requirements
hPa	Hectopascal (one hectopascal = one millibar)

ABBREVIATIONS USED IN AIRWAY MANUAL

HR	Hours (period of time)
HS	During Hours of Scheduled Operations
HST	High Speed Taxiway Turn-off
HSTIL	High Speed Taxiway Turn-off Indicator Lights
HUD	Head-Up Display
HUDLS	Head-Up Display Landing System
HX	No Specific Working Hours
Hz	Hertz (cycles per second)
I	Island
IAC	Instrument Approach Chart
IAF	Initial Approach Fix
IAML	Integrity Monitor Alarm
IAP	Instrument Approach Procedure
IAS	Indicated Airspeed
IATA	International Air Transport Association
IAWP	Initial Approach Waypoint
IBN	Identification Beacon
ICAO	International Civil Aviation Organization
IDENT	Identification
IF	Intermediate Fix
IFBP	Inflight Broadcast Procedure
IFR	Instrument Flight Rules
IGS	Instrument Guidance System
ILS	Instrument Landing System
IM	Inner Marker
IMAL	Integrity Monitor Alarm
IMC	Instrument Meteorological Conditions
IMTA	Intensive Military Training Area
INDEFLY	Indefinitely
IN or INS	Inches
INFO	Information

ABBREVIATIONS USED IN AIRWAY MANUAL

INOP	Inoperative
INS	Inertial Navigation System
INT	Intersection
INTL	International
IORRA	Indian Ocean Random RNAV Area
IR	Instrument Restricted Controlled Airspace
IS	Islands
ITWS	Integrated Terminal Weather System
I/V	Instrument/Visual Controlled Airspace
JAA	Joint Aviation Authorities
JAR-OPS	Joint Aviation Requirements–Operations
KGS	Kilograms
kHz	Kilohertz
KIAS	Knots Indicated Airspeed
KM	Kilometers
Kmh	Kilometer(s) per Hour
KT	Knots
KTAS	Knots True Airspeed
L	Locator (Compass)
LAA	Local Airport Advisory
LAAS	Local Area Augmentation System
LACFT	Large Aircraft
LAHSO	Land and Hold Short Operations
LAT	Latitude
LBCM	Locator Back Course Marker
LBM	Locator Back Marker
LBS	Pounds (Weight)
LCG	Load Classification Group
LCN	Load Classification Number
Lctr	Locator (Compass)
LDA	Landing Distance Available

ABBREVIATIONS USED IN AIRWAY MANUAL

LDA	Localizer-type Directional Aid
LDI	Landing Direction Indicator
LDIN	Lead-in Light System
LGTH	Length
LIM	Locator Inner Marker
LIRL	Low Intensity Runway Lights
LLWAS	Low Level Wind Shear Alert System
LMM	Locator Middle Marker
LNAV	Lateral Navigation
LNDG	Landing
LO	Locator at Outer Marker Site
LOC	Localizer
LOM	Locator Outer Marker
LONG	Longitude
LP	Localizer Performance
LPV	Localizer Performance with Vertical Guidance
LSALT	Lowest Safe Altitude
LT	Local Time
LTP	Landing Threshold Point
LTS	Lights
LTS	Lower Than Standard
LVP	Low Visibility Procedures
LWIS	Limited Weather Information System
M	Meters
MAA	Maximum Authorized Altitude
MACG	Missed Approach Climb Gradient
MAG	Magnetic
MAHF	Missed Approach Holding Fix
MALS	Medium Intensity Approach Light System
MALSF	Medium Intensity Approach Light System with Sequenced Flashing Lights

ABBREVIATIONS USED IN AIRWAY MANUAL

MALSR	Medium Intensity Approach Light System with Runway Alignment Indicator Lights
MAP	Missed Approach Point
MAX	Maximum
MB	Millibars
MCA	Minimum Crossing Altitude
MCAF	Marine Corps Air Facility
MCAS	Marine Corps Air Station
MCTA	Military Controlled Airspace
MDA	Minimum Descent Altitude
MDA(H)	Minimum Descent Altitude (Height)
MDT	Mountain Daylight Time
MEA	Minimum Enroute Altitude
MEHT	Minimum Eye Height Over Threshold
MEML	Memorial
MET	Meteorological
MF	Mandatory Frequency
MFA	Minimum Flight Altitude
MHA	Minimum Holding Altitude
MHz	Megahertz
MI	Medium Intensity (lights)
MIALS	Medium Intensity Approach Light System
MIL	Military
MIM	Minimum
MIN	Minute
MIPS	Military Instrument Procedure Standardization
MIRL	Medium Intensity Runway Edge Lights
MKR	Marker Radio Beacon
MLS	Microwave Landing System
MM	Millimeter
MM	Middle Marker

ABBREVIATIONS USED IN AIRWAY MANUAL

MNM	Minimum
MNPS	Minimum Navigation Performance Specifications
MOA	Military Operation Area
MOC	Minimum Obstacle/Obstruction Clearance
MOCA	Minimum Obstruction Clearance Altitude
MORA	Minimum Off-Route Altitude (Grid or Route)
MRA	Minimum Reception Altitude
MROT	Minimum Runway Occupancy Time
MSA	Minimum Safe/Sector Altitude
MSL	Mean Sea Level
MST	Mountain Standard Time
MTA	Military Training Area
MTAF	Mandatory Traffic Advisory Frequency
MTCA	Minimum Terrain Clearance Altitude
MTMA	Military Terminal Control Area
MTOM	Maximum Take-off Mass
MTOW	Maximum Take-off Weight
MUN	Municipal
MVA	Minimum Vectoring Altitude
N	Night, North or Northern
NA	Not Authorized
NAAS	Naval Auxiliary Air Station
NADC	Naval Air Development Center
NAEC	Naval Air Engineering Center
NAF	Naval Air Facility
NALF	Naval Auxiliary Landing Field
NAP	Noise Abatement Procedure
NAR	North American Routes
NAS	Naval Air Station
NAT	North Atlantic Traffic
NAT/OTS	North Atlantic Traffic/Organized Track System

ABBREVIATIONS USED IN AIRWAY MANUAL

NATIONAL XXX	National Specific Criteria
NATL	National
NAVAID	Navigational Aid
NCA	Northern Control Area
NCN	NavData Change Notices
NCRP	Non-Compulsory Reporting Point
NDB	Non-Directional Beacon/Radio Beacon
NE	Northeast
NM	Nautical Mile(s)
No	Number
NoPT	No Procedure Turn
NOTAM	Notices to Airmen
NOTSP	Not Specified
NPA	Non-Precision Approach
NW	Northwest
NWC	Naval Weapons Center
OAC	Oceanic Area Control
OAS	Obstacle Assessment Surface
OCA	Oceanic Control Area
OCA (H)	Obstacle Clearance Altitude (Height)
OCL	Obstacle Clearance Limit
OCNL	Occasional
OCTA	Oceanic Control Area
ODALS	Omni-Directional Approach Light System
ODP	Obstacle Departure Procedure
OFZ	Obstacle Free Zone
OM	Outer Marker
OPS	Operations or Operates
O/R	On Request
O/T	Other Times
OTR	Oceanic Transition Route

ABBREVIATIONS USED IN AIRWAY MANUAL

OTS	Other Than Standard
OTS	Out-of-Service
PA	Precision Approach
PAL	Pilot Activated Lighting
PANS-OPS	Procedures for Air Navigation Services - Aircraft Operations
PAPI	Precision Approach Path Indicator
PAR	Precision Approach Radar
PARK	Parking
PBN	Performance Based Navigation
PCL	Pilot Controlled Lighting
PCN	Pavement Classification Number
PCZ	Positive Control Zone
PDC	Pre-Departure Clearance
PDG	Procedure Design Gradient
PDT	Pacific Daylight Time
PERF	Performance
PERM	Permanent
PinS	Point In Space
PISTON	Piston Aircraft
PJE	Parachute Jumping Exercise
PLASI	Pulsating Visual Approach Slope Indicator
PNR	Prior Notice Required
POFZ	Precision Obstacle Free Zone
PPO	Prior Permission Only
PPR	Prior Permission Required
PRA	Precision Radar Approach
PRM	Precision Radar Monitor
P-RNAV	Precision RNAV
PROC	Procedure
PROP	Propeller Aircraft
PSP	Pierced Steel Planking

ABBREVIATIONS USED IN AIRWAY MANUAL

PST	Pacific Standard Time
PTO	Part Time Operation
PVT	Private Operator
QDM	Magnetic bearing to facility
QDR	Magnetic bearing from facility
QFE	Height above airport elevation (or runway threshold elevation) based on local station pressure
QNE	Altimeter setting 29.92" Hg or 1013.2 Mb.
QNH	Altitude above sea level based on local station pressure
R	R-063 or 063R Magnetic Course (radial) measured as 063 from a VOR station. Flight can be inbound or outbound on this line.
R	Runway Visual Range
RA	Radio Altimeter
RAI	Runway Alignment Indicator
RAIL	Runway Alignment Indicator Lights
RAIM	Receiver Autonomous Integrity Monitoring
RAPCON	Radar Approach Control
RASS	Remote Altimeter Source
RCAG	Remote Communications Air Ground
RCC	Rescue Coordination Center
RCL	Runway Centerline
RCLM	Runway Center Line Markings
RCO	Remote Communications Outlet
REF	Reference
REIL	Runway End Identifier Lights
REP	Reporting Point
RESA	Runway End Safety Area
REV	Reverse
REP	Ramp Entrance Point
RF	Radius to Fix
RFL	Requested Flight Level

ABBREVIATIONS USED IN AIRWAY MANUAL

RL	Runway (edge) Lights
RLLS	Runway Lead-in Light System
RMZ	Radio Mandatory Zone
RNAV	Area Navigation
RNP	Required Navigation Performance
RNP AR	Required Navigation Performance Authorization Required
RNPC	Required Navigation Performance Capability
ROC	Rate of Climb
RON	Remain Overnight
RPT	Regular Public Transport
RSA	Runway Safety Area
RTE	Route
RTF	Radiotelephony
RTS	Return to Service
RVR	Runway Visual Range
RVSM	Reduced Vertical Separation Minimum
RVV	Runway Visibility Values
RW	Runway
RWSL	Runway Status Lights
RWY	Runway
S	South or Southern
SAAAR	Special Aircraft and Aircrew Authorization Required
SALS	Short Approach Light System
SALSF	Short Approach Light System with Sequenced Flashing Lights
SAP	Stabilized Approach
SAR	Search and Rescue
SATCOM	Satellite voice air-ground calling
SAWRS	Supplementary Aviation Weather Reporting Station
SBAS	Satellite-Based Augmentation System
SCA	Southern Control Area
SCOB	Scattered Clouds or Better

ABBREVIATIONS USED IN AIRWAY MANUAL

SDF	Simplified Directional Facility
SDF	Step-Down Fix
SE	Southeast
SEC	Seconds
SELCAL	Selective Call System
SFC	Surface of the earth (either land or water)
SFL	Sequenced Flashing Lights
SFL-V	Sequenced Flashing Lights - Variable Light Intensity
SID	Standard Instrument Departure
SIWL	Single Isolated Wheel Load
SKD	Scheduled
SLD	Sealed Runway
SLP	Speed Limiting Point
SM	Statute Miles
SMA	Segment Minimum Altitude
SMGCS	Surface Movement Guidance and Control System
SMSA	Segment Minimum Safe Altitude
SOC	Start of Climb
SODALS	Simplified Omnidirectional Approach Lighting System
SPAR	French Light Precision Approach Radar
SRA	Special Rules Area
SRA	Surveillance Radar Approach
SRE	Surveillance Radar Element
SR-SS	Sunrise-Sunset
SSALF	Simplified Short Approach Light System with Sequenced Flashing Lights
SSALR	Simplified Short Approach Light System with Runway Alignment Indicator Lights
SSALS	Simplified Short Approach Light System
SSB	Single Sideband
SSR	Secondary Surveillance Radar (in U.S.A. ATCRBS)
STAP	Parameter Automatic Transmission System

ABBREVIATIONS USED IN AIRWAY MANUAL

STAR	Standard Terminal Arrival Route (USA)
	Standard Instrument Arrival (ICAO)
STD	Indication of an altimeter set to 29.92" Hg or 1013.2 hPa (Mb) without temperature correction
Std	Standard
ST-IN	Straight-in
STOL	Short Take-off and Landing
SUPP	Supplemental/Supplementary
SW	Single Wheel Landing Gear
SW	Southwest
SYS	System
°T	True (degrees)
T	Terrain clearance altitude (MOCA)
T	Transmits only (radio frequencies)
T-VASI	Tee Visual Approach Slope Indicator
TA	Transition Altitude
TAA	Terminal Arrival Area (FAA)
TAA	Terminal Arrival Altitude (ICAO)
TACAN	Tactical Air Navigation (bearing and distance station)
TAR	Terminal Area Surveillance Radar
TAS	True Air Speed
TCA	Terminal Control Area
TCAS	Traffic Alert and Collision Avoidance System
TCH	Threshold Crossing Height
TCTA	Transcontinental Control Area
TDWR	Terminal Doppler Weather Radar
TDZ	Touchdown Zone
TDZE	Touchdown Zone Elevation
TEMP	Temporary
TERPS	United States Standard for Terminal Instrument Procedure
THR	Threshold

ABBREVIATIONS USED IN AIRWAY MANUAL

TIBA	Traffic Information Broadcast by Aircraft
TIZ	Traffic Information Zone
TL	Transition Level
TMA	Terminal Control Area
TML	Terminal
TMN	Terminates
TMZ	Transponder Mandatory Zone
TNA	Transition Area
TODA	Take-off Distance Available
TORA	Take-off Run Available
TP	Turning Point
TRA	Temporary Reserved Airspace
TRACON	Terminal Radar Approach Control
TRANS	Transition(s)
TRANS ALT	Transition Altitude
TRANS LEVEL	Transition Level
TRCV	Tri-Color Visual Approach Slope Indicator
TSA	Temporary Segregated Area
TVOR	Terminal VOR
TWEB	Transcribed Weather Broadcast
TWIP	Terminal Weather Information for Pilots
TWR	Tower (Aerodrome Control)
TWY	Taxiway
U	Unknown/Unrestricted/Unspecified
U	UNICOM
UAS	Unmanned Aerial System
UAV	Unmanned Aerial Vehicle
UFN	Until Further Notice
UHF	Ultra High Frequency (300-3000 MHz)
UIR	Upper Flight Information Region
UNCT’L	Uncontrolled

ABBREVIATIONS USED IN AIRWAY MANUAL

UNICOM	Aeronautical Advisory Service
UNICOM (A)	Automated UNICOM
UNL	Unlimited
UPR	User Preferred Route
U/S	Unserviceable
USAF	US Air Force
USB	Upper Sideband
USN	US Navy
UTA	Upper Control Area
UTC	Coordinated Universal Time
V	Visibility
VAL	Vertical Alert Limit
VAR	Magnetic Variation
VASI	Visual Approach Slope Indicator
VDA	Vertical Descent Angle
VDP	Visual Descent Point
VE	Visual Exempted
VFR	Visual Flight Rules
VGSI	Visual Glide Slope Indicator
VHA	Volcanic Hazard Area
VHF	Very High Frequency (30-300 MHz)
VIS	Visibility
VMC	Visual Meteorological Conditions
VNAP	Vertical Noise Abatement Procedures
VNAV	Vertical Navigation
VOLMET	Meteorological Information for Aircraft in Flight
VOR	VHF Omnidirectional Range
VORTAC	VOR and TACAN co-located
VOT	Radiated Test Signal VOR
VPA	Vertical Path Angle
VPT	Visual Maneuvering with Prescribed Tracks

ABBREVIATIONS USED IN AIRWAY MANUAL

VSS	Visual Segment Surface
VV	Vertical Visibility
V/V	Vertical Velocity or speed
W	West or Western
WAAS	Wide Area Augmentation System
WATIR	Weather and Terminal Information Reciter
WH	Western Hemisphere
W/O	Without
WP	Area Navigation (RNAV) Waypoint
WSP	Weather Systems Processor
WX	Weather
X	Communication Frequency On Request
Z	Zulu Time/Coordinated Universal Time (UTC)

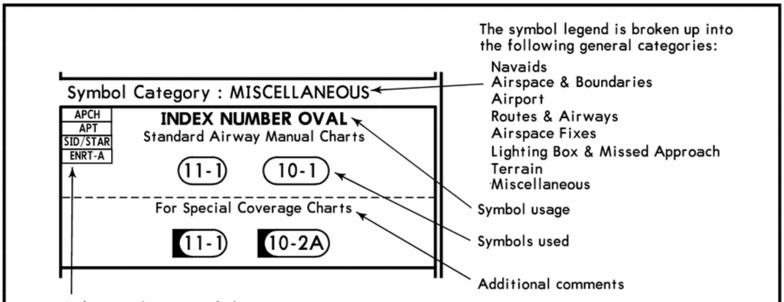
JEPPESEN®
A BOEING COMPANY

Introduction

Chart Legend

SYMBOLS
CHARTING SYMBOLS LEGEND

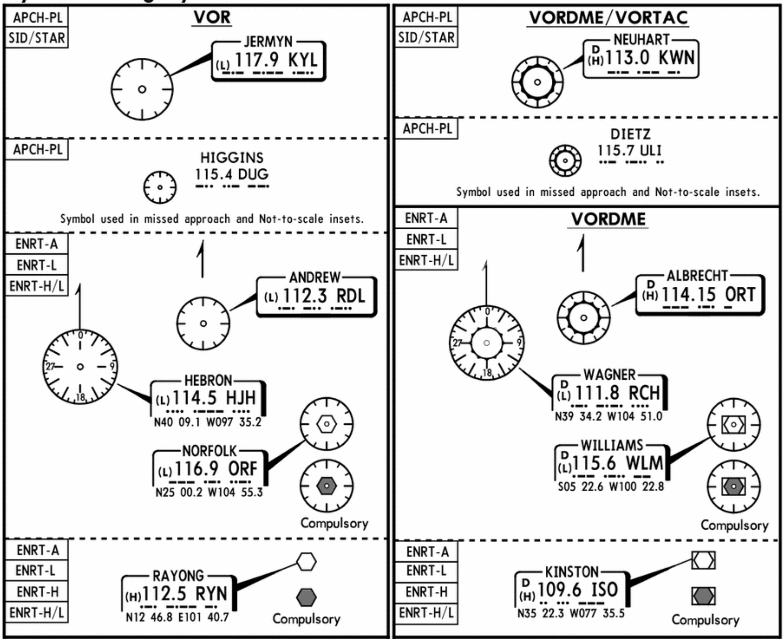
SYMBOLS



Indicates the types of chart usage.
The following chart abbreviations are used:

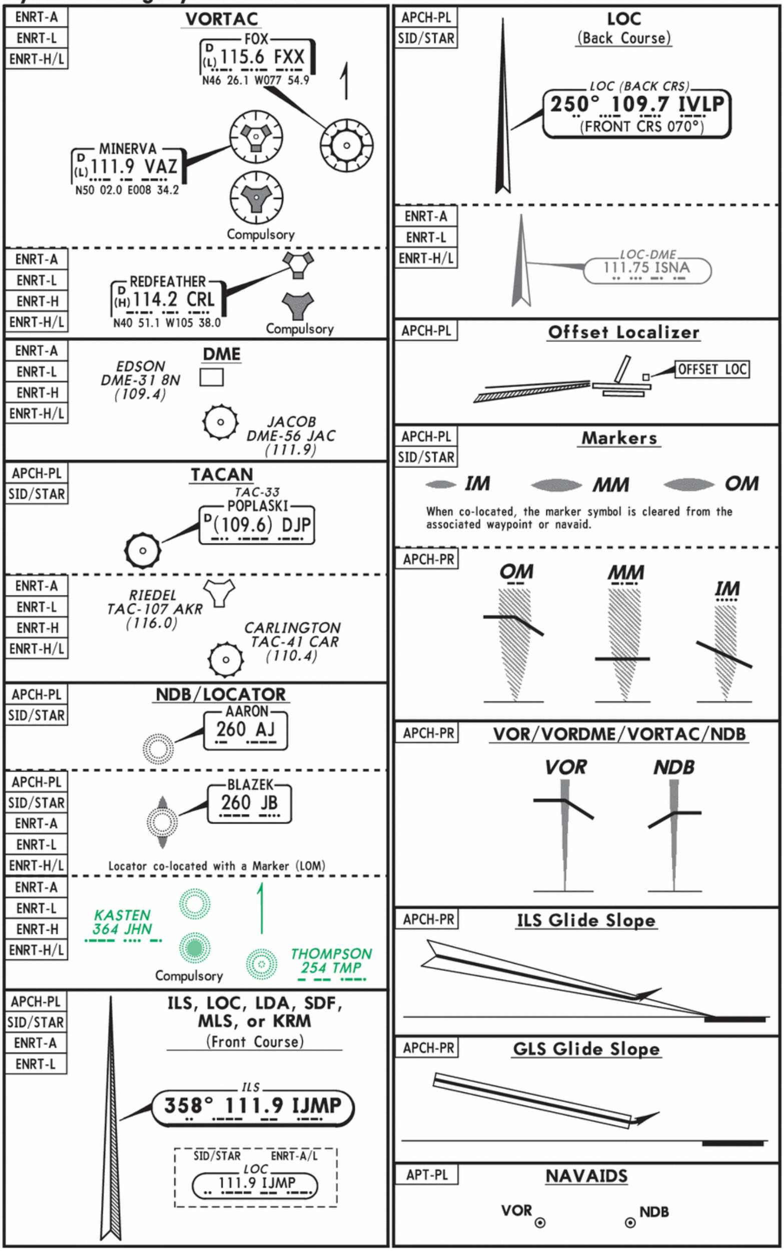
APCH-PL	Approach Chart - Planview
APCH-PR	Approach Chart - Profile View
APT-PL	Airport Chart - Planview
SID/STAR	SID, STAR, Arrival & Departure Charts
ENRT-A	Enroute Area Charts
ENRT-L	Enroute Low Altitude Charts
ENRT-H	Enroute High Altitude Charts
ENRT-H/L	Enroute High/Low Altitude Charts

Symbol Category: NAVAIDS



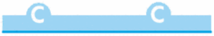
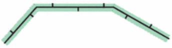
SYMBOLS
CHARTING SYMBOLS LEGEND

Symbol Category: NAVAIDS



SYMBOLS
CHARTING SYMBOLS LEGEND

Symbol Category: AIRSPACE & BOUNDARIES

ENRT-A ENRT-L ENRT-H ENRT-H/L	**Special Use Airspace** Advisory Area (Canada), Alert Area, Caution Area, JDA Areas (Japan), Military Operations Area, Temporary Reserved Airspace, Training Area, Warning Area	
APCH-PL APT-PL SID/STAR		
ENRT-A ENRT-L ENRT-H ENRT-H/L	**Special Use Airspace** Areas of Intense Air Activity, Danger Area, Flight Restricted Zones(FAA), Fuel Dumping Areas, High Intensity Radio Transmission Areas, Prohibited Area, Restricted Area	
APCH-PL APT-PL SID/STAR		
ENRT-A ENRT-L ENRT-H ENRT-H/L	**Special Flight Rules Area (FAA)**	
ENRT-A ENRT-L ENRT-H ENRT-H/L	**Class A Airspace** Control Area Extensions(Canada),Control Areas, Military Terminal Control Areas, Transition Areas(Canada), Terminal Control Areas, Upper Control Areas	
ENRT-A ENRT-L ENRT-H/L	**Class B Airspace** Class B (FAA),Control Area Extensions(Canada), Control Areas, Military Terminal Control Areas, Transition Areas (Canada), Terminal Control Areas, Upper Control Areas	
ENRT-A ENRT-L ENRT-H/L	**Class C Airspace** Class C (FAA),Control Area Extensions(Canada), Control Areas, Military Terminal Control Areas, Transition Areas (Canada), Terminal Control Areas, Upper Control Areas	
ENRT-A ENRT-L ENRT-H/L	**Class D Airspace** Control Area Extensions(Canada),Control Areas, Military Terminal Control Areas, Transition Areas(Canada), Terminal Control Areas, Upper Control Areas	
ENRT-A ENRT-L ENRT-H ENRT-H/L	**Class G Airspace**	
ENRT-H	**Control Area, Military Terminal Control Area, Terminal Control Area**	
ENRT-A ENRT-L ENRT-H/L	**Air Traffic Services** Class D (FAA), Class E (FAA), Control Zone, Military Control Zone, Tower Control Area	
ENRT-A ENRT-L ENRT-H/L	**Air Traffic Services** Air Traffic Zone, Helicopter Protected Zone, Helicopter Traffic Zone, Military Air Traffic Zone, Positive Control Area, Special Rules Area/Zone, Traffic Information Area/Zone	
ENRT-A ENRT-L ENRT-H	**Oceanic Control Area, FAA Control Areas**	
ENRT-A ENRT-L ENRT-H ENRT-H/L	**Air Defense Identification Zone**	
ENRT-A ENRT-L ENRT-H ENRT-H/L SID/STAR	**Flight Information Region / Upper Flight Information Region**	
ENRT-A ENRT-L ENRT-H ENRT-H/L	**Air Route Traffic Control Center, Area Control Center, Area of Responsibility, Delegated Airspace, Upper Area Control Center**	
ENRT-A ENRT-L ENRT-H ENRT-H/L	**CNS/ATM Equipment Boundary (MNPS, RNP, RVSM)**	
ENRT-A ENRT-L ENRT-H ENRT-H/L	**Random RNAV Area**	

SYMBOLS
CHARTING SYMBOLS LEGEND

Symbol Category: AIRSPACE & BOUNDARIES

ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

Enroute Communications Sector

Low or High Altitude Sectors

ENRT-H

High Altitude Sectors (if vertically sectorized)

APT-PL

SID/STAR

Lost Comms

ENRT-A
ENRT-L
ENRT-H/L

Frequency Boundary - Class E FIA (Australia)

ENRT-A
ENRT-L
ENRT-H/L

Frequency Boundary - Class G FIA (Australia)

ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

Frequency Boundary - HF

ENRT-A
ENRT-H
ENRT-H/L

Free Route Airspace

ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

International Boundary

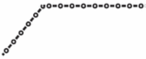
APCH-PL
APT-PL
SID/STAR

ENRT-A
ENRT-L
ENRT-H/L

Mandatory Broadcast Zone

ENRT-A
ENRT-L
ENRT-H
ENRT-H/L
SID/STAR

QNE/QNH Boundary



ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

RVSM Transition Boundary

ENRT-A
ENRT-L
ENRT-H/L

Special VFR Not Authorized

ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

Speed Restriction Boundary

ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

Time Zone

ENRT-H

State/Province Boundary

ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

Common Traffic Advisory Frequency Boundary (Australia)

ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

Advisory Radio Area, Radar Area/Zone

Symbol Category: AIRPORT

APT-PL

Runway Number

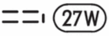
Runway number is magnetic unless followed by T for true in far north

APT-PL

Runway number and (when known) magnetic direction, unless followed by T for true in far north

APT-PL

Seaplane operating area, or water runway



APT-PL

Seaplane Operating Area

APT-PL

Paved Runway

SYMBOLS

CHARTING SYMBOLS LEGEND

Symbol Category: AIRPORT

APT-PL

Unpaved Runway

APT-PL

Displaced Threshold

APT-PL

Stop Bar or Hold Line

APT-PL

Category II/III Hold Line

APT-PL

Approach lights extending to displaced threshold

APT-PL

Arrester Gear

Unidirectional

APT-PL

Bidirectional

APT-PL

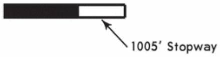
Jet Barrier

APT-PL

Closed Runway

APT-PL

Stopway or Overrun



APT-PL

Area Under Construction

APT-PL

Runway Shoulder (when readily noticeable)

APT-PL

Standard ALSF-I

APT-PL

Standard ALSF-II

APT-PL

MALSR/SSALR

APT-PL

MALS/MALSF

APT-PL

SALS

APT-PL

SSALF/SSALS

APT-PL

ODALS

APT-PL

HIALS (Calvert)

APT-PL

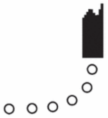
HIALS (Calvert II)

APT-PL

HIALS

APT-PL

LDIN/RLLS



SYMBOLS
CHARTING SYMBOLS LEGEND

Symbol Category: AIRPORT

APT-PL

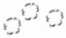
RAIL

APT-PL

Road

APT-PL

Trees



APT-PL

Bluff

APT-PL

Pole Line

APT-PL

Railroad

APT-PL

Ditch

APT-PL

Buildings

APT-PL

Lighted Pole

APT-PL

Unidentified Beacon

APT-PL

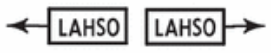
Permanently Closed Taxiway

APT-PL

Taxiway and Apron

APT-PL

LAHSO Distance Points



APT-PL

RVR Measuring Site

APT-PL

Wind Indicator

Cone

Lighted Cone

APT-PL

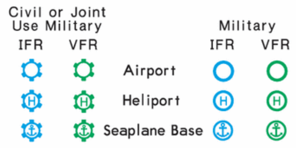
Tee

APT-PL

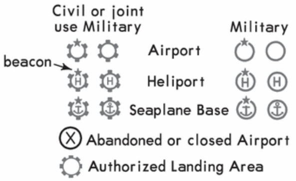
Tetrahedron

ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

Airports



APCH-PL
APT-PL
SID/STAR



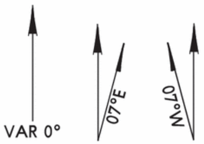
APCH-PL
ENRT-A

APT-PL

Helicopter Landing Pad

APT-PL

Magnetic Variation

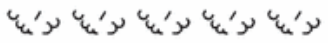


APT-PL

Airport Reference Point (ARP)

APT-PL

Tree Line

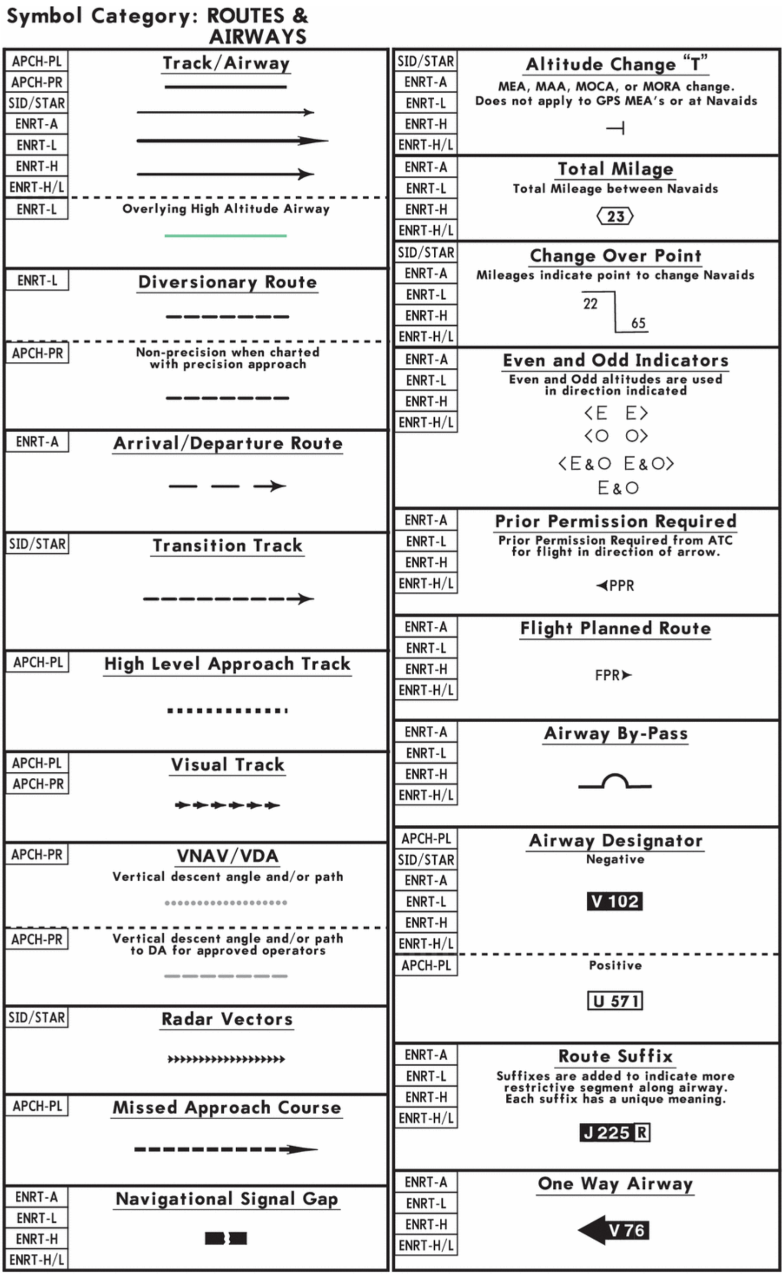


APT-PL

Building Area

SYMBOLS

CHARTING SYMBOLS LEGEND



Symbol Category: ROUTES & AIRWAYS

APCH-PL APCH-PR SID/STAR ENRT-A ENRT-L ENRT-H ENRT-H/L	**Track/Airway**		
ENRT-L		Overlying High Altitude Airway	
ENRT-L	**Diversionary Route**		
APCH-PR		Non-precision when charted with precision approach	
ENRT-A	**Arrival/Departure Route**		
SID/STAR	**Transition Track**		
APCH-PL	**High Level Approach Track**		
APCH-PL APCH-PR	**Visual Track**		
APCH-PR	**VNAV/VDA**	Vertical descent angle and/or path	
APCH-PR		Vertical descent angle and/or path to DA for approved operators	
SID/STAR	**Radar Vectors**		
APCH-PL	**Missed Approach Course**		
ENRT-A ENRT-L ENRT-H ENRT-H/L	**Navigational Signal Gap**		
SID/STAR ENRT-A ENRT-L ENRT-H ENRT-H/L	**Altitude Change "T"**	MEA, MAA, MOCA, or MORA change. Does not apply to GPS MEA's or at Navaids	
ENRT-A ENRT-L ENRT-H ENRT-H/L	**Total Milage**	Total Mileage between Navaids	23
SID/STAR ENRT-A ENRT-L ENRT-H ENRT-H/L	**Change Over Point**	Mileages indicate point to change Navaids	22 65
ENRT-A ENRT-L ENRT-H ENRT-H/L	**Even and Odd Indicators**	Even and Odd altitudes are used in direction indicated	<E E> <O O> <E&O E&O> E&O
ENRT-A ENRT-L ENRT-H ENRT-H/L	**Prior Permission Required**	Prior Permission Required from ATC for flight in direction of arrow.	◄PPR
ENRT-A ENRT-L ENRT-H ENRT-H/L	**Flight Planned Route**		FPR►
ENRT-A ENRT-L ENRT-H ENRT-H/L	**Airway By-Pass**		
APCH-PL SID/STAR ENRT-A ENRT-L ENRT-H ENRT-H/L	**Airway Designator**	Negative	V 102
APCH-PL		Positive	U 571
ENRT-A ENRT-L ENRT-H ENRT-H/L	**Route Suffix**	Suffixes are added to indicate more restrictive segment along airway. Each suffix has a unique meaning.	J 225 R
ENRT-A ENRT-L ENRT-H ENRT-H/L	**One Way Airway**		V 76

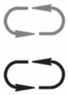
SYMBOLS

CHARTING SYMBOLS LEGEND

Symbol Category: ROUTES & AIRWAYS

APCH-PL
APCH-PR
APT-PL
SID/STAR
ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

Holding Patterns



SID/STAR
ENRT-A
ENRT-L
ENRT-H/L

Intercept Route

Symbol Category: AIRSPACE FIXES

APCH-PL
SID/STAR
ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

Non-Compulsory

ENRT-H/L

APCH-PL
SID/STAR
ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

Compulsory

ENRT-H/L

APCH-PL
SID/STAR
ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

RNAV Non-Compulsory

APCH-PL
SID/STAR
ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

RNAV Compulsory

APCH-PL
SID/STAR
ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

Mileage Break/CNF

Non-Compulsory Fix

APCH-PL
SID/STAR

Fly Over Fix

Indicated by circle around fix

ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

Meteorological Report Point

SID/STAR
ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

DME and DME Radial Formation

APCH-PR

Non Precision Final Approach Fix

APCH-PR

Non Precision Missed Approach Fix

M

Symbol Category: LIGHTING BOX & MISSED APPROACH

APCH-PR

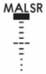
Standard ALSF-I

APCH-PR

Standard ALSF-II

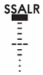
APCH-PR

MALSR



APCH-PR

SSALR



APCH-PR

MALS

APCH-PR

MALSF

APCH-PR

SALS

APCH-PR

SSALF

SYMBOLS
CHARTING SYMBOLS LEGEND

Symbol Category: LIGHTING BOX & MISSED APPROACH

APCH-PR

SSALS

APCH-PR

HIALS (Calvert)

APCH-PR

HIALS (Calvert II)

APCH-PR

HIALS

APCH-PR

ODALS

APCH-PR

LDIN/RLLS

APCH-PR

RAIL

APCH-PR

Climb

APCH-PR

Left Turn (less than 45°)

APCH-PR

Left Turn (greater than 45°)

APCH-PR

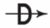
Right Turn (less than 45°)

APCH-PR

Right Turn (greater than 45°)

APCH-PR

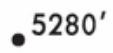
Direct



Symbol Category: TERRAIN

APCH-PL
APT-PL
SID/STAR
ENRT-A

Natural Terrain High Point

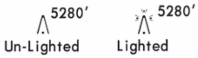


APCH-PL
APT-PL
SID/STAR

Man-made High Point

APCH-PL
APT-PL
SID/STAR

Unidentified Man-made Structure



APCH-PL

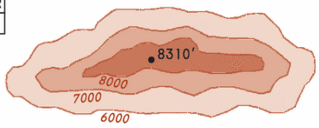
Highest Arrow

APCH-PL
APT-PL
SID/STAR

Hazard Beacon

APCH-PL
APT-PL
SID/STAR
ENRT-A

Generalized Terrain Contours



ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

Grid MORA

APCH-PL
APT-PL
ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

Water

SYMBOLS
CHARTING SYMBOLS LEGEND

Symbol Category: MISCELLANEOUS

APCH
APT
SID/STAR
ENRT-A

Index Number Oval

Standard Airway Manual Charts

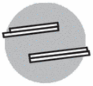
For Special Coverage Charts

APCH-PL
SID/STAR

Holding Pattern Length

SID/STAR

Arrival/Departure Airport



APCH-PL

City Pattern

APCH-PL

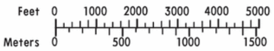
Airline Chart Icon

APT-PL
ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

North Arrow

APT-PL

Bar Scale



ENRT-L
ENRT-H
ENRT-H/L

Enroute Chart Overlap

ENRT-L
ENRT-H
ENRT-H/L

Area Chart Overlap

ENRT-L
ENRT-H
ENRT-H/L

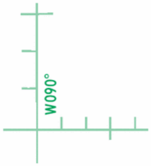
Inset Boundary

ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

Remote Communications Outlet (RCO)

ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

Grid



ENRT-A
ENRT-L
ENRT-H
ENRT-H/L

Isogonic Line

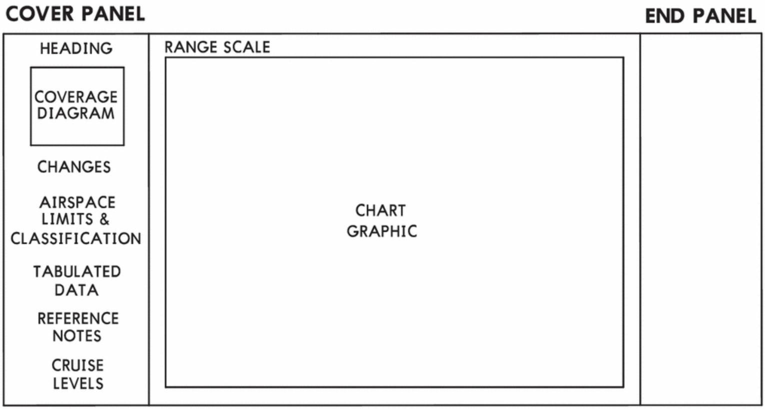
END OF SYMBOLS LEGEND

ENROUTE

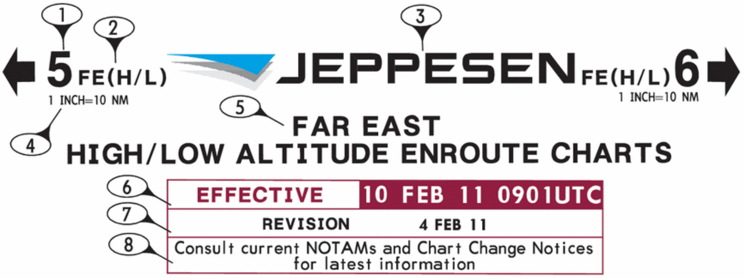
NOTE: This section of the Jeppesen legend pages provides a general overview regarding the layout and depiction of Enroute Charts.

Jeppesen Enroute Charts are compiled and constructed using the best available aeronautical and topographical reference charts. Most Enroute Charts use the Lambert Conformal Conic projection. The design is intended primarily for airway instrument navigation to be referenced to cockpit instruments. The following pages briefly explain the information used on Enroute charts throughout the world. Not all items explained apply to all charts. The Enroute chart is divided into specific areas of information as illustrated below.

ENROUTE CHART FORMAT



HEADING

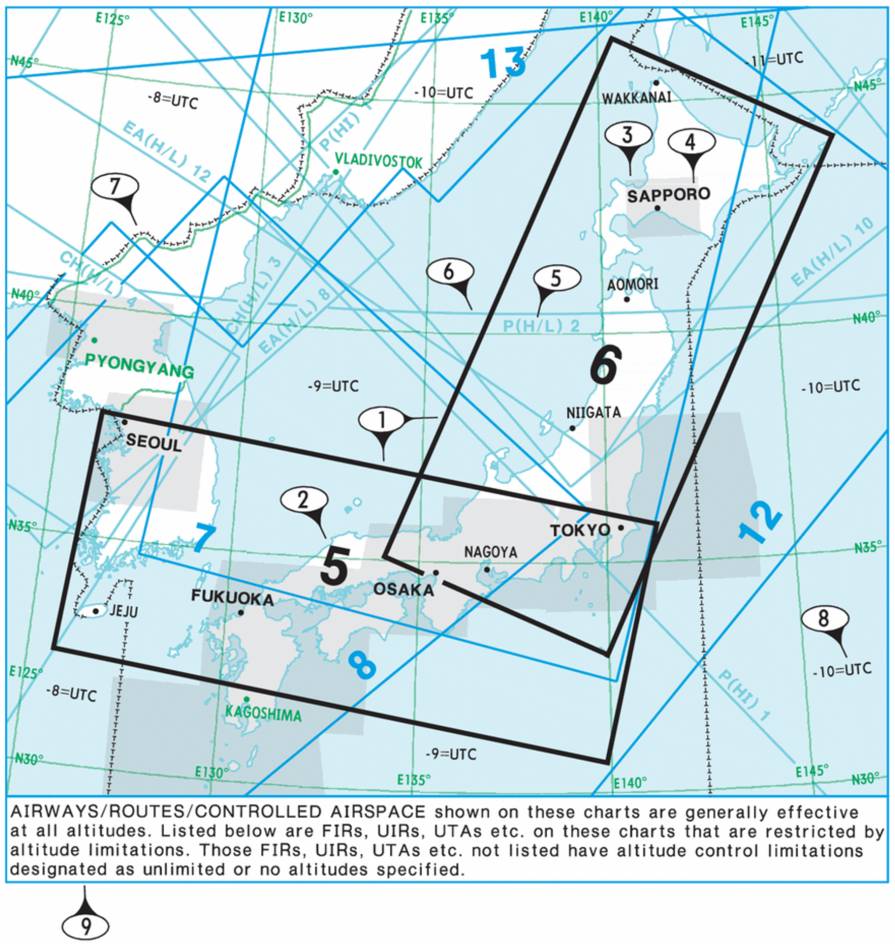


1 — Chart number.
2 — Chart name.
3 — Jeppesen company logo.
4 — Chart scale.
5 — Chart region and type.
6 — Chart effective date.
7 — Chart revision date.
8 — Chart Change Notice cross reference statement.

ENROUTE

ENROUTE CHART LEGEND

COVERAGE DIAGRAM



AIRWAYS/ROUTES/CONTROLLED AIRSPACE shown on these charts are generally effective at all altitudes. Listed below are FIRs, UIRs, UTAs etc. on these charts that are restricted by altitude limitations. Those FIRs, UIRs, UTAs etc. not listed have altitude control limitations designated as unlimited or no altitudes specified.

1 — Chart coverage neatline.
2 — Chart number.
3 — Area Chart geographic coverage.
4 — Area Chart location name.
5 — Overlapping Enroute Chart name.
6 — Overlapping Enroute Chart geographic coverage.
7 — Time Zone Boundary
8 — Time Zone Designator
9 — Chart intent note.

ENROUTE

ENROUTE CHART LEGEND

CHANGES

CHANGES

FE(H/L)**5** Training Areas desig, revoked (N of Pohang, Korea).

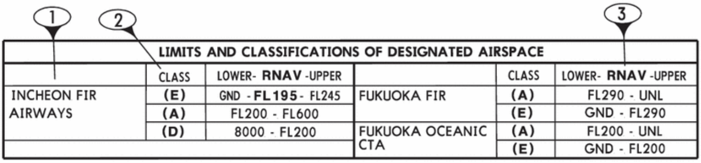
FE(H/L)**6** Airways desig, realigned (Japan). Tokyo ACC sector limits changed.

1 — Chart name.

2 — Chart number.

3 — Change note providing main changes made since previous revision.

AIRSPACE LIMITS AND CLASSIFICATION



LIMITS AND CLASSIFICATIONS OF DESIGNATED AIRSPACE

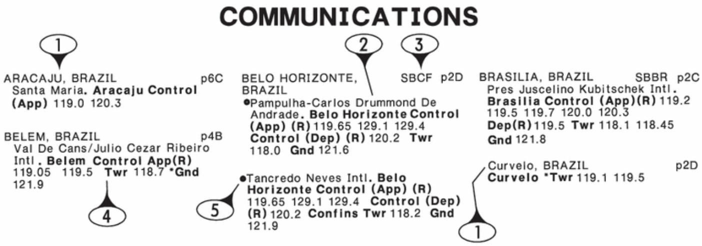
	CLASS	LOWER- **RNAV** -UPPER		CLASS	LOWER- **RNAV** -UPPER
INCHEON FIR AIRWAYS	(E)	GND - **FL195** - FL245	FUKUOKA FIR	(A)	FL290 - UNL
	(A)	FL200 - FL600		(E)	GND - FL290
	(D)	8000 - FL200	FUKUOKA OCEANIC CTA	(A)	FL200 - UNL
				(E)	GND - FL200

1 — FIR/UIR, Country or Controlled airspace name.

2 — Airspace classification.

3 — Airspace vertical limits.

TABULATED DATA



COMMUNICATIONS

ARACAJU, BRAZIL p6C
Santa Maria. **Aracaju Control (App)** 119.0 120.3

BELEM, BRAZIL p4B
Val De Cans/Julio Cezar Ribeiro Intl. **Belem Control App(R)** 119.05 119.5 **Twr** 118.7 ***Gnd** 121.9

BELO HORIZONTE, BRAZIL SBCF p2D
•Pampulha-Carlos Drummond De Andrade. **Belo Horizonte Control (App) (R)** 119.65 129.1 129.4 **Control (Dep) (R)** 120.2 **Twr** 118.0 **Gnd** 121.6

•Tancredo Neves Intl. **Belo Horizonte Control (App) (R)** 119.65 129.1 129.4 **Control (Dep) (R)** 120.2 **Confins Twr** 118.2 **Gnd** 121.9

BRASILIA, BRAZIL SBBR p2C
Pres Juscelino Kubitschek Intl. **Brasilia Control (App)(R)** 119.2 119.5 119.7 120.0 120.3 **Dep(R)** 119.5 **Twr** 118.1 118.45 **Gnd** 121.8

Curvelo, BRAZIL p2D
Curvelo *Twr 119.1 119.5

1 — Airport Location name. IFR = Upper case. VFR = Upper/Lower case.

2 — Airport name.

3 — Charted location is shown by Area chart and/or panel number-letter combination.

4 — Communication information (includes call name, App, Arr, Dep, Twr, Gnd).

BOLD NAME – Voice Call

T – Transmit only.

G – Guard only.

* – Part time operation.

X – On request.

(R) – Radar capability.

Airport Broadcast Service frequencies (ATIS, ASOS, AWOS, etc.) are positioned over the airport label on face of chart.

Common EMERGENCY 121.5 – not listed

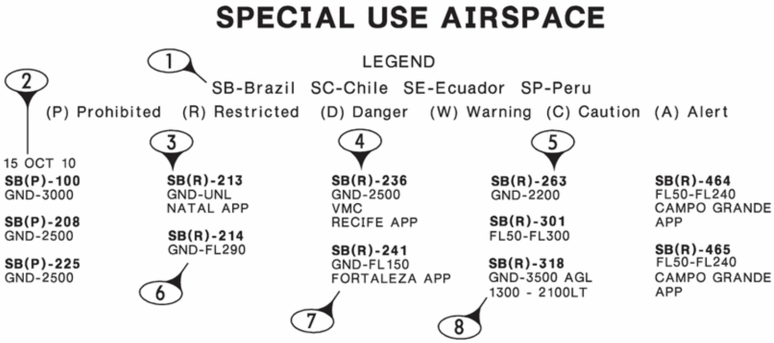
Refer to Glossary and Abbreviations in Introduction pages for further explanations.

5 — Bullet indicates multiple airports under same Location name.

ENROUTE

ENROUTE CHART LEGEND

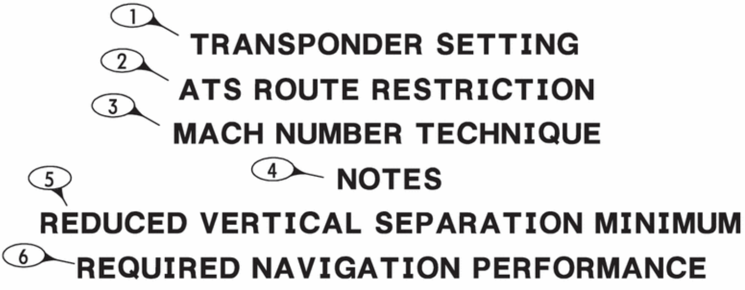
SPECIAL USE AIRSPACE



1 — Legend which includes:
Affected Country ICAO ident
Charted airspace types
2 — Tabulation change date.
3 — Country ICAO ident.
4 — Airspace type.
5 — Airspace ident.
6 — Airspace vertical limits.
7 — Airspace clearance approval agency.
8 — Times of Operation. H24 if not specified.

NOTE: Special use Airspace between GND/MSL and 2000' is not depicted on Enroute and Area charts in several regions.

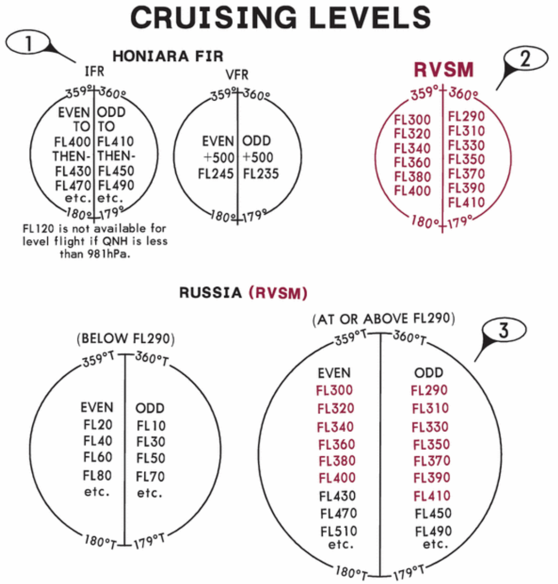
REFERENCE NOTES



1 — Settings and Procedures for Transponder Operations.
2 — Restrictions associated with ATS routes within a given FIR or UIR.
3 — Procedures for Mach Number reporting within a region or FIR/UIR.
4 — Notes which have operational significance to charted features.
5 — Procedures for RVSM Operations within a region or FIR/UIR.
6 — Procedures and RNP values listed for airways within a region or FIR/UIR.

ENROUTE
ENROUTE CHART LEGEND

CRUISING LEVELS



1 — Country and/or ICAO specified cruising altitudes/levels.

2 — Standard RVSM Cruise Table associated with charted RVSM airspace. Non standard flight levels are depicted on the chart underneath the airway designator.

3 — Cruise Table which incorporates both Conventional and RVSM cruising altitudes/levels.

RANGE SCALE

1 — Chart scale in Nautical Miles.

2 — Chart Projection.

END PANEL

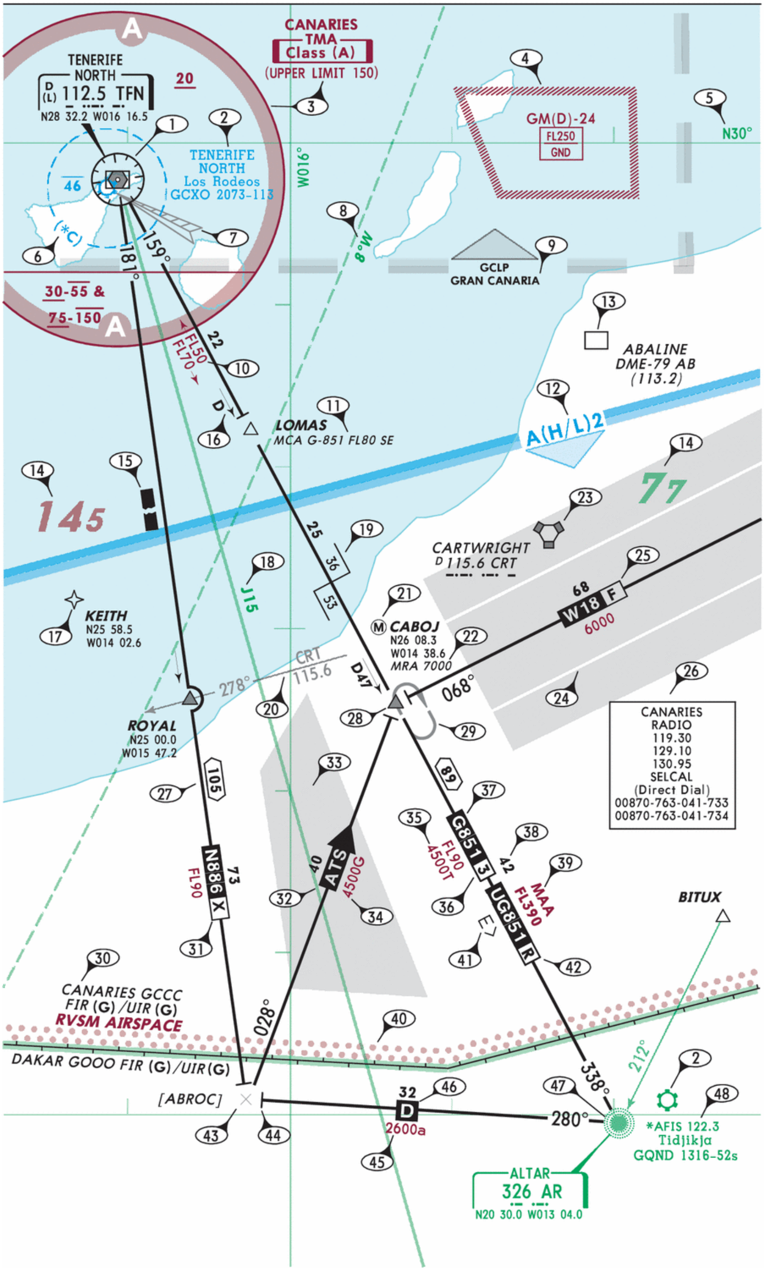
End Panels on Jeppesen Enroute Charts are primarily used for additional tabulated and reference information which can not all fit on the Cover Panel.

CHART GRAPHIC

The contents of an IFR Enroute chart include information provided by official government source, as well as, on rare occasion Jeppesen derived data. Charts are comprised of aeronautical data, cultural data, hydrography and on some charts terrain data.

ENROUTE

ENROUTE CHART LEGEND



ENROUTE
ENROUTE CHART LEGEND

1 — VORDME. Low and High/Low charts include a Compass Rose with VHF Navaids. Shadow box indicates navaid is airway component, with frequency, identifier, Morse code and INS coordinates. Small "D" indicates DME/TACAN. Class indicated by: (T) Terminal, (L) Low, (H) High.

2 — Airports - Location name, Airport name (if different than Location name), ICAO identifier, airport elevation and longest runway length to nearest 100 feet with 70 feet as the dividing point (add 00). "s" indicates soft surface, otherwise hard surface. IFR Airport in blue - Published procedures filed under the location name. VFR airport in green.

3 — Controlled Airspace. Limits add 00. When sectorized vertically, lower limit indicated by under bar, upper limit indicated by over bar.

4 — Special use airspace.

5 — Grid Lat-Long values.

6 — CTR. Asterisks are used in association with Class C, D and E airspace in the US only to indicate part time operations, otherwise hours are H24.

7 — ILS available at airport.

8 — Magnetic Variation.

9 — Area chart coverage.

10 — Directional MEAs.

11 — Minimum Crossing Altitude (MCA).

12 — Change to adjoining Enroute chart.

13 — DME.

14 — Grid MORA. Values 10,000 feet and greater are maroon. Values less than 10,000 feet are green. Values are depicted in hundreds of feet.

15 — Gap in Nav Signal coverage.

16 — "D" indicates DME/TACAN fix. Segment mileage is DME/TACAN distance from navaid. Arrow without a "D" designates a reporting point from facility.

17 — Non Compulsory RNAV Waypoint.

18 — High Altitude Route included on some low charts for orientation only.

19 — Changeover Point between two navaids.

20 — Intersection or fix formation (Bearing, frequency and ident of remote VHF or LF navaid).

21 — Met report required.

22 — Minimum Reception Altitude (MRA).

23 — VORTAC - High Altitude and off-route Navaids do not include a Compass Rose.

24 — Uncontrolled airway or advisory route.

25 — Route Suffix. D or F indicates ATC Advisory services only. F or G indicates Flight Information services only.

26 — Enroute Communications.

27 — Total mileage between Navaids.

28 — Compulsory Reporting Point represented by screened fill. Non Compulsory Reporting point is open, no fill.

29 — Holding pattern.

30 — FIR/UIR Boundary name, identifier and Airspace Class.

31 — Route usability by non B-RNAV equipped aircraft (within Europe only).

32 — Unnamed, official published ATS route with direction indication.

33 — Uncontrolled Airspace (Class F or G).

34 — GPS MEA.

35 — Minimum Obstruction Clearance Altitude (MOCA).

36 — Conditional Route Category (See Enroute Text pages Europe).

37 — Airway Designator.

38 — Segment mileage.

39 — Maximum Authorized Altitude (MAA).

40 — CNS/ATM Equipment Requirement Boundary.

41 — Non Standard Flight Levels (Even Flight Levels in direction indicated).

42 — RNAV ATS route when not identified by designator (used outside Europe).

ENROUTE

ENROUTE CHART LEGEND

43 — Named or unnamed airspace fix or mileage break. Database identifiers are enclosed in square brackets *[ABROC]*. They may be designated by the State (country) as Computer Navigation Fixes (CNFs) or derived by Jeppesen. These identifiers should not be used in filing flight plans nor should they be used when communicating with ATC; however they are also included in computer planning systems. They are shown only to enable the pilot to maintain orientation when using charts in concert with database navigation systems.

44 — Altitude Change.

45 — Route Minimum Off-Route Altitude (Route MORA).

46 — Direct Route (Requires ATC Approval, will not be accepted in Flight Plans).

47 — NDB.

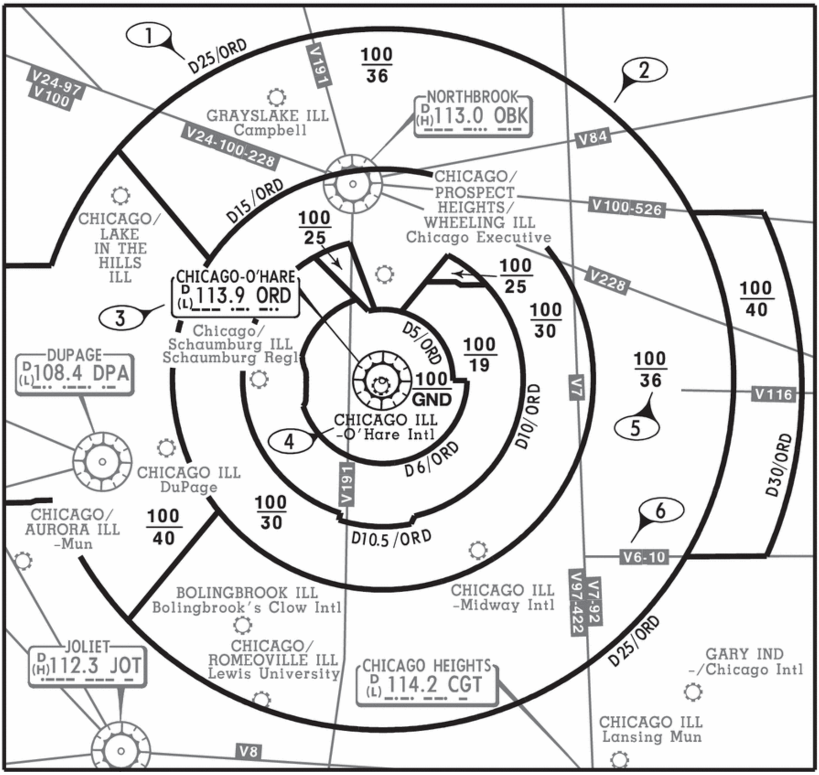
48 — Communications related to Airport listed above Airport label. App/Arr, Dep, Twr and Gnd listed in Chart tabulations. Asterisk indicates part time operation.

10–1B CHART LEGEND

10-1B charts depict the horizontal and vertical limits of Terminal airspace established by official source publications and provide orientation details for flights operating within the area. Associated airport communications are also included.

10-1B charts depicting US Class B airspace also includes general IFR and VFR Flight Procedures appropriate to that particular area.

SAMPLE 10–1B CONTENT



ENROUTE

ENROUTE CHART LEGEND

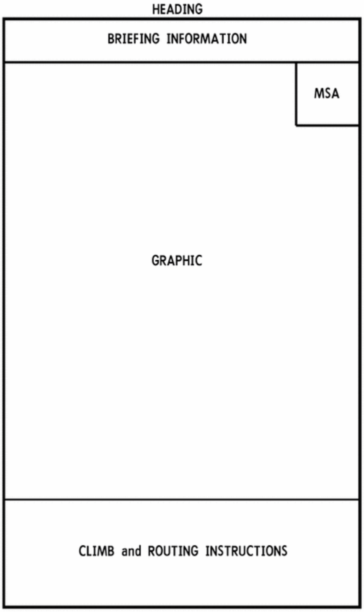
1 — DME arc distances used to define the Terminal airspace.
2 — Bold line represents the horizontal limits of the Terminal airspace and airspace sectors.
3 — Primary navaid used to further define the horizontal limits of the Terminal airspace.
4 — Primary airport is shown in bold print.
5 — Vertical limits of the Terminal airspace within charted sector in hundreds of feet.
6 — Screened information provided for orientation purposes. This includes airway information, airports and navaids.

END OF ENROUTE CHART LEGEND

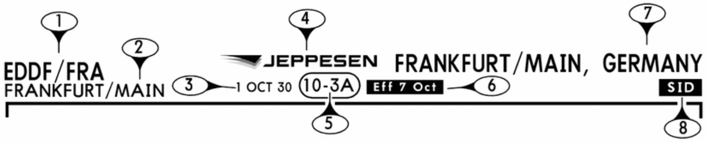
SID/STAR
SID/DP AND STAR LEGEND

SID/DP AND STAR

The SID & STAR section of the Jeppesen legend provides a general overview and depiction of Standard Instrument Departure (SID), Departure (DP), Standard Terminal Arrival Route/Standard Instrument Arrival (STAR), and Arrival charts. These charts are graphic illustrations of the procedures prescribed by the governing authority. A text description may be provided, in addition to the graphic, when it is supplied by the governing authority. All altitudes shown on SID/DP and STAR charts are MSL unless otherwise specified. All mileages are nautical, all radials and bearings are magnetic unless otherwise specified.



HEADING

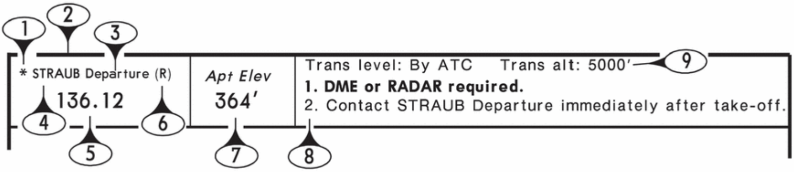


1 — ICAO indicators and IATA identifiers.
2 — Airport name.
3 — Chart revision date.
4 — Jeppesen company logo.
5 — Index number.
Charts are sequenced alphabetical or by runway number within similar type arrivals or departures.
6 — Chart effective date.
7 — Geographical location name.
8 — Chart type identifier.

SID/STAR

SID/DP AND STAR LEGEND

BRIEFING INFORMATION



1 — Indicates the service is part time.

2 — SID/DP Initial Departure Control Services or STAR Weather Services (e.g. ATIS) are depicted.

3 — Function of the service is shown when applicable.

4 — Service call sign is shown when transmit and receive, or transmit only ops are available. The call sign is omitted when the service is broadcast only or has a secondary function.

5 — All available primary frequencies are depicted.

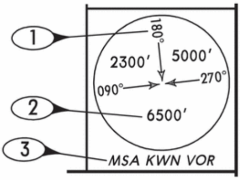
6 — Indicates that radar services are available.

7 — Airport elevation is provided for Arrival/Departure airport.

8 — Procedure restrictions and instructions. Required equipment notes are prominently displayed.

9 — Transition Level and Altitude.

MINIMUM SAFE or SECTOR ALTITUDE (MSA)



1 — Sector defining Radial/Bearing, always depicted inbound for the Navaid, Fix or Airport Reference Point (ARP).

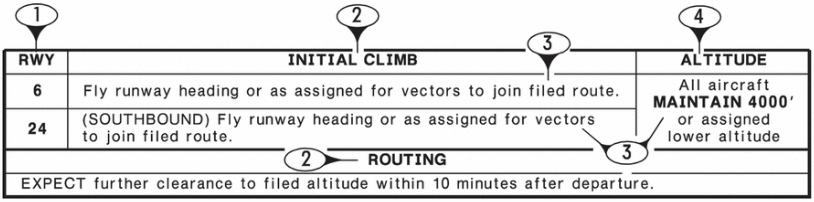
2 — Minimum safe/sector altitude.

3 — Navaid/Fix/ARP the MSA is predicated on.

NOTE: Normal coverage is a 25 NM radius from the forming facility/fix. If the protected coverage is other than 25 NM, that radius is depicted below the forming facility/fix. MSA is provided when specified by the governing authority for any procedure serving the airport.

CLIMB and ROUTING INSTRUCTIONS TABULATED TEXT BOX

Text description might be provided, in addition to the graphic, when it is supplied by the governing authority. Text should be used in conjunction with the graphic to fully understand the procedure to be flown. Neither the text nor the graphic is a stand alone representation of all instructions, speed, and altitude restrictions, but are a combined representation of the procedure.



RWY	INITIAL CLIMB	ALTITUDE
6	Fly runway heading or as assigned for vectors to join filed route.	All aircraft **MAINTAIN 4000′** or assigned lower altitude
24	(SOUTHBOUND) Fly runway heading or as assigned for vectors to join filed route.	
ROUTING		
EXPECT further clearance to filed altitude within 10 minutes after departure.		

Tabulated Text boxes, which include a wide variety of actions, instructions, or restrictions for the pilot, have certain common elements of design for SID, DP and STAR procedures.

1 — General identification applying to certain sections of the procedure, such as Runway, Arrival or SID identification.

2 — Segment of flight, such as Initial Climb, Routing, or Landing may be identified.

3 — Textual description, which compliments the graphic-based depictions or unique instructions, that cannot be graphically represented.

4 — General restriction that cannot be incorporated in the graphic or that would enhance understanding of procedure.

SID/STAR
SID/DP AND STAR LEGEND

GRAPHIC — INFORMATION BOXES

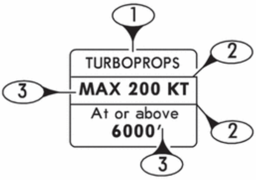
Information boxes are generally tied to the track, fix, or navaid to which the information applies. The content is associated with the graphic depiction on SID, DP, and STAR charts. Information boxes include a wide variety of actions, instructions, or restrictions.

Though information boxes vary widely based on the complexity of procedures, they do have certain common elements of design.

1 — Heading, if included, represent the who, what, where, or why of the information box.

2 — Instruction lines are used to separate instructions and conditions for improved clarity.

3 — Instructions or conditional statements associated with track, fix, navaid, or procedure.



GRAPHIC — LOST COMMUNICATIONS PROCEDURE

Unique lost communication instructions, provided by the governing authority for a procedure, are placed within the graphic and are outlined by the lost communication boundary.

GRAPHIC — SPEED RESTRICTIONS

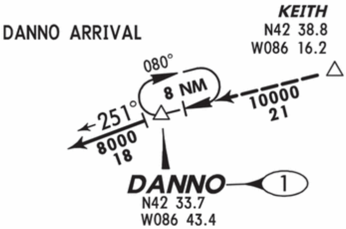
Speed restrictions that apply to the entire procedure are shown below the procedure title.

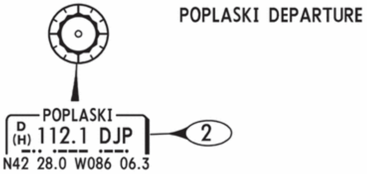
SPEED: ***DO NOT EXCEED 230 KT UNTIL ADVISED BY ATC***

Speed restrictions vary widely within individual procedures. They can be in the tabulated text, boxed, and/or placed in information boxes at the associated track, fix or phase of flight.

GRAPHIC — STARTING POINT AND END POINT OF STAR, DP, AND SID PROCEDURES

Navaids, intersections, or waypoints identified in the procedure title are shown prominently for easy identification of the starting points on STARs, and the ending points on SID or DP procedures.





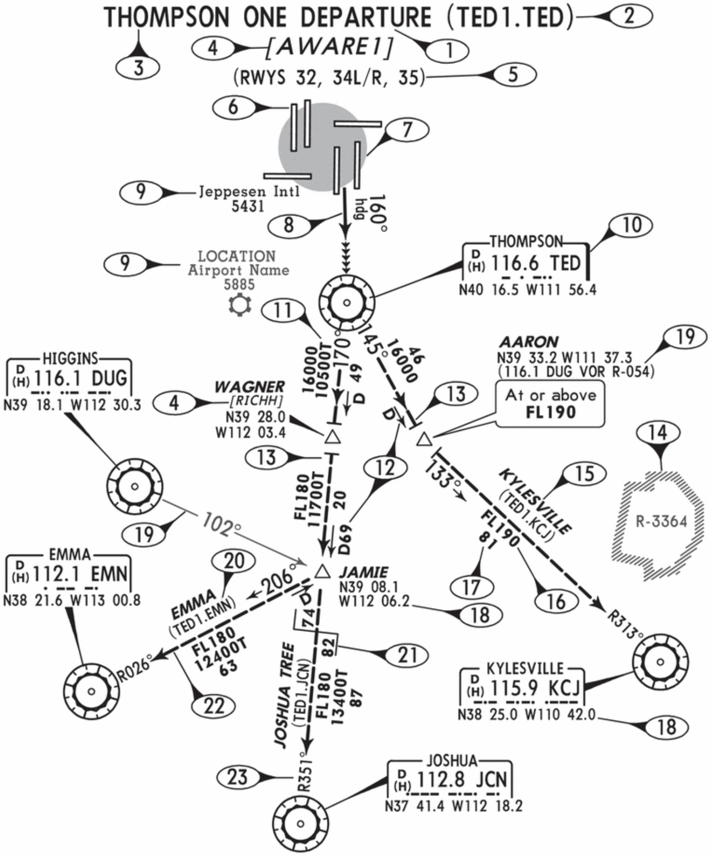
1 — Intersection or waypoint names are shown in larger text.

2 — Navaid boxes include a shadowed outline.

SID/STAR

SID/DP AND STAR LEGEND

GRAPHIC



1 — Type of procedure.
2 — Arrival/Departure code.
3 — Arrival/Departure name.
4 — Database identifiers are included when different than the Arrival/Departure code or name.
5 — Specified qualifying statements, such as runways, navigational requirements, or aircraft type.
6 — Runway layout is provided for all hard surface runways.
7 — Arrival/Departure airport is highlighted with circular screen.
8 — Arrival/Departure track of procedure represents a common course used by multiple transitions.
9 — Airport is listed only when SID, DP, or STAR also serves multiple airports, which are screened.
10 — Starting Point of STAR and end point of SID/DP procedures are shown prominently.
11 — T placed after altitude denotes a Minimum Obstruction Clearance Altitude (MOCA).
12 — Radial and DME forms the fix. The DME, if not displayed is the segment distance, if shown it is the total distance from the forming Navaid.
13 — Altitude T is placed when the altitude changes along a track at other than a Navaid.
14 — Certain Special Use Airspace Areas are charted when referenced in procedure source.

SID/STAR

SID/DP AND STAR LEGEND

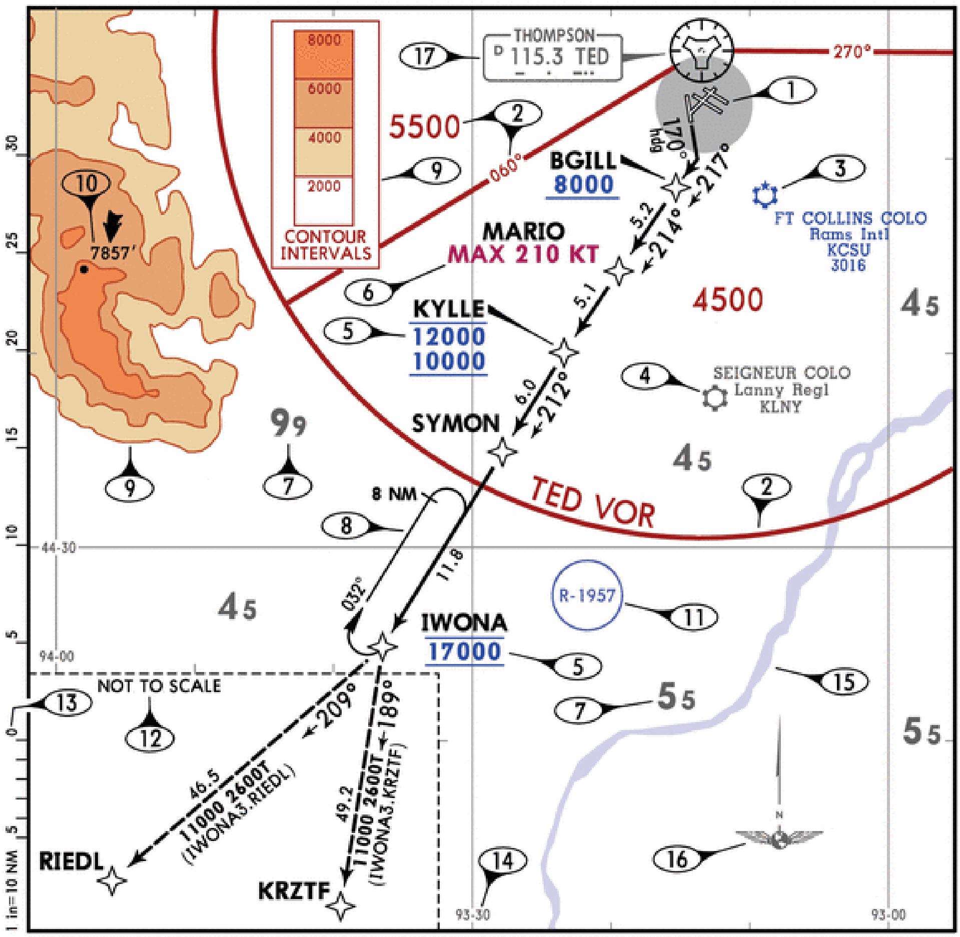
15 — Transition name placed on the last segment of the SID/DP and the first segment of STAR procedures.
16 — Minimum Enroute Altitude (MEA) unless otherwise designated.
17 — Segment distance.
18 — Coordinates of fix or Navaids.
19 — Formation radials are presented in many ways based on Navaid position & compositional space.
20 — Route identification code.
21 — At the Changeover point, the pilot changes primary navigation to the next Navaid.
22 — Transition track.
23 — VOR radial on which aircraft is flying inbound towards the Navaid.

SID/STAR

SID/DP AND STAR LEGEND

GRAPHIC — TO SCALE DEPICTION

Jeppesen has begun to use a To Scale graphical illustration for Standard Instrument Departure (SID), Departure (DP), Standard Terminal Arrival Route/Standard Instrument Arrival (STAR), and Arrival procedures to enhance terrain/situational awareness. The general philosophy is to depict as much of the area around the arrival/departure airport as possible To-Scale. As a result, there are several differences between our new To-Scale, and the traditional Not-To-Scale, graphic depictions. Those differences are explained below.



1 – Runway diagram of the primary airport is shown using the same scale as the to-scale area of the graphic.

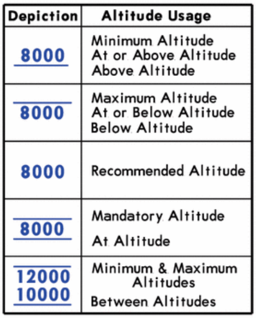
2 – Minimum Sector Altitudes (MSA), indicating the sectors (to-scale) and corresponding altitudes are shown.

3 – For procedures that serve multiple airports, those airports served by the procedure but not considered as the primary are shown using a blue color.

SID/STAR
SID/DP AND STAR LEGEND

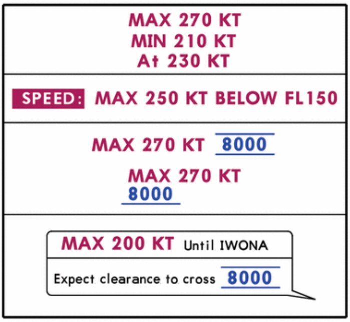
4 – All IFR airports not served by the procedure that are located within the boundaries of the To-Scale portion of the procedure graphic are shown using a subdued grey color. For procedures under the jurisdiction of the FAA, only those airports not served by the procedure and with at least one hard surface runway 6000' or greater in length will be shown using a subdued grey color.

5 – Procedure altitude restrictions are depicted blue in color and use line-work above and or below the value to indicate usage. See the following table for the meaning of each depiction:



Depiction	Altitude Usage
$\underline{8000}$	Minimum Altitude At or Above Altitude Above Altitude
$\overline{8000}$	Maximum Altitude At or Below Altitude Below Altitude
8000	Recommended Altitude
$\overline{\underline{8000}}$	Mandatory Altitude At Altitude
$\overline{12000}$ $\underline{10000}$	Minimum & Maximum Altitudes Between Altitudes

6 – Speed restrictions are shown in magenta. Speed restrictions are at times, combined with procedure altitudes.



MAX 270 KT
MIN 210 KT
At 230 KT

SPEED: MAX 250 KT BELOW FL150

MAX 270 KT $\overline{\underline{8000}}$

MAX 270 KT
$\underline{8000}$

MAX 200 KT Until IWONA
Expect clearance to cross $\overline{\underline{8000}}$

7 – Within To-Scale areas grid MORAs will be depicted with latitude/longitude defining the applicable sector. Sectors are formed by 30 minutes or one degree of latitude and longitude. The MORA value is shown using a large and small number. The large numbers represent thousands and the small numbers represent truncated hundreds. All Grid MORA values are shown using a grey color.

8 – Holding pattern leg lengths are depicted to scale. When a holding limit has been defined as a DME distance or NM leg length, those limits are shown along the outbound leg.

9 – Generalized terrain contours may be depicted based on several geographic factors. The elevation values applicable to the contour lines shown are indicated within a contour legend.

10 – The highest terrain high point or man-made structure that falls within the To-Scale portion of the graphic is shown and highlighted with an arrow.

11 – Special use airspace that has been identified by the State Authority as having significance are shown with a blue line indicating the outer boundaries.

12 – NOT TO SCALE insets will be used for the depiction of transition information when the chart scale used does not facilitate a to-scale depiction of the entire procedure. Information within the area indicated is depicted not to scale.

13 – The scale used for graphic depiction is indicated.

14 – Latitude/Longitude tics are shown in 10 minute increments along the neat line. The appropriate 30 minute or 1 degree tics are extended to form the MORA grid.

15 – Large rivers and water bodies are shown.

16 – Normally the graphic will be oriented with north being towards the top of the chart. At times a much better depiction can be obtained by using a different orientation. A north arrow is always shown to indicate the type of orientation used.

17 – Secondary navaid boxes, for navaids not directly used for procedure navigation, will be depicted using a grey color to differentiate them from primary navaids.

SID/STAR

SID/DP AND STAR LEGEND

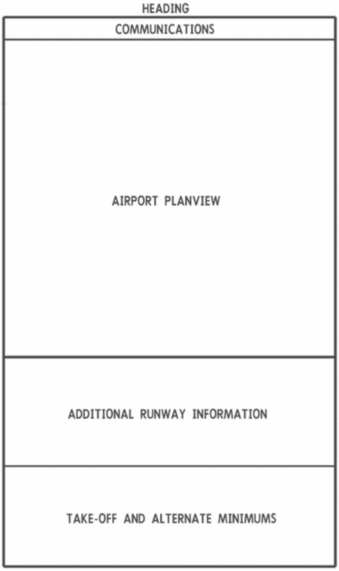
END OF SID/DP AND STAR LEGEND

AIRPORT

NOTE: This section of the Jeppesen legend provides a general overview regarding the depiction of airport diagrams and associated information.

The following briefly explains the symbology used on airport charts throughout the world. Not all items explained apply to all charts. The airport chart is divided into specific areas of information as illustrated below. To enhance the usability for larger airports, the Communications and Airport Planview sections are depicted on one side of the chart. An added Notes Section along with the Additional Runway Information, Take-off minimums, and Alternate minimums sections are depicted on the reverse side of the chart.

FORMAT



HEADING

1 — ICAO indicators and IATA airport identifiers.

2 — Airport elevation.

3 — Airport geographic latitude and longitude shown in degrees, minutes, and tenths of minutes.

4 — Chart index number. Same as the first approach chart when the airport chart is printed on the reverse side.

5 — Chart revision date.

6 — Chart effective date.

7 — Airport name.

8 — Geographic location name.

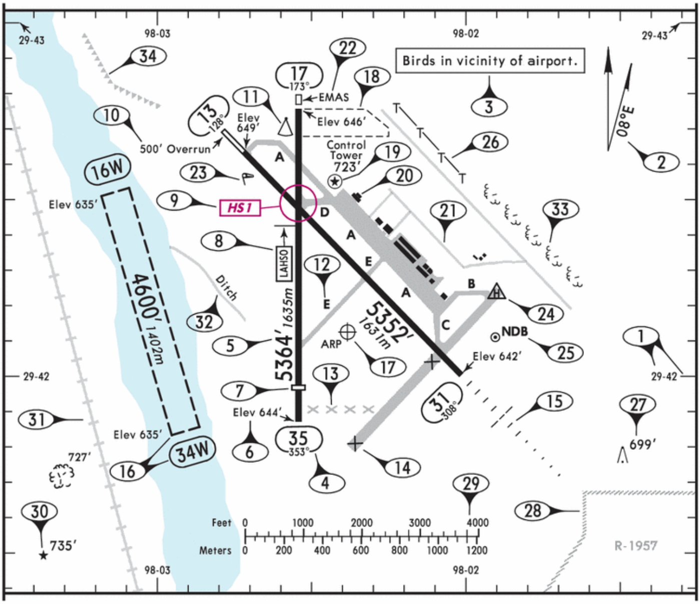
9 — Jeppesen company logo.

AIRPORT
AIRPORT CHART LEGEND

COMMUNICATIONS

For Communications Information See Approach Chart Legend — Page APPROACH-2

AIRPORT PLANVIEW



1 — The planview is a "To Scale" graphical depiction of the airport layout, a latitude/longitude grid in degrees, minutes, and tenths of minutes is depicted along the inside of the neat line.

2 — The airport magnetic variation is graphically and numerically depicted.

3 — Airport operational notes are placed within the planview. Notes pertaining to a specific area are placed within the area or tied to it.

4 — Runway designators (numbers) are magnetic unless followed by a "T" for true. Runway bearings are included when known.

5 — Physical length of the runway which does not include stopways, overruns, or adjustments for displaced thresholds. Shown in feet with the meter equivalent included at International Airports.

6 — The runway end elevation is depicted when known.

7 — When applicable, the physical location of displaced thresholds along the runway are shown.

8 — Stopping points along the runway are depicted for Land and Hold Short Operations.

9 — "Hot Spot" areas are depicted along with a corresponding label when applicable. A textual description is included within the planview or below the additional runway information band.

10 — When available, stopways and overruns are depicted with the applicable length.

11 — When known, the location of RVR transmissometers are shown with any applicable identifiers.

12 — All active taxiways and ramp areas are depicted using a grey area fill color. All taxiway identifiers and ramp names are included when known.

13 — All known permanently closed taxiways are shown.

14 — One of two depictions is used for closed runways depending on the nature of the closure:

a. Lengths and designators (numbers) are retained when the closure is temporary.

b. Lengths and designators (numbers) are removed when the closure is permanent.

15 — The configuration and length of all known approach light systems are shown.

AIRPORT
AIRPORT CHART LEGEND

16 — All seaplane operating areas/water runways a re shown. Runway numbers are followed by a "W", the physical length is included along with elevations.

17 — The geographical location of the Airport Reference Point (ARP) is depicted when known.

18 — Areas under construction are outlined using a light dashed line.

19 — When known, the location of the airport identification beacon is shown.

20 — Buildings on or near the airport are depicted.

21 — Roads on or near the airport are depicted if referenced in a Caution, Alert or Be Aware note.

22 — Location of Engineered Materials Arresting System (EMAS) pads are shown and labeled.

23 — All known wind direction indicators are depicted.

24 — Helicopter landing pads/areas.

25 — The geographical location of on airport VORs and NDBs is indicated and labeled.

26 — Pole lines that are on or near the airport are depicted.

27 — All known terrain high points and man-made structures with an elevation 50 feet above the nearest rwy end elevation are depicted. The applicable symbol and elevation are shown.

28 — Special use airspace, area outline and designator are depicted. A note, "Entire Chart Lies Within R-XXXX", is shown when the entire chart planview falls within a particular area.

29 — A scale for both feet and meters that is equivalent to the chart scale is shown.

30 — Hazard beacons within the planview are depicted along with an elevation if known.

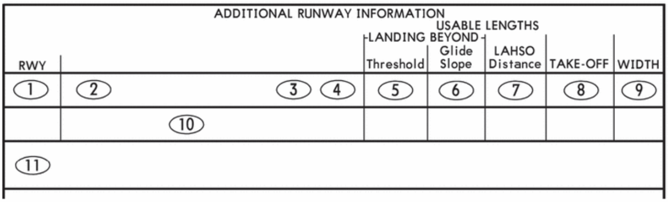
31 — Railroads on or near the airport are depicted if referenced in a Caution, Alert or Be Aware note.

32 — Ditches in the vicinity of the airport are depicted.

33 — Tree lines are depicted. An open ended tree line indicates the border of a forested area.

34 — Bluffs are shown with the arrows of the symbol pointing down, or toward lower elevation.

ADDITIONAL RUNWAY INFORMATION BAND



NOTE: For an explanation of the abbreviations used within the Additional Runway Information Band, see the Abbreviations Section. All distances depicted in the Additional Runway Information Band are in feet, the meter equivalent is also shown at International airports.

1 — Runway designators/numbers are depicted in the upper left and lower right corners of the box. All information shown to the right within the band applies to the indicated runways. When the information differs between runways, the band is separated with a line.

2 — All operational runway lighting and approach light systems are listed.

3 — Runway surface treatment (grooving) is indicated.

4 — "RVR" is depicted when one or more transmissometers are installed along the runway.

5 — When different from the physical runway length, landing distance beyond threshold is shown.

6 — When applicable, the distance from a point abeam the glide slope transmitter to the roll-out end of the rwy is shown. For PAR, the distance is from the GS interception with the runway.

7 — At airports with Land And Hold Short Operations (LAHSO), the distance from the runway threshold to the designated hold short point is shown.

8 — When take-off length is restricted, the physical rwy distance available for take-off is shown.

9 — The physical width of the runway is shown.

10 — This band is expanded to show information for all operational runways in numerical order.

11 — All notes related to the runway information depicted are shown in this section.

TAKE-OFF MINIMUMS (Eff Jan 2020)

Publication of take-off minimums does not constitute authority for their use by all operators. Each individual operator is responsible for ensuring that the proper minimums are used based on authorization specific to the type of operation.

Take-off minimums are supplied for all airports. When the Governing State Authority has not provided take-off visibilities, they will be derived by Jeppesen based on ICAO Doc 9365 Manual of All Weather Operations. For take-off minimums rules and tables refer to AIR TRAFFIC CONTROL — Aerodrome Operating Minimums JEPPESEN.

A "Std" label in the upper left corner of the minimums box indicates that the published visibilities are ICAO Doc 9365 compliant. Other labels, as described in Landing Minimums Legend, indicate compliance with other regulations.

Wide variations exist regarding take-off minimums depending on the governing agency, typically though they consist of a visibility/ceiling and associated required conditions for use.

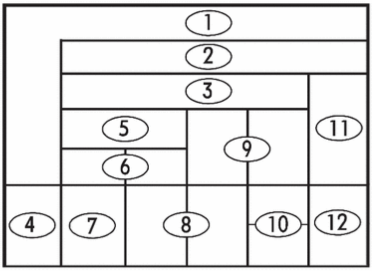
Generally, take-off minimums are shown in order of best (lowest) to worst (highest) starting at the top left and progressing to the bottom right of the format. This applies to the overall minimums box as well as for a particular runway or set of runways. Runway numbers will only be included if the State provides specific take-off minimums for a particular runway. The charted take-off minimums depend on runway lighting/equipment but may not be applicable for all runways. Pilots have to select the correct column according to the operational runway lights/equipment.

VIS and ceiling values are shown in feet, statute miles, meters or kilometers. RVR is shown in hundreds of feet or whole meters.

A VIS is always labeled with "V", an RVR is always labeled "R" and values which could be both are labeled "R/V".

Altitudes listed within climb gradients requirements are above Mean Sea Level (MSL). Ceilings specified for take-off are heights Above Airport Level (AAL).

Typical format used for charting take-off minimums:



1 — Take-off minimums header indicating the contents of the minimums box.

2 — If required, runway number/numbers, minimums below apply to the designated runway(s).

3 — General conditions, those that affect a wide range of the depicted minimums.

4 — If required, type of aircraft information is depicted here, typically in the form of number of aircraft engines or aircraft approach categories as published by the State.

5 — More specific conditions, those that affect only a few of the minimums.

6 — Very specific conditions, those that affect only the minimums directly below.

7 — Ceilings and RVR/met VIS authorized based on the conditions and runways listed above. When ceiling and visibilities are listed, both are required. In this format example, the minimums of this column would represent the best (lowest) available take-off minimums.

8 — Ceilings and visibilities authorized based on the conditions above, minimums typically become "higher" with less restrictions.

9 — The use of abbreviations is prevalent within the take-off minimums band given that many of the conditions/restrictions have lengthy explanations. See Chart Glossary and Abbreviations section for a more detailed description.

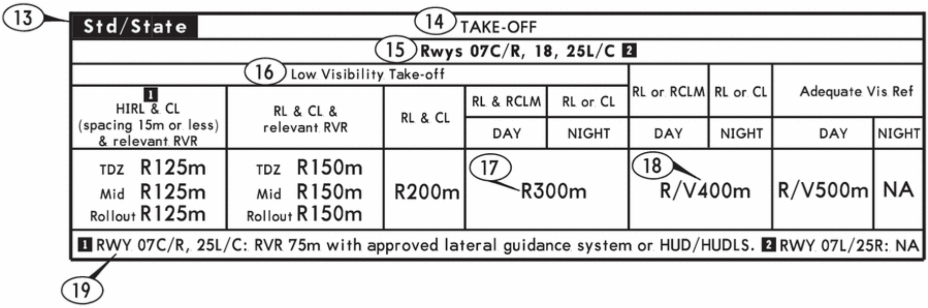
10 — The take-off minimums for a given set of conditions can differ based on aircraft type. Separate minimums are depicted for each aircraft type scenario.

11 — Usually the term "Other" is used to describe take-off minimums having no conditions.

12 — This being the farthest minimum box to the right, it would generally contain the highest set of take-off minimums with the least number of conditions for that particular runway.

AIRPORT

AIRPORT CHART LEGEND



Std/State	TAKE-OFF							
Rwys 07C/R, 18, 25L/C 2								
Low Visibility Take-off					RL or RCLM	RL or CL	Adequate Vis Ref	
1 HIRL & CL (spacing 15m or less) & relevant RVR	RL & CL & relevant RVR	RL & CL	RL & RCLM	RL or CL				
			DAY	NIGHT	DAY	NIGHT	DAY	NIGHT
TDZ R125m Mid R125m Rollout R125m	TDZ R150m Mid R150m Rollout R150m	R200m	R300m		R/V400m		R/V500m	NA
1 RWY 07C/R, 25L/C: RVR 75m with approved lateral guidance system or HUD/HUDLS. 2 RWY 07L/25R: NA								

13 — Minimums Label: Indicates that take-off minimums are compliant with a specific regulation, but never below State published values. For description of different labels refer to Landing Minimums Legend.

14 — Depending on the charted information the title simply refers to TAKE-OFF or contains additional information, e.g. DEPARTURE PROCEDURE.

15 — Runway numbers will only be listed if take-off minimums for the runways are different or if a runway is not authorized for take-off. This could happen because of State provided take-off minimums or restrictions.

16 — All operators should be aware that in some cases (e.g. “Approved Operators”, “Low Visibility Take-off”) a special approval is required prior to the use of these minimums.

17 — “R” means RVR.

18 — “R/V” means that the value could be both, RVR and meteorological VIS.

19 — All notes that pertain directly and only to the charted take-off minimums are depicted directly under and adjacent to the take-off minimums box.

Samples

Std	TAKE-OFF						
1 HIRL & CL (spacing 15m or less) & relevant RVR	RL & CL & relevant RVR	RL & CL	RL & RCLM	RL or CL	RL or RCLM	Adequate Vis Ref	
			DAY	NIGHT	DAY	DAY	NIGHT
TDZ R125m Mid R125m Rollout R125m	TDZ R150m Mid R150m Rollout R150m	R200m	R300m		R400m	R/V500m	NA
1 RWY 18, 25L, 25R: TDZ/Mid/Rollout R75m with approved lateral guidance system.							

Std	TAKE-OFF						
1 HIRL & CL (spacing 15m or less) & relevant RVR	RL & CL & relevant RVR	RL & CL	RL & RCLM	RL or CL	RL or RCLM	Adequate Vis Ref	
			DAY	NIGHT	DAY	DAY	NIGHT
TDZ R4 Mid R4 Rollout R4	TDZ R5 Mid R5 Rollout R5	R6	R10		R12	R16 or V1/4	NA
1 RWY 18, 25L, 25R: TDZ/Mid/Rollout R3 with approved lateral guidance system.							

Depiction of Take-off Minimums based on ECOMS tables and rules

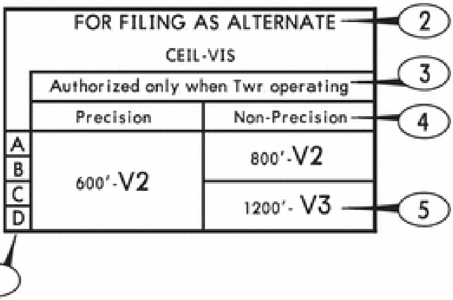
Refer to www.jeppesen.com/aom

AIRPORT

AIRPORT CHART LEGEND

ALTERNATE MINIMUMS (Eff Jan 2020)

Only those alternate minimums that have been published by the governing State Authority specifically for the landing airport will be charted. The values shown will be those supplied by the State.



1 — Typically alternate minimums are based on the landing minimums applicable to the available approach procedures at the landing airport. As a result, the subsequent alternate minimums relate to the aircraft approach categories. Aircraft categories are not shown if the same alternate minimums are applicable for all aircraft categories.

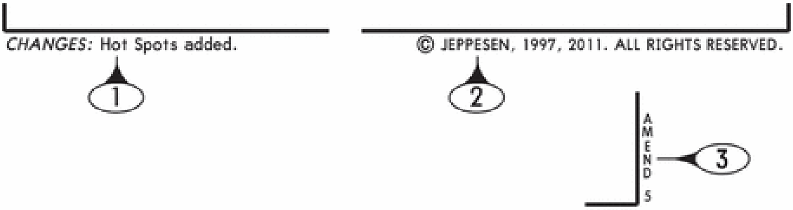
2 — The alternate minimums box is labeled as such.

3 — All applicable conditional notes are shown directly above the minimums they apply to.

4 — Approach procedure idents or classification for all appropriate procedures with the applicable alternate minimums charted directly below.

5 — Visibilities used in alternate minimums are shown in feet, statute/nautical miles, meters and kilometers as provided by the State. RVR values in feet and meteorological VIS values in statute/nautical miles are not labeled, for example: “R40” means RVR 4000 feet and “V2” means a meteorological VIS of 2 miles. Values in meters are labeled with an “m” and kilometers with a “km”. Ceiling values are always shown in feet or meter as reported by the State and are shown in front of the meteorological VIS.

CHART BOUNDARY LINE INFORMATION



1 — A brief summary of the changes applied to the chart during the last revision.

2 — Jeppesen Copyright label.

3 — Shown when source amendment information has been supplied by the State. Normally these amendment numbers directly relate to the take-off or alternate minimums.

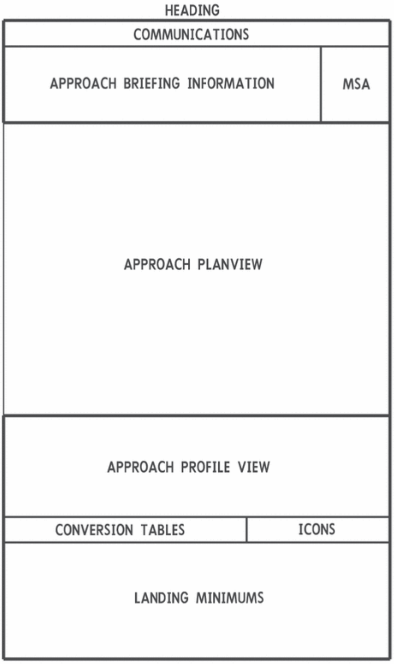
END OF AIRPORT CHART LEGEND

APPROACH

NOTE: This section of the Jeppesen legend provides a general overview regarding the depiction of approach procedures.

Approach charts are graphic representations of instrument approach procedures prescribed by the governing authority. The following briefly explains the symbology used on approach charts throughout the world. Not all items explained apply to all charts. The approach chart is divided into specific areas of information as illustrated below.

FORMAT



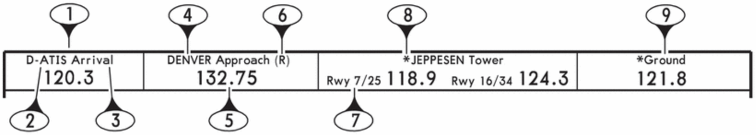
HEADING

1 — ICAO indicators and IATA airport identifiers.
2 — Airport name.
3 — Index number. Charts are sequenced by runway number within similar type approaches.
4 — Chart revision date.
5 — Chart effective date.
6 — Procedure identification.
7 — Geographical location name.
8 — Jeppesen company logo.

APPROACH

APPROACH CHART LEGEND

COMMUNICATIONS



1 — Communications are shown left to right in the order of normal use.

2 — Communication service, call sign is omitted when the service is broadcast only.

3 — Functionality of the service is shown when applicable.

4 — The service call sign is shown when transmit & receive or transmit only operations are available.

5 — All available primary frequencies are depicted.

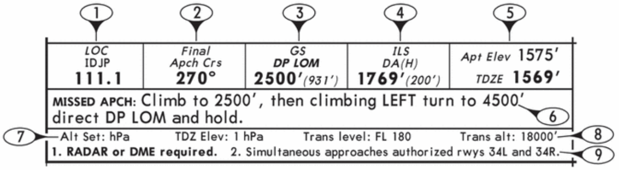
6 — Indicates that radar services are available.

7 — Sectors are defined for each frequency when applicable.

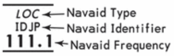
8 — Indicates the service is part time.

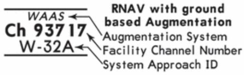
9 — When the service is a secondary function, the call sign is omitted.

APPROACH BRIEFING INFORMATION



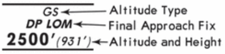
1 — Approach primary Navaid.





2 — Final approach course bearing.

3 — Crossing altitude at the FAF. Glide slope crossing altitude for precision approaches. Procedure altitude (Vertical Descent Altitude or Minimum Crossing Altitude) for non-precision approaches.



4 — Lowest DA(H) or MDA(H).

5 — Airport Elevation and Touchdown Zone/Threshold Elevation.

6 — Textual description of the Missed Approach Procedure.

7 — Altimeter Setting Information, Barometric Pressure Equivalents are included.

8 — Airport/Procedure Transition Level and Altitude.

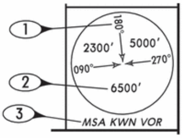
9 — Notes applicable to the Approach Procedure.

MINIMUM SAFE or SECTOR ALTITUDE (MSA)

1 — Sector defining Radial/Bearing, always depicted to the Navaid/Fix or Airport Reference Point (ARP).

2 — Minimum safe/sector altitude.

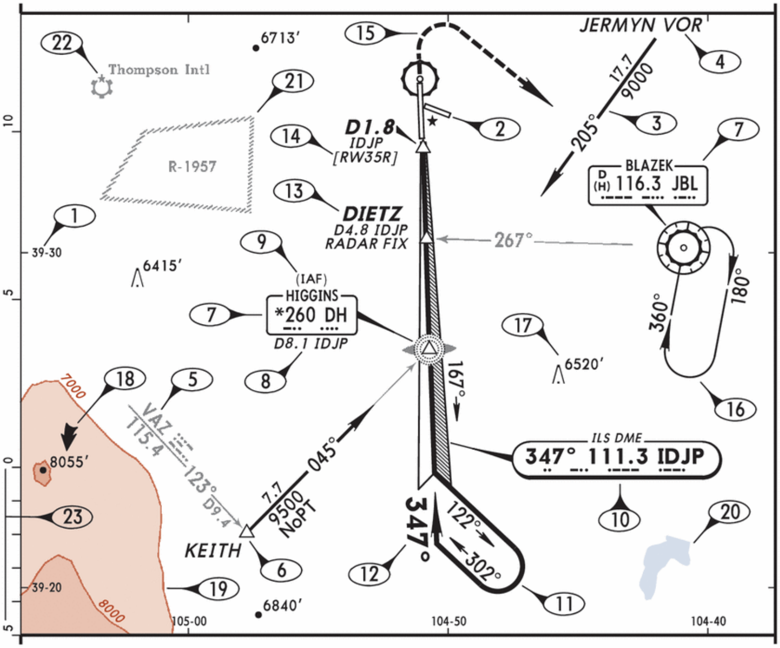
3 — Navaid/Fix/ARP the MSA is predicated on.



NOTE: Normal coverage is a 25 NM radius from the forming facility/fix. If the protected coverage is other than 25 NM, that radius is depicted below the forming facility/fix.

APPROACH
APPROACH CHART LEGEND

APPROACH PLANVIEW



1 — The planview is a graphical "To Scale" depiction of the approach procedure. Latitude and longitude tics are shown in 10 minute increments along the neatline.

2 — Complete runway layout is depicted for the primary airport.

3 — Approach transitions are depicted with a medium weight line. The bearing is normally inset within the track with the mileage and associated altitude placed along the track.

4 — Off-chart origination navaid/waypoint name. Navaid frequency, ident, and Morse code is shown when required for fix formation.

5 — VOR cross radials and NDB bearings used in forming a fix. DME formation distances are shown when applicable. Navaid frequency, ident, and Morse code shown as required.

6 — Airspace fixes depicted using several different symbols according to usage.

7 — Navaid boxes include the navaid name, identifier, Morse code, and frequency. A letter "D" indicates DME capability with an asterisk indicating part time.

8 — Substitute fix identification information located below facility box when applicable.

9 — Initial Approach Fixes and Intermediate Fixes are labeled as (IAF) and (IF) respectively.

10 — A shadowed navaid box indicates the primary navaid upon which lateral course guidance for the final approach segment is predicated.

11 — The final/intermediate approach course is indicated with a heavy weight line.

12 — The final approach course bearing shown in bold text, with a directional arrow as needed.

13 — Airspace fix names are shown near or tied to the fix, formational info is placed below name.

14 — Jeppesen-derived database identifiers are depicted when different from State-supplied name.

15 — The missed approach segment is shown with heavy weight dashed line work.

16 — Holding/Racetrack patterns are shown with both inbound and outbound bearings. Restrictions are charted when applicable, heavy weight tracks indicate the holding/racetrack is required.

17 — Some, but not all, terrain high points and man-made structures are depicted along with their elevations. Generally only high points 400' or more above the airport elevation are shown.

APPROACH

APPROACH CHART LEGEND

18 — Arrow indicates the highest of the portrayed high points within the planview area only.

19 — Generalized terrain contours may be depicted based on several geographic factors.

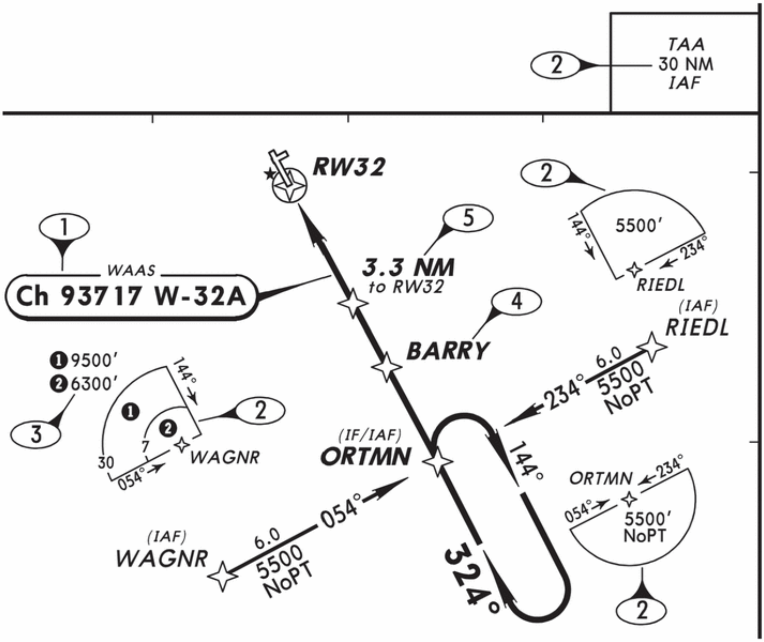
20 — Rivers/large water bodies are shown. Smaller and seasonal water areas are not depicted.

21 — Some, but not all, Special Use Airspace boundaries and identifiers are depicted.

22 — All secondary IFR airports, and VFR airports that lie under the final approach, are depicted.

23 — Charting scale used is indicated along the left side of the planview.

APPROACH PLANVIEW — RNAV PROCEDURE DIFFERENCES



1 — A primary navaid box is shown for RNAV approach procedures augmented by ground based facilities. The system type, channel, and system approach ID are shown.

2 — Some RNAV procedures utilize Terminal Arrival Area/Terminal Area Altitude (TAA). A graphical depiction of each TAA sector is placed within the planview in the corresponding area. The TAA's foundational waypoint is depicted along with the forming bearings, arrival altitudes, and applicable NoPT labels. Generally the TAA replaces the MSA as indicated in the MSA box.

3 — When the normal TAA coverage of 30 NM (25 NM ICAO) from the base waypoint is modified, the segmented areas are depicted with the applicable altitudes indicated.

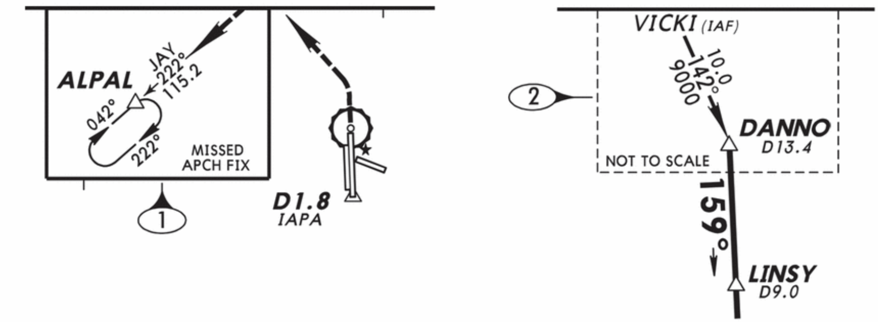
4 — Due to the required use of a database, only waypoint names are shown. Formations and coordinates are omitted.

5 — Along track distances, normally to the next named waypoint, are shown per source for un-named waypoints.

APPROACH

APPROACH CHART LEGEND

APPROACH PLANVIEW — NOT TO SCALE INSETS

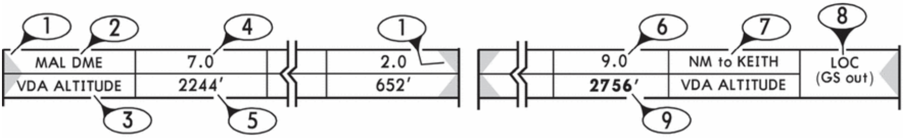


Insets are used to portray essential procedural information that falls outside of the planview boundary. The use of insets facilitates larger scales for depicting core segments of the procedure.

1 — A solid line is used to outline the inset when the information has been remoted from the associated "To Scale" tracks. Labels inside the inset indicate the usage of the contained procedural information.

2 — A dashed line is used to outline the inset when the information remains in line with the associated "To Scale" tracks. A NOT TO SCALE label is included inside the inset.

NON-PRECISION RECOMMENDED ALTITUDE DESCENT TABLE



General Description: The Recommended Altitude Descent table, shown to facilitate the CDFA technique, contains "check" altitudes that correlate directly to the Vertical Descent Angle (VDA) used in conjunction with the final approach segment of the procedure. When the State Authority has not supplied this information, Jeppesen will derive the altitudes based on the procedure VDA.

1 — The direction of the Recommended Altitude Descent table, top of descent down, is sequenced in the same direction as the flight tracks in the profile. A grey arrow indicates this left-to-right or right-to-left direction.

2 — The source for the DME "checkpoints" is indicated by the navaid ident. When the table is Jeppesen-derived, DME is used whenever possible for the establishment of the checkpoints.

3 — The row of recommended altitudes is labeled to indicate their associated use with the VDA.

4 — The DME distance that defines each checkpoint is depicted in whole and tenths of a NM.

5 — A recommended altitude, (which is defined by a position along the VDA at a given point) is supplied corresponding to each checkpoint in the table.

6 — When DME is not available, each checkpoint will be defined by a distance to a fix along the final approach course. This distance is shown in whole and tenths of a NM.

7 — The "to" waypoint is indicated when checkpoints are defined by a distance to a fix.

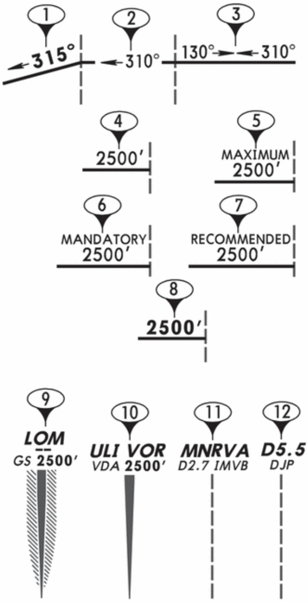
8 — When a Non-Precision approach is combined with a Precision approach, a qualifier is added to indicate that the depicted recommended altitudes relate to the non-precision approach only.

9 — Bold text indicates the altitude is charted in the FAF altitude box within the Briefing Strip.

APPROACH
APPROACH CHART LEGEND

APPROACH PROFILE VIEW

The Profile View graphically portrays the Final/Intermediate segments of the approach. A Not To Scale horizontal and vertical cross section is used.



1 — All procedure bearings are shown. Bold text is used to emphasize the Final Approach Course. Arrowheads are added as needed to indicate direction of flight.

2 — Bearings are placed either above, below, or inset in the track.

3 — Both inbound and outbound bearings are depicted for procedure holding/racetrack patterns.

4 — All altitudes depicted in the profile view are MINIMUM altitudes unless specifically labeled otherwise. All altitudes are above mean sea level in feet (AMSL).

5 — Maximum altitudes: may be abbreviated "MAX".

6 — Mandatory altitudes: abbreviations are not used.

7 — Recommended altitudes: abbreviations are not used.

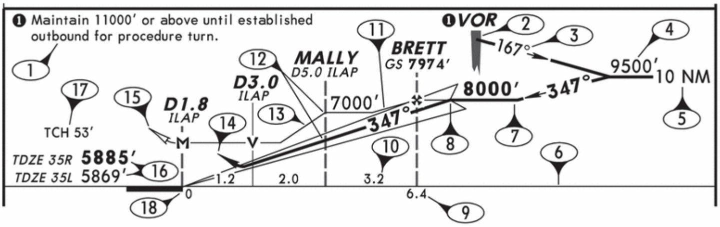
8 — Bold text is used to emphasize the procedure altitude at the FAF or the GS intercept altitude at the FAP/FAF. This is also the altitude shown in the Briefing Strip.

9 — The type of navaid is indicated. Identifying Morse code is shown for all markers. When known, glide slope crossing altitudes are included.

10 — The navaid ident or name is included where confusion may occur. The crossing altitude of the Vertical Descent Angle (VDA) is included whenever applicable.

11 — All fix names are shown along with any DME formations. The ident of the source DME is included when multiple DME sources are charted.

12 — Stand-alone DME fixes are depicted similar to named waypoints.



1 — Procedure notes that relate directly to information portrayed in the profile view are charted within the profile view, normally placed in the upper right or left corners.

2 — A "broken" navaid or fix symbol indicates that it does not fall directly in line with the final approach track.

3 — Outbound bearings associated with procedure turns are included for situational awareness.

4 — Minimum altitude while executing the procedure turn.

5 — The distance to remain within while executing the procedure turn. Distance is measured from the initiating navaid/fix unless otherwise indicated.

6 — Profile view "ground line". Represents an imaginary straight line originating from the runway threshold. No terrain high points or man-made structures are represented in the profile view.

7 — Procedure flight tracks are portrayed using a thick solid line. Multiple separate procedures using the same altitudes are represented by a single line.

8 — Final Approach Point (FAP). Beginning of the final approach segment for precision approaches.

9 — Nautical Mile (NM) distance to the "0" point. Not included at DME fixes.

10 — Nautical Mile (NM) distance between two navaids and or fixes.

11 — Final Approach Course bearing. Only repeated if a change in course occurs.

12 — Tracks are placed relative to each other based on the corresponding crossing altitudes.

13 — Non-precision procedure flight tracks that deviate from the Glide Slope and or the Vertical Descent Angle are depicted as a light solid line.

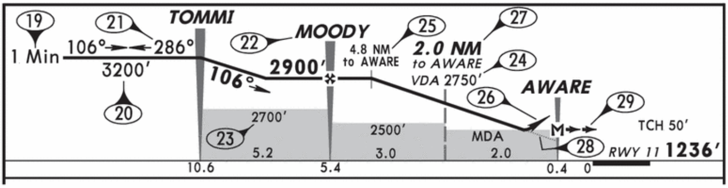
14 — Pull-up representing the DA/MDA or when reaching the descent limit along the GS/VDA.

15 — Pull-up arrow associated to a non-precision approach not using a CDFA technique.

16 — Touchdown zone, runway end, or threshold elevation labeled accordingly.

17 — Threshold crossing height associated to the charted glide slope or vertical descent angle.

18 — Runway block symbolizing the runway. The approach end represents the runway threshold.



19 — Time limit applicable to the outbound leg of the procedure holding/racetrack.

20 — Minimum altitude while executing the procedure holding/racetrack.

21 — Outbound and inbound bearings associated to the procedure holding/racetrack.

22 — RNAV waypoints are identified by their five character identifier only.

23 — Segment Minimum Altitudes (SMA) are represented by a shaded rectangle bordered by the two defining fixes. The minimum altitude is shown along the top edge of the sector.

24 — Altitudes that correspond to the VDA.

25 — Nautical miles to the next fix is supplied for the "Top of Descent" when not at a fix.

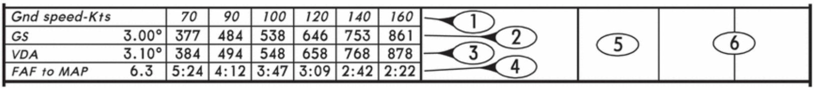
26 — Pull up along the VDA at the DA/MDA is depicted relative to the missed approach point.

27 — Nautical miles and name of "to" fixes are supplied for all along track distance fixes.

28 — A dotted gray line illustrates the VNAV path from the FAF to the Landing Threshold Point (LTP) TCH. The VNAV path supports CDFA flight techniques between the FAF and MAP only. The VNAV path is NOT intended to be used below the DA/MDA. In accordance with FAA and ICAO regulations, descent below DA/MDA is strictly prohibited without visual reference to the runway environment.

29 — Visual flight track is shown when the missed approach point is prior to the runway threshold.

DESCENT/TIMING CONVERSION TABLE — LIGHTING BOX — MISSED APPROACH ICONS



Gnd speed-Kts		70	90	100	120	140	160
GS	3.00°	377	484	538	646	753	861
VDA	3.10°	384	494	548	658	768	878
FAF to MAP	6.3	5:24	4:12	3:47	3:09	2:42	2:22

1 — Indicates Ground Speed in Knots for several common aircraft approach speeds.

2 — For precision approaches, Glide Slope angle is shown in degrees along with relative descent rates in feet per minute.

3 — For non-precision approaches, Vertical Descent Angle is shown, when applicable, in degrees along with relative descent rates in feet per minute.

4 — The location of the Missed Approach Point is defined, the distance and associated timing is included only when applicable.

5 — Installed approach lights, visual approach slope indicators, and runway end identification lights (REIL) are depicted for the straight-in landing runway.

6 — Missed approach Icons which symbolize the initial "up and out" actions associated with the missed approach procedure are depicted. The complete missed approach instructions are shown in textual form in the Briefing Strip.

APPROACH

APPROACH CHART LEGEND

LANDING MINIMUMS (Eff Jan 2020)

Publication of landing minimums does not constitute authority for their use by all operators. Each individual operator is responsible for ensuring that the proper minimums are used based on authorization specific to the type of operation.

Landing minimums are supplied for all approach procedures and known approach conditions. When the Governing State Authority has not provided landing visibilities for a particular approach procedure, they will be derived by Jeppesen based on ICAO Doc 9365 Manual of All Weather Operations. For landing minimums rules and tables refer to AIR TRAFFIC CONTROL — Aerodrome Operating Minimums JEPPESEN.

A “Std” label in the upper left corner of the minimums box indicates that the published visibilities are ICAO Doc 9365 compliant. Other labels, as described below, indicate compliance with other regulations.

Visibilities that have been derived by Jeppesen for straight-in procedures are all RVR, State provided VIS or CMV values will be labeled as such. Visibilities for circling procedures are always VIS. Operators using these visibilities should be aware of this. If ATC does not report RVR, pilots have to convert the reported meteorological VIS into a CMV, to compare it against the charted RVR (refer to the table at the end of this section and to AIR TRAFFIC CONTROL — Aerodrome Operating Minimums JEPPESEN).

Visibility values are reported and thus depicted in the form of nautical/statute miles, feet, meters and kilometers.

1 — Minimums Label: Indicates that landing minimums are compliant with a specific regulation, but never below State published values.

Std – Minimums are based on tables and rules from ICAO Doc 9365 (Manual of All Weather Operations). No comparison has been done to any other landing minimums criteria.

Std/State – Minimums are based on tables and rules from a State Regulation which is similar/close to ICAO Doc 9365 (e.g. EASA AIR OPS, Indian CAR), refer also to AIR TRAFFIC CONTROL — Aerodrome Operating Minimums JEPPESEN for identified differences to ICAO Doc 9365. No comparison has been done to any other landing minimums criteria.

TERPS – Minimums are based on TERPS change 20 or later. U.S. OPSPEC requirement for non-CDFA penalty applies. No comparison has been done to any other landing minimums criteria.

State – Minimums are shown as supplied by the State (unknown rules and tables). State minimums may be supplemented (e.g. for ALS out condition) by visibilities based on ICAO Doc 9365 but not below the State supplied minimums. No comparison has been done to any other landing minimums criteria.

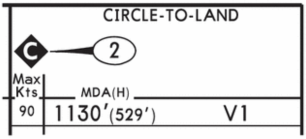
Military – Minimums are shown as supplied by a State Military. No comparison has been done to any other landing minimums criteria.

JAR-OPS – Minimums are based on tables and rules from JAR-OPS 1. No comparison has been done to any other landing minimums criteria.

No label indicates that the landing minimums are **not** yet converted to the new Jeppesen Standard AOM and are still based on ECOMS rules and tables (refer to www.jeppesen.com/aom).

A **Standard** or **Standard/DGCA** label indicates that the minimums are based on EASA AIR OPS, EU-OPS/CAR-OPS or Indian CAR, but are **not** yet converted to the new Jeppesen Standard AOM. During conversion to the new Standard AOM the new **Std/State** label and the new layout will be applied, the visibilities will remain unchanged. No comparison has been done to any other landing minimums criteria.

2 — Indicates that the published Circle-To-Land minimums are based on TERPS 8260.3B change 21 or later version. Expanded circling approach areas apply. For expanded circling approach area radii refer to AIR TRAFFIC CONTROL — United States — Rules and Procedures. The “C” is also depicted for circling minimums outside of the United States if applicable.



APPROACH

APPROACH CHART LEGEND

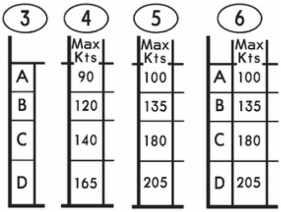
3 — Aircraft approach categories.

4 — TERPS **maximum** circling speeds.

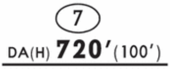
5 — ICAO **maximum** circling speeds.

Note: Known deviations from the TERPS or ICAO maximum circling speeds will be shown. For countries that do not supply maximum circling speeds, aircraft approach categories will be shown.

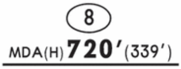
6 — For Circle-To-Land only approaches, both the aircraft approach categories and the maximum circling speeds are shown just prior to the circling minimums.



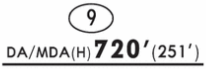
7 — Decision Altitude (Height) label, Decision Altitude and Decision Height for Precision approach and APV operations.
A charted DA(H) on Non-precision approaches which are converted to the new AOM Standard **(State** label) indicates that the DA(H) is published by the State, and only in this case a height loss might be incorporated by the State.
Note: A charted "DA(H)" on older Non-precision approaches with "Standard" minimums will be replaced by "DA/MDA(H)". On those charts a height loss is <u>not</u> incorporated, neither in charted DA(H) nor in the charted DA/MDA(H).



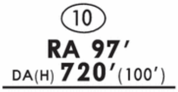
8 — Minimum Descent Altitude (Height) label, Minimum Descent Altitude and Minimum Descent Height for Non-precision approach operations. The MDA(H) is shown for non-CDFA minimums or if the State has supplied an MDA(H) on the procedure source.



9 — DA/MDA(H) label is shown, when either Decision Altitude (Height) or Minimum Descent Altitude (Height) can be used on Non-precision approaches depending on operational approval. This label is normally associated with CDFA minimums.
Note: Jeppesen charted DA/MDA(H) values do not include a height loss adjustment. Pilots have to check their operator's policy for the application of add-ons.



10 — Radio Altimeter height, associated with CAT II precision approaches. In some cases a specific Radio Altitude is supplied by the State as part of CAT III State minimums.



11 — Nautical or Statute mile VIS are depicted in whole and fractions of a mile. No units label is shown. A specified visibility of "V3/4" means "3/4 mile", "V2 1/2" means "2 1/2 miles".

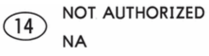
12 — Equivalent Runway Visual Range (RVR) values associated with nautical/statute mile VIS represent readings in hundreds of feet, "R40" means RVR 4000ft. Equivalent RVR values are shown when supplied or authorized by the State, applicable to a specific approach procedure.

13 — Visibilities in meters are labeled with an "m" while values in kilometers are labeled with a "km". There are only RVR values shown, except if a VIS is provided by the State. An RVR is labeled "R", a VIS value is labeled "V". An "R/V" label indicates that the charted value is either RVR or VIS.

APPROACH

APPROACH CHART LEGEND

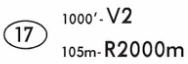
14 — The particular condition is **Not Authorized**. If necessary it will be abbreviated by “NA”.

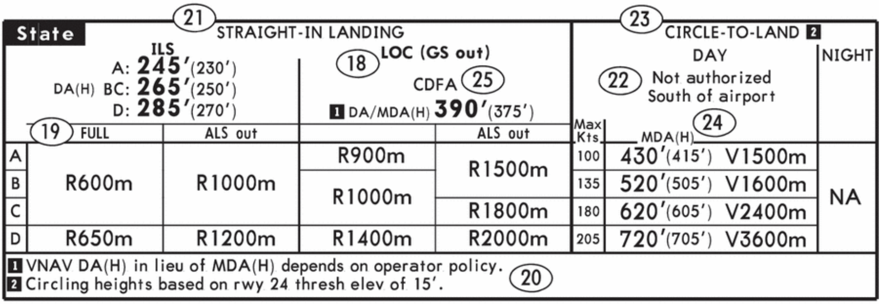


15 — The particular condition does **not apply**.

16 — Indicates that a ceiling is required as part of the overall landing minimums. Ceilings are shown as a height above ground level in feet or meters depending on the unit used for reporting.

17 — When required, ceilings are depicted prior to the associated visibility. Ceiling is always shown in smaller size in front of the RVR or VIS.





State — STRAIGHT-IN LANDING — CIRCLE-TO-LAND 2

ILS DA(H) A: 245'(230') BC: 265'(250') D: 285'(270')

LOC (GS out) CDFA 1 DA/MDA(H) 390'(375')

DAY: Not authorized South of airport — NIGHT

	FULL	ALS out		ALS out	Max Kts	MDA(H)	NIGHT
A	R600m	R1000m	R900m	R1500m	100	430'(415') V1500m	NA
B			R1000m		135	520'(505') V1600m	
C				R1800m	180	620'(605') V2400m	
D	R650m	R1200m	R1400m	R2000m	205	720'(705') V3600m	

1 VNAV DA(H) in lieu of MDA(H) depends on operator policy.
2 Circling heights based on rwy 24 thresh elev of 15'.

18 — Type of approach is indicated when multiple types are shown in minimums box.

19 — Known conditions or requirements that affect the minimums are shown above the visibilities.

20 — Notes that only apply to the charted minimums are shown within the minimums box.

21 — Label for straight-in minimums. The straight-in runway number is only shown if more runways are affected, for example if the State supplies side-step landing minimums.

22 — Notes that apply to a given set of minimums are shown above the affected values.

23 — The set of minimums applicable when a circling maneuver is required are labeled as such.

24 — The MDA(H) label for circle-to-land minimum descent altitudes and the associated height is shown at the top of the column.

25 — CDFA indicates that the minimums require the use of CDFA flight technique.

A charted “non-CDFA” indicates that the approach does not meet the CDFA criteria. Where the State regulation (“Std/State” label) requires an add-on, the 200m for CAT A & B and 400m for CAT C & D are incorporated into the charted visibility values.

ICAO DOC 9365 **does not** require the add-on, therefore the visibilities in minimums boxes with the “Std” label are charted as provided in Table 6-3 (refer to AIR TRAFFIC CONTROL — Aerodrome Operating Minimums JEPPESEN).

APPROACH

APPROACH CHART LEGEND

Labels used in conjunction with landing visibility values

R — An “R” label indicates that the associated value is an RVR.

When the State Authority has supplied landing visibilities, and has indicated that the value supplied is an RVR, the “R” label is applied.

Since all straight-in visibility values in ICAO Doc 9365 are in the form of an RVR, all values depicted when the State Authority has not supplied visibilities will be labeled with an “R”. This does not depend on the availability of RVR transmissometer. How these values are used is dependent on each individual operator’s regulations.

V — A “V” label indicates that the associated value is a metric or nautical/statute mile meteorological VIS. For straight-in procedures only VIS that have been supplied by the State Authority will be labeled with a “V”. Circling visibilities are always VIS and therefore labeled with a “V”.

R/V — An “R/V” label indicates that the associated value can be either an RVR or met VIS depending on what is reported by ATC. Only RVR/VIS values that have been supplied by the State Authority will be labeled with an “R/V”.

C — A “C” label indicates that the associated value is a converted meteorological visibility (CMV). A CMV is equivalent to an RVR and is derived from the meteorological visibility which is reported by ATC. Only CMV values that have been supplied by the State Authority will be labeled with a “C”.

Guide for Visibility Label Usage

Charted Visibility Label	Reported by ATC	Probable Pilot action (Note 1)
R or **C**	RVR	Reported RVR is compared directly to the R or C value on the chart.
	Met VIS	Reported met VIS is converted into CMV and then compared to the R or C value on the chart. **(Note 2)**
V	RVR	RVR in ft needs to be converted to sm, then compared directly to the V value on the chart. A metric RVR is compared directly to the V value on the chart.
	Met VIS	Reported met VIS is compared directly to the V value on the chart.
R/V	RVR	Reported RVR is compared directly to the R value on the chart.
	Met VIS	Reported met VIS is compared directly to the V value on the chart.

Note 1: Refer to AIR TRAFFIC CONTROL — Aerodrome Operating Minimums JEPPESEN for conversion factors depending on available approach and runway lights during day and night.

Note 2: An operator must ensure that a conversion of a reported met VIS to RVR/CMV is not used for take-off, for calculating any other required RVR minimum less than 800m, or when a reported RVR is available.
Conversion of met VIS to RVR may depend on individual operator's regulations.

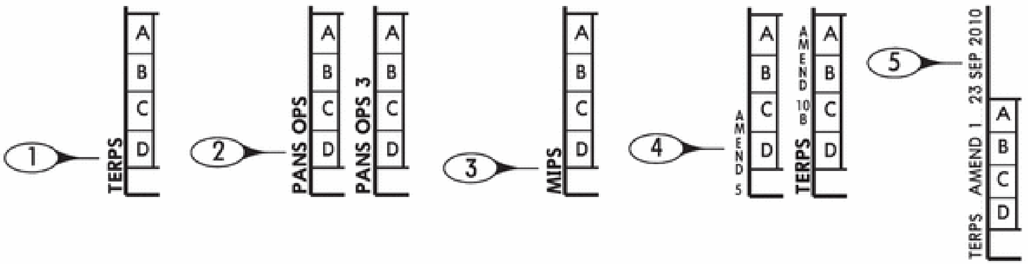
Depiction of Landing Minimums based on ECOMS tables and rules

Refer to www.jeppesen.com/aom

APPROACH

APPROACH CHART LEGEND

CHART BOUNDARY LINE INFORMATION



1 — Label indicates the State has specified that the approach procedure complies with the United States Standard for Terminal Procedures criteria as it relates to aircraft handling speeds and circling area development.

2 — Labels indicate the State has specified that the approach procedure complies with the ICAO PANS-OPS criteria as it relates to aircraft handling speeds and circling area development.

3 — Label indicates the MIPS design criteria when it is known that the procedure is designed according to Military Instrument Procedures Standardization, which is the short form for AATCP–1, NATO Supplement to ICAO Document 8168-0PS/611 Volume II.

4 — Shown when procedure source amendment information has been supplied by the State (USA).

5 — Currently only shown on U.S. approach procedures, the Procedure Amendment Reference Date is supplied on charts with an Effective Date later than 22 OCT 2009. This reference date is used to establish electronic database currency.

6— A brief summary of the changes applied to the chart during the last revision.

7 — Jeppesen Copyright label.

END OF APPROACH CHART LEGEND

CHART LEGEND - EASA AIR OPS AERODROME OPERATING MINIMUMS (AOM)

Publication of minimums does not constitute authority for their use by all operators. Each individual operator must obtain appropriate approval for their use.

1. GENERAL

The inverted **“Standard”** label in the upper left corner of the minimums box indicates that the minimums are based on EASA AIR OPS and State Minimums, if provided. They are not compared against other concepts like ECOMS. For a detailed excerpt of EASA AIR OPS minimums refer to Jeppesen ATC-Chapter "AERODROME OPERATING MINIMUMS - EASA AIR OPERATIONS".

Jeppesen charted minimums are not below any State-provided minimums. RVR/CMV/VIS values are shown in measuring units as reported by the governing agency.

AOM for take-off and landing are either shown on Jeppesen instrument approach or aerodrome charts or on a separate minimums listing.

Landing minimums will be shown as RVR, as provided within the EASA tables.

A Visibility, prefixed "VIS", will only be charted if a VIS value is published as State minimum.

A Converted Meteorological Visibility, prefixed “CMV”, will only be charted if a CMV value is published as State minimum.

Take-off minimums are shown as RVR, or without prefix if they are either RVR or VIS.

A Visibility, prefixed "VIS", will only be charted for take-off if a VIS value is published as State minimum.

Circling minimums without prefix are always visibilities.

For separate minimums listings (like 10-9S pages) RVR, CMV and VIS are abbreviated as “R”, “C” and “V”.

NOTE: Most of the samples in this document are intended to illustrate only the relevant information of the related paragraph. Other sections (like circling minimums) within the samples are intentionally left blank.

2. TAKE-OFF MINIMUMS

Low visibility take-off operations below a visibility of 800m require that the **operator** verifies that Low Visibility Procedures (LVP) or equivalent procedures have been established and are in force.

Jeppesen charts the lowest possible take-off minimums (including LVTO) because the LVP information is not always published in the AIP.

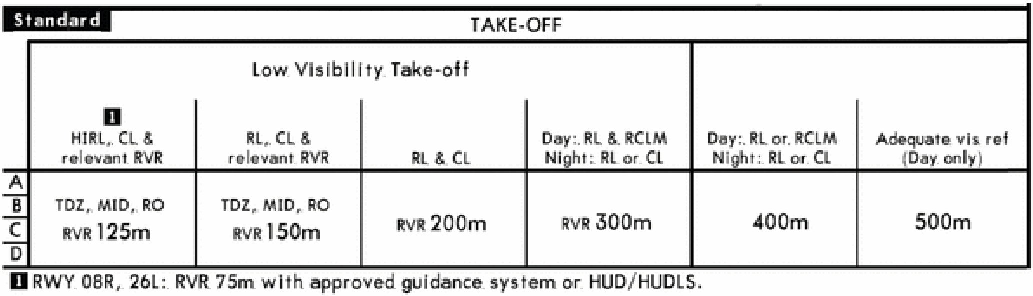
Only if there is a clear statement within the AIP that LVP are not available for the specific airport, the take-off minimum will be charted as RVR 550m VIS 800m (or higher State value).

The multiple RVR requirement means, that the required RVR value must be achieved for all of the relevant RVR reporting points (touchdown zone, mid and rollout end of runway), except for the initial part, which can be determined by pilot assessment. Approved operators may reduce their take-off minimums to RVR 75m with an approved lateral guidance system and if the runway is protected for CAT III landing operations and equivalent facilities are available.

Jeppesen charts a take-off RVR of 75m only if the runway is approved for CAT IIIB operations with RVR 75m.

Night operations always require runway end lights. This is not indicated in the take-off minimums box.

Sample of Take-off Minimums



Standard

TAKE-OFF

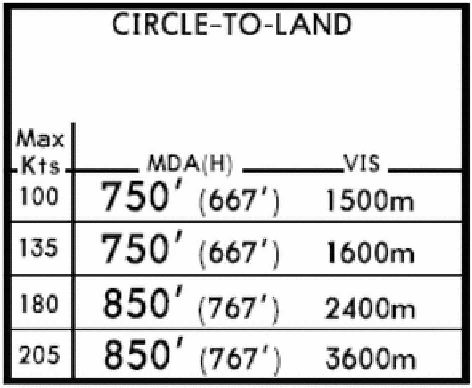
	Low Visibility Take-off					
	[1] HIRL, CL & relevant RVR	RL, CL & relevant RVR	RL & CL	Day: RL & RCLM Night: RL or CL	Day: RL or RCLM Night: RL or CL	Adequate vis ref (Day only)
A B C D	TDZ, MID, RO RVR 125m	TDZ, MID, RO RVR 150m	RVR 200m	RVR 300m	400m	500m

[1] RWY 08R, 26L: RVR 75m with approved guidance system or HUD/HUDLS.

3. CIRCLING MINIMUMS

Circling minimums are only charted if a circling OCA(H) or MDA(H) is provided by the procedure source. Otherwise, the circling box is removed. If circling is not authorized by the procedure source, it will be noted in the Briefing Strip header. Where straight-in minimums are higher than circling minimums (DH/MDH or RVR/VIS), a note is added to remind the pilot that the higher straight-in minimums have to be used.

Sample of Circling Minimums



CIRCLE-TO-LAND

Max Kts	MDA(H)	VIS
100	750′ (667′)	1500m
135	750′ (667′)	1600m
180	850′ (767′)	2400m
205	850′ (767′)	3600m

4. NON-PRECISION APPROACH MINIMUMS AND CHART PROFILE VIEW

According to the EASA AIR OPS requirements for Commercial Air Transport Operations (Part CAT), all non-precision approaches shall be flown using the continuous descent final approach (CDFA) technique with decision altitude (height), and the missed approach shall be executed when reaching the DA(H) or the missed approach point (MAP), whichever occurs first. The lateral part of the missed approach procedure must be flown via the MAP unless stated otherwise in the procedure.

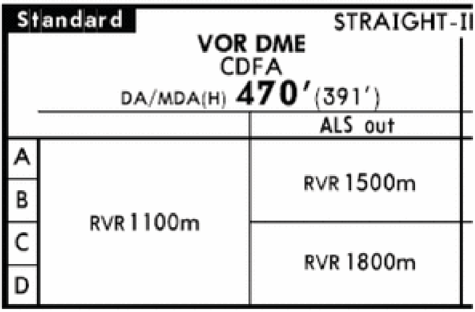
Jeppesen criteria for charting of CDFA or non-CDFA minimums are based on **AMC1 CAT.OP.MPA.115** Approach flight technique – aeroplanes.

Normally, only CDFA minimums are shown. They are identified by the use of a **DA/MDA(H)** label. **Jeppesen does not apply an add-on when publishing a DA/MDA(H) for a CDFA non-precision approach, because this depends on operator specific factors.**

The CDFA condition will always be identified by the term ‘CDFA” above the DA/MDA(H) label.

Non-CDFA minimums are shown in exceptional cases and identified by an MDA(H) label. The MDA(H) label is also charted if the State explicitly publishes an MDA(H) on procedure source instead of an OCA(H). The non-CDFA condition will always be identified by the term ‘non-CDFA” above the MDA(H) label.

Sample of Non-precision Minimums (CDFA)



Standard

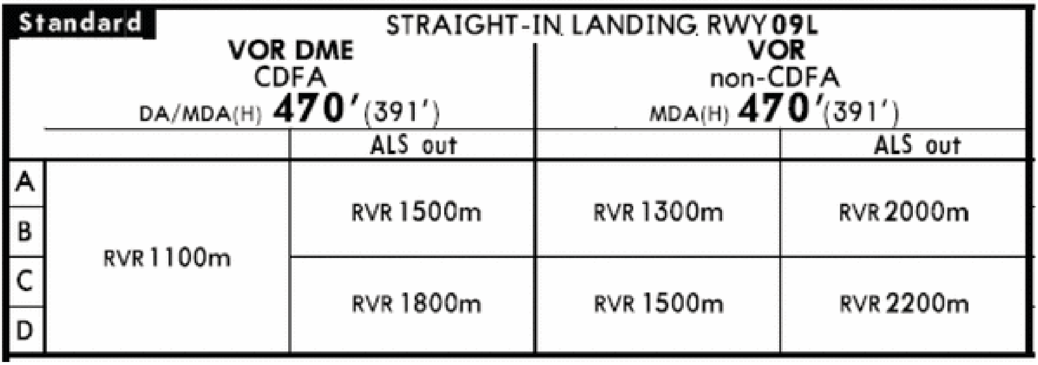
STRAIGHT-I

VOR DME
CDFA
DA/MDA(H) 470′(391′)

		ALS out
A	RVR 1100m	RVR 1500m
B		
C		RVR 1800m
D		

CHART LEGEND - EASA AIR OPS AERODROME OPERATING MINIMUMS (AOM)

Sample of Non-precision Minimums (CDFA + non-CDFA)



Standard

STRAIGHT-IN LANDING RWY 09L

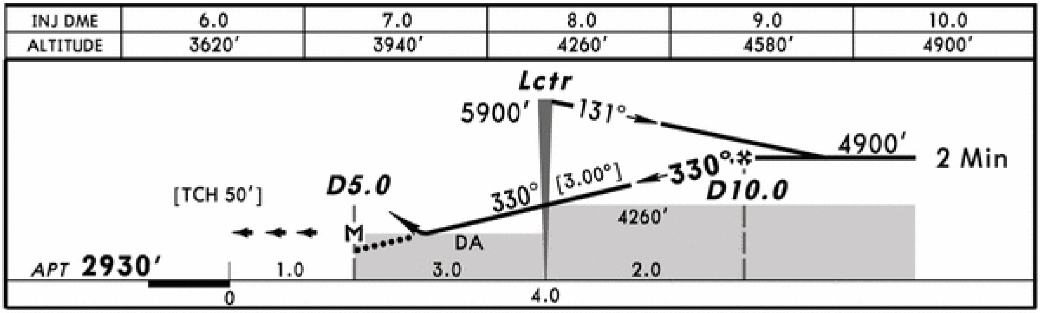
	VOR DME CDFA DA/MDA(H) 470′(391′)		VOR non-CDFA MDA(H) 470′(391′)	
		ALS out		ALS out
A	RVR 1100m	RVR 1500m	RVR 1300m	RVR 2000m
B				
C		RVR 1800m	RVR 1500m	RVR 2200m
D				

The profile depiction will be modified to show the continuous descent track on final approach. Source-published minimum altitudes will be shown as segment minimum altitudes in the profile (grey shaded box). These minimum altitudes are typically provided for obstacle clearance and must not be violated to remain clear of obstacles or terrain.

If not published by the procedure source, a table depicting distance vs altitude or DME vs altitude information will be calculated by Jeppesen and shown above the profile view.

The missed approach pull-up arrow is shown at the point where the decision height is reached. There is no level segment depicted prior to the MAP, the MAP symbol is shown at the same position as published by the procedure source.

CDFA depiction (profile view)

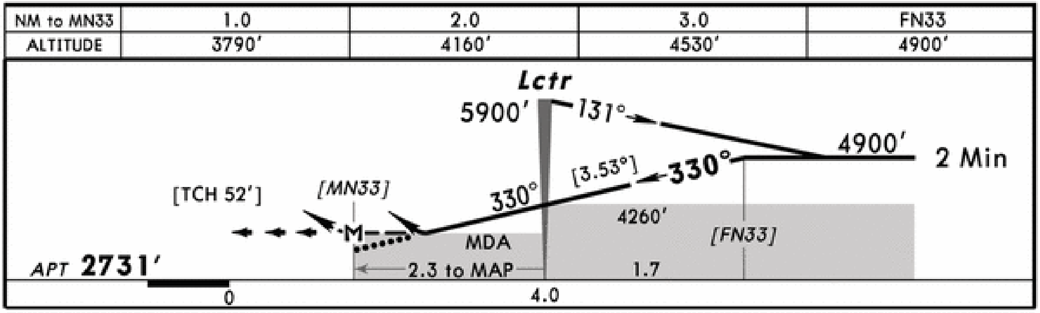


INJ DME	6.0	7.0	8.0	9.0	10.0
ALTITUDE	3620′	3940′	4260′	4580′	4900′

In exceptional cases it may be necessary to include both, CDFA and non-CDFA flight path. In this case, a level segment is shown prior to the missed approach point and the pull-up arrow is shown at the MAP to depict the non-CDFA procedure.

CHART LEGEND - EASA AIR OPS AERODROME OPERATING MINIMUMS (AOM)

CDFA and non-CDFA depiction (profile view)



NM to MN33	1.0	2.0	3.0	FN33
ALTITUDE	3790'	4160'	4530'	4900'

5. CAT I PRECISION AND APV APPROACH MINIMUMS

An RVR of less than 750m may be used:

a. for CAT I operations to runways with FALS and TDZ and CL, **or**

b. for CAT I operations to runways with FALS but without TDZ and/or CL when using an approved head-up guidance landing system (HUDLS) or an equivalent approved system, **or**

c. for CAT I operations to runways with FALS but without TDZ and/or CL when conducting a coupled or flight-director-flown approach to decision height, **or**

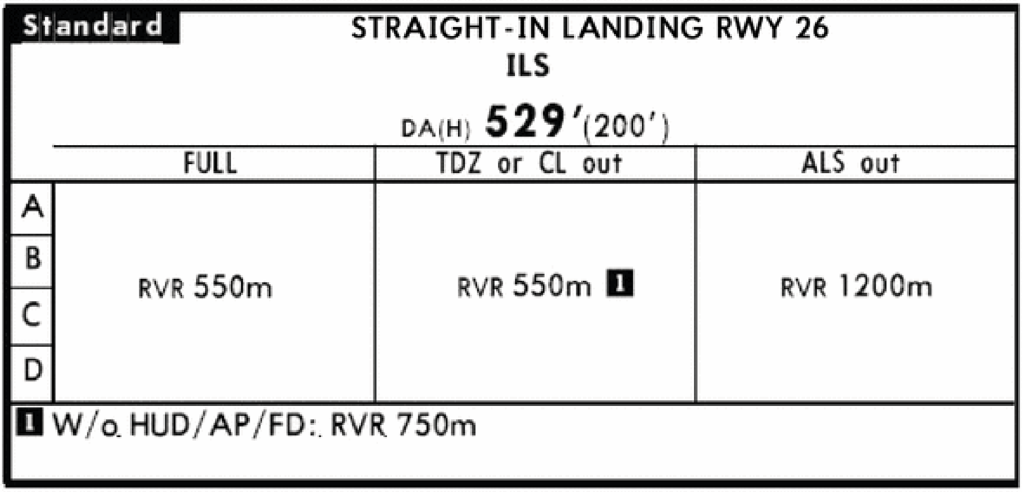
d. for APV operations to runways with FALS and TDZ and CL when using an approved head-up display (HUD).

NOTE: A conversion of reported meteorological visibility to CMV should not be used for any RVR minimum less than 800m. In this case a minimum VIS of 800m applies for the procedure. A charted “RVR XXXm” (any RVR below 800m) have to be understood as “RVR XXXm ***or*** *VIS 800m”.*

The European States publish more and more LPV (SBAS CAT I) procedures. To clearly differentiate between the CAT I and APV operations, the terms “LPV CAT I” and “LPV” are used in the minimums box.

CHART LEGEND - EASA AIR OPS AERODROME OPERATING MINIMUMS (AOM)

Sample of CAT I Minimums (FALS + TDZ + CL)



Standard

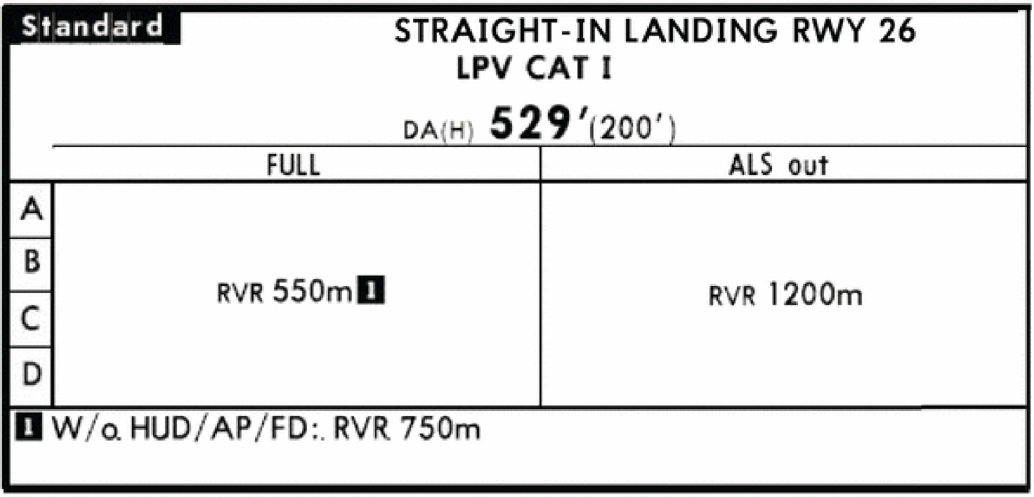
STRAIGHT-IN LANDING RWY 26
ILS
DA(H) **529'**(200')

	FULL	TDZ or CL out	ALS out
A	RVR 550m	RVR 550m [1]	RVR 1200m
B			
C			
D			

[1] W/o HUD/AP/FD: RVR 750m

The note “W/o HUD/AP/FD: RVR 750m” indicates that the use of HUD **or** autopilot **or** flight director is required if TDZ or CL are not available. Otherwise the RVR is 750m.

Sample of CAT I Minimums (FALS, no TDZ and/or no CL)



Standard

STRAIGHT-IN LANDING RWY 26
LPV CAT I
DA(H) **529'**(200')

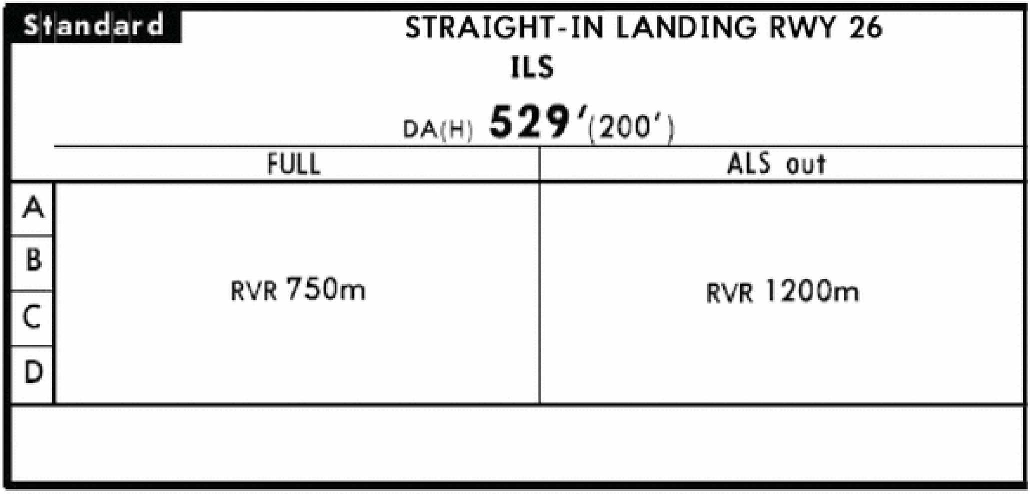
	FULL	ALS out
A	RVR 550m [1]	RVR 1200m
B		
C		
D		

[1] W/o HUD/AP/FD: RVR 750m

CHART LEGEND - EASA AIR OPS AERODROME OPERATING MINIMUMS (AOM)

The note “W/o HUD/AP/FD: RVR 750m” indicates that the use of HUD **or** autopilot **or** flight director is required for the charted RVR. Otherwise the RVR is 750m.

Sample of CAT I Minimums (IALS)



Standard

STRAIGHT-IN LANDING RWY 26

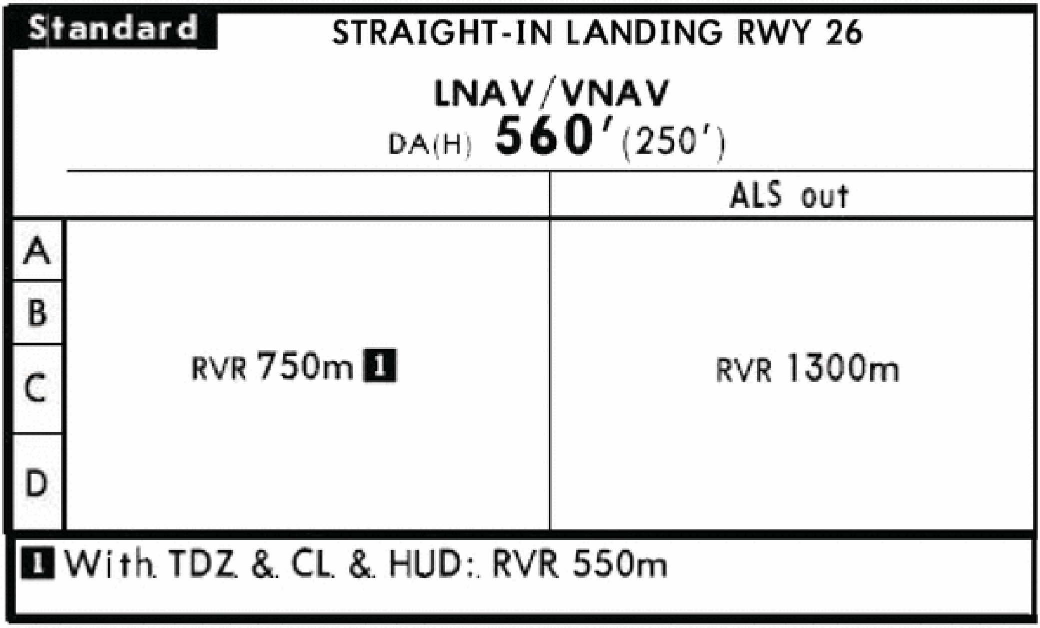
ILS

DA(H) 529'(200')

	FULL	ALS out
A	RVR 750m	RVR 1200m
B		
C		
D		

CHART LEGEND - EASA AIR OPS AERODROME OPERATING MINIMUMS (AOM)

Sample of APV Minimums (FALS + TDZ + CL)



Standard STRAIGHT-IN LANDING RWY 26

LNAV/VNAV
DA(H) 560′(250′)

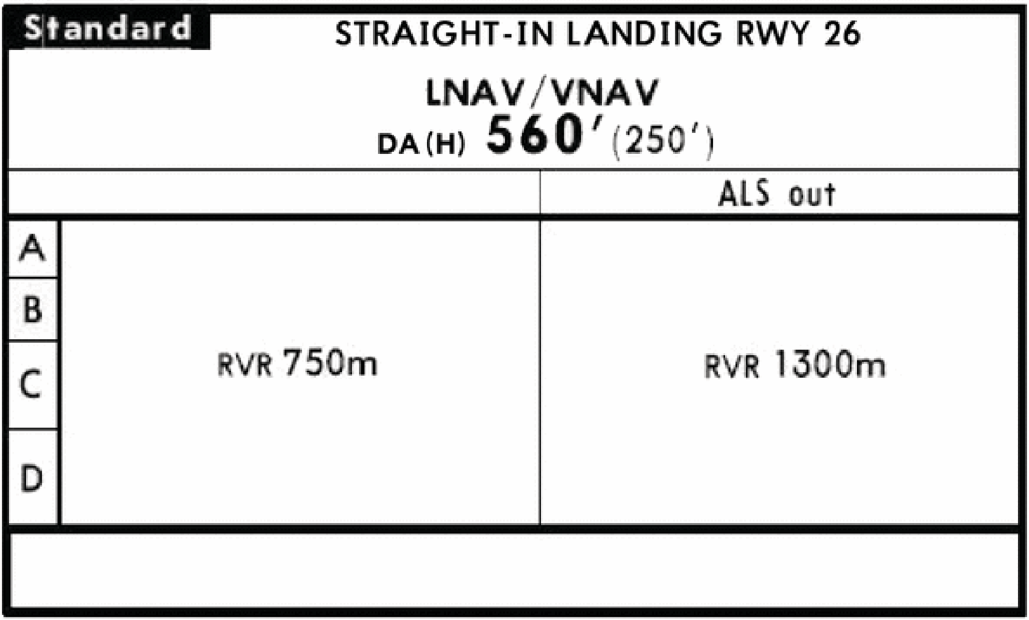
		ALS out
A B C D	RVR 750m 1	RVR 1300m

1 With TDZ & CL & HUD:. RVR 550m

The RVR is 750m. The RVR could only be reduced to 550m if TDZ **and** CL are operational **and** a HUD is used.

CHART LEGEND - EASA AIR OPS AERODROME OPERATING MINIMUMS (AOM)

Sample of APV Minimums (FALS, no TDZ and/or no CL)



Standard

STRAIGHT-IN LANDING RWY 26

LNAV/VNAV

DA(H) 560′(250′)

		ALS out
A	RVR 750m	RVR 1300m
B		
C		
D		

6. LOWER THAN STANDARD CAT I MINIMUMS

Operators must be approved by their authority to conduct lower than standard CAT I operations. For approved operators, tailored charts will be created on customer request only.

7. CAT II PRECISION APPROACH MINIMUMS

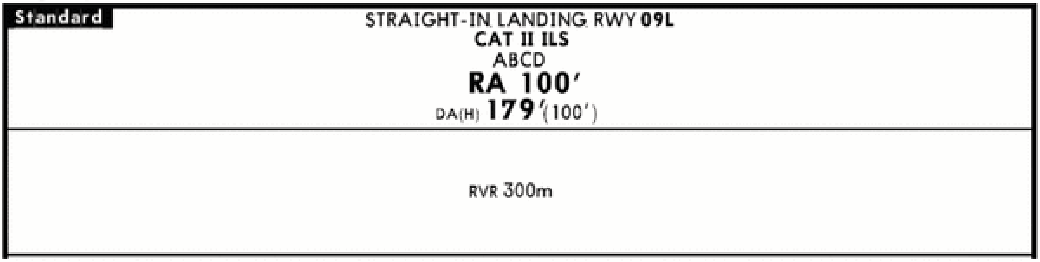
Minimums are applicable to EASA AIR OPS approved operators as well as to FAR 121 operators and those applying U.S. Operations Specifications (Ops Specs).

The minimum RVR is 300m.

EASA operators: For category D it is required to conduct an autoland. Otherwise, the minimum RVR is 350m; however, this value is not charted on Standard Jeppesen charts.

For US operators: Autoland or HUD to touchdown are required.

Sample of CAT II Minimums



Standard

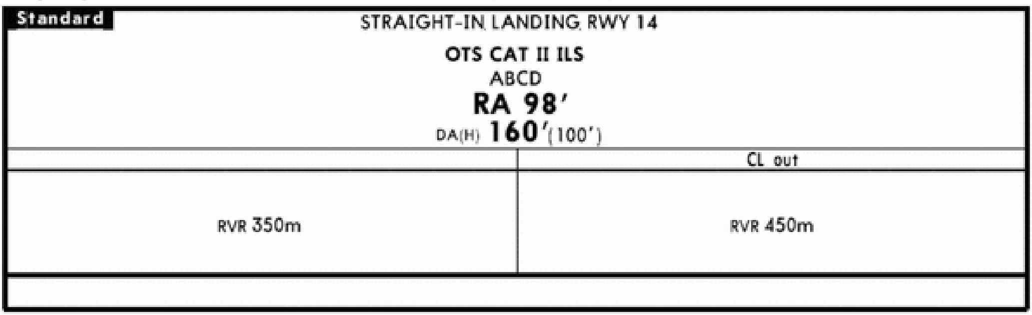
STRAIGHT-IN LANDING RWY **09L**
CAT II ILS
ABCD
RA 100′
DA(H) **179′**(100′)

RVR 300m

8. OTHER THAN STANDARD CAT II PRECISION APPROACH MINIMUMS

Other Than Standard CAT II minimums will only be published if the procedure is approved for it by the aerodrome's Civil Aviation Authority. Charting is similar to standard CAT II minimums. An RVR of 400m or below can only be used if CL are available.

Sample of other than Standard CAT II Minimums (FALS + CL)

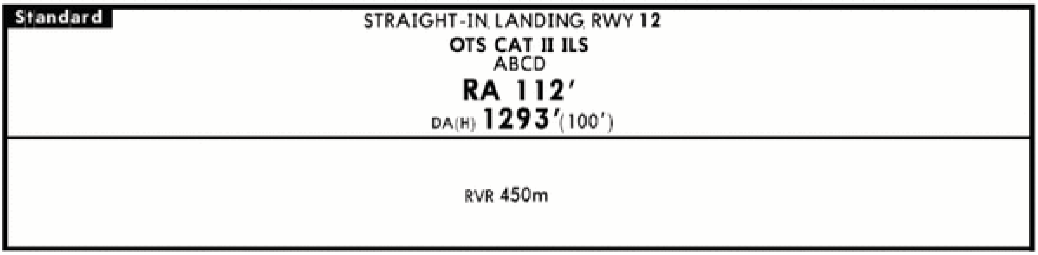


Standard

STRAIGHT-IN LANDING RWY 14
OTS CAT II ILS
ABCD
RA 98′
DA(H) **160′**(100′)

	CL out
RVR 350m	RVR 450m

Sample of other than Standard CAT II Minimums (FALS, no CL)



Standard

STRAIGHT-IN LANDING RWY 12
OTS CAT II ILS
ABCD
RA 112′
DA(H) **1293′**(100′)

RVR 450m

9. CAT III PRECISION APPROACH MINIMUMS

Only CAT IIIA minimums are charted on Standard charts within the EASA AIR OPS application area. The DH 50’ value is charted based on customer input and does not necessarily mean that the pilot has to use this value as decision height. There is no State within Europe publishing a *specific* DH value for CAT IIIA operations as State required minimum.

RVR 200m, as the minimum RVR for CAT IIIA operations according to EASA Air OPS, is charted unless a higher value is required by the State of the aerodrome.

Pilots have to check the Flight Operations Manual (or similar documents) for their specific approvals.

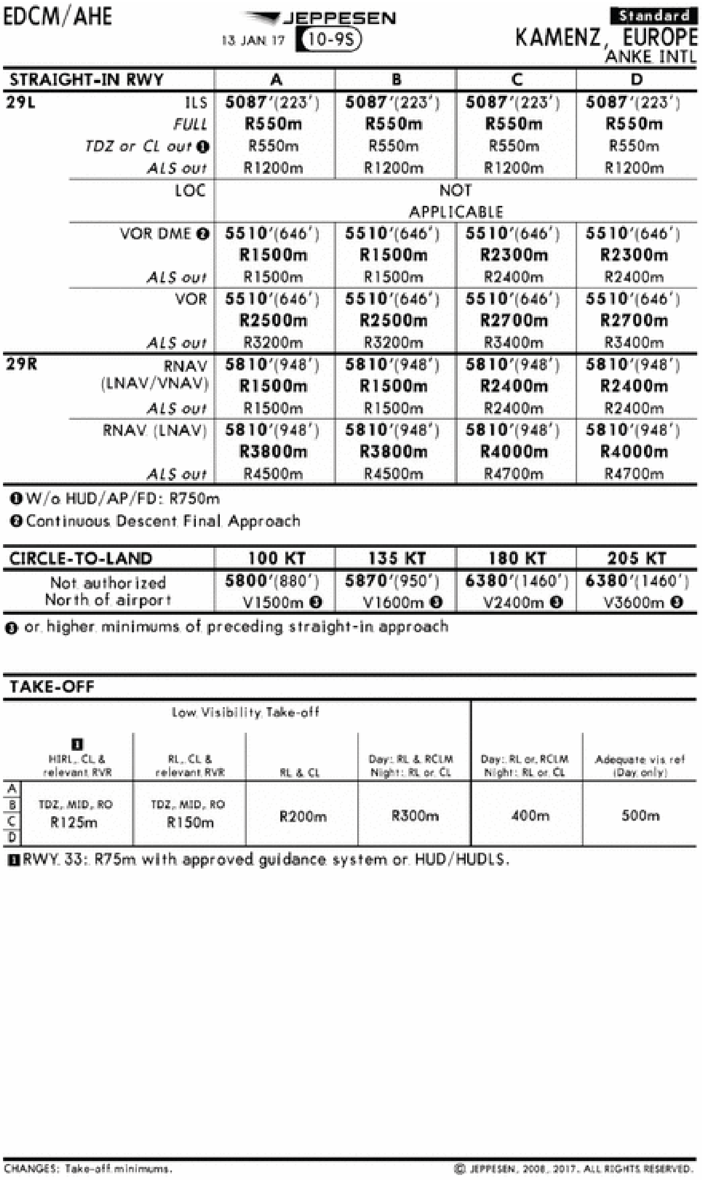
10. AERODROME MINIMUMS LISTING

On customer request, the EASA AIR OPS minimums may be made available on a minimums listing page. The listings are indexed as 10-9S/10-9S1, 20-9S/20-9S1, etc.

TERPS change 20 was harmonized with the EASA minimum tables for CAT I, APV and NPA (CAT C and D aircraft only). Those procedures with the TERPS label are therefore EASA AIR OPS compliant and a 10-9S page is normally not required.

CHART LEGEND - EASA AIR OPS AERODROME OPERATING MINIMUMS (AOM)

Sample of 10-9S chart



EDCM/AHE

JEPPESEN

13 JAN 17 10-9S

Standard

KAMENZ, EUROPE
ANKE INTL

STRAIGHT-IN RWY		A	B	C	D
29L	ILS	5087′(223′)	5087′(223′)	5087′(223′)	5087′(223′)
	FULL	**R550m**	**R550m**	**R550m**	**R550m**
	TDZ or CL out ❶	R550m	R550m	R550m	R550m
	ALS out	R1200m	R1200m	R1200m	R1200m
	LOC	NOT APPLICABLE			
	VOR DME ❷	5510′(646′) **R1500m**	5510′(646′) **R1500m**	5510′(646′) **R2300m**	5510′(646′) **R2300m**
	ALS out	R1500m	R1500m	R2400m	R2400m
	VOR	5510′(646′) **R2500m**	5510′(646′) **R2500m**	5510′(646′) **R2700m**	5510′(646′) **R2700m**
	ALS out	R3200m	R3200m	R3400m	R3400m
29R	RNAV (LNAV/VNAV)	5810′(948′) **R1500m**	5810′(948′) **R1500m**	5810′(948′) **R2400m**	5810′(948′) **R2400m**
	ALS out	R1500m	R1500m	R2400m	R2400m
	RNAV (LNAV)	5810′(948′) **R3800m**	5810′(948′) **R3800m**	5810′(948′) **R4000m**	5810′(948′) **R4000m**
	ALS out	R4500m	R4500m	R4700m	R4700m

❶ W/o HUD/AP/FD: R750m

❷ Continuous Descent Final Approach

CIRCLE-TO-LAND	100 KT	135 KT	180 KT	205 KT
Not authorized North of airport	5800′(880′) V1500m ❸	5870′(950′) V1600m ❸	6380′(1460′) V2400m ❸	6380′(1460′) V3600m ❸

❸ or higher minimums of preceding straight-in approach

TAKE-OFF

	Low Visibility Take-off					
	[1] HIRL, CL & relevant RVR	RL, CL & relevant RVR	RL & CL	Day: RL & RCLM Night: RL or CL	Day: RL or RCLM Night: RL or CL	Adequate vis ref (Day only)
A B C D	TDZ, MID, RO R125m	TDZ, MID, RO R150m	R200m	R300m	400m	500m

[1] RWY 33: R75m with approved guidance system or HUD/HUDLS.

CHANGES: Take-off minimums.

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11. DEPICTION OF EASA AIR OPS AOM IN CASE OF EXISTING STATE MINIMUMS

If State minimums are officially published, the depiction of AOM may differ from the standard depiction where all values are expressed as RVR or VIS.

a. If RVR and VIS are charted together, the RVR value is compulsory. If no RVR is reported, the reported VIS has to be used without conversion.

b. No prefix is charted if RVR and VIS is identical. The reported RVR is compulsory. If no RVR is reported, the reported VIS has to be used without conversion.

c. If only VIS is charted, the reported VIS has to be used without conversion.

d. If CMV is charted, the pilot converts a reported VIS and compare this value against the charted CMV.

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Introduction

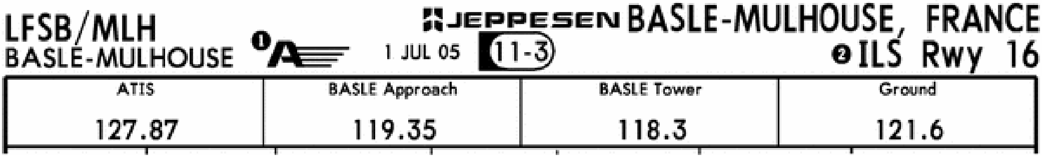
Chart Format Description Information

AIRLINE FORMAT
APPROACH CHART LEGEND AIRLINE FORMAT

GENERAL

This legend serves as supplementary information to the new format and regular approach chart legend. The following pages briefly explain the differences and symbols used on airline charts. Airline charts refer only to aircraft categories C and D. Blue as an additional color serves for better differentiation between primary and secondary information.

APPROACH CHART HEADING



LFSB/MLH
BASLE-MULHOUSE ①
JEPPESEN BASLE-MULHOUSE, FRANCE
1 JUL 05 11-3 ② ILS Rwy 16

ATIS	BASLE Approach	BASLE Tower	Ground
127.87	119.35	118.3	121.6

① Airline chart icon.

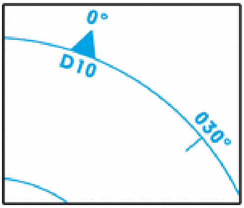
② The former reference to CAT II and CAT III suffixes are routinely being omitted by various states according to ICAO recommendations. Whenever possible, CAT I, CAT II, and IIIA ILS procedures will be combined.

LOC MH	Final Apch Crs	GS D3.6 MH	CAT IIIA ILS	CAT I & II ILS	Apt Elev 885'
111.55	155°	2030'(1166')	DH 50' ③	Refer to Minimums	RWY 864'

③ The lowest permissible CAT IIIA minimum will always be charted if a runway is CATIIIA approved together with a cross reference note for CAT I and CAT II referring to the minimums.

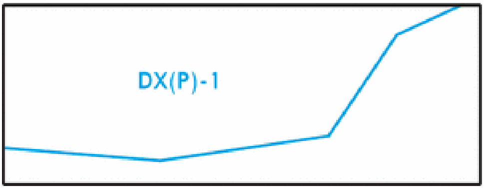
PLAN VIEW

DME distance and radial information spaced at intervals of 5 NM

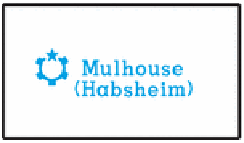


AIRLINE FORMAT
APPROACH CHART LEGEND AIRLINE FORMAT

Special use airspace (Prohibited, Restricted, Danger Areas)



Secondary airport



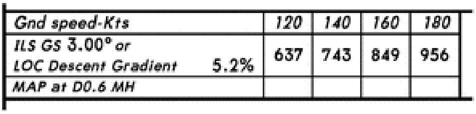
PROFILE VIEW

Recommended Altitude Descent Table

LOC (GS out)	MH DME	5.0	4.0	3.0	2.0	1.0
	ALTITUDE	2480′	2160′	1840′	1520′	1200′

When not already state-supplied, a DME ribbon, beginning at the final approach fix (FAF), will be shown for all non-precision approaches when a suitable DME is used in the procedure.

Conversion Table



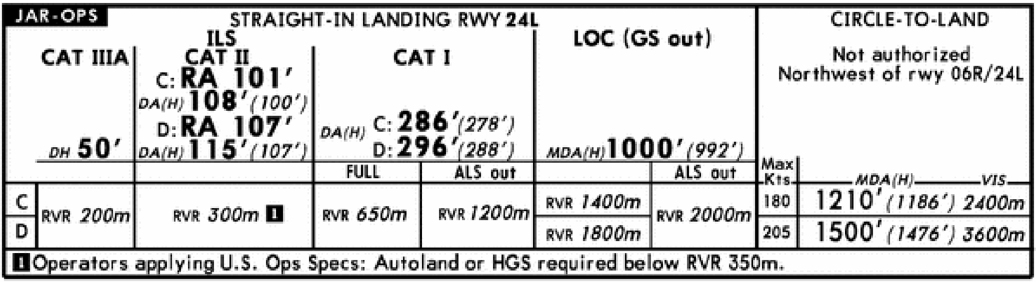
Gnd speed-Kts	*120*	*140*	*160*	*180*
ILS GS 3.00° or *LOC Descent Gradient* 5.2%	637	743	849	956
MAP at D0.6 MH				

The aircraft approach speeds have been adjusted to better match the aircraft categories C and D.

AIRLINE FORMAT
APPROACH CHART LEGEND AIRLINE FORMAT

APPROACH AND AIRPORT CHART MINIMUMS

Landing Minimums



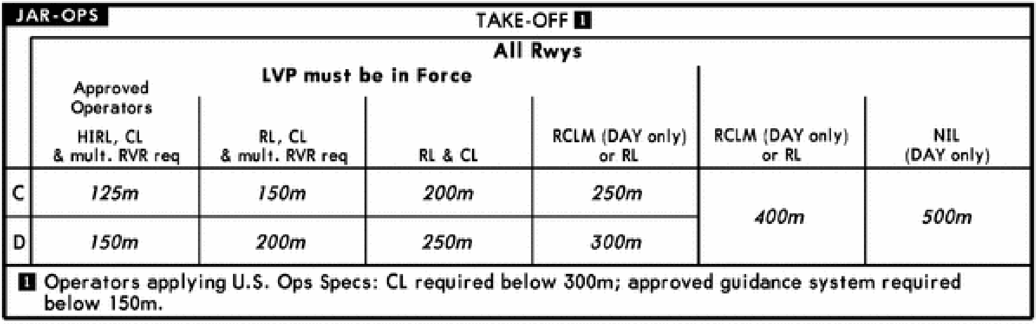
JAR-OPS

	STRAIGHT-IN LANDING RWY 24L CAT IIIA	ILS CAT II	CAT I		LOC (GS out)		CIRCLE-TO-LAND		
	DH 50′	C: RA 101′ DA(H) 108′(100′) D: RA 107′ DA(H) 115′(107′)	DA(H) C: 286′(278′) D: 296′(288′)		MDA(H) 1000′(992′)		Not authorized Northwest of rwy 06R/24L		
			FULL	ALS out		ALS out	Max Kts	MDA(H)	VIS
C	RVR 200m	RVR 300m [1]	RVR 650m	RVR 1200m	RVR 1400m	RVR 2000m	180	1210′(1186′)	2400m
D					RVR 1800m		205	1500′(1476′)	3600m

[1] Operators applying U.S. Ops Specs: Autoland or HGS required below RVR 350m.

Typical depiction of landing minimums for runways approved for ILS CAT IIIA operations.

Take-off Minimums



JAR-OPS

	TAKE-OFF [1] All Rwys LVP must be in Force Approved Operators HIRL, CL & mult. RVR req	RL, CL & mult. RVR req	RL & CL	RCLM (DAY only) or RL	RCLM (DAY only) or RL	NIL (DAY only)
C	125m	150m	200m	250m	400m	500m
D	150m	200m	250m	300m		

[1] Operators applying U.S. Ops Specs: CL required below 300m; approved guidance system required below 150m.

CAUTION: Legend pages titled "AIRLINE FORMAT" contain information specific to charts created for airlines. These legend pages include only those items that are unique to the airline format. For information not covered in the "AIRLINE FORMAT" legend, refer to the "NEW FORMAT" and regular "APPROACH CHART LEGEND."

SID/DP/STAR OVERVIEW CHART LEGEND AIRLINE FORMAT

SID/DP/STAR overview charts are to-scale; however, they are **not** intended for navigation purpose. They serve mainly to enhance terrain and general situational awareness and to provide basic information useful in flight planning. If ordered by your airline, these optional overview charts serve as supplementary information only in conjunction with the associated SID/DP/STAR charts.

The following pages briefly explain the differences and symbols used on the airline overview charts. Blue as an additional color serves to better differentiate between primary and secondary information.

AIRLINE FORMAT
APPROACH CHART LEGEND AIRLINE FORMAT

Sample Overview Chart

AIRLINE FORMAT

APPROACH CHART LEGEND AIRLINE FORMAT

LEGEND

❶ Airline chart icon.

❷ Index number (special chart for airlines).

❸ Standard terminal arrival overview.

❹ Standard terminal arrival routes to all available runways.

❺ Highest of portrayed terrain high point/man-made structures, or terrain contours in the charted plan view. Higher terrain or man-made structures may exist which have not been portrayed.

❻ North arrow.

❼ Large water area, lake, or river.

❽ Special use airspace (prohibited, restricted, danger areas).

❾ Secondary airport.

❿ DME distance circles preferably based on a VORDME on or in the vicinity of the airport concerned. Where no suitable VORDME is available, DME distance circles may be centered on ILS/LOCDME, stand-alone DME or TACAN locations. For quick identification, the box of the concerned radio aid is printed blue.

⓫ TMA boundary with name and airspace classification.

⓬ Brown box indicating the corresponding layer’s top elevation within the plan view.

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Introduction

Signs and Markings

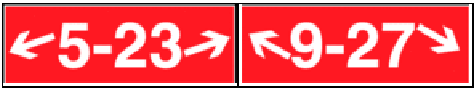
MANDATORY SIGNS

Mandatory signs have a red background with a white inscription. They are used to denote an entrance to a runway or critical area and areas where an aircraft is prohibited from entering.

TAXIWAY/RUNWAY AND RUNWAY/RUNWAY HOLDING

This sign is located at the holding position on taxiways that intersect a runway or on runways that intersect other runways. The inscription on the sign contains the designation of the intersecting runway. The runway numbers on the sign are arranged to correspond to the respective runway threshold. For example, “15-33” indicates that the threshold for Runway 15 is to the left and the threshold for Runway 33 is to the right. A runway holding position sign on a taxiway will be installed adjacent to holding position markings on the taxiway pavement. On runways, holding position markings will be located only on the runway pavement adjacent to the sign, if the runway is normally used by air traffic control for “Land, Hold Short” operations or as a taxiway.

On taxiways that intersect the beginning of the takeoff runway, only the designation of the takeoff runway may appear on the sign, while all other signs will have the designation of both runway directions.



When a sign is located on a taxiway that intersects the intersection of two runways, the designations for both runways will be shown on the sign along with arrows showing the approximate alignment of each runway. In addition to showing the approximate runway alignment, the arrow indicates the direction to the threshold of the runway whose designation is immediately next to the arrow.

ILS CRITICAL AREA HOLDING

At some airports, when the instrument landing system is being used, it is necessary to hold an aircraft on a taxiway at a location other than the normal holding position. In these situations the holding position sign for these operations will have the inscription “ILS” and be located adjacent to the holding position marking on the taxiway.

RUNWAY APPROACH AREA HOLDING

At some airports, it is necessary to hold an aircraft on a taxiway located in the approach or departure area for a runway so that the aircraft does not interfere with operations on that runway. In these situations, a sign with the designation of the approach end of the runway followed by a "dash" (-) and letters "APCH" will be located at the holding position on the taxiway. In this example, the sign may protect the approach to Runway 15 and/or the departure for Runway 33.

NO ENTRY

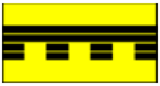
Prohibits an aircraft from entering an area. Typically, this sign would be located on a taxiway intended to be used in only one direction or at the intersection of vehicle roadways with runways, taxiways or aprons where the roadway may be mistaken as a taxiway or other aircraft movement surface.

LOCATION SIGNS

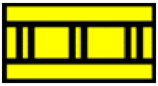
Location signs are used to identify either a taxiway or runway on which the aircraft is located. Other location signs provide a visual cue to pilots to assist them in determining when they have exited an area. The various location signs are described below.

Taxiway Location Signs have a black background with a yellow inscription and yellow border. The inscription is the designation of the taxiway on which the aircraft is located. These signs are installed along taxiways either by themselves or in conjunction with direction signs or runway holding position signs.

Runway Location Signs have a black background with a yellow inscription and yellow border. The inscription is the designation of the runway on which the aircraft is located. These signs are intended to complement the information available to pilots through their magnetic compass and typically are installed where the proximity of two or more runways to one another could cause pilots to be confused as to which runway they are on.



Runway Boundary Signs have a yellow background with a black inscription with a graphic depicting the pavement holding position marking. This sign, which faces the runway and is visible to the pilot exiting the runway, is located adjacent to the holding position marking on the pavement. The sign is intended to provide pilots with another visual cue which they can use as a guide in deciding when they are “clear of the runway.”



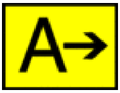
ILS Critical Area Boundary Signs have a yellow background with a black inscription and a graphic depicting the ILS pavement holding position marking. This sign is located adjacent to the ILS holding position marking on the pavement and can be seen by pilots leaving the critical area. The sign is intended to provide pilots with another visual cue which they can use as a guide in deciding when they are “clear of the ILS critical area.”

DIRECTION SIGNS

Direction signs have a yellow background with a black inscription. The inscription identifies the designations(s) of the intersecting taxiway(s) leading out of the intersection that a pilot would normally be expected to turn onto or hold short of. Each designation is accompanied by an arrow indicating the direction of the turn.

When more than one taxiway designation is shown on the sign each designation and its associated arrow is separated from the other taxiway designations by either a vertical message divider or a taxiway location sign.

Direction signs are normally located on the left prior to the intersection. When used on a runway to indicate an exit, the sign is located on the same side of the runway as the exit.



Taxiway Direction Sign or Runway Exit Sign

When the intersection is comprised of only one crossing taxiway, it will have two arrows associated with the crossing taxiway.

DESTINATION SIGNS

Destination signs also have a yellow background with a black inscription indicating a destination on the airport. These signs always have an arrow showing the direction of the taxi route to that destination. When the arrow on the destination sign indicates a turn, the sign is located prior to the intersection.

Destinations commonly shown on these types of signs include runways, aprons, terminals, military areas, civil aviation areas, cargo areas, international areas, and fixed base operators. An abbreviation may be used as the inscription on the sign for some of these destinations.

UNITED STATES AIRPORT SIGN SYSTEMS

Outbound Destination Sign

Outbound Destination Sign to Different Runways. More than one runway, separated by a dot, is shown where the taxiing route is common to both runways.

Inbound Destination Sign

INFORMATION SIGNS

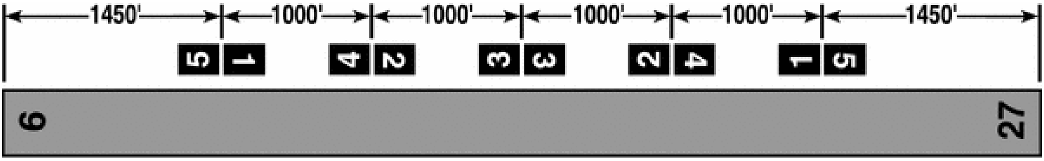
Information signs have a yellow background with a black inscription. They are used to provide the pilot with information on such things as areas that cannot be seen from the control tower, applicable radio frequencies, and noise abatement procedures. The airport operator determines the need, size, and location for these signs.

RUNWAY DISTANCE REMAINING SIGNS

Runway Distance Remaining Signs are used to provide distance remaining information to pilots during takeoff and landing operations. The signs are located along one or both sides of the runway, and the inscription consists of a *white numeral on a black background*. The signs indicate the distance remaining in thousands of feet.

The distance remaining may be *50 ft* less than shown on the sign. There is a 50 ft tolerance in the sign placement. *Some signs may be omitted* because they cannot meet this tolerance.

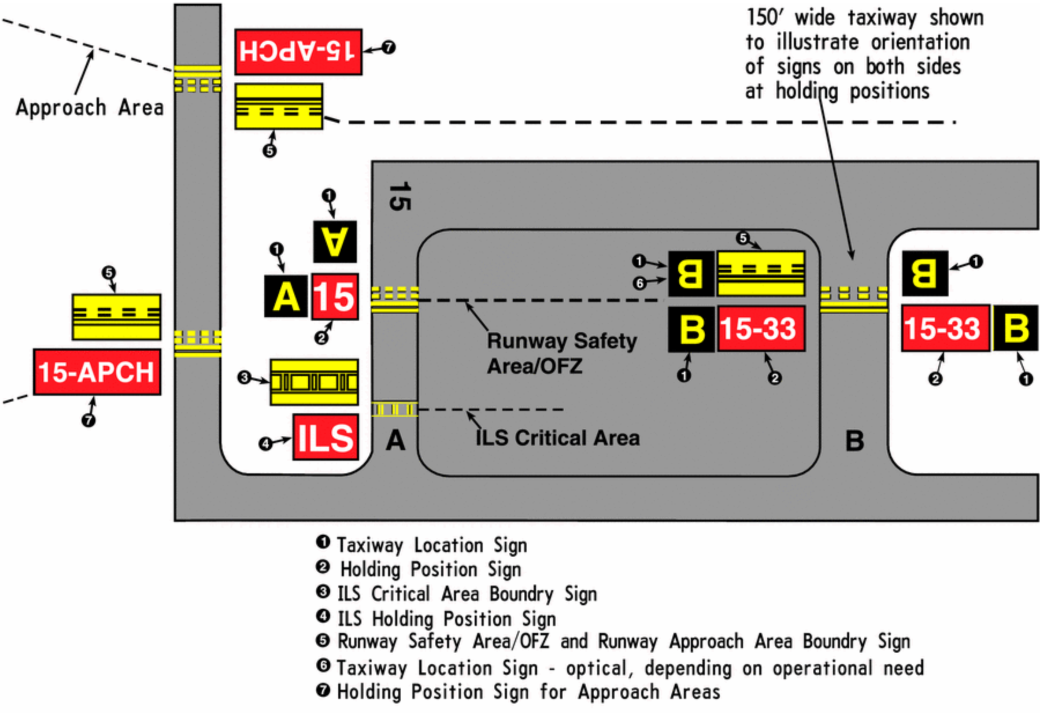
When runway length is not an even multiple of 1000 ft, half the "additional distance" is added to the first and last sign placement. The example below is for a 6900 ft runway.



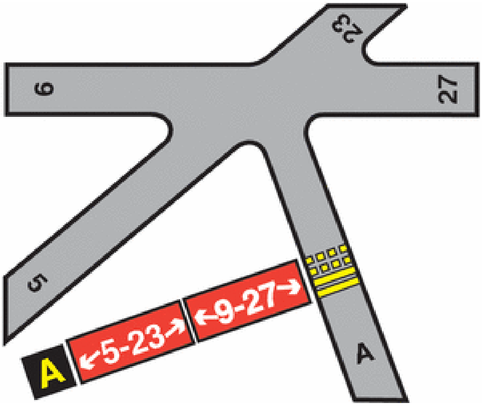
EXAMPLES

NOTE: Generally, signs will be lighted if the runway or taxiway on which they are installed is lighted. Holding position signs and any collocated location signs will be lighted if the runway for which they are installed is lighted even if the taxiway on which they are installed is unlighted.

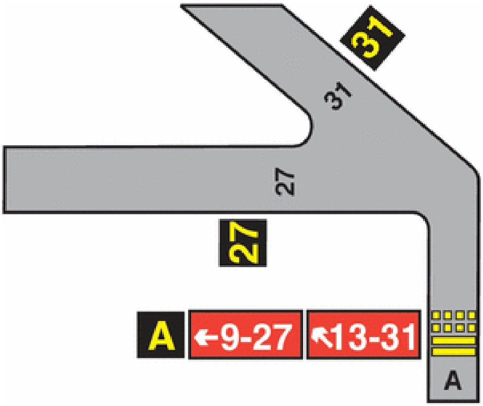
UNITED STATES AIRPORT SIGN SYSTEMS



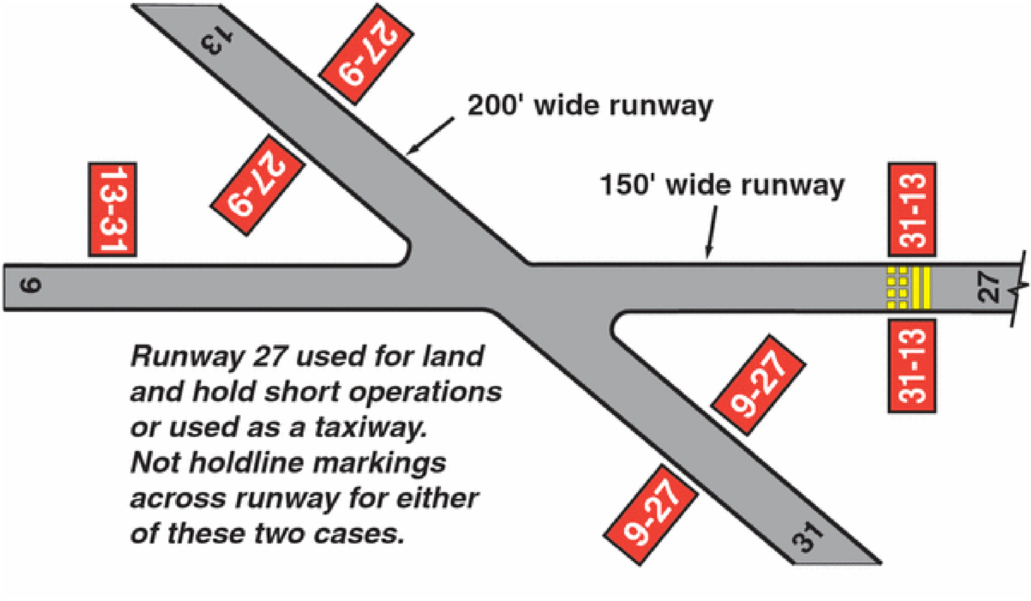
TAXIWAY ENTRANCE AT INTERSECTION OF TWO RUNWAYS



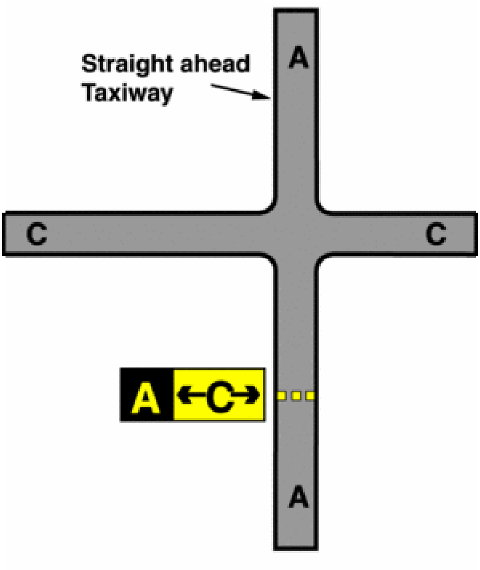
TAXIWAY ENTRANCE AT INTERSECTION OF TWO RUNWAY ENDS



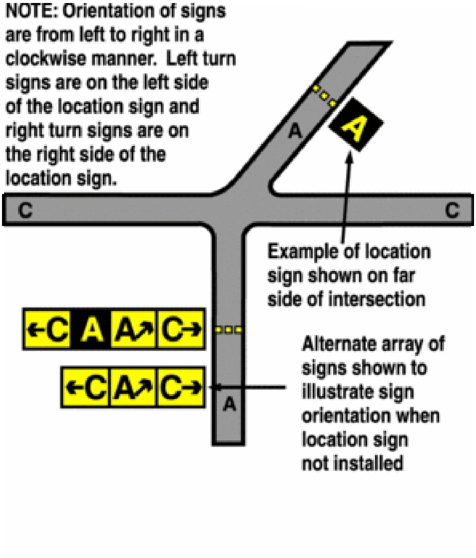
HOLDING POSITION SIGNS AT RUNWAY INTERSECTIONS



STANDARD 4-WAY TAXIWAY INTERSECTION



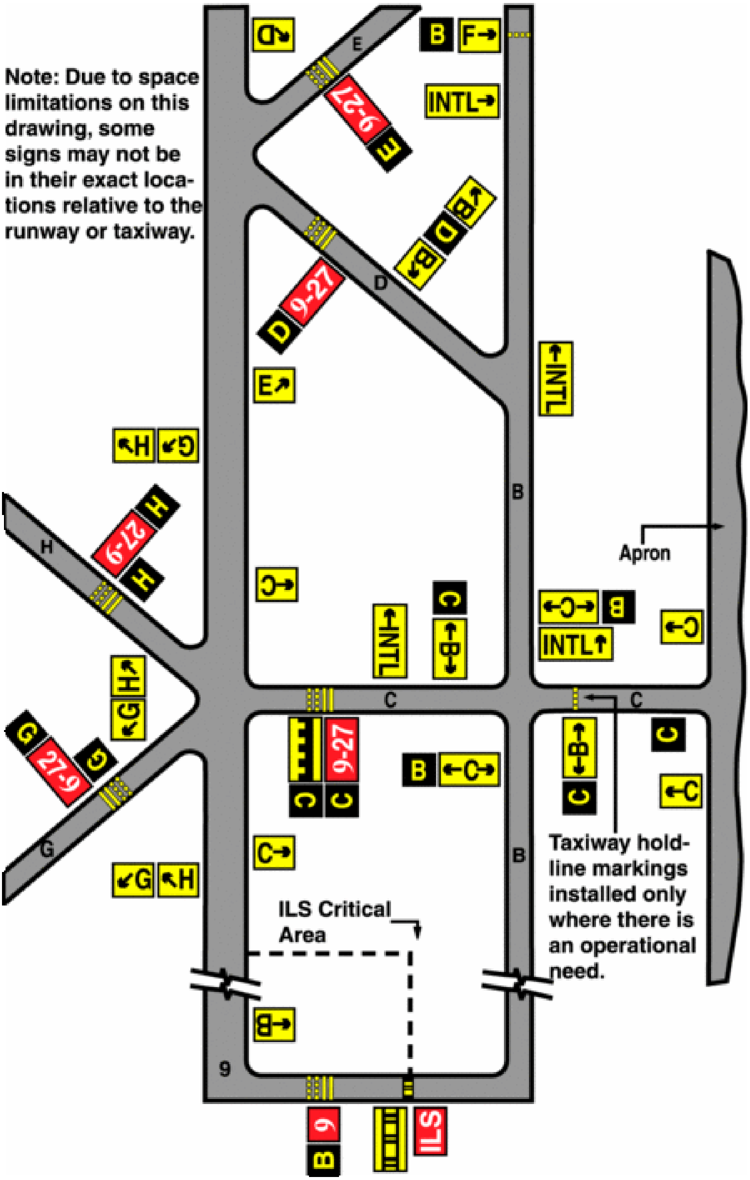
STRAIGHT AHEAD TAXIWAY HAS DIRECTION CHANGE GREATER THAN 25


NOTE: Orientation of signs are from left to right in a clockwise manner. Left turn signs are on the left side of the location sign and right turn signs are on the right side of the location sign.

Example of location sign shown on far side of intersection

Alternate array of signs shown to illustrate sign orientation when location sign not installed

SIGNING EXAMPLES FOR A COMPLEX AIRPORT



Note: Due to space limitations on this drawing, some signs may not be in their exact locations relative to the runway or taxiway.

Taxiway hold-line markings installed only where there is an operational need.

UNITED STATES INSTRUMENT RUNWAY MARKINGS

Runway markings are *white*. Markings, excluding hold lines and the runway designator marking (the runway number) are described below.

THRESHOLD MARKING

Eight longitudinal stripes of uniform dimensions arranged symmetrically about the runway centerline. They are always 150° long.

RUNWAY CENTERLINE MARKINGS

A line of uniformly spaced stripes and gaps located on the centerline of the runway. Stripes are 120' long.

RUNWAY TOUCHDOWN ZONE MARKINGS AND FIXED DISTANCE MARKINGS

Distance from approach end of runway to beginning of the markings	
500'	Touchdown Zone. Three bars 75' long on each side of the centerline. They are the beginning of the fixed distance markers. Fixed distance markers are positioned 500' apart.
1000'	Thousand Foot Fixed Distance Marker. One “heavy” bar on each side of the centerline, 150' long and 30' wide.
1500'	Two bars, 75' long, on each side of the centerline.
2000'	Two bars, 75' long, on each side of the centerline.
2500'	One bar, 75' long, on each side of the centerline.
3000'	One bar, 75' long, on each side of the centerline.

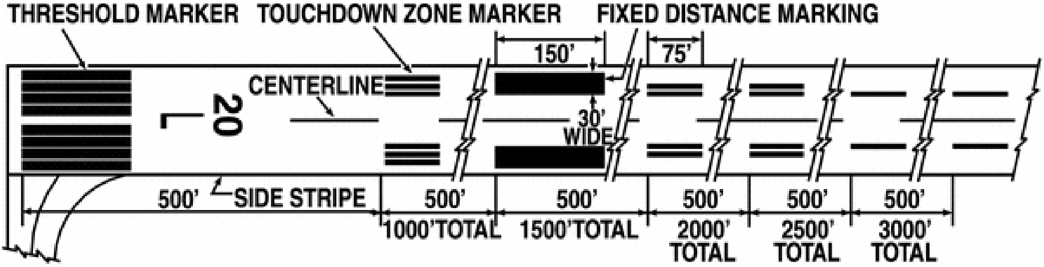
SIDE STRIPE MARKING

Continuous stripes located along each side of the runway to provide contrast with the surrounding terrain and/or to delineate the full strength runway pavement areas. Maximum distance between the stripes is 200'. *Side stripe markings are normally provided only on precision instrument runways*.

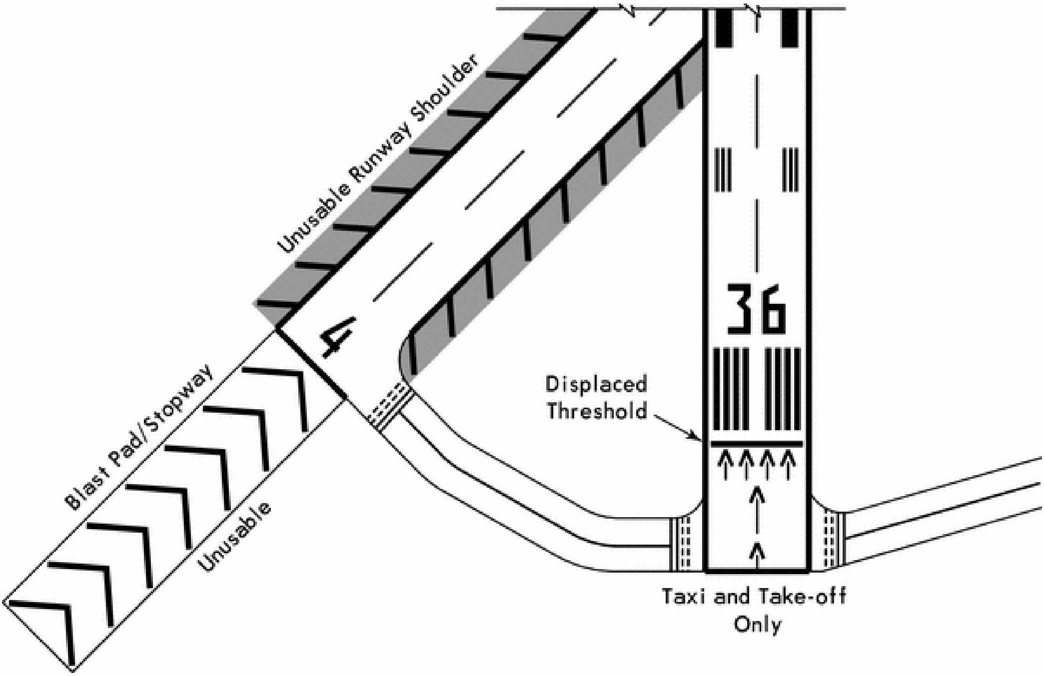
For non precision instrument runways: TDZ markers are not provided. Fixed distance markers are provided only on runways 4000' or longer used by jet aircraft.

UNITED STATES AIRPORT SIGN SYSTEMS

PRECISION INSTRUMENT RUNWAY



DISPLACED THRESHOLD MARKINGS AND MARKINGS FOR BLAST PADS AND STOPWAYS



ENHANCED TAXIWAY CENTERLINE AND RUNWAY HOLDING POSITION MARKINGS

APPLICATION

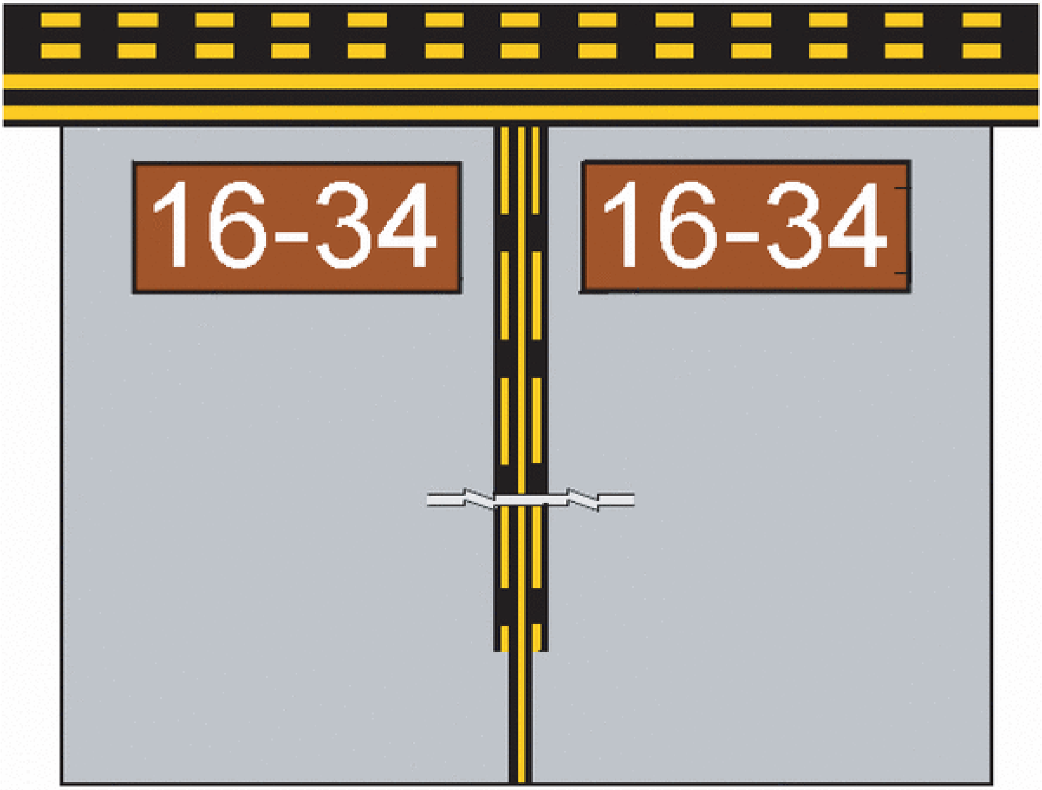
The taxiway centerline markings prior to runway holding positions are being enhanced to provide pilots with a visual cue that they are approaching a holding position. Runway holding position markings are also being extended onto the paved shoulders of taxiways and may be accompanied by surface painted holding position signs. These new markings will be the standard for many major airports in the United States.

CHARACTERISTICS

a. Taxiway centerline markings are modified beginning 150 feet prior to the runway holding position markings (where sufficient space is available) with the addition of parallel dashed yellow lines on both sides of the existing taxiway centerline.

b. Existing holding position markings are extended onto paved taxiway shoulders allowing them to be visible to pilots from the side windows of the cockpit for many aircraft.

c. Runway holding position signs may be painted on the surface of the taxiway on both sides of the taxiway centerline leading up to the runway holding position marking (where sufficient space is available), white numbers on red background.



END OF UNITED STATES AIRPORT SIGNS AND INSTRUMENT RUNWAY MARKINGS

MANDATORY INSTRUCTION SIGNS

APPLICATION

A mandatory instruction sign identifies a location beyond which an aircraft taxiing shall not proceed unless authorized by ATC. At uncontrolled airports, use appropriate precautions prior to proceeding. Mandatory instruction signs may include runway designation signs, category I, II or III holding position signs, runway-holding position signs and NO ENTRY signs. Runway-holding position markings are supplemented at a taxiway/runway or a runway/runway intersection with a runway designation sign. A runway designation sign at a taxiway/runway intersection or a runway/runway intersection will be supplemented with a location sign in the outboard (farthest from the taxiway) position, as appropriate. A NO ENTRY sign is provided when entry into an area is prohibited.

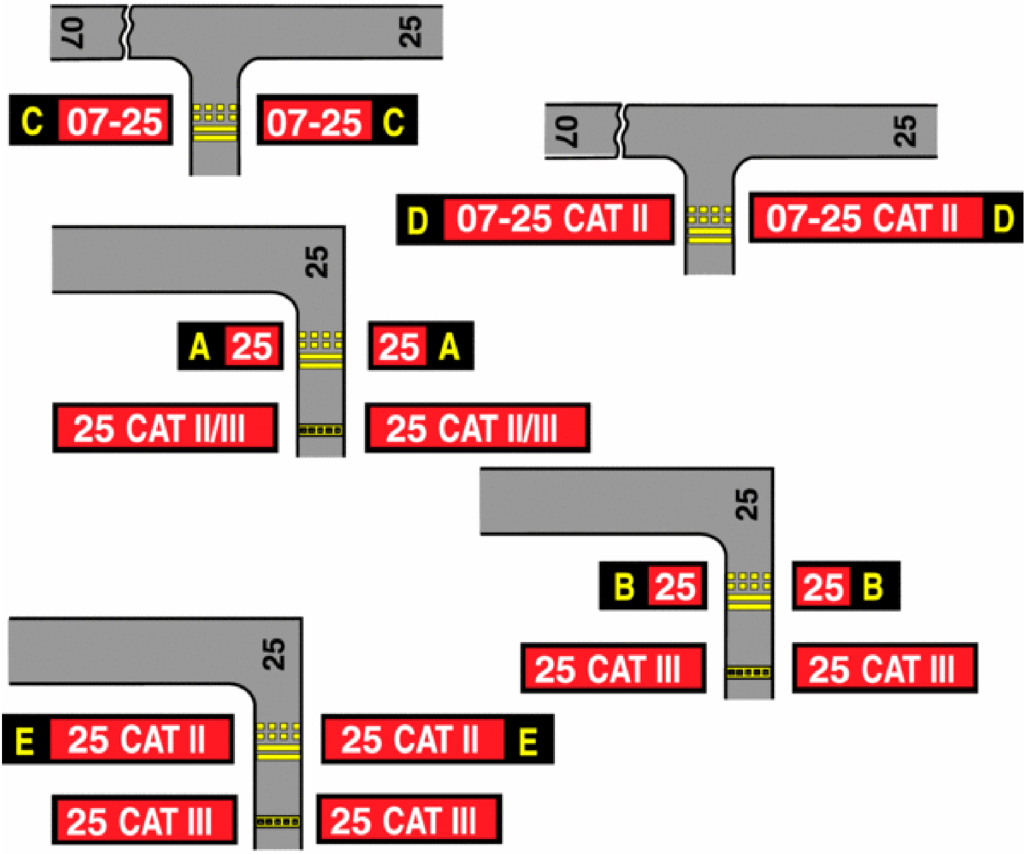
LOCATION

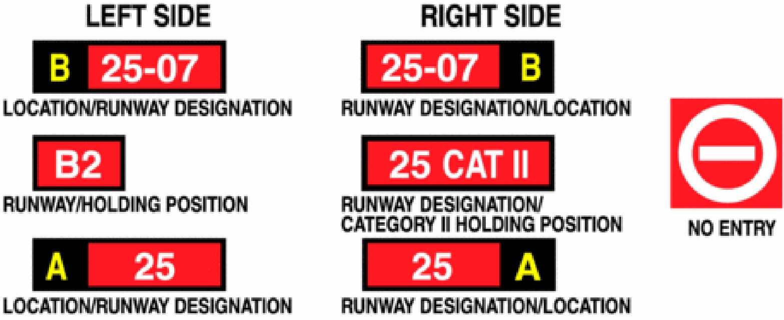
A runway designation sign at a taxiway/runway intersection or a runway/taxiway intersection will be located on each side of the runway-holding position marking facing into the direction of approach to the runway. A category I, II or III holding position sign will be located on each side of the runway-holding position marking facing into the direction of the approach to the critical area. A runway-holding position sign will be located on each side of the runway-holding position facing the approach to the obstacle limitation surface or ILS/MLS critical/sensitive area, as appropriate.

CHARACTERISTICS

Mandatory instruction signs have a red background, with white inscriptions. The inscriptions on a runway designation sign will consist of the runway designations of the intersecting runway properly oriented to the viewing direction. The inscriptions on a category I, II or III or joint II/III holding position sign will consist of the runway designator followed by CAT I, CAT II or CAT III as appropriate. The inscriptions on a runway-holding position sign will consist of the taxiway designation and a number.

ICAO RECOMMENDED AIRPORT SIGNS, RUNWAY AND TAXIWAY MARKINGS





INFORMATION SIGNS

APPLICATION

An information sign identifies a specific location or routing. Information signs include: direction, location, destination, runway exit and runway vacated signs. A runway exit sign is provided to identify a runway exit. A runway vacated sign is provided where the exit taxiway has no centerline lights and there is a need to indicate leaving the runway, the ILS/MLS critical/sensitive area. A destination sign indicates the direction to a specific destination, such as cargo, general aviation, etc. A combined location and direction sign indicates routing information prior to a taxiway intersection. A direction sign identifies the designation and direction at a taxiway intersection. A location sign is provided in conjunction with a runway designation sign except at a runway/runway intersection.

LOCATION

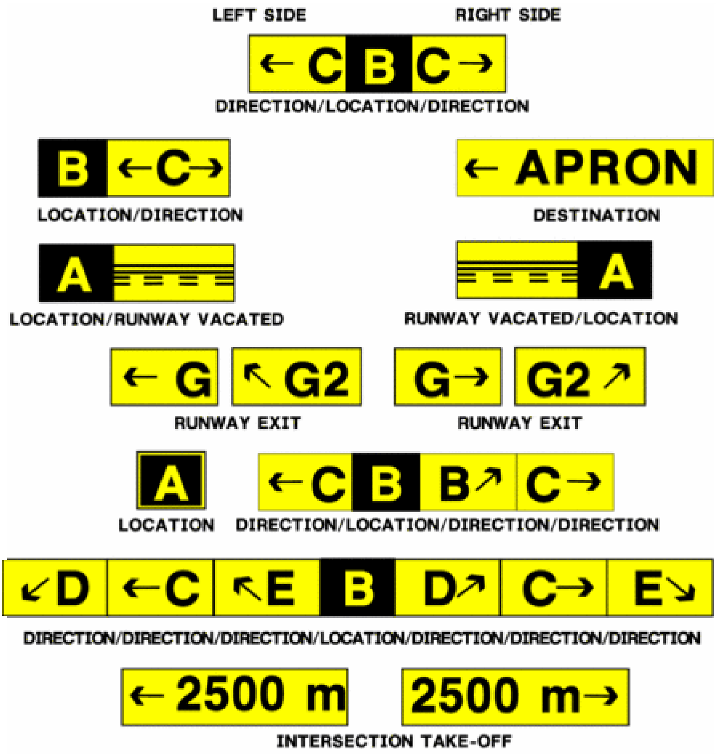
Information signs are located on the left-hand side of the taxiway in line with the taxiway intersection marking. Where there is no taxiway intersection marking the sign is installed at least 40m away from the centerline of the intersecting taxiway. A runway exit sign is located on the same side of the runway as the exit is located (i.e. left or right). A runway vacated sign is located at least on one side of the taxiway.

CHARACTERISTICS

An information sign other than a location sign consists of an inscription in black on a yellow background. A location sign consist of an inscription in yellow on a black background. A runway exit sign consist of the exit taxiway designator and an arrow indicating the direction to follow. A runway vacated sign depicts the runway-holding position marking as shown in the example in Pattern A in the example under “Runway-Holding Position Markings“. The inscriptions on a destination sign comprise an alpha, alphanumerical or numerical message identifying the destination plus an arrow indicating the direction to proceed. The inscriptions on a direction sign comprise an alpha, alphanumerical message identifying the taxiway(s) plus an arrow or arrows appropriately oriented as shown in the example. The inscription on a location sign comprise the destination of the location taxiway, runway or other pavement the aircraft is on or is entering.

NOTE: Generally, signs should be lighted if the runway or taxiway on which they are installed is lighted.

ICAO RECOMMENDED AIRPORT SIGNS, RUNWAY AND TAXIWAY MARKINGS



MANDATORY INSTRUCTION MARKINGS

APPLICATION

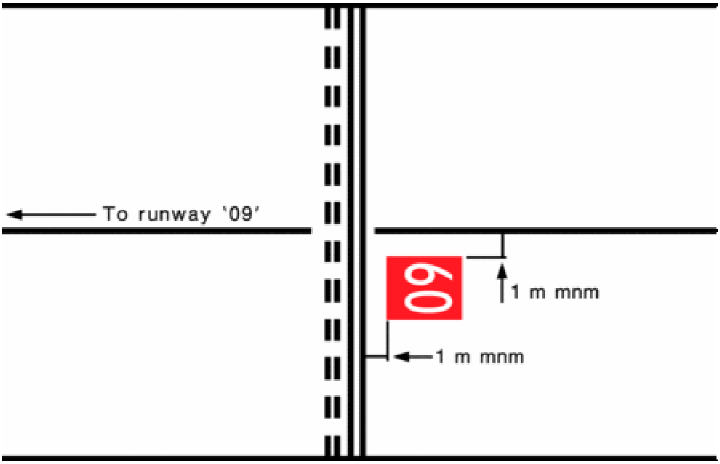
Where it is impracticable to install a mandatory instruction sign a mandatory instruction marking is provided on the surface of the pavement. Where operationally required, such as on taxiways exceeding 60m in width, a mandatory instruction sign may be supplemented by a mandatory instruction marking.

LOCATION

The mandatory instruction marking is located on the left-hand side of the taxiway center line marking on the holding side of the runway-holding position marking.

CHARACTERISTICS

Mandatory instruction markings consist of an inscription in white on a red background. Except for a NO ENTRY marking, the inscription provides information identical to that of the associated mandatory instruction sign. A NO ENTRY marking consists of an inscription in white reading NO ENTRY on a red background.



RUNWAY-HOLDING POSITION MARKINGS

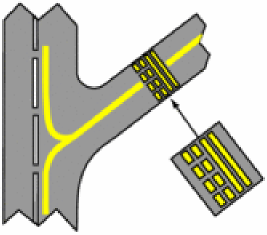
APPLICATION AND LOCATION

Runway-holding position markings are located at runway holding positions.

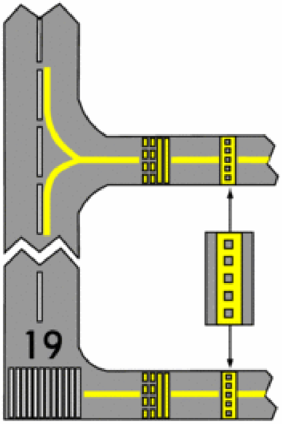
CHARACTERISTICS

At an intersection of a taxiway and a non-precision, non-instrument or take-off runway or where a single runway-holding position is provided at an intersection of a taxiway and a precision approach category I, II or III runway, the runway-holding position marking will be shown as in pattern A. Where two or three runway-holding positions are provided at such an intersection, the runway-holding position marking closer to the runway will be as shown as in pattern A, and the markings farther from the runway as in pattern B. Where a pattern B runway-holding position marking exceeds 60m in length, the term CAT II or CAT III as appropriate will be marked on the surface at the ends of the runway-holding position marking. The runway-holding position marking displayed at a runway/runway intersection will be perpendicular to the centerline of the runway forming part of the standard taxiroute. The runway-holding position marking will be shown as in pattern B.

Pattern A



Pattern B



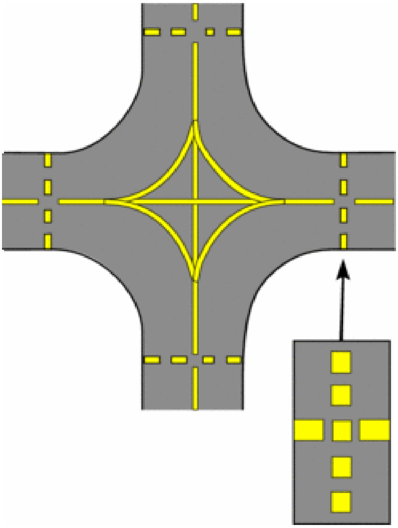
INTERMEDIATE HOLDING POSITION MARKINGS

APPLICATION AND LOCATION

An intermediate holding position marking is displayed at an intersection of two paved taxiways. It is positioned across the taxiway coincident with a stop bar or intermediate holding position lights, where provided.

CHARACTERISTICS

An intermediate holding position marking consists of a single broken yellow line.



STOP BARS

APPLICATION

A stop bar is provided at every runway-holding position when it is intended that the runway will be used in RVR conditions less than 350m or between 350m and 550m. A stop bar will be provided at an intermediate holding position to supplement markings with lights or where normal stop bar lights might be obscured.

LOCATION

Stop bars are located across the taxiway at the point where it is desired that traffic stop. Additional lights may be provided at the taxiway edge.

CHARACTERISTICS

Stop bars consist of lights spaced at intervals across the taxiway, showing red in the intended direction of approach to the intersection or runway-holding position. Stop bars installed at a runway-holding position will be unidirectional, showing red in the direction of approach to the runway.

RUNWAY GUARD LIGHTS

APPLICATION

Runway guard lights, configuration A, are located at each taxiway/runway intersection associated with a runway intended for use in:

RVR conditions less than 550m where a stop bar is not installed; and

RVR conditions between 550m and 1200m where traffic density is medium or low.

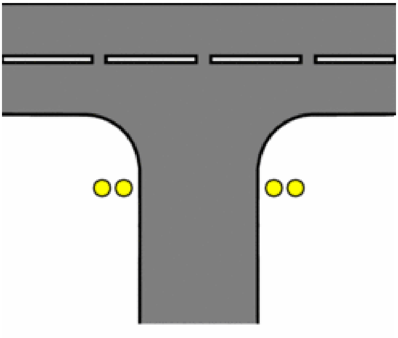
Configuration A or B or both will be provided at each taxiway/runway intersection where the configuration of the intersection needs to be enhanced, such as on a wide throat taxiway.

LOCATION

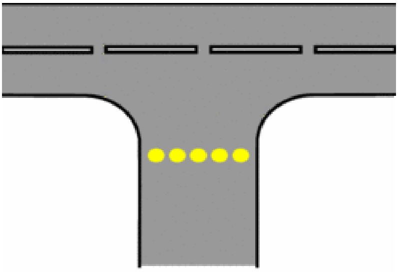
Runway guard lights, configuration A, are located at each side of a taxiway, whereas in configuration B they are located across the taxiway.

CHARACTERISTICS

Runway guard lights are unidirectional flashing yellow lights.



Configuration A



Configuration B

RUNWAY MARKINGS

Runway markings are white.

THRESHOLD MARKINGS

APPLICATION AND LOCATION

Threshold markings are provided at the threshold of a paved instrument and non-instrument runway intended for use by international commercial air transport.

CHARACTERISTICS

Runway threshold markings consist of a pattern of longitudinal stripes of uniform dimensions disposed symmetrically about the centerline of a runway. The number of stripes shall be in accordance with the runway width as follows:

RUNWAY WIDTH	NUMBER OF STRIPES
18m	4
23m	6
30m	8
45m	12
60m	16

Where a runway designator is placed within a threshold marking, there will be a minimum of three stripes on each side of the runway centerline. Stripes are at least 30m long.

RUNWAY DESIGNATION MARKINGS

APPLICATION AND LOCATION

Runway designation markings are located at the thresholds of a paved runway.

CHARACTERISTICS

Runway designation markings consists of a two-digit number located at the threshold. On parallel runways each runway designation number is supplemented by a letter in the order from left to right when viewed from the direction of approach.

RUNWAY CENTERLINE MARKINGS

APPLICATION AND LOCATION

A runway centerline marking is provided on a paved runway along the centerline.

CHARACTERISTICS

Runway centerline markings consist of a line of uniformly spaced stripes and gaps. Stripes are normally 30m long, gaps 20m long.

HIGH SPEED TAXIWAY TURN-OFF INDICATOR LIGHTS (HSTIL)

ICAO term is Rapid Exit Taxiway Indicator Lights (RETIL)

APPLICATION

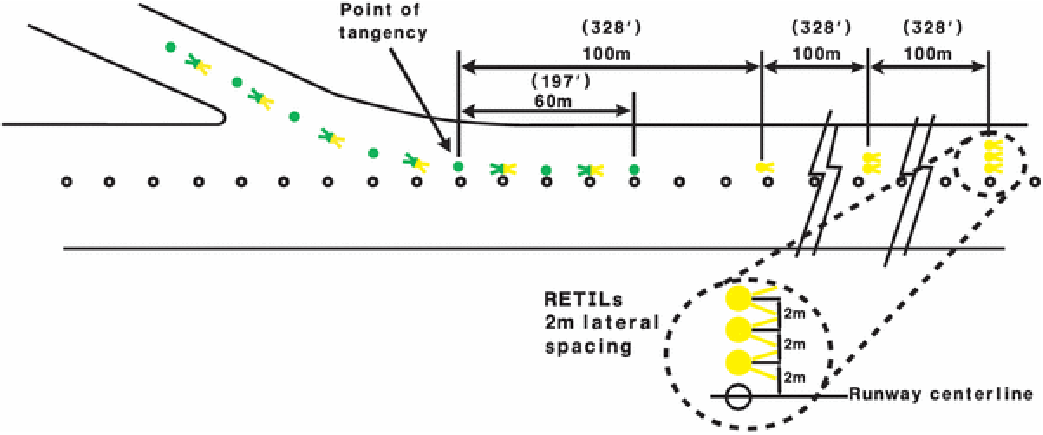
HSTIL should be provided on a runway intended for use in RVR conditions less than 350m and/or where traffic density is heavy.

LOCATION

A set of HSTIL shall be located on the runway on the same side of the runway centerline as the associated high speed turn-off taxiway, in the configuration shown below.

CHARACTERISTICS

HSTIL are fixed unidirectional yellow lights, aligned so as to be visible to the pilot of a landing airplane in the direction of approach to the runway.



RUNWAY TOUCHDOWN ZONE MARKINGS

APPLICATION

A touchdown zone marking is provided in the touchdown zone of a paved precision approach runway and non-precision approach runway or non-instrument runway where additional identification of the touchdown zone is required.

LOCATION AND CHARACTERISTICS

A touchdown zone marking shall consists of pairs of rectangular markings symmetrically disposed about the runway centerline with the number of pairs are related to the landing distance available (LDA).

A touchdown zone marking shall conform to either of the two runway patterns shown below.

LDA or DISTANCE BETWEEN THRESHOLDS	PAIR(S) OF MARKINGS
less than 900m	1
less than 1200m, but not less than 900m	2
less than 1500m, but not less than 1200m	3
less than 2400m, but not less than 1500m	4
2400m or more	6

RUNWAY AIMING POINT MARKINGS

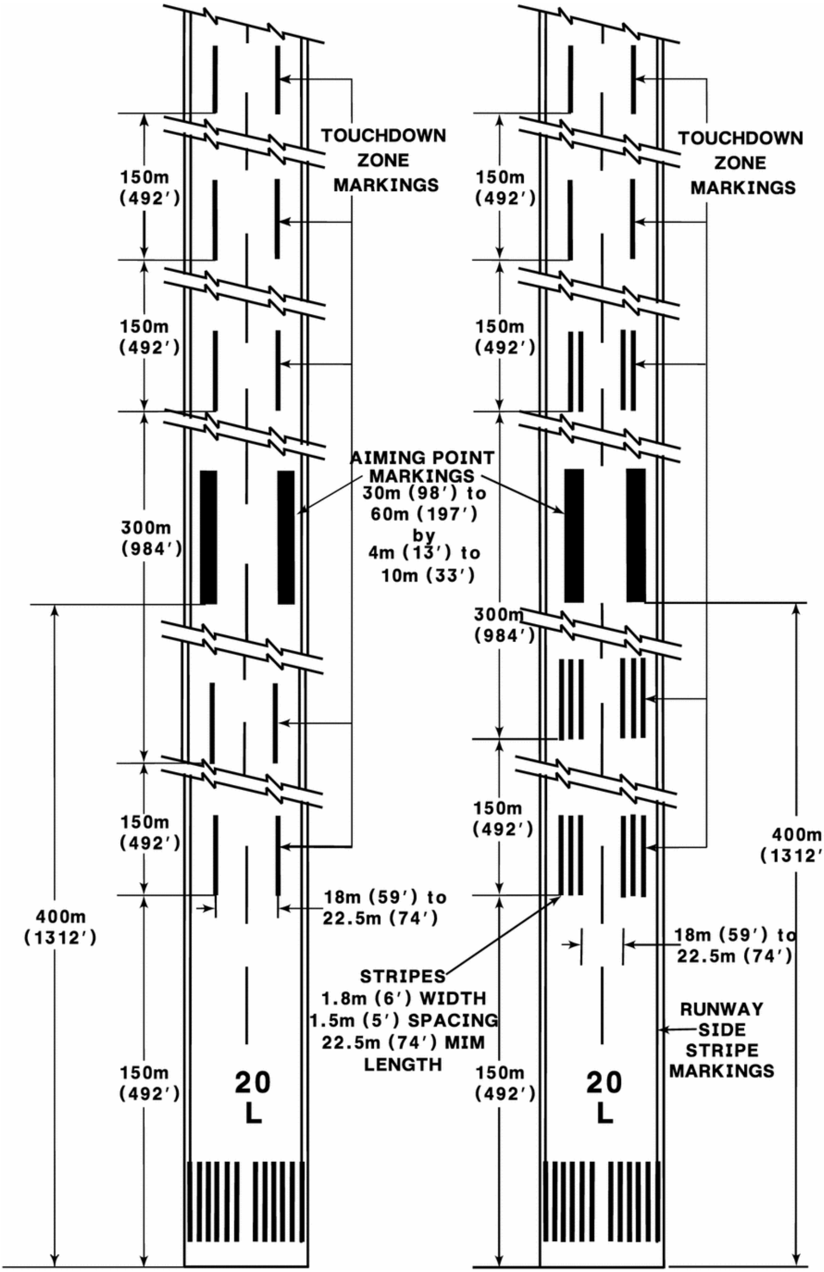
APPLICATION

An aiming point marking will be provided at each approach end of a paved instrument or non-instrument runway.

LOCATION AND CHARACTERISTICS

An aiming point marking consists of two conspicuous stripes in conformity with the dimensions shown for the runway patterns in the example shown under “Runway Touchdown Zone and Aiming Point Markings“.

ICAO RECOMMENDED AIRPORT SIGNS, RUNWAY AND TAXIWAY MARKINGS



RUNWAY SIDE STRIPE MARKING

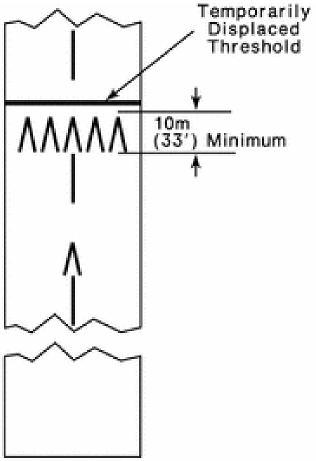
APPLICATION

Runway side stripe markings are provided between the thresholds of a paved runway where there is lack of contrast between the runway edges and the shoulders. Runway side stripe markings are provided on precision approach runways.

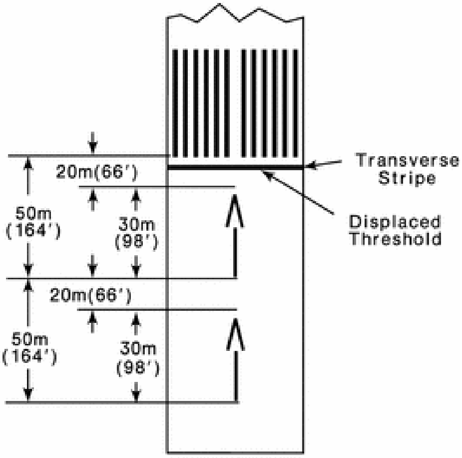
LOCATION AND CHARACTERISTICS

Runway side stripe markings consist of two stripes, one placed along each edge of the runway no more than 30m from the runway centerline regardless of the runway width.

DISPLACED THRESHOLD MARKINGS



TEMPORARILY DISPLACED THRESHOLD



TEMPORARILY OR PERMANENTLY DISPLACED THRESHOLD

CLOSED RUNWAYS AND TAXIWAYS OR PARTS THEREOF

APPLICATION AND LOCATION

A closed marking will be displayed at each end of a runway or portion thereof, declared permanently closed to the use of all aircraft. Additionally, markings are placed so that the maximum interval between the markings does not exceed 300m. On a taxiway, a closed markings shall marking shall be placed at least at each end of a taxiway or portion thereof that is closed.

CHARACTERISTICS

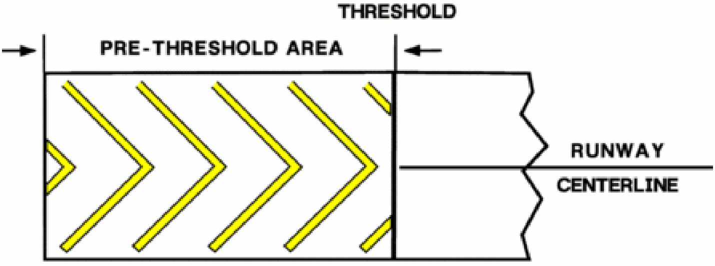
The closed marking is shaped like a cross. The marking is white when displayed on a runway and yellow when displayed on a taxiway.

NON LOAD-BEARING SURFACES

The boundary between load-bearing surfaces and non load-bearing surfaces, such as shoulders for taxiways, holding bays, aprons and other non load-bearing surfaces which, if used, might result in damage to the aircraft are indicated by a taxi side stripe. This marking consists of a pair of solid lines the same color as the taxiway centerline marking.

PRE-THRESHOLD AREA MARKING (CHEVRON MARKING)

When the paved surface prior to the threshold exceeds 60m in length and is not suitable for use by aircraft, the entire length will be marked with a chevron marking (preferably yellow) pointing in the direction of the runway threshold.



END OF ICAO RECOMMENDED AIRPORT SIGNS,
RUNWAY AND TAXIWAY MARKINGS

JEPPESEN®
A BOEING COMPANY

Introduction

Visual Docking Guidance Systems (VDGS)

PARKING AND DOCKING SYSTEMS

GENERAL DESCRIPTION

Visual Docking Guidance Systems (VDGS), sometimes referred to as Nose-in Docking Guidance Systems or Stand Entry Guidance Systems (SEG), provide centerline and/or stopping guidance for the precise positioning of the aircraft on a stand. Systems that provide stop guidance only are often combined with centerline guidance systems.

Where selective operation is possible, the system provides an identification of the selected aircraft type - PIC (pilot-in command - on the left seat) shall check the current aircraft type.

The centerline guidance unit is aligned to the PIC too.

NOTE 1: Where ground handling personnel is not present on the stand, pilot should not assume, that a stand is safe to enter simply because the stand (A)VDGS is active or lit. If the pilot has any doubt about the position of any equipment on or near to the stand, the aircraft should be stopped immediately and assistance should be requested.

NOTE 2: An aircraft should not be taxied onto a (A)VDGS equipped stand, when the guidance system is switched off or appears inactive. Except under the guidance of a marshaller.

NOTE 3: The (A)VDGS will be activated when the all necessary equipment is working and is safe for use by the type of aircraft assigned.

VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)

SYSTEMS PROVIDING CENTERLINE AND STOPPING GUIDANCE IN CONJUNCTION

Aircraft Parking and Information System (APIS/APIS++)

APIS/APIS++ is designed to be used from left pilots position and combines both alignment and stopping signals in one visual display mounted at the extension of the stand centerline at flight deck height ahead of the pilot.

The elements of the display as illustrated below are as follows:

a. An alphanumeric yellow dot matrix element displayed in the upper portion of the unit indicating as appropriate, any of the signals illustrated.

b. A yellow dot matrix progress strip element displayed on the lower left side of the unit indicating progress of the aircraft over the last 16.2m of the approach to the stop position.

c. The azimuth guidance element consists of a yellow moire pattern signal providing directional guidance to the pilot in relation to the stand centerline.

Prior to entering the stand the pilot must ensure that the following signals are displayed:

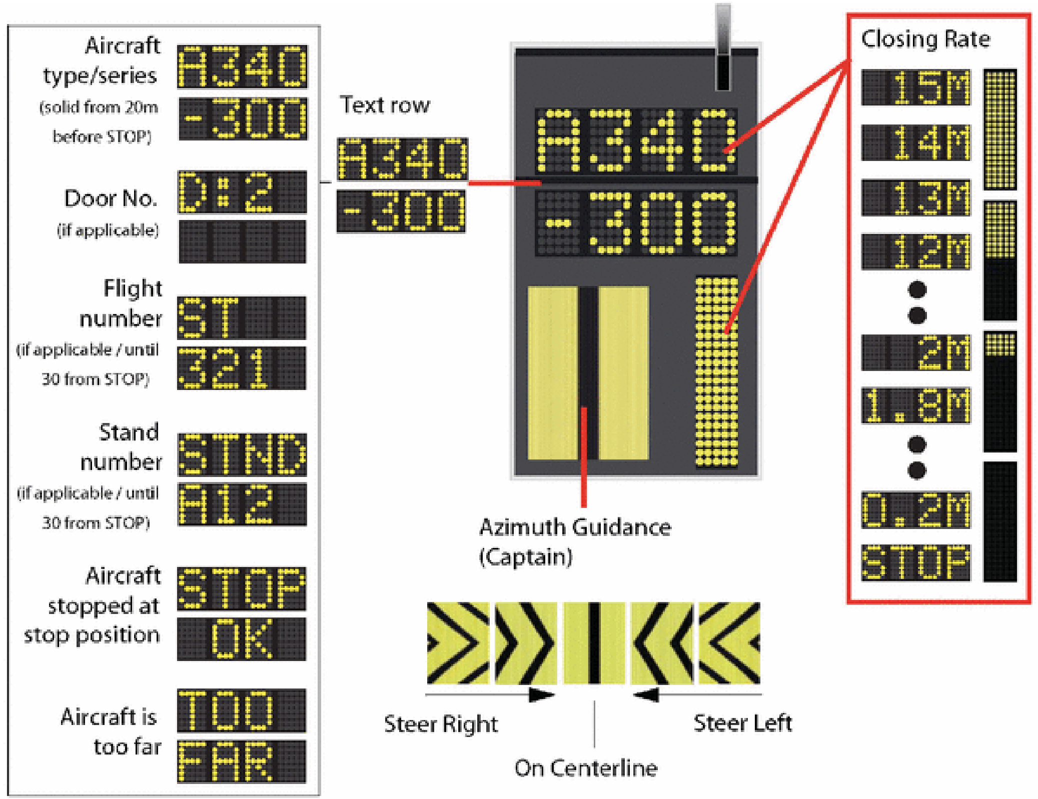
a. correct aircraft type;

b. correct stand number.

NOTE: Abort docking if display shows STOP or wrong aircraft type/series, or if the azimuth guidance display is not activated.

VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)

APIS++



Burroughs Optical Lens Docking Systems (BOLDS)

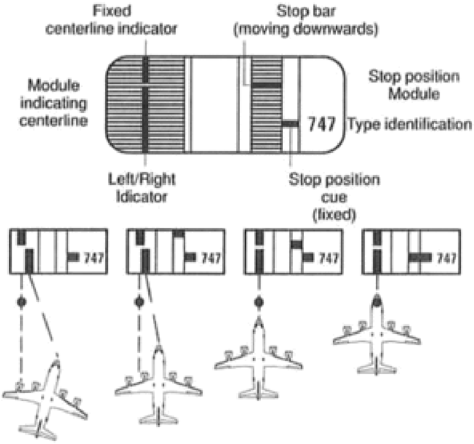
The BOLDS installation is mounted at pilot eye level and provides centerline and stop guidance. Centerline guidance is presented as a vertical bar of white light which is divided into 2 parts:

a. the upper part is fixed;

b. the lower part moves left/right to indicate that aircraft is left/right of centerline.

The equipment calibration is restricted to certain aircraft types which are displayed on the right side of the screen. This part is the stop guidance and consists of a vertical bar within which a white light bar (“stop cue”) moves up or down. When the ‘stop cue’ is horizontally aligned with the specific aircraft type, the aircraft is at the correct stopping point.

VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)



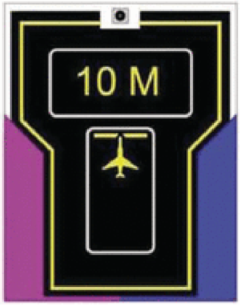
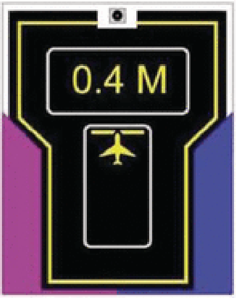
Honeywell Advanced Visual Docking Guidance System

The docking system is based on a video system. The following sequence of events identifies how a pilot would use this system to dock an aircraft at this gate.

VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)

	Gate ready for docking: Aircraft type and gate number are alternated in a flashing sequence across the top of display board.
	Aircraft detected: When the aircraft is detected, only the aircraft type is displayed steady across the top of the display. At this point, distance to gate will be measured in such increments: – 30m to 20m - 5m steps; – 20m to 10m - 2m steps; – 10m to 1m - 1m steps; – 1m to stop - 0.2m steps.
	Aircraft is right of centerline: Correction left is required.

VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)

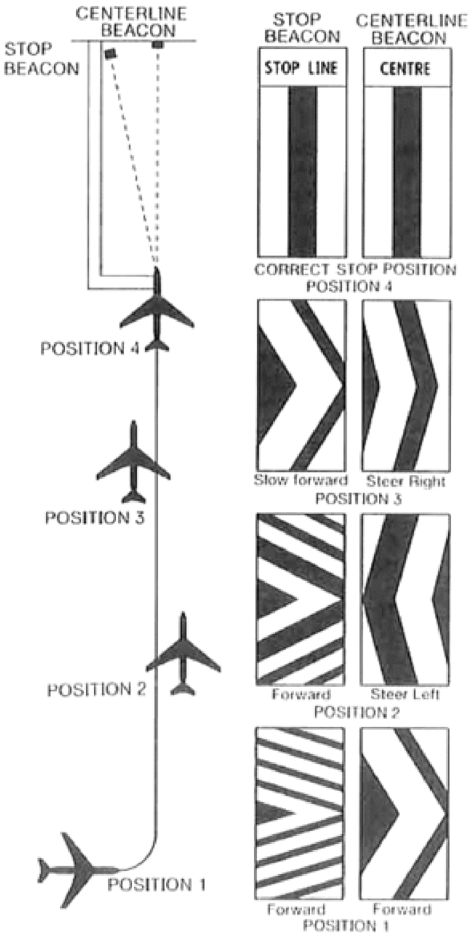
	Aircraft is left of centerline: Correction right is required.
	Aircraft is on centerline: 10m to final stop position. ***CAUTION: Approach slowly to final stop position.***
	Aircraft is on centerline: 0.4m to final stop position, prepare to stop the aircraft.
	STOP: Stop now, docking point reached. ONBLOCK STOP: Docking procedure finished completely.

	OK: Docking point reached. Successful docking.
	STOP TOO FAR: Aircraft has gone beyond docking position.
	ESTOP (emergency stop): Stop aircraft immediately, wait for docking instructions from Apron Control to resume docking procedure.

INOGON Airpark Stop and Centerline System

The INOGON Airpark Stop and Centerline Systems are based on the same technology used for the centerline guidance in the APIS and APS. The beacon observed by the pilot indicates, in the form of arrows, the direction in which he should steer and when the correct STOP position is reached.

VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)



Nose-in Guidance System Australia (NIG)

The system includes the following elements:

a. Position Identification Light;

b. Aerobridge Retracted Indicator;

c. Centerline Guidance Light unit;

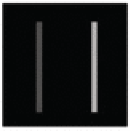
d. One or more Side Marker Light units.

The following is a brief description of the system:

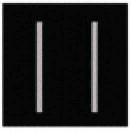
a. The Position Identification Light indicates the number of the docking position and is white numerals on a dark background (illuminated at night).

b. The Aerobridge Retracted Indicator consists of two lights. The green light indicates the Aerobridge is in the fully retracted position. The red light indicates that the Aerobridge is not fully retracted or that an element of the visual guidance docking system is unserviceable.

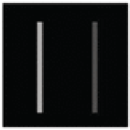
c. The Centreline Guidance Light provides azimuth information and is aligned with the left pilot position. The unit emits RED/ GREEN light beams and the signals are interpreted as shown below.



RED/GREEN
Left of centerline



GREEN/GREEN
On centerline



GREEN/RED
Right of centerline

d. One or more Side Marker Light units – with relevant aircraft types marked on the unit – indicate the stopping position as described below:

  1. Approaching the position, a preliminary dull GREEN light will show through the arrow-shaped aperture which also exhibits a cross bar.
  2. As the aircraft moves forward, the intensity of the green light increases until it becomes a bright arrow-head.
  3. As the aircraft continues, the arrow-head starts to reduce in size.
  4. When the arrow-head disappears, two white bars appear, one above the other, indicating the stopping position. In some installations, two sets of bars will appear.
  5. If the stopping position is passed, then a single RED bar appears.

VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)

RLG Automated Docking System

The RLG Automated Guide-in Docking System consists of a display and a set of sensors installed in the apron surface. The system is aligned with the left pilot's seat only.

The system is ready for use when:

a. the aircraft type is shown on the digital display:
b. the pair of green lights is switched on;
c. the green vertical light bar is switched on.

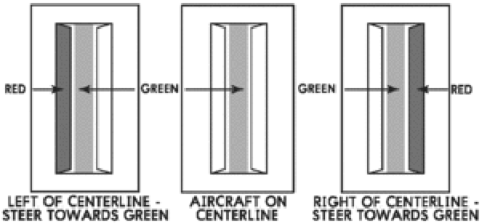
The pilot should be aware that the correct type of aircraft is displayed before using the system.

The centerline guidance is provided by means of 3 vertical bars:

- Visibility of the green bar only means that the aircraft is on the centerline.
- Visibility of the green and the left red bar means that the aircraft is left of the centerline; turn right.
- Visibility of the green and the right red bar means that the aircraft is right of the centerline; turn left.

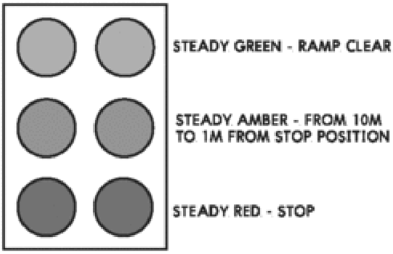
The guidance of the aircraft to the stop point is performed on the basis of 3 pairs of lights. When the yellow lights become active the taxi speed of the aircraft should immediately be reduced to the minimum taxi speed. The braking action should be commenced immediately after the red lights become active.

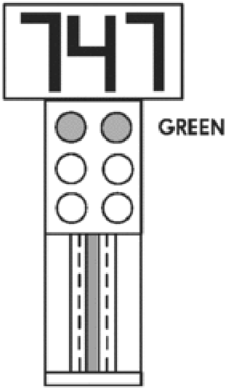
Azimuth Guidance



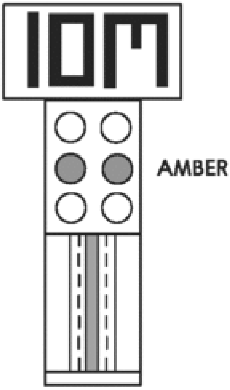
VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)

Stopping Guidance

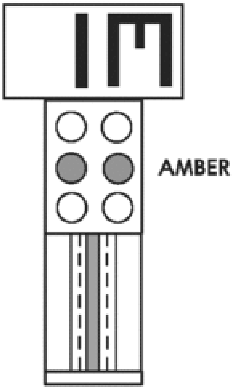




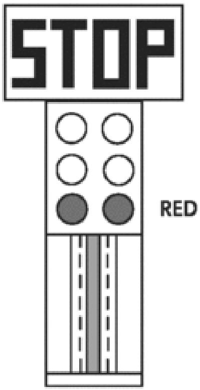
Ramp Clear. Green lamps illuminate when laser scanner acquires aircraft.



Amber lamps illuminate 10 meters from final stopping position.



Amber lamps continue to illuminate as display counts down to 1 meter.



Red lamps illuminate and the word "STOP" is displayed when aircraft reaches stopping position.

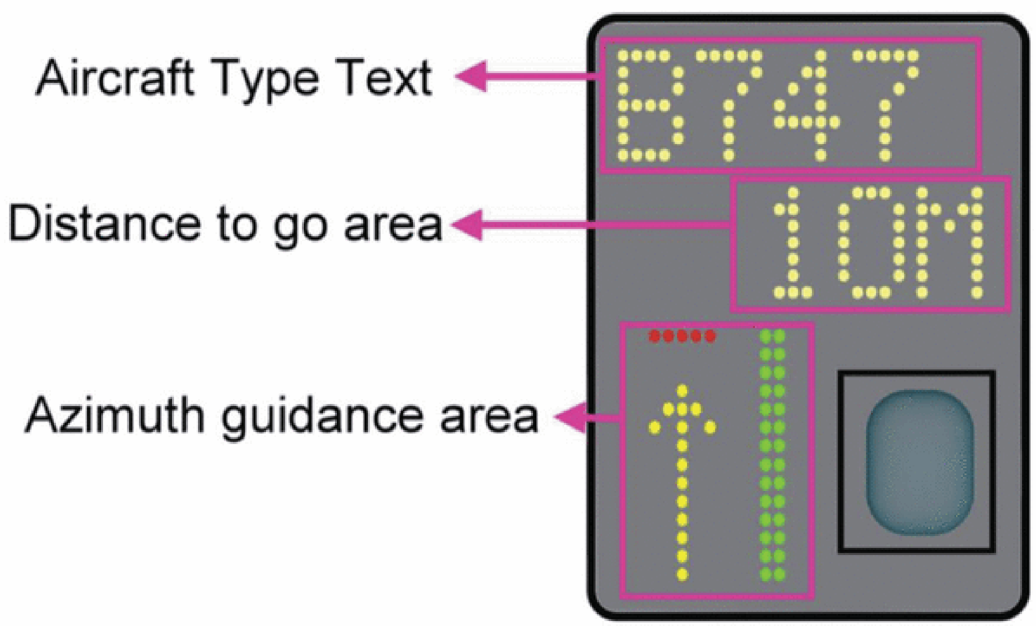
VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)

RLG GIS206-2 Automated Guide-in System

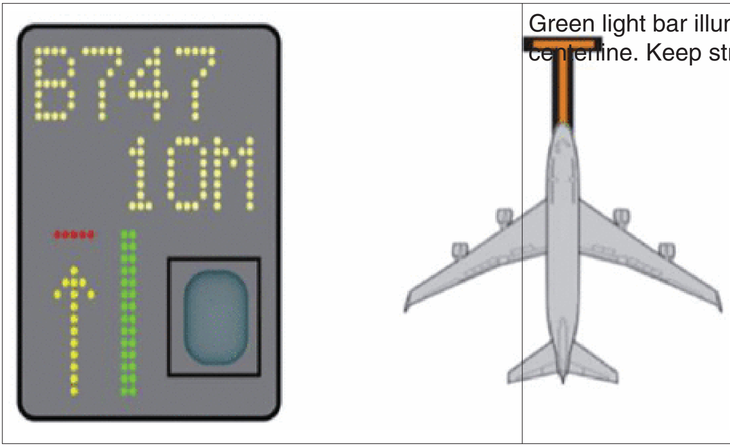
The RLG GIS206-2 laser guided docking system utilizes 2-axis laser scanning technique to track both the lateral and longitudinal positions of the incoming aircraft. This 3-D approach allows the system to identify the incoming aircraft and check it against the one selected by the operator. If the incoming aircraft fails to match the expected aircraft, an NO ID indication is immediately issued to both the pilot and the copilot.

Aircraft type, continuous closing distance, and azimuth guidance, etc., are presented on a single console clearly visible to both the pilot and copilot, simultaneously.

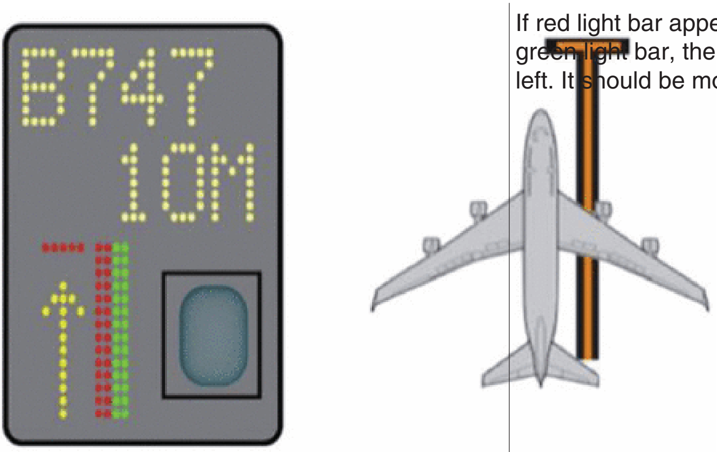
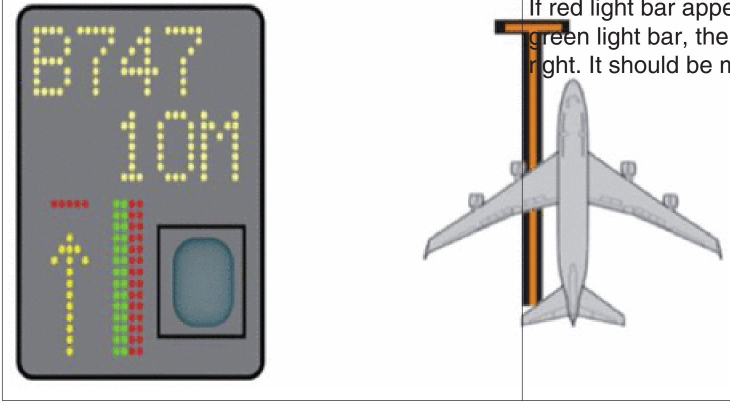
The system is operated only in the automatic mode. When the system fails, the aircraft must then be marshalled into the stand manually.



VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)

	Green light bar illuminates, the aircraft is on centerline. Keep straight ahead.

VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)

	If red light bar appears on the left side of the green light bar, the aircraft is off centerline to left. It should be moved rightwards.
	If red light bar appears on the right side of the green light bar, the aircraft is off centerline to right. It should be moved leftwards.

VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)

Safety measures:

Pilot must stop the aircraft immediately if he or she sees that:

- the docking system is not activated;
- NO ID is displayed;
- the word STOP is displayed.

When using the automated docking system, the pilot must taxi into the aircraft stand at minimum speed. The system will display SLOW if the aircraft taxi speed is too fast for reliable detection. To avoid overshoot, the pilot is advised to approach the stop position slowly and observe the closing rate information displayed. Closing information is displayed both as digital readout and in the form of progress meter. Pilot should stop the aircraft immediately when seeing the STOP indication or when signaled by the marshaller. The system will indicate any overshoot by displaying 2FAR.

VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)

SAFEDOCK Advanced Visual Docking Guidance System (A-VDGS)

System Overview:

The Safedock Advanced Visual Docking Guidance System (A-VDGS) is designed to provide active guidance to both pilots - using alphanumeric, azimuth and closing rate indicators - to support safe, efficient and precise aircraft parking at the gate during all operating conditions. Safedock uses an eye-safe infrared laser and 3D scanning technique to detect the aircraft and measure nose, engine and wing positions to verify aircraft type and safely guide the aircraft to the correct stop position.

VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)

Pilot Responsibilities:

When parking with guidance from the Safedock A-VDGS, pilots are asked to adhere to the following safety procedures:

- **never** enter the gate area unless the correct aircraft type and running arrows are displayed on the pilot display;
- **never** enter the gate area unless you can see that the safety zone is clear and it is safe to enter;
- **never** move the nose of the aircraft past the jet bridge unless the A-VDGS is displaying the guidance screen with centerline indicator;
- **always** stop the aircraft when the A-VDGS displays a WAIT or STOP message.

The Automated Docking Process:

A-VDGS capture, tracking & guidance:

When the A-VDGS captures the incoming aircraft the guidance screen appears:

- vertical yellow bar represents the centerline and provides closing rate to stop position;
- floating yellow arrow indicates position of the aircraft relative to centerline;
- red flashing arrow indicates the direction the pilot should steer to center on centerline;
- the absence of a red direction arrow indicates the aircraft is on the centerline;
- a digital countdown is provided for the last 30 meters.

SLOW:

If the aircraft is approaching faster than the accepted speed (> 4 knots), the system will show a SLOW message requiring pilots to adjust their speed. When the A-VDGS is in low visibility mode during heavy fog, rain or snow, the SLOW message is displayed requiring pilots to adjust their speed.

If the aircraft approaches with a speed higher than the A-VDGS can handle, a STOP message is displayed. The pilot must stop until the A-VDGS is restarted or manual guidance is provided.

When the aircraft reaches the stop position, the A-VDGS indicates STOP. (*There may be variations in the STOP position until pilots are acclimated.*)

An OK message indicates the docking is complete.

If the aircraft over shoots the stop position by more than one meter a TOO FAR message is displayed. A TOO FAR message may require the aircraft to be moved back.

Ground staff chock aircraft wheels and the A-VDGS displays CHOCK ON message. After receiving the CHOCK ON message, this is the indication to crews they can release their brakes.

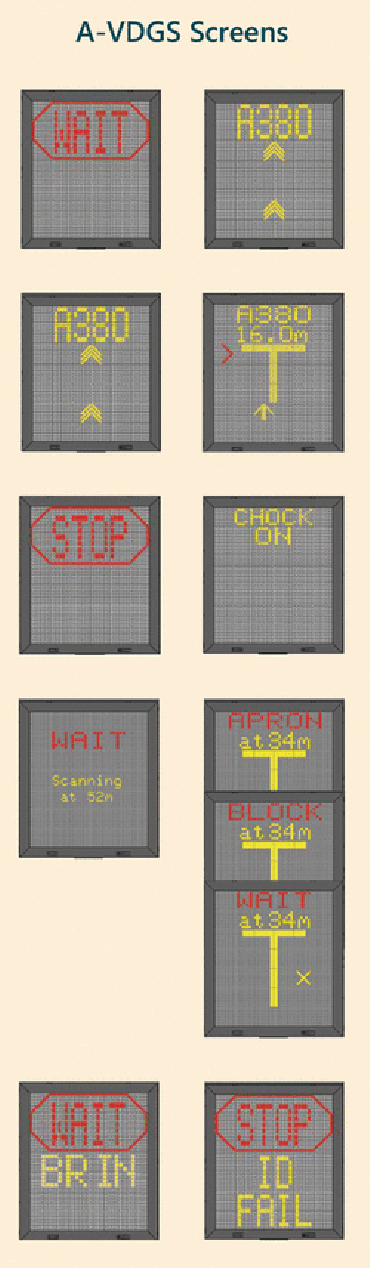
NOTE: After the main gear have been chocked, the ramp agent will provide the “chocks inserted” hand signal as a backup.

APRON BLOCK:

An APRON BLOCK occurs if the A-VDGS detects an obstacle blocking its view of the aircraft.

- The pilot is halted with a WAIT APRON BLOCK message.
- When the obstacle is removed the docking will restart on its own.
- The pilot should not proceed past the bridge until the guidance screen is displayed.

BR IN:



A BR IN message occurs when the boarding bridge is inside the safety zone. – The pilot is halted with a WAIT BR IN message. – When the bridge is moved to its parked position the docking will restart on its own. – The pilot should not proceed until the guidance screen is displayed. ID FAIL: An ID FAIL occurs when the A-VDGS cannot confirm verification of the aircraft type. – If verification is not made 12 meters before the stop position, the A-VDGS will display WAIT and make a second attempt at verification. – If this fails, the STOP ID FAIL message will display. – Pilots will require manual guidance to the gate.	

Safety procedures:

a. General warning.

   The SAFEDOCK DGS has a built-in error detection program to inform the aircraft pilot of impending dangers during the docking procedure. If the pilot is unsure of the information, being shown on the DGS display unit, he/she must immediately stop the aircraft and obtain further information for clearance.

b. Item to check before entering the stand area.

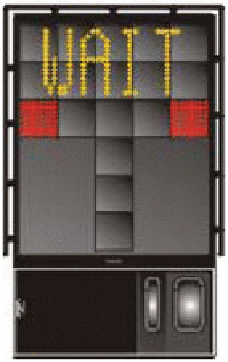
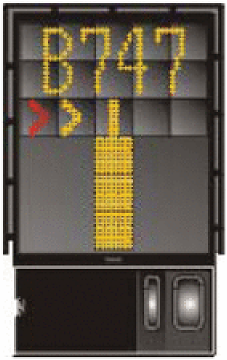
   WARNING: *The pilot shall not enter the stand area, unless the docking system first is showing the vertical running arrows. The pilot must not proceed beyond the bridge, unless these arrows have been superseded by the closing rate bar.*

   The pilot shall not enter the stand area, unless the aircraft type displayed is equal to the approaching aircraft. The correctness of other information, such as DOOR 2, shall also be checked.

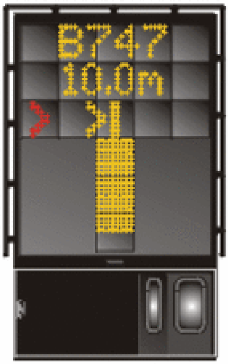
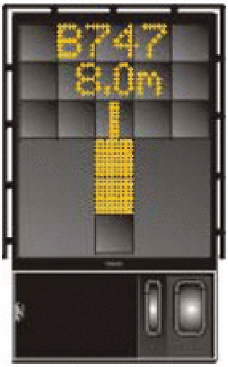
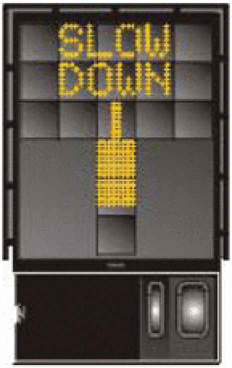
c. The SBU message.

   The message STOP SBU means that docking has been interrupted and has to be resumed only by manual guidance. Do not try to resume docking without manual guidance.

Safedock Procedures

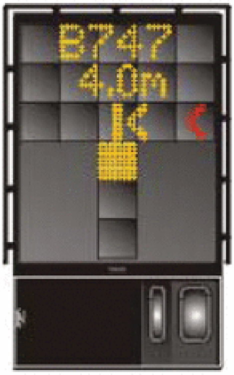
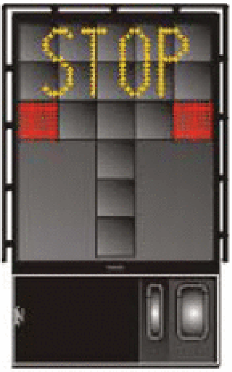
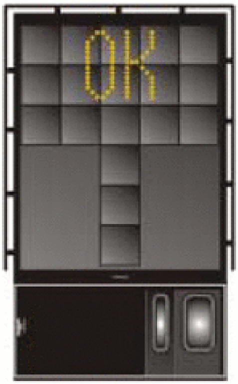
	Start-of-docking: When the system is started, “WAIT” will be displayed.
	Capture: The floating arrows indicate that the system is activated and in capture mode, searching for an approaching aircraft. It shall be checked that the correct aircraft type is displayed. The LEAD-IN line shall be followed. The pilot must not proceed beyond the bridge, unless the arrows have been superseded by closing rate bar.
	Tracking: When the aircraft has been caught by the laser, the floating arrow is replaced by the yellow centerline indicator. A flashing red and/or yellow arrow indicates the direction to turn for azimuth guidance. The vertical yellow arrow shows the position in relation to the centerline. This indicator gives correct position and azimuth guidance.

Safedock Procedures (continued)

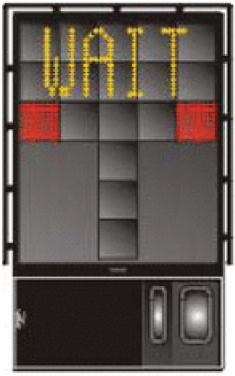
	Closing rate: Display of digital countdown from a specific distance to the stop-position. A yellow vertical closing rate bar/centerline indicator appears, optionally with a digital countdown indication, depending on the configuration. When the aircraft is less than 39ft (12m) from the stop position, the closing rate is indicated by turning off one row of the centerline symbol per 2ft (0.5m), covered by the aircraft. Thus, when the last row is turned off, 2ft (0.5m) remains from stop.
	Aligned to center: The aircraft is at the displayed distance to the stop position. The absence of any direction arrow indicates an aircraft on the centerline.
	Slow down: If the aircraft is approaching faster than the accepted speed, the system will show “SLOW DOWN” as a warning to the pilot.

VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)

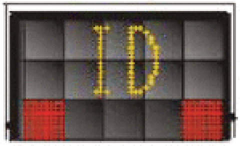
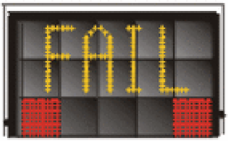
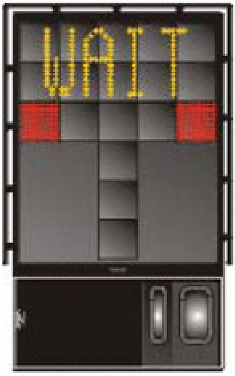
Safedock Procedures (continued)

	Azimuth Guidance: The aircraft is at the displayed distance from the stop-position. The yellow arrow indicates an aircraft to the right of the centerline, and the red flashing arrow indicates the direction to turn.
	Stop Position Reached: When the correct stop-position is reached, the display will show “STOP” and red lights will be lit.
	Docking Completed: When the aircraft has parked, “OK” will be displayed.

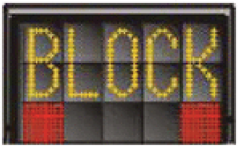
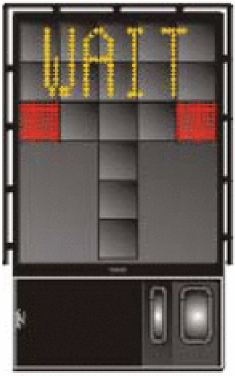
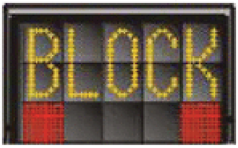
Safedock Procedures (continued)

	Overshoot: If the aircraft has overshot the stop-position, “TOO FAR” will be displayed.
	Wait: If some object is blocking the view toward the approaching aircraft or the detected aircraft is lost during docking close to STOP, the display will show “WAIT”. The docking will continue as soon as the blocking object has disappeared or the system detects the aircraft again. The pilot must not proceed beyond the bridge, unless the “WAIT” message has been superseded by the closing rate bar.
	Slow: The display will show “SLOW” when the docking system lose the aircraft very near the stop-position or visibility for docking system is reduced. The pilot must not proceed beyond the bridge, unless the closing-rate bar is shown.

Safedock Procedures (continued)

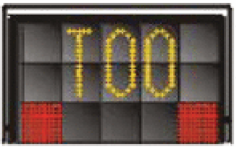
  	Aircraft Verification Failure: During entry into the stand, the aircraft geometry is being checked. If, for any reason, aircraft verification is not made 12 meters before the stop-position, the display will first show “WAIT” and make a second verification check. If this fails “STOP” and “ID FAIL” will be displayed. The text will be alternating on the upper two rows of the display. The pilot must not proceed beyond the bridge without manual guidance, unless the “WAIT” message has been superseded by the closing rate bar.
	Gate Blocked: If an object is found blocking the view from the docking system to the planned stop position for the aircraft, the docking procedure will be halted with a “WAIT” and “GATE BLOCK” message. The docking procedure will resume as soon as the blocking object has been removed. The pilot must not proceed beyond the bridge without manual guidance, unless the “WAIT” message has been superseded by the closing rate bar.

Safedock Procedures (continued)

  	
   	View Blocked: If the view towards the approaching aircraft is hindered, for instance by dirt on the laser-window, the docking system will report a View blocked condition. Once the system is able to see the aircraft through the hinder, the message will be replaced with a closing rate display The pilot must not proceed beyond the bridge without manual guidance, unless the “WAIT” message has been superseded by the closing rate bar.

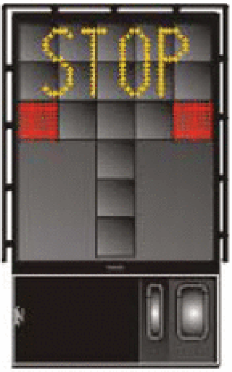
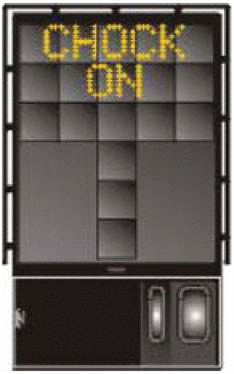
VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)

Safedock Procedures (continued)

 	SBU-Stop: Any unrecoverable error during the docking procedure will generate an “SBU (safety back-up)” condition. The display will show red stop bar and the text “STOP”, ”SBU”. A manual backup procedure must be used for docking guidance.
 	Too Fast: If the aircraft approaches with a speed higher than the docking system can handle, the message “STOP (with red squares)” and “TOO FAST” will be displayed. The docking system must be re-started or the docking procedure completed by manual guidance.

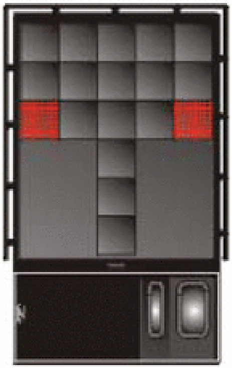
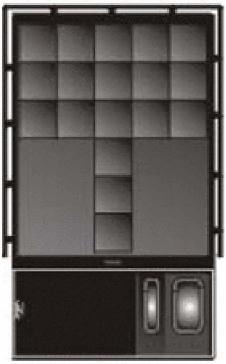
VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)

Safedock Procedures (continued)

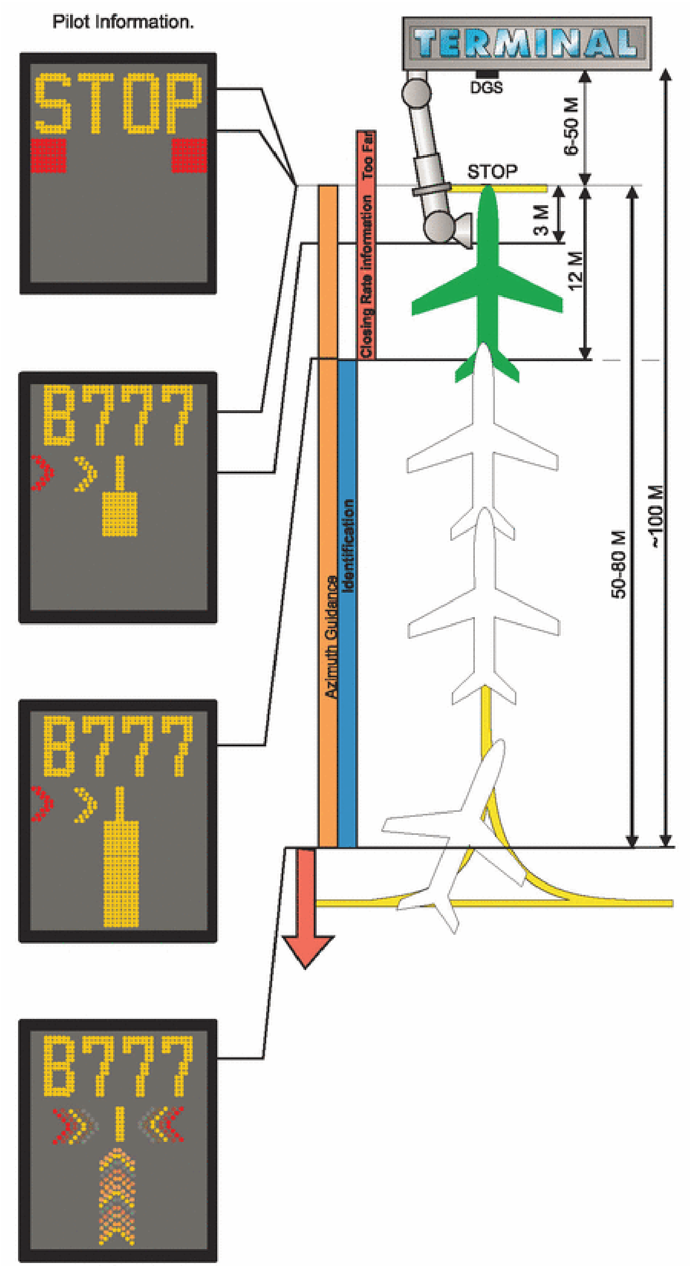
	
	Emergency Stop: When the Emergency "Stop" button is pressed, "STOP" is displayed.
	Chocks On: "CHOCK ON" will be displayed, when the ground staff has put the chocks in front of the nose wheel and pressed the "Chocks On" button on the Operator Panel.

VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)

Safedock Procedures (continued)

	Error: If a system error occurs, the message “ERROR” is displayed with an error code. The code is used for maintenance purposes.
	System Breakdown: In case of a severe system failure, the display will go black, except for a red stop indicator. A manual backup procedure must be used for docking guidance.
	Power Failure: In case of a power failure, the display will be completely black. A manual backup procedure must be used for docking guidance.

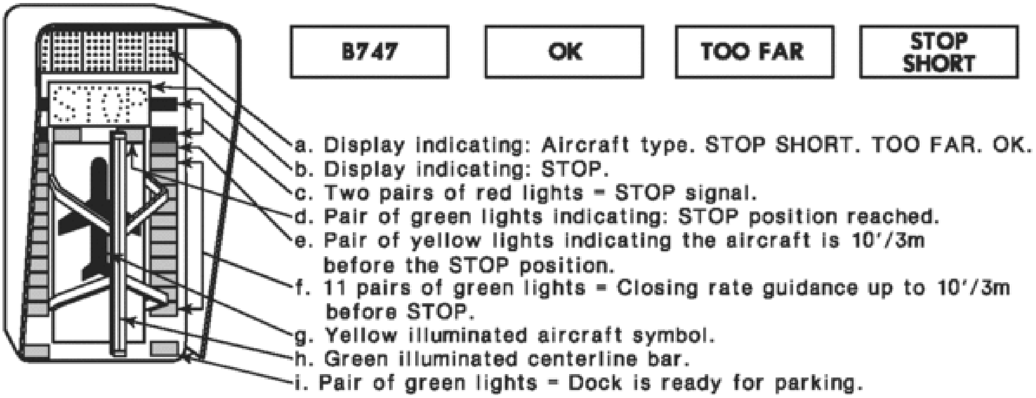
VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)



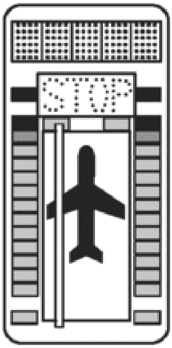
VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)

SAFEGATE Docking System

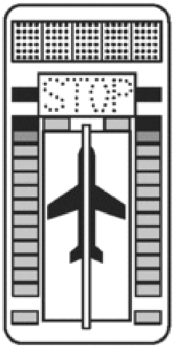
The SAFEGATE docking display is aligned for interpretation from the left pilot's seat only and provides centerline and stop guidance.



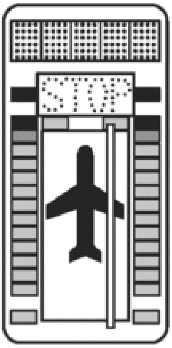
a. Display indicating: Aircraft type. STOP SHORT. TOO FAR. OK.
b. Display indicating: STOP.
c. Two pairs of red lights = STOP signal.
d. Pair of green lights indicating: STOP position reached.
e. Pair of yellow lights indicating the aircraft is 10'/3m before the STOP position.
f. 11 pairs of green lights = Closing rate guidance up to 10'/3m before STOP.
g. Yellow illuminated aircraft symbol.
h. Green illuminated centerline bar.
i. Pair of green lights = Dock is ready for parking.



TURN LEFT



ON CENTERLINE



TURN RIGHT

Docking maneuver:

a. Line-up to center aircraft symbol with green reference bar.

b. Check aircraft type displayed (flashing).

c. Check green bottom lights (flashing). When nosegear passes over first sensor, aircraft type display and green bottom lights will both change from flashing to steady.

d. Green closing rate lights will move upwards in relation to actual aircraft speed.

e. At 1m before the stop position, yellow lights will illuminate.

f. Reaching the stop position, all 4 red lights will illuminate concurrent with the displayed command STOP.

   If correctly positioned, OK will be displayed.

g. Beyond 1m of the nominal stop position, a warning will be displayed TOO FAR (flashing).

h. Emergency stop: All 4 red stop position lights and STOP will flash.

SYSTEMS PROVIDING CENTERLINE GUIDANCE ONLY

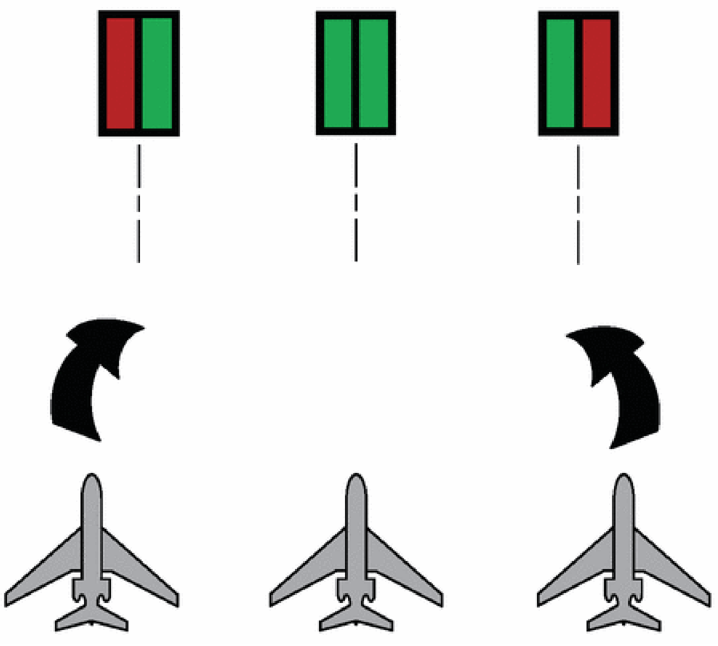
Azimuth Guidance for Noise-in Stands (AGNIS)

AGNIS provides stand centerline alignment guidance and is normally used in conjunction with marker boards, lines or mirrors, which provide stopping guidance separately. The AGNIS indicator is mounted at pilot eye level beneath the stand number and is aligned for interpretation from the left pilot's seat only. The unit displays 2 closely spaced vertical light bars in red and/or green light in such a manner that the pilot sees either:

Green	= aircraft on centerline
Red/green	= aircraft to the left of centerline
Green/red	= aircraft to the right of centerline

NOTE: Always turn towards the green.

VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)



CAUTION: The AGNIS guidance unit does NOT provide a stopping signal. The type of stopping guidance used in conjunction with AGNIS will be indicated (e.g. Parallax Aircraft Parking Aid [PAPA]) above or adjacent to the AGNIS.

In some cases a black base board is attached to the face of the pier under the AGNIS. In case of system unserviceability, a STOP SHORT sign is displayed to the aircraft immediately. Use caution and follow marshaller's signals as appropriate.

AGNIS may be supported by one of the following aids:

- PAPA;
- Mirror.

VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)

SYSTEMS PROVIDING STOP GUIDANCE ONLY

Mirror System

The Mirror System consists of a mirror mounted to the left of the stand centerline and facing the approaching aircraft. The mirror is angled so that the pilot in the left hand seat can see the reflection of the aircraft nose wheel during the last few meters of the parking maneuver. The correct stopping position is indicated by aircraft type designators painted in mirror image on the apron surface. As the aircraft approaches, the pilot is able to see in the mirror a reflection of the aircraft nose wheel and an appropriate designator where the aircraft should be stopped. A yellow javelin headed arrow may be used as the designator, with the aircraft type given.

Parallax Aircraft Parking Aid (PAPA)

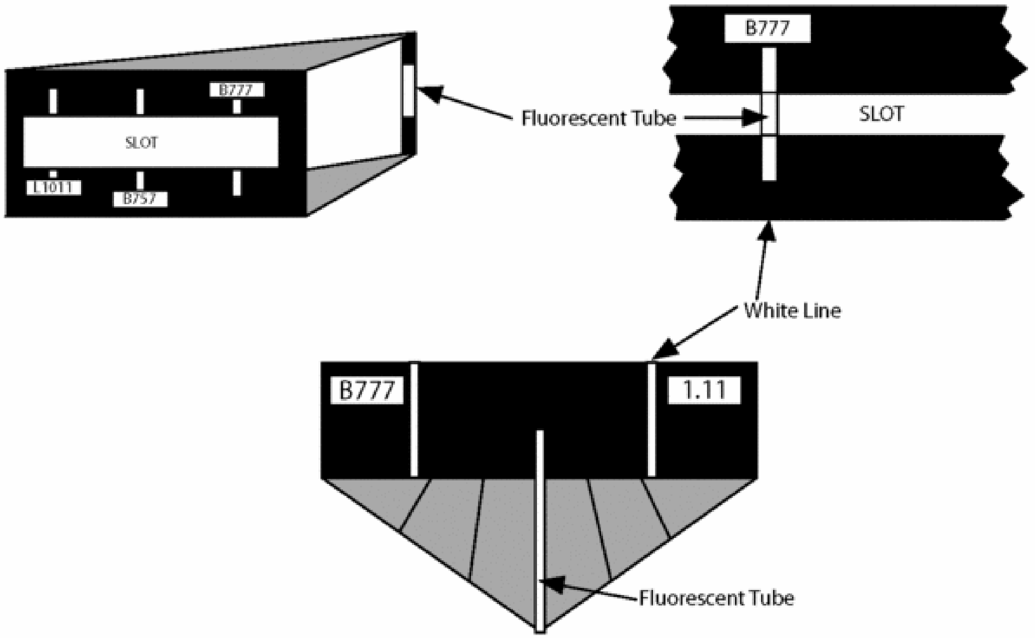
The system is designated for use from the left pilots position. This aid is normally positioned to the right side of the stand centerline and indicates the correct forward stopping position by employing a black board marked with white vertical lines bearing aircraft type identification labels and in which a horizontal slot has been cut.

A short distance behind the slot is a vertically mounted white fluorescent light tube.

The accuracy of this system depends on the accuracy of the of stand centerline.

Aircraft type line indicates the stop point. An alternative layout is illustrated also, where the board is not provided with a slot and the tube is mounted in front of it. The method of use is identical.

VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)



WARNING:

Under certain daylight conditions difficulty may be experienced in observing the fluorescent tube through the slot.

Side Marker Board (SMB)

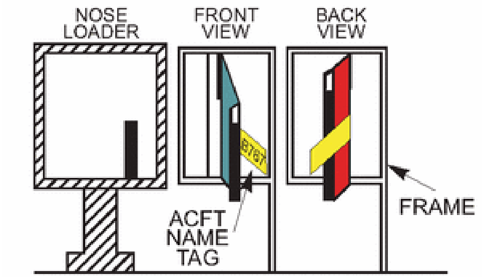
The SMB consists of a white base board on the pier side of the air jetty and vertical slats mounted on the face of the base board. It stands parallel to the stand centerline flush with the head of the air jetty in its retracted position.

The edge of each slat is black, the side facing the taxiway is green, and the side facing the pier is red. Each slat has a name tab(s) attached at appropriate pilot eye level to indicate the aircraft type(s) to which the slat applies. As the pilot enters the stand, the slat bearing tab appropriate to his aircraft type presents the green side. As the pilot approaches, the green side will appear to become narrower, and when the correct stop position is reached, pilot will see the black edge only. If the correct stop position is passed, the red side of the slat will come into view. It is advisable to approach the stopping position slowly.

The DC9 aircraft, which stops with the pilot's position abeam the air jetty head will not be served by the SMB. In this case the correct stopping position for this aircraft will consist of a mark on the air jetty itself.

VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)

One Slot Example



NOTE: When SMB is unserviceable, aircraft must be marshalled.

JEPPESEN®
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Chart Change Notices

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Chart Change Notices

NavData Change Data

AERONAUTICAL INFORMATION COMPATIBILITY

Jeppesen Airway Manual Charts are the same publications which Jeppesen has provided to the aviation community for many years. Jeppesen NavData has not been around for quite as long, but has established and maintained the same reputation for accuracy, reliability, and dependability with those customers who use computerized navigational systems and other computer navigation data bases from Jeppesen. For those who subscribe to both services, slight differences may occasionally be noted between what is seen on the chart and what is generated from the navigation data base. These differences may be caused by any or all of the following:

1. DIFFERENCES IN PUBLICATION CRITERIA

Jeppesen computerized NavData is updated and issued every 28 days. This is a relatively quick and simple operation for the user, since all of the changes are included on the updated tape or disk which is loaded into the aircraft navigation system or a main-frame computer system. The charts are quite a different story, as each chart must be individually updated and published. The new charts are then collated and mailed, and once received by the customer, must be filed individually in the Airway Manual. Variations, such as differences in information cut-off dates and lead time requirements, may bring about distribution in one medium before the other. These differences are generally resolved in the Jeppesen NavData Change Notices and the Jeppesen Chart Change Notices. The Change Notices provide a weekly or bi-weekly update to the NavData and Chart services. A review of the Jeppesen Change Notices pages prior to using either service will help to ensure that you have the most current information.

2. DIFFERENCES IN THE METHOD USED TO DETERMINE BEARING AND DISTANCE VALUE ON CHARTS AND IN COMPUTERIZED NAVIGATIONAL SYSTEMS

Bearings and distances on airways, approach transitions, and instrument approaches are published in a country's Aeronautical Information Publication (AIP). Almost exclusively, these values are taken from the AIP and published on Jeppesen charts. In contrast, the navigation data base contains exact locations of the navaids used to form tracks of airways, approach transitions, and instrument approaches. System software computes great circle route bearings and distances based on the most current navaid information on the desired route, and presents this data on the system display. Slight differences in bearing and distance may not be changed in the AIP, and therefore, may not change on the Jeppesen charts. But if navaid information has changed even minutely, differences may show up because the bearings and distances displayed are computed by the navigation system or computer flight planning software each time a particular track is called up.

3. DIFFERENCES IN WAYPOINT NAMES AND COORDINATES

Waypoint names published on Jeppesen charts are taken directly from official government sources. In some countries, there are no restrictions on the number of characters used in the name. Computerized navigation system software limits waypoint names to a maximum of five characters. Therefore, waypoint names with more than five characters will be abbreviated for entry into the navigation data base. Jeppesen has included an explanation of the method used to abbreviate these names on NavData pages 5 through 10, titled “NavData Name Conventions”. Note that the basic structure of the name is retained, and it should be relatively easy to tie that abbreviation generated by the data base to the complete name of the waypoint on the chart. In addition, there are unnamed turning points and intersections depicted on charts which must be included in the navigation data base. Therefore, certain names may appear in a computerized system which do not appear on a chart. The method used to identify these turning points and intersections is also included in “NavData Name Conventions”.

On standard Enroute and Area charts, for unnamed, or named with name other than five characters and no State assigned identifier, fixes/reporting points/ mileage breaks

-and-

For entry points on STAR charts and exit points on SID charts:

– The NavData identifier is published, adjacent to the point involved, within square brackets, and in italic type.

  EXAMPLE: *[ABC73]*. Should changes occur to a charted NavData identifier prior to the re-issue of the chart, the change will be announced in a special section of the Jeppesen Chart Change Notices titled “NavData Identifiers”. *NavData identifiers are Jeppesen derived only, and should not be used for ATC flight plan filing or used in ATC communications*.

  Coordinates on Jeppesen charts may also differ slightly from those generated by a computer. As stated in paragraph 1 above, the navigation data base is updated completely every 28 days. The charts, on the other hand, may accumulate small changes over a longer period of time. Because of these differences in publication schedules, there may be very slight differences between the charts and the NavData generated information.

4. INCOMPATIBILITY OF SOME ROUTES AND INSTRUMENT APPROACHES WITH COMPUTERIZED NAVIGATION SYSTEM SOFTWARE

By nature of their design, some routes and instrument approach procedures are not usable by certain computerized navigation systems. For example, consider an approach transition from the enroute structure to an instrument approach. In most cases these are named and defined as STARs, or they are tied into particular instrument approach procedures. To be compatible with computerized navigation system software, one of the above prerequisites must be present, that is, the transitions must be either named STARs, or connected to instrument approach procedures. But occasionally an AIP will define an approach transition which is not a named STAR and which is not connected to an instrument approach procedure. When neither of the conditions is met, approach transitions of this type may not be entered into the navigation data base. Certain approaches are also incompatible with system software, and may not be entered into the navigation data base. In most cases, these restrictions do not apply to publication of Jeppesen charts. All types of routes and approaches may be published on Jeppesen charts, but depending on the capabilities of the computerized navigation system, they may not appear in the system data base, and therefore you may not be able to call them up on your system display.

SUMMARY

Any or all of the above may cause slight differences between charts and information generated from the navigation data base. The Jeppesen NavData and Chart Change Notices should be reviewed prior to using either Jeppesen service. As a final note, be sure to obtain a preflight briefing to ensure that you have knowledge of any last minute changes affecting your flight.

NAVDATA IDENTIFIERS ON JEPPESEN CHARTS

On standard Enroute and Area Charts, for unnamed, or named with name other than five characters and no State assigned identifier, fixes/reporting points/mileage breaks

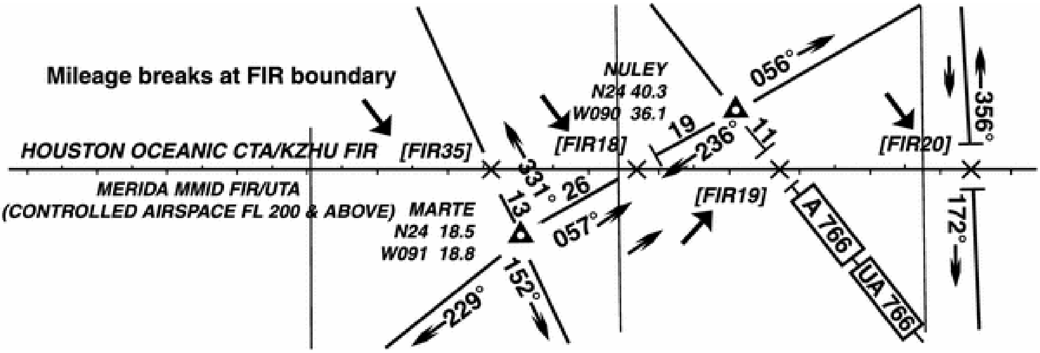
– and –

For entry points on STAR charts and exit points on SID charts:

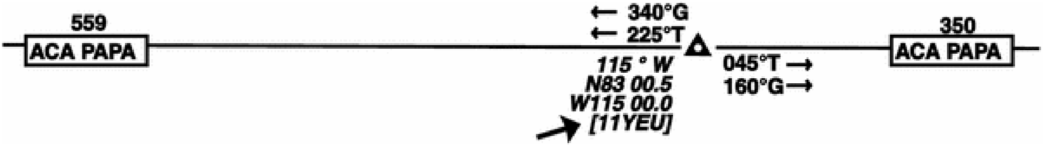
- The NavData identifier is published, adjacent to the point involved, within square brackets, and in italic type. Example: *[ABC73]*.

NavData identifiers are Jeppesen derived only, and should not be used for A TC flight plan filing or used in ATC communications.

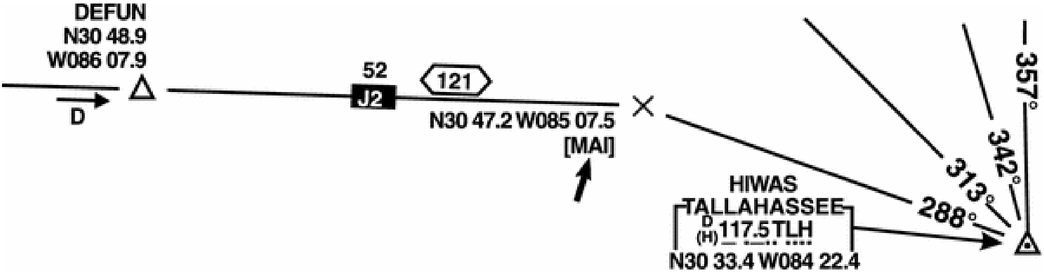
The identifiers are shown as in the examples below, always in italic type and always enclosed within square brackets.



AIRSPACE FIX NAMED ONLY “115° W”

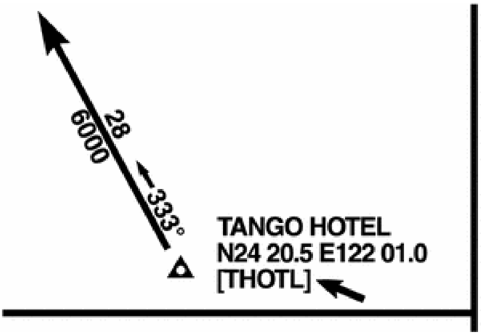


AIRWAY/ROUTE TURNING POINT



NAVDATA IDENTIFIERS ON JEPPESEN CHARTS

STAR Chart - “Tango Hotel” entry point from the enroute structure has more than five characters in its name.



WAYPOINT IDENTIFIERS

Waypoint names entered into the navigation data base are limited to a maximum of five characters. Official waypoint names assigned by a country's aviation information authority often have other than five characters. For compatibility with the navigation data base, waypoint identifiers are assigned to all waypoints in accordance with the ground rules set forth as follows:

a. **VOR, VORDME, VORTAC, TACAN and Non-Directional Beacons (NDB).** Waypoints located at any of the above types of facilities will take on the official I-, 2-, 3-, or 4-character identifier of the facility In question.

Examples:

Los Angeles VORTAC	LAX
Tyndall TACAN	PAM
Ft. Nelson NDB	YE
Newark NDB	EWR

b. **NDB**

NDB as Waypoint Concept

For systems employing the “NDB as Waypoint” concept, waypoints located at NDBs will be identified by the use of the station identifier followed by the alpha characters “NB”.

Examples:

Ft. Nelson NDB	YENB
Newark NDB	EWRNB

c. **Named RNAV Waypoints, Intersections and Reporting Points.** In many countries, these waypoints are assigned unique 5-character names, with the identifier the same as the name. For waypoints not so named, identifiers are developed using the following rules sequentially until 5 or fewer character groups emerge.

1. **One-Word Names**

   (a) Use the full name if five characters or less are involved.

   Examples:

   – ACRA, LOGAN, PIKE, DOT

   (b) Eliminate double letters.

   Examples:

   – KIMMEL becomes KIMEL

   – COTTON becomes KOTON

  - RABBITT becomes RABIT

(c) Keep first letter, first vowel and last letter. Drop other vowels starting from right to left.

Examples:

- ADOLPH becomes ADLPH
- BAILEY becomes BAILY
- BURWELL becomes BURWL

(d) Drop consonants, starting from right to left.

Examples:

- ANDREWS becomes ANDRS
- BRIDGEPORT becomes BRIDT

2. **Multiple Word Names**

Use the first letter of the first word and abbreviate the last word using the above rules for one-word names to reduce it to four characters.

Examples:

- CLEAR LAKE becomes CLAKE
- ROUGH AND READY becomes RREDY

3. **Phonetic Letter Names**

(a) When an ICAO phonetic alpha character is used as a waypoint name (Alpha, Bravo, Charlie, etc.), use the rules established in paragraph C.1 above. When more than one waypoint in a country has the same phonetic name, obtain uniqueness by applying rule E below.

Examples:

- Waypoint November becomes NOVMR
- Waypoint Charlie becomes CHARE
- Waypoint Alpha remains ALPHA

(b) When a double phonetic, such as Tango India, is used as the waypoint name, use the rules established in paragraph C.2 above.

(c) When a phonetic alpha character followed by a numeric and/or other alpha characters (A1, A1N, B2, etc.), is used as the waypoint name, it will appear the same in the data base as shown on aeronautical charts.

d. **Unnamed Waypoints**

1. **Unnamed Turn Points, Intersections and Bearing/Distance Waypoints** (For bearing/distance waypoints on terminal area procedures, see paragraph F.2)

NAVDATA NAME CONVENTIONS

(a) If an unnamed turn point, intersection or bearing/distance waypoint is colocated with a named waypoint or NAVAID station on a different route structure (e.g., low level or approach), the name or identifier of the colocated waypoint is used.

Example:

- Unnamed turn point on J2 between Lake Charles (LCH) and New Orleans (MSY) VORTACs is coincidental with the Lafayette (LFT) low level VORTAC. LFT is used as the identifier code for the turn point.

(b) Identifier codes for unnamed turn points, intersections or bearing/distance waypoints that are not coincidental with named waypoints should be constructed by taking the identifier code of the reference NAVAID for the turn point/intersection/(bearing/distance waypoint) (expected to be the nearest NAVAID serving the airway structure in which it is located) and the distance from this NAVAID to the turn point/intersection/(bearing/distance waypoint). If the distance is 99 nautical miles or less, the NAVAID identifier is placed first, followed by the distance. If the distance is 100 nautical miles or more, the last two digits only are used and placed ahead of the NAVAID identifier.

Examples: TIZ15

NAVAID	DISTANCE	CODE
INW	18	INW18
CSN	106	06CSN

2. **FIR, UIR and Controlled Airspace Reporting Positions**

In cases where the government authority does not provide unique 5-letter or less waypoint names, and in cases where the government supplied name cannot be converted to a unique 5-letter identifier using rules C.1, C.2, and C.3, the following rules are applied in developing an identifier for such waypoints.

(a) FIR – use the three characters “FIR” plus a numeric from 02 to 99. An identifier so developed is unique within the geographical area code.

Example: FIR09

(b) UIR – use the three characters “UIR” plus a numeric from 02 to 99. an identifier so developed is unique within the geographical area code.

Example: UIR39

(c) FIR/UIR – Use “FIR” and a numeric as indicated above.

Example: FIR69

(d) Controlled Airspace – use the 3-letter characters for the type of controlled airspace plus a numeric from 02 to 99. These are Terminal Waypoints and as such are unique within the Terminal Area. Examples of controlled airspace types are:

TMA	Terminal Control Area
CTA	Control Area
CTR	Control Zone
TIZ	Traffic Information Zone
ATZ	Aerodrome Traffic Zone

Example: CTR03

3. **Reporting Positions Defined by Coordinates**

   Entry/Exit positions to Oceanic Control Areas are often defined by waypoints which are "undesignated", made available in source documentation as geographical coordinates (Latitude/Longitude) expressed in full degrees. In cases where such positions are to be entered into the data base, the following rules are applied:

   (a) Positions in the northern hemisphere use the letters "N" and "E", the southern hemisphere use the letters "S" and "W" and numerics for latitude and longitude as follows:

      (1) Latitude, use values provided by source. Latitude will always precede longitude.

      (2) Longitude, use only the last two values of the three digit longitude value. Placement of the letter designator in the five character set indicates what the first digit is published as. The letter designator will be the last character if the longitude is less than 100 degrees and will be the third character if the longitude is 100 degrees or greater.

      (3) The letter "N" is used for north latitude and west longitude. The letter "E" is used for north latitude and east longitude. The letter "S" is used for south latitude and east longitude. The letter "W" is used for south latitude and west longitude.

   (b) Examples:

      N latitude/W longitude

      N52 00/W075 00 = 5275N

      N50 00/W040 00 = 5040N

      N07 00/W008 00 = 0708N

      N75 00/W170 00 = 75N70

      N07 00/W120 00 = 07N20

      N latitude/E longitude

      N50 00/E020 00 = 5020E

      N75 00/E050 00 = 7550E

N06 00/E008 00 = 0608E

N75 00/E150 00 = 75E50

N06 00/E110 00 = 06E10

S latitude/W longitude

S52 00/W075 00 = 5275W

S50 00/W040 00 = 5040W

S07 00/W008 00 = 0708W

S75 00/W170 00 = 75W70

S07 00/W120 00 = 07W20

S latitude/E longitude

S50 00/E020 00 = 5020S

S75 00/E050 00 = 7550S

S06 00/E008 00 = 0608S

S75 00/E150 00 = 75S50

S06 00/E110 00 = 06S10

e. **Duplicate Identifiers**

1. Should application of these rules result in more than one waypoint having the same identifier, a new identifier is generated for each waypoint by developing a four (or less) character identifier and adding a suffix number or letter.

Examples: SHAWNEE (COLO) SHAE1
SHAWNEE (CAL) SHAE2

2. If the suffix number reaches 10, start over with one and place the suffix in the fourth-character position. The original fourth character is placed in the fifth-character position.

Example: SHAWNEE (OKLA) SHA1E

f. **Terminal Waypoints**

The following rules are applied in developing identifiers for waypoints used solely in terminal area procedures. Such waypoint identifiers will be unique only for the airport specified. A way-point identifier used in a terminal area cannot be repeated in that terminal area but can be used in an enroute area encompassed by the same geographical area code. Terminal waypoint identifiers can be repeated in areas covered by different geographical codes. These Identifier developing rules are only applied when the waypoints in question have not been assigned official names/identifiers by the government authority.

NAVDATA NAME CONVENTIONS

1. **Airport-Related Waypoints** (Single Approach Procedure for given runway coded)

   Single Approach Procedure for given runway coded and Waypoints common to more than one approach: The following two-character codes are to be added to the runway identifier to create an airport-related waypoint identifier when no named waypoint has been established by the government source for the fix type:

   FF = Final Approach Fix
   AF = Initial Approach Fix
   IF = Intermediate Approach Fix
   CF = Final Approach Course Fix
   MA = Missed Approach Point Fix
   SD = Step-Down Fix

   NOTE: if multiple step-down fix waypoints need to be created, replace "D" with another character, retain the "S".

   RC = Runway Centerline Fix
   RW = Runway Fix
   * OM = Outer Marker Fix
   * MM = Middle Marker Fix
   * IM = Inner Marker Fix
   * BM = Backcourse Marker Fix
   TD = Touchdown point inboard of runway threshold

* See also rule G

Examples: FF36
MA09L

2. **Airport-Related Waypoints** (Multiple Approach Procedure for given runway coded.)

   Multiple approach Procedures for a given runway coded for which common waypoints cannot be established:

   - The following two-character codes are to be added to the runway identifier to create an airport-related waypoint identifier when no named waypoint has been established by the government source for the fix type:

NAVDATA NAME CONVENTIONS

Fx = Final Approach Fix, where “x” equals the Type of procedure in question

Ax = Initial Approach Fix, where “x” equals the Type of procedure in question

Ix = Intermediate Approach Fix, where “x” equals the Type of procedure in question

Cx = Final Approach Course Fix, where “x” equals the Type of procedure in question

Mx = Missed Approach Point Fix, where “x” equals the Type of procedure in question

Sx = Step-Down Fix Note: if multiple step-down fix waypoints need to be created, replace “D” with another character, retain the “S”.

Rx = Runway Centerline Fix, where “X” equals the Type of procedure in question

Tx = Touchdown Fix inboard of runway threshold, where “X” equals the Type of procedure in question

These procedure type characters do not appear on the Jeppesen Approach Charts.

The convention above for Multiple Approaches/Multiple Waypoints result in the following table:

Waypoint Type	**Waypoint codes based on the procedure route type.**					
	ILS (I)	ILS(L)	ILS(B)	VOR(V)	NDB (N)	MLS (M)
IAF	AI	AL	AB	AV	AN	AM
IF	II	IL	IB	IV	IN	IM
FACF	CI	CL	CB	CV	CN	CM
FAF	FI	FF	FB	FV	FN	FM
MAP	MI	ML	MB	MV	MN	MM
TDP	TI	TL	TB	TV	TN	TM
Step-Down	SI	SL	SB	SV	SN	SM
FEP	EI	EL	EB	EV	EN	EM
	RNAV (R)	TACAN (T)	IGS (G)	LDA (X)	SDF (U)	GPS (P)

NAVDATA NAME CONVENTIONS

Waypoint Type	**Waypoint codes based on the procedure route type.**					
IAF	AR	AT	AG	AX	AU	AP
IF	IR	IT	IG	IX	IU	IP
FACF	CR	CT	CG	CX	CU	CP
FAF	FR	FT	FG	FX	FU	FP
MAP	MR	MT	MG	MX	MU	MP
TDP	TR	TT	TG	TX	TU	TP
Step-Down	SR	ST	SG	SX	SU	SP
FEP	ER	ET	EG	EX	EU	EP
	MLS (W)	MLS (Y)	NDB +DME(Q)	FMS (F)	GLS (J)	VORDME (D)
IAF	AW	AY	AQ	1F	AJ	AD
IF	IW	IY	IQ	2F	IJ	ID
FACF	CW	CY	CQ	3F	CJ	CD
FAF	FW	FY	FQ	4F	FJ	FD
MAP	MW	MY	MQ	5F	MJ	MD
TDP	TW	TY	TQ	6F	TJ	TD
Step-Down	SW	SY	SQ	7F	SJ	SD
FEP	EW	EY	EQ	8F	EJ	ED
	VOR (S)					
IAF	AS					
IF	IS					
FACF	CS					
FAF	FS					
MAP	MS					
TDP	TS					
Step-Down	SS					
FEP	ES					

NOTE: “C-T-L” is “Circle-To-Land” Approach

the prefixes indicated in the table above assume that a unique geographical position (Latitude/Longitude) is required for each Waypoint and the “common waypoint” idea cannot be used. Should a single waypoints’ geographical position be such that it will serve as the same waypoint type for more than one coded approach procedure, a “common waypoint”; the Single Approach/Common Waypoint convention shall be used.

Note on prefixes for FMS(F) Approach Waypoints:

As the majority of the prefixes generated using the standard convention and the Route Type “F” produced duplicates or two character codes that would be easily confused with other coded, the numerical/alpha/runway identifier concept is used.

3. **Bearing/Distance Waypoints**

   Identifiers are developed by the application of the following rules:

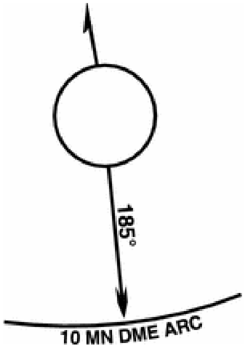
   (a) The first character is “D”.

   (b) Characters 2 through 4 signify the VHF NAVAID radial on which the waypoint lies.

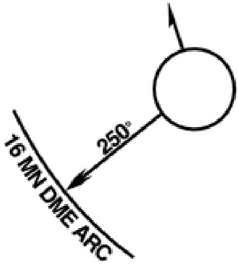
   (c) The last character is the DME arc radius defining the position of the waypoint on the radial. This radius is expressed as the equivalent letter of the alphabet, i.e., A = 1NM, G = 7NM, P = 16NM, etc.

   Examples:

D185J



D250P



(d) If distance is greater than 26NM, use the convention in paragraph D or E.

(e) If the arc radius is provided in official government source as nautical miles and tenths of nautical miles, the letter of the alphabet will reflect values rounded to full nautical miles, i.e., 10.5nm = 11nm or K, 10.4nm = 10nm or J. All values between 0.1 and 1.4 will be character “A”.

g. **Approach Marker Identification Priority Convention**

1. If the approach marker is named, use its name.

   Example: PIKKE OM Runway 26 will be PIKKE

2. If it is unnamed but an NDB, use the NDB ident followed by the letters NB

   Example: Ft. Nelson LOM will be YENB

3. If it is unnamed and not an NDB, use letters OM followed by the runway number.

   Example: Outer Marker for Runway 26 becomes OM26

NAVDATA NOTAM SERVICE

GENERAL

Jeppesen NavData Change Notices are provided to operators of airborne navigation systems using a navigation database produced and updated from information supplied by Jeppesen.

GEOGRAPHIC AREAS

The world is covered by ten Aeronautical Radio Inc. (ARINC) geographic areas, and the NavData Change Notices are issued in ten individual geographic coverages that correspond to the ARINC areas. Refer to NavData Pages 101 through 103 for a complete explanation of the ARINC and NavData coverages.

CONTENT

NavData Change Notices are issued weekly, and include significant temporary and permanent information changes affecting the flight data stored in your aircraft FMCS. Entries are published until the temporary condition no longer exists, or until the permanent change has been included in your NavData update.

All times are local unless otherwise indicated.

A vertical bar indicates new or revised information.

NAVDATA EFFECTIVE DATES

The NavData effective dates are highlighted in a box on the beginning page of each NavData Change Notices revision to ensure there is no confusion as to which 28 day update cycle the information applies to.

Every four weeks there are two sets of dates highlighted, the current cycle and the upcoming cycle. Entries still effective at the time of the Friday NavData Change Notices publication date and included in the next Thursday cycle update are followed by “(Until date)”. Entries for changes effective with the new cycle and received too late for inclusion are prefaced with “From date”.

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Jeppesen NavData Change Notices highlight only significant changes affecting Jeppesen navigation data that may be currently stored in your aircraft navigation system database. Check for NOTAMs and other pertinent information prior to flight.

WORLDWIDE GEOGRAPHIC COVERAGES

To ensure you can easily locate NavData Change Notices applicable to your particular areas of operation, each page is identified by a coverage code. NavData Change Notices coverage codes, and the areas covered by each, are shown on the following worldwide chart. These areas are coincidental with the established Aeronautical Radio Incorporated (ARINC) navigation data geographical areas. The associated ARINC navigation data area codes, which may appear in your navigation data base, are also provided.

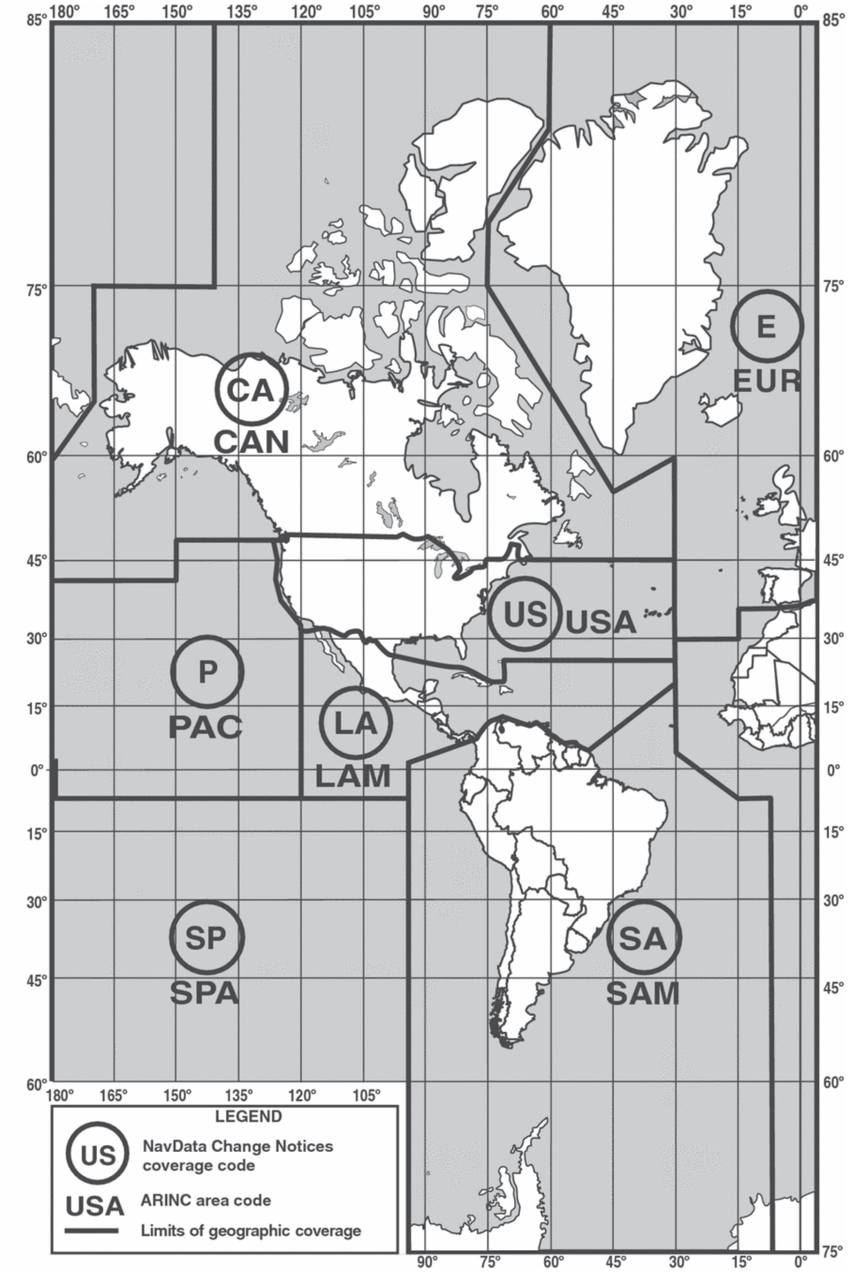
NAVDATA CHANGE NOTICES CODE	NAVDATA CHANGE NOTICES AREA NAME	ARINC AREA CODE
US	United States	USA
CA	Canada/Alaska	CAN
LA	Latin America	LAM
SA	South America	SAM
P	Pacific	PAC
SP	South Pacific	SPA
E	Europe	EUR
EE	Eastern Europe/China	EEU
A	Africa	AFR
ME	Middle East/South Asia	MES

Example:

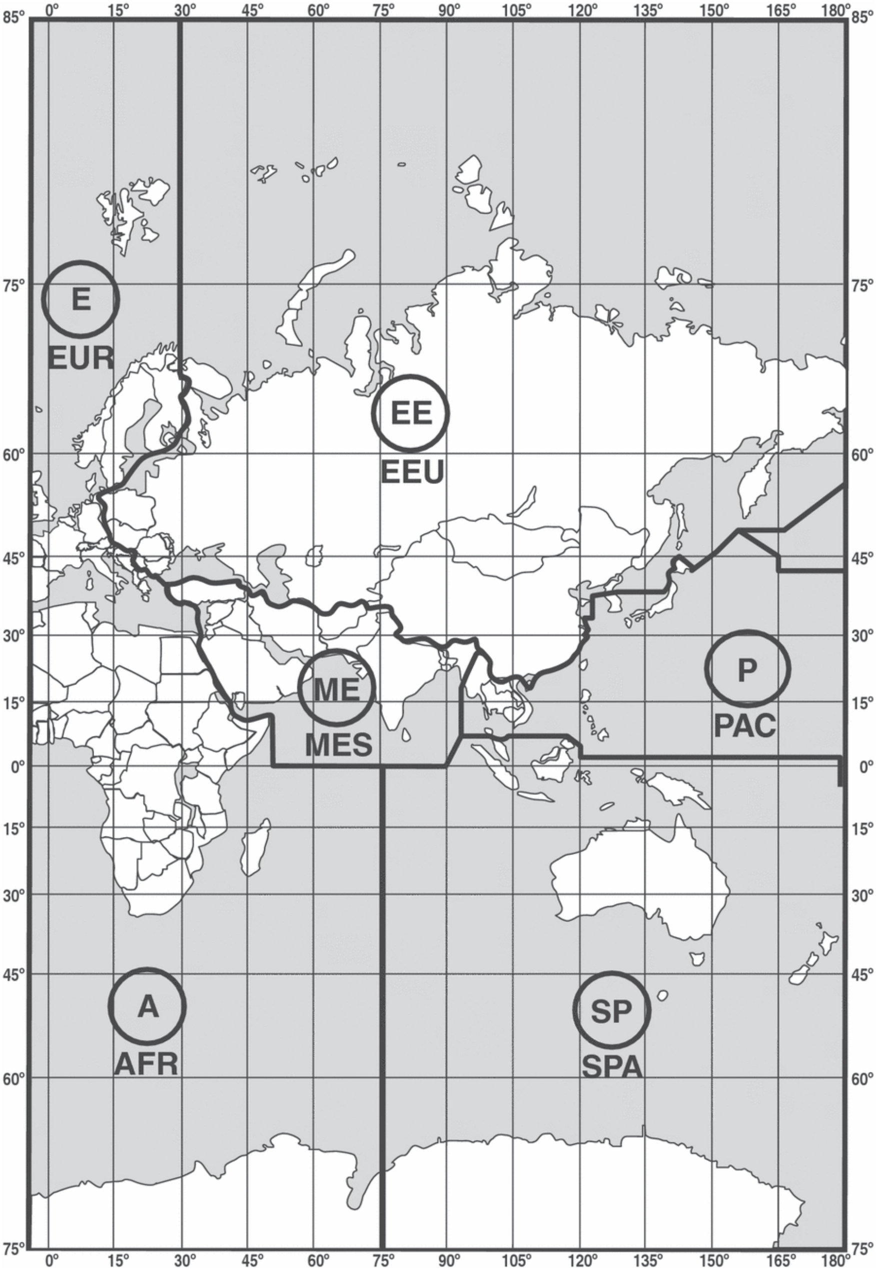
US	NavData Change Notices United States Page US-1 contains Change Notices applicable to the forty-eight United States, plus the portion of the Gulf of Mexico and the Atlantic Ocean shown on the following chart.
USA	USA is the ARINC area code for the same area.

NOTE: NavData Change Notices are provided only for your area of operation. You may or may not receive all of the coverages listed above.

NAVDATA CHANGE NOTICES



NAVDATA CHANGE NOTICES



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Enroute

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Enroute

Enroute Data - General

AIR/GROUND VOICE SERVICES

ARINC-1/2 – DOMESTIC U. S. VHF NETWORK:

a. Airborne coverage throughout the United States (continuous coverage above 20,000 feet).

b. On-the-ground coverage at most major airports within the United States.

c. Phone-patch capabilities for enroute message traffic.

d. Message delivery via ARINC Avinet^{SM} Service or via telephone.

e. Capability to check on enroute, destination, and alternate field weather.

f. Direct Dialing capability for aircraft equipped with DTMF microphones (dual tone multi-frequency)

ARINC-3/4 – INTERNATIONAL HF NETWORK:

a. Company message relay service and phone-patch capability via Long Distance Operational Control Frequencies (LDOCF).

b. Message delivery via Avinet.

c. Telephone delivery for non-Avinet subscribers.

d. Weather observations and forecasts available.

e. SELCAL-equipped aircraft need not monitor HF continuously.

ARINC-5/6 – MEXICO VHF NETWORK:

Provides services identical to the Domestic U.S. VHF Network where indicated within Mexico

ARINC-7/BLK– ASIA AREA HF LDOC COVERAGE:

Company message relay service and phone-patch capability via Long Distance Operational Control Frequencies (LDOCF).

GROUND COMMUNICATIONS CENTERS

NEW YORK (NYC)

Address: 613 Johnson Ave.
Bohemia, Long Island
NY
11716-2696
Tel: (631) 244-2480
Fax: (631) 563-2412

ADNS: NYCXGXA

SAN FRANCISCO (SFO)

Address: 6011 Industrial Way

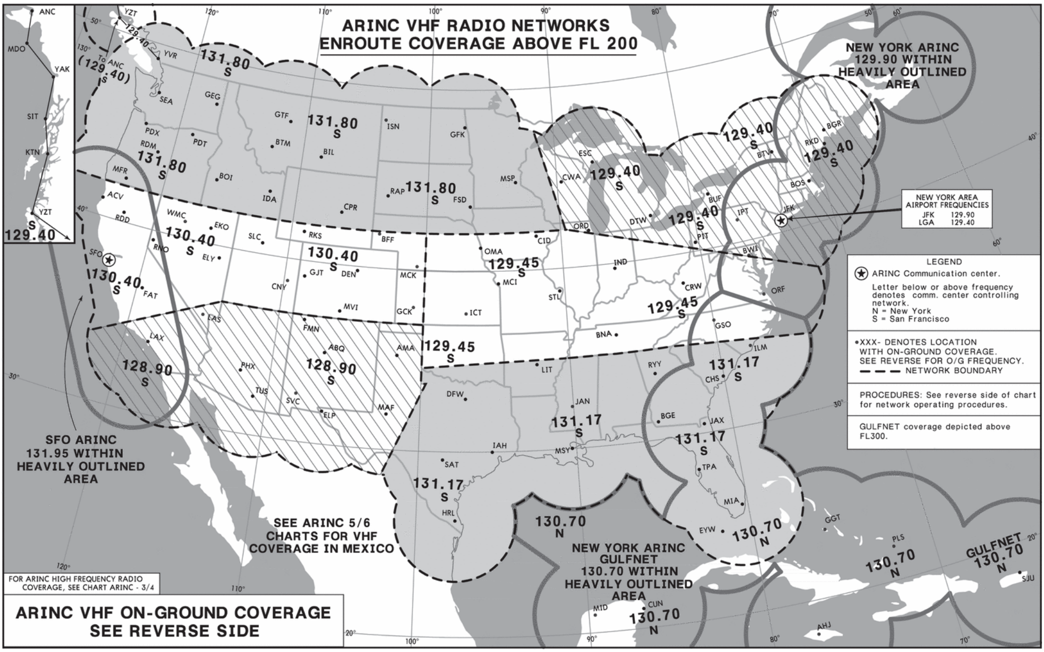
ARINC SERVICES AND COMMUNICATIONS

	Livermore
	CA
	94550
Tel:	(925) 294-8400
Fax:	(925) 294-9597

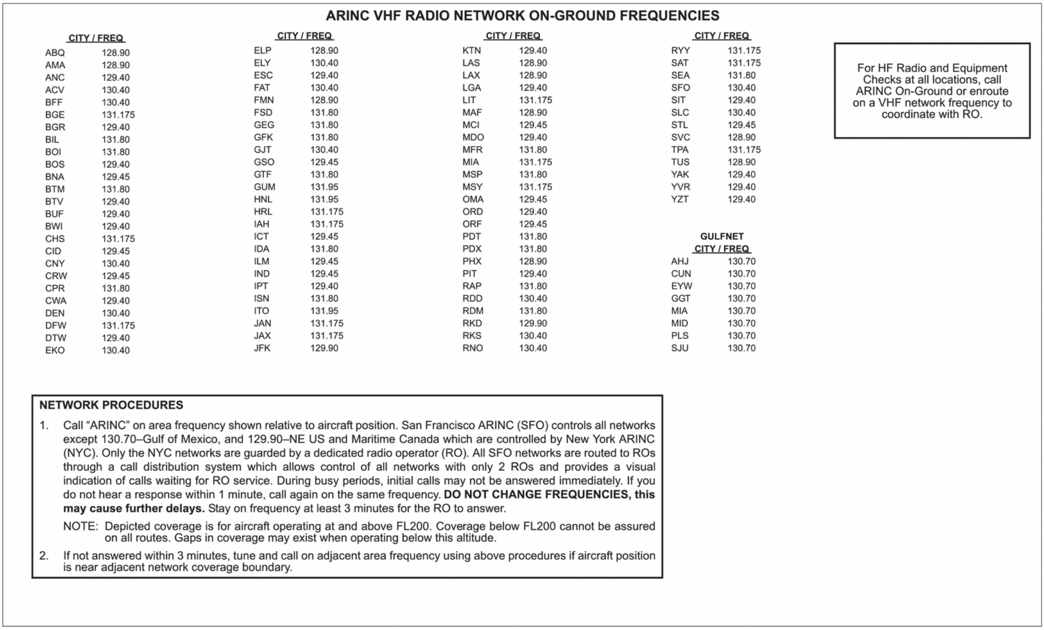
ADNS: SFOXGXA

Direct questions to ARINC Service Desk (800) 633-6882 or (703) 637-6360.

ARINC VHF RADIO NETWORKS — ENROUTE COVERAGE ABOVE FL 200



ARINC VHF RADIO NETWORK ON-GROUND FREQUENCIES



ARINC VHF RADIO NETWORK ON-GROUND FREQUENCIES

CITY	FREQ
ABQ	128.90
AMA	128.90
ANC	129.40
ACV	130.40
BFF	130.40
BGE	131.175
BGR	129.40
BIL	131.80
BOI	131.80
BOS	129.40
BNA	129.45
BTM	131.80
BTV	129.40
BUF	129.40
BWI	129.40
CHS	131.175
CID	129.45
CNY	130.40
CRW	129.45
CPR	131.80
CWA	129.40
DEN	130.40
DFW	131.175
DTW	129.40
EKO	130.40

CITY	FREQ
ELP	128.90
ELY	130.40
ESC	129.40
FAT	130.40
FMN	128.90
FSD	131.80
GEG	131.80
GFK	131.80
GJT	130.40
GSO	129.45
GTF	131.80
GUM	131.95
HNL	131.95
HRL	131.175
IAH	131.175
ICT	129.45
IDA	131.80
ILM	129.45
IND	129.45
IPT	129.40
ISN	131.80
ITO	131.95
JAN	131.175
JAX	131.175
JFK	129.90

CITY	FREQ
KTN	129.40
LAS	128.90
LAX	128.90
LGA	129.40
LIT	131.175
MAF	128.90
MCI	129.45
MDO	129.40
MFR	131.80
MIA	131.175
MSP	131.80
MSY	131.175
OMA	129.45
ORD	129.40
ORF	129.45
PDT	131.80
PDX	131.80
PHX	128.90
PIT	129.40
RAP	131.80
RDD	130.40
RDM	131.80
RKD	129.90
RKS	130.40
RNO	130.40

CITY	FREQ
RYY	131.175
SAT	131.175
SEA	131.80
SFO	130.40
SIT	129.40
SLC	130.40
STL	129.45
SVC	128.90
TPA	131.175
TUS	128.90
YAK	129.40
YVR	129.40
YZT	129.40

GULFNET

CITY	FREQ
AHJ	130.70
CUN	130.70
EYW	130.70
GGT	130.70
MIA	130.70
MID	130.70
PLS	130.70
SJU	130.70

For HF Radio and Equipment Checks at all locations, call ARINC On-Ground or enroute on a VHF network frequency to coordinate with RO.

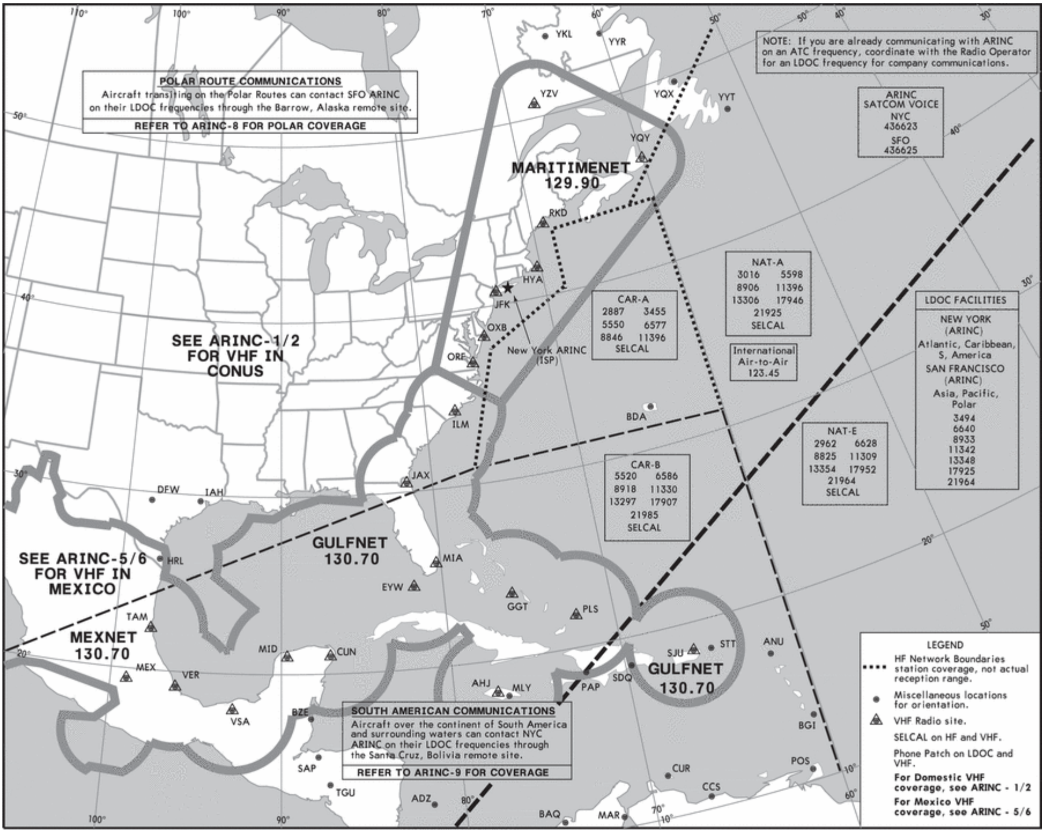
NETWORK PROCEDURES

1. Call “ARINC” on area frequency shown relative to aircraft position. San Francisco ARINC (SFO) controls all networks except 130.70–Gulf of Mexico, and 129.90–NE US and Maritime Canada which are controlled by New York ARINC (NYC). Only the NYC networks are guarded by a dedicated radio operator (RO). All SFO networks are routed to ROs through a call distribution system which allows control of all networks with only 2 ROs and provides a visual indication of calls waiting for RO service. During busy periods, initial calls may not be answered immediately. If you do not hear a response within 1 minute, call again on the same frequency. **DO NOT CHANGE FREQUENCIES, this may cause further delays.** Stay on frequency at least 3 minutes for the RO to answer.

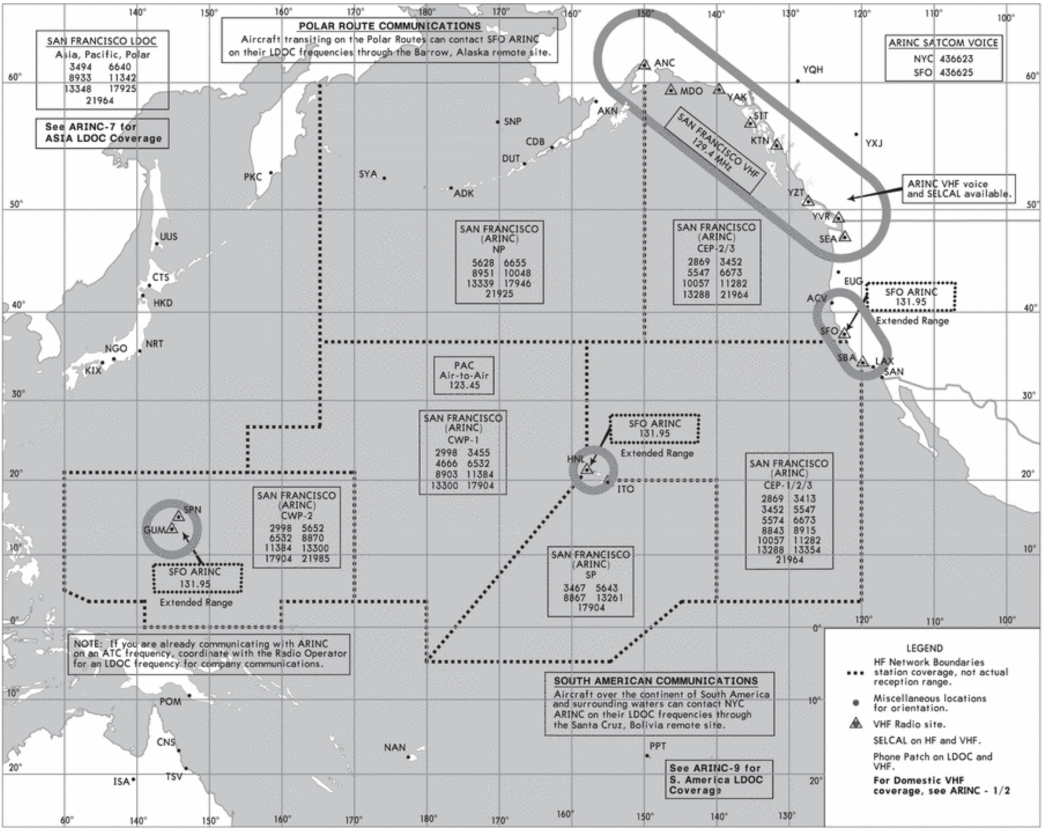
   NOTE: Depicted coverage is for aircraft operating at and above FL200. Coverage below FL200 cannot be assured on all routes. Gaps in coverage may exist when operating below this altitude.

2. If not answered within 3 minutes, tune and call on adjacent area frequency using above procedures if aircraft position is near adjacent network coverage boundary.

ARINC HF/VHF VOICE COVERAGE — ATLANTIC/CARIBBEAN



ARINC HF/VHF VOICE COVERAGE — PACIFIC



SAN FRANCISCO LDOC
Asia, Pacific, Polar
3494 6640
8933 11342
13348 17925
21964

See ARINC-7 for ASIA LDOC Coverage

POLAR ROUTE COMMUNICATIONS
Aircraft transiting on the Polar Routes can contact SFO ARINC on their LDOC frequencies through the Barrow, Alaska remote site.

ARINC SATCOM VOICE
NYC 436623
SFO 436625

ARINC VHF voice and SELCAL available.

SAN FRANCISCO (ARINC) NP
5628 6655
8951 10048
13339 17946
21925

SAN FRANCISCO (ARINC) CEP-2/3
2869 3452
5547 6673
10057 11282
13288 21964

SFO ARINC 131.95
Extended Range

PAC Air-to-Air 123.45

SAN FRANCISCO (ARINC) CWP-1
2998 3455
4666 6532
8903 11384
13300 17904

SFO ARINC 131.95
Extended Range

SAN FRANCISCO (ARINC) CEP-1/2/3
2869 3413
3452 5547
5574 6673
8843 8915
10057 11282
13288 13354
21964

SAN FRANCISCO (ARINC) CWP-2
2998 5652
6532 8870
11384 13300
17904 21985

SFO ARINC 131.95
Extended Range

SAN FRANCISCO (ARINC) SP
3467 5643
8867 13261
17904

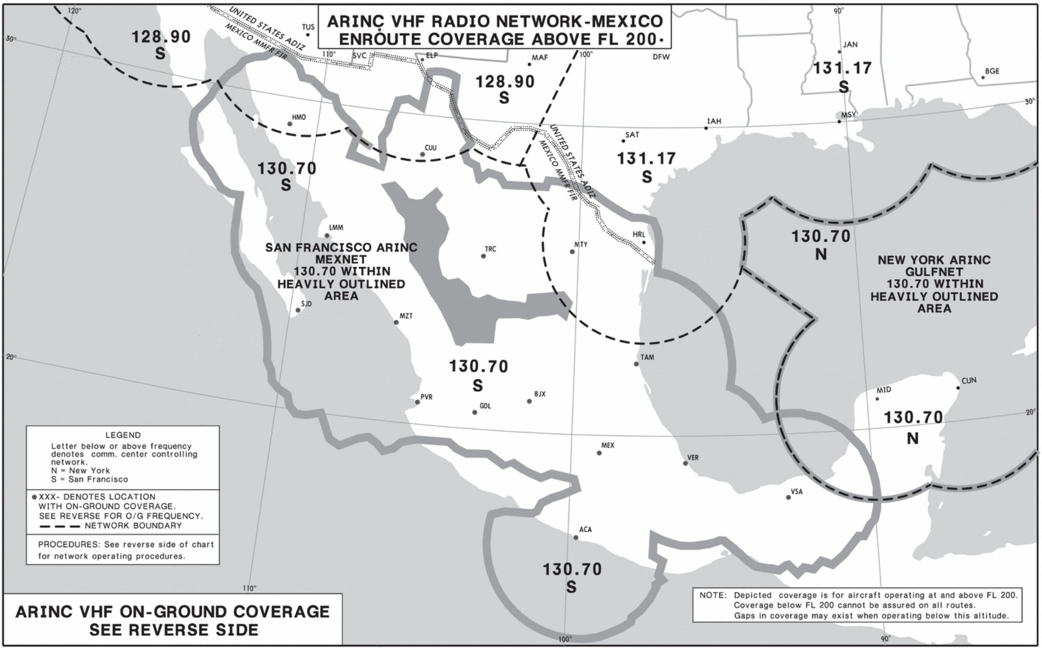
NOTE: If you are already communicating with ARINC on an ATC frequency, coordinate with the Radio Operator for an LDOC frequency for company communications.

SOUTH AMERICAN COMMUNICATIONS
Aircraft over the continent of South America and surrounding waters can contact NYC ARINC on their LDOC frequencies through the Santa Cruz, Bolivia remote site.

See ARINC-9 for S. America LDOC Coverage

LEGEND
- ▪▪▪ HF Network Boundaries station coverage, not actual reception range.
- ● Miscellaneous locations for orientation.
- ▲ VHF Radio site.
- SELCAL on HF and VHF.
- Phone Patch on LDOC and VHF.
- **For Domestic VHF coverage, see ARINC - 1/2**

ARINC VHF RADIO NETWORK — MEXICO — ENROUTE COVERAGE ABOVE FL 200



ARINC VHF RADIO NETWORK-MEXICO
ENROUTE COVERAGE ABOVE FL 200

LEGEND

Letter below or above frequency denotes comm. center controlling network.
N = New York
S = San Francisco

● XXX- DENOTES LOCATION WITH ON-GROUND COVERAGE. SEE REVERSE FOR O/G FREQUENCY.

— — — NETWORK BOUNDARY

PROCEDURES: See reverse side of chart for network operating procedures.

NOTE: Depicted coverage is for aircraft operating at and above FL 200. Coverage below FL 200 cannot be assured on all routes. Gaps in coverage may exist when operating below this altitude.

ARINC VHF ON-GROUND COVERAGE
SEE REVERSE SIDE

ARINC VHF RADIO NETWORK MEXICO ON GROUND FREQUENCY 130.7

ARINC VHF RADIO NETWORK MEXICO ONG ROUND COVERAGE FREQUENCY 130.7

IATA	CITY
ACA	ACAPULCO
BJX	LEON
CUU	CHIHUAHUA
GDL	GUADALAJARA
HMO	HERMOSILLO
LMM	LOS MOCHIS
MEX	MEXICO CITY
MTY	MONTERREY
MZT	MAZATLAN
PVR	PUERTO VALLARTA
SJD	SAN JOSE DEL CABO
TAM	TAMPICO
TRC	TORREON
VER	VERACRUZ
VSA	VILLAHERMOSA

For HF Radio and Equipment Checks at all locations, call ARINC On-Ground or enroute on a VHF network frequency to coordinate with RO.

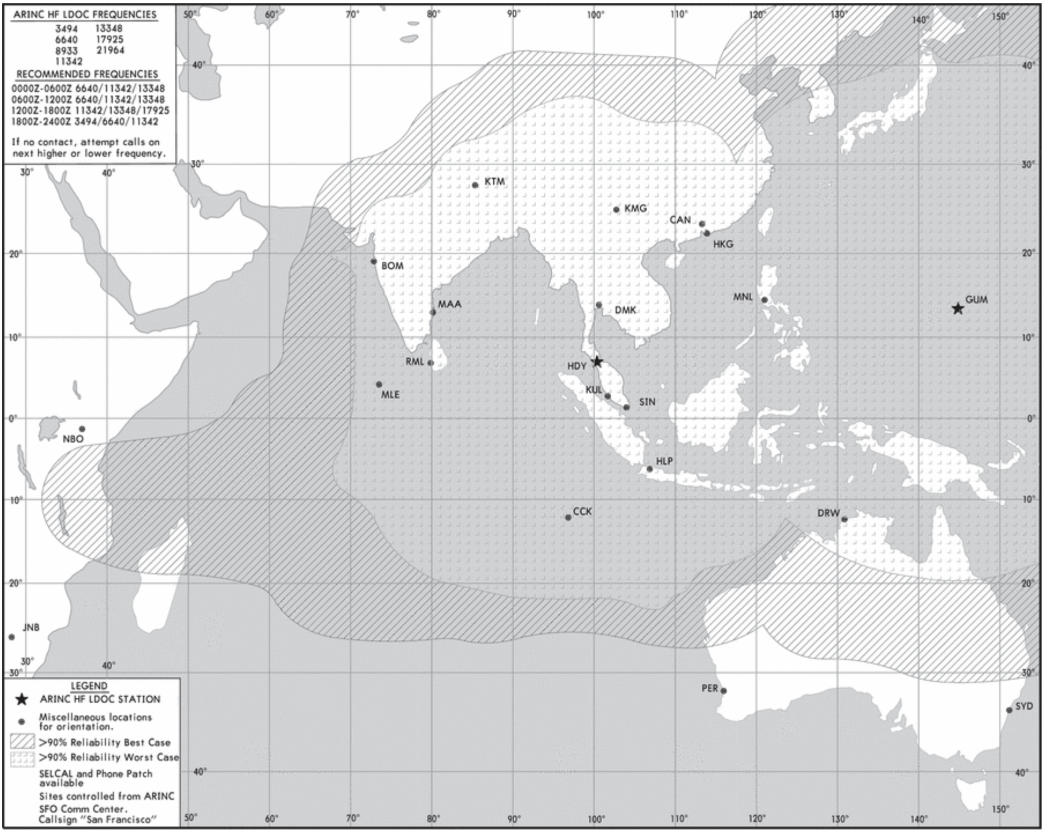
NETWORK PROCEDURES

1. Call “ARINC” on area frequency shown relative to aircraft position. San Francisco ARINC (SFO) controls all networks except 130.70–Gulf of Mexico, and 129.90–NE USa nd Maritime Canada which are controlled by New York ARINC (NYC). Only the NYC networks are guarded by a dedicated radio operator (RO). All SFO networks are routed to ROs through a call distribution system which allows control of all networks with only 3 ROs and provides a visual indication of calls waiting for RO service. During busy periods, initial calls may not be answered immediately. Ify ou do not hear a response within 1 minute, call again on the same frequency. **DO NOT CHANGE FREQUENCIES, this may cause further delays.** Stay on frequency atl east 3 minutes for the RO to answer.

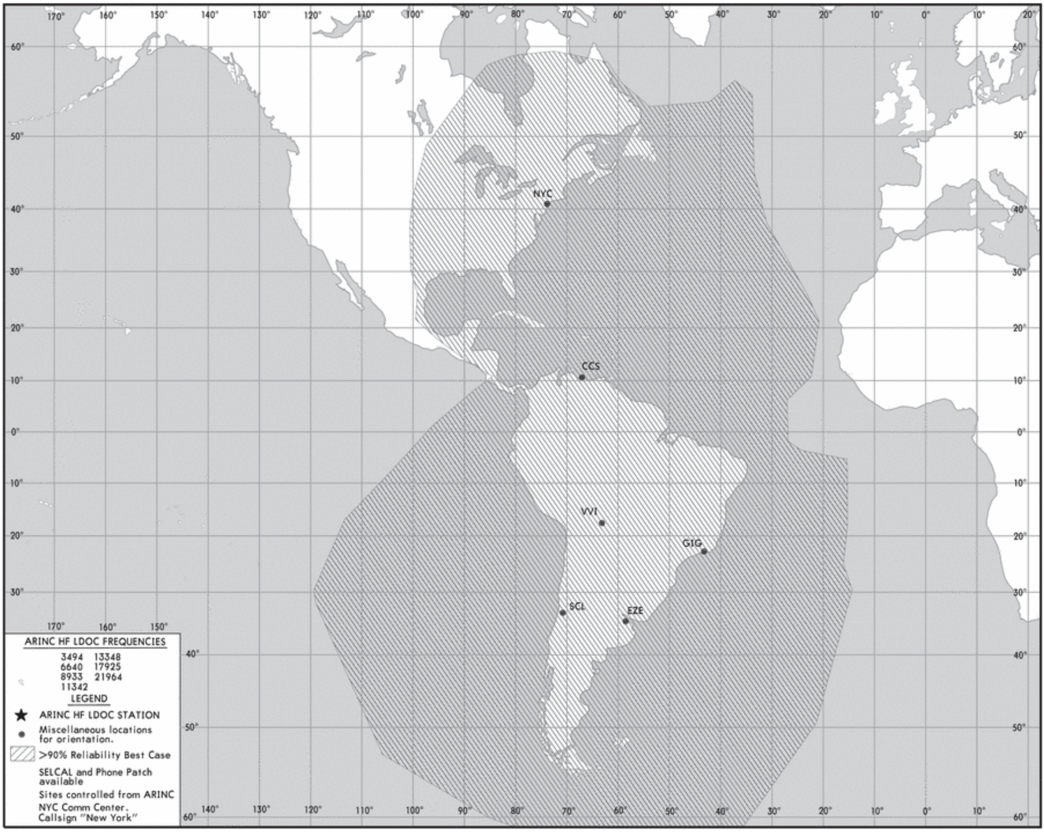
   NOTE: Depicted coverage is for aircraft operating at and above FL200. Coverage below FL200 cannot be assured on all routes. Gaps in coverage may exist when operating below this altitude.

2. If not answered within 3 minutes, tune and call on adjacent area frequency ifa ircraft position isn ear adjacent network coverage boundary.

ARINC HF LDOC COVERAGE — ASIA AREA

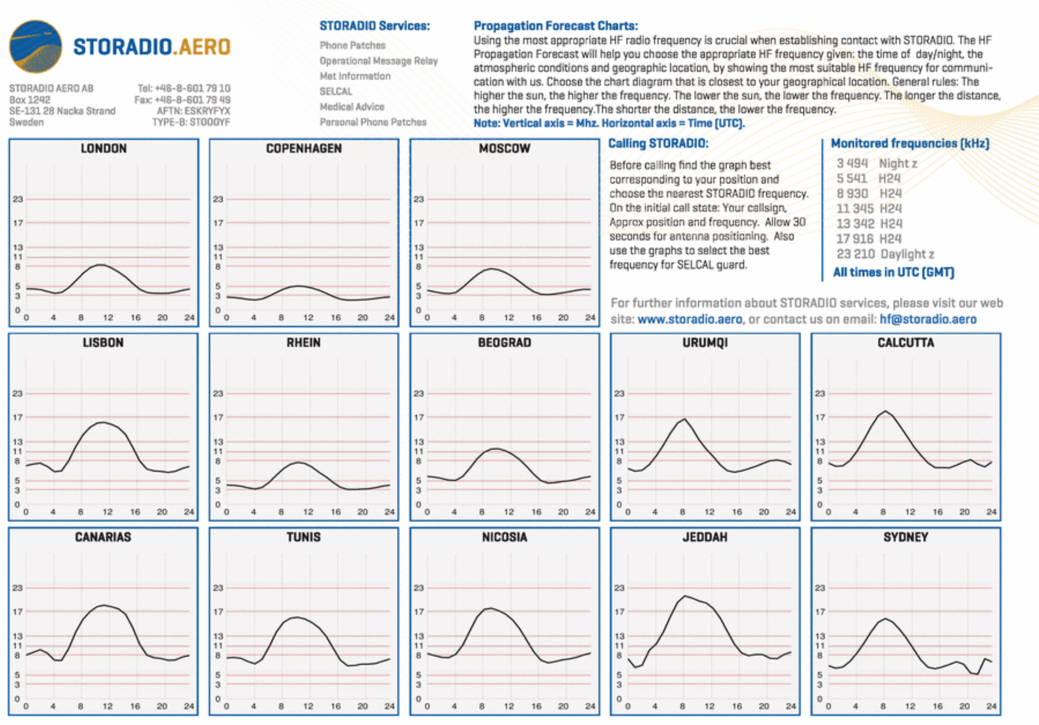


ARINC HF LDOC COVERAGE — AMERICAS AREA



LONG DISTANCE OPERATIONAL CONTROL

Period: MAY 2021 - JUL 2021



STORADIO.AERO

STORADIO AERO AB
Box 1242
SE-131 28 Nacka Strand
Sweden

Tel: +46-8-601 79 10
Fax: +46-8-601 79 49
AFTN: ESKRYFYX
TYPE-B: STOOOYF

STORADIO Services:

- Phone Patches
- Operational Message Relay
- Met Information
- SELCAL
- Medical Advice
- Personal Phone Patches

Propagation Forecast Charts:

Using the most appropriate HF radio frequency is crucial when establishing contact with STORADIO. The HF Propagation Forecast will help you choose the appropriate HF frequency given: the time of day/night, the atmospheric conditions and geographic location, by showing the most suitable HF frequency for communication with us. Choose the chart diagram that is closest to your geographical location. General rules: The higher the sun, the higher the frequency. The lower the sun, the lower the frequency. The longer the distance, the higher the frequency.The shorter the distance, the lower the frequency.

Note: Vertical axis = Mhz. Horizontal axis = Time (UTC).

Calling STORADIO:

Before calling find the graph best corresponding to your position and choose the nearest STORADIO frequency. On the initial call state: Your callsign, Approx position and frequency. Allow 30 seconds for antenna positioning. Also use the graphs to select the best frequency for SELCAL guard.

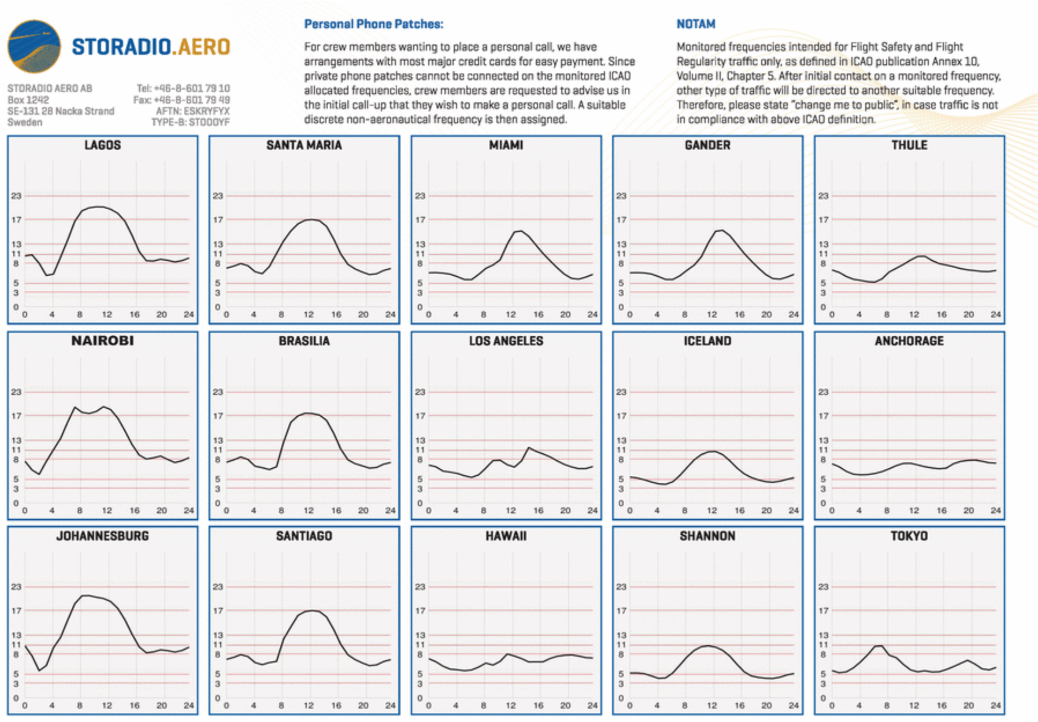
Monitored frequencies (kHz)

3 494	Night z
5 541	H24
8 930	H24
11 345	H24
13 342	H24
17 916	H24
23 210	Daylight z

All times in UTC (GMT)

For further information about STORADIO services, please visit our web site: www.storadio.aero, or contact us on email: hf@storadio.aero

STOCKHOLM RADIO



STORADIO.AERO

STORADIO AERO AB
Box 1242
SE-131 28 Nacka Strand
Sweden

Tel: +46-8-601 79 10
Fax: +46-8-601 79 49
AFTN: ESKRYFYX
TYPE-B: STODOYF

Personal Phone Patches:

For crew members wanting to place a personal call, we have arrangements with most major credit cards for easy payment. Since private phone patches cannot be connected on the monitored ICAO allocated frequencies, crew members are requested to advise us in the initial call-up that they wish to make a personal call. A suitable discrete non-aeronautical frequency is then assigned.

NOTAM

Monitored frequencies intended for Flight Safety and Flight Regularity traffic only, as defined in ICAO publication Annex 10, Volume II, Chapter 5. After initial contact on a monitored frequency, other type of traffic will be directed to another suitable frequency. Therefore, please state "change me to public", in case traffic is not in compliance with above ICAO definition.

BASIC OCEANIC LONG-RANGE NAVIGATION AND COMMUNICATION REQUIREMENTS

Any operation which is conducted in international oceanic airspace on an IFR flight plan, a VFR controlled flight plan, or at night, and is continued beyond the published range of normal airways navigation facilities (NDB, VOR/DME), is considered to be a long-range navigation operation. Accurate navigational performance is required to support the separation minima which air traffic control units apply. These separation minima can be found in the International Civil Aviation Organization (ICAO) Regional Supplementary Procedures Document 7030 and the Oceanic Air Traffic Control Handbook (FAA Order 7110.83).

Federal Aviation Regulation (FAR) 91.703 requires that civil aircraft must comply with ICAO, Annex 2 when operating over the high seas. In addition, ICAO, Annex 6, Part II stipulates that an airplane operated in international airspace be provided with navigation equipment which will enable it to proceed in accordance with the flight plan and with the requirements of air traffic services.

Annex 2 further requires that an aircraft shall adhere to the *“current flight plan unless a request for a change has been made and clearance obtained from the appropriate air traffic control unit.”* Annex 2 also requires that *“unless otherwise authorized by the appropriate ATS authority, or directed by the appropriate air traffic control unit, controlled flights shall, insofar as practicable: (a) when on an established ATS route, operate along the centerline of that route; or (b) when on another route, operate directly between the navigation facilities and/or points defining that route.”* In the event that a controlled flight inadvertently deviates from its current flight plan, the following action shall be taken:

a. Deviation from track: if the aircraft is off track, action shall be taken forthwith to adjust the heading of the aircraft to regain track as soon as practicable.

b. Variation in true airspeed: if the average true airspeed at cruising level between reporting points varies or is expected to vary by plus or minus 5 percent of the true airspeed, from that given in the flight plan, the appropriate air traffic services unit shall be so informed.

c. Change in time estimate: if the time estimate for the next applicable reporting point, flight information region boundary or destination airport, whichever comes first, is found to be in error in excess of 2 minutes from that notified to air traffic services, or such other period of time as is prescribed by the appropriate ATS authority or on the basis of air navigation regional agreements, a revised estimated time shall be notified as soon as possible to the appropriate air traffic services unit.

ICAO, Annex 6, Part II contains standards and recommended practices adopted as the minimum standards for all airplanes engaged in general aviation international air navigation. It requires that those airplanes operated in accordance with Instrument Flight Rules (IFRs), at night, or on a VFR controlled flight have installed and approved radio communication equipment capable of conducting two-way communication at any time during the flight with such aeronautical stations and on such frequencies as may be prescribed by the appropriate authority.

All of the aforementioned requirements contained in Annex 2 are incorporated in Section 91.1 of the FARs for those aircraft operating under United States civil certification in international oceanic airspace.

USE OF VERY HIGH FREQUENCY (VHF) AND HIGH FREQUENCY (HF) FOR COMMUNICATION

Due to the inherent *line of sight* limitations of VHF radio equipment when used for communications in international oceanic airspace, those aircraft operating on an IFR or controlled VFR flight plan beyond the communications capability of VHF *are required*, as per ICAO, Annex 2, to maintain a continuous listening watch and communications capability on the *assigned HF frequencies*. Although these frequencies will be designated by Air Traffic Control, actual communication will be with general purpose communication facilities such as international flight service stations or Aeronautical Radio, Inc. (ARINC). These facilities are responsible for the relay of position reports and other pertinent information between the aircraft and Air Traffic Control.

SPECIAL NORTH ATLANTIC, CARIBBEAN AND PACIFIC AREA COMMUNICATIONS

VHF air-to-air frequencies enable aircraft engaged on flights over remote and oceanic areas out of range of VHF ground stations to exchange necessary operational information and to facilitate the resolution of operational problems. Air-to-air frequencies are charted on appropriate Jeppesen Enroute charts.

GUARD OF VHF EMERGENCY FREQUENCY

Pilots should remember that there is a need to continuously guard the VHF emergency frequency 121.5 MHz when on long over-water flights, except when communications on other VHF channels, equipment limitations, or cockpit duties prevent simultaneous guarding of two channels. Guarding of 121.5 MHz is particularly critical when operating in proximity to flight information region (FIR) boundaries.

USE OF NON-DIRECTIONAL BEACON (NDB) FOR NAVIGATION

The use of an NDB as the *primary* source of navigation for long-range oceanic flight presents the operator with numerous limitations and restrictions that are inherent in low frequency radio equipment and the low frequency signals they receive. These include:

NDB navigation aids of the highest power (2000 or more watts) which are maintained and flight-checked as suitable for air navigation, but are limited in their usable service and/or reception range to no more than *75 nautical miles* from the facility, *at any altitude*.

Although the operator may be able to receive standard (AM/amplitude modulation) broadcast stations with NDB equipment, primary dependence on these facilities for air navigation is a questionable operating practice. The following are some of the inherent problems associated with reception of these stations:

a. Infrequent identification of the station.

b. Identification of foreign language stations may be impossible without some knowledge of the language.

c. Transmitter sites are not always collocated with studio facilities.

d. Termination of service without notice.

e. Weather systems causing erratic and unreliable reception of signal.

f. Atmospheric disturbances causing erratic and unreliable reception of signal.

g. No flight checks conducted to verify the suitability and reliability of the facility and its signal for use in air navigation.

h. Fluctuation (bending) of signal due to *shoreline/mountain* effect.

i. Standard broadcast stations are not dedicated for air navigation purposes.

Considering the aforementioned limitations, the operator should be able to navigate the aircraft so as to maintain the track/course and the tolerances specified in the Air Traffic Control Clearance (as per ICAO, Annex 2 and the Regional Supplementary Procedures Document 7030). Realizing that an error of 10 degrees, at a distance of 2000 miles, equates to approximately 350 miles of course deviation, the inadequacies of the *non-directional beacon* as the sole source of navigation for oceanic flight *must* be evaluated carefully.

SPECIAL EMERGENCY (AIR PIRACY)

a. A special emergency is a condition of air piracy, or other hostile act by a person(s) aboard an aircraft, which threatens the safety of the aircraft or its passengers.

b. The pilot of an aircraft reporting a special emergency condition should:

   1. If circumstances permit apply *distress or urgency* radio-telephony procedures. Include the details of the special emergency.

   2. If circumstances do not permit the use of prescribed *distress or urgency* procedures, transmit:

      (a) On the air/ground frequency in use at the time.

      (b) As many as possible of the following elements spoken distinctly and in the following order:

         (1) Name of the station addressed (time and circumstances permitting).

         (2) The identification of the aircraft and present position.

         (3) The nature of the special emergency condition and pilot intentions (circumstances permitting).

         (4) If unable to provide this information, use code words and/or transponder as follows: state “TRANSPONDER SEVEN FIVE ZERO ZERO.” Meaning: “I am being hijacked/forced to a new destination;” and/or use Transponder Setting MODE 3/A, Code 7500.

NOTE: Code 7500 will never be assigned by ATC without prior notification from the pilot that his aircraft is being subjected to unlawful interference. The pilot should refuse the assignment of Code 7500 in any other situation and inform the controller accordingly. Code 7500 will trigger the special emergency indicator in all radar ATC facilities.

c. Air traffic controllers will acknowledge and confirm receipt of transponder Code 7500 by asking the pilot to verify it. If the aircraft is not being subjected to unlawful interference, the pilot should respond to the query by broadcasting in the clear that he is not being subjected to unlawful interference. Upon receipt of this information, the controller will request the pilot to verify the code selection depicted in the code selector windows in the transponder control panel and change the code to the appropriate setting. If the pilot replies in the affirmative or does not reply, the controller will not ask further questions but will flight follow, respond to pilot requests and notify appropriate authorities.

d. If it is possible to do so without jeopardizing the safety of the flight, the pilot of a hijacked passenger aircraft, after departing from the cleared routing over which the aircraft was operating, will attempt to do one or more of the following things, insofar as circumstances may permit:

    1. Maintain a true airspeed of no more than 400 knots, and preferably an altitude of between 10,000 and 25,000 feet.
    2. Fly a course toward the destination which the hijacker has announced.

e. If these procedures result in either radio contact or air intercept, the pilot will attempt to comply with any instructions received which may direct him to an appropriate landing field.

DESIGNATORS OF ATS ROUTES AND ITS USE IN VOICE COMMUNICATIONS

According to ICAO Annex 11 basic designators for ATS routes shall consist of a maximum of five, in no case exceed six, alpha/numeric characters in order to be usable by both ground and airborne automation systems. The designator shall indicate the type of the route, that means: high/low altitude, specific airborne navigation equipment requirements (RNAV), aircraft type using the route primarily or exclusively.

COMPOSITION OF DESIGNATORS

a. The basic designator consists of one letter of the alphabet followed by a number from 1 to 999. The letters may be:

1.	**A, B, G, R**	—	for routes which form part of the regional networks of ATS routes **and** are not area navigation routes;
2.	**L, M, N, P**	—	for area navigation routes which form part of the regional networks of ATS routes;
3.	**H, J, V, W**	—	for routes which do **not** form part of the regional networks of ATS routes **and** are not area navigation routes;
4.	**Q, T, Y, Z**	—	for area navigation routes which do **not** form part of the regional networks of ATS routes.

b. Where applicable, one supplementary letter **shall** be added as a **prefix** to the basic designator as follows:

1.	**K**	—	to indicate a low level route established for use primarily by **helicopters**;
2.	**U**	—	to indicate that the route or portion thereof is established in the **upper airspace**;
3.	**S**	—	to indicate a route established exclusively for use by **supersonic** aircraft during acceleration/deceleration and while in **supersonic flight**.

c. Where applicable, a supplementary letter **may** be added after the basic designator of the ATS route as a **suffix** as follows:

1.	**F**	—	to indicate that on the route or portion thereof advisory service **only** is provided;
2.	**G**	—	to indicate that on the route or portion thereof flight information service **only** is provided;

DESIGNATORS OF ATS ROUTES AND ITS USE IN VOICE COMMUNICATIONS

3. **Y** — for RNP1 routes at and above FL200 to indicate that all turns on the route between 30 and 90 degrees shall be made within the tolerance of a tangential arc between the straight leg segments defined with a radius of 22.5 NM;
4. **Z** — for RNP1 routes at and below FL190 to indicate that all turns on the route between 30 and 90 degrees shall be made within the tolerance of a tangential arc between the straight leg segments defined with a radius of 15 NM.

USE OF DESIGNATORS IN COMMUNICATIONS

In voice communications, the basic letter of a designator should be spoken in accordance with the ICAO spelling alphabet.

Where the prefixes **K**, **U** or **S**, specified above, are used in voice communications, they should be pronounced as:

K = “Kopter” **U = “Upper”** and **S = “Supersonic”**

as in the English language.

Where suffixes “**F**”, “**G**”, “**Y**” or “**Z**” specified above are used, the flight crew should not be required to use them in voice communications.

Example:	A11	will be spoken Alfa 11
	UR5	will be spoken Upper Romeo 5
	KB34	will be spoken Kopter Bravo 34
	UW456 F	will be spoken Upper Whiskey 456

HF SSB FACILITIES

a. ARINC has established HF SSB Long Distance Operational Control Facilities at New York and San Francisco Communication Centers, and remote facilities in Barrow, Alaska, Santa Cruz, Bolivia, Guam and Hat Yai, Thailand.

NOTE: ARINC is a paid service. Aircraft operators desiring to make use of these facilities should make prior arrangements with ARINC for the handling of their traffic.

b. The purpose of this service is to provide direct voice communications between flight crews and their company control offices via HF SSB communications using “Phone Patch” techniques primarily in the international environment. Aircraft may use the frequencies listed below from any location where VHF coverage is unavailable. The only limiting factor being the actual propagation of the radio signals, which may vary depending upon the frequency, time of day, latitude, local atmospheric noise level and sun spot activity.

c. These facilities may be used for “flight regularity” messages. “Flight regularity” messages include those messages that require immediate action on the part of flight crews, aircraft operators, or agencies acting for aircraft operators for the efficient and expeditious utilization of aircraft to avoid serious delays or travel interruptions to passengers and/or cargo, or to avoid situations that could cause the aircraft operator to suffer significant economic penalties. Communications concerning air traffic control and meteorological data for international flights are considered “Flight Safety” messages and are usually handled on the ICAO Major World Air Route Area High Frequency and VHF Enroute Radio Telephone Networks or VHF ATS facilities.

d. These operational control communications are available 24 hours per day; generally, the higher frequencies will be used during daylight hours and the lower frequencies during the hours of darkness:

HF SSB LDOCF FREQUENCIES GUARDED (kHz)	**ARINC STATION LOCATION & CALL SIGN**					
	NEW YORK	**SAN FRANCISCO**	**SANTA CRUZ, BOLIVIA (Remote)**	**PACIFIC-GUAM (Remote)**	**BARROW, AK (Remote)**	**HAT YAI, THAILAND (Remote)**
3494	X	X	X	X	X	X
6640	X	X	X	X	X	X
8933	X	X	X	X	X	
11342	X	X	X	X	X	X
13348	X	X	X	X	X	X
17925	X	X	X	X	X	X
21964	X	X	X	X	X	X

<table>
<tr><th rowspan="2">HF SSB LDOCF FREQUENCIES GUARDED (kHz)</th><th colspan="6">ARINC STATION LOCATION & CALL SIGN</th></tr>
<tr><th>NEW YORK</th><th>SAN FRANCISCO</th><th>SANTA CRUZ, BOLIVIA (Remote)</th><th>PACIFIC-GUAM (Remote)</th><th>BARROW, AK (Remote)</th><th>HAT YAI, THAILAND (Remote)</th></tr>
<tr><td colspan="7">Worldwide Operational Control. (Phone patch service available.)</td></tr>
<tr><td colspan="7">*NOTE: ARINC stations transmitting SELCAL signals on these frequencies will utilize SSB full carrier mode.*</td></tr>
</table>

e. The ARINC facilities are equipped to provide through “Phone Patch” direct voice communications between flight crews and operational control offices or the ground radio operator may also accept messages from the aircraft for relay via normal air-ground delivery channels and vice versa.

f. Aircraft operators with SATCOM Voice can contact ARINC Aeronautical Stations using the following Inmarsat Security Codes:

ARINC Center	Inmarsat Security Code
SFO	436625
NYC	436623

RADIOTELEPHONY PROCEDURES

a. The air/ground/air radio channel is “one-way” (send or receive) only; break-ins and interruptions are not possible. In the normal “at rest” condition, the ground talker receives the aircraft transmission. When the ground talker speaks, a voice-operated relay switches the radio channel from receive to send and the aircraft receives his transmission. If the ground talker and the aircraft transmit simultaneously, neither will receive the other. Thus each should indicate the end of his transmission with the words “over” or “go ahead.” The ground talker should precede each transmission with an “err” or “uhh” to allow the voice-operated relay time to complete its switching function. If a malfunction of the voice-operated relay should occur during a connection, the ARINC Radio Operator will manually switch the channel between send and receive and the conversation can proceed in exactly the same manner.

b. Flight crews placing a call to their operational control office will call on one of the listed frequencies. The following is an example of the typical voice procedure used in a “Phone Patch” request from an aircraft:

Aircraft:	“New York, Trans Jet 468.”
Aero Sta:	“Trans Jet 468, New York, go ahead.”
Aircraft:	“Trans Jet 468 requests ‘Phone Patch’ with Trans Jet Ops Office at Kennedy.”

Aero Sta: “Roger Trans Jet 468. Standby for a ‘Phone Patch’. New York.”

Aircraft: “Trans Jet 468, standing by.”

c. The ARINC radio operator will then set up the “Phone Patch” as explained above and the voice procedure will continue as follows:

Aero Sta: “Trans Jet 468, ‘Phone Patch’ to Trans Jet Ops is ready. Go ahead with your message. New York.”

Aircraft: “Trans Jet Ops, this is Trans Jet 468, we are at 40 West. We are having trouble with the number 4 compressor. We have performed corrective procedures listed in the manual but we still have abnormal readings. Do you want us to proceed to Philadelphia or should we divert to Kennedy for maintenance? Go ahead.”

Ops Office: “Trans Jet 468, divert to Kennedy. Philadelphia maintenance not equipped to handle compressors. We will alert Kennedy maintenance. Plan to continue to Philadelphia after compressor repaired. Trans Jet Ops. Over.”

Aircraft: “Roger, divert to Kennedy. Trans Jet 468.”

Aircraft: “New York, Trans Jet 468 ‘Phone Patch’ completed.”

Aero Sta: “Trans Jet 468, Roger, New York.”

The ARINC radio operator will then disconnect the “Phone Patch.”

d. Flight crews operating in the European, North Atlantic, South American, Caribbean, and Pacific Areas will be expected to continue to pass their routine air-ground messages on the ICAO Major World Air Route Area (MWARA) Enroute Radiotelephone HF or VHF Networks while operating on international routes. Therefore, aircraft operating on international routes in the areas of the world mentioned above will be expected to maintain a listening watch or SELCAL guard on the appropriate ICAO/MWARA frequencies.

e. Aircraft equipped with dual HF transceivers may wish to maintain watch on both ICAO/MWARA and ARINC HF SSB Long Distance Operational Control Facility frequencies. Aircraft equipped with only one HF transceiver, and beyond the range of VHF communications, will be expected to maintain watch on ICAO/MWARA frequencies and to switch to ARINC HF SSB Long Distance Operational Control Facility frequencies only after coordination with the ICAO aeronautical station providing radio guard for the FIR/CTA in which the aircraft is operating.

INMARSAT SECURITY NUMBERS (SHORT CODES) AND SATCOM VOICE (PSTN)

GENERAL

INMARSAT, in conjunction with ICAO, has developed a telephone numbering plan to facilitate the use of satellite voice by suitably equipped aircraft as a backup to the existing primary A/G facilities. The use of SATCOM voice for this purpose requires on board embedded equipment.

FLIGHT CREW PROCEDURES

The number of call attempts made to establish contact with the radio station will be a pilot responsibility; however, if contact cannot be established within 5 minutes of waypoint transition, pilots should revert to the assigned HF frequencies for position report delivery.

On initial contact with a radio station, the flight crew should provide aircraft identification and request frequency assignment and perform a successful SELCAL check on HF, when required by the appropriate ATS authority. Subsequent communications with that radio station may then be performed via SATCOM or HF voice, in accordance with applicable airworthiness, operating and airspace requirements.

Although the underlying technology lends itself to a conversational mode of communications, such use can create misunderstanding and confusion. When using SATCOM, normal RTF conventions should be followed identical to HF communications in accordance with standard ICAO phraseology, as defined in Jeppesen ATC- Air Traffic Management (Doc 4444)\ Section 12, or in Annex 10, Volume II, Chapter 5 and Doc 8400 (not published herein).

The flight crew should normally make calls to the radio facility serving the airspace in which the aircraft is flying. If oceanic airspace has not been entered, the flight crew should attempt contact with the radio facility serving the first oceanic center. If a call is dropped during a communication, the party that initiated the original call should initiate the process to reestablish the call. If communications are lost with the current aeronautical station, the flight crew should attempt contact with any other aeronautical station to relay.

If a HF SELCAL check is required before or after entering a FIR, the flight crew should contact the radio operator and complete a HF SELCAL check in accordance with ICAO Annex 10, Volume II, paragraph 5.2.4 (not published herein).

The telephone numbering plan assigns a code specific to each FIR. When a ground earth station receives the unique code from the aircraft via satellite, it is converted and the call is routed to the appropriate ATS unit.

For emergency communications, the INMARSAT short codes and public switched telephone network (PSTN) numbers are as follows—

Region	Country	Facility	FIR	INMARSAT Security Number (Short Codes)	SATCOM Voice (PSTN)
AFRICA	Algeria	Algiers ACC	Algiers (DAAA)	460501	

INMARSAT SECURITY NUMBERS (SHORT CODES) AND SATCOM VOICE (PSTN)

Region	Country	Facility	FIR	INMARSAT Security Number (Short Codes)	SATCOM Voice (PSTN)
	Angola	Luanda ACC	Luanda FIR (FNAN)	460301	
		Luanda ACC (alternate)	Luanda FIR (FNAN)	460302	
		Luanda ACC (2nd alternate)	Luanda FIR (FNAN)	460303	
	Benin	Cotonou ATC	Accra (DGAC)	460106, 460111	
	Botswana	Gaborone ACC	Gaborone (FBGR)	460107	
	Burkina Faso	Ouagadougou ACC (satphone)	Niamey (DRRR)	460112	
		Ouagadougou ACC	Niamey (DRRR)	460113	
	Cameroon	Douala ACC (satphone)	Brazzaville (FCCC)	463802	
		Douala ACC	Brazzaville (FCCC)	463801	
	Canary IS	Canaries ACC (Operational Supervisor)	Canaries (GCCC)	424201	
		Canaries ACC (HF COM/AIS)	Canaries (GCCC)	424202	
	Cape Verde	Sal Oceanic ATC	Sal Oceanic (GVSC)	461701	
	Central Africa Rep.	Bangui ATC (satphone)	Brazzaville (FCCC)	467604	
		Bangui ATC	Brazzaville (FCCC)	467605	
	Chad	N'Djamena ACC (East Sector)	N'Djamena (FTTT)	467002	
		N'Djamena ACC (West Sector)	N'Djamena (FTTT)	467001	
		N'Djamena ACC/ West (satphone)	N'Djamena (FTTT)	467003	

INMARSAT SECURITY NUMBERS (SHORT CODES) AND SATCOM VOICE (PSTN)

Region	Country	Facility	FIR	INMARSAT Security Number (Short Codes)	SATCOM Voice (PSTN)
		N'Djamena ACC/ East (satphone)	N'Djamena (FTTT)	467004	
	Comoros	Moroni ATC	Antananarivo (FMMM)	464703	
		Moroni ATC (satphone)	Antananarivo (FMMM)	464704	
	Congo	Brazzaville Control	Brazzaville (FCCC)	467602	
	Congo, D.R. of	Kinshasa ACC	Kinshasa (FZZA)	467601	
	Cote d’Ivoire	Abidjan ACC (satphone)	Dakar Oceanic (GOOO)	466304	
		Abidjan ACC	Dakar Oceanic (GOOO)	466305	
	Equatorial Guinea	Malabo ATC	Brazzaville (FCCC)	460109	
		Malabo ATC (satphone)	Brazzaville (FCCC)	460110	
	Ethiopia	Addis Ababa ACC	Addis Ababa (HAAA)	462401	
	Gabon	Libreville ACC (satphone)	Brazzaville (FCCC)	463902	
		Libreville ACC	Libreville (FOOL)	463901	
	Ghana	Accra ATC	Accra (DGAC)	462701	
	Guinea-Bissau	Bissau ATC	Dakar Oceanic (GOOO)	462101	
		Bissau ATC (satphone)	Dakar Oceanic (GOOO)	462102	
	Madagascar	Antananarivo Control /Information	Antananarivo (FMMM)	464701	

INMARSAT SECURITY NUMBERS (SHORT CODES) AND SATCOM VOICE (PSTN)

Region	Country	Facility	FIR	INMARSAT Security Number (Short Codes)	SATCOM Voice (PSTN)
		Antananarivo ACC (satphone)	Antananarivo (FMMM)	464702	
	Malawi	Lilongwe ACC	Lilongwe (FWLL)	465501	
	Mali	Bamako ACC	Dakar Oceanic (GOOO)	465504	
		Bamako ACC (satphone)	Dakar Oceanic (GOOO)	465505	
	Mauritania	Nouakchott ACC	Dakar Oceanic (GOOO)	464504	
		Nouakchott ACC (satphone)	Dakar Oceanic (GOOO)	464505	
	Namibia	Windhoek ACC	Windhoek (FYWH)	465901, 465902	
	Niger	Niamey ACC	Niamey (DRRR)	465601	
		Niamey ACC (satphone)	Niamey (DRRR)	465602	
	Nigeria	Kano Control	Kano (DNKK)	465701	
		Lagos Control	Kano (DNKK)	465702	
	Senegal	Dakar ATC/FIS	Dakar Oceanic (GOOO)	466301	
		Dakar ACC	Dakar Oceanic (GOOO)	466302	
		Dakar ACC (satphone)	Dakar Oceanic (GOOO)	466303	
	Seychelles	Seychelles ACC/FIS/Alerting	Seychelles (FSSS)	466401	
	Somalia	Mogadishu FIS Center	Mogadishu (HCSM)	466601	252-18-57-393
	South Africa Rep	Cape Town ATC	Cape Town (FACA)	460102	

INMARSAT SECURITY NUMBERS (SHORT CODES) AND SATCOM VOICE (PSTN)

Region	Country	Facility	FIR	INMARSAT Security Number (Short Codes)	SATCOM Voice (PSTN)
		Port Elizabeth ATC	Cape Town (FACA)	460105	
		Bloemfontein ATC	Johannesburg (FAJA)	460101	
		Durban ATC	Johannesburg (FAJA)	460103	
		Johannesburg Oceanic ACC	Johannesburg Oceanic (FAJO)	460104	27-11-928-6456
	Sudan	Khartoum ACC	Khartoum (HSSK)	466201	
	Togo	Lome ATC	Accra (DGAC)	460108	
		Lome ACC	Accra (DGAC)	460201	
		Lome ACC (satphone)	Accra (DGAC)	460202	
	Zambia	Lusaka ACC	Lusaka (FLFI)	467801	
	Zimbabwe	Harare ACC/FIS Approach	Harare (FVHF)	467902	
		Harare Tower	Harare (FVHF)	467901	
ASIA	China	Beijing ACC	Beijing (ZBPE)	441201	
		Chengdu ACC	Chengdu (ZPKM)	441202	
		Hong Kong ATC	Hong Kong (VHHK)	441299	
		Kunming ATC	Kunming (ZPKM)	441204	
		Lanzhou ACC	Lanzhou (ZLHW)	441205	
		Lanzhou ACC (alternate)	Lanzhou (ZLHW)	441215	
		Urumqi ACC	Urumqi (ZWUQ)	441208	
		Shenyang ACC	Shenyang (ZYSH)	441207	
	Malaysia	Kota Kinabalu ATC/FIS	Kota Kinabalu (WBFC)	453301	

INMARSAT SECURITY NUMBERS (SHORT CODES) AND SATCOM VOICE (PSTN)

Region	Country	Facility	FIR	INMARSAT Security Number (Short Codes)	SATCOM Voice (PSTN)
		Kuala Lumpur ACC	Kuala Lumpur (WMFC)	453302	
	Vietnam	Ho Chi Minh ACC	Ho Chi Minh (VVTS)	457402	
EASTERN EUROPE	Estonia	Tallinn ACC	Tallinn (EETT)	427387, 427388	
	Hungary	Budapest ACC	Budapest (LHCC)	424301	
	Kazakhstan	Nur-Sultan ACC	Nur-Sultan (UACN)	427500	
		Nur-Sultan ACC (alternate)	Nur-Sultan (UACN)	427501	
		Shymkent ACC	Shymkent (UAII)	427510	
	Lithuania	Vilnius ACC	Vilnius (EYVL)	427389	
	Romania	Bucharest ACC	Bucharest (LRBB)	426401	
	Russia	Archangelsk ACC	Archangelsk (ULAA)	427305	
		Barnaul ACC	Novosibirsk (UNNT)	427308	
		Chita ACC	Irkutsk (UIII)	427313	
		Chulman ACC	Chulman (UELL)	427315	
		Khabarovsk ACC	Khabarovsk (UHHH)	427324	
		Kolpashevo ATC/Radio	Kolpashevo (UNNT)	427328	
		Magadan ACC	Magadan (UHMM)	427336	74-13-227-6719
		Mirny ACC	Mirny (UERR)	427339	
		Moscow ACC	Moscow (UUWV)	427340	
		Murmansk ACC	Murmansk (ULMM)	427341	
		Norilsk ACC	Norilsk (UOOO)	427343	
		Novosibirsk ACC	Novosibirsk (UNNT)	427344	
		Omsk ACC	Novosibirsk (UNNT)	427348	
		Petropavlosk-Kamchatsky ATC	Petropavlosk-Kamchatsky (UHPP)	427354	74-15-319-9395

INMARSAT SECURITY NUMBERS (SHORT CODES) AND SATCOM VOICE (PSTN)

Region	Country	Facility	FIR	INMARSAT Security Number (Short Codes)	SATCOM Voice (PSTN)
		Syktyvkar ACC	Syktyvkar (UUYY)	427366	
		Tiksi ACC	Yakutsk (UEEE)	427368	
		Yekaterinburg ACC	Yekaterinburg (USSV)	427385	
	Ukraine	Kiev ACC	Kyiv (UKBV)	427396	
		Lvov ACC	Kyiv (UKBV)	427397	
		Odesa ACC	Kyiv (UKBV)	427398	
		Simferopol ACC	Simferopol (UKFV)	427399	
	Uzbekistan	Samarkand ACC	Samarkand (UTSD)	427358	
EUROPE	Albania	Tirana ACC	Tirana (LAAA)	420101	
	Belgium	Brussels ACC	Brussels (EBUR)	420501	
	Denmark	Copenhagen ACC/APP	Copenhagen (EKDK)	421901	
		Sondrestrom FIS (up to FL195)	Sondrestrom (BGGL)	421902	
	France	Bordeaux ATC	Bordeaux (LFBB)	422701	
		Brest ATC	Brest (LFRR)	422702	
		Marseille ACC	Marseille (LFMM)	422703	
		Paris ACC	Paris (LFFF)	422704	
		Reims ACC	Reims (LFEE)	422705	
	Germany	Bremen ATC/FIS/ALRS	Bremen (EDWW)	421102	
		Dusseldorf ACC	Hannover (EDVV)	421103	
		Frankfurt ACC	Rhein (EDUU)	421104	
		Karlsruhe UAC	Rhein (EDUU)	421106	
		Munich ATC	Munich (EDMM)	421105	
	Greece	Athinai/Makedonia ACC	Hellas (LGGG)	423701	

INMARSAT SECURITY NUMBERS (SHORT CODES) AND SATCOM VOICE (PSTN)

Region	Country	Facility	FIR	INMARSAT Security Number (Short Codes)	SATCOM Voice (PSTN)
	Ireland	Shannon Control	Shannon (EISN)	425001	
		Shanwick Radio	Shanwick Oceanic (EGGX)	425002	353-61-36-86-78
	Italy	Brindisi ACC	Brindisi (LIBB)	424701	
		Milan ACC	Milan (LIMM)	424702	
		Padova ACC	Milan (LIMM)	424703	
		Rome ACC	Rome (LIRR)	424704	
	Malta	Malta ACC	Malta (LMMM)	425601	
	Norway	Bodo ATCC	Bodo Oceanic (ENOB)	425705	47-755-42900
		Bodo Oceanic Control	Bodo Oceanic (ENOB)	425701	47-755-42935
		Bodo Radio	Bodo Oceanic (ENOB)	425702	47-755-21283
		Oslo ACC	Polaris (ENOR)	425703	
		Stavanger ACC	Polaris (ENOR)	425704	
	Portugal	Lisbon ACC	Lisbon (LPPC)	426301	
		Santa Maria Radio/Oceanic	Santa Maria Oceanic (LPPO)	426302, 426305	351-29-68-86-655
	Sweden	Malmo ACC	Sweden (ESAA)	426501	
		Stockholm ACC	Sweden (ESAA)	426502	468-58-55-47-00
		Stockholm Radio (HF)	Sweden (ESAA)	426504	
	Switzerland	Geneva ACC	Switzerland (LSAS)	426901	
		Zurich ACC	Switzerland (LSAS)	426902	
	United Kingdom	RAF(U) Swanwick D & D	London (EGTT)	423202	

INMARSAT SECURITY NUMBERS (SHORT CODES) AND SATCOM VOICE (PSTN)

Region	Country	Facility	FIR	INMARSAT Security Number (Short Codes)	SATCOM Voice (PSTN)
LATIN AMERICA/ SOUTH AMERICA	Argentina	Ezeiza ACC	Ezeiza (SAEF)	470103	
	Bahamas	Nassau FSS	Nassau (MYNA)	430801	
		Nassau Approach Control	Nassau (MYNA)	430802	
	Brazil	Atlantico ACC	Atlantico (SBAO)	471001	
	Chile	Puerto Montt ACC	Puerto Montt (SCTZ)	472503	
		Punta Arenas ACC	Punta Arenas (SCCZ)	472504	
		Santiago ACC	Santiago (SCEZ)	472505	
	Colombia	Barranquilla ACC	Barranquilla (SKEC)	473001	
		Bogota ACC	Bogota (SKED)	473002	
	Dominican Republic	Santo Domingo ACC	Santo Domingo (MDCS)	432702	
	Ecuador	Guayaquil Center	Guayaquil (SEFG)	473501	
		Guayaquil ACC (alternate)	Guayaquil (SEFG)	473502	
	Falkland IS	Mount Pleasant ATC	Comodoro Rivadavia (SAVF)	422501	
		Mount Pleasant Operations	Comodoro Rivadavia (SAVF)	422502	
	French Guiana		Cayenne (SOOO)	463101	
	Honduras	Honduras ATC	Central American (MHTG)	433401	
	Jamaica	Kingston ACC	Kingston (MKJK)	433901	
	Peru	Lima ACC	Lima (SPIM)	476002	
		Lima ACC (alternate)	Lima (SPIM)	476003	

INMARSAT SECURITY NUMBERS (SHORT CODES) AND SATCOM VOICE (PSTN)

Region	Country	Facility	FIR	INMARSAT Security Number (Short Codes)	SATCOM Voice (PSTN)
	Suriname	Paramaribo ATC/FIS	Paramaribo (SMPM)	476501	
	Trinidad & Tobago	Piarco ACC	Piarco (TTZP)	436201	868-669-0619
	Uruguay	Montevideo ACC	Montevideo (SUEO)	477001	
MIDDLE EAST	Afghanistan	Kabul ACC (mobile number)	Kabul (OAKX)	440101	
		Kabul ACC (mobile number alternate)	Kabul (OAKX)	440102	
	Bahrain	Bahrain ACC/FIS	Bahrain (OBBB)	440801, 440802	
	Bangladesh	Dhaka ACC	Dhaka (VGFR)	440501	
	Cyprus	Nicosia ATC	Nicosia (LCCC)	420901	
	India	Chennai Oceanic Control	Chennai (VOMF)	441904	
		Chennai ACC	Chennai (VOMF)	441905	
		Chennai Oceanic Control (satphone)	Chennai (VOMF)	441930	
		Chennai SAR (satphone)	Chennai (VOMF)	441933	
		Hyderabad ACC	Chennai (VOMF)	441909	
		Delhi ACC	Delhi (VIDF)	441903	
		Kolkata ACC	Kolkata (VECF)	441902	
		Kolkata OCC (satphone)	Kolkata (VECF)	441921	
		Kolkata SAR (satphone)	Kolkata (VECF)	441932	
		Ahmedabad ACC	Mumbai (VABF)	441906	

INMARSAT SECURITY NUMBERS (SHORT CODES) AND SATCOM VOICE (PSTN)

Region	Country	Facility	FIR	INMARSAT Security Number (Short Codes)	SATCOM Voice (PSTN)
		Mumbai ATC (satphone)	Mumbai (VABF)	441901	91-22-268-28088
		Mumbai OCC (satphone)	Mumbai (VABF)	441920	
		Mumbai SAR (satphone)	Mumbai (VABF)	441931	
		Nagpur ACC	Mumbai (VABF)	441907	
		Thiruvananthapuram ACC	Chennai (VOMF)	441908	
	Iran	Tehran ACC	Tehran (OIIX)	442201	
	Israel	Tel Aviv ACC	Tel Aviv (LLLL)	442801	
		Tel Aviv Identification	Tel Aviv (LLLL)	442802	
		Tel Aviv (Southern Control)	Tel Aviv (LLLL)	442803	
	Jordan	Amman Center	Amman (OJAC)	443801	
	Libya	Tripoli Center	Tripoli (HLLL)	464201	
	Maldives	Male ATC	Male (VRMF)	445501	
	Pakistan	Karachi ACC	Karachi (OPKR)	446301	
		Lahore ACC	Lahore (OPLR)	446302	
	Saudi Arabia	Jeddah ATC	Jeddah (OEJD)	440301, 440302	966-12-6850532
	Sri Lanka	Colombo ACC	Colombo (VCCF)	441701	
		Colombo ACC (alternate)	Colombo (VCCF)	441702	
	Turkey	Ankara ACC	Ankara (LTAA)	427101	
	United Arab Emirates	Dubai Approach	Emirates (OMAE)	447002	
		Emirates ATC	Emirates (OMAE)	447001	

INMARSAT SECURITY NUMBERS (SHORT CODES) AND SATCOM VOICE (PSTN)

Region	Country	Facility	FIR	INMARSAT Security Number (Short Codes)	SATCOM Voice (PSTN)
	Yemen	Sana'a ACC	Sana'a (OYSC)	447302	
NORTH AMERICA/ NORTH ATLANTIC	Canada	Edmonton ACC	Edmonton (CZEG)	431601	1-780-890-2775
		Gander Domestic	Gander Domestic (CZQX)	431602	1-709-651-5297
		Gander Oceanic	Gander Oceanic (CZQX)	431603	1-709-651-5260
		Gander Radio	Gander Domestic (CZQX), Gander Oceanic (CZQX)	431613	1-709-651-5298
		Moncton ATC	Moncton (CZQM)	431604	1-506-867-8745
		Montreal ATC	Montreal (CZUL)	431605	1-514-636-3606
		Toronto ACC	Toronto (CZYZ)	431606	1-905-676-4509
		Vancouver ACC	Vancouver (CZVR)	431607	1-604-507-7875
		Winnipeg ATC	Winnipeg (CZWG)	431608	1-204-837-9481
	Iceland	Iceland Radio	Reykjavik (BIRD)	425105	709-651-5316
		Reykjavik (OAC Supervisor) (Reykjavik OAC Flight Safety Calls)	Reykjavik (BIRD)	425101	
		Reykjavik (OAC) (Reykjavik OAC Emergency calls only)	Reykjavik (BIRD)	425103	
	United States	New York East (NAT) Oceanic ATC (Emerg)	New York East (KZWY)	436695	631-468-1496
		New York Radio	New York East/West (KZWY)	436623	

INMARSAT SECURITY NUMBERS (SHORT CODES) AND SATCOM VOICE (PSTN)

Region	Country	Facility	FIR	INMARSAT Security Number (Short Codes)	SATCOM Voice (PSTN)
		New York West (WATRS) Oceanic ATC (Emerg)	New York West (KZWY)	436696	631-468-1495
PACIFIC	Australia	Brisbane ATC	Brisbane (YBBB)	450302	61-7-3866-3868
		Melbourne ATC	Melbourne (YMMM)	450303	61-3-9338-4032
		Perth TCU	Melbourne (YMMM)	450304	61-8-9476-8545
		Sydney TCU	Melbourne (YMMM)	450305	61-2-9556-6875
	Fiji	Nadi ACC/Radio	Nadi (NFFF)	452001	
	French Polynesia	Tahiti ACC	Tahiti (NTTT)	422790	
	Indonesia	Jakarta ACC (supervisor)	Jakarta (WIIF)	452503	
		Ujung Pandang ACC	Ujung Pandang (WAAF)	452504	
		Jakarta ACC-Upper Banda Aceh (U-BAC)	Jakarta (WIIF)	452505	
		Jakarta ACC-Upper Indian Oceanic (U-IOS)	Jakarta (WIIF)	452506	
		Jakarta ACC-Upper Pangkal Pinang (U-PKP)	Jakarta (WIIF)	452507	
		Jakarta ACC-East	Jakarta (WIIF)	452508	
	Japan	Fukuoka	Fukuoka (RJJJ)	443101	
	Korea (Republic of)	Incheon ACC	Incheon (RKRR)	444001	
		Daegu ACC	Incheon (RKRR)	444002	
	Myanmar	Yangon ACC	Yangon (VYYF)	450601	
	New Zealand	Auckland Oceanic	Auckland Oceanic (NZZO)	451201	

INMARSAT SECURITY NUMBERS (SHORT CODES) AND SATCOM VOICE (PSTN)

Region	Country	Facility	FIR	INMARSAT Security Number (Short Codes)	SATCOM Voice (PSTN)
		New Zealand ATC	New Zealand (NZZC)	451202	
	Papua New Guinea	Port Moresby ACC	Port Moresby (AYPM)	455301	
		Port Moresby ACC (alternate)	Port Moresby (AYPM)	455302	
		Port Moresby ACC (supervisor)	Port Moresby (AYPM)	455303	
	Philippines	Manila ACC	Manila (RPHI)	454801	
		Manila ACC (alternate)	Manila (RPHI)	454802	
		Manila ACC (2nd alternate)	Manila (RPHI)	454803	
	Singapore	Singapore ATC/HF	Singapore (WSJC)	456301	
	Taiwan	Taipei ACC	Taipei (RCAA)	441290, 441291	
	Thailand	Bangkok ACC	Bangkok (VTBB)	456702	
	United States	Anchorage Oceanic ATC (Emerg)	Anchorage Oceanic (PAZA)	436602	
		Oakland Center ATC (Emerg)	Oakland Oceanic (KZAK)	436697	510-745-3415
		San Francisco Radio	Oakland Oceanic (KZAK)	436625	

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Radio Data - General

GENERAL INFORMATION

The general information contained on the following pages is provided for use as 'quick reference'. It has been compiled from a variety of sources. Additional information can be found elsewhere in the Radio Aids section.

FREQUENCY BANDS

Radio frequencies lie within a relatively narrow range of the electro-magnetic spectrum between approximately 10 kHz and 300 GHz. This range is divided into bands, more or less in accordance with the propagation characteristics of the frequencies. These bands are:

VLF	Very Low Frequency	0 - 30 kHz
LF	Low Frequency	30 kHz - 300 kHz
MF	Medium Frequency	300 kHz - 3 MHz
HF	High Frequency	3 MHz - 30 MHz
VHF	Very High Frequency	30 MHz - 300 MHz*
UHF	Ultra High Frequency	300 MHz - 3 GHz*
SHF	Super High Frequency	3 GHz - 30 GHz
EHF	Extremely High Frequency	30 GHz - 300 GHz
*200 MHz - 3 GHz is considered UHF in Aviation.		

All VHF markers (FAN TYPE, OUTER, INNER and ZONE) operate on 75 MHz (75,000 KHz), and are tone modulated as follows:		
FM	Fan Marker (100 Watts)	3000 Hz
LFM	Low-Powered Fan Marker (5 Watts)	3000 Hz
MM	Middle Marker	1300 Hz
OM	Outer Marker	400 Hz
Z	Station Location Marker	3000 Hz

FREQUENCY ALLOCATION

Frequency allocation is established to provide a clear channeling between the various functions performed by aeronautical navaids and communications facilities. Although a general allocation plan is recognized on a world-wide basis, variations may occur within certain ranges. The listing below is intended to provide that allocation most generally used by civil operators.

NAVIGATION AIDS

190 - 535 kHz	Nondirectional Radio Beacon (low power) and Radio Range (low power).
190 - 1750 kHz	Non-directional Beacon (standard).
Non-directional Beacon (standard).	Marker Beacon.
108.0 - 117.975 MHz	VOR test facility (VOT).
108.0 - 111.975 MHz	ILS localizer (on odd-tenths plus twentieth frequencies, 108.1, 108.3 etc.)
108.0 - 111.975 MHz	VOR (even tenths or even tenths plus a twentieth of MHz).
111.975 - 117.975 MHz	VOR (even and odd tenths of MHz).
328.6 - 335.4 MHz	ILS glide slope.
960.0 - 1215.0 MHz	DME and TACAN.
1563.42 - 1587.42 MHz	GPS

AIRBORNE STATIONS

410 kHz	International DF (outside continental USA).
475 kHz	Working frequency exclusively for aircraft on sea flights desiring an intermediate frequency.
500 kHz	International frequency for aircraft and ships over the seas. Transmission on this frequency (except for urgent and safety messages and signals) must cease twice each hour, for three minute periods beginning at 15 and 45 minutes past each hour.
3281 kHz	Lighter-than-aircraft.

117.975 - 137.0 MHz AIR TRAFFIC CONTROL OPERATIONS

The minimum separation between assignable frequencies in the aeronautical mobile (R) service shall be 8.33 kHz.

It is recognized that in some regions or areas, 100 kHz, 50 kHz or 25 kHz channel spacing provides an adequate number of frequencies suitably related to international and national air services and that equipment designed specifically for 100 kHz, 50 kHz or 25 kHz channel spacing will remain adequate for services operating within such regions or areas. It is further recognized that assignments based on 25 kHz channel spacing as well as 8.33 kHz channel spacing may continue to co-exist within one region or area.

118 - 121.4 MHz inclusive	International and National Aeronautical Mobile Services
121.5 MHz	121.5 MHz
121.6 - 121.9917 MHz inclusive	International and National Aerodrome Surface Communications
122 - 123.05 MHz inclusive	National Aeronautical Mobile Services
123.1 MHz	Auxiliary frequency SAR
123.15 - 123.6917 MHz inclusive	National Aeronautical Mobile Services with the exception of 123.45 MHz.
123.45 MHz	Worldwide air-to-air communications
123.7 - 129.6917 MHz inclusive	International and National Aeronautical Mobile Services
129.7 - 130.8917 MHz	National Aeronautical Mobile Services
130.9 - 136.875 MHz inclusive	International and National Aeronautical Mobile Services
136.9 - 136.975 MHz inclusive	International and National Aeronautical Mobile Services
	Reserved for VHF air-ground data link communications.

EFFECTIVE RANGE OF RADIO TRANSMISSION

The range of VHF transmissions is normally about 7% more than an actual line of sight, and can be determined by the formula:

$$D = K \sqrt{h}$$

Where:		
D	=	distance in nautical miles;
h	=	height of the aircraft station above earth;
K	=	(corresponding to an effective earth's radius of 4/3 of the actual radius);
	=	2.22 when h is expressed in metres; and
	=	1.23 when h is expressed in feet.

Listed below is the appropriate range for VHF transmissions over flat terrain:

AIRCRAFT ALTITUDE	RANGE (NM)	AIRCRAFT ALTITUDE	RANGE (NM)
500 ft	28 NM	10,000 ft	122 NM
1000 ft	39 NM	15,000 ft	152 NM
1500 ft	48 NM	20,000 ft	174 NM
2000 ft	55 NM	30,000 ft	213 NM
3000 ft	69 NM	40,000 ft	246 NM
5000 ft	87 NM		

TYPES OF SIGNAL EMISSIONS

Designation		Type of Transmissions	Characteristics Supplementary
New	Old		
NON	A0	With no modulation.	–
A1A	A1	Telegraphy without the use of a modulating audio frequency (by on-off keying).	–
A2A	A2	Telegraphy by the on-off keying of an amplitude-modulating audio frequency or audio frequencies, or by the on-off keying of the modulated emission (special case; an unkeyed emission amplitude modulated).	–
A3A	A3	Telephony.	Double Sideband.
R3E	A3A		Single sideband, reduced carrier.
H3E	A3H		Single sideband, full carrier.
J3E	A3J		Single sideband, suppressed carrier.
–	A3B		Two independent sidebands.
B7E	–		Two independent sidebands containing quantized or digital information.
B8E	–		Two independent sidebands containing analogueinformation.
A4	A4	Facsimile (by a frequency modulated sub-carrier).	

GENERAL INFORMATION

Designation		Type of Transmissions	Characteristics Supplementary
New	Old		
R3C	A4A		Single sideband, reduced carrier.
J3C	–		Single sideband, suppressed carrier.
R7B	A7A	Multichannel voice-frequency telegraphy.	Single sideband, reduced carrier.
B9W	A9B	Cases not covered by the above, e.g., a combination of telephony and telegraphy.	Two independent sidebands.

SECTION 1. NAVIGATION AIDS

Information about Radio Aids published in this section is extracted from the United States Federal Aviation Administration's (FAA) Aeronautical Information Manual (AIM). It is provided for reference use only. The information is generally applicable around the world. Regional variations may exist. Within the section itself, additional references may be made to U.S. Federal Aviation Regulations (FARs). Relevant FARs can be obtained separately from Jeppesen, or they are available directly from the U.S. FAA by mail or via the internet.

1-1-1 GENERAL

a. Various types of air navigation aids are in use today, each serving a special purpose. These aids have varied owners and operators, namely: the Federal Aviation Administration (FAA), the military services, private organizations, individual states and foreign governments. The FAA has the statutory authority to establish, operate, maintain air navigation facilities and to prescribe standards for the operation of any of these aids which are used for instrument flight in federally controlled airspace. These aids are tabulated in the Chart Supplement U.S.

b. Pilots should be aware of the possibility of momentary erroneous indications on cockpit displays when the primary signal generator for a ground-based navigational transmitter (for example, a glideslope, VOR, or nondirectional beacon) is inoperative. Pilots should disregard any navigation indication, regardless of its apparent validity, if the particular transmitter was identified by NOTAM or otherwise as unusable or inoperative.

1-1-2 NONDIRECTIONAL RADIO BEACON (NDB)

a. A low or medium frequency radio beacon transmits nondirectional signals whereby the pilot of an aircraft properly equipped can determine bearings and "home" on the station. These facilities normally operate in a frequency band of 190 to 535 kilohertz (kHz), according to ICAO Annex 10 the frequency range for NDBs is between 190 and 1750 kHz, and transmit a continuous carrier with either 400 or 1020 hertz (Hz) modulation. All radio beacons except the compass locators transmit a continuous three-letter identification in code except during voice transmissions.

b. When a radio beacon is used in conjunction with the Instrument Landing System markers, it is called a Compass Locator.

c. Voice transmissions are made on radio beacons unless the letter "W" (without voice) is included in the class designator (HW).

d. Radio beacons are subject to disturbances that may result in erroneous bearing information. Such disturbances result from such factors as lightning, precipitation static, etc. At night, radio beacons are vulnerable to interference from distant stations. Nearly all disturbances which affect the Automatic Direction Finder (ADF) bearing also affect the facility's identification. Noisy identification usually occurs when the ADF needle is erratic. Voice, music or erroneous identification may be heard when a steady false bearing is being displayed. Since ADF receivers do not have a "flag" to warn the pilot when erroneous bearing information is being displayed, the pilot should continuously monitor the NDB's identification.

1-1-3 VHF OMNI-DIRECTIONAL RANGE (VOR)

a. VORs operate within the 108.0 to 117.95 MHz frequency band and have a power output necessary to provide coverage within their assigned operational service volume. They are subject to line-of-sight restrictions, and the range varies proportionally to the altitude of the receiving equipment.

   NOTE: *Normal service ranges for the various classes of VORs are given in Navigational Aid (NAVAID) Service Volumes, paragraph 1-1-8.*

b. Most VORs are equipped for voice transmission on the VOR frequency. VORs without voice capability are indicated by the letter “W” (without voice) included in the class designator (VORW).

c. The only positive method of identifying a VOR is by its Morse Code identification or by the recorded automatic voice identification which is always indicated by use of the word “VOR” following the range’s name. Reliance on determining the identification of an omnirange should never be placed on listening to voice transmissions by the Flight Service Station (FSS) (or approach control facility) involved. Many FSSs remotely operate several omniranges with different names. In some cases, none of the VORs have the name of the “parent” FSS. During periods of maintenance, the facility may radiate a T-E-S-T code (– • ••• –) or the code may be removed. Some VOR equipment decodes the identifier and displays it to the pilot for verification to charts, while other equipment simply displays the expected identifier from a database to aid in verification to the audio tones. You should be familiar with your equipment and use it appropriately. If your equipment automatically decodes the identifier, it is not necessary to listen to the audio identification.

d. Voice identification has been added to numerous VORs. The transmission consists of a voice announcement, “AIRVILLE VOR” alternating with the usual Morse Code identification.

e. The effectiveness of the VOR depends upon proper use and adjustment of both ground and airborne equipment.

   1. **Accuracy.** The accuracy of course alignment of the VOR is excellent, being generally plus or minus 1 degree.

   2. **Roughness.** On some VORs, minor course roughness may be observed, evidenced by course needle or brief flag alarm activity (some receivers are more susceptible to these irregularities than others). At a few stations, usually in mountainous terrain, the pilot may occasionally observe a brief course needle oscillation, similar to the indication of “approaching station.” Pilots flying over unfamiliar routes are cautioned to be on the alert for these vagaries, and in particular, to use the “to/from” indicator to determine positive station passage.

      (a) Certain propeller revolutions per minute (RPM) settings or helicopter rotor speeds can cause the VOR Course Deviation Indicator to fluctuate as much as plus or minus six degrees. Slight changes to the RPM setting will normally smooth out this roughness. Pilots are urged to check for this modulation phenomenon prior to reporting a VOR station or aircraft equipment for unsatisfactory operation.

f. **The VOR Minimum Operational Network (MON).** As flight procedures and route structure based on VORs are gradually being replaced with Performance-Based Navigation (PBN) procedures, the FAA is removing selected VORs from service. PBN procedures are primarily enabled by GPS and its augmentation systems, collectively referred to as Global Navigation Satellite System (GNSS). Aircraft that carry DME/DME equipment can also use RNAV which provides a backup to continue flying PBN during a GNSS disruption. For those aircraft that do not carry DME/DME, the FAA is retaining a limited network of VORs, called the VOR MON, to provide a basic conventional navigation service for operators to use if GNSS becomes unavailable. During a GNSS disruption, the MON will enable aircraft to navigate through the affected area or to a safe landing at a MON airport without reliance on GNSS. Navigation using the MON will not be as efficient as the new PBN route structure, but use of the MON will provide nearly continuous VOR signal coverage at 5,000 feet AGL across the NAS, outside of the Western U.S. Mountainous Area (WUSMA).

NOTE: *There is no plan to change the NAVAID and route structure in the WUSMA.*

The VOR MON has been retained principally for IFR aircraft that are not equipped with DME/DME avionics. However, VFR aircraft may use the MON as desired. Aircraft equipped with DME/DME navigation systems would, in most cases, use DME/DME to continue flight using RNAV to their destination. However, these aircraft may, of course, use the MON.

1. **Distance to a MON airport.** The VOR MON will ensure that regardless of an aircraft's position in the contiguous United States (CONUS), a MON airport (equipped with legacy ILS or VOR approaches) will be within 100 nautical miles. These airports are referred to as "MON airports" and will have an ILS approach or a VOR approach if an ILS is not available. VORs to support these approaches will be retained in the VOR MON. MON airports are charted on low-altitude en route charts and are contained in the Chart Supplement U.S. and other appropriate publications.

   NOTE: *Any suitable airport can be used to land in the event of a VOR outage. For example, an airport with a DME-required ILS approach may be available and could be used by aircraft that are equipped with DME. The intent of the MON airport is to provide an approach that can be used by aircraft without ADF or DME when radar may not be available.*

2. **Navigating to an airport.** The VOR MON will retain sufficient VORs and increase VOR service volume to ensure that pilots will have nearly continuous signal reception of a VOR when flying at 5,000 feet AGL. A key concept of the MON is to ensure that an aircraft will always be within 100 NM of an airport with an instrument approach that is not dependent on GPS. (See paragraph 1-1-8.) If the pilot encounters a GPS outage, the pilot will be able to proceed via VOR-to-VOR navigation at 5,000 feet AGL through the GPS outage area or to a safe landing at a MON airport or another suitable airport, as appropriate. Nearly all VORs inside of the WUSMA and outside the CONUS are being retained. In these areas, pilots use the existing (Victor and Jet) route structure and VORs to proceed through a GPS outage or to a landing.

3. **Using the VOR MON.**

(a) In the case of a planned GPS outage (for example, one that is in a published NOTAM), pilots may plan to fly through the outage using the MON as appropriate and as cleared by ATC. Similarly, aircraft not equipped with GPS may plan to fly and land using the MON, as appropriate and as cleared by ATC.

NOTE: *In many cases, flying using the MON may involve a more circuitous route than flying GPS-enabled RNAV.*

(b) In the case of an unscheduled GPS outage, pilots and ATC will need to coordinate the best outcome for all aircraft. It is possible that a GPS outage could be disruptive, causing high workload and demand for ATC service. Generally, the VOR MON concept will enable pilots to navigate through the GPS outage or land at a MON airport or at another airport that may have an appropriate approach or may be in visual conditions.

(1) The VOR MON is a reversionary service provided by the FAA for use by aircraft that are unable to continue RNAV during a GPS disruption. The FAA has not mandated that preflight or inflight planning include provisions for GPS- or WAAS-equipped aircraft to carry sufficient fuel to proceed to a MON airport in case of an unforeseen GPS outage. Specifically, flying to a MON airport as a filed alternate will not be explicitly required. Of course, consideration for the possibility of a GPS outage is prudent during flight planning as is maintaining proficiency with VOR navigation.

(2) Also, in case of a GPS outage, pilots may coordinate with ATC and elect to continue through the outage or land. The VOR MON is designed to ensure that an aircraft is within 100 NM of an airport, but pilots may decide to proceed to any appropriate airport where a landing can be made. WAAS users flying under Part 91 are not required to carry VOR avionics. These users do not have the ability or requirement to use the VOR MON. Prudent flight planning, by these WAAS-only aircraft, should consider the possibility of a GPS outage.

NOTE: *The FAA recognizes that non-GPS-based approaches will be reduced when VORs are eliminated, and that most airports with an instrument approach may only have GPS- or WAAS-based approaches. Pilots flying GPS- or WAAS-equipped aircraft that also have VOR/ILS avionics should be diligent to maintain proficiency in VOR and ILS approaches in the event of a GPS outage.*

1-1-4 VOR RECEIVER CHECK

a. The FAA VOR test facility (VOT) transmits a test signal which provides users a convenient means to determine the operational status and accuracy of a VOR receiver while on the ground where a VOT is located. The airborne use of VOT is permitted; however, its use is strictly limited to those areas/altitudes specifically authorized in the Chart Supplement U.S. or appropriate supplement.

b. To use the VOT service, tune in the VOT frequency on your VOR receiver. With the Course Deviation Indicator (CDI) centered, the omni-bearing selector should read 0 degrees with the to/from indication showing “from” or the omni-bearing selector should read 180 degrees with the to/from indication showing “to.” Should the VOR receiver operate an RMI (Radio Magnetic Indicator), it will indicate 180 degrees on any omni-bearing selector (OBS) setting. Two means of identification are used. One is a series of dots and the other is a continuous tone. Information concerning an individual test signal can be obtained from the local FSS.

c. Periodic VOR receiver calibration is most important. If a receiver’s Automatic Gain Control or modulation circuit deteriorates, it is possible for it to display acceptable accuracy and sensitivity close into the VOR or VOT and display out-of-tolerance readings when located at greater distances where weaker signal areas exist. The likelihood of this deterioration varies between receivers, and is generally considered a function of time. The best assurance of having an accurate receiver is periodic calibration. Yearly intervals are recommended at which time an authorized repair facility should recalibrate the receiver to the manufacturer’s specifications.

d. Federal Aviation Regulations (14 CFR Section 91.171) provides for certain VOR equipment accuracy checks prior to flight under instrument flight rules. To comply with this requirement and to ensure satisfactory operation of the airborne system, the FAA has provided pilots with the following means of checking VOR receiver accuracy:

   1. VOT or a radiated test signal from an appropriately rated radio repair station.
   2. Certified airborne checkpoints and airways.
   3. Certified checkpoints on the airport surface.
   4. If an airborne checkpoint is not available, select an established VOR airway. Select a prominent ground point, preferably more than 20 NM from the VOR ground facility and maneuver the aircraft directly over the point at a reasonably low altitude above terrain and obstructions.

e. A radiated VOT from an appropriately rated radio repair station serves the same purpose as an FAA VOR signal and the check is made in much the same manner as a VOT with the following differences:

   1. The frequency normally approved by the Federal Communications Commission is 108.0 MHz.
   2. Repair stations are not permitted to radiate the VOR test signal continuously; consequently, the owner or operator must make arrangements with the repair station to have the test signal transmitted. This service is not provided by all radio repair stations. The aircraft owner or operator must determine which repair station in the local area provides this service. A representative of the repair station must make an entry into the aircraft logbook or other permanent record certifying to the radial accuracy and the date of transmission. The owner, operator or representative of the repair station may accomplish the necessary checks in the aircraft and make a logbook entry stating the results.

It is necessary to verify which test radial is being transmitted and whether you should get a "to" or "from" indication.

f. Airborne and ground check points consist of certified radials that should be received at specific points on the airport surface or over specific landmarks while airborne in the immediate vicinity of the airport.

   1. Should an error in excess of plus or minus 4 degrees be indicated through use of a ground check, or plus or minus 6 degrees using the airborne check, Instrument Flight Rules (IFR) flight must not be attempted without first correcting the source of the error.

      CAUTION: *No correction other than the correction card figures supplied by the manufacturer should be applied in making these VOR receiver checks.*

   2. Locations of airborne check points, ground check points and VOTs are published in the Chart Supplement U.S.

   3. If a dual system VOR (units independent of each other except for the antenna) is installed in the aircraft, one system may be checked against the other. Turn both systems to the same VOR ground facility and note the indicated bearing to that station. The maximum permissible variations between the two indicated bearings is 4 degrees.

1-1-5 TACTICAL AIR NAVIGATION (TACAN)

a. For reasons peculiar to military or naval operations (unusual siting conditions, the pitching and rolling of a naval vessel, etc.) the civil VOR/Distance Measuring Equipment (DME) system of air navigation was considered unsuitable for military or naval use. A new navigational system, TACAN, was therefore developed by the military and naval forces to more readily lend itself to military and naval requirements. As a result, the FAA has integrated TACAN facilities with the civil VOR/DME program. Although the theoretical, or technical principles of operation of TACAN equipment are quite different from those of VOR/DME facilities, the end result, as far as the navigating pilot is concerned, is the same. These integrated facilities are called VORTACs.

b. TACAN ground equipment consists of either a fixed or mobile transmitting unit. The airborne unit in conjunction with the ground unit reduces the transmitted signal to a visual presentation of both azimuth and distance information. TACAN is a pulse system and operates in the Ultrahigh Frequency (UHF) band of frequencies. Its use requires TACAN airborne equipment and does not operate through conventional VOR equipment.

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 $^1/_2$ 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.*

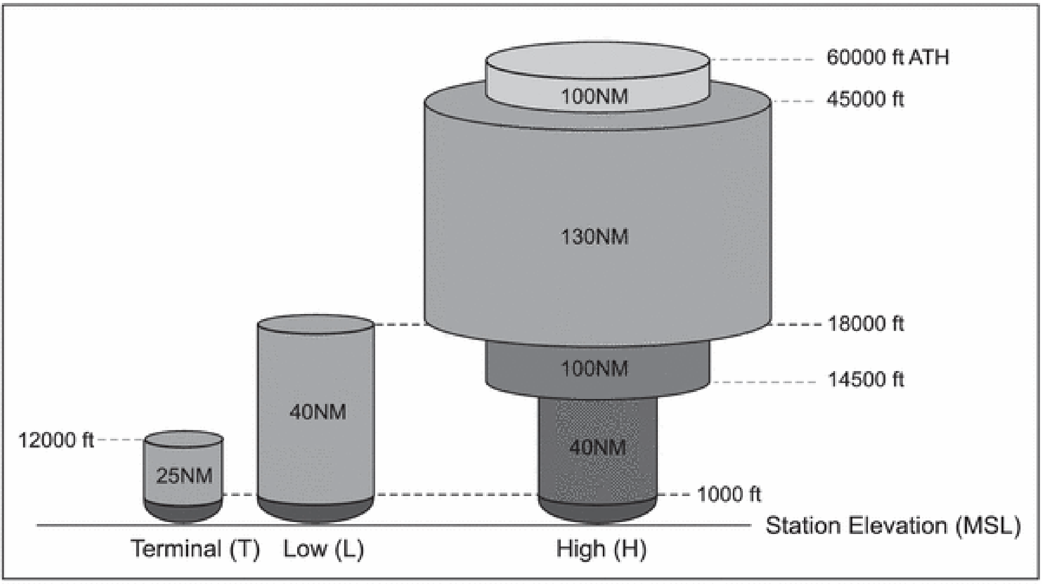
b. A NAVAID will have service volume restrictions if it does not conform to signal strength and course quality standards throughout the published SSV. Service volume restrictions are first published in Notices to Airmen (NOTAMs) and then with the alphabetical listing of the NAVAIDs in the Chart Supplement. 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.

FIGURE 1-1-1

Original Standard Service Volume



Mean Sea level (MSL)
Above Transmitter Height (ATH)

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FIGURE 1-1-2

Lower Edge of the Terminal Service Volume (in altitude ATH)

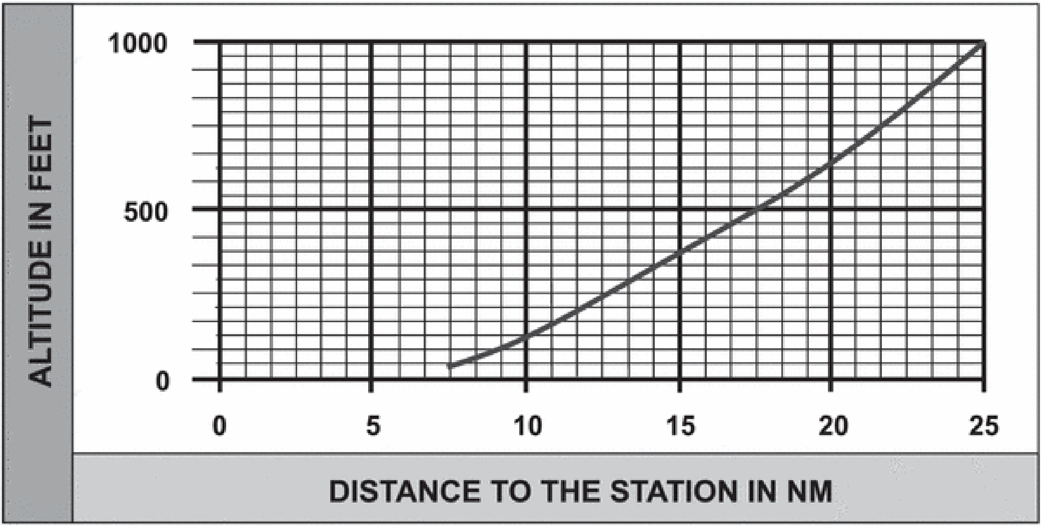
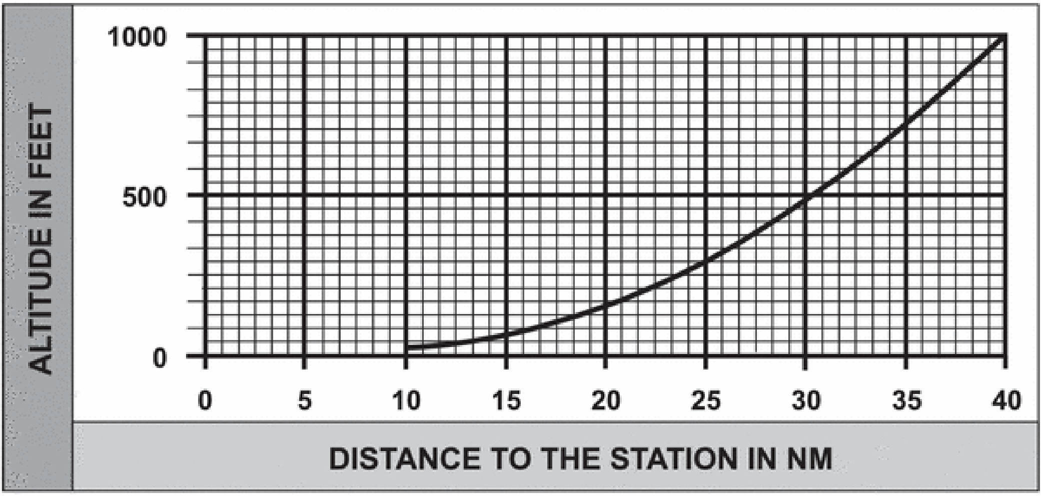


FIGURE 1-1-3

Lower Edge of Low and High Service Volumes (in altitude ATH)



SECTION 1. NAVIGATION AIDS

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 1-1-3f.) 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).

FIGURE 1-1-4

New VOR Service Volumes

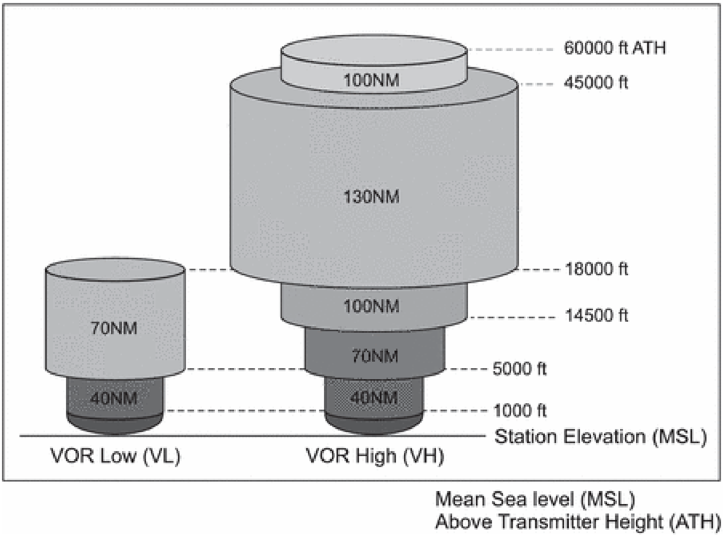
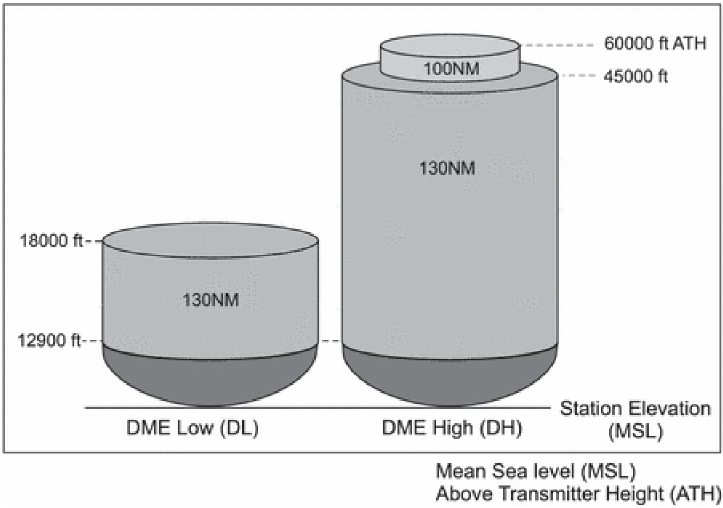


FIGURE 1-1-5

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.*

NOTE 2: *The TACAN azimuth will only be classified as T, L, or H.*

NOTE 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.*

TABLE 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.

SECTION 1. NAVIGATION AIDS

TABLE 1-1-1 VOR/DME/TACAN Standard Service Volumes (continued)

SSV Designator	Altitude and Range Boundaries
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.

TABLE 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

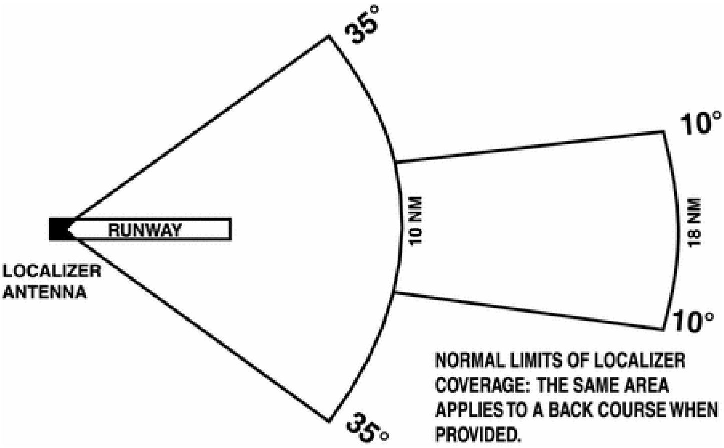
5. The localizer provides course guidance throughout the descent path to the runway threshold from a distance of 18 NM from the antenna between an altitude of 1,000 feet above the highest terrain along the course line and 4,500 feet above the elevation of the antenna site. Proper off-course indications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

FIGURE 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. An 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.

TABLE 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.)

TABLE 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
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

TABLE 1-1-4 Frequency Pairs Allocated for ILS (continued)

Localizer MHz	Glide Slope
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—*Jeppesen approach charts include 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.

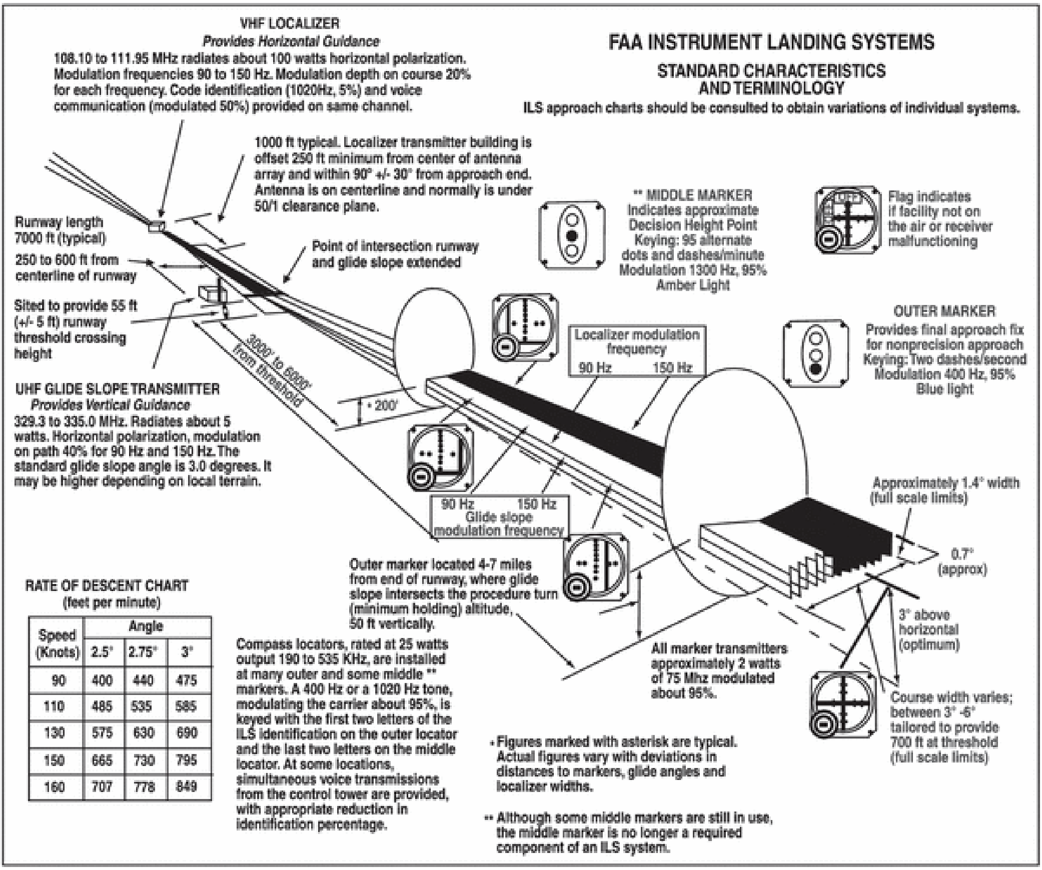
3. Aircraft holding below 5,000 feet between the outer marker and the airport may cause localizer signal variations for aircraft conducting the ILS approach. Accordingly, such holding is not authorized when weather or visibility conditions are less than ceiling 800 feet and/or visibility 2 miles.

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.*

FIGURE 1-1-7

FAA Instrument Landing Systems



FAA INSTRUMENT LANDING SYSTEMS

STANDARD CHARACTERISTICS AND TERMINOLOGY

ILS approach charts should be consulted to obtain variations of individual systems.

VHF LOCALIZER

Provides Horizontal Guidance

108.10 to 111.95 MHz radiates about 100 watts horizontal polarization. Modulation frequencies 90 to 150 Hz. Modulation depth on course 20% for each frequency. Code identification (1020Hz, 5%) and voice communication (modulated 50%) provided on same channel.

1000 ft typical. Localizer transmitter building is offset 250 ft minimum from center of antenna array and within 90° +/- 30° from approach end. Antenna is on centerline and normally is under 50/1 clearance plane.

Runway length 7000 ft (typical)

250 to 600 ft from centerline of runway

Sited to provide 55 ft (+/- 5 ft) runway threshold crossing height

Point of intersection runway and glide slope extended

UHF GLIDE SLOPE TRANSMITTER

Provides Vertical Guidance

329.3 to 335.0 MHz. Radiates about 5 watts. Horizontal polarization, modulation on path 40% for 90 Hz and 150 Hz. The standard glide slope angle is 3.0 degrees. It may be higher depending on local terrain.

** MIDDLE MARKER

Indicates approximate Decision Height Point

Keying: 95 alternate dots and dashes/minute

Modulation 1300 Hz, 95%

Amber Light

Flag indicates if facility not on the air or receiver malfunctioning

OUTER MARKER

Provides final approach fix for nonprecision approach

Keying: Two dashes/second

Modulation 400 Hz, 95%

Blue light

Approximately 1.4° width (full scale limits)

3° above horizontal (optimum)

Course width varies; between 3° -6° tailored to provide 700 ft at threshold (full scale limits)

Outer marker located 4-7 miles from end of runway, where glide slope intersects the procedure turn (minimum holding) altitude, 50 ft vertically.

All marker transmitters approximately 2 watts of 75 Mhz modulated about 95%.

Compass locators, rated at 25 watts output 190 to 535 KHz, are installed at many outer and some middle ** markers. A 400 Hz or a 1020 Hz tone, modulating the carrier about 95%, is keyed with the first two letters of the ILS identification on the outer locator and the last two letters on the middle locator. At some locations, simultaneous voice transmissions from the control tower are provided, with appropriate reduction in identification percentage.

RATE OF DESCENT CHART

(feet per minute)

Speed (Knots)	Angle		
	2.5°	2.75°	3°
90	400	440	475
110	485	535	585
130	575	630	690
150	665	730	795
160	707	778	849

* Figures marked with asterisk are typical. Actual figures vary with deviations in distances to markers, glide angles and localizer widths.

** Although some middle markers are still in use, the middle marker is no longer a required component of an ILS system.

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.

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 unflagged, 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/.**

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 Depart-

ment 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 integ-

rity 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 7-5-2, 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, reroute 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 (±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 ±5 NM either side of centerline to ±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 (±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 ±1 NM to ±0.3 NM at the FAWP. As sensitivity changes from ±1 NM to ±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 ±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 (±1NM) 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 sat-

ellite 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 proce-

dures (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 NOTAMs, 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).

TABLE 1-1-5 GPS IFR Equipment Classes/Categories

TSO-C129						
Equipment Class	**RAIM**	**Int. Nav Sys. to Prov. RAIM Equiv.**	**Oceanic**	**En Route**	**Terminal**	**Non-precision Approach Capable**
Class A - GPS sensor and navigation capability.						
A1	yes		yes	yes	yes	yes
A2	yes		yes	yes	yes	no

TABLE 1-1-5 GPS IFR Equipment Classes/Categories (continued)

TSO-C129						
Equipment Class	**RAIM**	**Int. Nav Sys. to Prov. RAIM Equiv.**	**Oceanic**	**En Route**	**Terminal**	**Non-precision Approach Capable**
Class 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
Class C - 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

TABLE 1-1-6 GPS Approval Required/Authorized Use

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

TABLE 1-1-6 GPS Approval Required/Authorized Use (continued)

Equipment Type[1]	Installation Approval Required	Operational Approval Required	IFR En Route[2]	IFR Terminal[2]	IFR Approach[3]	Oceanic Remote	In Lieu of ADF and/or DME[3]
IFR Oceanic/ Remote	X	X	X	X		X	X
IFR En Route, Terminal, and Approach	X	X	X	X	X		X

[1] To determine equipment approvals and limitations, refer to the AFM, AFM supplements, or pilot guides.

[2] Requires verification of data for correctness if database is expired.

[3] Requires current database or verification that the procedure has not been amended since the expiration of the database.

[4] 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.

[5] 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 $^1/_2$ 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 1-1-17d 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 A **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 A **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 A **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, ±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 ±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 ±1 NM until the point where the ILS angular splay reaches a width of ±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 (±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).*

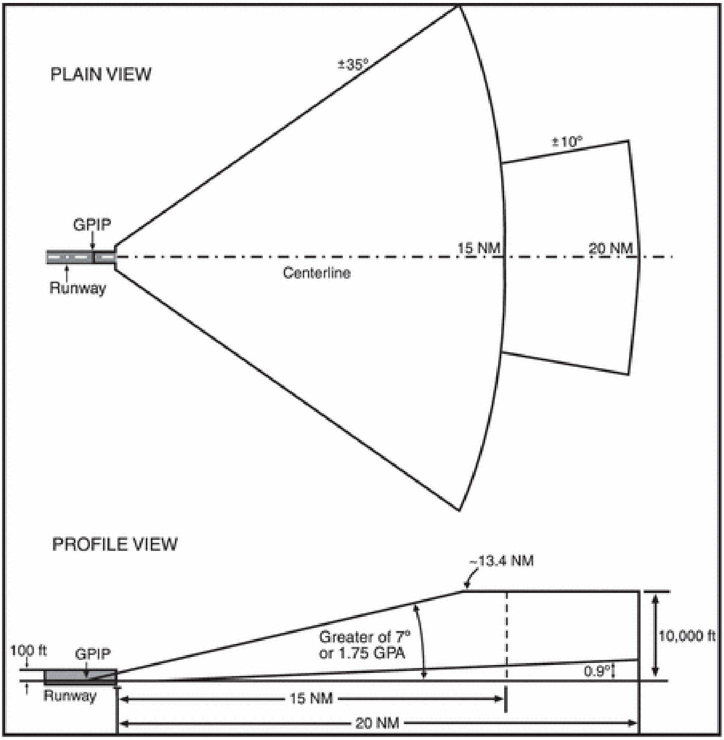
2. GLS displays three-dimension vertical and horizontal navigation guidance to the pilot much like ILS. GLS navigation is based on GPS signals augmented by position correction, integrity parameters, and approach path definition information transmitted over VHF from the local GBAS ground station. One 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.

FIGURE 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.*

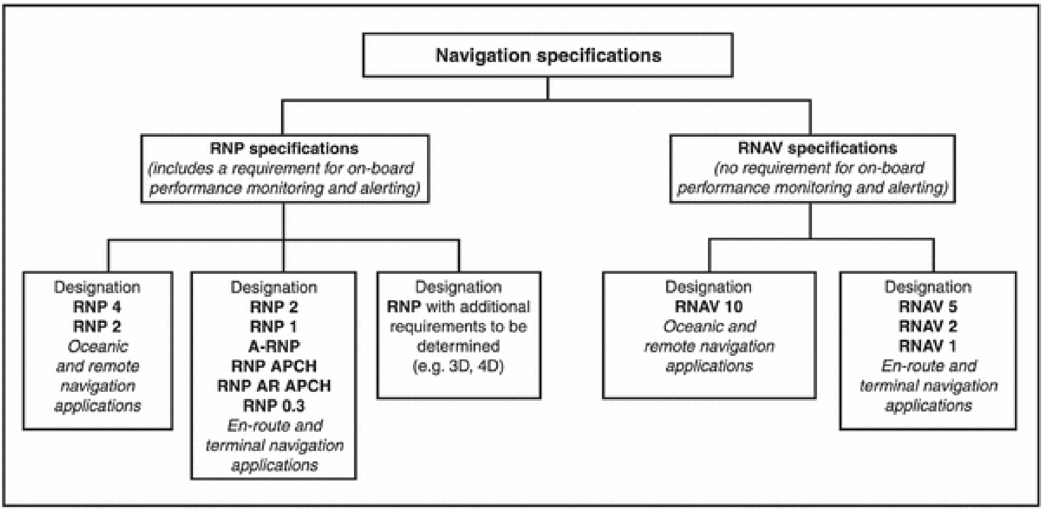
SECTION 2. PERFORMANCE-BASED NAVIGATION (PBN) AND AREA NAVIGATION (RNAV)

1-2-1 GENERAL

a. **Introduction to PBN.** As air travel has evolved, methods of navigation have improved to give operators more flexibility. PBN exists under the umbrella of area navigation (RNAV). The term RNAV in this context, as in procedure titles, just means "area navigation," regardless of the equipment capability of the aircraft. (See FIG 1-2-1.) Many operators have upgraded their systems to obtain the benefits of PBN. Within PBN there are two main categories of navigation methods or specifications: area navigation (RNAV) and required navigation performance (RNP). In this context, the term RNAV x means a specific navigation specification with a specified lateral accuracy value. For an aircraft to meet the requirements of PBN, a specified RNAV or RNP accuracy must be met 95 percent of the flight time. RNP is a PBN system that includes onboard performance monitoring and alerting capability (for example, Receiver Autonomous Integrity Monitoring (RAIM)). PBN also introduces the concept of navigation specifications (NavSpecs) which are a set of aircraft and aircrew requirements needed to support a navigation application within a defined airspace concept. For both RNP and RNAV NavSpecs, the numerical designation refers to the lateral navigation accuracy in nautical miles which is expected to be achieved at least 95 percent of the flight time by the population of aircraft operating within the airspace, route, or procedure. This information is detailed in International Civil Aviation Organization's (ICAO) Doc 9613, Performance-based Navigation (PBN) Manual and the latest FAA AC 90-105, Approval Guidance for RNP Operations and Barometric Vertical Navigation in the U.S. National Airspace System and in Remote and Oceanic Airspace.

FIGURE 1-2-1

Navigation Specifications



b. **Area Navigation (RNAV)**

1. **General.** RNAV is a method of navigation that 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. In the future, there will be an increased dependence on the use of RNAV in lieu of routes defined by ground-based navigation aids. RNAV routes and terminal procedures, including departure procedures (DPs) and standard terminal arrivals (STARs), are designed with RNAV systems in mind. There are several potential advantages of RNAV routes and procedures:

   (a) Time and fuel savings;

   (b) Reduced dependence on radar vectoring, altitude, and speed assignments allowing a reduction in required ATC radio transmissions; and

   (c) More efficient use of airspace.

   In addition to information found in this manual, guidance for domestic RNAV DPs, STARs, and routes may also be found in AC 90-100, U.S. Terminal and En Route Area Navigation (RNAV) Operations.

2. **RNAV Operations.** RNAV procedures, such as DPs and STARs, demand strict pilot awareness and maintenance of the procedure centerline. Pilots should possess a working knowledge of their aircraft navigation system to ensure RNAV procedures are flown in an appropriate manner. In addition, pilots should have an understanding of the various waypoint and leg types used in RNAV procedures; these are discussed in more detail below.

   (a) **Waypoints.** A waypoint is a predetermined geographical position that is defined in terms of latitude/longitude coordinates. Waypoints may be a simple named point in space or associated with existing navaids, intersections, or fixes. A waypoint is most often used to indicate a change in direction, speed, or altitude along the desired path. RNAV procedures make use of both fly-over and fly-by waypoints.

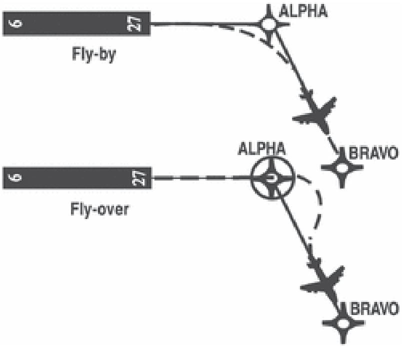
      (1) **Fly-by waypoints.** Fly-by waypoints are used when an aircraft should begin a turn to the next course prior to reaching the waypoint separating the two route segments. This is known as turn anticipation.

      (2) **Fly-over waypoints.** Fly-over waypoints are used when the aircraft must fly over the point prior to starting a turn.

      NOTE: *FIG 1-2-2 illustrates several differences between a fly-by and a fly-over waypoint.*

FIGURE 1-2-2

Fly-by and Fly-over Waypoints



(b) **RNAV Leg Types.** A leg type describes the desired path proceeding, following, or between waypoints on an RNAV procedure. Leg types are identified by a two-letter code that describes the path (e.g., heading, course, track, etc.) and the termination point (e.g., the path terminates at an altitude, distance, fix, etc.). Leg types used for procedure design are included in the aircraft navigation database, but not normally provided on the procedure chart. The narrative depiction of the RNAV chart describes how a procedure is flown. The "path and terminator concept" defines that every leg of a procedure has a termination point and some kind of path into that termination point. Some of the available leg types are described below.

(1) **Track to Fix.** A Track to Fix (TF) leg is intercepted and acquired as the flight track to the following waypoint. Track to a Fix legs are sometimes called point-to-point legs for this reason. ***Narrative:*** *"direct ALPHA, then on course to BRAVO WP."* See FIG 1-2-3.

(2) **Direct to Fix.** A Direct to Fix (DF) leg is a path described by an aircraft's track from an initial area direct to the next waypoint. ***Narrative:*** *"turn right direct BRAVO WP."* See FIG 1-2-4.

FIGURE 1-2-3

Track to Fix Leg Type

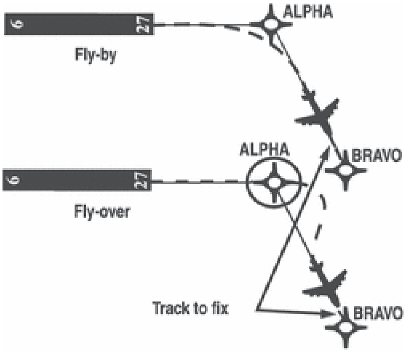
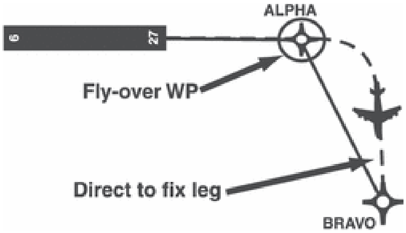


FIGURE 1-2-4

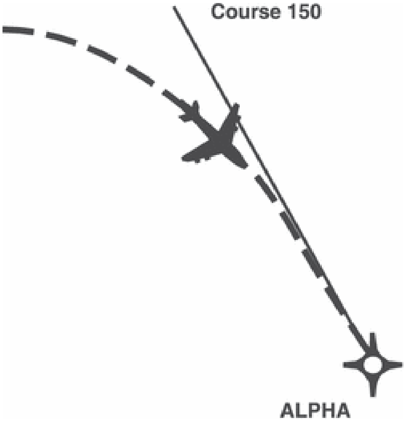
Direct to Fix Leg Type



(3) **Course to Fix.** A Course to Fix (CF) leg is a path that terminates at a fix with a specified course at that fix. ***Narrative:*** *"on course 150 to ALPHA WP."* See FIG 1-2-5.

FIGURE 1-2-5

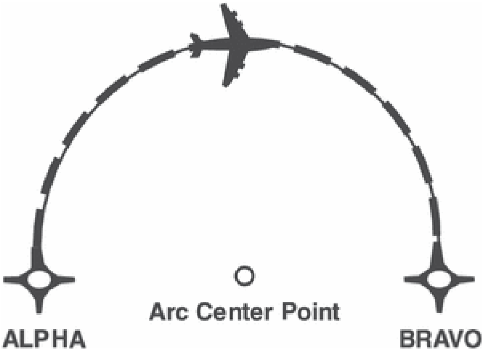
Course to Fix Leg Type



(4) **Radius to Fix.** A Radius to Fix (RF) leg is defined as a constant radius circular path around a defined turn center that terminates at a fix. See FIG 1-2-6.

FIGURE 1-2-6

Radius to Fix Leg Type



(5) **Heading.** A Heading leg may be defined as, but not limited to, a Heading to Altitude (VA), Heading to DME range (VD), and Heading to Manual Termination, i.e., Vector (VM). ***Narrative:*** *"climb heading 350 to 1500", "heading 265, at 9 DME west of PXR VORTAC, right turn heading 360", "fly heading 090, expect radar vectors to DRYHT INT."*

(c) **Navigation Issues.** Pilots should be aware of their navigation system inputs, alerts, and annunciations in order to make better-informed decisions. In addition, the availability and suitability of particular sensors/systems should be considered.

(1) **GPS/WAAS.** Operators using TSO-C129(), TSO-C196(), TSO-C145() or TSO-C146() systems should ensure departure and arrival airports are entered to ensure proper RAIM availability and CDI sensitivity.

(2) **DME/DME.** Operators should be aware that DME/DME position updating is dependent on navigation system logic and DME facility proximity, availability, geometry, and signal masking.

(3) **VOR/DME.** Unique VOR characteristics may result in less accurate values from VOR/DME position updating than from GPS or DME/DME position updating.

(4) **Inertial Navigation.** Inertial reference units and inertial navigation systems are often coupled with other types of navigation inputs, e.g., DME/DME or GPS, to improve overall navigation system performance.

NOTE: *Specific inertial position updating requirements may apply.*

(d) **Flight Management System (FMS).** An FMS is an integrated suite of sensors, receivers, and computers, coupled with a navigation database. These systems generally provide performance and RNAV guidance to displays and automatic flight control systems.

Inputs can be accepted from multiple sources such as GPS, DME, VOR, LOC and IRU. These inputs may be applied to a navigation solution one at a time or in combination. Some FMSs provide for the detection and isolation of faulty navigation information.

When appropriate navigation signals are available, FMSs will normally rely on GPS and/or DME/DME (that is, the use of distance information from two or more DME stations) for position updates. Other inputs may also be incorporated based on FMS system architecture and navigation source geometry.

NOTE: *DME/DME inputs coupled with one or more IRU(s) are often abbreviated as DME/DME/IRU or D/D/I.*

(e) **RNAV Navigation Specifications (Nav Specs)**

Nav Specs are a set of aircraft and aircrew requirements needed to support a navigation application within a defined airspace concept. For both RNP and RNAV designations, the numerical designation refers to the lateral navigation accuracy in nautical miles which is expected to be achieved at least 95 percent of the flight time by the population of aircraft operating within the airspace, route, or procedure. (See FIG 1-2-1.)

(1) **RNAV 1.** Typically RNAV 1 is used for DPs and STARs and appears on the charts. Aircraft must maintain a total system error of not more than 1 NM for 95 percent of the total flight time.

(2) **RNAV 2.** Typically RNAV 2 is used for en route operations unless otherwise specified. T-routes and Q-routes are examples of this Nav Spec. Aircraft must maintain a total system error of not more than 2 NM for 95 percent of the total flight time.

(3) **RNAV 10.** Typically RNAV 10 is used in oceanic operations. See paragraph 4-7-1 for specifics and explanation of the relationship between RNP 10 and RNAV 10 terminology.

1-2-2 REQUIRED NAVIGATION PERFORMANCE (RNP)

a. **General.** General. While both RNAV navigation specifications (NavSpecs) and RNP NavSpecs contain specific performance requirements, RNP is RNAV with the added requirement for onboard performance monitoring and alerting (OBPMA). RNP is also a statement of navigation performance necessary for operation within a defined airspace. A critical component of RNP is the ability of the aircraft navigation system to monitor its achieved navigation performance, and to identify for the pilot whether the operational requirement is, or is not, being met during an operation. OBPMA capability therefore allows a lessened reliance on air traffic control intervention and/or procedural separation to achieve the overall safety of the operation. RNP capability of the aircraft is a major component in determining the separation criteria to ensure that the overall containment of the operation is met. The RNP capability of an aircraft will vary depending upon the aircraft equipment and the navigation infrastructure. For example, an aircraft may be eligible for RNP 1, but may not be capable of RNP 1 operations due to limited NAVAID coverage or avionics failure. The Aircraft Flight Manual (AFM) or avionics documents for your aircraft should specifically state the aircraft's RNP eligibilities. Contact the manufacturer of the avionics or the aircraft if this information is missing or incomplete. NavSpecs should be considered different from one another, not "better" or "worse" based on the described lateral navigation accuracy. It is this concept that requires each NavSpec eligbility to be listed separately in the avionics documents or AFM. For example, RNP 1 is different from RNAV 1, and an RNP 1 eligibility does NOT mean automatic RNP 2 or RNAV 1 eligibility. As a safeguard, the FAA requires that aircraft navigation databases hold only those procedures that the aircraft maintains eligibility for. If you look for a specific instrument procedure in your aircraft's navigation database and cannot find it, it's likely that procedure contains PBN elements your aircraft is ineligible for or cannot compute and fly. Further, optional capabilities such as Radius-to-fix (RF) turns or scalability should be described in the AFM or avionics documents. Use the capabilities of your avionics suite to verify the appropriate waypoint and track data after loading the procedure from your database.

b. **PBN Operations.**

1. **Lateral Accuracy Values.** Lateral Accuracy values are applicable to a selected airspace, route, or procedure. The lateral accuracy value is a value typically expressed as a distance in nautical miles from the intended centerline of a procedure, route, or path.

RNP applications also account for potential errors at some multiple of lateral accuracy value (for example, twice the RNP lateral accuracy values).

(a) **RNP NavSpecs.** U.S. standard NavSpecs supporting typical RNP airspace uses are as specified below. Other NavSpecs may include different lateral accuracy values as identified by ICAO or other states. (See FIG 1-2-1.)

(1) **RNP Approach (RNP APCH).** In the U.S., RNP APCH procedures are titled RNAV (GPS) and offer several lines of minima to accommodate varying levels of aircraft equipage: either lateral navigation (LNAV), LNAV/vertical navigation (LNAV/VNAV), Localizer Performance with Vertical Guidance (LPV), and Localizer Performance (LP). GPS with or without Space-Based Augmentation System (SBAS) (for example, WAAS) can provide the lateral information to support LNAV minima. LNAV/VNAV incorporates LNAV lateral with vertical path guidance for systems and operators capable of either barometric or SBAS vertical. Pilots are required to use SBAS to fly to the LPV or LP minima. RF turn capability is optional in RNP APCH eligibility. This means that your aircraft may be eligible for RNP APCH operations, but you may not fly an RF turn unless RF turns are also specifically listed as a feature of your avionics suite. GBAS Landing System (GLS) procedures are also constructed using RNP APCH NavSpecs and provide precision approach capability. RNP APCH has a lateral accuracy value of 1 in the terminal and missed approach segments and essentially scales to RNP 0.3 (or 40 meters with SBAS) in the final approach. (See Paragraph 5-4-18, RNP AR Instrument Approach Procedures.)

(2) **RNP Authorization Required Approach (RNP AR APCH).** In the U.S., RNP AR APCH procedures are titled RNAV (RNP). These approaches have stringent equipage and pilot training standards and require special FAA authorization to fly. Scalability and RF turn capabilities are mandatory in RNP AR APCH eligibility. RNP AR APCH vertical navigation performance is based upon barometric VNAV or SBAS. RNP AR is intended to provide specific benefits at specific locations. It is not intended for every operator or aircraft. RNP AR capability requires specific aircraft performance, design, operational processes, training, and specific procedure design criteria to achieve the required target level of safety. RNP AR APCH has lateral accuracy values that can range below 1 in the terminal and missed approach segments and essentially scale to RNP 0.3 or lower in the final approach. Before conducting these procedures, operators should refer to the latest AC 90-101, Approval Guidance for RNP Procedures with AR. (See paragraph 5-4-18.)

(3) **RNP Authorization Required Departure (RNP AR DP).** Similar to RNP AR approaches, RNP AR departure procedures have stringent equipage and pilot training standards and require special FAA authorization to fly. Scalability and RF turn capabilities is mandatory in RNP AR DP eligibility. RNP AR DP is intended to provide specific benefits at specific locations. It is not intended for

every operator or aircraft. RNP AR DP capability requires specific aircraft performance, design, operational processes, training, and specific procedure design criteria to achieve the required target level of safety. RNP AR DP has lateral accuracy values that can scale to no lower than RNP 0.3 in the initial departure flight path. Before conducting these procedures, operators should refer to the latest AC 90-101, Approval Guidance for RNP Procedures with AR. (See paragraph 5-4-18.)

(4) **Advanced RNP (A-RNP).** Advanced RNP is a NavSpec with a minimum set of mandatory functions enabled in the aircraft's avionics suite. In the U.S., these minimum functions include capability to calculate and perform RF turns, scalable RNP, and parallel offset flight path generation. Higher continuity (such as dual systems) may be required for certain oceanic and remote continental airspace. Other "advanced" options for use in the en route environment (such as fixed radius transitions and Time of Arrival Control) are optional in the U.S. Typically, an aircraft eligible for A-RNP will also be eligible for operations comprising: RNP APCH, RNP/RNAV 1, RNP/RNAV 2, RNP 4, and RNP/RNAV 10. A-RNP allows for scalable RNP lateral navigation values (either 1.0 or 0.3) in the terminal environment. Use of these reduced lateral accuracies will normally require use of the aircraft's autopilot and/or flight director. See the latest AC 90-105 for more information on A-RNP, including NavSpec bundling options, eligibility determinations, and operations approvals.

NOTE: *A-RNP eligible aircraft are NOT automatically eligible for RNP AR APCH or RNP AR DP operations, as RNP AR eligibility requires a separate determination process and special FAA authorization.*

(5) **RNP 1.** RNP 1 requires a lateral accuracy value of 1 for arrival and departure in the terminal area, and the initial and intermediate approach phase when used on conventional procedures with PBN segments (for example, an ILS with a PBN feeder, IAF, or missed approach). RF turn capability is optional in RNP 1 eligibility. This means that your aircraft may be eligible for RNP 1 operations, but you may not fly an RF turn unless RF turns are also specifically listed as a feature of your avionics suite.

(6) **RNP 2.** RNP 2 will apply to both domestic and oceanic/remote operations with a lateral accuracy value of 2.

(7) **RNP 4.** RNP 4 will apply to oceanic and remote operations only with a lateral accuracy value of 4. RNP 4 eligibility will automatically confer RNP 10 eligibility.

(8) **RNP 10.** The RNP 10 NavSpec applies to certain oceanic and remote operations with a lateral accuracy of 10. In such airspace, the RNAV 10 NavSpec will be applied, so any aircraft eligible for RNP 10 will be deemed eligible for RNAV 10 operations. Further, any aircraft eligible for RNP 4 operations is automatically qualified for RNP 10/RNAV 10 operations. (See also the latest

AC 91-70, Oceanic and Remote Continental Airspace Operations, for more information on oceanic RNP/RNAV operations.)

(9) **RNP 0.3.** The RNP 0.3 NavSpec requires a lateral accuracy value of 0.3 for all authorized phases of flight. RNP 0.3 is not authorized for oceanic, remote, or the final approach segment. Use of RNP 0.3 by slow-flying fixed-wing aircraft is under consideration, but the RNP 0.3 NavSpec initially will apply only to rotorcraft operations. RF turn capability is optional in RNP 0.3 eligibility. This means that your aircraft may be eligible for RNP 0.3 operations, but you may not fly an RF turn unless RF turns are also specifically listed as a feature of your avionics suite.

NOTE: *On terminal procedures or en route charts, do not confuse a charted RNP value of 0.30, or any standard final approach course segment width of 0.30, with the NavSpec title "RNP 0.3." Charted RNP values of 0.30 or below should contain two decimal places (for example, RNP 0.15, or 0.10, or 0.30) whereas the NavSpec title will only state "RNP 0.3."*

(b) **Application of Standard Lateral Accuracy Values.** U.S. standard lateral accuracy values typically used for various routes and procedures supporting RNAV operations may be based on use of a specific navigational system or sensor such as GPS, or on multi-sensor RNAV systems having suitable performance.

(c) **Depiction of PBN Requirements.** In the U.S., PBN requirements like Lateral Accuracy Values or NavSpecs applicable to a procedure will be depicted on affected charts and procedures. In the U.S., a specific procedure's Performance-Based Navigation (PBN) requirements will be prominently displayed in separate, standardized notes boxes. For procedures with PBN elements, the "PBN box" will contain the procedure's NavSpec(s); and, if required: specific sensors or infrastructure needed for the navigation solution, any additional or advanced functional requirements, the minimum RNP value, and any amplifying remarks. Items listed in this PBN box are REQUIRED to fly the procedure's PBN elements. For example, an ILS with an RNAV missed approach would require a specific capability to fly the missed approach portion of the procedure. That required capability will be listed in the PBN box. The separate Equipment Requirements box will list ground-based equipment and/or airport specific requirements. On procedures with both PBN elements and ground-based equipment requirements, the PBN requirements box will be listed first. (See FIG 5-4-1.)

c. **Other RNP Applications Outside the U.S.** The FAA and ICAO member states have led initiatives in implementing the RNP concept to oceanic operations. For example, RNP-10 routes have been established in the northern Pacific (NOPAC) which has increased capacity and efficiency by reducing the distance between tracks to 50 NM. (See paragraph 4-7-1).

d. **Aircraft and Airborne Equipment Eligibility for RNP Operations.** Aircraft eligible for RNP operations will have an appropriate entry including special conditions and limitations in its AFM, avionics manual, or a supplement. Operators of aircraft not having specific RNP eligibility statements in the AFM or avionics documents may be issued operational approval including special conditions and limitations for specific RNP eligibilities.

NOTE: *Some airborne systems use Estimated Position Uncertainty (EPU) as a measure of the current estimated navigational performance. EPU may also be referred to as Actual Navigation Performance (ANP) or Estimated Position Error (EPE).*

TABLE 1-2-1 U.S. Standard RNP Levels

RNP Level	Typical Application	Primary Route Width (NM) – Centerline to Boundary
0.1 to 1.0	RNP AR Approach Segments	0.1 to 1.0
0.3 to 1.0	RNP Approach Segments	0.3 to 1.0
1	Terminal and En Route	1.0
2	En Route	2.0
4	Projected for oceanic/remote areas where 30 NM horizontal separation is applied.	4.0
10	Oceanic/remote areas where 50 NM lateral separation is applied.	10.0

1-2-3 USE OF SUITABLE AREA NAVIGATION (RNAV) SYSTEMS ON CONVENTIONAL PROCEDURES AND ROUTES

a. **Discussion.** This paragraph sets forth policy, while providing operational and airworthiness guidance regarding the suitability and use of RNAV systems when operating on, or transitioning to, conventional, non-RNAV routes and procedures within the U.S. National Airspace System (NAS):

1. Use of a suitable RNAV system as a Substitute Means of Navigation when a Very-High Frequency (VHF) Omni-directional Range (VOR), Distance Measuring Equipment (DME), Tactical Air Navigation (TACAN), VOR/TACAN (VORTAC), VOR/DME, Non-directional Beacon (NDB), or compass locator facility including locator outer marker and locator middle marker is out-of-service (that is, the navigation aid (NAVAID) information is not available); an aircraft is not equipped with an Automatic Direction Finder (ADF) or DME; or the installed ADF or DME on an aircraft is not operational. For example, if equipped with a suitable RNAV system, a pilot may hold over an out-of-service NDB.
2. Use of a suitable RNAV system as an Alternate Means of Navigation when a VOR, DME, VORTAC, VOR/DME, TACAN, NDB, or compass locator facility including locator outer marker and locator middle marker is operational and the respective aircraft is equipped with operational navigation equipment that is compatible with conventional navaids. For example, if equipped with a suitable RNAV system, a pilot may fly a procedure or route based on operational VOR system without monitoring the VOR.

NOTE:

a. *Additional information and associated requirements are available in Advisory Circular 90-108 titled "Use of Suitable RNAV Systems on Conventional Routes and Procedures."*

b. *Good planning and knowledge of your RNAV system are critical for safe and successful operations.*

c. *Pilots planning to use their RNAV system as a substitute means of navigation guidance in lieu of an out-of-service NAVAID may need to advise ATC of this intent and capability.*

d. *The navigation database should be current for the duration of the flight. If the AIRAC cycle will change during flight, operators and pilots should establish procedures to ensure the accuracy of navigation data, including suitability of navigation facilities used to define the routes and procedures for flight. To facilitate validating database currency, the FAA has developed procedures for publishing the amendment date that instrument approach procedures were last revised. The amendment date follows the amendment number, e.g., Amdt 4 14Jan10. Currency of graphic departure procedures and STARs may be ascertained by the numerical designation in the procedure title. If an amended chart is published for the procedure, or the procedure amendment date shown on the chart is on or after the expiration date of the database, the operator must not use the database to conduct the operation.*

b. **Types of RNAV Systems that Qualify as a Suitable RNAV System.** When installed in accordance with appropriate airworthiness installation requirements and operated in accordance with applicable operational guidance (for example, aircraft flight manual and Advisory Circular material), the following systems qualify as a suitable RNAV system:

1. An RNAV system with TSO-C129/-C145/-C146 equipment, installed in accordance with AC 20-138, Airworthiness Approval of Global Positioning System (GPS) Navigation Equipment for Use as a VFR and IFR Supplemental Navigation System, and authorized for instrument flight rules (IFR) en route and terminal operations (including those systems previously qualified for "GPS in lieu of ADF or DME" operations), or

2. An RNAV system with DME/DME/IRU inputs that is compliant with the equipment provisions of AC 90-100A, U.S. Terminal and En Route Area Navigation (RNAV) Operations, for RNAV routes. A table of compliant equipment is available at the following website:

   https://www.faa.gov/about/office_org/headquarters_offices/avs/offices/afx/afs/afs400/afs410/media/AC90-100compliance.pdf

NOTE: *Approved RNAV systems using DME/DME/IRU, without GPS/WAAS position input, may only be used as a substitute means of navigation when specifically authorized by a Notice to Airmen (NOTAM) or other FAA guidance for a specific procedure. The NOTAM or other FAA guidance authorizing the use of DME/DME/IRU systems will also identify any required DME facilities based on an FAA assessment of the DME navigation infrastructure.*

c. **Uses of Suitable RNAV Systems.** Subject to the operating requirements, operators may use a suitable RNAV system in the following ways.

1. Determine aircraft position relative to, or distance from a VOR (see NOTE 6 below), TACAN, NDB, compass locator, DME fix; or a named fix defined by a VOR radial, TACAN course, NDB bearing, or compass locator bearing intersecting a VOR or localizer course.
2. Navigate to or from a VOR, TACAN, NDB, or compass locator.
3. Hold over a VOR, TACAN, NDB, compass locator, or DME fix.
4. Fly an arc based upon DME.

NOTE:

a. The allowances described in this section apply even when a facility is explicitly identified as required on a procedure (for example, "Note ADF required").

b. These operations do not include lateral navigation on localizer-based courses (including localizer back-course guidance) without reference to raw localizer data.

c. Unless otherwise specified, a suitable RNAV system cannot be used for navigation on procedures that are identified as not authorized ("NA") without exception by a NOTAM. For example, an operator may not use a RNAV system to navigate on a procedure affected by an expired or unsatisfactory flight inspection, or a procedure that is based upon a recently decommissioned NAVAID.

d. Pilots may not substitute for the NAVAID (for example, a VOR or NDB) providing lateral guidance for the final approach segment. This restriction does not refer to instrument approach procedures with "or GPS" in the title when using GPS or WAAS. These allowances do not apply to procedures that are identified as not authorized (NA) without exception by a NOTAM, as other conditions may still exist and result in a procedure not being available. For example, these allowances do not apply to a procedure associated with an expired or unsatisfactory flight inspection, or is based upon a recently decommissioned NAVAID.

e. Use of a suitable RNAV system as a means to navigate on the final approach segment of an instrument approach procedure based on a VOR, TACAN or NDB signal, is allowable. The underlying NAVAID must be operational and the NAVAID monitored for final segment course alignment.

f. For the purpose of paragraph c, "VOR" includes VOR, VOR/DME, and VORTAC facilities and "compass locator" includes locator outer marker and locator middle marker.

d. **Alternate Airport Considerations.** For the purposes of flight planning, any required alternate airport must have an available instrument approach procedure that does not require the use of GPS. This restriction includes conducting a conventional approach at the alternate airport using a substitute means of navigation that is based upon the use of GPS. For example, these restrictions would apply when planning to use GPS equipment as a substitute means of navigation for an out-of-service VOR that supports an ILS missed approach procedure at an alternate airport. In this case, some other approach not reliant upon the use of GPS must be available. This restriction does not apply to RNAV systems using TSO-C145/-C146 WAAS equipment. For further WAAS guidance, see paragraph 1-1-18.

1. 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 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 applicable alternate airport weather minimums using:
   (a) Lateral navigation (LNAV) or circling minimum descent altitude (MDA);
   (b) LNAV/vertical navigation (LNAV/VNAV) DA, if equipped with and using approved barometric vertical navigation (baro-VNAV) equipment;
   (c) 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.
2. If the above conditions cannot be met, any required alternate airport 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.
3. This restriction does not apply to TSO-C145() and TSO-C146() equipped users (WAAS users). For further WAAS guidance, see paragraph 1-1-18.

1-2-4 PILOTS AND AIR TRAFFIC CONTROLLERS RECOGNIZING INTERFERENCE OR SPOOFING

a. Pilots need to maintain position awareness while navigating. This awareness may be facilitated by keeping relevant ground-based, legacy navigational aids tuned and available. By utilizing this practice, situational awareness is promoted and guards against significant pilot delay in recognizing the onset of GPS interference. Pilots may find cross-checks of other airborne systems (for example, DME/DME/IRU or VOR) useful to mitigate this otherwise undetected hazard.

REFERENCE—

AIM Paragraph 1-1-17, Global Positioning System (GPS).

AIM Paragraph 1-1-18, Wide Area Augmentation System (WAAS).

b. During preflight planning, pilots should be particularly alert for NOTAMs which could affect navigation (GPS or WAAS) along their route of flight, such as Department of Defense electronic signal tests with GPS.

REFERENCE—

AIM Paragraph 1-1-17, Global Positioning System (GPS).

AIM Paragraph 1-1-18, Wide Area Augmentation System (WAAS).

c. If the pilot experiences interruptions while navigating with GPS, the pilot and ATC may both incur a higher workload. In the aircraft, the pilot may need to change to a position determining method that does not require GPS-derived signals (for example, DME/DME/IRU or VOR). If transitioning to VOR navigation, the pilot should refer to the current Chart Supplement U.S. to identify airports with available conventional approaches associated with the VOR Minimum Operational Network (MON) program. If the pilot's aircraft is under ATC radar or multilateration surveillance, ATC may be able to provide radar vectors out of the interference affected area or to an alternate destination upon pilot request. An ADS-B Out aircraft's broadcast information may be incorrect and should not be relied upon for surveillance when interference or spoofing is suspected unless its accuracy can be verified by independent means. During the approach phase, a pilot might elect to continue in visual conditions or may need to execute the published missed approach. If the published missed approach procedure is GPS-based, the pilot will need alternate instructions. If the pilot were to choose to continue in visual conditions, the pilot could aid the controller by cancelling his/her IFR flight plan and proceeding visually to the airport to land. ATC would cancel the pilot's IFR clearance and issue a VFR squawk; freeing up the controller to handle other aircraft.

d. The FAA requests that pilots notify ATC if they experience interruptions to their GPS navigation or surveillance. GPS interference or outages associated with a known testing NOTAM should not be reported to ATC unless the interference/outage affects the pilot's ability to navigate his/her aircraft.

REFERENCE—*AIM Paragraph 1-1-13, User Reports Requested on NAVAID or Global Navigation Satellite System (GNSS) Performance or Interference.*

SECTION 5. SURVEILLANCE SYSTEMS

4-5-1 RADAR

a. **Capabilities**

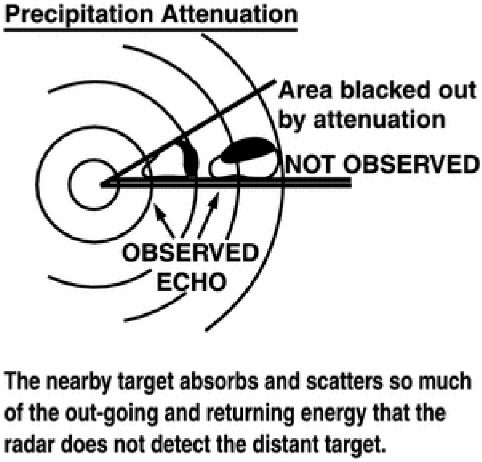
1. Radar is a method whereby radio waves are transmitted into the air and are then received when they have been reflected by an object in the path of the beam. Range is determined by measuring the time it takes (at the speed of light) for the radio wave to go out to the object and then return to the receiving antenna. The direction of a detected object from a radar site is determined by the position of the rotating antenna when the reflected portion of the radio wave is received.
2. More reliable maintenance and improved equipment have reduced radar system failures to a negligible factor. Most facilities actually have some components duplicated, one operating and another which immediately takes over when a malfunction occurs to the primary component.

b. **Limitations**

1. It is very important for the aviation community to recognize the fact that there are limitations to radar service and that ATC controllers may not always be able to issue traffic advisories concerning aircraft which are not under ATC control and cannot be seen on radar. (See FIG 4-5-1.)

FIGURE 4-5-1

Limitations to Radar Service



(a) The characteristics of radio waves are such that they normally travel in a continuous straight line unless they are:

(1) "Bent" by abnormal atmospheric phenomena such as temperature inversions;

(2) Reflected or attenuated by dense objects such as heavy clouds, precipitation, ground obstacles, mountains, etc.; or

(3) Screened by high terrain features.

(b) The bending of radar pulses, often called anomalous propagation or ducting, may cause many extraneous blips to appear on the radar operator's display if the beam has been bent toward the ground or may decrease the detection range if the wave is bent upward. It is difficult to solve the effects of anomalous propagation, but using beacon radar and electronically eliminating stationary and slow moving targets by a method called moving target indicator (MTI) usually negate the problem.

(c) Radar energy that strikes dense objects will be reflected and displayed on the operator's scope thereby blocking out aircraft at the same range and greatly weakening or completely eliminating the display of targets at a greater range. Again, radar beacon and MTI are very effectively used to combat ground clutter and weather phenomena, and a method of circularly polarizing the radar beam will eliminate some weather returns. A negative characteristic of MTI is that an aircraft flying a speed that coincides with the canceling signal of the MTI (tangential or “blind” speed) may not be displayed to the radar controller.

(d) Relatively low altitude aircraft will not be seen if they are screened by mountains or are below the radar beam due to earth curvature. The historical solution to screening has been the installation of strategically placed multiple radars, which has been done in some areas, but ADS-B now provides ATC surveillance in some areas with challenging terrain where multiple radar installations would be impractical.

(e) There are several other factors which affect radar control. The amount of reflective surface of an aircraft will determine the size of the radar return. Therefore, a small light airplane or a sleek jet fighter will be more difficult to see on primary radar than a large commercial jet or military bomber. Here again, the use of transponder or ADS-B equipment is invaluable. In addition, all FAA ATC facilities display automatically reported altitude information to the controller from appropriately equipped aircraft.

(f) At some locations within the ATC en route environment, secondary-radar-only (no primary radar) gap filler radar systems are used to give lower altitude radar coverage between two larger radar systems, each of which provides both primary and secondary radar coverage. ADS-B serves this same role, supplementing both primary and secondary radar. In those geographical areas served by secondary radar only or ADS-B, aircraft without either transponders or ADS-B equipment cannot be provided with radar service. Additionally, transponder or ADS-B equipped aircraft cannot be provided with radar advisories concerning primary targets and ATC radar-derived weather.

REFERENCE—*Pilot/Controller Glossary Term — Radar.*

(g) The controller's ability to advise a pilot flying on instruments or in visual conditions of the aircraft's proximity to another aircraft will be limited if the unknown aircraft is not observed on radar, if no flight plan information is available, or if the volume of traffic and workload prevent issuing traffic information. The controller's first priority is given to establishing vertical, lateral, or longitudinal separation between aircraft flying IFR under the control of ATC.

c. FAA radar units operate continuously at the locations shown in the Chart Supplement U.S., and their services are available to all pilots, both civil and military. Contact the associated FAA control tower or ARTCC on any frequency guarded for initial instructions, or in an emergency, any FAA facility for information on the nearest radar service.

4-5-2 AIR TRAFFIC CONTROL RADAR BEACON SYSTEM (ATCRBS)

a. The ATCRBS, sometimes referred to as secondary surveillance radar, consists of three main components:

1. **Interrogator.** Primary radar relies on a signal being transmitted from the radar antenna site and for this signal to be reflected or “bounced back” from an object (such as an aircraft). This reflected signal is then displayed as a “target” on the controller's radarscope. In the ATCRBS, the Interrogator, a ground based radar beacon transmitter-receiver, scans in synchronism with the primary radar and transmits discrete radio signals which repetitiously request all transponders, on the mode being used, to reply. The replies received are then mixed with the primary returns and both are displayed on the same radarscope.

2. **Transponder.** This airborne radar beacon transmitter-receiver automatically receives the signals from the interrogator and selectively replies with a specific pulse group (code) only to those interrogations being received on the mode to which it is set. These replies are independent of, and much stronger than a primary radar return.

3. **Radarscope.** The radarscope used by the controller displays returns from both the primary radar system and the ATCRBS. These returns, called targets, are what the controller refers to in the control and separation of traffic.

b. The job of identifying and maintaining identification of primary radar targets is a long and tedious task for the controller. Some of the advantages of ATCRBS over primary radar are:

1. Reinforcement of radar targets.

2. Rapid target identification.

3. Unique display of selected codes.

c. A part of the ATCRBS ground equipment is the decoder. This equipment enables a controller to assign discrete transponder codes to each aircraft under his/her control. Normally only one code will be assigned for the entire flight. Assignments are made by the ARTCC computer on the basis of the National Beacon Code Allocation Plan. The equipment is also designed to receive Mode C altitude information from the aircraft.

NOTE: *Refer to figures with explanatory legends for an illustration of the target symbology depicted on radar scopes in the NAS Stage A (en route), the ARTS III (terminal) Systems, and other nonautomated (broadband) radar systems. (See FIG 4-5-2 and FIG 4-5-3.)*

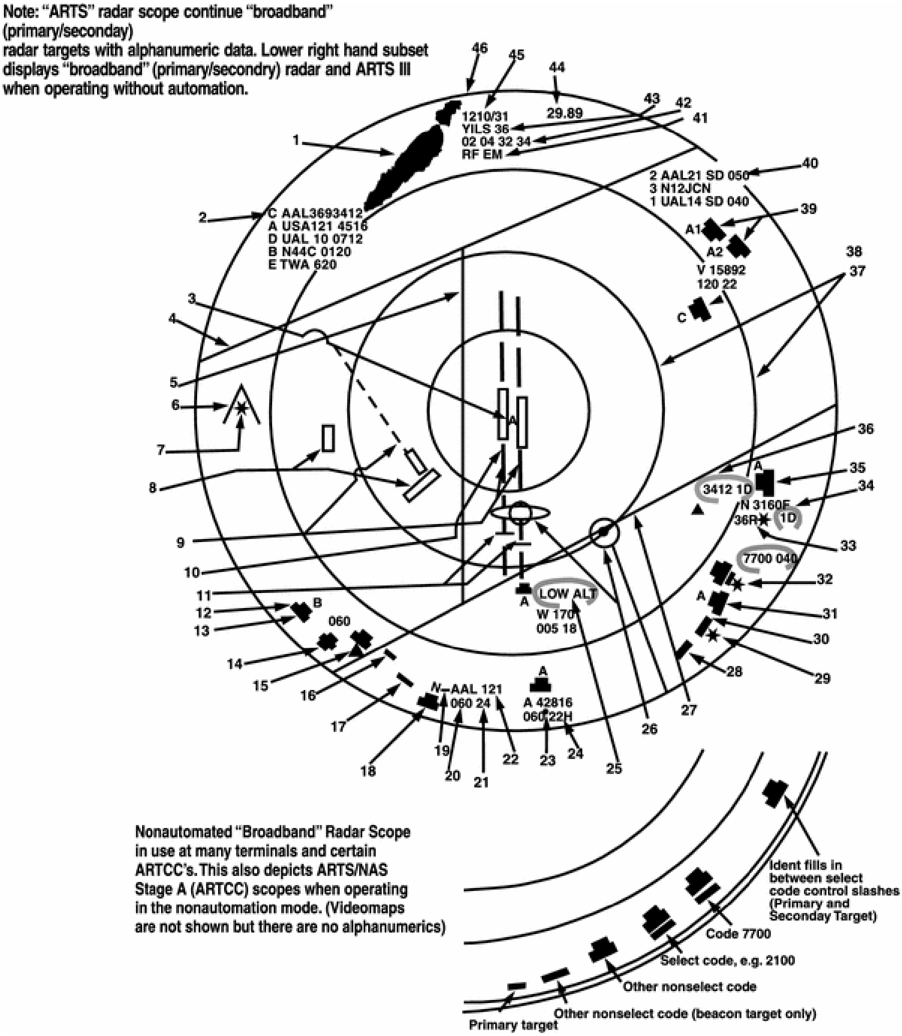
d. It should be emphasized that aircraft transponders greatly improve the effectiveness of radar systems.

REFERENCE—*AIM, Paragraph 4-1-20, Transponder and ADS-B Out Operation.*

SECTION 5. SURVEILLANCE SYSTEMS

FIGURE 4-5-2

ARTS III Radar Scope With Alphanumeric Data



Note: "ARTS" radar scope continue "broadband" (primary/seconday) radar targets with alphanumeric data. Lower right hand subset displays "broadband" (primary/secondry) radar and ARTS III when operating without automation.

Nonautomated "Broadband" Radar Scope in use at many terminals and certain ARTCC's. This also depicts ARTS/NAS Stage A (ARTCC) scopes when operating in the nonautomation mode. (Videomaps are not shown but there are no alphanumerics)

NOTE: *A number of radar terminals do not have ARTS equipment. Those facilities and certain ARTCCs outside the contiguous U.S. would have radar displays similar to the lower right hand subset. ARTS facilities and NAS Stage A ARTCCs, when operating in the nonautoma-*

tion mode, would also have similar displays and certain services based on automation may not be available.

EXAMPLE:

1. Areas of precipitation (can be reduced by CP)

2. Arrival/departure tabular list

3. Trackball (control) position symbol (A)

4. Airway (lines are sometimes deleted in part)

5. Radar limit line for control

6. Obstruction (video map)

7. Primary radar returns of obstacles or terrain (can be removed by MTI)

8. Satellite airports

9. Runway centerlines (marks and spaces indicate miles)

10. Primary airport with parallel runways

11. Approach gates

12. Tracked target (primary and beacon target)

13. Control position symbol

14. Untracked target select code (monitored) with Mode C readout of 5,000'

15. Untracked target without Mode C

16. Primary target

17. Beacon target only (secondary radar) (transponder)

18. Primary and beacon target

19. Leader line

20. Altitude Mode C readout is 6,000'

***NOTE:** Readouts may not be displayed because of nonreceipt of beacon information, garbled beacon signals, and flight plan data which is displayed alternately with the altitude readout.*

21. Ground speed readout is 240 knots

***NOTE:** Readouts may not be displayed because of a loss of beacon signal, a controller alert that a pilot was squawking emergency, radio failure, etc.*

22. Aircraft ID

23. Asterisk indicates a controller entry in Mode C block. In this case 5,000' is entered and “05” would alternate with Mode C readout.

24. Indicates heavy

SECTION 5. SURVEILLANCE SYSTEMS

25. “Low ALT” flashes to indicate when an aircraft's predicted descent places the aircraft in an unsafe proximity to terrain.

NOTE: *This feature does not function if the aircraft is not squawking Mode C. When a helicopter or aircraft is known to be operating below the lower safe limit, the “low ALT” can be changed to “inhibit” and flashing ceases.*

26. NAVAIDs

27. Airways

28. Primary target only

29. Nonmonitored. No Mode C (an asterisk would indicate nonmonitored with Mode C)

30. Beacon target only (secondary radar based on aircraft transponder)

31. Tracked target (primary and beacon target) control position A

32. Aircraft is squawking emergency Code 7700 and is nonmonitored, untracked, Mode C

33. Controller assigned runway 36 right alternates with Mode C readout

NOTE: *A three letter identifier could also indicate the arrival is at specific airport.*

34. Ident flashes

35. Identing target blossoms

36. Untracked target identing on a selected code

37. Range marks (10 and 15 miles) (can be changed/offset)

38. Aircraft controlled by center

39. Targets in suspend status

40. Coast/suspend list (aircraft holding, temporary loss of beacon/target, etc.)

41. Radio failure (emergency information)

42. Select beacon codes (being monitored)

43. General information (ATIS, runway, approach in use)

44. Altimeter setting

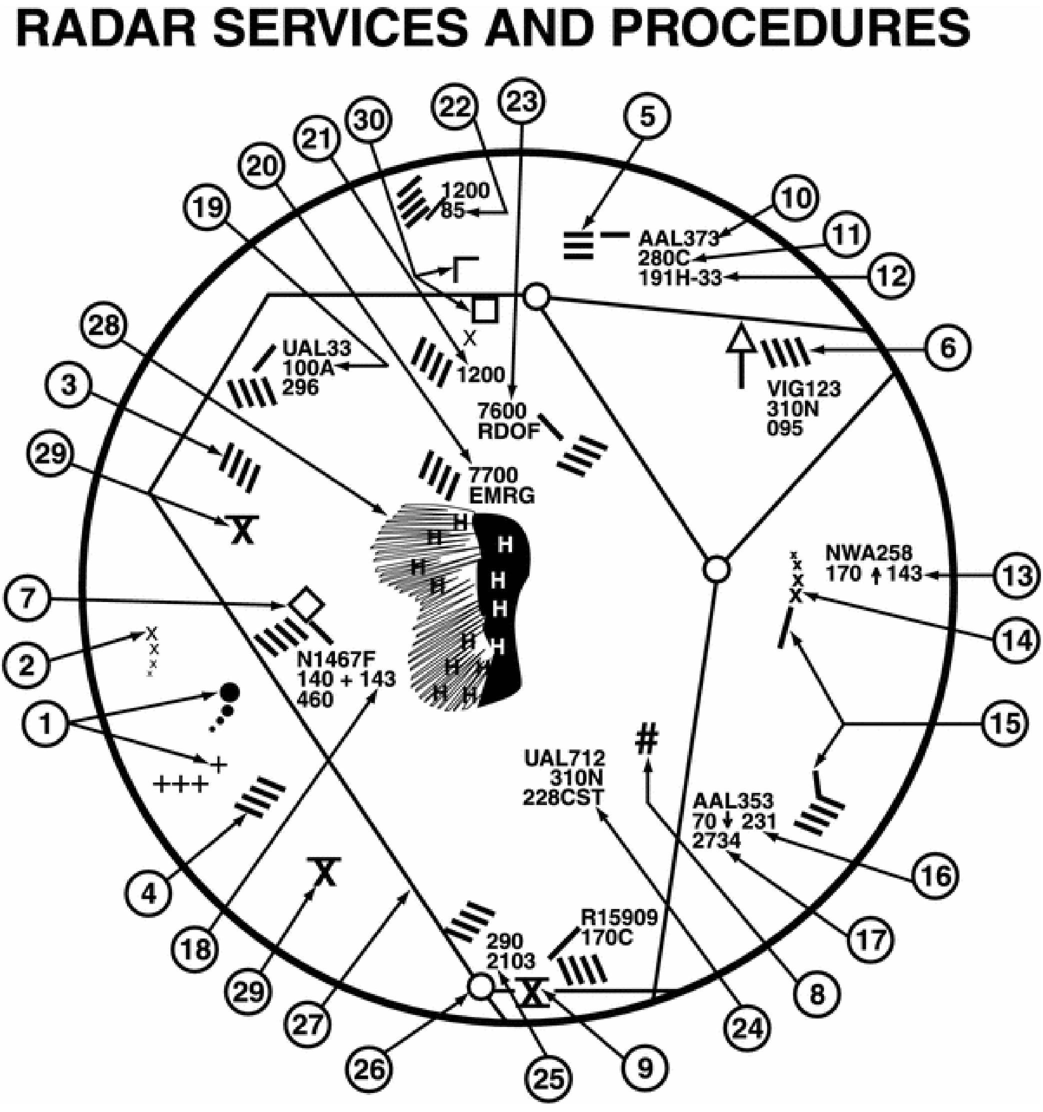
45. Time

46. System data area

SECTION 5. SURVEILLANCE SYSTEMS

FIGURE 4-5-3

NAS Stage A Controllers View Plan Display This figure illustrates the controller's radar scope (PVD) when operating in the full automation (RDP) mode, which is normally 20 hours per day. (When not in automation mode, the display is similar to the broadband mode shown in the ARTS III radar scope figure. Certain ARTCCs outside the contiguous U.S. also operate in "broadband" mode.)



EXAMPLE:

Target symbols:

1. Uncorrelated primary radar target [o] [+]

2. Correlated primary radar target [X]

See note below.

3. Uncorrelated beacon target [/]

4. Correlated beacon target [\ ]

5. Indenting beacon target [≡]

NOTE: *In Number 2 correlated means the association of radar data with the computer projected track of an identified aircraft.*

Position symbols:

6. Free track (no flight plan tracking) [Δ]

7. Flat track (flight plan tracking) [◊]

8. Coast (beacon target lost) [#]

9. Present position hold [X̄]

Data block information:

10. Aircraft ident

See note below.

11. Assigned altitude FL280, Mode C altitude same or within ±200' of assigned altitude.

See note below.

12. Computer ID #191, handoff is to sector 33 (0-33 would mean handoff accepted) See note below.

13. Assigned altitude 17,000', aircraft is climbing, Mode C readout was 14,300 when last beacon interrogation was received.

14. Leader line connecting target symbol and data block

15. Track velocity and direction vector line (projected ahead of target)

16. Assigned altitude 7,000, aircraft is descending, last Mode C readout (or last reported altitude) was 100' above FL230

17. Transponder code shows in full data block only when different than assigned code

18. Aircraft is 300' above assigned altitude

19. Reported altitude (no Mode C readout) same as assigned. (An “n” would indicate no reported altitude.)

20. Transponder set on emergency Code 7700 (EMRG flashes to attract attention)

21. Transponder Code 1200 (VFR) with no Mode C

22. Code 1200 (VFR) with Mode C and last altitude readout

23. Transponder set on radio failure Code 7600 (RDOF flashes)

24. Computer ID #228, CST indicates target is in coast status

25. Assigned altitude FL290, transponder code (these two items constitute a “limited data block”)

NOTE: *Numbers 10, 11, and 12 constitute a “full data block”*

Other symbols:

26. Navigational aid

27. Airway or jet route

28. Outline of weather returns based on primary radar. “H” represents areas of high density precipitation which might be thunderstorms. Radial lines indicated lower density precipitation.

29. Obstruction

30. Airports

Major: □

Small: ┌

4-5-3 SURVEILLANCE RADAR

a. Surveillance radars are divided into two general categories: Airport Surveillance Radar (ASR) and Air Route Surveillance Radar (ARSR).

1. ASR is designed to provide relatively short-range coverage in the general vicinity of an airport and to serve as an expeditious means of handling terminal area traffic through observation of precise aircraft locations on a radarscope. The ASR can also be used as an instrument approach aid.
2. ARSR is a long-range radar system designed primarily to provide a display of aircraft locations over large areas.
3. Center Radar Automated Radar Terminal Systems (ARTS) Processing (CENRAP) was developed to provide an alternative to a nonradar environment at terminal facilities should an ASR fail or malfunction. CENRAP sends aircraft radar beacon target information to the ASR terminal facility equipped with ARTS. Procedures used for the separation of aircraft may increase under certain conditions when a facility is utilizing CENRAP because radar target information updates at a slower rate than the normal ASR radar. Radar services for VFR aircraft are also limited during CENRAP operations because of the additional workload required to provide services to IFR aircraft.

b. Surveillance radars scan through 360 degrees of azimuth and present target information on a radar display located in a tower or center. This information is used independently or in conjunction with other navigational aids in the control of air traffic.

4-5-4 PRECISION APPROACH RADAR (PAR)

a. PAR is designed for use as a landing aid rather than an aid for sequencing and spacing aircraft. PAR equipment may be used as a primary landing aid (See Chapter 5, Air Traffic Procedures, for additional information), or it may be used to monitor other types of approaches. It is designed to display range, azimuth, and elevation information.

b. Two antennas are used in the PAR array, one scanning a vertical plane, and the other scanning horizontally. Since the range is limited to 10 miles, azimuth to 20 degrees, and elevation to 7 degrees, only the final approach area is covered. Each scope is divided into two parts. The upper half presents altitude and distance information, and the lower half presents azimuth and distance.

4-5-5 AIRPORT SURFACE DETECTION EQUIPMENT (ASDE-X)/ AIRPORT SURFACE SURVEILLANCE CAPABILITY (ASSC)

a. ASDE-X/ASSC is a multi-sensor surface surveillance system the FAA is acquiring for airports in the United States. This system provides high resolution, short-range, clutter free surveillance information about aircraft and vehicles, both moving and fixed, located on or near the surface of the airport's runways and taxiways under all weather and visibility conditions. The system consists of:

1. **A Primary Radar System.** ASDE-X/ASSC system coverage includes the airport surface and the airspace up to 200 feet above the surface. Typically located on the control tower or other strategic location on the airport, the Primary Radar antenna is able to detect and display aircraft that are not equipped with or have malfunctioning transponders or ADS-B.
2. **Interfaces.** ASDE-X/ASSC contains an automation interface for flight identification via all automation platforms and interfaces with the terminal radar for position information.
3. **Automation.** A Multi-sensor Data Processor (MSDP) combines all sensor reports into a single target which is displayed to the air traffic controller.
4. **Air Traffic Control Tower Display.** A high resolution, color monitor in the control tower cab provides controllers with a seamless picture of airport operations on the airport surface.

b. The combination of data collected from the multiple sensors ensures that the most accurate information about aircraft location is received in the tower, thereby increasing surface safety and efficiency.

c. The following facilities are operational with ASDE-X:

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Table 4-5-1

BWI	Baltimore Washington International
BOS	Boston Logan International
BDL	Bradley International
MDW	Chicago Midway
ORD	Chicago O’Hare International
CLT	Charlotte Douglas International
DFW	Dallas/Ft. Worth International
DEN	Denver International
DTW	Detroit Metro Wayne County
FLL	Ft. Lauderdale/Hollywood Intl
MKE	General Mitchell International
IAH	George Bush International
ATL	Hartsfield-Jackson Atlanta Intl
HNL	Honolulu International
JFK	John F. Kennedy International
SNA	John Wayne-Orange County
LGA	LaGuardia
STL	Lambert St. Louis International
LAS	Las Vegas McCarran International
LAX	Los Angeles International
SDF	Louisville International
MEM	Memphis International
MIA	Miami International
MSP	Minneapolis St. Paul International
EWR	Newark International
MCO	Orlando International
PHL	Philadelphia International
PHX	Phoenix Sky Harbor International
DCA	Ronald Reagan Washington National
SAN	San Diego International

Table 4-5-1 (continued)

SLC	Salt Lake City International
SEA	Seattle-Tacoma International
PVD	Theodore Francis Green State
IAD	Washington Dulles International
HOU	William P. Hobby International

d. The following facilities have been projected to receive ASSC:

Table 4-5-2

SFO	San Francisco International
CLE	Cleveland-Hopkins International
MCI	Kansas City International
CVG	Cincinnati/Northern Kentucky Intl
PDX	Portland International
MSY	Louis Armstrong New Orleans Intl
PIT	Pittsburgh International
ANC	Ted Stevens Anchorage International
ADW	Joint Base Andrews AFB

4-5-6 TRAFFIC INFORMATION SERVICE (TIS)

a. **Introduction.**

The Traffic Information Service (TIS) provides information to the cockpit via data link, that is similar to VFR radar traffic advisories normally received over voice radio. Among the first FAA-provided data services, TIS is intended to improve the safety and efficiency of “see and avoid” flight through an automatic display that informs the pilot of nearby traffic and potential conflict situations. This traffic display is intended to assist the pilot in visual acquisition of these aircraft. TIS employs an enhanced capability of the terminal Mode S radar system, which contains the surveillance data, as well as the data link required to “uplink” this information to suitably-equipped aircraft (known as a TIS “client”). TIS provides estimated position, altitude, altitude trend, and ground track information for up to 8 intruder aircraft within 7 NM horizontally, +3,500 and -3,000 feet vertically of the client aircraft (see FIG 4-5-4, TIS Proximity Coverage Volume). The range of a target reported at a distance greater than 7 NM only indicates that this target will be a threat within 34 seconds and does not display a precise distance. TIS will alert the pilot to aircraft (under surveillance of the Mode S radar) that are estimated to be within 34 seconds of potential collision, regardless of distance or altitude.

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TIS surveillance data is derived from the same radar used by ATC; this data is uplinked to the client aircraft on each radar scan (nominally every 5 seconds).

b. **Requirements.**

1. In order to use TIS, the client and any intruder aircraft must be equipped with the appropriate cockpit equipment and fly within the radar coverage of a Mode S radar capable of providing TIS. Typically, this will be within 55 NM of the sites depicted in FIG 4-5-5, Terminal Mode S Radar Sites. ATC communication is not a requirement to receive TIS, although it may be required by the particular airspace or flight operations in which TIS is being used.

FIGURE 4-5-4

TIS Proximity Coverage Volume

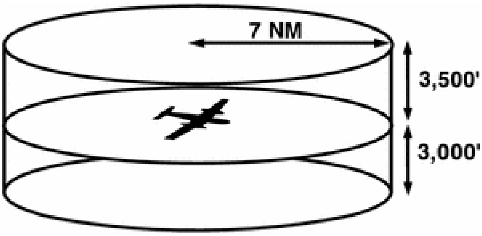

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FIGURE 4-5-5

Terminal Mode S Radar Sites

(APPROXIMATE LOCATIONS)

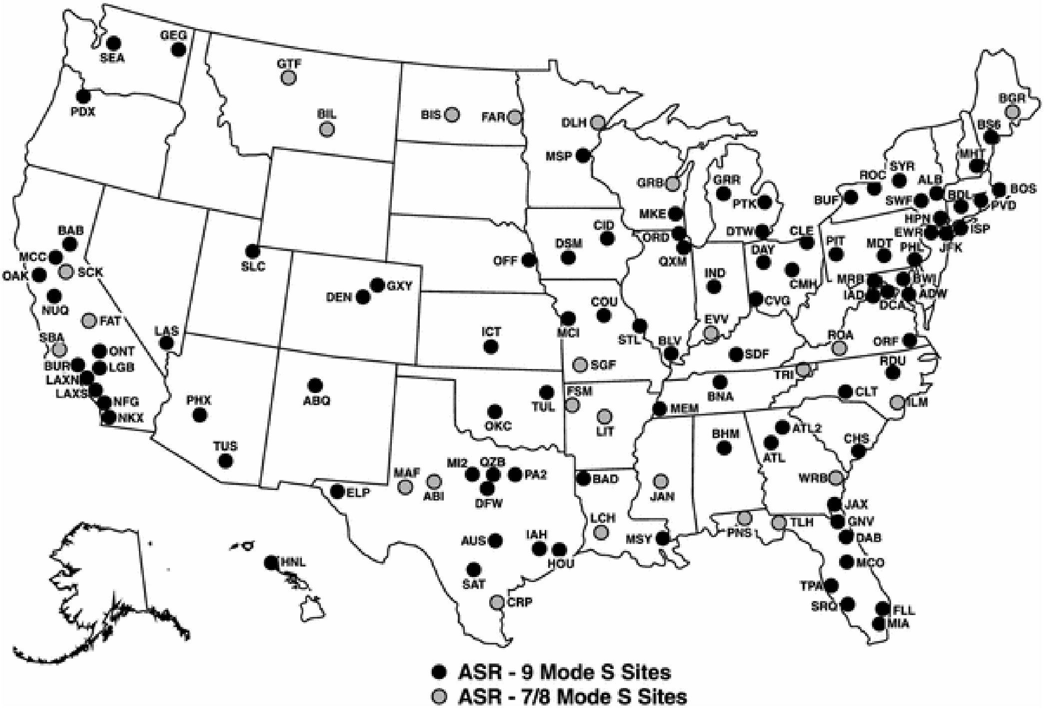

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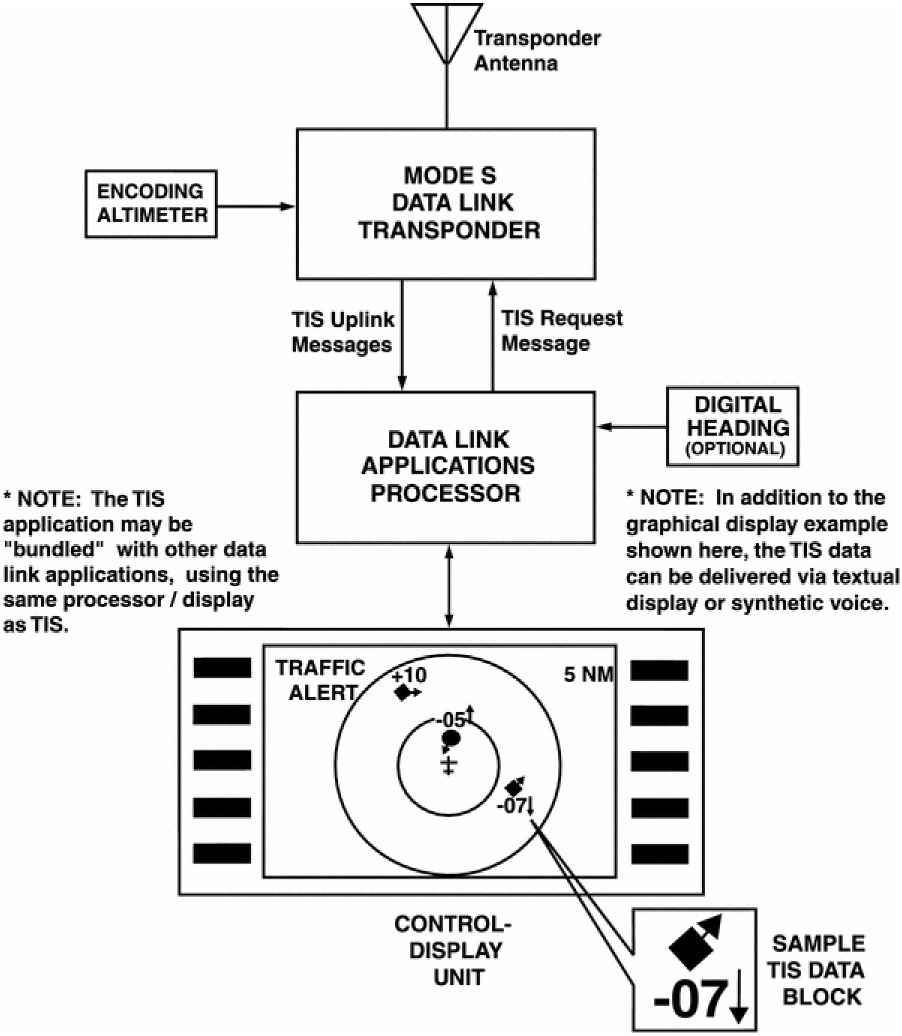
FIGURE 4-5-6

Traffic Information Service (TIS)

Avionics Block Diagram



* NOTE: The TIS application may be "bundled" with other data link applications, using the same processor / display as TIS.

* NOTE: In addition to the graphical display example shown here, the TIS data can be delivered via textual display or synthetic voice.

2. The cockpit equipment functionality required by a TIS client aircraft to receive the service consists of the following (refer to FIG 4-5-6):

   (a) Mode S data link transponder with altitude encoder.

(b) Data link applications processor with TIS software installed.

(c) Control-display unit.

(d) Optional equipment includes a digital heading source to correct display errors caused by “crab angle” and turning maneuvers.

NOTE: *Some of the above functions will likely be combined into single pieces of avionics, such as (a) and (b).*

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

4. TIS will initially be provided by the terminal Mode S systems that are paired with ASR-9 digital primary radars. These systems are in locations with the greatest traffic densities, thus will provide the greatest initial benefit. The remaining terminal Mode S sensors, which are paired with ASR-7 or ASR-8 analog primary radars, will provide TIS pending modification or relocation of these sites. See FIG 4-5-5, Terminal Mode S Radar Sites, for site locations. There is no mechanism in place, such as NOTAMs, to provide status update on individual radar sites since TIS is a nonessential, supplemental information service.

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

c. **Capabilities.**

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

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

   (a) Relative bearing information in 6-degree increments.

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

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

   (d) Estimated intruder ground track in 45-degree increments.

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

(f) Intruder priority as either an “traffic advisory” or “proximate” intruder.

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

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

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

(b) **TIS Traffic.** TIS traffic data is displayed.

(c) **Coasting.** The TIS display is more than 6 seconds old. This indicates a missing uplink from the ground system. When the TIS display information is more than 12 seconds old, the “No Traffic” status will be indicated.

(d) **No Traffic.** No intruders meet proximate or alert criteria. This condition may exist when the TIS system is fully functional or may indicate “coasting” between 12 and 59 seconds old (see (c) above).

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

(f) **TIS Disabled.** The pilot has not requested TIS or has disconnected from TIS.

(g) **Good-bye.** The client aircraft has flown outside of TIS coverage.

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

5. Depending on avionics system design, TIS may be presented to the pilot in a variety of different displays, including text and/or graphics. Voice annunciation may also be used, either alone or in combination with a visual display. FIG 4-5-6, Traffic Information Service (TIS), Avionics Block Diagram, shows an example of a TIS display using symbology similar to the Traffic Alert and Collision Avoidance System (TCAS) installed on most passenger air carrier/commuter aircraft in the U.S. The small symbol in the center represents the client aircraft and the display is oriented “track up,” with the 12 o'clock position at the top. The range rings indicate 2 and 5 NM. Each intruder is depicted by a symbol positioned at the approximate relative bearing and range from the client aircraft. The circular symbol near the center indicates an “alert” intruder and the diamond symbols indicate “proximate” intruders.

6. The inset in the lower right corner of FIG 4-5-6, Traffic Information Service (TIS), Avionics Block Diagram, shows a possible TIS data block display. The following information is contained in this data block:
   (a) The intruder, located approximately four o'clock, three miles, is a “proximate” aircraft and currently not a collision threat to the client aircraft. This is indicated by the diamond symbol used in this example.

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

   (c) The intruder altitude is 700 feet less than or below the client aircraft, indicated by the “-07” located under the symbol.

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

   NOTE: *If the intruder did not have an operating altitude encoder (Mode C), the altitude and altitude trend “tags” would have been omitted.*

d. **Limitations.**

1. TIS is **NOT** intended to be used as a collision avoidance system and does not relieve the pilot’s responsibility to “see and avoid” other aircraft (see Paragraph 5-5-8, See and Avoid). TIS must not be used for avoidance maneuvers during IMC or other times when there is no visual contact with the intruder aircraft. TIS is intended only to assist in visual acquisition of other aircraft in VMC. Avoidance maneuvers are neither provided nor authorized as a direct result of a TIS intruder display or TIS alert.

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

   (a) **Intruder Display Limitations.** TIS will only display aircraft with operating transponders installed. TIS relies on surveillance of the Mode S radar, which is a “secondary surveillance” radar similar to the ATCRBS described in paragraph 4-5-2.

   (b) **TIS Client Altitude Reporting Requirement.** Altitude reporting is required by the TIS client aircraft in order to receive TIS. If the altitude encoder is inoperative or disabled, TIS will be unavailable, as TIS requests will not be honored by the ground system. As such, TIS requires altitude reporting to determine the Proximity Coverage Volume as indicated in FIG 4-5-4. TIS users must be alert to altitude encoder malfunctions, as TIS has no mechanism to determine if client altitude reporting is correct. A failure of this nature will cause erroneous and possibly unpredictable TIS operation. If this malfunction is suspected, confirmation of altitude reporting with ATC is suggested.

(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 $^{1}/_{4}$ 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

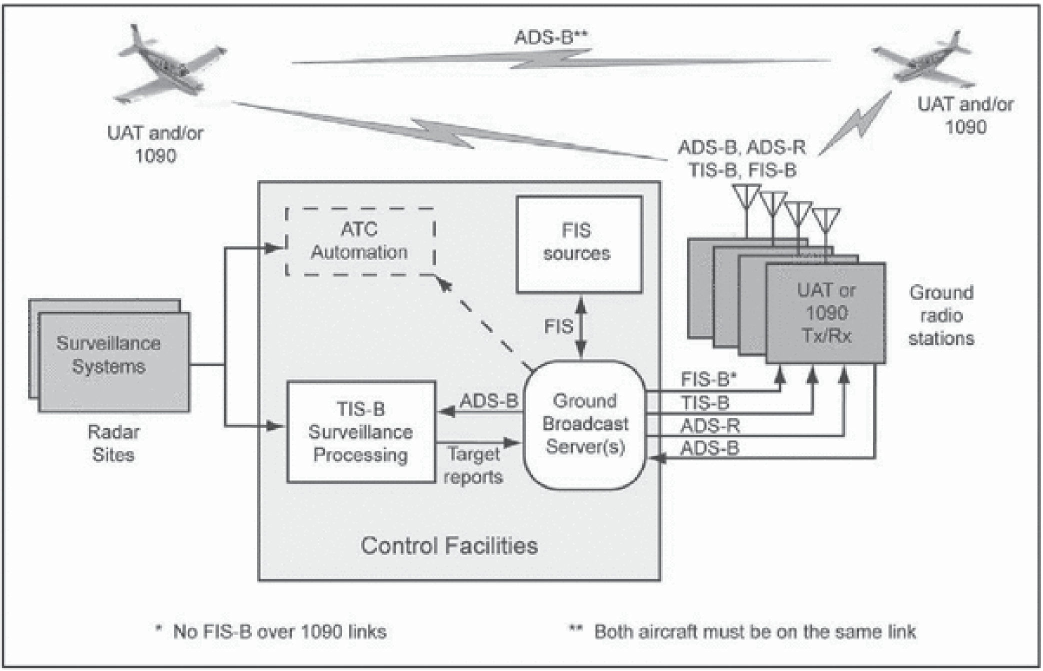
a. **Introduction.**

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.)

FIGURE 4-5-7

ADS-B, TIS-B, AND FIS-B:

Broadcast Services Architecture



2. In the United States, ADS-B equipped aircraft exchange information is 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

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not require it, operators equipped with ADS-B In will realize additional benefits from ADS-B broadcast services: Traffic Information Service-Broadcast (TIS-B) (Paragraph 4-5-8) and Flight Information Service-Broadcast (FIS-B) (Paragraph 4-5-9).

b. **ADS-B Certification and Performance Requirements.**

ADS-B equipment may be certified as a surveillance source for air traffic separation services using ADS-B Out. ADS-B equipment may also be certified for use with ADS-B In advisory services that enable appropriately equipped aircraft to display traffic and flight information. Refer to the aircraft's flight manual supplement or Pilot Operating Handbook for the capabilities of a specific aircraft installation.

c. **ADS-B Capabilities and Procedures.**

1. ADS-B enables improved surveillance services, both air-to-air and air-to-ground, especially in areas where radar is ineffective due to terrain or where it is impractical or cost prohibitive. Initial NAS applications of air-to-air ADS-B are for "advisory" use only, enhancing a pilot's visual acquisition of other nearby equipped aircraft either when airborne or on the airport surface. Additionally, ADS-B will enable ATC and fleet operators to monitor aircraft throughout the available ground station coverage area.

FIGURE 4-5-8

En Route — ADS-B/ADS-R/TIS-B/FIS-B Service Ceilings/Floors

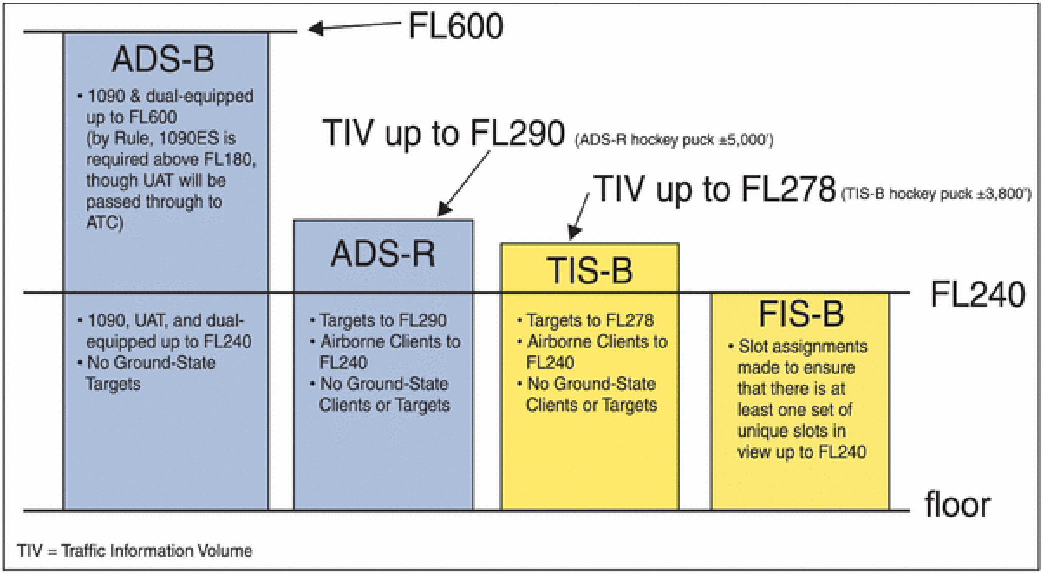

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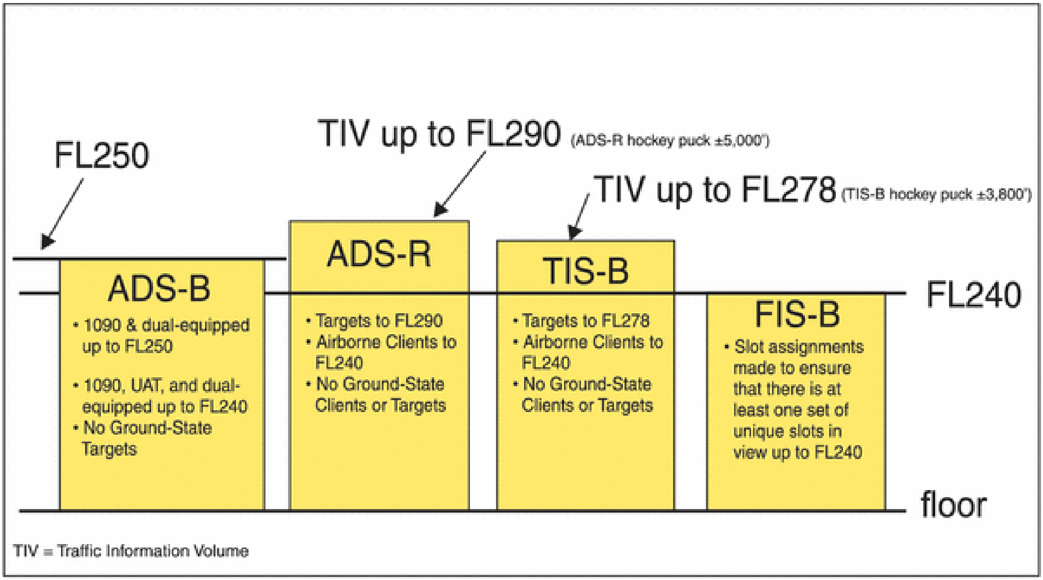
FIGURE 4-5-9

Terminal — ADS-B/ADS-R/TIS-B/FIS-B Service Ceilings/Floors



2. One of the data elements transmitted by ADS-B is the aircraft's Flight Identification (FLT ID). The FLT ID is comprised of a maximum of seven alphanumeric characters and must correspond to the aircraft identification filed in the flight plan. For airline and commuter aircraft, the FLT ID is usually the company name and flight number (for example, AAL3432), and is typically entered into the avionics by the flight crew during preflight. For general aviation (GA), if aircraft avionics allow dynamic modification of the FLT ID, the pilot can enter it prior to flight. However, some ADS-B avionics require the FLT ID to be set to the aircraft registration number (for example, N1234Q) by the installer and cannot be changed by the pilot from the cockpit. In both cases, the FLT ID must correspond to the aircraft identification filed in its flight plan.

   ATC automation systems use the transmitted ADS-B FLT ID to uniquely identify each aircraft within a given airspace, and to correlate it to its filed flight plan for the purpose of providing surveillance and separation services. If the FLT ID and the filed aircraft identification are not identical, a Call Sign Mis-Match (CSMM) is generated and ATC automation systems may not associate the aircraft with its filed flight plan. In this case, air traffic services may be delayed or unavailable until the CSMM is corrected. Consequently, it is imperative that flight crews and GA pilots ensure the FLT ID entry correctly matches the aircraft identification filed in their flight plan.

3. Each ADS-B aircraft is assigned a unique ICAO address (also known as a 24-bit address) that is broadcast by the ADS-B transmitter. This ICAO address is programmed at installation. Should multiple aircraft broadcast the same ICAO address while transiting the same ADS-B Only Service Volume, the ADS-B network may be unable to track the targets correctly. If radar reinforcement is available, tracking will continue. If radar is unavailable, the controller may lose target tracking entirely on one or both targets. Consequently, it is imperative that the ICAO address entry is correct.
4. Aircraft that are equipped with ADS-B avionics on the UAT datalink have a feature that allows them to broadcast an anonymous 24-bit ICAO address. In this mode, the UAT system creates a randomized address that does not match the actual ICAO address assigned to the aircraft. The UAT anonymous 24-bit address feature may only be used when the operator has not filed an IFR flight plan and is not requesting ATC services. In the anonymity mode, the aircraft's beacon code must be set to 1200 and, depending on the manufacturer's implementation, the aircraft FLT ID might not be transmitted. Pilots should be aware that while in UAT anonymity mode, they will not be eligible to receive ATC separation and flight following services, and may not benefit from enhanced ADS-B search and rescue capabilities.
5. ADS-B systems integrated with the transponder will automatically set the applicable emergency status when 7500, 7600, or 7700 are entered into the transponder. ADS-B systems not integrated with the transponder, or systems with optional emergency codes, will require that the appropriate emergency code is entered through a pilot interface. ADS-B is intended for inflight and airport surface use. Unless otherwise directed by ATC, transponder/ADS-B systems should be turned "on" and remain "on" whenever operating in the air or on the airport surface movement area.

d. **ATC Surveillance Services using ADS-B — Procedures and Recommended Phraseology**

Radar procedures, with the exceptions found in this paragraph, are identical to those procedures prescribed for radar in AIM Chapter 4 and Chapter 5.

1. Preflight:

   If ATC services are anticipated when either a VFR or IFR flight plan is filed, the aircraft identification (as entered in the flight plan) must be entered as the FLT ID in the ADS-B avionics.

2. Inflight:

   When requesting surveillance services while airborne, pilots must disable the anonymous feature, if so equipped, prior to contacting ATC. Pilots must also ensure that their transmitted ADS-B FLT ID matches the aircraft identification as entered in their flight plan.

3. Aircraft with an Inoperative/Malfunctioning ADS-B Transmitter:

   (a) ATC will inform the flight crew when the aircraft's ADS-B transmitter appears to be inoperative or malfunctioning:

PHRASEOLOGY:

YOUR ADS-B TRANSMITTER APPEARS TO BE INOPERATIVE/MALFUNCTIONING. STOP ADS-B TRANSMISSIONS.

(b) ATC will inform the flight crew if it becomes necessary to turn off the aircraft's ADS-B transmitter.

PHRASEOLOGY:

STOP ADS-B TRANSMISSIONS.

(c) Other malfunctions and considerations:

Loss of automatic altitude reporting capabilities (encoder failure) will result in loss of ATC altitude advisory services.

4. Procedures for Accommodation of Non-ADS-B Equipped Aircraft:

(a) Pilots of aircraft not equipped with ADS-B may only operate outside airspace designated as ADS-B airspace in 14 CFR §91.225. Pilots of unequipped aircraft wishing to fly any portion of a flight in ADS-B airspace may seek a deviation from the regulation to conduct operations without the required equipment. Direction for obtaining this deviation are available in Advisory Circular 90-114.

(b) While air traffic controllers can identify which aircraft are ADS-B equipped and which are not, there is no indication if a non-equipped pilot has obtained a preflight authorization to enter ADS-B airspace. Situations may occur when the pilot of a non-equipped aircraft, without an authorization to operate in ADS-B airspace receives an ATC-initiated in-flight clearance to fly a heading, route, or altitude that would penetrate ADS-B airspace. Such clearances may be for traffic, weather, or simply to shorten the aircraft's route of flight. When this occurs, the pilot should acknowledge and execute the clearance, but must advise the controller that they are not ADS-B equipped and have not received prior authorization to operate in ADS-B airspace. The controller, at their discretion, will either acknowledge and proceed with the new clearance, or modify the clearance to avoid ADS-B airspace. In either case, the FAA will normally not take enforcement action for non-equipage in these circumstances.

NOTE: *Pilots operating without ADS-B equipment must not request route or altitude changes that will result in an incursion into ADS-B airspace except for safety of flight; for example, weather avoidance. Unequipped aircraft that have not received a pre-flight deviation authorization will only be considered in compliance with regulation if the amendment to flight is initiated by ATC.*

EXAMPLE 1: ***ATC:*** *"November Two Three Quebec, turn fifteen degrees left, proceed direct Bradford when able, rest of route unchanged."*

Aircraft: *"November Two Three Quebec, turning fifteen degrees left, direct Bradford when able, rest of route unchanged. Be advised, we are negative ADS-B equipment and have not received authorization to operate in ADS-B airspace."*

ATC: *"November Two Three Quebec, roger"*

or

"November Two Three Quebec, roger, turn twenty degrees right, rejoin Victor Ten, rest of route unchanged."

EXAMPLE 2: ***ATC:*** *"November Four Alpha Tango, climb and maintain one zero thousand for traffic."*

Aircraft: *"November Four Alpha Tango, leaving eight thousand for one zero thousand. Be advised, we are negative ADS-B equipment and have not received authorization to operate in ADS-B airspace."*

ATC: *"November Four Alpha Tango, roger"*

or

"November Four Alpha Tango, roger, cancel climb clearance, maintain eight thousand."

REFERENCE—*Federal Register Notice, Volume 84, Number 62, dated April 1, 2019.*

e. **ADS-B Limitations.**

The ADS-B cockpit display of traffic is NOT intended to be used as a collision avoidance system and does not relieve the pilot's responsibility to "see and avoid" other aircraft. (See Paragraph 5-5-8, See and Avoid). ADS-B must not be used for avoidance maneuvers during IMC or other times when there is no visual contact with the intruder aircraft. ADS-B is intended only to assist in visual acquisition of other aircraft. No avoidance maneuvers are provided or authorized, as a direct result of an ADS-B target being displayed in the cockpit.

f. **Reports of ADS-B Malfunctions.**

Users of ADS-B can provide valuable assistance in the correction of malfunctions by reporting instances of undesirable system performance. Since ADS-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. 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. 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.)

SECTION 5. SURVEILLANCE SYSTEMS

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, Paragraph 7-1-11, Flight Information Services.

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. 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.

Table 4-5-3 — FIS-B Over UAT Product Update and Transmission Intervals

Product	Update Interval[1]	Transmission Interval (95%)[2]	Basic Product
AIRMET	As Available	5 minutes	Yes
AWW/WW	As Available, then at 15 minute intervals for 1 hour	5 minutes	No
Ceiling	As Available	10 minutes	No
Convective SIGMET	As Available, then at 15 minute intervals for 1 hour	5 minutes	Yes
D-ATIS	As Available	1 minute	No

Table 4-5-3 — FIS-B Over UAT Product Update and Transmission Intervals (continued)

Product	Update Interval[1]	Transmission Interval (95%)[2]	Basic Product
Echo Top	5 minutes	5 minutes	No
METAR/SPECI	1 minute (where available), As Available otherwise	5 minutes	Yes
MRMS NEXRAD (CONUS)	2 minutes	15 minutes	Yes
MRMS NEXRAD (Regional)	2 minutes	2.5 minutes	Yes
NOTAMs–D/FDC	As Available	10 minutes	Yes
NOTAMs–TFR	As Available	10 minutes	Yes
PIREP	As Available	10 minutes	Yes
SIGMET	As Available, then at 15 minute intervals for 1 hour	5 minutes	Yes
SUA Status	As Available	10 minutes	Yes
TAF/AMEND	6 Hours (±15 minutes)	10 minutes	Yes
Temperature Aloft	12 Hours (±15 minutes)	10 minutes	Yes
TWIP	As Available	1 minute	No
Winds Aloft	12 Hours (±15 minutes)	10 minutes	Yes
Lightning strikes[3]	5 minutes	5 minutes	Yes
Turbulence[3]	1 minute	15 minutes	Yes
Icing, Forecast Potential (FIP)[3]	60 minutes	15 minutes	Yes
Cloud tops[3]	30 minutes	15 minutes	Yes
1 Minute AWOS[3]	1 minute	10 minutes	No
Graphical–AIRMET[3]	As Available	5 minutes	Yes
Center Weather Advisory (CWA)[3]	As Available	10 minutes	Yes
Temporary Restricted Areas (TRA)	As Available	10 minutes	Yes
Temporary Military Operations Areas (TMOA)	As Available	10 minutes	Yes

[1] The Update Interval is the rate at which the product data is available from the source.

[2] The Transmission Interval is the amount of time within which a new or updated product transmission must be completed (95%) and the rate or repetition interval at which the product is rebroadcast (95%).

[3] The transmission and update intervals for the expanded set of basic meteorological products may be adjusted based on FAA and vendor agreement on the final product formats and performance requirements.

NOTE 1: *Details concerning the content, format, and symbols of the various data link products provided should be obtained from the specific avionics manufacturer.*

NOTE 2: *NOTAM-D and NOTAM-FDC products broadcast via FIS-B are limited to those issued or effective within the past 30 days.*

4-5-10 AUTOMATIC DEPENDENT SURVEILLANCE-REBROADCAST (ADS-R)

a. **Introduction.**

ADS-R is a datalink translation function of the ADS-B ground system required to accommodate the two separate operating frequencies (978 MHz and 1090 ES). 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. (See FIG 4-5-8 and FIG 4-5-9.)

b. **Reports of ADS-R Malfunctions.**

Users of ADS-R can provide valuable assistance in the correction of malfunctions by reporting instances of undesirable system performance. Since ADS-R 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. 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.

Information about Direction Finding Procedures published in this section is extracted from ICAO Annex 10. It is provided for reference use only. The information is generally applicable around the world. Regional variations may exist.

ICAO AERONAUTICAL TELECOMMUNICATION STANDARDS — ANNEX 10

6.2 DIRECTION FINDING INTRODUCTORY NOTES

1. Direction-finding stations work either singly or in groups of two or more stations under the direction of a main direction-finding station.
2. A direction-finding station working alone can only determine the direction of an aircraft in relation to itself.

6.2.1 Recommendation — A direction-finding station working alone should give the following, as requested:

1. true bearing of the aircraft, using the appropriate phrase;
2. true heading to be steered by the aircraft, with no wind, to head for the direction-finding station using the appropriate phrase;
3. magnetic bearing of the aircraft, using the appropriate phrase;
4. magnetic heading to be steered by the aircraft, with no wind, to make for the station using appropriate phrase.

6.2.2 Recommendation — When direction-finding stations work as a network to determine the position of an aircraft, the bearing taken by each station should be sent immediately to the station controlling the direction-finding network to enable the position of the aircraft to be determined.

6.2.2.1 Recommendation — The station controlling the network should, on request, give the aircraft its position in one of the following ways:

1. position in relation to a point of reference or in latitude and longitude, using the appropriate phrase;
2. true bearing of the aircraft in relation to the direction-finding station or other specified point using the appropriate phrase, and its distance from the direction-finding station or point, using the appropriate phrase;
3. magnetic heading to steer with no wind, to make for the direction-finding station or other specified point using the appropriate phrase, and its distance from the direction-finding station or point, using the appropriate phrase.

6.2.3 Aircraft stations shall normally make request for bearings, courses or positions, to the aeronautical station responsible, or to the station controlling the direction-finding network.

6.2.4 To request a bearing, heading or position, the aircraft station shall call the aeronautical station or the direction-finding control station on the listening frequency. The aircraft shall then specify the type of service that is desired by the use of the appropriate phrase.

DIRECTION FINDING PROCEDURES

6.2.5 In radiotelephony, an aircraft station which requests a bearing shall end the transmission by repeating its call sign. If the transmission has been too short for the direction-finding station to obtain a bearing, the aircraft shall give a longer transmission for two periods of the approximately ten seconds, or alternatively provide such other signals as may be requested by the direction-finding station.

6.2.5.1 In radiotelephony, an aircraft station which requests a bearing shall end the transmission by repeating its call sign. If the transmission has been too short for the direction-finding station to obtain a bearing, the aircraft shall give a longer transmission for two periods of the approximately ten seconds, or alternatively provide such other signals as may be requested by the direction-finding station.

NOTE: Certain types of VHF/DF stations require the provision of a modulated signal (voice transmission) in order to take a bearing.

6.2.6 When a direction-finding station is not satisfied with its observation, it shall request the aircraft station to repeat the transmission.

6.2.7 When a heading or bearing has been requested, the direction-finding station shall advise the aircraft station in the following form:

1. the appropriate phrase;
2. bearing or heading in degrees in relation to the direction-finding station, sent as three figures;
3. class of bearing;
4. time of observation, if necessary.

6.2.8 When a position has been requested, the direction-finding control station, after plotting all simultaneous observations, shall determine the observed position of the aircraft and shall advise the aircraft station in the following form:

1. the appropriate phrase;
2. the position;
3. class of position;
4. time of observation.

6.2.9 As soon as the aircraft station has received the bearing, heading or position it shall repeat back the message for confirmation, or correction.

6.2.10 When positions are given by bearing or heading and distance from a known point other than the station making the report, the reference point shall an aerodrome, prominent town or geographic feature. An aerodrome shall be given in preference to other places. When a large city or town is used as a reference place, the bearing or heading, and the distance given shall be measured from its center.

6.2.11 When the position is expressed in latitude and longitude, groups of figures for degrees and minutes shall be used followed by the letter N or S for latitude and the letter E or W for longitude, respectively. In radiotelephony the words NORTH, SOUTH, EAST or WEST shall be used.

6.2.12 According to the estimate by the direction-finding station of the accuracy of the observation, bearings and positions shall be classified as follows:

Bearings

Class "A" — Accurate within plus or minus 2 degrees;

Class "B" — Accurate within plus or minus 5 degrees;

Class "C" — Accurate within plus or minus 10 degrees;

Class "D" — Accuracy less than Class C.

Positions

Class "A" — Accurate within 9.3 km (5 NM);

Class "B" — Accurate within 37 km (20 NM);

Class "C" — Accurate within 92 km (50 NM);

Class "D" — Accuracy less than Class C.

6.2.13 Direction-finding stations shall have authority to refuse to give bearings, headings or positions when conditions are unsatisfactory or when bearings do not fall within the calibrated limits of the station, stating the reason at the time of refusal.

NAVIGATION AIDS LEGEND

LEGEND

The listings are in alphabetical sequence by country. The following information is provided:

Name	Official name (followed by location name, when different than navaid name).					
Ident	Identifier.					
Freq.	Frequency. VOR ghost frequency for TACAN or DME.					
Class	The following codes are used:					
	VOR	V				
	TACAN (channels 17-59 and 70-126)		T			
	TACAN (channels 1-16 and 60-69)		M			
	DME		D			
	Terminal Class			T		
	High Altitude Class			H		
	Low Altitude Class			L		
	Class Unrestricted			U		
	Not co-located VOR and TACAN or DME[1]				N	
	NDB (2000 watts or more)	H		H		
	NDB (50 - 1999 watts)	H				
	NDB (Less than 50 watts)	H		M		
	Used as LOM	H	O			
	Used as ILS back course locator	H	C			
	Locator (no class specified)	H		L		
	Marine Beacon	M				
	Voice capability:					
	Scheduled Weather Broadcast				B	
	No Voice on navaid frequency (omitted on TACAN and DME facilities)				W	
	Automatic Transcribed Weather Broadcast				A	

	EXAMPLE:					
	(H) VORDME	V	D	H		
	(H) VORTAC	V	T	H	W	N[1]
	(H) TACAN		T	H		
	(T) VOR	V		T	W	
	(HH) NDB (2000 watts or more)	H		H		

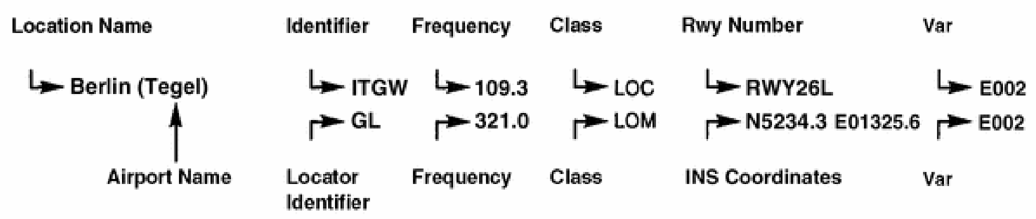
[1] The letter "N" indicates that the VOR and TACAN or DME facility are separated by at least 6 seconds (one tenth of a minute) of either longitude or latitude. The TACAN (T) or DME (D) facility class code is included with the VOR listing and the INS coordinates shown are for the VOR facility. On the line immediately below this listing the TACAN or DME facility information is listed with the TACAN or DME coordinates. To further highlight the difference in coordinates TACAN or DME identifier is offset below the VOR identifier.

INS Coordinates	In avionics keyboarding format, latitude and longitude in degrees, minutes and tenths of minutes.
VAR/Stn Decl	Magnetic variation/station declination.
Elev.	Station elevation, shown only for those navaids with DME capability and if this information is officially published by State authority.

ILS COMPONENTS

An ILS listing is provided at the end of each country listing. It is in alphabetical sequency by location name, and includes both localizer and outer marker/locator information.

LOCALIZER AND OUTER MARKER/LOCATOR



LOCALIZER CLASS		LOCATOR/MARKER CLASS	
LOC	Localizer	LOM	Locator Outer Marker
MLS	Microwave Landing System	OM	Outer Marker

LOCALIZER CLASS		LOCATOR/MARKER CLASS
SDF	Simplified Directional Aid	
LDA	Localizer Directional Aid	

PHONETIC ALPHABET AND MORSE CODE

LETTER	WORD	CODE	LETTER	WORD	CODE	LETTER	WORD	CODE
A	Alfa	• —	J	Juliett	• — — —	S	Sierra	• • •
B	Bravo	— • • •	K	Kilo	— • —	T	Tango	—
C	Charlie	— • — •	L	Lima	• — • •	U	Uniform	• • —
D	Delta	— • •	M	Mike	— —	V	Victor	• • • —
E	Echo	•	N	November	— •	W	Whiskey	• — —
F	Foxtrot	• • — •	O	Oscar	— — —	X	X-ray	— • • —
G	Golf	— — •	P	Papa	• — — •	Y	Yankee	— • — —
H	Hotel	• • • •	Q	Quebec	— — • —	Z	Zulu	— — • •
I	India	• •	R	Romeo	• — •			

NUMERAL	CODE
1	• — — — —
2	• • — — —
3	• • • — —
4	• • • • —
5	• • • • •
6	— • • • •
7	— — • • •
8	— — — • •
9	— — — — •
0	— — — — —

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METEOROLOGICAL SERVICE FOR INTERNATIONAL AIR NAVIGATION - ANNEX 3

In this part of the METEOROLOGY section, selected Chapters and paragraphs have been extracted from ICAO Annex 3 – Meteorological Service for International Air Navigation. Chapter and paragraph numbers reflect those contained in the Annex.

CHAPTER 1 – DEFINITIONS

1.1 DEFINITIONS

Refer to INTRODUCTION/GLOSSARY.

1.2 TERMS USED WITH A LIMITED MEANING

For the purpose of Annex 3, the following terms are used with a limited meaning as indicated below:

a. to avoid confusion in respect of the term “service” between the meteorological service considered as an administrative entity and the service which is provided, “meteorological authority” is used for the former and “service” for the latter;

b. “provide” is used solely in connection with the provision of service;

c. “issue” is used solely in connection with cases where the obligation specifically extends to sending out the information to a user;

d. “make available” is used solely in connection with cases where the obligation ends with making the information accessible to a user;

e. “supply” is used solely in connection with cases where either c) or d) applies.

CHAPTER 2 – GENERAL PROVISIONS

2.1 OBJECTIVE, DETERMINATION AND PROVISION OF METEOROLOGICAL SERVICE

2.1.1 The objective of meteorological service for international air navigation shall be to contribute towards the safety, regularity and efficiency of international air navigation.

2.1.2 This objective shall be achieved by supplying the following users: operators, flight crew members, air traffic services units, search and rescue services units, airport managements and others concerned with the conduct or development of international air navigation, with the meteorological information necessary for the performance of their respective functions.

2.1.3 Each Contracting State shall determine the meteorological service which it will provide to meet the needs of international air navigation. This determination shall be made in accordance with the provisions of this Annex and with due regard to regional air navigation agreements; it shall include the determination of the meteorological service to be provided for international air navigation over international waters and other areas which lie outside the territory of the State concerned.

2.1.4 Each Contracting State shall designate the authority, hereinafter referred to as the meteorological authority, to provide or to arrange for the provision of meteorological service for international air navigation on its behalf. Details of the meteorological authority so designated shall be included in the State aeronautical information publication, in accordance with Annex 15, Chapter 5.

2.1.5 Each Contracting State shall ensure that the designated meteorological authority complies with the requirements of the World Meteorological Organization in respect of qualifications and training of meteorological personnel providing services for international air navigation.

2.2 SUPPLY, USE AND QUALITY MANAGEMENT OF METEOROLOGICAL INFORMATION

2.2.1 Close liaison shall be maintained between those concerned with the supply and those concerned with the use of meteorological information on matters which affect the provision of meteorological service for international air navigation.

2.2.2 Each Contracting State should ensure that the designated meteorological authority referred to in 2.1.4 establishes and implements a properly organized quality system comprising procedures, processes and resources necessary to provide for the quality management of the meteorological information to be supplied to users listed in 2.1.2.

2.2.3 Recommendation – The quality system established in accordance with 2.2.2 should be in conformity with the International Organization for Standardization (ISO) 9000 series of quality assurance standards, and certified by an approved organization.

NOTE: The ISO 9000 series of quality assurance standards provide a basic framework for the development of a quality assurance programme. The details of a successful programme are to be formulated by each State and in most cases are unique to the State organization. Guidance on the establishment and implementation of a quality system is given in the Manual on the Quality Management System for the provision of Meteorological Service to International Air Navigation (Doc 9873).

2.2.4 Recommendation – The quality system should provide the users with assurance that the meteorological information supplied complies with the stated requirements in terms of the geographical and spatial coverage, format and content, time and frequency of issuance and period of validity, as well as the accuracy of measurements, observations and forecasts. Where the quality system indicates that the meteorological information to be supplied to the users does not comply with the stated requirements, and automatic error correction procedures are not appropriate, such information should not be supplied to the users unless it is validated with the originator.

NOTE: Requirements concerning the geographical and spatial coverage, format and content, time and frequency of issuance and period of validity of meteorological information to be supplied to aeronautical users are given in Chapters 3, 4, 6 to 10 and Appendices 2, 3, 5 to 9 of Annex 3 and the relevant regional air navigation plans. Guidance concerning the accuracy of measurement and observation, and accuracy of forecasts is given in Attachments A and B respectively to Annex 3.

2.2.5 Recommendation – In regard to the exchange of meteorological information for operational purposes, the quality system should include verification and validation procedures and resources for monitoring adherence to the prescribed transmission schedules for individual messages and/or bulletins required to be exchanged, and at the times of their filing for transmission.

The quality system should be capable of detecting excessive transit times of messages and bulletins received.

NOTE: Requirements concerning the exchange of operational meteorological information are given in Chapter 11 and Appendix 10 (not published herein) of Annex 3.

2.2.6 Demonstration of compliance of the quality system applied should be by audit. If non-conformity of the system is identified, action should be initiated to determine and correct the cause. All audit observations should be evidenced and properly documented.

2.2.7 Owing to the variability of meteorological elements in space and time, to limitations of observing techniques and to limitations caused by the definitions of some of the elements, the specific value of any of the elements given in a report shall be understood by the recipient to be the best approximation of the actual conditions at the time of observation.

NOTE: Guidance on the operationally desirable accuracy of measurement or observation is given in Attachment A.

2.2.8 Owing to the variability of meteorological elements in space and time, to limitations of forecasting techniques and to limitations caused by the definitions of some of the elements, the specific value of any of the elements given in a forecast shall be understood by the recipient to be the most probable value which the element is likely to assume during the period of the forecast. Similarly, when the time of occurrence or change of an element is given in a forecast, this time shall be understood to be the most probable time.

NOTE: Guidance on the operationally desirable accuracy of forecasts is given in Attachment B.

2.2.9 The meteorological information supplied to the users listed in 2.1.2 shall be consistent with Human Factors principles and shall be in forms which require a minimum of interpretation by these users, as specified in the following chapters.

NOTE: Guidance material on the application of Human Factors principles can be found in the Human Factors Training Manual (Doc 9683).

2.3 NOTIFICATIONS REQUIRED FROM OPERATORS

2.3.1 An operator requiring meteorological service or changes in existing meteorological service shall notify, sufficiently in advance, the meteorological authority or the aerodrome meteorological office concerned.

2.3.2 The meteorological authority shall be notified by the operator requiring service when:

a. new routes or new types of operations are planned;

b. changes of a lasting character are to be made in scheduled operations; and

c. other changes, affecting the provision of meteorological service, are planned.

Such information shall contain all details necessary for the planning of appropriate arrangements by the meteorological authority.

2.3.3 The operator or a flight crew member shall ensure that, where required by the meteorological authority in consultation with users, the aerodrome meteorological office concerned, is notified:

a. of flight schedules;

b. when non-scheduled flights are to be operated;

c. when flights are delayed, advanced or cancelled.

2.3.4 Recommendation – The notification to the aerodrome meteorological office of individual flights should contain the following information except that, in the case of scheduled flights, the requirement for some or all of this information may be waived as agreed between the aerodrome meteorological office and the operator concerned:

a. aerodrome of departure and estimated time of departure;

b. destination and estimated time of arrival;

c. route to be flown and estimated times of arrival at, and departure from, any intermediate aerodrome(s);

d. alternate aerodromes needed to complete the operational flight plan and taken from the relevant list contained in the regional air navigation plan;

e. cruising level;

f. type of flight, whether under visual or instrument flight rules;

g. type of meteorological information requested for a flight crew member, whether flight documentation and/or briefing or consultation; and

h. time(s) at which briefing, consultation and/or flight documentation are required.

CHAPTER 3 – GLOBAL SYSTEMS, SUPPORTING CENTERS AND METEOROLOGICAL OFFICES

NOTE: Technical specifications related to this Chapter are given in Appendix 2.

3.1 WORLD AREA FORECAST SYSTEM

The objective of the world area forecast system shall be to supply meteorological authorities and other users with global aeronautical meteorological en-route forecasts in digital form. This objective shall be achieved through a comprehensive, integrated, worldwide and, as far as practicable, uniform system, and in a cost-effective manner, taking full advantage of evolving technologies.

3.2 WORLD AREA FORECAST CENTERS

3.2.1 A Contracting State, having accepted the responsibility for providing a WAFC within the framework of the world area forecast system, shall arrange for that center:

a. to prepare gridded global forecasts of:

   1. upper wind;
   2. upper-air temperature and humidity;

    3. geopotential altitude of flight levels;
    4. flight level and temperature of tropopause;
    5. direction, speed and flight level of maximum wind;
    6. cumulonimbus clouds;
    7. icing; and
    8. turbulence;

b. to prepare global forecasts of significant weather (SIGWX) phenomena;

c. to issue the forecasts referred to in a) and b) in digital form to meteorological authorities and other users, as approved by the Contracting State on advice from the meteorological authority;

d. to receive information concerning the release of radioactive materials into the atmosphere, from its associated WMO Regional Specialized Meteorological Center (RSMC) for the provision of transport model products for radiological environmental emergency response, in order to include the information in SIGWX forecasts; and

e. to establish and maintain contact with VAACs for the exchange of information on volcanic activity in order to coordinate the inclusion of information on volcanic eruptions in SIGWX forecasts.

3.2.2 In case of interruption of the operation of a WAFC, its functions should be carried out by the other WAFC.

NOTE: Back-up procedures to be used in case of interruption of the operation of a WAFC are updated by the Meteorology Panel (METP) as necessary; the latest revision can be found on the ICAO METP website.

3.3 AERODROME METEOROLOGICAL OFFICES

3.3.1 Each Contracting State shall establish one or more aerodrome and/or meteorological office which shall be adequate for the provision of meteorological service required to satisfy the needs of international air navigation.

3.3.2 An aerodrome meteorological office shall carry out all or some of the following functions as necessary to meet the needs of flight operations at the aerodrome:

a. prepare and/or obtain forecasts and other relevant information for flights with which it is concerned; the extent of its responsibilities to prepare forecasts shall be related to the local availability and use of en-route and aerodrome forecast material received from other offices;

b. prepare and/or forecasts of local meteorological conditions;

c. maintain a continuous survey of meteorological conditions over the aerodromes for which it is designated to prepare forecasts;

d. provide briefing, consultation and flight documentation to flight crew members and/or flight operations personnel;

e. supply other meteorological information to aeronautical users;

f. display the available meteorological information;

g. exchange meteorological information with other meteorological offices; and

h. supply information received on pre-eruption volcanic activity, a volcanic eruption or volcanic ash cloud, to its associated air traffic services unit, aeronautical information service unit and meteorically watch office as agreed between the meteorological, aeronautical information service and ATS authorities concerned.

3.3.3 The aerodromes for which landing forecasts are required shall be determined by regional air navigation agreement.

3.3.4 For an aerodrome without aerodrome meteorological office located at the aerodrome:

a. the meteorological authority concerned shall designate one or more aerodrome meteorological office(s) to supply meteorological information as required;

b. the competent authorities shall establish means by which such information can be supplied to the aerodromes concerned.

3.4 METEOROLOGICAL WATCH OFFICES

3.4.1 A Contracting State, having accepted the responsibility for providing air traffic services within a flight information region (FIR) or a control area (CTA), shall establish, in accordance with regional air navigation agreement, one or more MWOs, or arrange for another Contracting State to do so.

3.4.2 An MWO shall:

a. maintain continuous watch over meteorological conditions affecting flight operations within its area of responsibility;

b. prepare SIGMET and other information relating to its area of responsibility;

c. supply SIGMET information and, as required, other meteorological information to associated air traffic services units;

d. disseminate SIGMET information;

e. when required by regional air navigation agreement, in accordance with 7.2.1:

    1. prepare AIRMET information related to its area of responsibility;
    2. supply AIRMET information to associated air traffic services units; and
    3. disseminate AIRMET information.

f. supply information received on pre-eruption volcanic activity, a volcanic eruption and volcanic ash cloud for which a SIGMET has not already been issued, to its associated area control center (ACC)/flight information center (FIC), as agreed between the meteorological and ATS authorities concerned, and to its associated VAAC as determined by regional air navigation agreement; and

g. supply information received concerning release of radioactive materials into the atmosphere, in the area for which it maintains watch or adjacent areas, to its associated ACC/FIC, as agreed between the meteorological and ATS authorities concerned, and to aeronautical information service units, as agreed between the meteorological and appropriate civil aviation authorities concerned. The information shall comprise location, date and time of the release, and forecast trajectories of the radioactive materials.

NOTE: The information is provided by RSMCs for the provision of transport model products for radiological environmental emergency response, at the request of the delegated authority of the State in which the radioactive material was released into the atmosphere, or the International Atomic Energy Agency (IAEA). The information is sent by the RSMC to a single contact point of the national meteorological service in each State. This contact point has the responsibility of redistributing the RSMC products within the State concerned. Furthermore, the information is provided by IAEA to RSMC co-located with VAAC London (designated as the focal point) which in turn notifies the ACCs concerned about the release.

3.4.3 Recommendation – The boundaries of the area over which meteorological watch is to be maintained by an *MWO* should be coincident with the boundaries of an FIR or a CTA or a combination of FIRs and/or CTAs.

3.5 VOLCANIC ASH ADVISORY CENTERS

3.5.1 A Contracting State, having accepted the responsibility for providing a VAAC within the framework of the international airways volcano watch, shall arrange for that center to respond to a notification that a volcano has erupted, or is expected to erupt or volcanic ash is reported in its area of responsibility, by:

a. monitoring relevant geostationary and polar-orbiting satellite data and, where available, relevant ground-based and airborne data, to detect existence and extent of volcanic ash in the atmosphere in the are concerned;

   NOTE: Relevant ground-based and airborne data include data derived from Doppler weather radar, ceilometers, lidar and passive infrared sensors.

b. activating the volcanic ash numerical trajectory/dispersion model in order to forecast the movement of any ash ‘cloud’ which has been detected or reported;

   NOTE: The numerical model may be its own or, by agreement, that of another VAAC.

c. issuing advisory information regarding the extent and forecast movement of the volcanic ash ‘cloud’ to:

   1. MWOs, ACCs and FICs serving FIRs in its area of responsibility which may be affected;
   2. other VAACs whose areas of responsibility may be affected;
   3. WAFCs, international OPMET databanks, international NOTAM offices, and centers designated by regional air navigation agreement for the operation of aeronautical fixed service Internet-based services; and

   4. airlines requiring the advisory information through the AFTN address provided specifically for this purpose; and

      NOTE: The AFTN address to be used by the VAACs is given in the Handbook on the International Airways Volcano Watch (IAVW) — Operational Procedures and Contact List (Doc 9766) which is available on the ICAO website.

d. issuing updated advisory information to the MWOs, ACCs, FICs and VAACs referred to in c). as necessary, but at least six hours until such time as:
   1. the volcanic ash “cloud” is no longer identifiable from satellite data and, where available, ground-based and airborne data;
   2. no further reports of volcanic ash are received from the area; and
   3. no further eruptions of the volcano are reported.

3.5.2 VAACs shall maintain a 24-hour watch.

3.5.3 In case of interruption of the operation of a VAAC, its functions shall be carried out by another VAAC or another meteorological center, as designated by the VAAC Provider State concerned.

NOTE: Back-up procedures to be used in case of interruption of the operation of a VAAC are included in Doc 9766.

3.6 STATE VOLCANO OBSERVATORIES

Contracting States with active or potentially active volcanoes shall arrange that State volcano observatories monitor these volcanoes and when observing:

a. significant pre-eruption volcanic activity, or a cessation thereof;
b. a volcanic eruption, or a cessation thereof; and/or
c. volcanic ash in the atmosphere

shall send this information as quickly as practicable to their associated ACC/FIC, MWO and VAAC.

NOTE 1: Pre-eruption volcanic activity in this context means unusual and/or increasing volcanic activity which could presage a volcanic eruption.

NOTE 2: Doc 9766 contains guidance material about active and potentially active volcanoes.

3.7 TROPICAL CYCLONE ADVISORY CENTERS

A Contracting State having accepted, by regional air navigation agreement, the responsibility for providing a TCAC shall arrange for that center to:

a. monitor the development of tropical cyclones in its area of responsibility, using geostationary and polar-orbiting satellite data, radar data and other meteorological information;

b. issue advisory information concerning the position of the cyclone center, its direction and speed of movement, central pressure and maximum surface wind near the center, in abbreviated plain language to:
    1. MWOs in its area of responsibility;
    2. other TCACs whose area of responsibility may be affected; and
    3. WAFCs, international OPMET databanks, and centers designated by regional air navigation agreement for the operation of aeronautical fixed service Internet-based services; and

c. issue updated advisory information to MWOs for each tropical cyclone, as necessary, but at least every 6 hours.

3.8 SPACE WEATHER CENTERS

3.8.1 A contracting State, having accepted the responsibility for providing a space weather center (SWXC), shall arrange for that center to monitor and provide advisory information on space weather phenomena in its area of responsibility by arranging for that center to:

a. monitor relevant ground-based, airborne and space-based observations to detect, and predict when possible, the existence of space weather phenomena that have an impact in the following areas:
    1. high frequency (HF) radio communications;
    2. communications via satellite;
    3. GNSS-based navigation and surveillance; and
    4. radiation exposure at flight levels;

b. issue advisory information regarding the extent, severity and duration of the space weather phenomena that have an impact referred to in a);

c. supply the advisory information referred to in b) to:
    1. area control centres, flight information centers and aerodrome meteorological offices in its area of responsibility which may be affected;
    2. other SWXCs; and
    3. international OPMET databanks, international NOTAM offices and aeronautical fixed service Internet-based services.

3.8.2 SWXC shall maintain a 24-hour watch.

3.8.3 In case of interruption of the operation of a SWXC, its functions shall be carried out by another SWXC or another center, as designated by the SWXC Provider State concerned.

NOTE: Guidance on the provision of space weather advisory information, including the ICAO-designated provider(s) of space weather advisory information, is provided in the Manual on Space Weather Information in Support of International Air Navigation (Doc 10100).

CHAPTER 4 – METEOROLOGICAL OBSERVATIONS AND REPORTS

NOTE: Technical specifications related to this Chapter are given in Appendix 3.

4.1 AERONAUTICAL METEOROLOGICAL STATIONS AND OBSERVATIONS

4.1.1 Each Contracting State shall establish, at aerodromes in its territory; such aeronautical meteorological stations as it determines to be necessary. An aeronautical meteorological station may be a separate station or may be combined with a synoptic station.

NOTE: Aeronautical meteorological stations may include sensors installed outside the aerodrome, where considered justified, by the meteorological authority to ensure the compliance of meteorological service for international air navigation with the provisions of Annex 3.

4.1.2 Recommendation – Each Contracting State should establish, or arrange for the establishment of, aeronautical meteorological stations on off-shore structures or at other points of significance in support of helicopter operations to off-shore structures, if required by regional air navigation agreement.

4.1.3 Aeronautical meteorological stations shall make routine observations at fixed intervals. At aerodromes, the routine observations shall be supplemented by special observations whenever specified changes occur in respect of surface wind, visibility, runway visual range, present weather, clouds and/or air temperature.

4.1.4 Each Contracting State should arrange for its aeronautical meteorological stations to be inspected at sufficiently frequent intervals to ensure that a high standard of observations is maintained, that instruments and all their indicators are functioning correctly, and that the exposure of the instruments has not changed significantly.

NOTE: Guidance on the inspection of aeronautical meteorological stations including the frequency of inspections is given in the Manual on Automatic Meteorological Observing Systems at Aerodromes (Doc 9837).

4.1.5 At aerodromes, with runways intended for Category II and III instrument approach and landing operations, automated equipment for measuring or assessing, as appropriate, and for monitoring and remote indicating of surface wind, visibility, runway visual range, height of cloud base, air and dew-point temperatures and atmospheric pressure shall be installed to support approach and landing and take-off operations. These devices shall be integrated automatic systems for acquisition, processing, dissemination and display in real time of the meteorological parameters affecting landing and take-off operations. The design of integrated automatic systems shall observe human factors principles and include back-up procedures.

NOTE 1: Categories of precision approach and landing operations are defined in Annex 6, Part I.

NOTE 2: Guidance material on the application of human factors principles can be found in the Human Factors Training Manual (Doc 9683).

4.1.6 Recommendation – At aerodromes, with runways intended for Category I instrument approach and landing operations, automated equipment for measuring or assessing, as appropriate, and for monitoring and remote indicating of surface wind, visibility, runway visual range, height of cloud base, air and dew-point temperatures and atmospheric pressure should be installed to support approach and landing and take-off operations. These devices should be integrated automatic systems for acquisition, processing, dissemination and display in real time of the meteorological parameters affecting landing and take-off operations. The design of integrated automatic systems should observe human factors principles and include back-up procedures.

4.1.7 Recommendation – Where an integrated semi-automatic system is used for the dissemination/display of meteorological information, it should be capable of accepting the manual insertion of data covering those meteorological elements which cannot be observed by automatic means.

4.1.8 The observations shall form the basis for the preparation of reports to be disseminated at the aerodrome of origin and for reports to be disseminated beyond the aerodrome of origin.

4.2 AGREEMENT BETWEEN METEOROLOGICAL AUTHORITIES AND AIR TRAFFIC SERVICES AUTHORITIES

Recommendation – An agreement between the meteorological authority and the appropriate ATS authority should be established to cover, among other things:

a. the provision in air traffic services units of displays related to integrated automatic systems;

b. the calibration and maintenance of these displays/instruments;

c. the use to be made of the displays/instruments by air traffic services personnel;

d. as and where necessary, supplementary visual observations (e.g. of meteorological phenomena of operational significance in the climb-out and approach areas) if and when made by air traffic services personnel to update or supplement the information supplied by the meteorological station;

e. meteorological information obtained from aircraft taking off or landing (e.g. on wind shear); and

f. if available, meteorological information obtained from ground weather radar.

NOTE: Guidance on the subject of coordination between ATS and meteorological services is contained in the Manual on Coordination between Air Traffic services, Aeronautical Information Services and Aeronautical Meteorological Services (Doc 9377).

4.3 ROUTINE OBSERVATIONS AND REPORTS

4.3.1 At aerodromes, routine observations shall be made throughout the 24 hours each day, except as otherwise agreed between the meteorological authority, the appropriate ATS authority and the operator concerned. Such observations shall be made at intervals of one hour or, if so determined by regional air navigation agreement, at intervals of one half-hour. At other aeronautical meteorological stations, such observations shall be made as determined by the meteorological authority taking into account the requirements of air traffic services units and aircraft operations.

4.3.2 Reports of routine observations shall be issued as:

a. local routine reports only for dissemination at the aerodrome of origin (intended for arriving and departing aircraft); and

b. METAR for dissemination beyond the aerodrome of origin (mainly intended for flight planning, VOLMET broadcasts and D-VOLMET).

NOTE: Meteorological information used in ATIS (voice-ATIS and D-ATIS) is to be extracted from the local routine report, in accordance with Annex 11, 4.3.6.1 g).

4.3.3 At aerodromes that are not operational throughout 24 hours in accordance with 4.3.1, METAR shall be issued prior to the aerodrome resuming operations in accordance with regional air navigation agreement.

4.4 SPECIAL OBSERVATIONS AND REPORTS

4.4.1 A list of criteria for special observations shall be established by the meteorological authority, in consultation with the appropriate ATS authority, operators and others concerned.

4.4.2 Reports of special observations shall be issued as:

a. local special reports, only for dissemination at the aerodrome of origin (intended for arriving and departing aircraft); and

b. SPECI for dissemination beyond the aerodrome of origin (mainly intended for flight planning, VOLMET broadcasts and D-VOLMET) unless METAR are issued at half-hourly intervals.

NOTE: Meteorological information used in ATIS (voice-ATIS and D-ATIS) is to be extracted from the local special report, in accordance with Annex 11, 4.3.6.1 g).

4.4.3 At aerodromes that are operational throughout 24 hours in accordance with 4.3.1, following the resumption of the issuance of METAR, SPECI shall be issued, as necessary.

4.5 CONTENTS OF REPORTS

4.5.1 Local routine, local special reports, METAR and SPECI shall contain the following elements in the order indicated:

a. identification of the type of report;

b. location indicator;

c. time of the observation;

d. identification of an automated or missing report, when applicable;

e. surface wind direction and speed;

f. visibility;

g. runway visual range, when applicable;

h. present weather;

i. cloud amount, cloud type (only for cumulonimbus and towering cumulus clouds) and height of cloud base or, where measured, vertical visibility;

j. air temperature and dew-point temperature; and

k. QNH and, when applicable, QFE (QFE included only in local routine and special reports).

NOTE: The location indicators referred to under b. and their significations are published in Location Indicators Doc 7910).

4.5.2 Recommendation – In addition to elements listed under 4.5.1 a) to k) local routine and special reports and METAR and SPECI should contain supplementary information to be placed after element k).

4.5.3 Optional elements included under supplementary information shall be included in METAR and SPECI in accordance with regional air navigation agreement.

4.6 OBSERVING AND REPORTING METEOROLOGICAL ELEMENTS

4.6.1 Surface Wind

4.6.1.1 The mean direction and the mean speed of the surface wind shall be measured, as well as significant variations of wind direction and speed, and reported in degrees true and meters per second (or knots), respectively.

4.6.1.2 Recommendation – When local routine and special reports are used for departing aircraft, the surface wind observations for these reports should be representative of conditions along the runway; when local routine and special reports are used for arriving aircraft, the surface wind observations for these reports should be representative of the touchdown zone.

4.6.1.3 Recommendation – For METAR and SPECI, the surface wind observations should be representative of conditions above the whole runway where there is only one runway and the whole runway complex where there is more than one runway.

4.6.2 Visibility

4.6.2.1 The visibility as defined in Chapter 1 shall be measured or observed, and reported in meters or kilometers.

4.6.2.2 Recommendation – When local routine and special reports are used for departing aircraft, the visibility observations for these reports should be representative of conditions along the runway; when local routine and special reports are used for arriving aircraft, the visibility observations for these reports should be representative of the touchdown zone of the runway.

4.6.2.3 Recommendation – For METAR and SPECI the visibility observations should be representative of the aerodrome.

4.6.3 Runway Visual Range

NOTE: Guidance on the subject of runway visual range is contained in the Manual of Runway Visual Range Observing and Reporting Practices (Doc 9328).

4.6.3.1 Runway visual range as defined in Chapter 1 shall be assessed on all runways intended for Category II and III instrument approach and landing operations.

4.6.3.2 Recommendation – Runway visual range as defined in Chapter 1 should be assessed on all runways intended for use during periods of reduced visibility, including:

a. precision approach runways intended for Category I instrument approach and landing operations; and

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b. runways used for take-off and having high-intensity edge lights and/or center line lights.

NOTE: Precision approach runways are defined in Annex 14, Volume I, Chapter 1, under 'Instrument runway'.

4.6.3.3 The runway visual range, assessed in accordance with 4.6.3.1 and 4.6.3.2, shall be reported in meters throughout periods when either the visibility or the runway visual range is less than 1500m.

4.6.3.4 Runway visual range assessments shall be representative of:

a. the touchdown zone of the runway intended for non-precision or Category I instrument approach and landings operations;

b. the touchdown zone and the mid-point of the runway intended for Category II instrument approach and landing operations; and

c. the touchdown zone, the mid-point and stop-end of the runway intended for Category III instrument approach and landing operations.

4.6.3.5 The units providing air traffic service and aeronautical information service for an aerodrome shall be kept informed without delay of changes in the serviceability status of the automated equipment used for assessing runway visual range.

4.6.4 Present Weather

4.6.4.1 The present weather occurring at the aerodrome vicinity shall be observed and reported as necessary. The following present weather phenomena shall be identified, as a minimum: rain, dizzle, snow and freezing precipitation (including intensity thereof), haze, mist, fog, freezing fog and thunderstorms (including thunderstorms in the vicinity).

4.6.4.2 Recommendation – For local routine and special reports, the present weather information should be representative of conditions at the aerodrome.

4.6.4.3 Recommendation – For METAR and SPECl, the present weather information should be representative of conditions at the aerodrome and, for certain specified present weather phenomena, in its vicinity.

4.6.5 Clouds

4.6.5.1 Cloud amount, cloud type and height of cloud base shall be observed, and reported as necessary to describe the clouds of operational significance. When the sky is obscured, vertical visibility shall be observed and reported, where measured, in lieu of cloud amount, cloud type and height of cloud base. The height of cloud base and vertical visibility shall be reported in meters (or feet).

4.6.5.2 Recommendation – Cloud observations for local routine and special reports should be representative of the runway threshold(s) in use.

4.6.5.3 Recommendation – Cloud observations for METAR and SPECI should be representative of the aerodrome and its vicinity.

4.6.6 Air Temperature and Dew-Point Temperature

4.6.6.1 The air temperature and the dew-point temperature shall be measured and reported in degrees Celsius.

4.6.6.2 Recommendation – Observation of air temperature and dew-point temperature for local routine and special reports and METAR and SPECI should be representative for the whole runway complex.

4.6.7 Atmospheric Pressure

The atmospheric pressure shall be measured, and QNH and QFE values shall be computed and reported in hectopascals.

4.6.8 Supplementary Information

Recommendation – Observations made at aerodromes should include the available supplementary information concerning significant meteorological conditions, particularly those in the approach and climb-out areas. Where practicable, the information should identify the location of the meteorological condition.

4.7 REPORTING METEOROLOGICAL INFORMATION FROM AUTOMATIC OBSERVING SYSTEMS

4.7.1 Recommendation – METAR and SPECI from automatic observing systems should be used by States in a position to do so during non-operational hours of the aerodrome, and during operational hours of the aerodrome as determined by the meteorological authority in consultation with users based on the availability and efficient use of personnel.

NOTE: Guidance on the use of automatic meteorological observing systems is given in Doc 9837.

4.7.2 Recommendation – Local routine and special reports from automatic systems should be used by States in a position to do so during operational hours of the aerodrome as determined by the meteorological authority in consultation with users based on the availability and efficient use of personnel.

4.7.3 Local routine and special reports and METAR and SPECI from automatic observing systems shall be identified with the word "AUTO".

4.8 OBSERVATIONS AND REPORTS OF VOLCANIC ACTIVITY

Recommendation – The occurrence of pre-eruption volcanic activity, volcanic eruptions and volcanic ash cloud should be reported without delay to the associated air traffic services unit, aeronautical information services unit and meteorological watch office. The report should be made in the form of a volcanic activity report comprising the following information in the order indicated:

a. message type, VOLCANIC ACTIVITY REPORT;

b. station identifier, location indicator or name of station;

c. date/time of message;

d. location of volcano and name, if known; and

e. concise description of event including, as appropriate, level of intensity of volcanic activity, occurrence of an eruption and its date and time and the existence of a volcanic ash cloud in the area together with direction of ash cloud movement and height.

NOTE: Pre-eruption volcanic activity in this context means unusual and/or increasing volcanic activity which could presage a volcanic eruption.

CHAPTER 5 – AIRCRAFT OBSERVATIONS AND REPORTS

NOTE: Technical specifications related to this Chapter are given in Appendix 4.

5.1 OBLIGATIONS OF STATES

Each Contracting State shall arrange, according to the provisions of this chapter, for observations to be made by aircraft of its registry operating on international air routes and for the recording and reporting of these observations.

5.2 TYPES OF AIRCRAFT OBSERVATIONS

The following aircraft observations shall be made:

a. routine aircraft observations during en-route and climb-out phases of the flight; and

b. special and other non-routine aircraft observations during any phase of the flight.

5.3 ROUTINE AIRCRAFT OBSERVATIONS – DESIGNATION

5.3.1 Recommendation – When air-ground data link is used and ADS-C or SSR Mode S is being applied, automated routine observations should be made every 15 minutes during the en-route phase and every 30 seconds during climb-out phase for the first 10 minutes of the flight.

5.3.2 Recommendation – For helicopter operations to and from aerodromes on off-shore structures, routine observations should be made from helicopters at points and times as agreed between the meteorological authorities and the helicopter operators concerned.

5.3.3 In the case of air routes with high density traffic (e.g. organized tracks), an aircraft from among the aircraft operating at each flight level shall be designated, at approximately hourly intervals, to make routine observations in accordance with 5.3.1. The designation procedures shall be subject to regional air navigation agreement.

5.3.4 In the case of the requirement to report during the climb-out phase, an aircraft shall be designated, at approximately hourly intervals, at each aerodrome to make routine observations in accordance with 5.3.1.

5.4 ROUTINE AIRCRAFT OBSERVATIONS – EXEMPTIONS

Aircraft not equipped with air-ground data link shall be exempted from making routine aircraft observations.

5.5 SPECIAL AIRCRAFT OBSERVATIONS

Special observations shall be made by all aircraft whenever the following conditions are encountered or observed:

a. moderate or severe turbulence; or

b. moderate or severe icing; or

c. severe mountain wave; or

d. thunderstorms, without hail, that are obscured, embedded, widespread or in squall lines; or

e. thunderstorms, with hail, that are obscured, embedded, widespread or in squall lines; or

f. heavy duststorm or heavy sandstorm; or

g. volcanic ash cloud; or

h. pre-eruption volcanic activity or a volcanic eruption.

   NOTE: Pre-eruption volcanic activity in this context means unusual and/or increasing volcanic activity which could presage a volcanic eruption.

i. as of 5 November 2020, runway braking action encountered is not as good as reported.

5.6 OTHER NON-ROUTINE AIRCRAFT OBSERVATIONS

When other meteorological conditions not listed under 5.5, e.g. wind shear, are encountered and which, in the opinion of the pilot-in-command, may affect the safety or markedly affect the efficiency of other aircraft operations, the pilot-in-command shall advise the appropriate air traffic services unit as soon as practicable.

NOTE: Icing, turbulence and, to a large extent, wind shear, are elements which, for the time being, cannot be satisfactorily observed from the ground and for which in most cases aircraft observations represent the only available evidence.

5.7 REPORTING OF AIRCRAFT OBSERVATIONS DURING FLIGHT

5.7.1 Aircraft observations shall be reported by air-ground data link. Where air-ground data link is not available or appropriate, special and other non-routine aircraft observations during flight shall be reported by voice communications.

5.7.2 Aircraft observations shall be reported during flight at the time the observation is made or as soon thereafter as is practicable.

5.7.3 Aircraft observations shall be reported as air-reports.

5.8 RELAY OF AIR-REPORTS BY AIR TRAFFIC SERVICES UNITS

The meteorological authority concerned shall make arrangements with the appropriate ATS authority to ensure that, on receipt by the ATS units of:

a. special air-reports by voice communications, the ATS units relay them without delay to their associated meteorological watch office; and

b. routine and special air-reports by data link communications, the ATS units relay them without delay to their associated meteorological watch office, the WAFCs and the centers designated by regional air navigation agreement for the operation of aeronautical fixed service Internet-based services.

5.9 RECORDING AND POST-FLIGHT REPORTING OF AIRCRAFT OBSERVATIONS OF VOLCANIC ACTIVITY

Special aircraft observations of pre-eruption volcanic activity, a volcanic eruption or volcanic ash cloud shall be recorded on the special air-report of volcanic activity form. A copy of the form shall be included with the flight documentation provided to flights operating on routes which, in the opinion of the meteorological authority concerned, could be affected by volcanic ash clouds.

CHAPTER 6 – FORECASTS

NOTE: Technical specifications related to this Chapter are given in Appendix 5.

6.1 USE OF FORECASTS

The issue of a new forecast by an aerodrome meteorological office, such as a routine aerodrome forecast, shall be understood to cancel automatically any forecast of the same type previously issued for the same place and for the same period of validity or part thereof.

6.2 AERODROME FORECASTS

6.2.1 An aerodrome forecast shall be prepared, on the basis of regional air navigation agreement, by the aerodrome meteorological office designated by the meteorological authority concerned.

NOTE: The aerodromes for which aerodrome forecasts are to be prepared and the period of validity of these forecasts are listed in the relevant facilities and services implementation document (FASID).

6.2.2 An aerodrome forecast shall be issued at a specified time not earlier than 1 hour prior to the beginning of its validity period and consist of a concise statement of the expected meteorological conditions at an aerodrome for a specified period.

6.2.3 Aerodrome forecasts and amendments thereto shall be issued as TAF and include the following information in the order indicated:

a. identification of the type of forecast;
b. location indicator;
c. time of issue of forecast;
d. identification of a missing forecast, when applicable;
e. date and period of validity of forecast;
f. identification of a cancelled forecast, when applicable;
g. surface wind;
h. visibility;
i. weather;
j. cloud; and
k. expect significant changes to one or more of these elements during the period of validity.

Optional elements shall be included in TAF in accordance with regional air navigation agreement.

NOTE: The visibility included in TAF refers to the forecast prevailing visibility.

6.2.4 Aerodrome meteorological offices preparing TAF shall keep the forecasts under continuous review and, when necessary, shall issue amendments promptly. The length of the forecast messages and the number of changes indicated in the forecast shall be kept to a minimum.

NOTE: Guidance on methods to keep TAF under continuous review is given in Chapter 3 of the Manual of Aeronautical Meteorological Practice (Doc 8896).

6.2.5 TAF that cannot be kept under continuous review shall be cancelled.

6.2.6 **Recommendation –** The period of validity of routine TAF should be not less than 6 hours nor more than 30 hours; this period of validity should be determined by regional air navigation agreement. Routine TAF valid for less than 12 hours should be issued every 3 hours and those valid for 12 to 30 hours should be issued every 6 hours.

6.2.7 When issuing TAF, aerodrome meteorological offices shall ensure that not more than one TAF is valid at an aerodrome at any given time.

6.3 LANDING FORECASTS

6.3.1 A landing forecast shall be prepared by the aerodrome meteorological office designated by the meteorological authority concerned as determined by regional air navigation agreement; such forecasts are intended to meet requirements of local users and of aircraft within about one hour’s flying time from the aerodrome.

6.3.2 Landing forecasts shall be prepared in the form of a trend forecast.

6.3.3 A trend forecast shall consist of a concise statement of expected significant changes in the meteorological conditions at that aerodrome to be appended to a local routine, local special report, METAR or SPECI. The period of validity of a trend forecast shall be 2 hours from the time of the report which forms part of the landing forecast.

6.4 FORECASTS FOR TAKE-OFF

6.4.1 A forecast for take-off shall be prepared by the aerodrome meteorological office designated by the meteorological authority concerned as agreed between the meteorological authority and operators concerned.

6.4.2 **Recommendation –** A forecast for take-off should refer to a specified period of time and should contain information on expected conditions over the runway complex in regard to surface wind direction and speed and any variations thereof, temperature, pressure (QNH), and any other elements as agreed locally.

6.4.3 **Recommendation –** A forecast for take-off should be supplied to operators and flight crew members on request within the 3 hours before the expected time of departure.

6.4.4 **Recommendation –** Aerodrome meteorological offices preparing forecasts for take-off should keep the forecasts under continuous review and, when necessary, should issue amendments promptly.

6.5 AREA FORECASTS FOR LOW-LEVEL FLIGHTS

6.5.1 When the density of traffic operating below flight level 100 (or up to flight level 150 in mountainous areas, or higher, where necessary) warrants the routine issue and dissemination of area forecasts for such operations, the frequency of issue, the form and the fixed time or period of validity of those forecasts and the criteria of amendments thereto shall be determined by the meteorological authority in consultation with the users.

6.5.2 When the density of traffic operating below flight level 100 warrants the issuance of AIRMET information in accordance with 7.2.1, area forecasts for such operations shall be prepared in a format agreed upon between the meteorological authorities concerned. When abbreviated plain language is used, the forecast shall be prepared as a GAMET area forecast, employing approved ICAO abbreviations and numerical values; when chart form is used, the forecast shall be prepared as a combination of forecasts of upper wind and upper-air temperature, and of SIGWX phenomena. The area forecasts shall be issued to cover the layer between ground and flight level 100 (or up to flight level 150 in mountainous areas, or higher, where necessary) and shall contain information on en-route weather phenomena hazardous to low-level flights, in support of the issuance of AIRMET information, and additional information required by low-level flights.

6.5.3 Area forecasts for low-level flights prepared in support of the issuance of AIRMET information shall be issued every 6 hours for a validity of 6 hours and transmitted to meteorological watch offices and/or aerodrome meteorological offices concerned not later than one hour prior to the beginning of their validity period.

CHAPTER 7 – SIGMET AND AIRMET INFORMATION, AERODROME WARNINGS AND WIND SHEAR WARNINGS AND ALERTS

NOTE: Technical specifications related to this Chapter are given in Appendix 6.

7.1 SIGMET INFORMATION

7.1.1 SIGMET information shall be issued by a meteorological watch office and shall give a concise description in abbreviated plain language concerning the occurrence or expected occurrence of specified en-route weather and other phenomena in the atmosphere that may affect the safety of aircraft operations, and of the development of those phenomena in time and space.

7.1.2 SIGMET information shall be cancelled when the phenomena are no longer occurring or are no longer expected to occur in the area.

7.1.3 The period of validity of a SIGMET message shall be not more than 4 hours. In the special case of SIGMET messages for volcanic ash cloud and tropical cyclones, the period of validity shall be extended up to 6 hours.

7.1.4 **Recommendation –** SIGMET messages concerning volcanic ash cloud and tropical cyclones should be based on advisory information provided by VAACs and TCACs, respectively, designated by regional air navigation agreement.

7.1.5 Close coordination shall be maintained between the meteorological watch office and the associated area control center/flight information center to ensure that information on volcanic ash included in SIGMET and NOTAM messages is consistent.

7.1.6 SIGMET messages shall be issued not more than 4 hours before the commencement of the period of validity. In the special case of SIGMET messages for volcanic ash cloud and tropical cyclones, these messages shall be issued as soon as practicable but not more than 12 hours before the commencement of the period of validity. SIGMET messages for volcanic ash and tropical cyclones shall be updated at least every 6 hours.

7.2 AIRMET INFORMATION

7.2.1 AIRMET information shall be issued by a meteorological watch office in accordance with regional air navigation agreement, taking into account the density of the air traffic operating below flight level 100. AIRMET information shall give a concise description in abbreviated plain language concerning the occurrence and/or expected occurrence of specified en-route weather phenomena, which have not been included in Section I of the area forecast for low-level flights issued in accordance with Chapter 6, section 6.5 and which may affect the safety of low-level flights, and of the development of those phenomena in time and space.

7.2.2 AIRMET information shall be cancelled when the phenomena are no longer occurring or are no longer expected to occur in the area.

7.2.3 The period of validity of an AIRMET message shall be not more than 4 hours.

7.3 AERODROME WARNINGS

7.3.1 Aerodrome warnings shall be issued by the aerodrome meteorological office designated by the meteorological authority concerned and shall give concise information of meteorological conditions which could adversely affect aircraft on the ground, including parked aircraft, and the aerodrome facilities and services.

7.3.2 **Recommendation –** Aerodrome warnings should be cancelled when the conditions are no longer occurring and/or no longer expected to occur at the aerodrome.

7.4 WIND SHEAR WARNINGS AND ALERTS

NOTE: Guidance on the subject is contained in the Manual on Low-level Wind Shear (Doc 9817). Wind shear alerts are expected to complement wind shear warnings and together are intended to enhance situational awareness of wind shear.

7.4.1 Wind shear warnings shall be prepared by the aerodrome meteorological office designated by the meteorological authority concerned for aerodromes where wind shear is considered a factor, in accordance with local arrangements with the appropriate ATS unit and operators concerned. Wind shear warnings shall give concise information on the observed or expected existence of wind shear which could adversely affect aircraft on the approach path or take-off path or during circling approach between runway level and 500m (1600ft) above that level and aircraft on the runway during the landing roll or take-off run. Where local topography has been shown to produce significant wind shears at heights in excess of 500m (1600ft) above runway level, then 500m (1600ft) shall not be considered restrictive.

7.4.2 Recommendation – Wind shear warnings for arriving aircraft and/or departing aircraft should be cancelled when aircraft reports indicate that wind shear no longer exists or, alternatively, after an agreed elapsed time. The criteria for the cancellation of a wind shear warning should be defined locally for each aerodrome, as agreed between the meteorological authority, the appropriate ATS authority and the operators concerned.

7.4.3 At aerodromes where wind shear is detected by automated, ground-based, wind shear remote-sensing or detection equipment, wind shear alerts generated by these systems shall be issued. Wind shear alerts shall give concise, up-to-date information related to the observed existence of wind shear involving a headwind/tailwind change of 7.5m/s (15kt) or more which could adversely affect aircraft on the final approach path or initial take-off path and aircraft on the runway during the landing roll or take-off run.

7.4.4 Recommendation – Wind shear alerts should be updated at least every minute. The wind shear alert should be cancelled as soon as the headwind/tailwind change falls below 7.5m/s (15kt).

CHAPTER 8 – AERONAUTICAL CLIMATOLOGICAL INFORMATION

NOTE: Technical specifications related to this Chapter are given in Appendix 7.

8.1 GENERAL PROVISIONS

NOTE: In cases where it is impracticable to meet the requirements for aeronautical climatological information on a national basis, the collection, processing and storage of observational data may be affected through computer facilities available for international use, and the responsibility for the preparation of required aeronautical climatological information may be delegated by agreement between the meteorological authorities concerned.

8.1.1 Aeronautical climatological information required for the planning of flight operations shall be prepared in the form of aerodrome climatological tables and aerodrome climatological summaries. Such information shall be supplied to aeronautical users as agreed between the meteorological authority and the user concerned.

NOTE: Climatological data required for aerodrome planning purposes are set out in Annex 14, Volume I, 3.1.4.

8.1.2 Recommendation – Aeronautical climatological information should normally be based on observations made over a period of at least 5 years and the period should be indicated in the information supplied.

8.1.3 Recommendation – Climatological data related to sites for new aerodromes and to additional runways at existing aerodromes should be collected starting as early as possible before commissioning of those aerodromes or runways.

8.2 AERODROME CLIMATOLOGICAL TABLES

Recommendation – Each Contracting State should made arrangements for collecting and retaining the necessary observational data and have the capability:

a. to prepare aerodrome climatological tables for each regular and alternate international aerodrome within its territory; and

b. to make available such climatological tables to an aeronautical user within a time period as agreed between the meteorological authority and the user concerned.

8.3 AERODROME CLIMATOLOGICAL SUMMARIES

Recommendation – Aerodrome climatological summaries should follow the procedures prescribed by the World Meteorological Organization *(WMO)*. Where computer facilities are available to store, process and retrieve the information, the summaries should be published, or otherwise made available to aeronautical users on request. Where such computer facilities are not available, the summaries should be prepared using the models specified by *WMO*, and should be published and kept up to date as necessary.

8.4 COPIES OF METEOROLOGICAL OBSERVATIONAL DATA

Each meteorological authority, on request and to the extent practicable, shall make available to any other meteorological authority, to operators and to others concerned with the application of meteorology to international air navigation, meteorological observational data required for research, investigation or operational analysis.

CHAPTER 9 – SERVICE FOR OPERATORS AND FLIGHT CREW MEMBERS

NOTE: Technical specifications and detailed criteria related to this Chapter are given in Appendix 8 (not herein published).

9.1 GENERAL PROVISIONS

9.1.1 Meteorological information shall be supplied to operators and flight crew members for:

a. pre-flight planning by operators;

b. in-flight replanning by operators using centralized operational control of flight operations;

c. use by flight crew members before departure; and

d. aircraft in flight.

9.1.2 Meteorological information supplied to operators and flight crew members shall cover the flight in respect of time, altitude and geographical extent. Accordingly, the information shall relate to appropriate fixed times, or periods of time, and shall extent to the aerodrome of intended landing, also covering the meteorological conditions expected between the aerodrome of intended landing and alternate aerodromes designated by the operator.

9.1.3 Meteorological information supplied to operators and flight crew members shall be up to date and include the following information, as agreed between the meteorological authority and the operators concerned:

a. forecasts of:

    1. upper wind and upper-air temperature;

2. upper-air humidity;
3. geopotential altitude of flight levels;
4. flight level and temperature of tropopause;
5. direction, speed and flight level of maximum wind;
6. SIGWX phenomena; and
7. cumulonimbus clouds, icing and turbulence;

NOTE 1: Forecasts of upper-air humidity and geopotential altitude of flight levels are used only in automatic flight planning and need not be displayed.

NOTE 2: Forecasts of cumulonimbus clouds, icing and turbulence are intended to be processed and, if necessary, visualized according to the specific thresholds relevant to user operations.

b. METAR or SPECI (including trend forecasts as issued in accordance with regional air navigation agreement) for the aerodromes of departure and intended landing, and for take-off, en-route and destination alternate aerodromes;

c. TAF or amended TAF for the aerodromes of departure and intended landing, and for take-off, en-route and destination alternate aerodromes;

d. forecasts for take-off;

e. SIGMET information and appropriate special air-reports relevant to the whole route;

NOTE: Appropriate special air-reports will be those not already used in the preparation of SIGMET.

f. volcanic ash and tropical cyclone advisory information relevant to the whole route;

g. as determined by regional air navigation agreement, GAMET area forecast and/or area forecasts for low-level flights in chart form prepared in support of the issuance of AIRMET information, and AIRMET information for low-level flights relevant to the whole route;

h. aerodrome warnings for the local aerodrome;

i. meteorological satellite images;

j. ground-based weather radar information; and

k. space weather advisory information relevant to the whole route.

9.1.4 Forecasts listed under 9.1.3 a) shall be generated from the digital forecasts provided by the WAFCs whenever these forecasts cover the intended flight path in respect of time, altitude and geographical extent, unless otherwise agreed between the meteorological authority and the operator concerned.

9.1.5 When forecasts are identified as being originated by the WAFCs, no modifications shall be made to their meteorological content.

9.1.6 Charts generated from the digital forecasts provided by the WAFCs shall be made available, as required by operators, for fixed areas of coverage as shown in Appendix 8, Figures A8-1, A8-2 and A8-3 (not published herein).

9.1.7 When forecasts of upper wind and upper-air temperature listed under 9.1.3 a) 1) are supplied in chart form, they shall be fixed time prognostic charts for flight levels as specified in Appendix 2, 1.2.2 a). When forecasts of SIGWX phenomena listed under 9.1.3 a) 6) are supplied in chart form, they shall be fixed time prognostic charts for an atmospheric layer limited by flight levels as specified in Appendix 2, 1.3.2 and Appendix 5, 4.3.2.

9.1.8 The forecasts of upper wind and upper-air temperature and of SIGWX phenomena above flight level 100 requested for pre-flight planning and in-flight replanning by the operator shall be supplied as soon as they become available, but not later than 3 hours before departure. Other meteorological information requested for pre-flight planning and in-flight replanning by the operator shall be supplied as soon as is practicable.

9.1.9 Where necessary, the meteorological authority of the State providing service for operators and flight crew members shall initiate coordinating action with the meteorological authorities of other States with a view to obtaining from them reports and/or forecasts required.

9.1.10 Meteorological information shall be supplied to operators and flight crew members at the location to be determined by the meteorological authority, after consultation with the operators and at the time agreed between the aerodrome meteorological office and the operator concerned. The service for pre-flight planning shall be confined to flights originating within the territory of the State concerned. At an aerodrome without an aerodrome meteorological office at the aerodrome, arrangements for the supply of meteorological information shall be as agreed upon between the meteorological authority and the operator concerned.

9.2 BRIEFING, CONSULTATION AND DISPLAY

NOTE: The requirements for the use of automated pre-flight information systems in providing briefing, consultation and display are given in 9.4.

9.2.1 Briefing and/or consultation shall be provided, on request, to flight crew members and/or other flight operations personnel. Its purpose shall be to supply the latest available information on existing and expected meteorological conditions along the route to be flown, at the aerodrome of intended landing, alternate aerodromes and other aerodromes as relevant, either to explain and amplify the information contained in the flight documentation or, if so agreed between the meteorological authority and the operator concerned, in lieu of flight documentation.

9.2.2 Meteorological information used for briefing, consultation and display shall include any or all of the information listed in 9.1.3.

9.2.3 If the aerodrome meteorological office expresses an opinion on the development of the meteorological conditions at an aerodrome which differs appreciably from the aerodrome forecast included in the flight documentation, the attention of flight crew members shall be drawn to the divergence. The portion of the briefing dealing with the divergence shall be recorded at the time of briefing and this record shall be made available to the operator.

9.2.4 The required briefing, consultation, display and/or flight documentation shall normally be provided by the aerodrome meteorological office associated with the aerodrome of departure. At an aerodrome where these services are not available, arrangements to meet the requirements of flight crew members shall be as agreed between the meteorological authority and the operator concerned. In exceptional circumstances, such as an undue delay, the aerodrome meteorological office associated with the aerodrome shall provide or, if that is not practicable, arrange for the provision of a new briefing, consultation and/or flight documentation as necessary.

9.2.5 Recommendation – The flight crew member or other flight operations personnel for whom briefing, consultation and/or flight documentation has been requested should visit the aerodrome meteorological office at the time agreed between the aerodrome meteorological office and the operator concerned. Where local circumstances at an aerodrome make personal briefing or consultation impracticable, the aerodrome meteorological office should provide those services by telephone or other suitable telecommunication facilities.

9.3 FLIGHT DOCUMENTATION

NOTE: The requirements for the use of automated pre-flight information systems in providing flight documentation are given in 9.4.

9.3.1 Flight documentation to be made available shall comprise information listed under 9.1.3 a) 1) and 6), b), c), e), f) and, if appropriate, g) and k). However, flight documentation for flights of two hours' duration or less, after a short stop or turnaround, shall be limited to the information operationally needed, but in all cases the flight documentation shall at least comprise information on 9.1.3 b), c), e), f) and, if appropriate, g) and k).

9.3.2 Whenever it becomes apparent that the meteorological information to be included in the flight documentation will differ materially from that made available for pre-flight planning and in-flight re-planning, the operator shall be advised immediately and, if practicable, be supplied with the revised information as agreed between the operator and the aerodrome meteorological office concerned.

9.3.3 Recommendation – In cases where a need for amendment arises after the flight documentation has been supplied, and before take-off of the aircraft, the aerodrome meteorological office should, as agreed locally, issue the necessary amendment or updated information to the operator or to the local air traffic services unit, for transmission to the aircraft.

9.3.4 The meteorological authority shall retain information supplied to flight crew members, either as printed copies or in computer files, for a period of at least 30 days from the date of issue. This information shall be made available, on request, for inquiries or investigations and, for these purposes, shall be retained until the inquiry or investigation is completed.

9.4 AUTOMATED PRE-FLIGHT INFORMATION SYSTEMS FOR BRIEFING, CONSULTATION, FLIGHT PLANNING AND FLIGHT DOCUMENTATION

9.4.1 Where the meteorological authority uses automated pre-flight information systems to supply and display meteorological information to operators and flight crew members for self-briefing, flight planning and flight documentation purposes, the information supplied and displayed shall comply with the relevant provisions in 9.1 to 9.3 inclusive.

9.4.2 **Recommendation –** Automated pre-flight information systems providing for a harmonized, common point of access to meteorological information and aeronautical information services information by operators, flight crew members and other aeronautical personnel concerned should be as agreed between the meteorological authority and the civil aviation authority or the agency to which the authority to provide service has been delegated in accordance with Annex 15, 2.1.1 c).

NOTE: The meteorological and aeronautical information services information concerned is specified in 9.1 to 9.3 and Appendix 8 (not published herein).

9.4.3 Where automated pre-flight information systems are used to provide a harmonized, common point of access to meteorological information and aeronautical information services information by operators, flight crew members and other aeronautical personnel concerned, the meteorological authority concerned shall remain responsible for the quality control and quality management if meteorological information by means of such systems in accordance with Chapter 2, 2.2.2.

NOTE: The responsibilities relating to aeronautical information services information and the quality assurance of the information is given in Annex 15, Chapter 1, 2 and 3.

9.5 INFORMATION FOR AIRCRAFT IN FLIGHT

9.5.1 Meteorological information for use by aircraft in flight shall be supplied by an aerodrome meteorological office or meteorological watch office to its associated air traffic services unit and through D-VOLMET or VOLMET broadcasts as determined by regional air navigation agreement. Meteorological information for planning by the operator for aircraft in flight shall be supplied on request, as agreed between the meteorological authority or authorities and the operator concerned.

9.5.2 Meteorological information for use by aircraft in flight shall be supplied to air traffic services units in accordance with specifications of Chapter 10.

9.5.3 Meteorological information shall be supplied through D-VOLMET or VOLMET broadcast in accordance with the specifications of Chapter 11.

CHAPTER 10 – INFORMATION FOR AIR TRAFFIC SERVICES, SEARCH AND RESCUE SERVICES AND AERONAUTICAL INFORMATION SERVICES

NOTE: Technical specifications related to this Chapter are given in Appendix 9 (not published herein).

10.1 INFORMATION FOR AIR TRAFFIC SERVICES UNITS

10.1.1 The meteorological authority shall designate an aerodrome meteorological office or meteorological watch office to be associated with each air traffic services unit. The associated aerodrome meteorological office or meteorological watch office shall, after coordination with air traffic services unit, supply, or arrange for the supply of, up-to-date meteorological information to the unit necessary for the conduct of its functions.

10.1.2 Recommendation – An aerodrome meteorological office should be associated with an aerodrome control tower or approach control unit for the provision of meteorological information.

10.1.3 A meteorological watch office shall be associated with a flight information center for the provision of meteorological information.

10.1.4 Recommendation – Where, owing to local circumstances, it is convenient for the duties of an associated aerodrome meteorological office or meteorological watch office to be shared between two or more aerodrome meteorological offices or meteorological watch offices, the division of responsibility should be determined by the meteorological authority in consultation with the appropriate ATS authority.

10.1.5 Any meteorological information requested by an air traffic services unit in connection with an aircraft emergency shall be supplied as rapidly as possible.

10.2 INFORMATION FOR SEARCH AND RESCUE SERVICES UNITS

Aerodrome meteorological offices or meteorological watch offices designated by the meteorological authority in accordance with regional air navigation agreement shall supply search and rescue services units with the meteorological information they require in a form established by mutual agreement. For that purpose, the designated aerodrome meteorological office or meteorological watch office shall maintain liaison with the search and rescue services unit throughout a search and rescue operation.

10.3 INFORMATION FOR AERONAUTICAL INFORMATION SERVICES UNITS

The meteorological authority, in coordination with the appropriate civil aviation authority, shall arrange for the supply of up-to-date meteorological information to relevant aeronautical information services units, as necessary, for the conduct of their functions.

CHAPTER 11 – REQUIREMENTS FOR AND USE OF COMMUNICATIONS

NOTE 1: Technical specification and detailed criteria related to this Chapter are given in Appendix 10 (not published herein).

NOTE 2: It is recognized that it is for each Contracting State to decide upon its own internal organization and responsibility for implementing the telecommunication facilities referred to in this Chapter.

11.1 REQUIREMENTS FOR COMMUNICATIONS

11.1.1 Suitable telecommunications facilities shall be made available to permit aerodrome meteorological offices and, as necessary, aeronautical meteorological stations to supply the required meteorological information to air traffic services units on the aerodromes for which those offices and stations are responsible, and in particular to aerodrome control towers, approach control offices and the aeronautical telecommunications stations serving these aerodromes.

11.1.2 Suitable telecommunications facilities shall be made available to permit meteorological watch offices to supply the required meteorological information to air traffic services and search and rescue services units in respect of the flight information regions, control areas and search and rescue regions for which those offices are responsible, and in particular to flight information centers, area control centers and rescue coordination centers and the associated aeronautical telecommunications stations.

11.1.3 Suitable telecommunication facilities shall be made available to permit world area forecast centers to supply the required world area forecast system products to aerodrome meteorological offices, meteorological authorities and other users.

11.1.4 Telecommunication facilities between aerodrome meteorological offices and, as necessary, aeronautical meteorological stations and aerodrome control towers or approach control units shall permit communications by direct speech, the speed with which the communications can be established being such that required points may normally be contacted within approximately 15 seconds.

11.1.5 **Recommendation –** Telecommunication facilities between aerodrome meteorological offices or meteorological watch offices and flight information centers, area control centers, rescue coordination centers and aeronautical telecommunication stations should permit:

a. communications by direct speech, the speed with which the communications can be established being such that the required points may normally be contacted within approximately 15 seconds; and

b. printed communications, when a record is required by the recipient; the message transmit time should not exceed 5 minutes.

NOTE: In 11.1.4 and 11.1.5 ‘approximately 15 seconds’ refers to telephony communications involving switchboard operation and ‘5 minutes’ refer to printed communications involving retransmission.

11.1.6 **Recommendation –** The telecommunication facilities required in accordance with 11.1.4 and 11.1.5 should be supplemented, as and where necessary, by other forms of visual or audio communications, for example, closed-circuit television or separate information processing systems.

11.1.7 **Recommendation –** As agreed between the meteorological authority and the operators concerned, provision should be made to enable operators to establish suitable telecommunications facilities for obtaining meteorological information from aerodrome meteorological offices or other appropriate sources.

11.1.8 Suitable telecommunications facilities shall be made available to permit meteorological offices to exchange operational meteorological information with other meteorological offices.

11.1.9 **Recommendation –** The telecommunications facilities used for the exchange of operational meteorological information should be the aeronautical fixed service or, for the exchange of non-time critical operational meteorological information, the public Internet, subject to availability, satisfactory operation and bilateral/multilateral and/or regional air navigation agreements.

NOTE 1: Aeronautical fixed service Internet-based services, operated by the world area forecast centers, providing for global coverage are used to support the global exchanges of operational meteorological information.

NOTE 2: Guidance material on non-time-critical operational meteorological information and relevant aspects of the public Internet is provided in the Guidelines on the Use of the Public Internet for Aeronautical Applications (Doc 9855).

11.2 USE OF AERONAUTICAL FIXED SERVICE COMMUNICATIONS AND THE PUBLIC INTERNET – METEOROLOGICAL BULLETINS

Meteorological bulletins containing operational meteorological information to be transmitted via aeronautical fixed service or the public Internet shall be originated by the appropriate meteorological office or aeronautical meteorological station.

NOTE: Meteorological bulletins containing operational meteorological information authorized for transmission via aeronautical fixed service are listed in Annex 10, Volume II, Chapter 4, together with the relevant priorities and priority indicators.

11.3 USE OF AERONAUTICAL FIXED SERVICE COMMUNICATIONS – WORLD AREA FORECAST SYSTEM PRODUCTS

Recommendation – World area forecast system products in digital form should be transmitted using binary data communication techniques. The method and channels used for dissemination of the products should be as determined by regional air navigation agreement.

11.4 USE OF AERONAUTICAL MOBILE SERVICE COMMUNICATION

The content and format of meteorological information transmitted to aircraft and by aircraft shall be consistent with the provisions of this Annex.

11.5 USE OF AERONAUTICAL DATA LINK SERVICE – CONTENTS OF D-VOLMET

D-VOLMET shall contain current METAR and SPECI together with trend forecasts where available, TAF and SIGMET, special air-reports not covered by SIGMET and, where available, AIRMET.

NOTE: The requirement to provide METAR and SPECI may be met by the data link-flight information service (D-FIS) application entitled ‘Data link-aerodrome routine meteorological report (D-METAR) service’; the requirement to provide TAF may be met by the D-FIS application entitled ‘Data link-aerodrome forecast (D-TAF) service’; and the requirement to provide SIGMET and AIRMET messages may be met by the D-FIS application entitled ‘Data link-SIGMET (D-SIGMET) service’. The details of these data link services are specified in the Manual of Air Traffic Services Data Link Applications (Doc 9694).

11.6 USE OF AERONAUTICAL BROADCAST SERVICE – CONTENTS OF VOLMET BROADCASTS

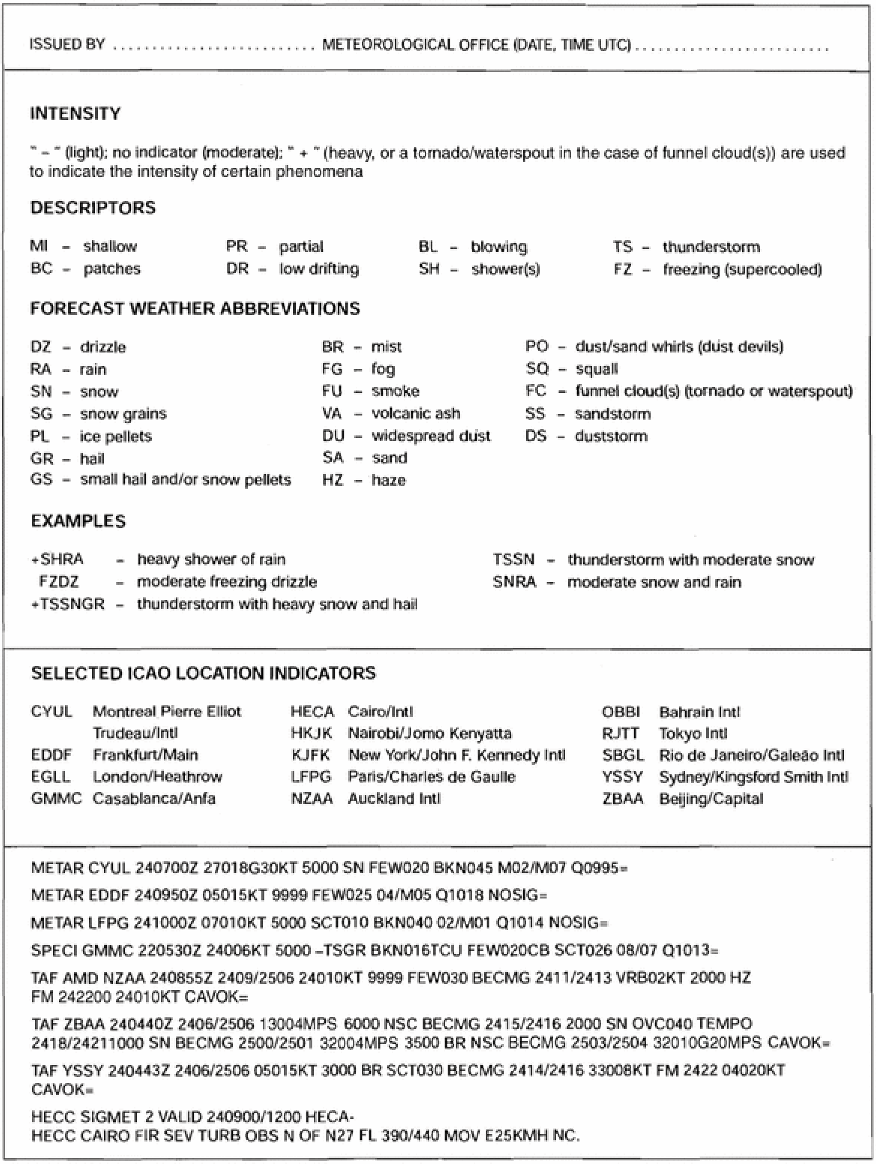
11.6.1 Continuous VOLMET broadcasts, normally on very high frequencies (VHF) shall contain current METAR and SPECI, together with trend forecasts where available.

11.6.2 Scheduled VOLMET broadcasts, normally on high frequencies (HF), shall contain current METAR and SPECI, together with trend forecasts where available and, where so determined by regional air navigation agreement, TAF and SIGMET.

Appendix 1. Flight Documentation – Model Charts and Forms

MODEL A	OPMET information
MODEL IS	Upper wind and temperature chart for standard isobaric surface
	Example 1 - Arrows, feathers and pennants (Mercartor projection)
	Example 2 - Arrows, feathers and pennants (Polar stereographic projection)
MODEL SWH	Significant weather chart (high level)
	Example - Polar stereographic projection (showing the jet stream vertical extent)
MODEL SWM	Significant weather chart (medium level)
MODEL SWL	Significant weather chart (low level)
	Example 1
	Example 2
MODEL TCG	Tropical cyclone advisory information in graphical format
MODEL VAG	Volcanic ash advisory information in graphical format
MODEL STC	SIGMET for tropical cyclone in graphical format
MODEL SVA	SIGMET for volcanic ash in graphical format
MODEL SGE	SIGMET for phenomena other than tropical cyclone and volcanic ash in graphical format
MODEL SN	Sheet of notations used in flight documentation

Appendix 1. Model A – OPMET Information



ISSUED BY .... METEOROLOGICAL OFFICE (DATE, TIME UTC) ....

INTENSITY

" – " (light); no indicator (moderate); " + " (heavy, or a tornado/waterspout in the case of funnel cloud(s)) are used to indicate the intensity of certain phenomena

DESCRIPTORS

MI – shallow
BC – patches
PR – partial
DR – low drifting
BL – blowing
SH – shower(s)
TS – thunderstorm
FZ – freezing (supercooled)

FORECAST WEATHER ABBREVIATIONS

DZ – drizzle
RA – rain
SN – snow
SG – snow grains
PL – ice pellets
GR – hail
GS – small hail and/or snow pellets
BR – mist
FG – fog
FU – smoke
VA – volcanic ash
DU – widespread dust
SA – sand
HZ – haze
PO – dust/sand whirls (dust devils)
SQ – squall
FC – funnel cloud(s) (tornado or waterspout)
SS – sandstorm
DS – duststorm

EXAMPLES

+SHRA – heavy shower of rain
FZDZ – moderate freezing drizzle
+TSSNGR – thunderstorm with heavy snow and hail
TSSN – thunderstorm with moderate snow
SNRA – moderate snow and rain

SELECTED ICAO LOCATION INDICATORS

CYUL	Montreal Pierre Elliot Trudeau/Intl
EDDF	Frankfurt/Main
EGLL	London/Heathrow
GMMC	Casablanca/Anfa
HECA	Cairo/Intl
HKJK	Nairobi/Jomo Kenyatta
KJFK	New York/John F. Kennedy Intl
LFPG	Paris/Charles de Gaulle
NZAA	Auckland Intl
OBBI	Bahrain Intl
RJTT	Tokyo Intl
SBGL	Rio de Janeiro/Galeão Intl
YSSY	Sydney/Kingsford Smith Intl
ZBAA	Beijing/Capital

METAR CYUL 240700Z 27018G30KT 5000 SN FEW020 BKN045 M02/M07 Q0995=

METAR EDDF 240950Z 05015KT 9999 FEW025 04/M05 Q1018 NOSIG=

METAR LFPG 241000Z 07010KT 5000 SCT010 BKN040 02/M01 Q1014 NOSIG=

SPECI GMMC 220530Z 24006KT 5000 –TSGR BKN016TCU FEW020CB SCT026 08/07 Q1013=

TAF AMD NZAA 240855Z 2409/2506 24010KT 9999 FEW030 BECMG 2411/2413 VRB02KT 2000 HZ
FM 242200 24010KT CAVOK=

TAF ZBAA 240440Z 2406/2506 13004MPS 6000 NSC BECMG 2415/2416 2000 SN OVC040 TEMPO
2418/24211000 SN BECMG 2500/2501 32004MPS 3500 BR NSC BECMG 2503/2504 32010G20MPS CAVOK=

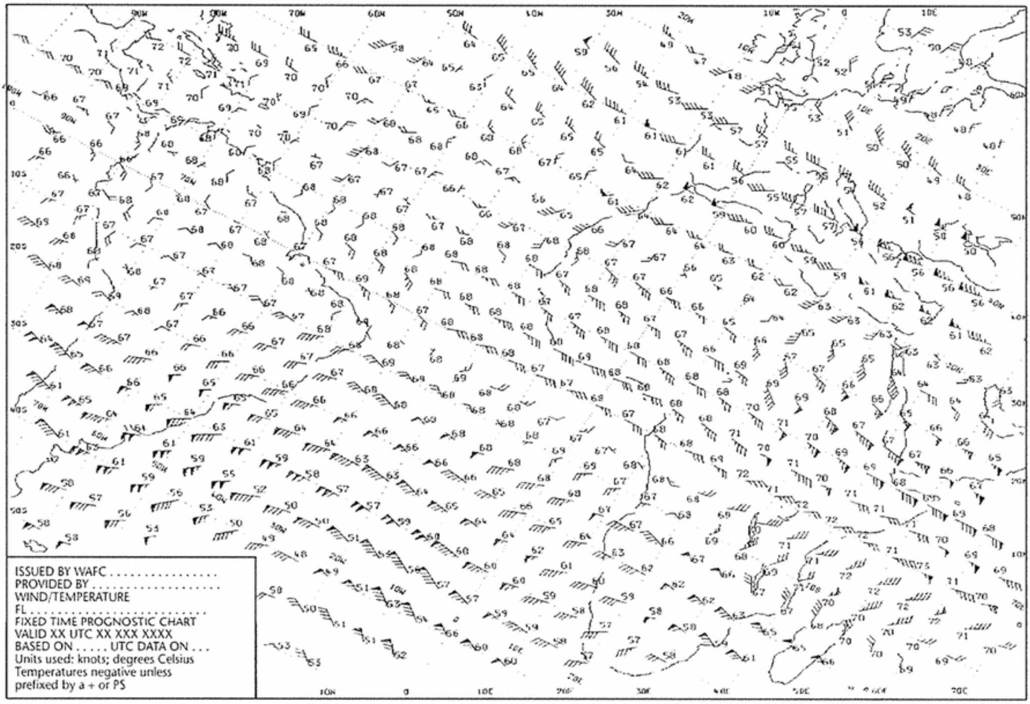
TAF YSSY 240443Z 2406/2506 05015KT 3000 BR SCT030 BECMG 2414/2416 33008KT FM 2422 04020KT
CAVOK=

HECC SIGMET 2 VALID 240900/1200 HECA-
HECC CAIRO FIR SEV TURB OBS N OF N27 FL 390/440 MOV E25KMH NC.

Appendix 1. Model IS – Upper Wind and Temperature Chart for Standard Isobaric Surface

EXAMPLE 1

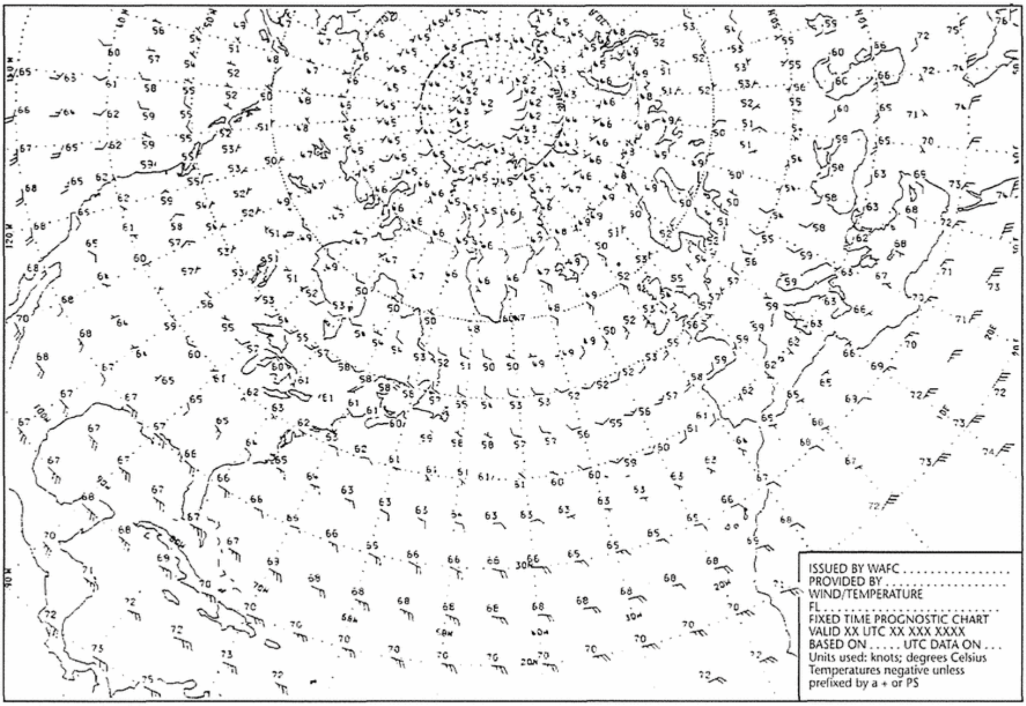
ARROWS, FEATHERS AND PENNANTS (MERCATOR PROJECTION)



METEOROLOGICAL SERVICE FOR INTERNATIONAL AIR NAVIGATION - ANNEX 3

EXAMPLE 2

ARROWS, FEATHERS AND PENNANTS (POLAR STEREOGRAPHIC PROJECTION)

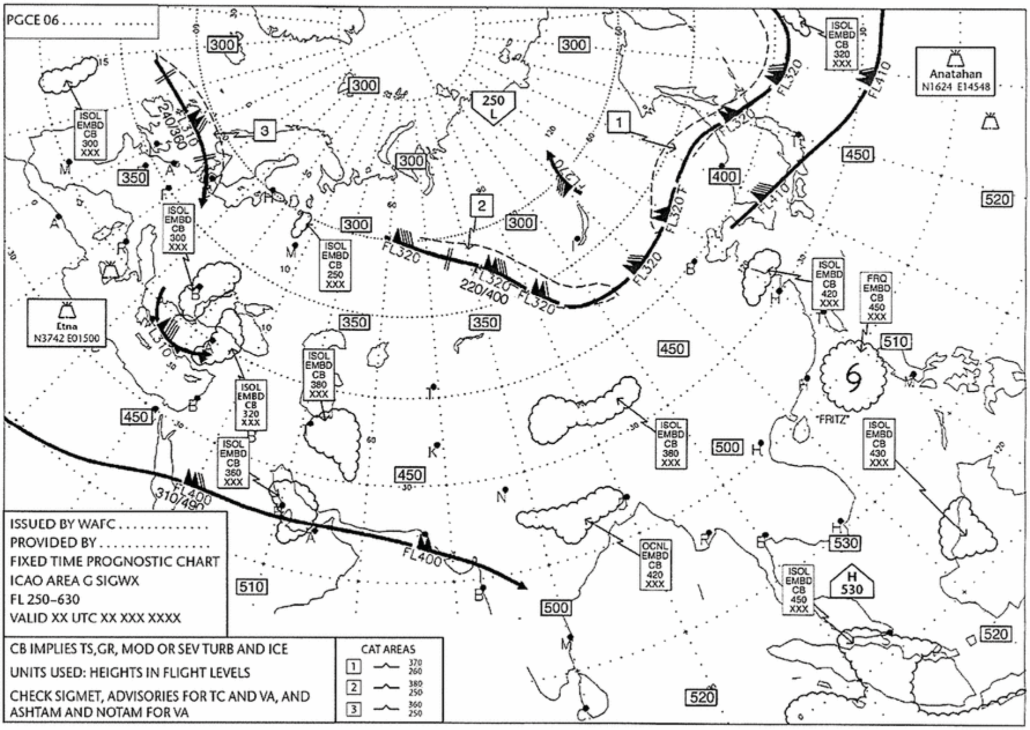


METEOROLOGICAL SERVICE FOR INTERNATIONAL AIR NAVIGATION - ANNEX 3

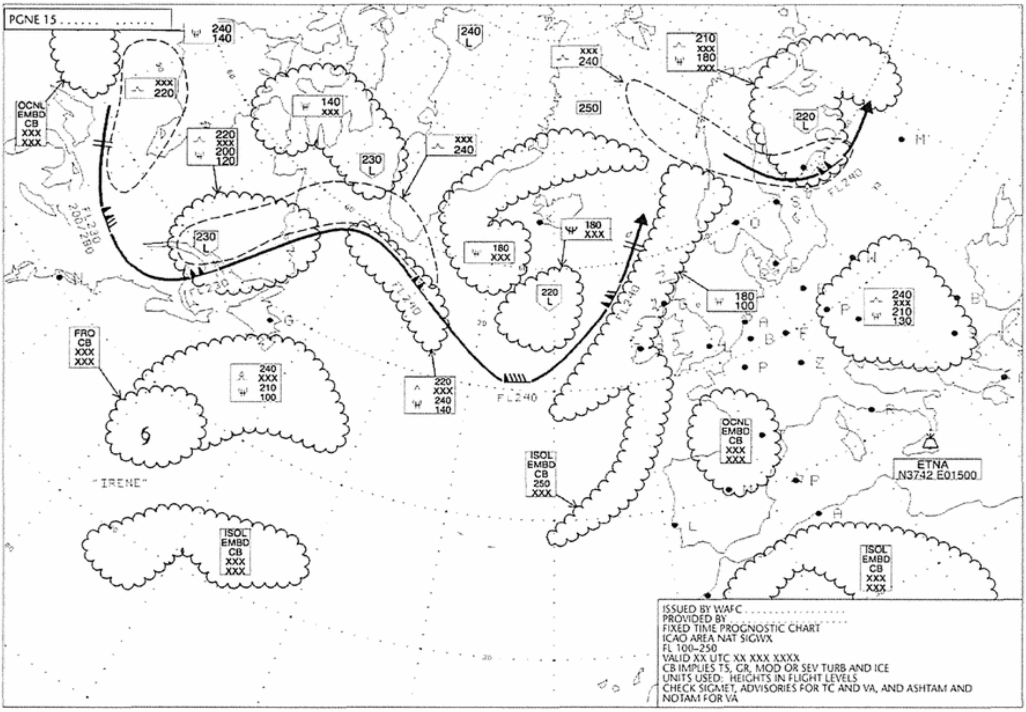
Appendix 1. Model SWH – Significant Weather Chart (High Level)

EXAMPLE

POLAR STEREOGRAPHIC PROJECTION (SHOWING THE JET STREAM VERTICAL EXTEND)

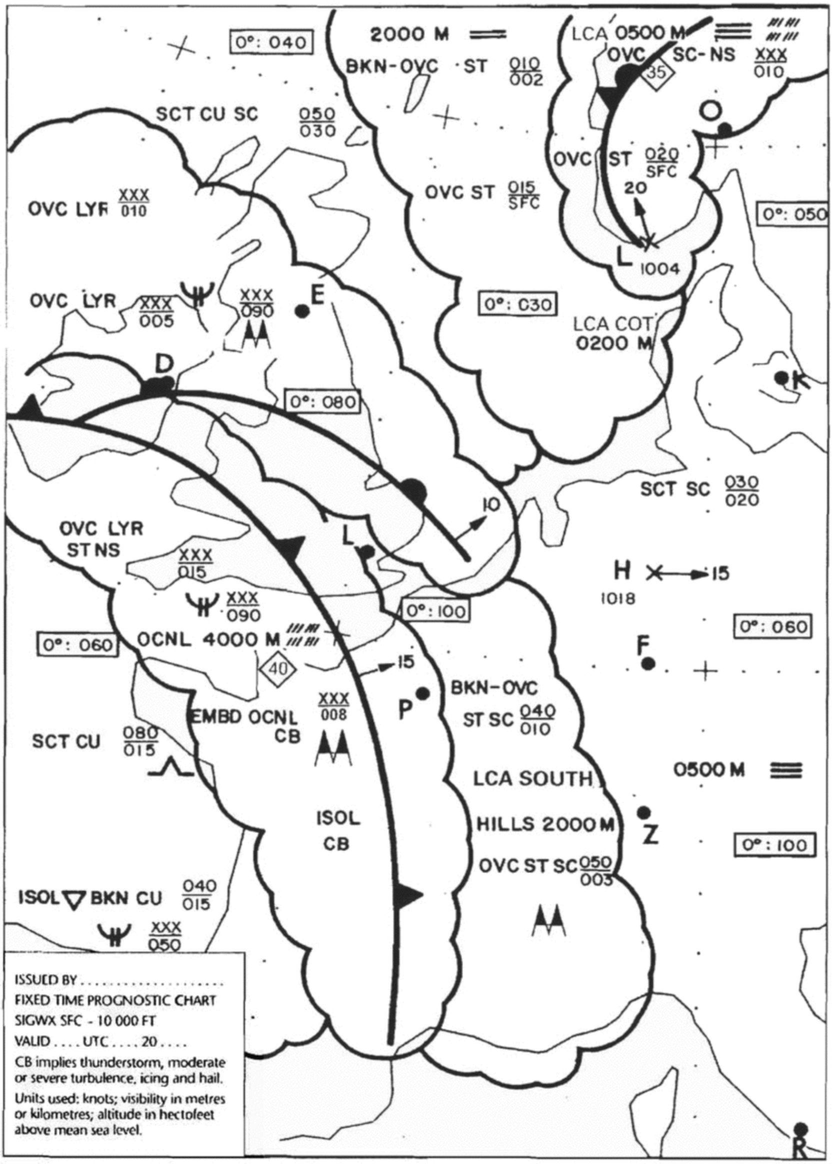


Appendix 1. Model SWM – Significant Weather Chart (Medium Level)



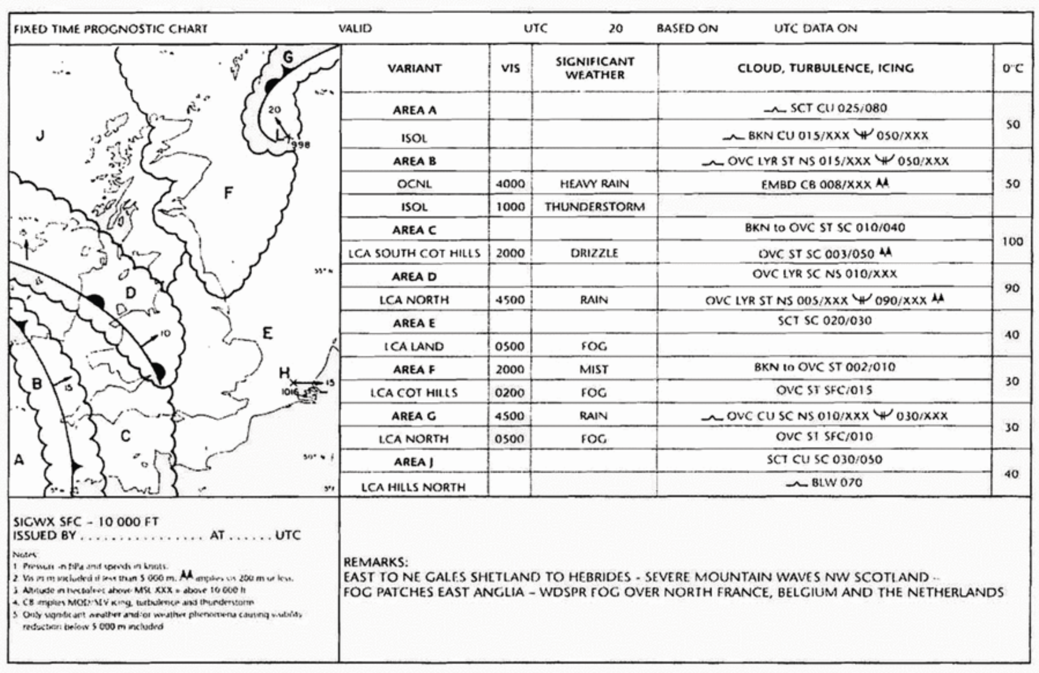
Appendix 1. Model SWL – Significant Weather Chart (Low Level)

EXAMPLE 1



METEOROLOGICAL SERVICE FOR INTERNATIONAL AIR NAVIGATION - ANNEX 3

EXAMPLE 2



FIXED TIME PROGNOSTIC CHART VALID UTC 20 BASED ON UTC DATA ON

VARIANT	VIS	SIGNIFICANT WEATHER	CLOUD, TURBULENCE, ICING	0°C
AREA A			⌃ SCT CU 025/080	50
ISOL			⌃ BKN CU 015/XXX Ѱ 050/XXX	
AREA B			⌃ OVC LYR ST NS 015/XXX Ѱ 050/XXX	50
OCNL	4000	HEAVY RAIN	EMBD CB 008/XXX ▲▲	
ISOL	1000	THUNDERSTORM		
AREA C			BKN to OVC ST SC 010/040	100
LCA SOUTH COT HILLS	2000	DRIZZLE	OVC ST SC 003/050 ▲▲	
AREA D			OVC LYR SC NS 010/XXX	90
LCA NORTH	4500	RAIN	OVC LYR ST NS 005/XXX Ѱ 090/XXX ▲▲	
AREA E			SCT SC 020/030	40
LCA LAND	0500	FOG		
AREA F	2000	MIST	BKN to OVC ST 002/010	30
LCA COT HILLS	0200	FOG	OVC ST SFC/015	
AREA G	4500	RAIN	⌃ OVC CU SC NS 010/XXX Ѱ 030/XXX	30
LCA NORTH	0500	FOG	OVC ST SFC/010	
AREA J			SCT CU SC 030/050	40
LCA HILLS NORTH			⌃ BLW 070	

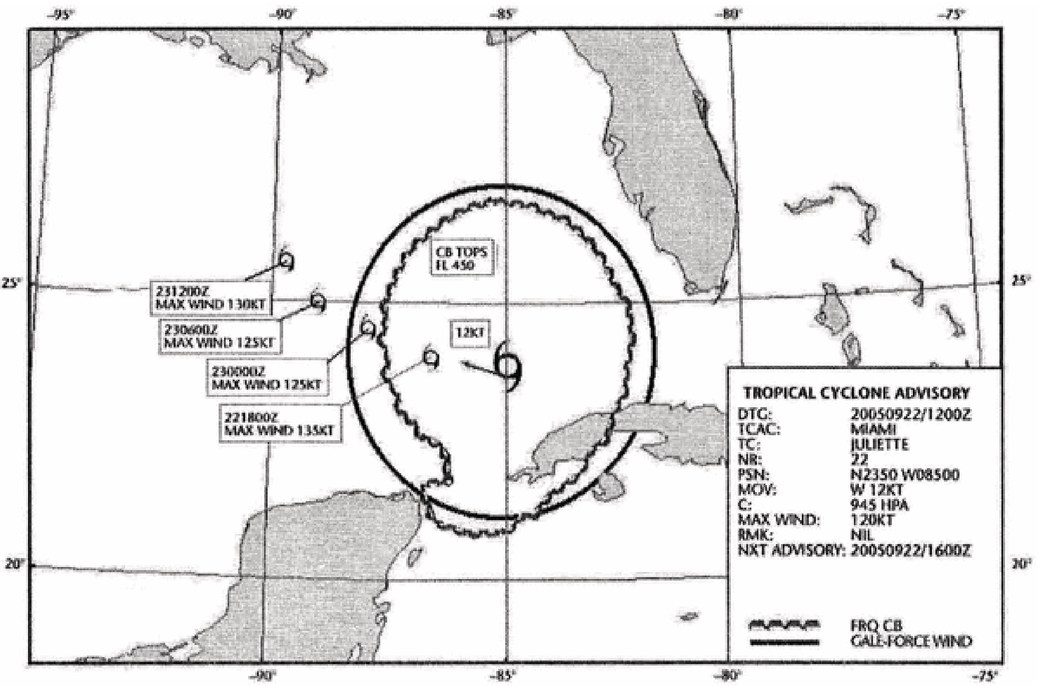
SIGWX SFC – 10 000 FT
ISSUED BY . . . . AT . . . . . . UTC

Notes:

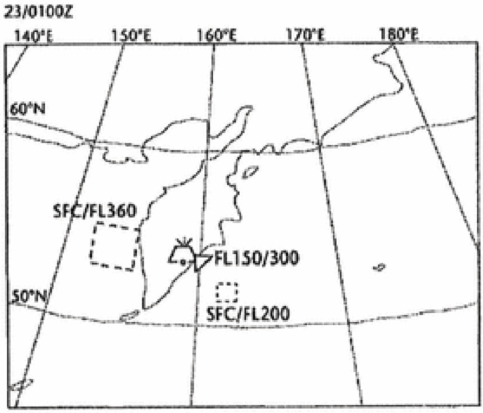
1. Pressure in hPa and speeds in knots.
2. Vis in m included if less than 5 000 m. ▲▲ implies vis 200 m or less.
3. Altitude in hectofeet above MSL XXX = above 10 000 ft
4. CB implies MOD/SEV icing, turbulence and thunderstorm
5. Only significant weather and/or weather phenomena causing visibility reduction below 5 000 m included

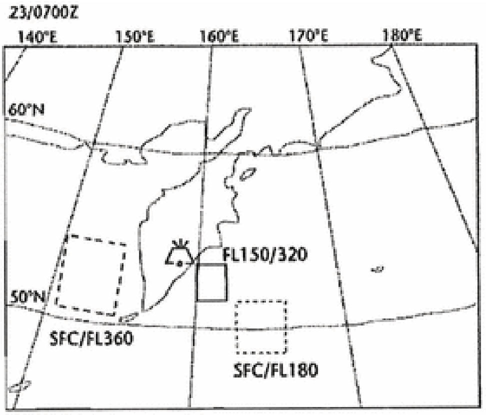
REMARKS:
EAST TO NE GALES SHETLAND TO HEBRIDES - SEVERE MOUNTAIN WAVES NW SCOTLAND –
FOG PATCHES EAST ANGLIA – WDSPR FOG OVER NORTH FRANCE, BELGIUM AND THE NETHERLANDS

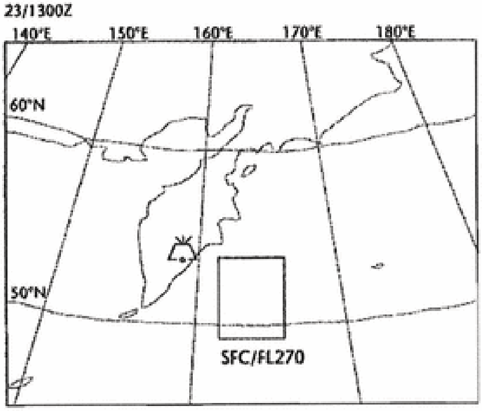
Appendix 1. Model TCG – Tropical Cyclone Advisory Information in Graphical Format

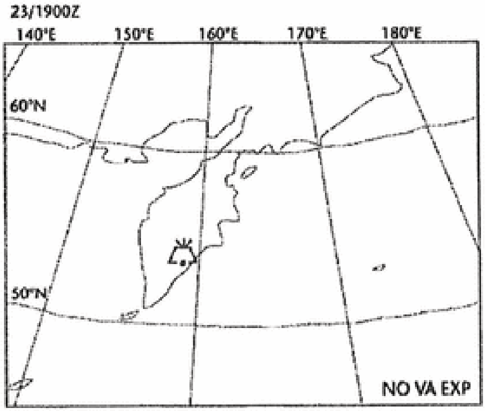


Appendix 1. Model VAG – Volcanic Ash Advisory Information in Graphical Format



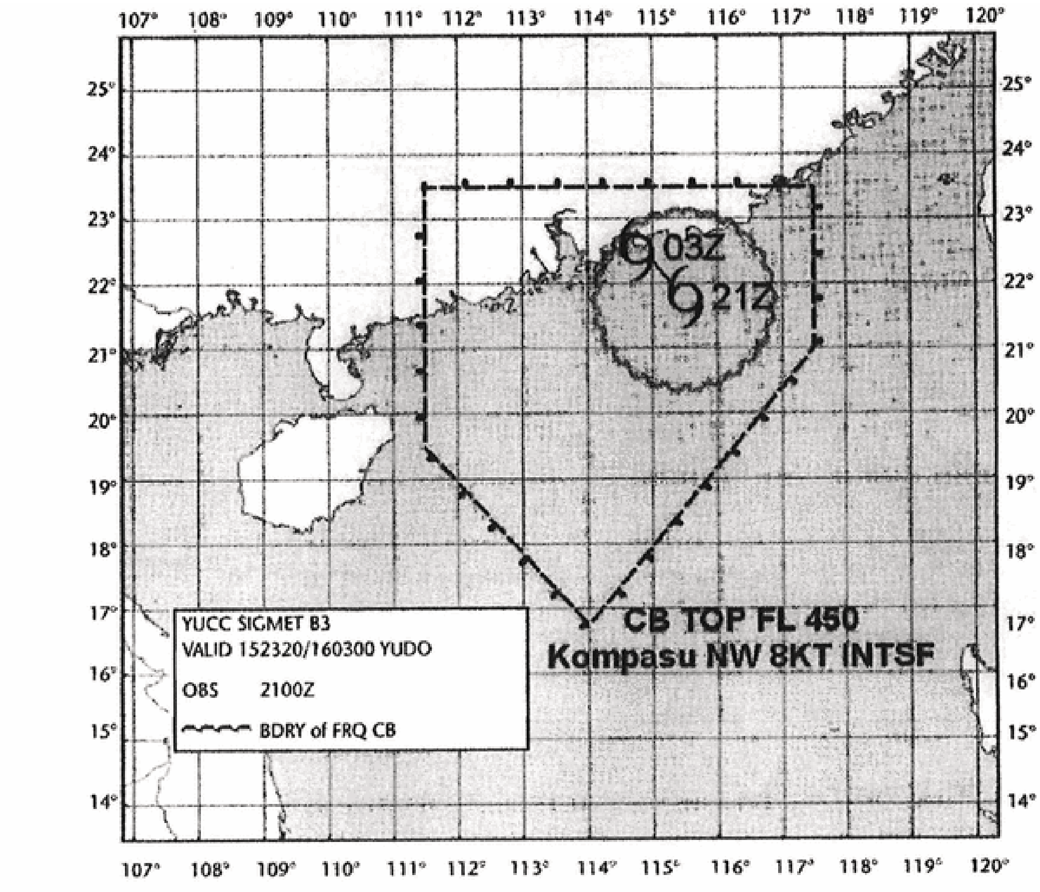






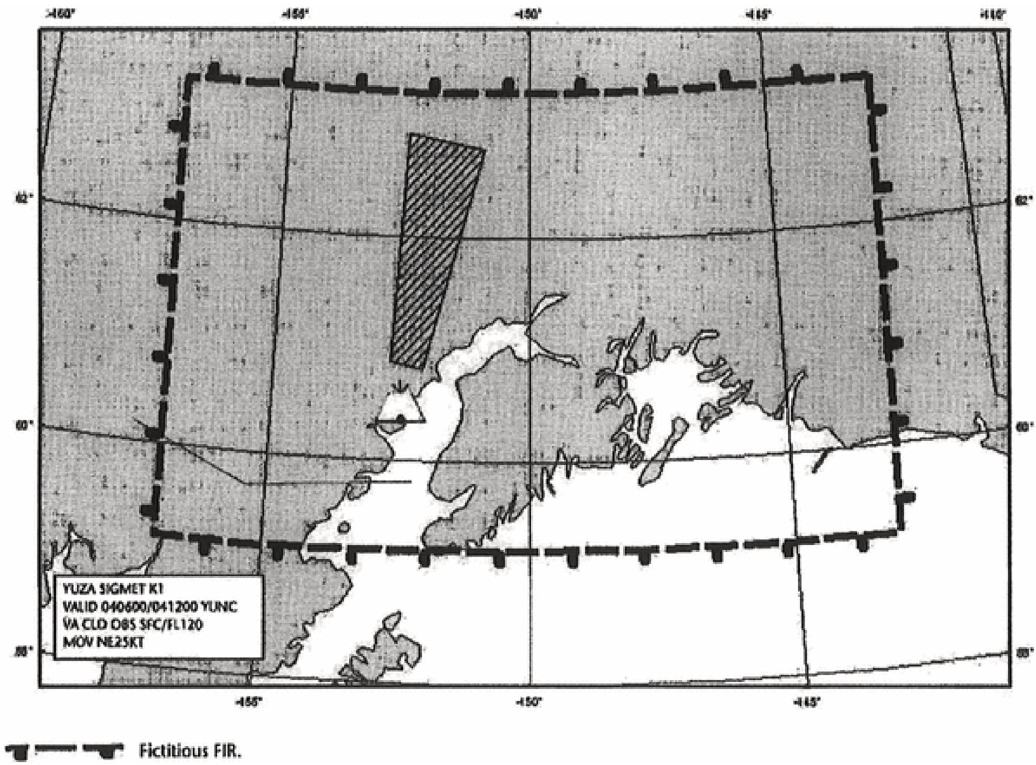
VOLCANIC ASH ADVISORY
DTG: 20080923/0130Z
VAAC: TOKYO
VOLCANO: KARYMSKY 1000-13
AREA: RUSSIAN FEDERATION
SUMMIT ELEV: 1536M
ADVISORY NR: 2008/4
INFO SOURCE: MTSAT-1R, KVERT KEMSD
AVIATION COLOUR CODE: RED
ERUPTION DETAILS: ERUPTED AT 20080923/0000Z FL300 REPORTED
RMK: LATEST REP FM KVERT (0120Z) INDICATES ERUPTION HAS CEASED
TWO DISPERSING VA CLD ARE EVIDENT ON SATELLITE IMAGERY
NXT ADVISORY: 20080923/0730Z

Appendix 1. Model STC – SIGMET for Tropical Cyclone in Graphical Format

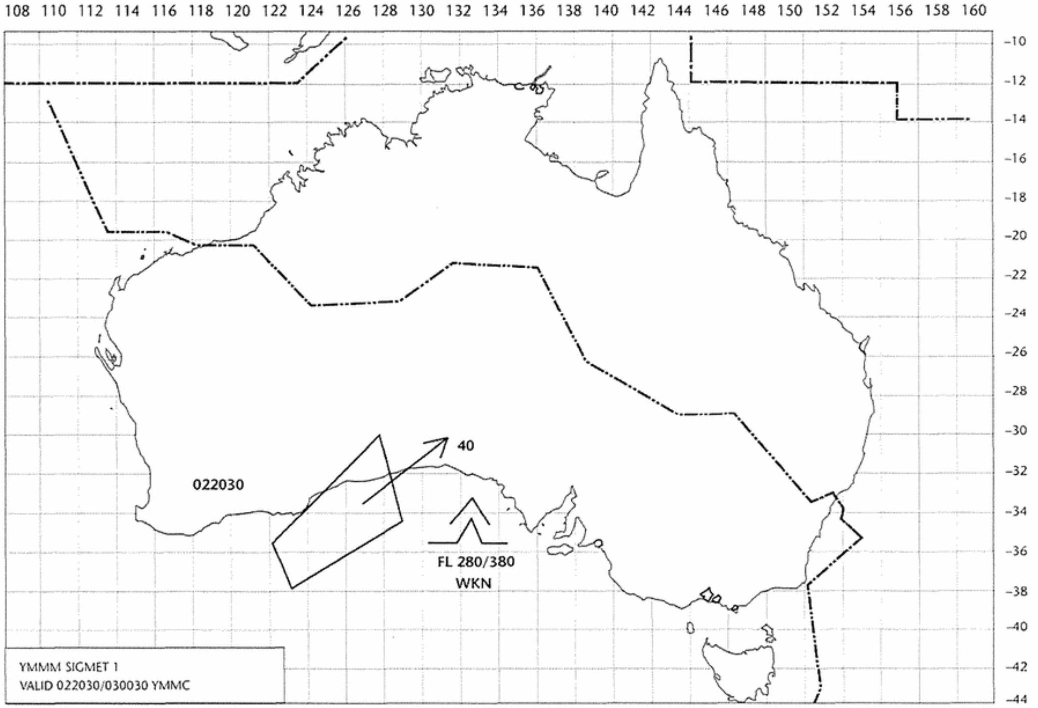


Note: ▬ ▬ Fictitious FIR.

Appendix 1. Model SVA – SIGMET for Volcanic Ash in Graphical Format



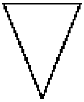
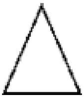
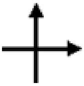
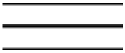
Appendix 1. Model SGE – SIGMET for Phenomena other than Tropical Cyclone and Volcanic Ash in Graphical Format

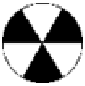
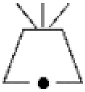


Appendix 1. Model SN – Sheet of Notations used in Flight Documentation

1. SYMBOLS FOR SIGNIFICANT WEATHER

NOTE: Height indications between which phenomena are expected, top above base as per chart legend.

	Tropical cyclone		Drizzle
	Severe squall line[1]		Rain
	Moderate turbulence		Snow
	Severe turbulence		Shower  Hail
	Mountain waves		Widespread blowing snow
	Moderate aircraft icing		Severe sand or dust haze
	Severe aircraft icing		Widespread sandstorm or dust-storm
	Widespread fog		Widespread haze

	Radioactive materials in the atmosphere[2]		Widespread mist
	Volcanic eruption[3]		Widespread smoke
	Mountain obscuration		Freezing precipitation[4]

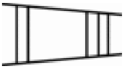
[1] In flight documentation for flights operating up to FL100, this symbol refers to “squall line”.

[2] The following Information should be included in a separate text box on the chart: radioactive materials in the atmosphere symbol; latitude/longitude of release site; and (if known) the name of the site of the radioactive source. In addition, the legend of SIGWX charts on which a release of radiation is indicated should contain “CHECK SIGMET AND NOTAM FOR RDOACT CLD’. The center of the radioactive materials in the atmosphere symbol should be placed on significant weather charts at the latitude/longitude site of the radioactive source.

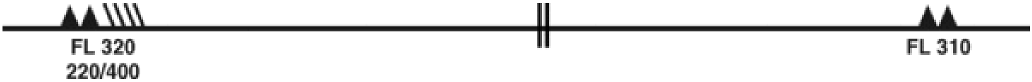
[3] The following information should be included in a separate text box on the chart: volcanic eruption symbol; the name of the volcano (if known); and the latitude/longitude of the eruption. In addition, the legend of SIGWX charts should indicate “CHECK SIGMET, ADVISORIES FOR TC AND VA, AND ASHTAM AND NOTAM FOR VA”. The dot on the base of the volcanic eruption symbol should be placed on significant weather charts at the latitude/longitude site of the volcanic event.

[4] This symbol does not refer to icing due to precipitation coming into contact with an aircraft which is at a very low temperature.

2. FRONTS AND CONVERGENCE ZONES AND OTHER SYMBOLS USED

	Cold front at the surface		Position, speed and level of max. wind
	Warm front at the surface		Convergence line
	Occluded front at the surface	0° : 100	Freezing level
	Quasi-stationary front at the surface		Intertropical convergence zone

	Tropopause high		State of the sea
	Tropopause low		Sea surface temperature
	Tropopause level		Widespread strong surface wind[1]



Wind arrows indicate the maximum wind in jet and the flight level at which it occurs. If the maximum wind speed is 60m/s (120kt) or more, the flight levels between which winds are greater than 40m/s (80kt) is placed below the maximum wind level. In the example, winds are greater than 40m/s (80kt) between FL220 and FL400. The heavy line delineating the jet axis begins/ends at the points where a wind speed of 40m/s (80kt) is forecast. ╫ Symbol used whenever the height of the jet axis changes by +/-3000ft or the speed changes by +/-20kt.

[1] This symbol refers to widespread surface wind speeds exceeding 15m/s (30kt).

3. ABBREVIATIONS USED TO DESCRIBE CLOUDS

3.1 TYPE

CI = Cirrus
CC = Cirrocumulus
CS = Cirrostratus
AC = Altocumulus
AS = Altostratus
NS = Nimbostratus
SC = Stratocumulus
ST = Stratus
CU = Cumulus
CB = Cumulonimbus

3.2 AMOUNT

Clouds except CB:

FEW = few (1/8 to 2/8);
SCT = scattered (3/8 to 4/8);
BKN = broken (5/8 to 7/8);
OVC = overcast (8/8ths).

CB only:

ISOL = individual CBs (isolated);

OCNL = well separated CBs (occasional);

FRQ = CBs with little or no separation (frequent);

EMBD = CBs embedded in layers of other clouds or concealed by haze (embedded).

3.3 HEIGHTS

Heights are indicated on SWH and SWM charts in flight levels (FL), top over base. When XXX is used, tops or bases are outside the layer of the atmosphere to which the chart applies.

In SWL charts:

a. Heights are indicated as altitudes above mean sea level.

b. The abbreviation SFC is used to indicate ground level.

4. DEPICTING OF LINES AND SYSTEMS ON SPECIFIC CHARTS

4.1 SWH AND SWM – SIGNIFICANT WEATHER CHARTS (HIGH AND MEDIUM)

Scalloped line	=	demarcation of areas of significant weather
Heavy broken line	=	delineation of area of CAT
Heavy solid line interrupted by wind arrow and flight level	=	position of jet stream axis with indication of wind direction, speed in kt or km/h and height in flight levels. The vertical extent of the jet stream is indicated (in flight levels), e.g. FL270 accompanied by 240/290 indicates that the jet extends from FL240 to FL290.
Flight levels inside small rectangles	=	height in flight levels of tropopause at spot locations; e.g., $\boxed{340}$. Low and High points of the tropopause topography are indicated by the letters L or H respectively inside a pentagon with the height in flight levels. Display explicit FL for JET dephts and tropopause height even if outside forecast bounds.

4.2 SWL – SIGNIFICANT WEATHER CHART (LOW LEVEL)

X	=	position of pressure centers given in hectopascals
L	=	center of low pressure
H	=	center of high pressure
Scalloped lines	=	demarcation of area of significant weather

Dashed lines = altitude of 0°C isotherm in feet (hectofeet) or meters

NOTE: 0°C level may also be indicated by; 0°:060 *i.e., 0°C level is at an altitude of 6000ft.*

Figures on arrows = speed in kt or km/h of movement of frontal systems, depressions or anticyclones

Figure inside the state of the sea symbol = total wave height in feet or meters

Figure inside the sea surface temperature symbol = sea surface temperature in °C

Figures inside the strong surface wind symbol = wind in kt or km/h

4.3 ARROWS, FEATHERS AND PENNANTS

Arrows indicate direction. Number of pennants and/or feathers correspond to speed.

EXAMPLE:[1]

270°/115kt (equivalent to 57.5m/s).

Pennants correspond to 50kt or 25m/s.

Feather correspond to 10kt or 5m/s.

Half-feather correspond to 5kt or 2.5m/s.

[1] A conversion factor of 1 to 2 is used.

Appendix 2. Technical Specifications related to Global Systems, Supporting Centers and Meteorological Offices

Table A2-1. Template for Advisory Message for Volcanic Ash

Key: M = inclusion mandatory, part of every message
O = inclusion optional
C = inclusion conditional, included whenever applicable
= = a double line indicates that the text following it should be placed on the subsequent line

NOTE 1: The ranges and resolutions for the numerical elements included in advisory messages for volcanic ash are shown in Appendix 6, Table A6-4.

NOTE 2: The explanations for the abbreviations can be found in the Procedures for Air Navigation Services - ICAO Abbreviations and Codes (PANS-ABC, Doc 8400).

NOTE 3: Inclusion of a “colon” after each element heading is mandatory.

NOTE 4: The numbers 1 to 19 are included only for clarity and they are not part of the advisory message, as shown in the example.

Table A2-1. Template for Advisory Message for Volcanic Ash

Element		Detailed Content	Template(s)		Examples	
1	Identification of the type of message (M)	Type of message	VA ADVISORY		VA ADVISORY	
2	Status indicator (C)[1]	Indicator of test or exercise	STATUS:	TEST or EXER	STATUS:	TEST EXER
3	Time of origin (M)	Year, month, day, time in UTC	DTG:	nnnnnnnn/nnnnZ	DTG:	20080923/0130Z
4	Name of VAAC (M)	Name of VAAC	VAAC:	nnnnnnnnnnnn	VAAC:	TOKYO
5	Name of volcano (M)	Name and IAVCEI[2] number of volcano	VOLCANO:	nnnnnnnnnnnn nn nnnnnnnn [nnnnnn] or UNKNOWN or UNNAMED	VOLCANO:	KARYMSKY 1000-13 UNNAMED

Table A2-1. Template for Advisory Message for Volcanic Ash (continued)

Element		Detailed Content	Template(s)		Examples	
6	Location of volcano (M)	Location of volcano in degrees and minutes	PSN:	Nnnnn or Snnnn Wnnnnn or Ennnnn or UNKNOWN	PSN:	N5403 E15927 UNKNOWN
7	State or region (M)	State, or region if ash is not reported over a State	AREA:	nnnnnnnnnn nnnnnn	AREA:	RUSSIA
8	Summit elevation (M)	Summit elevation in m (or ft)	SUMMIT ELEV:	nnnnM (or nnnnnFT)	SUMMIT ELEV:	1536M
9	Advisory number (M)	Year in full and message number (separate sequence for each volcano)	ADVISORY NR:	nnnn/[n][n][n]n	ADVISORY NR:	2008/4
10	Information source (M)	Information source using free text	INFO SOURCE:	Free text up to 32 characters	INFO SOURCE:	MTSAT-1R KVERT KEMSD
11	Colour code (O)	Aviation colour code	AVIATION COLOUR CODE:	RED or ORANGE or YELLOW or GREEN or UNKNOWN or NOT GIVEN or NIL	AVIATION COLOUR CODE:	RED
12	Eruption details (M)	Eruption details (including date/time of eruption(s))	ERUPTION DETAILS:	Free text up to 64 characters or UNKNOWN	ERUPTION DETAILS:	ERUPTION AT 20080923/0000Z FL300 REPORTED
13	Time of observation (or estimation) of ash (M)	Day and time (in UTC) of observation (or estimation) of volcanic ash	OBS (or EST) VA DTG:	nn/nnnnZ	OBS VA DTG:	23/0100Z

Table A2-1. Template for Advisory Message for Volcanic Ash (continued)

Element		Detailed Content	Template(s)		Examples	
14	Observed or estimated ash cloud (M)	Horizontal (in degrees and minutes) and vertical extent at the time of observation of the observed or estimated ash cloud or, if the base is unknown, the top of the observed or estimated ash cloud; Movement of the observed or estimated ash cloud	OBS VA CLD or EST VA CLD:	TOP FLnnn or SFC/FLnnn or FLnnn/nnn [nnKM WID LINE[3] BTN [nnNM WID LINE BTN)] Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - [Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]] - MOV N nnKMH (or KT) or MOV NE nnKMH (or KT) or MOV E nnKMH (or KT) or MOV SE nnKMH (or KT) or	OBS VA CLD:	FL250/300 N5400 E15930 - N5400 E16100 - N5300 E15945 - MOV SE 20KT SFC/FL200 N5130 E16130 - N5130 E16230 - N5230 E16230 - N5230 E16130 - MOV SE 15KT TOP FL240 MOV W 40KMH VA NOT IDENTIFIABLE FM SATELLITE DATA WIND FL050/070 180/12MPS

Table A2-1. Template for Advisory Message for Volcanic Ash (continued)

Element	Detailed Content	Template(s)	Examples
		MOV S nnKMH (or KT) or MOV SW nnKMH (or KT) or MOV W nnKMH (or KT) or MOV NW nnKMH (or KT)[4] or VA NOT IDENTIFIABLE FM SATELLITE DATA WIND FLnnn/nnn nnn/nn[n]MPS (or KT)[5] or WIND FLnnn/nnn VRBnnMPS (or KT) or WIND SFC/FLnnn nnn/nn(n)MPS (or KT) or WIND SFC/FLnnn VRBnnMPS (or KT)	

Table A2-1. Template for Advisory Message for Volcanic Ash (continued)

Element		Detailed Content	Template(s)		Examples	
15	Forecast height and position of the ash clouds (+6HR) (M)	Day and time (in UTC) (6 hours from the "Time of observation (or estimation) of ash" given in Item 13); Forecast height and position in degrees and minutes) for each cloud mass for that fixed valid time	FCST VA CLD +6HR:	nn/nnnnZ SFC or FLnnn/[FL]nnn [nnKM WID LINE^3 BTN (nnNM WID LINE BTN)] Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn][- Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]] ^{4} or NO VA EXP or NOT AVBL or NOT PROVIDED	FCST VA CLD +6HR:	23/0700Z FL250/350 N5130 E16030- N5130 E16230 - N5330 E16230 - N5330 E16030 - SFC/FL180 N4830 E16330 - N4830 E16630 - N5130 E16630 - N5130 E16330 NO VA EXP NOT AVBL NOT PROVIDED

Table A2-1. Template for Advisory Message for Volcanic Ash (continued)

Element		Detailed Content	Template(s)		Examples	
16	Forecast height and position of the ash clouds (+12HR) (M)	Day and time (in UTC) (12 hours from the "Time of observation (or estimation) of ash" given in Item 13); Forecast height and position (in degrees and minutes) for each cloud mass for that fixed valid time	FCST VA CLD +12HR:	nn/nnnnZ SFC or FLnnn/[FL]nnn [nnKM WID LINE^3 BTN (nnNM WID LINE BTN)] Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn][- Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]] ^{4} or NO VA EXP or NOT AVBL or NOT PROVIDED	FCST VA CLD +12HR:	23/1300Z SFC/FL270 N4830 E16130 - N4830 E16600 - N5300 E16600 - N5300 E16130 - NO VA EXP NOT AVBL NOT PROVIDED

Table A2-1. Template for Advisory Message for Volcanic Ash (continued)

Element		Detailed Content	Template(s)		Examples	
17	Forecast height and position of the ash clouds (+18HR) (M)	Day and time (in UTC) (18 hours from the "Time of observation (or estimation) of ash" given in Item 13); Forecast height and position (in degrees and minutes) for each cloud mass for that fixed valid time	FCST VA CLD +18HR:	nn/nnnnZ SFC or FLnnn/[FL]nnn [nnKM WID LINE[3] BTN (nnNM WID LINE BTN)] Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn][- Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]][4] or NO VA EXP or NOT AVBL or NOT PROVIDED	FCST VA CLD +18HR:	23/1900Z NO VA EXP NOT AVBL NOT PROVIDED

Table A2-1. Template for Advisory Message for Volcanic Ash (continued)

Element		Detailed Content	Template(s)		Examples	
18	Remarks (M)	Remarks, as necessary	RMK:	Free text up to 256 characters or NIL	RMK:	LATEST REP FM KVERT (0120Z) INDICATES ERUPTION HAS CEASED. TWO DISPERSING VA CLD ARE EVIDENT ON SATELLITE IMAGERY NIL
19	Next advisory (M)	Year, month, day and time in UTC	NXT ADVISORY:	nnnnnnnn/nnnnZ or NO LATER THAN nnnnnnnn/nnnnZ or NO FURTHER ADVISORIES or WILL BE ISSUED BY nnnnnnnn/nnnnZ	NXT ADVISORY:	20080923/0730Z NO LATER THAN nnnnnnnn/nnnnZ NO FURTHER ADVISORIES WILL BE ISSUED BY nnnnnnnn/nnnnZ

[1] Used only when the message issued to indicate that a test or an exercise is taking place. When the word 'TEST" or the abbreviation 'EXER" is included, the message may contain information that should not be used operationally or will otherwise end immediately after the word 'TEST'. [Applicable 7 November 2019]

[2] International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI).

[3] A straight line between two points drawn on a map in the Mercator projection or a straight line between two points which crosses lines of longitude at a constant angle.

[4] Up to 4 selected layers.

[5] If ash reported (e.g. AIREP) but not identifiable from satellite data.

Example A2-1. Advisory Message for Volcanic Ash

VA ADVISORY	
DTG:	20080923/0130Z
VAAC:	TOKYO
VOLCANO:	KARYMSKY 1000-13
PSN:	N5403 E15927
AREA:	RUSSIA
SUMMIT ELEV:	1536M
ADVISORY NR:	2008/4
INFO SOURCE:	MTSAT-1R KVERT KEMSD
AVIATION COLOUR CODE:	RED
ERUPTION DETAILS:	ERUPTION AT 20080923/0000Z FL300 REPORTED
OBS VA DTG:	23/0100Z
OBS VA CLD:	FL250/300 N5400 E15930 - N5400 E16100 - N5300 E15945 MOV SE 20KT SFC/FL200 N5130 E16130 - N5130 E16230 - N5230 E16230 - N5230 E16130 MOV SE 15KT
FCST VA CLD +6HR:	23/0700Z FL250/350 N5130 E16030 - N5130 E16230 - N5330 E16230 - N5330 E16030 SFC/FL180 N4830 E16330 - N4830 E1660 - N5130 E16630 - N5130 E16330
FCST VA CLD +12HR:	23/1300Z SFC/FL270 N4830 E16130 - N4830 E16600 - N5300 E16600 - N5300 E1630
FCST VA CLD +18HR:	23/1900Z NO VA EXP
RMK:	LATEST REP FM KVERT (0120Z) INDICATES ERUPTION HAS CEASED. TWO DISPERSING VA CLD ARE EVIDENT ON SATELLITE IMAGERY
NXT ADVISORY:	20080923/0730Z

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Table A2-2. Template for Advisory Message for Tropical Cyclones

Key:			
	M	=	inclusion mandatory, part of every message
	C	=	inclusion conditional, included whenever applicable
	=	=	a double line indicates that the text following it should be placed on the subsequent line

NOTE 1: The ranges and resolutions for the numerical elements included in advisory messages for tropical cyclones are shown in Appendix 6, Table A 6-4.

NOTE 2: The explanations for the abbreviations can be found in the Procedures for Air Navigation Services - ICAO Abbreviations and Codes (PANS-ABC, Doc 8400).

NOTE 3: All the elements are mandatory.

NOTE 4: Inclusion of a "colon" after each element heading is mandatory.

NOTE 5: The numbers 1 to 21are included only for clarity and they are not part of the advisory message, as shown in the example.

Table A2-2. Template for Advisory Message for Tropical Cyclones

Element		Detailed Content	Template(s)		Examples	
1	Identification of the type of message (M)	Type of message	TC ADVISORY		TC ADVISORY	
2	Status indicator (C)[1]	Indicator of test or exercise	STATUS:	TEST or EXER	STATUS:	TEST EXER
3	Time of origin (M)	Year, month, day, time in UTC of issue	DTG:	nnnnnnnn/nnnnZ	DTG:	20040925/1900Z
4	Name of TCAC (M)	Name of TCAC (location indicator or full name)	TCAC:	nnnn or nnnnnnnnnn	TCAC:	YUFO[2] MIAMI
5	Name of tropical cyclone (M)	Name of tropical cyclone or "NN" for unnamed tropical cyclone	TC:	nnnnnnnnnnnn or NN	TC:	GLORIA
6	Advisory number (M)	Year in full and message number (separate sequence for each cyclone)	ADVISORY NR:	nnnn/[n][n][n]n	ADVISORY NR:	2004/13

Table A2-2. Template for Advisory Message for Tropical Cyclones (continued)

Element		Detailed Content	Template(s)		Examples	
7	Observed position of centre (M)	Day and time in UTC and position of the centre of the tropical cyclone (in degrees and minutes)	OBS PSN:	nn/nnnnZ Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]	OBS PSN:	25/1800Z N2706 W07306
8	Observed CB cloud^3 (C)	Location of CB cloud referring to latitude and longitude (in degrees and minutes) and vertical extent (flight level)	CB:	WI nnnKM (or nnnNM) OF TC CENTER or WI^4 Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]- Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]- Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]- [Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]- Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]] and TOP [ABV or BLW] FLnnn	CB:	WI 250NM OF TC CENTRE TOP FL500
9	Direction and speed of movement (M)	Direction and speed of movement given in sixteen compass points and km/h (or kt), respectively, or stationary (< 2km/h (1kt))	MOV:	N nnKMH (or KT) or NNE nnKMH (or KT) or NE nnKMH (or KT) or ENE nnKMH (or KT) or	MOV:	NW 20KMH

Table A2-2. Template for Advisory Message for Tropical Cyclones (continued)

Element		Detailed Content	Template(s)		Examples	
				E nnKMH (or KT) or ESE nnKMH (or KT) or SE nnKMH (or KT) or SSE nnKMH (or KT) or S nnKMH (or KT) or SSW nnKMH (or KT) or SW nnKMH (or KT) or WSW nnKMH (or KT) or W nnKMH (or KT) or WNW nnKMH (or KT) or NW nnKMH (or KT) or NNW nnKMH (or KT) or STNR		
10	Central pressure (M)	Central pressure (in hPa)	C:	nnnHPA	C:	965HPA
11	Maximum surface wind (M)	Maximum surface wind near the centre (mean over 10 minutes, in m/s (or kt))	MAX WIND:	nn[n]MPS (or nn[n]KT)	MAX WIND:	22MPS

Table A2-2. Template for Advisory Message for Tropical Cyclones (continued)

Element		Detailed Content	Template(s)		Examples	
12	Forecast of centre position (+6HR) (M)	Day and time (in UTC) (6 hours from the "DTG" given in Item 2); Forecast position (in degrees and minutes) of the centre of the tropical cyclone	FCST PSN +6HR:	nn/nnnnZ Nnn[nn] or Snn[nn] Wnnn(nn) or Ennn[nn]	FCST PSN +6HR:	25/2200Z N2748 W07350
13	Forecast of maximum surface wind (+6HR) (M)	Forecast of maximum surface wind (6 hours after the "DTG" given in Item 3)	FCST MAX WIND +6HR:	nn[n]MPS (or nn[n]KT)	FCST MAX WIND +6HR:	22MPS
14	Forecast of centre position (+12HR) (M)	Day and time (in UTC) (12 hours from the "DTG" given in Item 3); Forecast position (in degrees and minutes) of the centre of the tropical cyclone	FCST PSN +12HR:	nn/nnnnZ Nnn[nn] or Snn[nn] Wnnn(nn) or Ennn[nn]	FCST PSN +12HR:	26/0400Z N2830 W07430
15	Forecast of maximum surface wind (+12HR) (M)	Forecast of maximum surface wind (12 hours after the "DTG" given in Item 3)	FCST MAX WIND +12HR:	nn[n]MPS (or nn[n]KT)	FCST MAX WIND +12HR:	22MPS
16	Forecast of centre position (+18HR) (M)	Day and time (in UTC) (18 hours from the "DTG" given in Item 3); Forecast position (in degrees and minutes) of the centre of the tropical cyclone	FCST PSN +18HR:	nn/nnnnZ Nnn[nn] or Snn[nn] Wnnn(nn) or Ennn[nn]	FCST PSN +18HR:	26/1000Z N2852 W07500
17	Forecast of maximum surface wind (+18HR) (M)	Forecast of maximum surface wind (18 hours after the "DTG" given in Item 3)	FCST MAX WIND +18HR:	nn[n]MPS (or nn[n]KT)	FCST MAX WIND +18HR:	21MPS

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Table A2-2. Template for Advisory Message for Tropical Cyclones (continued)

Element		Detailed Content	Template(s)		Examples	
18	Forecast of centre position (+24HR) (M)	Day and time (in UTC) (24 hours from the "DTG" given in Item 3); Forecast position (in degrees and minutes) of the centre of the tropical cyclone	FCST PSN +24HR:	nn/nnnnZ Nnn[nn] or Snn[nn] Wnnn(nn) or Ennn[nn]	FCST PSN +24HR:	26/1600Z N2912 W07530
19	Forecast of maximum surface wind (+24HR) (M)	Forecast of maximum surface wind (24 hours after the "DTG" given in Item 3)	FCST MAX WIND +24HR:	nn[n]MPS (or nn[n]KT)	FCST MAX WIND +24HR:	20MPS
20	Remarks (M)	Remarks, as necessary	RMK:	Free text up to 256 characters or NIL	RMK:	NIL
21	Expected time of issuance of next advisory (M)	Expected year, month, day and time (in UTC) of issuance of next advisory	NXT MSG:	[BFR] nnnnnnnn/nnnnZ or NO MSG EXP	NXT MSG:	20040925/2000Z

[1] Used only when the message issued to indicate that a test or an exercise is taking place. When the word "TEST" or the abbreviation "EXER" is included, the message may contain information that should not be used operationally or will otherwise end immediately after the word "TEST". [Applicable 7 November 2019]

[2] Fictitious location.

[3] In the case of CB clouds associated with a tropical cyclone covering more than one area within the area of responsibility, this element can be repeated, as necessary.

[4] The number of coordinates should be kept to a minimum and should not normally exceed seven.

Example A2-2. Advisory Message for Tropical Cyclones

TC ADVISORY	
DTG:	20040925/1900Z
TCAC:	YUFO[1]

Example A2-2. Advisory Message for Tropical Cyclones (continued)

TC ADVISORY	
TC:	GLORIA
ADVISORY NR:	2004/13
OBS PSN:	25/1800Z N2706 WI07306
CB	WI 250NM OF TC CENTRE TOP FL500
MOV:	NW 20KMH
C:	965HPA
MAX WIND:	22MPS
FCST PSN +6HR	25/2200Z N2748 W07350
FCST MAX WIND +6HR	22MPS
FCST PSN +12HR:	26/0400Z N2830 W07430
FCST MAX WIND +12HR:	22MPS
FCST PSN +18HR:	26/1000Z N2852 W07500
FCST MAX WIND +18HR:	21MPS
FCST PSN +24HR:	26/1600Z N2912 W07530
FCST MAX WIND +24HR:	20MPS
RMK:	NIL
NXT MSG:	19970925/2000Z

[1] Ficticious location

Table A2-3. Template for Advisory Message for Space Weather Information

Key:	M	=	inclusion mandatory, part of every message
	C	=	inclusion conditional, included whenever applicable;
	=	=	a double line indicates that the text following it should be placed on the subsequent line

NOTE 1: The explanations for the abbreviations can be found in the PANS-ABC, Doc 8400).

NOTE 2: The spatial resolutions are shown in Attachment E.

NOTE 3: Inclusion of a colon after each element heading is mandatory.

NOTE 4: The numbers 1 to 14 are included only for clarity and are not part of the advisory message, as shown in the examples.

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Table A2-3. Template for Advisory Message for Space Weather Information

Element		Detailed Content	Template(s)		Examples	
1	Identification of the type of message (M)	Type of message	SWX ADVISORY		SWX ADVISORY	
2	Status indicator (C)[1]	Indicator of test or exercise	STATUS:	TEST or EXER	STATUS:	TEST EXER
3	Time of origin (M)	Year, month, day and time in UTC	DTG:	nnnnnnnn/nnnnZ	DTG:	20161108/0100Z
4	Name of SWXC (M)	Name of SWXC	SWXC:	Nnnnnnnnnnnn	SWXC:	DONLON[2]
5	Advisory number (M)	Year in full and unique message number	ADVISORY NR:	nnnn/[n][n][n]n	ADVISORY NR:	2016/1
6	Number of advisory being replaced (C)	Number of the previously issued advisory being replaced	NR RPLC:	nnnn/[n][n][n]n	NR RPLC:	2016/1
7	Space weather effect and intensity (M)	Effect and intensity of the space weather phenomena	SWX EFFECT:	HF COM MOD or SEV or SATCOM MOD or SEV or GNSS MOD or SEV or HF COM MOD or SEV AND GNSS MOD or SEV or RADIATION[3] MOD or SEV	SWX EFFECT:	HF COM MOD SATCOM SEV GNSS SEV HF COM MOD AND GNSS MOD RADIATION MOD

Table A2-3. Template for Advisory Message for Space Weather Information (continued)

Element		Detailed Content	Template(s)		Examples	
8	Observed or expected space weather phenomena (M)	Day and time (in UTC) of observed phenomena (or forecast if phenomena have yet to occur) Horizontal extent^3 (latitude bands and longitude in degrees) and/or altitude of space weather phenomena	OBS (or FCST) SWX:	nn/nnnnZ DAYLIGHT SIDE or HNH and/or MNH and/or EQN and/or EQS and/or MSH and/or HSH Wnnn(nn) or Ennn(nn) - Wnnn(nn) or Ennn(nn) and/or ABV FLnnn or FLnnn - nnn or Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - [Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]] or NO SWX EXP	OBS SWX:	08/0100Z DAYLIGHT SIDE 08/0100Z HNH HSH E18000 - W18000 08/0100Z HNH HSH W18000 - W09000 ABV FL350

Table A2-3. Template for Advisory Message for Space Weather Information (continued)

Element		Detailed Content	Template(s)		Examples	
9	Forecast of the phenomena (+6HR) (M)	Day and time (in UTC) (6 hours from the time given in Item 8, rounded to the next full hour); Forecast extent and/or altitude of the space weather phenomena for that fixed valid time	FCST SWX +6HR:	nn/nnnnZ DAYLIGHT SIDE or HNH and/or MNH and/or EQN and/or EQS and/or MSH and/or HSH Wnnn(nn) or Ennn(nn) - Wnnn(nn) or Ennn(nn) and/or ABV FLnnn or FLnnn - nnn or Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - [Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]] or NO SWX EXP or NOT AVBL	FCST SWX +6HR:	08/0700Z DAYLIGHT SIDE 08/0700Z HNH HSH W18000 - W09000 ABV FL350 08/0700Z HNH HSH E18000 - W18000

Table A2-3. Template for Advisory Message for Space Weather Information (continued)

Element		Detailed Content	Template(s)		Examples	
10	Forecast of the phenomena (+12HR) (M)	Day and time (in UTC) (12 hours from the time given in Item 8, rounded to the next full hour); Forecast extent and/or altitude of the space weather phenomena for that fixed valid time	FCST SWX +12HR:	nn/nnnnZ DAYLIGHT SIDE or HNH and/or MNH and/or EQN and/or EQS and/or MSH and/or HSH Wnnn(nn) or Ennn(nn) - Wnnn(nn) or Ennn(nn) and/or ABV FLnnn or FLnnn - nnn or Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - [Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] -	FCST SWX +12HR:	08/1300Z DAYLIGHT SIDE 08/1300Z HNH HSH W18000 - W09000 ABV FL350 08/1300Z HNH HSH E18000 - W18000

Table A2-3. Template for Advisory Message for Space Weather Information (continued)

Element		Detailed Content	Template(s)	Examples
			Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]] or NO SWX EXP or NOT AVBL	

Table A2-3. Template for Advisory Message for Space Weather Information (continued)

Element		Detailed Content	Template(s)		Examples	
11	Forecast of the phenomena (+18HR) (M)	Day and time (in UTC) (18 hours from the time given in Item 8, rounded to the next full hour); Forecast extent and/or altitude of the space weather phenomena for that fixed valid time	FCST SWX +18HR:	nn/nnnnZ DAYLIGHT SIDE or HNH and/or MNH and/or EQN and/or EQS and/or MSH and/or HSH Wnnn(nn) or Ennn(nn) - Wnnn(nn) or Ennn(nn) and/or ABV FLnnn or FLnnn - nnn or Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - [Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]] or NO SWX EXP or NOT AVBL	FCST SWX +18HR:	08/1900Z DAYLIGHT SIDE 08/1900Z HNH HSH W18000 - W09000 ABV FL350 08/1300Z HNH HSH E18000 - W18000

Table A2-3. Template for Advisory Message for Space Weather Information (continued)

Element		Detailed Content	Template(s)		Examples	
12	Forecast of the phenomena (+24HR) (M)	Day and time (in UTC) (24 hours from the time given in Item 8, rounded to the next full hour); Forecast extent and/or altitude of the space weather phenomena for that fixed valid time	FCST SWX +24HR:	nn/nnnnZ DAYLIGHT SIDE or HNH and/or MNH and/or EQN and/or EQS and/or MSH and/or HSH Wnnn(nn) or Ennn(nn) - Wnnn(nn) or Ennn(nn) and/or	FCST SWX +24HR:	09/0100Z DAYLIGHT SIDE 09/0100Z HNH HSH W18000 - W09000 ABV FL350 09/0100Z HNH HSH E18000 - W18000

Table A2-3. Template for Advisory Message for Space Weather Information (continued)

Element		Detailed Content	Template(s)	Examples
			ABV FLnnn or FLnnn - nnn or Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - [Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]] or NO SWX EXP or NOT AVBL	

Table A2-3. Template for Advisory Message for Space Weather Information (continued)

Element		Detailed Content	Template(s)		Examples	
13	Remarks (M)	Remarks, as necessary	RMK:	Free text up to 256 characters or NIL	RMK:	SWX EVENT HAS CEASED WWW.SPACEWEATHERPROVIDER.GOV NIL
14	Next advisory (M)	Year, month, day and time in UTC	NXT ADVISORY:	nnnnnnnn/nnnnZ or NO FURTHER ADVISORIES or WILL BE ISSUED BY nnnnnnnn/nnnnZ	NXT ADVISORY:	20161108/0700Z NO FURTHER ADVISORIES

[1] Used only when the message issued to indicate that a test or an exercise is taking place. When the word “TEST” or the abbreviation “EXER” is included, the message may contain information that should not be used operationally or will otherwise end immediately after the word ”TEST”. [Applicable 7 November 2019]

[2] Ficticious location.

[3] One or more latitude ranges should be included in the space weather advisory information for “GNSS” and “RADIATION”.

Example A2-3. Space Weather Advisory Message (GNSS and HFCOM effects)

DTG:	20161108/0100Z
SWXC:	DONLON[1]
ADVISORY NR:	2016/2
NR RPLC:	2016/1
SWX EFFECT:	HF COM MOD AND GNSS MOD
OBS SWX:	08/0100Z HNH HSH E18000 - W18000
FCST SWX +6HR:	08/0700Z HNH HSH E18000 - W18000
FCST SWX + 12HR:	08/1300Z HNH HSH E18000 - W18000
FCST SWX + 18HR:	08/1900Z HNH HSH E18000 - W18000

Example A2-3. Space Weather Advisory Message (GNSS and HFCOM effects) (continued)

FCST SWX +24HR:	09/0100Z NO SWX EXP
RMK	LOW LVL GEOMAGNETIC STORMING CAUSING INCREASED AURORAL ACT AND SUBSEQUENT MOD DEGRADATION OF GNSS AND HF COM AVBL IN THE AURORAL ZONE. THIS STORMING EXP TO SUBSIDE IN THE FCST PERIOD. SEE WWW.SPACEWEATHERPROVIDER.WEB
NXT ADVISORY:	NO FURTHER ADVISORIES

[1] Ficticious location

Example A2-4. Space Weather Advisory Message (RADIATION effects)

SWX ADVISORY	
DTG:	20161108/0100Z
SWXC:	DONLON[1]
ADVISORY NR:	2016/2
NR RPLC:	2016/1
SWX EFFECT:	RADIATION MOD
OBS SWX:	08/0100Z HNH HSH E18000 - W18000 ABV FL350
FCST SWX +6HR:	08/0700Z HNH HSH E18000 - W18000 ABV FL350
FCST SWX + 12HR:	08/1300Z HNH HSH E18000 - W18000 ABV FL350
FCST SWX + 18HR:	08/1900Z HNH HSH E18000 - W18000 ABV FL350
FCST SWX +24HR:	09/0100Z NO SWX EXP
RMK	RADIATION LVL EXCEEDED 100 PCT OF BACKGROUND LVL AT FL350 AND ABV. THE CURRENT EVENT HAS PEAKED AND LVL SLW_RTN TO BACKGROUND LVL. SEE WWW.SPACEWEATHERPROVIDER.WEB
NXT ADVISORY:	NO FURTHER ADVISORIES

[1] Ficticious location

Example A2-5. Space Weather Advisory Message (HFCOM effects)

SWX ADVISORY	
DTG:	20161108/0100Z
SWXC:	DONLON[1]

Example A2-5. Space Weather Advisory Message (HFCOM effects) (continued)

SWX ADVISORY	
ADVISORY NR:	2016/1
SWX EFFECT:	HF COM SEV
OBS SWX:	08/0100Z DAYLIGHT SIDE
FCST SWX +6HR:	08/0700Z DAYLIGHT SIDE
FCST SWX + 12HR:	08/1300Z DAYLIGHT SIDE
FCST SWX + 18HR:	08/1900Z DAYLIGHT SIDE
FCST SWX +24HR:	09/0100Z NO SWX EXP
RMK	PERIODIC HF COM ABSORPTION AND LIKELY TO CONT IN THE NEAR TERM. CMPL AND PERIODIC LOSS OF HF ON THE SUNLIT SIDE OF THE EARTH EXP. CONT HF COM DEGRADATION LIKELY OVER THE NXT 7 DAYS. SEE WWW.SPACEWEATHERPROVIDER.WEB
NXT ADVISORY:	20161108/0700Z

[1] Ficticious location

Appendix 3. Technical Specifications related to Meteorological Observations and Reports

Table A3-1. Template for the Local Routine (MET REPORT) and Local Special (SPECIAL) Reports

Key:	M	=	inclusion mandatory, part of every message
	C	=	inclusion conditional, dependent on meteorological conditions
	O	=	inclusion optional

NOTE 1: The ranges and resolutions for the numerical elements included in the local routine and special reports are shown in Table A3-4 of this Appendix.

NOTE 2: The explanations for the abbreviations used can be found in the Procedures for Air Navigation Services - ICAO Abbreviations and Codes (PANS-ABC, Doc 8400).

Table A3-1. Template for the Local Routine (MET REPORT) and Local Special (SPECIAL) Reports

Element as specified in Chapter 4	Detailed Content	Template(s)	Examples
Identification of the type of report (M)	Type of report	MET REPORT or SPECIAL	MET REPORT SPECIAL
Location indicator (M)	ICAO location indiactor (M)	nnnn	YUDO[1]
Time of the observation (M)	Day and actual time of the observation in UTC	nnnnnnZ	221630Z
Identification of an automated report (C)	Automated report identifier (C)	AUTO	AUTO
Surface wind (M)	Name of the element (M)	WIND	WIND 240/4MPS (WIND 240/8KT)

Table A3-1. Template for the Local Routine (MET REPORT) and Local Special (SPECIAL) Reports (continued)

Element as specified in Chapter 4	Detailed Content	Template(s)			Examples
	Runway (O)[2]	RWY nn[L] or RWY nn[C] or RWY nn[R]			
	Runway section (O)[3]	TDZ			WIND RWY 18 TDZ 190/6MPS (WIND RWY 18 TDZ 190/12KT)
	Wind direction (M)	nnn/	VRB BTN nnn/ AND nnn/ or VRB	CALM	WIND VRB1MPS WIND CALM (WIND VRB2KT) WIND VRB BTN 350/ AND 050/1MPS (WIND VRB BTN 350/ AND 050/2KT)
	Wind speed (M)	[ABV]n[n][n]MPS (or [ABV]n[n]KT)			WIND 270/ABV49MPS (WIND 270/ABV99KT)
	Significant speed variations (C)[4]	MAX[ABV]nn[n] MNMn[n]			WIND 120/3MPS MAX9 MNM2 (WIND 120/6KT MAX18 MNM4)
	Significant directional variations (C)[5]	VRB BTN nnn/ AND nnn/	—		WIND 020/5MPS VRB BTN 350/ AND 070/ (WIND 020/10KT VRB BTN 350/ AND 070/)
	Runway sections (O)[3]	MID			WIND RWY 14R MID 140/6MPS (WIND RWY 14R MID 140/12KT)

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Table A3-1. Template for the Local Routine (MET REPORT) and Local Special (SPECIAL) Reports (continued)

Element as specified in Chapter 4	Detailed Content	Template(s)			Examples
	Wind direction (O)[3]	nnn/	VRB BTN nnn/ AND nnn/ or VRB	CALM	WIND RWY 27 TDZ 240/8MPS MAX14 MNM5 END 250/7MPS (WIND RWY 27 TDZ 240/16KT MAX28 MNM10 END 250/14KT)
	Wind speed (O)[3]	[ABV]n[n][n]MPS (or [ABV]n[n]KT)			
	Significant speed variations (C)[4]	MAX[ABV]nn[n] MNMn[n]			
	Significant directional variations (C)[5]	VRB BTN nnn/ AND nnn/	—		
	Runway section (O)[3]	END			
	Wind direction (O)[3]	nnn/	VRB BTN nnn/ AND nnn/ or VRB	CALM	
	Wind speed (O)[3]	[ABV]n[n][n]MPS (or [ABV]n[n]KT)			
	Significant speed variations (C)[4]	MAX[ABV]nn[n] MNMn[n]			
	Significant directional variations (C)[5]	VRB BTN nnn/ AND nnn/	—		

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Table A3-1. Template for the Local Routine (MET REPORT) and Local Special (SPECIAL) Reports (continued)

Element as specified in Chapter 4	Detailed Content	Template(s)		Examples
Visibility (M)	Name ot the element (M)	VIS	CAVOK	VIS 350M CAVOK VIS 7KM VIS 10KM VIS RWY 09 TDZ 800M END 1200M VIS RWY 18C TDZ 6KM RWY 27 TDZ 4000M
	Runway (O)[2]	RWY nn[L] or RWY nn[C] or RWY nn[R]		
	Runway section (O)[3]	TDZ		
	Visibilty (M)	n[n][n][n]M or n[n]KM		
	Runway section (O)[3]	MID		
	Visibility (O)[3]	n[n][n][n]M or n[n]KM		
	Runway section (O)[3]	END		
	Visibility (O)[3]	n[n][n][n]M or n[n]KM		
RVR (C)[6]	Name of the element (M)	RVR		RVR RWY 32 400M RVR RWY 20 1600M RVR RWY 10L BLW 50M RVR RWY 14 ABV 2000M RVR RWY 10 BLW 150M RVR RWY 12 ABV 1200M
	Runway (C)[7]	RWY nn[L] or RWY nn[C] or RWY nn[R]		
	Runway section (C)[8]	TDZ		
	RVR (M)	[ABV or BLW] nn[n][n]M		
	Runway section (C)[8]	MID		

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Table A3-1. Template for the Local Routine (MET REPORT) and Local Special (SPECIAL) Reports (continued)

Element as specified in Chapter 4	Detailed Content	Template(s)			Examples
	RVR (C)[8]	[ABV or BLW] nn[n][n]M			RVR RWY12 TDZ 1100M MID ABV 1400M RVR RWY 16 TDZ 600M MID 500M END 400M RVR RWY 26 500M RWY 20 800M
	Runway section (C)[8]	END			
	RVR (C)[8]	[ABV or BLW] nn[n][n]M			
Present weather (C)[9, 10]	Intensity of present weather (C)[9]	FBL or MOD or HVY	—		

Table A3-1. Template for the Local Routine (MET REPORT) and Local Special (SPECIAL) Reports (continued)

Element as specified in Chapter 4	Detailed Content	Template(s)			Examples
	Characteristics and type of present weather (C)[9, 11]	DZ or RA or SN or SG or PL or DS or SS or FZDZ or FZUP[12] or FC[13] or FZRA or SHGR or SHGS or SHRA or SHSN or SHUP[12] or TSGR or TSGS or TSRA or TSSN or TSUP[12] or UP[12]	FG or BR or SA or DU or HZ or FU or VA or SQ or PO or TS or BCFG or BLDU or BLSA or BLSN or DRDU or DRSA or DRSN or FZFG or MIFG or PRFG or //[12]		MOD RA HVY TSRA HVY DZ FBL SN HZ FG VA MIFG HVY TSRASN FBL SNRA FBL DZ FG HVY SHSN BLSN HVY TSUP //
Cloud (M)[14]	Name of the element (M)	CLD			CLD NSC CLD SCT 300M OVC 600M (CLD SCT 1000FT OVC 2000FT) CLD OBSC VER VIS 150M
	Runway (O)[2]	RWY nn[L] or RWY nn[C] or RWY nn[R]			

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Table A3-1. Template for the Local Routine (MET REPORT) and Local Special (SPECIAL) Reports (continued)

Element as specified in Chapter 4	Detailed Content	Template(s)				Examples
	Cloud amount (M) or vertical visibility (O)[9]	FEW or SCT or BKN or OVC or ///[12]	OBSC	NSC or NCD[12]		(CLD OBSC VER VIS 500FT) CLD BKN TCU 270M (CLD BKN TCU 900FT) CLD RWY 08R BKN 60M RWY 26 BKN 90M) (CLD RWY 08R BKN 200FT RWY 26 BKN 300FT) CLD /// CB ///M (CLD /// CB ///FT) CLD /// CB 400M (CLD /// CB 1200FT) CLD NCD
	Cloud type (C)[9]	CB or TCU or ///[12]	—			
	Height of cloud base or the value of vertical visibility (C)[9]	n[n][n][n] M (or n[n][n][n] FT) or ///M (or /// FT)[12]	[VER VIS n[n][n]M (or VER VIS n[n][n][n] FT)] or VER VIS ///M (or VER VIS ///FT)[12]			
Air temperature (M)	Name of the element (M)	T				T17 TMS08
	Air temperature (M)	[MS]nn				

Table A3-1. Template for the Local Routine (MET REPORT) and Local Special (SPECIAL) Reports (continued)

Element as specified in Chapter 4	Detailed Content	Template(s)	Examples
Dew-point temperature (M)	Name of the element (M)	DP	DP15 DPMS18
	Dew-point temperature (M)	[MS]nn	
Pressure values (M)	Name of the element (M)	QNH	QNH 0995HPA QNH 1009HPA
	QNH (M)	nnnnHPA	
	Name of the element (O)	QFE	QNH 1022HPA QFE 1001HPA QNH 0987HPA QFE RWY 18 0956HPA RWY 24 0955HPA
	QFE (O)	[RWY nn[L] or RWY nn[C] or RWY nn[R]] nnnnHPA [RWY nn[L] or RWY nn[C] or RWY nn[R] nnnnHPA]	
Supplementary information (C)[9]	Significant meteorological phenomena (C)[9]	CB or TS or MOD TURB or SEV TURB or WS or GR or SEV SQL or MOD ICE or SEV ICE or FZDZ or FZRA or SEV MTW or SS or DS or BLSN or FC[15]	FC IN APCH WS IN APCH 60M-WIND 360/13MPS WS RWY 12
	Location of the phenomenon (C)[9]	IN APCH [n[n][n][n]M-WIND nnn/n[n]MPS] or IN CLIMB-OUT [n[n][n][n]M-WIND nnn/n[n]MPS] (IN APCH [n[n][n][n]FT-WIND nnn/n[n]KT] or IN CLIMB-OUT [n[n][n][n]FT-WIND nnn/n[n]KT] or RWY nn[L] or RWY nn[C] or RWY nn[R]	

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Table A3-1. Template for the Local Routine (MET REPORT) and Local Special (SPECIAL) Reports (continued)

Element as specified in Chapter 4	Detailed Content	Template(s)			Examples
	Recent weather (C)[9, 10]	RERASN or REFZRA or REDZ or RE[SH]RA or RE[SH]SN or RESG or RESHGR or RESHGS or REBLSN or RESS or REDS or RETSRA or RETSSN or RETSGR or RETSGS or REFC or REPL or REUP[12] or REFZUP[12] or RETSUP[12] or RESHUP[12] or REVA or RETS			REFZRA CB IN CLIMB-OUT RETSRA
Trend forecast (O)[16]	Name of the element (M)	TREND			TREND NOSIG TREND BECMG FEW 600M (TREND BECMG FEW 2000FT)
	Change indicator (M)[17]	NOSIG	BECMG or TEMPO		TREND TEMPO 250/18MPS MAX25 (TREND TEMPO 250/36KT MAX50)
	Period of change (C)[9]		FMnnnn and/or TLnnnn or ATnnnn		
	Wind (C)[9]		nnn/[ABV]n[n][n]MPS [MAX[ABV]nn[n]] (or nnn/[ABV]n[n]KT [MAX[ABV]nn])		
	Visibility (C)[9]		VIS n[n][n][n]M or VIS n[n]KM	CAVOK	TREND BECMG AT1800 VIS 10KM NSW TREND BECMG TL1700 VIS 800M FG TREND BECMG FM1030 TL1130 CAVOK

Table A3-1. Template for the Local Routine (MET REPORT) and Local Special (SPECIAL) Reports (continued)

Element as specified in Chapter 4	Detailed Content	Template(s)					Examples
	Weather phenomenon intensity (C)[9]		FBL or MOD or HVY	—	NSW		TREND TEMPO TL1200 VIS 600M BECMG AT1230 VIS 8KM NSW CLD NSC

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Table A3-1. Template for the Local Routine (MET REPORT) and Local Special (SPECIAL) Reports (continued)

Element as specified in Chapter 4	Detailed Content	Template(s)					Examples
	Weather phenomenon: characteristics and type (C)[9, 10, 11]		DZ or RA or SN or SG or PL or DS or SS or FZDZ or FZRA or SHGR or SHGS or SHRA or SHSN or TSGR or TSGS or TSRA or TSSN	FG or BR or SA or DU or HZ or FU or VA or SQ or PO or FC or TS or BCFG or BLDU or BLSA or BLSN or DRDU or DRSA or DRSN or FZFG or MIFG or PRFG			TREND TEMPO FM0300 TL0430 MOD FZRA TREND BECMG FM1900 VIS 500M HVY SNRA TREND BECMG FM1100 MOD SN TEMPO FM1130 BLSN TREND BECMG AT 1130 CLD OVC 300M (TREND BECMG AT 1130 CLD OVC 1000FT) TREND TEMPO TL1530 HVY SHRA CLD BKN CB 360M (TREND TEMPO TL1530 HVY SHRA CLD BKN CB 1200FT)

Table A3-1. Template for the Local Routine (MET REPORT) and Local Special (SPECIAL) Reports (continued)

Element as specified in Chapter 4	Detailed Content	Template(s)					Examples
	Name of the element (C)[9]		CLD				
	Cloud amount and vertical visibility (C)[9, 14]		FEW or SCT or BKN or OVC	OBSC	NSC		
	Cloud type (C)[9, 14]		CB or TCU	—			
	Height of cloud base or the value of vertical visibility (C)[9, 14]		n[n][n][n] M (or n[n][n][n] FT)	[VER VIS n[n][n]M (or VER VIS n[n][n][n] FT)]			

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[1] Fictitous location.

[2] Optional values for one or more runways.

[3] Optinal values for one or more sections of the runway.

[4] To be included in accordance with 4.1.5.2 c).

[5] To be included in accordance with 4.1.5.2 b) 1).

[6] To be included if visibility or RVR < 1500m.

[7] To be included in accordance with 4.3.6.4 d)

[8] To be included in accordance with 4.3.6.4 c).

[9] To be included whenever applicable.

[10] One or more, up to a maximum of three groups, in accordance with 4.4.2.9 a), 4.8.1.1 and Appendix 5, 2.2.4.3.

[11] Precipitation types listed under 4.4.2.3 a) may be combined in accordance with 4.4.2.9 c) and Appendix 5, 2.2.4.1. Only moderate or heavy precipitation to be indicated in trend forecast in accordance with Appendix 5, 2.2.4.1.

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[12] For automated reports only.

[13] Heavy used to indicate tornado or waterspout; moderate used to indicate funnel cloud not reaching the ground.

[14] Up to four cloud layers in accordance with 4.5.4.3 e).

[15] Abbreviation plain language may be used in accordance with 4.8.1.2.

[16] To be included in accordance with Chapter 6, 6.3.2.

[17] Number of change indicators to be kept to a minimum in accordance with Appendix 5, 2.2.1, normally not exceeding three groups.

Table A3-2. Template for METAR and SPECI

Key:			
	M	=	inclusion mandatory, part of every message
	C	=	inclusion conditional, dependent on meteorological conditions or method of observation
	O	=	inclusion optional

NOTE 1: The ranges and resolutions for the numerical elements included in METAR and SPECI are shown in Table A3-5 of this Appendix.

NOTE 2: The explanations for the abbreviations used can be found in the PANS-ABC (Doc 8400).

Table A3-2. Template for METAR and SPECI

Element as specified in Chapter 4	Detailed Content	Template(s)	Examples
Identification of the type of report (M)	Type of report (M)	METAR, METAR COR, SPECI or SPECI COR	METAR METAR COR SPECI
Location indicator (M)	ICAO location indicator (M)	nnnn	YUDO[1]
Time of the observation (M)	Day and actual time of the observation in UTC (M)	nnnnnnZ	221630Z

Table A3-2. Template for METAR and SPECI (continued)

Element as specified in Chapter 4	Detailed Content	Template(s)		Examples	
Indentification of an automated or missing report (C)[2]	Automated or missing report identifier (C)	AUTO or NIL		AUTO NIL	
END OF METAR IF THE REPORT IS MISSING.					
Surface wind (M)	Wind direction (M)	nnn	VRB	24004MPS (24008KT)	VRB01MPS (VRB02KT)
	Wind speed (M)	[P]nn[n]		19006MPS (19012KT) 00000MPS (00000KT) 140P149MPS (140P99KT)	
	Significant speed variations (C)[3]	G[P]nn[n]		12003G09MPS (12006G18KT) 24008G14MPS (24016G28KT)	
	Units of measurement (M)	MPS (or KT)			
	Significant directional variations (C)[4]	nnnVnnn	–	02005MPS 350V070 (02010KT 350V070)	
Visibility (M)	Prevailing or minimum visibility (M)[5]	nnnn	CAVOK	0350 7000 9999 0800	CAVOK

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Table A3-2. Template for METAR and SPECI (continued)

Element as specified in Chapter 4	Detailed Content	Template(s)				Examples
	Minimum visibility and direction of the minimum visibility (C)[6]	nnnn[N] or nnnn[NE] or nnnn[E] or nnnn[SE] or nnnn[S] or nnnn[SW] or nnnn[W] or nnnn[NW]				2000 1200NW 6000 2800E 6000 2800
RVR (C)[7]	Name of the element (M)	R				R32/0400 R12R/1700 R10/M0050 R14L/P2000
	Runway (M)	nn[L]/ or nn[C]/ or nn[R]/				
	RVR (M)	[P or M]nnnn				R16L/0650 R16C/0500 R16R/0450 R17L/0450
	RVR past tendency (C)[8]	U, D or N				R12/1100U R26/0550N R20/0800D R12/0700
Present weather (C)[2, 9]	Intensity or proximity of present weather (C)[10]	- or +	—	VC		
	Characteristics and type of present weather (M)[11]	DZ or RA or SN or SG or PL or DS or SS or FZDZ or FZRA or FZUP[12] or	FG or BR or SA or DU or HZ or FU or VA or SQ or PO or TS or BCFG or BLDU or BLSA or BLSN or DRDU or DRSA or	FG or PO or FC or DS or SS or TS or SH or BLSN or BLSA or		RA HZ VCFG +TSRA FG VCSH +DZ VA VCTS -SN MIFG VCBLSA

Table A3-2. Template for METAR and SPECI (continued)

Element as specified in Chapter 4	Detailed Content	Template(s)				Examples
		FC[13] or SHGR or SHGS or SHRA or SHSN or SHUP[12] or TSGR or TSGS or TSRA or TSSN or TSUP[12] or UP[12]	DRSN or FZFG or MIFG or PRFG or //[12]	BLDU or VA		+TSRASN -SNRA DZ FG +SHSN BLSN UP FZUP TSUP FZUP //
Cloud (M)[14]	Cloud amount and height of cloud base or vertical visibility (M)	FEWnnn or SCTnnn or BKNnnn or OVCnnn or FEW///[12] or SCT///[12] or BKN///[12]	VVnnn or VV///[12]	NSC or NCD[12]		FEW015 VV005 OVC030 VV/// NSC SCT010 OVC020

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Table A3-2. Template for METAR and SPECI (continued)

Element as specified in Chapter 4	Detailed Content	Template(s)				Examples
		2 or OVC///[12] or ///nn[12] or //////[12]				BKN/// ///015
	Cloud Type (C)[2]	CB or TCU or ///[12]	—			BKN009TCU SCT008 BKN025CB ///CB NCD BKN025 ///
Air and dew-point temperature (M)	Air and dew-point temperatures (M)	[M]nn/[M]nn				17/10 02/M08 M01/M10
Pressure values (M)	Name of the element (M)	Q				Q0995 Q1009 Q1022 Q0987
	QNH (M)	nnnn				
Supplementary information (C)	Recent weather (C)[2, 9]	RERASN or REFZRA or REDZ or RE[SH]RA or RE[SH]SN or RESG or RESHGR or RESHGS or REBLSN or RESS or REDS or RETSRA or RETSSN or RETSGR or RETSGS or RETS or REFC or REVA or REPL or REUP[12] or REFZUP[12] or RETSUP[12] or RESHUP[12]				REFZRA RETSRA
	Wind shear (C)[2]	WS Rnn[L] or WS Rnn[C] or WS Rnn[R] or WS ALL RWY				WS R03 WS ALL RWY WSR18C

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Table A3-2. Template for METAR and SPECI (continued)

Element as specified in Chapter 4	Detailed Content		Template(s)			Examples	
	Sea-surface temperature and state of the sea or significant wave height (C)[15]		W[M]nn/Sn or W[M]nn/Hn[n][n]			W15/S2 W12/H75	
	State of the runway[16]	Runway designator (M)	Rnn[L]/ *or* Rnn[C]/ *or* Rnn[R]/		R/SNOCLO	R99/421594 R/SNOCLO R14L/CLRD//	
		Runway deposits (M)	n *or* /	CLRD//			
		Extent of runway contamination (M)	n *or* /				
		Depth of deposit (M)	n *or* //				
		Friction coefficient *or* braking action (M)	n *or* //				
Trend forecast (O)[17]	Change indicator (M)[18]		NOSIG	BECMG or TEMPO		NOSIG	BECMG FEW020

Table A3-2. Template for METAR and SPECI (continued)

Element as specified in Chapter 4	Detailed Content	Template(s)					Examples
	Period of change (C)[2]		FMnnnn and/or TLnnnn or ATnnnn				
	Wind (C)[2]		nnn[P]nn[n][G[P]nn[n]]MPS (or nnn[P]nn[G[P]nn]KT)				TEMPO 25018G25MPS (TEMPO 25035G50KT)
	Prevailing visibility (C)[2]		nnnn			CAVOK	BECMG FM1030 TL1130 CAVOK
	Weather phenomenon: intensity (C)[10]		- or +	—	NSW		BECMG TL1700 0800 FG BECMG AT1800 9000 NSW BECMG FM1900 0500 +SNRA BECMG FM1100 SN TEMPO FM1130 BLSN TEMPO FM0330 TL0430 FZRA TEMPO TL1200 0600 BECMG AT1200 8000 NSW NSC BECMG AT1130 OVC010 TEMPO TL1530 +SHRA BKN012CB

Table A3-2. Template for METAR and SPECI (continued)

Element as specified in Chapter 4	Detailed Content	Template(s)					Examples
	Weather phenomenon: characteristics and type (C)$^{2, 9, 11}$		DZ or RA or SN or SG or PL or DS or SS or FZDZ or FZRA or SHGR or SHGS or SHRA or SHSN or TSGR or TSGS or TSRA or TSSN	FG or BR or SA or DU or HZ or FU or VA or SQ or PO or FC or TS or BCFG or BLDU or BLSA or BLSN or DRDU or DRSA or DRSN or FZFG or MIFG or PRFG			

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Table A3-2. Template for METAR and SPECI (continued)

Element as specified in Chapter 4	Detailed Content	Template(s)					Examples
	Cloud amount and height of cloud base or vertical visibility (C)[2, 14]		FEWnnn or SCTnnn or BKNnnn or OVCnnn	VVnnn or VV///	NSC		
	Cloud type (C)[2, 14]		CB or TCU	—			

[1] Fictitous location.

[2] To be included whenever applicable.

[3] To be included in accordance with 4.1.5.2 c).

[4] To be included in accordance with 4.1.5.2 b) 1).

[5] To be included in accordance with 4.2.4.4 b).

[6] To be included in accordance with 4.2.4.4 a).

[7] To be included if visibility or RVR <1500m; for up to a maximum of four runways in accordance with 4.3.6.5 b).

[8] To be included in accordance with 4.3.6.6.

[9] One or more, up to a maximum of three groups, in accordance with 4.4.2.9 a), 4.8.1.1 and Appendix 5, 2.2.4.1.

[10] To be included whenever applicable; no qualifier for moderate intensity in accordance with 4.4.2.8.

[11] Precipitation types listed under 4.4.2.3 a) may be combined in accordance with 4.4.2.9 c) and Appendix 5, 2.2.4.1. Only moderate or heavy precipitation to be indicated in trend forecast in accordance with Appendix 5, 2.2.4.1.

[12] For automated reports only.

[13] Heavy used to indicate tornado or waterspout; moderate (no qualifier) to indicate funnel cloud not reaching the ground.

[14] Up to four cloud layers in accordance with 4.5.4.3 e).

[15] To be included in accordance with 4.8.1.5 a).

[16] To be included in accordance with 4.6.1.5 b) until 3 November 2021.

[17] To be included in accordance with Chapter 6, 6.3.2.

[18] Number of change indicators to be kept to a minimum in accordance with Appendix 5, 2.2.1, normally not exceeding three groups.

Table A3-3. Use of Change Indicators in Trend Forecast

Change Indicator	Time Indicator and Period	Meaning	
NOSIG	—	no significant changes are forecast	
BECMG	FM$n_1n_1n_1n_1$ TL$n_2n_2n_2n_2$	the change is forecast to	commence at $n_1n_1n_1n_1$ UTC and be completed by $n_2n_2n_2n_2$ UTC
	TLnnnn		commence at the beginning of the trend forecast period and be completed by nnnn UTC
	FMnnnn		commence at nnnn UTC and be completed by the end of the trend forecast period
	ATnnnn		occur at nnnn UTC (specified time)
	—		a. commence at the beginning of the trend forecast period and be completed by the end of the trend forecast period; or b. the time is uncertain
TEMPO	FM$n_1n_1n_1n_1$ TL$n_2n_2n_2n_2$	temporary fluctuations are forecast to	commence at $n_1n_1n_1n_1$ UTC and cease by $n_2n_2n_2n_2$ UTC
	TLnnnn		commence at the beginning of the trend forecast period and cease by nnnn UTC
	FMnnnn		commence at nnnn UTC and cease by the end of the trend forecast period
	—		commence at the beginning of the trend forecast period and cease by the end of the trend forecast period

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Tables A3-4. Ranges and Resolutions for the Numerical Elements included in Local Reports

Elements as specified in Chapter 4		Range	Resolution
Runway	(no units)	01 - 36	1
Wind direction	°true	010 - 360	10
Wind speed	MPS	1 - 99[1]	1
	KT	1 - 199[1]	1
Visibility	M	0 - 750	50
	M	800 - 4900	100
	KM	5 - 9	1
	KM	10 -	0 (fixed value: 10KM)
Runway visual range	M	0 - 375	25
	M	400 - 750	50
	M	800 - 2000	100
Vertical visibility	M	0 - 75[2]	15
	M	90 - 600	30
	FT	0 - 250[2]	50
	FT	300 - 2000	100
Clouds: height of cloud base	M	0 - 75[2]	15
	M	90 - 3000	30
	FT	0 - 250[2]	50
	FT	300 - 10000	100
Air temperature; Dew-point temperature	°C	-80 - +60	1
QNH; QFE	hPa	0500 - 1100	1

[1] There is no aeronautical requirement to report surface wind speeds of 50m/s (100kt) or more; however, provision has been made for reporting wind speeds up to 99m/s (199kt) for non-aeronautical purposes, as necessary.

[2] Under circumstances as specified in 4.5.4.2; otherwise a resolution of 30m (100ft) is to be used.

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Table A3-5. Ranges and Resolutions for the Numerical Elements included in METAR and SPECI

Element as specified in Chapter 4			Range	Resolution
Runway		(no units)	01 - 36	1
Wind direction		°true	000 - 360	10
Wind speed		MPS	00 - 99[1]	1
		KT	00 - 199[1]	1
Visibility		M	0000 - 0750	50
		M	0800 - 4900	100
		M	5000 - 9000	1000
		M	10000 -	0 (fixed value: 9999)
Runway visual range		M	0000 - 0375	25
		M	0400 - 0750	50
		M	0800 - 2000	100
Vertical visibility		30's M (100's FT)	000 - 020	1
Clouds: height of cloud base		30's M (100's FT)	000 - 100	1
Air temperature; Dew-point temperature		°C	-80 - +60	1
QNH		hPa	0850 - 1100	1
Sea-surface temperature		°C	-10 - +40	1
State of the sea		(no units)	0 - 9	1
Significant wave height		M	0 - 999	0.1
State of the runway	Runway designator:	(no units)	01-36; 88; 99	1
	Runway deposit:	(no units)	0-9	1
	Extent of runway contamination:	(no units)	1; 2; 5; 9	—

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Table A3-5. Ranges and Resolutions for the Numerical Elements included in METAR and SPECI (continued)

Element as specified in Chapter 4			Range	Resolution
	Depth of deposit:	(no units)	00-90; 92-99	1
	Friction coefficient/braking action:	(no units)	00-95; 99	1

[1] There is no aeronautical requirement to report surface wind speeds of 50m/s (100kt) or more; however, provision has been made for reporting wind speeds up to 99m/s (199kt) for non-aeronautical purposes, as necessary.

Example A3-1. Routine Report

a. Local routine report (same location and weather conditions as METAR):

MET REPORT YUDO 221630Z WIND 240/4MPS VIS 600M RVR RWY 12 TDZ 1000M MOD DZ FG CLD SCT 300M OVC 600M T17 DP16 QNH 1018 HPA TREND BECMG TL1700 VIS 800M FG BECMG AT1800 VIS 10KM NSW

b. METAR for YUDO (Donlon/International)[1]:

METAR YUDO 221630Z 24004MPS 0600 R12/1000U DZ FG SCT010 OVC020 17/16 Q1018 BECMG TL1700 0800 FG BECMG AT1800 9999 NSW

Meaning of both reports:

Routine report for Donlon/International[1] issued on the 22nd of the month at 1630 UTC; surface wind direction 240 degrees; wind speed 4 meters per second; visibility (along the runway(s) in the local routine report; prevailing visibility in METAR) 600 meters; runway visual range representative of the touchdown zone for runway 12 is 1000 meters and the runway visual range values have shown an upward tendency during previous 10 minutes (RVR tendency to be included in METAR only); and moderate drizzle and fog; scattered cloud at 300 meters; overcast at 600 meters; air temperature 17 degrees Celsius; dew-point temperature 16 degrees Celsius; QNH 1018 hectopascals; trend during next 2 hours, visibility (along the runway(s) in the local routine report; prevailing visibility in METAR) becoming 800 meters in fog by 1700 UTC; at 1800 UTC visibility (along the runway(s) in the local routine report; prevailing visibility in METAR) becoming 10 kilometers or more and nil significant weather.

NOTE: In this example, the primary units "meter per second" and "meter" were used for wind speed and height of cloud base, respectively. However, in accordance with Annex 5, the corresponding non-SI alternative units "knot" and "foot" may be used instead.

[1] Fictitious location.

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Example A3-2. Special Report

a. **Local special report (same location and weather conditions as SPECI):**

SPECIAL YUDO 151115Z WIND 050/25KT MAX37 MNM10 VIS 1200M RVR RWY 05 ABV 1800M HVY TSRA CLD BKN CB 500FT T25 DP22 QNH 1008 HPA TREND TEMPO TL1200 VIS 600M BECMG AT1200 VIS 8KM NSW NSC.

b. **SPECI for YUDO (Donlon/International[1]):**

SPECI YUDO 151115Z 05025G37KT 3000 1200NE+TSRA BKNO05CB 25/22 Q1008 TEMPO TL1200 0600 BECMG AT1200 8000 NSW NSC

Meaning of both reports:

Selected special report for Donlon/International[1] issued on the 15th of the month at 1115 UTC; surface wind direction 050 degrees; wind speed 25 knots gusting between 10 and 37 knots (minimum wind speed not to be included in SPECI) visibility 1200 meters (along the runway(s) in the local special report); prevailing visibility 3000 meters (in SPECI) with minimum visibility 1200 meters to north east (directional variations to be included in SPECI only); RVR above 1800 meters on runway 05 (RVR not required in SPECI with prevailing visibility of 3000 meters); thunderstorm with heavy rain; broken cumulonimbus cloud at 500 feet; air temperature 25 degrees Celsius; dew-point temperature 22 degrees Celsius; QNH 1008 hectopascals; trend during next 2 hours, visibility (along the runway(s) in the local special report; prevailing visibility in SPECI) temporarily 600 meters from 1115 to 1200, becoming at 1200 UTC visibility (along the runway(s) in the local special report; prevailing visibility in SPECI) 8 kilometers, thunderstorm ceases and nil significant weather and nil significant cloud.

NOTE: In this example, the non-SI alternative units "knot" and “foot" were used for wind speed and height of cloud base, respectively. However, in accordance with Annex 5, the corresponding primary units "meter per second" and "meter" may be used instead.

[1] Fictitious location.

Example A3-3. Volcanic Activity Report

VOLCANIC ACTIVITY REPORT YUSB[1] 231500 MT TROJEEN[1] VOLCANO N5605 W12652 ERUPTED 231445 LARGE ASH CLOUD EXTENDING TO APPROX 30000 FEET MOVING SW

Meaning:

Volcanic activity report issued by Siby/Bistock meteorological station at 1500 UTC on the 23rd of the month. Mt. Trojeen volcano 56 degrees 5 minutes north 126 degrees 52 minutes west erupted at 1445 UTC on the 23rd; a large ash cloud was observed extending to approximately 30 000 feet and moving in a south-westerly direction.

[1] Fictitious location.

Appendix 4. Technical Specifications related to Aircraft Observations and Reports

(See Chapter 5 of this Annex.)

1. CONTENTS OF AIR-REPORTS

1.1 ROUTINE AIR-REPORTS BY AIR-GROUND DATA LINK

1.1.1 When air-ground data link is used and automatic dependent surveillance (ADS-C) or SSR Mode S is being applied, the elements contained in routine air-reports shall be:

Message type designator
Aircraft identification
  Data block 1
    Latitude
    Longitude
    Level
    Time
  Data block 2
    Wind direction
    Wind speed
    Wind quality flag
    Air temperature
    Turbulence (if available)
    Humidity (if available)

NOTE: When ADS-C or SSR Mode S is being applied, the requirements of routine air-reports may be met by the combination of the basic ADS-C/SSR Mode S data block (data block 1) and the meteorological information data block (data block 2), available from ADS-C or SSR Mode S reports. The ADS-C message format is specified in the PANS-ATM (Doc 4444), 4.11.4 and Chapter 13 and the SSR Mode S message format is specified in Annex 10, Volume III, Part I, Chapter 5.

1.1.2 When air-ground data link is used while ADS-C and SSR Mode S are not being applied, the elements contained in routine reports shall be:

Message type designator
  Section 1 (Position information)
    Aircraft identification
    Position or latitude and longitude

    Time
    Flight level or altitude
    Next position and time over
    Ensuing significant point
  Section 2 (Operational information)
    Estimated time of arrival
    Endurance
  Section 3 (Meteorological information)
    Air temperature
    Wind direction
    Wind speed
    Turbulence
    Aircraft icing
    Humidity (if available)

NOTE: When air-ground data link is used while ADS-C and SSR Mode S are not being applied, the requirements of routine air-reports may be met by the controller pilot data link communication (CPDLC) application entitled "Position report". The details of this data link application are specified in the Manual of Air Traffic Services Data Link Applications (Doc 9694) and in Annex 10, Volume III, Part I.

1.2 SPECIAL AIR-REPORTS BY AIR-GROUND DATA LINK

When air-ground data link is used, the elements contained in special air-reports shall be:

- Message type designator
- Aircraft identification
  - Data block 1
    - Latitude
    - Longitude
    - Level
    - Time
  - Data block 2
    - Wind direction
    - Wind speed
    - Wind quality flag

Air temperature

Turbulence (if available)

Humidity (if available)

Data block 3

Condition prompting the issuance of a special air-report (one condition to be selected from the list presented in Table A4-1).

NOTE 1: The requirements of special air-reports may be met by the data link fight information service (D-FIS) application entitled "Special air-report service". The details of this data link application are specified in Doc 9694.

NOTE 2: In the case of a special air-report of pre-eruption volcanic activity, volcanic eruption or volcanic ash cloud, additional requirements are indicated in 4.2.

1.3 SPECIAL AIR-REPORTS BY VOICE COMMUNICATIONS

When voice communications are used, the elements contained in routine air-reports shall be:

Message type designator

Section 1 (Position information):

Aircraft identification

Position or latitude and longitude

Time

Level or range of levels

Section 3 (Meteorological information):

Conditions prompting the issuance of a special air-report, to be selected from the list presented in Table A4-1.

NOTE 1: Air-reports are considered routine by default. The message type designator for special air-reports is specified in the PANS-ATM (Doc 4444), Appendix 1.

NOTE 2: In the case of a special air-report of pre-eruption volcanic activity, volcanic eruption or volcanic ash cloud, additional requirements are indicated in 4.2.

2. CRITERIA FOR REPORTING

2.1 GENERAL

When air-ground data link is used, the wind direction, wind speed, wind quality flag, air temperature, turbulence and humidity included in air-reports shall be reported in accordance with the following criteria.

2.2 WIND DIRECTION

The wind direction shall be reported in terms of degrees true, rounded to the nearest whole degree.

2.3 WIND SPEED

The wind speed shall be reported in meters per second or knots, rounded to the nearest 1m/s (1kt). The units of measurement used for the wind speed shall be indicated.

2.4 WIND QUALITY FLAG

The wind quality flag shall be reported as 0 when the roll angle is less than 5 degrees and as 1 when the roll angle is 5 degrees or more.

2.5 AIR TEMPERATURE

The air temperature shall be reported to the nearest tenth of a degree Celsius.

2.6 TURBULENCE

The turbulence shall be reported in terms of the cube root of the Eddy Dissipation Rate (EDR).

2.6.1 Routine Air-reports

The turbulence shall be reported during the en-route phase of the flight and shall refer to the 15-minute period immediately preceding the observation. Both the average and peak value of turbulence, together with the time of occurrence of the peak value to the nearest minute, shall be observed. The average and peak values shall be reported in terms of the cube root of EDR. The time of occurrence of the peak value shall be reported as indicated in Table A4-2. The turbulence shall be reported during the climb-out phase for the first 10 minutes of the flight and shall refer to the 30-second period immediately preceding the observation. The peak value of turbulence shall be observed.

2.6.2 Interpretation of the Turbulence Report

Turbulence shall be considered:

a. severe when the peak value of the cube root of EDR exceeds 0.7;

b. moderate when the peak value of the cube root of EDR is above 0.4 and below or equal to 0.7;

c. light when the peak value of the cube root of EDR is above 0.1 and below or equal 0.4; and

d. nil when the peak value of the cube root of EDR is below or equal to 0.1.

NOTE: The EDR is an aircraft-independent measure of turbulence. However, the relationship between the EDR value and the perception of turbulence is a function of aircraft type, and the mass, altitude, configuration and airspeed of the aircraft. The EDR values given above describe the severity levels for a medium-sized transport aircraft under typical en-route conditions (i.e. altitude, airspeed and weight).

2.6.3 Special Air-reports

Special air-reports on turbulence shall be made during any phase of the flight whenever the peak value of the cube root of EDR exceeds 0.4. The special air-report on turbulence shall be made with reference to the 1-minute period immediately preceding the observation. Both the average and peak value of turbulence shall be observed. The average and peak values shall be reported in terms of the cube root of EDR. Special air-reports shall be issued every minute until such time as the peak values of the cube root of EDR fall below 0.4.

2.7 HUMIDITY

The humidity shall be reported as the relative humidity, rounded to the nearest whole per cent.

NOTE: The ranges and resolutions for the meteorological elements included in air-reports are shown in Table A4-3.

Table A4-1. Template for the Special Air-report (Downlink)

Key: M = inclusion mandatory, part of every message
C = inclusion conditional; included whenever available

NOTE: Message to be prompted by the pilot-in-command. Currently only the condition "SEV TURB" can be automated (see 2.6.3).

Table A4-1. Template for the Special Air-report (Downlink)

Element as specified in Chapter 5	Detailed Content	Template(s)	Examples
Message type designator (M)	Type of the air-report (M)	ARS	ARS
Aircraft identification (M)	Aircraft radiotelephony call sign (M)	nnnnnn	VA812
DATA BLOCK 1			
Latitude (M)	Latitude in degrees and minutes (M)	Nnnnn or Snnnn	S4506
Longitude (M)	Longitude in degrees and minutes (M)	Wnnnnn or Ennnnn	E01056
Level (M)	Flight level (M)	FLnnn or FLnnn to FLnnn	FL330 FL280 to FL310
Time (M)	Time of occurrence in hours and minutes (M)	OBS AT nnnnZ	OBS AT 1216Z
DATA BLOCK 2			
Wind direction (M)	Wind direction in degrees true (M)	nnn/	262/
Wind speed (M)	Wind speed in meters per second (or knots) (M)	nnnMPS (or nnnKT)	40MPS (080KT)
Wind quality flag (M)	Wind quality flag (M)	n	1

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Table A4-1. Template for the Special Air-report (Downlink) (continued)

Element as specified in Chapter 5	Detailed Content	Template(s)	Examples
Air temperature (M)	Air temperature in tenths of degrees C (M)	T[M]nnn	T127 TM455
Turbulence (C)	Turbulence in hundredths of $m^{2/3}$ s^{-1} and the time of occurrence of the peak value (C)[1]	EDRnnn/nn	EDR064/08
Humidity (C)	Relative humidity in per cent (C)	RHnnn	RH054
DATA BLOCK 3			
Condition prompting the issuance of a special air-report (M)		SEV TURB [EDRnnn][2] or SEV ICE or SEV MTW or TS GR[3] or TS[3] or HVY SS[4] or VA CLD [FLnnn/nnn] or VA[5] [MT nnnnnnnnnn nnnnnnnnnn] or MOD TURB [EDRnnn][2] or MOD ICE	SEV TURB EDR076 VA CLD FL050/100

[1] The time of occurrence to be reported in accordance with Table A4-2.

[2] The turbulence index to be reported in accordance with 2.6.3.

[3] Obscured, embedded or widespread thunderstorms or thunderstorms in squall lines.

[4] Duststorm or sandstorm.

[5] Pre-eruption volcanic activity or a volcanic eruption.

Table A4-2. Time of Occurrence of the Peak Value to be reported

Peak Value of Turbulence occurring during the one-minute Period .... minutes prior to the Observation	Value to be reported
0 - 1	0
1 - 2	1
2 - 3	2
...	...
13 - 14	13
14 - 15	14
No timing information available	15

Table A4-3. Ranges and Resolutions for the Meteorological Elements included in Air-reports

Element as specified in Chapter 5		Range	Resolution
Wind direction	°true	000 - 360	1
Wind speed	MPS	00 - 125	2
	KT	00 - 250	1
Wind quality flag	(index)[1]	0 - 1	1
Air temperature	°C	-80 - +60	0.1
Turbulence: routine air-report	$m^{2/3} s^{-1}$	0 - 2	0.01
	(time of occurrence)[1]	0 - 15	1
Turbulence: special air-report	$m^{2/3} s^{-1}$	0 - 2	0.01
Humidity	%	0 - 100	1

[1] Non-dimensional.

Appendix 5. Technical Specifications related to Forecasts

(See Chapter 6 of this Annex.)

1. CRITERIA RELATED TO TAF

1.1 TAF FORMAT

1.1.1 TAF shall be issued in accordance with the template shown in Table A5-1 and disseminated in the TAF code form prescribed by the World Meteorological Organization (WMO).

NOTE: The TAF code form is contained in the Manual on Codes (WMO-No. 306), Volume I.1, Part A - Alphanumeric Codes.

1.1.2 Recommendation – *Until 4 November 2020, TAF should be disseminated in IWZZM GML form in addition to the dissemination of the TAF in accordance with 1.1.1. As of 5 November 2020, TAF shall be disseminated in IWXXM GML form in addition to the dissemination of the TAF in accordance with 1.1.1.*

NOTE: The technical specifications for IWXXM are contained in the Manual on Codes (WMO-No. 306), Volume I.3, Part D - Representation Derived from Data Models. Guidance on the implementation of IWXXM is provided in the Manual on the Digital Exchange of Aeronautical Meteorological Information (Doc 10003).

Table A5-1. Template for TAF

Key:	M	=	inclusion mandatory, part of every message
	C	=	inclusion conditional, dependent on meteorological condition or method of observation
	O	=	inclusion optional

NOTE 1: The ranges and resolutions for the numerical elements included in TAF are shown in Table A5-4 of this Appendix.

NOTE 2: The explanations for the abbreviations used can be found in the Procedures for Air Navigation Services - ICAO Abbreviations and Codes (PANS-ABC, Doc 8400).

Table A5-1. Template for TAF

Element as specified in Chapter 6	Detailed Content	Template(s)	Examples
Identification of the type of forecast (M)	Type of forecast (M)	TAF or TAF AMD or TAF COR	TAF TAF AMD
Location indicator (M)	ICAO location indicator (M)	nnnn	YUDO[1]

Table A5-1. Template for TAF (continued)

Element as specified in Chapter 6	Detailed Content	Template(s)	Examples
Time of issue of forecast (M)	Day and time of issue of the forecast in UTC (M)	nnnnnnZ	160000Z
Identification of a missing forecast (C)	Missing forecast identifier (C)	NIL	NIL
END OF TAF IF THE FORECAST IS MISSING			
Day and period of validity of forecast (M)	Days and period of the validity of the forecast in UTC (M)	nnnn/nnnn	0812/0918
Identification of a cancelled forecast (C)	Cancelled forecast identifier (C)	CNL	CNL
END OF TAF IF THE FORECAST IS CANCELLED			
Surface wind (M)	Wind direction (M)	nnn or VRB[2]	24004MPS; VRB01MPS (24008KT); (VRB02KT) 19005MPS (19010KT) 00000MPS (00000KT) 140P49MPS (140P99KT) 12003G09MPS (12006G18KT) 24008G14MPS (24016G28KT)
	Wind speed (M)	[P]nn[n]	
	Significant speed variations (C)[3]	G[P]nn[n]	
	Units of measurement (M)	MPS (or KT)	

Table A5-1. Template for TAF (continued)

Element as specified in Chapter 6	Detailed Content	Template(s)			Examples	
Visibility (M)	Prevailing visibility (M)	nnnn		CAVOK	0350 7000 9000 9999	CAVOK
Weather (C)[4, 5]	Intensity of weather phenomena (C)[6]	- or +	—		RA +TSRA -FZDZ PRFG +TSRASN SNRA FG	HZ FG
	Characteristics and type of weather phenomena (C)[7]	DZ or RA or SN or SG or PL or DS or SS or FZDZ or FZRA or	FG or BR or SA or DU or HZ or FU or VA or SQ or PO or FC or TS or			

Table A5-1. Template for TAF (continued)

Element as specified in Chapter 6	Detailed Content	Template(s)				Examples
		SHGR or SHGS or SHRA or SHSN or TSGR or TSGS or TSRA or TSSN		BCFG or BLDU or BLSA or BLSN or DRDU or DRSA or DRSN or FZFG or MIFG or PRFG		
Cloud (M)[8]	Cloud amount and height of base or vertical visibility (M)	FEWnnn or SCTnnn or BKNnnn or OVCnnn	VVnnn or VV///	NSC		FEW010 VV005 OVC020 VV/// NSC SCT005 BKN012
	Cloud type (C)[4]	CB or TCU	—			SCT008 BKN025CB
Temperature (O)[9]	Name of the element (M)	TX				TX25/1013Z TN09/1005Z TX05/2112Z TNM02/2103Z
	Maximum temperature (M)	[M]nn/				
	Day and time of occurrence of the maximum temperature (M)	nnnnZ				

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Table A5-1. Template for TAF (continued)

<table>
<tr><th>Element as specified in Chapter 6</th><th>Detailed Content</th><th colspan="4">Template(s)</th><th>Examples</th></tr>
<tr><td rowspan="3"></td><td>Name of the element (M)</td><td colspan="4">TN</td><td rowspan="3"></td></tr>
<tr><td>Minimum temperature (M)</td><td colspan="4">[M]nn/</td></tr>
<tr><td>Day and time of occurrence of the minimum temperature (M)</td><td colspan="4">nnnnZ</td></tr>
<tr><td rowspan="6">Expected significant changes to one or more of the above elements during the period of validity (C)[4, 10]</td><td>Change or probability indicator (M)</td><td colspan="4">PROB30 [TEMPO] or PROB40 [TEMPO] or BECMG or
TEMPO or FM</td><td rowspan="6">TEMPO 0815/0818 25017G25MPS
(TEMPO 0815/0818 25034G50KT)
TEMPO 2212/2214 17006G13MPS 1000
TSRA SCT010CB BKN020
(TEMPO 2212/2214 17012G26KT 1000
TSRA SCT010CB BKN020)
BECMG 3010/3011 00000MPS 2400 OVC010
(BECMG 3010/3011 00000KT 2400 OVC010)
PROB30 1412/1414 0800 FG
BECMG 1412/1414 RA
TEMPO 2503/2504 FZRA
TEMPO 0612/0615 BLSN
PROB40 TEMPO 2923/3001 0500 FG</td></tr>
<tr><td>Period of occurrence or change (M)</td><td colspan="4">nnnn/nnnn or nnnnnn[11]</td></tr>
<tr><td>Wind (C)[4]</td><td colspan="4">nnn[P]nn[n][G[P]nn[n]]MPS
or
VRBnnMPS
(or
nnn[P]nn[G[P]nn]KT
or
VRBnnKT)</td></tr>
<tr><td>Prevailing visibility (C)[4]</td><td colspan="3">nnnn</td><td rowspan="2">CAV-OK</td></tr>
<tr><td>Weather phenomenon: intensity (C)[6]</td><td>- or +</td><td>—</td><td>NSW</td></tr>
</table>

Table A5-1. Template for TAF (continued)

Element as specified in Chapter 6	Detailed Content	Template(s)				Examples
	Weather phenomenon: characteristics and type (C)[4, 7]	DZ or RA or SN or SG or PL or DS or SS or FZDZ or FZRA or SHGR or SHGS or SHRA or SHSN or TSGR or TSGS or TSRA or TSSN	FG or BR or SA or DU or HZ or FU or VA or SQ or PO or FC or TS or BCFG or BLDU or BLSA or BLSN or DRDU or DRSA or DRSN or FZFG or MIFG or PRFG			

Table A5-1. Template for TAF (continued)

Element as specified in Chapter 6	Detailed Content	Template(s)				Examples
	Cloud amount and height of base or vertical visibility (C)[4]	FEWnnn or SCTnnn or BKNnnn or OVCnnn	VVnnn or VV///	NSC		FM051230 15015KMH 9999 BKN020 (FM051230 15008KT 9999 BKN020) BECMG 1618/1620 8000 NSW NSC BECMG 2306/2308 SCT015CB BKN020
	Cloud type (C)[4]	CB or TCU	—			

[1] Fictitious location.

[2] To be used in accordance with 1.2.1.

[3] To be included in accordance with 1.2.1.

[4] To be included whenever applicable.

[5] One or more, up to a maximum of three, groups in accordance with 1.2.3.

[6] To be included whenever applicable in accordance with 1.2.3. No qualifier for moderate intensity.

[7] Weather phenomena to be included in accordance with 1.2.3.

[8] Up to four cloud layers in accordance with 1.2.4.

[9] To be included in accordance with 1.2.5, consisting of up to a maximum of four temperatures (two maximum temperatures and two minimum temperatures).

[10] To be included in accordance with 1.3, 1.4 and 1.5.

[11] To be used with FM only.

Table A5-2. Use of Change and Time Indicators in TAF

Change or Time Indicator		Time Period	Meaning
FM		$n_dn_dn_hn_hn_mn_m$	used to indicate a significant change in most weather elements occurring at n_dn_d day, n_hn_h hours and n_mn_m minutes (UTC); all the elements given before "FM" are to be included following “FM” (i.e. they are all superseded by those following the abbreviation)

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Table A5-2. Use of Change and Time Indicators in TAF (continued)

Change or Time Indicator		Time Period	Meaning	
BECMG		$n_{d1}n_{d1}n_{h1}n_{h1}/n_{d2}n_{d2}n_{h2}n_{h2}$	the change is forecast to commence at $n_{d1}n_{d1}$ day and $n_{h1}n_{h1}$ hours (UTC) and be completed by $n_{d2}n_{d2}$ day and $n_{h2}n_{h2}$ hours (UTC); only those elements for which a change is forecast are to be given following “BECMG”; the time period $n_{d1}n_{d1}n_{h1}n_{h1}/n_{d2}n_{d2}n_{h2}n_{h2}n_{h2}$ should normally be less than 2 hours and in any case should not exceed 4 hours	
TEMPO		$n_{d1}n_{d1}n_{h1}n_{h1}/n_{d2}n_{d2}n_{h2}n_{h2}$	temporary fluctuations are forecast to commence at $n_{d1}n_{d1}$ day and $n_{h1}n_{h1}$ hours (UTC) and cease by $n_{d2}n_{d2}$ day and $n_{h2}n_{h2}$ hours (UTC); only those elements for which fluctuations are forecast are to be given following “TEMPO”; temporary fluctuations should not last more than one hour in each instance, and in the aggregate, cover less than half of the period $n_{d1}n_{d1}n_{h1}n_{h1}/n_{d2}n_{d2}n_{h2}n_{h2}$	
PROBnn	—	$n_{d1}n_{d1}n_{h1}n_{h1}/n_{d2}n_{d2}n_{h2}n_{h2}$	probability of occurrence (in %) of an alternative value of a forecast element or elements; nn = 30 or nn = 40 only; to be placed after the element(s) concerned	—
	TEMPO	$n_{d1}n_{d1}n_{h1}n_{h1}/n_{d2}n_{d2}n_{h2}n_{h2}$		probability of occurrence of temporary fluctuations

Table A5-4. Ranges and Resolutions for the Numerical Elements included in TAF

Element as specified in Chapter 6		Range	Resolution
Wind direction:	° true	000 - 360	10
Wind speed:	MPS	00 - 99[1]	1
	KT	00 - 199[1]	1
Visibility:	M	0000 - 0750	50
	M	0800 - 4900	100
	M	5000 - 9000	1000
	M	10000 –	0 (fixed value: 9999)
Vertical visibility:	30's M (100's FT)	000 - 020	1

Table A5-4. Ranges and Resolutions for the Numerical Elements included in TAF (continued)

Element as specified in Chapter 6		Range	Resolution
Cloud: height of base:	30's M (100's FT)	000 - 100	1
Air temperature (maximum and minimum):	°C	-80 - +60	1

[1] There is no aeronautical requirement to report surface wind speeds of 50m/s (100kt) or more; however, provision has been made for reporting wind speeds up to 99m/s (199kt) for non-aeronautical purposes, as necessary.

Example A5-1. TAF

TAF for YUDO (Donlon/International)[1]:

TAF YUDO 160000Z 1606/1624 13005MPS 9000 BKN020 BECMG 1606/1608 SCT015CB BKN020 TEMPO 1608/1612 17006G12MPS 1000 TSRA SCT010CB BKN020 FM161230 15004MPS 9999 BKN020

Meaning:

TAF for Donlon/International[1] issued on the 16th of the month at 0000 UTC valid from 0600 UTC to 2400 UTC on the 16th of the month; surface wind direction 130 degrees; wind speed 5 meters per second; visibility 9 kilometers, broken cloud at 600 meters; becoming between 0600 UTC and 0800 UTC on the 16th of the month, scattered cumulonimbus cloud at 450 meters and broken cloud at 600 meters; temporarily between 0800 UTC and 1200 UTC on the 16th of the month surface wind direction 170 degrees; wind speed 6 meters per second gusting to 12 meters per second; visibility 1000 meters in a thunderstorm with moderate rain, scattered cumulonimbus cloud at 300 meters and broken cloud at 600 meters; from 1230 UTC on the 16th of the month surface wind direction 150 degrees; wind speed 4 meters per second; visibility 10 kilometers or more; and broken cloud at 600 meters.

NOTE: In this example, the primary units "meter per second" and "meter" were used for wind speed and height of cloud base, respectively. However, in accordance with Annex 5, the corresponding non-SI alternative units "knot" and "foot" may be used instead.

[1] Fictitious location.

Example A5-2. Cancellation of TAF

Cancellation of TAF for YUDO (Donlon/International)[1]:

TAF AMD YUDO 161500Z 1606/1624 CNL

Meaning:

Amended TAF for Donlon/International[1] issued on the 16th of the month at 1500 UTC cancelling the previously issued TAF valid from 0600 UTC to 2400 UTC on the 16th of the month.

---

[1] Fictitious location.

Appendix 6. Technical Specifications related to SIGMET and AIRMET Information, Aerodrome Warnings and Wind Shear Warnings and Alerts

(See Chapter 7 of this Annex.)

NOTE: Data type designators to be used in abbreviated headings for SIGMET, AIRMET tropical cyclone and volcanic ash advisory messages are given in the Manual on the Global Telecommunication System (WMO-No. 386).

Table A6-1A. Template for SIGMET and AIRMET Messages

Key:	M	=	inclusion mandatory, part of every message
	C	=	inclusion conditional, included whenever applicable
	=	=	a double line indicates that the text following it should be placed on the subsequent line

NOTE 1: The ranges and resolutions for the numerical elements included in SIGMET/AIRMET messages and in special air-reports are shown in Table A6-4 of this Appendix.

NOTE 2: Severe or moderate icing and severe or moderate turbulence (SEV ICE, MOD ICE, SEV TURB, MOD TURB) associated with thunderstorms, cumulonimbus clouds or tropical cyclones should not be included.

Table A6-1A. Template for SIGMET and AIRMET Messages

Element	Detailed Content	SIGMET template	AIRMET template	SPECIAL message examples	AIRMET message examples
Location indicator of FIR/CTA (M)[1]	ICAO location indicator of the ATS unit serving the FIR or CTA to which the SIGMET/ AIRMET refers	nnnn		YUCC[2] YUDD[2]	
Identification (M)	Message identification and sequence number[3]	SIGMET [n][n]n	AIRMET [n][n]n	SIGMET 1 SIGMET 01 SIGMET A01	AIRMET 9 AIRMET 19 AIRMET B19

Table A6-1A. Template for SIGMET and AIRMET Messages (continued)

Element	Detailed Content	SIGMET template	AIRMET template	SPECIAL message examples	AIRMET message examples
Validity period (M)	Date-time groups indicating the period of validity in UTC	VALID nnnnnn/nnnnnn		VALID 010000/010400 VALID 221215/221600 VALID 101520/101800 VALID 251600/252200 VALID 152000/160000 VALID 192300/200300	
Location indicator of MWO (M)	Location indicator of MWO originating the message with a separating hyphen	nnnn–		YUDO–[2] YUSO–[2]	
Name of the FIR/CTA (M)	Location indicator and name of the FIR/CTA[4] for which the SIGMET/AIRMET is issued	nnnn nnnnnnnnnn FIR or UIR or FIR/UIR or nnnn nnnnnnnnnn CTA	nnnn nnnnnnnnnn FIR[/n]	YUCC AMSWELL FIR[2] YUDD SHANLON[2] FIR/UIR[2] UIR FIR/UIR YUDD SHANLON CTA[2]	YUCC AMSWELL FIR/2[2] YUDD SHANLON FIR[2]
IF THE SIGMET OR AIRMET MESSAGE IS TO BE CANCELLED, SEE DETAILS AT THE END OF THE TEMPLATE					
Status indicator (C)[5]	Indicator of test or exercise	TEST or EXER	TEST or EXER	TEST EXER	TEST EXER

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Table A6-1A. Template for SIGMET and AIRMET Messages (continued)

Element	Detailed Content	SIGMET template	AIRMET template	SPECIAL message examples	AIRMET message examples
Phenomenon (M)[6]	Description of phenomenon causing the issuance of SIGMET/ AIRMET	OBSC[7] TS[GR[8]]	SFC WIND nnn/ nn[n] MPS (or SFC WIND nnn/nn[n]KT)	OBSC TS OBSC TSGR EMBD TS	SFC WIND 040/40MPS SFC WIND 310/20KT SFC VIS 1500M (BR)

Table A6-1A. Template for SIGMET and AIRMET Messages (continued)

Element	Detailed Content	SIGMET template	AIRMET template	SPECIAL message examples	AIRMET message examples
		EMBD[9] TS[GR[8]] FRQ[10] TS[GR[8]] SQL[11] TS[GR[8]] TC nnnnnnnnnn PSN Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] CB orTC NN[12] PSN Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] CB SEV TURB[13] SEV ICE[14] SEV ICE (FZRA)[14] SEV MTW[15] HVY DS	SFC VIS nnnnM (nn)[16] ISOL[17] TS[GR][8] OCNL[18] TS[GR[8]] MT OBSC BKN CLD [n]nnn/[ABV] [n]nnnM (or BKN CLD[n]nnn/ [ABV] [n]nnnnFT) or BKN CLD SFC/[ABV] [n]nnnM (or BKN CLD SFC/[ABV] [n]nnnnFT) OVC CLD nnn/[ABV] [n]nnnM (or OVC CLD [n]nnn/[ABV] [n]nnnnFT) or OVC CLD SFC/[ABV] [n]nnnM (or OVC CLD SFC/[ABV] [n]nnnnFT)	EMBD TSGR FRQ TS FRQ TSGR SQL TS SQL TSGR TC GLORIA PSN N10 W060 CB TC NN PSN S2030 E06030 CB SEV TURB SEV ICE SEV ICE(FZRA) SEV MTW	ISOL TS ISOL TSGR OCNL TS OCNL TSGR MT OBSC BKN CLD 120/900M BKN CLD 400/3000FT BKN CLD 1000/5000ft BKN CLD SFC/3000M BKN CLD SFC/ABV10000FT OVC CLD 270/ABV3000M

Table A6-1A. Template for SIGMET and AIRMET Messages (continued)

Element	Detailed Content	SIGMET template	AIRMET template	SPECIAL message examples	AIRMET message examples
		HVY SS [VA ERUPTION] [MT nnnnnnnnnn] [PSN Nnn[nn] or Snn[nn] Ennn[nn] or Wnnn[nn]] VA CLD RDOACT CLD	ISOL[17] CB[19] OCNL[18] CB[19] FRQ[10] CB[19] ISOL[17] TCU[19] OCNL[18] TCU[19] FRQ[10] TCU[19] MOD TURB[13] MOD ICE[14] MOD MTW[15]	HVY DS HVY SS VA ERUPTION MT ASHVAL[2] PSN S15 E073 VA CLD RDOACT CLD	OVC CLD 900/ABV10000FT OVC CLD 1000/5000ft OVC CLD SFC/3000M OVC CLD SFC/ABV10000FT ISOL CB OCNL CB FRQ CB ISOL TCU OCNL TCU FRQ TCU MOD TURB MOD ICE MOD MTW
Observed or forecast phenomenon (M)	Indication whether the information is observed and expected to continue, or forecast	OBS [AT nnnnZ] FCST [AT nnnnZ]		OBS OBS AT 1210Z FCST FCST AT 1815Z	

Table A6-1A. Template for SIGMET and AIRMET Messages (continued)

Element	Detailed Content	SIGMET template	AIRMET template	SPECIAL message examples	AIRMET message examples
Location (C)[20]	Location (referring to latitude and longitude (in degrees and minutes)	Nnn[nn] Wnnn[nn] or Nnn[nn] Ennn[nn] or Snn[nn] Wnnn[nn] or Snn[nn] Ennn[nn] or N OF Nnn[nn] or S OF Nnn[nn] or N OF Snn[nn] or S OF Snn[nn] or [AND] W OF Wnnn[nn] or E OF Wnnn[nn] or W OF Ennn[nn] or E OF Ennn[nn] or N OF Nnn[nn] or N OF Snn[nn] AND S OF Nnn[nn] or S OF Snn[nn] or W OF Wnnn[nn] or W OF Ennn[nn] AND		N2020 W07005 N48 E010 S60 W160 S0530 E16530 N OF N50 S OF N5430 N OF S10 S OF S4530 W OF W155 E OF W45 W OF E15540 E OF E09015 N OF N1515 AND W OF E13530 S OF N45 AND N OF N40 N OF LINE S2520 W11510 - S2520 W12010 SW OF LINE N50 W005 - N60 W020 SW OF LINE N50 W020 - N45 E010 AND NE OF LINE N45 W020 - N40 E010 WI N6030 E02550 - N6055 E02500 -	

Table A6-1A. Template for SIGMET and AIRMET Messages (continued)

Element	Detailed Content	SIGMET template	AIRMET template	SPECIAL message examples	AIRMET message examples
		E OF Wnnn[nn] or E OF Ennn[nn] or N OF LINE[21] or NE OF LINE[21] or E OF LINE[21] or SE OF LINE[21] or S OF LINE[21] or SW OF LINE[21] or W OF LINE[21] or NW OF LINE[21] Nnn[nn] or Snn[nn] Wnnn[nn] or			

Table A6-1A. Template for SIGMET and AIRMET Messages (continued)

Element	Detailed Content	SIGMET template	AIRMET template	SPECIAL message examples	AIRMET message examples
		Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] [- Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]] [- Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]] [AND N OF LINE[21] or NE OF LINE[21] or E OF LINE[21] or SE OF LINE[21] or S OF LINE[21] or SW OF LINE[21] or W OF LINE[21] or NW OF LINE[21] Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] [- Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nnJ] [- Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]]] or WI[21,22] Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]- Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]- Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]- [Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]- Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]]		N6050 E02630 - N6030 E02550 APRX 50KM WID LINE BTN N64 W017 - N60 W010 - N57 E010 ENTIRE FIR ENTIRE UIR ENTIRE FIR/UIR ENTIRE CTA WI 400KM OF TC CENTER WI 250KM OF TC CENTER WI 30KM OF N6030 E02550 (applicable as of 7 November 2019)	

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Table A6-1A. Template for SIGMET and AIRMET Messages (continued)

Element	Detailed Content	SIGMET template	AIRMET template	SPECIAL message examples	AIRMET message examples
		or APRX nnKM WID LINE[21] BTN (or nnNM WID LINE[21] BTN) Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] [- Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] [- Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]] [- Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]] or ENTIRE UIR or ENTIRE FIR or ENTIRE FIR/UIR or ENTIRE CTA or[23] WI nnnKM (or nnnNM) OF TC CENTER or[24] WI nnKM (or nnNM) OF Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]			
Level (C)[20,24]	Flight level or altitude	[SFC/]FLnnn or [SFC/[nnnnM (or[SFC/][n]nnnnFT) or FLnnn/nnn or TOP FLnnn or		FL180 SFC/FL070 SFC/3000M SFC/10000FT FL050/080	

Table A6-1A. Template for SIGMET and AIRMET Messages (continued)

Element	Detailed Content	SIGMET template	AIRMET template	SPECIAL message examples	AIRMET message examples
		[TOP] ABV FLnnn (or [TOP] ABV [n]nnnnFT) [nnnn/[nnnnM (or [[n]nnnn/[[n]nnnnFT) or [nnnnM/]FLnnn (or [[n]nnnnFT/]FLnnn) or[23] TOP [ABV or BLW] FLnnn		TOP FL390 ABV FL250 TOP ABV FL 100 3000M 2000/3000M 8000FT 6000/12000FT 2000M/FL150 10000FT/FL250 TOP FL500 TOP ABV FL500 TOP BLW FL450	

Table A6-1A. Template for SIGMET and AIRMET Messages (continued)

Element	Detailed Content	SIGMET template	AIRMET template	SPECIAL message examples	AIRMET message examples
Movements or expected movement (C)[20,25]	Movement or expected movement (direction and speed) with reference to one of the sixteen points of compass or stationary	MOV N [nnKMH] or MOV NNE [nnKMH] or MOV NE [nnKMH] or MOV ENE [nnKMH] or MOV E [nnKMH] or MOV ESE [nnKMH] or MOV SE [nnKMH] or MOV SSE [nnKMH] or MOV S [nnKMH] or MOV SSW [nnKMH] or MOV SW [nnKMH] or MOV WSW [nnKMH] or MOV W [nnKMH] or MOV WNW [nnKMH] or MOV NW [nnKMH] or MOV NNW [nnKMH] (or MOV N [nnKT] or MOV NNE [nnKT] or MOV NE [nnKT] or MOV ENE [nnKT] or MOV E [nnKT] or MOV ESE [nnKT] or MOV SE [nnKT] or MOV SSE [nnKT] or MOV S [nnKT] or MOV SSW [nnKT] or MOV SW [nnKT] or MOV WSW [nnKT] or MOV W [nnKT] or MOV WNW [nnKT] or MOV NW [nnKT] or MOV NNW [nnKT]) or STNR		MOV SE MOV NNW MOV E 40KMH MOV E 20KT MOV WSW 20KT STNR	
Changes in intensity (C)[20]	Expected changes in intensity	INTSF or WKN or NC		INTSF WKN NC	
Forecast time (C)[25]	Indication of the forecast time of phenomenon	FCST AT nnnnZ	—	FCST AT 2200Z	—

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Table A6-1A. Template for SIGMET and AIRMET Messages (continued)

Element	Detailed Content	SIGMET template	AIRMET template	SPECIAL message examples	AIRMET message examples
TC forecast position (C)$_{23}$	Forecast position of TC center at the end of the validity period of the SIGMET message	TC CENTRE PSN Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]	—	TC CENTRE PSN N1030 TC CENTRE PSN E1600015	—

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Table A6-1A. Template for SIGMET and AIRMET Messages (continued)

Element	Detailed Content	SIGMET template	AIRMET template	SPECIAL message examples	AIRMET message examples
Forecast position (C)[20, 25, 26]	Forecast position of phenomenon at the end of the validity period of the SIGMET message	Nnn[nn] Wnnn[nn] or Nnn[nn] Ennn[nn] or Snn[nn] Wnnn[nn] or Snn[nn] Ennn[nn] or N OF Nnn[nn] or S OF Nnn[nn] or N OF Snn[nn] or S OF Snn[nn] [AND] W OF Wnnn[nn] or E OF Wnnn[nn] or W OF Ennn[nn] or E OF Ennn[nn] or N OF Nnn[nn] or N OF Snn[nn] AND S OF Nnn[nn] or S OF Snn[nn]	—	N30 W170 N OF N30 S OF S50 AND W OF E170 S OF N46 AND N OF N39 NE OF LINE N35 W020 - N45W040 SW OF LINE N48 W020 - N43 E010 AND NE OF LINE N43 W020 - N38 E010 WI N20 W090 - N05 W090 - N10 W100 - N20 W100 - N20 W090 APRX 50KM WID LINE BTN N64 W017 - N57 W005 - N55 E010 - N55 E030 ENTIRE FIR ENTIRE UIR ENTIRE FIR/UIR ENTIRE CTA	—

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Table A6-1A. Template for SIGMET and AIRMET Messages (continued)

Element	Detailed Content	SIGMET template	AIRMET template	SPECIAL message examples	AIRMET message examples
		or W OF Wnnn[nn] or W OF Ennn[nn] AND E OF Wnnn[nn] or E OF Ennn[nn] or N OF LINE[21] or NE OF LINE[21] or E OF LINE[21] or SE OF LINE[21] or S OF LINE[21] or SW OF LINE[21] or W OF LINE[21] or NW OF LINE[21] Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]		NO VA EXP WI 30KM OF N6030 E02550 (applicable as of 7 November 2019)	

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Table A6-1A. Template for SIGMET and AIRMET Messages (continued)

Element	Detailed Content	SIGMET template	AIRMET template	SPECIAL message examples	AIRMET message examples
		[- Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] [AND N OF LINE[21] or NE OF LINE[21] or E OF LINE[21] or SE OF LINE[21] or S OF LINE[21] or SW OF LINE[21] or W OF LINE[21] or NW OF LINE[21] Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] [- Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]]]			

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Table A6-1A. Template for SIGMET and AIRMET Messages (continued)

Element	Detailed Content	SIGMET template	AIRMET template	SPECIAL message examples	AIRMET message examples
		or WI[21, 22] Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]			

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Table A6-1A. Template for SIGMET and AIRMET Messages (continued)

Element	Detailed Content	SIGMET template	AIRMET template	SPECIAL message examples	AIRMET message examples
		or APRX nnKM WID LINE[21] BTN (nnNM WID LINE[21] BTN) Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] - Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn] [- Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]] [- Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]]			

Table A6-1A. Template for SIGMET and AIRMET Messages (continued)

Element	Detailed Content	SIGMET template	AIRMET template	SPECIAL message examples	AIRMET message examples
		or ENTIRE FIR or ENTIRE UIR or ENTIRE FIR/UIR or ENTIRE CTA or[27] NO VA EXP or[24] WI nnKM (or nnNM) OF Nnn[nn] or Snn[nn] Wnnn[nn] or Ennn[nn]			
Repetition of elements (C)[28]	Repetition of elements included in a SIGMET message for volcanic ash cloud or tropical cyclone	[AND][28]	—	AND	—

Table A6-1A. Template for SIGMET and AIRMET Messages (continued)

Element	Detailed Content	SIGMET template	AIRMET template	SPECIAL message examples	AIRMET message examples
OR					
Cancellation of SIGMET/ AIRMET (C)[29]	Cancellation of SIGMET/ AIRMET referring to its identification	CNL SIGMET [n][n]n nnnnnn/ nnnnnn or[27] CNL SIGMET [n][n]n nnnnnn/ nnnnnn VA MOV TO nnnn FIR	CNL AIRMET [n][n]n nnnnnn/nnnnnn	CNL SIGMET 2 101200/101600 CNL SIGMET A13 251030/251430 VA MOV TO YUDO FIR[2]	CNL AIRMET 05 151520/151800

[1] See 4.1

[2] Fictitious location.

[3] In accordance with 1.1.3 and 2.1.2.

[4] See 2.1.3.

[5] Used only when the message issued to indicate that a test or an exercise is taking place. When the word "TEST" or the abbreviation 'EXER' is included, the message may contain information that should not be used operationally or will otherwise end immediately after the word “TEST”. [Applicable 7 November 2019]

[6] In accordance with 1.1.4 and 2.1.4.

[7] In accordance with 4.2.1 a).

[8] In accordance with 4.2.4.

[9] In accordance with 4.2.1 b).

[10] In accordance with 4.2.2.

[11] In accordance with 4.2.3.

[12] Used for unnamed tropical cyclones.

[13] In accordance with 4.2.5. and 4.2.6.

[14] In accordance with 4.2.7.

[15] In accordance with 4.2.8.

[16] In accordance with 2.1.4.

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[17] In accordance with 4.2.1 c).

[18] In accordance with 4.2.1 d).

[19] The use of cumulonimbus (CB) and towering cumulus (TCU) is restricted to AIRMETs in accordance with 2.1.4.

[20] In the case of volcanic ash cloud or tropical cyclone covering more than one area within the FIR, these elements can be repeated, as necessary.

[21] A straight line is to be used between two points drawn on a map in the Mercator projection or between two points which crosses lines of longitude at a constant angle.

[22] The number of coordinates should be kept to a minimum and should not normally exceed seven.

[23] Only for SIGMET messages for tropical cyclones.

[24] Only for SIGMET messages for radioactive cloud. When detailed information on the release is not available, a radius of up to 30 kilometers (or 16 nautical miles) from the source may be applied; and a vertical extent from surface (SFC) to the upper limit of the flight information region/upper flight information region (FIR/UIR) or control area (CTA) is to be applied. *[Applicable 7 November 2019]*

[25] The elements "forecast time" and "forecast position" are not to be used in conjunction with the element "movement or expected movement".

[26] The levels of the phenomena remain fixed throughout the forecast period.

[27] Only for SIGMET messages for volcanic ash.

[28] To be used for two volcanic ash clouds or two centers of tropical cyclones simultaneously affecting the FIR concerned.

[29] End of the message (as the SIGMET/AIRMET message is being cancelled).

Table A6-1B. Template for Special Air-Reports (uplink)

Key: M = inclusion mandatory, part of every message;

C = inclusion conditional, included whenever applicable;

= = a double line indicates that the text following it should be placed on the subsequent line.

NOTE: The ranges and resolutions for the numerical elements included in special air-reports are shown in Table A6-4 of this appendix.

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Table A6-1B. Template for Special Air-Reports (uplink)

Element	Detailed Content	Template[1, 2]	Examples
Identification (M)	Message identification	ARS	ARS
Aircraft Identification (M)	Aircraft radiotelephony call sign	nnnnnn	VA812[3]
Observed phenomenon (M)	Description of observed phenomenon causing the issuance of the special air-report[4]	TS TSGR SEV TURB SEV ICE SEV MTW HVY SS VA CLD VA [MT nnnnnnnnnn] MOD TURB MOD ICE	TS TSGR SEV TURB SEV ICE SEV MTW HVY SS VA CLD VA VA MT ASHVAL[5] MOD TURB MOD ICE
Observation time (M)	Time of observation of observed phenomenon	OBS AT nnnnZ	OBS AT 1210Z
Location (C)	Location (referring to latitudeand longitude (in degrees and minutes)) of observed phenomenon	NnnnnWnnnnn or NnnnnEnnnnn or SnnnnWnnnnn or SnnnnEnnnnn	N2020W07005 S4812E01036
Level (C)	Flight level or altitude of observed phenomenon	FLnnn or FLnnn/nnn or nnnnM (or [n]nnnnFT)	FL390 FL 180/210 3000M 12000FT

[1] No wind and temperature to be uplinked to other aircraft in flight in accordance with 3.2.

[2] See 3.1.

[3] Fictitious call sign.

[4] In the case of special air-report for volcanic ash cloud, the vertical extent (if observed) and name of the volcano (if known) can be used.

[5] Fictitious location.

Table A6-2. Template for Aerodrome Warnings

Key: M = inclusion mandatory, part of every message
C = inclusion conditional, included whenever applicable

NOTE 1: The ranges and resolutions for the numerical elements included in wind shear warnings are shown in Table A 6-4 of this Appendix.

NOTE 2: The explanations for the abbreviations can be found in the Procedures for Air Navigation Services - ICAO Abbreviations and Codes (PANS-ABC, Doc 8400).

Table A6-2. Template for Aerodrome Warnings

Element	Detailed Content	Template	Example
Location indicator of the aerodrome (M)	Location indicator of the aerodrome	nnnn	YUCC[1]
Identification of the type of message (M)	Type of message and sequence number	AD WRNG [n]n	AD WRNG 2
Validity period (M)	Day and time of validity period in UTC	VALID nnnnnn/nnnnnn	VALID 211230/211530

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Table A6-2. Template for Aerodrome Warnings (continued)

Element	Detailed Content	Template	Example
IF THE AERODROME WARNING IS TO BE CANCELLED, SEE DETAILS AT THE END OF THE TEMPLATE			
Phenomenon (M)[2]	Description of phenomenon causing the issuance of the aerodrome warning	TC[3] nnnnnnnnnn or [HVY] TS or GR or [HVY] SN [nnCM][3] or [HVY] FZRA or [HVY] FZDZ or RIME[4] or [HVY] SS or [HVY] DS or SA or DU or SFC WSPD nn[n]MPS MAX nn[n] (SFC WSPD nn[n]KT MAX nn[n]) or SFC WIND nnn/ nn[n]MPS MAX nn[n] (SFC WIND nnn/ nn[n]KT MAX nn[n]) or SQ or FROST or TSUNAMI or VA[DEPO] or TOX CHEM or free text up to 32 characters[5]	TC ANDREW HVY SN 25CM SFC WSPD 20MPS MAX 30 VA TSUNAMI

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Table A6-2. Template for Aerodrome Warnings (continued)

Element	Detailed Content	Template	Example
Observed or forecast phenomenon (M)	Indication whether the information is observed and expected to continue, or forecast	OBS [AT nnnnZ] or FCST	OBS AT 1200Z OBS
Changes in intensity (C)	Expected changes in intensity	INTSF or WKN or NC	WKN
OR			
Cancellation of aerodrome warning[6]	Cancellation of aerodrome warning referring to its identification	CNL AD WRNG [n]n nnnnnn/nnnnnn	CNL AD WRNG 2 211230/211530[6]

[1] Fictitious location.

[2] One phenomenon or a combination thereof, in accordance with 5.1.3.

[3] In accordance with 5.1.3.

[4] Hoar frost or rime in accordance with 5.1.3.

[5] In accordance with 5.1.4.

[6] End of the message (as the aerodrome warning is being cancelled).

Table A6-3. Template for Wind Shear Warnings

Key: M = inclusion mandatory, part of every message
C = inclusion conditional, included whenever applicable

NOTE 1: The ranges and resolutions for the numerical elements included in wind shear warnings are shown in Table A 6-4 of this Appendix.

NOTE 2: The explanations for the abbreviations can be found in the PANS-ABC (Doc 8400).

Table A6-3. Template for Wind Shear Warnings

Element	Detailed content	Template	Example
Location indicator of the aerodrome (M)	Location indicator of the aerodrome	nnnn	YUCC[1]
Identification of the type of message (M)	Type of message and sequence number	WS WRNG [n]n	WS WRNG 1

Table A6-3. Template for Wind Shear Warnings (continued)

Element	Detailed content	Template	Example
Time of origin and validity period (M)	Day and time of issue and, where applicable, validity period in UTC	nnnnnn [VALID TL nnnnnn] or [VALID nnnnnn/nnnnnn]	211230 VALID TL 211330 221200 VALID 221215/221315
IF THE WIND SHEAR WARNING IS TO BE CANCELLED, SEE DETAILS AT THE END OF THE TEMPLATE			
Phenomenon (M)	Identification of the phenomenon and its location	[MOD] or [SEV] WS IN APCH or [MOD] or [SEV] WS [APCH] RWYnnn or [MOD] or [SEV] WS IN CLIMB-OUT or [MOD] or [SEV] WS CLIMB-OUT RWYnnn or MBST IN APCH or MBST [APCH] RWYnnn or MBST IN CLIMB-OUT or MBST CLIMB-OUT RWYnnn	WS APCH RWY12 MOD WS RWY34 WS IN CLIMB-OUT MBST APCH RWY26 MBST IN CLIMB-OUT
Observed, reported or forecast phenomenon (M)	Identification whether the phenomenon is observed or reported and expected to continue or forecast	REP AT nnnn nnnnnnnn or OBS [AT nnnn] or FCST	REP AT 1510 B747 OBS AT 1205 FCST

Table A6-3. Template for Wind Shear Warnings (continued)

Element	Detailed content	Template	Example
Details of the phenomenon (C)[2]	Description of phenomenon causing the issuance of the wind shear warning	SFC WIND: nnn/nnMPS (or nnn/nnKT) nnnM (nnnFT)-WIND: nnn/nnMPS (or nnn/nnKT) or nnKMH (or nnKT) LOSS nnKM (or nnNM) FNA RWYnn or nnKMH (or nnKT) GAIN nnKM (or nnNM) FNA RWYnn	SFC WIND: 320/5MPS 60M-WIND: 360/13MPS (SFC WIND: 320/10KT 200FT-WIND: 360/26KT) 60KMH LOSS 4KM FNA RWY13 (30KT LOSS 2NM FNA RWY13)
OR			
Cancellation of wind shear warning[3]	Cancellation of wind shear warning referring to its identification	CNL WS WRNG [n]n nnnnnn/nnnnnn	CNL WS WRNG 1 211230/211330[3]

[1] Fictitious location.

[2] Additional provisions in 6.2.3.

[3] End of the message (as the wind shear warning is being cancelled).

Table A6-4. Ranges and Resolutions for the Numerical Elements included in Volcanic Ash and Tropical Cyclone Advisory Messages, SIGMET/AIRMET Messages and Aerodrome and Wind Shear Warnings

Element as specified in Appendices 2 and 6		Range	Resolution
Summit elevation:	M	000 - 8100	1
	FT	000 - 27000	1
Advisory number:	for VA (index)[1]	000 - 2000	1
	for TC (index)[1]	00 - 99	1
Maximum surface wind:	MPS	00 - 99	1
	KT	00 - 199	1
Central pressure:	hPa	850 - 1050	1

Table A6-4. Ranges and Resolutions for the Numerical Elements included in Volcanic Ash and Tropical Cyclone Advisory Messages, SIGMET/AIRMET Messages and Aerodrome and Wind Shear Warnings (continued)

Element as specified in Appendices 2 and 6		Range	Resolution
Surface wind speed:	MPS	15 - 49	1
	KT	30 - 99	1
Surface visibility:	M	0000 - 0750	50
	M	0800 - 5000	100
Cloud: height of base:	M	000 - 300	30
	FT	000 - 1000	100
Cloud: height of top:	M	000 - 2970	30
	M	3000 - 20000	300
	FT	000 - 9900	100
	FT	10000 - 60000	1000
Latitudes:	° (degrees)	00 - 90	1
	' (minutes)	00 - 60	1
Longitudes:	° (degrees)	000 -180	1
	' (minutes)	00 - 60	1
Flight levels:		000 - 650	10
Movement:	KMH	0 - 300	10
	KT	0 - 150	5

[1] Non-dimensional.

METEOROLOGICAL SERVICE FOR INTERNATIONAL AIR NAVIGATION - ANNEX 3

Example A6-1. SIGMET and AIRMET Message and the Corresponding Cancellations

SIGMET	**Cancellation of SIGMET**
YUDD SIGMET 2 VALID 101200/101600 YUSO - YUDD SHANLON FIR/UIR OBSC TS FCST S OF N54 AND E OF W012 TOP FL390 MOV E 20KT WKN	YUDD SIGMET 3 VALID 101345/101600 YUSO - YUDD SHANLON FIR/UIR CNL SIGMET 2 101200/101600
AIRMET	**Cancellation of AIRMET**
YUDD AIRMET 1 VALID 151520/151800 YUSO - YUDD SHANLON FIR ISOL TS OBS N OF S50 TOP ABV FL100 STNR WKN	YUDD AIRMET 2 VALID 151650/151800 YUSO - YUDD SHANLON FIR CNL AIRMET 1 151520/151800

Example A6-2. SIGMET Message for Tropical Cyclone

YUCC SIGMET 3 VALID 251600/252200 YUDO -

YUCC AMSWELL FIR TC GLORIA PSN N2706 W07306 CB OBS AT 1600Z WI 250NM OF TC CENTER TOP FL500 NC FCST AT 2200Z TC CENTER N2740 W07345

Meaning:

The third SIGMET message issued for the AMSWELL[1] flight information region (identified by YUCC Amswell area control center) by the Donlon/International[1] meteorological watch office (YUDO) since 0001 UTC; the message is valid from 1600 UTC to 2200 UTC on the 25th of the month; tropical cyclone Gloria at 27 degrees 6 minutes n011h and 73 degrees 6 minutes west; cumulonimbus was observed at 1600 UTC within 250 nautical miles of the center of the tropical cyclone with top at flight level 500; no changes in intensity are expected; at 2200 UTC the center of the tropical cyclone is forecast to be located at 27 degrees 40 minutes north and 73 degrees 45 minutes west.

[1] Fictitious locations.

Example A6-3. SIGMET Message for Volcanic Ash

YUDD SIGMET 2 VALID 211100/211700 YUSO -

YUDD SHANLON FIR/UIR VA ERUPTION MT ASHVAL PSN S1500 E07348 VA CLD OBS AT 1100Z APRX 50KM WID LINE BTN S1500 E07348 - S1530 E07642 FL310/450 INTSF FCST AT 1700Z APRX 50KM WID LINE BTN S1506 E07500 - S1518 E08112 - S1712 E08330

Meaning:

The second SIGMET message issued for the SHANLON[1] flight information region (identified by YUDD Shanlon area control center/upper flight information region) by the Shanlon/International[1] meteorological watch office (YUSO) since 0001 UTC; the message is valid from 1100 UTC to 1700 UTC on the 21st of the month; volcanic ash eruption of Mount Ashval[1] located at 15 degrees south and 73 degrees 48 minutes east; volcanic ash cloud observed at 1100 UTC in an approximately 50 km wide line between 15 degrees south and 73 degrees 48 minutes east, and 15 degrees 30 minutes south and 76 degrees 42 minutes east; between flight levels 310 and 450, intensifying at 1700 UTC the volcanic ash cloud is forecast to be located in an approximate 50 km wide line between 15 degrees 6 minutes south and 75 degrees east, 15 degrees 18 minutes south and 81 degrees 12 minutes east, and 17 degrees 12 minutes south and 83 degrees 30 minutes east.

[1] Fictitious locations.

Example A6-4. SIGMET Message for Radioactive Cloud

YUCC SIGMET 2 VALID 201200/201600 YUDO -

YUCC AMSWELL FIR RDOACT CLD OBS AT 1155Z WI S5000 W14000 - S5000 W13800 - S5200 W13800 - S5200 W14000 - S5000 W14000 SFC/FL100 WKN FCST AT 1600Z WI S5200 W14000 - S5200 W13800 - S5300 W13800 - S5300 W14000 - S5200 W14000

Meaning:

The second SIGMET message issued for the AMSWELL[1] flight information region (identified by YUCC Amswell area control center) by the Donlon/International[1] meteorological watch office (YUDO) since 0001 UTC; the message is valid from 1200 UTC to 1600 UTC on the 20th of the month; radioactive cloud was observed at 1155 UTC within an area bounded by 50 degrees 0 minutes south 140 degrees 0 minutes west to 50 degrees 0 minutes south 138 degrees 0 minutes west to 52 degrees 0 minutes south 138 degrees 0 minutes west to 52 degrees 0 minutes south 140 degrees 0 minutes west to 50 degrees 0 minutes south 140 degrees 0 minutes west and between the surface and flight level 100; the radioactive cloud is expected to weaken in intensity; at 1600 UTC the radioactive cloud is forecast to be located within an area bounded by 52 degrees 0 minutes south 140 degrees 0 minutes west to 52 degrees 0 minutes south 138 degrees 0 minutes west to 53 degrees 0 minutes south 138 degrees 0 minutes west to 53 degrees 0 minutes south 140 degrees 0 minutes west to 52 degrees 0 minutes south 140 degrees 0 minutes west.

[1] Fictitious location.

Example A6-5. SIGMET Message for Severe Turbulence

YUCC SIGMET 5 VALID 221215/221600 YUDO -

YUCC AMSWELL FIR SEV TURB OBS AT 1210Z N2020 W07005 FL250 INTSF FCST 1600Z S OF N2020 E OF W06950

Meaning:

The fifth SIGMET message issued for the AMSWELL[1] flight information region (identified by YUCC Amswell area control center) by the Donlon/International[1] meteorological watch office (YUDO) since 0001 UTC; the message is valid from 1215 UTC to 1600 UTC on the 22nd of the month; severe turbulence was observed at 1210 UTC 20 degrees 20 minutes north and 70 degrees 5 minutes west at flight level 250; the turbulence is expected to strengthen in intensity; at 1600 UTC the severe turbulence is forecast to be located south of 20 degrees 20 minutes north and east of 69 degrees 50 minutes west.

[1] Fictitious locations.

Example A6-6. AIRMET Message for Moderate Mountain Wave

YUCC AIRMET 2 VALID 221215/221600 YUDO -

YUCC AMSWELL FIR MOD MTW OBS AT 1205Z N48 E010 FL080 STNR NC

Meaning:

The second AIRMET message issued for the AMSWELL[1] flight information region (identified by YUCC Amswell area control center) by the Donlon/Intemational[1] meteorological watch office (YUDO) since 0001 UTC; the message is valid from 1215 UTC to 1600 UTC on the 22nd of the month; moderate mountain wave was observed at 1205 UTC at 48 degrees north and 10 degrees east at flight level 080; the mountain wave is expected to remain stationary and not to undergo any changes in intensity.

[1] Fictitious locations.

AERODROME WEATHER REPORT - METAR AND SPECI DECODE

IDENTIFICATION GROUPS

METAR or **SPECI**	**METAR** - Aviation routine weather report code name **SPECI** - Aviation special weather report code name
COR	COR - Code word used as appropriate
CCCC	ICAO four-letter location indicator
YYGGgg	In individual messages, day of the month and time of observation in hours and minutes UTC
Z	Indicator of UTC
NIL	NIL - Code word used as appropriate
(AUTO)	Fully automated observation indicator

SURFACE WIND

ddd	Mean wind direction in degrees true rounded off to nearest 10 degrees (**VRB = V**A**R**IA**B**LE when ff < 3kt)	00000 = calm	P199KMH (P99KT, P49MPS) mean ff or f_mf_m = 200KMH (100KT, 50MPS) or more
ff	Mean wind speed (10-minute mean or since discontinuity)		
G	Indicator of **G**ust - if necessary		
f_mf_m	Maximum wind speed (gust) - if necessary		
KMH or KT or MPS	Wind speed units used		
Followed when there is a variation in wind direction of 60° or more but less than 180° and wind speed ≥ 3KT by group below:			
$d_nd_nd_n$	Extreme direction of wind		
V	Indicator of **V**ariability		
$d_xd_xd_x$	Other extreme direction of wind (measured clockwise)		

AERODROME WEATHER REPORT

PREVAILING VISIBILITY

VVVV	Prevailing visibility in meters or lowest visibility if visibility is not the same and fluctuating and the prevailing visibility cannot be determined. 9999 = 10km or more
Followed when visibility is not the same and minimum visibility ≠ prevailing and visibility < 1500m or visibility < 50% of prevailing and less than 5000m by the group below:	
$V_nV_nV_nV_n$	Lowest visibility
NDV	Abbreviation for no directional variations.
Followed by	
$V_nV_nV_nV_n$	Lowest visibility
D_v	General direction of lowest visibility or most operationally significant if minimum visibility observed in more than one direction.

RUNWAY VISUAL RANGE (RVR) WHERE REQUIRED, UP TO FOUR ACTIVE RUNWAYS

R	Indicator of RVR
D_RD_R	Runway designator – for parallel runways may have **LL, L, C, R** or **RR** appended (**L** = left; **C** = center; **R** = right)
$V_RV_RV_RV_R$	RVR (10-minute mean) at the touchdown zone P2000 = more than 2000m, M0050 = less than 50m
i	RVR tendency indicator over past 10 minutes. **U** = upward; **D** = downward; **N** = no distinct change. **Omitted** if possible to determine
Replaced when there are significant variations in RVR by the group below:	
R	Indicator of RVR
D_RD_R	Runway designator – for parallel runways may have **LL, L C, R** or **RR**
$V_RV_RV_RV_R$	RVR in meters (one-minute mean minimum value during last 10 minutes)
V	Indicator of significant **V**ariation
$V_RV_RV_RV_R$	RVR in meters (one-minute mean maximum value during last 10 minutes)

AERODROME WEATHER REPORT

RUNWAY VISUAL RANGE (RVR) WHERE REQUIRED, UP TO FOUR ACTIVE RUNWAYS (continued)

i	RVR tendency indicator
Note: 25m STEP if RVR < 400m 50m STEP if 400 ≤ RVR < 800m 100m STEP if RVR ≥ 800m	

PRESENT WEATHER

w'w'	Present weather (see table w'w' at the end of this sequence)

CLOUDS*

$N_sN_sN_s$	Cloud amount: **FEW - FEW** (1 - 2 oktas) **SCT - SC**a**T**tered (3 - 4 oktas) **BKN - B**ro**K**e**N** (5 - 7 oktas) **OVC - OV**er**C**ast (8 oktas)
$h_sh_sh_s$	Height of base of clouds in units of 30m (100ft)
(CC)	Cloud type - only **CB** (cumulonimubs) or **TCU** (towering cumulus) indicated or /// if it cannot be observed by automatic system
Replaced when sky is obscured and information on vertical visibility is available by the group below:	
VV	Indicator of **V**ertical **V**isibility
$h_sh_sh_s$	Vertical visibility in units of 30m (100ft) /// = vertical visibility unavailable
Replaced when there are no such clouds, no restriction on vertical visibility and **CAVOK** is not appropriate by:	
NSC	**N**il **S**ignificant **C**loud
Replaced when automatic system is used and no cloud detected by:	
NCD	**N**o **C**loud **D**etected
* Clouds of operational significance (i.e. below 1500m (5000ft) or below the highest minimum sector altitude, whichever is greater, and CB or TCU)	

AERODROME WEATHER REPORT

CAVOK

Ceiling **A**nd **V**isibility **OK**. **Replaces** visibility RVR, present weather and cloud if:	
(1)	Visibility is 10km or more
(2)	No cumulonimbus, towering cumulus and no other cloud below 1500m (5000ft) or below the highest minimum sector altitude, whichever is greater, and
(3)	No significant present weather (see table w'w' at the end of this sequence)

TEMP AND DEW POINT

T'T'	Temperature in whole degrees Celsius (if below 0°C preceded by **M**)
$T'_dT'_d$	Dew-point temperature in whole degrees Celsius (if below 0°C preceded by **M**)

PRESSURE

Q	Indicator of **Q**NH in hectopascals. If Q = **A** then QNH is in inches
$P_HP_HP_HP_H$	QNH rounded down to the whole nearest hectopascal or to tenths and hundreths of an inch, depending on indicator

SUPPLEMENTARY INFORMATION

RECENT WEATHER	
RE	Indicator of **RE**cent weather
w'w'	**RE**cent weather since previous report (intensity NOT to be reported)
WIND SHEAR	
WS	**W**ind **S**hear
R	**R**UN**W**AY
D_RD_R	Runway designator – for parallel runways, may have **LL, L, C, R** or **RR** appended (**L** = left; **C** = center; **R** = right)
Replaced when all runways are affected by wind shear by: **WS ALL RWY**	
STATE OF THE SEA / SURFACE TEMP	
W	Group indicator letter
T_sT_s	Temperature in whole degrees Celsius
S	Indicator of state of the sea
S'	State of water surface

AERODROME WEATHER REPORT

SUPPLEMENTARY INFORMATION (continued)

S’	STATE OF THE SEA
Code figure	Descriptive terms
0	Calm (glassy)
1	Calm (rippled)
2	Smooth (wavelets)
3	Slight
4	Moderate
5	Rough
6	Very rough
7	High
8	Very high
9	Phenomenal

STATE OF THE RUNWAY **	
RD_RD_R	Indicator of runway
E_R	Runway deposits
C_R	Extent of runway contamination
e_Re_R	Depth of deposit
B_RB_R	Friction coefficient/breaking action
** State of the runway to be provided by appropriate airport authority	

TREND FORECAST - TWO HOURS FROM TIME OF OBSERVATION

CHANGE INDICATORS		
TTTTT or NOSIG	**BECMG**	**BECoMinG**, used where changes are expected to reach or pass through specified values at a regular or irregular rate
	TEMPO	**TEMPO**rary fluctuations of less than one hour and in aggregate less than half the period indicated by YYGG/ $Y_eY_eG_eG_e$
	NOSIG	**NO SIG**NIFICANT CHANGE

CHANGE AND TIME	
TT	Can be **AT** or **FM** = FROM or **TL** = TILL
GGgg	Associated time group in hours and minutes UTC

TREND FORECAST - TWO HOURS FROM TIME OF OBSERVATION (continued)

FORECAST WIND		
ddd	Forecast mean wind direction in degrees true, rounded to nearest 10 degrees (**VRB** = **V**A**R**IA**B**LE)	00000 = calm
ff	Forecast mean wind speed	
G	Indicator of **G**ust	
f_mf_m	Forecast maximum wind speed (gust)	
KMH or **KT** or **MPS**	Wind speed units	
FORECAST VISIBILITY		
VVVV	Forecast prevailing visibility in meters 9999 = 10km or more	
FORECAST WEATHER		
w'w'	Forecast significant weather (see table w'w' at the edn of this sequence)	
Replaced when significant weather ends by:		
NSW	**N**il **S**ignificant **W**eather	
FORECAST CLOUDS OF OPERATIONAL SIGNIFICANCE OR VERTICAL VISIBILITY		
$N_sN_sN_s$	Forecast cloud amount	
$h_sh_sh_s$	Forecast height of base of cloud	
(CC)	Cloud type - only **CB**	
Replaced when sky expected to be obscured and vertical visibility forecasts are undertaken by:		
VV	Indicator of **V**ertical **V**isibility	
$h_sh_sh_s$	Vertical visibility in units of 30m (100ft)	
Replaced when a change to clear sky forecast by:		
SKC	**SK**y **C**lear	
Replaced when no cumulonimbus, towering cumulus and no other cloud below 1500m (5000ft) or highest minimum sector altitude, whichever is greater, are forecast and **CAVOK** is not appropriate by:		
NSC	**N**il **S**ignificant **C**loud	
RMK		
Information included by national decision but not disseminated internationally		

w’w’ SIGNIFICANT PRESENT, FORECAST AND RECENT WEATHER

QUALIFIER				WEATHER PHENOMENA					
Intensity of Proximity 1		**Descriptor 2**		**Precipitation 3**		**Obscuration 4**		**Other 5**	
–	Light	**MI**	Shallow	**DZ**	Drizzle	**BR**	Mist	**PO**	Dust/sand whirls (dust devils)
	Moderate (no qualifier)	**BC**	Patches	**RA**	Rain	**FG**	Fog		
+	Heavy or well-developed in the case of **PO** and **FC**	**PR**	Partial (covering part of the aerodrome)	**SN**	Snow	**FU**	Smoke	**SQ**	Squalls
				SG	Snow grains	**VA**	Volcanic ash	**FC**	Funnel cloud(s) (tornado or waterspout)
						DU	Widespread dust		
VC	In the vicinity	**DR**	Low drifting	**PL**	Ice pellets	**SA**	Sand	**SS**	Sandstorm
		BL	Blowing			**HZ**	Haze	**DS**	Duststorm
		SH	Shower(s)	**GR**	Hail				
		TS	Thunderstorm	**GS**	Small hail and/or snow pellets				
		FZ	Freezing (supercooled)	**UP**	Unknown Precipitation				

NOTES:

1. The w’w’ groups are constructed by considering columns 1 to 5 in the table above in sequence, that is intensity, followed by description, followed by weather phenomena. An example could be: **+ SHRA** (heavy shower(s) of rain).
2. A precipitation combination has dominant type first.
3. **DR** (low drifting) less than two meters above ground, **BL** (blowing) two meters or more above ground.
4. **GR** is used when hailstone diameter is 5mm or more. When less than 5mm, **GS** is used.
5. **BR** - visibility at least 1000m but not more than 5000 m. **FG** - visibility less than 1000m.
6. **VC** – between approximately 8km and 16km from the aerodrome reference point.

AERODROME WEATHER FORECAST - TAF DECODE

IDENTIFICATION GROUPS	
TAF or **TAF AMD** or **TAF COR**	Code names for aerodrome forecast, amended aerodrome forecast and corrected aerodrome forecast, respectively
CCCC	ICAO four-letter location indicator
YYGGgg	Date and time of issue of forecast in UTC
Z	Indicator of UTC
NIL	Indicator of missing forecast
$Y_1Y_1G_1G_1/Y_2Y_2G_2G_2$	Period of validity, beginning on Y_1Y_1 day of month at G_1G_1 (UTC) and ending on Y_2Y_2 day of month at G_2G_2 (UTC)
CNL	Indicator of cancelled forecast

FORECAST SURFACE WIND			
ddd	Mean wind direction in degrees true rounded to nearest 10ºC (**VRB**=**V**a**R**ia**B**le when ff < 3kt)	00000 = calm	
ff	Mean wind speed		P199KMH (P99KT, P49MPS) mean f_mf_m = 200KMH (100KT, 50MPS) or more
G	Indicator of **G**ust		
f_mf_m	Maximum wind speed (gust)		
KMH or **KT** or **MPS**	Wind speed units used		

FORECAST PREVAILING VISIBILITY	
VVVV	Prevailing visibility in metres 9999 = 10km or more

w'w' FORECAST SIGNIFICANT WEATHER									
QUALIFIER				**WEATHER PHENOMENA**					
Intensity of Proximity 1		**Descriptor 2**		**Precipitation 3**		**Obscuration 4**		**Other 5**	
–	Light	**MI**	Shallow	**DZ**	Drizzle	**BR**	Mist	**PO**	Dust/sand whirls (dust devils)
	Moderate (no qualifier)	**BC**	Patches	**RA**	Rain	**FG**	Fog		
+	Heavy or well-developed in the case of **PO** and **FC**	**PR**	Partial (covering part of the aerodrome)	**SN**	Snow	**FU**	Smoke	**SQ**	Squalls
				SG	Snow grains	**VA**	Volcanic ash	**FC**	Funnel cloud(s) (tornado or waterspout)
						DU	Widespread dust		
VC	In the vicinity	**DR**	Low drifting	**PL**	Ice pellets	**SA**	Sand	**SS**	Sandstorm
		BL	Blowing	**GR**	Hail	**HZ**	Haze	**DS**	Duststorm
		SH	Shower(s)	**GS**	Small hail and/or snow pellets				
		TS	Thunderstorm						
		FZ	Freezing (supercooled)	**UP**	Unknown Precipitation				
Replaced when significant weather phenomenon forecast to end by:									
NSW	**N**il **S**ignificant **W**eather								

NOTES:

1. The w'w' groups are constructed by considering columns 1 to 5 in the table above in sequence, that is intensity, followed by description, followed by weather phenomena. An example could be: **+ SHRA** (heavy shower(s) of rain).
2. A precipitation combination has dominant type first.
3. **DR** (low drifting) less than two metres above ground, **BL** (blowing) two metres or more above ground.
4. **GR** is used when hailstone diameter is 5mm or more. When less than 5mm, **GS** is used.
5. **BR** – visibility at least 1000m but not more than 5000m. **FG** – visibility less than 1000m.
6. **VC** – between approximately 8km and 16km from the aerodrome reference point.

AERODROME WEATHER FORECAST

FORECAST CLOUD AMOUNT AND HEIGHT*	
$N_sN_sN_s$	Cloud amount: **FEW - FEW** (1-2 oktas) **SCT - SC**a**T**tered (3-4 oktas) **BKN - B**ro**K**e**N** (5-7 oktas) **OVC - OV**er**C**ast (8 oktas)
$h_sh_sh_s$	Height of base of cloud in units of 30m (100ft)
(cc)	Cloud type - only **CB** (cumulonimbus) is indicated
Replaced when sky is expected to be obscured and information on vertical visibility is available by:	
VV	Indicator of **V**ertical **V**isibility
$h_sh_sh_s$	Vertical visibility in units of 30m (100ft)
Replaced when no cumulonimbus , towering cumulus and no other cloud below 1500m (5000ft) or below the highest minimum sector altitude, whichever is greater, are forecast and **CAVOK** and **SKC** are not appropriate by:	
NSC	**N**il **S**ignificant **C**loud
* Clouds of operational significance (i.e. below 1500m (5000ft) or below highest minimum sector altitude, whichever is greater, and CB or TCU)	

CAVOK	
Ceiling **A**nd **V**isibility **OK**. **Replaces** visibility, weather and cloud if:	
(1)	Visibility is forecast to be 10km or more
(2)	No cumulonimbus cloud and no other cloud forecast below 1500m (5000ft) or below the highest minimum sector altitude, whichever is greater, and
(3)	No significant weather forecast (see table w'w' above)

SIGNIFICANT CHANGES IN FORECAST CONDITIONS INDICATED BY:	
PROBABILITY	
PROB	**PROB**ability
C_2C_2	Only 30 or 40 used, indicating 30% or 40%

AERODROME WEATHER FORECAST

SIGNIFICANT CHANGES IN FORECAST CONDITIONS INDICATED BY:		
DATE AND TIME		
YYGG/$Y_eY_eG_eG_e$	Beginning day and time (UTC) YYGG and end day and time (UTC) $Y_eY_eG_eG_e$ of forecast period	
Probability is used to indicate the probability of occurence of: (a) an alternative element or elements (b) temporary fluctuations		
CHANGE		
TTTTT	Type of significant change:	
	BECMG	**BEC**o**M**in**G**, used where changes are expected to reach or pass through specified values at a regular or irregular rate
	TEMPO	**TEMPO**rary fluctuations of less than 1 hour and in aggregate less than half the period indicated by YYGG/$Y_eY_eG_eG_e$
DATE AND TIME		
YYGG/$Y_eY_eG_eG_e$	Beginning day and time (UTC) YYGG and end day and time (UTC) $Y_eY_eG_eG_e$ of forecast period	
OR		
If one set of weather conditions is expected to change more or less completely to a different set of conditions, thus indicating the beginning of another self-contained part of the forecast, by:		
TTYYGGgg		
This takes the form **FM**YYGGgg where **FM** is the abbreviation for **F**ro**M** and YYGGgg is the day of month and time in hours and minutes UTC. All forecast conditions before this group are superseded by conditions indicated after the group.		

BY REGIONAL AGREEMENT	
FORECAST TEMPERATURE	
TX, TN	**TX, TN** Indicators of maximum and minimum forecast temperatures, respectively
YYT_FT_F	YYT_FT_F Date and forecast temperature at G_FG_F Temperatures below 0°C preceded by **M**
$Y_eY_eG_FG_F$	$Y_eY_eG_FG_F$ Date and time UTC to which forecast temperature refers
Z	**Z** Indicator of UTC

AERODROME WEATHER FORECAST

FORECAST TURBULENCE CONDITIONS (OPTIONAL)	
Six digits for all turbulence groups, first digit always 5	
Second digit	**Turbulence type**
0	None
1	Light turbulence
2	Moderate turbulence in clear air, occasional
3	Moderate turbulence in clear air, frequent
4	Moderate turbulence in cloud, occasional
5	Moderate turbulence in cloud, frequent
6	Severe turbulence in clear air, occasional
7	Severe turbulence in clear air, frequent
8	Severe turbulence in cloud, occasional
9	Severe turbulence in cloud, frequent
Third to fifth digit: height of lowest turbulence layer in units of 30m (100ft) above the aerodrome	
Sixth digit	**Thickness of layer**
0	Up to top of cloud
1	300m/1000ft
2	600m/2000ft
3	900m/3000ft
4	1200m/4000ft
5	1500m/5000ft
6	1800m/6000ft
7	2100m/7000ft
8	2400m/8000ft
9	2700m/9000ft

FORECAST ICING CONDITIONS (OPTIONAL)
Six digits for all icing groups, first digit always 6

Second digit	**Icing type**
0	No icing
1	Light icing
2	Light icing in cloud
3	Light icing in precipitation
4	Moderate icing
5	Moderate icing in cloud
6	Moderate icing in precipitation
7	Severe icing
8	Severe icing in cloud
9	Severe icing in precipitation
Third to fifth digit: height of lowest turbulence layer in units of 30m (100ft) above the aerodrome	
Sixth digit	**Thickness of layer**
0	Up to top of cloud
1	300m/1000ft
2	600m/2000ft
3	900m/3000ft
4	1200m/4000ft
5	1500m/5000ft
6	1800m/6000ft
7	2100m/7000ft
8	2400m/8000ft
9	2700m/9000ft

JEPPESEN®
A BOEING COMPANY

Meteorology

Meteorological Operational Telecommunications Network - Europe (RODEX) Broadcast Information

ENCODING SCHEME FOR RUNWAY CONDITIONS

Information of runway conditions will be expressed by means of the figure group $RD_RD_R/E_RC_Re_Re_RB_RB_R$ where:

R	denotes the runway indicator
D_RD_R	denotes the runway designator
E_R	denotes the runway deposits
C_R	denotes the extent or runway contamination
e_Re_R	denotes the depth of deposit on the runway
B_RB_R	denotes the friction coefficient or braking action on the runway

The following explanations govern the composition and use of this ten-figure group, or in the case of several parallel runways, eleven-figure group:

RUNWAY DESIGNATOR

The message is preceded by indicator R followed by the threshold designator (D_RD_R). This will be expressed as two digits corresponding to the runway designator, e.g. R09/, R27/, R35/, etc. Parallel runways are designated by the letters L (left), C (center) and R (right runway).

NOTE: The information to be included in runway state messages will be for the main instrument runway or runway(s) in use. When parallel runways are in use, information on both runways will be included or, where this is not possible, the information given may not alternate between the two runways, but should be given for the runway with the best surface conditions.

RUNWAY DEPOSITS

The type of deposits on the RWY will be indicated by the digits 0 to 9 or a slash (/) in accordance with the following scale as follows:

0 = Dry and clear of deposits
1 = Damp
2 = Wet or water patches
3 = Rime or frost (Depth normally less than 1mm)
4 = Dry snow
5 = Wet snow
6 = Slush
7 = Ice
8 = Compacted or rolled snow

9 = Frozen ruts

/ = Type of deposit not reported (e.g., due to runway clearance in progress).

EXTENT OF RUNWAY CONTAMINATION

The extent of contamination through deposits on the runway is indicated in percentages in accordance with the following scale: It will be expressed as a single digit:

1 = up to 10% of runway contaminated (covered)

2 = more than 10% to 25% of runway contaminated (covered)

5 = more than 25% to 50% of runway contaminated (covered)

9 = more than 50% to 100% of runway contaminated (covered)

/ = not reported (e.g., due to runway clearance in progress).

DEPTH OF DEPOSIT ON THE RUNWAY

The depth of deposit is indicated by two digits in accordance with the following scale:

0 = less than 1mm

1 = 1mm

2 = 2mm

etc.

10 = 10mm

etc.

15 = 15mm

etc.

20 = 20mm

etc. up to

90 = 90mm

Thereafter, the depth is indicated by:

92 = 10cm

93 = 15cm

94 = 20cm

95 = 25cm

96 = 30cm

DECODE OF EIGHT FIGURE GROUP APPENDED TO MOTNE/OPMET BROADCASTS

97	=	35cm
98	=	40cm or more
99	=	runway or runways non-operational due to snow, slush, ice, large drifts or runway clearance
//	=	depth of deposit operationally not significant or not measurable

NOTE 1: This does not necessarily require depth to be measured to a millimeter unit. Larger intervals up to 90 can be expressed by using the above direct-reading scale.

NOTE 2: Where depth is measured at a number of points along a runway the average value should be transmitted or, if operationally significant, the highest value.

NOTE 3: Code figure 91 is not used. Code figures 92 to 98 permit the depth of deposit (in cm) to be derived by multiplying the last digit by 5 (e.g. 94 = 4 x 5 = 20).

NOTE 4: If deposits of the type reported by the code figures 3, 7, 8 and 9 of code E_R are reported, the depth of deposits is normally not significant and two oblique strokes (//) will be reported. Similarly, the depth of standing water will only be reported if an accurate and representative measurement is guaranteed.

FRICTION COEFFICIENT OR BRAKING ACTION ON THE RUNWAY

The friction coefficient is denoted by two digits or, if the coefficient is not available, the estimated braking action is denoted by two digits.

a. Friction coefficient

EXAMPLE 1: 28 = Friction coefficient 0.28

EXAMPLE 2: 35 = Friction coefficient 0.35

b. Braking action

95 = Good

94 = Medium / Good

93 = Medium

92 = Medium / Poor

91 = Poor

99 = Unreliable

// = Braking action not reported; Runway not operational, Aerodrome closed; etc.

DECODE OF EIGHT FIGURE GROUP APPENDED TO MOTNE/OPMET BROADCASTS

Friction coefficient for compacted snow- and/or ice-covered runways

Measured coefficient	Estimated braking action	Code
0.40 and above	Good	5
0.39 to 0.36	Medium to good	4
0.35 to 0.30	Medium	3
0.29 to 0.26	Medium to poor	2
0.25 and below	Poor	1

NOTE 1: Where braking action is assessed at a number of points along a runway, the mean value will be transmitted or, if operationally significant, the lowest value.

NOTE 2: If measuring equipment does not allow measurement of friction with satisfactory reliability, which may be the case when a runway is contaminated by wet snow, slush, or loose snow, the figures 99 will be used.

NOTE 3: If the braking conditions cannot be reported (e.g. due to runway clearance in progress, runway not operational, runway conditions not watched during airport closure, etc.) two oblique strokes (//) will be entered.

EXAMPLES

NOTE: The occasion may arise when a new report or a valid report is not available in time for dissemination with the appropriate METAR message. In this case, the previous runway state report will be repeated, as indicated by the figures R99/ in place of the runway designator.

R99/421594 – Dry snow covering 11% to 25% of the runway: depth 15mm; braking action medium to good.

R14L///99// – Runway 14L non-operational due to runway clearance in progress.

R14L////// – Runway 14L contaminated but reports are not available or are not updated due to aerodrome closure or curfew, etc.

R88//////// – All runways are contaminated but reports are not available or are not updated due to aerodrome closure or curfew, etc.

R14L/CLRD// – Runway 14L contamination has ceased to exist.

(No further reports will be sent unless recontamination occurs).

AERODROME PAVEMENT CONDITION REPORTS THROUGH SNOWTAM/RODEX

During winter period information on runway condition for the listed airports is published via SNOWTAM or is included at the end of METAR (RODEX) messages.

Following countries do not specify the airports providing this information: Bosnia-Herzegovina, Cyprus, Gibraltar, Ireland, Italy, Kazakhstan, Kyrgyzstan, Malta, Norway, Portugal, Russia, Slovenia, Tajikistan, Turkmenistan, United Kingdom and Uzbekistan.

ALBANIA

Tirana

ARMENIA

Gyumri (Shirak)

Yerevan (Zvartnots)

AUSTRIA

Graz

Hohenems (Dornbirn)

Innsbruck

Klagenfurt

Linz

Salzburg

St Johann/Tirol

Vienna (Schwechat)

Voslau

Wels

Wiener Neustadt/Ost

Zell Am See

AZERBAIJAN

Baku (Heydar Aliyev Intl)

Gabala

Ganja

Lenkoran

AERODROME PAVEMENT CONDITION REPORTS (THROUGH SNOWTAM/MOTNE)

AZERBAIJAN

Nakhchivan

Zagatala

BELARUS

Brest

Homiel

Hrodna

Mahiliou

Minsk (Minsk-2)

Viciebsk

BELGIUM

Antwerp (Deurne)

Brussels (National)

Charleroi (Brussels South)

Liege

Oostende-Brugge (Oostende)

BULGARIA

Burgas

Gorna Oryahovitsa

Plovdiv

Sofia

Varna

CROATIA

Dubrovnik (Cilipi)

Osijek (Klisa)

Zagreb (Franjo Tudjman)

Split (Kastela)

AERODROME PAVEMENT CONDITION REPORTS (THROUGH SNOWTAM/MOTNE)

CZECHIA

Brno (Turany)

Caslav

Karlovy Vary

Kbely

Kunovice

Namest

Ostrava (Mosnov)

Pardubice

Prague (Ruzyne)

DENMARK

Aalborg

Aarhus

Billund

Bornholm (Ronne)

Copenhagen (Kastrup)

Copenhagen (Roskilde)

Esbjerg

Karup (Midtjyllands Lufthavn)

Odense (Hans Christian Andersen)

Sindal

Sonderborg

Stauning

Vojens/Skrydstrup

ESTONIA

Kardla

Kuressaare

Parnu

Tallinn (Lennart Meri)

Tartu

AERODROME PAVEMENT CONDITION REPORTS (THROUGH SNOWTAM/MOTNE)

FINLAND

Enontekio

Halli

Helsinki (Vantaa)

Ivalo

Joensuu

Jyvaskyla

Kajaani

Kemi (Tornio)

Kittila

Kokkola-Pietarsaari

Kuopio

Kuusamo

Lappeenranta

Mariehamn

Mikkeli

Oulu

Pori

Rovaniemi

Savonlinna

Seinajoki

Tampere (Pirkkala)

Turku

Utti

Vaasa

FRANCE

Agen (La Garenne)

Albert (Bray)

Angouleme (Brie Champniers)

Annecy (Meythet)

FRANCE

Aurillac

Avignon (Caumont)

Avord

Basle-Mulhouse

Beauvais (Tille)

Biarritz (Pays Basque)

Bordeaux (Merignac)

Brest (Bretagne)

Brive (Souillac)

Caen (Carpiquet)

Carcassonne (Salvaza)

Cazaux

Chalons (Vatry)

Chambery (Aix-Les-Bains)

Chateaudun

Chateauxroux (Deols)

Clermont-Ferrand/Auvergne

Cognac (Chateaubernard)

Colmar (Houssen)

Deauville (Normandie)

Dole (Tavaux)

Epinal (Mirecourt)

Etain (Rouvres)

Evreux (Fauville)

Grenoble (Isere)

Hyeres (Le Palyvestre Navy)

Istres (Le Tube)

Landivisiau (Navy)

Lanveoc (Poulmic Navy)

Le Havre (Octeville)

AERODROME PAVEMENT CONDITION REPORTS (THROUGH SNOWTAM/MOTNE)

FRANCE

Le Puy (Loudes)

Lille (Lesquin)

Limoges (Bellegarde)

Lorient (Lann-Bihoue)

Luxeuil (St Sauveur)

Lyon (Bron)

Lyon (Saint Exupery)

Marseille/Provence

Metz-Nancy/Lorraine

Mont-De-Marsan

Montpellier/Mediterrannee

Nancy (Essey)

Nancy (Ochey)

Nantes/Atlantique

Nice/Cote D’Azur

Nimes (Garons)

Orange (Caritat)

Orleans (Bricy)

Orleans (St Denis de L’Hotel)

Paris (Charles-De-Gaulle)

Paris (Le Bourget)

Paris (Orly)

Pau/Pyrenees

Perpignan (Rivesaltes)

Phalsbourg (Boursheid)

Pontoise (Cormeilles-En-Vexin)

Quimper (Pluguffan)

Rennes (St Jacques)

Rodez (Aveyron)

Rouen/Vallee de Seine

AERODROME PAVEMENT CONDITION REPORTS (THROUGH SNOWTAM/MOTNE)

FRANCE

St Dizier (Robinson)

St Etienne (Loire)

Strasbourg (Entzheim)

Tarbes (Lourdes-Pyrenees)

Toulouse (Blagnac)

Toulouse (Francazal)

Tours (Val De Loire)

Toussus-Le-Noble

Valence (Chabeuil)

Villacoublay (Velizy)

GEORGIA

Batumi

Tbilisi

GERMANY

Berlin Brandenburg

Bremen

Cologne-Bonn

Dortmund

Dresden

Duesseldorf

Erfurt-Weimar

Frankfurt-Hahn

Frankfurt/Main

Friedrichshafen

Hamburg

Leipzig-Halle

Luebeck (Blankensee)

Muenster/Osnabrueck

Munich

AERODROME PAVEMENT CONDITION REPORTS (THROUGH SNOWTAM/MOTNE)

GERMANY

Niederrhein

Niederstetten

Nuernberg

Paderborn/Lippstadt

Saarbruecken

Stuttgart

GREECE

Athens (Eleftherios Venizelos Intl)

Iraklion (Nikos Kazantzakis)

Kerkira (Ioannis Kapodistrias)

Rodos (Diagoras)

Thessaloniki (Makedonia)

HUNGARY

Bekescsaba

Budapest (Liszt Ferenc Intl)

Debrecen (Intl)

Gyor-Per

Heviz (Heviz-Balaton)

Nyiregyhaza

Pecs (Pogany)

Szeged

KOSOVO

Pristina (Adem Jashari)

LATVIA

Liepaja

Riga

AERODROME PAVEMENT CONDITION REPORTS (THROUGH SNOWTAM/MOTNE)

LITHUANIA

Kaunas (Intl)

Palanga (Intl)

Siauliai (Intl)

Vilnius (Intl)

LUXEMBOURG

Luxembourg

MOLDOVA

Chisinau (Intl)

Marculesti (Intl)

MONTENEGRO

Podgorica

NETHERLANDS

Amsterdam (Schiphol)

Eindhoven

Groningen (Eelde)

Lelystad

Maastricht (Maastricht-Aachen)

Rotterdam

NORTH MACEDONIA

Ohrid (St Paul the Apostle)

Skopje (Intl)

POLAND

Bydgoszcz

Gdansk (Lech Walesa)

Katowice (Pyrzowice)

Krakow (Balice)

AERODROME PAVEMENT CONDITION REPORTS (THROUGH SNOWTAM/MOTNE)

POLAND

Lodz
Lublin
Olsztyn-Mazury
Poznan (Lawica)
Radom (Sadkow)
Rzeszow (Jasionka)
Szczecin (Goleniow)
Warsaw (Chopin)
Warsaw (Modlin)
Wroclaw (Strachowice)
Zielona Gora (Babimost)

ROMANIA

Arad
Bacau (Georg Enescu)
Baia Mare (Maramures)
Bucharest (Baneasa-Aurel Vlaicu)
Bucharest (Henri Coanda)
Cluj-Napoca (Avram Iancu)
Constanta (Mihail Kogalniceanu-Constanta)
Craiova
Iasi
Oradea
Satu Mare
Sibiu
Suceava (Stefan cel Mare)
Targu Mures (Transilvania-Targu Mures)
Timisoara (Traian Vuia)
Tulcea (Delta Dunarii)

AERODROME PAVEMENT CONDITION REPORTS (THROUGH SNOWTAM/MOTNE)

SERBIA

Belgrade (Nikola Tesla)

Kraljevo (Morava)

Nis (Konstantin Veliki)

Podgorica

SLOVAKIA

Bratislava (M.R. Stefanik)

Kosice

Piestany

Poprad (Tatry)

Zilina

SPAIN

A Coruna

Alicante (Alicante-Elche)

Almeria

Asturias

Barcelona (Josep Tarradellas/El Prat)

Bilbao

Burgos (Villafria)

Cordoba

Girona

Granada (Federico Garcia Lorca)

Huesca (Pirineos)

Ibiza

Jerez

Logrono (Agoncillo)

Madrid (Adolfo Suarez Madrid-Barajas)

Madrid (Cuatro Vientos)

Malaga (Costa del Sol)

Mallorca (Son Bonet)

AERODROME PAVEMENT CONDITION REPORTS (THROUGH SNOWTAM/MOTNE)

SPAIN

Menorca

Murcia (Region de Murcia)

Palma de Mallorca

Pamplona

Reus

Sabadell

San Sebastian

Santander (Seve Ballesteros-Santander)

Santiago (Rosalia de Castro)

Seville

Valencia

Vigo

Vitoria

SWEDEN

Angelholm

Are Ostersund

Arvidsjaur

Borlange

Gallivare

Goteborg (Landvetter)

Goteborg (Save)

Hagfors

Halmstad

Jonkoping

Kalmar

Karlstad

Kiruna

Kramfors-Solleftea

Kristianstad

AERODROME PAVEMENT CONDITION REPORTS (THROUGH SNOWTAM/MOTNE)

SWEDEN

Linkoping (Saab)
Lulea (Kallax)
Lycksele
Malmo
Mora (Siljan)
Norrkoping (Kungsangen)
Orebro
Ornskoldsvik
Pajala
Ronneby
Skelleftea
Stockholm (Arlanda)
Stockholm (Bromma)
Stockholm (Skavsta)
Stockholm (Vaesteraas)
Sundsvall-Timra
Trollhattan-Vanersborg
Umea
Vaxjo (Kronoberg)
Vilhelmina
Visby

SWITZERLAND

Bern (Belp)
Geneva
Grenchen
Les Eplatures
Lugano
Samedan
Sion

SWITZERLAND

St. Gallen (Altenrhein)

Zurich

TURKEY

Adana (Intl)

Ankara (Esenboga Intl)

Antalya (Intl)

Balikesir (Koca Seyit)

Bursa (Yenisehir)

Canakkale

Denizli (Cardak)

Diyarbakir

Elazig

Erzurum (Intl)

Eskisehir (Hasan Polatkan)

Gaziantep (Intl)

Gazipasa (Alanya)

Hatay

Isparta (Suleyman Demirel)

Istanbul

Istanbul (Ataturk Intl)

Istanbul (Sabiha Gokcen Intl)

Izmir (Adnan Menderes Intl)

Kapadokya

Kayseri

Konya

Malatya

Milas (Bodrum Intl)

Mugla (Dalaman Intl)

Samsun (Carsamba)

TURKEY

Sanliurfa (Gap Intl)

Sivas (Nuri Demirag)

Tekirdag (Corlu Ataturk Intl)

Trabzon (Intl)

Van (Ferit Melen)

Zafer

Zonguldak (Caycuma)

UKRAINE

Chernivtsi (Intl)

Dnipro

Ivano-Frankivsk (Intl)

Kharkiv (Osnova)

Kharkiv (Sokolnyky Natl)

Kherson (Intl)

Kirovohrad

Kremenchuk (Velyka Kokhnivka Natl)

Kryvyi Rih (Lozuvatka)

Kyiv (Antonov-1 Natl)

Kyiv (Antonov-2 Intl)

Kyiv (Boryspil Intl)

Kyiv (Zhuliany Intl)

Lviv (Intl)

Mykolaiv (Intl)

Odesa

Ozerne (Intl)

Poltava (Suprunivka Intl)

Rivne (Intl)

Sumy (Natl)

Ternopil (Natl)

AERODROME PAVEMENT CONDITION REPORTS (THROUGH SNOWTAM/MOTNE)

UKRAINE

Uzhhorod (Intl)

Vinnytsia (Gavryshivka Intl)

Zaporizhzhia (Intl)

Zhytomyr (S.P. Korolyov Natl)

Tables and Codes

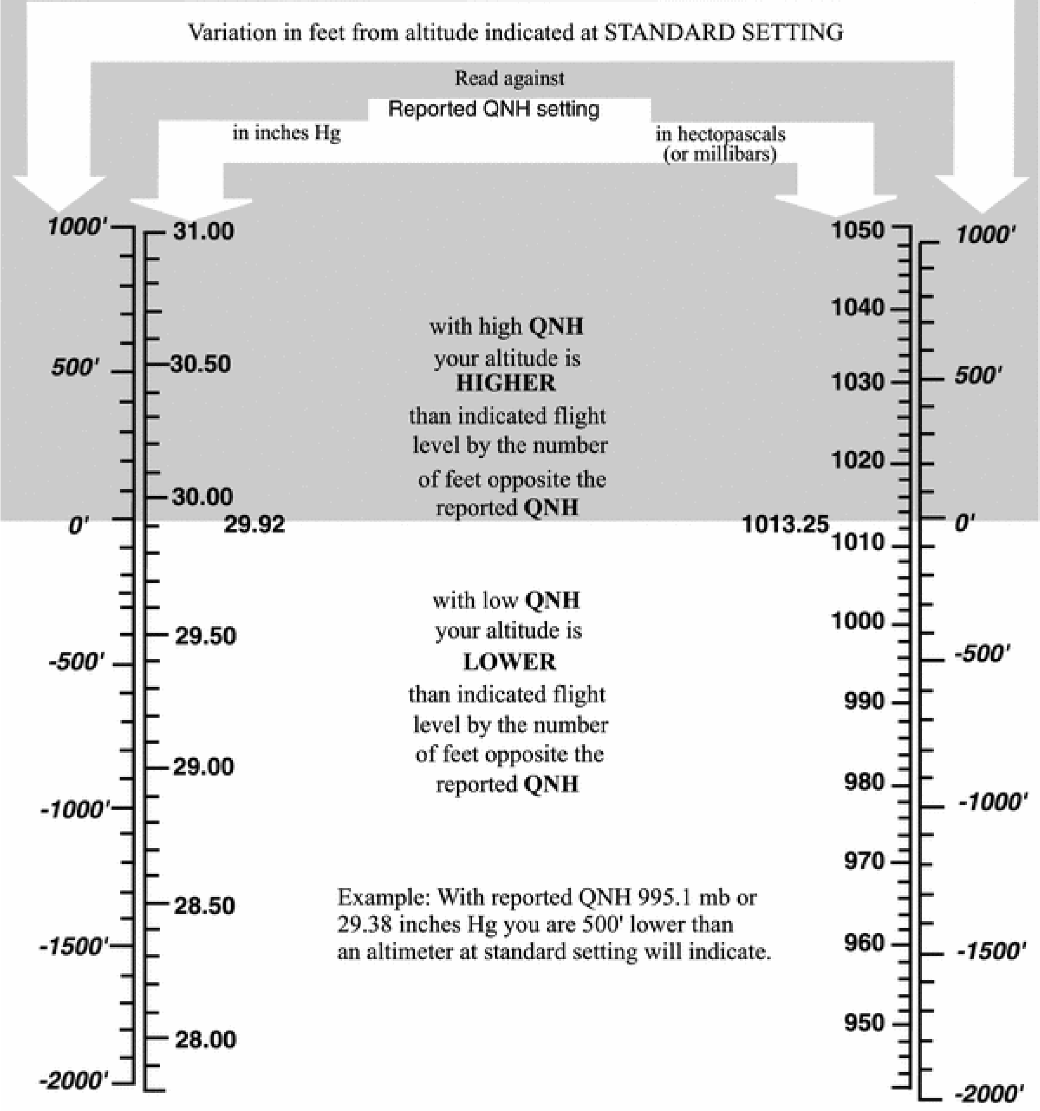
Tables and Codes

Tables and Codes - Reference Information

ALTIMETER SETTING

SETTING	AT AIRPORT	IN THE AIR
QNE (Standard) 29.92 in. Hg. — 1013.25 hPa — 1013.25 mb	Variable elevation reading above or below actual elevation	Positive separation by pressure level but at varying actual altitudes
QNH (Sea Level)	Actual elevation reading when aircraft on ground	Altitude indicated (without consideration of temperature)
QFE (Station)	Zero elevation reading when aircraft on ground	Height above ground indicated (without consideration of temperature)

FLIGHT LEVEL TABLE



with high **QNH** your altitude is **HIGHER** than indicated flight level by the number of feet opposite the reported **QNH**

with low **QNH** your altitude is **LOWER** than indicated flight level by the number of feet opposite the reported **QNH**

Example: With reported QNH 995.1 mb or 29.38 inches Hg you are 500' lower than an altimeter at standard setting will indicate.

CAUTION: True altitude is obtained only by application of temperature correction

PHONETIC ALPHABET AND MORSE CODE

LETTER	CODE	WORD	LATIN ALPHABET REPRESENTATION
A	• –	Alfa	AL FAH
B	– • • •	Bravo	BRAH VOH
C	– • – •	Charlie	CHAR LEE or SHAR LEE
D	– • •	Delta	DELL TAH
E	•	Echo	ECK OH
F	• • – •	Foxtrot	FOKS TROT
G	– – •	Golf	GOLF
H	• • • •	Hotel	HOH TELL
I	• •	India	IN DEE AH
J	• – – –	Juliett	JEW LEE ETT
K	– • –	Kilo	KEY LOH
L	• – • •	Lima	LEE MAH
M	– –	Mike	MIKE
N	– •	November	NO VEM BER
O	– – –	Oscar	OSS CAH
P	• – – •	Papa	PAH PAH
Q	– – • –	Quebec	KEH BECK
R	• – •	Romeo	ROW ME OH
S	• • •	Sierra	SEE AIR RAH
T	–	Tango	TANG GO
U	• • –	Uniform	YOU NEE FORM or OO NEE FORM
V	• • • –	Victor	VIK TAH
W	• – –	Whiskey	WISS KEY
X	– • • –	X-ray	ECKS RAY
Y	– • – –	Yankee	YANG KEY
Z	– – • •	Zulu	ZOO LOO

REFERENCE TABLES

NUMERAL OR NUMERAL ELEMENT	CODE	PRONUNCIATION
1	• – – – –	WUN
2	• • – – –	TOO
3	• • • – –	TREE
4	• • • • –	FOW-er
5	• • • • •	FIFE
6	– • • • •	SIX
7	– – • • •	SEV-en
8	– – – • •	AIT
9	– – – – •	NIN-er
0	– – – – –	ZE-RO
Decimal		DAY-SEE-MAL
Thousand		TOU-SAND

METRIC MULTIPLES AND SUB-MULTIPLES

Multiplying Factor	Prefix	Symbol	Examples
1 000 000 000 000 = 10^{12}	terra	T	
1 000 000 000 = 10^{9}	giga	G	
1 000 000 = 10^{6}	mega	M	megahertz, etc.
1 000 =10^{3}	kilo	k	kilogram, kilometer, etc.
100=10^{2}	hecto	h	
10=10^{1}	deka	da	
1			meter, gram, liter, etc.
0.1=10^{-1}	deci	d	
0.01=10^{-2}	centi	c	
0.001=10^{-3}	milli	m	milligram, millimeter, etc.
0.000 001=10^{-6}	micro	µ	
0.000 000 001=10^{-9}	nano	n	
0.000 000 000 001=10^{-12}	pico	p	

WIND COMPONENT TABLES

ANGLE BETWEEN WIND DIRECTION AND HEADING (LEFT OR RIGHT)								
WIND SPEED KNOTS	10	20	30	40	50	60	70	80
	HEADWIND COMPONENT							
5	-5	-5	-4	-4	-3	-3	-2	-1
10	-10	-9	-9	-8	-6	-5	-3	-2
15	-15	-14	-13	-11	-10	-8	-5	-3
20	-20	-19	-17	-15	-13	-10	-7	-3
25	-25	-23	-22	-19	-16	-13	-9	-4
30	-29	-28	-26	-23	-19	-15	-10	-5
35	-34	-33	-30	-27	-22	-18	-12	-6
40	-39	-38	-35	-31	-26	-20	-14	-7
45	-44	-42	-39	-34	-29	-23	-15	-8
50	-49	-47	-43	-38	-32	-25	-17	-9
55	-54	-52	-48	-42	-35	-28	-19	-9
60	-59	-56	-52	-46	-39	-30	-21	-10
65	-64	-61	-56	-50	-42	-33	-22	-11
70	-69	-66	-61	-54	-45	-35	-24	-12

ANGLE BETWEEN WIND DIRECTION AND HEADING (LEFT OR RIGHT)								
WIND SPEED KNOTS	10	20	30	40	50	60	70	80
	CROSSWIND COMPONENT							
5	1	2	3	3	4	4	5	5
10	2	3	5	6	8	9	9	10
15	3	5	8	10	11	13	14	15
20	3	7	10	13	15	17	19	20
25	4	9	13	16	19	22	23	25
30	5	10	15	19	23	26	28	29
35	6	12	18	22	27	30	33	34
40	7	14	20	26	31	35	38	39
45	8	15	23	29	34	39	42	44

ANGLE BETWEEN WIND DIRECTION AND HEADING (LEFT OR RIGHT)								
WIND SPEED KNOTS	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**
	CROSSWIND COMPONENT							
50	9	17	25	32	38	43	47	49
55	9	19	28	35	42	48	52	54
60	10	21	30	39	46	52	56	59
65	11	22	33	42	50	56	61	64
70	12	24	35	45	54	61	66	69

ANGLE BETWEEN WIND DIRECTION AND HEADING (LEFT OR RIGHT)								
WIND SPEED KNOTS	**100**	**110**	**120**	**130**	**140**	**150**	**160**	**170**
	TAILWIND COMPONENT							
5	+1	+2	+3	+3	+4	+4	+5	+5
10	+2	+3	+5	+6	+8	+9	+9	+10
15	+3	+5	+8	+10	+11	+13	+14	+15
20	+3	+7	+10	+13	+15	+17	+19	+20
25	+4	+9	+13	+16	+19	+22	+23	+25
30	+5	+10	+15	+19	+23	+26	+28	+29
35	+6	+12	+18	+22	+27	+30	+33	+34
40	+7	+14	+20	+26	+31	+35	+38	+39
45	+8	+15	+23	+29	+34	+39	+42	+44
50	+9	+17	+25	+32	+38	+43	+47	+49
55	+9	+19	+28	+35	+42	+48	+52	+54
60	+10	+21	+30	+39	+46	+52	+56	+59
65	+11	+22	+33	+42	+50	+56	+61	+64
70	+12	+24	+35	+45	+54	+61	+66	+69

PRESSURE ALTITUDE

Inches of Mercury	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
21.00	9475	9462	9450	9438	9425	9413	9401	9388	9376	9364
21.10	9352	9339	9327	9315	9303	9290	9278	9266	9254	9241
21.20	9229	9217	9205	9192	9180	9168	9156	9144	9131	9119
21.30	9107	9095	9083	9071	9058	9046	9034	9022	9010	8998
21.40	8986	8973	8961	8949	8937	8925	8913	8901	8889	8877
21.50	8864	8852	8840	8828	8816	8804	8792	8780	8768	8756
21.60	8744	8732	8720	8708	8696	8684	8672	8660	8648	8636
21.70	8624	8612	8600	8588	8576	8564	8552	8540	8528	8516
21.80	8504	8492	8480	8468	8456	8444	8432	8420	8408	8397
21.90	8385	8373	8361	8349	8337	8325	8313	8301	8290	8278
22.00	8266	8254	8242	8230	8218	8207	8195	8183	8171	8159
22.10	8147	8136	8124	8112	8100	8088	8077	8065	8053	8041
22.20	8029	8018	8006	7994	7982	7971	7959	7947	7935	7924
22.30	7912	7900	7888	7877	7865	7853	7841	7830	7918	7806
22.40	7795	7783	7771	7760	7748	7736	7725	7713	7701	7690
22.50	7678	7666	7655	7643	7631	7620	7608	7597	7585	7573
22.60	7562	7550	7538	7527	7515	7504	7492	7481	7469	7457
22.70	7446	7434	7423	7411	7400	7388	7377	7365	7353	7342
22.80	7330	7319	7307	7296	7284	7273	7261	7250	7238	7227
22.90	7215	7204	7192	7181	7169	7158	7146	7135	7124	7112
23.00	7101	7089	7078	7066	7055	7044	7032	7021	7009	6998
23.10	6986	6975	6964	6952	6941	6929	6918	6907	6895	6884
23.20	6873	6861	6850	6839	6827	6816	6804	6793	6782	6770
23.30	6759	6748	6737	6725	6714	6703	6691	6680	6669	6657
23.40	6646	6635	6624	6612	6601	6590	6578	6567	6556	6545
23.50	6533	6522	6511	6500	6488	6477	6466	6455	6444	6432
23.60	6421	6410	6399	6388	6376	6365	6354	6343	6332	6320
23.70	6309	6298	6287	6276	6265	6253	6242	6231	6220	6209

Inches of Mercury	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
23.80	6198	6187	6176	6164	6153	6142	6131	6120	6109	6098
23.90	6087	6076	6064	6053	6042	6031	6020	6009	5998	5987
24.00	5976	5965	5954	5943	5932	5921	5910	5899	5888	5877
24.10	5866	5855	5844	5832	5821	5810	5799	5788	5777	5767
24.20	5756	5745	5734	5723	5712	5701	5690	5679	5668	5657
24.30	5646	5635	5624	5613	5602	5591	5580	5569	5558	5548
24.40	5537	5526	5515	5504	5493	5482	5471	5460	5449	5439
24.50	5428	5417	5406	5395	5384	5373	5363	5352	5341	5330
24.60	5319	5308	5297	5287	5276	5265	5254	5243	5233	5222
24.70	5211	5200	5189	5179	5168	5157	5146	5135	5125	5114
24.80	5103	5092	5082	5071	5060	5049	5039	5028	5017	5006
24.90	4996	4985	4974	4963	4953	4942	4931	4921	4910	4899
25.00	4888	4878	4867	4856	4846	4835	4824	4814	4803	4792
25.10	4782	4771	4760	4750	4739	4728	4718	4707	4696	4686
25.20	4675	4665	4654	4643	4633	4622	4612	4601	4590	4580
25.30	4569	4559	4548	4537	4527	4516	4506	4495	4484	4474
25.40	4463	4453	4442	4432	4421	4411	4400	4390	4379	4368
25.50	4358	4347	4337	4326	4316	4305	4295	4284	4274	4263
25.60	4253	4242	4232	4221	4211	4200	4190	4179	4169	4159
25.70	4148	4138	4127	4117	4106	4096	4085	4075	4064	4054
25.80	4044	4033	4023	4012	4002	3992	3981	3971	3960	3950
25.90	3939	3929	3919	3908	3898	3888	3877	3867	3856	3846
26.00	3836	3825	3815	3805	3794	3784	3774	3763	3753	3743
26.10	3732	3722	3712	3701	3691	3681	3670	3660	3650	3639
26.20	3629	3619	3609	3598	3588	3578	3567	3557	3547	3537
26.30	3526	3516	3506	3495	3485	3475	3465	3454	3444	3434
26.40	3424	3414	3403	3393	3383	3373	3362	3352	3342	3332
26.50	3322	3311	3301	3291	3281	3271	3260	3250	3240	3230
26.60	3220	3210	3199	3189	3179	3169	3159	3149	3138	3128
26.70	3118	3108	3098	3088	3078	3067	3057	3047	3037	3027

REFERENCE TABLES

Inches of Mercury	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
26.80	3017	3007	2997	2987	2976	2966	2956	2946	2936	2926
26.90	2916	2906	2896	2886	2876	2866	2855	2845	2835	2825
27.00	2815	2805	2795	2785	2775	2765	2755	2745	2735	2725
27.10	2715	2705	2695	2685	2675	2665	2655	2645	2635	2625
27.20	2615	2605	2595	2585	2575	2565	2555	2545	2535	2525
27.30	2515	2505	2495	2485	2475	2465	2455	2445	2435	2426
27.40	2416	2406	2396	2386	2376	2366	2356	2346	2336	2326
27.50	2316	2307	2297	2287	2277	2267	2257	2247	2237	2227
27.60	2218	2208	2198	2188	2178	2168	2158	2149	2139	2129
27.70	2119	2109	2099	2089	2080	2070	2060	2050	2040	2030
27.80	2021	2011	2001	1991	1981	1972	1962	1952	1942	1932
27.90	1923	1913	1903	1893	1884	1874	1864	1854	1844	1835
28.00	1825	1815	1805	1796	1786	1776	1766	1757	1747	1737
28.10	1727	1718	1708	1698	1689	1679	1669	1659	1650	1640
28.20	1630	1621	1611	1601	1592	1582	1572	1562	1553	1543
28.30	1533	1524	1514	1504	1495	1485	1475	1466	1456	1446
28.40	1437	1427	1417	1408	1398	1389	1379	1369	1360	1350
28.50	1340	1331	1321	1312	1302	1292	1283	1273	1264	1254
28.60	1244	1235	1225	1216	1206	1196	1187	1177	1168	1158
28.70	1149	1139	1129	1120	1110	1101	1091	1082	1072	1063
28.80	1053	1044	1034	1024	1015	1005	996	986	977	967
28.90	958	948	939	929	920	910	901	891	882	872
29.00	863	853	844	834	825	815	806	796	787	778
29.10	768	759	749	740	730	721	711	702	693	683
29.20	674	664	655	645	636	627	617	608	598	589
29.30	579	570	561	551	542	532	523	514	504	495
29.40	486	476	467	457	448	439	429	420	411	401
29.50	392	382	373	364	354	345	336	326	317	308
29.60	298	289	280	270	261	252	242	233	224	215
29.70	205	196	187	177	168	159	149	140	131	122

Inches of Mercury	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
29.80	112	103	94	84	75	66	57	47	38	29
29.90	20	10	1	-8	-17	-27	-36	-45	-54	-64
30.00	-73	-82	-91	-100	-110	-119	-128	-137	-147	-156
30.10	-165	-174	-183	-193	-202	-211	-220	-229	-238	-248
30.20	-257	-266	-275	-284	-294	-303	-312	-321	-330	-339
30.30	-348	-358	-367	-376	-385	-394	-403	-413	-422	-431
30.40	-440	-449	-458	-467	-476	-486	-495	-504	-513	-522
30.50	-531	-540	-549	-558	-568	-577	-586	-595	-604	-613
30.60	-622	-631	-640	-649	-658	-667	-676	-686	-695	-704
30.70	-713	-722	-731	-740	-749	-758	-767	-776	-785	-794
30.80	-803	-812	-821	-830	-839	-848	-857	-866	-875	-884
30.90	-893	-902	-911	-920	-929	-938	-947	-956	-965	-974
31.00	-983	-992	-1001	-1010	-1019	-1028	-1037	-1046	-1055	-1064

INCHES TO HECTOPASCALS (OR MILLIBARS)

1 inch of mercury = 33.863 hectopascals = 33.863 millibars										
Inches of Mercury	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
	HECTOPASCALS (or MILLIBARS)									
21.0	711.1	711.5	711.8	712.2	712.5	712.8	713.2	713.5	713.9	714.2
21.1	714.5	714.9	715.2	715.5	715.9	716.2	716.6	716.9	717.2	717.6
21.2	717.9	718.3	718.6	718.9	719.3	719.6	719.9	720.3	720.6	721.0
21.3	721.3	721.6	722.0	722.3	722.7	723.0	723.3	723.7	724.0	724.3
21.4	724.7	725.0	725.4	725.7	726.0	726.4	726.7	727.1	727.4	727.7
21.5	728.1	728.4	728.8	729.1	729.4	729.8	730.1	730.4	730.8	731.1
21.6	731.5	731.8	732.1	732.5	732.8	733.2	733.5	733.8	734.2	734.5
21.7	734.8	735.2	735.5	735.9	736.2	736.5	736.9	737.2	737.6	737.9
21.8	738.2	738.6	738.9	739.2	739.6	739.9	740.3	740.6	740.9	741.3
21.9	741.6	742.0	742.3	742.6	743.0	743.3	743.7	744.0	744.3	744.7
22.0	745.0	745.3	745.7	746.0	746.4	746.7	747.0	747.4	747.7	748.1
22.1	748.4	748.7	749.1	749.4	749.7	750.1	750.4	750.8	751.1	751.4

1 inch of mercury = 33.863 hectopascals = 33.863 millibars

Inches of Mercury	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
	HECTOPASCALS (or MILLIBARS)									
22.2	751.8	752.1	752.5	752.8	753.1	753.5	753.8	754.2	754.5	754.8
22.3	755.2	755.5	755.8	756.2	756.5	756.9	757.2	757.5	757.9	758.2
22.4	758.6	758.9	759.2	759.6	759.9	760.2	760.6	760.9	761.3	761.6
22.5	761.9	762.3	762.6	763.0	763.3	763.6	764.0	764.3	764.6	765.0
22.6	765.3	765.7	766.0	766.3	766.7	767.0	767.4	767.7	768.0	768.4
22.7	768.7	769.1	769.4	769.7	770.1	770.4	770.7	771.1	771.4	771.8
22.8	772.1	772.4	772.8	773.1	773.5	773.8	774.1	774.5	774.8	775.1
22.9	775.5	775.8	776.2	776.5	776.8	777.2	777.5	777.9	778.2	778.5
23.0	778.9	779.2	779.5	779.9	780.2	780.6	780.9	781.2	781.6	781.9
23.1	782.3	782.6	782.9	783.3	783.6	784.0	784.3	784.6	785.0	785.3
23.2	785.6	786.0	786.3	786.7	787.0	787.3	787.7	788.0	788.4	788.7
23.3	789.0	789.4	789.7	790.0	790.4	790.7	791.1	791.4	791.7	792.1
23.4	792.4	792.8	793.1	793.4	793.8	794.1	794.4	794.8	795.1	795.5
23.5	795.8	796.1	796.5	796.8	797.2	797.5	797.8	798.2	798.5	798.9
23.6	799.2	799.5	799.9	800.2	800.5	800.9	801.2	801.6	801.9	802.2
23.7	802.6	802.9	803.3	803.6	803.9	804.3	804.6	804.9	805.3	805.6
23.8	806.0	806.3	806.6	807.0	807.3	807.7	808.0	808.3	808.7	809.0
23.9	809.3	809.7	810.0	810.4	810.7	811.0	811.4	811.7	812.1	812.4
24.0	812.7	813.1	813.4	813.8	814.1	814.4	814.8	815.1	815.4	815.8
24.1	816.1	816.5	816.8	817.1	817.5	817.8	818.2	818.5	818.8	819.2
24.2	819.5	819.8	820.2	820.5	820.9	821.2	821.5	821.9	822.2	822.6
24.3	822.9	823.2	823.6	823.9	824.2	824.6	824.9	825.3	825.6	825.9
24.4	826.3	826.6	827.0	827.3	827.6	828.0	828.3	828.7	829.0	829.3
24.5	829.7	830.0	830.3	830.7	831.0	831.4	831.7	832.0	832.4	832.7
24.6	833.1	833.4	833.7	834.1	834.4	834.7	835.1	835.4	835.8	836.1
24.7	836.4	836.8	837.1	837.5	837.8	838.1	838.5	838.8	839.1	839.5
24.8	839.8	840.2	840.5	840.8	841.2	841.5	841.9	842.2	842.5	842.9
24.9	843.2	843.6	843.9	844.2	844.6	844.9	845.2	845.6	845.9	846.3

REFERENCE TABLES

1 inch of mercury = 33.863 hectopascals = 33.863 millibars

Inches of Mercury	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
	HECTOPASCALS (or MILLIBARS)									
25.0	846.6	846.9	847.3	847.6	848.0	848.3	848.6	849.0	849.3	849.6
25.1	850.0	850.3	850.7	851.0	851.3	851.7	852.0	852.4	852.7	853.0
25.2	853.4	853.7	854.0	854.4	854.7	855.1	855.4	855.7	856.1	856.4
25.3	856.8	857.1	857.4	857.8	858.1	858.5	858.8	859.1	859.5	859.8
25.4	860.1	860.5	860.8	861.2	861.5	861.8	862.2	862.5	862.9	863.2
25.5	863.5	863.9	864.2	864.5	864.9	865.2	865.6	865.9	866.2	866.6
25.6	866.9	867.3	867.6	867.9	868.3	868.6	868.9	869.3	869.6	870.0
25.7	870.3	870.6	871.0	871.3	871.7	872.0	872.3	872.7	873.0	873.4
25.8	873.7	874.0	874.4	874.7	875.0	875.4	875.7	876.1	876.4	876.7
25.9	877.1	877.4	877.8	878.1	878.4	878.8	879.1	879.4	879.8	880.1
26.0	880.5	880.8	881.1	881.5	881.8	882.2	882.5	882.8	883.2	883.5
26.1	883.8	884.2	884.5	884.9	885.2	885.5	885.9	886.2	886.6	886.9
26.2	887.2	887.6	887.9	888.3	888.6	888.9	889.3	889.6	889.9	890.3
26.3	890.6	891.0	891.3	891.6	892.0	892.3	892.7	893.0	893.3	893.7
26.4	894.0	894.3	894.7	895.0	895.4	895.7	896.0	896.4	896.7	897.1
26.5	897.4	897.7	898.1	898.4	898.7	899.1	899.4	899.8	900.1	900.4
26.6	900.8	901.1	901.5	901.8	902.1	902.5	902.8	903.2	903.5	903.8
26.7	904.2	904.5	904.8	905.2	905.5	905.9	906.2	906.5	906.9	907.2
26.8	907.6	907.9	908.2	908.6	908.9	909.2	909.6	909.9	910.3	910.6
26.9	910.9	911.3	911.6	912.0	912.3	912.6	913.0	913.3	913.6	914.0
27.0	914.3	914.7	915.0	915.3	915.7	916.0	916.4	916.7	917.0	917.4
27.1	917.7	918.1	918.4	918.7	919.1	919.4	919.7	920.1	920.4	920.8
27.2	921.1	921.4	921.8	922.1	922.5	922.8	923.1	923.5	923.8	924.1
27.3	924.5	924.8	925.2	925.5	925.8	926.2	926.5	926.9	927.2	927.5
27.4	927.9	928.2	928.5	928.9	929.2	929.6	929.9	930.2	930.6	930.9
27.5	931.3	931.6	931.9	932.3	932.6	933.0	933.3	933.6	934.0	934.3
27.6	934.6	935.0	935.3	935.7	936.0	936.3	936.7	937.0	937.4	937.7
27.7	938.0	938.4	938.7	939.0	939.4	939.7	940.1	940.4	940.7	941.1

REFERENCE TABLES

1 inch of mercury = 33.863 hectopascals = 33.863 millibars

Inches of Mercury	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
	HECTOPASCALS (or MILLIBARS)									
27.8	941.4	941.8	942.1	942.4	842.8	943.1	943.4	943.8	944.1	944.5
27.9	944.8	945.1	945.5	945.8	946.2	946.5	946.8	947.2	947.5	947.9
28.0	948.2	948.5	948.9	949.2	949.5	949.9	950.2	950.6	950.9	951.2
28.1	951.6	951.9	952.3	952.6	952.9	953.3	953.6	953.9	954.3	954.6
28.2	955.0	955.3	955.6	956.0	956.3	956.7	957.0	957.3	957.7	958.0
28.3	958.3	958.7	959.0	959.4	959.7	960.0	960.4	960.7	961.1	961.4
28.4	961.7	962.1	962.4	962.8	963.1	963.4	963.8	964.1	964.4	964.8
28.5	965.1	965.5	965.8	966.1	966.5	966.8	967.2	967.5	967.8	968.2
28.6	968.5	968.8	969.2	969.5	969.9	970.2	970.5	970.9	971.2	971.6
28.7	971.9	972.2	972.6	972.9	973.2	973.6	973.9	974.3	974.6	974.9
28.8	975.3	975.6	976.0	976.3	976.6	977.0	977.3	977.7	978.0	978.3
28.9	978.7	979.0	979.3	979.7	980.0	980.4	980.7	981.0	981.4	981.7
29.0	982.1	982.4	982.7	983.1	983.4	983.7	984.1	984.4	984.8	985.1
29.1	985.4	985.8	986.1	986.5	986.8	987.1	987.5	987.8	988.2	988.5
29.2	988.8	989.2	989.5	989.8	990.2	990.5	990.9	991.2	991.5	991.9
29.3	992.2	992.6	992.9	993.2	993.6	993.9	994.2	994.6	994.9	995.3
29.4	995.6	995.9	996.3	996.6	997.0	997.3	997.6	998.0	998.3	998.6
29.5	999.0	999.3	999.7	1000.0	1000.4	1000.7	1001.0	1001.4	1001.7	1002.0
29.6	1002.4	1002.7	1003.1	1003.4	1003.7	1004.1	1004.4	1004.7	1005.1	1005.4
29.7	1005.8	1006.1	1006.4	1006.8	1007.1	1007.5	1007.8	1008.1	1008.5	1008.8
29.8	1009.1	1009.5	1009.8	1010.2	1010.5	1010.8	1011.2	1011.5	1011.9	1012.2
29.9	1012.5	1012.9	1013.2	1013.5	1013.9	1014.2	1014.6	1014.9	1015.2	1015.6
30.0	1015.9	1016.3	1016.6	1016.9	1017.3	1017.6	1018.0	1018.3	1018.6	1019.0
30.1	1019.3	1019.6	1020.0	1020.3	1020.7	1021.0	1021.3	1021.7	1022.0	1022.4
30.2	1022.7	1023.0	1023.4	1023.7	1024.0	1024.4	1024.7	1025.1	1025.4	1025.7
30.3	1026.1	1026.4	1026.8	1027.1	1027.4	1027.8	1028.1	1028.4	1028.8	1029.1
30.4	1029.5	1029.8	1030.1	1030.5	1030.8	1031.2	1031.5	1031.8	1032.2	1032.5
30.5	1032.9	1033.2	1033.5	1033.9	1034.2	1034.5	1034.9	1035.2	1035.6	1035.9

1 inch of mercury = 33.863 hectopascals = 33.863 millibars										
Inches of Mercury	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
	HECTOPASCALS (or MILLIBARS)									
30.6	1036.2	1036.6	1036.9	1037.3	1037.6	1037.9	1038.3	1038.6	1038.9	1039.3
30.7	1039.6	1040.0	1040.3	1040.6	1041.0	1041.3	1041.7	1042.0	1042.3	1042.7
30.8	1043.0	1043.3	1043.7	1044.0	1044.4	1044.7	1045.0	1045.4	1045.7	1046.1
30.9	1046.4	1046.7	1047.1	1047.4	1047.8	1048.1	1048.4	1048.8	1049.1	1049.4

HECTOPASCALS (OR MILLIBARS) TO INCHES

(1 hectopascal = 1 millibar = 0.02953 inches of mercury)										
hPa or mb	0	1	2	3	4	5	6	7	8	9
	INCHES OF MERCURY									
710	20.97	21.00	21.03	21.05	21.08	21.11	21.14	21.17	21.20	21.23
720	21.26	21.29	21.32	21.35	21.38	21.41	21.44	21.47	21.50	21.53
730	21.56	21.59	21.62	21.65	21.67	21.70	21.73	21.76	21.79	21.82
740	21.85	21.88	21.91	21.94	21.97	22.00	22.03	22.06	22.09	22.12
750	22.15	22.18	22.21	22.24	22.27	22.30	22.32	22.35	22.38	22.41
760	22.44	22.47	22.50	22.53	22.56	22.59	22.62	22.65	22.68	22.71
770	22.74	22.77	22.80	22.83	22.86	22.89	22.92	22.94	22.97	23.00
780	23.03	23.06	23.09	23.12	23.15	23.18	23.21	23.24	23.27	23.30
790	23.33	23.36	23.39	23.42	23.45	23.48	23.51	23.54	23.56	23.59
800	23.62	23.65	23.68	23.71	23.74	23.77	23.80	23.83	23.86	23.89
810	23.92	23.95	23.98	24.01	24.04	24.07	24.10	24.13	24.16	24.19
820	24.21	24.24	24.27	24.30	24.33	24.36	24.39	24.42	24.45	24.48
830	24.51	24.54	24.57	24.60	24.63	24.66	24.69	24.72	24.75	24.78
840	24.81	24.83	24.86	24.89	24.92	24.95	24.98	25.01	25.04	25.07
850	25.10	25.13	25.16	25.19	25.22	25.25	25.28	25.31	25.34	25.37
860	25.40	25.43	25.45	25.48	25.51	25.54	25.57	25.60	25.63	25.66
870	25.69	25.72	25.75	25.78	25.81	25.84	25.87	25.90	25.93	25.96
880	25.99	26.02	26.05	26.07	26.10	26.13	26.16	26.19	26.22	26.25
890	26.28	26.31	26.34	26.37	26.40	26.43	26.46	26.49	26.52	26.55

(1 hectopascal = 1 millibar = 0.02953 inches of mercury)										
hPa or mb	0	1	2	3	4	5	6	7	8	9
	INCHES OF MERCURY									
900	26.58	26.61	26.64	26.67	26.70	26.72	26.75	26.78	26.81	26.84
910	26.87	26.90	26.93	26.96	26.99	27.02	27.05	27.08	27.11	27.14
920	27.17	27.20	27.23	27.26	27.29	27.32	27.34	27.37	27.40	27.43
930	27.46	27.49	27.52	27.55	27.58	27.61	27.64	27.67	27.70	27.73
940	27.76	27.79	27.82	27.85	27.88	27.91	27.94	27.96	27.99	28.02
950	28.05	28.08	28.11	28.14	28.17	28.20	28.23	28.26	28.29	28.32
960	28.35	28.38	28.41	28.44	28.47	28.50	28.53	28.56	28.58	28.61
970	28.64	28.67	28.70	28.73	28.76	28.79	28.82	28.85	28.88	28.91
980	28.94	28.97	29.00	29.03	29.06	29.09	29.12	29.15	29.18	29.21
990	29.23	29.26	29.29	29.32	29.35	29.38	29.41	29.44	29.47	29.50
1000	29.53	29.56	29.59	29.62	29.65	29.68	29.71	29.74	29.77	29.80
1010	29.83	29.85	29.88	29.91	29.94	29.97	30.00	30.03	30.06	30.09
1020	30.12	30.15	30.18	30.21	30.24	30.27	30.30	30.33	30.36	30.39
1030	30.42	30.45	30.47	30.50	30.53	30.56	30.59	30.62	30.65	30.68
1040	30.71	30.74	30.77	30.80	30.83	30.86	30.89	30.92	30.95	30.98
1050	31.01	31.04	31.07	31.10	31.12	31.15	31.18	31.21	31.24	31.27

MILLIMETERS TO HECTOPASCALS (OR MILLIBARS)

(1 millimeter of mercury = 1.3332 hectopascals = 1.3332 millibars)										
MM of Mercury	0	1	2	3	4	5	6	7	8	9
	HECTOPASCALS (or MILLIBARS)									
530	706.6	707.9	709.3	710.6	711.9	713.3	714.6	715.9	717.3	718.6
540	719.9	721.3	722.6	723.9	725.3	726.6	727.9	729.3	730.6	731.9
550	733.3	734.6	735.9	737.3	738.6	739.9	741.3	742.6	743.9	745.3
560	746.6	747.9	749.3	750.6	751.9	753.3	754.6	755.9	757.3	758.6
570	759.9	761.3	762.6	763.9	765.3	766.6	767.9	769.3	770.6	771.9
580	773.3	774.6	775.9	777.3	778.6	779.9	781.3	782.6	783.9	785.3
590	786.6	787.9	789.3	790.6	791.9	793.3	794.6	795.9	797.3	798.6

(1 millimeter of mercury = 1.3332 hectopascals = 1.3332 millibars)

MM of Mercury	0	1	2	3	4	5	6	7	8	9
	HECTOPASCALS (or MILLIBARS)									
600	799.9	801.3	802.6	803.9	805.3	806.6	807.9	809.3	810.6	811.9
610	813.3	814.6	815.9	817.3	818.6	819.9	821.3	822.6	823.9	825.3
620	826.6	827.9	829.3	830.6	831.9	833.3	834.6	835.9	837.3	838.6
630	839.9	841.3	842.6	843.9	845.2	846.6	847.9	849.3	850.6	851.9
640	853.3	854.6	855.9	857.3	858.6	859.9	861.3	862.6	863.9	865.3
650	866.6	867.9	869.3	870.6	871.9	873.3	874.6	875.9	877.3	878.6
660	879.9	881.3	882.6	883.9	885.3	886.6	887.9	889.3	890.6	891.9
670	893.3	894.6	895.9	897.3	898.6	899.9	901.3	902.6	903.9	905.3
680	906.6	907.9	909.3	910.6	911.9	913.3	914.6	915.9	917.3	918.6
690	919.9	921.3	922.6	923.9	925.3	926.6	927.9	929.3	930.6	931.9
700	933.3	934.6	935.9	937.3	938.6	939.9	941.3	942.6	943.9	945.3
710	946.6	947.9	949.3	950.6	951.9	953.3	954.6	955.9	957.3	958.6
720	959.9	961.3	962.6	963.9	965.3	966.6	967.9	969.3	970.6	971.9
730	973.3	974.6	975.9	977.3	978.6	979.9	981.3	982.6	983.9	985.3
740	986.6	987.9	989.3	990.6	991.9	993.3	994.6	995.9	997.3	998.6
750	999.9	1001.3	1002.6	1003.9	1005.3	1006.6	1007.9	1009.3	1010.6	1011.9
760	1013.3	1014.6	1015.9	1017.2	1018.6	1019.9	1021.2	1022.6	1023.9	1025.2
770	1026.6	1027.9	1029.2	1030.6	1031.9	1033.2	1034.6	1035.9	1037.2	1038.6
780	1039.9	1041.2	1042.6	1043.9	1045.2	1046.6	1047.9	1049.2	1050.6	1051.9
790	1053.2	1054.6	1055.9	1057.2	1058.6	1059.9	1061.2	1062.6	1063.9	1065.2
800	1066.6	1067.9	1069.2	1070.6	1071.9	1073.2	1074.6	1075.9	1077.2	1078.6

CONVERSIONS

METERS PER SECOND TO FEET PER MINUTE

(mps = 196.85 fpm)

MPS	FPM	MPS	FPM
1	197	1.5	295
2	394	2.5	492

REFERENCE TABLES

(mps = 196.85 fpm)			
MPS	**FPM**	**MPS**	**FPM**
3	591	3.5	689
4	787	4.5	885
5	984	5.5	1082
6	1181	6.5	1279
7	1378	7.5	1476
8	1575	8.5	1673
9	1772	9.5	1870
10	1969	10.5	2067
11	2165	11.5	2263
12	2362	12.5	2460
13	2559	13.5	2657
14	2756	14.5	2854
15	2953	15.5	3051
16	3150	16.5	3248
17	3346	17.5	3444
18	3543	18.5	3641
19	3740	19.5	3838
20	3937		

METERS PER SECOND TO KNOTS

(1 mps = 1.9438 knots)			
Meters p/sec.	**Knots**	**Meters p/sec.**	**Knots**
0	-	1	1.9
2	3.9	3	5.8
4	7.8	5	9.7
6	11.7	7	13.6
8	15.6	9	17.5
10	19.4	11	21.4
12	23.3	13	25.3

REFERENCE TABLES

(1 mps = 1.9438 knots)			
Meters p/sec.	**Knots**	**Meters p/sec.**	**Knots**
14	27.2	15	29.2
16	31.1	17	33.0
18	35.0	19	36.9
20	38.9	21	40.8
22	42.8	23	44.7
24	46.6	25	48.6
26	50.5	27	52.5
28	54.4	29	56.4
30	58.3	31	60.3
32	62.2	33	64.1
34	66.1	35	68.0
36	70	37	71.9
38	73.9	39	75.8
40	77.8	41	79.7
42	81.6	43	83.6
44	85.5	45	87.5
46	89.4	47	91.4
48	93.3	49	95.2
50	97.2	51	99.1
52	101.1	53	103.0
54	105.0	55	106.9
56	108.8	57	110.8
58	112.7	59	114.7
60	116.6	61	118.6
62	120.5	63	122.5
64	124.4	65	126.3
66	128.3	67	130.2
68	132.2	69	134.1

REFERENCE TABLES

(1 mps = 1.9438 knots)			
Meters p/sec.	**Knots**	**Meters p/sec.**	**Knots**
70	136.1	71	138.0
72	140.0	73	141.9
74	143.8	75	145.8
76	147.7	77	149.7
78	151.6	79	153.6

TEMPERATURES

(CELSIUS/FAHRENHEIT)			
°C	**°F**	**°C**	**°F**
-40	-40.0	-39	-38.2
-38	-36.4	-37	-34.6
-36	-32.8	-35	-31.0
-34	-29.2	-33	-27.4
-32	-25.6	-31	-23.8
-30	-22.0	-29	-20.2
-28	-18.4	-27	-16.6
-26	-14.8	-25	-13.0
-24	-11.2	-23	-9.4
-22	-7.6	-21	-5.8
-20	-4.0	-19	-2.2
-18	-0.4	-17	1.4
-16	3.2	-15	5.0
-14	6.8	-13	8.6
-12	10.4	-11	12.2
-10	14.0	-9	15.8
-8	17.6	-7	19.4
-6	21.2	-5	23.0
-4	24.8	-3	26.6
-2	28.4	-1	30.2

REFERENCE TABLES

(CELSIUS/FAHRENHEIT)			
°C	°F	°C	°F
0	32.0	1	33.8
2	35.6	3	37.4
4	39.2	5	41.0
6	42.8	7	44.6
8	46.4	9	48.2
10	50.0	11	51.8
12	53.6	13	55.4
14	57.2	15	59.0
16	60.8	17	62.6
18	64.4	19	66.2
20	68.0	21	69.8
22	71.6	23	73.4
24	75.2	25	77.0
26	78.8	27	80.6
28	82.4	29	84.2
30	86.0	31	87.8
32	89.6	33	91.4
34	93.2	35	95.0
36	96.8	37	98.6
38	100.4	39	102.2
40	104.0	41	105.8
42	107.6	43	109.4
44	111.2	45	113.0
46	114.8	47	116.6
48	118.4	49	120.2
50	122.0	51	123.8
52	125.6	53	127.4
54	129.2	55	131.0

REFERENCE TABLES

WEIGHT

Lbs →	Kgs Lbs	← Kgs
2.2046	1	.45359
4	2	1
7	3	1
9	4	2
11	5	2
13	6	3
15	7	3
18	8	4
20	9	4
22	10	4
44	20	9
66	30	14
88	40	18
110	50	23
132	60	27
154	70	32
176	80	36
198	90	41
220	100	45
441	200	91
661	300	136
882	400	181
1102	500	227
1323	600	272
1543	700	318
1764	800	363
1984	900	408
2205	1000	454

REFERENCE TABLES

DISTANCES

to SM	KILOMETERS	to NM
0.62137	1	0.53996
1.24	2	1.08
1.86	3	1.62
2.49	4	2.16
3.11	5	2.70
3.73	6	3.24
4.35	7	3.78
4.97	8	4.32
5.59	9	4.86
6.21	10	5.40
12.43	20	10.80
18.64	30	16.20
24.85	40	21.60
31.07	50	27.00
37.28	60	32.40
43.50	70	37.80
49.71	80	43.20
55.92	90	48.60
62.14	100	54.00
124.27	200	107.99
186.41	300	161.99
248.55	400	215.98
310.69	500	269.98
372.82	600	323.97
434.96	700	377.97
497.10	800	431.97

	KILOMETERS	
to SM		to NM
559.23	900	485.96
621.37	1000	539.96

	STATUTE MILES	
to KM		to NM
1.6093	1	0.86898
3.22	2	1.74
4.83	3	2.61
6.44	4	3.48
8.05	5	4.34
9.66	6	5.21
11.27	7	6.08
12.87	8	6.95
14.48	9	7.82
16.09	10	8.69
32.19	20	17.38
48.28	30	26.07
64.37	40	34.76
80.47	50	43.45
96.56	60	52.14
112.65	70	60.83
128.75	80	69.52
144.84	90	78.20
160.93	100	86.90
321.87	200	173.80
482.30	300	260.69
643.74	400	347.59
804.67	500	434.49
965.61	600	521.39

REFERENCE TABLES

STATUTE MILES to KM		to NM
1126.54	700	608.28
1287.48	800	695.18
1448.41	900	782.01
1609.34	1000	868.98

NAUTICAL MILES to KM		to SM
1.8520	1	1.1508
3.70	2	2.30
5.56	3	3.45
7.41	4	4.60
9.26	5	5.75
11.11	6	6.90
12.96	7	8.06
14.82	8	9.21
16.67	9	10.36
18.52	10	11.51
37.04	20	23.02
55.56	30	34.52
74.08	40	46.03
92.60	50	57.54
111.12	60	69.05
129.64	70	80.56
148.16	80	92.06
166.68	90	103.57
185.20	100	115.08
370.40	200	230.16
555.60	300	345.23
740.80	400	460.31

REFERENCE TABLES

<table>
<tr><th colspan="3">NAUTICAL MILES</th></tr>
<tr><th>to KM</th><th></th><th>to SM</th></tr>
<tr><td>926.00</td><td>500</td><td>575.39</td></tr>
<tr><td>1111.20</td><td>600</td><td>690.47</td></tr>
<tr><td>1296.40</td><td>700</td><td>805.55</td></tr>
<tr><td>1481.60</td><td>800</td><td>920.62</td></tr>
<tr><td>1666.80</td><td>900</td><td>1035.70</td></tr>
<tr><td>1852.00</td><td>1000</td><td>1150.78</td></tr>
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<table>
<tr><th colspan="3">METERS to FEET</th></tr>
<tr><th colspan="3">Meters → Ft | Meters ← Ft</th></tr>
<tr><td>.3048</td><td>1</td><td>3.2808</td></tr>
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<tr><td>18</td><td>60</td><td>197</td></tr>
<tr><td>21</td><td>70</td><td>230</td></tr>
<tr><td>24</td><td>80</td><td>262</td></tr>
<tr><td>27</td><td>90</td><td>295</td></tr>
<tr><td>30</td><td>100</td><td>328</td></tr>
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REFERENCE TABLES

METERS to FEET

Meters →	Ft Meters ←	Ft
61	200	656
91	300	984
122	400	1312
152	500	1640
183	600	1968
213	700	2296
244	800	2625
274	900	2953
305	1000	3281

METERS to YARDS

Meters →	Yds Meters ←	Yds
.9144	1	1.0936
2	2	2
3	3	3
4	4	4
5	5	5
5	6	7
6	7	8
7	8	9
8	9	10
9	10	11
18	20	22
27	30	33
36	40	44
46	50	55
55	60	66
64	70	77

REFERENCE TABLES

METERS to YARDS

Meters →	Yds Meters ←	Yds
73	80	88
82	90	99
91	100	110
183	200	219
274	300	329
366	400	438
457	500	548
549	600	658
640	700	767
732	800	877
823	900	987
914	1000	1096

INCHES to MILLIMETERS (mm)

Inches →	mm Inches ←	mm
.03937	1	25.4
.07874	2	50.8
.11811	3	76.2
.15748	4	101.6
.19685	5	127.0
.23622	6	152.4
.27559	7	177.8
.31496	8	203.2
.35433	9	228.6
.3937	10	254.0
.7874	20	508.0
1.1811	30	762.0
1.5748	40	1016.0

INCHES to MILLIMETERS (mm)

Inches →	**mm** **Inches**	← **mm**
1.9685	50	1270.0
2.3622	60	1524.0
2.7559	70	1778.0
3.1496	80	2032.0
3.5433	90	2286.0
3.9370	100	2540.0
7.8140	200	5080.0
11.8110	300	7620.0
15.7480	400	10160.0
19.6850	500	12700.0
23.6220	600	15240.0
27.5590	700	17780.0
31.4960	800	20320.0
35.4330	900	22860.0
39.3701	1000	25400.0

VOLUME

Imp Gal →	**U.S. Gal** **Imp Gal**	← **U.S. Gal**
.83267	1	1.2010
2	2	2
2	3	4
3	4	5
4	5	6
5	6	7
6	7	8
7	8	10
7	9	11
8	10	12

REFERENCE TABLES

Imp Gal →	U.S. Gal Imp Gal	← U.S. Gal
17	20	24
25	30	36
33	40	48
42	50	60
50	60	72
58	70	84
67	80	96
75	90	108
83	100	120
167	200	240
250	300	360
333	400	480
416	500	600
500	600	721
583	700	841
666	800	961
750	900	1081
833	1000	1201

U.S. Gal →	Liter U.S. Gal	← Liter
.26418	1	3.7853
1	2	8
1	3	11
1	4	15
1	5	19
2	6	23
2	7	26
2	8	30
2	9	34

REFERENCE TABLES

U.S. Gal →	Liter U.S. Gal	← Liter
3	10	38
5	20	76
8	30	114
11	40	151
13	50	189
16	60	227
18	70	265
21	80	303
24	90	341
26	100	378
53	200	757
79	300	1136
106	400	1514
132	500	1893
158	600	2271
185	700	2650
211	800	3028
238	900	3407
264	1000	3785

Imp Gal →	Liter Imp Gal	← Liter
.21997	1	4.5460
.4	2	9
.7	3	14
.9	4	18
1	5	23
1	6	27
2	7	32
2	8	36

REFERENCE TABLES

Imp Gal → Liter		Imp Gal ← Liter
2	9	41
2	10	45
4	20	91
7	30	136
9	40	182
11	50	227
13	60	273
15	70	318
18	80	364
20	90	409
22	100	455
44	200	909
66	300	1364
88	400	1818
110	500	2273
132	600	2728
154	700	3182
176	800	3637
198	900	4091
220	1000	4546

OIL VOLUME/WEIGHT
(approximate according to Temp)

U.S. Gal → Lbs		U.S. Gal ← Lbs
.13333	1	7.5000
.3	2	15
.4	3	22
.5	4	30
.7	5	38

REFERENCE TABLES

OIL VOLUME/WEIGHT

(approximate according to Temp)

U.S. Gal →	Lbs U.S. Gal	← Lbs
.8	6	45
.9	7	52
1.1	8	60
1.2	9	68
1.3	10	75
3	20	150
4	30	225
5	40	300
7	50	375
8	60	450
9	70	525
11	80	600
12	90	675
13	100	750
27	200	1500
40	300	2250
53	400	3000
67	500	3750
80	600	4500
93	700	5250
107	800	6000
120	900	6750
133	1000	7500

REFERENCE TABLES

OIL VOLUME/WEIGHT
(approximate according to Temp)

Liter →	Lbs Liter	← Lbs
.50471	1	1.9813
1.0	2	4
1.5	3	6
2.0	4	8
2.5	5	10
3.0	6	12
3.5	7	14
4.0	8	16
4.5	9	18
5.0	10	20
10	20	40
15	30	59
20	40	79
25	50	99
30	60	119
35	70	139
40	80	158
45	90	178
50	100	198
101	200	396
151	300	594
202	400	792
252	500	991
303	600	1189
353	700	1387
404	800	1585

OIL VOLUME/WEIGHT
(approximate according to Temp)

<table>
<tr><th colspan="2">Liter → Lbs</th><th colspan="2">Liter ← Lbs</th></tr>
<tr><td>454</td><td colspan="2">900</td><td>1783</td></tr>
<tr><td>505</td><td colspan="2">1000</td><td>1981</td></tr>
</table>

OIL VOLUME/WEIGHT
(approximate according to Temp)

<table>
<tr><th colspan="2">Liter → Kg</th><th colspan="2">Liter ← Kg</th></tr>
<tr><td>1.1127</td><td colspan="2">1</td><td>.89871</td></tr>
<tr><td>2</td><td colspan="2">2</td><td>2</td></tr>
<tr><td>3</td><td colspan="2">3</td><td>3</td></tr>
<tr><td>4</td><td colspan="2">4</td><td>4</td></tr>
<tr><td>6</td><td colspan="2">5</td><td>5</td></tr>
<tr><td>7</td><td colspan="2">6</td><td>5</td></tr>
<tr><td>8</td><td colspan="2">7</td><td>6</td></tr>
<tr><td>9</td><td colspan="2">8</td><td>7</td></tr>
<tr><td>10</td><td colspan="2">9</td><td>8</td></tr>
<tr><td>11</td><td colspan="2">10</td><td>9</td></tr>
<tr><td>22</td><td colspan="2">20</td><td>18</td></tr>
<tr><td>33</td><td colspan="2">30</td><td>27</td></tr>
<tr><td>44</td><td colspan="2">40</td><td>36</td></tr>
<tr><td>56</td><td colspan="2">50</td><td>45</td></tr>
<tr><td>67</td><td colspan="2">60</td><td>54</td></tr>
<tr><td>78</td><td colspan="2">70</td><td>63</td></tr>
<tr><td>89</td><td colspan="2">80</td><td>72</td></tr>
<tr><td>100</td><td colspan="2">90</td><td>81</td></tr>
<tr><td>111</td><td colspan="2">100</td><td>90</td></tr>
<tr><td>222</td><td colspan="2">200</td><td>180</td></tr>
<tr><td>334</td><td colspan="2">300</td><td>270</td></tr>
</table>

REFERENCE TABLES

OIL VOLUME/WEIGHT

(approximate according to Temp)

Liter → Kg **Liter ← Kg**

445	400	360
556	500	449
668	600	539
779	700	629
890	800	719
1001	900	809
1113	1000	899

TURBINE FUEL VOLUME/WEIGHT

(up to 5 pounds variation per 100 gallons due to fuel grade and temperature)

Liter → Lbs **Liter ← Lbs**

0.57	1	1.8
1.1	2	3.6
1.7	3	5.4
2.3	4	7.2
2.8	5	9.0
3.4	6	11
4	7	13
4.5	8	14
5.1	9	16
5.7	10	18
11	20	36
17	30	54
23	40	72
28	50	90
34	60	110
40	70	130

REFERENCE TABLES

TURBINE FUEL VOLUME/WEIGHT

(up to 5 pounds variation per 100 gallons due to fuel grade and temperature)

Liter → Lbs		Liter ← Lbs
45	80	140
51	90	160
57	100	180
110	200	360
170	300	540
230	400	720
280	500	900
340	600	1100
400	700	1300
450	800	1400
510	900	1600
570	1000	1800

TURBINE FUEL VOLUME/WEIGHT

(up to 5 pounds variation per 100 gallons due to fuel grade and temperature)

U.S. Gal → Lbs		U.S. Gal ← Lbs
0.15	1	6.7
.3	2	13
.45	3	20
.6	4	27
.75	5	33
.9	6	40
1.05	7	47
1.2	8	53
1.35	9	60
1.5	10	67
3	20	130

REFERENCE TABLES

TURBINE FUEL VOLUME/WEIGHT

(up to 5 pounds variation per 100 gallons due to fuel grade and temperature)

U.S. Gal →	Lbs U.S. Gal ←	Lbs
4.5	30	200
6	40	270
7.5	50	330
9	60	400
10.5	70	470
12	80	530
13.5	90	600
15	100	670
30	200	1300
45	300	2000
60	400	2700
75	500	3300
90	600	4000
105	700	4700
120	800	5300
135	900	6000
150	1000	6700

TURBINE FUEL VOLUME/WEIGHT

(up to 5 pounds variation per 100 gallons due to fuel grade and temperature)

Liter →	Kg Liter ←	Kg
1.25	1	.8
2.5	2	1.6
3.8	3	2.4
5.0	4	3.2
6.2	5	4.0
7.5	6	4.8

REFERENCE TABLES

TURBINE FUEL VOLUME/WEIGHT

(up to 5 pounds variation per 100 gallons due to fuel grade and temperature)

Liter →	Kg Liter	← Kg
8.8	7	5.6
10	8	6.4
11	9	7.2
12	10	8
25	20	16
38	30	24
50	40	32
62	50	40
75	60	48
88	70	56
100	80	64
110	90	72
120	100	80
250	200	160
380	300	240
500	400	320
620	500	400
750	600	480
880	700	560
1000	800	640
1100	900	720
1200	1000	800

REFERENCE TABLES

AVIATION GAS VOLUME/WEIGHT
(approximate according to temperature)

Gal →	Lbs Gal ←	Lbs
.167	1	6.00
.3	2	12
.5	3	18
.7	4	24
.8	5	30
1.0	6	36
1.2	7	42
1.3	8	48
1.5	9	54
1.7	10	60
3	20	120
5	30	180
7	40	240
8	50	300
10	60	360
12	70	420
13	80	480
15	90	540
17	100	600
33	200	1200
50	300	1800
67	400	2400
83	500	3000
100	600	3600
117	700	4200
133	800	4800

REFERENCE TABLES

AVIATION GAS VOLUME/WEIGHT
(approximate according to temperature)

Gal →	Lbs Gal	← Lbs
150	900	5400
167	1000	6000

AVIATION GAS VOLUME/WEIGHT
(approximate according to temperature)

Liter →	Lbs Liter	← Lbs
.631	1	1.58
1	2	3
2	3	5
2	4	6
3	5	8
4	6	10
4	7	11
5	8	13
6	9	14
6	10	16
13	20	32
19	30	48
25	40	63
32	50	79
38	60	95
44	70	111
50	80	127
57	90	143
63	100	158
126	200	317
189	300	476

REFERENCE TABLES

AVIATION GAS VOLUME/WEIGHT (approximate according to temperature)		
Liter →	Lbs Liter	← Lbs
252	400	634
315	500	793
378	600	951
442	700	1110
505	800	1268
568	900	1427
631	1000	1585

AVIATION GAS VOLUME/WEIGHT (approximate according to temperature)		
Liter →	Kg Liter	← Kg
1.39	1	.719
3	2	1
4	3	2
6	4	3
7	5	4
8	6	4
10	7	5
11	8	6
12	9	6
14	10	7
28	20	14
42	30	22
56	40	29
70	50	36
83	60	43
97	70	50

<table>
<tr><th colspan="4">AVIATION GAS VOLUME/WEIGHT
(approximate according to temperature)</th></tr>
<tr><th colspan="2">Liter → Kg</th><th colspan="2">Liter ← Kg</th></tr>
<tr><td>111</td><td colspan="2">80</td><td>58</td></tr>
<tr><td>125</td><td colspan="2">90</td><td>65</td></tr>
<tr><td>139</td><td colspan="2">100</td><td>72</td></tr>
<tr><td>278</td><td colspan="2">200</td><td>144</td></tr>
<tr><td>417</td><td colspan="2">300</td><td>216</td></tr>
<tr><td>556</td><td colspan="2">400</td><td>288</td></tr>
<tr><td>695</td><td colspan="2">500</td><td>359</td></tr>
<tr><td>834</td><td colspan="2">600</td><td>431</td></tr>
<tr><td>974</td><td colspan="2">700</td><td>503</td></tr>
<tr><td>1113</td><td colspan="2">800</td><td>575</td></tr>
<tr><td>1252</td><td colspan="2">900</td><td>647</td></tr>
<tr><td>1391</td><td colspan="2">1000</td><td>719</td></tr>
</table>

ALTIMETER CORRECTIONS

Extracted from ICAO Document 8168; Vol I; Part III, Chapter 4 — ALTIMETER SETTING PROCEDURES.

NOTE: This chapter deals with altimeter corrections for pressure, temperature and, where appropriate, wind and terrain effects. The pilot is responsible for these corrections except when under radar vectoring. In that case, the radar controller shall issue clearances such that the prescribed obstacle clearance will exist at all times, taking the cold temperature correction into account.

PRESSURE CORRECTION

Flight Levels

When flying at levels with the altimeter set to 1013.2 hPa, the minimum safe altitude must be corrected for deviations in pressure when the pressure is lower than the standard atmosphere (1013 hPa). An appropriate correction is 10m (30 ft) per hPa below 1013 hPa. Alternatively, the correction can be obtained from standard correction graphs or tables supplied by the operator.

QNH/QFE

When using the QNH or QFE altimeter setting (giving altitude or height above QFE datum respectively), a pressure correction is not required.

TEMPERATURE CORRECTION

Requirement for Temperature Correction

The calculated minimum safe altitudes/heights must be adjusted when the ambient temperature on the surface is much lower than that predicted by the standard atmosphere. In such conditions, an approximate correction is 4 percent height increase for every 10° C below standard temperature as measured at the altimeter setting source. This is safe for all altimeter setting source altitudes for temperatures above -15°.

Tabulated Corrections

For colder temperatures, a more accurate correction should be obtained from Tables 1 and 2 below. These tables are calculated for a sea level aerodrome. They are therefore conservative when applied at higher aerodromes.

NOTE 1: The corrections have been rounded up to the next 5m or 10 ft increment.

NOTE 2: Temperature values from the reporting station (normally the aerodrome) nearest to the position of the aircraft should be used.

Table 1 – Values to be added by the pilot to minimum promulgated heights/altitudes (m)

Aerodrome Temperature (°C)	Height above the elevation of the altimeter setting source (metres)													
	60	90	120	150	180	210	240	270	300	450	600	900	1200	1500
0	5	5	10	10	10	15	15	15	20	25	35	50	70	85
-10	10	10	15	15	25	20	25	30	30	45	60	90	120	150
-20	10	15	20	25	25	30	35	40	45	65	85	130	170	215
-30	15	20	25	30	35	40	45	55	60	85	115	170	230	285
-40	15	25	30	40	45	50	60	65	75	110	145	220	290	365
-50	20	30	40	45	55	65	75	80	90	135	180	270	360	450

Table 2 – Values to be added by the pilot to minimum promulgated heights/altitudes (ft)

Aerodrome Temperature (°C)	Height above the elevation of the altimeter setting source (feet)													
	200	300	400	500	600	700	800	900	1000	1500	2000	3000	4000	5000
0	20	20	30	30	40	40	50	50	60	90	120	170	230	280
-10	20	30	40	50	60	70	80	90	100	150	200	290	390	490
-20	30	50	60	70	90	100	120	130	140	210	280	420	570	710
-30	40	60	80	100	120	140	150	170	190	280	380	570	760	950
-40	50	80	100	120	150	170	190	220	240	360	480	720	970	1210

Table 2 – Values to be added by the pilot to minimum promulgated heights/altitudes (ft) (continued)

Aerodrome Temperature (°C)	Height above the elevation of the altimeter setting source (feet)													
	200	300	400	500	600	700	800	900	1000	1500	2000	3000	4000	5000
-50	60	90	120	150	180	210	240	270	300	450	590	890	1190	1500

MOUNTAINOUS AREAS — ENROUTE

The MOC over mountainous areas is normally applied during the design of routes and is stated in State aeronautical information publications. However, where no information is available, the margins in Tables 3 and 4 may be used when:

a. the selected cruising altitude or flight level or one engine inoperative stabilizing altitude is at or close to the calculated minimum safe altitude; and

b. the flight is within 19km (10 NM) of terrain having a maximum elevation exceeding 900m (3000 ft).

MOUNTAINOUS AREAS — TERMINAL AREAS

The combination of strong winds and mountainous terrain can cause local changes in atmospheric pressure due to the Bernoulli effect. This occurs particularly when the wind direction is across mountain crests or ridges. It is not possible to make an exact calculation, but theoretical studies have indicated altimeter errors as shown in Tables 5 and 6. Although States may provide guidance, it is up to the pilot-in-command to evaluate whether the combination of terrain, wind strength and direction are such as to make a correction for wind necessary.

Corrections for wind speed should be applied in addition to the standard corrections for pressure and temperature, and ATC advised.

Table 3 – Margin in mountainous areas (SI units)

Terrain variation	MOC
Between 900m and 1500m	450m
Greater than 1500m	600m

Table 4 – Margin in mountainous areas (non-SI units)

Terrain variation	MOC
Between 3000 ft and 5000 ft	1476 ft
Greater than 5000 ft	1969 ft

REFERENCE TABLES

Table 5 – Altimeter error due to wind speed (SI units)

Wind speed (km/h)	Altimeter error (m)
37	17
74	62
111	139
148	247

Table 6 – Altimeter error due to wind speed (non-SI units)

Wind speed (kt)	Altimeter error (ft)
20	53
40	201
60	455
80	812

NOTE: The wind speed values were measured 30m above aerodrome elevation.

Tables and Codes

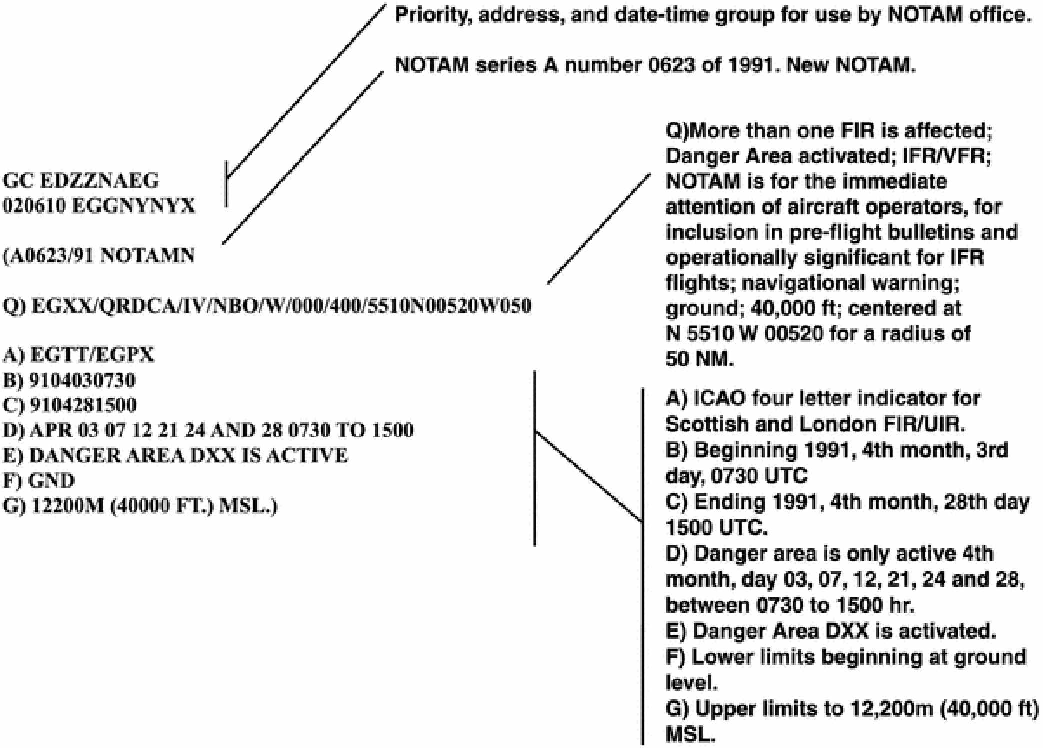
NOTAM Reference Information

NOTAMS

INTRODUCTION

NOTAMs promulgating significant information changes are disseminated from locations all over the world. NOTAMs are intended to supplement Aeronautical Information Publications and provide a fast medium for disseminating information at a short notice. The following format and codes are used in disseminating NOTAMs.

TYPICAL NOTAM — IN THE SYSTEM NOTAM FORMAT



GC EDZZNAEG
020610 EGGNYNYX

(A0623/91 NOTAMN

Q) EGXX/QRDCA/IV/NBO/W/000/400/5510N00520W050

A) EGTT/EGPX
B) 9104030730
C) 9104281500
D) APR 03 07 12 21 24 AND 28 0730 TO 1500
E) DANGER AREA DXX IS ACTIVE
F) GND
G) 12200M (40000 FT.) MSL.)

Priority, address, and date-time group for use by NOTAM office.

NOTAM series A number 0623 of 1991. New NOTAM.

Q)More than one FIR is affected; Danger Area activated; IFR/VFR; NOTAM is for the immediate attention of aircraft operators, for inclusion in pre-flight bulletins and operationally significant for IFR flights; navigational warning; ground; 40,000 ft; centered at N 5510 W 00520 for a radius of 50 NM.

A) ICAO four letter indicator for Scottish and London FIR/UIR.
B) Beginning 1991, 4th month, 3rd day, 0730 UTC
C) Ending 1991, 4th month, 28th day 1500 UTC.
D) Danger area is only active 4th month, day 03, 07, 12, 21, 24 and 28, between 0730 to 1500 hr.
E) Danger Area DXX is activated.
F) Lower limits beginning at ground level.
G) Upper limits to 12,200m (40,000 ft) MSL.

FORMAT EXPLANATION OF SYSTEM NOTAM

NOTAMN — New NOTAM

NOTAMR — Replaces a previous NOTAM

NOTAMC — Cancels a NOTAM

NOTAMS — SNOWTAM

NOTAM format item Q is divided into eight separate qualifier fields.

a. FIR — ICAO location indicator plus “XX” if applicable to more than one FIR.

b. NOTAM CODE — If the subject of the NOTAM (second and third letter of NOTAM code) is not in the NOTAM Code , the following letters should be used to reference the subject category.

QAGXX = AGA QCOXX = COM QRCXX = RAC QXXXX = Other

c. TRAFFIC — I = IFR
V = VFR
IV = IFR/VFR

d. PURPOSE — N = Selected for the immediate attention of aircraft operators.
B = Selected for preflight information bulletins.
O = Operationally significant for IFR flights.
M = Miscellaneous.

e. SCOPE — A = Aerodrome
E = Enroute
W = Navigational warning

f. LOWER — Used when applicable to indicate lower limits of the affected area. Default value of 000 is used when limit is not defined.

g. UPPER — Used when applicable to indicate upper limit of the affected area. Default value of 999 is used when limit is not defined.

h. COORDINATES RADIUS — Latitude and longitude present approximate center of a circle whose radius encompasses the whole area of influence.

NOTAM format items A thru G provide information on location, times, changes and limits.

A) ICAO location indicator of aerodrome or FIR.

B) Ten figure date-time group indicating when the NOTAM comes into force.

C) Ten figure date-time group or PERM indicating the duration of the NOTAM. If the duration of the NOTAM is uncertain, the approximate duration must be indicated using the date-time group followed by EST.

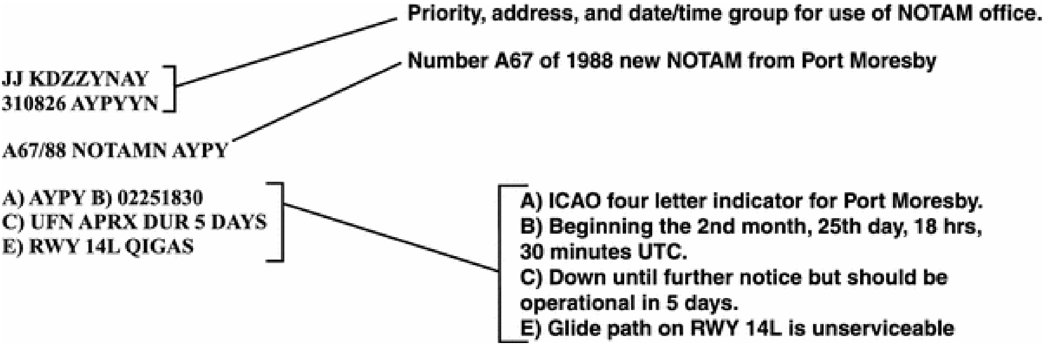
D) Specified periods for changes being reported, otherwise omitted.

E) Decoded NOTAM code in plain language. ICAO abbreviations may be used where appropriate.

F)
G) } These items are normally applicable to navigational warnings or airspace restrictions clearly indicating reference datum and units of measurement. Item F provides the lower limit and item G provides the upper limit.

SOME STATES ARE STILL PROMULGATING CLASS I NOTAMS IN THE PREVIOUS FORMAT.

PREVIOUS NOTAM FORMAT AND EXPLANATION



JJ KDZZYNAY
310826 AYPYYN

A67/88 NOTAMN AYPY

A) AYPY B) 02251830
C) UFN APRX DUR 5 DAYS
E) RWY 14L QIGAS

Priority, address, and date/time group for use of NOTAM office.

Number A67 of 1988 new NOTAM from Port Moresby

A) ICAO four letter indicator for Port Moresby.
B) Beginning the 2nd month, 25th day, 18 hrs, 30 minutes UTC.
C) Down until further notice but should be operational in 5 days.
E) Glide path on RWY 14L is unserviceable

A) ICAO location indicator of aerodrome or FIR.

B) Eight figure date-time group, WIE (with immediate effect), or WEF (with effect from) indicating when the NOTAM comes into force.

C) Eight figure date-time group, PERM, or UFN (until further notice) indicating the duration of the NOTAM. If the duration of the NOTAM is UFN, the approximate duration of the information should also be indicated.

D) Specified periods for changes being reported, otherwise omitted.

E) NOTAM code, abbreviated plain language or both.

F)
G) } These items are normally applicable to navigational warnings or airspace restrictions clearly indicating reference datum and units of measurement.

NOTAM CODE

SECOND AND THIRD LETTERS

SECOND AND THIRD LETTERS (Q__ __)		
CODE	SIGNIFICATION	UNIFORM ABBREVIATED PHRASEOLOGY
AGA		
Lighting facilities (L)		
LA	Approach light system *(specify runway and type)*	als
LB	Aerodrome beacon	abn
LC	Runway centerline lights *(specify runway)*	rcll
LD	Landing direction indicator lights	ldi lgt
LE	Runway edge lights *(specify runway)*	redl
LF	Sequenced flashing lights *(specify runway)*	sequenced flg lgt
LG	Pilot-controlled lighting	pcl
LH	High intensity runway lights *(specify runway)*	high intst rwy lgt
LI	Runway end identifier lights *(specify runway)*	rwy end id lgt
LJ	Runway alignment indicator lights *(specify runway)*	rai lgt
LK	Category II components of approach lighting system *(specify runway)*	cat II components als
LL	Low intensity runway lights *(specify runway)*	low intst rwy lgt
LM	Medium intensity runway lights *(specify runway)*	medium intst rwy lgt
LP	Precision approach path indicator (PAPI) *(specify runway)*	papi
LR	All landing area lighting facilities	ldg area lgt fac
LS	Stopway lights *(specify runway)*	stwl
LT	Threshold lights *(specify runway)*	thr lgt
LU	Helicopter approach path indicator	hapi
LV	Visual approach slope indicator system *(specify type and runway)*	vasis
LW	Heliport lighting	heliport lgt
LX	Taxiway centerline lights *(specify taxiway)*	twy cl lgt
LY	Taxiway edge lights *(specify taxiway)*	twy edge lgt

NOTAMS

SECOND AND THIRD LETTERS (Q__ __)		
CODE	**SIGNIFICATION**	**UNIFORM ABBREVIATED PHRASEOLOGY**
LZ	Runway touchdown zone lights *(specify runway)*	rtzl
AGA		
Movement and landing area (M)		
MA	Movement area	mov area
MB	Bearing strength *(specify part of landing area or movement area)*	bearing strength
MC	Clearway *(specify runway)*	cwy
MD	Declared distances *(specify runway)*	declared dist
MG	Taxiing guidance system	tgs
MH	Runway arresting gear *(specify runway)*	rag
MK	Parking area	prkg area
MM	Daylight markings *(specify threshold, centerline, etc.)*	day markings
MN	Apron	apron
MO	Stopbar *(specify taxiway)*	stopbar
MP	Aircraft stands *(specify)*	acft stand
MR	Runway *(specify runway)*	rwy
MS	Stopway *(specify runway)*	swy
MT	Threshold *(specify runway)*	thr
MU	Runway turning bay *(specify runway)*	rwy turning bay
MW	Strip/shoulder *(specify runway)*	strip/shoulder
MX	Taxiway(s) *(specify)*	twy
MY	Rapid exit taxiway *(specify)*	rapid exit twy
AGA		
Facilities and services (F)		
FA	Aerodrome	ad
FB	Friction Measuring Device (specify type)	friction measuring device
FC	Ceiling measurement equipment	ceiling measurement eqpt
FD	Docking system *(specify AGNIS, BOLDS, etc.)*	dckg system

NOTAMS

SECOND AND THIRD LETTERS (Q__ __)		
CODE	**SIGNIFICATION**	**UNIFORM ABBREVIATED PHRASEOLOGY**
FE	Oxygen *(specify type)*	oxygen
FF	Fire fighting and rescue	fire and rescue
FG	Ground movement control	gnd mov ctl
FH	Helicopter alighting area/platform	hel alighting area
FI	Aircraft de-icing*(specify)*	acft de-ice
FJ	Oils (specify type)	oil
FL	Landing direction indicator	ldi
FM	Meteorological service *(specify type)*	met
FO	Fog dispersal system	fg dispersal
FP	Heliport	heliport
FS	Snow removal equipment	sn removal eqpt
FT	Transmissometer *(specify runway and, where applicable, designator(s) of transmissometer(s))*	transmissometer
FU	Fuel availability	fuel avbl
FW	Wind direction indicator	wdi
FZ	Customs	cust
ATM		
Airspace organization (A)		
AA	Minimum altitude *(specify enroute/crossing/safe)*	mnm alt
AC	Control zone (CTR)	ctr
AD	Air defense identification zone (ADIZ)	adiz
AE	Control area (CTA)	cta
AF	Flight information region	fir
AH	Upper control area	uta
AL	Minimum usable flight level	mnm usable fl
AN	Area navigation route	rnav route
AO	Oceanic control area	oca
AP	Reporting point *(specify name or coded designator)*	rep

NOTAMS

SECOND AND THIRD LETTERS (Q__ __)		
CODE	**SIGNIFICATION**	**UNIFORM ABBREVIATED PHRASEOLOGY**
AR	ATS route *(specify)*	ats rte
AT	Terminal control area (TMA)	tma
AU	Upper flight information region (UIR)	uir
AV	Upper advisory area (UDA)	uda
AX	Significant point	sig
AZ	Aerodrome traffic zone	atz
ATM		
Air traffic and VOLMET services (S)		
SA	Automatic terminal information service (ATIS)	atis
SB	ATS reporting office	aro
SC	Area control center	acc
SE	Flight information service	fis
SF	Aerodrome flight information service	afis
SL	Flow control center	flow ctl center
SO	Oceanic area control center	oac
SP	Approach control service	app
SS	Flight service station	fss
ST	Aerodrome control tower	twr
SU	Upper area control center	uac
SV	VOLMET Broadcast	volmet
SY	Upper advisory service *(specify)*	upper advisory ser
ATM		
Air traffic procedures (P)		
PA	Standard instrument arrival *(specify route designator)*	star
PB	Standard VFR arrival	std vfr arr
PC	Contingency procedure	contingency proc
PD	Standard instrument departure *(specify route designator)*	sid

NOTAMS

SECOND AND THIRD LETTERS (Q__ __)		
CODE	**SIGNIFICATION**	**UNIFORM ABBREVIATED PHRASEOLOGY**
PE	Standard VFR department	std vfr dep
PF	Flow control procedure	flow ctl proc
PH	Holding procedure	hldg proc
PI	Instrument approach procedure *(specify type and runway)*	inst apch proc
PK	VFR approach procedure	vfr apch proc
PL	Flight plan processing, filing and related contingency	fpl
PM	Aerodrome operating minima *(specify procedure and amended minimum)*	opr minima
PN	Noise operating restrictions	noise opr restrictions
PO	Obstacle clearance altitude and height *(specify procedure)*	oca och
PR	Radio failure procedure	rdo failure proc
PT	Transition altitude or transition level *(specify)*	ta/trl
PU	Missed approach procedure *(specify runway)*	missed apch proc
PX	Minimum holding altitude *(specify fix)*	mnm hldg alt
PZ	ADIZ procedure	adiz proc
CNS		
Communication and surveillance facilities (C)		
CA	Air/ground facility *(specify service and frequency)*	a/g fac
CB	Automatic dependent surveillance – broadcast *(details)*	ads-b
CC	Automatic dependent surveillance – contract *(details)*	ads-c
CD	Controller-pilot datalink communications *(details)*	cpdlc
CE	Enroute surveillance radar	rsr
CG	Ground controlled approach system	gca
CL	Selective calling system	selcal
CM	Surface movement radar	smr
CP	Precision approach radar *(specify runway)*	par

NOTAMS

SECOND AND THIRD LETTERS (Q__ __)		
CODE	**SIGNIFICATION**	**UNIFORM ABBREVIATED PHRASEOLOGY**
CR	Surveillance radar element of precision approach radar system *(specify wavelength)*	sre
CS	Secondary surveillance radar	ssr
CT	Terminal area surveillance radar	tar
CNS		
Instrument and microwave landing systems (I)		
IC	Instrument landing system *(specify runway)*	ils
ID	DME associated with ILS	ils dme
IG	Glide path (ILS) *(specify runway)*	ils gp
II	Inner marker (ILS) *(specify runway)*	ils im
IL	Localizer (ILS) *(specify runway)*	ils llz
IM	Middle marker (ILS)*(specify runway)*	ils mm
IN	Localizer *(not associated with ILS)*	llz
IO	Outer marker (ILS) *(specify runway)*	ils om
IS	ILS Category I *(specify runway)*	ils cat I
IT	ILS Category II *(specify runway)*	ils cat II
IU	ILS Category III *(specify runway)*	ils cat III
IW	Microwave landing system *(specify runway)*	mls
IX	Locator, outer (ILS) *(specify runway)*	ils lo
IY	Locator, middle (ILS) *(specify runway)*	ils lm
CNS		
GNSS services (G)		
GA	GNSS airfield-specific operations *(specify operation)*	gnss airfield
GW	GNSS area-wide operations *(specify operation)*	gnss area
CNS		
Terminal and enroute navigation facilities (N)		
NA	All radio navigation facilities (except. . .)	all rdo nav fac
NB	Non-directional radio beacon	ndb

NOTAMS

SECOND AND THIRD LETTERS (Q__ __)		
CODE	**SIGNIFICATION**	**UNIFORM ABBREVIATED PHRASEOLOGY**
NC	DECCA	decca
ND	Distance measuring equipment	dme
NF	Fan marker	fan mkr
NL	Locator *(specify identification)*	l
NM	VOR/DME	vor/dme
NN	TACAN	tacan
NO	OMEGA	omega
NT	VORTAC	vortac
NV	VOR	vor
NX	Direction finding station *(specify type and frequency)*	df
Navigation warnings		
Airspace restrictions (R)		
RA	Airspace reservation *(specify)*	airspace reservation
RD	Danger area *(specify)*	. . d . .
RM	Military operating area	moa
RO	Overflying of . . . *(specify)*	overflying
RP	Prohibited area *(specify)*	. . p . .
RR	Restricted area	. . r . .
RT	Temporary restricted area *(specify area)*	tempo restricted area
Navigation warnings		
Warnings (W)		
WA	Air display	air display
WB	Aerobatics	aerobatics
WC	Captive balloon or kite	captive balloon/kite
WD	Demolition of explosives	demolition of explosives
WE	Exercises *(specify)*	exer
WF	Air refuelling	air refuelling
WG	Glider flying	gld fly

NOTAMS

SECOND AND THIRD LETTERS (Q__ __)		
CODE	**SIGNIFICATION**	**UNIFORM ABBREVIATED PHRASEOLOGY**
WH	Blasting	blasting
WJ	Banner/target towing	banner/target towing
WL	Ascent of free balloon	ascent of free balloon
WM	Missile, gun or rocket firing	missile/gun/rocket frng
WP	Parachute jumping exercise, paragliding or hang gliding	pje/paragliding/hang gliding
WR	Radioactive materials or toxic chemicals *(specify)*	radioactive materials/toxic chemicals
WS	Burning or blowing gas	burning/blowing gas
WT	Mass movement of aircraft	mass mov of acft
WU	Unmanned aircraft	ua
WV	Formation flight	formation flt
WW	Significant volcanic activity	significant volcanic act
WY	Aerial survey	aerial survey
WZ	Model flying	model fly
Other information (O)		
OA	Aeronautical information service	ais
OB	Obstacle *(specify details)*	obst
OE	Aircraft entry requirements	acft entry rqmnts
OL	Obstacle lights on . . . *(specify)*	obst lgt
OR	Rescue co-ordination center	rcc

FOURTH AND FIFTH LETTERS

FOURTH AND FIFTH LETTERS		
CODE	**SIGNIFICATION**	**UNIFORM ABBREVIATED PHRASEOLOGY**
Availability (A)		
AC	Withdrawn for maintenance	withdrawn maint
AD	Available for daylight operation	avbl day ops
AF	Flight checked and found reliable	fltck okay

NOTAMS

FOURTH AND FIFTH LETTERS		
CODE	**SIGNIFICATION**	**UNIFORM ABBREVIATED PHRASEOLOGY**
AG	Operating but ground checked only, awaiting flight check	opr but gnd ck only, awaiting flt ck
AH	Hours of service are now . . . *(specify)*	hr ser
AK	Resumed normal operation	okay
AL	Operative (or reoperative) subject to previously published limitations/conditions	opr subj previous cond
AM	Military operations only	mil ops only
AN	Available for night operation	avbl ngt ops
AO	Operational	opr
AP	Available, prior permission required	avbl ppr
AR	Available on request	avbl o/r
AS	Unserviceable	u/s
AU	Not available *(specify reason if appropriate)*	not avbl
AW	Completely withdrawn	withdrawn
AX	Previously promulgated shutdown has been cancelled	promulgated shutdown cnl
Changes (C)		
CA	Activated	act
CC	Completed	cmpl
CD	Deactivated	deactivated
CE	Erected	erected
CF	Operating frequency(ies) changed to	opr freq changed to
CG	Downgraded to	downgraded to
CH	Changed	changed
CI	Identification or radio call sign changed to	ident/rdo call sign changed to
CL	Realigned	realigned
CM	Displaced	displaced
CN	Cancelled	cnl
CO	Operating	opr

NOTAMS

FOURTH AND FIFTH LETTERS		
CODE	**SIGNIFICATION**	**UNIFORM ABBREVIATED PHRASEOLOGY**
CP	Operating on reduced power	opr reduced pwr
CR	Temporarily replaced by	tempo rplcd by
CS	Installed	instl
CT	On test, do not use	on test, do not use
Hazard conditions (H)		
HA	Braking action is. . . a. Poor b. Medium/Poor c. Poor d. Medium/Good e. Good	ba is . . .
HB	Friction coefficient is. . . *(specify friction measuring device used)*	friction coefficient is
HC	Covered by compacted snow to a depth of	cov compacted sn depth
HD	Covered by dry snow to a depth of	cov dry sn depth
HE	Covered by water to a depth of	cov water depth
HF	Totally free of snow and ice	free of sn and ice
HG	Grass cutting in progress	grass cutting inpr
HH	Hazard due to *(specify)*	hazard due
HI	Covered by ice	cov ice
HJ	Launch planned. . .*(specify balloon flight identification or project code name, launch site, planned period of launch(es) - date/time, expected climb direction, estimated time to pass 18,000m (60,000 ft), or reaching cruise level if at or below 18,000m (60,000 ft), together with estimated location)*	launch plan
HK	Bird migration in progress *(specify direction)*	bird migration inpr
HL	Snow clearance completed	snow clr cmpl
HM	Marked by	marked by
HN	Covered by wet snow or slush to a depth of	cov wet sn/slush depth

FOURTH AND FIFTH LETTERS		
CODE	**SIGNIFICATION**	**UNIFORM ABBREVIATED PHRASEOLOGY**
HO	Obscured by snow	obscured by sn
HP	Snow clearance in progress	snow clr inpr
HQ	Operation cancelled. . .*(specify balloon flight identification or project code name)*	opr cnl
HR	Standing water	standing water
HS	Sanding in progress	sanding inpr
HT	Approach according to signal area only	apch according signal area only
HU	Launch in progress. . .*(specify balloon flight identification or project code name, launch site, date/time of launch(es), estimated time passing 18,000m (60,000 ft), or reaching cruising level if at or below 18,000m (60,000 ft), together with estimated location, estimated date/time of termination of the flight and planned location of ground contact, when applicable)*	launch inpr
HV	Work completed	work cmpl
HW	Work in progress	wip
HX	Concentration of birds	bird concentration
HY	Snow banks exist *(specify height)*	sn banks hgt
HZ	Covered by frozen ruts and ridges	cov frozen ruts and ridges
Limitations (L)		
LA	Operating on auxiliary power supply	opr aux pwr
LB	Reserved for aircraft based therein	reserved for acft based therein
LC	Closed	clsd
LD	Unsafe	unsafe
LE	Operating without auxiliary power supply	opr aux wo pwr
LF	Interference from	interference fm
LG	Operating without identification	opr wo ident
LH	Unserviceable for aircraft heavier than	u/s acft heavier than
LI	Closed to IFR operations	clsd ifr ops
LK	Operating a a fixed light	opr as f lgt. . .

NOTAMS

FOURTH AND FIFTH LETTERS		
CODE	**SIGNIFICATION**	**UNIFORM ABBREVIATED PHRASEOLOGY**
LL	Usable for length of. .and width of. .	usable len/wid. . .
LN	Closed to all night operations	clsed to all ngt ops
LP	Prohibited to	prohibited to
LR	Aircraft restricted to runways and taxiways	acft restricted to rwy and twy
LS	Subject to interruption	subj intrp
LT	Limited to	ltd to
LV	Closed to VFR operations	clsd vfr ops
LW	Will take place	will take place
LX	Operating but caution advised due to	opr but caution advised due to
Other (XX)		
XX	Where 4th and 5th letter code does not cover the situation use XX and supplement by plain language	(plain language following the NOTAM Code)

Tables and Codes

SNOWTAM Reference Information

SNOWTAM

Extracted from ICAO Annex 15 — AERONAUTICAL INFORMATION SERVICES

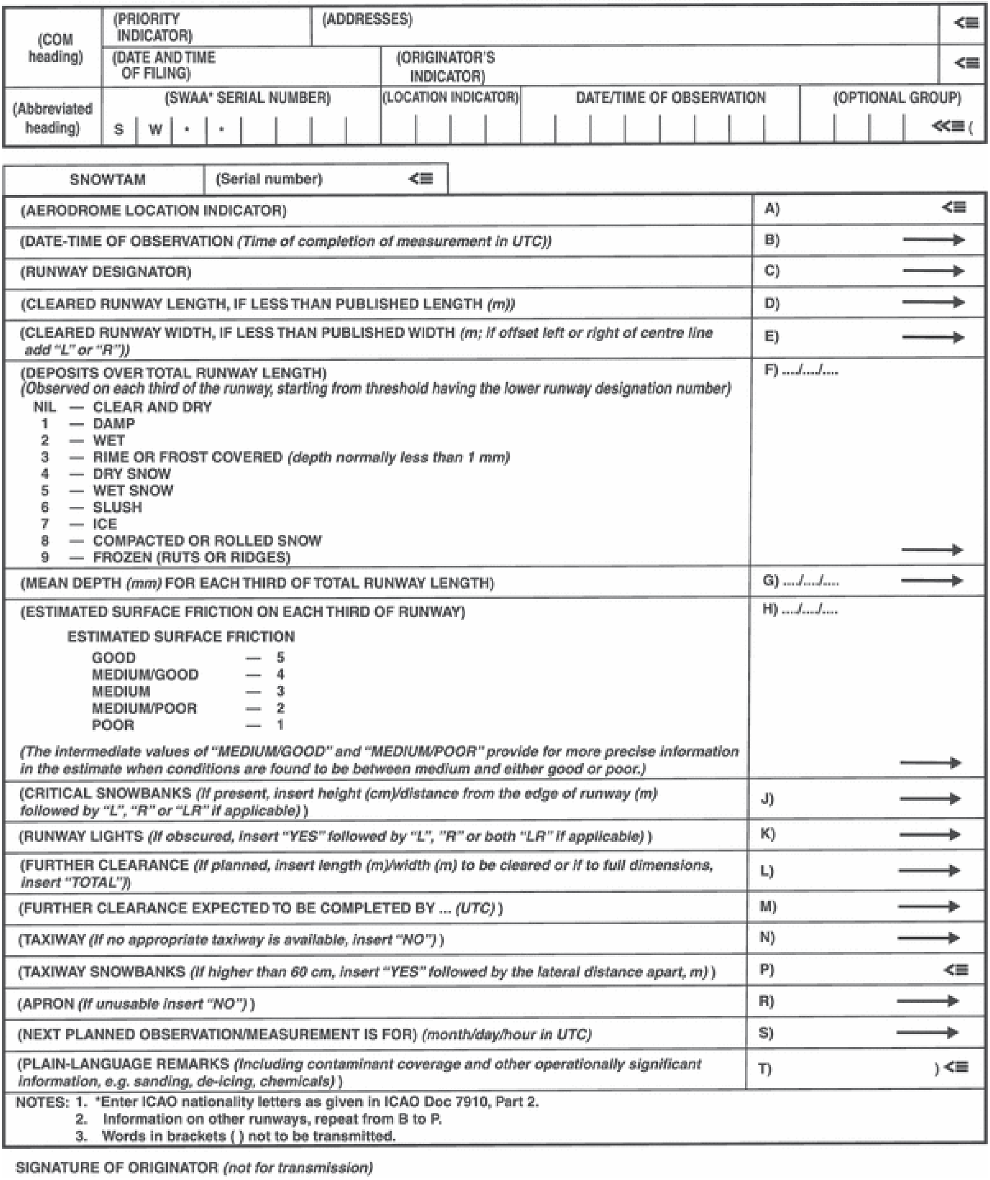
ORIGINATION AND DISTRIBUTION

Notification of the presence or removal or significant changes in hazardous conditions due to snow, slush, ice or water on the movement area is to be made preferably by use of the SNOWTAM format, or the NOTAM Code and plain language.

Information concerning snow, ice and standing water on aerodrome pavements shall, when reported by means of a SNOWTAM, contain information in the order shown in the following SNOWTAM Format.

SNOWTAM

SNOWTAM FORMAT



(COM heading)	(PRIORITY INDICATOR)	(ADDRESSES)	<≡
	(DATE AND TIME OF FILING)	(ORIGINATOR'S INDICATOR)	<≡

(Abbreviated heading)	(SWAA* SERIAL NUMBER)	(LOCATION INDICATOR)	DATE/TIME OF OBSERVATION	(OPTIONAL GROUP)	
	S W * *				<<≡ (

SNOWTAM	(Serial number) <≡

(AERODROME LOCATION INDICATOR)	A)	<≡
(DATE-TIME OF OBSERVATION *(Time of completion of measurement in UTC)*)	B)	→
(RUNWAY DESIGNATOR)	C)	→
(CLEARED RUNWAY LENGTH, IF LESS THAN PUBLISHED LENGTH *(m)*)	D)	→
(CLEARED RUNWAY WIDTH, IF LESS THAN PUBLISHED WIDTH *(m; if offset left or right of centre line add "L" or "R")*)	E)	→
(DEPOSITS OVER TOTAL RUNWAY LENGTH) *(Observed on each third of the runway, starting from threshold having the lower runway designation number)* NIL — CLEAR AND DRY 1 — DAMP 2 — WET 3 — RIME OR FROST COVERED *(depth normally less than 1 mm)* 4 — DRY SNOW 5 — WET SNOW 6 — SLUSH 7 — ICE 8 — COMPACTED OR ROLLED SNOW 9 — FROZEN (RUTS OR RIDGES)	F) ..../..../....	→
(MEAN DEPTH *(mm)* FOR EACH THIRD OF TOTAL RUNWAY LENGTH)	G) ..../..../....	→
(ESTIMATED SURFACE FRICTION ON EACH THIRD OF RUNWAY) ESTIMATED SURFACE FRICTION GOOD — 5 MEDIUM/GOOD — 4 MEDIUM — 3 MEDIUM/POOR — 2 POOR — 1 *(The intermediate values of "MEDIUM/GOOD" and "MEDIUM/POOR" provide for more precise information in the estimate when conditions are found to be between medium and either good or poor.)*	H) ..../..../....	→
(CRITICAL SNOWBANKS *(If present, insert height (cm)/distance from the edge of runway (m) followed by "L", "R" or "LR" if applicable)*)	J)	→
(RUNWAY LIGHTS *(If obscured, insert "YES" followed by "L", "R" or both "LR" if applicable)*)	K)	→
(FURTHER CLEARANCE *(If planned, insert length (m)/width (m) to be cleared or if to full dimensions, insert "TOTAL")*)	L)	→
(FURTHER CLEARANCE EXPECTED TO BE COMPLETED BY ... *(UTC)*)	M)	→
(TAXIWAY *(If no appropriate taxiway is available, insert "NO")*)	N)	→
(TAXIWAY SNOWBANKS *(If higher than 60 cm, insert "YES" followed by the lateral distance apart, m)*)	P)	<≡
(APRON *(If unusable insert "NO")*)	R)	→
(NEXT PLANNED OBSERVATION/MEASUREMENT IS FOR) *(month/day/hour in UTC)*	S)	→
(PLAIN-LANGUAGE REMARKS *(Including contaminant coverage and other operationally significant information, e.g. sanding, de-icing, chemicals)*)	T)	) <≡

NOTES:
1. *Enter ICAO nationality letters as given in ICAO Doc 7910, Part 2.
2. Information on other runways, repeat from B to P.
3. Words in brackets ( ) not to be transmitted.

SIGNATURE OF ORIGINATOR *(not for transmission)*

GUIDANCE FOR THE COMPLETION OF THE SNOWTAM FORMAT

GENERAL

a. When reporting on two or three runways, repeat Items B to P inclusive.

b. Items together with their indicator must be dropped completely, where no information is to be included.

c. Metric units must be used and the unit of measurement not reported.

d. The maximum validity of SNOWTAM is 24 hours. New SNOWTAM must be issued whenever there is a significant change in conditions. The following changes relating to runway conditions are considered as significant:

   1. a change in the coefficient of friction of about 0.05;
   2. changes in depth of deposit greater than the following:
      - 20mm for dry snow;
      - 10mm for wet snow;
      - 3mm for slush;
   3. a change in the available length or width of a runway of 10 per cent or more;
   4. any change in the type of deposit or extent of coverage which requires reclassification in Items F or T of the SNOWTAM;
   5. when critical snow banks exist on one or both sides of the runway, any change in the height or distance from centerline;
   6. any change in the conspicuity of runway lighting caused by obscuring of the lights;
   7. any other conditions known to be significant according to experience or local circumstances.

e. The abbreviated heading “TTAAiiii CCCC MMYYGGgg (BBB)” is included to facilitate the automatic processing of SNOWTAM messages in computer data banks. The explanation of these symbols is:

TT = data designator for SNOWTAM = SW;

AA = geographical designator for States; e.g., LF = France, EG = United Kingdom;

iiii = SNOWTAM serial number in a four-figure group;

CCCC = four-letter location indicator of the aerodrome to which the SNOWTAM refers;

MMYGGgg = date/time of observation/measurement, whereby:

– MM =

month; e.g., January = 01, December = 12

– YY =

day of the month

– GGgg =

time in hours (GG) and minutes (gg) UTC;

(BBB) = optional group for: correction to SNOWTAM message previously disseminated with the same serial number = COR.

NOTE 1: Brackets in (BBB) are used to indicate that this group is optional.

NOTE 2: When reporting on more than one runway and individual dates/times of observation/measurement are indicated by repeated Item B, the latest date/time of observation/measuring is inserted in the abbreviated heading (MMYYGGgg).

EXAMPLE: Abbreviated heading of SNOWTAM No. 149 from Zurich, measurement/observation of 7 November at 0620 UTC:

SWLS0149 LSZH 1107 0620

NOTE: The information groups are separated by a space, as illustrated above.

f. The text “SNOWTAM” in the SNOWTAM Format and the SNOWTAM serial number in a four-digit group shall be separated by a space, for example: SNOWTAM 0124.

g. For readability purposes for the SNOWTAM message, include a line feed after the SNOWTAM serial number, after Item A, after the last item referring to the runway (e.g. Item P) and after Item S.

– **Item A**

Aerodrome location indicator (four-letter location indicator).

– **Item B**

Eight-figure date/time group – giving time of observation as month, day, hour and minutes in UTC; this item must always be completed.

– **Item C**

Lower runway designator number.

– **Item D**

Cleared runway length in meters, if less than published length (see Item T on reporting on part of runway not cleared).

– **Item E**

SNOWTAM

Cleared runway width in meters, if less than published width; if offset left or right of center line, add (without space) “L” or “R”, as viewed from the threshold having the lower runway designation number.

- **Item F**

  Deposit over total runway length as explained in SNOWTAM Format. Suitable combinations of these numbers may be used to indicate varying conditions over runway segments. If more than one deposit is present on the same portion of the runway, they should be reported in sequence from the top (closest to the sky) to the bottom (closest to the runway). Drifts, depths of deposit appreciably greater than the average values or other significant characteristics of the deposits may be reported under Item T in plain language. The values for each third of the runway shall be separated by an oblique stroke (/), without space between the deposit values and the oblique stroke, for example: 47/47/47.

  NOTE: Definitions for the various types of snow are given at the end of this Appendix.

- **Item G**

  Mean depth in millimeters deposit for each third of total runway length, or “XX” if not measurable or operationally not significant; the assessment to be made to an accuracy of 20mm for dry snow, 10mm for wet snow and 3mm for slush. The values for each third of the runway shall be separated by an oblique stroke (/), without space between the values and the oblique stroke, for example: 20/20/20.

- **Item H**

  Estimated surface friction on each third of the runway (single digit) in the order from the threshold having the lower runway designation number.

  Friction measurement devices can be used as part of the overall runway surface assessment. Some States may have developed procedures for runway surface assessment which may include the use of information obtained from friction measuring devices and the reporting of quantitative values. In such cases, these procedures should be published in the AIP and the reporting made in Item (T) of the SNOWTAM format.

  The values for each third of the runway are separated by an oblique stroke (/), without space between the values and the oblique stroke-, for example: 5/5/5.

- **Item J**

  Critical Snowbanks. If present insert height in centimeters and distance from edge of runway in meters, followed (without space) by left (“L”) or right (“R”) side or both sides (“LR”), as viewed from the threshold having the lower runway designation number.

- **Item K**

  If runway lights are obscured, insert “YES” followed (without space) by “L”, “R” or both “LR”, as viewed from the threshold having the lower runway designation number.

- **Item L**

When further clearance will be undertaken, enter length and width of runway or “TOTAL” if runway will be cleared to full dimensions.

– **Item M**

Enter the anticipated time of completion in UTC.

– **Item N**

The code (and combination of codes) for Item F may be used to describe taxiway conditions; enter “NO” if no taxiways serving the associated runway are available.

– **Item P**

If snow banks are higher than 60 cm, enter “YES” followed by the lateral distance parting the snow banks (the distance between) in meters.

– **Item R**

The code (and combination of codes) for Item F may be used to describe apron conditions; enter “NO” if apron unusable.

– **Item S**

Enter the anticipated time of next observation/measurement in UTC.

– **Item T**

Describe in plain language any operationally significant information but always report on length of uncleared runway (Item D) and extent of runway contamination (Item F) for each third of the runway (if appropriate) in accordance with the following scale:

RWY CONTAMINATION 10% — if 10% or less of runway contaminated

RWY CONTAMINATION 25% — if 11-25% of runway contaminated

RWY CONTAMINATION 50% — if 26-50% of runway contaminated

RWY CONTAMINATION 100% — if 51-100% of runway contaminated.

EXAMPLE OF COMPLETED SNOWTAM FORMAT

GG EHAMZQZX EDDFZQZX EKCHZQZX

070645 LSZHYNYX

SWLS0149 LSZH 11070700

SNOWTAM 0149

A) LSZH

B) 11070620	C) 02	D) . . . P)
B) 11070600	C) 09	D) . . . P)
B) 11070700	C) 12	D) . . . P)

R) NO S) 11070920

T) DEICING

NOTE: See the Aeronautical Information Services Manual (Doc 8126) (not published herein) for additional SNOWTAM examples incorporating different runway conditions.

DEFINITIONS OF THE VARIOUS TYPES OF SNOW

SLUSH — Water-saturated snow which with a heel-and-toe slap-down motion against the ground will be displaced with a splatter; specific gravity: 0.5 up to 0.8.

NOTE: Combinations of ice, snow and/or standing water may, especially when rain, rain and snow, or snow is falling, produce substances with specific gravities in excess of 0.8. These substances, due to their high water/ice content, will have a transparent rather than a cloudy appearance and, at the higher specific gravities, will be readily distinguishable from slush.

SNOW (on the ground) —

a. ***Dry Snow:*** Snow which can be blown if loose or, if compacted by hand, will fall apart again upon release; specific gravity: up to but not including 0.35.

b. ***Wet Snow:*** Snow which, if compacted by hand, will stick together and tend to or form a snowball; specific gravity: 0.35 up to but not including 0.5.

c. ***Compacted Snow:*** Snow which has been compressed into a solid mass that resists further compression and will hold together or break up into lumps if picked up; specific gravity: 0.5 and over.

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Tables and Codes

Radio Frequency and Time Information

STANDARD TIME SIGNALS

General

In airspaces such as North Atlantic (NAT) minimum navigation performance specifications (MNPS) airspace, the time reference system(s) to be used during the flight for calculation of waypoint estimated times of arrival (ETAs) and waypoint actual times of arrival (ATAs) shall be synchronized to universal coordinated time (UTC). All ETAs and ATAs passed to air traffic control shall be based on a time reference that has been synchronized to UTC or equivalent. Acceptable sources of UTC include:

WWV – National Institute of Standards and Technology (Fort Collins, Colorado). WWV operates 24 hours a day on 2500, 5000, 10000, 15000, 20000 kHz (AM/single sideband (SSB)) and provides UTC voice every minute.

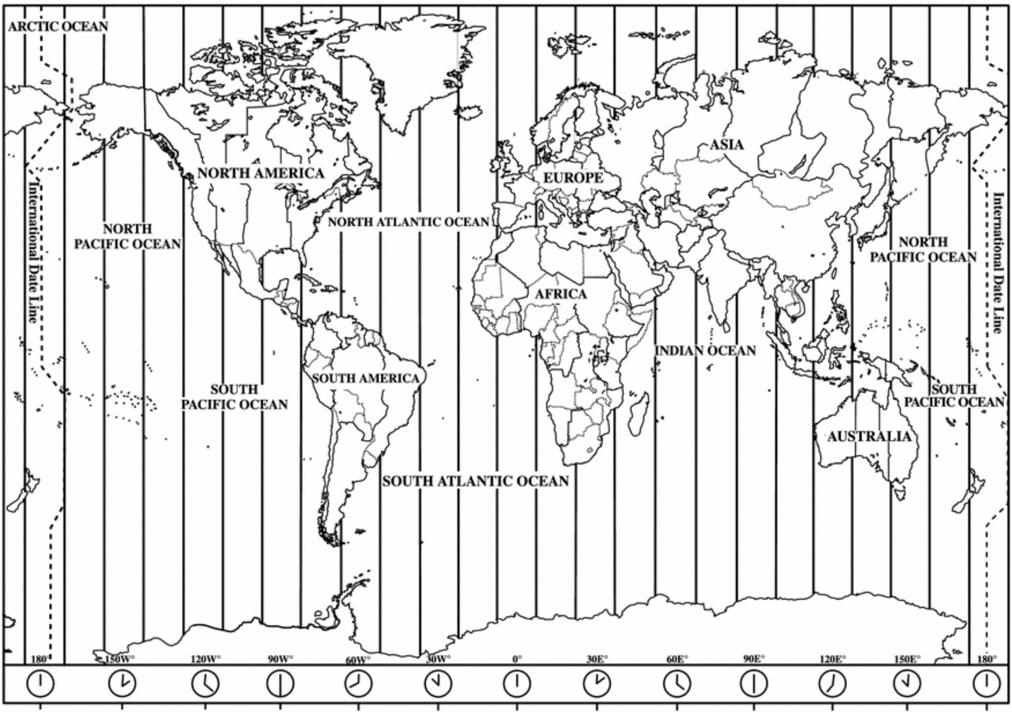
GPS (corrected to UTC) – Available 24 hours a day to those pilots who can access the time signal over their shipboard GPS equipment.

CHU – National Research Council (NRC) – Available 24 hours a day on 3330, 7850, and 14670 kHz (SSB). In the final 10-second period of each minute, a bilingual station identification and time announcement is made.

BBC – British Broadcasting Corporation (United Kingdom). The BBC transmits on a number of domestic and worldwide frequencies and transmits the Greenwich time signal (referenced to UTC) once every hour on most frequencies, although there are some exceptions.

Any other source shown to the State of Registry or State of Operator (as appropriate) to be an equivalent source of UTC.

STANDARD TIME SIGNALS



STANDARD TIME ZONES RELATIVE TO UTC

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Tables and Codes

Sunrise and Sunset Tables

SUNRISE AND SUNSET TABLES

SUNRISE JANUARY UNTIL JUNE

LAT	Jan		Feb		Mar		Apr		May		Jun	
	01	16	03	15	02	14	01	16	01	16	03	15
77ºN				1036	0809	0640	0430	0217				
75ºN				0940	0751	0635	0443	0257				
65ºN	1007	0936	0842	0801	0707	0624	0517	0422	0327	0223	0133	0105
60ºN	0902	0847	0810	0739	0656	0621	0526	0441	0359	0321	0247	0236
58ºN	0846	0833	0800	0732	0653	0620	0529	0447	0408	0334	0305	0256
56ºN	0831	0820	0752	0726	0650	0619	0531	0453	0417	0346	0320	0313
54ºN	0819	0810	0744	0721	0647	0618	0534	0458	0424	0356	0333	0327
52ºN	0808	0801	0737	0716	0644	0617	0536	0502	0431	0405	0345	0339
50ºN	0759	0752	0731	0711	0642	0617	0537	0506	0437	0413	0355	0350
45ºN	0738	0734	0718	0701	0637	0615	0541	0514	0450	0430	0416	0413
40ºN	0722	0720	0707	0653	0632	0614	0545	0521	0500	0444	0433	0430
35ºN	0708	0708	0658	0646	0629	0613	0547	0527	0510	0456	0447	0445
30ºN	0656	0657	0649	0640	0625	0612	0550	0533	0517	0506	0459	0458
25ºN	0645	0649	0642	0635	0622	0611	0552	0537	0525	0515	0510	0510
20ºN	0635	0638	0635	0629	0619	0610	0554	0542	0531	0524	0520	0520
15ºN	0626	0630	0629	0625	0617	0609	0556	0546	0537	0531	0529	0530
10ºN	0617	0622	0622	0620	0614	0608	0557	0549	0543	0539	0538	0539
5ºN	0608	0614	0616	0615	0612	0607	0559	0553	0548	0546	0546	0548
0º	0600	0606	0610	0611	0609	0606	0601	0557	0554	0553	0554	0557
5ºS	0552	0559	0604	0607	0606	0605	0602	0600	0600	0559	0603	0606
10ºS	0543	0551	0558	0602	0604	0604	0604	0604	0605	0607	0611	0614
15ºS	0534	0543	0552	0557	0601	0603	0605	0607	0611	0613	0620	0623
20ºS	0525	0534	0545	0552	0558	0602	0607	0611	0616	0621	0629	0632
25ºS	0514	0525	0538	0546	0555	0600	0609	0615	0623	0629	0639	0643
30ºS	0503	0515	0530	0540	0551	0559	0610	0619	0629	0632	0649	0654
35ºS	0450	0504	0522	0534	0548	0557	0613	0624	0637	0647	0701	0706

SUNRISE AND SUNSET TABLES

LAT	Jan		Feb		Mar		Apr		May		Jun	
	01	16	03	15	02	14	01	16	01	16	03	15
40°S	0436	0451	0512	0526	0543	0556	0615	0629	0645	0659	0713	0720
45°S	0418	0435	0500	0517	0538	0553	0618	0636	0655	0711	0730	0737
50°S	0356	0416	0445	0506	0532	0551	0621	0643	0707	0727	0750	0758
55°S	0327	0351	0427	0452	0524	0548	0624	0652	0721	0746	0815	0825
60°S	0244	0315	0402	0434	0514	0543	0629	0704	0741	0814	0850	0903

SUNRISE JULY UNTIL DECEMBER

LAT	JUL		AUG		SEP		OCT		NOV		DEC	
	01	16	03	15	02	14	01	14	01	16	01	16
77°N					0309	0438	0635	0759				
75°N					0337	0450	0629	0748	1001			
65°N	0114	0200	0303	0344	0441	0516	0612	0649	0748	0840	0930	1006
60°N	0242	0305	0345	0413	0457	0525	0607	0636	0722	0800	0835	0858
58°N	0302	0322	0357	0422	0501	0527	0606	0632	0714	0748	0820	0841
56°N	0318	0336	0407	0430	0506	0529	0604	0629	0706	0738	0807	0826
54°N	0332	0348	0416	0437	0509	0531	0603	0625	0700	0729	0755	0814
52°N	0344	0359	0424	0443	0513	0532	0602	0623	0654	0721	0745	0802
50°N	0355	0408	0432	0449	0516	0534	0601	0620	0649	0714	0737	0753
45°N	0417	0428	0447	0501	0523	0537	0559	0614	0638	0659	0718	0732
40°N	0437	0444	0500	0511	0528	0540	0557	0609	0629	0646	0702	0715
35°N	0449	0458	0511	0520	0533	0542	0555	0605	0621	0635	0649	0701
30°N	0502	0509	0520	0527	0537	0544	0554	0601	0614	0626	0638	0649
25°N	0514	0520	0528	0534	0541	0546	0552	0558	0607	0617	0628	0638
20°N	0524	0529	0536	0540	0545	0547	0551	0554	0601	0609	0619	0628
15°N	0534	0538	0543	0546	0548	0549	0550	0551	0556	0602	0610	0618
10°N	0543	0546	0550	0551	0551	0550	0549	0548	0550	0555	0601	0609
5°N	0552	0554	0556	0556	0554	0551	0547	0546	0545	0548	0553	0601
0°	0600	0602	0603	0601	0556	0552	0546	0543	0540	0541	0545	0552
5°S	0609	0610	0609	0606	0559	0554	0545	0540	0535	0534	0538	0543

LAT	JUL		AUG		SEP		OCT		NOV		DEC	
	01	16	03	15	02	14	01	14	01	16	01	16
10°S	0618	0618	0616	0611	0602	0555	0544	0537	0530	0527	0530	0534
15°S	0626	0626	0622	0616	0605	0556	0543	0534	0524	0520	0521	0525
20°S	0636	0635	0629	0622	0608	0557	0542	0531	0518	0512	0512	0515
25°S	0646	0644	0636	0627	0611	0559	0540	0527	0512	0504	0503	0505
30°S	0657	0654	0644	0634	0615	0600	0538	0523	0504	0455	0452	0453
35°S	0709	0705	0653	0640	0618	0601	0537	0519	0458	0445	0440	0440
40°S	0723	0718	0703	0648	0622	0603	0534	0514	0449	0434	0426	0425
45°S	0739	0732	0714	0657	0627	0605	0532	0508	0439	0421	0410	0408
50°S	0800	0751	0728	0708	0633	0607	0529	0501	0427	0404	0350	0345
55°S	0826	0814	0746	0722	0640	0609	0525	0452	0411	0343	0323	0315
60°S	0904	0847	0810	0740	0649	0613	0520	0441	0350	0313	0245	0231

SUNSET JANUARY UNTIL JUNE

LAT	JAN		FEB		MAR		APR		MAY		JUN	
	01	16	03	15	02	14	01	16	01	16	03	15
77°N				1354	1618	1742	1943	2153				
75°N				1450	1636	1746	1929	2109				
65°N	1401	1444	1547	1629	1719	1757	1852	1940	2030	2123	2226	2258
60°N	1505	1534	1619	1651	1729	1759	1848	1920	1657	2034	2111	2125
58°N	1522	1548	1629	1657	1733	1800	1840	1914	1947	2020	2052	2105
56°N	1536	1600	1637	1703	1736	1801	1838	1908	1939	2008	2037	2048
54°N	1548	1610	1645	1709	1739	1802	1836	1903	1931	1958	2024	2034
52°N	1559	1620	1651	1714	1741	1802	1833	1859	1924	1949	2012	2022
50°N	1609	1628	1657	1718	1743	1803	1832	1855	1918	1940	2002	2011
45°N	1629	1646	1710	1728	1749	1804	1827	1846	1905	1923	1941	1948
40°N	1645	1700	1721	1736	1753	1806	1824	1839	1854	1909	1924	1930
35°N	1659	1713	1731	1743	1756	1807	1821	1833	1845	1857	1910	1915
30°N	1711	1723	1739	1749	1800	1808	1819	1828	1837	1847	1857	1902
25°N	1722	1733	1746	1754	1803	1808	1816	1823	1830	1838	1846	1851

SUNRISE AND SUNSET TABLES

LAT	JAN		FEB		MAR		APR		MAY		JUN	
	01	16	03	15	02	14	01	16	01	16	03	15
20ºN	1732	1742	1753	1759	1805	1809	1814	1819	1823	1829	1836	1840
15ºN	1741	1750	1759	1804	1808	1810	1812	1814	1817	1821	1827	1831
10ºN	1750	1758	1806	1809	1811	1811	1811	1811	1812	1814	1818	1822
5ºN	1759	1806	1812	1813	1813	1812	1809	1807	1806	1807	1810	1813
0º	1807	1814	1817	1818	1816	1813	1807	1803	1800	1800	1802	1804
5ºS	1816	1821	1823	1822	1818	1813	1805	1800	1756	1753	1754	1756
10ºS	1825	1829	1829	1827	1820	1814	1803	1756	1750	1746	1746	1747
15ºS	1834	1837	1835	1832	1823	1815	1802	1753	1745	1738	1737	1738
20ºS	1844	1846	1842	1837	1826	1816	1800	1749	1739	1731	1728	1729
25ºS	1845	1855	1849	1842	1829	1817	1758	1745	1732	1723	1718	1718
30ºS	1905	1905	1857	1848	1832	1819	1756	1740	1726	1714	1708	1707
35ºS	1918	1916	1905	1855	1836	1820	1754	1736	1718	1705	1656	1655
40ºS	1932	1929	1915	1903	1840	1822	1751	1730	1710	1653	1643	1641
45ºS	1950	1945	1927	1911	1845	1824	1749	1724	1700	1641	1627	1624
50ºS	2012	2004	1941	1922	1851	1826	1745	1717	1648	1625	1607	1604
55ºS	2041	2029	1959	1936	1859	1829	1742	1707	1633	1605	1542	1537
60ºS	2124	2104	2024	1954	1908	1833	1736	1655	1614	1538	1507	1458

SUNSET JULY UNTIL DECEMBER

LAT	JUL		AUG		SEP		OCT		NOV		DEC	
	01	16	03	15	02	14	01	14	01	16	01	16
77ºN					2045	1909	1700	1530				
75ºN				2319	2017	1858	1707	1550	1324			
65ºN	2252	2209	2106	2023	1916	1832	1726	1642	1539	1449	1408	1346
60ºN	2125	2106	2026	1954	1901	1825	1730	1655	1605	1529	1503	1456
58ºN	2105	2049	2014	1945	1857	1823	1732	1659	1613	1541	1518	1510
56ºN	2049	2035	2004	1937	1853	1821	1733	1703	1620	1551	1531	1525
54ºN	2035	2023	1955	1931	1849	1819	1735	1706	1626	1600	1542	1538
52ºN	2023	2013	1947	1924	1846	1818	1736	1709	1632	1608	1552	1549

SUNRISE AND SUNSET TABLES

LAT	JUL		AUG		SEP		OCT		NOV		DEC	
	01	16	03	15	02	14	01	14	01	16	01	16
50ºN	2013	2003	1940	1919	1842	1816	1737	1712	1637	1615	1601	1559
45ºN	1950	1943	1924	1907	1836	1813	1739	1718	1649	1631	1620	1619
40ºN	1933	1927	1912	1857	1830	1811	1741	1723	1658	1643	1635	1636
35ºN	1918	1914	1901	1849	1826	1809	1743	1727	1706	1654	1649	1650
30ºN	1905	1902	1852	1841	1822	1807	1745	1731	1713	1704	1700	1702
25ºN	1854	1852	1844	1835	1818	1805	1746	1734	1720	1712	1710	1713
20ºN	1843	1843	1836	1829	1815	1804	1748	1738	1726	1720	1719	1724
15ºN	1834	1834	1829	1823	1812	1803	1749	1741	1731	1728	1728	1733
10ºN	1825	1825	1822	1818	1809	1801	1750	1744	1737	1735	1737	1742
5ºN	1816	1817	1816	1813	1806	1800	1751	1747	1742	1742	1745	1751
0º	1807	1810	1810	1808	1803	1759	1753	1749	1747	1748	1753	1759
5ºS	1759	1802	1804	1803	1800	1758	1754	1752	1752	1755	1801	1808
10ºS	1751	1754	1757	1758	1758	1757	1756	1755	1757	1802	1809	1817
15ºS	1742	1746	1751	1753	1755	1756	1757	1759	1803	1809	1818	1826
20ºS	1732	1738	1744	1747	1752	1755	1759	1802	1809	1816	1827	1835
25ºS	1722	1728	1737	1742	1749	1754	1800	1806	1815	1825	1837	1846
30ºS	1711	1719	1729	1735	1745	1752	1802	1810	1822	1834	1847	1857
35ºS	1659	1708	1721	1729	1742	1751	1804	1814	1830	1844	1849	1910
40ºS	1645	1655	1711	1721	1738	1750	1806	1819	1838	1855	1913	1925
45ºS	1629	1640	1659	1712	1733	1748	1809	1825	1849	1909	1930	1943
50ºS	1609	1622	1645	1701	1727	1746	1812	1832	1901	1926	1950	2006
55ºS	1542	1559	1628	1648	1720	1743	1816	1841	1917	1947	2017	2036
60ºS	1504	1526	1604	1630	1711	1740	1821	1853	1938	2017	2056	2120

CALCULATION EXAMPLE

General

To obtain sunrise/sunset UTC time do the following steps:

- Convert present longitude into hours and minutes

  1 degree = 4 minutes; 15 degrees = 1 hour;

SUNRISE AND SUNSET TABLES

- Add this to the Local Mean Time (LMT) at 0° found in the table if the longitude is West;
- Subtract this from the Local Mean Time (LMT) at 0° found in the table if the longitude is East.

To obtain begin and end of night time, perform the additional step:

- For latitudes between 30° and 60°, the night begins 30 min after SS and finishes 30 min before SR;
- For latitudes lower or equal 30°, the night begins 15 min after SS and finishes 15 min before SR;
- End of civil twilight: period during which the centre of the solar disc is more than 6° below the horizon.

Sunrise Calculation

EXAMPLE: Date: 15 February;

Position according to the FMS N45° E010°;

Result according to the table above:

0701 correction for longitude: - 40 min

SR = 0621 UTC

Sunset Calculation

EXAMPLE: Date: 16 May;

Position according to the FMS: N45° E010°;

Result according to the table above:

1923 correction for longitude: - 40 min

SS = 1843 UTC

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Tables and Codes

Dialing Codes

INTERNATIONAL DIALLING PROCEDURES

Based on the recommendations of the International Telecommunication Union ITU Operational Bulletin 994 dated 15 December 2011

COUNTRY	Code
Afghanistan	+93
Albania	+355
Algeria	+213
American Samoa	+1
Andorra	+376
Angola	+244
Anguilla	+1
Antigua and Barbuda	+1
Argentina	+54
Armenia	+374
Aruba	+297
Ascension I	+247
Australia	+61
Australian Ext. Terr.[7]	+672
Austria	+43
Azerbaijan	+994
Bahamas	+1
Bahrain	+973
Bangladesh	+880
Barbados	+1
Belarus	+375
Belgium[2]	+32
Belize	+501
Benin	+229
Bermuda	+1
Bhutan	+975
Bolivia	+591

INTERNATIONAL DIALLING PROCEDURES

COUNTRY	Code
Bosnia-Herzegovina	+387
Botswana	+267
Brazil	+55
British Virgin Is	+1
Brunei Darussalam	+673
Bulgaria	+359
Burkina Faso	+226
Burundi	+257
Cambodia	+855
Cameroon	+237
Canada	+1
Cape Verde	+238
Cayman Is	+1
Central African Rep.	+236
Chad	+235
Chile	+56
China, P.R. of	+86
Colombia[1]	+57
Comoros[4]	+269
Congo D.R. of	+243
Congo, Rep of	+242
Cook Is	+682
Costa Rica	+506
Croatia	+385
Cuba	+53
Cyprus	+357
Czech	+420
Denmark	+45
Diego Garcia	+246

INTERNATIONAL DIALLING PROCEDURES

COUNTRY	Code
Djibouti	+253
Dominica	+1
Dominican Rep.	+1
Ecuador	+593
Egypt	+20
El Salvador	+503
Equatorial Guinea	+240
Eritrea	+291
Estonia	+372
Eswatini	+268
Ethiopia	+251
Falkland Is (Malvinas)	+500
Faroe Is	+298
Fiji Is	+679
Finland	+358
France[2]	+33
French Guiana	+594
French Polynesia	+689
Gabon	+241
Gambia	+220
Georgia	+995
Germany	+49
Ghana	+233
Gibraltar	+350
Greece[2]	+30
Greenland	+299
Grenada	+1
Group of countries, shared code[12]	+388
Guadeloupe	+590

INTERNATIONAL DIALLING PROCEDURES

COUNTRY	Code
Guam	+1
Guatemala	+502
Guinea Rep	+224
Guinea-Bissau	+245
Guyana	+592
Haiti	+509
Honduras	+504
Hong Kong, P.R. of China	+852
Hungary	+36
Iceland	+354
India	+91
Indonesia	+62
Iran	+98
Iraq	+964
Ireland[3]	+353
Israel	+972
Italy[6]	+39
Ivory Coast	+225
Jamaica	+1
Japan	+81
Jordan	+962
Kazakhstan	+7
Kenya[11]	+254
Kiribati	+686
Korea, DPR of	+850
Korea, Rep of	+82
Kuwait	+965
Kyrgyzstan	+996
Laos	+856

INTERNATIONAL DIALLING PROCEDURES

COUNTRY	Code
Latvia	+371
Lebanon	+961
Lesotho	+266
Liberia	+231
Libya SPAJ	+218
Liechtenstein	+423
Lithuania	+370
Luxembourg	+352
Macao, P.R. of China	+853
Madagascar	+261
Malawi	+265
Malaysia[8]	+60
Maledives	+960
Mali	+223
Malta	+356
Marshall Is	+692
Martinique	+596
Mauritania	+222
Mauritius	+230
Mayotte[4]	+269
Mexico	+52
Micronesia	+691
Moldova	+373
Monaco	+377
Mongolia	+976
Montenegro	+382
Montserrat I	+1
Morocco	+212
Mozambique	+258

INTERNATIONAL DIALLING PROCEDURES

COUNTRY	Code
Myanmar	+95
Namibia	+264
Nauru	+674
Nepal	+977
Neth Antilles	+599
Netherlands	+31
New Caledonia	+687
New Zealand	+64
Nicaragua	+505
Niger	+227
Nigeria	+234
Niue	+683
North Macedonia	+389
Northern Marianas Is	+1
Norway	+47
Oman	+968
Pakistan	+92
Palau	+680
Panama	+507
Papua New Guinea	+675
Paraguay	+595
Peru	+51
Philippines	+63
Poland	+48
Portugal	+351
Puerto Rico	+1
Qatar	+974
Reunion	+262
Romania	+40

INTERNATIONAL DIALLING PROCEDURES

COUNTRY	Code
Russia	+7
Rwanda	+250
St Helena	+290
St Kitts	+1
St Pierre I	+508
St Vincent	+1
Samoa	+685
San Marino[5]	+378
Sao Tome and Principe	+239
Saudi Arabia	+966
Senegal	+221
Serbia	+381
Seychelles	+248
Sierra Leone	+232
Singapore[9]	+65
Slovakia	+421
Slovenia	+386
Solomon Is	+677
Somalia	+252
South African Rep	+27
Spain	+34
Sri Lanka	+94
Sudan	+249
Suriname	+597
Sweden	+46
Switzerland	+41
Syria	+963
Taiwan	+886
Tajikistan	+992

INTERNATIONAL DIALLING PROCEDURES

COUNTRY	Code
Tanzania[11]	+255
Thailand	+66
Timor-Leste	+670
Togo	+228
Tokelau	+690
Tonga	+676
Trinidad and Tobago	+1
Tunisia	+216
Turkey	+90
Turkmenistan	+993
Turks and Caicos Is	+1
Tuvalu	+688
Uganda[11]	+256
Ukraine	+380
United Arab Emirates	+971
United Kingdom	+44
United States	+1
Uruguay	+598
Uzbekistan	+998
Vanuatu	+678
Vatican[10]	+379
Vatican	+39
Venezuela	+58
Vietnam	+84
Virgin Is	+1
Wallis and Futuna Is	+681
Yemen	+967
Zambia	+260
Zimbabwe	+263

INTERNATIONAL DIALLING PROCEDURES

[1] The length of the national (significant) number(s) will be 8 digits for geographic numbering and 10 digits for non-geographic numbering (networks and services).

[2] The ‘0’ is used on all domestic calls, including in the same city, but is omitted when dialing from other countries.

[3] When dialing from Ireland to Northern Ireland, the area code used should be ‘048’ instead of ‘004428’.

[4] In Comoros Islands, the subscriber numbers begin with digit ‘3 and 7’ and Mayotte digit ‘2 and 6’.

[5] When dialing from San Marino to Italy, the complete national subscriber number must be used, without prefixing the number by ‘0039’.

[6] When dialing from Italy to San Marino, the subscriber number must be prefixed by ‘0549’ instead of ‘00378’.

[7] Including Australia Antarctic Territory Bases and Norfolk Island (international prefix for Norfolk Island is ‘0101’).

[8] When dialing from Malaysia to Singapore, the subscriber number must be prefixed by ‘02’ instead of ‘0065’.

[9] When dialing from Singapore to Malaysia, the area code and subscriber number must be prefixed by ‘020’ instead of ‘00160’.

[10] The country code is listed for future use (Vatican is currently using country code ‘39’).

[11] When dialing between Kenya, Tanzania and Uganda the national (significant) number must be prefixed by 005 for Kenya, 006 for Uganda and 007 for Tanzania.

[12] ECTRA (a European body) proposed that country code +388 be assigned for a European Telephony Numbering Space (ETNS), applicable throughout Europe for Europe-wide services. This code would supplement, but not replace, existing country codes used by each European Nation. One advantage is that companies could replace different numbers from different European countries with a single +388 number. For more information see http://www.etns.org.

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Tables and Codes

True Track Tables

NORTH ATLANTIC CROSSING TRACKS / DISTANCES

ABBREVIATIONS

WPT1	-	Name of Waypoint 1	
LAT1	-	Latitude of Waypoint 1:	N4539 => N45°39'
LONG1	-	Longitude of Waypoint 1:	W05206 => W052°06'
LAT2	-	Latitude of Waypoint 2:	46 => N46°00'
LONG2	-	Longitude of Waypoint 2:	50 => W050°00' (only full degrees)
EAST	-	Initial true track between Waypoint 1 and Waypoint 2, eastbound	
WEST	-	Initial true track between Waypoint 1 and Waypoint 2, westbound	
DIST	-	Distance between Waypoint 1 and Waypoint 2 (great circle)	

All distances are great circle distances between the respective positions

EAST ATLANTIC WAYPOINTS

WPT1 LAT1 LONG1	LAT2	LONG2	EAST	WEST	DIST
ADARA N5130 W015	5230	20	106	290	195
	5130	20	88	272	187
	5030	20	70	254	199
AGORI N57 W013	58	20	102	288	234
	57	20	87	273	229
	56	20	72	258	240
AMLAD N5615 W010	5730	20	99	287	337
	5630	20	88	277	334
	5530	20	78	266	341
APSOV N5549 W010	56	20	88	276	338
	55	20	78	266	345
	54	20	68	257	363
ARMED N4230 W014	4530	20	123	307	316
	4430	20	113	297	288
	4330	20	101	285	271
	4230	20	88	272	266

NORTH ATLANTIC CROSSING TRACKS / DISTANCES

EAST ATLANTIC WAYPOINTS (continued)

WPT1 LAT1 LONG1	LAT2	LONG2	EAST	WEST	DIST
ATSIX N60 W010	61	20	97	286	302
	60	20	86	274	301
	59	20	75	263	311
BALIX N59 W010	60	20	97	285	311
	59	20	86	274	310
	58	20	75	263	320
BANAL N42 W015	44	20	117	300	251
	43	20	103	287	230
	42	20	88	271	224
	41	20	73	257	233
BEDRA N49 W015	50	20	105	289	205
	49	20	88	272	198
	48	20	71	255	208
	47	20	57	241	234
BEGAS N45 W009	47	20	100	288	475
	46	20	93	281	468
	45	20	86	274	468
BERUX N45 W011	46	20	96	282	384
	45	20	87	273	383
	44	20	78	264	391
BILTO N5630 W015	5730	20	108	292	175
	5630	20	88	272	166
	5530	20	68	252	179
BUNAV N4630 W00845	4930	20	107	296	487
	4830	20	101	289	473
	4730	20	93	282	465
	4630	20	86	274	466

NORTH ATLANTIC CROSSING TRACKS / DISTANCES

EAST ATLANTIC WAYPOINTS (continued)

WPT1 LAT1 LONG1	LAT2	LONG2	EAST	WEST	DIST
	4530	20	79	267	474
	4430	20	72	260	489
DETOX N41 W015	42	20	103	286	233
	41	20	88	271	227
	40	20	73	257	237
DINIM N51 W015	52	20	106	290	197
	51	20	88	272	189
	50	20	70	254	201
DIXIS N45 W010	46	20	94	281	426
	45	20	86	273	425
	44	20	78	265	433
DOGAL N54 W015	55	20	107	291	185
	54	20	88	272	177
	53	20	69	253	189
ERAKA N58 W010	59	20	97	285	320
	58	20	86	274	319
	57	20	75	264	329
ERPES N40 W015	41	20	103	286	237
	40	20	88	271	231
	39	20	74	257	240
ETARI N5530 W015	5630	20	108	292	179
	5530	20	88	272	171
	5430	20	69	253	183
ETIKI N48 W00845	49	20	93	282	452
	48	20	86	274	453
	47	20	78	267	461
	46	20	71	259	477

EAST ATLANTIC WAYPOINTS (continued)

WPT1 LAT1 LONG1	LAT2	LONG2	EAST	WEST	DIST
	45	20	65	253	499
	44	20	59	247	528
GOMUP N57 W010	58	20	96	285	329
	57	20	86	274	327
	56	20	75	264	338
GUNTI N39 W015	40	20	103	286	240
	39	20	88	271	234
	38	20	74	257	243
HIDRA N4430 W013	4530	20	99	284	304
	4430	20	88	272	301
	4330	20	76	261	309
	4230	20	66	251	328
IBROD N5630 W010	5730	20	96	285	333
	5630	20	86	274	332
	5530	20	76	264	342
KESIX N5657 W014	58	20	105	291	204
	57	20	88	273	197
	56	20	72	257	208
KOGAD N4930 W015	5030	20	105	289	203
	4930	20	88	272	196
	4830	20	71	255	206
KOMUT N38 W015	39	20	103	286	243
	38	20	88	271	237
	37	20	74	257	246
KOPAS N44 W013	45	20	99	284	306
	44	20	87	272	303
	43	20	76	261	311

NORTH ATLANTIC CROSSING TRACKS / DISTANCES

EAST ATLANTIC WAYPOINTS (continued)

WPT1 LAT1 LONG1	LAT2	LONG2	EAST	WEST	DIST
LASNO N4836 W009	49	20	89	277	437
	48	20	81	269	442
	47	20	74	262	455
	46	20	67	255	475
	45	20	60	248	502
LIMRI N52 W015	53	20	106	290	193
	52	20	88	272	185
	51	20	70	254	197
LUTAK N37 W015	38	20	102	285	246
	37	20	88	271	240
	36	20	74	257	249
LUTOV N5514 W010	56	20	94	282	343
	55	20	84	272	345
	54	20	74	262	356
MALOT N53 W015	54	20	106	290	189
	53	20	88	272	181
	52	20	70	254	193
MIMKU N56 W010	57	20	96	284	338
	56	20	86	274	337
	55	20	76	264	346
MUDOS N4330 W013	4530	20	109	294	324
	4430	20	99	284	309
	4330	20	88	272	306
	4230	20	77	261	314
NEBIN N5330 W015	5430	20	107	291	187
	5330	20	88	272	179
	5230	20	70	254	191

NORTH ATLANTIC CROSSING TRACKS / DISTANCES

EAST ATLANTIC WAYPOINTS (continued)

WPT1 LAT1 LONG1	LAT2	LONG2	EAST	WEST	DIST
NERTU N49 W014	50	20	102	287	242
	49	20	88	272	237
	48	20	74	258	247
	47	20	61	246	270
NIBOG N55 W010	56	20	96	284	346
	55	20	86	274	345
	54	20	76	264	355
OMOKO N4850 W012	49	20	89	275	317
	48	20	78	264	324
	47	20	68	254	341
	46	20	56	245	368
	45	20	52	238	401
PASAS N45 W013	46	20	99	284	301
	45	20	87	272	298
	44	20	76	261	306
PIKIL N56 W015	57	20	108	292	177
	56	20	88	272	168
	55	20	68	252	181
PITAX N45 W012	46	20	97	283	343
	45	20	87	273	340
	44	20	77	263	349
RATSU N61 W010	61	20	86	274	292
	60	20	74	263	302
	59	20	64	253	324
RESNO N55 W015	56	20	107	291	181
	55	20	88	272	173
	54	20	69	253	185

NORTH ATLANTIC CROSSING TRACKS / DISTANCES

EAST ATLANTIC WAYPOINTS (continued)

WPT1 LAT1 LONG1	LAT2	LONG2	EAST	WEST	DIST
RETEN N43 W013	45	20	109	294	326
	44	20	98	283	311
	43	20	87	272	308
	42	20	77	261	316
RODEL N5030 W015	51	20	97	281	193
	50	20	79	263	195
	49	20	63	247	214
SEPAL N47 W00845	49	20	100	289	468
	48	20	93	281	461
	47	20	86	274	462
	46	20	78	267	470
	45	20	71	260	485
	44	20	65	253	507
SIVIR N46 W00845	48	20	100	288	477
	47	20	93	281	470
	46	20	86	274	470
	45	20	79	267	478
	44	20	72	260	493
SOMAX N50 W015	51	20	105	289	201
	50	20	88	272	194
	49	20	71	255	205
SUNOT N57 W015	58	20	108	293	173
	57	20	88	272	164
	56	20	68	252	177
TOBOR N5230 W015	53	20	97	281	185
	52	20	79	263	187
	51	20	62	246	207

NORTH ATLANTIC CROSSING TRACKS / DISTANCES

EAST ATLANTIC WAYPOINTS (continued)

WPT1 LAT1 LONG1	LAT2	LONG2	EAST	WEST	DIST
UMLER N4730 W00845	49	20	97	285	460
	48	20	90	278	456
	47	20	82	270	460
	46	20	75	263	472
	45	20	68	256	491
	44	20	62	250	515
VENER N5430 W015	55	20	98	282	176
	54	20	78	262	178
	53	20	61	245	200

WEST ATLANTIC WAYPOINTS

WPT1 LAT1 LONG1	LAT2	LONG2	EAST	WEST	DIST
ALLRY N5030 W052	52	50	39	221	117
	51	50	68	249	82
	50	50	111	292	83
	49	50	138	320	119
AVPUT N6502 W060	66	50	72	261	256
	65	50	86	275	254
	64	50	99	288	266
AVUTI N57282 W058	60	50	55	242	293
	59	50	67	253	270
	58	50	80	266	259
	57	50	93	279	262
BALOO N3424 W06208	37	60	33	214	187
	36	60	47	228	142

NORTH ATLANTIC CROSSING TRACKS / DISTANCES

WEST ATLANTIC WAYPOINTS (continued)

WPT1 LAT1 LONG1	LAT2	LONG2	EAST	WEST	DIST
	35	60	71	252	112
BDA N3221 W06441	38	60	33	216	409
	37	60	38	221	362
	36	60	45	228	319
	35	60	55	237	283
	34	60	66	249	256
	33	60	79	262	240
BERUS N63 W063	64	60	52	234	101
	63	60	88	271	82
	62	60	124	307	103
BOKTO N5658 W058	58	50	73	260	266
	57	50	86	273	262
	56	50	99	286	272
BUDAR N50 W052	53	50	22	203	195
	52	50	31	213	142
	51	50	51	233	97
CLAVY N6414 W059	66	50	61	249	252
	65	50	75	263	237
	64	50	89	277	237
CUDDY N5642 W057	59	50	55	241	263
	58	50	68	254	240
	57	50	83	268	231
	56	50	97	283	23
DORYY N5602 W057	60	50	40	226	326
	59	50	49	235	288
	58	50	60	246	258
	57	50	73	259	240

NORTH ATLANTIC CROSSING TRACKS / DISTANCES

WEST ATLANTIC WAYPOINTS (continued)

WPT1 LAT1 LONG1	LAT2	LONG2	EAST	WEST	DIST
EMBOK N6328 W058	66	50	50	237	256
	65	50	63	250	229
	64	50	78	265	216
ENNSO N5532 W057	57	50	66	252	250
	56	50	80	266	239
	55	50	95	280	242
ELSIR N4930 W052	51	50	40	221	119
	50	50	68	250	83
	49	50	110	292	84
GRIBS N6130 W063	62	60	69	252	91
	61	60	108	290	92
	60	60	134	317	126
HOIST N5502 W057	59	50	41	227	331
	58	50	50	235	293
	57	50	60	246	264
	56	50	73	259	246
	55	50	88	273	242
IBERG N49 W052	52	50	22	204	196
	51	50	32	214	143
	50	50	52	233	99
IKMAN N6230 W063	63	60	69	251	88
	62	60	108	291	89
	61	60	135	318	124
IRBIM N5839 W06032	62	50	53	242	373
	61	50	62	251	348
	60	50	71	261	333
	59	50	82	271	329

NORTH ATLANTIC CROSSING TRACKS / DISTANCES

WEST ATLANTIC WAYPOINTS (continued)

WPT1 LAT1 LONG1	LAT2	LONG2	EAST	WEST	DIST
IRLOK N5432 W057	57	50	55	241	280
	56	50	67	253	256
	55	50	81	266	245
JANJO N5402 W057	58	50	42	228	335
	57	50	58	236	298
	56	50	61	247	269
	55	50	74	260	251
	54	50	88	273	248
JOOPY N4830 W052	50	50	40	222	120
	49	50	69	250	85
	48	50	110	291	86
KAGLY N6330 W063	64	60	68	251	85
	63	60	109	291	87
	62	60	136	319	122
KENKI N65 W063	66	60	50	232	96
	65	60	88	271	76
	64	60	126	309	98
KETLA N6228 W058	64	50	63	251	236
	63	50	78	265	223
	62	50	94	281	226
KODIK N5328 W05712	55	50	67	253	270
	54	50	80	266	258
	53	50	93	279	261
LAZEY N3335 W06129	36	60	26	207	162
	35	60	40	221	112
	34	60	71	252	78
LIBOR	64	50	57	244	251

NORTH ATLANTIC CROSSING TRACKS / DISTANCES

WEST ATLANTIC WAYPOINTS (continued)

WPT1 LAT1 LONG1	LAT2	LONG2	EAST	WEST	DIST
N6158 W058	63	50	71	258	231
	62	50	86	273	226
LOMSI N5306 W05647	57	50	42	228	331
	56	50	51	236	294
	55	50	62	247	266
	54	50	75	260	249
	53	50	89	274	246
MAXAR N6128 W058	64	50	52	239	268
	63	50	64	251	243
	62	50	78	266	230
MELDI N5244 W05621	54	50	69	254	241
	53	50	84	269	231
	52	50	98	283	238
MIBNO N6035 W06232	62	50	71	262	372
	61	50	80	271	369
	60	50	90	281	375
	59	50	98	289	391
MOATT N5801 W05955	62	50	47	236	382
	61	50	55	244	352
	60	50	65	253	330
	59	50	75	263	318
MUSAK N48 W052	51	50	23	204	196
	50	50	33	214	144
	49	50	52	234	100
MUSLO N6010 W062	63	60	18	199	180
	62	60	27	209	125
	61	60	49	231	78

NORTH ATLANTIC CROSSING TRACKS / DISTANCES

WEST ATLANTIC WAYPOINTS (continued)

WPT1 LAT1 LONG1	LAT2	LONG2	EAST	WEST	DIST
MUSVA N64 W063	65	60	51	233	98
	64	60	88	271	79
	63	60	125	308	101
NALDI N6430 W063	66	60	38	221	118
	65	60	67	250	83
	64	60	109	292	84
NEEKO N5224 W05550	55	50	51	235	260
	54	50	63	248	231
	53	50	78	263	216
	52	50	94	279	217
NICSO N4730 W052	49	50	41	222	121
	48	50	69	250	86
	47	50	110	291	87
NIFTY N6058 W058	63	50	58	245	257
	62	50	71	258	238
	61	50	86	273	234
OMSAT N47 W052	50	50	23	205	197
	49	50	33	215	145
	48	50	53	234	101
PELTU N5206 W05510	54	50	57	241	219
	53	50	72	256	197
	52	50	90	274	191
PEPKI N5944 W06137	62	50	63	253	366
	61	50	72	262	354
	60	50	82	272	351
	59	50	92	282	359
PIDSO	63	50	53	240	274

NORTH ATLANTIC CROSSING TRACKS / DISTANCES

WEST ATLANTIC WAYPOINTS (continued)

WPT1 LAT1 LONG1	LAT2	LONG2	EAST	WEST	DIST
N6028 W058	62	50	65	252	249
	61	50	79	266	238
PORTI N4630 W052	48	50	41	223	122
	47	50	69	251	88
	46	50	109	291	89
RADUN N5958 W058	62	50	59	246	264
	61	50	72	259	245
	60	50	86	273	241
RAFIN N4453 W05148	46	50	48	229	102
	45	50	84	265	77
	44	50	124	305	94
RELIC N46 W052	49	50	24	205	198
	48	50	34	215	145
	47	50	53	235	102
RIKAL N5148 W05432	52	50	84	268	169
	51	50	104	288	177
	50	50	120	304	203
SAVRY N5928 W058	62	50	54	241	280
	61	50	65	252	256
	60	50	79	266	245
SAXAN N5129 W05351	54	50	41	224	206
	53	50	56	239	169
	52	50	76	259	147
SINGA N5913 W06105	62	50	58	248	367
	61	50	67	257	349
	60	50	77	267	341
SUPRY	47	50	42	223	123

NORTH ATLANTIC CROSSING TRACKS / DISTANCES

WEST ATLANTIC WAYPOINTS (continued)

WPT1 LAT1 LONG1	LAT2	LONG2	EAST	WEST	DIST
N4530 W052	46	50	70	251	89
	45	50	109	290	90
TOXIT N5858 W058	61	50	60	247	270
	60	50	72	259	252
	59	50	86	273	248
TUDEP N5110 W05314	52	50	66	249	131
	51	50	93	276	123
	50	50	118	301	142
UMESI N5050 W05236	51	50	83	265	99
	50	50	116	298	112
	49	50	137	319	149
URTAK N5828 W058	61	50	54	241	287
	60	50	66	253	263
	59	50	79	266	252
VESMI N5758 W058	60	50	60	247	277
	59	50	73	260	259
	58	50	86	273	255
YAY N5123 W05605	59	50	22	207	502
	58	50	25	210	450
	57	50	30	215	399
YQX N4854 W05432	56	50	19	203	458
	55	50	23	206	403
	54	50	27	211	350
YYT N4729 W05251	48	50	74	256	120
	47	50	103	285	120
	46	50	126	308	148

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
10N	20N	833.6	42.8	317.2
10N	1930N	812.8	44.3	315.7
10N	19N	792.6	45.9	314.1
10N	1830N	773.0	47.6	312.4
10N	18N	754.1	49.4	310.6
10N	1730N	735.9	51.2	308.8
10N	17N	718.5	53.1	306.9
10N	1630N	701.9	55.2	304.8
10N	16N	686.3	57.3	302.7
10N	1530N	671.6	59.5	300.5
10N	15N	657.9	61.9	298.1
10N	1430N	645.3	64.3	295.7
10N	14N	633.9	66.8	293.2
10N	1330N	623.7	69.4	290.6
10N	13N	614.8	72.0	288.0
10N	1230N	607.2	74.8	285.2
10N	12N	601.0	77.6	282.4
10N	1130N	596.3	80.4	279.6
10N	11N	593.0	83.3	276.7
10N	1030N	591.2	86.2	273.8
10N	10N	590.9	89.1	270.9
10N	0930N	592.1	92	268.0
10N	09N	594.8	94.9	265.1
10N	0830N	599.0	97.8	262.2
10N	08N	604.6	100.6	259.4
10N	0730N	611.6	103.4	256.6
10N	07N	620.0	106.1	253.9
10N	0630N	629.7	108.7	251.3

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
10N	06N	640.7	111.2	248.8
10N	0530N	652.8	113.7	246.3
10N	05N	666.0	116.0	244.0
10N	0430N	680.3	118.3	241.7
10N	04N	695.6	120.5	239.5
10N	0330N	711.8	122.5	237.5
10N	03N	728.9	124.5	235.5
10N	0230N	746.8	126.4	233.6
10N	02N	765.4	128.2	231.8
10N	0130N	784.7	129.9	230.1
10N	01N	804.7	131.5	228.5
10N	0030N	825.3	133.1	226.9
10N	00N	846.4	134.6	225.4
1030N	20N	811.8	44.2	315.8
1030N	1930N	791.6	45.8	314.2
1030N	19N	772.0	47.5	312.5
1030N	1830N	753.1	49.3	310.7
1030N	18N	734.9	51.1	308.9
1030N	1730N	717.5	53.1	306.9
1030N	17N	700.9	55.1	304.9
1030N	1630N	685.3	57.2	302.8
1030N	16N	670.6	59.4	300.6
1030N	1530N	656.9	61.8	298.2
1030N	15N	644.3	64.2	295.8
1030N	1430N	632.9	66.7	293.3
1030N	14N	622.7	69.3	290.7
1030N	1330N	613.8	71.9	288.1
1030N	13N	606.2	74.7	285.3

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
1030N	1230N	600.0	77.5	282.5
1030N	12N	595.3	80.3	279.7
1030N	1130N	592.0	83.2	276.8
1030N	11N	590.2	86.2	273.8
1030N	1030N	589.9	89.1	270.9
1030N	10N	591.2	92.0	268.0
1030N	0930N	593.9	94.9	265.1
1030N	09N	598.1	97.8	262.2
1030N	0830N	603.8	100.6	259.4
1030N	08N	610.8	103.4	256.6
1030N	0730N	619.3	106.1	253.9
1030N	07N	629.0	108.7	251.3
1030N	0630N	640.0	111.2	248.8
1030N	06N	652.1	113.7	246.3
1030N	0530N	665.4	116.0	244.0
1030N	05N	679.7	118.3	241.7
1030N	0430N	695.1	120.4	239.6
1030N	04N	711.3	122.5	237.5
1030N	0330N	728.4	124.5	235.5
1030N	03N	746.3	126.4	233.6
1030N	0230N	765.0	128.2	231.8
1030N	02N	784.3	129.9	230.1
1030N	0130N	804.3	131.5	228.5
1030N	01N	824.9	133.1	226.9
1030N	0030N	846.0	134.5	225.5
1030N	00N	867.7	135.9	224.1
11N	21N	831.6	42.6	317.4
11N	2030N	810.8	44.1	315.9

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
11N	20N	790.6	45.7	314.3
11N	1930N	771.0	47.4	312.6
11N	19N	752.0	49.2	310.8
11N	1830N	733.8	51.0	309.0
11N	18N	716.4	53.0	307.0
11N	1730N	699.9	55.0	305.0
11N	17N	684.2	57.1	302.9
11N	1630N	669.5	59.4	300.6
11N	16N	655.8	61.7	298.3
11N	1530N	643.2	64.1	295.9
11N	15N	631.8	66.6	293.4
11N	1430N	621.6	69.2	290.8
11N	14N	612.7	71.9	288.1
11N	1330N	605.1	74.6	285.4
11N	13N	599.0	77.4	282.6
11N	1230N	594.2	80.3	279.7
11N	12N	591.0	83.2	276.8
11N	1130N	589.2	86.1	273.9
11N	11N	589.0	89.0	271.0
11N	1030N	590.2	92.0	268.0
11N	10N	593.0	94.9	265.1
11N	0930N	597.2	97.7	262.3
11N	09N	602.9	100.6	259.4
11N	0830N	610.0	103.3	256.7
11N	08N	618.5	106.0	254.0
11N	0730N	628.2	108.7	251.3
11N	07N	639.2	111.2	248.8
11N	0630N	651.4	113.7	246.3

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
11N	06N	664.7	116.0	244.0
11N	0530N	679.1	118.3	241.7
11N	05N	694.5	120.4	239.6
11N	0430N	710.7	122.5	237.5
11N	04N	727.9	124.5	235.5
11N	0330N	745.8	126.4	233.6
11N	03N	764.5	128.1	231.9
11N	0230N	783.9	129.9	230.1
11N	02N	803.9	131.5	228.5
11N	0130N	824.5	133.0	227.0
11N	01N	845.7	134.5	225.5
1130N	21N	809.8	44.0	316.0
1130N	2030N	789.5	45.6	314.4
1130N	20N	769.9	47.3	312.7
1130N	1930N	751.0	49.0	311.0
1130N	19N	732.8	50.9	309.1
1130N	1830N	715.4	52.9	307.1
1130N	18N	689.8	54.9	305.1
1130N	1730N	683.1	57.0	303.0
1130N	17N	668.4	59.3	300.7
1130N	1630N	654.7	61.6	298.4
1130N	16N	642.1	64.0	296.0
1130N	1530N	630.7	66.5	293.5
1130N	15N	620.5	69.1	290.9
1130N	1430N	611.6	71.8	288.2
1130N	14N	604.0	74.5	285.5
1130N	1330N	597.9	77.4	282.6
1130N	13N	593.2	80.2	279.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
1130N	1230N	589.9	83.1	276.9
1130N	12N	588.2	86.1	273.9
1130N	1130N	587.9	89.0	271.0
1130N	11N	589.2	91.9	268.1
1130N	1030N	592.0	94.8	265.2
1130N	10N	596.3	97.7	262.3
1130N	0930N	602.0	100.5	259.5
1130N	09N	609.1	103.3	256.7
1130N	0830N	617.6	106.0	254.0
1130N	08N	627.4	108.6	251.4
1130N	0730N	638.5	111.2	248.8
1130N	07N	650.7	113.6	246.4
1130N	0630N	664.0	116.0	244.0
1130N	06N	678.4	118.3	241.7
1130N	0530N	693.8	120.4	239.6
1130N	05N	710.1	122.5	237.5
1130N	0430N	727.3	124.5	235.5
1130N	04N	745.3	126.4	233.6
1130N	0330N	764.0	128.1	231.9
1130N	03N	783.4	129.9	230.1
1130N	0230N	803.4	131.5	228.5
1130N	02N	824.1	133.0	227.0
1130N	0130N	845.2	134.5	225.5
1130N	01N	866.9	135.9	224.1
12N	22N	829.5	42.4	317.6
12N	2130N	808.7	43.9	316.1
12N	21N	788.4	45.5	314.5
12N	2030N	768.8	47.2	312.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
12N	20N	749.9	48.9	311.1
12N	1930N	731.7	50.8	309.2
12N	19N	714.2	52.7	307.3
12N	1830N	697.6	54.8	305.2
12N	18N	682.0	56.9	303.1
12N	1730N	667.2	59.2	300.8
12N	17N	653.5	61.5	298.5
12N	1630N	641.0	63.9	296.1
12N	16N	629.5	66.4	293.6
12N	1530N	619.4	69.0	291.0
12N	15N	610.4	71.7	288.3
12N	1430N	602.9	74.5	285.5
12N	14N	596.7	77.3	282.7
12N	1330N	592.0	80.2	279.8
12N	13N	588.8	83.1	276.9
12N	1230N	587.1	86.0	274.0
12N	12N	586.9	89.0	271.0
12N	1130N	588.2	91.9	268.1
12N	11N	591.0	94.8	265.2
12N	1030N	595.3	97.7	262.3
12N	10N	601.0	100.5	259.5
12N	0930N	608.2	103.3	256.7
12N	09N	616.7	106.0	254.0
12N	0830N	626.5	108.6	251.4
12N	08N	637.6	111.2	248.8
12N	0730N	649.9	113.6	246.4
12N	07N	663.3	116.0	244.0
12N	0630N	677.7	118.2	241.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
12N	06N	693.1	120.4	239.6
12N	0530N	709.5	122.5	237.5
12N	05N	726.7	124.5	235.5
12N	0430N	744.7	126.3	233.7
12N	04N	763.4	128.1	231.9
12N	0330N	782.9	129.8	230.2
12N	03N	802.9	131.5	228.5
12N	0230N	823.6	133.0	227.0
12N	02N	844.8	134.5	225.5
1230N	22N	807.6	43.8	316.2
1230N	2130N	787.3	45.4	314.6
1230N	21N	767.7	47.1	312.9
1230N	2030N	748.7	48.8	311.2
1230N	20N	730.5	50.7	309.3
1230N	1930N	713.1	52.6	307.4
1230N	19N	696.5	54.7	305.3
1230N	1830N	680.8	56.8	303.2
1230N	18N	666.1	59.1	300.9
1230N	1730N	652.4	61.4	298.6
1230N	17N	639.8	63.8	296.2
1230N	1630N	628.3	66.3	293.7
1230N	16N	618.2	69.0	291.0
1230N	1530N	609.3	71.6	288.4
1230N	15N	601.7	74.4	285.6
1230N	1430N	595.6	77.2	282.8
1230N	14N	590.9	80.1	279.9
1230N	1330N	587.7	83.0	277.0
1230N	13N	585.9	86.0	274.0

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
1230N	1230N	585.7	88.9	271.1
1230N	12N	587.1	91.9	268.1
1230N	1130N	589.9	94.8	265.2
1230N	11N	594.2	97.7	262.3
1230N	1030N	600.0	100.5	259.5
1230N	10N	607.2	103.3	256.7
1230N	0930N	615.8	106.0	254.0
1230N	09N	625.6	108.6	251.4
1230N	0830N	636.8	111.2	248.8
1230N	08N	649.1	113.6	246.4
1230N	0730N	662.5	116.0	244.0
1230N	07N	677.0	118.2	241.8
1230N	0630N	692.4	120.4	239.6
1230N	06N	708.8	122.5	237.5
1230N	0530N	726.0	124.5	235.5
1230N	05N	744.1	126.3	233.7
1230N	0430N	762.8	128.1	231.9
1230N	04N	782.3	129.8	230.2
1230N	0330N	802.4	131.5	228.5
1230N	03N	823.1	133.0	227.0
1230N	0230N	844.3	134.5	225.5
1230N	02N	866.1	135.9	224.1
13N	23N	827.3	42.1	317.9
13N	2230N	806.5	43.6	316.4
13N	22N	786.2	45.2	314.8
13N	2130N	766.6	46.9	313.1
13N	21N	747.6	48.7	311.3
13N	2030N	729.3	50.6	309.4

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
13N	20N	711.9	52.5	307.5
13N	1930N	695.3	54.6	305.4
13N	19N	679.6	56.7	303.3
13N	1830N	664.8	59.0	301.0
13N	18N	651.1	61.3	298.7
13N	1730N	638.5	63.7	296.3
13N	17N	627.1	66.3	293.7
13N	1630N	616.9	68.9	291.1
13N	16N	608.0	71.6	288.4
13N	1530N	600.5	74.3	285.7
13N	15N	594.3	77.2	282.8
13N	1430N	589.7	80.0	280.0
13N	14N	586.5	83.0	277.0
13N	1330N	584.8	85.9	274.1
13N	13N	584.6	88.9	271.1
13N	1230N	585.9	91.8	268.2
13N	12N	588.8	94.7	265.3
13N	1130N	593.2	97.6	262.4
13N	11N	599.0	100.5	259.5
13N	1030N	606.2	103.3	256.7
13N	10N	614.8	106.0	254.0
13N	0930N	624.7	108.6	251.4
13N	09N	635.9	111.2	248.8
13N	0830N	648.2	113.6	246.4
13N	08N	661.6	116.0	244.0
13N	0730N	676.2	118.2	241.8
13N	07N	691.6	120.4	239.6
13N	0630N	708.1	122.5	237.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
13N	06N	725.3	124.4	235.6
13N	0530N	743.4	126.3	233.7
13N	05N	762.2	128.1	231.9
13N	0430N	781.7	129.8	230.2
13N	04N	801.8	131.4	228.6
13N	0330N	822.6	133.0	227.0
13N	03N	843.8	134.5	225.5
1330N	23N	805.3	43.5	316.5
1330N	2230N	785.0	45.1	314.9
1330N	22N	765.4	46.8	313.2
1330N	2130N	746.4	48.6	311.4
1330N	21N	728.1	50.5	309.5
1330N	2030N	710.7	52.4	307.6
1330N	20N	694.0	54.5	305.5
1330N	1930N	678.3	56.6	303.4
1330N	19N	663.6	58.9	301.1
1330N	1830N	649.9	61.2	298.8
1330N	18N	637.3	63.6	296.4
1330N	1730N	625.8	66.2	293.8
1330N	17N	615.6	68.8	291.2
1330N	1630N	606.7	71.5	288.5
1330N	16N	599.2	74.3	285.7
1330N	1530N	593.1	77.1	282.9
1330N	15N	588.4	80.0	280.0
1330N	1430N	585.2	82.9	277.1
1330N	14N	585.5	85.9	274.1
1330N	1330N	583.4	88.8	271.2
1330N	13N	584.8	91.8	268.2

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
1330N	1230N	587.7	94.7	265.3
1330N	12N	592.0	97.6	262.4
1330N	1130N	597.9	100.5	259.5
1330N	11N	605.1	103.2	256.8
1330N	1030N	613.8	106.0	254.0
1330N	10N	623.7	108.6	251.4
1330N	0930N	634.9	111.1	248.9
1330N	09N	647.3	113.6	246.4
1330N	0830N	660.8	116.0	244.0
1330N	08N	675.3	118.2	241.8
1330N	0730N	690.9	120.4	239.6
1330N	07N	707.3	122.5	237.5
1330N	0630N	724.6	124.4	235.6
1330N	06N	742.7	126.3	233.7
1330N	0530N	761.6	128.1	231.9
1330N	05N	781.1	129.8	230.2
1330N	0430N	801.2	131.4	228.6
1330N	04N	822.0	133.0	227.0
1330N	0330N	843.3	134.5	225.5
1330N	03N	865.1	135.9	224.1
14N	24N	825.0	41.9	318.1
14N	2330N	804.1	43.4	316.6
14N	23N	783.8	45.0	315.0
14N	2230N	764.2	46.7	313.3
14N	22N	745.2	48.5	311.5
14N	2130N	726.9	50.3	309.7
14N	21N	709.4	52.3	307.7
14N	2030N	692.8	54.3	305.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
14N	20N	677.0	56.5	303.5
14N	1930N	662.3	58.7	301.3
14N	19N	648.6	61.1	298.9
14N	1830N	636.0	63.5	296.5
14N	18N	624.5	66.1	293.9
14N	1730N	614.3	68.7	291.3
14N	17N	605.4	71.4	288.6
14N	1630N	597.9	74.2	285.8
14N	16N	591.8	77.0	283.0
14N	1530N	587.1	79.9	280.1
14N	15N	583.9	82.9	277.1
14N	1430N	582.3	85.8	274.2
14N	14N	582.1	88.8	271.2
14N	1330N	583.5	91.7	268.3
14N	13N	586.5	94.7	265.3
14N	1230N	590.9	97.6	262.4
14N	12N	596.7	100.4	259.6
14N	1130N	604.0	103.2	256.8
14N	11N	612.7	105.9	254.1
14N	1030N	622.7	108.6	251.4
14N	10N	633.9	111.1	248.9
14N	0930N	646.3	113.6	246.4
14N	09N	659.9	116.0	244.0
14N	0830N	674.4	118.2	241.8
14N	08N	690.0	120.4	239.6
14N	0730N	706.5	122.5	237.5
14N	07N	723.8	124.4	235.6
14N	0630N	742.0	126.3	233.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
14N	06N	760.9	128.1	231.9
14N	0530N	780.4	129.8	230.2
14N	05N	800.6	131.4	228.6
14N	0430N	821.4	133.0	227.0
14N	04N	842.7	134.5	225.5
1430N	24N	802.9	43.3	316.7
1430N	2330N	782.6	44.9	315.1
1430N	23N	762.9	46.6	313.4
1430N	2230N	743.9	48.3	311.7
1430N	22N	725.6	50.2	309.8
1430N	2130N	708.1	52.2	307.8
1430N	21N	691.5	54.2	305.8
1430N	2030N	675.7	56.4	303.6
1430N	20N	660.9	58.6	301.4
1430N	1930N	647.2	61.0	299.0
1430N	19N	634.6	63.4	296.6
1430N	1830N	623.2	66.0	294.0
1430N	18N	613.0	68.6	291.4
1430N	1730N	604.1	71.3	288.7
1430N	17N	596.5	74.1	285.9
1430N	1630N	590.4	77.0	283.0
1430N	16N	585.8	79.9	280.1
1430N	1530N	582.6	82.8	277.2
1430N	15N	581.0	85.8	274.2
1430N	1430N	580.8	88.7	271.3
1430N	14N	582.3	91.7	268.3
1430N	1330N	585.2	94.7	265.3
1430N	13N	589.7	97.6	262.4

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
1430N	1230N	595.6	100.4	259.6
1430N	12N	602.9	103.2	256.8
1430N	1130N	611.6	105.9	254.1
1430N	11N	621.6	108.6	251.4
1430N	1030N	632.9	111.1	248.9
1430N	10N	645.3	113.6	246.4
1430N	0930N	658.9	116.0	244.0
1430N	09N	673.5	118.2	241.8
1430N	0830N	689.1	120.4	239.6
1430N	08N	705.7	122.5	237.5
1430N	0730N	723.0	124.4	235.6
1430N	07N	741.2	126.3	233.7
1430N	0630N	760.1	128.1	231.9
1430N	06N	779.7	129.8	230.2
1430N	0530N	800.0	131.4	228.6
1430N	05N	820.8	133.0	227.0
1430N	0430N	842.1	134.5	225.5
1430N	04N	864.0	135.8	224.2
15N	25N	822.6	41.6	318.4
15N	2430N	801.7	43.1	316.9
15N	24N	781.3	44.7	315.3
15N	2330N	761.6	46.4	313.6
15N	23N	742.6	48.2	311.8
15N	2230N	724.3	50.1	309.9
15N	22N	706.8	52.1	307.9
15N	2130N	690.1	54.1	305.9
15N	21N	674.4	56.3	303.7
15N	2030N	659.6	58.5	301.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
15N	20N	645.8	60.9	299.1
15N	1930N	633.2	63.3	296.7
15N	19N	621.8	65.9	294.1
15N	1830N	611.6	68.5	291.5
15N	18N	602.7	72.0	288.8
15N	1730N	595.1	74.0	286.0
15N	17N	589.0	76.9	283.1
15N	1630N	584.4	79.8	280.2
15N	16N	581.2	82.7	277.3
15N	1530N	579.6	85.7	274.3
15N	15N	579.5	88.7	271.3
15N	1430N	581.0	91.7	268.3
15N	14N	583.9	94.6	265.4
15N	1330N	588.4	97.5	262.5
15N	13N	594.3	100.4	259.6
15N	1230N	601.7	103.2	256.8
15N	12N	610.4	105.9	254.1
15N	1130N	620.5	108.6	251.4
15N	11N	631.8	111.1	248.9
15N	1030N	644.3	113.6	246.4
15N	10N	657.9	116.0	244.0
15N	0930N	672.6	118.2	241.8
15N	09N	688.2	120.4	239.6
15N	0830N	704.8	122.5	237.5
15N	08N	722.2	124.4	235.6
15N	0730N	740.4	126.3	233.7
15N	07N	759.4	128.1	231.9
15N	0630N	779.0	129.8	230.2

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
15N	06N	799.3	131.4	228.6
15N	0530N	820.1	133.0	227.0
15N	05N	841.5	134.5	225.5
1530N	25N	800.4	43.0	317.0
1530N	2430N	780.1	44.6	315.4
1530N	24N	760.3	46.3	313.7
1530N	2330N	741.3	48.1	311.9
1530N	23N	723.0	50.0	310.0
1530N	2230N	705.4	51.9	308.1
1530N	22N	688.7	54.0	306.0
1530N	2130N	673.0	56.2	303.8
1530N	21N	658.2	58.4	301.6
1530N	2030N	644.4	60.8	299.2
1530N	20N	631.8	63.2	296.8
1530N	1930N	620.3	65.8	294.2
1530N	19N	610.1	68.4	291.6
1530N	1830N	601.2	71.2	288.8
1530N	18N	593.7	74.0	286.0
1530N	1730N	587.6	76.8	283.2
1530N	17N	582.9	79.7	280.3
1530N	1630N	579.8	82.7	277.3
1530N	16N	578.2	85.7	274.3
1530N	1530N	578.1	88.7	271.3
1530N	15N	579.6	91.6	268.4
1530N	1430N	582.6	94.6	265.4
1530N	14N	587.1	97.5	262.5
1530N	1330N	593.1	100.4	259.6
1530N	13N	600.5	103.2	256.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
1530N	1230N	609.3	105.9	254.1
1530N	12N	619.4	108.6	251.4
1530N	1130N	630.7	111.1	248.9
1530N	11N	643.2	113.6	246.4
1530N	1030N	656.9	116.0	244.0
1530N	10N	671.6	118.2	241.8
1530N	0930N	687.3	120.4	239.6
1530N	09N	703.9	122.5	237.5
1530N	0830N	721.3	124.5	235.5
1530N	08N	739.6	126.3	233.7
1530N	0730N	758.6	128.1	231.9
1530N	07N	778.2	129.8	230.2
1530N	0630N	798.5	131.4	228.6
1530N	06N	819.4	133.0	227.0
1530N	0530N	840.9	134.5	225.5
1530N	05N	862.8	135.8	224.2
16N	26N	820.1	41.3	318.7
16N	2530N	799.1	42.9	317.1
16N	25N	778.7	44.5	315.5
16N	2430N	759.0	46.2	313.8
16N	24N	739.9	48.0	312.0
16N	2330N	721.6	49.8	310.2
16N	23N	704.0	51.8	308.2
16N	2230N	687.3	53.9	306.1
16N	22N	671.5	56.0	304.0
16N	2130N	656.7	58.3	301.7
16N	21N	643.0	60.7	299.3
16N	2030N	630.3	63.1	296.9

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
16N	20N	618.9	65.7	294.3
16N	1930N	608.6	68.3	291.7
16N	19N	599.7	71.1	288.9
16N	1830N	592.2	73.9	286.1
16N	18N	586.1	76.7	283.3
16N	1730N	581.5	79.7	280.3
16N	17N	578.3	82.6	277.4
16N	1630N	576.8	85.6	274.4
16N	16N	576.7	88.6	271.4
16N	1530N	578.2	91.6	268.4
16N	15N	581.2	94.6	265.4
16N	1430N	585.8	97.5	262.5
16N	14N	591.8	100.4	259.6
16N	1330N	599.2	103.2	256.8
16N	13N	608.0	105.9	254.1
16N	1230N	618.2	108.6	251.4
16N	12N	629.5	111.1	248.9
16N	1130N	642.1	113.6	246.4
16N	11N	655.8	116.0	244.0
16N	1030N	670.6	118.2	241.8
16N	10N	686.3	120.4	239.6
16N	0930N	702.9	122.5	237.5
16N	09N	720.4	124.5	235.5
16N	0830N	738.7	126.3	233.7
16N	08N	757.7	128.1	231.9
16N	0730N	777.4	129.8	230.2
16N	07N	797.8	131.4	228.6
16N	0630N	818.7	133.0	227.0

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
16N	06N	840.2	134.4	225.6
1630N	26N	797.8	42.7	317.3
1630N	2530N	777.4	44.3	315.7
1630N	25N	757.6	46.0	314.0
1630N	2430N	738.5	47.8	312.2
1630N	24N	720.2	49.7	310.3
1630N	2330N	702.6	51.7	308.3
1630N	23N	685.9	53.8	306.2
1630N	2230N	670.1	55.9	304.1
1630N	22N	655.2	58.2	301.8
1630N	2130N	641.5	60.6	299.4
1630N	21N	628.8	63.0	297.0
1630N	2030N	617.3	65.6	294.4
1630N	20N	607.1	68.2	291.8
1630N	1930N	598.2	71.0	289.0
1630N	19N	590.7	73.8	286.2
1630N	1830N	584.6	76.7	283.3
1630N	18N	580.0	79.6	280.4
1630N	1730N	576.8	82.6	277.4
1630N	17N	575.3	85.6	274.4
1630N	1630N	575.2	88.6	271.4
1630N	16N	576.8	91.6	268.4
1630N	1530N	579.8	94.5	265.5
1630N	15N	584.4	97.5	262.5
1630N	1430N	590.4	100.4	259.6
1630N	14N	597.9	103.2	256.8
1630N	1330N	606.7	105.9	254.1
1630N	13N	616.9	108.6	251.4

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
1630N	1230N	628.3	111.1	248.9
1630N	12N	641.0	113.6	246.4
1630N	1130N	654.7	116.0	244.0
1630N	11N	669.5	118.3	241.7
1630N	1030N	685.3	120.4	239.6
1630N	10N	701.9	122.5	237.5
1630N	0930N	719.5	124.5	235.5
1630N	09N	737.8	126.4	233.6
1630N	0830N	756.9	128.1	231.9
1630N	08N	776.6	129.8	230.2
1630N	0730N	797.0	131.5	228.5
1630N	07N	818.0	133.0	227.0
1630N	0630N	839.5	134.5	225.5
1630N	06N	861.4	135.9	224.1
17N	27N	817.4	41.1	318.9
17N	2630N	796.4	42.6	317.4
17N	26N	776.0	44.2	315.8
17N	2530N	756.2	45.9	314.1
17N	25N	737.1	47.7	312.3
17N	2430N	718.7	49.6	310.4
17N	24N	701.1	51.6	308.4
17N	2330N	684.4	53.6	306.4
17N	23N	668.6	55.8	304.2
17N	2230N	653.7	58.1	301.9
17N	22N	639.9	60.4	299.6
17N	2130N	627.3	62.9	297.1
17N	21N	615.8	65.5	294.5
17N	2030N	605.5	68.1	291.9

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
17N	20N	596.6	70.9	289.1
17N	1930N	589.1	73.7	286.3
17N	19N	583.0	76.6	283.4
17N	1830N	578.4	79.5	280.5
17N	18N	575.3	82.5	277.5
17N	1730N	573.7	85.5	274.5
17N	17N	573.7	88.5	271.5
17N	1630N	575.3	91.5	268.5
17N	16N	578.3	94.5	265.5
17N	1530N	582.9	97.5	262.5
17N	15N	589.0	100.3	259.7
17N	1430N	596.5	103.2	256.8
17N	14N	605.4	105.9	254.1
17N	1330N	615.6	108.6	251.4
17N	13N	627.1	111.1	248.9
17N	1230N	639.8	113.6	246.4
17N	12N	653.5	116.0	244.0
17N	1130N	668.4	118.3	241.7
17N	11N	684.2	120.4	239.6
17N	1030N	700.9	122.5	237.5
17N	10N	718.5	124.5	235.5
17N	0930N	736.9	126.4	233.6
17N	09N	756.0	128.2	231.8
17N	0830N	775.8	129.9	230.1
17N	08N	796.2	131.5	228.5
17N	0730N	817.2	133.0	227.0
17N	07N	838.7	134.5	225.5
1730N	27N	795.1	42.4	317.6

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
1730N	2630N	774.6	44.1	315.9
1730N	26N	754.8	45.8	314.2
1730N	2530N	735.7	47.6	312.4
1730N	25N	717.3	49.4	310.6
1730N	2430N	699.6	51.4	308.6
1730N	24N	682.9	53.5	306.5
1730N	2330N	667.0	55.7	304.3
1730N	23N	652.2	58.0	302.0
1730N	2230N	638.4	60.3	299.7
1730N	22N	625.7	62.8	297.2
1730N	2130N	614.2	65.4	294.6
1730N	21N	603.9	68.1	291.9
1730N	2030N	595.0	70.8	289.2
1730N	20N	587.5	73.6	286.4
1730N	1930N	581.4	76.5	283.5
1730N	19N	576.8	79.5	280.5
1730N	1830N	573.7	82.5	277.5
1730N	18N	572.2	85.5	274.5
1730N	1730N	572.2	88.5	271.5
1730N	17N	573.7	91.5	268.5
1730N	1630N	576.8	94.5	265.5
1730N	16N	581.5	97.4	262.6
1730N	1530N	587.6	100.3	259.7
1730N	15N	595.1	103.2	256.8
1730N	1430N	604.1	105.9	254.1
1730N	14N	614.3	108.6	251.4
1730N	1330N	625.8	111.1	248.9
1730N	13N	638.5	113.6	246.4

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
1730N	1230N	652.4	116.0	244.0
1730N	12N	667.2	118.3	241.7
1730N	1130N	683.1	120.4	239.6
1730N	11N	699.9	122.5	237.5
1730N	1030N	717.5	124.5	235.5
1730N	10N	735.9	126.4	233.6
1730N	0930N	755.0	128.2	231.8
1730N	09N	774.9	129.9	230.1
1730N	0830N	795.3	131.5	228.5
1730N	08N	816.3	133.0	227.0
1730N	0730N	837.9	134.5	225.5
1730N	07N	860.0	135.9	224.1
18N	28N	814.7	40.8	319.2
18N	2730N	793.7	42.3	317.7
18N	27N	773.2	43.9	316.1
18N	2630N	753.3	45.6	314.4
18N	26N	734.2	47.4	312.6
18N	2530N	715.8	49.3	310.7
18N	25N	698.1	51.3	308.7
18N	2430N	681.3	53.4	306.6
18N	24N	665.5	55.5	304.5
18N	2330N	650.6	57.8	302.2
18N	23N	636.8	60.2	299.8
18N	2230N	624.1	62.7	297.3
18N	22N	612.6	65.3	294.7
18N	2130N	602.3	68.0	292.0
18N	21N	593.4	70.7	289.3
18N	2030N	585.8	73.5	286.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
18N	20N	579.8	76.4	283.6
18N	1930N	575.2	79.4	280.6
18N	19N	572.1	82.4	277.6
18N	1830N	570.5	85.4	274.6
18N	18N	570.6	88.4	271.6
18N	1730N	572.2	91.5	268.5
18N	17N	575.3	94.5	265.5
18N	1630N	580.0	97.4	262.6
18N	16N	586.1	100.3	259.7
18N	1530N	593.7	103.1	256.9
18N	15N	602.7	105.9	254.1
18N	1430N	613.0	108.6	251.4
18N	14N	624.5	111.2	248.8
18N	1330N	637.3	113.6	246.4
18N	13N	651.1	116.0	244.0
18N	1230N	666.1	118.3	241.7
18N	12N	682.0	120.5	239.5
18N	1130N	698.8	122.5	237.5
18N	11N	716.4	124.5	235.5
18N	1030N	734.9	126.4	233.6
18N	10N	754.1	128.2	231.8
18N	0930N	773.9	129.9	230.1
18N	09N	794.4	131.5	228.5
18N	0830N	815.5	133.0	227.0
18N	08N	837.1	134.5	225.5
1830N	28N	792.2	42.2	317.8
1830N	2730N	771.7	43.8	316.2
1830N	27N	751.9	45.5	314.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
1830N	2630N	732.7	47.3	312.7
1830N	26N	714.2	49.2	310.8
1830N	2530N	696.6	51.1	308.9
1830N	25N	679.8	53.2	306.8
1830N	2430N	663.9	55.4	304.6
1830N	24N	649.0	57.7	302.3
1830N	2330N	635.1	60.1	299.9
1830N	23N	622.4	62.6	297.4
1830N	2230N	610.9	65.2	294.8
1830N	22N	600.6	67.9	292.1
1830N	2130N	591.7	70.6	289.4
1830N	21N	584.2	73.5	286.5
1830N	2030N	578.1	76.4	283.6
1830N	20N	573.5	79.3	280.7
1830N	1930N	570.4	82.3	277.7
1830N	19N	568.9	85.4	274.6
1830N	1830N	568.9	88.4	271.6
1830N	18N	570.5	91.4	268.6
1830N	1730N	573.7	94.4	265.6
1830N	17N	578.4	97.4	262.6
1830N	1630N	584.6	100.3	259.7
1830N	16N	592.2	103.1	256.9
1830N	1530N	601.2	105.9	254.1
1830N	15N	611.6	108.6	251.4
1830N	1430N	623.2	111.2	248.8
1830N	14N	636.0	113.6	246.4
1830N	1330N	649.9	116.0	244.0
1830N	13N	664.8	118.3	241.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
1830N	1230N	680.8	120.5	239.5
1830N	12N	697.6	122.6	237.4
1830N	1130N	715.4	124.5	235.5
1830N	11N	733.8	126.4	233.6
1830N	1030N	753.1	128.2	231.8
1830N	10N	773.0	129.9	230.1
1830N	0930N	793.5	131.5	228.5
1830N	09N	814.6	133.0	227.0
1830N	0830N	836.3	134.5	225.5
1830N	08N	858.4	135.9	224.1
19N	29N	811.9	40.5	319.5
19N	2830N	790.8	42.0	318.0
19N	28N	770.2	43.6	316.4
19N	2730N	750.3	45.3	314.7
19N	27N	731.1	47.1	312.9
19N	2630N	712.7	49.0	311.0
19N	26N	695.0	51.0	309.0
19N	2530N	678.1	53.1	306.9
19N	25N	662.2	55.3	304.7
19N	2430N	647.3	57.6	302.4
19N	24N	633.4	60.0	300.0
19N	2330N	620.7	62.5	297.5
19N	23N	609.2	65.1	294.9
19N	2230N	598.9	67.7	292.3
19N	22N	590.0	70.5	289.5
19N	2130N	582.4	73.4	286.6
19N	21N	576.3	76.3	283.7
19N	2030N	571.7	79.3	280.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
19N	20N	568.7	82.3	277.7
19N	1930N	567.2	85.3	274.7
19N	19N	567.2	88.4	271.6
19N	1830N	568.9	91.4	268.6
19N	18N	572.1	94.4	265.6
19N	1730N	576.8	97.4	262.6
19N	17N	583.0	100.3	259.7
19N	1630N	590.7	103.1	256.9
19N	16N	599.7	105.9	254.1
19N	1530N	610.1	108.6	251.4
19N	15N	621.8	111.2	248.8
19N	1430N	634.6	113.7	246.3
19N	14N	648.6	116.0	244.0
19N	1330N	663.6	118.3	241.7
19N	13N	679.6	120.5	239.5
19N	1230N	696.5	122.6	237.4
19N	12N	714.2	124.6	235.4
19N	1130N	732.8	126.4	233.6
19N	11N	752.0	128.2	231.8
19N	1030N	772.0	129.9	230.1
19N	10N	792.6	131.5	228.5
19N	0930N	813.7	133.1	226.9
19N	09N	835.4	134.5	225.5
1930N	29N	789.3	41.9	318.1
1930N	2830N	768.7	43.5	316.5
1930N	28N	748.8	45.2	314.8
1930N	2730N	729.6	47.0	313.0
1930N	27N	711.1	48.9	311.1

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
1930N	2630N	693.4	50.9	309.1
1930N	26N	676.5	53.0	307.0
1930N	2530N	660.6	55.2	304.8
1930N	25N	645.6	57.4	302.6
1930N	2430N	631.7	59.8	300.2
1930N	24N	619.0	62.3	297.7
1930N	2330N	607.4	65.0	295.0
1930N	23N	597.1	67.6	292.4
1930N	2230N	588.2	70.4	289.6
1930N	22N	580.6	73.3	286.7
1930N	2130N	574.6	76.2	283.8
1930N	21N	570.0	79.2	280.8
1930N	2030N	566.9	82.2	277.8
1930N	20N	565.4	85.3	274.7
1930N	1930N	565.5	88.3	271.7
1930N	19N	567.2	91.4	268.6
1930N	1830N	570.4	94.4	265.6
1930N	18N	575.2	97.4	262.6
1930N	1730N	581.4	100.3	259.7
1930N	17N	589.1	103.1	256.9
1930N	1630N	598.2	105.9	254.1
1930N	16N	608.6	108.6	251.4
1930N	1530N	620.3	111.2	248.8
1930N	15N	633.2	113.7	246.3
1930N	1430N	647.2	116.1	243.9
1930N	14N	662.3	118.3	241.7
1930N	1330N	678.3	120.5	239.5
1930N	13N	695.3	122.6	237.4

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
1930N	1230N	713.1	124.6	235.4
1930N	12N	731.7	126.5	233.5
1930N	1130N	751.0	128.3	231.7
1930N	11N	771.0	130.0	230.0
1930N	1030N	791.6	131.6	228.4
1930N	10N	812.8	133.1	226.9
1930N	0930N	834.5	134.6	225.4
1930N	09N	856.7	135.9	224.1
20N	30N	808.9	40.2	319.8
20N	2930N	787.8	41.7	318.3
20N	29N	767.2	43.3	316.7
20N	2830N	747.2	45.0	315.0
20N	28N	728.0	46.8	313.2
20N	2730N	709.4	48.7	311.3
20N	27N	691.7	50.8	309.3
20N	2630N	674.8	52.8	307.2
20N	26N	658.9	55.0	305.0
20N	2530N	643.9	57.3	302.7
20N	25N	630.0	59.7	300.3
20N	2430N	617.2	62.2	297.8
20N	24N	605.6	64.8	295.2
20N	2330N	595.3	67.5	292.5
20N	23N	586.4	70.3	289.7
20N	2230N	578.8	73.2	286.8
20N	22N	572.7	76.1	283.9
20N	2130N	568.1	79.1	280.9
20N	21N	565.1	82.2	277.8
20N	2030N	563.6	85.2	274.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
20N	20N	563.7	88.3	271.7
20N	1930N	565.4	91.3	268.7
20N	19N	568.7	94.4	265.6
20N	1830N	573.5	97.3	262.7
20N	18N	579.8	100.3	259.7
20N	1730N	587.5	103.1	256.9
20N	17N	596.6	105.9	254.1
20N	1630N	607.1	108.6	251.4
20N	16N	618.9	111.2	248.8
20N	1530N	631.8	113.7	246.3
20N	15N	645.8	116.1	243.9
20N	1430N	660.9	118.4	241.6
20N	14N	677.0	120.6	239.4
20N	1330N	694.0	122.6	237.4
20N	13N	711.9	124.6	235.4
20N	1230N	730.5	126.5	233.5
20N	12N	749.9	128.3	231.7
20N	1130N	769.9	130.0	230.0
20N	11N	790.6	131.6	228.4
20N	1030N	811.8	133.1	226.9
20N	10N	833.5	134.6	225.4
2030N	30N	786.2	41.5	318.5
2030N	2930N	765.6	43.2	316.8
2030N	29N	745.6	44.9	315.1
2030N	2830N	726.3	46.7	313.3
2030N	28N	707.8	48.6	311.4
2030N	2730N	690.0	50.6	309.4
2030N	27N	673.1	52.7	307.3

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
2030N	2630N	657.1	54.9	305.1
2030N	26N	642.1	57.2	302.8
2030N	2530N	628.2	59.6	300.4
2030N	25N	615.4	62.1	267.9
2030N	2430N	603.8	64.7	295.3
2030N	24N	593.5	67.4	292.6
2030N	2330N	584.5	70.2	289.8
2030N	23N	577.0	73.1	286.9
2030N	2230N	570.9	76.1	283.9
2030N	22N	566.3	79.1	280.9
2030N	2130N	563.3	82.1	277.9
2030N	21N	561.8	85.2	274.8
2030N	2030N	561.9	88.2	271.8
2030N	20N	563.6	91.3	268.7
2030N	1930N	566.9	94.3	265.7
2030N	19N	571.7	97.3	262.7
2030N	1830N	578.1	100.3	259.7
2030N	18N	585.8	103.1	256.9
2030N	1730N	595.0	105.9	254.1
2030N	17N	605.5	108.6	251.4
2030N	1630N	617.3	111.2	248.8
2030N	16N	630.3	113.7	246.3
2030N	1530N	644.4	116.1	243.9
2030N	15N	659.6	118.4	241.6
2030N	1430N	675.7	120.6	239.4
2030N	14N	692.8	122.7	237.3
2030N	1330N	710.7	124.6	235.4
2030N	13N	729.3	126.5	233.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
2030N	1230N	748.7	128.3	231.7
2030N	12N	768.8	130.0	230.0
2030N	1130N	789.5	131.6	228.4
2030N	11N	810.8	133.2	226.8
2030N	1030N	832.6	134.6	225.4
2030N	10N	854.9	136.0	224.0
21N	31N	805.9	39.8	320.2
21N	3030N	784.7	41.4	318.6
21N	30N	764.0	43.0	317.0
21N	2930N	744.0	44.7	315.3
21N	29N	724.7	46.5	313.5
21N	2830N	706.1	48.4	311.6
21N	28N	688.3	50.4	309.6
21N	2730N	671.4	52.5	307.5
21N	27N	655.4	54.7	305.3
21N	2630N	640.3	57.0	303.0
21N	26N	626.4	59.5	300.5
21N	2530N	613.6	62.0	298.0
21N	25N	601.9	64.6	295.4
21N	2430N	591.6	67.3	292.7
21N	24N	582.6	70.1	289.9
21N	2330N	575.1	73.0	287.0
21N	23N	569.0	76.0	284.0
21N	2230N	564.4	79.0	281.0
21N	22N	561.4	82.0	278.0
21N	2130N	559.9	85.1	274.9
21N	21N	560.1	88.2	271.8
21N	2030N	561.8	91.3	268.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
21N	20N	565.1	94.3	265.7
21N	1930N	570.0	97.3	262.7
21N	19N	576.3	100.3	259.7
21N	1830N	584.2	103.1	256.9
21N	18N	593.4	105.9	254.1
21N	1730N	603.9	108.6	251.4
21N	17N	615.8	111.2	248.8
21N	1630N	628.8	113.7	246.3
21N	16N	643.0	116.1	243.9
21N	1530N	658.2	118.4	241.6
21N	15N	674.4	120.6	239.4
21N	1430N	691.5	122.7	237.3
21N	14N	709.4	124.7	235.3
21N	1330N	728.1	126.6	233.4
21N	13N	747.6	128.3	231.7
21N	1230N	767.7	130.0	230.0
21N	12N	788.4	131.7	228.3
21N	1130N	809.8	133.2	226.8
21N	11N	831.6	134.6	225.4
2130N	31N	783.1	41.2	318.8
2130N	3030N	762.4	42.9	317.1
2130N	30N	742.4	44.6	315.4
2130N	2930N	723.0	46.4	313.6
2130N	29N	704.4	48.3	311.7
2130N	2830N	686.6	50.3	309.7
2130N	28N	669.6	52.4	307.6
2130N	2730N	653.5	54.6	305.4
2130N	27N	638.5	56.9	303.1

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
2130N	2630N	624.5	59.3	300.7
2130N	26N	611.7	61.9	298.1
2130N	2530N	600.0	64.5	295.5
2130N	25N	589.7	67.2	292.8
2130N	2430N	580.7	70.0	290.0
2130N	24N	573.1	72.9	287.1
2130N	2330N	567.0	75.9	284.1
2130N	23N	562.5	78.9	281.1
2130N	2230N	559.4	82.0	278.0
2130N	22N	558.0	85.1	274.9
2130N	2130N	558.2	88.2	271.8
2130N	21N	559.9	91.2	268.8
2130N	2030N	563.3	94.3	265.7
2130N	20N	568.1	97.3	262.7
2130N	1930N	574.6	100.3	259.7
2130N	19N	582.4	103.1	256.9
2130N	1830N	591.7	105.9	254.1
2130N	18N	602.3	108.6	251.4
2130N	1730N	614.2	111.3	248.7
2130N	17N	627.3	113.8	246.2
2130N	1630N	641.5	116.2	243.8
2130N	16N	656.7	118.5	241.5
2130N	1530N	673.0	120.6	239.4
2130N	15N	690.1	122.7	237.3
2130N	1430N	708.1	124.7	235.3
2130N	14N	726.9	126.6	233.4
2130N	1330N	746.4	128.4	231.6
2130N	13N	766.6	130.1	229.9

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
2130N	1230N	787.3	131.7	228.3
2130N	12N	808.7	133.2	226.8
2130N	1130N	830.6	134.7	225.3
2130N	11N	852.9	136.0	224.0
22N	32N	802.7	39.5	320.5
22N	3130N	781.5	41.1	318.9
22N	31N	760.8	42.7	317.3
22N	3030N	740.7	44.4	315.6
22N	30N	721.3	46.2	313.8
22N	2930N	702.6	48.1	311.9
22N	29N	684.8	50.1	309.9
22N	2830N	667.8	52.2	307.8
22N	28N	651.7	54.4	305.6
22N	2730N	636.6	56.8	303.2
22N	27N	622.6	59.2	300.8
22N	2630N	609.8	61.7	298.3
22N	26N	598.1	64.4	295.6
22N	2530N	587.7	67.1	292.9
22N	25N	578.7	69.9	290.1
22N	2430N	571.2	72.8	287.2
22N	24N	565.0	75.8	284.2
22N	2330N	560.5	78.8	281.2
22N	23N	557.5	81.9	278.1
22N	2230N	556.0	85.0	275.0
22N	22N	556.2	88.1	271.9
22N	2130N	558.0	91.2	268.8
22N	21N	561.4	94.3	265.7
22N	2030N	566.3	97.3	262.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
22N	20N	572.7	100.3	259.7
22N	1930N	580.6	103.1	256.9
22N	19N	590.0	106.0	254.0
22N	1830N	600.6	108.7	251.3
22N	18N	612.6	111.3	248.7
22N	1730N	625.7	113.8	246.2
22N	17N	639.9	116.2	243.8
22N	1630N	655.2	118.5	241.5
22N	16N	671.5	120.7	239.3
22N	1530N	688.7	122.8	237.2
22N	15N	706.8	124.7	235.3
22N	1430N	725.6	126.6	233.4
22N	14N	745.2	128.4	231.6
22N	1330N	765.4	130.1	229.9
22N	13N	786.2	131.7	228.3
22N	1230N	807.6	133.2	226.8
22N	12N	829.5	134.7	225.3
2230N	32N	779.8	40.9	319.1
2230N	3130N	759.1	42.5	317.5
2230N	31N	739.0	44.2	315.8
2230N	3030N	719.6	46.1	313.9
2230N	30N	700.9	48.0	312.0
2230N	2930N	683.0	50.0	310.0
2230N	29N	665.9	52.1	307.9
2230N	2830N	649.8	54.3	305.7
2230N	28N	634.7	56.6	303.4
2230N	2730N	620.7	59.1	300.9
2230N	27N	607.8	61.6	298.4

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
2230N	2630N	596.1	64.2	295.8
2230N	26N	585.7	67.0	293.0
2230N	2530N	576.7	69.8	290.2
2230N	25N	569.1	72.7	287.3
2230N	2430N	563.0	75.7	284.3
2230N	24N	558.4	78.8	281.2
2230N	2330N	555.4	81.9	278.1
2230N	23N	554.0	85.0	275.0
2230N	2230N	554.2	88.1	271.9
2230N	22N	556.0	91.2	268.8
2230N	2130N	559.4	94.3	265.7
2230N	21N	564.4	97.3	262.7
2230N	2030N	570.9	100.3	259.7
2230N	20N	578.8	103.2	256.8
2230N	1930N	588.2	106.0	254.0
2230N	19N	598.9	108.7	251.3
2230N	1830N	610.9	111.3	248.7
2230N	18N	624.1	113.8	246.2
2230N	1730N	638.4	116.2	243.8
2230N	17N	653.7	118.5	241.5
2230N	1630N	670.1	120.7	239.3
2230N	16N	687.3	122.8	237.2
2230N	1530N	705.4	124.8	235.2
2230N	15N	724.3	126.7	233.3
2230N	1430N	743.9	128.5	231.5
2230N	14N	764.2	130.2	229.8
2230N	1330N	785.0	131.8	228.2
2230N	13N	806.5	133.3	226.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
2230N	1230N	828.4	134.7	225.3
2230N	12N	850.9	136.1	223.9
23N	33N	799.5	39.2	320.8
23N	3230N	778.2	40.7	319.3
23N	32N	757.4	42.4	317.6
23N	3130N	737.3	44.1	315.9
23N	31N	717.8	45.9	314.1
23N	3030N	699.1	47.8	312.2
23N	30N	681.1	49.8	310.2
23N	2930N	664.1	51.9	308.1
23N	29N	647.9	54.1	305.9
23N	2830N	632.8	56.5	303.5
23N	28N	618.7	58.9	301.1
23N	2730N	605.8	61.5	298.5
23N	27N	594.1	64.1	295.9
23N	2630N	583.7	66.9	293.1
23N	26N	574.7	69.7	290.3
23N	2530N	567.1	72.6	287.4
23N	25N	561.0	75.6	284.4
23N	2430N	556.4	78.7	281.3
23N	24N	553.4	81.8	278.2
23N	2330N	552.0	84.9	275.1
23N	23N	552.2	88.0	272.0
23N	2230N	554.0	91.2	268.8
23N	22N	557.5	94.2	265.8
23N	2130N	562.5	97.3	262.7
23N	21N	569.0	100.3	259.7
23N	2030N	577.0	103.2	256.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
23N	20N	586.4	106.0	254.0
23N	1930N	597.1	108.7	251.3
23N	19N	609.2	111.3	248.7
23N	1830N	622.4	113.9	246.1
23N	18N	636.8	116.3	243.7
23N	1730N	652.2	118.6	241.4
23N	17N	668.6	120.8	239.2
23N	1630N	685.9	122.8	237.2
23N	16N	704.0	124.8	235.2
23N	1530N	723.0	126.7	233.3
23N	15N	742.6	128.5	231.5
23N	1430N	762.9	130.2	229.8
23N	14N	783.8	131.8	228.2
23N	1330N	805.3	133.3	226.7
23N	13N	827.3	134.8	225.2
2330N	33N	776.5	40.6	319.4
2330N	3230N	755.7	42.2	317.8
2330N	32N	735.5	43.9	316.1
2330N	3130N	716.0	45.7	314.3
2330N	31N	697.2	47.6	312.4
2330N	3030N	679.3	49.7	310.3
2330N	30N	662.2	51.8	308.2
2330N	2930N	646.0	54.0	306.0
2330N	29N	630.8	56.3	303.7
2330N	2830N	616.7	58.8	301.2
2330N	28N	603.8	61.3	298.7
2330N	2730N	592.1	64.0	296.0
2330N	27N	581.6	66.8	293.2

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
2330N	2630N	572.6	69.6	290.4
2330N	26N	565.0	72.5	287.5
2330N	2530N	558.9	75.6	284.4
2330N	25N	554.3	78.6	281.4
2330N	2430N	551.3	81.7	278.3
2330N	24N	549.9	84.9	275.1
2330N	2330N	550.1	88.0	272.0
2330N	23N	552.0	91.1	268.9
2330N	2230N	555.4	94.2	265.8
2330N	22N	560.5	97.3	262.7
2330N	2130N	567.0	100.3	259.7
2330N	21N	575.1	103.2	256.8
2330N	2030N	584.5	106.0	254.0
2330N	20N	595.3	108.7	251.3
2330N	1930N	607.4	111.4	248.6
2330N	19N	620.7	113.9	246.1
2330N	1830N	635.1	116.3	243.7
2330N	18N	650.6	118.6	241.4
2330N	1730N	667.0	120.8	239.2
2330N	17N	684.4	122.9	237.1
2330N	1630N	702.6	124.9	235.1
2330N	16N	721.6	126.8	233.2
2330N	1530N	741.3	128.5	231.5
2330N	15N	761.6	130.2	229.8
2330N	1430N	782.6	131.8	228.2
2330N	14N	804.1	133.4	226.6
2330N	1330N	826.2	134.8	225.2
2330N	13N	848.7	136.2	223.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
24N	34N	796.2	38.8	321.2
24N	3330N	774.8	40.4	319.6
24N	33N	753.9	42.0	318.0
24N	3230N	733.7	43.7	316.3
24N	32N	714.2	45.6	314.4
24N	3130N	695.4	47.5	312.5
24N	31N	677.4	49.5	310.5
24N	3030N	660.3	51.6	308.4
24N	30N	644.0	53.8	306.2
24N	2930N	628.8	56.2	303.8
24N	29N	614.7	58.6	301.4
24N	2830N	601.7	61.0	298.8
24N	28N	590.0	63.9	296.1
24N	2730N	579.5	66.6	293.4
24N	27N	570.5	69.5	290.5
24N	2630N	562.8	72.4	287.6
24N	26N	556.7	75.5	284.5
24N	2530N	552.1	78.5	281.5
24N	25N	549.1	81.7	278.3
24N	2430N	547.8	84.8	275.2
24N	24N	548.0	88.0	272.0
24N	2330N	549.9	91.1	268.9
24N	23N	553.4	94.2	265.8
24N	2230N	558.4	97.3	262.7
24N	22N	565.0	100.3	259.7
24N	2130N	573.1	103.2	256.8
24N	21N	582.6	106.0	254.0
24N	2030N	593.5	108.8	251.2

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
24N	20N	605.6	111.4	248.6
24N	1930N	619.0	113.9	246.1
24N	19N	633.4	116.3	243.7
24N	1830N	649.0	118.6	241.4
24N	18N	665.5	120.8	239.2
24N	1730N	682.9	122.9	237.1
24N	17N	701.1	124.9	235.1
24N	1630N	720.2	126.8	233.2
24N	16N	739.9	128.6	231.4
24N	1530N	760.3	130.3	229.7
24N	15N	781.3	131.9	228.1
24N	1430N	802.9	133.4	226.6
24N	14N	825.0	134.9	225.1
2430N	34N	773.0	40.2	319.8
2430N	3330N	752.2	41.8	318.2
2430N	33N	731.9	43.6	316.4
2430N	3230N	712.3	45.4	314.6
2430N	32N	693.5	47.3	312.7
2430N	3130N	675.5	49.3	310.7
2430N	31N	658.3	51.4	308.6
2430N	3030N	642.0	53.7	306.3
2430N	30N	626.8	56.0	304.0
2430N	2930N	612.6	58.5	301.5
2430N	29N	599.6	61.1	298.9
2430N	2830N	587.9	63.7	296.3
2430N	28N	577.4	66.5	293.5
2430N	2730N	568.3	69.4	290.6
2430N	27N	560.7	72.3	287.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
2430N	2630N	554.5	75.4	284.6
2430N	26N	549.9	78.5	281.5
2430N	2530N	547.0	81.6	278.4
2430N	25N	545.6	84.8	275.2
2430N	2430N	545.9	87.9	272.1
2430N	24N	547.8	91.1	268.9
2430N	2330N	551.3	94.2	265.8
2430N	23N	556.4	97.3	262.7
2430N	2230N	563.0	100.3	259.7
2430N	22N	571.2	103.2	256.8
2430N	2130N	580.7	106.0	254.0
2430N	21N	591.6	108.8	251.2
2430N	2030N	603.8	111.4	248.6
2430N	20N	617.2	114.0	246.0
2430N	1930N	631.7	116.4	243.6
2430N	19N	647.3	118.7	241.3
2430N	1830N	663.9	120.9	239.1
2430N	18N	681.3	123.0	237.0
2430N	1730N	699.6	125.0	235.0
2430N	17N	718.7	126.9	233.1
2430N	1630N	738.5	128.6	231.4
2430N	16N	759.0	130.3	229.7
2430N	1530N	780.1	131.9	228.1
2430N	15N	801.7	133.5	226.5
2430N	1430N	823.8	134.9	225.1
2430N	14N	846.4	136.3	223.7
25N	35N	792.8	38.5	321.5
25N	3430N	771.3	40.0	320.0

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
25N	34N	750.4	41.7	318.3
25N	3330N	730.1	43.4	316.6
25N	33N	710.5	45.2	314.8
25N	3230N	691.6	47.1	312.9
25N	32N	673.5	49.2	310.8
25N	3130N	656.3	51.3	308.7
25N	31N	640.0	53.5	306.5
25N	3030N	624.7	55.9	304.1
25N	30N	610.5	58.3	301.7
25N	2930N	597.5	60.9	299.1
25N	29N	585.7	63.6	296.4
25N	2830N	575.2	66.4	293.6
25N	28N	566.1	69.3	290.7
25N	2730N	558.4	72.2	287.8
25N	27N	552.3	75.3	284.7
25N	2630N	547.7	78.4	281.6
25N	26N	544.7	81.5	278.5
25N	2530N	543.4	84.7	275.3
25N	25N	543.7	87.9	272.1
25N	2430N	545.6	91.0	269.0
25N	24N	549.1	94.2	265.8
25N	2330N	554.3	97.3	262.7
25N	23N	561.0	100.3	259.7
25N	2230N	569.1	103.2	256.8
25N	22N	578.7	106.1	253.9
25N	2130N	589.7	108.8	251.2
25N	21N	601.9	111.5	248.5
25N	2030N	615.4	114.0	246.0

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
25N	20N	630.0	116.4	243.6
25N	1930N	645.6	118.7	241.3
25N	19N	662.2	120.9	239.1
25N	1830N	679.8	123.0	237.0
25N	18N	698.1	125.0	235.0
25N	1730N	717.3	126.9	233.1
25N	17N	737.1	128.7	231.3
25N	1630N	757.6	130.4	229.6
25N	16N	778.7	132.0	228.0
25N	1530N	800.4	133.5	226.5
25N	15N	822.6	134.9	225.1
2530N	35N	769.5	39.8	320.2
2530N	3430N	748.5	41.5	318.5
2530N	34N	728.2	43.2	316.8
2530N	3330N	708.6	45.0	315.0
2530N	33N	689.7	47.0	313.0
2530N	3230N	671.5	49.0	311.0
2530N	32N	654.3	51.1	308.9
2530N	3130N	638.0	53.4	306.6
2530N	31N	622.7	55.7	304.3
2530N	3030N	608.4	58.2	301.8
2530N	30N	595.3	60.8	299.2
2530N	2930N	583.5	63.5	296.5
2530N	29N	573.0	66.3	293.7
2530N	2830N	563.9	69.2	290.8
2530N	28N	556.2	72.1	287.9
2530N	2730N	550.0	75.2	284.8
2530N	27N	545.4	78.3	281.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
2530N	2630N	542.5	81.5	278.5
2530N	26N	541.1	84.6	275.4
2530N	2530N	541.4	87.8	272.2
2530N	25N	543.4	91.0	269.0
2530N	2430N	547.0	94.2	265.8
2530N	24N	552.1	97.3	262.7
2530N	2330N	558.9	100.3	259.7
2530N	23N	567.1	103.2	256.8
2530N	2230N	576.7	106.1	253.9
2530N	22N	587.7	108.9	251.1
2530N	2130N	600.0	111.5	248.5
2530N	21N	613.6	114.0	246.0
2530N	2030N	628.2	116.5	243.5
2530N	20N	643.9	118.8	241.2
2530N	1930N	660.6	121.0	239.0
2530N	19N	678.1	123.1	236.9
2530N	1830N	696.6	125.1	234.9
2530N	18N	715.8	127.0	233.0
2530N	1730N	735.7	128.7	231.3
2530N	17N	756.2	130.4	229.6
2530N	1630N	777.4	132.0	228.0
2530N	16N	799.1	133.6	226.4
2530N	1530N	821.4	135.0	225.0
2530N	15N	844.1	136.4	223.6
26N	36N	789.3	38.1	321.9
26N	3530N	767.7	39.7	320.3
26N	35N	746.7	41.3	318.7
26N	3430N	726.3	43.0	317.0

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
26N	34N	706.7	44.8	315.2
26N	3330N	687.7	46.8	313.2
26N	33N	669.5	48.8	311.2
26N	3230N	652.2	50.9	309.1
26N	32N	635.9	53.2	306.8
26N	3130N	620.5	55.6	304.4
26N	31N	606.3	58.0	302.0
26N	3030N	593.2	60.6	299.4
26N	30N	581.3	63.3	296.7
26N	2930N	570.7	66.1	293.9
26N	29N	561.6	69.0	291.0
26N	2830N	553.9	72.0	288.0
26N	28N	547.7	75.1	284.9
26N	2730N	543.1	78.2	281.8
26N	27N	540.2	81.4	278.6
26N	2630N	538.8	84.6	275.4
26N	26N	539.1	87.8	272.2
26N	2530N	541.1	91.0	269.0
26N	25N	544.7	94.1	265.9
26N	2430N	549.9	97.3	262.7
26N	24N	556.7	100.3	259.7
26N	2330N	565.0	103.2	256.8
26N	23N	574.7	106.1	253.9
26N	2230N	585.7	108.9	251.1
26N	22N	598.1	111.5	248.5
26N	2130N	611.7	114.1	245.9
26N	21N	626.4	116.5	243.5
26N	2030N	642.1	118.8	241.2

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
26N	20N	658.9	121.1	238.9
26N	1930N	676.5	123.1	236.9
26N	19N	695.0	125.1	234.9
26N	1830N	714.2	127.0	233.0
26N	18N	734.2	128.8	231.2
26N	1730N	754.8	130.5	229.5
26N	17N	776.0	132.1	227.9
26N	1630N	797.8	133.6	226.4
26N	16N	820.1	135.1	224.9
2630N	36N	765.9	39.5	320.5
2630N	3530N	744.8	41.1	318.9
2630N	35N	724.4	42.8	317.2
2630N	3430N	704.7	44.7	315.3
2630N	34N	685.7	46.6	313.4
2630N	3330N	667.5	48.6	311.4
2630N	33N	650.2	50.8	309.2
2630N	3230N	633.8	53.0	307.0
2630N	32N	618.4	55.4	304.6
2630N	3130N	604.1	57.9	302.1
2630N	31N	590.9	60.5	299.5
2630N	3030N	579.0	63.2	296.8
2630N	30N	568.4	66.0	294.0
2630N	2930N	559.3	68.9	291.1
2630N	29N	551.6	71.9	288.1
2630N	2830N	545.4	75.0	285.0
2630N	28N	540.8	78.1	281.9
2630N	2730N	537.8	81.3	278.7
2630N	27N	536.5	84.5	275.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
2630N	2630N	536.8	87.8	272.2
2630N	26N	538.8	91.0	269.0
2630N	2530N	542.5	94.1	265.9
2630N	25N	547.7	97.2	262.8
2630N	2430N	554.5	100.3	259.7
2630N	24N	562.8	103.3	256.7
2630N	2330N	572.6	106.1	253.9
2630N	23N	583.7	108.9	251.1
2630N	2230N	596.1	111.6	248.4
2630N	22N	609.8	114.1	245.9
2630N	2130N	624.5	116.6	243.4
2630N	21N	640.3	118.9	241.1
2630N	2030N	657.1	121.1	238.9
2630N	20N	674.8	123.2	236.8
2630N	1930N	693.4	125.2	234.8
2630N	19N	712.7	127.1	232.9
2630N	1830N	732.7	128.9	231.1
2630N	18N	753.3	130.6	229.4
2630N	1730N	774.6	132.2	227.8
2630N	17N	796.4	133.7	226.3
2630N	1630N	818.8	135.1	224.9
2630N	16N	841.6	136.5	223.5
27N	37N	785.7	37.7	322.3
27N	3630N	764.0	39.3	320.7
27N	36N	743.0	40.9	319.1
27N	3530N	722.5	42.7	317.3
27N	35N	702.7	44.5	315.5
27N	3430N	683.7	46.4	313.6

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
27N	34N	665.4	48.4	311.6
27N	3330N	648.1	50.6	309.4
27N	33N	631.6	52.9	307.1
27N	3230N	616.2	55.2	304.8
27N	32N	601.8	57.7	302.3
27N	3130N	588.7	60.3	299.7
27N	31N	576.7	63.0	297.0
27N	3030N	566.1	65.9	294.1
27N	30N	556.9	68.8	291.2
27N	2930N	549.2	71.8	288.2
27N	29N	543.0	74.9	285.1
27N	2830N	538.4	78.1	281.9
27N	28N	535.4	81.3	278.7
27N	2730N	534.1	84.5	275.5
27N	27N	534.5	87.7	272.3
27N	2630N	536.5	90.9	269.1
27N	26N	540.2	94.1	265.9
27N	2530N	545.4	97.2	262.8
27N	25N	552.3	100.3	259.7
27N	2430N	560.7	103.3	256.7
27N	24N	570.5	106.2	253.8
27N	2330N	581.6	109.0	251.0
27N	23N	594.1	111.6	248.4
27N	2230N	607.8	114.2	245.8
27N	22N	622.6	116.6	243.4
27N	2130N	636.5	119.0	241.0
27N	21N	655.4	121.2	238.8
27N	2030N	673.1	123.3	236.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
27N	20N	691.7	125.3	234.7
27N	1930N	711.1	127.1	232.9
27N	19N	731.1	128.9	231.1
27N	1830N	751.9	130.6	229.4
27N	18N	773.2	132.2	227.8
27N	1730N	795.1	133.7	226.3
27N	17N	817.4	135.2	224.8
2730N	37N	762.2	39.1	320.9
2730N	3630N	741.1	40.7	319.3
2730N	36N	720.6	42.5	317.5
2730N	3530N	700.7	44.3	315.7
2730N	35N	681.7	46.2	313.8
2730N	3430N	663.4	48.3	311.7
2730N	34N	645.9	50.4	309.6
2730N	3330N	629.4	52.7	307.3
2730N	33N	614.0	55.1	304.9
2730N	3230N	599.6	57.6	302.4
2730N	32N	586.4	60.2	299.8
2730N	3130N	574.4	62.9	297.1
2730N	31N	563.8	65.7	294.3
2730N	3030N	554.5	68.7	291.3
2730N	30N	546.8	71.7	288.3
2730N	2930N	540.6	74.8	285.2
2730N	29N	536.0	78.0	282.0
2730N	2830N	533.0	81.2	278.8
2730N	28N	531.7	84.4	275.6
2730N	2730N	532.1	87.7	272.3
2730N	27N	534.1	90.9	269.1

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
2730N	2630N	537.8	94.1	265.9
2730N	26N	543.1	97.3	262.7
2730N	2530N	550.0	100.3	259.7
2730N	25N	558.4	103.3	256.7
2730N	2430N	568.3	106.2	253.8
2730N	24N	579.5	109.0	251.0
2730N	2330N	592.1	111.7	248.3
2730N	23N	605.8	114.2	245.8
2730N	2230N	620.7	116.7	243.3
2730N	22N	636.6	119.0	241.0
2730N	2130N	653.5	121.2	238.8
2730N	21N	671.4	123.3	236.7
2730N	2030N	690.0	125.3	234.7
2730N	20N	709.4	127.2	232.8
2730N	1930N	729.6	129.0	231.0
2730N	19N	750.3	130.7	229.3
2730N	1830N	771.7	132.3	227.7
2730N	18N	793.7	133.8	226.2
2730N	1730N	816.1	135.2	224.8
2730N	17N	839.0	136.6	223.4
28N	38N	782.0	37.3	322.7
28N	3730N	760.3	38.9	321.1
28N	37N	739.1	40.5	319.5
28N	3630N	718.6	42.3	317.7
28N	36N	698.7	44.1	315.9
28N	3530N	679.6	46.0	314.0
28N	35N	661.2	48.1	311.9
28N	3430N	643.8	50.2	309.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
28N	34N	627.2	52.5	307.5
28N	3330N	611.7	54.9	305.1
28N	33N	597.3	57.4	302.6
28N	3230N	584.0	60.0	300.0
28N	32N	572.0	62.8	297.2
28N	3130N	561.4	65.6	294.4
28N	31N	552.1	68.6	291.4
28N	3030N	544.3	71.6	288.4
28N	30N	538.1	74.7	285.3
28N	2930N	533.5	77.9	282.1
28N	29N	530.5	81.1	278.9
28N	2830N	529.2	84.4	275.6
28N	28N	529.6	87.6	272.4
28N	2730N	531.7	90.9	269.1
28N	27N	535.4	94.1	265.9
28N	2630N	540.8	97.3	262.7
28N	26N	547.7	100.3	259.7
28N	2530N	556.2	103.3	256.7
28N	25N	566.1	106.2	253.8
28N	2430N	577.4	109.0	251.0
28N	24N	590.0	111.7	248.3
28N	2330N	603.8	114.3	245.7
28N	23N	618.7	116.8	243.2
28N	2230N	634.7	119.1	240.9
28N	22N	651.7	121.3	238.7
28N	2130N	669.6	123.4	236.6
28N	21N	688.3	125.4	234.6
28N	2030N	707.8	127.3	232.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
28N	20N	728.0	129.1	230.9
28N	1930N	748.8	130.8	229.2
28N	19N	770.2	132.4	227.6
28N	1830N	792.2	133.9	226.1
28N	18N	814.7	135.3	224.7
2830N	38N	758.4	38.7	321.3
2830N	3730N	737.2	40.3	319.7
2830N	37N	716.6	42.1	317.9
2830N	3630N	696.7	43.9	316.1
2830N	36N	677.5	45.8	314.2
2830N	3530N	659.1	47.9	312.1
2830N	35N	641.6	50.0	310.0
2830N	3430N	625.0	52.3	307.7
2830N	34N	609.4	54.7	305.3
2830N	3330N	595.0	57.2	302.8
2830N	33N	581.7	59.9	300.1
2830N	3230N	569.6	62.6	297.4
2830N	32N	558.9	65.5	294.5
2830N	3130N	549.6	68.4	291.6
2830N	31N	541.9	71.5	288.5
2830N	3030N	535.6	74.6	285.4
2830N	30N	531.0	77.8	282.2
2830N	2930N	528.0	81.1	278.9
2830N	29N	526.7	84.3	275.7
2830N	2830N	527.1	87.6	272.4
2830N	28N	529.2	90.9	269.1
2830N	2730N	533.0	94.1	265.9
2830N	27N	538.4	97.3	262.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
2830N	2630N	545.4	100.4	259.6
2830N	26N	553.9	103.4	256.6
2830N	2530N	563.9	106.3	253.7
2830N	25N	575.2	109.1	250.9
2830N	2430N	587.9	111.8	248.2
2830N	24N	601.7	114.4	245.6
2830N	2330N	616.7	116.8	243.2
2830N	23N	632.8	119.2	240.8
2830N	2230N	649.8	121.4	238.6
2830N	22N	667.8	123.5	236.5
2830N	2130N	686.6	125.5	234.5
2830N	21N	706.1	127.4	232.6
2830N	2030N	726.3	129.1	230.9
2830N	20N	747.2	130.8	229.2
2830N	1930N	768.7	132.4	227.6
2830N	19N	790.8	133.9	226.1
2830N	1830N	813.3	135.4	224.6
2830N	18N	836.3	136.7	223.3
29N	39N	778.3	37.0	323.0
29N	3830N	756.5	38.5	321.5
29N	38N	735.2	40.1	319.9
29N	3730N	714.6	41.9	318.1
29N	37N	694.6	43.7	316.3
29N	3630N	675.4	45.6	314.4
29N	36N	656.9	47.7	312.3
29N	3530N	639.4	49.9	310.1
29N	35N	622.7	52.1	307.9
29N	3430N	607.1	54.5	305.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
29N	34N	592.6	57.1	302.9
29N	3330N	579.3	59.7	300.3
29N	33N	567.2	62.5	297.5
29N	3230N	556.5	65.3	294.7
29N	32N	547.1	68.3	291.7
29N	3130N	539.3	71.4	288.6
29N	31N	533.1	74.5	285.5
29N	3030N	528.5	77.7	282.3
29N	30N	525.5	81.0	279.0
29N	2930N	524.2	84.3	275.7
29N	29N	524.6	87.6	270.4
29N	2830N	526.7	90.8	269.2
29N	28N	530.5	94.1	265.9
29N	2730N	536.0	97.3	262.7
29N	27N	543.0	100.4	259.6
29N	2630N	551.6	103.4	256.6
29N	26N	561.6	106.3	253.7
29N	2530N	573.0	109.1	250.9
29N	25N	585.7	111.8	248.2
29N	2430N	599.6	114.4	245.6
29N	24N	614.7	116.9	243.1
29N	2330N	630.8	119.2	240.8
29N	23N	647.9	121.4	238.6
29N	2230N	665.9	123.5	236.5
29N	22N	684.8	125.5	234.5
29N	2130N	704.4	127.4	232.6
29N	21N	724.7	129.2	230.8
29N	2030N	745.6	130.9	229.1

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
29N	20N	767.2	132.5	227.5
29N	1930N	789.3	134.0	226.0
29N	19N	811.9	135.4	224.6
2930N	39N	754.5	38.3	321.7
2930N	3830N	733.2	39.9	320.1
2930N	38N	712.5	41.7	318.3
2930N	3730N	692.5	43.5	316.5
2930N	37N	673.2	45.4	314.6
2930N	3630N	654.8	47.5	312.5
2930N	36N	637.1	49.7	310.3
2930N	3530N	620.5	52.0	308.0
2930N	35N	604.8	54.4	305.6
2930N	3430N	590.2	56.9	303.1
2930N	34N	576.8	59.5	300.5
2930N	3330N	564.7	62.3	297.7
2930N	33N	554.0	65.2	294.8
2930N	3230N	544.6	68.2	291.8
2930N	32N	536.8	71.3	288.7
2930N	3130N	530.5	74.4	285.6
2930N	31N	525.9	77.6	282.4
2930N	3030N	522.9	80.9	279.1
2930N	30N	521.6	84.2	275.8
2930N	2930N	522.1	87.5	272.5
2930N	29N	524.2	90.8	269.2
2930N	2830N	528.0	94.1	265.9
2930N	28N	533.5	97.3	262.7
2930N	2730N	540.6	100.4	259.6
2930N	27N	549.2	103.4	256.6

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
2930N	2630N	559.3	106.4	253.6
2930N	26N	570.7	109.2	250.8
2930N	2530N	583.5	111.9	248.1
2930N	25N	597.5	114.5	245.5
2930N	2430N	612.6	116.9	243.1
2930N	24N	628.8	119.3	240.7
2930N	2330N	646.0	121.5	238.5
2930N	23N	664.1	123.6	236.4
2930N	2230N	683.0	125.6	234.4
2930N	22N	702.6	127.5	232.5
2930N	2130N	723.0	129.3	230.7
2930N	21N	744.0	131.0	229.0
2930N	2030N	765.6	132.6	227.4
2930N	20N	787.8	134.1	225.9
2930N	1930N	810.4	135.5	224.5
2930N	19N	833.5	136.8	223.2
30N	40N	774.5	36.5	323.5
30N	3930N	752.6	38.1	321.9
30N	39N	731.2	39.7	320.3
30N	3830N	710.5	41.5	318.5
30N	38N	690.4	43.3	316.7
30N	3730N	671.1	45.2	314.8
30N	37N	652.6	47.3	312.7
30N	3630N	634.9	49.5	310.5
30N	36N	618.1	51.8	308.2
30N	3530N	602.4	54.2	305.8
30N	35N	587.8	56.7	303.3
30N	3430N	574.4	59.4	300.6

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
30N	34N	562.2	62.1	297.9
30N	3330N	551.4	65.0	295.0
30N	33N	542.0	68.0	292.0
30N	3230N	534.2	71.1	288.9
30N	32N	527.9	74.3	285.7
30N	3130N	523.2	77.6	282.4
30N	31N	520.3	80.9	279.1
30N	3030N	519.0	84.2	275.8
30N	30N	519.5	87.5	272.5
30N	2930N	521.6	90.8	269.2
30N	29N	525.5	94.1	265.9
30N	2830N	531.0	97.3	262.7
30N	28N	538.1	100.4	259.6
30N	2730N	546.8	103.5	256.5
30N	27N	556.9	106.4	253.6
30N	2630N	568.4	109.2	250.8
30N	26N	581.3	112.0	248.0
30N	2530N	595.3	114.5	245.5
30N	25N	610.5	117.0	243.0
30N	2430N	626.8	119.4	240.6
30N	24N	644.0	121.6	238.4
30N	2330N	662.2	123.7	236.3
30N	23N	681.1	125.7	234.3
30N	2230N	700.9	127.6	232.4
30N	22N	721.3	129.3	230.7
30N	2130N	742.4	131.1	228.9
30N	21N	764.0	132.6	227.4
30N	2030N	786.2	134.2	225.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
30N	20N	808.9	135.6	224.4
3030N	40N	750.6	37.9	322.1
3030N	3930N	729.2	39.5	320.5
3030N	39N	708.4	41.3	318.7
3030N	3830N	688.3	43.1	316.9
3030N	38N	668.9	45.0	315.0
3030N	3730N	650.3	47.1	312.9
3030N	37N	632.6	49.3	310.7
3030N	3630N	615.8	51.6	308.4
3030N	36N	600.0	54.0	306.0
3030N	3530N	585.4	56.5	303.5
3030N	35N	571.9	59.2	300.8
3030N	3430N	559.7	62.0	298.0
3030N	34N	548.8	64.9	295.1
3030N	3330N	539.4	67.9	292.1
3030N	33N	531.6	71.0	289.0
3030N	3230N	525.2	74.2	285.8
3030N	32N	520.6	77.5	282.5
3030N	3130N	517.6	80.8	279.2
3030N	31N	516.3	84.1	275.9
3030N	3030N	516.8	87.5	272.5
3030N	30N	519.0	90.8	269.2
3030N	2930N	522.9	94.1	265.9
3030N	29N	528.5	97.3	262.7
3030N	2830N	535.6	100.4	259.6
3030N	28N	544.3	103.5	256.5
3030N	2730N	554.5	106.5	253.5
3030N	27N	566.1	109.3	250.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
3030N	2630N	579.0	112.0	248.0
3030N	26N	593.2	114.6	245.4
3030N	2530N	608.4	117.1	242.9
3030N	25N	624.7	119.4	240.6
3030N	2430N	642.0	121.7	238.3
3030N	24N	660.3	123.8	236.2
3030N	2330N	679.3	125.8	234.2
3030N	23N	699.1	127.7	232.3
3030N	2230N	719.6	129.5	230.5
3030N	22N	740.7	131.1	228.9
3030N	2130N	762.4	132.7	227.3
3030N	21N	784.7	134.2	225.8
3030N	2030N	807.4	135.7	224.3
3030N	20N	830.6	137.0	223.0
31N	41N	770.6	36.1	323.9
31N	4030N	748.6	37.7	322.3
31N	40N	727.2	39.3	320.7
31N	3930N	706.3	41.0	319.0
31N	39N	686.1	42.9	317.1
31N	3830N	666.7	44.8	315.2
31N	38N	648.1	46.9	313.1
31N	3730N	630.3	49.1	310.9
31N	37N	613.4	51.4	308.6
31N	3630N	597.6	53.8	306.2
31N	36N	582.9	56.4	303.6
31N	3530N	569.4	59.0	301.0
31N	35N	557.1	61.8	298.2
31N	3430N	546.2	64.7	295.3

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
31N	34N	536.8	67.8	292.2
31N	3330N	528.9	70.9	289.1
31N	33N	522.6	74.1	285.9
31N	3230N	517.9	77.4	282.6
31N	32N	514.9	80.7	279.3
31N	3130N	513.6	84.1	275.9
31N	31N	514.1	87.4	272.6
31N	3030N	516.3	90.8	269.2
31N	30N	520.3	94.1	265.9
31N	2930N	525.9	97.3	262.7
31N	29N	533.1	100.5	259.5
31N	2830N	541.9	103.5	256.5
31N	28N	552.1	106.5	253.5
31N	2730N	563.8	109.4	250.6
31N	27N	576.7	112.1	247.9
31N	2630N	590.9	114.7	245.3
31N	26N	606.3	117.2	242.8
31N	2530N	622.7	119.5	240.5
31N	25N	640.0	121.8	238.2
31N	2430N	658.3	123.9	236.1
31N	24N	677.4	125.9	234.1
31N	2330N	697.2	127.8	232.2
31N	23N	717.8	129.5	230.5
31N	2230N	739.0	131.2	228.8
31N	22N	760.8	132.8	227.2
31N	2130N	783.1	134.3	225.7
31N	21N	805.9	135.7	224.3
3130N	41N	746.6	37.5	322.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
3130N	4030N	725.1	39.1	320.9
3130N	40N	704.2	40.8	319.2
3130N	3930N	684.0	42.7	317.3
3130N	39N	664.5	44.6	315.4
3130N	3830N	645.8	46.7	313.3
3130N	38N	627.9	48.9	311.1
3130N	3730N	611.0	51.2	308.8
3130N	37N	595.2	53.6	306.4
3130N	3630N	580.4	56.2	303.8
3130N	36N	566.8	58.9	301.1
3130N	3530N	554.5	61.7	298.3
3130N	35N	543.6	64.6	295.4
3130N	3430N	534.1	67.6	292.4
3130N	34N	526.2	70.8	289.2
3130N	3330N	519.8	74.0	286.0
3130N	33N	515.1	77.3	282.7
3130N	3230N	512.2	80.6	279.4
3130N	32N	510.9	84.0	276.0
3130N	3130N	511.4	87.4	272.6
3130N	31N	513.6	90.7	269.3
3130N	3030N	517.6	94.1	265.9
3130N	30N	523.2	97.3	262.7
3130N	2930N	530.5	100.5	259.5
3130N	29N	539.3	103.6	256.4
3130N	2830N	549.6	106.5	253.5
3130N	28N	561.4	109.4	250.6
3130N	2730N	574.4	112.1	247.9
3130N	27N	588.6	114.8	245.2

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
3130N	2630N	604.1	117.2	242.8
3130N	26N	620.5	119.6	240.4
3130N	2530N	638.0	121.8	238.2
3130N	25N	656.3	124.0	236.0
3130N	2430N	675.5	126.0	234.0
3130N	24N	695.4	127.8	232.2
3130N	2330N	716.0	129.6	230.4
3130N	23N	737.3	131.3	228.7
3130N	2230N	759.1	132.9	227.1
3130N	22N	781.5	134.4	225.6
3130N	2130N	804.3	135.8	224.2
3130N	21N	827.6	137.2	222.8
32N	42N	766.7	35.7	324.3
32N	4130N	744.6	37.2	322.8
32N	41N	723.0	38.9	321.1
32N	4030N	702.1	40.6	319.4
32N	40N	681.8	42.5	317.5
32N	3930N	662.2	44.4	315.6
32N	39N	643.5	46.5	313.5
32N	3830N	625.6	48.7	311.3
32N	38N	608.6	51.0	309.0
32N	3730N	592.7	53.4	306.6
32N	37N	577.9	56.0	304.0
32N	3630N	564.2	58.7	301.3
32N	36N	551.9	61.5	298.5
32N	3530N	540.9	64.4	295.6
32N	35N	531.4	67.5	292.5
32N	3430N	523.4	70.6	289.4

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
32N	34N	517.1	73.9	286.1
32N	3330N	512.4	77.2	282.8
32N	33N	509.4	80.6	279.4
32N	3230N	508.1	83.9	276.1
32N	32N	508.7	87.3	272.7
32N	3130N	510.9	90.7	269.3
32N	31N	514.9	94.0	266.0
32N	3030N	520.6	97.3	262.7
32N	30N	527.9	100.5	259.5
32N	2930N	536.8	103.6	256.4
32N	29N	547.1	106.6	253.4
32N	2830N	558.9	109.5	250.5
32N	28N	572.0	112.2	247.8
32N	2730N	586.4	114.8	245.2
32N	27N	601.8	117.3	242.7
32N	2630N	618.4	119.7	240.3
32N	26N	635.9	121.9	238.1
32N	2530N	654.3	124.1	235.9
32N	25N	673.5	126.0	234.0
32N	2430N	693.5	127.9	232.1
32N	24N	714.2	129.7	230.3
32N	2330N	735.5	131.4	228.6
32N	23N	757.4	133.0	227.0
32N	2230N	779.8	134.5	225.5
32N	22N	802.7	135.9	224.1
3230N	42N	742.5	37.0	323.0
3230N	4130N	720.9	38.7	321.3
3230N	41N	699.9	40.4	319.6

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
3230N	4030N	679.6	42.2	317.8
3230N	40N	660.0	44.2	315.8
3230N	3930N	614.1	46.3	313.7
3230N	39N	623.2	48.5	311.5
3230N	3830N	606.2	50.8	309.2
3230N	38N	590.2	53.2	306.8
3230N	3730N	575.3	55.8	304.2
3230N	37N	561.6	58.5	301.5
3230N	3630N	549.2	61.3	298.7
3230N	36N	538.2	64.3	295.7
3230N	3530N	528.7	67.3	292.7
3230N	35N	520.7	70.5	289.5
3230N	3430N	514.3	73.8	286.2
3230N	34N	509.6	77.1	282.9
3230N	3330N	506.6	80.5	279.5
3230N	33N	505.3	83.9	276.1
3230N	3230N	505.9	87.3	272.7
3230N	32N	508.1	90.7	269.3
3230N	3130N	512.2	94.0	266.0
3230N	31N	517.9	97.3	262.7
3230N	3030N	525.2	100.5	259.5
3230N	30N	534.2	103.7	256.3
3230N	2930N	544.6	106.7	253.3
3230N	29N	556.5	109.5	250.5
3230N	2830N	569.6	112.3	247.7
3230N	28N	584.0	114.9	245.1
3230N	2730N	599.6	117.4	242.6
3230N	27N	616.2	119.8	240.2

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
3230N	2630N	633.8	122.0	238.0
3230N	26N	652.2	124.1	235.9
3230N	2530N	671.5	126.1	233.9
3230N	25N	691.6	128.0	232.0
3230N	2430N	712.3	129.8	230.2
3230N	24N	733.7	131.5	228.5
3230N	2330N	755.7	133.1	226.9
3230N	23N	778.2	134.6	225.4
3230N	2230N	801.1	136.0	224.0
3230N	22N	824.5	137.3	222.7
33N	43N	762.7	35.2	324.8
33N	4230N	740.5	36.8	323.2
33N	42N	718.8	38.4	321.6
33N	4130N	697.7	40.2	319.8
33N	41N	677.3	42.0	318.0
33N	4030N	657.7	44.0	316.0
33N	40N	638.8	46.1	313.9
33N	3930N	620.8	48.2	311.8
33N	39N	603.7	50.6	309.4
33N	3830N	587.7	53.0	307.0
33N	38N	572.7	55.6	304.4
33N	3730N	559.0	58.3	301.7
33N	37N	546.6	61.2	298.8
33N	3630N	535.5	64.1	295.9
33N	36N	525.9	67.2	292.8
33N	3530N	517.9	70.4	289.6
33N	35N	511.4	73.7	286.3
33N	3430N	506.7	77.0	283.0

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
33N	34N	503.7	80.4	279.6
33N	3330N	502.5	83.8	276.2
33N	33N	503.0	87.3	272.7
33N	3230N	505.3	90.7	269.3
33N	32N	509.4	94.0	266.0
33N	3130N	515.1	97.4	262.6
33N	31N	522.6	100.6	259.4
33N	3030N	531.6	103.7	256.3
33N	30N	542.0	106.7	253.3
33N	2930N	554.0	109.6	250.4
33N	29N	567.2	112.4	247.6
33N	2830N	581.7	115.0	245.0
33N	28N	597.3	117.5	242.5
33N	2730N	614.0	119.9	240.1
33N	27N	631.6	122.1	237.9
33N	2630N	650.2	124.2	235.8
33N	26N	669.5	126.2	233.8
33N	2530N	689.7	128.1	231.9
33N	25N	710.5	129.9	230.1
33N	2430N	731.9	131.6	228.4
33N	24N	753.9	133.2	226.8
33N	2330N	776.5	134.7	225.3
33N	23N	799.5	136.1	223.9
3330N	43N	738.4	36.6	323.4
3330N	4230N	716.7	38.2	321.8
3330N	42N	695.6	39.9	320.1
3330N	4130N	675.1	41.8	318.2
3330N	41N	655.4	43.8	316.2

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
3330N	4030N	636.4	45.8	314.2
3330N	40N	618.3	48.0	312.0
3330N	3930N	601.2	50.4	309.6
3330N	39N	585.1	52.8	307.2
3330N	3830N	570.1	55.4	304.6
3330N	38N	556.3	58.1	301.9
3330N	3730N	543.8	61.0	299.0
3330N	37N	532.7	64.0	296.0
3330N	3630N	523.1	67.1	292.9
3330N	36N	515.0	70.3	289.7
3330N	3530N	508.6	73.6	286.4
3330N	35N	503.8	76.9	283.1
3330N	3430N	500.8	80.3	279.7
3330N	34N	499.6	83.8	276.2
3330N	3330N	500.1	87.2	272.8
3330N	33N	502.5	90.7	269.3
3330N	3230N	506.6	94.0	266.0
3330N	32N	512.4	97.4	262.6
3330N	3130N	519.8	100.6	259.4
3330N	31N	528.9	103.7	256.3
3330N	3030N	539.4	106.8	253.2
3330N	30N	551.4	109.7	250.3
3330N	2930N	564.7	112.4	247.6
3330N	29N	579.3	115.1	244.9
3330N	2830N	595.0	117.6	242.4
3330N	28N	611.7	120.0	240.0
3330N	2730N	629.4	122.2	237.8
3330N	27N	648.1	124.3	235.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
3330N	2630N	667.5	126.3	233.7
3330N	26N	687.7	128.2	231.8
3330N	2530N	708.6	130.0	230.0
3330N	25N	730.1	131.7	228.3
3330N	2430N	752.2	133.3	226.7
3330N	24N	774.8	134.8	225.2
3330N	2330N	797.8	136.2	223.8
3330N	23N	821.4	137.5	222.5
34N	44N	758.7	34.8	325.2
34N	4330N	736.3	36.3	323.7
34N	43N	714.5	38.0	322.0
34N	4230N	693.4	39.7	320.3
34N	42N	672.8	41.6	318.4
34N	4130N	653.0	43.5	316.5
34N	41N	634.0	45.6	314.4
34N	4030N	615.9	47.8	312.2
34N	40N	598.7	50.1	309.9
34N	3930N	582.5	52.6	307.4
34N	39N	567.5	55.2	304.8
34N	3830N	553.6	57.9	302.1
34N	38N	541.1	60.8	299.2
34N	3730N	529.9	63.8	296.2
34N	37N	520.3	66.9	293.1
34N	3630N	512.1	70.1	289.9
34N	36N	505.7	73.4	286.6
34N	3530N	500.9	76.8	283.2
34N	35N	499.3	80.3	279.7
34N	3430N	498.1	83.7	276.3

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
34N	34N	498.6	87.2	272.8
34N	3330N	499.6	90.6	269.4
34N	33N	503.7	94.1	265.9
34N	3230N	509.6	97.4	262.6
34N	32N	517.1	100.6	259.4
34N	3130N	526.2	103.8	256.2
34N	31N	536.8	106.8	253.2
34N	3030N	548.8	109.7	250.3
34N	30N	562.2	112.5	247.5
34N	2930N	576.8	115.2	244.8
34N	29N	592.6	117.7	242.3
34N	2830N	609.4	120.1	239.9
34N	28N	627.2	122.3	237.7
34N	2730N	645.9	124.4	235.6
34N	27N	665.4	126.4	233.6
34N	2630N	685.7	128.3	231.7
34N	26N	706.7	130.1	229.9
34N	2530N	728.2	131.8	228.2
34N	25N	750.4	133.4	226.6
34N	2430N	773.0	134.9	225.1
34N	24N	796.2	136.3	223.7
3430N	44N	734.2	36.1	323.9
3430N	4330N	712.4	37.7	322.3
3430N	43N	691.1	39.5	320.5
3430N	4230N	670.6	41.3	318.7
3430N	42N	650.7	43.3	316.7
3430N	4130N	631.6	45.4	314.6
3430N	41N	613.4	47.6	312.4

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
3430N	4030N	596.2	49.9	310.1
3430N	40N	579.9	52.4	307.6
3430N	3930N	564.8	55.0	305.0
3430N	39N	550.9	57.7	302.3
3430N	3830N	538.3	60.6	299.4
3430N	38N	527.1	63.6	296.4
3430N	3730N	517.4	66.8	293.2
3430N	37N	509.2	70.0	290.0
3430N	3630N	502.7	73.3	286.7
3430N	36N	499.3	76.8	283.2
3430N	3530N	496.3	80.2	279.8
3430N	35N	495.1	83.7	276.3
3430N	3430N	495.7	87.2	272.8
3430N	34N	498.1	90.6	269.4
3430N	3330N	500.8	94.1	265.9
3430N	33N	506.7	97.4	262.6
3430N	3230N	514.3	100.7	259.3
3430N	32N	523.4	103.9	256.1
3430N	3130N	534.1	106.9	253.1
3430N	31N	546.2	109.8	250.2
3430N	3030N	559.7	112.6	247.4
3430N	30N	574.4	115.3	244.7
3430N	2930N	590.2	117.8	242.2
3430N	29N	607.1	120.2	239.8
3430N	2830N	625.0	122.4	237.6
3430N	28N	643.8	124.6	235.4
3430N	2730N	663.4	126.6	233.4
3430N	27N	683.7	128.4	231.6

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
3430N	2630N	704.7	130.2	229.8
3430N	26N	726.3	131.9	228.1
3430N	2530N	748.5	133.5	226.5
3430N	25N	771.3	135.0	225.0
3430N	2430N	794.5	136.4	223.6
3430N	24N	818.1	137.7	222.3
35N	45N	754.6	34.3	325.7
35N	4430N	732.1	35.9	324.1
35N	44N	710.2	37.5	322.5
35N	4330N	688.9	39.3	320.7
35N	43N	668.3	41.1	318.9
35N	4230N	648.3	43.1	316.9
35N	42N	629.2	45.2	314.8
35N	4130N	610.9	47.4	312.6
35N	41N	593.6	49.7	310.3
35N	4030N	577.3	52.2	307.8
35N	40N	562.1	54.8	305.2
35N	3930N	548.2	57.5	302.5
35N	39N	535.5	60.4	299.6
35N	3830N	524.2	63.5	296.5
35N	38N	514.5	66.6	293.4
35N	3730N	506.3	69.9	290.1
35N	37N	499.8	73.2	286.8
35N	3630N	496.4	76.7	283.3
35N	36N	493.3	80.1	279.9
35N	3530N	492.1	83.6	276.4
35N	35N	492.7	87.1	272.9
35N	3430N	495.1	90.6	269.4

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
35N	34N	499.3	94.0	266.0
35N	3330N	503.8	97.4	262.6
35N	33N	511.4	100.7	259.3
35N	3230N	520.7	103.9	256.1
35N	32N	531.4	107.0	253.0
35N	3130N	543.6	109.9	250.1
35N	31N	557.1	112.7	247.3
35N	3030N	571.9	115.4	244.6
35N	30N	587.8	117.9	242.1
35N	2930N	604.8	120.3	239.7
35N	29N	622.7	122.5	237.5
35N	2830N	641.6	124.7	235.3
35N	28N	661.2	126.7	233.3
35N	2730N	681.7	128.6	231.4
35N	27N	702.7	130.3	229.7
35N	2630N	724.4	132.0	228.0
35N	26N	746.7	133.6	226.4
35N	2530N	769.5	135.1	224.9
35N	25N	792.8	136.5	223.5
3530N	45N	730.0	35.6	324.4
3530N	4430N	708.0	37.3	322.7
3530N	44N	686.6	39.0	321.0
3530N	4330N	665.9	40.9	319.1
3530N	43N	645.9	42.8	317.2
3530N	4230N	626.7	44.9	315.1
3530N	42N	608.4	47.1	312.9
3530N	4130N	591.0	49.5	310.5
3530N	41N	574.6	52.0	308.0

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
3530N	4030N	559.4	54.6	305.4
3530N	40N	545.4	57.4	302.6
3530N	3930N	532.7	60.3	299.7
3530N	39N	521.3	63.3	296.7
3530N	3830N	511.5	66.4	293.6
3530N	38N	503.3	69.7	290.3
3530N	3730N	498.1	73.1	286.9
3530N	37N	493.3	76.6	283.4
3530N	3630N	490.3	80.1	279.9
3530N	36N	489.1	83.6	276.4
3530N	3530N	489.7	87.1	272.9
3530N	35N	492.1	90.6	269.4
3530N	3430N	496.3	94.0	266.0
3530N	34N	500.9	97.5	262.5
3530N	3330N	508.6	100.8	259.2
3530N	33N	517.9	104.0	256.0
3530N	3230N	528.7	107.0	253.0
3530N	32N	540.9	110.0	250.0
3530N	3130N	554.5	112.8	247.2
3530N	31N	569.4	115.5	244.5
3530N	3030N	585.4	118.0	242.0
3530N	30N	602.4	120.4	239.6
3530N	2930N	620.5	122.6	237.4
3530N	29N	639.4	124.8	235.2
3530N	2830N	659.1	126.8	233.2
3530N	28N	679.6	128.7	231.3
3530N	2730N	700.7	130.5	229.5
3530N	27N	722.5	132.1	227.9

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
3530N	2630N	744.8	133.7	226.3
3530N	26N	767.7	135.2	224.8
3530N	2530N	791.0	136.6	223.4
3530N	25N	814.8	137.9	222.1
36N	46N	750.4	33.8	326.2
36N	4530N	727.8	35.4	324.6
36N	45N	705.8	37.0	323.0
36N	4430N	684.4	38.8	321.2
36N	44N	663.6	40.6	319.4
36N	4330N	643.5	42.6	317.4
36N	43N	624.3	44.7	315.3
36N	4230N	605.9	46.9	313.1
36N	42N	588.4	49.3	310.7
36N	4130N	572.0	51.7	308.3
36N	41N	556.7	54.4	305.6
36N	4030N	542.6	57.1	302.9
36N	40N	529.8	60.1	299.9
36N	3930N	518.4	63.1	296.9
36N	39N	508.6	66.3	293.7
36N	3830N	500.3	69.6	290.4
36N	38N	495.1	73.0	287.0
36N	3730N	490.2	76.5	283.5
36N	37N	487.2	80.0	280.0
36N	3630N	486.0	83.5	276.5
36N	36N	486.6	87.1	272.9
36N	3530N	489.1	90.6	269.4
36N	35N	493.3	94.0	266.0
36N	3430N	499.3	97.4	262.6

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
36N	34N	505.7	100.8	259.2
36N	3330N	515.0	104.0	256.0
36N	33N	525.9	107.1	252.9
36N	3230N	538.2	110.1	249.9
36N	32N	551.9	112.9	247.1
36N	3130N	566.8	115.6	244.4
36N	31N	582.9	118.1	241.9
36N	3030N	600.0	120.5	239.5
36N	30N	618.1	122.8	237.2
36N	2930N	637.1	124.9	235.1
36N	29N	656.9	126.9	233.1
36N	2830N	677.5	128.8	231.2
36N	28N	698.7	130.6	229.4
36N	2730N	720.6	132.2	227.8
36N	27N	743.0	133.8	226.2
36N	2630N	765.9	135.3	224.7
36N	26N	789.3	136.7	223.3
3630N	46N	725.7	35.1	324.9
3630N	4530N	703.6	36.8	323.2
3630N	45N	682.1	38.5	321.5
3630N	4430N	661.3	40.4	319.6
3630N	44N	641.1	42.3	317.7
3630N	4330N	621.8	44.4	315.6
3630N	43N	603.3	46.7	313.3
3630N	4230N	585.8	49.0	311.0
3630N	42N	569.3	51.5	308.5
3630N	4130N	553.9	54.2	305.8
3630N	41N	539.7	56.9	303.1

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
3630N	4030N	526.9	59.9	300.1
3630N	40N	515.5	62.9	297.1
3630N	3930N	505.6	66.1	293.9
3630N	39N	498.6	69.5	290.5
3630N	3830N	492.0	72.9	287.1
3630N	38N	487.2	76.4	283.6
3630N	3730N	484.1	79.9	280.1
3630N	37N	482.9	83.5	276.5
3630N	3630N	483.5	87.0	273.0
3630N	36N	486.0	90.6	269.4
3630N	3530N	490.3	94.0	266.0
3630N	35N	496.3	97.5	262.5
3630N	3430N	502.7	100.9	259.1
3630N	34N	512.1	104.1	255.9
3630N	3330N	523.1	107.2	252.8
3630N	33N	535.5	110.2	249.8
3630N	3230N	549.2	113.0	247.0
3630N	32N	564.2	115.7	244.3
3630N	3130N	580.4	118.2	241.8
3630N	31N	597.6	120.6	239.4
3630N	3030N	615.8	122.9	237.1
3630N	30N	634.9	125.0	235.0
3630N	2930N	654.8	127.0	233.0
3630N	29N	675.4	128.9	231.1
3630N	2830N	696.7	130.7	229.3
3630N	28N	718.6	132.4	227.6
3630N	2730N	741.1	133.9	226.1
3630N	27N	764.0	135.4	224.6

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
3630N	2630N	787.5	136.8	223.2
3630N	26N	811.4	138.1	221.9
37N	47N	746.2	33.4	326.6
37N	4630N	723.5	34.9	325.1
37N	46N	701.4	36.5	323.5
37N	4530N	679.8	38.3	321.7
37N	45N	658.9	40.1	319.9
37N	4430N	638.7	42.1	317.9
37N	44N	619.3	44.2	315.8
37N	4330N	600.7	46.4	313.6
37N	43N	583.1	48.8	311.2
37N	4230N	566.6	51.3	308.7
37N	42N	551.1	53.9	306.1
37N	4130N	536.9	56.7	303.3
37N	41N	524.0	59.7	300.3
37N	4030N	512.5	62.7	297.3
37N	40N	502.5	66.0	294.0
37N	3930N	495.5	69.3	290.7
37N	39N	488.9	72.8	287.2
37N	3830N	484.0	76.3	283.7
37N	38N	481.0	79.8	280.2
37N	3730N	479.8	83.4	276.6
37N	37N	480.4	87.0	273.0
37N	3630N	482.9	90.5	269.5
37N	36N	487.2	94.1	265.9
37N	3530N	493.3	97.5	262.5
37N	35N	499.8	100.9	259.1
37N	3430N	509.2	104.1	255.9

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
37N	34N	520.3	107.3	252.7
37N	3330N	532.7	110.2	249.8
37N	33N	546.6	113.1	246.9
37N	3230N	561.6	115.8	244.2
37N	32N	577.9	118.3	241.7
37N	3130N	595.2	120.7	239.3
37N	31N	613.4	123.0	237.0
37N	3030N	632.6	125.1	234.9
37N	30N	652.6	127.1	232.9
37N	2930N	673.2	129.0	231.0
37N	29N	694.6	130.8	229.2
37N	2830N	716.6	132.5	227.5
37N	28N	739.1	134.1	225.9
37N	2730N	762.2	135.5	224.5
37N	27N	785.7	136.9	223.1
3730N	47N	721.4	34.6	325.4
3730N	4630N	699.1	36.3	323.7
3730N	46N	677.5	38.0	322.0
3730N	4530N	656.5	39.9	320.1
3730N	45N	636.3	41.8	318.2
3730N	4430N	616.8	43.9	316.1
3730N	44N	598.1	46.2	313.8
3730N	4330N	580.5	48.5	311.5
3730N	43N	563.8	51.1	308.9
3730N	4230N	548.3	53.7	306.3
3730N	42N	534.0	56.5	303.5
3730N	4130N	521.0	59.5	300.5
3730N	41N	509.5	62.6	297.4

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
3730N	4030N	499.5	65.8	294.2
3730N	40N	492.4	69.2	290.8
3730N	3930N	485.7	72.6	287.4
3730N	39N	480.9	76.2	283.8
3730N	3830N	477.8	79.7	280.3
3730N	38N	476.6	83.3	276.7
3730N	3730N	477.2	86.9	273.1
3730N	37N	479.8	90.5	269.5
3730N	3630N	484.1	94.1	265.9
3730N	36N	490.2	97.5	262.5
3730N	3530N	498.1	100.9	259.1
3730N	35N	506.3	104.2	255.8
3730N	3430N	517.4	107.3	252.7
3730N	34N	529.9	110.3	249.7
3730N	3330N	543.8	113.2	246.8
3730N	33N	559.0	115.9	244.1
3730N	3230N	575.3	118.4	241.6
3730N	32N	592.7	120.9	239.1
3730N	3130N	611.0	123.1	236.9
3730N	31N	630.3	125.3	234.7
3730N	3030N	650.3	127.3	232.7
3730N	30N	671.1	129.2	230.8
3730N	2930N	692.5	130.9	229.1
3730N	29N	714.6	132.6	227.4
3730N	2830N	737.2	134.2	225.8
3730N	28N	760.3	135.7	224.3
3730N	2730N	783.9	137.0	223.0
3730N	27N	807.9	138.4	221.6

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
38N	48N	742.0	32.9	327.1
38N	4730N	719.2	34.4	325.6
38N	47N	696.9	36.0	324.0
38N	4630N	675.2	37.8	322.2
38N	46N	654.1	39.6	320.4
38N	4530N	633.8	41.6	318.4
38N	45N	614.2	43.7	316.3
38N	4430N	595.5	45.9	314.1
38N	44N	577.8	48.3	311.7
38N	4330N	561.0	50.8	309.2
38N	43N	545.5	53.5	306.5
38N	4230N	531.1	56.3	303.7
38N	42N	518.0	59.3	300.7
38N	4130N	506.4	62.4	297.6
38N	41N	497.7	65.7	294.3
38N	4030N	489.3	69.0	291.0
38N	40N	482.6	72.5	287.5
38N	3930N	477.7	76.0	284.0
38N	39N	474.6	79.6	280.4
38N	3830N	473.4	83.3	276.7
38N	38N	474.0	86.9	273.1
38N	3730N	476.6	90.5	269.5
38N	37N	481.0	94.1	265.9
38N	3630N	487.2	97.6	262.4
38N	36N	495.1	100.9	259.1
38N	3530N	503.3	104.3	255.7
38N	35N	514.5	107.4	252.6
38N	3430N	527.1	110.4	249.6

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
38N	34N	541.1	113.3	246.7
38N	3330N	556.3	116.0	244.0
38N	33N	572.7	118.6	241.4
38N	3230N	590.2	121.0	239.0
38N	32N	608.6	123.3	236.7
38N	3130N	627.9	125.4	234.6
38N	31N	648.1	127.4	232.6
38N	3030N	668.9	129.3	230.7
38N	30N	690.4	131.1	228.9
38N	2930N	712.5	132.7	227.3
38N	29N	735.2	134.3	225.7
38N	2830N	758.4	135.8	224.2
38N	28N	782.0	137.2	222.8
3830N	48N	717.0	34.1	325.9
3830N	4730N	694.6	35.8	324.2
3830N	47N	672.9	37.5	322.5
3830N	4630N	651.7	39.4	320.6
3830N	46N	631.3	41.3	318.7
3830N	4530N	611.7	43.4	316.6
3830N	45N	592.9	45.7	314.3
3830N	4430N	575.1	48.1	311.9
3830N	44N	558.3	50.6	309.4
3830N	4330N	542.6	53.3	306.7
3830N	43N	528.2	56.1	303.9
3830N	4230N	515.0	59.1	300.9
3830N	42N	503.4	62.2	297.8
3830N	4130N	494.5	65.5	294.5
3830N	41N	486.1	68.9	291.1

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
3830N	4030N	479.4	72.4	287.6
3830N	40N	474.4	75.9	284.1
3830N	3930N	471.3	79.6	280.4
3830N	39N	470.1	83.2	276.8
3830N	3830N	470.8	86.9	273.1
3830N	38N	473.4	90.5	269.5
3830N	3730N	477.8	94.1	265.9
3830N	37N	484.0	97.6	262.4
3830N	3630N	492.0	101.0	259.0
3830N	36N	500.3	104.4	255.6
3830N	3530N	511.5	107.5	252.5
3830N	35N	524.2	110.5	249.5
3830N	3430N	538.3	113.4	246.6
3830N	34N	553.6	116.1	243.9
3830N	3330N	570.1	118.7	241.3
3830N	33N	587.7	121.1	238.9
3830N	3230N	606.2	123.4	236.6
3830N	32N	625.6	125.5	234.5
3830N	3130N	645.8	127.5	232.5
3830N	31N	666.7	129.4	230.6
3830N	3030N	688.3	131.2	228.8
3830N	30N	710.5	132.9	227.1
3830N	2930N	733.2	134.4	225.6
3830N	29N	756.5	135.9	224.1
3830N	2830N	780.2	137.3	222.7
3830N	28N	804.3	138.6	221.4
39N	49N	737.7	32.3	327.7
39N	4830N	714.8	33.9	326.1

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
39N	48N	692.4	35.5	324.5
39N	4730N	670.5	37.2	322.8
39N	47N	649.3	39.1	320.9
39N	4630N	628.8	41.1	318.9
39N	46N	609.1	43.2	316.8
39N	4530N	590.3	45.4	314.6
39N	45N	572.3	47.8	312.2
39N	4430N	555.5	50.3	309.7
39N	44N	539.7	53.0	307.0
39N	4330N	525.2	55.9	304.1
39N	43N	512.0	58.8	301.2
39N	4230N	500.3	62.0	298.0
39N	42N	491.4	65.3	294.7
39N	4130N	482.9	68.7	291.3
39N	41N	476.1	72.2	287.8
39N	4030N	471.1	75.8	284.2
39N	40N	468.0	79.5	280.5
39N	3930N	466.8	83.2	276.8
39N	39N	467.5	86.8	273.2
39N	3830N	470.1	90.5	269.5
39N	38N	474.6	94.1	265.9
39N	3730N	480.9	97.6	262.4
39N	37N	488.9	101.1	258.9
39N	3630N	498.6	104.4	255.6
39N	36N	508.6	107.6	252.4
39N	3530N	521.3	110.6	249.4
39N	35N	535.5	113.5	246.5
39N	3430N	550.9	116.2	243.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
39N	34N	567.5	118.8	241.2
39N	3330N	585.1	121.2	238.8
39N	33N	603.7	123.5	236.5
39N	3230N	623.2	125.7	234.3
39N	32N	643.5	127.7	232.3
39N	3130N	664.5	129.6	230.4
39N	31N	686.1	131.3	228.7
39N	3030N	708.4	133.0	227.0
39N	30N	731.2	134.6	225.4
39N	2930N	754.5	136.0	224.0
39N	29N	778.3	137.4	222.6
3930N	49N	712.6	33.6	326.4
3930N	4830N	690.1	35.2	324.8
3930N	48N	668.2	37.0	323.0
3930N	4730N	646.9	38.8	321.2
3930N	47N	626.3	40.8	319.2
3930N	4630N	606.5	42.9	317.1
3930N	46N	587.6	45.2	314.8
3930N	4530N	569.6	47.6	312.4
3930N	45N	552.6	50.1	309.9
3930N	4430N	536.8	52.8	307.2
3930N	44N	522.2	55.6	304.4
3930N	4330N	509.0	58.6	301.4
3930N	43N	498.4	61.9	298.1
3930N	4230N	488.2	65.2	294.8
3930N	42N	479.7	68.6	291.4
3930N	4130N	472.8	72.1	287.9
3930N	41N	467.8	75.7	284.3

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
3930N	4030N	464.7	79.4	280.6
3930N	40N	463.5	83.1	276.9
3930N	3930N	464.2	86.8	273.2
3930N	39N	466.8	90.5	269.5
3930N	3830N	471.3	94.1	265.9
3930N	38N	477.7	97.7	262.3
3930N	3730N	485.7	101.1	258.9
3930N	37N	495.5	104.4	255.6
3930N	3630N	505.6	107.7	252.3
3930N	36N	518.4	110.7	249.3
3930N	3530N	532.7	113.6	246.4
3930N	35N	548.2	116.4	243.6
3930N	3430N	564.8	119.0	241.0
3930N	34N	582.5	121.4	238.6
3930N	3330N	601.2	123.7	236.3
3930N	33N	620.8	125.8	234.2
3930N	3230N	641.1	127.8	232.2
3930N	32N	662.2	129.7	230.3
3930N	3130N	684.0	131.5	228.5
3930N	31N	706.3	133.1	226.9
3930N	3030N	729.2	134.7	225.3
3930N	30N	752.6	136.2	223.8
3930N	2930N	776.4	137.5	222.5
3930N	29N	800.6	138.8	221.2
40N	50N	733.4	31.8	328.2
40N	4930N	710.4	33.3	326.7
40N	49N	687.8	35.0	325.0
40N	4830N	665.8	36.7	323.3

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
40N	48N	644.4	38.6	321.4
40N	4730N	623.8	40.5	319.5
40N	47N	603.9	42.7	317.3
40N	4630N	584.9	44.9	315.1
40N	46N	566.8	47.3	312.7
40N	4530N	549.8	49.8	310.2
40N	45N	533.9	52.5	307.5
40N	4430N	519.2	55.4	304.6
40N	44N	505.9	58.4	301.6
40N	4330N	495.3	61.7	298.3
40N	43N	485.0	65.0	295.0
40N	4230N	476.4	68.4	291.6
40N	42N	469.5	72.0	288.0
40N	4130N	464.5	75.6	284.4
40N	41N	461.4	79.3	280.7
40N	4030N	460.1	83.0	277.0
40N	40N	460.8	86.8	273.2
40N	3930N	463.5	90.5	269.5
40N	39N	468.0	94.1	265.9
40N	3830N	474.4	97.7	262.3
40N	38N	482.6	101.2	258.8
40N	3730N	492.4	104.5	255.5
40N	37N	502.5	107.8	252.2
40N	3630N	515.5	110.9	249.1
40N	36N	529.8	113.8	246.2
40N	3530N	545.4	116.5	243.5
40N	35N	562.1	119.1	240.9
40N	3430N	579.9	121.5	238.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
40N	34N	598.7	123.8	236.2
40N	3330N	618.3	126.0	234.0
40N	33N	638.8	128.0	232.0
40N	3230N	660.0	129.9	230.1
40N	32N	681.8	131.6	228.4
40N	3130N	704.2	133.3	226.7
40N	31N	727.2	134.8	225.2
40N	3030N	750.6	136.3	223.7
40N	30N	774.5	137.7	222.3
4030N	50N	708.1	33.1	326.9
4030N	4930N	685.5	34.7	325.3
4030N	49N	663.4	36.4	323.6
4030N	4830N	642.0	38.3	321.7
4030N	48N	621.3	40.3	319.7
4030N	4730N	601.3	42.4	317.6
4030N	47N	582.2	44.6	315.4
4030N	4630N	564.1	47.0	313.0
4030N	46N	546.9	49.6	310.4
4030N	4530N	530.9	52.3	307.7
4030N	45N	516.2	55.2	304.8
4030N	4430N	502.8	58.2	301.8
4030N	44N	492.1	61.5	298.5
4030N	4330N	481.8	64.8	295.2
4030N	43N	473.1	68.2	291.8
4030N	4230N	466.2	71.8	288.2
4030N	42N	461.1	75.5	284.5
4030N	4130N	458.0	79.2	280.8
4030N	41N	456.7	83.0	277.0

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
4030N	4030N	457.5	86.7	273.3
4030N	40N	460.1	90.5	269.5
4030N	3930N	464.7	94.2	265.8
4030N	39N	471.1	97.8	262.2
4030N	3830N	479.4	101.2	258.8
4030N	38N	489.3	104.6	255.4
4030N	3730N	499.5	107.9	252.1
4030N	37N	512.5	111.0	249.0
4030N	3630N	526.9	113.9	246.1
4030N	36N	542.6	116.6	243.4
4030N	3530N	559.4	119.2	240.8
4030N	35N	577.3	121.7	238.3
4030N	3430N	596.2	124.0	236.0
4030N	34N	615.9	126.1	233.9
4030N	3330N	636.4	128.1	231.9
4030N	33N	657.7	130.0	230.0
4030N	3230N	679.6	131.8	228.2
4030N	32N	702.1	133.4	226.6
4030N	3130N	725.1	135.0	225.0
4030N	31N	748.6	136.4	223.6
4030N	3030N	772.6	137.8	222.2
4030N	30N	796.9	139.1	220.9
41N	51N	729.1	31.3	328.7
41N	5030N	705.9	32.8	327.2
41N	50N	683.2	34.4	325.6
41N	4930N	661.0	36.2	323.8
41N	49N	639.5	38.0	322.0
41N	4830N	618.7	40.0	320.0

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
41N	48N	598.7	42.1	317.9
41N	4730N	579.5	44.4	315.6
41N	47N	561.3	46.8	313.2
41N	4630N	544.0	49.3	310.7
41N	46N	528.0	52.0	308.0
41N	4530N	513.1	54.9	305.1
41N	45N	499.7	58.0	302.0
41N	4430N	488.9	61.3	298.7
41N	44N	478.52	64.6	295.4
41N	4330N	469.8	68.1	291.9
41N	43N	462.8	71.7	288.3
41N	4230N	457.7	75.4	284.6
41N	42N	454.5	79.1	280.9
41N	4130N	453.3	82.9	277.1
41N	41N	454.0	86.7	273.3
41N	4030N	456.7	90.5	269.5
41N	40N	461.4	94.2	265.8
41N	3930N	467.8	97.8	262.2
41N	39N	476.1	101.3	258.7
41N	3830N	486.1	104.7	255.3
41N	38N	497.7	107.9	252.1
41N	3730N	509.5	111.1	248.9
41N	37N	524.0	114.0	246.0
41N	3630N	539.7	116.8	243.2
41N	36N	556.7	119.4	240.6
41N	3530N	574.6	121.8	238.2
41N	35N	593.6	124.1	235.9
41N	3430N	613.4	126.3	233.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
41N	34N	634.0	128.3	231.7
41N	3330N	655.4	130.2	229.8
41N	33N	677.3	131.9	228.1
41N	3230N	699.9	133.6	226.4
41N	32N	723.0	135.0	225.0
41N	3130N	746.6	136.6	223.4
41N	31N	770.6	138.0	222.0
4130N	51N	703.7	32.5	327.5
4130N	5030N	680.9	34.1	325.9
4130N	50N	658.7	35.9	324.1
4130N	4930N	637.1	37.7	322.3
4130N	49N	616.2	39.7	320.3
4130N	4830N	596.1	41.8	318.2
4130N	48N	576.8	44.1	315.9
4130N	4730N	558.4	46.5	313.5
4130N	47N	541.1	49.1	310.9
4130N	4630N	525.0	51.8	308.2
4130N	46N	510.1	54.7	305.3
4130N	4530N	497.8	57.8	302.2
4130N	45N	485.7	61.0	299.0
4130N	4430N	475.2	64.4	295.6
4130N	44N	466.4	67.9	292.1
4130N	4330N	459.4	71.5	288.5
4130N	43N	454.3	75.2	284.8
4130N	4230N	451.1	79.0	281.0
4130N	42N	449.8	82.9	277.1
4130N	4130N	450.6	86.7	273.3
4130N	41N	453.3	90.5	269.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
4130N	4030N	458.0	94.2	265.8
4130N	40N	464.5	97.9	262.1
4130N	3930N	472.8	101.4	258.6
4130N	39N	482.9	104.8	255.2
4130N	3830N	494.5	108.0	252.0
4130N	38N	506.4	111.2	248.8
4130N	3730N	521.0	114.1	245.9
4130N	37N	536.9	116.9	243.1
4130N	3630N	553.9	119.5	240.5
4130N	36N	572.0	122.0	238.0
4130N	3530N	591.0	124.3	235.7
4130N	35N	610.9	126.4	233.6
4130N	3430N	631.6	128.4	231.6
4130N	34N	653.0	130.3	229.7
4130N	3330N	675.1	132.1	227.9
4130N	33N	697.4	133.7	226.3
4130N	3230N	720.9	135.3	224.7
4130N	32N	744.6	136.7	223.3
4130N	3130N	768.7	138.1	221.9
4130N	31N	793.2	139.4	220.6
42N	52N	724.8	30.7	329.3
42N	5130N	701.4	32.2	327.8
42N	51N	678.6	33.9	326.1
42N	5030N	656.3	35.6	324.4
42N	50N	634.6	37.4	322.6
42N	4930N	613.6	39.4	320.6
42N	49N	593.4	41.5	318.5
42N	4830N	574.0	43.8	316.2

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
42N	48N	555.6	46.2	313.8
42N	4730N	538.2	48.8	311.2
42N	47N	522.0	51.5	308.5
42N	4630N	507.0	54.4	305.6
42N	46N	494.6	57.6	302.4
42N	4530N	482.5	60.8	299.2
42N	45N	471.9	64.2	295.8
42N	4430N	463.1	67.7	292.3
42N	44N	456.0	71.4	288.6
42N	4330N	450.8	75.1	284.9
42N	43N	447.6	78.9	281.1
42N	4230N	446.4	82.8	277.2
42N	42N	447.1	86.6	273.4
42N	4130N	449.8	90.5	269.5
42N	41N	454.5	94.2	265.8
42N	4030N	461.1	97.9	262.1
42N	40N	469.5	101.5	258.5
42N	3930N	479.7	104.9	255.1
42N	39N	491.4	108.1	251.9
42N	3830N	503.4	111.3	248.7
42N	38N	518.0	114.3	245.7
42N	3730N	534.0	117.1	242.9
42N	37N	551.1	119.7	240.3
42N	3630N	569.3	122.1	237.9
42N	36N	588.4	124.4	235.6
42N	3530N	608.4	126.6	233.4
42N	35N	629.2	128.6	231.4
42N	3430N	650.7	130.5	229.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
42N	34N	672.8	132.2	227.8
42N	3330N	695.7	133.9	226.1
42N	33N	718.8	135.4	224.6
42N	3230N	742.5	136.9	223.1
42N	32N	766.7	138.3	221.7
4230N	52N	699.2	32.0	328.0
4230N	5130N	676.2	33.6	326.4
4230N	51N	653.9	35.3	324.7
4230N	5030N	632.1	37.2	322.8
4230N	50N	611.0	39.1	320.9
4230N	4930N	590.7	41.3	318.7
4230N	49N	571.3	43.5	316.5
4230N	4830N	552.8	45.9	314.1
4230N	48N	535.3	48.5	311.5
4230N	4730N	519.0	51.3	308.7
4230N	47N	503.9	54.2	305.8
4230N	4630N	491.4	57.3	302.7
4230N	46N	479.2	60.6	299.4
4230N	4530N	468.6	64.0	296.0
4230N	45N	459.7	67.6	292.4
4230N	4430N	452.5	71.2	288.8
4230N	44N	447.3	75.0	285.0
4230N	4330N	444.1	78.8	281.2
4230N	43N	442.8	82.7	277.3
4230N	4230N	443.6	86.6	273.4
4230N	42N	446.4	90.5	269.5
4230N	4130N	451.1	94.3	265.7
4230N	41N	457.73	98.0	262.0

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
4230N	4030N	466.2	101.5	258.5
4230N	40N	476.4	105.0	255.0
4230N	3930N	488.2	108.3	251.7
4230N	39N	500.3	111.5	248.5
4230N	3830N	515.0	114.4	245.6
4230N	38N	531.1	117.2	242.8
4230N	3730N	548.3	119.8	240.2
4230N	37N	566.6	122.3	237.7
4230N	3630N	585.8	124.6	235.4
4230N	36N	605.9	126.7	233.3
4230N	3530N	626.7	128.8	231.2
4230N	35N	648.3	130.6	229.4
4230N	3430N	670.6	132.4	227.6
4230N	34N	693.4	134.1	225.9
4230N	3330N	716.7	135.6	224.4
4230N	33N	740.5	137.0	223.0
4230N	3230N	764.7	138.4	221.6
4230N	32N	789.3	139.7	220.3
43N	53N	720.4	30.1	329.9
43N	5230N	696.9	31.7	328.3
43N	52N	673.9	33.3	326.7
43N	5130N	651.4	35.0	325.0
43N	51N	629.6	36.9	323.1
43N	5030N	608.5	38.8	321.2
43N	50N	588.1	41.0	319.0
43N	4930N	568.5	43.2	316.8
43N	49N	549.9	45.7	314.3
43N	4830N	532.4	48.2	311.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
43N	48N	515.9	51.0	309.0
43N	4730N	500.7	53.9	306.1
43N	47N	488.2	57.1	302.9
43N	4630N	475.9	60.4	299.6
43N	46N	465.2	63.8	296.2
43N	4530N	456.2	67.4	292.6
43N	45N	449.1	71.1	288.9
43N	4430N	443.8	74.9	285.1
43N	44N	440.5	78.7	281.3
43N	4330N	439.3	82.7	277.3
43N	43N	440.0	86.6	273.4
43N	4230N	442.8	90.5	269.5
43N	42N	447.6	94.3	265.7
43N	4130N	454.3	98.0	262.0
43N	41N	462.8	101.6	258.4
43N	4030N	473.1	105.1	254.9
43N	40N	485.0	108.4	251.6
43N	3930N	498.4	111.5	248.5
43N	39N	512.0	114.6	245.4
43N	3830N	528.2	117.4	242.6
43N	38N	545.5	120.0	240.0
43N	3730N	563.8	122.5	237.5
43N	37N	583.1	124.8	235.2
43N	3630N	603.3	126.9	233.1
43N	36N	624.3	128.9	231.1
43N	3530N	645.9	130.8	229.2
43N	35N	668.3	132.6	227.4
43N	3430N	691.1	134.2	225.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
43N	34N	714.5	135.8	224.2
43N	3330N	738.4	137.2	222.8
43N	33N	762.7	138.6	221.4
4330N	53N	694.7	31.4	328.6
4330N	5230N	671.6	33.0	327.0
4330N	52N	649.0	34.7	325.3
4330N	5130N	627.1	36.6	323.4
4330N	51N	605.9	38.6	321.4
4330N	5030N	585.4	40.7	319.3
4330N	50N	565.8	42.9	317.1
4330N	4930N	547.1	45.4	314.6
4330N	49N	529.4	48.0	312.0
4330N	4830N	512.9	50.7	309.3
4330N	48N	498.8	53.7	306.3
4330N	4730N	485.0	56.9	303.1
4330N	47N	472.6	60.1	299.9
4330N	4630N	461.8	63.6	296.4
4330N	46N	452.8	67.2	292.8
4330N	4530N	445.5	70.9	289.1
4330N	45N	440.2	74.7	285.3
4330N	4430N	436.9	78.6	281.4
4330N	44N	435.7	82.6	277.4
4330N	4330N	436.4	86.5	273.5
4330N	43N	439.3	90.5	269.5
4330N	4230N	444.1	94.3	265.7
4330N	42N	450.8	98.1	261.9
4330N	4130N	459.4	101.7	258.3
4330N	41N	469.8	105.2	254.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
4330N	4030N	481.8	108.5	251.5
4330N	40N	495.3	111.7	248.3
4330N	3930N	509.0	114.7	245.3
4330N	39N	525.2	117.5	242.5
4330N	3830N	542.6	120.2	239.8
4330N	38N	561.0	122.6	237.4
4330N	3730N	580.5	124.9	235.1
4330N	37N	600.7	127.1	232.9
4330N	3630N	621.8	129.1	230.9
4330N	36N	643.5	131.0	229.0
4330N	3530N	665.9	132.7	227.3
4330N	35N	688.9	134.4	225.6
4330N	3430N	712.4	135.9	224.1
4330N	34N	736.3	137.4	222.6
4330N	3330N	760.7	138.7	221.3
4330N	33N	785.4	140.0	220.0
44N	54N	716.1	29.6	330.4
44N	5330N	692.4	31.1	328.9
44N	53N	669.2	32.7	327.3
44N	5230N	646.6	34.4	325.6
44N	52N	624.6	36.3	323.7
44N	5130N	603.3	38.3	321.7
44N	51N	582.7	40.4	319.6
44N	5030N	563.0	42.6	317.4
44N	50N	544.2	45.1	314.9
44N	4930N	526.4	47.7	312.3
44N	49N	509.8	50.4	309.6
44N	4830N	495.7	53.5	306.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
44N	48N	481.7	56.6	303.4
44N	4730N	469.2	59.9	300.1
44N	47N	458.4	63.4	296.6
44N	4630N	449.3	67.0	293.0
44N	46N	442.0	70.8	289.2
44N	4530N	436.6	74.6	285.4
44N	45N	433.3	78.6	281.4
44N	4430N	432.0	82.5	277.5
44N	44N	432.8	86.5	273.5
44N	4330N	435.7	90.5	269.5
44N	43N	440.5	94.4	265.6
44N	4230N	447.3	98.1	261.9
44N	42N	456.0	101.8	258.2
44N	4130N	466.4	105.3	254.7
44N	41N	478.5	108.6	251.4
44N	4030N	492.1	111.8	248.2
44N	40N	505.9	114.8	245.2
44N	3930N	522.2	117.7	242.3
44N	39N	539.7	120.3	239.7
44N	3830N	558.3	122.8	237.2
44N	38N	577.8	125.1	234.9
44N	3730N	598.1	127.3	232.7
44N	37N	619.3	129.3	230.7
44N	3630N	641.1	131.2	228.8
44N	36N	663.6	132.9	227.1
44N	3530N	686.6	134.6	225.4
44N	35N	710.2	136.1	223.9
44N	3430N	734.2	137.5	222.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
44N	34N	758.7	138.9	221.1
4430N	54N	690.1	30.8	329.2
4430N	5330N	666.9	32.4	327.6
4430N	53N	644.2	34.1	325.9
4430N	5230N	622.1	36.0	324.0
4430N	52N	600.7	37.9	322.1
4430N	5130N	580.0	40.1	319.9
4430N	51N	560.2	42.3	317.7
4430N	5030N	541.3	44.8	315.2
4430N	50N	523.4	47.4	312.6
4430N	4930N	506.7	50.2	309.8
4430N	49N	492.5	53.2	306.8
4430N	4830N	478.4	56.3	303.7
4430N	48N	465.9	59.7	300.3
4430N	4730N	454.9	63.2	296.8
4430N	47N	445.7	66.8	293.2
4430N	4630N	438.4	70.6	289.4
4430N	46N	433.0	74.5	285.5
4430N	4530N	429.7	78.5	281.5
4430N	45N	428.4	82.5	277.5
4430N	4430N	429.2	86.5	273.5
4430N	44N	432.0	90.5	269.5
4430N	4330N	436.9	94.4	265.6
4430N	43N	443.8	98.2	261.8
4430N	4230N	452.5	101.9	258.1
4430N	42N	463.1	105.4	254.6
4430N	4130N	475.2	108.8	251.2
4430N	41N	488.9	111.9	248.1

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
4430N	4030N	502.8	115.0	245.0
4430N	40N	519.2	117.9	242.1
4430N	3930N	536.8	120.5	239.5
4430N	39N	555.5	123.0	237.0
4430N	3830N	575.1	125.3	234.7
4430N	38N	595.5	127.4	232.6
4430N	3730N	616.8	129.5	230.5
4430N	37N	638.7	131.3	228.7
4430N	3630N	661.3	133.1	226.9
4430N	36N	684.4	134.7	225.3
4430N	3530N	708.0	136.3	223.7
4430N	35N	732.1	137.7	222.3
4430N	3430N	756.6	139.0	221.0
4430N	34N	781.5	140.3	219.7
45N	55N	711.7	29.0	331.0
45N	5430N	687.9	30.5	329.5
45N	54N	664.6	32.1	327.9
45N	5330N	641.8	33.8	326.2
45N	53N	619.6	35.7	324.3
45N	5230N	598.0	37.6	322.4
45N	52N	577.3	39.8	320.2
45N	5130N	557.4	42.0	318.0
45N	51N	538.4	44.5	315.5
45N	5030N	520.4	47.1	312.9
45N	50N	503.6	49.9	310.1
45N	4930N	489.3	53.0	307.0
45N	49N	475.2	56.1	303.9
45N	4830N	462.5	59.4	300.6

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
45N	48N	451.5	62.9	297.1
45N	4730N	442.2	66.6	293.4
45N	47N	434.8	70.4	289.6
45N	4630N	429.4	74.3	285.7
45N	46N	426.0	78.4	281.6
45N	4530N	424.7	82.4	277.6
45N	45N	425.5	86.5	273.5
45N	4430N	428.4	90.5	269.5
45N	44N	433.3	94.4	265.6
45N	4330N	440.2	98.2	261.8
45N	43N	449.1	102.0	258.0
45N	4230N	459.7	105.5	254.5
45N	42N	471.9	108.9	251.1
45N	4130N	485.7	112.1	247.9
45N	41N	499.7	115.2	244.8
45N	4030N	516.2	118.0	242.0
45N	40N	533.9	120.7	239.3
45N	3930N	552.6	123.2	236.8
45N	39N	572.3	125.5	234.5
45N	3830N	592.9	127.6	232.4
45N	38N	614.2	129.6	230.4
45N	3730N	636.3	131.5	228.5
45N	37N	658.9	133.3	226.7
45N	3630N	682.1	134.9	225.1
45N	36N	705.8	136.4	223.6
45N	3530N	730.0	137.9	222.1
45N	35N	754.6	139.2	220.8
4530N	55N	685.6	30.2	329.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
4530N	5430N	662.2	31.8	328.2
4530N	54N	639.3	33.5	326.5
4530N	5330N	617.1	35.3	324.7
4530N	53N	595.5	37.3	322.7
4530N	5230N	574.6	39.4	320.6
4530N	52N	554.6	41.7	318.3
4530N	5130N	535.5	44.2	315.8
4530N	51N	517.4	46.8	313.2
4530N	5030N	500.5	49.6	310.4
4530N	50N	486.1	52.6	307.4
4530N	4930N	471.8	55.8	304.2
4530N	49N	459.1	59.2	300.8
4530N	4830N	448.0	62.7	297.3
4530N	48N	438.6	66.4	293.6
4530N	4730N	431.2	70.3	289.7
4530N	47N	425.7	74.2	285.8
4530N	4630N	422.3	78.2	281.8
4530N	46N	420.9	82.3	277.7
4530N	4530N	421.7	86.4	273.6
4530N	45N	424.7	90.5	269.5
4530N	4430N	429.7	94.5	265.5
4530N	44N	436.6	98.3	261.7
4530N	4330N	445.5	102.1	257.9
4530N	43N	456.2	105.6	254.4
4530N	4230N	468.6	109.0	251.0
4530N	42N	482.5	112.2	247.8
4530N	4130N	497.8	115.3	244.7
4530N	41N	513.1	118.2	241.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
4530N	4030N	530.9	120.9	239.1
4530N	40N	549.8	123.3	236.7
4530N	3930N	569.6	125.7	234.3
4530N	39N	590.3	127.8	232.2
4530N	3830N	611.7	129.8	230.2
4530N	38N	633.8	131.7	228.3
4530N	3730N	656.5	133.5	226.5
4530N	37N	679.8	135.1	224.9
4530N	3630N	703.6	136.6	223.4
4530N	36N	727.8	138.0	222.0
4530N	3530N	752.5	139.4	220.6
4530N	35N	777.5	140.6	219.4
46N	56N	707.3	28.4	331.6
46N	5530N	683.4	29.9	330.1
46N	55N	659.9	31.5	328.5
46N	5430N	636.9	33.2	326.8
46N	54N	614.5	35.0	325.0
46N	5330N	592.8	37.0	323.0
46N	53N	571.9	39.1	320.9
46N	5230N	551.8	41.4	318.6
46N	52N	532.6	43.9	316.1
46N	5130N	514.4	46.5	313.5
46N	51N	498.6	49.4	310.6
46N	5030N	482.9	52.4	307.6
46N	50N	468.5	55.5	304.5
46N	4930N	455.7	58.9	301.1
46N	49N	444.5	62.5	297.5
46N	4830N	435.0	66.2	293.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
46N	48N	427.5	70.1	289.9
46N	4730N	422.0	74.1	285.9
46N	47N	418.5	78.1	281.9
46N	4630N	417.2	82.3	277.7
46N	46N	418.0	86.4	273.6
46N	4530N	420.9	90.5	269.5
46N	45N	426.0	94.5	265.5
46N	4430N	433.0	98.4	261.6
46N	44N	442.0	102.2	257.8
46N	4330N	452.8	105.8	254.2
46N	43N	465.2	109.2	250.8
46N	4230N	479.2	112.4	247.6
46N	42N	494.6	115.4	244.6
46N	4130N	510.1	118.4	241.6
46N	41N	528.0	121.0	239.0
46N	4030N	546.9	123.5	236.5
46N	40N	566.8	125.9	234.1
46N	3930N	587.6	128.0	232.0
46N	39N	609.1	130.0	230.0
46N	3830N	631.3	131.9	228.1
46N	38N	654.1	133.7	226.3
46N	3730N	677.5	135.3	224.7
46N	37N	701.4	136.8	223.2
46N	3630N	725.7	138.2	221.8
46N	36N	750.4	139.6	220.4
4630N	56N	681.1	29.6	330.4
4630N	5530N	657.5	31.2	328.8
4630N	55N	634.5	32.9	327.1

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
4630N	5430N	612.0	34.7	325.3
4630N	54N	590.2	36.7	323.3
4630N	5330N	569.2	38.8	321.2
4630N	53N	548.9	41.1	318.9
4630N	5230N	529.6	43.5	316.5
4630N	52N	511.4	46.2	313.8
4630N	5130N	495.5	49.1	310.9
4630N	51N	479.6	52.1	307.9
4630N	5030N	465.2	55.3	304.7
4630N	50N	452.2	58.7	301.3
4630N	4930N	440.9	62.2	297.8
4630N	49N	431.4	66.0	294.0
4630N	4830N	423.8	69.9	290.1
4630N	48N	418.2	73.9	286.1
4630N	4730N	414.7	78.0	282.0
4630N	47N	413.4	82.2	277.8
4630N	4630N	414.2	86.4	273.6
4630N	46N	417.2	90.5	269.5
4630N	4530N	422.3	94.5	265.5
4630N	45N	429.4	98.5	261.5
4630N	4430N	438.4	102.3	257.7
4630N	44N	449.3	105.9	254.1
4630N	4330N	461.8	109.3	250.7
4630N	43N	475.9	112.6	247.4
4630N	4230N	491.4	115.6	244.4
4630N	42N	507.0	118.6	241.4
4630N	4130N	525.0	121.2	238.8
4630N	41N	544.0	123.7	236.3

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
4630N	4030N	564.1	126.1	233.9
4630N	40N	584.9	128.2	231.8
4630N	3930N	606.5	130.2	229.8
4630N	39N	628.8	132.1	227.9
4630N	3830N	651.7	133.8	226.2
4630N	38N	675.2	135.5	224.5
4630N	3730N	699.1	137.0	223.0
4630N	37N	723.5	138.4	221.6
4630N	3630N	748.3	139.7	220.3
4630N	36N	773.5	141.0	219.0
47N	57N	703.0	27.8	332.2
47N	5630N	678.8	29.2	330.8
47N	56N	655.2	30.8	329.2
47N	5530N	632.0	32.5	327.5
47N	55N	609.5	34.4	325.6
47N	5430N	587.6	36.4	323.6
47N	54N	566.4	38.5	321.5
47N	5330N	546.1	40.8	319.2
47N	53N	526.7	43.2	316.8
47N	5230N	508.3	45.8	314.2
47N	52N	492.4	48.8	311.2
47N	5130N	476.4	51.8	308.2
47N	51N	461.8	55.0	305.0
47N	5030N	448.7	58.4	301.6
47N	50N	437.3	62.0	298.0
47N	4930N	427.8	65.8	294.2
47N	49N	420.1	69.7	290.3
47N	4830N	414.5	73.8	286.2

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
47N	48N	410.9	77.9	282.1
47N	4730N	409.6	82.1	277.9
47N	47N	410.4	86.3	273.7
47N	4630N	413.4	90.5	269.5
47N	46N	418.5	94.6	265.4
47N	4530N	425.7	98.5	261.5
47N	45N	434.8	102.4	257.6
47N	4430N	445.7	106.0	254.0
47N	44N	458.4	109.5	250.5
47N	4330N	472.6	112.7	247.3
47N	43N	488.2	115.8	244.2
47N	4230N	503.9	118.8	241.2
47N	42N	522.0	121.4	238.6
47N	4130N	541.1	123.9	236.1
47N	41N	561.3	126.3	233.7
47N	4030N	582.2	128.4	231.6
47N	40N	603.9	130.4	229.6
47N	3930N	626.3	132.3	227.7
47N	39N	649.3	134.0	226.0
47N	3830N	672.9	135.7	224.3
47N	38N	696.9	137.2	222.8
47N	3730N	721.4	138.6	221.4
47N	37N	746.2	139.9	220.1
4730N	57N	676.6	28.9	331.1
4730N	5630N	652.8	30.5	329.5
4730N	56N	629.6	32.2	327.8
4730N	5530N	607.0	34.0	326.0
4730N	55N	585.0	36.0	324.0

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
4730N	5430N	563.7	38.1	321.9
4730N	54N	543.3	40.4	319.6
4730N	5330N	523.8	42.9	317.1
4730N	53N	505.3	45.5	314.5
4730N	5230N	489.2	48.4	311.6
4730N	52N	473.1	51.5	308.5
4730N	5130N	458.4	54.7	305.3
4730N	51N	445.2	55.1	304.9
4730N	5030N	433.8	61.8	298.2
4730N	50N	424.1	65.6	294.4
4730N	4930N	416.3	69.5	290.5
4730N	49N	410.7	73.6	286.4
4730N	4830N	407.1	77.8	282.2
4730N	48N	405.7	82.1	277.9
4730N	4730N	406.5	86.3	273.7
4730N	47N	409.6	90.5	269.5
4730N	4630N	414.7	94.6	265.4
4730N	46N	422.0	98.6	261.4
4730N	4530N	431.2	102.5	257.5
4730N	45N	442.2	106.1	253.9
4730N	4430N	454.9	109.6	250.4
4730N	44N	469.2	112.9	247.1
4730N	4330N	485.0	116.0	244.0
4730N	43N	500.7	119.0	241.0
4730N	4230N	519.0	121.6	238.4
4730N	42N	538.2	124.1	235.9
4730N	4130N	558.4	126.5	233.5
4730N	41N	579.5	128.6	231.4

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
4730N	4030N	601.3	130.6	229.4
4730N	40N	623.8	132.5	227.5
4730N	3930N	646.9	134.2	225.8
4730N	39N	670.5	135.9	224.1
4730N	3830N	694.6	137.4	222.6
4730N	38N	719.2	138.8	221.2
4730N	3730N	744.1	140.1	219.9
4730N	37N	769.4	141.3	218.7
48N	58N	698.6	27.1	332.9
48N	5730N	674.3	28.6	331.4
48N	57N	650.5	30.2	329.8
48N	5630N	627.2	31.9	328.1
48N	56N	604.4	33.7	326.3
48N	5530N	582.3	35.7	324.3
48N	55N	561.0	37.8	322.2
48N	5430N	540.4	40.1	319.9
48N	54N	520.8	42.6	317.4
48N	5330N	502.2	45.2	314.8
48N	53N	486.0	48.1	311.9
48N	5230N	469.8	51.2	308.8
48N	52N	455.0	54.4	305.6
48N	5130N	441.7	57.9	302.1
48N	51N	430.2	61.5	298.5
48N	5030N	420.4	65.4	294.6
48N	50N	412.6	69.4	290.6
48N	4930N	406.8	73.5	286.5
48N	49N	403.2	77.7	282.3
48N	4830N	401.8	82.0	278.0

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
48N	48N	402.7	86.3	273.7
48N	4730N	405.7	90.5	269.5
48N	47N	410.9	94.7	265.3
48N	4630N	418.2	98.7	261.3
48N	46N	427.5	102.6	257.4
48N	4530N	438.6	106.3	253.7
48N	45N	451.5	109.8	250.2
48N	4430N	465.9	113.1	246.9
48N	44N	481.7	116.2	243.8
48N	4330N	498.8	119.1	240.9
48N	43N	515.9	121.8	238.2
48N	4230N	535.3	124.4	235.6
48N	42N	555.6	126.7	233.3
48N	4130N	576.8	128.8	231.2
48N	41N	598.7	130.9	229.1
48N	4030N	621.3	132.7	227.3
48N	40N	644.4	134.5	225.5
48N	3930N	668.2	136.1	223.9
48N	39N	692.4	137.6	222.4
48N	3830N	717.0	139.0	221.0
48N	38N	742.0	140.3	219.7
4830N	58N	672.1	28.3	331.7
4830N	5730N	648.1	29.9	330.1
4830N	57N	624.7	31.5	328.5
4830N	5630N	601.9	33.4	326.6
4830N	56N	579.7	35.3	324.7
4830N	5530N	558.2	37.5	322.5
4830N	55N	537.6	39.8	320.2

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
4830N	5430N	517.8	42.2	317.8
4830N	54N	499.1	44.9	315.1
4830N	5330N	482.9	47.8	312.2
4830N	53N	466.5	50.8	309.2
4830N	5230N	451.6	54.1	305.9
4830N	52N	438.2	57.6	302.4
4830N	5130N	426.5	61.3	298.7
4830N	51N	416.7	65.1	294.9
4830N	5030N	408.8	69.2	290.8
4830N	50N	403.0	73.3	286.7
4830N	4930N	399.3	77.6	282.4
4830N	49N	397.9	81.9	278.1
4830N	4830N	398.8	86.2	273.8
4830N	48N	401.8	90.5	269.5
4830N	4730N	407.1	94.7	265.3
4830N	47N	414.5	98.8	261.2
4830N	4630N	423.8	102.7	257.3
4830N	46N	435.0	106.4	253.6
4830N	4530N	448.0	110.0	250.0
4830N	45N	462.5	113.3	246.7
4830N	4430N	478.4	116.4	243.6
4830N	44N	495.7	119.3	240.7
4830N	4330N	512.9	122.1	237.9
4830N	43N	532.4	124.6	235.4
4830N	4230N	552.8	126.9	233.1
4830N	42N	574.0	129.1	230.9
4830N	4130N	596.1	131.1	228.9
4830N	41N	618.7	132.9	227.1

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
4830N	4030N	642.0	134.7	225.3
4830N	40N	665.8	136.3	223.7
4830N	3930N	690.1	137.8	222.2
4830N	39N	714.8	139.2	220.8
4830N	3830N	739.9	140.5	219.5
4830N	38N	765.3	141.7	218.3
49N	59N	694.3	26.5	333.5
49N	5830N	669.8	27.9	332.1
49N	58N	645.8	29.5	330.5
49N	5730N	622.3	31.2	328.8
49N	57N	599.4	33.0	327.0
49N	5630N	577.1	35.0	325.0
49N	56N	555.5	37.1	322.9
49N	5530N	534.7	39.4	320.6
49N	55N	514.9	41.9	318.1
49N	5430N	497.4	44.6	315.4
49N	54N	479.7	47.5	312.5
49N	5330N	463.2	50.5	309.5
49N	53N	448.2	53.8	306.2
49N	5230N	434.7	57.3	302.7
49N	52N	422.9	61.0	299.0
49N	5130N	412.9	64.9	295.1
49N	51N	405.0	69.0	291.0
49N	5030N	399.1	73.2	286.8
49N	50N	395.4	77.5	282.5
49N	4930N	394.0	81.8	278.2
49N	49N	394.8	86.2	273.8
49N	4830N	397.9	90.5	269.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
49N	48N	403.2	94.8	265.2
49N	4730N	410.7	98.9	261.1
49N	47N	420.1	102.8	257.2
49N	4630N	431.4	106.6	253.4
49N	46N	444.5	110.1	249.9
49N	4530N	459.1	113.5	246.5
49N	45N	475.2	116.6	243.4
49N	4430N	492.5	119.5	240.5
49N	44N	509.8	122.3	237.7
49N	4330N	529.4	124.8	235.2
49N	43N	549.9	127.1	232.9
49N	4230N	571.3	129.3	230.7
49N	42N	593.4	131.3	228.7
49N	4130N	616.2	133.2	226.8
49N	41N	639.5	134.9	225.1
49N	4030N	663.4	136.5	223.5
49N	40N	687.8	138.0	222.0
49N	3930N	712.6	139.4	220.6
49N	39N	737.7	140.7	219.3
4930N	59N	667.6	27.6	332.4
4930N	5830N	643.5	29.2	330.8
4930N	58N	619.9	30.9	329.1
4930N	5730N	596.8	32.7	327.3
4930N	57N	547.5	34.6	325.4
4930N	5630N	552.8	36.8	323.2
4930N	56N	531.9	39.1	320.9
4930N	5530N	511.9	41.5	318.5
4930N	55N	494.3	44.3	315.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
4930N	5430N	476.5	47.1	312.9
4930N	54N	459.9	50.2	309.8
4930N	5330N	444.7	53.5	306.5
4930N	53N	431.1	57.0	303.0
4930N	5230N	419.2	60.7	299.3
4930N	52N	409.2	64.7	295.3
4930N	5130N	401.1	68.8	291.2
4930N	51N	395.2	73.0	287.0
4930N	5030N	391.4	77.4	282.6
4930N	50N	390.0	81.8	278.2
4930N	4930N	390.8	86.2	273.8
4930N	49N	394.0	90.6	269.4
4930N	4830N	399.3	94.8	265.2
4930N	48N	406.8	99.0	261.0
4930N	4730N	416.3	103.0	257.0
4930N	47N	427.8	106.7	253.3
4930N	4630N	440.9	110.3	249.7
4930N	46N	455.7	113.7	246.3
4930N	4530N	471.8	116.8	243.2
4930N	45N	489.3	119.7	240.3
4930N	4430N	506.7	122.5	237.5
4930N	44N	526.4	125.0	235.0
4930N	4330N	547.1	127.3	232.7
4930N	43N	568.5	129.5	230.5
4930N	4230N	590.7	131.5	228.5
4930N	42N	613.6	133.4	226.6
4930N	4130N	637.1	135.1	224.9
4930N	41N	661.0	136.7	223.3

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
4930N	4030N	685.5	138.2	221.8
4930N	40N	710.4	139.6	220.4
4930N	3930N	735.6	140.9	219.1
4930N	39N	761.2	142.1	217.9
50N	60N	690.0	25.8	334.2
50N	5930N	665.4	27.3	332.7
50N	59N	641.2	28.8	331.2
50N	5830N	617.5	30.5	329.5
50N	58N	594.3	32.3	327.7
50N	5730N	571.8	34.3	325.7
50N	57N	550.0	36.4	323.6
50N	5630N	529.0	38.7	321.3
50N	56N	509.0	41.2	318.8
50N	5530N	491.2	43.9	316.1
50N	55N	473.3	46.8	313.2
50N	5430N	456.6	49.9	310.1
50N	54N	441.3	53.2	306.8
50N	5330N	427.5	56.7	303.3
50N	53N	415.5	60.5	299.5
50N	5230N	405.4	64.4	295.6
50N	52N	397.2	68.6	291.4
50N	5130N	391.2	72.8	287.2
50N	51N	387.5	77.2	282.8
50N	5030N	386.0	81.7	278.3
50N	50N	386.8	86.2	273.8
50N	4930N	390.0	90.6	269.4
50N	49N	395.4	94.9	265.1
50N	4830N	403.0	99.1	260.9

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
50N	48N	412.6	103.1	256.9
50N	4730N	424.1	106.9	253.1
50N	47N	437.3	110.5	249.5
50N	4630N	452.2	113.9	246.1
50N	46N	468.5	117.0	243.0
50N	4530N	486.1	119.9	240.1
50N	45N	503.6	122.7	237.3
50N	4430N	523.4	125.2	234.8
50N	44N	544.2	127.6	232.4
50N	4330N	565.8	129.7	230.3
50N	43N	588.1	131.7	228.3
50N	4230N	611.0	133.6	226.4
50N	42N	634.6	135.3	224.7
50N	4130N	658.7	136.9	223.1
50N	41N	683.2	138.4	221.6
50N	4030N	708.1	139.8	220.2
50N	40N	733.4	141.1	218.9
5030N	60N	663.1	26.9	333.1
5030N	5930N	638.8	28.5	331.5
5030N	59N	615.0	30.2	329.8
5030N	5830N	591.8	32.0	328.0
5030N	58N	569.2	33.9	326.1
5030N	5730N	547.3	36.0	324.0
5030N	57N	526.2	38.3	321.7
5030N	5630N	506.0	40.8	319.2
5030N	56N	488.1	43.5	316.5
5030N	5530N	470.0	46.4	313.6
5030N	55N	453.2	49.5	310.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
5030N	5430N	437.8	52.9	307.1
5030N	54N	424.0	56.4	303.6
5030N	5330N	411.8	60.2	299.8
5030N	53N	401.6	64.2	295.8
5030N	5230N	393.3	68.4	291.6
5030N	52N	387.3	72.7	287.3
5030N	5130N	383.5	77.1	282.9
5030N	51N	382.0	81.6	278.4
5030N	5030N	382.8	86.1	273.9
5030N	50N	386.0	90.6	269.4
5030N	4930N	391.4	95.0	265.0
5030N	49N	399.0	99.2	260.8
5030N	4830N	408.8	103.2	256.8
5030N	48N	420.4	107.1	252.9
5030N	4730N	433.8	110.7	249.3
5030N	47N	448.7	114.1	245.9
5030N	4630N	465.2	117.2	242.8
5030N	46N	482.9	120.2	239.8
5030N	4530N	500.5	123.0	237.0
5030N	45N	520.4	125.5	234.5
5030N	4430N	541.3	127.8	232.2
5030N	44N	563.0	130.0	230.0
5030N	4330N	585.4	132.0	228.0
5030N	43N	608.5	133.8	226.2
5030N	4230N	632.1	135.5	224.5
5030N	42N	656.3	137.1	222.9
5030N	4130N	680.9	138.6	221.4
5030N	41N	705.9	140.0	220.0

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
5030N	4030N	731.3	141.3	218.7
5030N	40N	757.0	142.5	217.5
51N	61N	685.7	25.1	334.9
51N	6030N	660.9	26.6	333.4
51N	60N	636.5	28.1	331.9
51N	5930N	612.6	29.8	330.2
51N	59N	589.3	31.6	328.4
51N	5830N	566.6	33.6	326.4
51N	58N	544.6	35.7	324.3
51N	5730N	523.3	38.0	322.0
51N	57N	503.0	40.4	319.6
51N	5630N	485.1	43.2	316.8
51N	56N	466.8	46.1	313.9
51N	5530N	449.9	49.2	310.8
51N	55N	434.3	52.5	307.5
51N	5430N	420.3	56.1	303.9
51N	54N	408.1	59.9	300.1
51N	5330N	397.7	63.9	296.1
51N	53N	389.4	68.1	291.9
51N	5230N	383.3	72.5	287.5
51N	52N	379.4	77.0	283.0
51N	5130N	377.9	81.5	278.5
51N	51N	378.7	86.1	273.9
51N	5030N	382.0	90.6	269.4
51N	50N	387.5	95.0	265.0
51N	4930N	395.2	99.3	260.7
51N	49N	405.0	103.4	256.6
51N	4830N	416.7	107.2	252.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
51N	48N	430.2	110.9	249.1
51N	4730N	445.2	114.3	245.7
51N	47N	461.8	117.4	242.6
51N	4630N	479.6	120.4	239.6
51N	46N	498.6	123.1	236.9
51N	4530N	517.4	125.7	234.3
51N	45N	538.4	128.0	232.0
51N	4430N	560.2	130.2	229.8
51N	44N	582.7	132.2	227.8
51N	4330N	605.9	134.1	225.9
51N	43N	629.6	135.8	224.2
51N	4230N	653.9	137.4	222.6
51N	42N	678.6	138.8	221.2
51N	4130N	703.7	140.2	219.8
51N	41N	729.1	141.5	218.5
5130N	61N	658.7	26.2	333.8
5130N	6030N	634.2	27.8	332.2
5130N	60N	610.2	29.4	330.6
5130N	5930N	586.8	31.3	328.7
5130N	59N	564.0	33.2	326.8
5130N	5830N	541.8	35.3	324.7
5130N	58N	520.5	37.6	322.4
5130N	5730N	500.0	40.1	319.9
5130N	57N	482.0	42.8	317.2
5130N	5630N	463.6	45.7	314.3
5130N	56N	446.5	48.8	311.2
5130N	5530N	430.8	52.2	307.8
5130N	55N	416.7	55.8	304.2

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
5130N	5430N	404.4	59.6	300.4
5130N	54N	393.9	63.7	296.3
5130N	5330N	385.5	67.9	292.1
5130N	53N	379.3	72.3	287.7
5130N	5230N	375.4	76.9	283.1
5130N	52N	373.8	81.5	278.5
5130N	5130N	374.7	86.1	273.9
5130N	51N	377.9	90.6	269.4
5130N	5030N	383.5	95.1	264.9
5130N	50N	391.2	99.4	260.6
5130N	4930N	401.1	103.5	256.5
5130N	49N	412.9	107.4	252.6
5130N	4830N	426.5	111.1	248.9
5130N	48N	441.7	114.5	245.5
5130N	4730N	458.4	117.7	242.3
5130N	47N	476.4	120.6	239.4
5130N	4630N	495.5	123.4	236.6
5130N	46N	514.4	126.0	234.0
5130N	4530N	535.5	128.3	231.7
5130N	45N	557.4	130.5	229.5
5130N	4430N	580.0	132.5	227.5
5130N	44N	603.3	134.3	225.7
5130N	4330N	627.1	136.0	224.0
5130N	43N	651.4	137.6	222.4
5130N	4230N	676.2	139.1	220.9
5130N	42N	701.4	140.4	219.6
5130N	4130N	727.0	141.7	218.3
5130N	41N	752.8	142.9	217.1

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
52N	62N	681.5	24.4	335.6
52N	6130N	656.5	25.9	334.1
52N	61N	631.9	27.4	332.6
52N	6030N	607.8	29.1	330.9
52N	60N	584.3	30.9	329.1
52N	5930N	561.4	32.8	327.2
52N	59N	539.1	34.9	325.1
52N	5830N	517.6	37.2	322.8
52N	58N	498.5	39.7	320.3
52N	5730N	478.9	42.4	317.6
52N	57N	460.4	45.3	314.7
52N	5630N	443.2	48.5	311.5
52N	56N	427.3	51.8	308.2
52N	5530N	413.1	55.5	304.5
52N	55N	400.6	59.3	300.7
52N	5430N	390.0	63.4	296.6
52N	54N	381.5	67.7	292.3
52N	5330N	375.2	72.2	287.8
52N	53N	371.3	76.7	283.3
52N	5230N	369.7	81.4	278.6
52N	52N	370.5	86.1	273.9
52N	5130N	373.8	90.7	269.3
52N	51N	379.4	95.2	264.8
52N	5030N	387.3	99.5	260.5
52N	50N	397.2	103.6	256.4
52N	4930N	409.2	107.6	252.4
52N	49N	422.9	111.3	248.7
52N	4830N	438.2	114.7	245.3

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
52N	48N	455.0	117.9	242.1
52N	4730N	473.1	120.9	239.1
52N	47N	492.4	123.6	236.4
52N	4630N	511.4	126.2	233.8
52N	46N	532.6	128.6	231.4
52N	4530N	554.6	130.7	229.3
52N	45N	577.3	132.7	227.3
52N	4430N	600.7	134.6	225.4
52N	44N	624.6	136.3	223.7
52N	4330N	649.0	137.8	222.2
52N	43N	673.9	139.3	220.7
52N	4230N	699.2	140.7	219.3
52N	42N	724.8	141.9	218.1
5230N	62N	654.3	25.5	334.5
5230N	6130N	629.6	27.1	332.9
5230N	61N	605.4	28.7	331.3
5230N	6030N	581.8	30.5	329.5
5230N	60N	558.8	32.4	327.6
5230N	5930N	536.4	34.5	325.5
5230N	59N	514.8	36.8	323.2
5230N	5830N	495.5	39.4	320.6
5230N	58N	475.8	42.0	318.0
5230N	5730N	457.1	45.0	315.0
5230N	57N	439.8	48.1	311.9
5230N	5630N	423.8	51.5	308.5
5230N	56N	409.5	55.1	304.9
5230N	5530N	396.8	59.0	301.0
5230N	55N	386.1	63.1	296.9

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
5230N	5430N	377.5	67.5	292.5
5230N	54N	317.2	72.0	288.0
5230N	5330N	367.1	76.6	283.4
5230N	53N	365.5	81.3	278.7
5230N	5230N	366.4	86.0	274.0
5230N	52N	369.7	90.7	269.3
5230N	5130N	375.4	95.2	264.8
5230N	51N	383.3	99.6	260.4
5230N	5030N	393.3	103.8	256.2
5230N	50N	405.4	107.8	252.2
5230N	4930N	419.2	111.5	248.5
5230N	49N	434.7	114.9	245.1
5230N	4830N	451.6	118.2	241.8
5230N	48N	469.8	121.1	238.9
5230N	4730N	489.2	123.9	236.1
5230N	47N	508.3	126.5	233.5
5230N	4630N	529.6	128.8	231.2
5230N	46N	551.8	131.0	229.0
5230N	4530N	574.6	133.0	227.0
5230N	45N	598.1	134.8	225.2
5230N	4430N	622.1	136.5	223.5
5230N	44N	646.6	138.1	221.9
5230N	4330N	671.6	139.5	220.5
5230N	43N	696.9	140.9	219.1
5230N	4230N	722.6	142.1	217.9
5230N	42N	748.6	143.3	216.7
53N	63N	677.3	23.7	336.3
53N	6230N	652.1	25.2	334.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
53N	62N	627.3	26.7	333.3
53N	6130N	603.1	28.3	331.7
53N	61N	579.3	30.1	329.9
53N	6030N	556.2	32.1	327.9
53N	60N	533.7	34.2	325.8
53N	5930N	512.0	36.4	323.6
53N	59N	492.6	39.0	321.0
53N	5830N	472.7	41.7	318.3
53N	58N	453.9	44.6	315.4
53N	5730N	436.4	47.7	312.3
53N	57N	420.3	51.1	308.9
53N	5630N	405.8	54.8	305.2
53N	56N	393.1	58.7	301.3
53N	5530N	382.2	62.9	297.1
53N	55N	373.5	67.2	292.8
53N	5430N	367.1	71.8	288.2
53N	54N	363.0	76.5	283.5
53N	5330N	361.4	81.2	278.8
53N	53N	362.2	86.0	274.0
53N	5230N	365.5	90.7	269.3
53N	52N	371.3	95.3	264.7
53N	5130N	379.3	99.7	260.3
53N	51N	389.4	104.0	256.0
53N	5030N	401.6	108.0	252.0
53N	50N	415.5	111.7	248.3
53N	4930N	431.1	115.2	244.8
53N	49N	448.2	118.4	241.6
53N	4830N	466.5	121.4	238.6

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
53N	48N	486.0	124.1	235.9
53N	4730N	505.3	126.8	233.2
53N	47N	526.7	129.0	231.0
53N	4630N	548.9	131.3	228.7
53N	46N	571.9	133.2	226.8
53N	4530N	595.5	135.1	224.9
53N	45N	619.6	136.8	223.2
53N	4430N	644.2	138.3	221.7
53N	44N	669.2	139.8	220.2
53N	4330N	694.7	141.1	218.9
53N	43	720.4	142.4	217.6
5330N	63N	649.9	24.8	335.2
5330N	6230N	625.1	26.3	333.7
5330N	62N	600.7	28.0	332.0
5330N	6130N	576.8	29.7	330.3
5330N	61N	553.6	31.7	328.3
5330N	6030N	531.0	33.8	326.2
5330N	60N	509.1	36.0	324.0
5330N	5930N	489.6	38.6	321.4
5330N	59N	469.6	41.3	318.7
5330N	5830N	450.7	44.2	315.8
5330N	58N	433.0	47.3	312.7
5330N	5730N	416.8	50.8	309.2
5330N	57N	402.1	54.5	305.5
5330N	5630N	389.3	58.4	301.6
5330N	56N	378.3	62.6	297.4
5330N	5530N	369.5	67.0	293.0
5330N	55N	363.0	71.6	288.4

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
5330N	5430N	358.8	76.3	283.7
5330N	54N	357.2	81.1	278.9
5330N	5330N	358.0	86.0	274.0
5330N	53N	361.4	90.7	269.3
5330N	5230N	367.1	95.4	264.6
5330N	52N	375.2	99.9	260.1
5330N	5130N	385.5	104.1	255.9
5330N	51N	397.7	108.1	251.9
5330N	5030N	411.8	111.9	248.1
5330N	50N	427.5	115.4	244.6
5330N	4930N	444.7	118.7	241.3
5330N	49N	463.2	121.7	238.3
5330N	4830N	482.9	124.4	235.6
5330N	48N	502.2	127.0	233.0
5330N	4730N	523.8	129.4	230.6
5330N	47N	546.1	131.5	228.5
5330N	4630N	569.2	133.5	226.5
5330N	46N	592.8	135.3	224.7
5330N	4530N	617.1	137.0	223.0
5330N	45N	641.8	138.6	221.4
5330N	4430N	666.9	140.0	220.0
5330N	44N	692.4	141.4	218.6
5330N	4330N	718.3	142.6	217.4
5330N	43N	744.4	143.8	216.2
54N	64N	673.1	23.0	337.0
54N	6330N	647.7	24.4	355.6
54N	63N	622.8	25.9	334.1
54N	6230N	598.3	27.6	332.4

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
54N	62N	574.4	29.4	330.6
54N	6130N	551.0	31.3	328.7
54N	61N	528.3	33.4	326.6
54N	6030N	506.3	35.6	324.4
54N	60N	486.7	38.2	321.8
54N	5930N	466.5	40.9	319.1
54N	59N	447.4	43.8	316.2
54N	5830N	429.6	47.0	313.0
54N	58N	413.3	50.4	309.6
54N	5730N	398.5	54.1	305.9
54N	57N	385.4	58.1	301.9
54N	5630N	374.4	62.3	297.7
54N	56N	365.5	66.8	293.2
54N	5530N	358.8	71.4	288.6
54N	55N	354.6	76.2	283.8
54N	5430N	352.9	81.1	278.9
54N	54N	353.8	85.9	274.1
54N	5330N	357.2	90.8	269.2
54N	53N	363.0	95.5	264.5
54N	5230N	371.2	100.0	260.0
54N	52N	381.5	104.3	255.7
54N	5130N	393.9	108.3	251.7
54N	51N	408.1	112.1	247.9
54N	5030N	424.0	115.7	244.3
54N	50N	441.3	118.9	241.1
54N	4930N	459.9	121.9	238.1
54N	49N	479.7	124.7	235.3
54N	4830N	499.1	127.3	232.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
54N	48N	520.8	129.6	230.4
54N	4730N	543.3	131.8	228.2
54N	47N	566.4	133.8	226.2
54N	4630N	590.2	135.6	224.4
54N	46N	614.5	137.3	222.7
54N	4530N	639.3	138.8	221.2
54N	45N	664.6	140.3	219.7
54N	4430N	690.1	141.6	218.4
54N	44N	716.1	142.8	217.2
5430N	64N	645.6	24.1	335.9
5430N	6330N	620.6	25.6	334.4
5430N	63N	596.0	27.2	332.8
5430N	6230N	571.9	29.0	331.0
5430N	62N	548.4	30.9	329.1
5430N	6130N	525.6	33.0	327.0
5430N	61N	503.5	35.2	324.8
5430N	6030N	483.7	37.8	322.2
5430N	60N	463.4	40.4	319.6
5430N	5930N	444.2	43.4	316.6
5430N	59N	426.3	46.6	313.4
5430N	5830N	409.7	50.0	310.0
5430N	58N	394.8	53.7	306.3
5430N	5730N	381.6	57.7	302.3
5430N	57N	370.4	62.0	298.0
5430N	5630N	361.4	66.5	293.5
5430N	56N	354.7	71.2	288.8
5430N	5530N	350.4	76.1	283.9
5430N	55N	348.7	81.0	279.0

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
5430N	5430N	349.5	85.9	274.1
5430N	54N	352.9	90.8	269.2
5430N	5330N	358.8	95.6	264.4
5430N	53N	367.1	100.1	259.9
5430N	5230N	377.5	104.5	255.5
5430N	52N	390.0	108.6	251.4
5430N	5130N	404.4	112.4	247.6
5430N	51N	420.3	115.9	244.1
5430N	5030N	437.8	119.2	240.8
5430N	50N	456.6	122.2	237.8
5430N	4930N	476.5	125.0	235.0
5430N	49N	497.4	127.5	232.5
5430N	4830N	517.8	129.9	230.1
5430N	48N	540.4	132.1	227.9
5430N	4730N	563.7	134.1	225.9
5430N	47N	587.6	135.9	224.1
5430N	4630N	612.0	137.5	222.5
5430N	46N	636.9	139.1	220.9
5430N	4530N	662.2	140.5	219.5
5430N	45N	687.9	141.8	218.2
5430N	4430N	713.9	143.1	216.9
5430N	44N	740.2	144.2	215.8
55N	65N	669.0	22.3	337.7
55N	6430N	643.5	23.7	336.3
55N	64N	618.3	25.2	334.8
55N	6330N	593.6	26.8	333.2
55N	63N	569.5	28.6	331.4
55N	6230N	545.8	30.5	329.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
55N	62N	522.9	32.5	327.5
55N	6130N	500.7	34.8	325.2
55N	61N	480.8	37.3	322.7
55N	6030N	460.3	40.0	320.0
55N	60N	441.0	43.0	317.0
55N	5930N	422.9	46.2	313.8
55N	59N	406.2	49.6	310.4
55N	5830N	391.1	53.4	306.6
55N	58N	377.8	57.4	302.6
55N	5730N	366.5	61.7	298.3
55N	57N	357.3	66.3	293.7
55N	5630N	350.5	71.0	289.0
55N	56N	346.2	75.9	284.1
55N	5530N	344.4	80.9	279.1
55N	55N	345.2	85.9	274.1
55N	5430N	348.7	90.8	269.2
55N	54N	354.6	95.6	264.4
55N	5330N	363.0	100.3	259.7
55N	53N	373.5	104.7	255.3
55N	5230N	386.1	108.8	251.2
55N	52N	400.6	112.6	247.4
55N	5130N	416.7	116.2	243.8
55N	51N	434.3	119.5	240.5
55N	5030N	453.2	122.5	237.5
55N	50N	473.3	125.3	234.7
55N	4930N	494.3	121.8	232.2
55N	49N	514.9	130.2	229.8
55N	4830N	537.6	132.4	227.6

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
55N	48N	561.0	134.3	225.7
55N	4730N	585.0	136.1	223.9
55N	47N	609.5	137.8	222.2
55N	4630N	634.5	139.4	220.6
55N	46N	659.9	140.8	219.2
55N	4530N	685.6	142.1	217.9
55N	45N	711.7	143.3	216.7
5530N	65N	641.3	23.3	336.7
5530N	6430N	616.1	24.8	335.2
5530N	64N	591.3	26.4	333.6
5530N	6330N	567.0	28.2	331.8
5530N	63N	543.3	30.1	329.9
5530N	6230N	520.2	32.1	327.9
5530N	62N	499.4	34.4	325.6
5530N	6130N	477.8	36.9	323.1
5530N	61N	457.2	39.6	320.4
5530N	6030N	437.7	42.5	317.5
5530N	60N	419.5	45.8	314.2
5530N	5930N	402.6	49.2	310.8
5530N	59N	387.4	53.0	307.0
5530N	5830N	373.9	57.1	302.9
5530N	58N	362.5	61.4	298.6
5530N	5730N	353.2	66.0	294.0
5530N	57N	346.3	70.8	289.2
5530N	5630N	341.9	75.8	284.2
5530N	56N	340.1	80.8	279.2
5530N	5530N	340.9	85.9	274.1
5530N	55N	344.4	90.9	269.1

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
5530N	5430N	350.4	95.7	264.3
5530N	54N	358.8	100.4	259.6
5530N	5330N	369.5	104.8	255.2
5530N	53N	382.2	109.0	251.0
5530N	5230N	396.8	112.9	247.1
5530N	52N	413.1	116.5	243.5
5530N	5130N	430.8	119.8	240.2
5530N	51N	449.9	122.8	237.2
5530N	5030N	470.0	125.6	234.4
5530N	50N	491.2	128.1	231.9
5530N	4930N	511.9	130.5	229.5
5530N	49N	534.7	132.7	227.3
5530N	4830N	558.2	134.6	225.4
5530N	48N	582.3	136.4	223.6
5530N	4730N	607.0	138.1	221.9
5530N	47N	632.0	139.6	220.4
5530N	4630N	657.5	141.0	219.0
5530N	46N	683.4	142.3	217.7
5530N	4530N	709.5	143.6	216.4
5530N	45N	736.0	144.7	215.3
56N	66N	664.9	21.6	338.4
56N	6530N	639.2	22.9	337.1
56N	65N	613.9	24.4	335.6
56N	6430N	589.0	26.0	334.0
56N	64N	564.6	27.7	332.3
56N	6330N	540.8	29.6	330.4
56N	63N	517.5	31.7	328.3
56N	6230N	496.6	34.0	326.0

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
56N	62N	474.9	36.5	323.5
56N	6130N	454.2	39.2	320.8
56N	61N	434.5	42.1	317.9
56N	6030N	416.1	45.3	314.7
56N	60N	399.1	48.8	311.2
56N	5930N	383.7	52.6	307.4
56N	59N	370.1	56.7	303.3
56N	5830N	358.5	61.1	298.9
56N	58N	349.1	65.7	294.3
56N	5730N	342.1	70.6	289.4
56N	57N	337.6	75.6	284.4
56N	5630N	335.8	80.7	279.3
56N	56N	336.6	85.8	274.2
56N	5530N	340.1	90.9	269.1
56N	55N	346.2	95.8	264.2
56N	5430N	354.7	100.6	259.4
56N	54N	365.5	105.0	255.0
56N	5330N	378.3	109.2	250.8
56N	53N	393.1	113.1	246.9
56N	5230N	409.5	116.7	243.3
56N	52N	427.3	120.0	240.0
56N	5130N	446.5	123.1	236.9
56N	51N	466.8	125.9	234.1
56N	5030N	488.1	128.4	231.6
56N	50N	509.0	130.8	229.2
56N	4930N	531.9	133.0	227.0
56N	49N	555.5	134.9	225.1
56N	4830N	579.7	136.7	223.3

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
56N	48N	604.4	138.4	221.6
56N	4730N	629.6	139.9	220.1
56N	47N	655.2	141.3	218.7
56N	4630N	681.1	142.6	217.4
56N	46N	707.3	143.8	216.2
5630N	66N	637.1	22.5	337.5
5630N	6530N	611.7	24.0	336.0
5630N	65N	586.7	25.6	334.4
5630N	6430N	562.2	27.3	332.7
5630N	64N	538.2	29.2	330.8
5630N	6330N	514.9	31.3	328.7
5630N	63N	493.9	33.6	326.4
5630N	6230N	472.0	36.0	324.0
5630N	62N	451.1	38.7	321.3
5630N	6130N	431.3	41.7	318.3
5630N	61N	412.7	44.9	315.1
5630N	6030N	395.5	48.4	311.6
5630N	60N	380.0	52.2	307.8
5630N	5930N	366.2	56.3	303.7
5630N	59N	354.5	60.8	299.2
5630N	5830N	344.9	65.4	294.6
5630N	58N	337.8	70.4	289.6
5630N	5730N	333.3	75.4	284.6
5630N	57N	331.4	80.6	279.4
5630N	5630N	332.2	85.8	274.2
5630N	56N	335.8	91.0	269.0
5630N	5530N	341.9	95.9	264.1
5630N	55N	350.5	100.7	259.3

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
5630N	5430N	361.4	105.2	254.8
5630N	54N	374.4	109.5	250.5
5630N	5330N	389.3	113.4	246.6
5630N	53N	405.8	117.0	243.0
5630N	5230N	423.8	120.3	239.7
5630N	52N	443.2	123.4	236.6
5630N	5130N	463.6	126.2	233.8
5630N	51N	485.1	128.7	231.3
5630N	5030N	506.0	131.1	228.9
5630N	50N	529.0	133.3	226.7
5630N	4930N	552.8	135.2	224.8
5630N	49N	577.1	137.0	223.0
5630N	4830N	601.9	138.7	221.3
5630N	48N	627.2	140.2	219.8
5630N	4730N	652.8	141.6	218.4
5630N	47N	678.8	142.9	217.1
5630N	4630N	705.2	144.1	215.9
5630N	46N	731.8	145.2	214.8
57N	67N	660.9	20.8	339.2
57N	6630N	635.1	22.1	337.9
57N	66N	609.5	23.6	336.4
57N	6530N	584.4	25.2	334.8
57N	65N	559.8	26.9	333.1
57N	6430N	535.7	28.8	331.2
57N	64N	512.3	30.8	329.2
57N	6330N	491.1	33.1	326.9
57N	63N	469.1	35.6	324.4
57N	6230N	448.0	38.3	321.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
57N	62N	428.1	41.2	318.8
57N	6130N	409.3	44.5	315.5
57N	61N	392.0	48.0	312.0
57N	6030N	376.3	51.8	308.2
57N	60N	362.3	56.0	304.0
57N	5930N	350.4	60.4	299.6
57N	59N	340.8	65.2	294.8
57N	5830N	333.6	70.1	289.9
57N	58N	328.9	75.3	284.7
57N	5730N	327.0	80.5	279.5
57N	57N	327.9	85.8	274.2
57N	5630N	331.4	91.0	269.0
57N	56N	337.6	96.0	264.0
57N	5530N	346.3	100.9	259.1
57N	55N	357.3	105.4	254.6
57N	5430N	370.4	109.7	250.3
57N	54N	385.4	113.7	246.3
57N	5330N	402.1	117.3	242.7
57N	53N	420.3	120.7	239.3
57N	5230N	439.8	123.7	236.3
57N	52N	460.4	126.5	233.5
57N	5130N	482.0	129.1	230.9
57N	51N	503.0	131.4	228.6
57N	5030N	526.2	133.6	226.4
57N	50N	550.0	135.5	224.5
57N	4930N	574.5	137.3	222.7
57N	49N	599.4	138.9	221.1
57N	4830N	624.7	140.5	219.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
57N	48N	650.5	141.8	218.2
57N	4730N	676.6	143.1	216.9
57N	47N	703.0	144.3	215.7
5730N	67N	633.0	21.7	338.3
5730N	6630N	607.4	23.2	336.8
5730N	66N	528.2	24.8	335.2
5730N	6530N	557.4	26.5	333.5
5730N	65N	533.2	28.4	331.6
5730N	6430N	509.6	30.4	329.6
5730N	64N	488.3	32.7	327.3
5730N	6330N	466.2	35.1	324.9
5730N	63N	445.0	37.8	322.2
5730N	6230N	424.9	40.8	319.2
5730N	62N	405.9	44.0	316.0
5730N	6130N	388.4	47.6	312.4
5730N	61N	372.5	51.4	308.6
5730N	6030N	358.5	55.6	304.4
5730N	60N	346.4	60.1	299.9
5730N	5930N	336.6	64.9	295.1
5730N	59N	329.3	69.9	290.1
5730N	5830N	324.6	75.1	284.9
5730N	58N	322.6	80.4	279.6
5730N	5730N	323.4	85.8	274.2
5730N	57N	327.0	91.0	269.0
5730N	5630N	333.3	96.2	263.8
5730N	56N	342.1	101.0	259.0
5730N	5530N	353.2	105.7	254.3
5730N	55N	366.5	110.0	250.0

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
5730N	5430N	381.6	113.9	246.1
5730N	54N	398.5	117.6	242.4
5730N	5330N	416.8	121.0	239.0
5730N	53N	436.4	124.0	236.0
5730N	5230N	457.1	126.8	233.2
5730N	52N	478.9	129.4	230.6
5730N	5130N	500.0	131.8	228.2
5730N	51N	523.3	133.9	226.1
5730N	5030N	547.3	135.8	224.2
5730N	50N	571.8	137.6	222.4
5730N	4930N	596.8	139.2	220.8
5730N	49N	622.3	140.7	219.3
5730N	4830N	648.1	142.1	217.9
5730N	48N	674.3	143.4	216.6
5730N	4730N	700.8	144.6	215.4
5730N	47N	727.6	145.7	214.3
58N	68N	657.0	20.0	340.0
58N	6730N	631.0	21.3	338.7
58N	67N	605.2	22.8	337.2
58N	6630N	579.9	24.4	335.6
58N	66N	555.1	26.1	333.9
58N	6530N	530.7	27.9	332.1
58N	65N	507.0	30.0	330.0
58N	6430N	485.6	32.2	327.8
58N	64N	463.3	34.7	325.3
58N	6330N	442.0	37.4	322.6
58N	63N	421.7	40.3	319.7
58N	6230N	402.6	43.6	316.4

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
58N	62N	384.9	47.1	312.9
58N	6130N	368.8	51.0	309.0
58N	61N	354.6	55.2	304.8
58N	6030N	342.4	59.7	300.3
58N	60N	332.4	64.6	295.4
58N	5930N	325.0	69.7	290.3
58N	59N	320.2	74.9	285.1
58N	5830N	318.2	80.3	279.7
58N	58N	319.0	85.8	274.2
58N	5730N	322.6	91.1	268.9
58N	57N	328.9	96.3	263.7
58N	5630N	337.8	101.2	258.8
58N	56N	349.1	105.9	254.1
58N	5530N	362.5	110.2	249.8
58N	55N	377.8	114.2	245.8
58N	5430N	394.8	117.9	242.1
58N	54N	413.3	121.3	238.7
58N	5330N	433.0	124.4	235.6
58N	53N	453.9	127.2	232.8
58N	5230N	475.8	129.7	230.3
58N	52N	498.5	132.0	228.0
58N	5130N	520.5	134.2	225.8
58N	51N	544.6	136.1	223.9
58N	5030N	569.2	137.9	222.1
58N	50N	594.3	139.5	220.5
58N	4930N	619.9	141.0	219.0
58N	49N	645.8	142.4	217.6
58N	4830N	672.1	143.7	216.3

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
58N	48N	698.6	144.8	215.2
5830N	68N	628.9	20.9	339.1
5830N	6730N	603.1	22.4	337.6
5830N	67N	577.7	23.9	336.1
5830N	6630N	552.7	25.6	334.4
5830N	66N	528.3	27.5	332.5
5830N	6530N	504.4	29.5	330.5
5830N	65N	482.9	31.8	328.2
5830N	6430N	460.5	34.2	325.8
5830N	64N	438.9	36.9	323.1
5830N	6330N	418.5	39.9	320.1
5830N	63N	399.2	43.1	316.9
5830N	6230N	381.3	46.7	313.3
5830N	62N	365.1	50.6	309.4
5830N	6130N	350.7	54.8	305.2
5830N	61N	338.3	59.4	300.6
5830N	6030N	328.2	64.3	295.7
5830N	60N	320.7	69.4	290.6
5830N	5930N	315.8	74.8	285.2
5830N	59N	313.7	80.2	279.8
5830N	5830N	314.5	85.7	274.3
5830N	58N	318.2	91.1	268.9
5830N	5730N	324.6	96.4	263.6
5830N	57N	333.6	101.4	258.6
5830N	5630N	344.9	106.1	253.9
5830N	56N	358.5	110.5	249.5
5830N	5530N	373.9	114.5	245.5
5830N	55N	391.1	118.2	241.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
5830N	5430N	409.7	121.6	238.4
5830N	54N	429.6	124.7	235.3
5830N	5330N	450.7	127.5	232.5
5830N	53N	472.7	130.1	229.9
5830N	5230N	495.5	132.4	227.6
5830N	52N	517.6	134.5	225.5
5830N	5130N	541.8	136.5	223.5
5830N	51N	566.6	138.2	221.8
5830N	5030N	591.8	139.8	220.2
5830N	50N	617.5	141.3	218.7
5830N	4930N	643.5	142.7	217.3
5830N	49N	669.8	144.0	216.0
5830N	4830N	696.5	145.1	214.9
5830N	48N	723.4	146.2	213.8
59N	69N	653.2	19.2	340.8
59N	6830N	626.9	20.5	339.5
59N	68N	601.0	22.0	338.0
59N	6730N	575.5	23.5	336.5
59N	67N	550.4	25.2	334.8
59N	6630N	525.8	27.0	333.0
59N	66N	501.9	29.0	331.0
59N	6530N	480.2	31.3	328.7
59N	65N	457.6	33.7	326.3
59N	6430N	435.9	36.4	323.6
59N	64N	415.3	39.4	320.6
59N	6330N	395.8	42.6	317.4
59N	63N	377.8	46.2	313.8
59N	6230N	361.4	50.1	309.9

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
59N	62N	346.8	54.4	305.6
59N	6130N	334.2	59.0	301.0
59N	61N	324.0	63.9	296.1
59N	6030N	316.3	69.2	290.8
59N	60N	311.4	74.6	285.4
59N	5930N	309.3	80.1	279.9
59N	59N	310.1	85.7	274.3
59N	5830N	313.7	91.2	268.8
59N	58N	320.2	96.5	263.5
59N	5730N	329.3	101.6	258.4
59N	57N	340.8	106.3	253.7
59N	5630N	354.5	110.8	249.2
59N	56N	370.1	114.8	245.2
59N	5530N	387.4	118.6	241.4
59N	55N	406.2	122.0	238.0
59N	5430N	426.3	125.0	235.0
59N	54N	447.4	127.9	232.1
59N	5330N	469.6	130.4	229.6
59N	53N	492.6	132.7	227.3
59N	5230N	514.8	134.9	225.1
59N	52N	539.1	136.8	223.2
59N	5130N	564.0	138.5	221.5
59N	51N	589.3	140.2	219.8
59N	5030N	615.0	141.6	218.4
59N	50N	641.2	143.0	217.0
59N	4930N	667.6	144.2	215.8
59N	49N	694.3	145.4	214.6
5930N	69N	624.9	20.1	339.9

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
5930N	6830N	598.9	21.5	338.5
5930N	68N	573.3	23.1	336.9
5930N	6730N	548.1	24.7	335.3
5930N	67N	523.4	26.6	333.4
5930N	6630N	499.3	28.6	331.4
5930N	66N	477.5	30.8	329.2
5930N	6530N	454.8	33.3	326.7
5930N	65N	432.9	35.9	324.1
5930N	6430N	412.1	38.9	321.1
5930N	64N	392.5	42.2	317.8
5930N	6330N	374.3	45.7	314.3
5930N	63N	357.7	49.7	310.3
5930N	6230N	342.9	54.0	306.0
5930N	62N	330.2	58.6	301.4
5930N	6130N	319.8	63.6	296.4
5930N	61N	312.0	68.9	291.1
5930N	6030N	306.9	74.4	285.6
5930N	60N	304.8	80.0	280.0
5930N	5930N	305.5	85.7	274.3
5930N	59N	309.3	91.3	268.7
5930N	5830N	315.8	96.6	263.4
5930N	58N	325.0	101.8	258.2
5930N	5730N	336.6	106.6	253.4
5930N	57N	350.4	111.1	248.9
5930N	5630N	366.2	115.2	244.8
5930N	56N	383.7	118.9	241.1
5930N	5530N	402.6	122.3	237.7
5930N	55N	422.9	125.4	234.6

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
5930N	5430N	444.2	128.2	231.8
5930N	54N	466.5	130.8	229.2
5930N	5330N	489.6	133.1	226.9
5930N	53N	512.0	135.2	224.8
5930N	5230N	536.4	137.1	222.9
5930N	52N	561.4	138.9	221.1
5930N	5130N	586.8	140.5	219.5
5930N	51N	612.6	141.9	218.1
5930N	5030N	638.8	143.3	216.7
5930N	50N	665.4	144.5	215.5
5930N	4930N	692.2	145.7	214.3
5930N	49N	719.2	146.7	213.3
60N	70N	649.4	18.4	341.6
60N	6930N	623.0	19.7	340.3
60N	69N	596.9	21.1	338.9
60N	6830N	571.1	22.6	337.4
60N	68N	545.8	24.3	335.7
60N	6730N	521.0	26.1	333.9
60N	67N	498.5	28.1	331.9
60N	6630N	474.8	30.3	329.7
60N	66N	451.9	32.8	327.2
60N	6530N	429.9	35.4	324.6
60N	65N	408.9	38.4	321.6
60N	6430N	389.2	41.7	318.3
60N	64N	370.7	45.3	314.7
60N	6330N	353.9	49.2	310.8
60N	63N	339.0	53.5	306.5
60N	6230N	326.1	58.2	301.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
60N	62N	315.6	63.3	296.7
60N	6130N	307.6	68.6	291.4
60N	61N	302.5	74.2	285.8
60N	6030N	300.2	79.9	280.1
60N	60N	301.0	85.7	274.3
60N	5930N	304.8	91.3	268.7
60N	59N	311.4	96.8	263.2
60N	5830N	320.7	102.0	258.0
60N	58N	332.4	106.8	253.2
60N	5730N	346.4	111.3	248.7
60N	57N	362.3	115.5	244.5
60N	5630N	380.0	119.2	240.8
60N	56N	399.1	122.7	237.3
60N	5530N	419.5	125.8	234.2
60N	55N	441.0	128.6	231.4
60N	5430N	463.4	131.1	228.9
60N	54N	486.7	133.4	226.6
60N	5330N	509.1	135.6	224.4
60N	53N	533.7	137.5	222.5
60N	5230N	558.8	139.2	220.8
60N	52N	584.3	140.8	219.2
60N	5130N	610.2	142.2	217.8
60N	51N	636.5	143.6	216.4
60N	5030N	663.1	144.8	215.2
60N	50N	690.0	145.9	214.1
6030N	70N	621.0	19.3	340.7
6030N	6930N	594.8	20.7	339.3
6030N	69N	569.0	22.2	337.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
6030N	6830N	543.6	23.8	336.2
6030N	68N	518.6	25.6	334.4
6030N	6730N	496.0	27.7	332.3
6030N	67N	472.2	29.9	330.1
6030N	6630N	449.1	32.3	327.7
6030N	66N	427.0	34.9	325.1
6030N	6530N	405.8	37.9	322.1
6030N	65N	385.8	41.2	318.8
6030N	6430N	367.2	44.8	315.2
6030N	64N	350.2	48.7	311.3
6030N	6330N	335.1	53.1	306.9
6030N	63N	322.0	57.8	302.2
6030N	6230N	311.3	62.9	297.1
6030N	62N	303.2	68.4	291.6
6030N	6130N	298.0	74.0	286.0
6030N	61N	295.7	79.8	280.2
6030N	6030N	296.5	85.6	274.4
6030N	60N	300.2	91.4	268.6
6030N	5930N	306.9	96.9	263.1
6030N	59N	316.3	102.2	257.8
6030N	5830N	328.2	107.1	252.9
6030N	58N	342.4	111.7	248.3
6030N	5730N	358.5	115.8	244.2
6030N	57N	376.3	119.6	240.4
6030N	5630N	395.5	123.0	237.0
6030N	56N	416.1	126.1	233.9
6030N	5530N	437.7	128.9	231.1
6030N	55N	460.3	131.5	228.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
6030N	5430N	483.7	133.8	226.2
6030N	54N	506.3	135.9	224.1
6030N	5330N	531.0	137.8	222.2
6030N	53N	556.2	139.5	220.5
6030N	5230N	581.8	141.1	218.9
6030N	52N	607.8	142.6	217.4
6030N	5130N	634.2	143.9	216.1
6030N	51N	660.9	145.1	214.9
6030N	5030N	687.9	146.2	213.8
6030N	50N	715.1	147.3	212.7
61N	71N	645.8	17.6	342.4
61N	7030N	619.1	18.9	341.1
61N	70N	592.8	20.2	339.8
61N	6930N	566.9	21.7	338.3
61N	69N	541.3	23.4	336.6
61N	6830N	516.3	25.2	334.8
61N	68N	493.5	27.2	332.8
61N	6730N	469.6	29.4	330.6
61N	67N	446.4	31.8	328.2
61N	6630N	424.0	34.4	325.6
61N	66N	402.7	37.4	322.6
61N	6530N	382.5	40.6	319.4
61N	65N	363.7	44.3	315.7
61N	6430N	346.5	48.3	311.7
61N	64N	331.2	52.7	307.3
61N	6330N	317.9	57.4	302.6
61N	63N	307.1	62.6	297.4
61N	6230N	298.2	68.1	291.9

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
61N	62N	293.5	73.8	286.2
61N	6130N	291.1	79.7	280.3
61N	61N	291.9	85.6	274.4
61N	6030N	295.7	91.4	268.6
61N	60N	302.5	97.1	262.9
61N	5930N	312.0	102.4	257.6
61N	59N	324.0	107.4	252.6
61N	5830N	338.3	112.0	248.0
61N	58N	354.6	116.2	243.8
61N	5730N	372.5	120.0	240.0
61N	57N	392.0	123.4	236.6
61N	5630N	412.7	126.5	233.5
61N	56N	434.5	129.3	230.7
61N	5530N	457.2	131.9	228.1
61N	55N	480.8	134.1	225.9
61N	5430N	503.5	136.3	223.7
61N	54N	528.3	138.2	221.8
61N	5330N	553.6	139.9	220.1
61N	53N	579.3	141.5	218.5
61N	5230N	605.4	142.9	217.1
61N	52N	631.9	144.2	215.8
61N	5130N	658.7	145.4	214.6
61N	51N	685.7	146.5	213.5
6130N	71N	617.2	18.5	341.5
6130N	7030N	590.8	19.8	340.2
6130N	70N	564.8	21.3	338.7
6130N	6930N	539.1	22.9	337.1
6130N	69N	513.9	24.7	335.3

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
6130N	6830N	491.1	26.7	333.3
6130N	68N	467.0	28.9	331.1
6130N	6730N	443.6	31.2	328.8
6130N	67N	421.1	33.9	326.1
6130N	6630N	399.6	36.9	323.1
6130N	66N	379.2	40.1	319.9
6130N	6530N	360.2	43.8	316.2
6130N	65N	342.8	47.8	312.2
6130N	6430N	327.3	52.2	307.8
6130N	64N	313.8	57.0	303.0
6130N	6330N	302.8	62.2	297.8
6130N	63N	294.4	67.8	292.2
6130N	6230N	288.9	73.6	286.4
6130N	62N	286.5	79.6	280.4
6130N	6130N	287.3	85.6	274.4
6130N	61N	291.1	91.5	268.5
6130N	6030N	298.0	97.2	262.8
6130N	60N	307.6	102.6	257.4
6130N	5930N	319.8	107.7	252.3
6130N	59N	334.2	112.3	247.7
6130N	5830N	350.7	116.5	243.5
6130N	58N	368.8	120.3	239.7
6130N	5730N	388.4	123.8	236.2
6130N	57N	409.3	126.9	233.1
6130N	5630N	431.3	129.7	230.3
6130N	56N	454.2	132.3	227.7
6130N	5530N	477.8	136.5	225.5
6130N	55N	500.7	136.7	223.3

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
6130N	5430N	525.6	138.5	221.5
6130N	54N	551.0	140.2	219.8
6130N	5330N	576.8	141.8	218.2
6130N	53N	603.1	143.2	216.8
6130N	5230N	629.6	144.5	215.5
6130N	52N	656.5	145.7	214.3
6130N	5130N	683.6	146.8	213.2
6130N	51N	710.9	147.8	212.2
62N	72N	642.2	16.8	343.2
62N	7130N	615.4	18.0	342.0
62N	71N	588.8	19.4	340.6
62N	7030N	562.7	20.8	339.2
62N	70N	536.9	22.4	337.6
62N	6930N	511.6	24.2	335.8
62N	69N	488.6	26.2	333.8
62N	6830N	464.4	28.3	331.7
62N	68N	440.8	30.7	329.3
62N	6730N	418.2	33.4	326.6
62N	67N	396.5	36.3	323.7
62N	6630N	375.9	39.6	320.4
62N	66N	356.7	43.2	316.8
62N	6530N	339.1	47.3	312.7
62N	65N	323.4	51.7	308.3
62N	6430N	309.7	56.6	303.4
62N	64N	298.5	61.8	298.2
62N	6330N	290.0	67.5	292.5
62N	63N	284.4	73.4	286.6
62N	6230N	281.9	79.5	280.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
62N	62N	282.6	85.6	274.4
62N	6130N	286.5	91.6	268.4
62N	61N	293.5	97.4	262.6
62N	6030N	303.2	102.9	257.1
62N	60N	315.6	108.0	252.0
62N	5930N	330.2	112.6	247.4
62N	59N	346.8	116.9	243.1
62N	5830N	365.1	120.7	239.3
62N	58N	384.9	124.2	235.8
62N	5730N	405.9	127.3	232.7
62N	57N	428.1	130.1	229.9
62N	5630N	451.1	132.6	227.4
62N	56N	474.9	134.9	225.1
62N	5530N	499.4	137.0	223.0
62N	55N	522.9	138.9	221.1
62N	5430N	548.4	140.6	219.4
62N	54N	574.4	142.1	217.9
62N	5330N	600.7	143.5	216.5
62N	53N	627.3	144.8	215.2
62N	5230N	654.3	146.0	214.0
62N	52N	681.5	147.1	212.9
6230N	72N	613.5	17.6	342.4
6230N	7130N	586.9	18.9	341.1
6230N	71N	560.6	20.4	339.6
6230N	7030N	534.7	22.0	338.0
6230N	70N	509.3	23.7	336.3
6230N	6930N	486.2	25.7	334.3
6230N	69N	461.8	27.8	332.2

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
6230N	6830N	438.1	30.2	329.8
6230N	68N	415.3	32.8	327.2
6230N	6730N	393.4	35.8	324.2
6230N	67N	372.6	39.1	320.9
6230N	6630N	353.2	42.7	317.3
6230N	66N	335.4	46.7	313.3
6230N	6530N	319.5	51.2	308.8
6230N	65N	305.6	56.1	303.9
6230N	6430N	294.2	61.5	298.5
6230N	64N	285.5	67.2	292.8
6230N	6330N	279.8	73.2	286.8
6230N	63N	277.3	79.3	280.7
6230N	6230N	278.0	85.6	274.4
6230N	62N	281.9	91.7	268.3
6230N	6130N	288.9	97.6	262.4
6230N	61N	298.8	103.1	256.9
6230N	6030N	311.3	108.3	251.7
6230N	60N	326.1	113.0	247.0
6230N	5930N	342.9	117.3	242.7
6230N	59N	361.4	121.1	238.9
6230N	5830N	381.3	124.6	235.4
6230N	58N	402.6	127.7	232.3
6230N	5730N	424.9	130.5	229.5
6230N	57N	448.0	133.0	227.0
6230N	5630N	472.0	135.3	224.7
6230N	56N	496.6	137.4	222.6
6230N	5530N	520.2	139.3	220.7
6230N	55N	545.8	140.9	219.1

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
6230N	5430N	571.9	142.5	217.5
6230N	54N	598.3	143.9	216.1
6230N	5330N	625.1	145.2	214.8
6230N	53N	652.1	146.3	213.7
6230N	5230N	679.4	147.4	212.6
6230N	52N	706.8	148.4	211.6
63N	73N	638.7	15.9	344.1
63N	7230N	611.7	17.2	342.8
63N	72N	585.0	18.5	341.5
63N	7130N	558.6	19.9	340.1
63N	71N	532.6	21.5	338.5
63N	7030N	507.1	23.2	336.8
63N	70N	483.8	25.2	334.8
63N	6930N	459.3	27.3	332.7
63N	69N	435.4	29.7	330.3
63N	6830N	412.4	32.3	327.7
63N	68N	390.3	35.2	324.8
63N	6730N	369.4	38.5	321.5
63N	67N	349.8	42.1	317.9
63N	6630N	331.8	46.2	313.8
63N	66N	315.6	50.7	309.3
63N	6530N	301.5	55.7	304.3
63N	65N	289.9	61.1	298.9
63N	6430N	281.1	66.8	293.2
63N	64N	275.3	72.9	287.1
63N	6330N	272.7	79.2	280.8
63N	63N	273.3	85.5	274.5
63N	6230N	277.3	91.8	268.2

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
63N	62N	284.4	97.7	262.3
63N	6130N	294.4	103.4	256.6
63N	61N	307.1	108.6	251.4
63N	6030N	322.0	113.3	246.7
63N	60N	339.0	117.6	242.4
63N	5930N	357.7	121.5	238.5
63N	59N	377.8	125.0	235.0
63N	5830N	399.2	128.1	231.9
63N	58N	421.7	130.9	229.1
63N	5730N	445.0	133.5	226.5
63N	57N	469.1	135.7	224.3
63N	5630N	493.9	137.8	222.2
63N	56N	517.5	139.6	220.4
63N	5530N	543.3	141.3	218.7
63N	55N	569.5	142.8	217.2
63N	5430N	596.0	144.2	215.8
63N	54N	622.8	145.5	214.5
63N	5330N	649.9	146.7	213.3
63N	53N	677.3	147.7	212.3
6330N	73N	609.9	16.7	343.3
6330N	7230N	583.1	18.0	342.0
6330N	72N	556.6	19.4	340.6
6330N	7130N	530.5	21.0	339.0
6330N	71N	504.8	22.7	337.3
6330N	7030N	481.5	24.7	335.3
6330N	70N	456.8	26.8	333.2
6330N	6930N	432.8	29.1	330.9
6330N	69N	409.5	31.7	328.3

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
6330N	6830N	387.3	34.7	325.3
6330N	68N	366.2	37.9	322.1
6330N	6730N	346.3	41.6	318.4
6330N	67N	328.1	45.7	314.3
6330N	6630N	311.7	50.2	309.8
6330N	66N	297.4	55.2	304.8
6330N	6530N	285.6	60.6	299.4
6330N	65N	276.6	66.5	293.5
6330N	6430N	270.7	72.7	287.3
6330N	64N	268.0	79.1	280.9
6330N	6330N	268.7	85.5	274.5
6330N	63N	272.7	91.8	268.2
6330N	6230N	279.8	97.9	262.1
6330N	62N	290.0	103.6	256.4
6330N	6130N	302.8	108.9	251.1
6330N	61N	317.9	113.7	246.3
6330N	6030N	335.1	118.0	242.0
6330N	60N	353.9	122.0	238.0
6330N	5930N	374.3	125.4	234.6
6330N	59N	395.8	128.6	231.4
6330N	5830N	418.5	131.4	228.6
6330N	58N	442.0	133.9	226.1
6330N	5730N	466.2	136.1	223.9
6330N	57N	491.1	138.2	221.8
6330N	5630N	514.9	140.0	220.0
6330N	56N	540.8	151.7	218.3
6330N	5530N	567.0	153.2	216.8
6330N	55N	593.6	154.6	215.4

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
6330N	5430N	620.6	155.8	214.2
6330N	54N	647.7	157.0	213.0
6330N	5330N	675.2	158.0	212.0
6330N	53N	702.8	159.0	211.0
64N	74N	635.3	15.1	344.9
64N	7330N	608.1	16.3	343.7
64N	73N	581.2	17.6	342.4
64N	7230N	554.6	19.0	341.0
64N	72N	528.4	20.5	339.5
64N	7130N	502.6	22.2	337.8
64N	71N	479.1	24.1	335.9
64N	7030N	454.3	26.2	333.8
64N	70N	430.1	28.6	331.4
64N	6930N	406.7	31.2	328.8
64N	69N	384.3	34.1	325.9
64N	6830N	362.9	37.4	322.6
64N	68N	342.9	41.0	319.0
64N	6730N	324.4	45.1	314.9
64N	67N	307.8	49.7	310.3
64N	6630N	293.3	54.7	305.3
64N	66N	281.3	60.2	299.8
64N	6530N	272.2	66.2	293.8
64N	65N	266.1	72.5	287.5
64N	6430N	263.3	78.9	281.1
64N	64N	263.9	85.5	274.5
64N	6330N	268.0	91.9	268.1
64N	63N	275.3	98.1	261.9
64N	6230N	285.5	103.9	256.1

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
64N	62N	298.5	109.2	250.8
64N	6130N	313.8	114.1	245.9
64N	61N	331.2	118.5	241.5
64N	6030N	350.2	122.4	237.6
64N	60N	370.7	125.9	234.1
64N	5930N	392.5	129.0	231.0
64N	59N	415.3	131.8	228.2
64N	5830N	438.9	134.3	225.7
64N	58N	463.3	136.5	223.5
64N	5730N	488.3	138.6	221.4
64N	57N	512.3	140.4	219.6
64N	5630N	538.2	142.1	217.9
64N	56N	564.6	143.6	216.4
64N	5530N	591.3	144.9	215.1
64N	55N	618.3	146.2	213.8
64N	5430N	645.6	147.3	212.7
64N	54N	673.1	148.4	211.6
6430N	74N	606.4	15.8	344.2
6430N	7330N	579.4	17.1	342.9
6430N	73N	552.7	18.5	341.5
6430N	7230N	526.4	20.0	340.0
6430N	72N	500.4	21.7	338.3
6430N	7130N	476.8	23.6	336.4
6430N	71N	451.8	25.7	334.3
6430N	7030N	427.5	28.0	332.0
6430N	70N	403.9	30.6	329.4
6430N	6930N	381.3	33.5	326.5
6430N	69N	359.7	36.8	323.2

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
6430N	6830N	339.5	40.4	319.6
6430N	68N	320.8	44.5	315.5
6430N	6730N	303.9	49.1	310.9
6430N	67N	289.2	54.2	305.8
6430N	6630N	277.0	59.8	300.2
6430N	66N	267.7	65.8	294.2
6430N	6530N	261.4	72.2	287.8
6430N	65N	258.6	78.8	281.2
6430N	6430N	259.2	85.5	274.5
6430N	64N	263.3	92.0	268.0
6430N	6330N	270.7	98.3	261.7
6430N	63N	281.1	104.2	255.8
6430N	6230N	294.2	109.6	250.4
6430N	62N	309.7	114.5	245.5
6430N	6130N	327.3	118.9	241.1
6430N	61N	346.5	122.8	237.2
6430N	6030N	367.2	126.3	233.7
6430N	60N	389.2	129.5	230.5
6430N	5930N	412.1	130.5	227.7
6430N	59N	435.9	134.7	225.3
6430N	5830N	460.5	137.0	223.0
6430N	58N	485.6	139.0	221.0
6430N	5730N	509.6	140.8	219.2
6430N	57N	535.7	142.5	217.5
6430N	5630N	562.2	143.9	216.1
6430N	56N	589.0	145.3	214.7
6430N	5530N	616.1	146.5	213.5
6430N	55N	643.5	147.6	212.4

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
6430N	5430N	671.0	148.7	211.3
6430N	54N	698.8	149.6	210.4
65N	75N	632.1	14.2	345.8
65N	7430N	604.7	15.4	344.6
65N	74N	577.6	16.6	343.4
65N	7330N	550.8	18.0	342.0
65N	73N	524.3	19.5	340.5
65N	7230N	498.3	21.2	338.8
65N	72N	474.6	23.1	336.9
65N	7130N	449.4	25.1	334.9
65N	71N	424.9	27.4	332.6
65N	7030N	401.2	30.0	330.0
65N	70N	378.3	32.9	327.1
65N	6930N	356.6	36.2	323.8
65N	69N	336.1	39.8	320.2
65N	6830N	317.2	43.9	316.1
65N	68N	300.1	48.6	311.4
65N	6730N	285.2	53.7	306.3
65N	67N	272.7	59.3	300.7
65N	6630N	263.2	65.4	294.6
65N	66N	256.8	71.8	288.1
65N	6530N	253.9	78.7	281.3
65N	65N	254.5	85.5	274.5
65N	6430N	258.6	92.1	267.9
65N	64N	266.1	98.5	261.5
65N	6330N	276.6	104.5	255.5
65N	63N	289.9	109.9	250.1
65N	6230N	305.6	114.9	245.1

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
65N	62N	323.4	119.3	240.7
65N	6130N	342.8	123.3	236.7
65N	61N	363.7	126.8	233.2
65N	6030N	385.8	129.9	230.1
65N	60N	408.9	132.7	227.3
65N	5930N	432.9	135.2	224.8
65N	59N	457.6	137.4	222.6
65N	5830N	482.9	139.4	220.6
65N	58N	507.0	141.2	218.8
65N	5730N	533.2	142.8	217.2
65N	57N	559.8	144.3	215.7
65N	5630N	586.7	145.6	214.4
65N	56N	613.9	146.9	213.1
65N	5530N	641.3	148.0	212.0
65N	55N	669.0	149.0	211.0
6530N	75N	603.0	14.9	345.1
6530N	7430N	575.8	16.2	343.8
6530N	74N	548.9	17.5	342.5
6530N	7330N	522.3	19.0	341.0
6530N	73N	498.2	20.7	339.3
6530N	7230N	472.3	22.5	337.5
6530N	72N	447.0	24.6	335.4
6530N	7130N	422.4	26.9	333.1
6530N	71N	398.4	29.4	330.6
6530N	7030N	375.4	32.3	327.7
6530N	70N	353.4	35.5	324.5
6530N	6930N	332.8	39.2	320.8
6530N	69N	313.6	43.3	316.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
6530N	6830N	296.3	48.0	312.0
6530N	68N	281.1	53.1	306.9
6530N	6730N	268.4	58.9	301.1
6530N	67N	258.7	65.0	295.0
6530N	6630N	252.2	71.7	288.3
6530N	66N	249.1	78.5	281.5
6530N	6530N	249.7	85.4	274.6
6530N	65N	253.9	92.2	267.8
6530N	6430N	261.4	98.7	261.3
6530N	64N	272.2	104.8	255.2
6530N	6330N	285.6	110.3	249.7
6530N	63N	301.5	115.3	244.7
6530N	6230N	319.5	119.8	240.2
6530N	62N	339.1	123.8	236.2
6530N	6130N	360.2	127.3	232.7
6530N	61N	382.5	130.4	229.6
6530N	6030N	405.8	133.2	226.8
6530N	60N	429.9	135.6	224.4
6530N	5930N	454.8	137.8	222.2
6530N	59N	480.2	139.8	220.2
6530N	5830N	504.4	141.6	218.4
6530N	58N	530.7	143.2	216.8
6530N	5730N	557.4	144.7	215.3
6530N	57N	584.4	146.0	214.0
6530N	5630N	611.7	147.2	212.8
6530N	56N	639.2	148.3	211.7
6530N	5530N	667.0	149.3	210.7
6530N	55N	694.9	150.3	209.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
66N	76N	628.9	13.3	346.7
66N	7530N	601.4	14.5	345.5
66N	75N	574.1	15.7	344.3
66N	7430N	547.1	17.0	343.0
66N	74N	520.4	18.5	341.5
66N	7330N	496.1	20.2	339.8
66N	73N	470.1	22.0	338.0
66N	7230N	444.7	24.0	336.0
66N	72N	419.8	26.3	333.7
66N	7130N	395.7	28.8	331.2
66N	71N	372.5	31.7	328.3
66N	7030N	350.3	34.9	325.1
66N	70N	329.4	38.6	321.4
66N	6930N	310.0	42.7	317.3
66N	69N	292.4	47.4	312.6
66N	6830N	277.0	52.6	307.4
66N	68N	264.1	58.4	301.6
66N	6730N	254.2	64.7	295.3
66N	67N	247.5	71.4	288.6
66N	6630N	244.4	78.4	281.6
66N	66N	244.9	85.4	274.6
66N	6530N	249.1	92.3	267.7
66N	65N	256.8	99.0	261.0
66N	6430N	267.7	105.1	254.9
66N	64N	281.3	110.7	249.3
66N	6330N	297.4	115.7	244.3
66N	63N	315.6	120.2	239.8
66N	6230N	335.4	124.2	235.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
66N	62N	356.7	127.8	232.2
66N	6130N	379.2	130.9	229.1
66N	61N	402.7	133.6	226.4
66N	6030N	427.0	136.1	223.9
66N	60N	451.9	138.3	221.7
66N	5930N	477.5	140.3	219.7
66N	59N	501.9	142.1	217.9
66N	5830N	528.3	143.6	216.4
66N	58N	555.1	145.1	214.9
66N	5730N	582.2	146.4	213.6
66N	57N	609.5	147.6	212.4
66N	5630N	637.1	148.7	211.3
66N	56N	664.9	149.7	210.3
6630N	76N	599.8	14.0	346.0
6630N	7530N	572.4	15.2	344.8
6630N	75N	545.3	16.5	343.5
6630N	7430N	518.5	18.0	342.0
6630N	74N	494.1	19.6	340.4
6630N	7330N	467.9	21.4	338.6
6630N	73N	442.3	23.4	336.6
6630N	7230N	417.3	25.7	334.3
6630N	72N	393.1	28.2	331.8
6630N	7130N	369.6	31.1	328.9
6630N	71N	347.2	34.3	325.7
6630N	7030N	326.1	37.9	322.1
6630N	70N	306.5	42.1	317.9
6630N	6930N	288.6	46.8	313.2
6630N	69N	272.9	52.0	308.0

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
6630N	6830N	259.8	57.9	302.1
6630N	68N	249.7	64.3	295.7
6630N	6730N	242.8	71.1	288.9
6630N	67N	239.6	78.2	281.8
6630N	6630N	240.1	85.4	274.6
6630N	66N	244.4	92.5	267.5
6630N	6530N	252.2	99.2	260.8
6630N	65N	263.2	105.4	254.6
6630N	6430N	277.0	111.1	248.9
6630N	64N	293.3	116.2	243.8
6630N	6330N	311.7	120.7	239.3
6630N	63N	331.8	124.7	235.3
6630N	6230N	353.2	128.3	231.7
6630N	62N	375.9	131.4	228.6
6630N	6130N	399.6	134.1	225.9
6630N	61N	424.0	136.6	223.4
6630N	6030N	449.1	138.8	221.2
6630N	60N	474.8	140.7	219.3
6630N	5930N	499.3	142.5	217.5
6630N	59N	525.8	144.1	215.9
6630N	5830N	552.7	145.5	214.5
6630N	58N	579.9	146.8	213.2
6630N	5730N	607.4	147.9	212.1
6630N	57N	635.1	149.0	211.0
6630N	5630N	662.9	150.0	210.0
6630N	56N	691.0	150.9	209.1
67N	77N	625.9	12.5	347.5
67N	7630N	598.2	13.5	346.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
67N	76N	570.7	14.7	345.3
67N	7530N	543.5	16.0	344.0
67N	75N	516.6	17.5	342.5
67N	7430N	492.1	19.1	340.9
67N	74N	465.8	20.9	339.1
67N	7330N	440.1	22.8	337.2
67N	73N	414.9	25.1	334.9
67N	7230N	390.4	27.6	332.4
67N	72N	366.8	30.4	329.6
67N	7130N	344.2	33.6	326.4
67N	71N	322.8	37.3	322.7
67N	7030N	302.9	41.4	318.6
67N	70N	284.8	46.1	313.9
67N	6930N	268.9	51.4	308.6
67N	69N	255.5	57.3	302.7
67N	6830N	245.1	63.8	296.2
67N	68N	238.1	70.8	289.2
67N	6730N	234.8	78.0	282.0
67N	67N	235.3	85.4	274.6
67N	6630N	239.6	92.6	267.4
67N	66N	247.5	99.4	260.6
67N	6530N	258.7	105.8	254.2
67N	65N	272.7	111.5	248.5
67N	6430N	289.2	116.7	243.3
67N	64N	307.8	121.2	238.8
67N	6330N	328.1	125.2	234.8
67N	63N	349.8	128.8	231.2
67N	6230N	372.6	131.9	228.1

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
67N	62N	396.5	134.6	225.4
67N	6130N	421.1	137.1	222.9
67N	61N	446.4	139.2	220.8
67N	6030N	472.2	141.2	218.8
67N	60N	498.5	142.9	217.1
67N	5930N	523.4	144.5	215.5
67N	59N	550.4	145.9	214.1
67N	5830N	577.7	147.1	212.9
67N	58N	605.2	148.3	211.7
67N	5730N	633.0	149.4	210.6
67N	57N	660.9	150.3	209.7
6730N	77N	596.6	13.1	346.9
6730N	7630N	569.1	14.2	345.8
6730N	76N	541.7	15.5	344.5
6730N	7530N	514.7	16.9	343.1
6730N	75N	490.1	18.5	341.5
6730N	7430N	463.7	20.3	339.7
6730N	74N	437.8	22.2	337.8
6730N	7330N	412.5	24.5	335.5
6730N	73N	387.8	26.9	333.1
6730N	7230N	364.0	29.8	330.2
6730N	72N	341.2	33.0	327.0
6730N	7130N	319.6	36.6	323.4
6730N	71N	299.4	40.8	319.2
6730N	7030N	281.1	45.5	314.5
6730N	70N	264.9	50.8	309.2
6730N	6930N	251.2	56.8	303.2
6730N	69N	240.6	63.4	296.6

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
6730N	6830N	233.4	70.5	289.5
6730N	68N	230.0	77.9	282.1
6730N	6730N	230.4	85.4	274.6
6730N	67N	234.8	92.7	267.3
6730N	6630N	242.8	99.7	260.3
6730N	66N	254.2	106.1	253.9
6730N	6530N	268.4	112.0	248.0
6730N	65N	285.2	117.1	242.9
6730N	6430N	303.9	121.7	238.3
6730N	64N	324.4	125.8	234.2
6730N	6330N	346.3	129.3	230.7
6730N	63N	369.4	132.4	227.6
6730N	6230N	393.4	135.1	224.9
6730N	62N	418.2	137.6	222.4
6730N	6130N	443.6	139.7	220.3
6730N	61N	469.6	141.6	218.4
6730N	6030N	496.0	143.3	216.7
6730N	60N	521.0	144.9	215.1
6730N	5930N	548.1	146.3	213.7
6730N	59N	575.5	147.5	212.5
6730N	5830N	603.1	148.7	211.3
6730N	58N	631.0	149.7	210.3
6730N	5730N	659.0	150.7	209.3
6730N	57N	687.2	151.6	208.4
68N	78N	623.0	11.6	348.4
68N	7730N	595.1	12.6	347.4
68N	77N	567.4	13.7	346.3
68N	7630N	540.0	15.0	345.0

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
68N	76N	512.9	16.4	343.6
68N	7530N	488.2	18.0	342.0
68N	75N	461.6	19.7	340.3
68N	7430N	435.6	21.7	338.3
68N	74N	410.1	23.8	336.2
68N	7330N	385.3	26.3	333.7
68N	73N	361.2	29.1	330.9
68N	7230N	338.2	32.3	327.7
68N	72N	316.3	35.9	324.1
68N	7130N	295.9	40.1	319.9
68N	71N	277.3	44.8	315.2
68N	7030N	260.8	50.2	309.8
68N	70N	246.9	56.2	303.8
68N	6930N	236.1	62.9	297.1
68N	69N	228.7	70.1	289.9
68N	6830N	225.1	77.7	282.3
68N	68N	225.6	85.4	274.6
68N	6730N	230.0	92.9	267.1
68N	67N	238.1	100.0	260.0
68N	6630N	249.7	106.5	253.5
68N	66N	264.1	112.4	247.6
68N	6530N	281.1	117.7	242.3
68N	65N	300.1	122.3	237.7
68N	6430N	320.8	126.3	233.7
68N	64N	342.9	129.8	230.2
68N	6330N	366.2	132.9	227.1
68N	63N	390.3	135.7	224.3
68N	6230N	415.3	138.1	221.9

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
68N	62N	440.8	140.2	219.8
68N	6130N	467.0	142.1	217.9
68N	61N	493.5	143.8	216.2
68N	6030N	518.6	145.3	214.7
68N	60N	545.8	146.7	213.3
68N	5930N	573.3	147.9	212.1
68N	59N	601.0	149.1	210.9
68N	5830N	628.9	150.1	209.9
68N	58N	657.0	151.0	209.0
6830N	78N	593.6	12.1	347.9
6830N	7730N	565.9	13.3	346.7
6830N	77N	538.4	14.5	345.5
6830N	7630N	511.1	15.9	344.1
6830N	76N	486.3	17.4	342.6
6830N	7530N	459.6	19.1	340.9
6830N	75N	433.4	21.0	339.0
6830N	7430N	407.7	23.2	336.8
6830N	74N	382.7	25.6	334.4
6830N	7330N	358.5	28.4	331.6
6830N	73N	335.2	31.6	328.4
6830N	7230N	313.2	35.2	324.8
6830N	72N	292.5	39.4	320.6
6830N	7130N	273.6	44.1	315.9
6830N	71N	256.8	49.6	310.4
6830N	7030N	242.7	55.7	304.3
6830N	70N	231.6	62.4	297.6
6830N	6930N	224.0	69.8	290.2
6830N	69N	220.3	77.5	282.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
6830N	6830N	220.7	85.3	274.7
6830N	68N	225.1	93.0	267.0
6830N	6730N	233.4	100.3	259.7
6830N	67N	245.1	106.9	253.1
6830N	6630N	259.8	112.9	247.1
6830N	66N	277.0	118.2	241.8
6830N	6530N	296.3	122.8	237.2
6830N	65N	317.2	126.9	233.1
6830N	6430N	339.5	130.4	229.6
6830N	64N	362.9	133.5	226.5
6830N	6330N	387.3	136.2	223.8
6830N	63N	412.4	138.6	221.4
6830N	6230N	438.1	140.7	219.3
6830N	62N	464.4	142.5	217.5
6830N	6130N	491.1	144.2	215.8
6830N	61N	516.3	145.8	214.2
6830N	6030N	543.6	147.1	212.9
6830N	60N	571.1	148.3	211.7
6830N	5930N	598.9	149.4	210.6
6830N	59N	626.9	150.4	209.6
6830N	5830N	655.1	151.4	208.6
6830N	58N	683.4	152.2	207.8
69N	79N	620.2	10.6	349.4
69N	7830N	592.2	11.6	348.4
69N	78N	564.3	12.8	347.2
69N	7730N	536.7	14.0	346.0
69N	77N	509.4	15.3	344.7
69N	7630N	484.4	16.9	343.1

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
69N	76N	457.6	18.5	341.5
69N	7530N	431.3	20.4	339.6
69N	75N	405.4	22.6	337.4
69N	7430N	380.3	25.0	335.0
69N	74N	355.8	27.7	332.3
69N	7330N	332.3	30.9	329.1
69N	73N	310.0	34.5	325.5
69N	7230N	289.1	38.7	321.3
69N	72N	269.9	43.4	316.6
69N	7130N	252.8	48.9	311.1
69N	71N	238.4	55.1	304.9
69N	7030N	227.0	61.9	298.1
69N	70N	219.3	69.4	290.6
69N	6930N	215.4	77.3	282.7
69N	69N	215.8	85.3	274.7
69N	6830N	220.3	93.2	266.8
69N	68N	228.7	100.6	259.4
69N	6730N	240.6	107.3	252.7
69N	67N	255.5	113.4	246.6
69N	6630N	272.9	118.7	241.3
69N	66N	292.4	123.4	236.6
69N	6530N	313.6	127.4	232.6
69N	65N	336.1	131.0	229.0
69N	6430N	359.7	134.0	226.0
69N	64N	384.3	136.7	223.3
69N	6330N	409.5	139.1	220.9
69N	63N	435.4	141.2	218.8
69N	6230N	461.8	143.0	217.0

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
69N	62N	488.6	144.7	215.3
69N	6130N	513.9	146.2	213.8
69N	61N	541.3	147.5	212.5
69N	6030N	569.0	148.7	211.3
69N	60N	596.9	149.8	210.2
69N	5930N	624.9	150.8	209.2
69N	59N	653.2	151.7	208.3
6930N	79N	590.8	11.2	348.8
6930N	7830N	562.8	12.3	347.7
6930N	78N	535.1	13.5	346.5
6930N	7730N	507.7	14.8	345.2
6930N	77N	482.6	16.4	343.7
6930N	7630N	455.7	17.9	342.1
6930N	76N	429.2	19.8	340.2
6930N	7530N	403.2	21.9	338.1
6930N	75N	377.8	24.3	335.7
6930N	7430N	353.2	27.0	333.0
6930N	74N	329.5	30.2	329.8
6930N	7330N	306.9	33.8	326.2
6930N	73N	285.7	37.9	322.1
6930N	7230N	266.2	42.7	317.3
6930N	72N	248.9	48.2	311.8
6930N	7130N	234.1	54.4	305.6
6930N	71N	222.5	61.4	298.6
6930N	7030N	214.5	69.0	291
6930N	70N	210.6	77.1	282.9
6930N	6930N	210.9	85.3	274.7
6930N	69N	215.4	93.3	266.7

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE	TRUE TRACK	
FROM	TO	NM	EASTBOUND	WESTBOUND
6930N	6830N	224.0	100.9	259.1
6930N	68N	236.1	107.7	252.3
6930N	6730N	251.2	113.9	246.1
6930N	67N	268.9	119.3	240.7
6930N	6630N	288.6	123.9	236.1
6930N	66N	310.0	128.0	232.0
6930N	6530N	332.8	131.5	228.5
6930N	65N	356.6	134.6	225.4
6930N	6430N	381.3	137.3	222.7
6930N	64N	406.7	139.6	220.4
6930N	6330N	432.8	141.7	218.3
6930N	63N	459.3	143.5	216.5
6930N	6230N	486.2	145.2	214.8
6930N	62N	511.6	146.6	213.4
6930N	6130N	539.1	148.0	212.0
6930N	61N	566.9	149.1	210.9
6930N	6030N	594.8	150.2	209.8
6930N	60N	623.0	151.2	208.8
6930N	5930N	651.3	152.1	207.9
6930N	59N	679.8	152.9	207.1
70N	80N	617.6	9.7	350.3
70N	7930N	589.4	10.7	349.3
70N	79N	561.4	11.8	348.2
70N	7830N	533.6	12.9	347.1
70N	78N	506.0	14.2	345.8
70N	7730N	480.8	15.7	344.3
70N	77N	453.8	17.3	342.7
70N	7630N	427.1	19.2	340.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
70N	76N	401.0	21.3	338.7
70N	7530N	375.4	23.6	336.4
70N	75N	350.6	26.3	333.7
70N	7430N	326.6	29.4	330.6
70N	74N	303.8	33.0	327.0
70N	7330N	282.3	37.2	322.8
70N	73N	262.6	42.0	318.0
70N	7230N	244.9	47.5	312.5
70N	72N	229.9	53.8	306.2
70N	7130N	218.0	60.9	299.1
70N	71N	209.8	68.7	291.3
70N	7030N	205.7	76.9	283.1
70N	70N	206.0	85.3	274.7
70N	6930N	210.6	93.5	266.5
70N	69N	219.3	101.2	258.8
70N	6830N	231.6	108.2	251.8
70N	68N	246.9	114.4	245.6
70N	6730N	264.9	119.8	240.2
70N	67N	284.8	124.5	235.5
70N	6630N	306.5	128.6	231.4
70N	66N	329.4	132.1	227.9
70N	6530N	353.4	135.2	224.8
70N	65N	378.3	137.8	222.2
70N	6430N	403.9	140.2	219.8
70N	64N	430.1	142.2	217.8
70N	6330N	456.8	144.0	216.0
70N	63N	483.8	145.6	214.4
70N	6230N	509.3	147.1	212.9

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
70N	62N	536.9	148.4	211.6
70N	6130N	564.8	149.6	210.4
70N	61N	592.8	150.6	209.4
70N	6030N	621.0	151.6	208.4
70N	60N	649.4	152.5	207.5
7030N	80N	588.1	10.2	349.8
7030N	7930N	559.9	11.2	348.8
7030N	79N	532.0	12.4	347.6
7030N	7830N	504.4	13.7	346.3
7030N	78N	479.1	15.1	344.9
7030N	7730N	451.9	16.7	343.3
7030N	77N	425.1	18.6	341.4
7030N	7630N	398.8	20.6	339.4
7030N	76N	373.1	22.9	337.1
7030N	7530N	348.0	25.6	334.4
7030N	75N	323.9	28.7	331.3
7030N	7430N	300.8	32.2	327.8
7030N	74N	279.0	36.4	323.6
7030N	7330N	259.0	41.2	318.8
7030N	73N	241.0	46.7	313.3
7030N	7230N	225.7	53.1	306.9
7030N	72N	213.5	60.3	299.7
7030N	7130N	205.0	68.2	291.8
7030N	71N	200.8	76.7	283.3
7030N	7030N	201.0	85.3	274.7
7030N	70N	205.7	93.7	266.3
7030N	6930N	214.5	101.5	258.5
7030N	69N	227.0	108.7	251.3

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
7030N	6830N	242.7	115.0	245.0
7030N	68N	260.8	120.4	239.6
7030N	6730N	281.1	125.2	234.8
7030N	67N	302.9	129.2	230.8
7030N	6630N	326.1	132.7	227.3
7030N	66N	350.3	135.8	224.2
7030N	6530N	375.4	138.4	221.6
7030N	65N	401.2	140.7	219.3
7030N	6430N	427.5	142.7	217.3
7030N	64N	454.3	144.5	215.5
7030N	6330N	481.5	146.1	213.9
7030N	63N	501.1	147.6	212.4
7030N	6230N	534.7	148.8	211.2
7030N	62N	562.7	150.0	210.0
7030N	6130N	590.8	151.0	209.0
7030N	61N	619.1	152.0	208.0
7030N	6030N	647.6	152.8	207.2
7030N	60N	676.2	153.6	206.4
71N	81N	615.1	9.8	351.2
71N	8030N	586.8	9.7	350.3
71N	80N	558.6	10.7	349.3
71N	7930N	530.6	11.9	348.1
71N	79N	502.8	13.1	346.9
71N	7830N	477.4	14.6	345.4
71N	78N	450.1	16.1	343.9
71N	7730N	423.2	17.9	342.1
71N	77N	396.7	19.9	340.1
71N	7630N	370.8	22.2	337.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
71N	76N	345.5	24.9	335.1
71N	7530N	321.1	27.9	332.1
71N	75N	297.8	31.5	328.5
71N	7430N	275.8	35.6	324.4
71N	74N	255.4	40.4	319.6
71N	7330N	237.1	46.0	314.0
71N	73N	221.5	52.4	307.6
71N	7230N	209.0	59.7	300.3
71N	72N	200.3	67.8	292.2
71N	7130N	195.9	76.4	283.6
71N	71N	196.1	85.3	274.7
71N	7030N	200.8	93.9	266.1
71N	70N	209.8	101.9	258.1
71N	6930N	222.5	109.2	250.8
71N	69N	238.4	115.5	244.5
71N	6830N	256.8	121.0	239.0
71N	68N	277.3	125.8	234.2
71N	6730N	299.4	129.9	230.1
71N	67N	322.8	133.4	226.6
71N	6630N	347.2	136.4	223.6
71N	66N	372.5	139.0	221.0
71N	6530N	398.4	141.3	218.7
71N	65N	424.9	143.3	216.7
71N	6430N	451.8	145.0	215.0
71N	64N	479.1	146.6	213.4
71N	6330N	504.8	148.0	212.0
71N	63N	532.6	149.3	210.7
71N	6230N	560.6	150.4	209.6

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
71N	62N	588.8	151.4	208.6
71N	6130N	617.2	152.4	207.6
71N	61N	645.8	153.2	206.8
7130N	81N	585.5	9.2	350.8
7130N	8030N	557.2	10.2	349.8
7130N	80N	529.1	11.3	348.7
7130N	7930N	501.2	12.6	347.4
7130N	79N	475.6	14.0	346.0
7130N	7830N	448.3	15.5	344.5
7130N	78N	421.2	17.3	342.7
7130N	7730N	394.6	19.3	340.7
7130N	77N	368.5	21.5	338.5
7130N	7630N	343.1	24.1	335.9
7130N	76N	318.4	27.2	332.8
7130N	7530N	294.9	30.7	329.3
7130N	75N	272.6	34.8	325.2
7130N	7430N	251.9	39.6	320.4
7130N	74N	233.3	45.2	314.8
7130N	7330N	217.3	51.7	308.3
7130N	73N	204.5	59.0	301.0
7130N	7230N	195.5	67.4	292.6
7130N	72N	191.0	76.2	283.8
7130N	7130N	191.1	85.3	274.7
7130N	71N	195.9	94.1	265.9
7130N	7030N	205.0	102.3	257.7
7130N	70N	218.0	109.7	250.3
7130N	6930N	234.1	116.1	243.9
7130N	69N	252.8	121.7	238.3

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
7130N	6830N	273.6	126.5	233.5
7130N	68N	295.9	130.5	229.5
7130N	6730N	319.6	134.0	226.0
7130N	67N	344.2	137.0	223.0
7130N	6630N	369.6	139.6	220.4
7130N	66N	395.7	141.8	218.2
7130N	6530N	422.4	143.8	216.2
7130N	65N	449.4	145.6	214.4
7130N	6430N	476.8	147.1	212.9
7130N	64N	502.6	148.5	211.5
7130N	6330N	530.5	149.7	210.3
7130N	63N	558.6	150.8	209.2
7130N	6230N	586.9	151.8	208.2
7130N	62N	615.4	152.7	207.3
7130N	6130N	644.0	153.6	206.4
7130N	61N	672.7	154.3	205.7
72N	82N	612.8	7.8	352.2
72N	8130N	584.3	8.7	351.3
72N	81N	555.9	9.7	350.3
72N	8030N	527.7	10.8	349.2
72N	80N	499.7	12.0	348.0
72N	7930N	474.2	13.4	346.6
72N	79N	446.6	14.9	345.1
72N	7830N	419.4	16.6	343.4
72N	78N	392.6	18.6	341.4
72N	7730N	366.3	20.8	339.2
72N	77N	340.7	23.4	336.6
72N	7630N	315.8	26.4	333.6

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
72N	76N	292.0	29.8	330.2
72N	7530N	269.4	33.9	326.1
72N	75N	248.4	38.7	321.3
72N	7430N	229.5	44.4	315.6
72N	74N	213.1	50.9	309.1
72N	7330N	200.0	58.5	301.5
72N	73N	190.8	66.9	293.1
72N	7230N	186.0	75.9	284.1
72N	72N	186.1	85.2	274.8
72N	7130N	191.0	94.3	265.7
72N	71N	200.3	102.7	257.3
72N	7030N	213.5	110.2	249.8
72N	70N	229.9	116.7	243.3
72N	6930N	248.9	122.4	237.6
72N	69N	269.9	127.1	232.9
72N	6830N	292.5	131.2	228.8
72N	68N	316.3	134.7	225.3
72N	6730N	341.2	137.6	222.4
72N\	67N	366.8	140.2	219.8
72N	6630N	393.1	142.4	217.6
72N	66N	419.8	144.4	215.6
72N	6530N	447.0	146.1	213.9
72N	65N	474.6	147.6	212.4
72N	6430N	500.4	149.0	211.0
72N	64N	528.4	150.2	209.8
72N	6330N	556.6	151.3	208.7
72N	63N	585.0	152.3	207.7
72N	6230N	613.5	153.1	206.9

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
72N	62N	642.2	154.0	206.0
7230N	82N	583.1	8.2	351.8
7230N	8130N	554.6	9.2	350.8
7230N	81N	526.4	10.3	349.7
7230N	8030N	498.3	11.4	348.6
7230N	80N	472.6	12.8	347.2
7230N	7930N	444.9	14.3	345.7
7230N	79N	417.5	15.9	344.1
7230N	7830N	390.6	17.9	342.1
7230N	78N	364.1	20.1	339.9
7230N	7730N	338.3	22.6	337.4
7230N	77N	313.2	25.6	334.4
7230N	7630N	289.1	29.0	331.0
7230N	76N	266.3	33.1	326.9
7230N	7530N	245.0	37.9	322.1
7230N	75N	225.7	43.5	316.5
7230N	7430N	209.0	50.1	309.9
7230N	74N	195.5	57.8	302.2
7230N	7330N	186.0	66.4	293.6
7230N	73N	181.1	75.7	284.3
7230N	7230N	181.1	85.2	274.8
7230N	72N	186.0	94.5	265.5
7230N	7130N	195.5	103.1	256.9
7230N	71N	209.0	110.8	249.2
7230N	7030N	225.7	117.4	242.6
7230N	70N	244.9	123.0	237.0
7230N	6930N	266.2	127.8	232.2
7230N	69N	289.1	131.9	228.1

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
7230N	6830N	313.2	135.3	224.7
7230N	68N	338.2	138.3	221.7
7230N	6730N	364.0	140.8	219.2
7230N	67N	390.4	143.0	217.0
7230N	6630N	417.3	144.9	215.1
7230N	66N	444.7	146.6	213.4
7230N	6530N	472.3	148.1	211.9
7230N	65N	498.3	149.5	210.5
7230N	6430N	526.4	150.6	209.4
7230N	64N	554.6	151.7	208.3
7230N	6330N	583.1	152.7	207.3
7230N	63N	611.7	153.5	206.5
7230N	6230N	640.4	154.3	205.7
7230N	62N	669.3	155.1	204.9
73N	83N	610.6	6.9	353.1
73N	8230N	582.0	7.7	352.3
73N	82N	553.4	8.7	351.3
73N	8130N	525.1	9.7	350.3
73N	81N	499.2	10.9	349.1
73N	8030N	471.1	12.2	347.8
73N	80N	443.3	13.6	346.4
73N	7930N	415.8	15.3	344.7
73N	79N	388.7	17.2	342.8
73N	7830N	362.0	19.3	340.7
73N	78N	336.0	21.8	338.2
73N	7730N	310.7	24.7	335.3
73N	77N	286.3	28.1	331.9
73N	7630N	263.2	32.2	327.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
73N	76N	241.6	37.0	323.0
73N	7530N	221.9	42.6	317.4
73N	75N	204.9	49.3	310.7
73N	7430N	191.1	57.1	302.9
73N	74N	181.3	65.9	294.1
73N	7330N	176.1	75.4	284.6
73N	73N	176.1	85.2	274.8
73N	7230N	181.1	94.8	265.2
73N	72N	190.8	103.6	256.4
73N	7130N	204.5	111.4	248.6
73N	71N	221.5	118.1	241.9
73N	7030N	241.0	123.8	236.2
73N	70N	262.6	128.5	231.5
73N	6930N	285.7	132.6	227.4
73N	69N	310.0	136.0	224.0
73N	6830N	335.2	138.9	221.1
73N	68N	361.2	141.5	218.5
73N	6730N	387.8	143.6	216.4
73N	67N	414.9	145.5	214.5
73N	6630N	442.3	147.2	212.8
73N	66N	470.1	148.6	211.4
73N	6530N	498.2	149.9	210.1
73N	65N	524.3	151.1	208.9
73N	6430N	552.7	152.2	207.8
73N	64N	581.2	153.1	206.9
73N	6330N	609.9	154.0	206.0
73N	63N	638.7	154.7	205.3
7330N	83N	580.9	7.2	352.8

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
7330N	8230N	552.2	8.1	351.9
7330N	82N	523.8	9.2	350.8
7330N	8130N	497.8	10.3	349.7
7330N	81N	469.6	11.6	348.4
7330N	8030N	441.7	13.0	347.0
7330N	80N	414.0	14.6	345.4
7330N	7930N	386.8	16.5	343.5
7330N	79N	360.0	18.6	341.4
7330N	7830N	333.7	21.0	339.0
7330N	78N	308.2	23.9	336.1
7330N	7730N	283.6	27.3	332.7
7330N	77N	260.2	31.3	328.7
7330N	7630N	238.2	36.0	324.0
7330N	76N	218.2	41.7	318.3
7330N	7530N	200.8	48.4	311.6
7330N	75N	186.6	56.3	303.7
7330N	7430N	176.5	65.3	294.7
7330N	74N	171.2	75.1	284.9
7330N	7330N	171.0	85.2	274.8
7330N	73N	176.1	95.0	265.0
7330N	7230N	186.0	104.0	256.0
7330N	72N	200.0	112.0	248.0
7330N	7130N	217.3	118.8	241.2
7330N	71N	237.1	124.5	235.5
7330N	7030N	259.0	129.3	230.7
7330N	70N	282.3	133.3	226.7
7330N	6930N	306.9	136.7	223.3
7330N	69N	332.3	139.6	220.4

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
7330N	6830N	358.5	142.1	217.9
7330N	68N	385.3	144.2	215.8
7330N	6730N	412.5	146.1	213.9
7330N	67N	440.1	147.7	212.3
7330N	6630N	467.9	149.2	210.8
7330N	66N	496.1	150.4	209.6
7330N	6530N	522.3	151.6	208.4
7330N	65N	550.8	152.6	207.4
7330N	6430N	579.4	153.5	206.5
7330N	64N	608.1	154.4	205.6
7330N	6330N	637.0	155.1	204.9
7330N	63N	665.9	155.8	204.2
74N	84N	608.6	5.9	354.1
74N	8330N	579.8	6.7	353.3
74N	83N	551.1	7.6	352.4
74N	8230N	522.6	8.6	351.4
74N	82N	496.5	9.7	350.3
74N	8130N	468.2	10.9	349.1
74N	81N	440.2	12.3	347.7
74N	8030N	412.4	13.9	346.1
74N	80N	385.0	15.7	344.3
74N	7930N	358.0	17.8	342.2
74N	79N	331.6	20.2	339.8
74N	7830N	305.8	23.1	336.9
74N	78N	280.9	26.4	333.6
74N	7730N	257.2	30.3	329.7
74N	77N	234.9	35.1	324.9
74N	7630N	214.6	40.8	319.2

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
74N	76N	196.8	47.6	312.4
74N	7530N	182.2	55.5	304.5
74N	75N	171.8	64.7	295.3
74N	7430N	166.2	74.8	285.2
74N	74N	166.0	85.2	274.8
74N	7330N	171.2	95.3	264.7
74N	73N	181.3	104.5	255.5
74N	7230N	195.5	112.6	247.4
74N	72N	213.1	119.5	240.5
74N	7130N	233.3	125.3	234.7
74N	71N	255.4	130.1	229.9
74N	7030N	279.0	134.1	225.9
74N	70N	303.8	137.5	222.5
74N	6930N	329.5	140.3	219.7
74N	69N	355.8	142.8	217.2
74N	6830N	382.7	144.9	215.1
74N	68N	410.1	146.7	213.3
74N	6730N	437.8	148.3	211.7
74N	67N	465.8	149.7	210.3
74N	6630N	494.1	150.9	209.1
74N	66N	520.4	152.1	207.9
74N	6530N	548.9	153.1	206.9
74N	65N	577.6	154.0	206.0
74N	6430N	606.4	154.8	205.2
74N	64N	635.3	155.5	204.5
7430N	84N	578.8	6.2	353.8
7430N	8330N	550.0	7.1	352.9
7430N	83N	521.4	8.0	352.0

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
7430N	8230N	495.3	9.1	350.9
7430N	82N	466.9	10.3	349.7
7430N	8130N	438.7	11.7	348.3
7430N	81N	410.8	13.2	346.8
7430N	8030N	383.2	15.0	345.0
7430N	80N	356.1	17.0	343.0
7430N	7930N	329.4	19.4	340.6
7430N	79N	303.5	22.2	337.8
7430N	7830N	278.3	25.5	334.5
7430N	78N	254.3	29.4	330.6
7430N	7730N	231.7	34.1	325.9
7430N	77N	211.0	39.8	320.2
7430N	7630N	192.8	46.6	313.4
7430N	76N	177.8	54.7	305.3
7430N	7530N	167.0	64.1	295.9
7430N	75N	161.2	74.4	285.6
7430N	7430N	160.9	85.2	274.8
7430N	74N	166.2	95.6	264.4
7430N	7330N	176.5	105.1	254.9
7430N	73N	191.1	113.3	246.7
7430N	7230N	209.0	120.3	239.7
7430N	72N	229.5	126.1	233.9
7430N	7130N	251.9	130.9	229.1
7430N	71N	275.8	134.9	225.1
7430N	7030N	300.8	138.2	221.8
7430N	70N	326.6	141.0	219.0
7430N	6930N	353.2	143.4	216.6
7430N	69N	380.3	145.5	214.5

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
7430N	6830N	407.7	147.3	212.7
7430N	68N	435.6	148.9	211.1
7430N	6730N	463.7	150.2	209.8
7430N	67N	492.1	151.4	208.6
7430N	6630N	518.5	152.6	207.4
7430N	66N	547.1	153.5	206.5
7430N	6530N	575.8	154.4	205.6
7430N	65N	604.7	155.2	204.8
7430N	6430N	633.7	155.9	204.1
7430N	64N	662.7	156.6	203.4
75N	85N	606.8	4.9	355.1
75N	8430N	577.8	5.7	354.3
75N	84N	549.0	6.5	353.5
75N	8330N	520.3	7.5	352.5
75N	83N	494.1	8.5	351.5
75N	8230N	465.5	9.7	350.3
75N	82N	437.2	11.0	349.0
75N	8130N	409.2	12.5	347.5
75N	81N	381.5	14.3	345.7
75N	8030N	354.2	16.3	343.7
75N	80N	327.4	18.6	341.4
75N	7930N	301.2	21.3	338.7
75N	79N	275.8	24.5	335.5
75N	7830N	251.5	28.4	331.6
75N	78N	228.5	33.1	326.9
75N	7730N	207.4	38.8	321.2
75N	77N	188.8	45.6	314.4
75N	7630N	173.5	53.9	306.1

N. HEMISPHERE INITIAL GREAT CIRCLE TRUE TRACK AND DISTANCE TABLE FOR 10 DEGREE CHANGE IN LONGITUDE

LATITUDE		DISTANCE NM	TRUE TRACK	
FROM	TO		EASTBOUND	WESTBOUND
75N	76N	162.3	63.4	296.6
75N	7530N	156.2	74.1	285.9
75N	75N	155.9	85.2	274.8
75N	7430N	161.2	95.9	264.1
75N	74N	171.8	105.6	254.4
75N	7330N	186.6	114.0	246.0
75N	73N	204.9	121.1	238.9
75N	7230N	225.7	126.9	233.1
75N	72N	248.4	131.7	228.3
75N	7130N	272.6	135.6	224.4
75N	71N	297.8	139.0	221.0
75N	7030N	323.9	141.7	218.3
75N	70N	350.6	144.1	215.9
75N	6930N	377.8	146.1	213.9
75N	69N	405.4	147.9	212.1
75N	6830N	433.4	149.4	210.6
75N	68N	461.6	150.8	209.2
75N	6730N	490.1	152.0	208.0
75N	67N	516.6	153.0	207.0
75N	6630N	545.3	154.0	206.0
75N	66N	574.1	154.8	205.2
75N	6530N	603.0	155.6	204.4
75N	65N	632.1	156.3	203.7

GREAT CIRCLE/TRUE TRACK AND DISTANCE TABLES

TRUE TRACK AND DISTANCE FOR EACH 10° DIFFERENCE IN LONGITUDE FROM 0° TO 20° N.

TO FROM	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5
20	052½ 691 307½	057 659 303	061½ 630 298½	066½ 605 293½	072 586 288	078 572 282	084 565 276	090 563 270	096 569 264	102 580 258	107½ 597 252½	112½ 619 247½	117½ 646 242½										
19	049 731 311	053 695 307	057 662 303	062 633 298	067 609 293	072 590 288	078 576 282	084 569 276	090 562 270	096 572 264	102 583 258	107½ 600 252½	112½ 622 247½	117½ 649 242½									
18	046 773 314	049½ 734 310½	053 698 307	057 665 303	062 637 298	067 613 293	072½ 593 287½	078 580 282	084 572 276	090 571 270	096 575 264	101½ 586 258½	107½ 602 252½	112½ 625 247½	117½ 651 242½								
17	043 817 317	046 776 314	049½ 737 310½	053 701 307	057½ 669 302½	062 640 298	067 616 293	072½ 597 287½	078 583 282	084 575 276	090 574 270	096 578 264	101½ 589 258½	107 605 253	112½ 627 247½	117 654 243							
16	040½ 864 319½	043 820 317	046 779 314	049½ 740 310½	053½ 704 306½	057½ 672 302½	062 643 298	067 619 293	072½ 600 287½	078 586 282	084 578 276	090 577 270	096 581 264	101½ 592 258½	107 608 253	112½ 630 247½	117 656 243						
15	038 911 322	040½ 866 319½	043½ 823 316½	046½ 781 313½	050 743 310	053½ 707 306½	058 674 302	062½ 646 297½	067½ 622 292½	072½ 603 287½	078½ 589 281½	084 581 276	090 580 270	096 584 264	101½ 594 258½	107 610 253	112½ 632 247½						
14	036 960 324	038 914 322	040½ 868 319½	043½ 825 316½	046½ 784 313½	050 745 310	054 709 306	058 677 302	062½ 649 297½	067½ 625 292½	073 605 287	078½ 592 281½	084 583 276	090 582 270	096 586 264	101½ 597 258½	107 613 253	112½ 634 247½					
13	034 1010 326	036 962 324	038½ 916 321½	041 871 319	043½ 827 316½	047 786 313	050 748 310	054 712 306	058 680 302	062½ 651 297½	067½ 627 292½	073 608 287	078½ 594 281½	084 586 276	090 585 270	096 589 264	101½ 599 258½	107 615 253	112½ 636 247½				
12	032½ 1062 327½	034 1012 326	036 964 324	038½ 918 321½	041 873 319	044 829 316	047 788 313	050½ 750 309½	054 714 306	058 682 302	062½ 654 297½	067½ 630 292½	073 610 287	078½ 597 281½	084 589 276	090 587 270	096 591 264	101½ 601 258½	107 617 253	112 638 248			
11		032½ 1064 327½	034½ 1014 325½	036½ 966 323½	038½ 920 321½	041 875 319	044 831 316	047 790 313	050½ 752 309½	054 716 306	058½ 684 301½	063 656 297	067½ 632 292½	073 613 287	078½ 599 281½	084 591 276	090 589 270	096 593 264	101½ 603 258½	107 618 253	112 639 248		
10			032½ 1065 327½	034½ 1016 325½	036½ 968 323½	039 922 321	041½ 877 318½	044 833 316	047 792 313	050½ 754 309½	054 718 306	058½ 686 301½	063 658 297	068 634 292	073 615 287	078½ 601 281½	084 593 276	090 591 270	096 595 264	101½ 605 258½	107 620 253	112 641 248	
9				032½ 1067 327½	034½ 1018 325½	036½ 970 323½	039 923 321	041½ 878 318½	044 835 316	047½ 794 312½	050½ 756 309½	054½ 720 305½	058½ 688 301½	063 660 297	068 636 292	073 617 287	078½ 603 281½	084 595 276	090 593 270	095½ 596 264½	101½ 606 258½	107 621 253	112 642 248
8					033 1068 327	034½ 1019 325½	037 972 323	039 925 321	041½ 880 318½	044½ 837 315½	047½ 797 312½	051 758 309	054½ 722 305½	058½ 690 301½	063 662 297	068 638 292	073 618 287	078½ 605 281½	084 596 276	090 594 270	095½ 598 264½	101 607 259	107 623 253
7						033 1070 327	035 1021 325	037 973 323	039 926 321	041½ 882 318½	044½ 839 315½	047½ 798 312½	051 759 309	054½ 724 305½	058½ 692 301½	063 683 297	068 639 292	073 620 287	078½ 606 281½	084 598 276	090 596 270	095½ 599 264½	101 609 259
6							033 1071 327	035 1022 325	037 974 323	039½ 928 320½	042 883 318	044½ 840 315½	047½ 799 312½	051 761 309	054½ 725 305½	059 693 301	063 665 297	068 641 292	073 621 287	078½ 607 281½	084 599 276	090 597 270	095½ 600 264½
5								033 1073 327	035 1023 325	037 976 323	039½ 929 320½	042 884 318	044½ 841 315½	047½ 800 312½	051 762 309	055 727 305	059 694 301	063 666 297	068 642 292	073 623 287	078½ 609 281½	084 600 276	090 598 270
4									033½ 1074 326½	035 1025 325	037 977 323	039½ 931 320½	042 886 318	044½ 843 315½	048 802 312	051 763 309	055 728 305	059 696 301	063½ 667 296½	068 643 292	073½ 624 286½	079 610 281	084½ 601 275½
3										033½ 1075 326½	034½ 1026 325½	037½ 978 322½	039½ 932 320½	042 887 318	045 844 315	048 803 312	051 764 309	055 729 305	059 697 301	063½ 668 296½	068 644 292	073½ 625 286½	078½ 610 281½
2											034½ 1076 325½	035½ 1027 324½	037½ 979 322½	039½ 933 320½	042 888 318	045 845 315	048 804 312	051 765 309	055 730 305	059 697 301	063½ 669 296½	068 645 292	073½ 625 286½
1												033½ 1077 326½	035½ 1028 324½	037½ 980 322½	039½ 934 320½	042 889 318	045 846 315	048 805 312	051½ 766 308½	055 731 305	059 698 301	063½ 670 296½	068 645 292
0													033½ 1078 326½	035½ 1029 324½	037½ 981 322½	040 934 320	042½ 889 317½	045 846 315	048 805 312	051½ 767 308½	055 731 305	059 699 301	063½ 670 296½

FOR MAGNETIC TRACKS

NOTE: USE LEFT HAND COLUMN FOR LATITUDE **FROM** AND TOP LINE FOR LATITUDE **TO**.

1. Extract true track from table.
2. To find magnetic track: From flight progress chart extract variation for middle of leg and apply to true track.

MAG TR = TRUE TR + VAR W
- VAR E

CONVERGENCY CORRECTION

Apply to AV TRUE TRACK (for change of Longitude) to obtain INITIAL TRUE G.C. TRACK

LAT	CORR E	CORR W
76N	-4.8	+4.8
54N	-4	+4
37N	-3	+3
24N	-2	+2
12N	-1	+1
0	0	0
12S	+1	-1
24S	+2	-2
37S	+3	-3

NOTE: ***TRUE TRACK will gradually change during a leg, so the convergency correction will decrease through ZERO at mid point to an equal and opposite value at the end of the leg.***

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Air Traffic Control

Introduction

AIR TRAFFIC CONTROL INTRODUCTION

This Air Traffic Control Section is designed to provide pilots with International Civil Aviation Organization (ICAO) Standards, Recommended Practices and Procedures for international operations. In addition, on a state-by-state basis, flight procedures unique to each state, or different from the published ICAO rules and procedures, are included. Each part of this Air Traffic Control Section is described below.

ICAO DEFINITIONS

These definitions are applicable to the ICAO information contained in this ATC section and have been extracted from appropriate ICAO publications.

FLIGHT PROCEDURES

Information is extracted from the latest amended edition of Procedures for Air Navigation Services — Aircraft Operations (PANS-OPS), Document 8168, Volume I, Flight Procedures. Topics include departure, approach, holding, and noise abatement procedures.

ICAO RULES OF THE AIR—ANNEX 2 and ICAO ATS AIRSPACE CLASSIFICATIONS—ANNEX 11

ICAO Rules of the Air consist of an extraction of ICAO Annex 2. ICAO ATS Airspace Classifications contain definitions and requirements for airspace classifications.

ICAO PROCEDURES FOR AIR NAVIGATION SERVICES AIR TRAFFIC MANAGEMENT PANS-ATM (DOC 4444)

These pages contain those extracts of the PANS-ATM Document 4444 that have been specifically identified as being of particular interest to pilots-in-command.

TRAFFIC INFORMATION BROADCASTS BY AIRCRAFT (TIBA)

Extracted from Attachment B, Annex 11 to ICAO DOC 7300. This section presents when, why and how TIBA is implemented.

MACH NUMBER TECHNIQUE

These pages contain the objectives, prerequisites and general procedures for Mach Number Technique as laid out in ICAO DOC 9426.

REQUIRED NAVIGATIONAL PERFORMANCE (RNP) AREA NAVIGATION (RNAV)

RNP and RNAV approval and certification requirements, system descriptions, and general operational limitations are described.

EASA AIR OPS AERODROME OPERATING MINIMUMS (AOM)

This section is extracted from EASA AIR OPS regarding the use and methods used to determine AOM.

STATE PAGES RULES AND PROCEDURES

These pages contain flight information applicable to the specific state. They are compiled by Jeppesen using the state's Aeronautical Information Publication (AIP) as primary source material.

The state name is shown with the page number, such as Australia-1, Bulgaria-1, etc. Information is presented as follows:

– **GENERAL**

  A general statement concerning conformance, or non-conformance, with ICAO procedures and units of measurement used by the state are provided.

– **FLIGHT PROCEDURES**

  HOLDING

  Holding speed tables are provided in the Flight Procedures ICAO pages. Reference to the specific, applicable table is included on the state rules and procedures page. If the state has exceptions to the published holding tables, a complete tabulation of holding speeds is provided.

– **PROCEDURE LIMITATIONS AND OPTIONS**

  Statements concerning conformance with ICAO PANS-OPS are included here. The latest version of PANS-OPS, Volume I is provided in the ICAO Flight Procedures chapter. The statement "Instrument Procedures are in conformance with the new PANS-OPS Document 8168, Volume II" indicates compliance with this document.

  Procedure limitations, non-standard circling protected area, airspeed restrictions, and similar type information is included. Significant state differences with ICAO PANS-OPS Instrument Departure Procedures are also published under this heading.

– **AIRPORT OPERATING MINIMUMS**

  The type landing, take-off and alternate minimums published by the state are detailed. If the state publishes Obstruction Clearance Altitude/Height (OCA/H), or the earlier PANS-OPS Obstruction Clearance Limit (OCL) information, the information is noted. Approach ban information is also included.

– **PILOT CONTROLLED LIGHTING (PCL)**

  The pilot operating procedures are included for those States utilizing a standard PCL system.

– **NOISE ABATEMENT PROCEDURES**

  Standard procedures, unique to all airports within a state and not published elsewhere by Jeppesen, are listed here.

– **ATS AIRSPACE CLASSIFICATION**

  Airspace classifications are explained in ICAO ATS Airspace Classifications Annex 11. Statements under this heading indicate classifications the state has implemented, include any state exceptions, or provide a brief description of the system still in effect.

- **SPECIAL REQUIREMENTS AND REGULATIONS**

  Special restrictions to filing flight plans, night operations, special reporting procedures, use of non-standard altimeter setting procedures, etc., are listed under this heading.

- **DIFFERENCES FROM ICAO STANDARDS AND PROCEDURES**

  Information published is limited to significant state differences with ICAO Definitions, ICAO Annex 2, Rules of the Air, and PANS-ATM, Document 4444, referenced to specific paragraph numbers.

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Air Traffic Control

International Civil Aviation Organization - Definitions

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

Definitions in this listing are extracted from the following ICAO documents:

ICAO RULES OF THE AIR, ANNEX 2

PROCEDURES FOR AIR NAVIGATION SERVICES — AIR TRAFFIC MANAGEMENT, PANS-ATM (Doc 4444)

PROCEDURES FOR AIR NAVIGATION SERVICES — AIRCRAFT OPERATIONS, PANS-OPS (Doc 8168)

DEFINITIONS

ACCEPTING UNIT/CONTROLLER — Air traffic control unit/air traffic controller next to take control of an aircraft.

NOTE: See definition of "transferring unit/controller".

ACROBATIC FLIGHT — Manoeuvres intentionally performed by an aircraft involving an abrupt change in its attitude, an abnormal attitude, or an abnormal variation in speed.

ADS AGREEMENT — An ADS reporting plan which establishes the conditions of ADS data reporting (i.e., data required by the air traffic services unit and frequency of ADS reports which have to be agreed to prior to the provision of the ADS services).

NOTE: The terms of the agreement will be exchanged between the ground system and the aircraft by means of a contract, or a series of contracts.

ADS-C AGREEMENT — A reporting plan which establishes the conditions of ADS-C data reporting (i.e. data required by the air traffic services unit and frequency of ADS-C reports which have to be agreed to prior to using ADS-C in the provision of air traffic services).

NOTE: The terms of the agreement will be exchanged between the ground system and the aircraft by means of a contract, or a series of contracts.

ADS CONTRACT — A means by which the terms of an ADS agreement will be exchanged between the ground system and the aircraft, specifying under what conditions ADS reports would be initiated, and what data would be contained in the reports.

NOTE: The term “ADS contract” is a generic term meaning variously, ADS event contract, ADS demand contract, ADS periodic contract or an emergency mode. Ground forwarding of ADS reports may be implemented between ground systems.

ADVISORY AIRSPACE — An airspace of defined dimensions, or designated route, within which air traffic advisory service is available.

ADVISORY ROUTE — A designated route along which air traffic advisory service is available.

NOTE: Air traffic control service provides a much more complete service than air traffic advisory service; advisory areas and routes are therefore not established within controlled airspace, but air traffic advisory service may be provided below and above control areas.

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 surface movement of aircraft.

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

NOTE: The term "aerodrome" where used in the provisions relating to flight plans and ATS messages is intended to cover also sites other than aerodromes which may be used by certain types of aircraft; e.g., helicopters or balloons.

AERODROME CONTROL SERVICE — Air traffic control service for aerodrome traffic.

AERODROME CONTROL TOWER — A unit established to provide air traffic control service to aerodrome traffic.

AERODROME ELEVATION — The elevation of the highest point of the landing area.

AERODROME TRAFFIC — All traffic on the manoeuvring area of an aerodrome and all aircraft flying in the vicinity of an aerodrome.

NOTE: An aircraft is in the vicinity of an aerodrome when it is in, entering or leaving an aerodrome traffic circuit.

AERODROME TRAFFIC CIRCUIT — The specified path to be flown by aircraft operating in the vicinity of an aerodrome.

AERODROME TRAFFIC ZONE — An airspace of defined dimensions established around an aerodrome for the protection of aerodrome traffic.

AERONAUTICAL FIXED SERVICE (AFS) — A telecommunication service between specified fixed points provided primarily for the safety of air navigation and for the regular, efficient and economical operation of air services.

AERONAUTICAL FIXED STATION — A station in the aeronautical fixed service.

AERONAUTICAL GROUND LIGHT — Any light specially provided as an aid to air navigation, other than a light displayed on an aircraft.

AERONAUTICAL INFORMATION PUBLICATION (AIP) — A publication issued by or with the authority of a State and containing aeronautical information of a lasting character essential to air navigation.

AERONAUTICAL MOBILE SERVICE — A mobile service between aeronautical stations and aircraft stations, or between aircraft stations, in which survival craft stations may participate; emergency position-indicating radio beacon stations may also participate in this service on designated distress and emergency frequencies.

AERONAUTICAL STATION — A land station in the aeronautical mobile service. In certain instances, an aeronautical station may be located, for example, on board ship or on a platform at sea.

AERONAUTICAL TELECOMMUNICATION SERVICE — A telecommunication service provided for any aeronautical purpose.

AERONAUTICAL TELECOMMUNICATION STATION — A station in the aeronautical telecommunication service.

AEROPLANE — A power-driven heavier-than-air aircraft, deriving its lift in flight chiefly from aerodynamic reactions on surfaces which remain fixed under given conditions of flight.

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

AIRBORNE COLLISION AVOIDANCE SYSTEM (ACAS) — An aircraft system based on secondary surveillance radar (SSR) transponder signals which operates independently of ground-based equipment to provide advice to the pilot on potential conflicting aircraft that are equipped with SSR transponders.

AIRCRAFT — Any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth’s surface.

AIRCRAFT ADDRESS — A unique combination of 24 bits available for assignment to an aircraft for the purpose of air-ground communications, navigation and surveillance.

AIRCRAFT IDENTIFICATION — A group of letters, figures or a combination thereof which is either identical to, or the coded equivalent of, the aircraft call sign to be used in air-ground communications, and which is used to identify the aircraft in ground-ground air traffic services communications.

AIRCRAFT OBSERVATION — The evaluation of one or more meteorological elements made from an aircraft in flight.

AIRCRAFT PROXIMITY — A situation in which, in the opinion of a pilot or air traffic services personnel, the distance between aircraft as well as their relative positions and speed have been such that the safety of the aircraft involved may have been compromised. An aircraft proximity is classified as follows:

***Risk of Collision* —** The risk classification of an aircraft proximity in which serious risk of collision has existed.

***Safety not Assured* —** The risk classification of an aircraft proximity in which the safety of the aircraft may have been compromised.

***No Risk of Collision* —** The risk classification of an aircraft proximity in which no risk of collision has existed.

***Risk not Determined* —** The risk classification of an aircraft proximity in which insufficient information was available to determine the risk involved, or inconclusive or conflicting evidence precluded such determination.

AIR-GROUND COMMUNICATION — Two-way communication between aircraft and stations or locations on the surface of the earth.

AIR-GROUND CONTROL RADIO STATION — An aeronautical telecommunication station having primary responsibility for handling communications pertaining to the operation and control of aircraft in a given area.

AIRMET INFORMATION — Information issued by a meteorological watch office concerning the occurrence or expected occurrence of specified en route weather phenomena which may affect the safety of low-level aircraft operations and which was not already included in the forecast issued for low-level flights in the flight information region concerned or sub-area thereof.

AIRPROX — The code word used in an air traffic incident report to designate aircraft proximity.

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

AIR-REPORT — A report from an aircraft in flight prepared in conformity with requirements for position and operational and/or meteorological reporting.

AIR-TAXIING — Movement of a helicopter/VTOL above the surface of an aerodrome, normally in ground effect and at a ground speed normally less than 37 km/h (20 kt).

NOTE: The actual height may vary, and some helicopters may require air-taxiing above 8m (25 ft) AGL to reduce ground effect turbulence or provide clearance for cargo slingloads.

AIR-TO-GROUND COMMUNICATION — One-way communication from aircraft to stations or locations on the surface of the earth.

AIR TRAFFIC — All aircraft in flight or operating on the manoeuvring area of an aerodrome.

AIR TRAFFIC ADVISORY SERVICE — A service provided within advisory airspace to ensure separation, in so far as practical, between aircraft which are operating on IFR flight plans.

AIR TRAFFIC CONTROL CLEARANCE — Authorization for an aircraft to proceed under conditions specified by an air traffic control unit.

NOTE 1: For convenience, the term “air traffic control clearance” is frequently abbreviated to “clearance” when used in appropriate contexts.

NOTE 2: The abbreviated term “clearance” may be prefixed by the words “taxi,” “take-off,” “departure,” “en route,” “approach” or “landing” to indicate the particular portion of flight to which the air traffic control clearance relates.

AIR TRAFFIC CONTROL INSTRUCTION — Directives issued by air traffic control for the purpose of requiring a pilot to take a specific action.

AIR TRAFFIC CONTROL SERVICE — A service provided for the purpose of:

a. preventing collisions:
    1. between aircraft; and
    2. on the manoeuvring area between aircraft and obstructions; and

b. expediting and maintaining an orderly flow of air traffic.

AIR TRAFFIC CONTROL UNIT — A generic term meaning variously, area control centre, approach control office or aerodrome control tower.

AIR TRAFFIC FLOW MANAGEMENT (ATFM) — A service established with the objective of contributing to a safe, orderly and expeditious flow of air traffic by ensuring that ATC capacity is utilized to the maximum extent possible, and that the traffic volume is compatible with the capacities declared by the appropriate ATS authority.

AIR TRAFFIC SERVICE (ATS) — A generic term meaning variously, flight information service, alerting service, air traffic advisory service, air traffic control service (area control service, approach control service or aerodrome control service).

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

AIR TRAFFIC SERVICES AIRSPACES — Airspaces of defined dimensions, alphabetically designated, within which specific types of flights may operate and for which air traffic services and rules of operation are specified.

NOTE: ATS airspaces are classified as Class "A" to "G."

AIR TRAFFIC SERVICES REPORTING OFFICE — A unit established for the purpose of receiving reports concerning air traffic services and flight plans submitted before departure.

NOTE: An air traffic services reporting office may be established as a separate unit or combined with an existing unit, such as another air traffic services unit, or a unit of the aeronautical information service.

AIR TRAFFIC SERVICES UNIT — A generic term meaning variously, air traffic control unit, flight information centre or air traffic services reporting office.

AIRWAY — A control area or portion thereof established in the form of a corridor.

ALERFA — The code word used to designate an alert phase.

ALERTING SERVICE — A service provided to notify appropriate organizations regarding aircraft in need of search and rescue aid, and assist such organizations as required.

ALERT PHASE — A situation wherein apprehension exists as to the safety of an aircraft and its occupants.

ALLOCATION, ALLOCATE — Distribution of frequencies, SSR Codes, etc. to a State, unit or service, Distribution of 24-bit aircraft addresses to a State or common mark registering authority.

ALPHANUMERIC CHARACTERS (Alphanumerics) — A collective term for letters and figures (digits).

ALTERNATE AERODROME — An aerodrome to which an aircraft may proceed when it becomes either impossible or inadvisable to proceed to or to land at the aerodrome of intended landing where the necessary services and facilities are available, where aircraft performance requirements can be met and which is operational at the expected time of use. Alternate aerodromes include the following:

***Take-Off Alternate* —** An alternate aerodrome at which an aircraft would be able to land should this become necessary shortly after take-off and it is not possible to use the aerodrome of departure.

***En-Route Alternate* —** An alternate aerodrome at which an aircraft would be able to land in the event that a diversion becomes necessary while en-route.

***Destination Alternate* —** An alternate aerodrome at which an aircraft would be able to land should it become either impossible or inadvisable to land at the aerodrome of intended landing.

NOTE: The aerodrome from which a flight departs may also be an en route or a destination alternate aerodrome for that flight.

ALTITUDE — The vertical distance of a level, a point, or an object considered as a point, measured from mean sea level (MSL).

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

APPROACH CONTROL SERVICE — Air traffic control service for arriving or departing controlled flights.

APPROACH CONTROL UNIT — A unit established to provide air traffic control service to controlled flights arriving at, or departing from, one or more aerodromes.

APPROACH SEQUENCE — The order in which two or more aircraft are cleared to approach to land at the aerodrome.

APPROPRIATE ATS AUTHORITY — The relevant authority designated by the State responsible for providing air traffic services in the airspace concerned.

APPROPRIATE AUTHORITY —

a. ***Regarding flight over the high seas:*** The relevant authority of the State of Registry.

b. ***Regarding flight other than over the high seas:*** The relevant authority of the State having sovereignty over the territory being overflown.

APRON — A defined area, on a land aerodrome, intended to accommodate aircraft for purposes of loading or unloading passengers, mail or cargo, fueling, parking or maintenance.

AREA CONTROL CENTRE (ACC) — A unit established to provide air traffic control service to controlled flights in control areas under its jurisdiction.

AREA CONTROL SERVICE — Air traffic control service for controlled flights in control areas.

AREA MINIMUM ALTITUDE (AMA) — The minimum altitude to be used under instrument meteorological conditions (IMC), that provides a minimum obstacle clearance within a specified area, normally formed by parallels and meridians.

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.

AREA NAVIGATION ROUTE — An ATS route established for the use of aircraft capable of employing area navigation.

ASSIGNMENT, ASSIGN — Distribution of frequencies to stations. Distribution of SSR Codes or 24-bit addresses to aircraft.

ATIS — The symbol used to designate automatic terminal information service.

ATS ROUTE — A specified route designed for channeling the flow of traffic as necessary for the provision of air traffic services.

NOTE 1: The term “ATS route” is used to mean variously, airway, advisory route, controlled or uncontrolled route, arrival or departure route, etc.

NOTE 2: An ATS route is defined by route specifications which include an ATS route designator, the track to or from significant points (waypoints), distance between significant points, reporting requirements and, as determined by the appropriate ATS authority, the lowest safe altitude.

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

ATS SURVEILLANCE SERVICE — A term used to indicate a service provided directly by means of an ATS surveillance system.

ATS SURVEILLANCE SYSTEM — 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.

AUTOMATIC DEPENDENT SURVEILLANCE — BROADCAST (ADS-B) — A means by which aircraft, aerodrome vehicles and other objects can automatically transmit and/or receive data such as identification, position and additional data, as appropriate, in a broadcast mode via a data link.

AUTOMATIC DEPENDENT SURVEILLANCE — CONTRACT (ADS-C) — A means by which the terms of an ADS-C agreement will be exchanged between the ground system and the aircraft, via a data link, specifying under what conditions ADS-C reports would be initiated, and what data would be contained in the reports.

NOTE: The abbreviated term “ADS” contract is commonly used to refer to ADS event contract, ADS demand contract or an emergency mode.

AUTOMATIC TERMINAL INFORMATION SERVICE (ATIS) — The automatic provision of current, routine information to arriving and departing aircraft throughout 24 hours or a specified portion thereof:

- *Data link-automatic terminal information service (D-ATIS)*. The provision of ATIS via data link.
- *Voice-automatic terminal information service (Voice-ATIS)*. The provision of ATIS by means of continuous and repetitive voice broadcasts.

BALKED LANDING — A landing manoeuvre that is unexpectedly discontinued at any point below the OCA/H.

BASE TURN — A turn executed by the aircraft during the initial approach between the end of the outbound track and the beginning of the intermediate or final approach track. The tracks are not reciprocal.

NOTE: Base turns may be designated as being made either in level flight or while descending, according to the circumstances of each individual procedure.

BLIND TRANSMISSION — A transmission from one station to another station in circumstances where two-way communication cannot be established but where it is believed that the called station is able to receive the transmission.

BROADCAST — A transmission of information relating to air navigation that is not addressed to a specific station or stations.

CEILING — The height above the ground or water of the base of the lowest layer of cloud below 6,000 metres (20,000 feet) covering more than half the sky.

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

CHANGEOVER POINT — The point at which an aircraft navigating on an ATS route segment defined by reference to very high frequency omnidirectional radio ranges is expected to transfer its primary navigational reference from the facility behind the aircraft to the next facility ahead of the aircraft.

NOTE: Changeover points are established to provide the optimum balance in respect of signal strength and quality between facilities at all levels to be used and to ensure a common source of azimuth guidance for all aircraft operating along the same portion of a route segment.

CIRCLING APPROACH — An extension of an instrument approach procedure which provides for visual circling of the aerodrome prior to landing.

CLEARANCE LIMIT — The point to which an aircraft is granted an air traffic control clearance.

CONTINUOUS CLIMB OPERATION (CCO) — An operation, enabled by airspace design, procedure design and ATC, in which a departing aircraft climbs continuously, to the greatest possible extent, by employing optimum climb engine thrust and climb speeds until reaching the cruise flight level.

CONTINUOUS DESCENT FINAL APPROACH (CDFA) — A technique, consistent with stabilized approach procedures, for flying the final approach segment of a non-precision instrument approach procedure as a continuous descent, without level-off, from an altitude/height at or above the final approach fix altitude/height to a point approximately 15m (50 ft) above the landing runway threshold or the point where the flare maneuver should begin for the type of aircraft flown.

CONTINUOUS DESCENT OPERATION (CDO) — An operation, enabled by airspace design, procedure design and ATC, in which an arriving aircraft descends continuously, to the greatest possible extent, by employing minimum engine thrust, ideally in a low drag configuration, prior to the final approach fix/final approach point.

CODE (SSR) — The number assigned to a particular multiple pulse reply signal transmitted by a transponder in Mode A or Mode C.

COMPUTER — A device which performs sequences of arithmetical and logical steps upon data without human intervention.

NOTE: When the word “computer” is used in this document it may denote a computer complex, which includes one or more computers and peripheral equipment.

CONTROL AREA — A controlled airspace extending upwards from a specified limit above the earth.

CONTROLLED AERODROME — An aerodrome at which air traffic control service is provided to aerodrome traffic.

NOTE: The term “controlled aerodrome” indicates that air traffic control service is provided to aerodrome traffic but does not necessarily imply that a control zone exists.

CONTROLLED AIRSPACE — An airspace of defined dimensions within which air traffic control service is provided in accordance with the airspace classification.

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

NOTE: Controlled airspace is a generic term which covers ATS airspace Classes A, B, C, D and E as described in Annex 11, 2.6.

CONTROLLED FLIGHT — Any flight which is subject to an air traffic control clearance.

CONTROLLER-PILOT DATA LINK COMMUNICATIONS (CPDLC) — A means of communication between controller and pilot, using data link for ATC communications.

CONTROL ZONE — A controlled airspace extending upwards from the surface of the earth to a specified upper limit.

CRUISE CLIMB — An aeroplane cruising technique resulting in a net increase in altitude as the aeroplane mass decreases.

CRUISING LEVEL — A level maintained during a significant portion of a flight.

CURRENT FLIGHT PLAN (CPL) — The flight plan, including changes, if any, brought about by subsequent clearances.

NOTE: When the word “message” is used as a suffix to this term, it denotes the content and format of the current flight plan data sent from one unit to another.

DANGER AREA — An airspace of defined dimensions within which activities dangerous to the flight of aircraft may exist at specified times.

DATA CONVENTION — An agreed set of rules governing the manner or sequence in which a set of data may be combined into a meaningful communication.

DATA LINK COMMUNICATIONS — A form of communication intended for the exchange of messages via a data link.

DATA LINK INITIATION CAPABILITY (DLIC) — A data link application that provides the ability to exchange addresses, names and version numbers necessary to initiate data link applications.

DEAD RECKONING (DR) NAVIGATION — The estimating or determining of position by advancing an earlier known position by the application of direction, time and speed data.

DECISION ALTITUDE (DA) OR DECISION HEIGHT (DH) — A specified altitude, or height, in a 3D instrument approach operation at which a missed approach must be initiated if the required visual reference to continue the approach has not been established.

NOTE 1: Decision altitude (DA) is referenced to mean sea level and decision height (DH) is referenced to the threshold elevation.

NOTE 2: The required visual reference means that section of the visual aids or of the approach area which should have been in view for sufficient time for the pilot to have made an assessment of the aircraft position and rate of change of position, in relation to the desired flight path. In Category III operations with a decision height the required visual reference is that specified for the particular procedure and operation.

NOTE 3: For convenience where both expressions are used they may be written in the form “decision altitude/height” and abbreviated “DA/H.”

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

DEPENDENT PARALLEL APPROACHES — Simultaneous approaches to parallel or near-parallel instrument runways where ATS surveillance system separation minima between aircraft on adjacent extended runway centre lines are prescribed.

DETRESFA — The code word used to designate a distress phase.

DESCENT FIX — A fix established in a precision approach at the FAP to eliminate certain obstacles before the FAP, which would otherwise have to be considered for obstacle clearance purposes.

DESCENT POINT (DP) — A point defined by track and distance from the MAPt to identify the point at which the helicopter may descend below the OCA/H on a visual descent to the heliport or landing location.

DIRECT VISUAL SEGMENT (DIRECT-VS) — A visual segment designed as:

a. a leg in a PinS approach, which may contain a single turn, from the MAPt direct to the heliport or landing location or via a descent point to the heliport or landing location; or

b. a straight leg from the helicopter or landing location to the IDF in a PinS departure.

DISCRETE CODE — A four-digit SSR Code with the last two digits not being “00.”

DISTRESS PHASE — A situation wherein there is a reasonable certainty that an aircraft and its occupants are threatened by grave and imminent danger or require immediate assistance.

DME DISTANCE — The line of sight distance (slant range) from the source of a DME signal to the receiving antenna.

ELEVATION — The vertical distance of a point or a level, on or affixed to the surface of the earth, measured from mean sea level.

EMERGENCY PHASE — A generic term meaning, as the case may be, uncertainty phase, alert phase or distress phase.

ESTIMATED ELAPSED TIME — The estimated time required to proceed from one significant point to another.

ESTIMATED OFF-BLOCK TIME — The estimated time at which the aircraft will commence movement associated with departure.

ESTIMATED TIME OF ARRIVAL — For IFR flights, the time at which it is estimated that the aircraft will 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 aerodrome, the time at which the aircraft will arrive over the aerodrome. For VFR flights, the time at which it is estimated that the aircraft will arrive over the aerodrome.

EXPECTED APPROACH TIME — The time at which ATC expects that an arriving aircraft, following a delay, will leave the holding point to complete its approach for a landing.

NOTE: The actual time of leaving the holding point will depend upon the approach clearance.

FILED FLIGHT PLAN (FPL) — The flight plan as filed with an ATS unit by the pilot or a designated representative, without any subsequent changes.

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

FINAL APPROACH — That part of an instrument approach procedure which commences at the specified final approach fix or point, or, where such a fix or point is not specified:

a. at the end of the last procedure turn, base turn or inbound turn of a racetrack procedure, if specified; or

b. at the point of interception of the last track specified in the approach procedure; and ends at a point in the vicinity of an aerodrome from which:

   1. landing can be made; or
   2. a missed approach procedure is initiated.

FINAL APPROACH AND TAKE-OFF AREA (FATO) — A defined area over which the final phase of the approach manoeuvre to hover or landing is completed and from which the take-off manoeuvre is commenced. Where the FATO is to be used by performance Class 1 helicopters, the defined area includes the rejected take-off area available.

FINAL APPROACH SEGMENT (FAS) — That segment of an instrument approach procedure in which alignment and descent for landing are accomplished.

FLIGHT CREW MEMBER — A licensed crew member charged with duties essential to the operation of an aircraft during flight duty period.

FLIGHT INFORMATION CENTRE — A unit established to provide flight information service and alerting service.

FLIGHT INFORMATION REGION (FIR) — An airspace of defined dimensions within which flight information service and alerting service are provided.

FLIGHT INFORMATION SERVICE — A service provided for the purpose of giving advice and information useful for the safe and efficient conduct of flights.

FLIGHT LEVEL (FL) — A surface of constant atmospheric pressure which is related to a specific pressure datum, 1013.2 hectopascals (hPa), and is separated from other such surfaces by specific pressure intervals.

NOTE 1: A pressure type altimeter calibrated in accordance with the Standard Atmosphere:

a. when set to a QNH altimeter setting, will indicate altitude;

b. when set to a QFE altimeter setting, will indicate height above the QFE reference datum;

c. when set to a pressure of 1013.2 hectopascals (hPa), may be used to indicate flight levels.

NOTE 2: The terms “height” and “altitude,” used in NOTE 1 above, indicate altimetric rather than geometric heights and altitudes.

FLIGHT PATH MONITORING — The use of ATS surveillance systems for the purpose of providing aircraft with information and advice relative to significant deviations from nominal flight path, including deviations from the terms of their air traffic control clearances.

NOTE: Some applications may require a specific technology, e.g. radar, to support the function of flight path monitoring.

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

FLIGHT PLAN — Specified information provided to air traffic services units, relative to an intended flight or portion of a flight of an aircraft.

NOTE: Specifications for flight plans are contained in ICAO Rules of the Air, Annex 2. A Model Flight Form is contained in ICAO Rules of the Air and Air Traffic Services, PANS-RAC (Doc 4444), Appendix 2.

FLIGHT VISIBILITY — The visibility forward from the cockpit of an aircraft in flight.

FLOW CONTROL — Measures designed to adjust the flow of traffic into a given airspace, along a given route, or bound for a given aerodrome, so as to ensure the most effective utilization of the airspace.

FORECAST — A statement of expected meteorological conditions for a specified time or period, and for a specified area or portion of airspace.

FREE TEXT MESSAGE ELEMENT — Part of a message that does not conform to any standard message element in the PANS-ATM (Doc 4444).

GBAS LANDING SYSTEM (GLS) — A system for approach and landing operations utilizing GNSS, augmented by a ground based augmentation system (GBAS), as the primary navigational reference.

GLIDE PATH — A descent profile determined for vertical guidance during a final approach.

GROUND EFFECT — A condition of improved performance (lift) due to the interference of the surface with the airflow pattern of the rotor system when a helicopter or other VTOL aircraft is operating near the ground.

NOTE: Rotor efficiency is increased by ground effect to a height of about one rotor diameter for most helicopters.

GROUND VISIBILITY — The visibility at an aerodrome, as reported by an accredited observer or by automatic systems.

HEADING — The direction in which the longitudinal axis of an aircraft is pointed, usually expressed in degrees from North (true, magnetic, compass or grid).

HEIGHT — The vertical distance of a level, a point or an object considered as a point, measured from a specified datum.

HEIGHT ABOVE SURFACE (HAS) — The difference in height between the OCA and the elevation of the highest terrain, water surface or obstacle within a radius of at least 1.5km (0.8 NM) from the MAPt in a PinS "Proceed VFR" procedure.

HELIPORT REFERENCE POINT (HRP) — The designated location of a heliport or a landing location.

HOLDING FIX — A geographical location that serves as a reference for a holding procedure.

HOLDING PROCEDURE — A predetermined manoeuvre which keeps an aircraft within a specified airspace while awaiting further clearance.

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

HOT SPOT — A location on an aerodrome movement area with a history or potential risk of collision or runway incursion, and where heightened attention by pilots/drivers is necessary.

HUMAN FACTORS PRINCIPLES — Principles which apply to aeronautical design, certification, training, operations and maintenance and which seek safe interface between the human and other system components by proper consideration to human performance.

HUMAN PERFORMANCE — Human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations.

IDENTIFICATION — The situation which exists when the position indication of a particular aircraft is seen on a situation display and positively identified.

IFR — The symbol used to designate the instrument flight rules.

IFR FLIGHT — A flight conducted in accordance with the instrument flight rules.

IMC — The symbol used to designate instrument meteorological conditions.

INCERFA — The code word used to designate an uncertainty phase.

INCIDENT — An occurrence, other than an accident, associated with the operation of an aircraft which affects or could affect the safety of operation.

NOTE: The type of incidents which are of main interest to the International Civil Aviation Organization for accident prevention studies can be found at http://www.icao.int/anb/aig

INDEPENDENT PARALLEL APPROACHES — Simultaneous approaches to parallel or near-parallel instrument runways where ATS surveillance system separation minima between aircraft on adjacent extended runway centre lines are not prescribed.

INDEPENDENT PARALLEL DEPARTURES — Simultaneous departures from parallel or near-parallel instrument runways.

INITIAL APPROACH FIX (IAF) — A fix that marks the beginning of the initial segment and the end of the arrival segment, if applicable. In RNAV applications this fix is normally defined by a fly-by waypoint.

INITIAL APPROACH SEGMENT — 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.

INITIAL DEPARTURE FIX (IDF) — The terminal fix for the visual segment and the fix where the instrument phase of the PinS departure begins.

INSTRUMENT APPROACH OPERATIONS — 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.

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

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. sell-contained navigation aid or a combination of these.

INSTRUMENT APPROACH PROCEDURE (IAP) — A series of predetermined manoeuvres 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. Instrument approach procedures are classified as follows:

- *Non-precision approach (NPA) procedure*. An instrument approach procedure designed for 2D instrument approach operations Type A.

  NOTE: Non-precision approach procedures may be flown using a continuous descent final approach (CDFA) technique. CDFAs with advisory VNAV guidance calculated by on-board equipment are considered 3D instrument approach operations. CDFAs with manual calculation of the required rate of descent are considered 2D instrument approach operations. For more information on CDFAs, refer to PANS-OPS (Doc 8168), Volume I, Part II, Section 5.

- *Approach procedure with vertical guidance (APV).* A performance-based navigation (PBN) instrument approach procedure designed for 3D instrument approach operations Type A.

- *Precision approach (PA) procedure*. An instrument approach procedure based on navigation systems (ILS, MLS, GLS and SBAS Cat I) designed for 3D instrument approach operations Type A or B.

  NOTE: Refer to Annex 6 for instrument approach operation types (not published herein).

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.

NOTE 1: The specified minima for visual meteorological conditions are contained in ICAO Rules of the Air, Annex 2, Chapter 4.

NOTE 2: In a control zone, a VFR flight may proceed under instrument meteorological conditions if and as authorized by air traffic control.

INTERMEDIATE APPROACH SEGMENT — That segment of an instrument approach procedure between either the intermediate approach fix and the final approach fix or point, or between the end of a reversal, racetrack or dead reckoning track procedure and the final approach fix or point, as appropriate.

INTERMEDIATE FIX (IF) — A fix that marks the end of an initial segment and the beginning of the intermediate segment. In RNAV applications this fix is normally defined by a fly-by waypoint.

ITP AIRCRAFT — An aircraft approved by the State of the Operator to conduct in-trail procedure (ITP).

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

ITP DISTANCE — The distance between the ITP aircraft and a reference aircraft as defined by:

a. aircraft on the same track, the difference in distance to an aircraft calculated common point along a projection of each other's track; or

b. aircraft on parallel tracks, the distance measured along the track of one of the aircraft using its calculated position and the point abeam the calculated position of the other aircraft.

NOTE: Reference aircraft refers to one or two aircraft with ADS-B data that meet the ITP criteria described in 5.4.2.7 (not published herein) and are indicated to ATC by the ITP aircraft as part of the ITP clearance request.

LANDING AREA — That part of a movement area intended for the landing or take-off of aircraft.

LANDING LOCATION — A marked or unmarked area that has the same physical characteristics as a visual heliport final approach and take-off area (FATO).

LEVEL — A generic term relating to the vertical position of an aircraft in flight and meaning variously, height, altitude or flight level.

LOCATION INDICATOR — A four-letter code group formulated in accordance with rules prescribed by ICAO and assigned to the location of an aeronautical fixed station.

LOCALIZER PERFORMANCE WITH VERTICAL GUIDANCE (LPV) — The label to denote minima lines associated with APV-I or APV-II performance on approach charts.

LOGON ADDRESS — A specified code used for data link logon to an ATS unit.

MANOEUVERING AREA — That part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, excluding aprons.

MANOEUVERING VISUAL SEGMENT (MANOEUVERING-VS) — PinS visual segment protected for the following manoeuverers for:

PinS approaches. Visual manoeuver from the MAPt around the heliport or landing location to land from a direction other than directly from the MAPt.

PinS departures. Take-off in a direction other than directly to the IDF followed by visual manoeuver to join the instrument segment at the IDF.

METEOROLOGICAL INFORMATION — Meteorological report, analysis, forecast, and any other statement relating to existing or expected meteorological conditions.

METEOROLOGICAL OFFICE — An office designated to provide meteorological service for international air navigation.

METEOROLOGICAL REPORT — A statement of observed meteorological conditions related to a specified time and location.

MINIMUM DESCENT ALTITUDE (MDA) OR MINIMUM DESCENT HEIGHT (MDH) — A specified altitude or height in a 2D instrument approach operation or circling approach below which descent must not be made without the required visual reference.

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

NOTE 1: Minimum descent altitude (MDA) is referenced to mean sea level and minimum descent height (MDH) is referenced to the aerodrome elevation or to the threshold elevation if that is more than 2m (7 ft) below the aerodrome elevation. A minimum descent height for a circling approach is referenced to the aerodrome elevation.

NOTE 2: The required visual reference means that section of the visual aids or of the approach area which should have been in view for sufficient time for the pilot to have made an assessment of the aircraft position and rate of change of position, in relation to the desired flight path. In the case of a circling approach the required visual reference is the runway environment.

NOTE 3: For convenience when both expressions are used they may be written in the form "minimum descent altitude/height" abbreviated "MDA/H."

MINIMUM ENROUTE ALTITUDE (MEA) — The altitude for an enroute segment that provides adequate reception of relevant navigation facilities and ATS communications, complies with the airspace structure and provides the required obstacle clearance.

MINIMUM FUEL — The term used to describe a situation in which an aircraft's fuel supply has reached a state where the flight is committed to land at a specific aerodrome and no additional delay can be accepted.

MINIMUM INSTRUMENT METEOROLOGICAL CONDITIONS AIRSPEED (V_{mini}) — The minimum indicated airspeed that a specific helicopter is certified to operate in instrument meteorological conditions.

MINIMUM OBSTACLE CLEARANCE ALTITUDE (MOCA) — The minimum altitude for a defined segment that provides the required obstacle clearance.

MINIMUM SECTOR ALTITUDE (MSA) — The lowest altitude which may be used which will provide a minimum clearance of 300m (1000 ft) above all objects located in an area contained within a sector of a circle of 46km (25 NM) radius centered on a significant point, the airport reference point (ARP) or the heliport reference point (HRP).

MINIMUM STABILIZATION DISTANCE (MSD) — The minimum distance to complete a turn manoeuvre and after which a new manoeuvre can be initiated. The minimum stabilization distance is used to compute the minimum distance between waypoints.

MISSED APPROACH HOLDING FIX (MAHF) — A fix used in RNAV applications that marks the end of the missed approach segment and the centre point for the missed approach holding.

MISSED APPROACH POINT (MAPt) — That point in an instrument approach procedure at or before which the prescribed missed approach procedure must be initiated in order to ensure that the minimum obstacle clearance is not infringed.

MISSED APPROACH PROCEDURE — The procedure to be followed if the approach cannot be continued.

MODE (SSR) — The conventional identifier related to specific functions of the interrogation signals transmitted by an SSR interrogator. There are four modes specified in ICAO Annex 10 (not published herein): A, C, S and intermode.

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

MOVEMENT AREA — That part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, consisting of the manoeuvring area and the apron(s).

MULTILATERATION (MLAT) SYSTEM — A group of equipment configured to provide position derived from the secondary surveillance radar (SSR) transponder signals (replies or squitters) primarily using time difference of arrival (TDOA) techniques. Additional information, including identification, can be extracted from the received signals.

NEAR-PARALLEL RUNWAYS — Non-intersecting runways whose extended centre lines have an angle of convergence / divergence of 15 degrees or less.

NEXT DATA AUTHORITY — The ground system so designated by the current data authority through which an onward transfer of communications and control can take place.

NORMAL OPERATING ZONE (NOZ) — Airspace of defined dimensions extending to either side of a published instrument approach procedure final approach course or track. Only that half of the normal operating zone adjacent to a no transgression zone (NTZ) is taken into account in independent parallel approaches.

NOTAM — A notice distributed by means of telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations.

NO TRANSGRESSION ZONE (NTZ) — In the context of independent parallel approaches, a corridor of airspace of defined dimensions located centrally between the two extended runway centre lines, where a penetration by an aircraft requires a controller intervention to manoeuvre any threatened aircraft on the adjacent approach.

OBSTACLE ASSESSMENT SURFACE (OAS) — A defined surface intended for the purpose of determining those obstacles to be considered in the calculation of obstacle clearance altitude/height for a specific ILS facility and procedure.

OBSTACLE CLEARANCE ALTITUDE (OCA) OR OBSTACLE CLEARANCE HEIGHT (OCH) — The lowest altitude or the lowest height above the elevation of the relevant runway threshold or the aerodrome elevation as applicable, used in establishing compliance with appropriate obstacle clearance criteria.

NOTE 1: Obstacle clearance altitude is referenced to mean sea level and obstacle clearance height is referenced to the threshold elevation or in the case of non-precision approaches to the aerodrome elevation or the threshold elevation if that is more than 2m (7 ft) below the aerodrome elevation. An obstacle clearance height for a circling approach is referenced to the aerodrome elevation.

NOTE 2: For convenience when both expressions are used they may be written in the form “obstacle clearance altitude/height” and abbreviated “OCA/H.”

OBSTACLE FREE ZONE (OFZ) — The airspace above the inner approach surface, inner transitional surfaces, and balked landing surface and that portion of the strip bounded by these surfaces, which is not penetrated by any fixed obstacle other than a low-mass and frangibility mounted one required for air navigation purposes.

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

OPERATIONAL CONTROL — The exercise of authority over the initiation, continuation, diversion or termination of a flight in the interest of the safety of the aircraft and the regularity and efficiency of the flight.

OPERATOR — A person, organization or enterprise engaged in or offering to engage in an aircraft operation.

PERFORMANCE-BASED COMMUNICATION (PBC) — Communication based on performance specifications applied to the provision of air traffic services.

NOTE: An RCP specification includes communication performance requirements that are allocated to system components in terms of the communication to be provided and associated transaction time, continuity, availability, integrity, safety and functionality needed for the proposed operation in the context of a particular airspace concept.

PERFORMANCE-BASED NAVIGATION (PBN) — Area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace.

NOTE: Performance requirements are expressed in navigation specifications (RNAV specification, RNP specification) in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular airspace concept.

PERFORMANCE-BASED SURVEILLANCE (PBS) — Surveillance based on performance specifications applied to the provision of air traffic services.

NOTE: An RSP specification includes surveillance performance requirements that are allocated to system components in terms of the surveillance to be provided and associated data delivery time, continuity, availability, integrity, accuracy of the surveillance data, safety and functionality needed for the proposed operation in the context of a particular airspace concept.

PILOT-IN-COMMAND — The pilot designated by the operator, or in the case of general aviation, the owner, as being in command and charged with the safe conduct of a flight.

POINT-IN-SPACE APPROACH (PinS) — An approach procedure designed for helicopters only that includes both a visual and an instrument segment.

POINT-IN-SPACE DEPARTURE (PinS) — A departure procedure designed for helicopters only that includes both a visual and an instrument segment.

POINT-IN-SPACE REFERENCE POINT (PRP) — Reference point for the point-in-space approach as identified by the latitude and longitude of the MAPt.

POSITION INDICATION — The visual indication, in non-symbolic and/or symbolic form, on a situation display, of the position of an aircraft, airport vehicle or other object.

POSITION SYMBOL — The visual indication in symbolic form, on a situation display, of the position of an aircraft, airport vehicle or other object, obtained after automatic processing of positional data derived from any source,

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

PRECISION APPROACH RADAR (PAR) — Primary radar equipment used to determine the position of an aircraft during final approach, in terms of lateral and vertical deviations relative to a nominal approach path, and in range relative to touchdown.

NOTE: Precision approach radars are designated to enable pilots of aircraft to be given guidance by radio communication during the final stages of the approach to land.

PREFORMATTED FREE TEXT MESSAGE ELEMENT — A free text message element that is stored within the aircraft system or ground system for selection.

PRESSURE-ALTITUDE — An atmospheric pressure expressed in terms of altitude which corresponds to that pressure in the Standard Atmosphere.

PRIMARY AREA — A defined area symmetrically disposed about the nominal flight track in which full obstacle clearance is provided. (See also **SECONDARY AREA**.)

PRIMARY RADAR — A radar system which uses reflected radio signals.

PRIMARY SURVEILLANCE RADAR (PSR) — A surveillance radar system which uses reflected radio signals.

PROBLEMATIC USE OF SUBSTANCES — The use of one or more psychoactive substances by aviation personnel in a way that:

a. constitutes a direct hazard to the user or endangers the lives, health or welfare of others; and/or

b. causes or worsens an occupational, social, mental or physical problem or disorder.

PROCEDURAL CONTROL — Term used to indicate that information derived from an ATS surveillance system is not required for the provision of air traffic control service.

PROCEDURAL SEPARATION — The separation used when providing procedural control.

PROCEDURE ALTITUDE/HEIGHT — A specified altitude/height flown operationally at or above the minimum altitude/height and established to accommodate a stabilized descent at a prescribed descent gradient/angle in the intermediate/final approach segment.

PROCEDURE TURN — A manoeuvre in which a turn is made away from a designated track followed by a turn in the opposite direction to permit the aircraft to intercept and proceed along the reciprocal of the designated track.

NOTE 1: Procedure turns are designated “left” or “right” according to the direction of the initial turn.

NOTE 2: Procedure turns may be designated as being made either in level flight or while descending, according to the circumstances of each individual procedure.

PROFILE — The orthogonal projection of a flight path or portion thereof on the vertical surface containing the nominal track.

PROHIBITED AREA — An airspace of defined dimensions, above the land areas or territorial waters of a State, within which the flight of aircraft is prohibited.

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

PSR BLIP — The visual indication, in non-symbolic form, on a situation display of the position of an aircraft obtained by primary radar.

PSYCHOACTIVE SUBSTANCES — Alcohol, opioids, cannabinoids, sedatives and hypnotics, cocaine, other psychostimulants, hallucinogens, and volatile solvents, whereas coffee and tobacco are excluded.

RACETRACK PROCEDURE — A procedure designed to enable the aircraft to reduce altitude during the initial approach segment and/or establish the aircraft inbound when the entry into a reversal procedure is not practical.

RADAR — A radio detection device which provides information on range, azimuth and/or elevation of objects.

RADAR APPROACH — An approach, in which the final approach phase is executed under the direction of a controller using radar.

RADAR CLUTTER — The visual indication on a situation display of unwanted signals.

RADAR CONTACT — The situation which exists when the radar position of a particular aircraft is seen and identified on a situation display.

RADAR SEPARATION — The separation used when aircraft position information is derived from radar sources.

RADIOTELEPHONY — A form of radio communication primarily intended for the exchange of information in the form of speech.

RECEIVING UNIT/CONTROLLER — Air traffic services unit/air traffic controller to which a message is sent.

NOTE: See definition of "sending unit/controller".

REMOTE PILOT — A person charged by the operator with duties essential to the operation of a remotely piloted aircraft and who manipulates the flight controls, as appropriate, during flight time.

REMOTE PILOT STATION — The component of the remotely piloted aircraft system containing the equipment used to pilot the remotely piloted aircraft.

REMOTELY PILOTED AIRCRAFT (RPA) — An unmanned aircraft which is piloted from a remote pilot station.

REMOTELY PILOTED AIRCRAFT SYSTEM (RPAS) — A remotely piloted aircraft, its associated remote pilot station(s), the required command and control links and any other components as specified in the type design.

REPETITIVE FLIGHT PLAN (RPL) — A flight plan related to a series of frequently recurring, regularly operated individual flights with identical basic features, submitted by an operator for retention and repetitive use by ATS units.

REPORTING POINT — A specified geographical location in relation to which the position of an aircraft can be reported.

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

REQUIRED COMMUNICATION PERFORMANCE (RCP) — A set of requirements for air traffic service provision and associated ground equipment, aircraft capability, and operations needed to support performance-based communication.

REQUIRED NAVIGATION PERFORMANCE (RNP) — A statement of the navigation performance accuracy necessary for operation within a defined airspace.

NOTE: Navigation performance and requirements are defined for a particular RNP type and/or application.

RESCUE COORDINATION CENTRE — A unit responsible for promoting efficient organization of search and rescue service and for coordinating the conduct of search and rescue operations within a search and rescue region.

RESCUE UNIT — A unit composed of trained personnel and provided with equipment suitable for the expeditious conduct of search and rescue.

RESTRICTED AREA — An airspace of defined dimensions, above the land areas or territorial waters of a State, within which the flight of aircraft is restricted in accordance with certain specified conditions.

REVERSAL PROCEDURE — A procedure designed to enable aircraft to reverse direction during the initial approach segment of an instrument approach procedure. The sequence may include procedure turns or base turns.

RNP TYPE — A containment value expressed as a distance in nautical miles from the intended position within which flights would be for at least 95 per cent of the total flying time.

EXAMPLE: RNP 4 represents a navigation accuracy of plus or minus 7.4 km (4 NM) on a 95 percent containment basis.

RPA OBSERVER — A trained and competent person designated by the operator who, by visual observation of the remotely piloted aircraft, assists the remote pilot in the safe conduct of the flight.

RUNWAY — A defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft.

RUNWAY-HOLDING POSITION — A designated position intended to protect a runway, an obstacle limitation surface, or an ILS/MLS critical/sensitive area at which taxiing aircraft and vehicles shall stop and hold, unless otherwise authorized by the aerodrome control tower.

NOTE: In radiotelephony phraseologies, the expression “holding point” is used to designate the runway-holding position.

RUNWAY INCURSION — Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take-off of aircraft.

RUNWAY VISUAL RANGE (RVR) — The range over which the pilot of an aircraft on the centre line of a runway can see the runway surface markings or the lights delineating the runway or identifying its centre line.

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

SAFETY MANAGEMENT SYSTEM (SMS) — A systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures.

SAFETY-SENSITIVE PERSONNEL — Persons who might endanger aviation safety if they perform their duties and functions improperly including, but not limited to, crew members, aircraft maintenance personnel and air traffic controllers.

SECONDARY AREA — A defined area on each side of the primary area located along the nominal flight track in which decreasing obstacle clearance is provided. (See also **PRIMARY AREA**)

SECONDARY RADAR — A radar system wherein a radio signal transmitted from a radar station initiates the transmission of a radio signal from another station.

SECONDARY SURVEILLANCE RADAR (SSR) — A surveillance radar system which uses transmitters / receivers (interrogators) and transponders.

SEGREGATED PARALLEL OPERATIONS — Simultaneous operations on parallel or near-parallel instrument runways in which one runway is used exclusively for approaches and the other runway is used exclusively for departures.

SENDING UNIT/CONTROLLER — Air traffic services unit/air traffic controller transmitting a message.

NOTE: See definition of "receiving unit/controller”.

SHORELINE — A line following the general contour of the shore, except that in cases of inlets or bays less than 30 NM in width, the line shall pass directly across the inlet or bay to intersect the general contour on the opposite side.

SIGMET INFORMATION — Information issued by a meteorological watch office concerning the occurrence or expected occurrence of specified en-route weather and other phenomena which may affect the safety of aircraft operations.

SIGNAL AREA — An area on an aerodrome used for the display of ground signals.

SIGNIFICANT POINT — A specified geographical location used in defining an ATS route or the flight path of an aircraft and for other navigation and ATS purposes.

NOTE: There are three categories of significant points: ground-based navigation aid, intersection and waypoint. In the context of this definition, intersection is a significant point expressed as radials, bearings and/or distances from ground-based navigation aids.

SITUATION DISPLAY — An electronic display depicting the position and movement of aircraft and other information as required.

SLUSH — Water-saturated snow which with a heel-and-toe slap-down motion against the ground will be displaced with a splatter; specific gravity: 0.5 up to 0.8.

NOTE: Combinations of ice, snow and/or standing water may, especially when rain, rain and snow, or snow is falling, produce substances with specific gravities in excess of 0.8. These substances, due to their high water/ice content, will have a transparent rather than a cloudy appearance and, at the higher specific gravities, will be readily distinguishable from slush.

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SNOW (on the ground) —

a. *Dry snow*. Snow which can be blown if loose or, if compacted by hand, will fall apart upon release; specific gravity: up to but not including 0.35.

b. *Wet snow*. Snow which, if compacted by hand, will stick together and tend to or form a snowball; specific gravity: 0.35 up to but not including 0.5.

c. *Compacted snow*. Snow which has been compressed into a solid mass that resists further compression and will hold together or break up into lumps if picked up; specific gravity: 0.5 and over.

SPECIAL VFR FLIGHT — A VFR flight cleared by air traffic control to operate within a control zone in meteorological conditions below VMC.

SSR RESPONSE — The visual indication, in non-symbolic form, on a situation display, of a response from an SSR transponder in reply to an interrogation.

STANDARD INSTRUMENT ARRIVAL (STAR) — A designated instrument flight rule (IFR) arrival route linking a significant point, normally on an ATS route, with a point from which a published instrument approach procedure can be commenced.

STANDARD INSTRUMENT DEPARTURE (SID) — A designated instrument flight rule (IFR) departure route linking the aerodrome or a specified runway of the aerodrome with a specified significant point, normally on a designated ATS route, at which the enroute phase of a flight commences.

STANDARD MESSAGE ELEMENT — Part of a message defined in the PANS-ATM (Doc 4444) in terms of display format, intended use and attributes.

STANDARDIZED FREE TEXT MESSAGE ELEMENT — A message element that uses a defined free text message format, using specific words in a specific order.

NOTE: Standardized free text message elements may be manually entered by the user or preformatted.

STOPWAY — A defined rectangular area on the ground at the end of take-off run available prepared as a suitable area in which an aircraft can be stopped in the case of an abandoned take-off.

SURVEILLANCE RADAR — Radar equipment used to determine the position of an aircraft in range and azimuth.

TAXIING — Movement of an aircraft on the surface of an aerodrome under its own power, excluding take-off and landing.

TAXIWAY — A defined path on a land aerodrome established for the taxiing of aircraft and intended to provide a link between one part of the aerodrome and another, including:

***Aircraft Stand Taxilane* —** A portion of an apron designated as a taxiway and intended to provide access to aircraft stands only.

***Apron Taxiway* —** A portion of a taxiway system located on an apron and intended to provide a through taxi route across the apron.

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***Rapid Exit Taxiway* —** A taxiway connected to a runway at an acute angle and designed to allow landing aeroplanes to turn off at higher speeds than are achieved on other exit taxi-ways and thereby minimizing runway occupancy times.

TERMINAL ARRIVAL ALTITUDE (TAA) — The lowest altitude that will provide a minimum clearance of 300m (1000 ft) above all objects located in an arc of a circle defined by a 46km (25 NM) radius centered on the initial approach fix (IAF), or where there is no IAF on the intermediate fix (IF), delimited by straight lines joining the extremity of the arc to the IF. The combined TAAs associated with an approach procedure shall account for an area of 360 degrees around the IF.

TERMINAL CONTROL AREA (TMA) — A control area normally established at the confluence of ATS routes in the vicinity of one or more major aerodromes.

THRESHOLD (THR) — The beginning of that portion of the runway usable for landing.

TIME DIFFERENCE OF ARRIVAL (TDOA) — The difference in relative time that a transponder signal from the same aircraft (or ground vehicle) is received at different receivers.

TOTAL ESTIMATED ELAPSED TIME — For IFR flights, the estimated time required from take-off 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 take-off to arrive over the destination aerodrome.

TOUCHDOWN — 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.

TRACK — 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).

TRAFFIC AVOIDANCE ADVICE — Advice provided by an air traffic services unit specifying manoeuvres to assist a pilot to avoid a collision.

TRAFFIC INFORMATION — Information issued by an air traffic services unit to alert a pilot to other known or observed air traffic which may be in proximity to the position or intended route of flight and to help the pilot avoid a collision.

TRANSFER OF CONTROL POINT — A defined point located along the flight path of an aircraft, at which the responsibility for providing air traffic control service to the aircraft is transferred from one control unit or control position to the next.

TRANSFERRING UNIT/CONTROLLER — 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 ALTITUDE — The altitude at or below which the vertical position of an aircraft is controlled by reference to altitudes.

TRANSITION LAYER — The airspace between the transition altitude and the transition level.

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

TRANSITION LEVEL — The lowest flight level available for use above the transition altitude.

UNCERTAINTY PHASE — A situation wherein uncertainty exists as to the safety of an aircraft and its occupants.

UNMANNED FREE BALLOON — A non-power-driven, unmanned, lighter-than-air aircraft in free flight.

NOTE: Unmanned free balloons are classified as heavy, medium or light in accordance with specifications contained in ICAO Rules of the Air, Annex 2, Appendix 5.

VECTORING — Provision of navigational guidance to aircraft in the form of specific headings, based on the use of an ATS surveillance system.

VERTICAL PATH ANGLE (VPA) — Angle of the published final approach descent in baro-VNAV procedures.

VFR — The symbol used to designate the visual flight rules.

VFR FLIGHT — A flight conducted in accordance with the visual flight rules.

VISIBILITY — Visibility for aeronautical purposes is the greater of:

a. the greatest distance at which a black object of suitable dimensions, situated near the ground, can be seen and recognized when observed against a bright background;

b. the greatest distance at which lights in the vicinity of 1000 candelas can be seen and identified against an unlit background.

NOTE 1: The two distances have different values in air of a given extinction coefficient, and the latter b) varies with the background illumination. The former a) is represented by the meteorological optical range (MOR).

NOTE 2: The definition applies to the observations of visibility in local routine and special reports, to the observations of prevailing and minimum visibility reported in METAR and SPECI and to the observations of ground visibility.

VISUAL APPROACH — An approach by an IFR flight when either part or all of an instrument approach procedure is not completed and the approach is executed in visual reference to terrain.

VISUAL MANOEUVERING (CIRCLING) AREA — The area in which obstacle clearance should be taken into consideration for aircraft carrying out a circling approach.

VISUAL METEOROLOGICAL CONDITIONS (VMC) — Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling equal to or better than specified minima.

NOTE: The specified minima are contained in ICAO Rules of the Air, Annex 2, Chapter 4.

VISUAL SEGMENT DESCENT ANGLE (VSDA) — The angle between the MDA/H at the MPAt/DP and the heliport crossing height.

VISUAL SEGMENT DESIGN GRADIENT (VSDG) — The gradient of the visual segment in a PinS departure procedure. The visual segment connects the heliport or landing location with the initial departure fix (IDF) minimum crossing altitude (MCA).

INTERNATIONAL CIVIL AVIATION ORGANIZATION -- DEFINITIONS

VISUAL SURVEILLANCE SYSTEM — An electro-optical system providing an electronic visual presentation of traffic and any other information necessary to maintain situational awareness at an aerodrome and its vicinity.

VMC — The symbol used to designate visual meteorological conditions.

WAYPOINT — A specified geographical location used to define an area navigation route or the flight path of an aircraft employing area navigation. Waypoints are identified as either:

***Fly-By Waypoint* —** A waypoint which requires turn anticipation to allow tangential interception of the next segment of a route or procedure, or

***Flyover Waypoint* —** A waypoint at which a turn is initiated in order to join the next segment of a route or procedure.

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Air Traffic Control

International Civil Aviation Organization - Flight Procedures

FLIGHT PROCEDURES - (DOC 8168) AIR TRAFFIC CONTROL

Extracted from ICAO Document 8168, Volume I - Sixth Edition - Procedures for Air Navigation Services - AIRCRAFT OPERATIONS, Flight Procedures and from ICAO Document 8168, Volume III - First Edition - Procedures for Air Navigation Services - AIRCRAFT OPERATIONS, Aircraft Operating Procedures, herein known as PANS-OPS.

1 GENERAL

1.1 This section describes operational procedures and outlines the parameters on which the criteria of ICAO Document 8168, Volume II - *Construction of Visual and Instrument Flight Procedures,* are based, so as to illustrate the need for pilots to adhere strictly to the published procedures.

1.1.1 With the exception of this introductory material, paragraphs have been extracted in whole or in part from PANS-OPS. The PANS-OPS paragraph numbers are used beginning with Part I.

1.2 STATE PAGES - RULES AND PROCEDURES

1.2.1 On RULES AND PROCEDURES pages, any differences to the latest PANS-OPS are explained under the subtitle “Flight Procedures”.

Extracted from ICAO Document 8168, Volume I - Sixth Edition - Procedures for Air Navigation Services - AIRCRAFT OPERATIONS, Flight Procedures, herein known as PANS-OPS.

1 GENERAL REQUIREMENTS

1.1 GENERAL

1.1.1 Procedures contained in PANS-OPS assume that all engines are operating. Development of contingency procedures is the responsibility of the operator.

1.1.2 Procedures depict tracks or bearings. The pilot should attempt to maintain the track or bearing by applying corrections to heading for known wind.

1.1.3 All examples of calculations in this document are based on an altitude of 600 m (2000 ft) above mean sea level (MSL) and a temperature of international standard atmosphere (ISA) +15°C unless otherwise stated.

NOTE: Detailed specifications for instrument approach procedure construction, primarily for the use of procedures specialists, are contained in PANS-OPS, Volume II.

1.2 OBSTACLE CLEARANCE

Obstacle clearance is a primary safety consideration in the development of instrument flight procedures. The criteria used and the detailed method of calculation are covered in PANS-OPS, Volume II. However, from the operational point of view it is stressed that the obstacle clearance applied in the development of each instrument procedure is considered to be the minimum required for an acceptable level of safety in operations.

1.3 AREAS

1.3.1 Where track guidance is provided in the design of a procedure, each segment comprises a specified volume of airspace, the vertical cross-section of which is an area located symmetrically about the centre line of each segment. The vertical cross-section of each segment is divided into primary and secondary areas. Full obstacle clearances are applied over the primary areas reducing to zero at the outer edges of the secondary areas (see Figure II-1-1-1).

1.3.2 On straight segments, the width of the primary area at any given point is equal to one-half of the total width. The width of each secondary area is equal to one-quarter of the total width.

1.3.4 The minimum obstacle clearance (MOC) is provided for the whole width of the primary area. In the secondary area, MOC is provided at the inner edges reducing to zero at the outer edges.

NOTE: Areas for RNP AR Procedures are described in the Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual (Doc 9905).

1.4 USE OF FLIGHT MANAGEMENT SYSTEM (FMS)/AREA NAVIGATION (RNAV) EQUIPMENT IN CONVENTIONAL PROCEDURES

1.4.1 Where FMS/RNAV equipment is available, it may be used to fly conventional procedures provided:

a. the procedure is monitored using the basic display normally associated with that procedure; and

b. the tolerances for flight using raw data on the basic display are complied with.

1.4.2 Lead radials are for use by non-RNAV-equipped aircraft and are not intended to restrict the use of turn anticipation by the FMS.

1.5 TURNING POINTS

The turning point (TP) is specified in one of two ways:

a. *at a designated facility or fix* - the turn is made upon arrival overhead a facility or fix; or

b. *at a designated altitude* - the turn is made upon reaching the designated altitude unless an additional fix or distance is specified to limit early turns (departures and missed approach only); or

c. *at a designated waypoint* - turns in performance-based navigation (PBN) procedures may be either fly-by, fly-over or constant radius arc to a fix (RF). See Figures II-1-1-2, II-1-1-3 and II-1-1-4.

1.6 PROTECTION AREA FOR TURNS

Speed is a controlling factor in determining the aircraft track during the turn. The outer boundary of the turning area is based on the highest speed of the category for which the procedure is authorized. The inner boundary caters for the slowest aircraft.

NOTE: For more information about the construction of protected areas for turns, see Attachment A - Procedure Design Principles.

1.7 COLD TEMPERATURE CORRECTION

1.7.1 Temperatures lower than those of the standard atmosphere result in the actual altitude of an aircraft being lower than that indicated by the barometric altimeter. As a consequence, the MOC actually achieved could be lower than the prescribed MOC. In order to prevent this, the pilot shall correct for low temperatures. The pilot is responsible for any necessary cold temperature corrections to all published minimum altitudes/heights in both conventional and PBN procedures. This includes:

a. the altitudes/heights for the initial and intermediate segment(s);

b. the decision altitude/height (DA/H) or minimum descent altitude/height (MDA/H); and

c. subsequent missed approach altitudes/heights.

1.7.2 The final approach path vertical path angle (VPA) on a 3D approach operation which is based on barometric vertical navigation (baro-VNAV) criteria is safeguarded against the effects of low temperature by the design of the procedure. This will ensure that the effective VPA at the minimum temperature published on the chart will not be less than 2.5° and has been obstacle assessed. By applying the cold temperature correction to this procedure type the nominal VPA will actually be flown. This can be achieved by manual application of the correction by the pilot, or in some cases where certified systems are used, through automatic application of the correction by an FMS.

NOTE: For more information on the use of automated systems for temperature compensation, see the Performance-based Navigation (PBN) Manual (Doc 9613).

Figure II-1-1-1. Relationship of minimum obstacle clearances in primary and secondary areas in cross-section

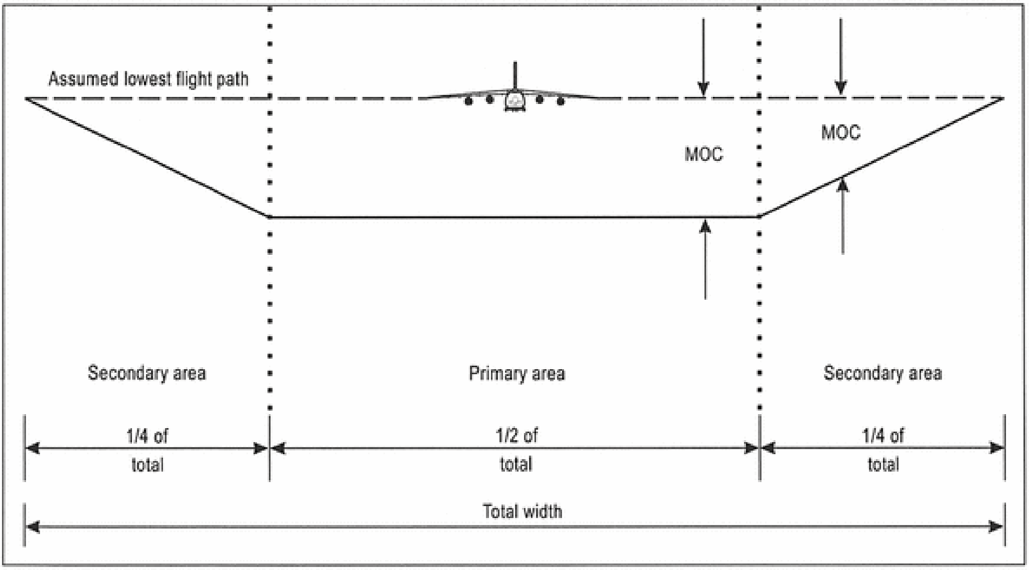


Figure II-1-1-2. Fly by waypoint (WP1)

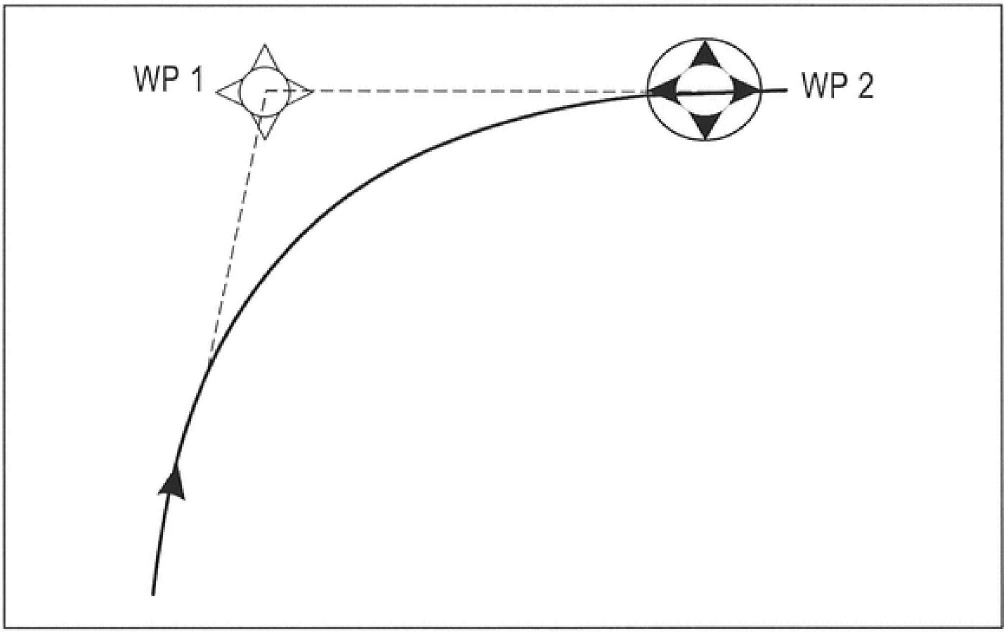


Figure II-1-1-3. Fly-over waypoint

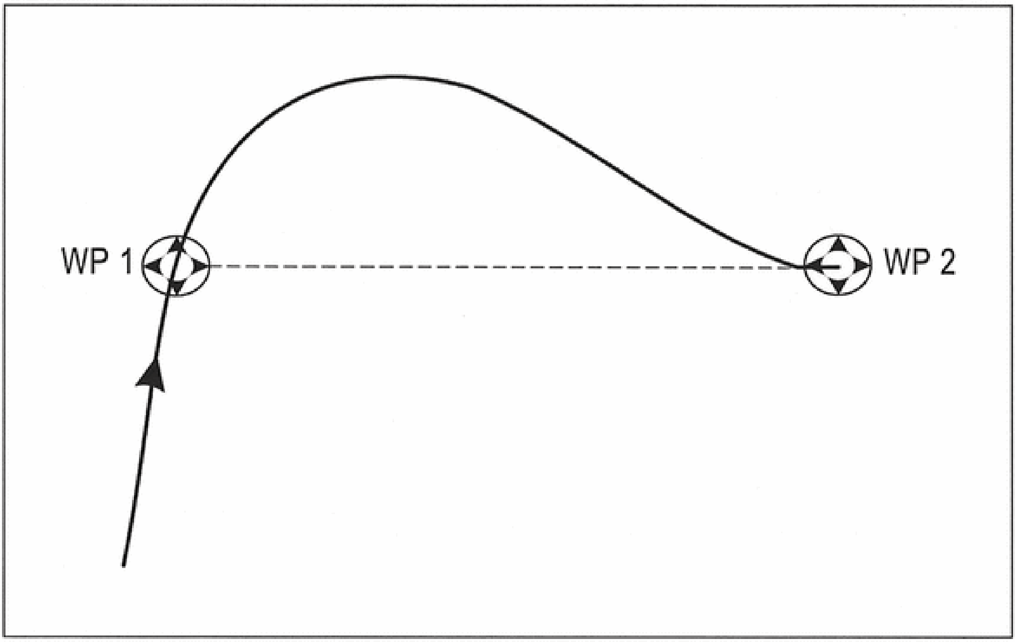
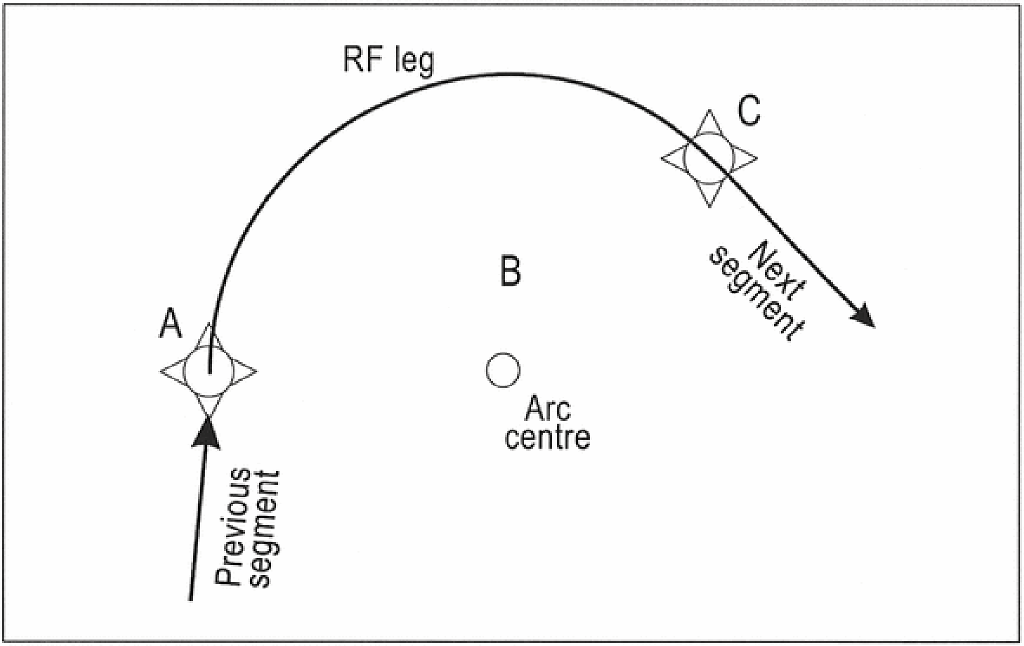


Figure II-1-1-4. RF turn



Extracted from ICAO Document 8168, Volume I - Sixth Edition - Procedures for Air Navigation Services - AIRCRAFT OPERATIONS, Flight Procedures, herein known as PANS-OPS.

1 GENERAL REQUIREMENTS

1.1 INTRODUCTION

1.1.1 The criteria in this section are designed to provide the pilot and other flight operations personnel with an appreciation, from the operational point of view, of the parameters and criteria used in the design of instrument departure procedures. These include, but are not limited to, standard instrument departure (SID) routes and associated procedures (see Annex 11, Appendix 3).

1.1.2 These procedures assume that all engines are operating. In order to ensure acceptable clearance above obstacles during the departure phase, instrument departure procedures may be published as specific routes to be followed or as omnidirectional departures, together with procedure design gradients and details of significant obstacles.

1.1.3 A departure procedure is established for each runway on which an instrument departure is expected to be used. Procedures will be developed for different categories of aircraft as required.

1.2 CONTINGENCY PROCEDURES

1.2.1 Development of contingency procedures, required to cover the case of engine failure or an emergency in flight which occurs after V1, is the responsibility of the operator, in accordance with Annex 6. Where terrain and obstacles permit, these procedures should follow the normal departure route.

1.2.2 Turning procedures

When it is necessary to develop a turning procedure to avoid an obstacle which would have become limiting, the procedure should be described in detail in the appropriate operator or aircraft manual. The point for start of turn in this procedure shall be readily identifiable by the pilot when flying under instrument conditions.

1.3 INSTRUMENT DEPARTURE PROCEDURE

1.3.1 Design considerations

The design of an instrument departure procedure is, in general, dictated by the terrain surrounding the aerodrome. It may also be required to provide for air traffic control (ATC) requirements in the case of SID routes. These factors in turn influence the type and siting of navigation aids in relation to the departure route. Airspace restrictions may also affect the routing and siting of navigation aids.

1.3.2 Aerodrome operating minima

Where obstacles cannot be cleared by the appropriate margin when the aircraft is flown on instruments, aerodrome operating minima are established to permit visual flight clear of obstacles.

1.3.3 Wind effect

1.3.3.1 When flying departure routes expressed as tracks or bearings, the pilot shall compensate for known or estimated winds.

1.3.3.2 When being vectored, the pilot should not compensate for wind effects.

1.3.4 Vectors

Pilots should not accept vectors during departure unless:

a. they are above the minimum altitude(s)/height(s) required to maintain obstacle clearance in the event of engine failure. This relates to engine failure between V1 and minimum sector altitude or the end of the contingency procedure as appropriate; or

b. the departure route is non-critical with respect to obstacle clearance.

1.4 OBSTACLE CLEARANCE

1.4.1 The minimum obstacle clearance (MOC) equals zero at the departure end of the runway (DER). From that point, it increases by 0.8 per cent of the horizontal distance in the direction of flight assuming a maximum turn of 15°.

1.4.2 During the turn, a MOC of 75 m (246 ft) (CAT H, 65 m (213 ft)) is provided.

1.5 PROCEDURE DESIGN GRADIENT (PDG)

1.5.1 Unless otherwise published, a PDG of 3.3 per cent is assumed.

1.5.2 For conversion of climb gradient for cockpit use, see Figure II-2-1-2.

1.6 FIXES AS AN AID IN OBSTACLE AVOIDANCE

Whenever suitably located distance measuring equipment (DME) exists, additional specific height/distance information intended for obstacle avoidance may be published. Waypoints or other suitable fixes should be used by the pilot to provide a means of monitoring climb performance.

1.7 PERFORMANCE-BASED NAVIGATION (PBN) DEPARTURES

1.7.1 *Description.* A PBN departure is a departure procedure containing area navigation (RNAV) or required navigation performance (RNP) segments.

1.7.2 *PBN requirements box.* PBN departure procedures are promulgated with a PBN requirements box. The box contains the following information:

a. identification of the applicable navigation specification(s) that were used to design the departure procedure;

b. restrictions on navigation equipment required to fly the procedure (for example, global navigation satellite system (GNSS) only) if applicable; and

c. information related to optional functionality of the applicable navigation specification such as the use of constant radius arc to a fix (RF) legs or RNP scalability, if applicable.

1.7.3 Applicable navigation specifications

The applicable navigation specifications for PBN departure operations are:

a. RNAV 2;

b. RNAV 1;

c. RNP 1;

d. RNP 0.3 (Helicopters); and

e. Advanced RNP (A-RNP).

NOTE: For complete details of the applicability of PBN navigation specifications to departure procedures, see the Performance-based Navigation (PBN) Manual (Doc 9613).

1.7.4 The navigation specifications may be applied on a departure route segment basis.

1.7.5 *Navigation database.* Departure procedure information is contained in a navigation database using the WGS-84 coordinate system. If the navigation database does not contain the departure procedure, the procedure shall not be used.

1.7.6 PBN operational approval

1.7.6.1 Pilots shall verify, before operating on any PBN route or procedure, that they have approval to operate on the navigation specification used. Where there are additional restrictions, for example, sensor use or optional functionality as discussed in para 1.7.2 above, the pilot shall also verify that these restrictions are complied with.

1.7.6.2 Prior to operating on any PBN procedure, the pilot shall confirm:

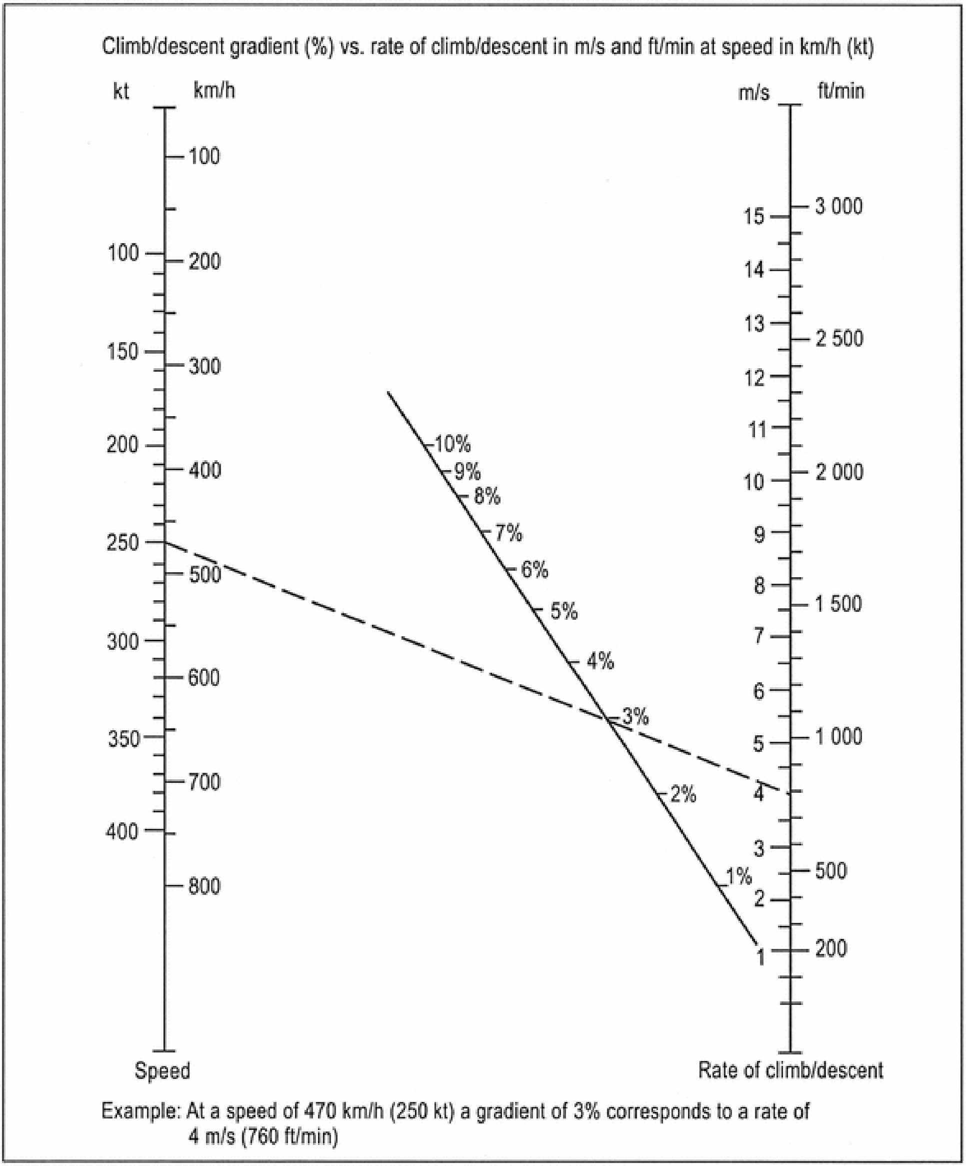
a. the operation of all required navigation aids (ground and space-based);

b. the correct functioning of the navigation equipment;

c. the validity of the navigation database; and

d. waypoint and segment data, with reference to the published chart.

Figure II-2-1-2. Conversion nomogram



Climb/descent gradient (%) vs. rate of climb/descent in m/s and ft/min at speed in km/h (kt)

Example: At a speed of 470 km/h (250 kt) a gradient of 3% corresponds to a rate of 4 m/s (760 ft/min)

2 STANDARD INSTRUMENT DEPARTURES

2.1 GENERAL

2.1.1 A standard instrument departure (SID) is a departure procedure that is normally developed to accommodate as many aircraft categories as possible. Departures that are limited to specific aircraft categories are clearly annotated (see Section 5, Chapter 1, 1.4, “Categories of aircraft”).

2.1.2 For procedure design purposes, the SID terminates at the first fix/facility/waypoint of the en-route phase following the departure procedure.

2.1.3 SIDs are based on track guidance acquired:

a. for conventional straight departures, within 20.0 km (10.8 NM) from the DER;

b. for conventional turning departures within 10.0 km (5.4 NM) after completion of turns; and

c. for PBN departure procedures normally at the DER.

2.2 PROCEDURE DESIGN GRADIENT

2.2.1 The standard design gradient for departure procedures is 3.3 per cent.

2.2.2 When obstacles exist which affect the departure route, procedure design gradients greater than 3.3 per cent may be specified. When such a gradient is specified, the altitude/height to which it extends is promulgated.

2.2.3 For information regarding rates of climb necessary to meet the specified climb gradients the pilot should refer to Figure II-2-1-2.

2.3 STRAIGHT DEPARTURES

Wherever possible, a straight departure is specified. A straight departure is one in which the initial departure track is within 15° of the alignment of the runway centre line.

2.4 TURNING DEPARTURES

2.4.1 When a departure route requires a turn of more than 15°, it is called a turning departure. Straight flight is assumed until reaching an altitude/height of at least 120 m (394 ft). Procedures normally cater for turns at a point 600 m from the beginning of the runway. However, in some cases, turns should not be initiated before the DER (or a specified point), and this information will be noted on the departure chart.

2.4.2 For Category H procedures, turns may be initiated 90 m (295 ft) above the elevation of the DER or final approach and take-off area (FATO) and the earliest turn initiation point is at the beginning of the runway FATO.

2.4.3 Flight speeds for turning departure are specified in Table II-2-2-1. Wherever limiting speeds other than those specified in Table II-2-2-1 are promulgated, they shall be complied with in order to remain within the appropriate areas. If an aeroplane operation requires a higher speed, then an alternative departure procedure shall be requested.

2.4.4 Turn speeds

2.4.4.1 The maximum speeds used for departure turns shall be those of the final missed approach increased by 10 per cent to account for increased aeroplane mass in departure (see Table II-2-2-1), unless otherwise annotated on the procedure.

2.4.4.2 In exceptional cases, where acceptable terrain clearances cannot otherwise be provided, turning departure routes are constructed with maximum speeds as low as the intermediate missed approach speed increased by 10 per cent (see Tables II-5-1-1 and II-5-1-2). In such cases, the procedure is annotated “Departure turn limited to ... km/h (kt) IAS maximum”.

Table II-2-2-1. Maximum speeds for turning departures

Aeroplane Category	Maximum Speed km/h (kt)
A	225 (120)
B	305 (165)
C	490 (265)
D	540 (290)
E	560 (300)
H	165 (90)

3 OMNIDIRECTIONAL DEPARTURES

3.1 GENERAL

3.1.1 In cases where no suitable navigation aid is available, or no track guidance is provided, omnidirectional procedures are used.

3.1.2 Where obstacles do not permit development of omnidirectional procedures, the pilot shall ensure that ceiling and visibility will permit obstacles to be avoided visually.

3.1.3 Omnidirectional departures may specify sectors to be avoided.

3.2 BEGINNING OF DEPARTURE

3.2.1 The departure procedure begins at the departure end of the runway (DER), which is the end of the area declared suitable for take-off (i.e. the end of the runway or clearway as appropriate).

3.2.2 Since the point of lift-off will vary, the departure procedure assumes that a turn at 120 m (394 ft) above the elevation of the aerodrome is not initiated by the pilot sooner than 600 m from the beginning of the runway.

3.2.3 Procedures are normally designed/optimized for turns at a point 600 m from the beginning of the runway. However, in some cases the pilot shall not be allowed to initiate a turn before the DER (or a specified point), and this information will be noted on the departure chart.

3.3 PROCEDURE DESIGN GRADIENT (PDG)

3.3.1 Unless otherwise specified, departure procedures assume a 3.3 per cent (helicopters, 5 per cent) PDG and straight climb on the extended runway centre line until reaching 120 m (394 ft) (helicopters, 90 m (295 ft)) above the aerodrome elevation.

3.3.2 The basic procedure ensures:

a. the aircraft climbs on the extended runway centre line to 120 m (394 ft) (helicopters, 90 m (295 ft)) before turning; and

b. at least 75 m (246 ft) (CAT H, 65 m (213 ft)) of obstacle clearance is provided before any turns greater than 15°.

Extracted from ICAO Document 8168, Volume I - Sixth Edition - Procedures for Air Navigation Services - AIRCRAFT OPERATIONS, Flight Procedures, herein known as PANS-OPS.

1 EN-ROUTE PROCEDURES

1.1

1.2 OBSTACLE CLEARANCE AREAS

1.2.1 In defining obstacle clearance areas, both primary and secondary areas are specified. These are defined in such a way as to ensure that the aircraft position will be contained within the primary area 95 per cent of the time and within the secondary area 99.7 per cent of the time.

1.2.2 Area minimum altitudes

1.2.2.1 For en-route charts the area minimum altitude shall be shown within each quadrant referenced to true north, except in areas of high latitude where it is determined by the appropriate authority that true north orientation of the chart is impractical.

1.2.2.2 In high latitude areas as described in 1.2.2.1, the area minimum altitude should be shown within each quadrant formed by reference lines of the grid used.

1.4 OBSTACLE CLEARANCE

1.4.1 The minimum obstacle clearance (MOC) value to be applied in the primary area for the en-route phase of an instrument flight rules (IFR) flight is 300 m (1000 ft). In mountainous areas, this shall be increased depending on the variation in terrain elevation as follows:

Variation in terrain elevation	MOC
Between 900 m (3000 ft) and 1500 m (5000 ft)	450 m (1476 ft)
Greater than 1500 m (5000 ft)	600 m (1969 ft)

1.4.2 The MOC to be applied outside the primary area is normally equal to half the value of that applied in the primary area. Where this is found to be too constraining an alternative method is to use a value which reduces from the full MOC at the edge of the primary area to zero at the outer edge of the secondary area.

1.4.3 Minimum obstacle clearance altitude (MOCA). The MOCA is the minimum altitude for a defined segment that provides the required MOC. A MOCA is determined and published for each segment of the route.

1.5 PERFORMANCE-BASED NAVIGATION (PBN) EN-ROUTE PROCEDURES

1.5.1 Standard conditions

1.5.1.1 The general criteria for very high frequency omnidirectional radio range (VOR) and non-directional beacon (NDB) routes apply except where amended in 1.5.1.2 and 1.5.2.

1.5.1.2 The standard assumptions on which en-route PBN procedures are developed are:

a. the fix tolerance area of the waypoint is a circle of radius equal to the navigation specification accuracy value; and

b. the navigation system provides information which the pilot monitors and uses to intervene in order to limit excursions outside of the designed area.

1.5.2 Applicable navigation specifications

The applicable navigation specifications for PBN en-route operations are:

a. RNAV 10;

b. RNAV 5;

c. RNAV 2;

d. RNAV 1;

e. RNP 4;

f. RNP 2;

g. RNP 0.3 (Helicopters); and

h. Advanced RNP (A-RNP).

NOTE: For complete details of the applicability of PBN navigation specifications to en-route procedures, see the Performance-based Navigation (PBN) Manual (Doc 9613).

1.5.3 PBN operational approval

1.5.3.1 Pilots shall verify, before operating on any PBN route, that they have approval to operate on the navigation specification(s) used. Where there are additional restrictions, for example, sensor use or optional functionality, the pilot shall also verify that these restrictions are complied with.

1.5.3.2 Prior to operating on any PBN procedure, the pilot shall confirm:

a. the operation of all required navigation aids (ground and space-based);

b. the correct functioning of the navigation equipment; and

c. the validity of the navigation database, where required.

1.5.4 Magnetic bearing on a PBN (RNAV or RNP) route segment

1.5.4.1 The magnetic bearing for a PBN route segment is based on the true course and the magnetic variation at the significant point at origin of the route segment.

1.5.4.2 Pilots should use the magnetic bearing as reference only, because their navigation system will fly the true course from one significant point to another.

1.5.5 En-route turns

1.5.5.1 There are three types of turns for PBN routes:

a. the fly-over turn at a waypoint;

b. the fly-by turn at a waypoint; and

c. the fixed radius transition (FRT). An FRT may be applied at fixes between area navigation route segments on the en-route structure and may be used with Advanced RNP, RNP 4 and RNP 2 navigation specifications.

NOTE: More information on constant radius turns in the en-route phase of flight is addressed in Doc 9613, Volume II, Part C, Appendix 2.

1.5.5.2 Pilots shall verify they are approved to operate on routes with FRTs prior to commencing any route which specifies their use.

FLIGHT PROCEDURES (DOC 8168) - ARRIVAL PROCEDURES

Extracted from ICAO Document 8168, Volume I - Sixth Edition - Procedures for Air Navigation Services - AIRCRAFT OPERATIONS, Flight Procedures, herein known as PANS-OPS.

1 GENERAL REQUIREMENTS

1.1 GENERAL

1.1.1 A standard instrument arrival (STAR) route permits transition from the en-route phase to the approach phase.

1.1.2 When necessary or where an operational advantage is obtained, arrival routes from the en-route phase to a fix or facility used in the procedure are published. This is normally the initial approach fix (IAF).

1.1.3 Omnidirectional or sector arrivals can be provided taking into account minimum sector altitudes (MSA).

1.2 TERMINAL AREA RADAR (TAR)

When TAR is employed, the aircraft will be vectored to a fix, or onto the intermediate or final approach track, at a point where the approach may be continued by the pilot by referring to the instrument approach chart (IAC).

1.3 MINIMUM SECTOR ALTITUDES (MSA)/TERMINAL ARRIVAL ALTITUDES (TAA)

MSAs and TAAs are established for each aerodrome and provide at least 300 m (1000 ft) obstacle clearance within 46 km (25 NM) of the significant point, the aerodrome reference point (ARP) or the heliport reference point (HRP) associated with the approach procedure for that aerodrome.

1.4 PERFORMANCE-BASED NAVIGATION (PBN) ARRIVALS

1.4.1 *Description*. A PBN arrival is an arrival procedure containing PBN segments. PBN arrival procedures may use terminal arrival altitudes to establish procedure altitudes for arrivals.

1.4.2 *PBN requirements box*. PBN arrival procedures are promulgated with a PBN requirements box. The box contains the following information:

a. identification of the applicable navigation specification(s) that were used to design the arrival procedure;

b. restrictions on navigation equipment required to fly the procedure (for example, global navigation satellite system (GNSS) only); and

c. information related to optional functionality of the applicable navigation specification, such as the use of constant radius arc to a fix (RF) legs or required navigation performance (RNP) scalability.

1.4.3 Applicable navigation specifications

1.4.3.1 The applicable navigation specifications for PBN arrival operations are:

a. RNAV 5 (initial part of a STAR outside 56 km (30 NM and above MSA only);

b. RNAV 2;
c. RNAV 1;
d. RNP 1;
e. RNP 0.3 (Helicopters); and
f. Advanced RNP (A-RNP).

NOTE: For complete details of the applicability of PBN navigation specifications to arrival procedures, see the Performance-based Navigation (PBN) Manual (Doc 9613).

1.4.3.2 *Navigation database*. Arrival waypoint information is contained in a navigation database using the WGS-84 coordinate system. If the navigation database does not contain the arrival procedure, the procedure shall not be used.

NOTE: A navigation database is not required for RNAV 5 operations.

1.4.4 PBN operational approval

1.4.4.1 Pilots shall verify, before operating on any PBN route or procedure, that they have approval to operate on the navigation specification used. Where there are additional restrictions, for example, sensor use or optional functionality as discussed in 1.4.2, the pilot shall also verify that these restrictions are complied with.

1.4.4.2 Prior to operating on any PBN procedure, the pilot shall confirm:

a. the operation of all required navigation aids (ground and space-based);
b. the correct functioning of the navigation equipment;
c. the validity of the navigation database, where required; and
d. waypoint and segment data, with reference to the published chart.

2 TERMINAL ARRIVAL ALTITUDE

2.1 GENERAL

2.1.1 TAAs are associated with a PBN procedure based upon the “T” or “Y” arrangement, with three IAFs arranged around the intermediate fix (IF) to allow for aircraft to join from all directions. (See Figures II-4-2-3 and II-4-2-4.)

2.1.2 Modifications to this standard pattern are sometimes necessary, for example, eliminating one or both of the base leg areas.

2.1.3 An aircraft approaching the terminal area and intending to conduct a PBN approach shall track via the appropriate IAF associated with the procedure. The publication of TAAs avoids the requirement for distance and/or azimuth information in relation to the MSA reference point and provides obstacle clearance while tracking direct to an IAF.

2.1.4 Where published, TAAs replace the 46 km (25 NM) MSA.

2.1.5 The standard TAA arrangement consists of three areas defined by the extension of the initial legs and the intermediate segment course from IF to final approach fix (FAF) or final approach point (FAP). These areas are called the straight-in, left base and right base areas.

2.1.6 TAA area boundaries are defined by a radial area navigation (RNAV) distance from, and magnetic bearings to, the TAA reference point. The TAA reference point is normally the associated IAF but in some cases may be the IF.

2.1.7 The standard TAA radius is 46 km (25 NM) from the IAF, and the boundaries between TAAs are normally defined by the extension of the initial segments (see Figure II-4-2-1).

2.1.8 Minimum altitudes charted for each TAA shall provide at least 300 m (1000 ft) obstacle clearance.

2.2 STEP DOWN ARCS

TAAs may contain step down arcs defined by distance from the IAF (see Figure II-4-2-2).

2.3 TAA ICONS

TAAs are depicted on the plan view of approach charts by the use of icons which identify the TAA reference point (IAF or IF), the radius from the reference point, and the bearings of the TAA boundaries. The icon will show minimum altitudes and step downs. The IAF for each TAA is identified by the waypoint name to help the pilot orient the icon to the approach procedure. The IAF name and the distance of the TAA boundary from the IAF are included on the outside arc of the TAA icon. TAA icons also identify, where necessary, the location of the intermediate fix by the letters “IF” and not the IF waypoint identifier to avoid misidentification of the TAA reference point and to assist in situational awareness (see Figures II-4-2-3 to II-4-2-5).

2.4 FLIGHT PROCEDURES

2.4.1 Establishment

Prior to operating at the TAA, the pilot shall determine that the aircraft is located within the TAA boundary. This should be done by selecting the relevant IAF and confirming the bearing and distance of the aircraft to the IAF. That bearing should then be compared with the published bearings that define the lateral boundaries of the TAA. This is critical when approaching the TAA near the boundary between areas, especially where TAAs are at different levels.

2.4.2 Manoeuvring

An aircraft may be manoeuvred at the TAA provided the flight path is contained within the TAA boundaries by reference to bearings and distance to the IAF.

2.4.3 Transitioning between TAAs

When transitioning from one TAA to another, the pilot shall ensure that the aircraft reaches or maintains the higher of the two TAA values prior to crossing the boundary between TAAs. The pilot shall exercise caution in transitioning to another TAA to ensure that reference is made to the correct IAF and that the aircraft is contained within the boundaries of both TAAs.

2.4.4 Entry to procedure

An aircraft established within a TAA area may enter the associated approach procedure at the IAF without conducting a procedure turn provided the angle of turn at the IAF does not exceed 110°. In most cases, the design of the TAA will not require a turn in excess of 110°; if necessary, the aircraft should be manoeuvred within the TAA to establish the aircraft on a track prior to arrival at the IAF that does not require a procedure turn (see Figure II-4-2-6).

2.4.5 Reversal procedures

Where entry cannot be made to the procedure with a turn at the IAF less than 110°, a reversal procedure shall be flown.

2.4.6 Arrival holding

A racetrack holding procedure will normally be located at an IAF or the IF. When one or more of the IAFs from the standard “T” or “Y” pattern are not provided, the holding pattern will normally be located to facilitate entry to the procedure (see Figure II-4-2-7).

2.5 NON-STANDARD TAA

2.5.1 Modification to the standard TAA design may be necessary to accommodate operational requirements. Variations may eliminate one or both of the base areas or modify the angular size of the straight-in area.

2.5.2 If both the left and right base areas are eliminated, the straight-in area is constructed on the straight-in IAF or IF with a 46 km (25NM) radius, through 360° of arc (see Figure II-4-2-8).

2.5.3 For procedures with a single TAA, the TAA area may be subdivided by pie-shaped sectors with the boundaries identified by magnetic bearings to the IAF, and may have one step down arc (see Figure II-4-2-9).

Figure II-4-2-1. Typical TAA arrangement

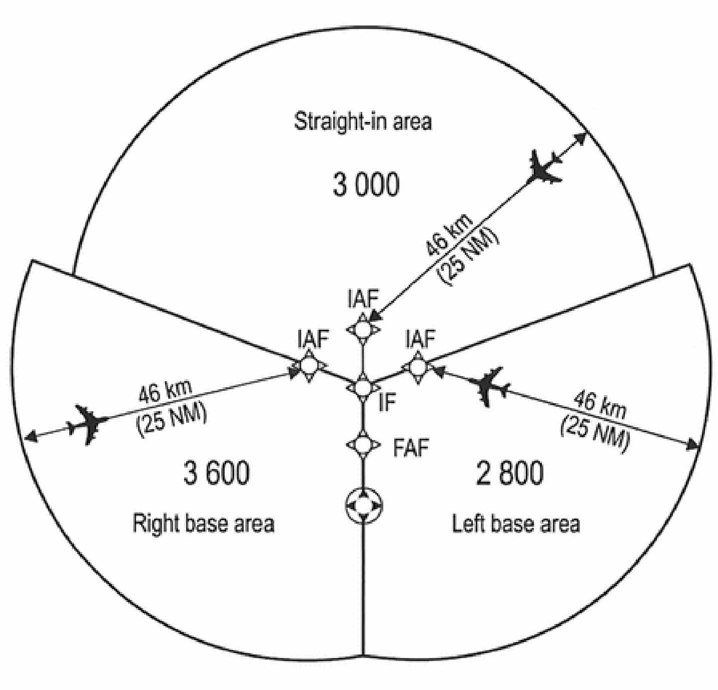


Figure II-4-2-2. TAA with step down arcs

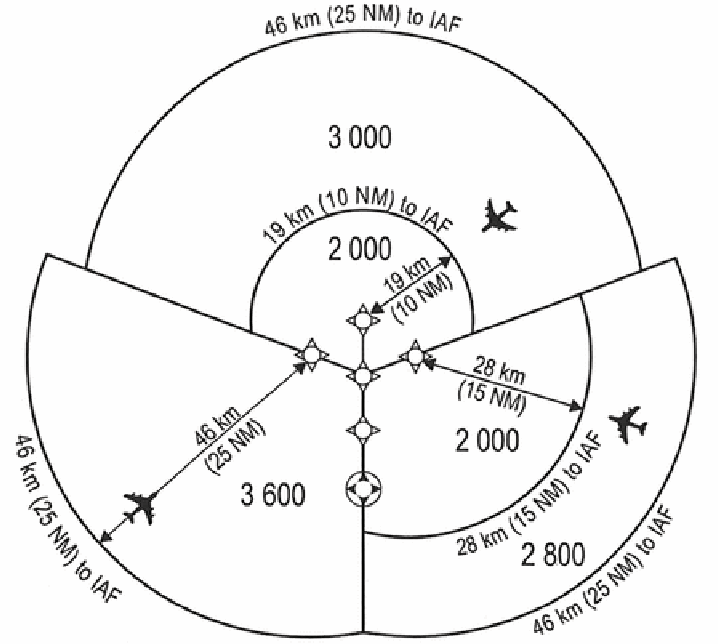


Figure II-4-2-3. TAA “Y” bar icon arrangement

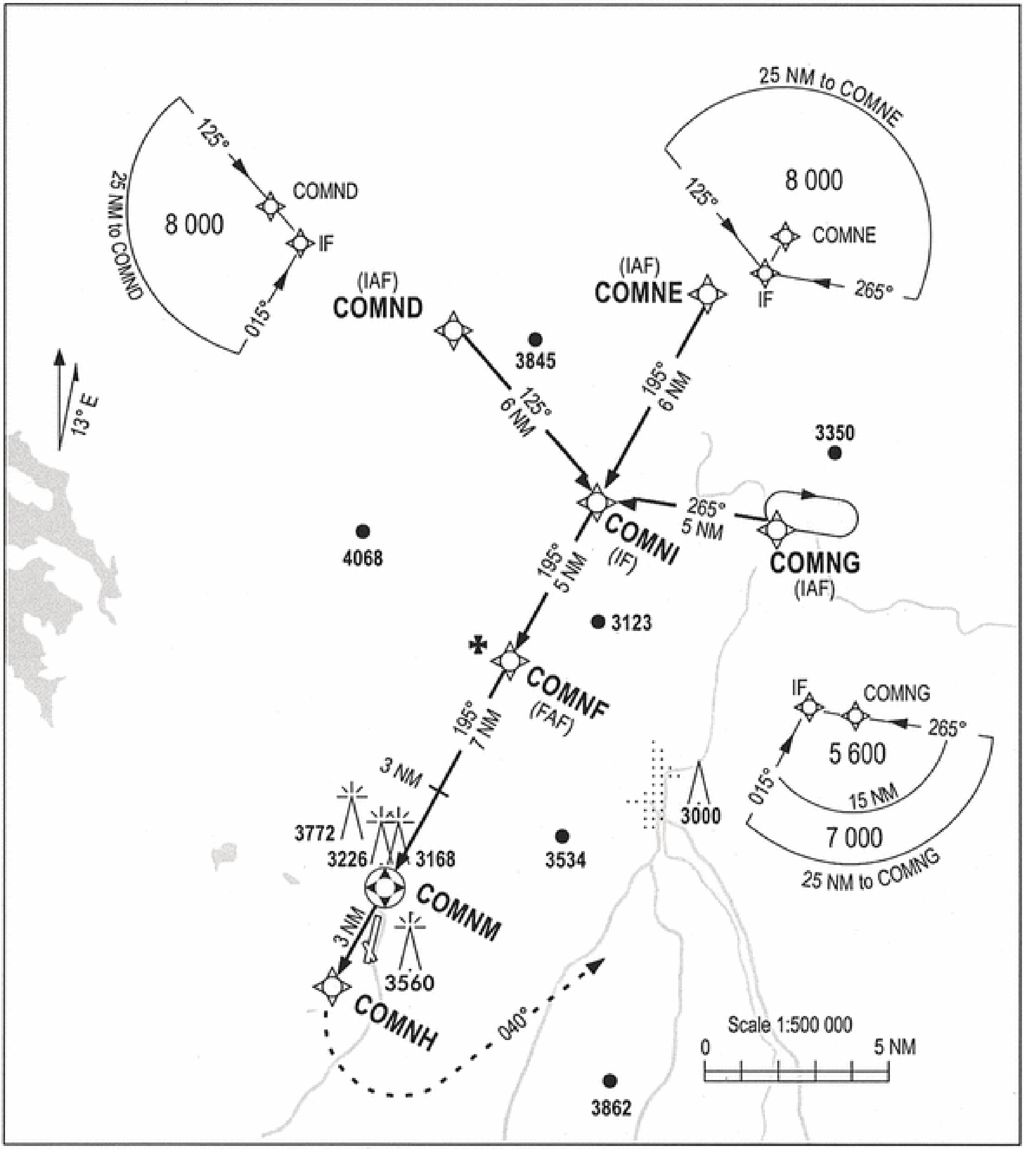


Figure II-4-2-4. “T” bar icon arrangement

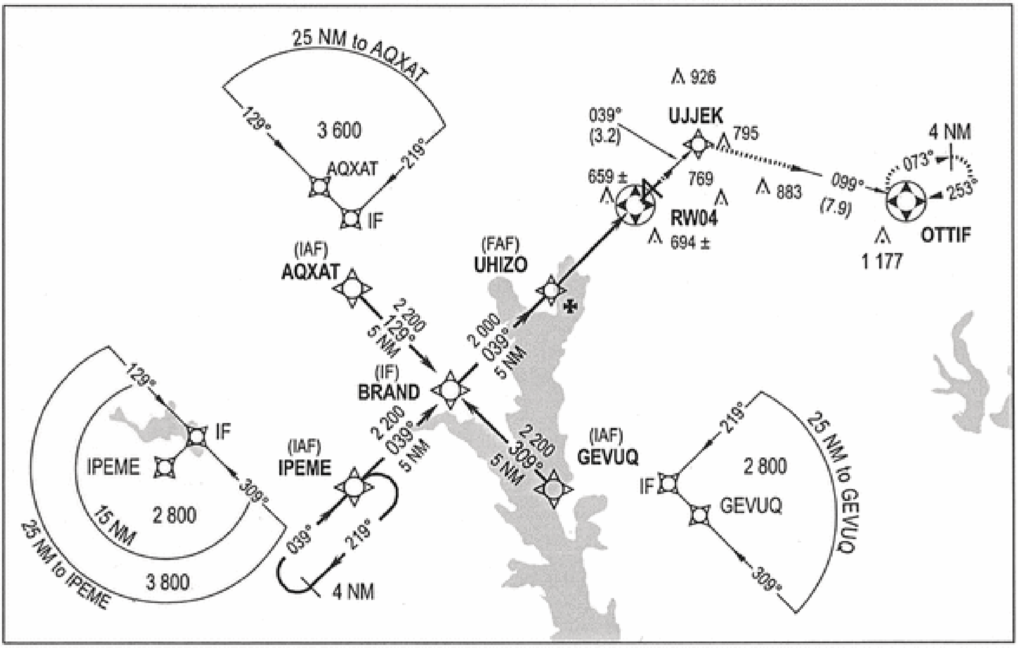


Figure II-4-2-5. “T” bar icon arrangement without centre initial approach fix

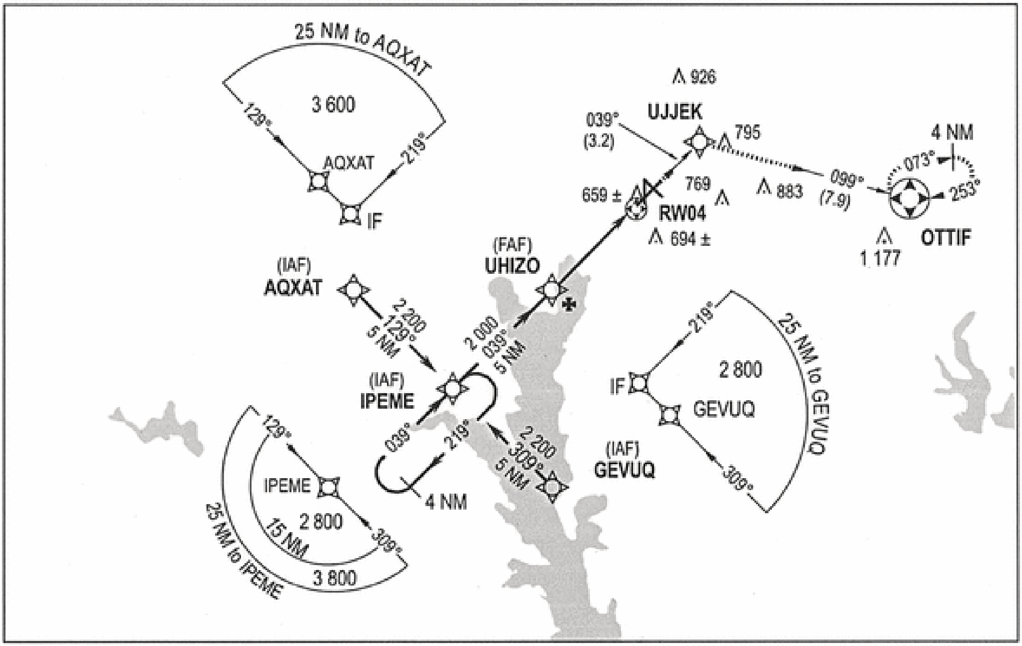


Figure II-4-2-6. Procedure entry

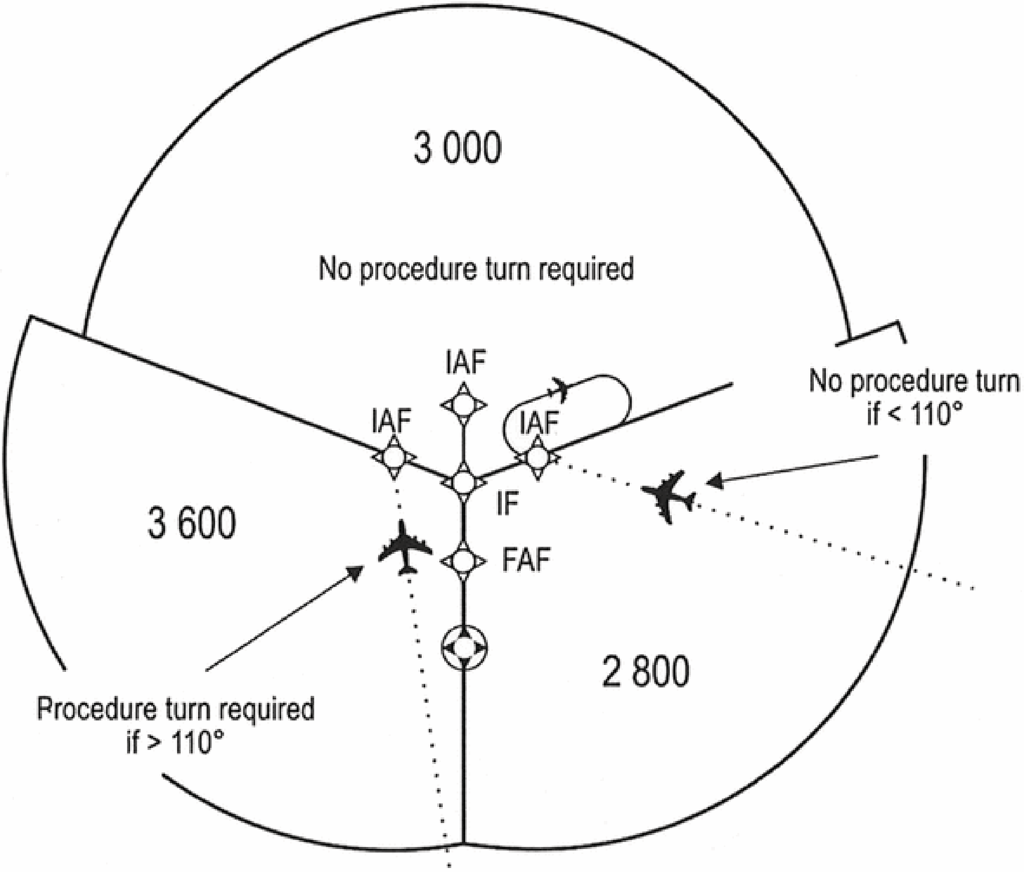


Figure II-4-2-7. TAA arrangement without right base

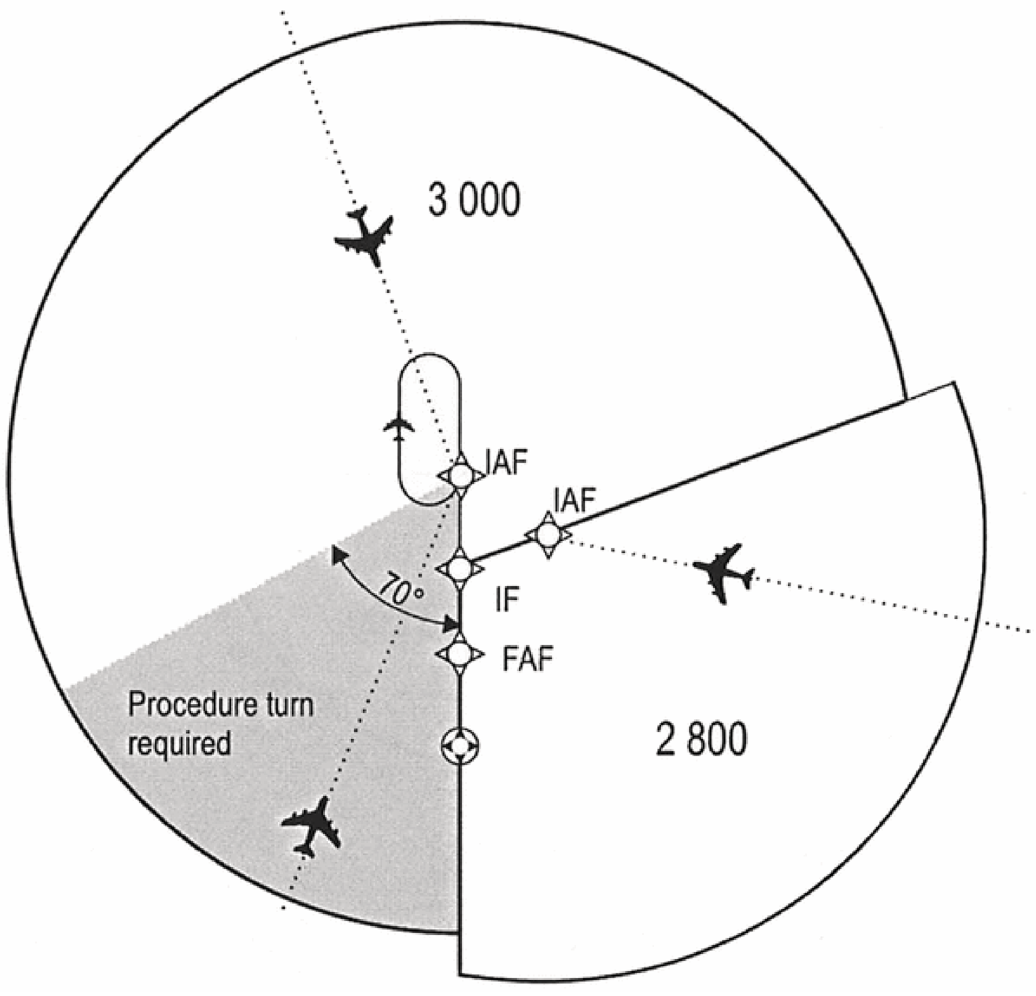


Figure II-4-2-8. TAA arrangement without left and right base

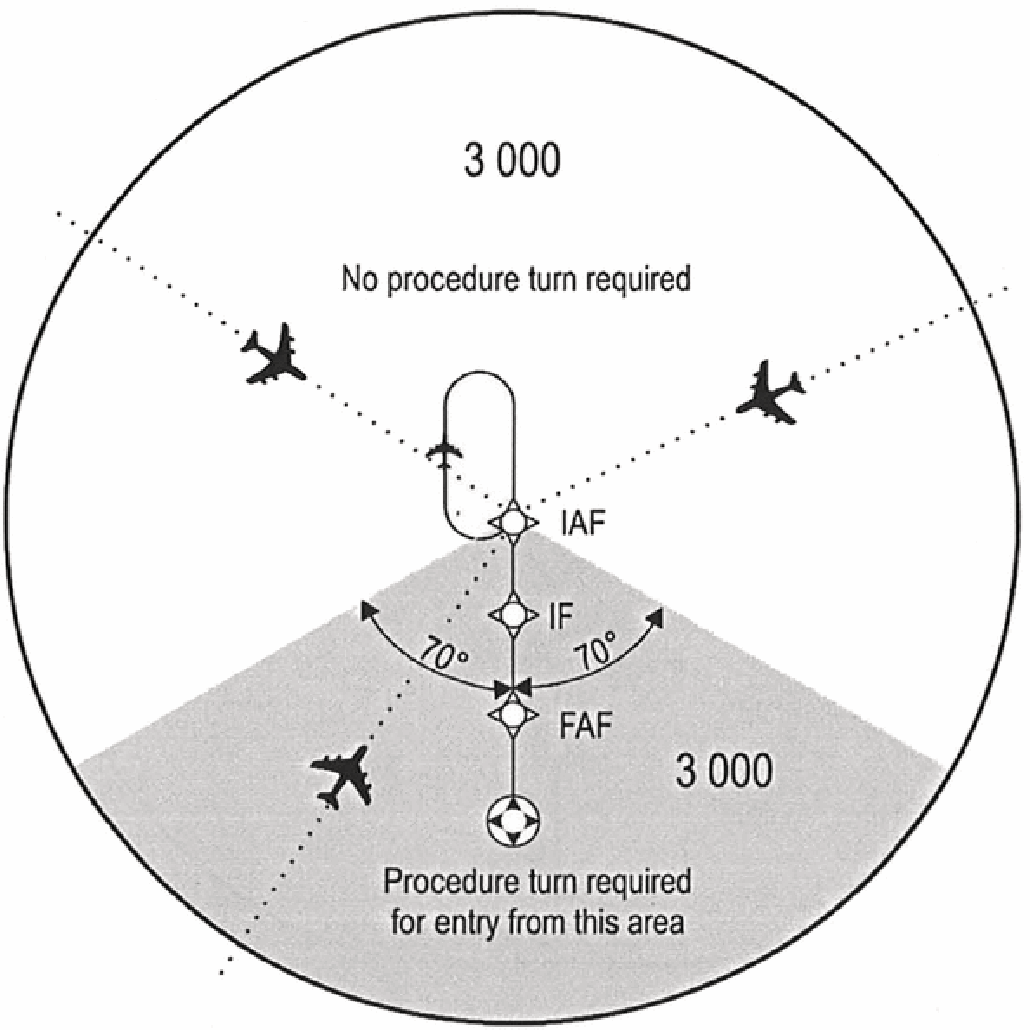
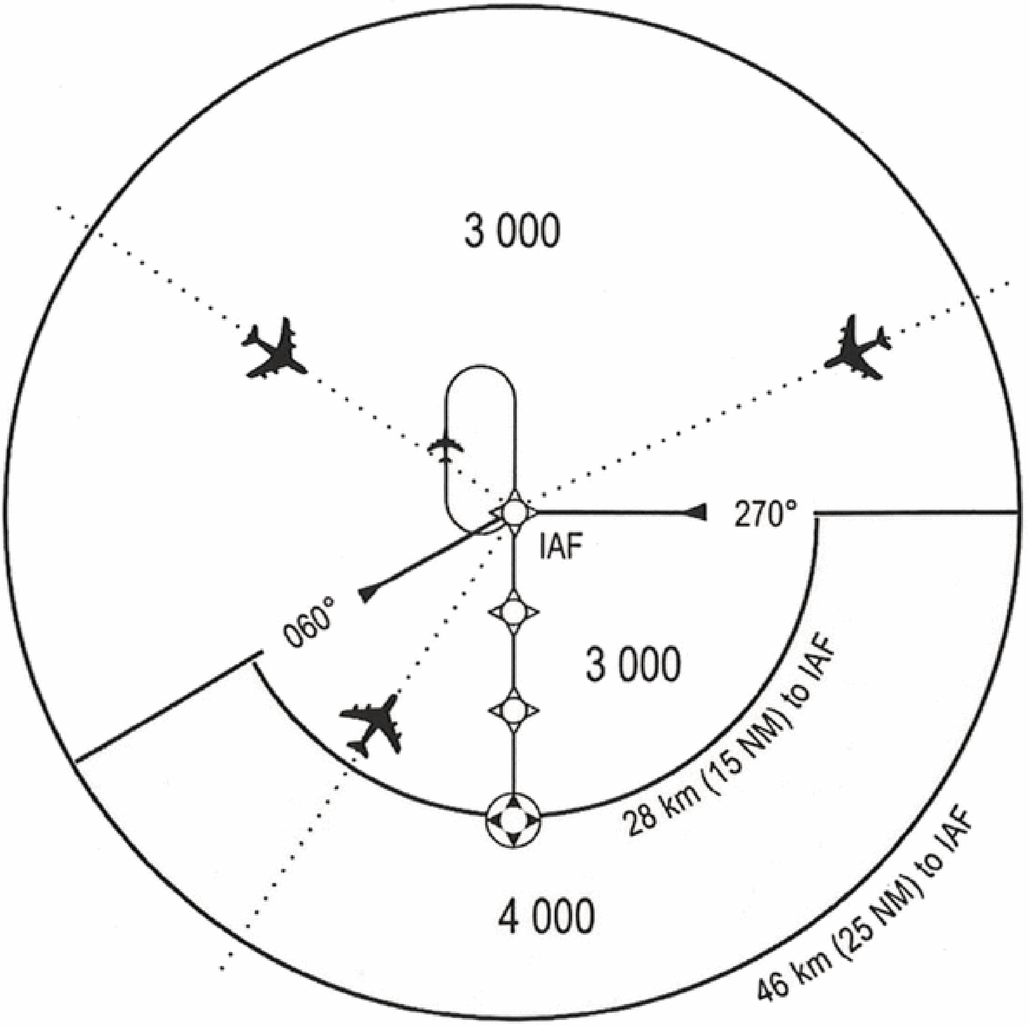


Figure II-4-2-9. Single TAA with sectorization and step down



Extracted from ICAO Document 8168, Volume I - Sixth Edition - Procedures for Air Navigation Services - AIRCRAFT OPERATIONS, Flight Procedures, herein known as PANS-OPS.

1 GENERAL REQUIREMENTS

1.1 INTRODUCTION

This chapter explains the procedures to be followed and the limitations to be observed in order to achieve an acceptable level of safety in the conduct of instrument approach procedures.

1.2 INSTRUMENT APPROACH PROCEDURE

1.2.1 Conventional instrument approach procedures are based on navigation guidance provided by ground-based systems.

1.2.2 For aircraft with a database of approach procedures, prior to commencing the approach the pilot shall verify the correct procedure was loaded into the navigation system by comparing it to the approach charts. This check shall include:

a. the waypoint sequence; and

b. the reasonableness of the tracks and distances of the approach segments, and the accuracy of the inbound course and length of the final approach segment (FAS).

1.2.3 Segments of the approach procedure

1.2.3.1 An instrument approach procedure may have five separate segments. They are the arrival, initial, intermediate, final and missed approach segments. (See Figure II-5-1-1.) In addition, an area for circling the aerodrome under visual conditions is also considered (see Chapter 5 of this section).

1.2.3.2 The approach segments begin and end at designated fixes. However, under some circumstances certain of the segments may begin at specified points where no fixes are available. For example, the FAS of a precision approach may start where the intermediate flight altitude intersects the nominal glide path (the final approach point).

1.2.4 Types of approach

1.2.4.1 There are two types of approach: straight-in and circling.

1.2.4.2 Straight-in approach. Wherever possible, a straight-in approach will be specified which is aligned with the runway centre line. The pilot should be aware that for non-precision approaches, a straight-in approach is considered acceptable if the angle between the final approach track and the runway centre line is 30° or less.

1.2.4.3 *Circling approach*. A circling approach will be specified in those cases where terrain or other constraints cause the final approach track alignment or descent gradient to fall outside the criteria for a straight-in approach. The final approach track of a circling approach procedure is in most cases aligned to pass over some portion of the usable landing surface of the aerodrome.

1.3 PERFORMANCE-BASED NAVIGATION (PBN) APPROACHES

1.3.1 *Description*. A PBN approach is an approach procedure containing PBN segments.

1.3.2 *PBN requirements box*. PBN approach procedures are promulgated with a PBN requirements box. The box contains the following information:

a. identification of the applicable navigation specification(s) that were used to design the approach procedure;

b. restrictions on navigation equipment required to fly the procedure (for example, global navigation satellite system (GNSS) only); and

c. information related to optional functionality of the applicable navigation specification, such as the use of constant radius arc to a fix (RF) legs or required navigation performance (RNP) scalability.

1.3.3 Applicable navigation specifications

The applicable navigation specifications for PBN approach operations are:

a. RNP APCH;

b. RNP AR APCH; and

c. Advanced RNP (A-RNP).

NOTE: For complete details of the applicability of PBN navigation specifications to approach procedures, see the Performance-based Navigation (PBN) Manual (Doc 9613).

1.3.4 *Navigation database*. Approach procedure information is contained in a navigation database using the WGS-84 coordinate system. If the navigation database does not contain the approach procedure, the procedure shall not be used.

1.3.5 Hybrid approaches are possible, in which PBN segments are used to connect to a conventional final approach, such as an instrument landing system (ILS) approach. For such approaches the chart will be titled consistently with the final approach type but will also include a PBN requirements box as described in 1.3.2 above.

1.3.6 PBN operational approval

1.3.6.1 Pilots shall verify, before operating on any PBN route or procedure, that they have approval to operate on the navigation specification(s) used in the design of the procedure. Where there are additional restrictions, for example, sensor use or optional functionality as discussed in 1.3.2, the pilot shall also verify that these restrictions are complied with.

1.3.6.2 Prior to operating on any PBN procedure, the pilot shall confirm:

a. the operation of all required navigation aids (ground and space-based);

b. the correct functioning of the navigation equipment;

c. the validity of the navigation database; and

d. waypoint and segment data, with reference to the published chart.

1.4 CATEGORIES OF AIRCRAFT

1.4.1 Aircraft performance has a direct effect on the airspace and visibility required for the various manoeuvres associated with the conduct of instrument approach procedures. The most significant performance factor is aircraft speed. Accordingly, categories of typical aircraft have been established.

1.4.2 The criterion taken into consideration for the classification of aeroplanes by categories is the indicated airspeed at threshold (V_{at}).

1.4.3 Aircraft categories will be referred to by their letter designations as shown in Table II-5-1-1.

1.4.4 *Permanent change of category (maximum landing mass)*. An operator may impose a permanent lower landing mass, and use of this mass for determining V_{at} if approved by the State of the Operator. The category defined for a given aeroplane shall be a permanent value and independent of changing day-to-day operations.

1.4.5 The instrument approach chart (IAC) specifies the individual categories of aircraft for which the procedure is approved. Normally, procedures will be designed to provide protected airspace and obstacle clearance for aircraft up to and including Category D. However, where airspace requirements are critical, procedures may be restricted to lower speed categories.

1.4.6 Alternatively, the procedure may specify a maximum IAS for a particular segment without reference to aircraft category. In any case, the pilot shall comply with the procedures and information depicted on instrument flight charts and the appropriate flight parameters shown in Tables II-5-1-1 and II-5-1-2 to ensure that the aircraft remains in the areas developed for obstacle clearance purposes.

1.4.7 Helicopters

Helicopter pilots may use Category A minima on instrument procedures designed for aeroplanes. However, specific procedures may be developed for helicopters and these shall be clearly designated “H”. Category H procedures shall not be promulgated on the same IAC as joint helicopter/aeroplane procedures.

1.5 OBSTACLE CLEARANCE

Obstacle clearance is a primary safety consideration in the development of instrument approach procedures. The criteria used and the detailed method of calculation are covered in PANS-OPS, Volume II. However, from the operational point of view, the pilot should be aware that the obstacle clearance applied in the development of each instrument approach procedure is considered to be the minimum required for an acceptable level of safety in operations.

1.6 OBSTACLE CLEARANCE ALTITUDE/HEIGHT (OCA/H)

For each individual approach procedure an obstacle clearance altitude/height (OCA/H) is calculated in the development of the procedure and published on the IAC. In the case of precision approach and circling approach procedures, an OCA/H is specified for each category of aircraft listed in 1.4. Obstacle clearance altitude/height (OCA/H) is:

a. in a precision approach procedure, the lowest altitude (OCA) or alternatively the lowest height above the elevation of the relevant runway threshold (OCH), at which a missed approach shall be initiated to ensure compliance with the appropriate obstacle clearance criteria; or

b. in a non-precision approach procedure, the lowest altitude (OCA) or alternatively the lowest height above aerodrome elevation or the elevation of the relevant runway threshold, if the threshold elevation is more than 2 m (7 ft) below the aerodrome elevation (OCH), below which an aircraft cannot descend without infringing the appropriate obstacle clearance criteria; or

c. in a visual (circling) procedure, the lowest altitude (OCA) or alternatively the lowest height above the aerodrome elevation (OCH) below which an aircraft cannot descend without infringing the appropriate obstacle clearance criteria.

1.7 FACTORS AFFECTING OPERATIONAL MINIMA

In general, minima are developed by adding the effect of a number of operational factors to OCA/H to produce, in the case of precision approaches, decision altitude (DA) or decision height (DH) and, in the case of non-precision approaches, minimum descent altitude (MDA) or minimum descent height (MDH). The general operational factors to be considered are specified in Annex 6. The detailed criteria and methods for determining operating minima are currently under development for this document. The relationship of OCA/H to operating minima (landing) is shown in Figures II-5-1-2, II-5-1-3 and II-5-1-4.

1.8 VERTICAL PATH CONTROL ON NON-PRECISION APPROACH PROCEDURES

1.8.1 Introduction

1.8.1.1 Studies have shown that the risk of controlled flight into terrain (CFIT) is high on non-precision approaches. While the procedures themselves are not inherently unsafe, the use of the traditional step down descent technique for flying non-precision approaches is prone to error, and is therefore discouraged. Operators should reduce this risk by emphasizing training and standardization in vertical path control on non-precision approach procedures. Operators typically employ one of three techniques for vertical path control on non-precision approaches:

a. continuous descent final approach (CDFA);

b. constant angle descent; and

c. step down approach.

Of these techniques, the CDFA technique is preferred. Operators should use the CDFA technique whenever possible as it adds to the safety of the approach operation by reducing pilot workload and by lessening the possibility of error in flying the approach.

1.8.2 Continuous descent final approach (CDFA)

1.8.2.1 Many Contracting States require the use of the CDFA technique and apply increased visibility or runway visual range (RVR) requirements when the technique is not used.

1.8.2.2 This technique requires a continuous descent, flown either with vertical navigation (VNAV) guidance calculated by on-board equipment or based on manual calculation of the required rate of descent, without level-offs. The rate of descent is selected and adjusted to achieve a continuous descent to a point approximately 15 m (50 ft) above the landing runway threshold or the point where the flare manoeuvre should begin for the type of aircraft flown. The descent shall be calculated and flown to pass at or above the minimum altitude at any step down fix (SDF).

1.8.2.3 If the visual references required to land have not been acquired when the aircraft is approaching the MDA/H, the vertical (climbing) portion of the missed approach shall be initiated at an altitude above the minimum descent altitude/height (MDA/H) sufficient to prevent the aircraft from descending through the MDA/H. At no time is the aircraft to be flown in level flight at or near the MDA/H. Any turns on the missed approach shall not begin until the aircraft reaches the missed approach point (MAPt). Likewise, if the aircraft reaches the MAPt before descending to near the MDA/H, the missed approach shall be initiated at the MAPt.

1.8.2.4 An increment for the MDA/H may be prescribed by the operator to determine the altitude/height at which the vertical portion of the missed approach shall be initiated in order to prevent descent below the MDA/H. In such cases, there is no need to increase the RVR or visibility requirements for the approach. The RVR and/or visibility published for the original MDA/H should be used.

1.8.2.5 Upon approaching the MDA/H only two options exist for the pilot: continue the descent below MDA/H to land with the required visual references in sight; or execute a missed approach. There is no level flight segment after reaching the MDA/H.

1.8.2.6 The CDFA technique simplifies the final segment of the non-precision approach by incorporating techniques similar to those used when flying a precision approach procedure or an approach procedure with vertical guidance (APV). The CDFA technique improves pilot situational awareness and is entirely consistent with all “stabilized approach” criteria.

1.8.3 Constant angle descent

1.8.3.1 The second technique involves achieving a constant, unbroken angle from the final approach fix (FAF), or optimum point on procedures without an FAF, to a reference datum above the runway threshold, e.g. 15 m (50 ft). When the aircraft approaches the MDA/H, a decision shall be made to either continue on the constant angle or level off at or above the MDA/H, depending on visual conditions.

1.8.3.2 If the visual conditions are adequate, the pilot should continue the descent to the runway without any intermediate level-off.

1.8.3.3 If visual conditions are not adequate to continue, the aircraft shall level off at or above the MDA/H and continue inbound until either:

a. encountering visual conditions sufficient to descend below the MDA/H to the runway; or

b. reaching the published MAPt and thereafter executing the missed approach procedure.

1.8.4 Step down descent

The third technique involves an expeditious descent and is described as “descend immediately to not below the minimum SDF altitude/height or MDA/H, as appropriate”. This technique is acceptable as long as the achieved descent gradient remains less than 15 per cent and the missed approach is initiated at or before the MAPt. Careful attention to altitude control shall be taken with this technique due to the high rates of descent before reaching the MDA/H and, thereafter, because of the increased time of exposure to obstacles at the MDA.

1.8.5 Temperature correction

In all cases, regardless of the flight technique used, a temperature correction shall be applied to all minimum altitudes (see PANS-OPS, Volume III, Section 2, Chapter 4, 4.3, “Temperature correction”).

1.8.6 Missed approach

Regardless of the type of vertical path control that is used on a non-precision approach, in the event of a missed approach the lateral “turning“ portion of the missed approach procedure shall not be executed prior to the MAPt.

1.8.7 Training

Regardless of which of the above described techniques an operator chooses to employ, the pilot shall receive specific and appropriate training for that technique.

1.9 APPROACH OPERATIONS UTILIZING BAROMETRIC VERTICAL NAVIGATION (BARO-VNAV) EQUIPMENT

1.9.1 Baro-VNAV equipment can be used in two different scenarios to provide vertical guidance on a 3D approach operation, detailed in Chapter 2 of this section:

a. *Approach operations on APV procedures designed for 3D operations*. In this case, the use of a baro-VNAV system is required. The operation shall be conducted to a DA/H.

b. *Approach operations on non-precision approach procedures*. In this case, the use of a baro-VNAV system is not required but auxiliary to facilitate the CDFA technique as described in 1.8.2. This means that advisory VNAV guidance is being overlaid on a non-precision approach. The-lateral navigation guidance is predicated on the navigation system designated on the chart. The operation shall be conducted to a derived DA/H which shall be calculated by the operator, based on the MDA/H for the procedure. The derived decision altitude/height (DA/H) shall be not lower than the MDA/H.

1.10 DESCENT GRADIENT

1.10.1 Wherever possible, descent procedures are planned with an optimum gradient/angle of 5.2 per cent/3.0°. When necessary, the descent gradient may be increased up to a maximum value which is dependent on aircraft category.

1.10.2 In certain cases, the maximum allowable descent gradient results in descent rates which exceed the recommended rates of descent for some aircraft. For example, at 280 km/h (150 kt), this maximum gradient results in a 5 m/s (1000 ft/min) rate of descent.

1.10.3 The pilot should consider carefully the descent rate required for non-precision FAS before starting the approach.

1.10.4 Any constant descent angle shall clear all SDF minimum crossing altitudes (MCAs) within any segment.

1.10.5 Procedure altitude/height

Procedure altitudes/heights are provided to support a stabilized descent gradient in the final segment in order to assist with CFIT prevention initiatives. Procedure altitudes/heights are therefore developed to place the aircraft at altitudes/heights that would normally be flown to intercept and fly an optimum 5.2 per cent (3.0°) descent path angle in the FAS to a 15 m (50 ft) threshold crossing for non-precision approach procedures and procedures with vertical guidance. In no case will a procedure altitude/height be less than any OCA/H.

Table II-5-1-1. Speeds for procedure calculations in kilometers per hour (km/h)

Aircraft Category	V_{at}	Initial Approach Speeds	Final Approach Speeds	Maximum Speeds for Visual Manoeuvring (Circling)	Maximum Speeds for Missed Approach	
					Intermediate	Final
A	<169	165/280 (205*)	130/185	185	185	205
B	169/223	220/335 (260*)	155/240	250	240	280
C	224/260	295/445	215/295	335	295	445
D	261/306	345/465	240/345	380	345	490
E	307/390	345/467	285/425	445	425	510
H	N/A	130/220**	110/165***	N/A	165	165
CAT H (PinS)***	N/A	130/220	110/165	N/A	130 or 165	130 or 165

V_{at} — Speed at threshold based on 1.3 times stall speed V_{so} or 1.23 times stall speed V_{s1g} in the landing configuration at maximum certificated landing mass. (Not applicable to helicopters.)

* Maximum speed for reversal and racetrack procedures.

** Maximum speed for reversal and racetrack procedures up to and including 6000 ft is 185 km/h, and maximum speed for reversal and racetrack procedures above 6000 ft is 205 km/h.

*** Helicopter point-in-space procedures based on basic GNSS may be designed using maximum speeds of 220 km/h for initial and intermediate segments and 165 km/h on final and missed approach segments, or 165 km/h for initial and intermediate segments and 130 km/h on final and missed approach segments depending on the operational need.

Table II-5-1-2. Speeds for procedure calculations in knots (kt)

Aircraft Category	V_{at}	Initial Approach Speeds	Final Approach Speeds	Maximum Speeds for Visual Manoeuvring (Circling)	Maximum Speeds for Missed Approach	
					Intermediate	Final
A	<91	90/150 (110*)	70/100	100	100	110
B	91/120	120/180 (140*)	85/130	135	130	150
C	121/140	160/240	115/160	180	160	240
D	141/165	185/250	130/185	205	185	265
E	166/210	185/250	155/230	240	230	275
H	N/A	70/120**	60/90***	N/A	90	90
CAT H (PinS)***	N/A	70/120	60/90	N/A	70 or 90	70 or 90

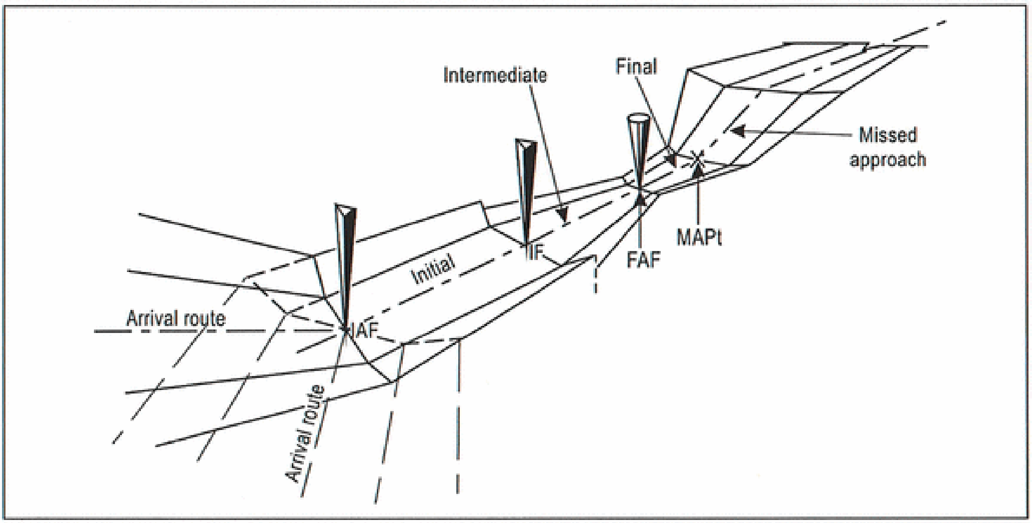
V_{at} — Speed at threshold based on 1.3 times stall speed V_{so} or 1.23 times stall speed V_{s1g} in the landing configuration at maximum certificated landing mass. (Not applicable to helicopters.)

* Maximum speed for reversal and racetrack procedures.

** Maximum speed for reversal and racetrack procedures up to and including 6000 ft is 100 kt, and maximum speed for reversal and racetrack procedures above 6000 ft is 110 kt.

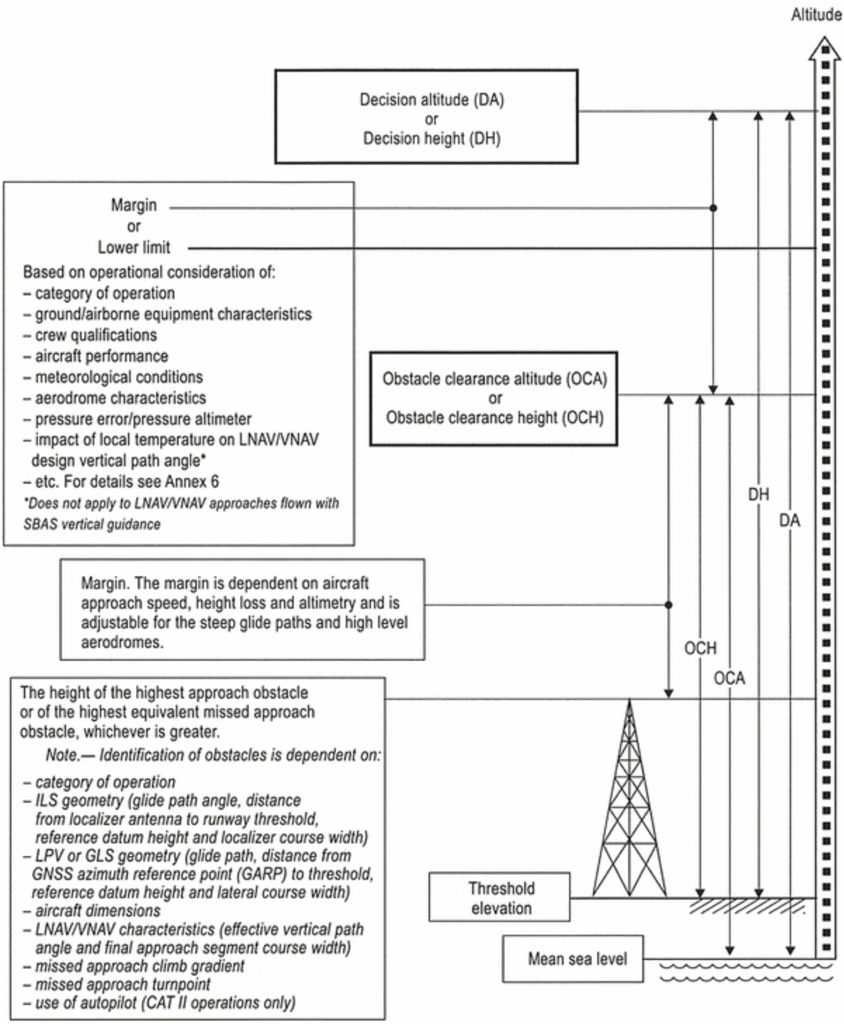
*** Helicopter point-in-space procedures based on basic GNSS may be designed using maximum speeds of 120 KIAS for initial and intermediate segments and 90 KIAS on final and missed approach segments, or 90 KIAS initial and intermediate segments and 70 KIAS on final and missed approach segments depending on the operational need.

Figure II-5-1-1. Segments of instrument approach



PRECISION APPROACH AND APPROACH WITH VERTICAL GUIDANCE

Figure II-5-1-2. Relationship of obstacle clearance altitude/height (OCA/H) to decision altitude/height (DA/H) for precision approaches and approach procedures with vertical guidance (APVs)



Based on operational consideration of:
- category of operation
- ground/airborne equipment characteristics
- crew qualifications
- aircraft performance
- meteorological conditions
- aerodrome characteristics
- pressure error/pressure altimeter
- impact of local temperature on LNAV/VNAV design vertical path angle*
- etc. For details see Annex 6

**Does not apply to LNAV/VNAV approaches flown with SBAS vertical guidance*

Margin. The margin is dependent on aircraft approach speed, height loss and altimetry and is adjustable for the steep glide paths and high level aerodromes.

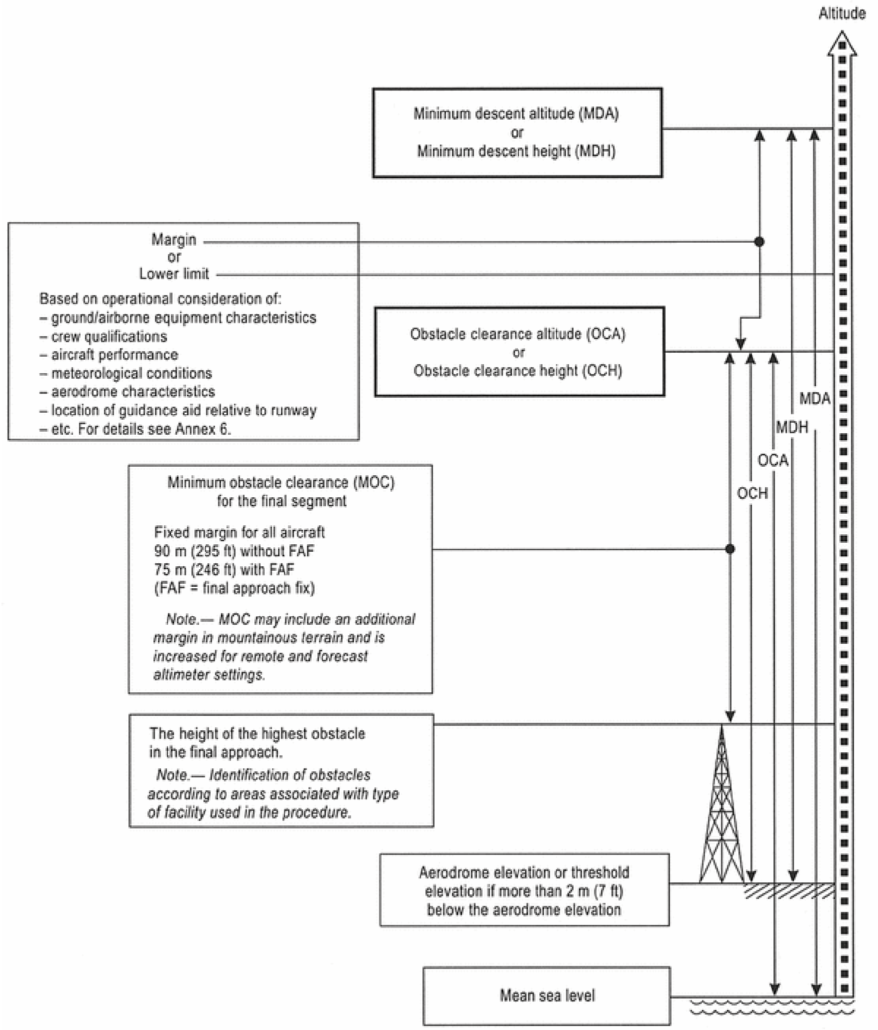
The height of the highest approach obstacle or of the highest equivalent missed approach obstacle, whichever is greater.

Note.— Identification of obstacles is dependent on:

- *category of operation*
- *ILS geometry (glide path angle, distance from localizer antenna to runway threshold, reference datum height and localizer course width)*
- *LPV or GLS geometry (glide path, distance from GNSS azimuth reference point (GARP) to threshold, reference datum height and lateral course width)*
- *aircraft dimensions*
- *LNAV/VNAV characteristics (effective vertical path angle and final approach segment course width)*
- *missed approach climb gradient*
- *missed approach turnpoint*
- *use of autopilot (CAT II operations only)*

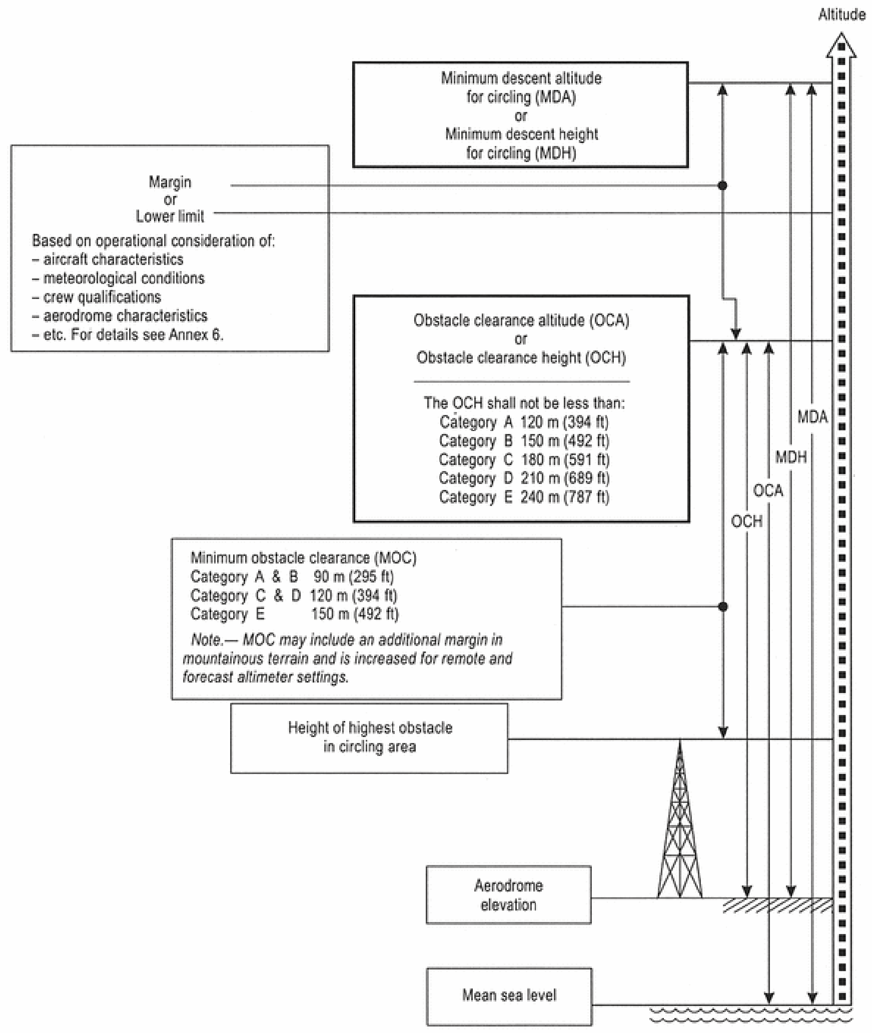
NON-PRECISION APPROACH

Figure II-5-1-3. Relationship of obstacle clearance altitude/height (OCA/H) to minimum descent altitude/height (MDA/H) for non-precision approaches (example with a controlling obstacle in the final approach)



VISUAL MANOEUVRING (CIRCLING)

Figure II-5-1-4. Relationship of obstacle clearance altitude/height (OCA/H) to minimum descent altitude/height (MDA/H) for visual manoeuvring (circling)



2 INSTRUMENT APPROACH OPERATIONS

2.1 GENERAL

2.1.1 Prior to the introduction of PBN procedures, there was a simple relationship between instrument approach procedures and instrument approach operations:

a. non-precision approach procedures (NPA) were published which were flown as a two-dimensional (2D) operation; and

b. precision approach procedures (PA) were published which were flown as a three-dimensional (3D) operation.

2.1.2 With the introduction of a variety of PBN vertically guided approaches which are not precision approaches (for example, the APV baro-VNAV approach and satellite-based augmentation system (SBAS) APV-I approach) there is no longer a simple relationship between the approach procedure and the type of operation.

2.1.3 From an operational perspective, the classification of different instrument approach procedures into precision, non-precision, etc., is no longer relevant. The important classification is whether the approach is operated as 2D or 3D.

2.2 INSTRUMENT APPROACH OPERATIONS

2.2.1 There are two methods for flying instrument approach operations, 2D and 3D. In a 2D approach operation, only lateral guidance will be displayed to the pilot, for example, in the form of a very high frequency omnidirectional radio range (VOR) needle or ILS lateral deviation scale. A 3D approach operation will also provide vertical guidance in the form of a vertical deviation scale.

2.2.2 The nature of the instrument approach operation depends on both the instrument approach procedure and the technique used to fly the procedure.

2.2.3 Operations using a CDFA technique may be considered to be 3D or 2D depending on how the vertical profile is determined and on the guidance provided to the pilot. (See 2.5 for more information.)

2.3 3D APPROACH OPERATIONS

2.3.1 A 3D instrument approach operation uses lateral and vertical navigation guidance.

2.3.2 Lateral and vertical navigation guidance refers to the guidance provided either by:

a. a ground-based radio navigation aid such as an ILS or microwave landing system (MLS); or

b. computer-generated navigation data from ground-based, space-based or self-contained navigation aids, or a combination of these.

2.3.3 Manually calculated rate/angle of descent is not considered vertical guidance, therefore this is not considered to be a 3D approach operation.

2.3.4 3D operations are conducted to a DA/H, which allows for height loss after the commencement of the missed approach.

2.3.5 3D approach operations can be either:

a. Type A with a DH of 75 m (250 ft) or above; or

b. Type B with a DH less than 75 m (250 ft).

2.4 2D APPROACH OPERATIONS

2.4.1 A 2D instrument approach operation uses lateral navigation guidance only.

2.4.2 2D operations are conducted to an MDA/H, below which the aircraft should not descend without adequate visual references.

2.4.3 2D approach operations can only be Type A with an MDH of 75 m (250 ft) or above.

2.5 CONTINUOUS DESCENT FINAL APPROACH (CDFA) TECHNIQUE

2.5.1 The CDFA technique can support either 2D or 3D approach operations and is a method of flying a non-precision approach. This is described in Chapter 1, paragraph 1.8.2 of this section.

2.5.2 There are two methods of flying the CDFA:

a. using a manually calculated descent profile (rate/angle of descent); and

b. using a descent profile calculated by the on-board equipment such as baro-VNAV or SBAS.

2.5.3 In the case of a descent profile calculated manually by rate of descent/angle of descent, the lack of positive guidance means the operation shall be considered to be 2D and shall be operated to an MDA/H as normal.

2.5.4 Where on-board equipment, such as a baro-VNAV system or SBAS receiver, is used to generate the descent profile and associated positive guidance, the operation shall be considered to be 3D. In this case the following shall be confirmed prior to operation:

a. a derived DA/H shall be calculated to ensure the aircraft does not descend below the published MDA/H;

b. the pilot shall verify that the descent profile satisfies all the requirements for SDFs, as indicated on the approach chart;

c. the system in use (e.g. baro-VNAV, SBAS) shall be certified for use for the intended operation; and

d. in the case of a baro-VNAV system, operations shall only be flown with a current local altimeter setting source available, and the QNH/QFE, as appropriate, set on the aircraft‘s altimeter. Procedures using a remote altimeter setting source cannot support the use of the baro-VNAV function.

2.5.5 Table II-5-2-1 indicates how this technique affects the approach operation on different instrument approach procedures.

Table II-5-2-1. Instrument approach procedures versus operations

Procedure		Operation		
Chart identification	Minima box label	Type of operation	Minima	Type (A or B)
NDB RWY XX	NDB	2D	MDA/H	A
		3D (CDFA with positive guidance)	Derived DA	
VOR RWY XX	VOR	2D	MDA/H	A
		3D (CDFA with positive guidance)	Derived DA	
ILS RWY XX or LOC RWY XX	LOC	2D	MDA/H	A
		3D (CDFA with positive guidance)	Derived DA	
RNP RWY XX	LNAV	2D	MDA/H	A
		3D (CDFA with positive guidance)	Derived DA	
RNP RWY XX	LP	2D	MDA/H	A
		3D (CDFA with positive guidance)	Derived DA	
RNP RWY XX	LNAV/VNAV[1]	3D	DA/H	A
RNP RWY XX (AR)	RNP 0.X	3D	DA/H	A
RNP RWY XX	LPV[2]	3D	DA/H	A or B[3]
ILS RWY XX	CAT I CAT II CAT III A/B/C	3D	DA/H	A or B
MLS RWY XX	CAT I CAT II CAT III A/B/C	3D	DA/H	A or B
GLS RWY XX	CAT I	3D	DA/H	A or B

[1] Requires baro-VNAV or SBAS equipment.

[2] Requires SBAS equipment.

[3] SBAS CAT I procedures may be Type A or Type B. SBAS APV procedures are only Type A.

3 INITIAL APPROACH

3.1 GENERAL

3.1.1 Purpose

The initial approach segment begins at the initial approach fix (IAF) and ends at the intermediate fix (IF). In the initial approach, the aircraft has left the en-route structure and is manoeuvring to enter the intermediate approach segment.

3.1.2 Maximum angle of interception

Track guidance should be provided along the initial approach segment to the IF, with a maximum angle of interception of:

a. 90° for a precision approach; and
b. 120° for a non-precision approach.

3.1.3 Minimum obstacle clearance (MOC)

The initial approach segment provides at least 300 m (1000 ft) of obstacle clearance in the primary area, reducing laterally to zero at the outer edge of the secondary area.

3.1.4 PBN initial segments

3.1.4.1 The PBN navigation specifications applicable to all segments of the approach are detailed in Chapter 1, 1.3. Additionally, PBN initial segments may be designed using the following navigation specifications:

a. RNAV 1;
b. RNP 1; and
c. RNP 0.3 (Helicopters); and
d. Advanced RNP (A-RNP).

NOTE: For complete details of the applicability of PBN navigation specifications to approach procedures, see the Performance-based Navigation (PBN) Manual (Doc 9613).

3.1.4.2 A PBN initial segment may be used to link up with a non-PBN final approach, such as an ILS or GBAS landing system (GLS).

3.2 TYPES OF MANOEUVRES

3.2.1 Where no suitable IAF or IF is available to construct the instrument procedure, a reversal procedure, racetrack or holding pattern is required.

3.2.2 Reversal procedure

3.2.2.1 The reversal procedure may be in the form of a procedure or base turn. Entry is restricted to a specific direction or sector.

3.2.2.2 The directions and timing specified should be strictly followed in order to remain within the airspace provided. It should be noted that the airspace provided for these procedures does not permit racetrack or holding manoeuvre to be conducted unless so specified.

3.2.2.3 There are three generally recognized manoeuvres related to the reversal procedure, as shown in Figure II-5-3-1:

a. 45°/180° procedure turn (see Figure II-5-3-1 A), starts at a facility or fix and consists of:
    1. a straight leg with track guidance. This straight leg may be timed or may be limited by a radial or distance measuring equipment (DME) distance;
    2. a 45° turn;
    3. a straight leg without track guidance. This straight leg is timed. It is:
        (a) 1 minute from the start of the turn for Category A and B aircraft; and
        (b) 1 minute 15 seconds from the start of the turn for Category C, D and E aircraft; and
    4. a 180° turn in the opposite direction to intercept the inbound track.

    Unless specifically excluded, this procedure can also be used where an 80°/260° procedure turn is specified (see 3.2.2.3 b).

b. 80°/260° procedure turn (see Figure II-5-3-1 B), starts at a facility or fix and consists of:
    1. a straight leg with track guidance. This straight leg may be timed or may be limited by a radial or DME distance;
    2. an 80° turn;
    3. an immediate 260° turn in the opposite direction on completion of the 80° turn, to intercept the inbound track.

    Unless specifically excluded, this procedure can also be used where a 45°/180° procedure turn is specified (see 3.2.2.3 a).

c. base turn (see Figure II-5-3-1 C), consisting of:
    1. a specified outbound track and timing or DME distance from a facility; followed by
    2. a turn to intercept the inbound track.

3.2.3 Racetrack procedure

3.2.3.1 A racetrack procedure (see Figure II-5-3-1 D) consists of:

a. a turn from the inbound track through 180° from overhead the facility or fix on to the outbound track. The outbound leg may be timed or may be limited by a radial or DME distance; followed by

b. a 180° turn in the same direction to return to the inbound track.

3.3 FLIGHT PROCEDURES FOR RACETRACK AND REVERSAL PROCEDURES

3.3.1 Entry

3.3.1.1 Unless the procedure specifies particular entry restrictions, reversal procedures shall be entered from a track within ±30° of the outbound track of the reversal procedure. However, for base turns, where the ±30° direct entry sector does not include the reciprocal of the inbound track, the entry sector is expanded to include it. (See Figures II-5-3-2 and II-5-3-3.)

3.3.1.2 Typically, a racetrack procedure is used when aircraft arrive overhead the fix from a direction which does not allow direct entry to the reversal, as shown in Figure II-5-3-4. In these cases, aircraft should enter the procedure in a manner similar to that prescribed for a holding procedure entry with the following considerations:

a. offset entry from Sector 2 shall limit the time on the 30° offset track to 1 min 30 s, after which the pilot should turn to a heading parallel to the outbound track for the remainder of the outbound time. If the outbound time is only 1 min, the time on the 30° offset track shall be 1 min also;

b. parallel entry shall not return directly to the facility without first intercepting the inbound track when proceeding to the final segment of the approach procedure; and

c. all manoeuvring shall be done in so far as possible on the manoeuvring side of the inbound track.

3.3.2 Speed restrictions

These may be specified in addition to, or instead of, aircraft category restrictions. The speeds shall not be exceeded to ensure that the aircraft remains within the limits of the protected areas.

3.3.3 Bank angle

Procedures are based on average achieved bank angle of 25°, or the bank angle giving a rate of turn of 3°/second, whichever is less.

3.3.4 Descent

The aircraft shall cross the fix or facility and fly outbound on the specified track, descending as necessary to the procedure altitude/height but no lower than the minimum crossing altitude/height (MCA/H) associated with that segment. If a further descent is specified after the inbound turn, this descent shall not be started until the aircraft is established on the inbound track. An aircraft is considered established when it is:

a. within half full scale deflection for the ILS and VOR; or

b. within ±5° of the required bearing for the NDB.

3.3.5 Racetrack procedure outbound leg

3.3.5.1 When the procedure is based on a facility, the outbound timing starts:

a. from abeam the facility; or

b. on attaining the outbound heading,

whichever comes later.

3.3.5.2 When the procedure is based on a fix, the outbound timing starts from attaining the outbound heading.

3.3.5.3 The turn on to the inbound track should be started:

a. within the specified time (adjusted for wind); or

b. when encountering any DME distance; or

c. when the radial/bearing specifying a limiting distance has been reached,

whichever occurs first.

3.3.5.4 When a DME distance or radial/bearing is specified for the end of the outbound leg, it shall not be exceeded when flying on the outbound track.

3.3.6 Wind effect

To achieve a stabilized approach, due allowance should be made in both heading and timing to compensate for the effects of wind so that the aircraft regains the inbound track as accurately and expeditiously as possible. In making these corrections, full use should be made of the indications available from the aid and from estimated or known winds. This is particularly important for slow aircraft in high wind conditions. Failure to compensate for wind effects may result in the aircraft departing the protected area of the procedure.

3.3.7 Descent rates

The specified timings and procedure altitudes are based on rates of descent that do not exceed the values shown in Table II-5-3-1.

3.3.8 Shuttle

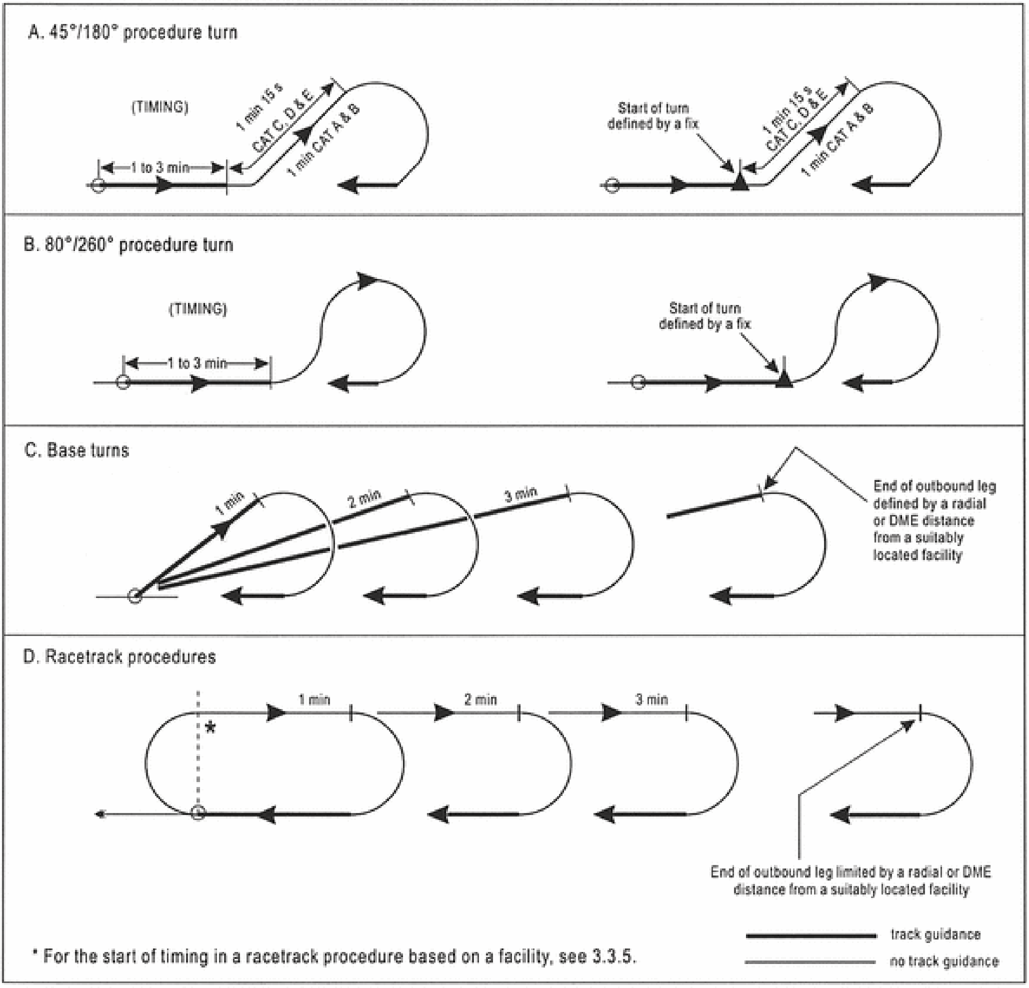
A shuttle is defined as a descent or climb conducted in a holding pattern. This is normally prescribed where the descent required between the end of initial approach and the beginning of final approach exceeds the values shown in Table II-5-3-1.

Table II-5-3-1. Maximum/minimum descent rate to be specified on a reversal or racetrack procedure

Outbound track	Maximum	Minimum
Category A/B	245 m/min (804 ft/min)	N/A
Category C/D/E/H	365 m/min (1197 ft/min)	N/A
Inbound track	**Maximum**	**Minimum**
Category A/B	200 m/min (655 ft/min)	120 m/min (394 ft/min)
Category H	230 m/min (755 ft/min)	N/A
Category C/D/E	305 m/min (1000 ft/min)	180 m/min (590 ft/min)

FLIGHT PROCEDURES (DOC 8168) - APPROACH PROCEDURES

Figure II-5-3-1. Types of reversal and racetrack procedures



* For the start of timing in a racetrack procedure based on a facility, see 3.3.5.

Figure II-5-3-2. Direct entry to procedure turn

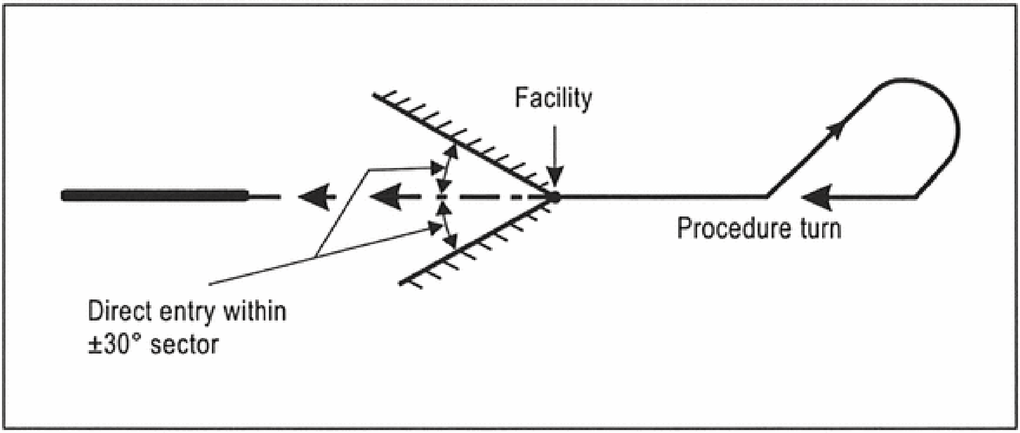


Figure II-5-3-3. Direct entry to base turn

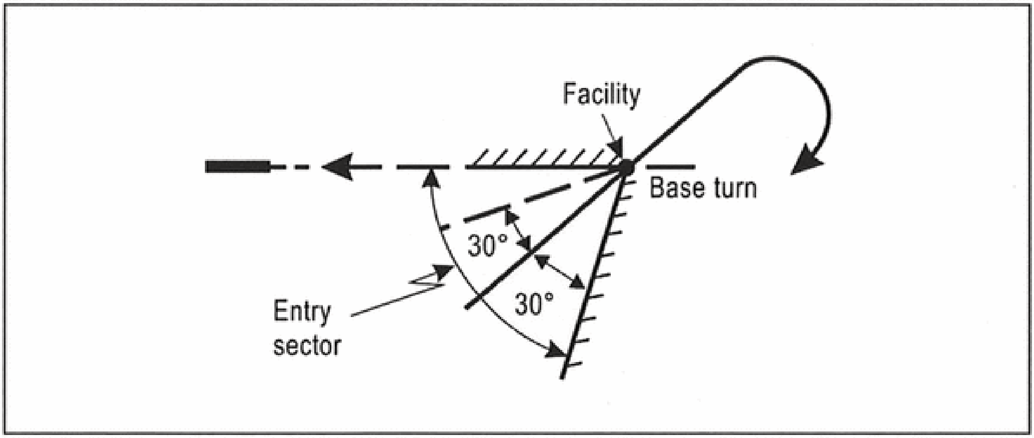
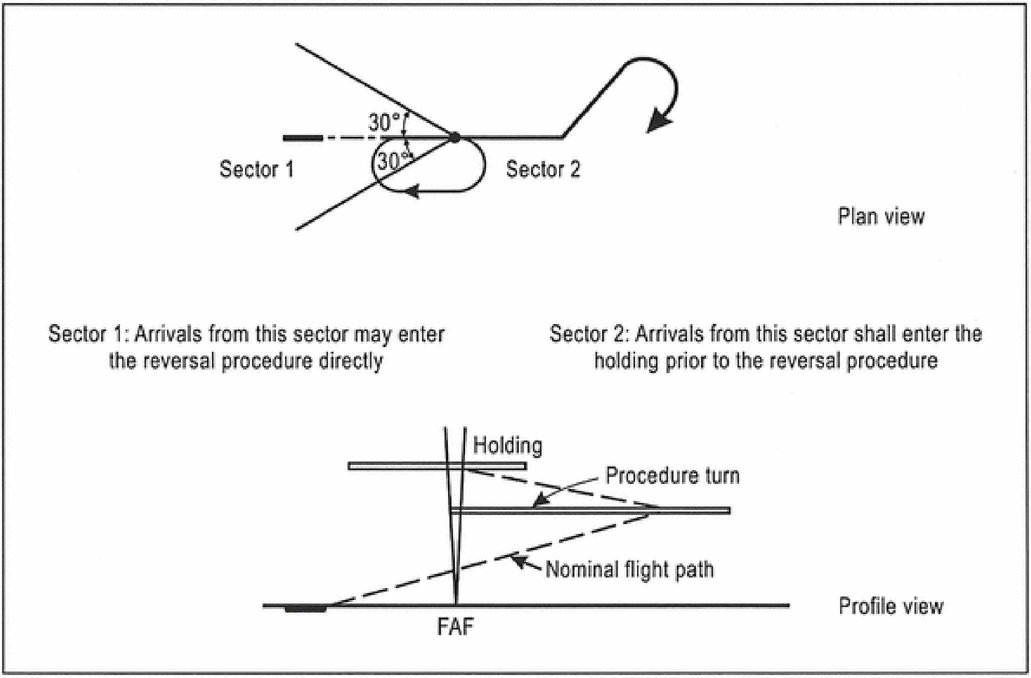


Fig II-5-3-4. Example of omnidirectional arrival using a holding procedure in association with a reversal procedure



Sector 1: Arrivals from this sector may enter the reversal procedure directly

Sector 2: Arrivals from this sector shall enter the holding prior to the reversal procedure

4 INTERMEDIATE APPROACH

4.1 PURPOSE

This is the segment during which the aircraft speed and configuration should be adjusted to prepare the aircraft for final approach. For this reason, the designed descent gradient is kept as shallow as possible. To fly an efficient descent profile, the pilot may elect to configure the aircraft while in a continuous descent along this segment.

4.2 MINIMUM OBSTACLE CLEARANCE (MOC)

During the intermediate approach, the obstacle clearance requirement is 150 m (492 ft) in the primary area, reducing laterally to zero at the outer edge of the secondary area.

4.3 BEGINNING AND END OF THE SEGMENT (CONVENTIONAL PROCEDURES)

4.3.1 Where a FAF is available, the intermediate approach segment begins when the aircraft is on the inbound track of the procedure turn, base turn or final inbound leg of the racetrack procedure. It ends at the FAF or final approach point (FAP), as applicable.

4.3.2 Where no FAF is specified, the inbound track is the FAS.

4.4 PBN INTERMEDIATE SEGMENTS

4.4.1 The PBN navigation specifications applicable to all segments of the approach are detailed in Chapter 1, 1.3. Additionally, PBN intermediate segments may be designed using the following navigation specifications:

a. RNAV 1;

b. RNP 1; and

c. RNP 0.3 (Helicopters).

NOTE: For complete details of the applicability of PBN navigation specifications to approach procedures, see the Performance-based Navigation (PBN) Manual (Doc 9613).

4.4.2 A PBN intermediate segment may be used to link up with a non-PBN final approach, such as an ILS or GLS.

4.5 BEGINNING AND END OF THE SEGMENT (PBN PROCEDURES)

4.5.1 The intermediate segment usually contains a straight component immediately before the FAF/FAP.

4.5.2 Where included, the length of the straight component is variable but will not be less than 3.7 km (2.0 NM) allowing the aircraft to be stabilized prior to the FAF/FAP and to provide for mode and display switching prior to the FAF/FAP.

4.5.3 Alternatively, an RF leg may be used linking directly to the FAF. In this case no straight component is provided.

5 FINAL APPROACH

5.1 GENERAL

5.1.1 Purpose

This is the segment in which alignment and final descent for landing are made. Final approach may be made to a runway for a straight-in landing, or to an aerodrome for a visual circling manoeuvre.

5.1.2 Types of final approach

The criteria for final approach vary according to the type. These types are:

a. non-precision approach (NPA) with FAF;

b. NPA without FAF;

c. APV; and

d. precision approach (PA).

5.2 NON-PRECISION APPROACH (NPA) WITH FINAL APPROACH FIX (FAF)

5.2.1 These procedures are designed for 2D approach operations Type A, but may be flown as a 3D operation using the CDFA technique. For more information refer to Chapter 2 of this section.

5.2.2 FAF location

This segment begins at a facility or fix, called the FAF and ends at the MAPt (see Figure II-5-1-1). The FAF is sited on the final approach track at a distance that permits selection of final approach configuration, deceleration to final approach speed, and descent from intermediate approach altitude/height to the appropriate MDA/H either for a straight in approach or for a visual circling manoeuvre.

5.2.3 Descent gradient

5.2.3.1 Compatible with the primary safety consideration of obstacle clearance an NPA provides the optimum final approach descent gradient of 5 .2 per cent, or 3°, providing a rate of descent of 52 m per km (318 ft per NM).

5.2.3.2 Information provided in approach charts displays the optimum constant approach slope.

5.2.4 FAF crossing

5.2.4.1 The FAF should be crossed at the prescribed procedure altitude/height in descent but in all cases, not lower than the MCA associated with the FAF under international standard atmosphere (ISA) conditions. The descent should be initiated prior to the FAF, in order to achieve the prescribed descent gradient/angle. Delaying the descent until reaching the FAF at the procedure altitude/height will cause the descent gradient/angle to be greater than 3°. Where range information is available, descent profile information is provided.

5.2.4.2 In the event of an overshoot of the FAF, no descent below the MCA associated with the FAF shall be initiated before the aircraft is established on the final approach course.

5.2.5 Step down fix (SDF)

5.2.5.1 An SDF may be incorporated in some non-precision approach procedures. In this case, two OCA/H values are published:

a. a higher value applicable to the primary procedure; and
b. a lower value applicable only if the SDF is positively identified during the approach (see Figure II-5-5-1).

5.2.5.2 In the case of a VOR/DME, several SDFs may be depicted, each with its associated MCA.

5.2.5.3 For helicopter operations, rates of descent after crossing the FAF and any SDF should be limited, so as not to penetrate the obstacle plane.

5.2.5.4 Where a step down procedure using a suitably located DME is published, the pilot shall not begin descent until established on the specified track. Once established on track, descent shall be accomplished without descending below the published DME distance/height requirements.

5.2.5.5 *Performance-based navigation (PBN) procedure SDFs*. A PBN step down· fix is flown in the same manner as a ground-based approach. Any required SDFs prior to the missed approach waypoint will be identified by along-track distances.

5.3 NPA WITHOUT FAF

5.3.1 In the case of an aerodrome served by a single facility located on or near the aerodrome where no other facility is suitably situated to form a FAF, a procedure may be designed where the facility is both the IAF and the MAPt.

5.3.2 In the absence of a FAF, descent to MDA/H is made once the aircraft is established inbound on the final approach track.

5.3.3 In procedures of this type, the final approach track may not be aligned on the runway centre line. Whether OCA/H for straight-in approach limits is published or not depends on the angular difference between the track and the runway, and position of the track with respect to the runway threshold.

5.4 APV APPROACH PROCEDURES

5.4.1 These procedures are designed for 3D approach operations Type A. For more information refer to Chapter 2 of this section.

5.4.2 Two types of APV approach procedures are considered:

a. procedures based on vertical guidance from Baro-VNAV systems; and

b. procedures based on SBAS vertical guidance.

5.4.3 APV/BARO-VNAV approach procedures

5.4.3.1 Baro-VNAV is a navigation system that presents to the pilot computed vertical guidance referenced to a specified vertical path angle (VPA), nominally 3°.

5.4.3.2 APV/baro-VNAV approach procedures are classified as instrument approach procedures in support of 3D approach operations. Such procedures use a DA/H charted as a lateral navigation/vertical navigation (LNAV/VNAV) line of minima. They should not be confused with classical NPA procedures, which use an MDA/H below which the aircraft shall not descend.

5.4.3.3 APV/baro-VNAV approach procedures provide a greater margin of safety than non-precision approach procedures by providing for a guided, stabilized descent to landing. They are particularly relevant to large commercial jet transport aircraft, for which they are considered safer than the alternative technique of an early descent to minimum altitudes. An independent altimeter cross-check which is available for ILS, MLS, GLS, SBAS APV-I/CAT I is not available with APV/baro-VNAV since the altimeter is also the source on which the vertical guidance is based. Mitigation of altimeter failures or incorrect settings shall be accomplished by means of standard operating procedures similar to those applied to non-precision approach procedures.

5.4.3.4 The inaccuracies inherent in barometric altimeters, combined with the certificated performance of the specific PBN navigation specification used, make these procedures less accurate than precision approach systems; and the pilot should consider this possibility when making the decision to land at DA/H.

5.4.3.5 The lateral portions of APV/baro-VNAV criteria are based on Advanced RNP, RNP APCH or RNP AR APCH criteria. However, the FAF is not part of the APV/baro-VNAV procedure and is replaced by a FAP. Similarly, the MAPt is replaced by an aircraft-category-dependent DA/H. This is analogous to a precision approach.

5.4.3.6 The lowest published APV/baro-VNAV DH is 75 m (250 ft).

5.4.3.7 Temperature constraints

5.4.3.7.1 The pilot shall be responsible for any necessary cold temperature corrections to all published minimum altitudes/heights. This includes:

a. the altitudes/heights for the initial and intermediate segment(s);

b. the DA/H or MDA/H; and

c. subsequent missed approach altitudes/heights.

5.4.3.7.2 Only the FAS VPA of the APV baro-VNAV procedure is safeguarded against the effects of low temperature by the design of the procedure. The minimum temperature on the chart relates to a minimum VPA of 2.5°, and the maximum temperature on the chart relates to a maximum VPA of 3.5°.

5.4.3.7.3 Baro-VNAV procedures are not permitted when the aerodrome temperature is below the promulgated minimum aerodrome temperature for the procedure, unless the flight management system (FMS) is equipped with approved automated cold temperature compensation for the final approach.

5.4.3.7.4 The charted temperature range applies to the LNAV/VNAV minima only and does not apply to other minima.

5.4.3.7.5 For aircraft with approved automated cold temperature compensation FMS systems, the promulgated minimum temperature can be disregarded provided the actual temperature is within the limits of the aircraft certification.

5.4.3.7.6 Below the equipment certified limiting temperature, an LNAV procedure may still be used provided that such a procedure is promulgated for the approach and the appropriate cold temperature altimeter correction is applied to all minimum promulgated altitudes/heights by the pilot.

5.4.3.7.7 Procedure temperature restrictions do not apply when SBAS is used to fly LNAV/VNAV procedures.

5.4.3.7.8 A VPA deviation table provides an aerodrome temperature with an associated true VPA. This table is intended to advise the pilot that, although the non-temperature compensated aircraft‘s avionics system may be indicating the promulgated final approach VPA, the actual VPA is different from the information presented to them by the aircraft‘s avionics system. This table is not intended to have the pilot adjust the VPA flown to achieve the actual promulgated VPA, nor is it meant to affect those avionics systems that have a capacity to properly apply temperature compensation to a baro-derived final approach VPA. To show the difference in the minimum temperature application, examples of these tables for aerodrome elevations at mean sea level and at 6 000 feet are provided in Tables II-5-5-1 and II-5-5-2.

Table II-5-5-1 VPA deviations at MSL

Aerodrome temperature	Actual VPA
+30°C	3.2°
+15°C	3.0°
0°C	2.8°
-15°C	2.7°
-31°C	2.5°

Table II-5-5-2 VPA deviations at 6000 ft MSL

Aerodrome temperature	Actual VPA
+22°C	3.2°
+3°C	3.0°
-20°C	2.7°
-30°C	2.6°
-43°C	2.5°

NOTE: Values presented in Tables II-5-5-1 and II-5-5-2 are not representative of actual values that may be calculated for a particular aerodrome.

5.4.3.7.9 Some baro-VNAV systems have the capability to correctly compensate for the temperature effects on the VPA of an instrument approach procedure following an input of the aerodrome (altimeter source) temperature by the pilot. A pilot operating aircraft with this feature active can expect that the angle displayed will be the corrected VPA, thus the VPA deviation table is not applicable.

5.4.3.8 Altimeter setting

Baro-VNAV approach operations shall only be flown with a current local altimeter setting source available and the QNH/QFE, as appropriate, set on the aircraft's altimeter. Remote altimeter settings are not approved for this type of operation.

5.4.3.9 Vertical guidance sensitivity

5.4.3.9.1 Cockpit displays showing vertical path deviation shall be suitably located and have sufficient sensitivity to enable the pilot to limit vertical path excursions to less than ±22 m (±75 ft).

5.4.3.9.2 Where equipment does not meet these criteria, an operational assessment and specific flight crew procedure may be required for the approval of baro-VNAV operations. This may include requirements for the availability and use of a flight director or autopilot system coupled to the vertical guidance.

5.4.4 SBAS approach procedures

5.4.4.1 These procedures are designed for the following types of operations:

a. 2D approach operation type A: LP minima;

b. 3D approach operation type A: LPV minima (APV); and

c. 3D approach operation type A or B: LPV minima (CAT I).

5.4.4.2 SBAS equipment may be used to operate on procedures based on baro-VNAV criteria. In such cases, published temperature restrictions for barometric VNAV procedures do not apply.

5.4.4.3 The charted minima lines associated with SBAS APV-I or CAT I performance levels are labelled “LPV” (localizer performance with vertical guidance). This labelling indicates that the lateral performance is equivalent to an ILS localizer lateral performance. The charted lines of minima for an SBAS 2D approach operation are labelled “LP”.

5.4.4.4 The term APV-I refers to a performance level of GNSS approach and landing operations with vertical guidance, and this term is not intended to be used for charting.

5.5 PRECISION APPROACH

5.5.1 These procedures are designed for 3D approach operations and may be classified as either Type A or Type B, depending on the DA/H in use. For more information refer to Chapter 2 of this section.

5.5.2 Final approach point (FAP)

The FAS begins at the FAP. This is a point in space on the final approach track where the intermediate approach altitude/height intercepts the nominal glide path of the ILS, GLS or SBAS CAT I, or the MLS elevation angle.

5.5.3 Final approach length

The intermediate approach altitude/height generally intercepts the glide path of the ILS, GLS or SBAS CAT I, or the MLS elevation angle, at heights from 300 m (1000 ft) to 900 m (3000 ft) above runway elevation.

5.5.4 Outer marker/DME fix/waypoint

5.5.4.1 The final approach area contains a fix, waypoint or facility that permits verification of the ILS, GLS or SBAS CAT I glide path or MLS elevation angle/altimeter relationship. The outer marker, waypoint or equivalent DME fix is normally used for this purpose. Prior to crossing the outer marker, waypoint or DME fix, descent may be made on the ILS, GLS or SBAS CAT I glide path or MLS elevation angle to the altitude/height of the published outer marker, waypoint or DME fix crossing altitude/height.

5.5.4.2 Descent below the fix crossing altitude/height should not be made prior to crossing the outer marker, waypoint or DME fix. Allowance should be made for non-ISA conditions (see PANS-OPS, Volume III).

NOTE: Pressure altimeters are calibrated to indicate true altitude under ISA conditions. Any deviation from ISA will therefore result in an erroneous reading on the altimeter. If the temperature is higher than ISA, then the true altitude will be higher than the figure indicated by the altimeter. Similarly, the true altitude will be lower when the temperature is lower than ISA. The altimeter error may be significant in extremely cold temperatures.

5.5.4.3 In the event of loss of ILS, GLS or SBAS CAT I glide path or MLS elevation angle guidance during the approach, the procedure may become a non-precision approach. The OCA/H and associated procedure published for the glide path/MLS elevation angle inoperative case will then apply.

5.6 PRECISION APPROACH GLIDE PATH ANGLE/ELEVATION ANGLE

For ILS/MLS/GLS the following minimum, optimum and maximum glide path angles/elevation angles are established:

minimum:	-2.5°
optimum:	-3°
maximum:	3.5° (3° for CAT II/III operations)

5.7 DETERMINATION OF DECISION ALTITUDE (DA) OR DECISION HEIGHT (DH)

5.7.1 In addition to the physical characteristics of the ILS/MLS/GBAS installation, or SBAS CAT I procedure design, obstacles both in the approach and in the missed approach areas are considered in the calculation of the OCA/H for a procedure. The calculated OCA/H is the height of the highest approach obstacle or equivalent missed approach obstacle, plus an aircraft category related allowance.

5.7.2 In assessing these obstacles, the operational variables of the aircraft category, approach coupling, category of operation and missed approach climb performance are considered. The OCA/H values, as appropriate, are promulgated on the IAC for those categories of aircraft for which the procedure is designed.

5.7.3 Additional factors, including those in Annex 6, Part I, Chapter 4, 4.2.8, are considered by the operator and are applied to the OCA/H. This results in the DA/H value.

5.7.4 *Height loss margins*. Table II-5-5-3 shows the allowance used by the procedures specialist for vertical displacement during initiation of a missed approach. It takes into account the type of altimeter used and the height loss due to aircraft characteristics. It should be recognized that no allowance has been included in the table for any abnormal meteorological conditions; for example, wind shear and turbulence.

5.7.4.1 Height loss is a function of speed; therefore, Table II-5-5-3 shows the calculation only for a reference speed, which is the upper limit of each category. This provides a conservative figure that can be used in all cases.

5.7.4.2 If a height loss/altimeter margin is required for a specific V_{at}, the following formulae apply:

Use of radio altimeter	Use of pressure altimeter
Margin = $(0.096\ V_{at} - 3.2)$ metres where V_{at} in km/h	Margin = $(0.068\ V_{at} + 28.3)$ metres where V_{at} in km/h
Margin = $(0.177\ V_{at} - 3.2)$ metres where V_{at} in kt	Margin = $(0.125\ V_{at} + 28.3)$ metres where V_{at} in kt

5.7.5 Non-standard procedures

5.7.5.1 Non-standard procedures are those involving glide paths greater than 3.5° or any angle when the nominal rate of descent exceeds 5 m/sec (1000 ft/min). Procedure design takes into account multiple additional factors.

5.7.5.2 Non-standard procedures are normally restricted to specifically approved operators and aircraft, and are promulgated with appropriate aircraft and crew restrictions annotated on the approach chart.

5.7.5.3 Consideration shall also be given to operational factors including configuration, engine-out operation, maximum tailwind/minimum headwind limits, weather minima, visual aids and crew qualifications.

5.7.6 Protection of the precision segment

5.7.6.1 Descent on the ILS/GLS/SBAS/CAT I glide path angle, the APV vertical path or the MLS elevation angle shall never be initiated until the aircraft is within the tracking tolerance of the localizer/azimuth/final approach course due to the narrower protection area.

5.7.6.2 To remain within the protection area, the pilot should not deviate from the centre line more than halfscale deflection after being established on track. Thereafter, the aircraft should adhere to the on-course, on-glide path/elevation angle position to ensure there is no loss of protection from obstacles.

5.7.7 Operators shall consider weight, altitude and temperature limitations and wind velocity when determining the DA/H for a missed approach, since the OCA/H might be based on an obstacle in the missed approach area and since advantage may be taken of variable missed approach climb performances.

Table II-5-5-3. Height loss/altimeter margin for maximum V_{at} by aircraft category

Aircraft category (maximum V_{at})	Margin using radio altimeter		Margin using pressure altimeter	
	Metres	Feet	Metres	Feet

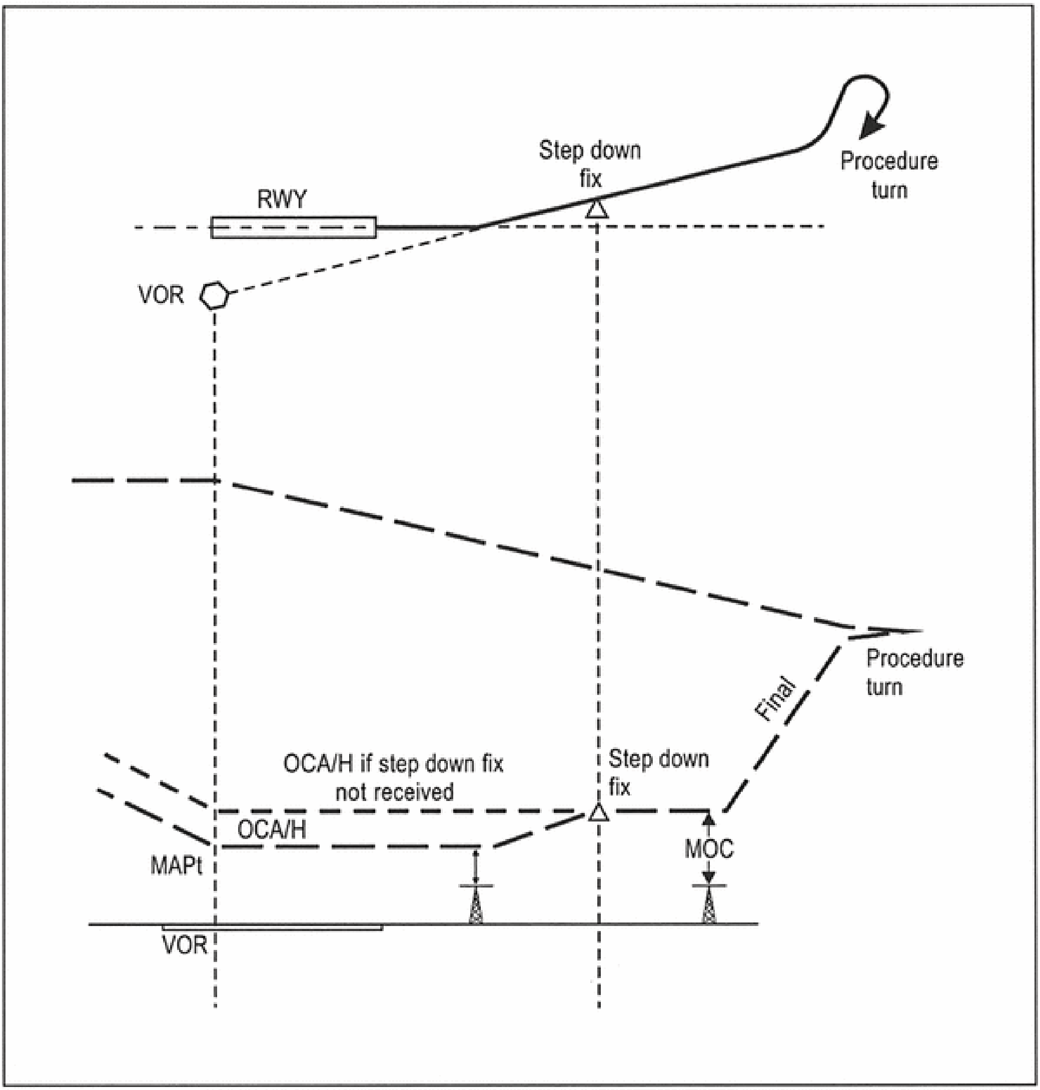
Table II-5-5-3. Height loss/altimeter margin for maximum Vat by aircraft category (continued)

A — 169 km/h (90 kt)	13	42	40	130
B — 223 km/h (120 kt)	18	59	43	142
C — 260 km/h (140 kt)	22	71	46	150
D — 306 km/h (165 kt)	26	85	49	161
H — 167 km/h (90 kt)	8	25	35	115

NOTE 1: Cat H speed is the maximum final approach speed, not V_{at}

NOTE 2: Since height loss varies with speed, the table shows only the calculation for a reference speed, which is the upper limit for each category.

Figure II-5-5-1. Step down fix



6 VISUAL MANOEUVRING (CIRCLING)

6.1 PURPOSE

6.1.1 Visual manoeuvring (circling) is the term used to describe the phase of flight after an instrument approach has been completed. It brings the aircraft into position for landing on a runway which is not suitably located for straight-in approach, i.e. one where the criteria for alignment or descent gradient cannot be met.

6.1.2 Circling procedures are not promulgated for helicopters; however, this does not preclude a helicopter from flying a circling procedure if desired. The helicopter pilot shall conduct visual manoeuvres in adequate meteorological conditions to see and avoid obstacles in the vicinity of the final approach course for Category A or H procedures. However, the pilot shall be alert to any operational notes regarding air traffic services (ATS) requirements while manoeuvring to land.

6.2 VISUAL FLIGHT MANOEUVRE

6.2.1 A circling approach is a visual flight manoeuvre. Each circling situation is different because of variables such as runway layout, final approach track, wind velocity and meteorological conditions. Therefore, there can be no single procedure designed that will cater for conducting a circling approach in every situation.

6.2.2 After initial visual contact, the runway environment should be kept in sight while the aircraft is kept within the visual manoeuvring area, arid not below the MDA/H for circling. The runway environment includes features such as the runway threshold or approach lighting aids or other markings identifiable with the runway.

6.3 PROTECTION

6.3.1 The visual manoeuvring area

The visual manoeuvring area for a circling approach is determined by drawing arcs centred on each runway threshold and joining those arcs with tangent lines (see Figure II-5-6-1).

6.3.2 Obstacle clearance

When the visual manoeuvring (circling) area has been established, the OCA/H is determined for each category of aircraft (see Table II-5-6-1).

NOTE: The information in Table II-5-6-1 should not be construed as operating minima.

6.3.3 Minimum descent altitude/height (MDA/H)

When the OCA/H is established, an MDA/H is also specified to allow for operational considerations. Descent below MDA/H should not be made until:

a. required visual reference has been established and can be maintained throughout the manoeuvre;

b. the pilot has the landing threshold in sight; and

c. the required obstacle clearance can be maintained and the aircraft is in a position to carry out a landing using normal rates of descent and angles of bank.

6.3.4 Visual manoeuvring (circling) area exclusions

6.3.4.1 A sector in the circling area where a prominent obstacle exists may be ignored for OCA/H calculations if it is outside the final approach and missed approach areas for the instrument approach. This sector is bounded by the dimensions of Annex 14, Volume I, instrument approach surfaces (see Figure II-5-6-2).

6.3.4.2 When this option is exercised, the published procedure prohibits circling within the entire sector in which the obstacle is located (see Figure II-5-6-2).

6.4 MISSED APPROACH PROCEDURE WHILE CIRCLING

6.4.1 If visual reference is lost while circling to land from an instrument approach, the missed approach specified for that particular procedure shall be followed. The transition from the visual (circling) manoeuvre to the missed approach should be initiated by a climbing turn, within the circling area, towards the landing runway, to return to the circling altitude or higher, immediately followed by interception and execution of the missed approach procedure. The indicated airspeed during these manoeuvres shall not exceed the maximum indicated airspeed associated with visual manoeuvring.

6.4.2 The circling manoeuvre may be carried out in more than one direction. For this reason, different patterns are required to establish the aircraft on the prescribed missed approach course depending on its position at the time visual reference is lost.

6.5 VISUAL MANOEUVRING USING PRESCRIBED TRACK

6.5.1 General

6.5.1.1 In those locations where clearly defined visual features permit (and if it is operationally desirable), a State may prescribe a specific track for visual manoeuvring in addition to the circling area.

6.5.1.2 Since visual manoeuvring with a prescribed track is intended for use where specific terrain features warrant such a procedure, the pilot shall be familiar with the terrain and visual cues to be used in weather conditions above the aerodrome operating minima prescribed for this procedure.

6.5.1.3 This procedure is based on the aircraft speed category. It is published on a special chart on which the visual features used to define the track, or other characteristic features near the track, are shown.

6.5.1.4 Note that in this procedure:

a. navigation is primarily by visual reference and any supplemental navigation information presented is advisory only; and

b. the missed approach for the normal instrument procedure applies, but the prescribed tracks provide for manoeuvring to allow for a go-around and to achieve a safe altitude/height thereafter joining the downwind leg of the prescribed track procedure or the instrument missed approach trajectory).

6.5.2 Standard track (general case)

6.5.2.1 Figure II-5-6-3 shows a standard track general case.

6.5.2.2 The direction and the length of each segment are defined. If a speed restriction is prescribed, it is published on the chart.

6.5.3 Minimum obstacle clearance (MOC) and obstacle clearance altitude/height (OCA/H)

The OCA/H for visual manoeuvring on prescribed tracks provides the MOC over the highest obstacle within the prescribed track area and is not less than the OCA/H calculated for the instrument approach procedure which leads to the visual manoeuvre.

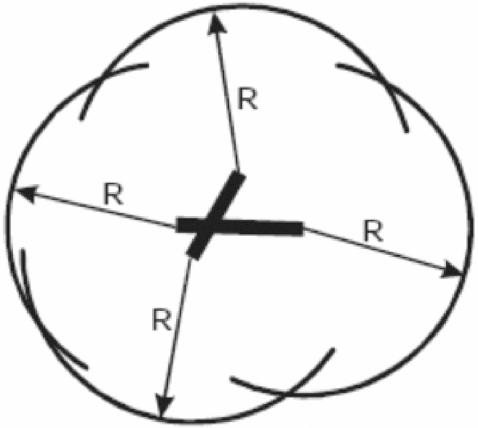
6.5.4 Visual aids

Visual aids associated with the runway used for the prescribed track (sequenced flashing lights, PAPI, VASIS, etc.) are shown on the chart with their main characteristics (i.e. slope of the PAPI or VASIS). Lighting on obstacles is specified on the chart.

Table II-5-6-1. OCA/H for visual manoeuvring (circling) approach

Aircraft category	Obstacle clearance m (ft)	Lowest OCH above aerodrome elevation m (ft)	Minimum visibility km (NM)
A	90 (295)	120 (394)	1.9 (1.0)
B	90 (295)	150 (492)	2.8 (1.5)
C	120 (394)	180 (591)	3.7 (2.0)
D	120 (394)	210 (689)	4.6 (2.5)
E	150 (492)	240 (787)	6.5 (3.5)

Figure II-5-6-1. Visual manoeuvring (circling) area



Radius of the arcs (R) varies with the aircraft category

Figure II-5-6-2. Visual manoeuvring (circling) area — prohibition on circling

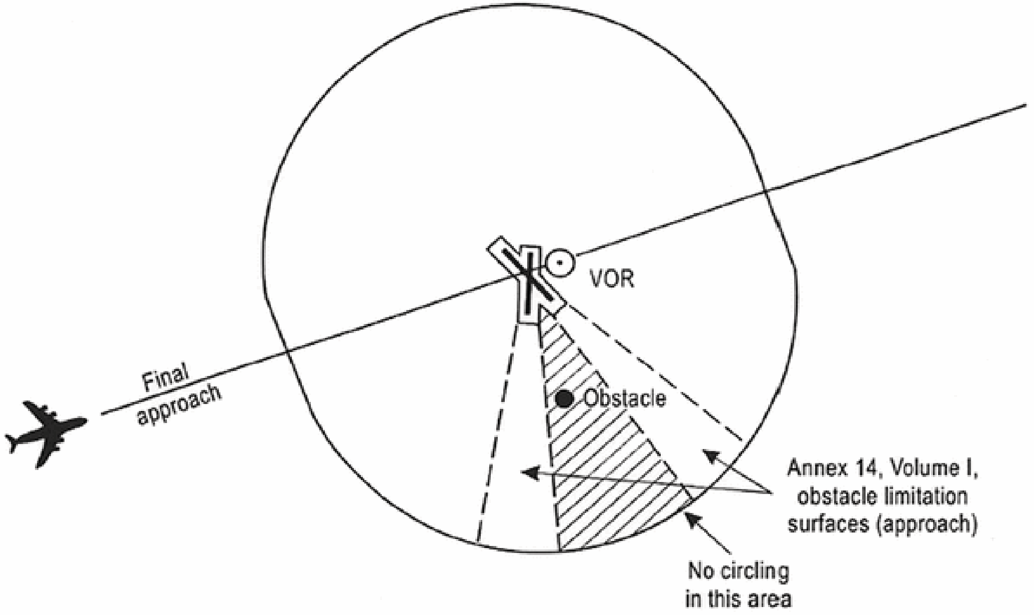
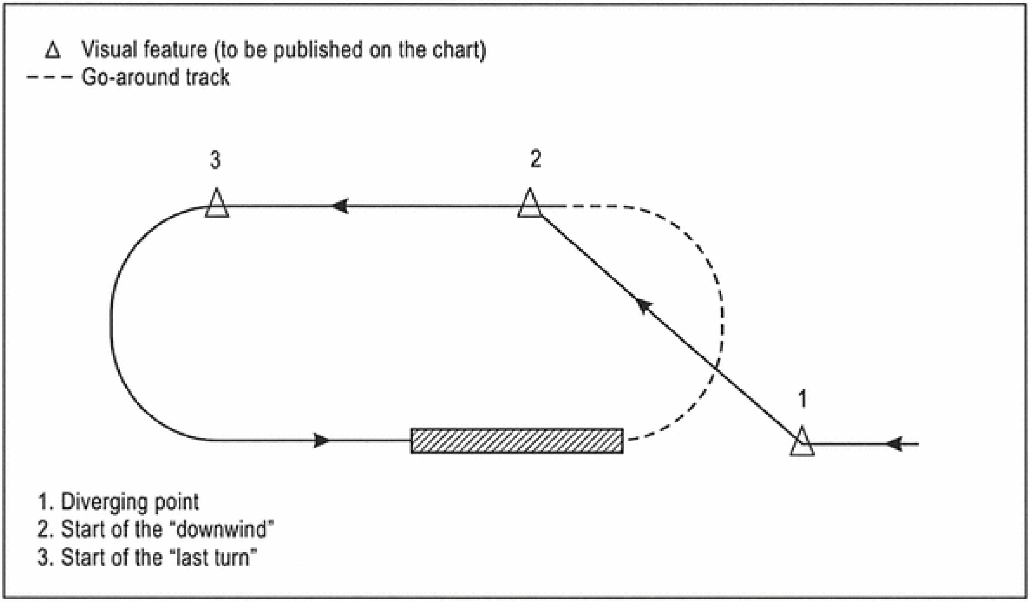


Figure II-5-6-3. Standard track general case



7 MISSED APPROACH

7.1 GENERAL

7.1.1 During the missed approach phase of the instrument approach procedure, the pilot is faced with the demanding task of changing the aircraft configuration, attitude and altitude. For this reason, the design of the missed approach has been kept as simple as possible and consists of three phases (initial, intermediate and final). (See Figure II-5-7-1.)

7.1.2 Only one missed approach procedure is established for each instrument approach procedure. It is designed to provide protection from obstacles throughout the missed approach manoeuvre. It specifies a point where the missed approach begins, and a point or an altitude/ height where it ends.

7.1.3 The missed approach should be initiated at the DA/H on a 3D approach operation if the required visual reference to continue the approach has not been established.

7.1.4 On a 2D approach operation, descent shall not be made below the MDA or MDH without the required visual reference. The pilot should be aware that no obstacle or terrain protection is provided when descending below MDA/H during the execution of the approach or missed approach.

7.1.5 The MAPt in a procedure may be defined by:

a. the point of intersection of a glide path with the applicable DA/H in APV or precision approaches; or

b. a navigation facility, a fix, a waypoint or a specified distance from the FAF in non-precision approaches. For PBN non-precision approach procedures, the MAPt waypoint is normally located at the landing runway threshold (LTP). However, for offset procedures and other procedures where the MAPt is not located at the LTP, it is located at the fictitious threshold point (FTP).

7.1.6 When the MAPt is defined by a navigation facility, a waypoint or a fix, the distance from the FAF to the MAPt is normally published as well, and may be used for timing to the MAPt. In all cases where timing may not be used, the procedure is annotated “timing not authorized for defining the MAPt”.

7.1.7 If upon reaching the MAPt the required visual reference is not established, the procedure requires that a missed approach be initiated at once in order to maintain protection from obstacles.

7.1.8 Missed approach tracking requirements

7.1.8.1 Unless a greater priority exists, the pilot shall fly the missed approach procedure as published.

7.1.8.2 If upon reaching the MAPt the required visual reference is not established, the pilot shall initiate a missed approach immediately in order to maintain protection from obstacles.

7.1.8.3 If a missed approach is initiated before arriving at the MAPt, the pilot should continue the lateral tracking of the approach being conducted until reaching the MAPt, then follow the missed approach procedure as published in order to remain within the protected airspace. This does not preclude flying over the MAPt at an altitude/height greater than that required by the procedure.

7.1.8.4 When the first requirement of a missed approach procedure is defined by an altitude/ height, additional protection is provided for the safeguarding of early turns, should they be operationally required. When an early turn is not possible, the approach chart will specify the earliest point (DME, MAPt or equivalent point) at which turns can be made.

7.1.9 Missed approach gradient

7.1.9.1 Normal missed approach procedures are based on a minimum climb gradient of 2.5 per cent (4.2 per cent CAT H). A gradient of 2 per cent may be used in the procedure construction if the necessary survey and safeguarding have been provided. With the approval of the appropriate authority, gradients of 3, 4 or 5 per cent may be used for aircraft whose climb performance permits an operational advantage to be thus obtained.

7.1.9.2 When a gradient other than 2.5 per cent is used, this is indicated on the IAC. In addition to the OCA/H for the non-standard gradient, the OCA/H applicable to the nominal 2.5 per cent gradient will also be shown.

7.1.9.3 The pilot should be aware that a missed approach procedure which is based on the nominal climb gradient of 2.5 per cent or greater cannot be used by all aircraft when operating at high gross mass and non-normal configurations, including engine-out conditions. The operation of aircraft under these conditions needs special consideration at aerodromes that are critical due to obstacles on the missed approach area. This may result in a special procedure being established with a possible increase in the DA/H or MDA/H.

7.2 INITIAL PHASE

The initial phase begins at the MAPt and ends at the start of climb (SOC). This phase requires the concentrated attention of the pilot on establishing the climb and the changes in aircraft configuration. It is assumed that guidance equipment is not extensively utilized during these manoeuvres, and for this reason, no turns are specified in this phase.

7.3 INTERMEDIATE PHASE

7.3.1 The intermediate phase begins at the SOC. The climb is continued, normally straight ahead. It extends to the first point where 50 m (164 ft) obstacle clearance is obtained and can be maintained.

7.3.2 The intermediate missed approach track may be changed by a maximum of 15° from that of the initial missed approach phase. During this phase, it is assumed that the aircraft begins track corrections.

7.4 FINAL PHASE

The final phase begins at the point where 50 m (164 ft) obstacle clearance is first obtained (for Category H procedures, 40 m (131 ft)) and can be maintained. It extends to the point where a new approach, holding or a return to en-route flight is initiated. Turns may be prescribed in this phase.

7.5 TURNING MISSED APPROACH

7.5.1 Turns in a missed approach procedure are only prescribed where terrain or other factors make a turn necessary.

7.5.2 Where an obstacle is located early in the missed approach procedure, the IAC is annotated “Missed approach turn as soon as operationally practicable to _____ heading“.

7.5.3 Airspeed

7.5.3.1 The protected airspace for turns is based on the speeds for final missed approach (see Tables II-5-1-1 and II 5-1-2).

7.5.3.2 Where operationally required to avoid obstacles, the IAS as slow as for intermediate missed approach may be used. In this case, the IAC contains the following note: “Missed approach turn limited to ____ km/h (kt) IAS maximum”.

7.5.3.3 Pilots shall comply with such annotations on approach charts and to execute the appropriate manoeuvres without undue delay.

7.6 PBN MISSED APPROACH ATTRIBUTES

7.6.1 A PBN missed approach is a missed approach procedure containing RNAV or RNP segments.

7.6.2 PBN procedures are promulgated with a PBN requirements box. The box contains the following information:

a. identification of the applicable navigation specification(s) that were used to design the procedure;

b. restrictions on navigation equipment required to fly the procedure (for example GNSS only); and

c. information related to optional functionality of the applicable navigation specification, such as the use of RF legs or RNP scalability.

7.6.3 Applicable navigation specifications

The applicable navigation specifications for PBN missed approach segments are:

a. RNP APCH;

b. RNP AR APCH;

c. Advanced RNP;

d. RNP 0.3 (Helicopters);

e. RNAV 1; and

f. RNP 1.

NOTE: For complete details of the applicability of PBN navigation specifications to the missed approach, see the Performance-based Navigation (PBN) Manual (Doc 9613).

7.6.4 The navigation specifications may be applied on a missed approach route segment basis. The aircraft and pilot shall be approved to operate on the navigation specification that applies to the missed approach.

7.6.5 Missed approach procedure information is contained in a navigation database using the WGS-84 coordinate system. If the navigation database does not contain the missed approach procedure, the procedure shall not be used.

7.6.6 PBN operational approval

7.6.6.1 Pilots shall verify, before operating on any PBN route or procedure, that they have approval to operate on the navigation specification used. Where there are additional restrictions, for example sensor use or optional functionality as discussed in 7.6.2, the pilot shall also verify that these are complied with.

7.6.6.2 Prior to operating on any PBN procedure, the pilot shall confirm:

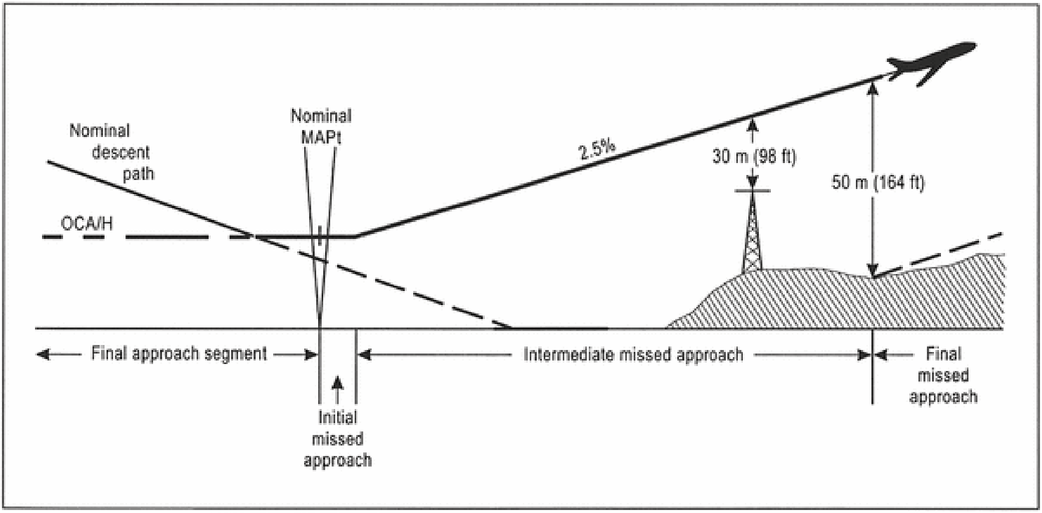
a. the operation of all required navigation aids (ground and space-based);

b. the correct functioning of the navigation equipment;

c. the validity of the navigation database; and

d. waypoint and segment data, with reference to the published chart.

Figure II-5-7-1. Missed approach phases



Extracted from ICAO Document 8168, Volume I - Sixth Edition - Procedures for Air Navigation Services - AIRCRAFT OPERATIONS, Flight Procedures, herein known as PANS-OPS.

1 GENERAL REQUIREMENTS

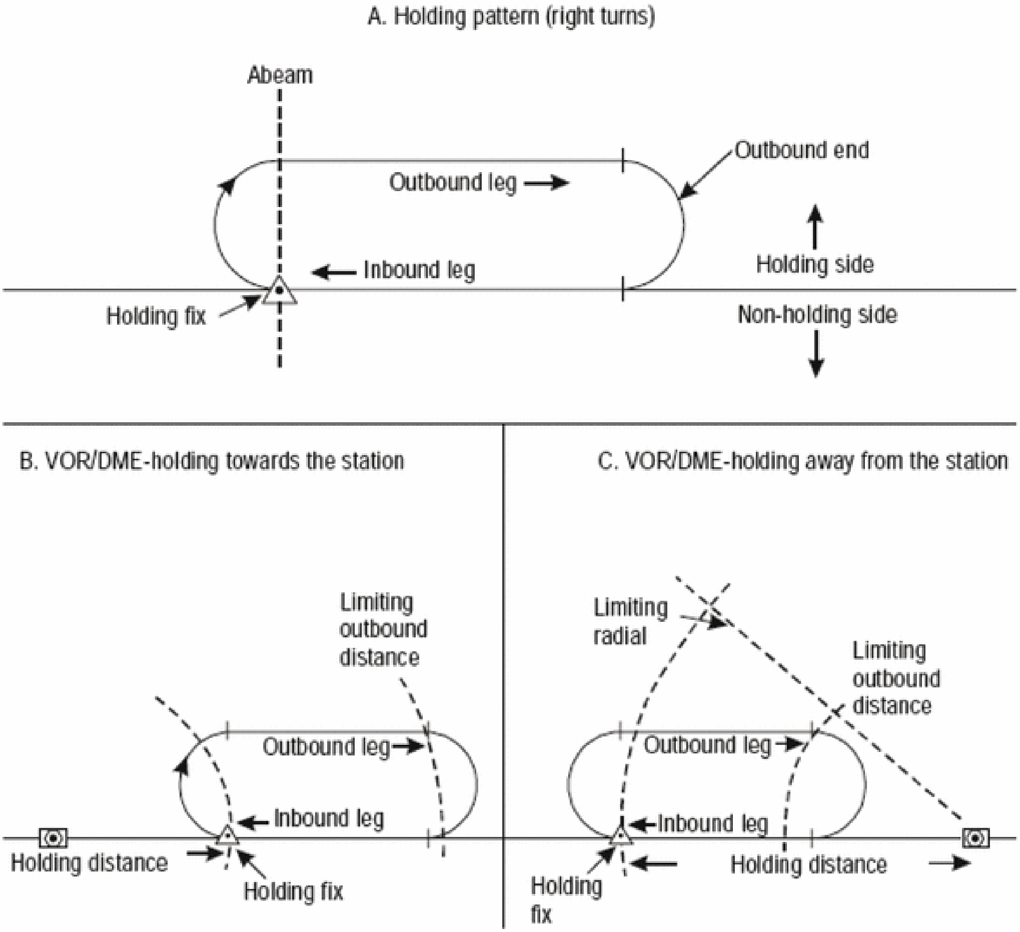
1.1 GENERAL

The procedures described in this section are related to right turn holding patterns. For left turn holding patterns, the corresponding entry and holding procedures are symmetrical with respect to the inbound holding track.

1.2 SHAPE AND TERMINOLOGY ASSOCIATED WITH HOLDING PATTERN

The shape and terminology associated with the holding pattern are given in Figure II-6-1-1.

Figure II-6-1-1. Shape and terminology associated with right turn holding pattern



2 HOLDING (CONVENTIONAL)

2.1 SPEEDS, RATE OF TURN, TIMING, DISTANCE AND LIMITING RADIAL

2.1.1 Speeds

2.1.1.1 Holding patterns shall be entered and flown at or below the airspeeds given in Table II-6-2-1.

2.1.1.2 These speeds are rounded to the nearest multiple of five for operational reasons. From the standpoint of operational safety, these speeds are considered to be equivalent to the unrounded originals.

2.1.2 Bank angle/rate of turn

All turns shall be made at a bank angle of 25° or at a rate of 3° per second, whichever requires the lesser bank.

2.1.3 Allowance for known wind

All procedures depict tracks. The pilot should attempt to maintain the track by making allowance for known wind by applying corrections both to heading and timing. This should be done during entry and while flying in the holding pattern.

2.1.4 Start of outbound timing

Outbound timing begins over or abeam the fix, whichever occurs later. If the abeam position cannot be determined, start timing when the turn to outbound is completed.

2.1.5 Outbound leg length based on a distance measuring equipment (DME) distance

If the outbound leg length is based on a DME distance, then the outbound leg terminates as soon as the limiting DME distance is reached.

2.1.6 Limiting radials

2.1.6.1 In the case of holding away from the station (see Figure II-6-1-1 C), where the distance from the holding fix to the very high frequency omnidirectional radio range/distance measuring equipment (VOR/DME) station is short, a limiting radial may be specified. A limiting radial may also be specified where airspace conservation is essential.

2.1.6.2 If the limiting radial is reached before the limiting DME distance, this radial should be followed until a turn inbound is initiated. The turn should be initiated at the latest where the limiting DME distance is reached.

2.1.7 Air traffic control (ATC) notification

If for any reason a pilot is unable to conform to the procedures for normal conditions, ATC should be advised as early as possible.

2.2 HOLD ENTRY

2.2.1 Paragraphs 2.2.3.2 and 2.2.9 related to hold entry represent general guidance. Variations of the basic procedure for local conditions may be authorized by States after appropriate consultation with the operators concerned.

2.2.2 The entry into the holding pattern shall be according to heading in relation to the three entry sectors shown in Figure II-6-2-1, recognizing a zone of flexibility of 5° on either side of the sector boundaries.

2.2.3 Restrictions on hold entry

2.2.3.1 For holding on a VOR intersection, the entry track is limited to the radials forming the intersection.

2.2.3.2 For holding on a VOR/DME fix, the entry track is limited to:

a. the VOR radial;

b. the DME arc (where specified); or

c. the entry radial to a VOR/DME fix at the end of the outbound leg, as published.

2.2.4 Section 1 entry

Sector 1 procedure-parallel entry (see Figure II-6-2-1):

a. at the fix, the aircraft is turned left onto an outbound heading for the appropriate period of time (see 2.2.9, “Time/distance outbound”); then

b. the aircraft is turned toward the holding side to intercept the inbound track or to return directly to the fix; and then

c. on second arrival over the holding fix, the aircraft is turned right to follow the holding pattern.

2.2.5 Sector 2 entry

Sector 2 procedure - offset entry (see Figure II-6-2-1):

a. at the fix, the aircraft is turned onto a heading to make good a track making an angle of 30° from the reciprocal of the inbound track on the holding side; then

b. the aircraft will fly outbound:

   1. for the appropriate period of time (see 2.2.9, “Time/distance outbound”), where timing is specified; or
   2. until the appropriate limiting DME distance is reached, where distance is specified. If a limiting radial is also specified, then the outbound distance is determined either by the limiting DME distance or the limiting radial, whichever comes first;

c. the aircraft is turned right to intercept the inbound holding track; and

d. on second arrival over the holding-fix, the aircraft is turned right to follow the holding pattern.

2.2.6 Sector 3 entry

Sector 3 procedure - direct entry (see Figure II-6-2-1):

Having reached the fix, the aircraft is turned right to follow the holding pattern.

2.2.7 DME arc entry

To be used where specified. At the fix, the aircraft shall enter the holding pattern in accordance with either the Sector 1 or Sector 3 entry procedure.

2.2.8 Special entry procedure for VOR/DME holding

2.2.8.1 Where a special entry procedure is used, the entry radial is clearly depicted.

2.2.8.2 Arrival to a VOR/DME holding pattern may be:

a. along the axis of the inbound track;

b. along a published track; or

c. by radar vectoring, when aircraft shall be established on prescribed protected flight paths.

2.2.8.3 The entry point should be either of the following two options:

a. the holding fix: In this case, the aircraft shall arrive at the entry point by means of:

   1. the VOR radial for the inbound leg; or
   2. the DME arc defining the holding fix.

b. the fix at the end of the outbound leg, in which case, the aircraft will arrive at the entry point by means of the VOR radial passing through the fix at the end of the outbound leg.

2.2.8.4 It is also possible to make use of guidance from another radio facility (e.g. non-directional beacon (NDB)).

2.2.8.5 The following describes the method of arrival at a VOR/DME holding and the corresponding entry procedures, where the entry point is the holding fix.

2.2.8.5.1 For arrival on the VOR radial of the inbound leg, on the same heading as the inbound track (see Figure II-6-2-2 A) the entry consists of following the holding pattern.

2.2.8.5.2 For arrival on the VOR radial of the inbound leg, on a heading reciprocal to the inbound track (see Figure II-6-2-2-B):

a. On arrival over the holding fix, the aircraft turns onto the holding side on a track making an angle of 30° with the reciprocal of the inbound track, until reaching the DME outbound limiting distance.

b. At this point it turns to intercept the inbound track.

c. In the case of a VOR/DME holding entry away from the facility with a limiting radial, if the aircraft encounters the radial ahead of the DME distance, it shall turn and follow it until reaching the DME outbound limiting distance, at which point it turns to join the inbound track.

2.2.8.5.3 For arrival on the DME arc defining the holding fix, from the non-holding side (see Figure II-6-2-2 C):

a. On arrival over the holding fix, the aircraft turns and follows a track parallel to and on the same heading as the outbound track.

b. When it reaches the DME outbound limiting distance, the aircraft turns to intercept the inbound track.

2.2.8.5.4 For arrival on the DME arc defining the holding fix, from the holding side (see Figure II-6-2-2 E):

a. On arrival over the holding fix, the aircraft turns and follows a track parallel and reciprocal to the inbound track, until reaching the DME limiting outbound distance. It then turns to intercept the inbound track.

b. If the entry point is the fix at the end of the outbound leg, arrival (or last segment thereof) is effected along the VOR radial passing through the outbound fix. On arrival over the fix at the end of the outbound leg, the aircraft turns and follows the holding pattern (see Figure II 6-2-2 F and G).

2.2.9 Time/distance outbound

2.2.9.1 The still air time for flying the outbound entry heading should not exceed:

a. one minute if at or below 4250 m (14000 ft); or

b. one and one-half minutes if above 4250 m (14000 ft).

2.2.9.2 Where DME is available, the length of the outbound leg may be specified in terms of distance instead of time.

2.3 HOLDING

2.3.1 Still air condition

After entering the holding pattern, on the second and subsequent arrivals over the fix, the aircraft turns to fly an outbound track to position the aircraft for the turn onto the inbound track. It continues outbound:

a. where timing is specified:

   1. for one minute if at or below 4250 m (14000 ft); or

   2. for one and one-half minutes if above 4250 m (14000 ft); or

b. where distance is specified until the appropriate limiting DME distance is reached.

Then, the aircraft turns so as to realign itself on the inbound track.

2.3.2 Corrections for wind effect

Allowance should be made in both heading and timing to compensate for the effects of wind to ensure the inbound track is regained before passing the holding fix inbound. In making these corrections, full use should be made of the indications available from the navaid and estimated or known wind.

2.3.3 Departing the pattern

When clearance is received specifying the time of departure from the holding point, the pilot should adjust the pattern within the limits of the established holding procedure in order to leave the holding point at the time specified.

2.4 OBSTACLE CLEARANCE

2.4.1 Holding area

The holding area includes the basic holding area and the entry area. The basic holding area is the airspace required for a holding pattern at a specific level, based on the allowances for aircraft speed, wind effect, timing errors, holding fix characteristics, etc. The entry area is the airspace required for the entry procedure.

2.4.2 Buffer area

2.4.2.1 An additional buffer area extends 9.3 km (5.0 NM) beyond the boundary of the holding area. Significant obstacles in the buffer area are taken into consideration when determining the minimum holding level.

2.4.2.2 For helicopter holding procedures, the buffer area is 3.7 km (2 NM) wide and only applies below 1830 m (6000 ft).

2.4.3 Minimum holding level

The minimum permissible holding level (see Figure II-6-2-3) provides a clearance of at least 300 m (984 ft) above obstacles in the holding area, and a clearance which ranges from 300 m (984 ft) at the edge of the holding area to a minimum of 60 m (197 ft) at the 5.0 NM limit of the buffer area.

2.4.4 Obstacle clearance over high terrain or in mountainous areas

Over high terrain or in mountainous areas, additional obstacle clearance up to a total of 600 m (1969 ft) is provided to accommodate the possible effects of turbulence, down drafts and other meteorological phenomena on the performance of altimeters.

Table IV-1-1 (or II-6-2-1 in PANS-OPS). Holding Speeds - Categories A through E

Levels[1]	Normal conditions	Turbulence conditions
Up to 4250 m (14000 ft) inclusive	425 km/h (230 kt)[2]	520 km/h (280 kt)[3]
	315 km/h (170 kt)[4]	315 km/h (170 kt)[4]
Above 4250 m (14000 ft) to 6100 m (20000 ft) inclusive	445 km/h (240 kt)[5]	520 km/h (280 kt) or 0.8 Mach, whichever is less[3]
Above 6100 m (20000 ft) to 10350 m (34000 ft) inclusive	490 km/h (265 kt)[5]	
Above 10350 m (34000 ft)	0.83 Mach	0.83 Mach

Table IV-1-1 (or II-6-2-1 in PANS-OPS). Holding Speeds - Categories A through E (continued)

Levels[1]	Normal conditions	Turbulence conditions

1. The levels shown represent *altitudes* or corresponding *flight levels* depending upon the altimeter setting in use.

2. When the holding procedure is followed by the initial segment of an instrument approach procedure promulgated at a speed higher than 425 km/h (230 kt), the holding should also be promulgated at this higher speed wherever possible.

3. The speed of 520 km/h (280 kt) (0.8 Mach) reserved for turbulence conditions shall be used for holding only after prior clearance with ATC, unless the relevant publications indicate that the holding area can accommodate aircraft flight at these high holding speeds.

4. For holdings limited to CAT A and B aircraft only.

5. Wherever possible, 520 km/h (280 kt) should be used for holding procedures associated with airway route structures.

Table IV-1-2. PANS-OPS Second Edition Holding Speeds Applicable to Many of the Presently Published Holdings

Levels[1]	Propeller[2] aircraft	Jet aircraft	
		Normal conditions	Turbulence conditions
up to 1850 m inclusive 6000 ft	315 km/h (170 kt)	390 km/h (210 kt)	520 km/h (280 kt) or 0.8 Mach whichever is less[3]
above 1850 m to 4250 m inclusive 6000 ft to 14000 ft	315 km/h (170 kt)	405 km/h (220 kt)	
above 4250 m 14000 ft	325 km/h (175 kt)	445 km/h (240 kt)	

Table IV-1-2. PANS-OPS Second Edition Holding Speeds Applicable to Many of the Presently Published Holdings (continued)

Levels[1]	Propeller[2] aircraft	Jet aircraft	
		Normal conditions	Turbulence conditions

1. The levels tabulated represent altitudes or corresponding flight levels depending upon the altimeter setting in use.

2. Certain types of propeller aircraft may need to hold at higher speeds.

3. The speed of 520 km/h (280 kt) (0.8 Mach) reserved for turbulence conditions shall be used for holding only after prior clearance with ATC, unless the relevant publications indicate that the holding area can accommodate aircraft flying at these high holding speeds.

NOTE: Holdings calculated in accordance with the Second Edition criteria should not be flown at higher holding speeds as the lateral limits of the holding area are larger when the holding speed is higher. The obstacle clearance or separation may not be guaranteed when these holdings are flown at the new higher holding speeds.

Table IV-1-3. Holding Speeds Per U.S. FAA Regulations

Levels	All aircraft
at 6000 ft or below	200 kt
above 6000 ft to and including 14000 ft	230 kt
above 14000 ft	265 kt

1. Holding patterns from 6001 ft to 14000 ft may be restricted to a maximum airspeed of 210 kt. This nonstandard pattern will be depicted by an icon.

2. Holding patterns at all altitudes may be restricted to a maximum airspeed of 175 kt. This nonstandard pattern will be depicted by an icon.

3. Holding patterns at USAF airfields only - 310 kt maximum, unless otherwise depicted.

4. Holding patterns at U.S. Navy fields only - 230 kt maximum, unless otherwise depicted.

Figure II-6-2-1. Entry sectors

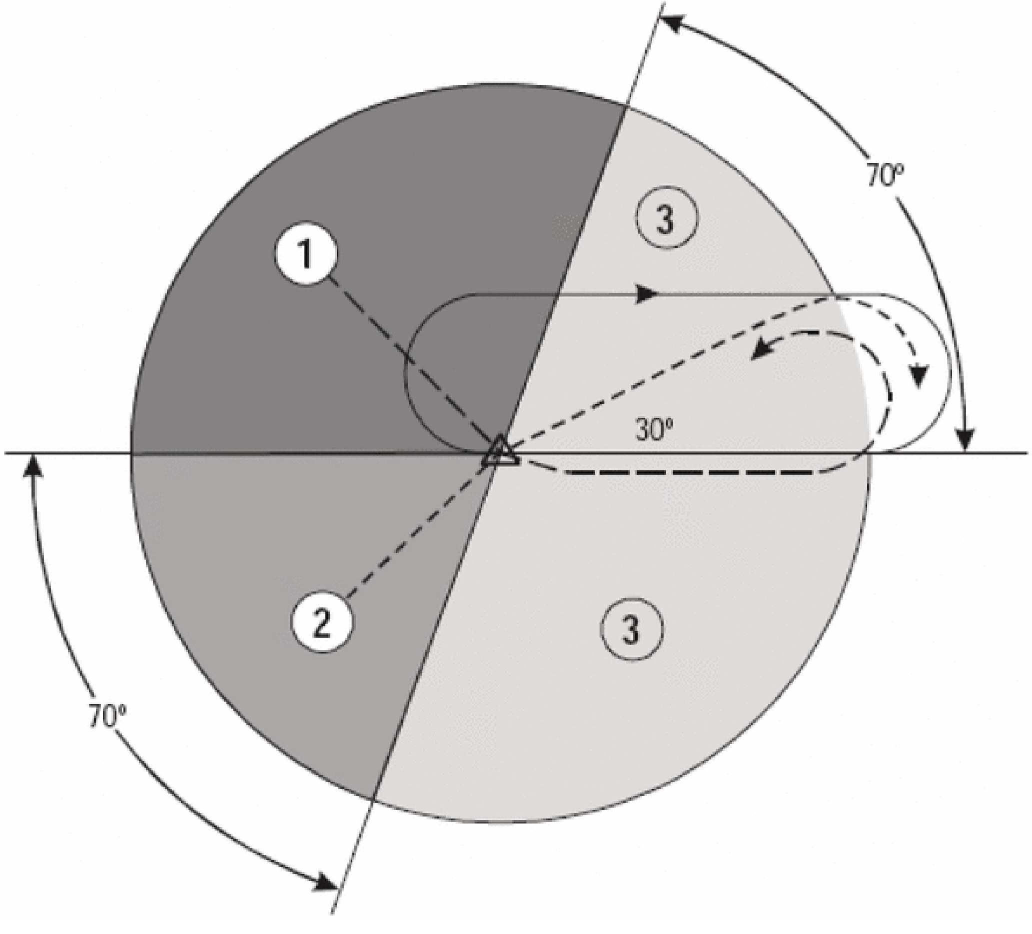


Figure II-6-2-2. VOR/DME holding entry procedures

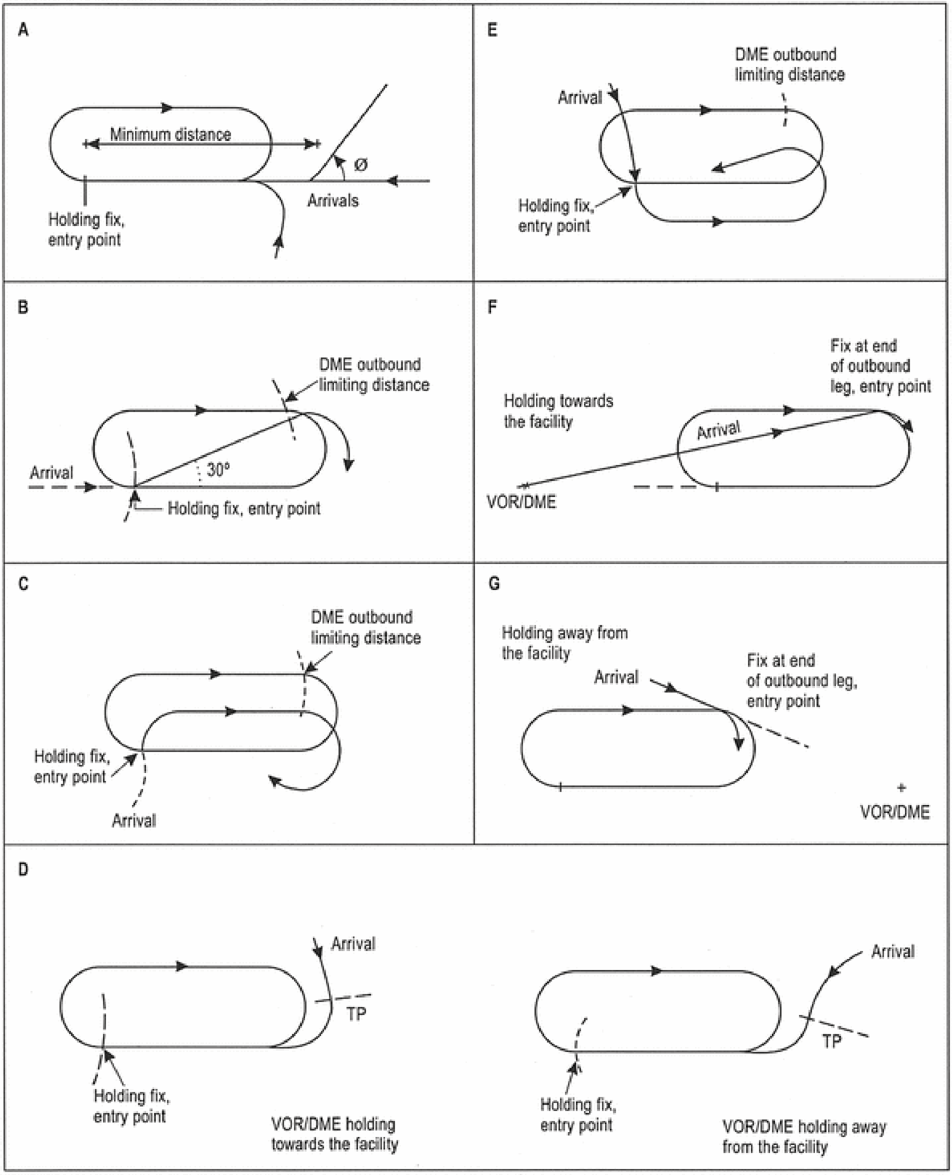
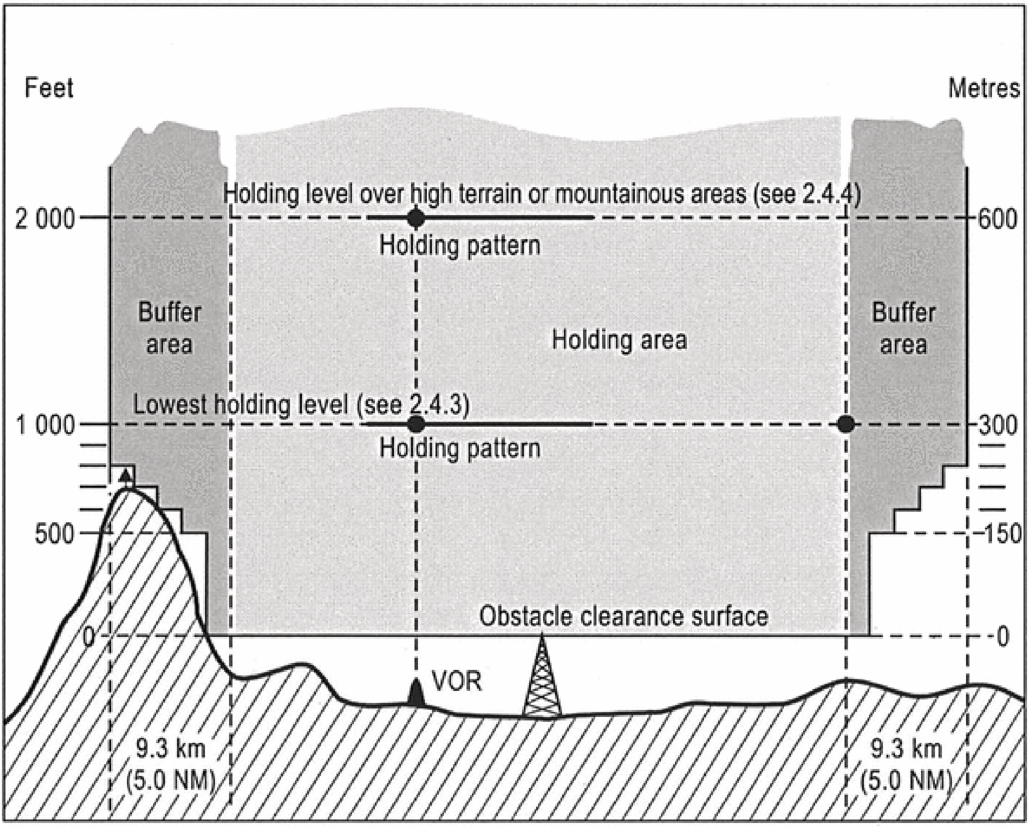


Figure II-6-2-3. Minimum holding level as determined by the obstacle clearance surface related to the holding area and the buffer area



3 HOLDING (RNAV)

3.1 INTRODUCTION

3.1.1 The general criteria in Section 6, Chapter 2, “Holding (Conventional)”, are applicable except as modified or amplified by the material in this chapter.

3.1.2 Area navigation (RNAV) holding uses different criteria for defining the protected space and is only available to those aircraft which have a certified ability to comply with these criteria.

3.1.3 The RNAV holding pattern design criteria protect all types of RNAV systems.

3.2 AIRCRAFT EQUIPPED WITH RNAV SYSTEMS INCLUDING CERTIFIED RNAV HOLDING FUNCTIONALITY

3.2.1 These systems may be used to carry out RNAV holding, provided that:

a. the aircraft is fitted with serviceable RNAV equipment; and

b. the pilot has a current knowledge of how to operate the equipment to optimize navigation accuracy.

3.2.2 Holding waypoints and supporting data contained in the navigation database are calculated and promulgated by the State authority. Holding waypoints may also be input by the operator or the pilot for some applications (e.g. RNAV 5) when identified in operations approval documentation. Any errors introduced from the navigation database or manual entry will affect the actual computed position. The pilot should cross-check the waypoint position using VOR/DME fix information where this is available.

3.2.3 Some RNAV systems can fly conventional holding patterns without strict compliance with PANS-OPS, Volume II, assumptions. Before these systems are used operationally, they shall have demonstrated, to the satisfaction of the appropriate authority, that their commands will contain the aircraft within the basic holding area defined by PANS-OPS, Volume II, for the environmental conditions assumed by those criteria. The pilot shall verify overflight of the stipulated fixes by means of the reference facility.

3.2.4 Performance-based navigation (PBN) holding may be conducted in specifically designed holding patterns. These holding patterns utilize the criteria and flight procedure assumptions of conventional holding with orientations. However, the holding pattern is established on a track to the holding waypoint. These holding patterns assume that the aircraft is approved for the PBN navigation specification associated with the holding pattern and is being operated in accordance with that approval.

3.3 CONVENTIONAL HOLDING PATTERNS

Conventional holding patterns may be flown with the assistance of an RNAV system. In this case, the RNAV system has no other function than to provide guidance for the autopilot or flight director. The pilot remains responsible for ensuring that the aircraft complies with the speed, bank angle, timing and distance assumptions contained in Chapter 2, 2.1 of this section.

3.4 PILOT RESPONSIBILITIES

3.4.1 When RNAV equipment is used for non-RNAV holding procedures, the pilot shall verify inbound track, direction of turn and positional accuracy at the holding fix on each passage of the fix.

3.4.2 The pilot shall ensure that speeds used to fly the RNAV holding procedures comply with Tables II-6-2-1 and II-6-2-2.

3.5 RNAV HOLDING ENTRIES

Entries into an RNAV holding pattern are the same as for conventional holding unless clearly specified otherwise.

FLIGHT PROCEDURES (DOC 8168) - ATTACHMENT A

Extracted from ICAO Document 8168, Volume I - Sixth Edition - Procedures for Air Navigation Services - AIRCRAFT OPERATIONS, Flight Procedures, herein known as PANS-OPS.

1 GENERAL PRINCIPLES OF PROCEDURE DESIGN

1.1 An instrument flight procedure is a series of predetermined manoeuvres designed to be flown by referring to the flight instruments. These provide specific protection from obstacles, and are typically used in the arrival, approach and departures phases of flight.

1.2 There are three main principles that apply to the design of all instrument flight procedures; they should be safe, as simple as possible and economical in both time and airspace. Safety requires the use of common sense and operational judgement. Simple procedures are essential at a time when pilot workload is high and the consequences of error can be fatal. Economical procedures are increasingly necessary where flight time can have an economic impact and where airspace is often in short supply.

1.3 The PANS-OPS caters for a wide variety of conditions in each area or segment of an instrument flight procedure. It is important that pilots understand the assumptions used in the design of procedures and the protections afforded by the procedures so as not to exceed them. The procedure design process involves the following concepts:

a. each instrument flight procedure is characterized by a sequence of segments based on surfaces or areas;

b. these areas or segments and their associated obstacle protection are designed in accordance with aircraft category and type of navigation facility; and

c. the areas or segments are assessed to find the highest obstacle within each area or segment.

The minimum obstacle clearance (MOC) applicable to each area or segment is added to the highest obstacle to calculate the minimum obstacle clearance altitudes for each area or segment.

1.4 Obstacle clearance is the primary safety consideration in developing instrument flight procedures, and because of variable factors such as terrain, aircraft characteristics and pilot ability, the detailed procedures are based on present standard equipment and practices. However, the obstacle clearance included in the specifications is considered to be the minimum which cannot be safely reduced.

1.5 Procedures contained in the PANS-OPS assume that all engines are operating. Development of contingency procedures is the responsibility of the operator.

1.6 The criteria in the PANS-OPS make use of standard conditions for aircraft characteristics. However, allowance is made in the criteria to deviate from these standard conditions when specific airspace or operational requirements apply.

1.7 Where example calculations are used, these assume an elevation of 2000 ft above mean sea level (MSL) and a temperature of international standard atmosphere (ISA) + 15°C.

1.8 For procedure design purposes where speeds are given in IAS and need to be converted to true airspeed (TAS), this conversion is achieved on the basis of the ISA where:

Atmospheric pressure	1013.2hPA
Temperature	+15°C
Temperature lapse rate	2°C / 1000 ft

1.9 All procedures depict tracks or bearings unless otherwise annotated. Pilots should attempt to therefore maintain the track or bearing by applying corrections to heading for known wind.

1.10 Navigation accuracy requirements in procedure design are normally omnidirectional, in that winds that have the most adverse effect are considered. Nevertheless, it is expected that pilots when flying an instrument flight procedure will always correct for the actual or estimated wind, except when being vectored.

1.11 Different assumed wind speed values are used in procedure design according to the phase of flight or segment of the procedure. Unless, site-specific, 95 per cent statistical values are available, the following assumed wind speed values are used:

Phase of flight	Winds used
Departure	30 kt omnidirectional for turns
En-route/initial approach segment	ICAO standard wind of (2 x altitude in feet/ 1000) + 47 kt
Holding	ICAO standard wind of (2 x altitude in feet/ 1000) + 47 kt
Final and missed approach segments	30 kt for turns

1.12 All published procedures use degrees magnetic.

1.13 ADDITIONAL CONSIDERATIONS FOR MOUNTAINOUS AREAS

When procedures are designed for use in mountainous areas, consideration is given to induced altimeter error and pilot control problems which result when winds of 37 km/h (20 kt) or more move over such areas. Where these conditions are known to exist, MOC may be increased by as much as 100 per cent.

2 BASIC DESIGN CONCEPTS

2.1 ACCURACY OF FIXES

2.1.1 General

2.1.1.1 Fixes and points used in designing instrument flight procedures are normally based on standard navigation systems.

2.1.1.2 Because all navigation facilities and waypoints have accuracy limitations, the geographic point which is identified is not precise but may be anywhere within an area called the fix tolerance area which surrounds the plotted location of the facility, waypoint or intersection. Figure A-2-1 illustrates the fix tolerance area formed by the intersection of two radials or tracks from different navigation facilities.

2.1.2 Fix tolerance factors

2.1.2.1 The dimensions of the fix tolerance area are determined by the system use accuracy of the navigation aid(s) on which the fix is based, and for conventional navigation aids, on the distance from the facility.

2.1.2.2 See Table A-2-1 for system use accuracies for conventional navigation aids and Table A-2-2 for the tolerances on which these values are based.

2.1.2.3 See 2.2.7 for fix tolerances when using performance-based navigation (PBN) systems.

2.1.3 Fix tolerance for other types of navigation systems

2.1.3.1 *Surveillance radar*. Radar fix tolerances are based on radar mapping accuracies, azimuth resolution, flight technical tolerance, controller technical tolerances, and the speed of aircraft in the terminal area. The fix tolerances are listed below:

a. terminal area surveillance radar (TAR) within 37 km (20 NM): fix tolerance is ±1.6 km (0.8 NM); and

b. en-route surveillance radar (RSR) within 74 km (40 NM): fix tolerance is ±3.2 km (1.7 NM).

2.1.3.2 *Distance measuring equipment (DME)*. Fix tolerance is ±0.46 km (0.25 NM) + 1.25 per cent of distance to the antenna.

2.1.3.3 *75 MHz marker beacon*. See Figure A-2-2 to determine the fix tolerance for instrument landing system (ILS) and “z” markers for use with instrument approach procedures.

Table A-2-1. System use accuracy (2 SD) of facility providing track guidance and facility not providing track guidance

	VOR[1]	***ILS***	***NDB***
System use accuracy of facility providing track	±5.2°	±2.4°	±6.9°
System use accuracy of facility NOT providing track	±4.5°	±1.4°	±6.2°

[1] The VOR values of ±5.2° and ±4.5° may be modified according to the value of a) in Table A-2-2, resulting from flight tests.

Table A-2-2. Tolerances on which system use accuracies are based

The values in Table A-2-1 are the result of a combination, on a root sum square basis, of the following tolerances:	*VOR*	*ILS*	*NDB*
a) Ground system tolerance	±3.6°	±1°[1]	±3°
b) Airborne receiving system tolerance	±2.7°	±1°	±5.4°
c) Flight technical tolerance[2]	±2.5°	±2°	±3°

[1] Includes beam bends.

[2] Flight technical tolerance is only applied to navigation aids providing track guidance. It is not applied to fix intersecting navigation aids.

2.2 PROTECTED AREAS

2.2.1 Primary and secondary areas

2.2.1.1 For each straight segment of the procedure an area is specified extending either side of the defined track. Normally the area is symmetrical on both sides of the intended track.

2.2.1.2 In general, this area is subdivided into primary and secondary areas. However, in some cases, primary areas only are specified. When secondary areas are specified, the outer half of each side of the area (normally 25 per cent of the total width) is designated as secondary area. (See Figure A-2-3.)

2.2.1.3 Full obstacle clearance is provided throughout the entire primary area, and in the secondary area, the obstacle clearance is reduced linearly from the full clearance at the inner edge to zero at the outer edge, as shown in Figure A-2-3.

2.2.2 Calculation of area widths – conventional navigation

2.2.2.1 The actual width of the area is determined by the phase of flight.

2.2.2.2 En-route areas-are constructed differently. See Part II, Section 3, Chapter 1 for details.

2.2.3 Standard arrival routes (STAR) of 46 km or longer (25 NM)

When the length of the arrival route is greater than or equal to 46 km (25 NM), en-route criteria apply prior to the 46 km (25 NM) distance to the initial approach fix (IAF). The area width decreases from 46 km (25 NM) with a convergence angle of 30° each side of the axis, until reaching the width determined by the initial approach criteria.

2.2.4 Arrival routes less than 46 km (25 NM)

When the length of the arrival route is less than 46 km (25 NM), the area width decreases from the beginning of the arrival route with a convergence angle of 30° each side of the axis, until reaching the width determined by the initial approach criteria.

2.2.5 Initial approach

The initial approach segment has no standard length. The length is that which is sufficient to permit the altitude change required by the procedure. The width is divided into:

a. a primary area which extends laterally 4.6 km (2.5 NM) on each side of the track; and

b. a secondary area which adds an additional 4.6 km (2.5 NM) on each side of the primary area.

2.2.6 Intermediate approach

In a straight-in approach, the width of the intermediate approach segment tapers from a maximum width of ±9.2 km (±5 NM) at the intermediate fix (IF) to its minimum width at the final approach fix (FAF) (or (FAP)). The segment is divided laterally as follows:

a. a primary area which extends laterally on each side of the track; and

b. a secondary area on each side of the primary area.

2.2.7 PBN fix tolerances and protected areas

2.2.7.1 The obstacle clearance area for PBN is based on the total system error (TSE) which is dependent upon position estimation error (PEE), path definition error (PDE), display error and flight technical error (FTE). The PBN protected areas are based upon calculations considering the following elements.

NOTE: For a description of error as related to performance-based navigation, see the Performance-based Navigation (PBN) Manual (Doc 9613).

2.2.7.1.1 Cross-track tolerance (XTT)

A fix tolerance measured perpendicularly to the nominal track resulting from the airborne and ground equipment tolerances and the flight technical error (FTE).

2.2.7.1.2 Along-track tolerance (ATT)

A fix tolerance measured along the nominal track resulting from the airborne and ground equipment tolerances. See Figure A-2-4 for graphical depiction of XTT and ATT.

2.2.7.1.3 The TSE is then used to define the XTT and ATT values as follows:

a. XTT = TSE

b. ATT = 0.8*TSE

2.2.7.2 For PBN procedures, the width of the area is defined based on the required navigation performance (RNP) navigation accuracy requirement of the associated navigation specification, plus a buffer value (see 2.2.7.3).

2.2.7.2.1 Specifically, the semi-width (½ A/W) of the area is:

½ A/W = 1.5 x RNP navigation accuracy requirement + buffer value

2.2.7.2.2 Since the required accuracy figures are constant, there is no splay associated with the area width of a PBN route or procedure segment.

2.2.7.2.3 Figure A-2-5 shows an example of the area associated with a PBN procedure based on:

a. RNP 1 navigation specification; and
b. STAR route between 56 km (30 NM) and 28 km (15 NM) from the aerodrome reference point (ARP).

This results in a ½ A/W of (1.5 x 1) + 1 = 2.5 NM.

2.2.7.2.4 The ½ A/W value calculated in this way is used in all PBN procedures except RNP AR procedures and final approach segments (FAS) of RNP APCH procedures based on the use of satellite-based augmentation system (SBAS) (SBAS approach procedure with vertical guidance (APV)-I, SBAS CAT I and SBAS non-precision approach (NPA)). The buffer value is based on aircraft characteristics (speed, manoeuvrability, etc.) and the phase of flight and is used to address blunder errors beyond a 3 standard deviation value. Buffer values do not apply to the FAS of approach procedures based on the use of SBAS.

2.2.7.3 *Buffer values*. Buffer values for phase of flight are presented in Table A-2-3.

NOTE: Helicopter only procedures use different buffer values.

Table A-2-3. Buffer values (BV) for phase of flight

Phase of flights	En-route	Terminal	FAS	Missed approach
Application	Standard instrument departures (SIDs) and STARs greater than or equal to 56 km (30 NM) from departure or destination ARP	STARS, initial and intermediate segments less than 56 km (30 NM) from ARP and SIDs and missed approach segments less than 56 km (30 NM) from ARP but more than 28 km (15 NM) from ARP	-	Missed approach segments and SIDs up to 28 km (15 NM) from the ARP
BV for CAT A - E	3704 m (2.0 NM)	1852 m (1.0 NM)	926 m (0.5 NM)	926 m (0.5 NM)

2.2.7.4 *XTT and ½ A/W values for phases of flight*. For PBN operations, values of XTT are assigned based on the phase of flight and the applicable navigation specifications to that phase of flight. Tables A-2-4 and A-2-7 present the XTT values for the phase of flight and applicable navigation specifications. A blank (—) cell in the table indicates the navigation specification is not applicable to that phase of flight. Tables A-2-5 and A-2-8 depict the ½ A/W values for the various flight phases and applicable navigation specifications.

NOTE: The identification of applicable navigation specifications for a given phase of flight can be found in Doc 9613, Table II-A-1-1.

Table A-2-4. Navigation specification and phase of flight XTT fix tolerances (NM)

Navigation specification	Phase of flight					
	En-route/SID/STAR (≥30 NM from ARP)	STAR/IF/IAF/SID/ missed approach (<30 NM from ARP)	FAF	MAPt	Missed approach (<15 NM ARP)	SID (<15 NM ARP)
RNAV 1/ RNAV 2[1]	2.00	1.00	—	—	1.00	1.00
RNP 2	2.00	—	—	—	—	—
RNP 1	1.00 (SID/STAR)	1.00	—	—	1.00	1.00
RNP APCH	—	1.00	0.3[2]/0.0216[3]	0.3[2]/0.0216[3]	1.00	—
A-RNP[4]	2.00 or 1.00	1.00	0.3	0.3	1.00	1.00
RNP 0.3[5]	0.30	0.30	—	—	0.30	0.30

[1] RNAV 2 is intended for use outside of the terminal control area (TMA), and RNAV 1 for TMA applications.

[2] RNP APCH Section A (LNAV/VNAV) only.

[3] RNP APCH Section B (LP/LPV) only.

[4] A-RNP permits a range of scalable navigation accuracy requirements, as detailed in Doc 9613. However, PANS-OPS, Volume II, contains only criteria for 1 NM accuracy values, so for consistency this is the only value presented here.

[5] Intended for helicopter operations only.

Table A-2-5. Navigation specification and phase of flight ½ A/W (NM)

Navigation specification	Phase of flight					
	En-route/SID/STAR (≥30 NM from ARP)	STAR/IF/IAF/SID/missed approach (<30 NM from ARP)	FAF	MAPt	Missed approach (<15 NM ARP)	SID (<15 NM ARP)
RNAV 1/ RNAV 2[1]	5.00	2.50	—	—	2.00	2.00
RNP 2	5.00	—	—	—	—	—
RNP 1	3.50 (SID/STAR)	2.50	—	—	2.00	2.00
RNP APCH	—	2.50 (IF/IAF/missed approach only)	1.45[2]/N/A[3]	0.95[2]/N/A[3]	2.00	—
A-RNP[4]	5.00 or 3.50	2.50	1.45	0.95	2.00	2.00
RNP 0.3[5]	1.45	1.15	—	—	0.80	0.80

[1] RNAV 2 is intended for use outside of the TMA, and RNAV 1 for TMA applications.

[2] RNP APCH Section A (LNAV/VNAV) only.

[3] RNP APCH Section B (LP/LPV) only.

[4] A-RNP permits a range of scalable navigation accuracy requirements, as detailed in Doc 9613. However, PANS-OPS, Volume II, contains only criteria for 1 NM accuracy values, so for consistency this is the only value presented here.

[5] Intended for helicopter operations only.

2.2.7.4.1 RNAV 1 criteria are used for SIDs and STARs that can be supported by either global navigation satellite system (GNSS) or DME/DME infrastructure.

2.2.7.4.2 RNP 1 criteria are used for SIDs and STARs using GNSS as the primary navigation sensor.

2.2.7.4.3 RNP APCH criteria are divided into two sections. Section A criteria, which are used for RNAV (GNSS) instrument approach procedures, are applied only within 56 km (30 NM) of the destination ARP. Outside this distance either RNAV 1 or RNP 1 criteria are used unless otherwise specified. For Section A criteria, the XTT at both the FAF and MAPt is 556 m (0.3 NM). Additionally, Section A ½ A/W criteria taper from ±2685 m (1.45 NM) at the FAF to ±1759 m (0.95 NM) at the MAPt.

2.2.7.4.4 Criteria associated with RNP APCH Section B are applicable to approach procedures based on the use of SBAS. Section B criteria capture the benefits of angular guidance on the FAS. The XTT value at the FAF and MAPt is 40.0 m. The final approach ½ A/W values at the FAF are dependent on the length of the FAS.

2.2.7.4.5 *Area width for CAT H.* Because of the flight characteristics of helicopters there are slight reductions in the ½ A/W values for arrival, approach and departure phases of flight when certain navigation specifications are used to design the procedure. The reduction is in the buffer values used to calculate the ½ A/W:

a. for en-route and SIDs/STARs >56 km (30 NM) from the ARP, the buffer value is 1852 m (1.0 NM);

b. in the TMA the buffer value is 1296 m (0.7 NM); and

c. for the final segment the buffer value is 648 m (0.35 NM).

2.2.7.4.6 Tables A-2-6 and A-2-9 identify ½ A/W values for CAT H that are different from those depicted in Table A-2-5.

Table A-2-6. Navigation specification and phase of flight ½ A/W (NM) (CAT H)

Navigation specification	Phase of flight					
	En-route/SID/STAR (≥30 NM from ARP)	STAR/IF/IAF/SID/missed approach (<30 NM from ARP)	FAF	MAPt	Missed approach (<15 NM ARP)	SID (<15 NM ARP)
RNAV 1/ RNAV 2[1]	4.00	2.20	—	—	1.85	1.85
RNP 1	2.50 (SID/STAR)	2.20	—	—	1.85	1.85
RNP APCH	—	2.20 (IF/IAF/missed approach only)	1.15[2]/N/A[3]	0.80[2]/N/A[3]	1.85	—

[1] RNAV 2 is intended for use outside of the TMA and RNAV 1 for TMA applications.

[2] RNP APCH Section A (LNAV/VNAV) only.

[3] RNP APCH Section B (LP/LPV) only.

Table A-2-7. Navigation specification and phase of flight XTT fix tolerances (m)

Navigation specification	Phase of flight					
	En-route/SID/STAR (≥56 km from ARP)	STAR/IF/IAF/SID/missed approach (<56 km from ARP)	FAF	MAPt	Missed approach (<28 km ARP)	SID (<28 km ARP)
RNAV 1/ RNAV 2[1]	3704	1852	—	—	1852	1852
RNP 2	3704	—	—	—	—	—

Table A-2-7. Navigation specification and phase of flight XTT fix tolerances (m) (continued)

Navigation specification	Phase of flight					
	En-route/SID/STAR (≥56 km from ARP)	**STAR/IF/IAF/SID/ missed approach (<56 km from ARP)**	**FAF**	**MAPt**	**Missed approach (<28 km ARP)**	**SID (<28 km ARP)**
RNP 1	1852 (SID/STAR)	1852	—	—	1852	1852
RNP APCH	—	1852	556[2]/40 m[3]	556[2]/40 m[3]	1852	—
A-RNP[4]	3704 or 1852	1852	556	556	1852	1852
RNP 0.3[5]	556	556	—	—	556	556

[1] RNAV 2 is intended for use outside of the TMA, and RNAV 1 for TMA applications.

[2] RNP APCH Section A (LNAV/VNAV) only.

[3] RNP APCH Section B (LP/LPV) only.

[4] A-RNP permits a range of scalable navigation accuracy requirements, as detailed in Doc 9613. However, PANS-OPS, Volume II, contains only criteria for 1 NM accuracy values so for consistency this is the only value presented here.

[5] Intended for helicopter operations only.

Table A-2-8. Navigation specification and phase of flight ½ A/W (m)

Navigation specification	Phase of flight					
	En-route/SID/STAR (≥56 NM from ARP)	**STAR/IF/IAF/SID/ missed approach (<56 NM from ARP)**	**FAF**	**MAPt**	**Missed approach (<28 NM ARP)**	**SID (<28 NM ARP)**
RNAV 1/ RNAV 2[1]	9260	4630	—	—	3704	3704
RNP 2	9260	—	—	—	—	—
RNP 1	6482 (SID/STAR)	4630	—	—	3704	3704
RNP APCH	—	4630 (IF/IAF/missed approach only)	2685[2]/N/A[3]	1759[2]/N/A[3]	3704	—

Table A-2-8. Navigation specification and phase of flight ½ A/W (m) (continued)

Navigation specification	Phase of flight					
	En-route/SID/STAR (≥56 NM from ARP)	STAR/IF/IAF/SID/missed approach (<56 NM from ARP)	FAF	MAPt	Missed approach (<28 NM ARP)	SID (<28 NM ARP)
A-RNP[4]	9260 or 6482	4630	2685	1759	3704	3704
RNP 0.3[5]	2685	2130	—	—	1482	1482

[1] RNAV 2 is intended for use outside of the TMA, and RNAV 1 for TMA applications.

[2] RNP APCH Section A (LNAV/VNAV) only.

[3] RNP APCH Section B (LP/LPV) only.

[4] A-RNP permits a range of scalable navigation accuracy requirements, as detailed in Doc 9613. However, PANS-OPS, Volume II, contains only criteria for 1 NM accuracy values so for consistency this is the only value presented here.

[5] Intended for helicopter operations only.

Table A-2-9. Navigation specification and phase of flight ½ A/W (m) (CAT H)

Navigation specification	Phase of flight					
	En-route/SID/STAR (≥56 km from ARP)	STAR/IF/IAF/SID/missed approach (<56 km from ARP)	FAF	MAPt	Missed approach (<28 km ARP)	SID (<28 km ARP)
RNAV 1/ RNAV 2[1]	7400	4074	—	—	3426	3426
RNP 1	4630 (SID/STAR)	4074	—	—	3426	3426
RNP APCH	—	4074 (IF/IAF/missed approach only)	2130[2]/ N/A[3]	1482[2]/ N/A[3]	3426	—

[1] RNAV 2 is intended for use outside of the TMA, and RNAV 1 for TMA applications.

[2] RNP APCH Section A (LNAV/VNAV) only.

[3] RNP APCH Section B (LP/LPV) only.

2.3 TURN AREA CONSTRUCTION

2.3.1 General

A turning point may be specified in any of three ways. (See Part II, Section 1, 1.5 for a description.)

2.3.2 Turn parameters

The turn area is defined by a number of parameters, these include:

a. altitude;

b. indicated airspeed (IAS);

c. wind;

d. bank angle (α);

e. flight technical tolerances;

f. fix tolerance (see section 1 of this appendix); and

g. rate of turn (R) in degrees/second.

2.3.3 Calculation of the protection area for turns

2.3.3.1 As with any turning manoeuvre, speed is a controlling factor in determining the aircraft track during the turn.

2.3.3.1.1 Inner boundary

The inner boundary caters for the slowest aircraft. It starts at the earliest fix tolerance of the turning point and splays outward at an angle of 15° relative to the nominal track.

2.3.3.1.2 Outer boundary

The outer boundary of the turning area is based on the highest speed of the category for which the procedure is authorized.

2.3.3.1.3 The protection area starts at a point which is determined by the latest fix tolerance and discussion of FTE.

2.3.3.1.4 There are two methods for constructing the curving portion of the outer boundary.

2.3.3.1.4.1 *Wind spirals*. In the wind spiral method, the area is based on a radius of turn (r) calculated for a specific value of TAS and bank angle. The outer boundary of the tum area is constructed using a spiral derived from the still air radius (r). The resultant spiral is created from applying wind effect for the time taken to change heading by the specified amount for the turn.

2.3.3.1.4.2 *Bounding circles*. As an alternative to the wind spiral, a simplified method can be used in which circles are drawn to bound the turning area. Unlike the wind spiral method, the wind effect used here is always that of a course change of 90°. The area so constructed is larger and therefore, more conservative.

2.3.3.2 Where no track guidance is provided during a turn specified by the procedure, the total width of the area is considered primary area.

2.4 PERFORMANCE-BASED NAVIGATION – PATH TERMINATORS

2.4.1 General

2.4.1.1 All data used by a navigation system for PBN that is certified for terminal operations are held in a navigation database. These databases are derived from data that is coded in accordance with the aviation industry standard: ARINC 424 — *Navigation System Database Specification*, or an equivalent industry standard.

2.4.1.2 In order to achieve the translation of the textual description of a procedure, and the routes depicted on the charts into a code suitable for navigation systems, the aviation industry has developed the “path and termination” concept for terminal procedures.

2.4.1.3 The path terminators are described in detail in PANS-OPS, Volume II, Part III, Section 2, Chapter 5. They are used to define specific ground tracks on the assumption that aircraft approved to fly PBN procedures have the capability to maintain consistent tracks based upon the use of appropriate ARINC 424 path terminators or their equivalent.

2.4.1.4 Path terminators define each segment of a PBN route from take-off until the en-route segment is joined, and from the point where the aircraft leaves the en-route segment until the end of the PBN procedure(s).

2.4.1.5 Path terminators are not used to construct en-route segments or other routes outside terminal airspace.

2.4.1.6 Many aircraft are equipped with systems that are only capable of using a subset of the available ARINC 424 path terminators.

2.4.2 Path and terminator combinations

2.4.2.1 Each segment of the procedure is identified by a two-letter code which denotes the path and terminator for the segment. These codes are shown in Table A-2-10.

Table A-2-10. Path and terminator codes

Path	Code	Terminator	Code
Course to	C	Altitude	A
Direct track	D	Fix	F
Fix to	F	Intercept	I
Hold	H	Manual termination	M
Initial	I		
Constant radius	R		
Track between	T		
Heading to	V		

2.4.2.2 Combining these two elements creates a set of leg types for use in procedure design. For example, a CA leg is one where a specified course (C) is followed until reaching a defined altitude (A).

2.4.2.3 The minimum PBN leg type requirements for each navigation specification can be found in Doc 9613.

Figure A-2-1. Example of a fix tolerance area

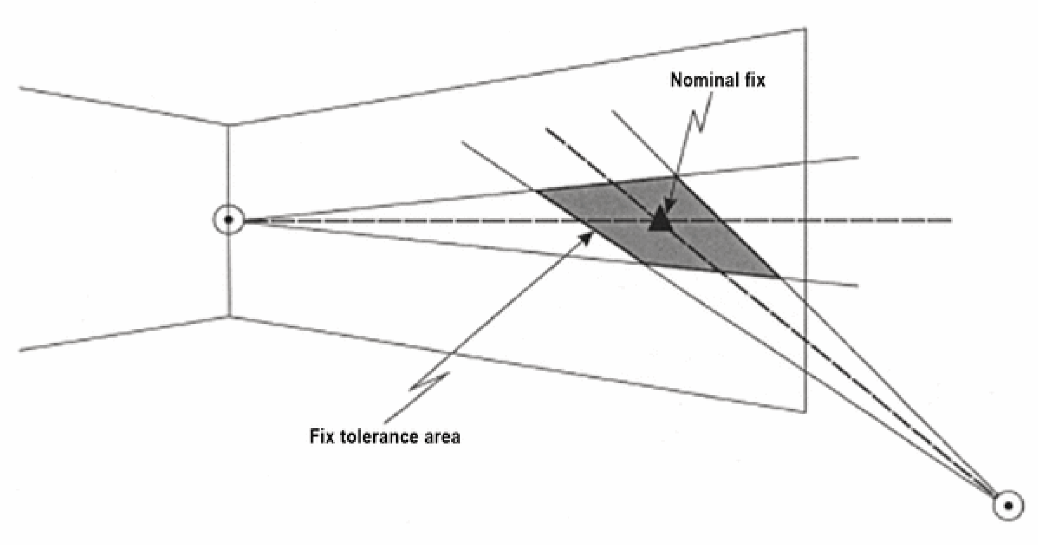
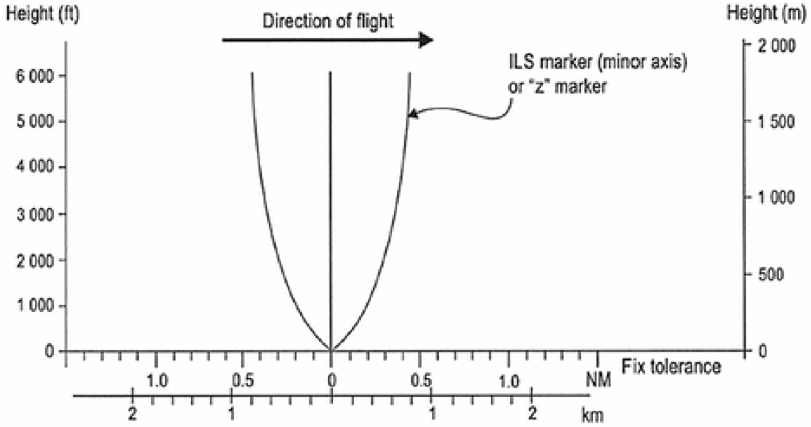


Figure A-2-2. ILS or “z” marker coverage



Note.—This figure is based on the use of modern aircraft antenna systems with a receiver sensitivity setting of 1 000 µV up to 1 800 m (5 905 ft) above the facility.

NOTE: This figure is based on the use of modern aircraft antenna systems with a receiver sensitivity setting of 1000 µV up to 1800 m (5905 ft) above the facility.

Figure A-2-3. Primary and secondary areas of a segment

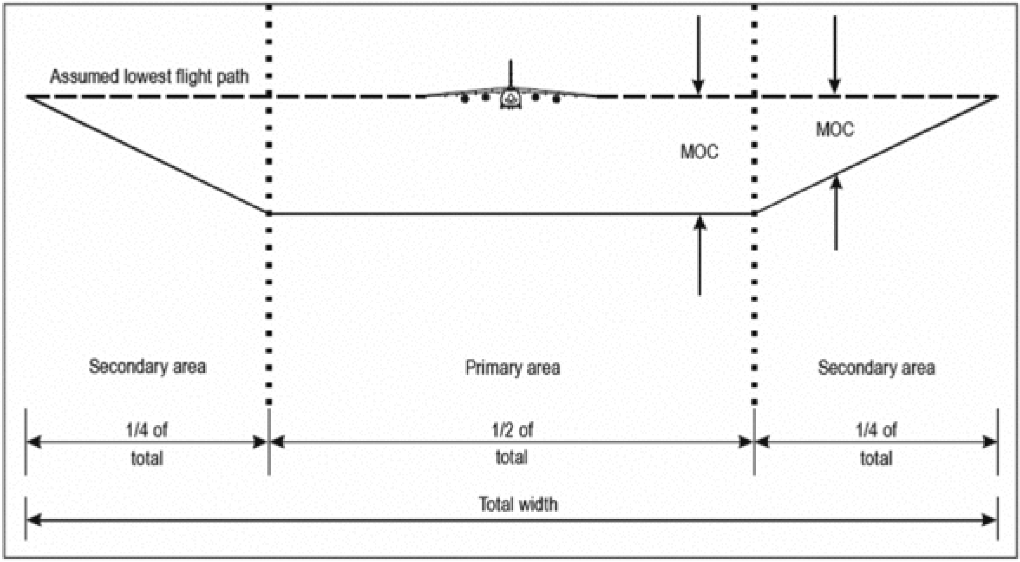


Figure A-2-4. Orientation of ATT and XTT relative to the intended flight path

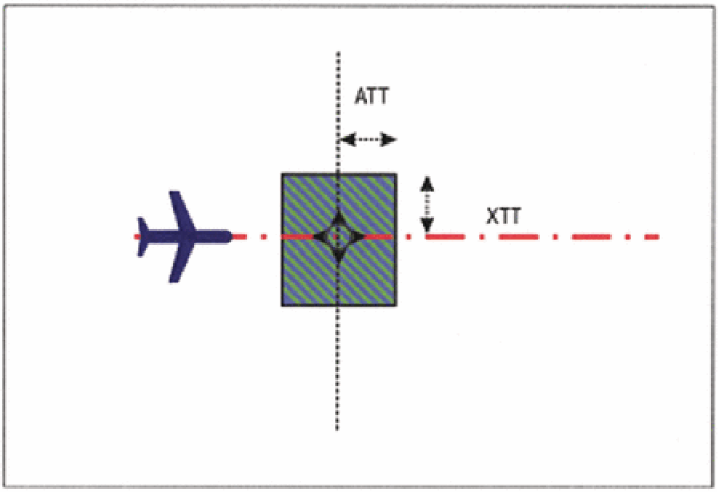
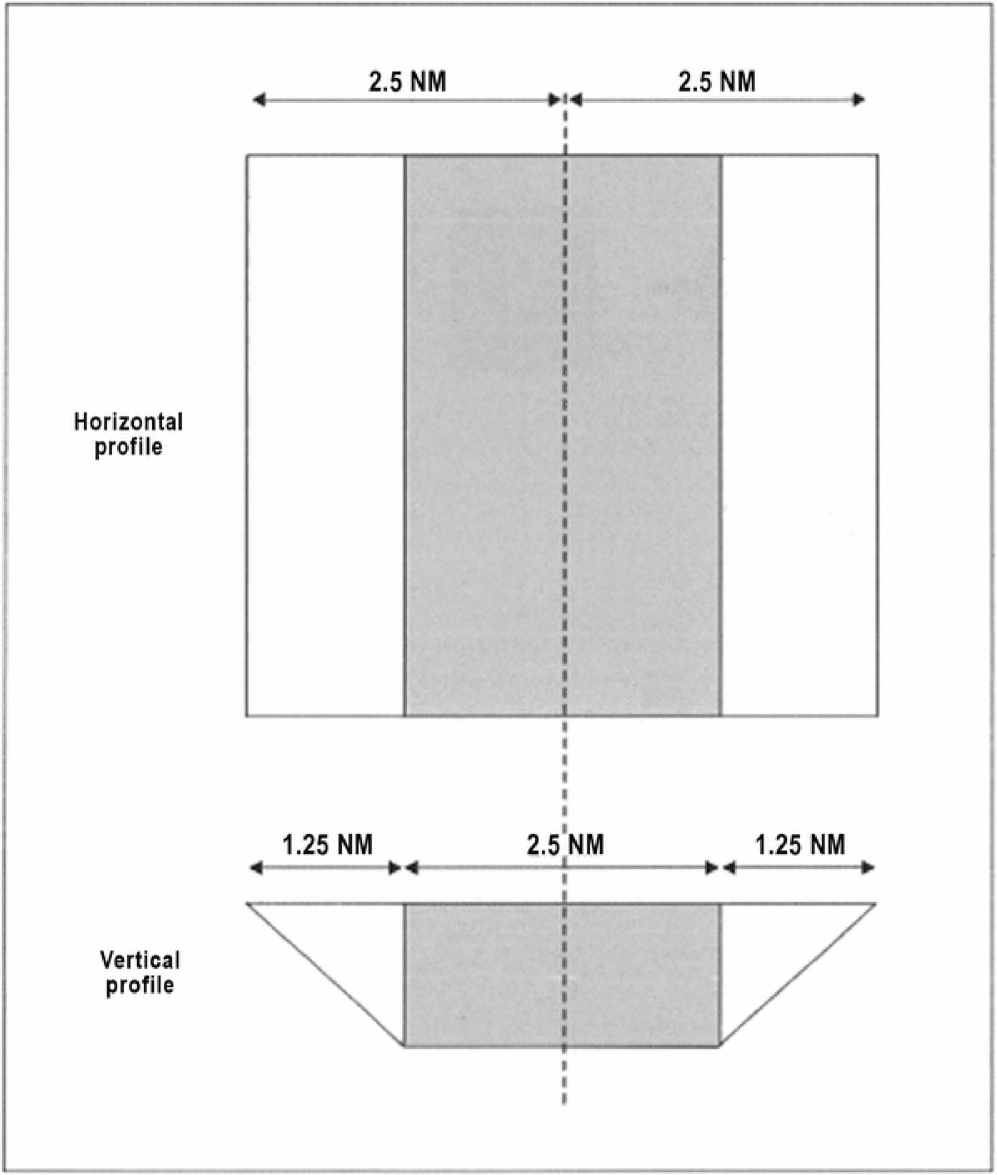


Figure A-2-5. Area width for an RNP 1 STAR between 15 NM and 30 NM from the ARP



3 FLIGHT PHASE SPECIFIC PRINCIPLES

3.1 DEPARTURE PROCEDURES

3.1.1 Procedure design gradient (PDG)

3.1.1.1 The PDG is used by the procedure designer to identify critical obstacles in the departure and to specify a minimum climb gradient for the procedure. The departure route may be adjusted to minimize the PDG consistent with other constraints.

3.1.1.2 Unless otherwise published, a PDG of 3.3 per cent (5.0 per cent for CAT H) is assumed.

3.1.1.3 The PDG is based on:

a. an obstacle identification surface (OIS) having a 2.5 per cent gradient (4.2 per cent for CAT H) or a gradient determined by the most critical obstacle penetrating the surface, whichever is the higher; and

b. an additional margin of 0.8 per cent.

3.1.1.4 For conversion of climb gradients to rates of climb for operational use, see Part II, Section 2, Chapter 1, Figure II-2-1-2.

3.1.2 Obstacle clearance

3.1.2.1 For other than turning departures and CAT H point-in-space (PinS) departures, the MOC provided by the procedure is determined as a factor of the distance from the departure end of the runway (DER).

3.1.2.2 A figure of 0.8 per cent of this distance is used to calculate the MOC. Some example values are shown in Tables A-3-1 and A-3-2.

Table A-3-1. Departure MOC for given distance from DER

Distance from DER (NM)	Distance from DER (ft)	MOC (ft)
0	0	0
1	6076	49
2	12152	97
3	18228	146
4	24304	194
5	30380	243
10	60760	486
21	127596	1021

Table A-3-2. Departure MOC for given distance from DER (SI Units)

Distance from DER (km)	MOC (m)
0	0
2	16
4	32
6	48
8	64
10	80
20	160
40	320

1.2.3 The MOC in a turning departure is a fixed value of 75 m (246 ft) (for CAT H, 65 m (213 ft)).

1.2.4 CAT H PinS departures are based on visual or visual flight rules (VFR) flight to the initial departure fix (IDF), so no MOC is provided in this segment. For “proceed visually,“ PinS departures, the visual segment design gradient (VSDG) is established to provide a MOC of 30 m at the IDF. The MOC continues to expand with distance.

3.2 EN-ROUTE

3.2.1 GENERAL

3.2.1.1 Two methods can be used to determine en-route obstacle clearance areas:

a. a simplified method, which is the standard method; and

b. a refined method, which can be used when the simplified method is too constraining.

3.2.1.2 Obstacle clearance areas

In the simplified method, the obstacle clearance area is divided into a central primary area and two lateral buffer areas, which use half the MOC value. In the refined method, the obstacle clearance area is divided into a central primary area and two lateral secondary areas, which use the progressively reducing MOC. The width of the primary area corresponds to 95 per cent probability of containment (2 SD). The total width of the area corresponds to 99.7 per cent probability of containment (3 SD).

3.2.1.3 Reductions to secondary area widths

Secondary areas for en-route operations may be reduced when justified by factors such as:

a. relevant information on flight operational experience;

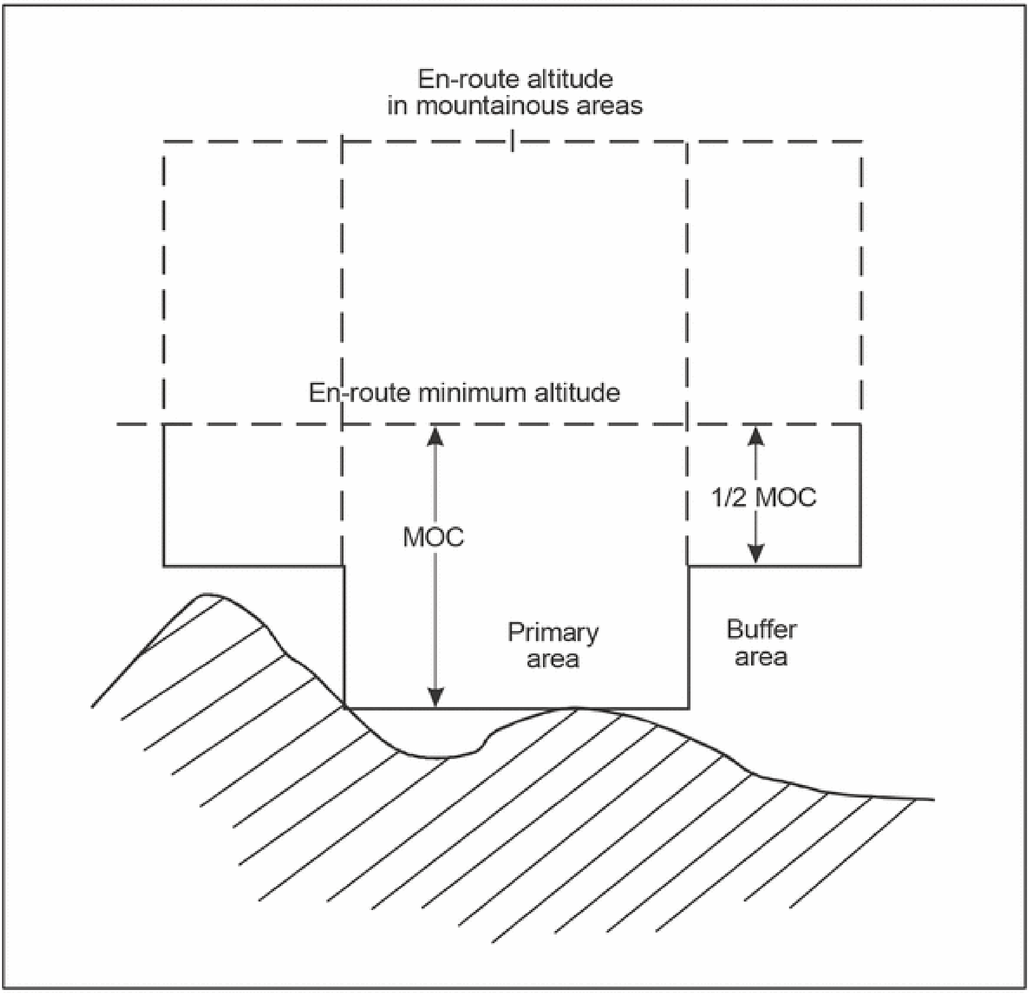
b. regular flight inspection of facilities to ensure better than standard signals; and/or

c. surveillance.

3.2.1.4 Minimum obstacle clearance (MOC)

3.2.1.4.1 The MOC value to be applied in the primary area for the en-route phase of an instrument flight rules (IFR) flight is 300 m (984 ft). (See 3.2.4 for MOC in mountainous areas). In the buffer area, the MOC is equal to half the value of the primary area MOC (see Figure A-3-0). In secondary areas the MOC progressively reduces to zero at the outer edge.

Figure A-3-0. En-route MOC – Primary and buffer areas



3.2.1.4.2 A minimum obstacle clearance altitude (MOCA) is determined and published for each segment of the route. The MOCA provides the required MOC above obstacles contained inside the obstacle clearance areas.

3.2.2 En-route clearance areas – conventional routes

3.2.2.1 Area without track guidance

When track guidance is not provided, for example, outside the coverage of navigation facilities along the route, the primary area splays at an angle of 15° from its width at the last point where track guidance was available. The width of the buffer area (simplified method) or the secondary area (refined method) is progressively reduced to zero, ending in an area without track guidance where the full MOC is applied.

3.2.2.2 Area width

3.2.2.2.1 Abeam the facility, the total area has a constant width of 18.5 km (10.0 NM), which is comprised of the primary area and a buffer area. The primary area maintains a constant width of 9.3 km (5.0 NM) on either side of the nominal track.The buffer area also maintains a constant width of 9.3 km (5.0 NM) with half of this area on either side of the primary area.

3.2.2.2.2 When the distance from the facility increases beyond:

a. 92.3 km (49.8 NM) for very high frequency omnidirectional radio range (VOR); and

b. 60 km (32 NM) for non-directional beacon (NDB),

the widths of the primary and buffer areas are increased by an angle of splay which is determined by the type of facility. The angle of splay is depicted in Table A-3-3.

Table A-3-3. Angle of splay for en-route navigation aids

	Primary area	Buffer area
VOR	5.7°	9.1°
NDB	7.95°	13.0°

NOTE: The area widths and splay angles outlined in 3.2.2.2.1 and 3.2.2.2.2 apply to the simplified method. For the refined method, the VOR widths are 2 NM less and angles for both VOR and NDB are slightly larger.

3.2.2.2.3 The buffer area is further increased by an additional fixed width on the outside of the buffer area, parallel to its edge. This width is:

a. 3.7 km (2.0 NM) for VOR; and

b. 4.6 km (2.5 NM) for NDB.

3.2.3 En-route clearance areas – PBN routes

3.2.3.1 En-route oceanic and remote areas. The applicable navigation specifications are:

a. RNAV 10;

b. RNP 4;

c. RNP 2;

d. A-RNP.

3.2.3.2 The clearance area ½ A/W established by the formula:

½ A/W = 1.5 x navigation specification navigation accuracy requirement + en-route buffer value of 2 NM.

NOTE: In some cases, such as RNAV 5, a smaller value than the required accuracy of the navigation specification is used, depending on the nature of the errors and the integrity monitoring alarm limit of the system.

3.2.3.3 Table A-3-4 presents the applicable navigation accuracy requirements and clearance ½ A/W.

Table A-3-4. En-route oceanic/remote ½ A/W

Navigation specification	Accuracy requirement (NM)	½ A/W (NM)
RNAV 10	10	17
RNP 4	4	8
RNP 2	2	5

3.2.3.4 En-route continental areas. The applicable navigation specifications are:

a. RNAV 5;

b. RNAV 2;

c. RNP 2;

d. A-RNP;

e. RNP 0.3.

3.2.3.5 Table A-3-5 depicts the en-route continental clearance area ½ A/W for area navigation routes.

Table A-3-5. En-route continental ½ A/W

Navigation specification	Accuracy requirement (NM)	½ A/W (NM)
RNAV 5	5	5.77[1]
RNAV 2 (GNSS)	2	5
RNAV 2 (DME/DME)	2	4.26

Table A-3-5. En-route continental ½ A/W (continued)

Navigation specification	Accuracy requirement (NM)	½ A/W (NM)
RNP 2	2	5
RNP 0.3	0.3	1.45

[1] This figure is calculated using 2.51 NM instead of 5 NM.

3.2.4 MOC in mountainous areas

3.2.4.1 In mountainous areas, the MOC is increased, depending on variation in terrain elevation as shown in the Table A-3-6.

Table A-3-6. MOC in mountainous areas

Elevation	MOC
Between 900 m (3000 ft) and 1500 m (5000 ft)	450 m (1476 ft)
Greater than 1500 m (5000 ft)	600 m (1969 ft)

3.2.4.2 Mountainous areas are identified by the State and promulgated in the State Aeronautical Information Publication.

3.3 ARRIVAL AND APPROACH PROCEDURES

3.3.1 Categories of aircraft

3.3.1.1 Aircraft performance has a direct effect on the airspace required for the various manoeuvres associated with the conduct of instrument approach procedures. The most significant performance factor is aircraft speed.

3.3.1.2 Accordingly, categories of typical aircraft have been established. These categories provide a standardized basis for relating aircraft manoeuvrability to specific instrument approach procedures. For precision approach procedures, the dimensions of the aircraft ate also a factor for the calculation of the obstacle clearance height (OCH). For Category DL aircraft, an additional obstacle clearance altitude/height (OCA/H) is provided, when necessary, to take into account the specific dimensions of these aircraft.

3.3.1.3 The criterion taken into consideration for the classification of aeroplanes by categories is the indicated airspeed at threshold (V_{at}), which is equal to the stall speed V_{so} multiplied by 1.3, or stall speed V_{s1g} multiplied by 1.23 in the landing configuration at the maximum certificated landing mass. If both V_{so} and V_{s1g} are available, the higher resulting V_{at} shall be applied.

3.3.1.4 The landing configuration that is to be taken into consideration is defined by the operator or by the aircraft manufacturer.

3.3.1.5 Aircraft categories are listed in Part II, Section 5, Chapter 1.

3.3.1.6 The instrument approach chart (IAC) will specify the individual categories of aircraft for which the procedure is approved. Normally, procedures will be designed to provide protected airspace and obstacle clearance for aircraft up to and including Category D. However, where airspace requirements are critical, procedures may be restricted to lower speed categories.

3.3.1.7 Alternatively, the procedure may specify a maximum IAS for a particular segment. In any case, it is essential that pilots comply with the procedures and information depicted on instrument flight charts and the appropriate flight parameters shown in Tables II-5-1-1 and II-5-1-2 if the aircraft is to remain in the areas developed for obstacle clearance purposes.

3.3.1.8 Helicopters

3.3.1.8.1 The stall speed method of calculating aircraft category does not apply to helicopters. Pilots flying helicopters may utilize instrument approach procedures promulgated for Category A aeroplanes. However, specific procedures may be developed for helicopters, and these shall be clearly designated “CAT H”. Category H procedures shall not be promulgated on the same IAC as joint helicopter/aeroplane procedures.

3.3.1.8.2 It is intended that helicopter only procedures should be designed using the same conventional techniques and practices as those pertaining to Category A aeroplanes. Some criteria such as minimum airspeeds and descent gradients may be different, but the principles are the same. For CAT H procedures, the maximum speed to be used on the final approach and missed approach segments is charted.

3.3.2 Descent gradient

3.3.2.1 In instrument approach procedure design, adequate space is allowed for descent from the facility, fix or waypoint crossing altitude/height to the runway threshold for straight-in approach or to OCA/H for circling approaches.

3.3.2.2 Adequate space for descent is provided by establishing a maximum allowable descent gradient for each - segment of the procedure. The optimum descent gradient/angle in the FAS of a procedure with FAF is 5.2 per cent/3.0° (52 m/km (318 ft/NM)).

3.3.2.3 Where a steeper descent gradient is necessary, the maximum permissible is:

a. 6.5 per cent/3.7° (65 m/km (395 ft/NM)) for Category A and B aircraft;

b. 6.1 per cent/3.5° (61 m/km (370 ft/NM)) for Category C, D and E aircraft, and

c. 10 per cent (5.7°) for Category H.

3.3.2.4 For procedures with VOR or NDB on aerodrome and no FAF, rates of descent in the final approach phase are given in Table A-3-7. In the case of a precision approach, the operationally preferred glide path angle is 3.0° as specified in Annex 10, Volume I.

3.3.2.5 For ILS, the minimum descent gradient is 2.5°.

Table A-3-7. Rate of descent in the FAS of a procedure with no FAF

Aircraft categories	Rate of descent	
	Minimum	Maximum
A, B	2 m/s (394 ft/min)	3.33 m/s (655 ft/min)
C, D, E	3 m/s (590 ft/min)	5.08 m/s (1000 ft/min)

3.3.3 RNP APCH “Y“ and “T“ bar construction

3.3.3.1 *Offset IAFs*. Offset IAFs in procedures based on the “Y” or “T” bar design concept for RNP APCH procedures are aligned such that a course change of 70° to 90° is required at the IF. A capture region is associated with each IAF of the RNP APCH procedure from which the aircraft will enter the procedure. The capture region for tracks inbound to the offset IAFs extends 180° about the IAFs, thus providing a Sector 3 entry in cases where the track change at the IF is 70°. The central IAF is aligned with the intermediate segment, the angle being identical to the track change at the IF for the corresponding offset IAF. In this way, there are no gaps between the capture regions of all IAFs regardless of the course change at the IF. Its capture region is 70° to 90° either side of the final track. For turns greater than 110° at the IAFs, Sector 1 or 2 entries should be used.

3.3.3.2 The initial approach segments have no maximum length. The optimum length is 9.3 km (5.0 NM). The minimum segment length is established by using the highest initial approach speed of the fastest category of aircraft for which the approach is designed and the minimum distance between waypoints required by the aircraft avionics in order to correctly sequence the waypoints.

3.3.4 Minimum obstacle clearance (MOC)

3.3.4.1 Minimum sector altitudes (MSAs)

3.3.4.1.1 MSAs are established for each aerodrome where instrument approach procedures have been established. Each MSA is calculated by:

a. taking the highest elevation in the sector concerned;
b. adding a clearance of at least 300 m (984 ft); and
c. rounding the resulting value up to-the next higher 50 m or 100 ft increment, as appropriate.

3.3.4.1.2 If the difference between sector altitudes is insignificant (i.e. in the order of 100 m or 300 ft as appropriate) a minimum altitude applicable to all sectors may be established.

3.3.4.1.3 A minimum altitude shall apply within a radius of 46 km (25 NM) of the significant point, the ARP, or the heliport reference point (HRP) on which the instrument approach is based. The MOC when flying over mountainous areas should be increased by as much as 300 m (984 ft).

3.3.4.1.4 Obstacles within a buffer zone of 9 km (5 NM) around the boundaries of any given sector shall be considered as well.

3.3.4.2 Initial and intermediate segments

3.3.4.2.1 MOC for the initial segment of an approach is 300 m (984 ft).

3.3.4.2.2 MOC for the intermediate segment of an approach is 150 m (492 ft). The altitudes/heights selected by application of the obstacle clearance specified shall be rounded upwards to the next 50 m or 100 ft, as appropriate.

3.3.4.3 Non-precision approaches (NPAs)

3.3.4.3.1 For an NPA with a FAF, a minimum of 75 m (246 ft) clearance is provided.

3.3.4.3.2 For an NPA without a FAF this figure is increased to 90 m (295 ft).

3.3.4.4 Approach with vertical guidance (APV) approaches

3.3.4.4.1 *General*. APV approaches are 3D approach operations. Criteria for these procedures support stabilized flight on FAS. APV procedures are based on equipment that does not meet the requirements for precision approaches.

3.3.4.4.2 *Obstacle clearance criteria*. There are two different sets of criteria used for APV procedure design (APV/barometric vertical navigation (baro-VNAV) and SBAS APV-I criteria). Each set of criteria was prepared to address a specific section of the RNP APCH navigation specification, as described in Doc 9613.

3.3.4.4.2.1 APV/baro-VNAV criteria are designed to address procedure construction in accordance with Doc 9613, specifically Section A of the RNP APCH navigation specification, coupled with baro-VNAV vertical guidance as described in Attachment A of Doc 9613.

3.3.4.4.2.2 SBAS APV-I criteria were developed to meet the requirements of Section B of the RNP APCH navigation specification.

3.3.4.4.3 *Criteria differences*. Procedure construction for Section A procedures provides obstacle protection within a maximum-to-minimum temperature band published on the approach chart. The use of a remote altimeter setting source is not permitted with LNAV/VNAV procedures utilizing baro-VNAV vertical guidance. Procedure construction is based on the linear navigation guidance provide by GNSS/baro-VNAV equipment.

3.3.4.4.3.1 Procedure construction for Section B procedures utilizes criteria that cater to the angular lateral and vertical guidance on the FAS provided by SBAS equipment. Since barometric altimetry input is not used in generating vertical guidance with SBAS, there are no temperature restrictions or remote altimeter setting source restrictions with the SBAS criteria.

3.3.4.4.4 The minimum published decision height (DH) for APV procedures, regardless of the criteria set used, is 75 m (250 ft).

3.3.4.5 Precision approaches

3.3.4.5.1 Precision instrument approach criteria exist for ILS, microwave landing systems (MLS), GBAS landing systems (GLS) and SBAS CAT I.

3.3.4.5.2 Obstacle clearance altitudes for precision approaches can be calculated by a number of different methods. However, all methods use assessment surfaces to discriminate between significant and insignificant obstacles.

3.3.4.5.3 The highest significant obstacle on the approach (or missed approach, converted to an equivalent height) is used to determine the obstacle clearance altitude by adding a height loss margin to its elevation. The margin is dependent on the aircraft category and whether pressure or radio altimetry is used. The values are shown in Table A-3-8.

Table A-3-8. Height loss/altimeter margin for maximum V_{at} by aircraft category

Aircraft category (maximum V_{at})	Margin using radio altimeter		Margin using pressure altimeter	
	Metres	Feet	Metres	Feet
A – 169 km/h (90 kt)	13	42	40	130
B – 223 km/h (120 kt)	18	59	43	142
C – 260 km/h (140 kt)	22	71	46	150
D – 306 km/h (165 kt)	26	85	49	161
H – 167 km/h (90 kt)	8	25	35	115

NOTE 1: CAT H speed is the maximum final approach speed, not V_{at}.

NOTE 2: Since height loss varies with speed, the table shows only the calculation for a reference speed, which is the upper limit for each category.

3.3.4.5.4 It should be recognized that no allowance has been included in the table for any abnormal meteorological conditions; for example, wind shear and turbulence.

3.3.4.6 Missed approach – non-precision approach (NPA)

3.3.4.6.1 The beginning MOC on the missed approach is the value used for the final segment of the approach.

3.3.4.6.2 This initial phase continues until the start of climb (SOC); this marks the commencement of the intermediate phase of the missed approach. The SOC is defined by reference to aircraft category missed approach speed, a 10 kt tailwind and assumed delays to cater for pilot reaction time and aircraft configuration changes. No turns are designed prior to the SOC.

3.3.4.6.3 The MOC in the intermediate phase is 30 m (98 ft) when no turns are employed, otherwise 50 m (164 ft). Any track change greater than 15° is defined as a turn.

3.3.4.6.4 The final phase of the missed approach is at the point where a clearance of 50 m (164 ft) can be maintained.

3.3.4.6.5 The missed approach obstacle clearances are shown on Figure A-3-1.

3.3.4.7 Missed approach – precision approach and APV

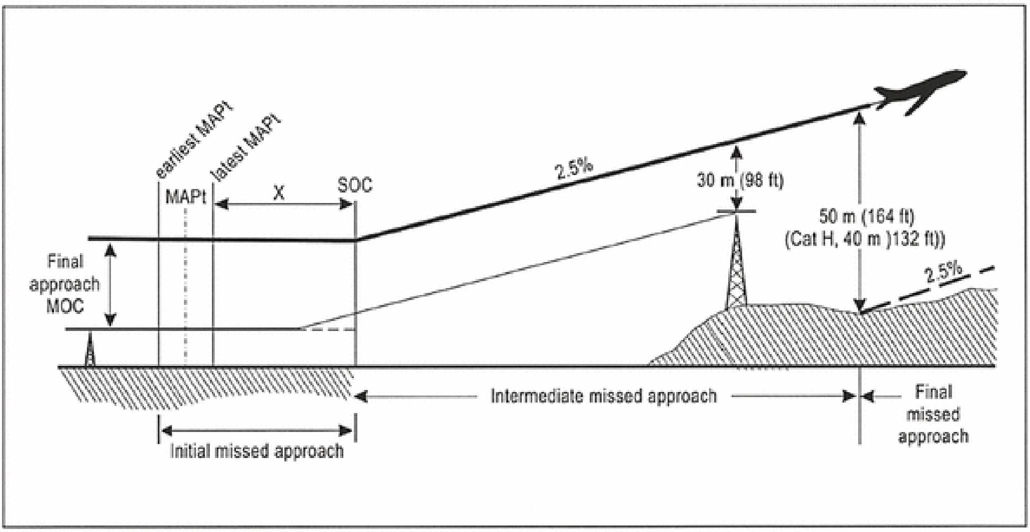
For precision approaches and APVs, an SOC is not defined. The decision altitude is always established at a level that will accommodate height loss (see Table A-3-8). Therefore, the climb is assumed to commence after the full height loss has occurred. These factors are “worst case” and are subsumed by the design of the procedure’s assessment surfaces.

3.3.5 Procedure altitude/height

3.3.5.1 In addition to minimum IFR altitudes established for each segment of the procedure, procedure altitudes/heights will also be provided. Procedure altitudes/heights will, in all cases, be at or above any minimum crossing altitude (MCA) associated with the segment. Procedure altitude/height will be established taking into account the air traffic control needs for that phase of flight.

3.3.5.2 Procedure altitudes/heights are developed to place the aircraft at altitudes/heights that would normally be flown to intercept and fly an optimum 5.2 per cent (3.0°) descent path angle in the FAS to a 15 m (50 ft) threshold crossing for NPA procedures and procedures with vertical guidance. In no case will a procedure altitude/height be lower than any OCA/H.

Figure A-3-1. Obstacle clearance in the missed approach



Extracted from ICAO Document 8168, Volume III - First Edition - Procedures for Air Navigation Services - AIRCRAFT OPERATIONS, Flight Procedures, herein known as PANS-OPS.

1 INTRODUCTION TO ALTIMETER SETTING PROCEDURES

1.1 These procedures describe the method for providing adequate vertical separation between aircraft and for providing adequate terrain clearance during all phases of a flight. This method is based on the following basic principles:

a. States may specify a fixed altitude known as the transition altitude. In flight, when an aircraft is at or below the transition altitude, its vertical position is expressed in terms of altitude, which is determined from an altimeter set to sea level pressure (QNH).

b. In flight above the transition altitude, the vertical position of an aircraft is expressed in terms of flight levels, which are surfaces of constant atmospheric pressure based on an altimeter setting of 1013.2 hPa.

c. The change in reference from altitude to flight levels, and vice versa, is made:

   1. at the transition **altitude**, when climbing; and
   2. at the transition **level**, when descending.

d. The transition level may be nearly coincident with the transition altitude to maximize the number of flight levels available. Alternatively, the transition level may be located 300 m (or 1000 ft) above the transition altitude to permit the transition altitude and the transition level to be used concurrently in cruising flight, with vertical separation ensured. The airspace between the transition level and the transition altitude is called the transition layer.

e. Where no transition altitude has been established for the area, aircraft in the en-route phase shall be flown at a flight level.

f. The adequacy of terrain clearance during any phase of a flight may be maintained in any of several ways, depending upon the facilities available in a particular area. The recommended methods in the order of preference are:

   1. the use of current QNH reports from an adequate network of QNH reporting stations;
   2. the use of such QNH reports as are available, combined with other meteorological information such as forecast lowest mean sea level pressure for the route or portions thereof; and
   3. where relevant current information is not available, the use of values of the lowest altitudes or flight levels, derived from climatological data.

g. During the approach to land, terrain clearance may be determined by using:

   1. the QNH altimeter setting (giving altitude); or
   2. under specified circumstances a QFE setting (giving height above the QFE datum).

1.3 These procedures apply to all IFR flights and to other flights which are operating at specific cruising levels in accordance with Annex 2 - Rules of the Air or the Procedures for Air Navigation

Services - Air Traffic Management (PANS-ATM, Doc 4444) or the Regional Supplementary Procedures (Doc 7030).

2 BASIC ALTIMETER SETTING REQUIREMENTS

2.1 GENERAL

2.1.1 System of flight levels

2.1.1.1 Flight level zero shall be located at the atmospheric pressure level of 1013.2 hPa. Consecutive flight levels shall be separated by a pressure interval corresponding to at least 500 ft (152.4 m) in the standard atmosphere.

2.1.2 Transition altitude

2.1.2.1 A transition altitude shall normally be specified for each aerodrome by the State in which the aerodrome is located.

2.1.2.2 Where two or more closely spaced aerodromes are located so that coordinated procedures are required, a common transition altitude shall be established. This common transition altitude shall be the highest that would be required if the aerodromes were considered separately.

2.1.2.4 The height above the aerodrome of the transition altitude shall be as low as possible but normally not less than 900 m (3000 ft).

2.1.2.5 The calculated height of the transition altitude shall be rounded up to the next full 300 m (1000 ft).

2.1.2.7 Transition altitudes shall be published in aeronautical information publications and shown on the appropriate charts.

2.1.3 Transition level

2.1.3.1 States shall make provision for the determination of the transition level to be used at any given time at each of their aerodromes.

2.1.3.2 Where two or more closely spaced aerodromes are located so that coordinated procedures and a common transition altitude are required, a common transition level shall also be used at those aerodromes.

2.1.4 References to vertical position

2.1.4.1 The vertical position of aircraft operating at or below the transition altitude shall be expressed in terms of altitude. Vertical position at or above the transition level shall be expressed in terms of flight levels. This terminology applies during:

a. climb;
b. en-route flight; and
c. approach and landing

2.1.4.2 Passing through the transition layer

While passing through the transition layer, vertical position shall be expressed in terms of:

a. flight levels when climbing; and

b. altitude when descending.

2.2 TAKE-OFF AND CLIMB

A QNH altimeter setting shall be made available to aircraft in taxi clearance prior to take-off.

2.3 EN-ROUTE

2.3.1 When complying with the specifications of Annex 2, an aircraft shall be flown at altitudes or flight levels (as applicable) corresponding to the magnetic tracks shown in the table of cruising levels in Appendix 3 to Annex 2.

2.3.2 Terrain clearance

2.3.2.1 QNH altimeter setting reports should be provided from sufficient locations to permit determination of terrain clearance with an acceptable degree of accuracy.

2.3.2.2 For areas where adequate QNH altimeter setting reports cannot be provided, the appropriate authorities shall provide the information required to determine the lowest flight level which will ensure adequate terrain clearance. This information shall be made available in the most usable form.

2.4 APPROACH AND LANDING

2.4.1 The QNH altimeter setting shall be made available to aircraft in approach clearances and in clearances to enter the traffic circuit.

2.4.2 A QFE altimeter setting, clearly identified as such, should be made available in approach and landing clearances. This should be available on request or on a regular basis, in accordance with local arrangements.

2.4.3 References to vertical positioning after approach clearance

After approach clearance has been issued and the descent to land is begun, the vertical positioning of an aircraft above the transition level may be by reference to altitudes (QNH) provided that level flight above the transition altitude is not indicated or anticipated.

2.5 MISSED APPROACH

The relevant parts of 2.2, “Take-off and climb”, 2.3, “En-route”, and 2.4, “Approach and landing” shall apply in the event of a missed approach.

3 PROCEDURES FOR OPERATORS AND PILOTS

3.1 FLIGHT PLANNING

3.1.1 The levels at which a flight is to be conducted shall be specified in a flight plan:

a. as flight levels if the flight is to be conducted at or above the transition level (or the lowest usable flight level, if applicable); and

b. as altitudes if the flight is to be conducted at or below the transition altitude.

3.1.2 The altitudes or flight levels selected for flight:

a. should ensure adequate terrain clearance at all points along the route;

b. should satisfy air traffic control requirements; and

c. should be compatible with the table of cruising levels in Appendix 3 to Annex 2, if relevant.

NOTE 1: The information required to determine the lowest altitude or flight level which ensures adequate terrain clearance may be obtained from the appropriate services unit (e.g. aeronautical information, air traffic or meteorological).

NOTE 2: The choice of altitudes or flight levels depends upon how accurately their vertical position relative to the terrain can be estimated. This in turn depends upon the type of meteorological information available. A lower altitude or flight level may be used with confidence when its position is based on current information which is relevant to the particular route to be flown and when it is known that amendments to this information will be available in flight. See 3.4.2, "Terrain clearance". A higher altitude or flight level will be used when based on information less relevant to the particular route to be flown and the time of the flight. The latter type of information may be provided in chart or table form and may be applicable to a large area and any period of time.

NOTE 3: Flights over level terrain may often be conducted at one altitude or flight level. On the other hand, flights over mountainous terrain may require several changes in altitudes or flight levels to account for changes in the elevation of the terrain. The use of several altitudes or flight levels may also be required to comply with air traffic services requirements.

3.2 PRE-FLIGHT OPERATIONAL TEST

The following test should be carried out in an aircraft by flight crew members before flight. Flight crews should be advised of the purpose of the test and the manner in which it should be carried out. They should also be given specific instructions on the action to be taken based on the test results.

QNH Setting

a. With the aircraft at a known elevation on the aerodrome, set the altimeter pressure scale to the current QNH setting.

b. Vibrate the instrument by tapping unless mechanical vibration is provided. A serviceable altimeter indicates the elevation of the point selected, plus the height of the altimeter above this point, within a tolerance of:

   1. ±20 m or 60 ft for altimeters with a test range of 0 to 9000 m (0 to 30000 ft); and
   2. ±25 m or 80 ft for altimeters with a test range of 0 to 15000 m (0 to 50000 ft).

QFE Setting

a. With the aircraft at a known elevation on the aerodrome, set the altimeter pressure scale to the current QFE setting.

b. Vibrate the instrument by tapping unless mechanical vibration is provided. A serviceable altimeter indicates the height of the altimeter in relation to the QFE reference point, within a tolerance of:

   1. ±20 m or 60 ft for altimeters with a test range of 0 to 9000 m (0 to 30000 ft); and
   2. ±25 m or 80 ft for altimeters with a test range of 0 to 15000 m (0 to 50000 ft).

3.3 TAKE-OFF AND CLIMB

3.3.1 Before taking off, one altimeter shall be set on the latest QNH altimeter setting for the aerodrome.

3.3.2 During climb to, and while at the transition altitude, references to the vertical position of the aircraft in air-ground communications shall be expressed in terms of altitudes.

3.3.3 On climbing through the transition altitude, the reference for the vertical position of the aircraft shall be changed from altitudes (QNH) to flight levels (1013.2 hPa), and thereafter the vertical position shall be expressed in terms of flight levels.

3.4 EN-ROUTE

3.4.1 Vertical separation

3.4.1.1 During en-route flight at or below the transition altitude, an aircraft shall be flown at altitudes. References to the vertical position of the aircraft in air-ground communications shall be expressed in terms of altitudes.

3.4.1.2 During en-route flight at or above transition levels or the lowest usable flight level, whichever is applicable, an aircraft shall be flown at flight levels. References to the vertical position of the aircraft in air-ground-communications shall be expressed in terms of flight levels.

3.4.2 Terrain clearance

3.4.2.1 Where adequate QNH altimeter setting reports are available, the latest and most appropriate reports shall be used for assessing terrain clearance.

3.4.2.2 Where the adequacy of terrain clearance cannot be assessed with an acceptable degree of accuracy by means of the QNH reports available or forecast lowest mean sea level pressure, other information shall be obtained for checking the adequacy of terrain clearance.

3.5 APPROACH AND LANDING

3.5.1 Before beginning the initial approach to an aerodrome, the number of the transition level shall be obtained.

3.5.2 Before descending below the transition level, the latest QNH altimeter setting for the aerodrome shall be obtained.

3.5.3 As the aircraft descends through the transition level, the reference for the vertical position of the aircraft shall be changed from flight levels (1013.2 hPa) to altitudes (QNH). From this point on, the vertical position of the aircraft shall be expressed in terms of altitudes.

3.5.4 When an aircraft which has been given a clearance as number one to land is completing its approach using QFE, the vertical position of the aircraft shall be expressed in terms of the height above the aerodrome datum which was used in establishing obstacle clearance height (OCH). All subsequent references to vertical position shall be made in terms of height.

4 ALTIMETER CORRECTIONS

NOTE: This chapter deals with altimeter corrections for pressure, temperature and, where appropriate, wind and terrain effects. The pilot is responsible for these corrections except when under radar vectoring. In that case, the radar controller issues clearances such that the prescribed obstacle clearance will exist at all times, taking the cold temperature correction into account.

4.1 RESPONSIBILITY

4.1.1 Pilot's responsibility

The pilot-in-command is responsible for the safety of the operation and the safety of the aeroplane and of all persons on board during flight time (Annex 6, 4.5.1). This includes responsibility for obstacle clearance, except when an IFR flight is being vectored.

4.1.2 Operator's responsibility

The operator is responsible for establishing minimum flight altitudes, which may not be less than those established by States that are flown over (Annex 6, 4.2.6). The operator is responsible for specifying a method for determining these minimum altitudes (Annex 6, 4.2.6). Annex 6 recommends that the method should be approved by the State of the Operator and also recommends the factors to be taken into account.

4.1.3 State's responsibility

Annex 15, Appendix 1 (Contents of Aeronautical Information Publication), indicates that States should publish in Section GEN 3.3.5, “The criteria used to determine minimum flight altitudes”. If nothing is published, it should be assumed that no corrections have been applied by the State.

4.1.4 Air traffic control (ATC)

If an aircraft is cleared by ATC to an altitude which the pilot-in-command finds unacceptable due to low temperature, then the pilot-in-command should request a higher altitude. If such a request is not received, ATC will consider that the clearance has been accepted and will be complied with.

4.1.5 Flights outside controlled airspace

4.1.5.1 For IFR flights outside controlled airspace, including flights operating below the lower limit of controlled airspace, the determination of the lowest usable flight level is the responsibility of the pilot-in-command. Current or forecast QNH and temperature values should be taken into account.

4.1.5.2 It is possible that altimeter corrections below controlled airspace may accumulate to the point where the aircraft's position may impinge on a flight level or assigned altitude in controlled airspace. The pilot-in-command must then obtain clearance from the appropriate control agency.

4.2 PRESSURE CORRECTION

4.2.1 Flight levels

When flying at levels with the altimeter set to 1013.2 hPa, the minimum safe altitude must be corrected for deviations in pressure when the pressure is lower than the standard atmosphere (1013 hPa). An appropriate correction is 10 m (30 ft) per hPa below 1013 hPa. Alternatively, the correction can be obtained from standard correction graphs or tables supplied by the operator.

4.2.2 QNH/QFE

When using the QNH or QFE altimeter setting (giving altitude or height above QFE datum respectively), a pressure correction is not required.

4.3 TEMPERATURE CORRECTION

4.3.1 Requirement for temperature correction

The calculated minimum safe altitudes/heights must be adjusted when the ambient temperature on the surface is much lower than that predicted by the standard atmosphere. In such conditions, an approximate correction is 4 per cent height increase for every 10°C below standard temperature as measured at the altimeter setting source. This is safe for all altimeter setting source altitudes for temperatures above -15°C.

4.3.2 Tabulated corrections

For colder temperatures, a more accurate correction should be obtained from Tables 2-4-1 a) and 2-4-1 b). These tables are calculated for a sea level aerodrome. They are therefore conservative when applied at higher aerodromes.

4.3.4 Accurate corrections

4.3.4.1 For occasions when a more accurate temperature correction is required, this may be obtained from Equation 24 of the Engineering Sciences Data Unit (ESDU) publication, Performance, Volume 2, Item Number 7702. This assumes an off-standard atmosphere.

$$\frac{-\Delta t_{std}}{L_0} \ln\left(\frac{1 + L_0 \times \Delta h_{PAirplane}}{t_0 + L_0 \times \Delta h_{PAerodrome}}\right)$$

where:

$\Delta h_{PAirplane}$ = aircraft height above aerodrome (pressure)

$\Delta h_{GAirplane}$ = aircraft height above aerodrome (geopotential)

Δt_{std} = temperature deviation from the International Standard Atmosphere (ISA) temperature

L_0 = standard temperature lapse rate with pressure altitude in the first layer (sea level to tropopause) of the ISA

t_0 = standard temperature at sea level

4.3.6 Small corrections

For practical operational use, it is appropriate to apply a temperature correction when the value of the correction exceeds 20 per cent of the associated minimum obstacle clearance (MOC).

4.4 MOUNTAINOUS AREAS – EN-ROUTE

The MOC over mountainous areas is normally applied during the design of routes and is stated in State aeronautical information publications. However, where no information is available, the margins in Tables 2-4-2 and 2-4-3 may be used when:

a. the selected cruising altitude or flight level or one engine inoperative stabilizing altitude is at or close to the calculated minimum safe altitude; and

b. the flight is within 19 km (10 NM) of terrain having a maximum elevation exceeding 900 m (3000 ft).

4.5 MOUNTAINOUS TERRAIN - TERMINAL AREAS

4.5.1 The combination of strong winds and mountainous terrain can cause local changes in atmospheric pressure due to the Bernoulli effect. This occurs particularly when the wind direction is across mountain crests or ridges. It is not possible to make an exact calculation, but theoretical studies (CFD Norway, Report 109.1989) have indicated altimeter errors as shown in Tables 2-4-4 and 2-4-5. Although States may provide guidance, it is up to the pilot-in-command to evaluate whether the combination of terrain, wind strength and direction are such as to make a correction for wind necessary.

4.5.2 Corrections for wind speed should be applied in addition to the standard corrections for pressure and temperature, and ATC should be advised.

Table 2-4-1 a). Values to be added by the pilot to minimum promulgated heights/altitudes (m)

Aerodrome temperature (°C)	Height above the elevation of the altimeter setting source (metres)													
	60	90	120	150	180	210	240	270	300	450	600	900	1200	1500
0	5	5	10	10	10	15	15	15	20	25	35	50	70	85
–10	10	10	15	15	25	20	25	30	30	45	60	90	120	150
–20	10	15	20	25	25	30	35	40	45	65	85	130	170	215
–30	15	20	25	30	35	40	45	55	60	85	115	170	230	285
–40	15	25	30	40	45	50	60	65	75	110	145	220	290	365
–50	20	30	40	45	55	65	75	80	90	135	180	270	360	450

Table 2-4-1 b). Values to be added by the pilot to minimum promulgated heights/altitudes (ft)

Aerodrome temperature (°C)	**Height above the elevation of the altimeter setting source (feet)**													
	200	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1500**	**2000**	**3000**	**4000**	**5000**
0	20	20	30	30	40	40	50	50	60	90	120	170	230	280
–10	20	30	40	50	60	70	80	90	100	150	200	290	390	490
–20	30	50	60	70	90	100	120	130	140	210	280	420	570	710
–30	40	60	80	100	120	140	150	170	190	280	380	570	760	950
–40	50	80	100	120	150	170	190	220	240	360	480	720	970	1210
–50	60	90	120	150	180	210	240	270	300	450	590	890	1190	1500

Table 2-4-2/3. Margin in mountainous areas

Terrain variation	**MOC**
Between 3000 ft and 5000 ft (900 m and 1500 m)	1476 ft (450 m)
Greater than 5000 ft (1500 m)	1969 ft (600 m)

Table 2-4-4/5. Altimeter error due to wind speed

Wind speed	**Altimeter error**
20 kt (37 km/h)	53 ft (17 m)
40 kt (74 km/h)	201 ft (62 m)
60 kt (111 km/h)	455 ft (139 m)
80 kt (148 km/h)	812 ft (247 m)

Extracted from ICAO Document 8168, Volume III - First Edition - Procedures for Air Navigation Services - AIRCRAFT OPERATIONS, Flight Procedures, herein known as PANS-OPS.

1 MODES OF OPERATION

1.2 MODES OF OPERATION

1.2.1 There can be a variety of modes of operation associated with the use of parallel or near-parallel instrument runways.

1.2.1.1 Modes 1 and 2 - Simultaneous parallel instrument approaches

There are two basic modes of operation for approaches made to parallel runways:

a. Mode 1, Independent parallel approaches: In this mode, radar separation minima between aircraft using adjacent ILS and/or MLS are not prescribed; and

b. Mode 2, Dependent parallel approaches: In this mode, radar separation minima between aircraft using adjacent ILS and/or MLS are prescribed.

1.2.1.2 Mode 3 - Simultaneous instrument departures

Mode 3, Independent parallel departures: In this mode, aircraft are departing in the same direction from parallel runways simultaneously.

1.2.1.3 Mode 4 - Segregated parallel approaches/departures

Mode 4, Segregated parallel operations: In this mode, one runway is used for approaches, and one runway is used for departures.

1.2.1.4 Semi-mixed and mixed operations

1.2.1.4.1 In the case of parallel approaches and departures, there may be semi-mixed operations. In this scenario:

a. one runway is used exclusively for departures, while the other runway accepts a mixture of approaches and departures; or

b. one runway is used exclusively for approaches while the other runway accepts a mixture of approaches and departures.

1.2.1.4.2 There may also be mixed operations, i.e. simultaneous parallel approaches with departures interspersed on both runways.

1.3 OPERATIONAL APPROVAL

1.3.1 Aircraft Eligibility

1.3.1.1 An aircraft may be utilized for parallel operations if:

a. for operations utilizing a precision approach, the aircraft has the relevant precision approach capability; and

b. for operations utilizing a PBN approach, the aircraft meets the eligibility requirements for the particular navigation specification used in the design of the procedures.

NOTE: More information on aircraft eligibility for navigation specification is contained in the Performance-based Navigation (PBN) Manual (Doc 9613).

1.4 PARALLEL APPROACH OPERATIONS

Independent/dependent parallel approaches operations may be conducted using any combination of three-dimensional (3D) instrument approach operations provided that:

a. instrument approach charts are available that contain operational notes regarding the parallel approach procedures;

b. aircraft are advised as early as possible of the assigned runway, instrument approach procedures and any additional information considered necessary to confirm correct selection;

c. the final approach course or track is intercepted by use of:

   1. vectoring; or

   2. a published arrival and approach procedure that intercepts with the IAF or IF;

d. as early as practicable after an aircraft has established communication with approach control, the aircraft is advised that independent parallel approaches are in force. This information may be provided through the automatic terminal information service (ATIS) broadcasts. In addition, the aircraft shall be advised of the runway identification and the ILS localizer and/or MLS frequency to be used; and

e. dedicated radio channels or override capability for the monitoring controllers to use for the appropriate voice communication facilities are provided.

NOTE: Refer to Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444), Chapter 6 for further detail.

1.5 INTERCEPTING THE FINAL APPROACH COURSE OR TRACK

1.5.1 When simultaneous independent parallel approaches are in progress, the following apply:

a. the main objective is that both aircraft be established on the approved instrument approach procedure final approach course or track before the 300 m (1000 ft) vertical separation is reduced;

b. all approaches, regardless of weather conditions, will be monitored using an ATS surveillance system. Control instructions and information to ensure separation between aircraft and to ensure that aircraft do not enter the NTZ will be issued as necessary. The air traffic control procedure will be to either vector arriving aircraft or use an arrival or approach procedure to position the aircraft for an intercept of one or the other of the parallel approach courses or tracks. When cleared for an ILS or MLS approach, a procedure turn is not permitted;

c. when vectoring to intercept the final approach course or track, the final vector will meet the following conditions:

   1. enable the aircraft to intercept at an angle not greater than 30 degrees;
   2. provide at least 1.9 km (1.0 NM) straight and level flight prior to the final approach course or track intercept; and
   3. enable the aircraft to be established on the final approach course or track, in level flight for at least 3.7 km (2.0 NM) prior to intercepting the glide path or vertical path for the selected instrument approach procedure;

d. the published arrival or approach procedure used to position the aircraft for an intercept of the final course or track will be designed in accordance with the procedures detailed in PANS-OPS, Volume II, Part II, Section 1, with specific reference to simultaneous approaches to parallel or near-parallel instrument runways;

e. each pair of parallel approaches will have a “high side” and a “low side” for positioning aircraft to provide vertical separation until aircraft are established inbound on their respective parallel final approach course or track. The low side altitude will normally be such that the aircraft will be established on the final approach course or track well before glide path or vertical path interception. The high side altitude will be 300 m (1000 ft) above the low side.

   NOTE: The application of vertical separation may be discontinued after the initial approach fix (IAF) or intermediate approach fix (IF) when an aircraft is established on an RNP AR APCH procedure, in accordance with the provisions in the Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM Doc 4444), Chapter 6.

f. when the aircraft is assigned its final heading to intercept the final approach course or track, it will be advised of:

   1. the altitude to be maintained until:
      (a) the aircraft is established on the final approach course or track; and
      (b) the aircraft has reached the glide path or vertical path intercept point; and
   2. if required, clearance for the final approach;

g. if an aircraft is observed to overshoot the turn-to-final or to continue on a track which will penetrate the NTZ, the aircraft will be instructed to return immediately to the correct track. Pilots are not required to acknowledge these transmissions or subsequent instructions while on final approach unless requested to do so;

h. once the 300 m (1000 ft) vertical separation is reduced, the controller monitoring the approach will issue control instructions if the aircraft deviates substantially from the final approach course or track;

i. if an aircraft that deviates substantially from the final approach course or track fails to take corrective action and penetrates the NTZ, the aircraft on the adjacent final approach course or track will be instructed to immediately climb and turn to the assigned altitude and heading in order to avoid the deviating aircraft.

1.7 TRACK DIVERGENCE

Simultaneous parallel operations require diverging tracks for missed approach procedures and departures. When turns are prescribed to establish divergence, pilots shall begin the turns as soon as practicable.

Extracted from ICAO Document 8168, Volume III - First Edition - Procedures for Air Navigation Services - AIRCRAFT OPERATIONS, Flight Procedures, herein known as PANS-OPS.

1 OPERATION OF TRANSPONDERS

1.1 GENERAL

1.1.1 When an aircraft carries a serviceable transponder, the pilot shall operate the transponder at all times during flight, regardless of whether the aircraft is within or outside airspace where secondary surveillance radar (SSR) is used for ATS purposes.

1.1.3 When the aircraft carries serviceable Mode C equipment, the pilot shall continuously operate this mode, unless otherwise directed by ATC.

1.1.5 When requested by ATC to “CONFIRM SQUAWK [code]” the pilot shall:

a. verify the Mode A code setting on the transponder;

b. reselect the assigned code if necessary; and

c. confirm to ATC the setting displayed on the controls of the transponder.

1.1.6 Pilots shall not SQUAWK IDENT unless requested by ATC.

1.2 USE OF MODE C

Whenever Mode C is operated, pilots shall, in air-ground voice communications where level information is required, give such information by stating their level to the nearest full 30 m or 100 ft as indicated on the pilot’s altimeter.

1.3 USE OF MODE S

Pilots of aircraft equipped with Mode S having an aircraft identification feature shall set the aircraft identification in the transponder. This setting shall correspond to the aircraft identification specified in item 7 of the ICAO flight plan, or, if no flight plan has been filed, the aircraft registration.

1.4 EMERGENCY PROCEDURES

The pilot of an aircraft in a state of emergency shall set the transponder to Mode A Code 7700 unless ATC has previously directed the pilot to operate the transponder on a specified code. In the latter case, the pilot shall continue to use the specified code unless otherwise advised by ATC. However, a pilot may select Mode A Code 7700 whenever there is a specific reason to believe that this would be the best course of action.

1.5 COMMUNICATION FAILURE PROCEDURES

The pilot of an aircraft losing two-way communications shall set the transponder to Mode A Code 7600.

NOTE: A controller who observes an SSR response indicating selection of the communications failure code will determine the extent of the failure by instructing the pilot to SQUAWK IDENT or to change code. If it is determined that the aircraft receiver is functioning, further control of the aircraft will be continued using code changes or IDENT transmission to acknowledge receipt of *clearances. Different procedures may be applied to Mode S equipped aircraft in areas of Mode S coverage.*

1.6 UNLAWFUL INTERFERENCE WITH AIRCRAFT IN FLIGHT

1.6.1 If there is unlawful interference with an aircraft in flight, the pilot-in-command shall attempt to set the transponder to Mode A Code 7500 in order to indicate the situation. If circumstances so warrant, Code 7700 should be used instead.

1.6.2 If a pilot has selected Mode A Code 7500 and has been requested to confirm this code by ATC (in accordance with 1.1.5), the pilot shall, according to circumstances, either confirm this or not reply at all.

NOTE: If the pilot does not reply, ATC will take this as confirmation that the use of Code 7500 is not an inadvertent false code selection.

1.7 TRANSPONDER FAILURE PROCEDURES WHEN THE CARRIAGE OF A FUNCTIONING TRANSPONDER IS MANDATORY

1.7.1 In case of a transponder failure after departure, ATC units shall attempt to provide for continuation of the flight to the destination aerodrome in accordance with the flight plan. Pilots may, however, expect to comply with specific restrictions.

2 PHRASEOLOGY

2.2 PHRASEOLOGY USED BY PILOTS

Pilots shall read back the mode and code to be set when they acknowledge mode/code setting instructions.

3 OPERATION OF AIRBORNE COLLISION AVOIDANCE SYSTEM (ACAS) EQUIPMENT

3.1.1 The information provided by an ACAS is intended to assist pilots in the safe operation of aircraft by providing advice on appropriate action to reduce the risk of collision. This is achieved through resolution advisories (RAs), which propose manoeuvres, and through traffic advisories (TAs), which are intended to prompt visual acquisition and to act as a warning that an RA may follow. TAs indicate the approximate positions of intruding aircraft that may later cause resolution advisories. RAs propose vertical manoeuvres that are predicted to increase or maintain separation from threatening aircraft. ACAS I equipment is only capable of providing TAs, while ACAS II is capable of providing both TAs and RAs. In this chapter, reference to ACAS means ACAS II.

3.1.2 ACAS indications shall be used by pilots in the avoidance of potential collisions, the enhancement of situational awareness, and the active search for, and visual acquisition of, conflicting traffic.

3.1.3 Nothing in the procedures specified in 3.2 hereunder shall prevent pilots-in-command from exercising their best judgment and full authority in the choice of the best course of action to resolve a traffic conflict or avert a potential collision.

3.2 USE OF ACAS INDICATIONS

The indications generated by ACAS shall be used by pilots in conformity with the following safety considerations:

a. pilots shall not maneuver their aircraft in response to traffic advisories (TAs) only;

b. on receipt of a TA, pilots shall use all available information to prepare for appropriate action if an RA occurs; and

c. in the event of an RA, pilots shall:

   1. respond immediately by following the RA as indicated, unless doing so would jeopardize the safety of the aeroplane;

      NOTE 1: Stall warning, wind shear, and ground proximity warning system alerts have precedence over ACAS.

      NOTE 2: Visually acquired traffic may not be the same traffic causing an RA. Visual perception of an encounter may be misleading, particularly at night.

   2. follow the RA even if there is a conflict between the RA and an air traffic control (ATC) instruction to manoeuvre;

   3. not manoeuvre in the opposite sense to an RA;

      NOTE: In the case of an ACAS-ACAS coordinated encounter, the RAs complement each other in order to reduce the potential for collision. Manoeuvres, or lack of manoeuvres, that result in vertical rates opposite to the sense of an RA could result in a collision with the intruder aircraft.

   4. as soon as possible, as permitted by flight crew workload, notify the appropriate ATC unit of any RA which requires a deviation from the current ATC instruction or clearance;

      NOTE: Unless informed by the pilot, ATC does not know when ACAS issues RAs. It is possible for ATC to issue instructions that are unknowingly contrary to ACAS RA indications. Therefore, it is important that ATC be notified when an ATC instruction or clearance is not being followed because it conflicts with an RA.

   5. promptly comply with any modified RAs;

   6. limit the alterations of the flight path to the minimum extent necessary to comply with the RAs;

   7. promptly return to the terms of the ATC instruction or clearance when the conflict is resolved; and

   8. notify ATC when returning to the current clearance.

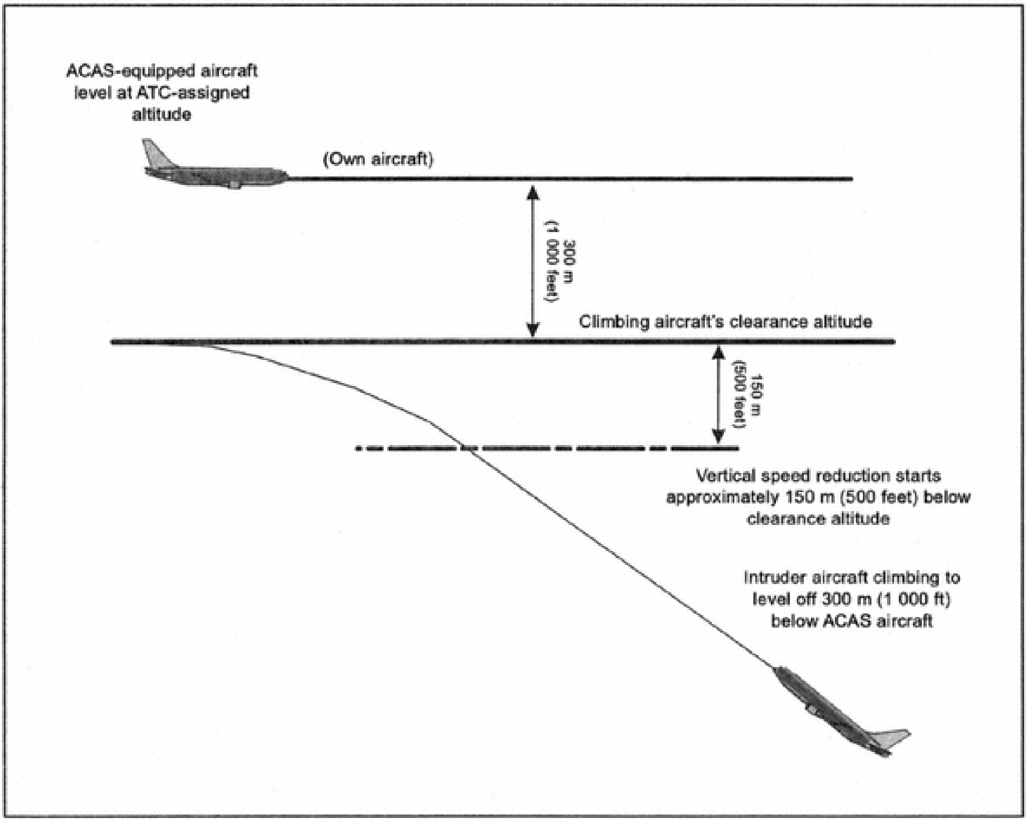
   NOTE 1: Procedures in regard to ACAS-equipped aircraft and the phraseology to be used for the notification of manoeuvres in response to a resolution advisory are contained in the PANS-ATM (Doc 4444), Chapters 15 and 12 respectively.

NOTE 2: Where aircraft can provide automatic following of an RA when the autopilot is engaged supported by a link between ACAS and autopilot, the operational procedures in items 4) and 8) still apply.

3.3 HIGH VERTICAL RATE (HVR) ENCOUNTERS

Pilots should use appropriate procedures by which an aeroplane climbing or descending to an assigned altitude or flight level, especially with an autopilot engaged, may do so at a rate less than 8 m/s (or 1500 ft/min) throughout the last 300 m (or 1000 ft) of climb or descent to the assigned altitude or flight level when the pilot is made aware of another aircraft at or approaching an adjacent altitude or flight level, unless otherwise instructed by ATC. Some aircraft have auto-flight systems with the capability to detect the presence of such aircraft and adjust their vertical rate accordingly. These procedures are intended to avoid unnecessary ACAS II resolution advisories in aircraft at or approaching adjacent altitudes or flight levels. For commercial operations, these procedures should be specified by the operator.

Figure 4-3-B-1. Representative HVR encounter geometry



FLIGHT PROCEDURES (DOC 8168) - OPERATIONAL FLIGHT INFORMATION

Extracted from ICAO Document 8168, Volume III - First Edition - Procedures for Air Navigation Services - AIRCRAFT OPERATIONS, Flight Procedures, herein known as PANS-OPS.

1 AERODROME SURFACE OPERATIONS

1.1 Operators shall develop and implement standard operating procedures (SOPs) for aerodrome surface operations. The development and implementation of SOPs shall take into consideration the risk factors (listed in 1.3) associated with the following operations:

a. runway intersection take-offs;

b. line-up and wait clearances;

c. land and hold-short clearances;

d. take-offs from displaced runway thresholds;

e. hazards associated with runway crossing traffic;

f. hazards associated with runway crossing traffic in the case of closely spaced parallel runways; and

g. hazards associated with the risk of collision at hot spot locations on aerodromes.

1.3 Operators should ensure that flight personnel are aware of the risk factors in the aerodrome surface operations listed in 1.1. Such risk factors should include, but not be limited to:

a. human error due to excessive workload, loss of vigilance and fatigue;

b. potential distractions associated with the performance of flight deck tasks; and

c. failure to use standard phraseology in aeronautical communications.

NOTE: The safety of aerodrome surface operations is especially vulnerable to the failure to use standard phraseology in aeronautical communications. Frequency congestion, as well as operational considerations, may adversely affect the issuance and read-back of clearances, leaving flight crews' and controllers vulnerable to misunderstandings.

2 READ-BACK OF CLEARANCES AND SAFETY-RELATED INFORMATION

NOTE: Provisions on read-back of clearances and safety-related information are included in Annex 11, Chapter 3, 3.7.3, and in the PANS-ATM (Doc 4444), Chapter 4.

3 STABILIZED APPROACH PROCEDURE

3.1 GENERAL

The primary safety consideration in the development of the stabilized approach procedure shall be maintenance of the intended flight path as depicted in the published approach procedure, without excessive manoeuvring. The parameters to be considered in the definition of a stabilized approach are listed in 3.2.

3.2 PARAMETERS FOR THE STABILIZED APPROACH

The parameters for the stabilized approach shall be defined by the operator's standard operating procedures (SOPs). These parameters shall be included in the operator's operations manual and shall provide details regarding at least the following:

a. range of speeds specific to each aircraft type;
b. minimum power setting(s) specific to each aircraft type;
c. range of attitudes specific to each aircraft type;
d. crossing altitude deviation tolerances;
e. configuration(s) specific to each aircraft type;
f. maximum sink rate; and
g. completion of checklists and crew briefings.

3.3 ELEMENTS OF THE STABILIZED APPROACH

The elements of a stabilized approach (according to the parameters in 3.2) shall be stated in the operator's SOPs. These elements should include as a minimum:

a. that in instrument meteorological conditions (IMC), all flights shall be stabilized by no lower than 300 m (1000 ft) height above threshold; and
b. that all flights of any nature shall be stabilized by no lower than 150 m (500 ft) height above threshold.

3.4 GO-AROUND POLICY

Standard operating procedures should include the operator's policy with regard to the parameters in 3.2 and the elements in 3.3. This policy should state that if an approach is not stabilized in accordance with 3.3, or has become destabilized at any subsequent point during an approach, a go-around is required. Operators should reinforce this policy through training.

4 REDUCED POWER TAKE-OFF

Reduced power take-off should not be required in adverse operating conditions such as:

a. if the runway surface conditions are adversely affected (e.g. by snow, slush, ice, water, mud, rubber, oil or other substances);
b. when the horizontal visibility is less than 1.9 km (1 NM);
c. when the crosswind component, including gusts, exceeds 28 km/h (15 kt);
d. when the tailwind component, including gusts, exceeds 9 km/h (5 kt); and
e. when wind shear has been reported or forecast or when thunderstorms are expected to affect the approach or departure.

NOTE: Some operating manuals (or the flight manual) may impose restrictions on the use of reduced take-off power while engine anti-icing systems are operating.

Extracted from ICAO Document 8168, Volume III - First Edition - Procedures for Air Navigation Services - AIRCRAFT OPERATIONS, Flight Procedures, herein known as PANS-OPS.

1 STANDARD OPERATING PROCEDURES (SOPS)

1.1 GENERAL

Operators shall established standard operating procedures (SOPs) that provide guidance to flight operations personnel to ensure safe, efficient, logical and predictable means of carrying out flight procedures.

1.4 SOPS IMPLEMENTATION AND USE

Operators should established a formal process of feedback from flight operations personnel to ensure standardization, compliance and evaluation of reasons for non-compliance during SOPs implementation and use.

2 CHECKLISTS

2.1 GENERAL

Operators shall establish checklists as an integral part of standard operating procedures (SOPs). Checklists should describe the actions relevant to specific phases of operations (engine start, taxi, take-off etc.) that flight crews must perform or verify and which relate to flight safety. Checklists should also provide a framework for verifying aircraft and systems configuration that guards against vulnerabilities in human performance.

2.3.2 Number of checklist items

The number of items in checklists should be restricted to those critical to flight safety.

2.3.3 Checklist interruptions

SOPs should include techniques to ensure a step-by-step, uninterrupted sequence of completing checklists. SOPs should unambiguously indicate the actions by flight crews in case of checklist interruptions.

2.3.4 Checklist ambiguity

Checklist responses should portray the actual status or the value of the item (switches, levers, lights, quantities, etc.). Checklists should avoid non-specific responses such as “set”, “checked”, or “completed”.

2.3.5 Checklist coupling

Checklists should be coupled to specific phases of flight (engine start, taxi, take-off, etc.). SOPs should avoid tight coupling of checklists with the critical part of a phase of flight (for example, completing the take-off checklist on the active runway). SOPs should dictate a use of checklists that allows buffers for detection and recovery from incorrect configurations.

3 CREW BRIEFINGS

3.1.1 Operators shall establish crew briefings as an integral part of standard operating procedures (SOPs). Crew briefings communicate duties, standardize activities, ensure that a plan of action is shared by crew members and enhance crew situational awareness.

3.1.2 Operators shall establish both individual and combined crew briefings for flight crew and cabin crew.

3.3.2 Any intended deviation from SOPs required by operational circumstances should be included as a specific briefing item.

3.5.3 Flight crew departure briefings should prioritize all relevant conditions that exist for the take-off and climb. They should include, but not be limited to:

a. runway in use, aircraft configuration and take-off speeds;

b. taxi-out route and relevant hot spots;

c. departure procedures;

d. departure routes;

e. navigation and communications equipment set-up;

f. aerodrome, terrain and performance restrictions, including noise abatement procedures (if applicable);

g. take-off alternates (if applicable);

h. any item(s) included in the minimum equipment list (if applicable);

i. review of applicable emergency procedures; and

j. applicable standard call-outs.

3.5.4 Flight crew arrival briefings should prioritize all relevant conditions that exist for the descent, approach and landing. They should include, but not be limited to:

a. terrain restrictions and minimum safe altitudes during descent;

b. arrival routes;

c. instrument or visual approach procedures and runway in use;

d. operational minima, aircraft configuration, and landing speeds;

e. navigation and communications equipment set-up;

f. taxi-in route and relevant hot spots;

g. missed approach procedures;

h. alternate aerodromes and fuel considerations;

i. review of applicable emergency procedures;

j. applicable standard call-outs; and

k. cold temperature correction.

Extracted from ICAO Document 8168, Volume III - First Edition - Procedures for Air Navigation Services - AIRCRAFT OPERATIONS, Flight Procedures, herein known as PANS-OPS.

1 OPERATION OF AUTOMATIC DEPENDENT SURVEILLANCE - BROADCAST IN (ADS-B IN) TRAFFIC DISPLAY

1.1 ADS-B IN TRAFFIC DISPLAY OVERVIEW

1.1.1 ADS-B IN on-board traffic displays are based on aircraft receiving and making use of ADS-B message information transmitted by other aircraft/vehicles or ground stations. The applications enhance the pilot's traffic situational awareness both while airborne and on the airport surface through the display of traffic symbols enriched by the received ADS-B messages (e.g. aircraft identification, track, altitude).

NOTE: Depending on the implementation, a single display can show ADS-B traffic symbols and those generated by ACAS.

1.1.2 Training on the use of the ADS-B IN traffic display shall be provided to pilots.

1.2 USE OF INFORMATION PROVIDED BY ADS-B IN TRAFFIC DISPLAY

1.2.1 When using an ADS-B IN traffic display:

a. in the event of a TA or an RA, pilots shall comply with the ACAS procedures whether or not the tracks generated by ADS-B are shown on the same display as those generated by ACAS;

b. unless approved by the State of the Operator, ADS-B IN traffic display shall only be used as supplementary information to current procedures;

c. its use should not lead to a significant increase in radio communications; and

d. pilots shall not undertake any manoeuvres relative to traffic based solely on the ADS-B IN traffic display that would lead to either a deviation from or a non-execution of an ATC clearance or instruction unless exercising their emergency authority.

NOTE 1: See Annex 2 – Rules of the Air, sections 3.2 and 3.6.2.

NOTE 2: ADS-B IN is not a collision avoidance system.

NOTE 3: Acceptable reaction to a traffic situation observed on an ADS-B IN traffic display may, for example, include manoeuvring into airspace visually cleared for traffic within the limitations of the current ATC clearance and remaining stationary during surface operations when a clearance to enter a runway has been provided.

NOTE 4: The ADS-B IN traffic picture displayed may be incomplete, e.g. due to the presence of non-ADS-B equipped aircraft in the same airspace.

1.2.2 Pilots may use the information provided by the ADS-B IN traffic display to aid with the visual acquisition of surrounding traffic. The ADS-B IN information supplements other information such as that which may be obtained through visual scanning or radio communications.

1.2.3 Operators shall include in their standard operating procedures (SOPs) (see Section 6, Chapter 1) specific guidance for using ADS-B IN to support ATC procedures specified in PANS-ATM (Doc 4444).

NOTE: An example is the in-trail procedure (ITP) described in PANS-ATM, Chapter 5, 5.4.2.7, "Longitudinal separation minima based on distance using ADS-B in-trail procedure (ITP)". Details of the ITP equipment are specified in RTCA DO-312/EUROCAE ED-159, Safety Performance and Interoperability Requirements Document for the In-Trail Procedure in Oceanic Airspace (ATSA-ITP) Application. Additional information can be found in RTCA DO-317A/EUROCAE ED-194, Minimum Operational Performance Standards (MOPS) for Aircraft Surveillance Applications (ASA) System and Supplement.

FLIGHT PROCEDURES - (DOC 8168) NOISE ABATEMENT PROCEDURES

Extracted from ICAO Document 8168, Volume III - First Edition - Procedures for Air Navigation Services - AIRCRAFT OPERATIONS, Flight Procedures, herein known as PANS-OPS.

1 GENERAL NOISE ABATEMENT INFORMATION

1.1 Nothing in these procedures shall prevent the pilot-in-command from exercising authority for the safe operation of the aeroplane.

1.2 Noise abatement procedures shall not be implemented except where a need for such procedures has been determined.

1.3 The procedures herein describe the methods for noise abatement. They have been designed for application to turbojet aeroplanes. They can comprise any one or more of the following:

a. use of noise preferential runways to direct the initial and final flight paths of aeroplanes away from noise-sensitive areas;

b. use of noise preferential routes to assist aeroplanes in avoiding noise-sensitive areas on departure and arrival, including the use of turns to direct aeroplanes away from noise-sensitive areas located under or adjacent to the usual take-off and approach flight paths; and

c. use of noise abatement take-off or approach procedures, designed to minimize the overall exposure to noise on the ground and at the same time maintain the required levels of flight safety.

1.4 For the purpose of these procedures, the heights given in metres and feet and speeds given in kilometers/hour and knots are considered to be operationally acceptable equivalents.

2 NOISE PREFERENTIAL RUNWAYS AND ROUTES

2.1 NOISE PREFERENTIAL RUNWAYS

2.1.1 A runway for take-off or landing, appropriate to the operation, may be nominated for noise abatement purposes, the objective being to utilize whenever possible those runways that permit aeroplanes to avoid noise-sensitive areas during the initial departure and final approach phases of flight.

2.1.2 Runways should not be selected for noise abatement purposes for landing operations unless they are equipped with suitable glide path guidance, e.g. ILS, or a visual approach slope indicator system for operations in visual meteorological conditions.

2.1.3 A pilot-in-command prompted by safety concerns can refuse a runway offered for noise preferential reasons.

2.1.4 Noise abatement shall not be determining factor in runway nomination under the following circumstances:

a. if the runway surface conditions are adversely affected (e.g. by snow, slush, ice, water, mud, rubber, oil or other substances);

b. for landing in conditions:

    1. when the ceiling is lower than 150 m (500 ft) above aerodrome elevation or the visibility is less than 1.9 km (1 NM); or
    2. when the approach requires vertical minima greater than 100 m (300 ft) above aerodrome elevation and:
        (a) the ceiling is lower than 240 m (800 ft) above aerodrome elevation; or
        (b) the visibility is less than 3000 m;

c. for take-off when the visibility is less than 1900 m;

d. when wind shear has been reported or forecast or when thunderstorms are expected to affect the approach or departure;

e. when the crosswind component, including gusts, exceeds 28 km/h (15 kt), or the tailwind component, including gusts, exceeds 9 km/h (5 kt).

2.2 NOISE PREFERENTIAL ROUTES

2.2.1 Noise preferential routes are established to ensure that departing and arriving aeroplanes avoid over-flying noise-sensitive areas in the vicinity of the aerodrome as far as practicable.

2.2.2 In establishing noise preferential routes:

a. turns during take-off and climb should not be required unless:

    1. the aeroplane has reached (and can maintain throughout the turn) a height of not less than 150 m (500 ft) above terrain and the highest obstacles under the flight path;

       NOTE: PANS-OPS, Volume II, permits turns after take-off at 120 m (394 ft) (helicopters, 90 m (295 ft)) and obstacle clearance of at least 75 m (246 ft) (CAT H, 65 m (213 ft)) during the aircraft's turn. These are minimum requirements for noise abatement purposes.

    2. the bank angle for turns after take-off is limited to 15° except where adequate provision is made for an acceleration phase permitting attainment of safe speeds for bank angles greater than 15°;

b. no turns should be required coincident with a reduction of power associated with a noise abatement procedure; and

c. sufficient navigation guidance should be provided to permit aeroplanes to adhere to the designated route.

2.2.3 In establishing noise preferential routes, the safety criteria of standard departure and standard arrival routes regarding obstacle clearance climb gradients and other factors should be taken into full consideration.

2.2.4 Where noise preferential routes are established, these routes and standard departure and arrival routes should be compatible.

2.2.5 An aeroplane should not be diverted from its assigned route unless:

a. in the case of a departing aeroplane, it has attained the altitude or height which represents the upper limit for noise abatement procedures; or

b. it is necessary for the safety of the aeroplane (e.g. for avoidance of severe weather or to resolve a traffic conflict).

3 AEROPLANE OPERATING PROCEDURES

3.1 INTRODUCTION

3.1.2 The State in which the aerodrome is located is responsible for ensuring that aerodrome operators specify the location, of noise sensitive areas and/or the location of noise monitors and their respective maximum allowable noise levels, if applicable. Aircraft operators are responsible for developing operating procedures in accordance with this chapter to meet the noise concerns of aerodrome operators. The approval of the aircraft operators' procedures by the State of the Operator will ensure that the safety criteria contained in 3.3 of this chapter are met.

3.1.3 The appendix to this chapter contains two examples of noise abatement departure climb procedures. One example is designed to alleviate noise close to the aerodrome, and the other is designed to alleviate noise more distant from the aerodrome.

3.2 OPERATIONAL LIMITATIONS

3.2.1 General

The pilot-in-command has the authority to decide not to execute a noise abatement departure procedure if conditions preclude the safe execution of the procedure.

3.2.2 Departure climb

Aeroplane operating procedures for the departure climb shall ensure that the safety of flight operations is maintained while minimizing exposure to noise on the ground. The following requirements need to be satisfied.

a. All necessary obstacle data shall be made available to the operator, and the procedure design gradient shall be observed.

b. Conduct of noise abatement climb procedures is secondary to meeting obstacle clearance requirements.

c. The power or thrust settings specified in the aircraft operating manual are to take account of the need for engine anti-icing when applicable.

d. The power or thrust settings to be used subsequent to the failure or shutdown of an engine or any other apparent loss of performance, at any stage in the take-off or noise abatement climb, are at the discretion of the pilot-in-command, and noise abatement considerations no longer apply.

e. Noise abatement climb procedures are not to be required in conditions where wind shear warnings exist, or the presence of wind shear or downburst activity is suspected.

f. The maximum acceptable body angle specified for an aeroplane type shall not be exceeded.

3.3 DEVELOPMENT OF PROCEDURES

3.3.1 Noise abatement procedures shall be developed by the aircraft operator for each aeroplane type (with advice from the aeroplane manufacturer, as needed) and approved by the State of the Operator complying at a minimum with the following safety criteria.

a. Initial power or thrust reductions shall not be executed below a height of 240 m (800 ft) above the aerodrome elevation.

b. The level of power or thrust for the flap/slat configuration, after power or thrust reduction, shall not be less than:

   1. for aeroplanes in which derated take-off thrust and climb thrust are computed by the flight management system, the computed climb power/thrust; or
   2. for other aeroplanes, normal climb power/thrust.

3.3.2 To minimize the impact on training while maintaining flexibility to address variations in the location of noise sensitive areas, the aeroplane operator shall develop no more than two noise abatement procedures for each aeroplane type. It is recommended that one procedure should provide noise benefits for areas close to the aerodrome, and the other for areas more distant from the aerodrome.

3.3.3 Any difference of power or thrust reduction initiation height for noise abatement purposes constitutes a new procedure.

3.4 AEROPLANE OPERATING PROCEDURES - APPROACH

3.4.1 In noise abatement approach procedures which are developed:

a. the aeroplane shall not be required to be in any configuration other than the final landing configuration at any point after passing the outer marker or 5 NM from the threshold of the runway of intended landing, whichever is earlier; and

b. excessive rates of descent shall not be required.

3.4.2 When it is necessary to develop a noise abatement approach procedure based on currently available (1982) systems and equipment, the following safety considerations shall be take fully into account:

a. glide path or approach angles should not require an approach to be made:

   1. above the ILS glide path angle;
   2. above the glide path of the visual approach slope indicator system;
   3. above the normal PAR final approach angle; and
   4. above an angle of 3° except where it has been necessary to establish, for operational purposes, an ILS with a glide path angle greater than 3°;

b. the pilot should not be required to complete a turn on to final approach at distances less than will:

1. in the case of visual operations, permit an adequate period of stabilized flight on final approach before crossing the runway threshold; or
2. in the case of instrument approaches, permit the aircraft to be established on final approach prior to interception of the glide path.

3.4.4 Compliance with published noise abatement approach procedures should not be required in adverse operating conditions such as:

a. if the runway is not clear and dry, i.e. it is adversely affected by snow, slush, ice or water, mud, rubber, oil or other substances;

b. in conditions when the ceiling is lower than 150 m (500 ft) above aerodrome elevation, or when the horizontal visibility is less than 1.9 km (1 NM);

c. when the crosswind component, including gusts, exceeds 28 km/h (15 kt);

d. when the tailwind component, including gusts, exceeds 9 km/h (5 kt); and

e. when wind shear has been reported or forecast or when adverse weather conditions, e.g. thunderstorms, are expected to affect the approach.

3.5 AEROPLANE OPERATING PROCEDURES - LANDING

Noise abatement procedures shall not contain a prohibition of use of reverse thrust during landing.

3.6 DISPLACED THRESHOLDS

The practice of using a displaced runway threshold as a noise abatement measure shall not be employed unless aircraft noise is significantly reduced by such use and the runway length remaining is safe and sufficient for all operational requirements.

3.7 CONFIGURATION AND SPEED CHANGES

Deviations from normal configuration and speeds appropriate to the phase of flight shall not be made mandatory.

3.8 UPPER LIMIT

Noise abatement procedures shall include information on the altitude/height above which they are no longer applicable.

3.9 COMMUNICATIONS

In order not to distract flight crews during the execution of noise abatement procedures, air/ground communications should be kept to a minimum.

Appendix to Chapter 3 - NOISE ABATEMENT DEPARTURE CLIMB GUIDANCE

1 GENERAL

1.1 Aeroplane operating procedures for the departure climb shall ensure that the necessary safety of flight operations is maintained while minimizing exposure to noise on the ground. These procedures are provided as examples because the noise reductions obtained depend greatly on the type of aeroplane, engine type, thrust required, and the height at which thrust is reduced. For this reason, procedures that provide the best possible noise benefit may differ significantly from one aeroplane type to another, and between aeroplanes of the same type with different engines.

States should avoid the practice of requiring all operators to use one of the example procedures for departures from specific runways, and should instead allow aircraft operators to develop operational procedures that maximize the noise benefits obtainable from their aeroplanes. This is not intended to prevent States from suggesting the use of a procedure based on one of the examples, as an alternative to operator-specific procedures. The following two examples of operating procedures for the climb have been developed as guidance and are considered safe when the criteria in 3.2.2 are satisfied.

The first example (NADP 1) is intended to describe one method, but not the only method, of providing noise reduction for noise-sensitive areas in close proximity to the departure end of the runway (see Figure 9-3-App-1).

The second example (NADP 2) similarly describes one method, but not the only method, of providing noise reduction to areas more distant from the runway end (see Figure 9-3-App-2). Aircraft operators may find that to suit their particular route system (i.e. at aerodromes where they operate), two different procedures, one designed for close and the other designed for distant noise reduction, may be appropriate.

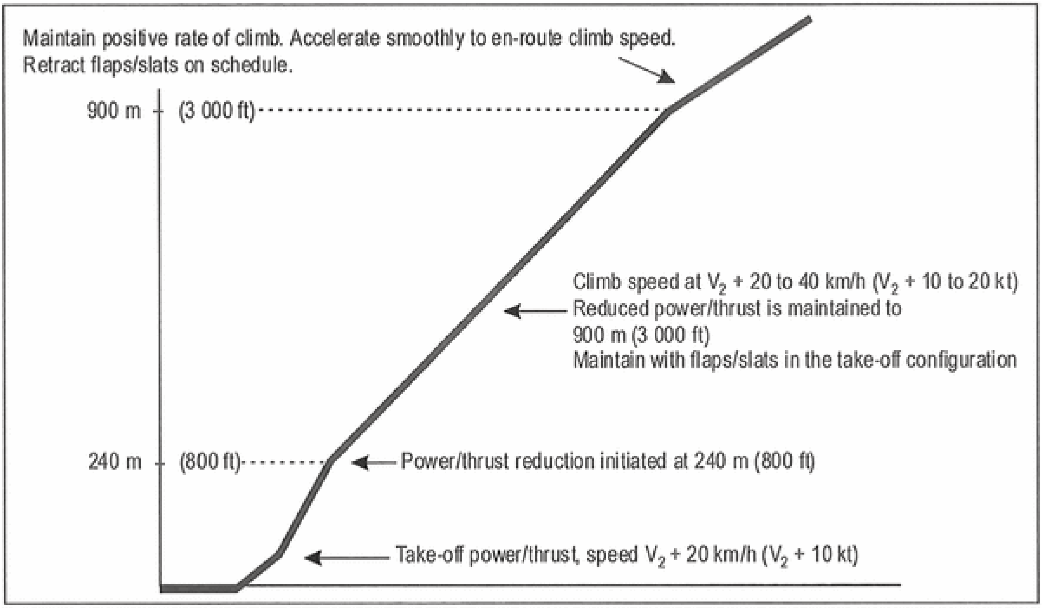
1.2 The two example procedures differ in that the acceleration segment for flap/slat retraction is either initiated prior to reaching the maximum prescribed height or at the maximum prescribed height. To ensure optimum acceleration performance, power or thrust reduction may be initiated at an intermediate flap setting.

2 NOISE ABATEMENT DEPARTURE CLIMB - EXAMPLE OF A PROCEDURE ALLEVIATING NOISE CLOSE TO THE AERODROME (NADP 1)

2.1 This procedure involves a power or thrust reduction at or above the prescribed minimum altitude (240 m (800 ft) above aerodrome elevation) and the delay of flap/slat retraction until the prescribed maximum altitude is attained. At the prescribed maximum altitude (900 m (3000 ft) above aerodrome elevation), the aircraft is accelerated and the flaps/slats are retracted on schedule while maintaining a positive rate of climb, to complete the transition to normal en-route climb speed. The initial climbing speed to the noise abatement initiation point is not less than V_2 plus 20 km/h (V_2 plus 10 kt).

2.2 In the example shown below, on reaching an altitude of 240 m (800 ft) above aerodrome elevation, engine power or thrust is adjusted in accordance with the noise abatement power/thrust schedule provided in the aircraft operating manual. A climb speed of V_2 plus 20 to 40 km/h (V_2 plus 10 to 20 kt) is maintained with flaps and slats in the take-off configuration. On reaching an altitude of 900 m (3000 ft) above aerodrome elevation, the aircraft is accelerated and the flaps/slats are retracted on schedule while maintaining a positive rate of climb to complete the transition to normal en-route climb speed.

Figure 9-3-App-1. Noise abatement take-off climb — Example of a procedure alleviating noise close to the aerodrome (NADP 1)



3 NOISE ABATEMENT DEPARTURE CLIMB - EXAMPLE OF A PROCEDURE ALLEVIATING NOISE DISTANT FROM THE AERODROME (NADP 2)

3.1 This procedure involves initiation of flap/slat retraction at or above the prescribed minimum altitude (240 m (800 ft) above aerodrome elevation) but before reaching the prescribed maximum altitude (900 m (3000 ft) above aerodrome elevation). The flaps/slats are to be retracted on schedule while maintaining a positive rate of climb. Intermediate flap retraction, if required for performance, may be accomplished below the prescribed minimum altitude. The power or thrust reduction is initiated at a point along the acceleration segment that ensures satisfactory acceleration performance. At the prescribed maximum altitude, a transition is made to normal en-route climb procedures. The initial climbing speed to the noise abatement initiation point is not less than V_2 plus 20 km/h (V_2 plus 10kt).

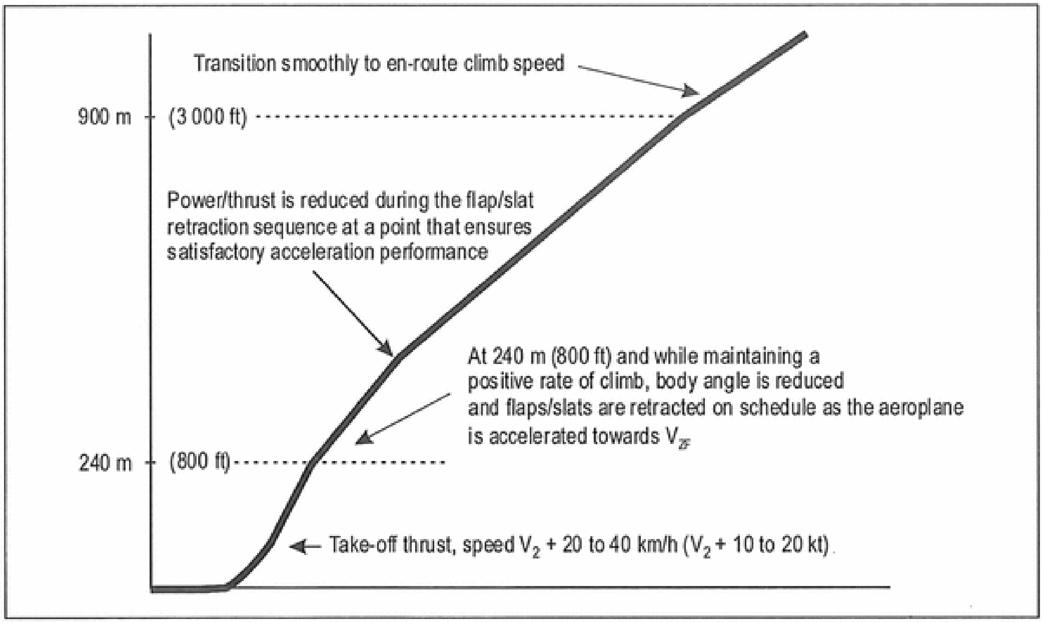
3.2 In the example shown below, on reaching 240 m (800 ft) above aerodrome elevation, the aircraft body angle/angle of pitch is decreased, the aeroplane is accelerated towards V_{zf}, and the flaps/slats are retracted on schedule. Power or thrust reduction is initiated at a point along the acceleration segment that ensures satisfactory acceleration performance. A positive rate of climb is maintained to 900 m (3000 ft) above aerodrome elevation. On reaching this altitude, a transition is made to normal en-route climb speed.

3.3 An aeroplane should not be diverted from its assigned route unless:

a. in the case of a departing aeroplane it has attained the altitude or height which represents the upper limit for noise abatement procedures; or

b. it is necessary for the safety of the aeroplane (e.g. for avoidance of severe weather or to resolve a traffic conflict).

Figure 9-3-App-2. Noise abatement take-off climb — Example of a procedure alleviating noise distant from the aerodrome (NADP 2)



SUPERCEDED NOISE ABATEMENT PROCEDURES

NOTE: Many locations continue to prescribe the former Noise Abatement Departure Procedures A and B. Though no longer part of the ICAO PANS-OPS Doc. 8168, they have been reproduced in the following paragraphs as supplementary information.

Noise Abatement Departure Procedure A (NADP A)

Take-off to 450 m (1500 ft) above aerodrome elevation:

- take-off power
- take-off flap
- climb at V_2 + 20 to 40 km/h (V_2 + 10 to 20 kt) (or as limited by body angle).

At 450 m (1500 ft):

- reduce thrust to not less than climb power/thrust.

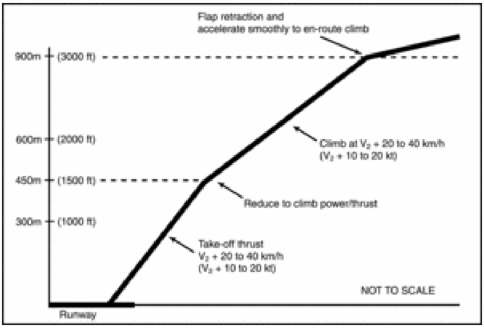
At 450 m (1500 ft) to 900 m (3000 ft):

- climb at V_2 + 20 to 40 km/h (V_2 + 10 to 20 kt).

At 900 m (3000 ft):

- accelerate smoothly to enroute climb speed with flap retraction on schedule.

Noise Abatement Take-Off Climb - Procedure A



NOTE: For purposes of these procedures the heights given in metres and feet, and speeds given in kilometers/hour and knots are considered to be operationally acceptable equivalents.

Noise Abatement Departure Procedure B (NADP B)

Take-off to 300 m (1000 ft) above aerodrome elevation:

- take-off power/thrust
- take-off flap
- climb at V_2 + 20 to 40 km/h (V_2 + 10 to 20 kt).

At 300 m (1000 ft):

- maintaining a positive rate of climb, accelerate to zero flap minimum safe manoeuvring speed (V_{ZF}) retracting flap on schedule;

thereafter, reduce thrust consistent with the following:

a. for high by-pass ration engines reduce to normal climb power/thrust;

b. for low by-pass ratio engines, reduce power/thrust to below normal climb thrust but not less than that necessary to maintain the final take-off engine-out climb gradient; and

c. for aeroplanes with slow flap retracting reduce power/thrust at an intermediate flap setting;

thereafter, from 300 m (1000 ft) to 900 m (3000 ft):

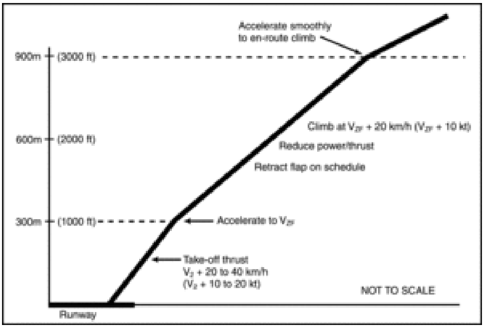
– continue climb at not greater than V_{ZF} + 20 km/h (V_{ZF} + 10 kt).

At 900 m (3000 ft):

– accelerate smoothly to enroute climb speed.

NOTE: Aeroplanes such as supersonic aeroplanes not using wing flaps for take-off should reduce thrust before attaining 300 m (1000 ft) but not lower than 150 m (500 ft).

Noise Abatement Take-Off Climb - Procedure B



NOTE: For purposes of these procedures the heights given in metres and feet, and speeds given in kilometers/hour and knots are considered to be operationally acceptable equivalents.

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Air Traffic Control

International Civil Aviation Organization - Rules of the Air

ICAO RULES OF THE AIR - ANNEX 2

Extracted from ICAO Rules of the Air, Annex 2

CHAPTER 1 - DEFINITIONS

See AIR TRAFFIC CONTROL - International Civil Aviation Organization Definitions.

CHAPTER 2 - APPLICABILITY OF THE RULES OF THE AIR

2.1 TERRITORIAL APPLICATION OF THE RULES OF THE AIR

2.1.1 The rules of the air shall apply to aircraft bearing the nationality and registration marks of a Contracting State, wherever they may be, to the extent that they do not conflict with the rules published by the State having jurisdiction over the territory overflown.

NOTE: The council of the International Civil Aviation Organization resolved, in adopting Annex 2 in April 1948 and Amendment 1 to the said Annex in November 1951, that the Annex constitutes "Rules relating to the flight and manoeuvre of aircraft" within the meaning of Article 12 of the Convention. Over the high seas, therefore, these rules apply without exception.

2.1.2 If, and so long as, a Contracting State has not notified the International Civil Aviation Organization to the contrary, it shall be deemed, as regards aircraft of its registration, to have agreed as follows:

For purposes of flight over those parts of the high seas where a Contracting State has accepted, pursuant to a regional air navigation agreement, the responsibility of providing air traffic services, the "appropriate ATS authority" referred to in this Annex is the relevant authority designated by the State responsible for providing those services.

NOTE: The phrase "regional air navigation agreement" refers to an agreement approved by the Council of ICAO normally on the advice of a Regional Air Navigational Meeting.

2.2 COMPLIANCE WITH THE RULES OF THE AIR

The operation of an aircraft either in flight or on the movement area of an aerodrome shall be in compliance with the general rules and, in addition, when in flight, either with:

a. the visual flight rules, or

b. the instrument flight rules.

NOTE 1: Information relevant to the services provided to aircraft operating in accordance with both visual flight rules and instrument flight rules in the seven ATS airspace classes contained in Annex 11 are published as ICAO ATS AIRSPACE CLASSIFICATIONS – ANNEX 11, 2.6 CLASSIFICATION OF AIRSPACES.

NOTE 2: A pilot may elect to fly in accordance with instrument flight rules in visual meteorological conditions or he may be required to do so by the appropriate ATS authority.

2.3 RESPONSIBILITY FOR COMPLIANCE WITH THE RULES OF THE AIR

2.3.1 Responsibility of Pilot-in-Command

The pilot-in-command of an aircraft shall, whether manipulating the controls or not, be responsible for the operation of the aircraft in accordance with the rules of the air, except that the pilot-in-command may depart from these rules in circumstances that render such departure absolutely necessary in the interests of safety.

2.3.2 Pre-Flight Action

Before beginning a flight, the pilot-in-command of an aircraft shall become familiar with all available information appropriate to the intended operation. Pre-flight action for flights away from the vicinity of an aerodrome, and for all IFR flights, shall include a careful study of available current weather reports and forecasts, taking into consideration fuel requirements and an alternative course of action if the flight cannot be completed as planned.

2.4 AUTHORITY OF PILOT-IN-COMMAND OF AN AIRCRAFT

The pilot-in-command of an aircraft shall have final authority as to the disposition of the aircraft while in command.

2.5 PROBLEMATIC USE OF PSYCHOACTIVE SUBSTANCES

No person whose function is critical to the safety of aviation (safety-sensitive personnel) shall undertake that function while under the influence of any psychoactive substance, by reason of which human performance is impaired. No such person shall engage in any kind of problematic use of substances.

CHAPTER 3 — GENERAL RULES

3.1 PROTECTION OF PERSONS AND PROPERTY

3.1.1 Negligent or Reckless Operation of Aircraft

An aircraft shall not be operated in a negligent or reckless manner so as to endanger life or property of others.

3.1.2 Minimum Heights

Except when necessary for take-off or landing, or except by permission from the appropriate authority, aircraft shall not be flown over the congested areas of cities, towns or settlements or over an open-air assembly of persons, unless at such a height as will permit, in the event of an emergency arising, a landing to be made without undue hazard to persons or property on the surface.

NOTE: See 4.6 for minimum heights for VFR flights and 5.1.2 for minimum levels for IFR flights.

3.1.3 Cruising Levels

The cruising levels at which a flight or a portion of a flight is to be conducted shall be in terms of:

a. flight levels, for flights at or above the lowest usable flight level or, where applicable, above the transition altitude;

b. altitudes, for flights below the lowest usable flight level or, where applicable, at or below the transition altitude.

NOTE: The system of flight levels is prescribed in the Procedures for Air Navigation Services — Aircraft Operations, (Doc 8168) (not published herein).

3.1.4 Dropping or Spraying

Nothing shall be dropped or sprayed from an aircraft in flight except under conditions prescribed by the appropriate authority and as indicated by relevant information, advice and/or clearance from the appropriate air traffic services unit.

3.1.5 Towing

No aircraft or other object shall be towed by an aircraft, except in accordance with requirements prescribed by the appropriate authority and as indicated by relevant information, advice and/or clearance from the appropriate air traffic services unit.

3.1.6 Parachute Descents

Parachute descents, other than emergency descents, shall not be made except under conditions prescribed by the appropriate authority and as indicated by relevant information, advice and/or clearance from the appropriate air traffic services unit.

3.1.7 Acrobatic Flight

No aircraft shall be flown acrobatically except under conditions prescribed by the appropriate authority and as indicated by relevant information, advice and/or clearance from the appropriate air traffic services unit.

3.1.8 Formation Flights

Aircraft shall not be flown in formation except by pre-arrangement among the pilots-in-command of the aircraft taking part in the flight and, for formation flight in controlled airspace, in accordance with the conditions prescribed by the appropriate ATS authority(ies). These conditions shall include the following:

a. the formation operates as a single aircraft with regard to navigation and position reporting;

b. separation between aircraft in the flight shall be the responsibility of the flight leader and the pilots-in-command of the other aircraft in the flight and shall include periods of transition when aircraft are manoeuvring to attain their own separation within the formation and during join-up and break-away; and

c. a distance not exceeding 1km (0.5 NM) laterally and longitudinally and 30m (100 ft) vertically from the flight leader shall be maintained by each aircraft.

3.1.9 Remotely Piloted Aircraft

A remotely piloted aircraft shall be operated in such a manner as to minimize hazards to persons, property or other aircraft and in accordance with the conditions specified in Appendix 4.

3.1.10 Unmanned Free Balloons

An unmanned free balloon shall be operated in such a manner as to minimize hazards to persons, property or other aircraft and in accordance with the conditions specified in Appendix 5.

3.1.11 Prohibited Areas and Restricted Areas

Aircraft shall not be flown in a prohibited area, or in a restricted area, the particulars of which have been duly published, except in accordance with the conditions of the restrictions or by permission of the State over whose territory the areas are established.

3.2 AVOIDANCE OF COLLISIONS

Nothing in these rules shall relieve the pilot-in-command of an aircraft from the responsibility of taking such action, including collision avoidance maneuvers based on resolution advisories provided by ACAS equipment, as will best avert collision.

NOTE 1: It is important that vigilance for the purpose of detecting potential collisions be exercised on board an aircraft, regardless of the type of flight or the class of airspace in which the aircraft is operating, and while operating on the movement area of an airport.

NOTE 2: Operating procedures for use of ACAS detailing the responsibilities of the pilot-in-command are contained in AIR TRAFFIC CONTROL – International Civil Aviation Organization Flight Procedures (PANS-OPS Doc 8168, Vol I, Part VIII, Chapter 3).

NOTE 3: Carriage requirements for ACAS equipment are addressed in Annex 6, Part I, Chapter 6 and Part II, Chapter 6 (not published herein).

3.2.1 Proximity

An aircraft shall not be operated in such proximity to other aircraft as to create a collision hazard.

3.2.2 Right-of-Way

The aircraft that has the right-of-way shall maintain its heading and speed.

NOTE 1: Operating procedures for use of ACAS are contained in AIR TRAFFIC CONTROL – International Civil Aviation Organization Flight Procedures (PANS-OPS Doc 8168, Vol I, Part VIII, Chapter 3).

NOTE 2: Carriage requirements for ACAS equipment are addressed in Annex 6, Part I, Chapter 6 (not published herein).

3.2.2.1 An aircraft that is obliged by the following rules to keep out of the way of another shall avoid passing over, under or in front of the other, unless it passes well clear and takes into account the effect of aircraft wake turbulence.

3.2.2.2 Approaching Head-On

When two aircraft are approaching head-on or approximately so and there is danger of collision, each shall alter its heading to the right.

3.2.2.3 Converging

When two aircraft are converging at approximately the same level, the aircraft that has the other on its right shall give way, except as follows:

a. power-driven heavier-than-air aircraft shall give way to airships, gliders and balloons;
b. airships shall give way to gliders and balloons;
c. gliders shall give way to balloons;
d. power-driven aircraft shall give way to aircraft which are seen to be towing other aircraft or objects.

3.2.2.4 Overtaking

An overtaking aircraft is an aircraft that approaches another from the rear on a line forming an angle of less than 70 degrees with the plane of symmetry of the latter; i.e., is in such a position with reference to the other aircraft that at night it should be unable to see either of the aircraft’s left (port) or right (starboard) navigation lights. An aircraft that is being overtaken has the right-of-way and the overtaking aircraft, whether climbing, descending or in horizontal flight, shall keep out of the way of the other aircraft by altering its heading to the right, and no subsequent change in the relative positions of the two aircraft shall absolve the overtaking aircraft from this obligation until it is entirely past and clear.

3.2.2.5 Landing

3.2.2.5.1 An aircraft in flight, or operating on the ground or water, shall give way to aircraft landing or in the final stages of an approach to land.

3.2.2.5.2 When two or more heavier-than-air aircraft are approaching an aerodrome for the purpose of landing, aircraft at the higher level shall give way to aircraft at the lower level, but the latter shall not take advantage of this rule to cut in front of another which is in the final stages of an approach to land, or to overtake that aircraft. Nevertheless, power-driven heavier-than-air aircraft shall give way to gliders.

3.2.2.5.3 EMERGENCY LANDING

An aircraft that is aware that another is compelled to land shall give way to that aircraft.

3.2.2.6 Taking Off

An aircraft taxiing on the maneuvering area of an airport shall give way to aircraft taking off or about to take off.

3.2.2.7 Surface Movement of Aircraft

3.2.2.7.1 In case of danger of collision between two aircraft taxiing on the movement area of an aerodrome the following shall apply:

a. when two aircraft are approaching head on, or approximately so, each shall stop or where practicable alter its course to the right so as to keep well clear;

b. when two aircraft are on a converging course, the one which has the other on its right shall give way;

c. an aircraft which is being overtaken by another aircraft shall have the right-of-way and the overtaking aircraft shall keep well clear of the other aircraft.

NOTE: For the description of an overtaking aircraft see 3.2.2.4.

3.2.2.7.2 An aircraft taxiing on the manoeuvring area shall stop and hold at all runway-holding positions unless otherwise authorized by the aerodrome control tower.

NOTE: For runway-holding position markings and related signs, see Annex 14, Volume I, 5.2.10 and 5.4.2 or the INTRODUCTION – Signs and Markings – ICAO Recommended Airport Signs and Taxiway Markings.

3.2.2.7.3 An aircraft taxiing on the manoeuvring area shall stop and hold at all lighted stop bars and may proceed further when the lights are switched off.

3.2.3 Lights to be Displayed by Aircraft

NOTE 1: The characteristics of lights intended to meet the requirements of 3.2.3 for aeroplanes are specified in Annex 8. Specifications for navigation lights for aeroplanes are contained in the Appendices to Parts I and II of Annex 6. Detailed technical specifications for lights for aeroplanes are contained in Volume II, Part A, Chapter 4 of the Airworthiness Manual (Doc 9760) and for helicopters in Part A, Chapter 5 of that document. (Annex 6 and 8, and Doc 9760 not published herein).

NOTE 2: In the context of 3.2.3.2c. and 3.2.3.4a., an aircraft is understood to be operating when it is taxiing or being towed or is stopped temporarily during the course of taxiing or being towed.

NOTE 3: For aircraft on the water see 3.2.6.2.

3.2.3.1 Except as provided by 3.2.3.5, from sunset to sunrise or during any other period which may be prescribed by the appropriate authority all aircraft in flight shall display:

a. anti-collision lights intended to attract attention to the aircraft; and

b. navigation lights intended to indicate the relative path of the aircraft to an observer and other lights shall not be displayed if they are likely to be mistaken for these lights.

NOTE: Lights fitted for other purposes, such as landing lights and airframe floodlights, may be used in addition to the anti-collision lights specified in the Airworthiness Manual Volume II (Doc 9760) to enhance aircraft conspicuity.

3.2.3.2 Except as provided by 3.2.3.5, from sunset to sunrise or during any other period prescribed by the appropriate authority:

a. all aircraft moving on the movement area of an aerodrome shall display navigation lights intended to indicate the relative path of the aircraft to an observer and other lights shall not be displayed if they are likely to be mistaken for these lights;

b. unless stationary and otherwise adequately illuminated, all aircraft on the movement area of an aerodrome shall display lights intended to indicate the extremities of their structure;

c. all aircraft operating on the movement area of an aerodrome shall display lights intended to attract attention to the aircraft; and

d. all aircraft on the movement area of an aerodrome whose engines are running shall display lights which indicate that fact.

NOTE: If suitably located on the aircraft, the navigation lights referred to in 3.2.3.1b. may also meet the requirements of 3.2.3.2b. Red anti-collision lights fitted to meet the requirements of 3.2.3.1a. may also meet the requirements of 3.2.3.2c. and 3.2.3.2d. provided they do not subject observers to harmful dazzle.

3.2.3.3 Except as provided by 3.2.3.5, all aircraft in flight and fitted with anti-collision lights to meet the requirement of 3.2.3.1a. shall display such lights also outside of the period specified in 3.2.3.1.

3.2.3.4 Except as provided by 3.2.3.5, all aircraft:

a. operating on the movement area of an aerodrome and fitted with anti-collision lights to meet the requirements of 3.2.3.2c.; or

b. on the movement area of an aerodrome and fitted with lights to meet the requirement of 3.2.3.2d);

shall display such lights also outside the period specified in 3.2.3.2.

3.2.3.5 A pilot shall be permitted to switch off or reduce the intensity of any flashing lights fitted to meet the requirements of 3.2.3.1, 3.2.3.2, 3.2.3.3 and 3.2.3.4 if they do or are likely to:

a. adversely affect the satisfactory performance of duties; or

b. subject an outside observer to harmful dazzle.

3.2.4 Simulated Instrument Flights

An aircraft shall not be flown under simulated instrument flight conditions unless:

a. fully functioning dual controls are installed in the aircraft; and

b. a qualified pilot occupies a control seat to act as safety pilot for the person who is flying under simulated instrument conditions. The safety pilot shall have adequate vision forward and to each side of the aircraft, or a competent observer in communication with the safety pilot shall occupy a position in the aircraft from which the observer's field of vision adequately supplements that of the safety pilot.

3.2.5 Operation on and in the Vicinity of an Aerodrome

An aircraft operated on or in the vicinity of an aerodrome shall, whether or not within an aerodrome traffic zone:

a. observe other aerodrome traffic for the purpose of avoiding collision;

b. conform with or avoid the pattern of traffic formed by other aircraft in operation;

c. make all turns to the left, when approaching for a landing and after taking off, unless otherwise instructed;

d. land and take off into the wind unless safety, the runway configuration, or air traffic considerations determine that a different direction is preferable.

NOTE 1: See 3.6.5.1.

NOTE 2: Additional rules may apply in aerodrome traffic zones.

3.2.6 Water Operations

NOTE: In addition to the provisions of 3.2.6.1, rules set forth in the International Regulations for Preventing Collisions at Sea, developed by the International Conference on Revision of the International Regulations for Preventing Collisions at Sea (London, 1972) may be applicable in certain cases.

3.2.6.1 When two aircraft or an aircraft and a vessel are approaching one another and there is a risk of collision, the aircraft shall proceed with careful regard to existing circumstances and conditions including the limitations of the respective craft.

3.2.6.1.1 CONVERGING

An aircraft which has another aircraft or a vessel on its right shall give way so as to keep well clear.

3.2.6.1.2 APPROACHING HEAD-ON

An aircraft approaching another aircraft or a vessel head-on, or approximately so, shall alter its heading to the right to keep well clear.

3.2.6.1.3 OVERTAKING

The aircraft or vessel which is being overtaken has the right-of-way, and the one overtaking shall alter its heading to keep well clear.

3.2.6.1.4 LANDING AND TAKING OFF

Aircraft landing on or taking off from the water shall, in so far as practicable, keep well clear of all vessels and avoid impeding their navigation.

3.2.6.2 Lights to be Displayed by Aircraft on the Water

Between sunset and sunrise or such other period between sunset and sunrise as may be prescribed by the appropriate authority, all aircraft on the water shall display lights as required by the International Regulations for Preventing Collisions at Sea (revised 1972) unless it is impractical for them to do so, in which case they shall display lights as closely similar as possible in characteristics and position to those required by the International Regulations.

NOTE 1: Specifications for lights to be shown by aeroplanes on the water are contained in the Appendices to Parts I and II of Annex 6 (not published herein).

NOTE 2: The International Regulations for Preventing Collisions at Sea specify that the rules concerning lights shall be complied with from sunset to sunrise. Any lesser period between sunset *and sunrise established in accordance with 3.2.6.2 cannot, therefore, be applied in areas where the International Regulations for Preventing Collisions at Sea apply; e.g., on the high seas.*

3.3 FLIGHT PLANS

3.3.1 Submission of a Flight Plan

3.3.1.1 Information relative to an intended flight or portion of a flight, to be provided to air traffic services units, shall be in the form of a flight plan.

3.3.1.2 A flight plan shall be submitted prior to operating:

a. any flight or portion thereof to be provided with air traffic control service;

b. any IFR flight within advisory airspace;

c. any flight within or into designated areas, or along designated routes, when so required by the appropriate ATS authority to facilitate the provision of flight information, alerting and search and rescue services;

d. any flight within or into designated areas, or along designated routes, when so required by the appropriate ATS authority to facilitate coordination with appropriate military units or with air traffic services units in adjacent States in order to avoid the possible need for interception for the purpose of identification;

e. any flight across international borders.

NOTE: The term “flight plan” is used to mean variously, full information on all items comprised in the flight plan description, covering the whole route of a flight, or limited information required when the purpose is to obtain a clearance for a minor portion of a flight such as to cross an airway, to take off from, or to land at a controlled aerodrome.

3.3.1.3 A flight plan shall be submitted before departure to an air traffic services reporting office or, during flight, transmitted to the appropriate air traffic services unit or air-ground control radio station, unless arrangements have been made for submission of repetitive flight plans.

3.3.1.4 Unless otherwise prescribed by the appropriate ATS authority, a flight plan for a flight to be provided with air traffic control service or air traffic advisory service shall be submitted at least sixty minutes before departure, or, if submitted during flight, at a time which will ensure its receipt by the appropriate air traffic services unit at least ten minutes before the aircraft is estimated to reach:

a. the intended point of entry into a control area or advisory area; or

b. the point of crossing an airway or advisory route.

3.3.2 Contents of a Flight Plan

A flight plan shall comprise information regarding such of the following items as are considered relevant by the appropriate ATS authority:

- Aircraft identification
- Flight rules and type of flight

- Number and type(s) of aircraft and wake turbulence category
- Equipment
- Departure aerodrome (see Note 1)
- Estimated off-block time (see Note 2)
- Cruising speed(s)
- Cruising level(s)
- Route to be followed
- Destination aerodrome and total estimated elapsed time
- Alternate aerodrome(s)
- Fuel endurance
- Total number of persons on board
- Emergency and survival equipment
- Other information

NOTE 1: For flight plans submitted during flight, the information provided in respect of this item will be an indication of the location from which supplementary information concerning the flight may be obtained, if required.

NOTE 2: For flight plans submitted during flight, the information to be provided in respect of this item will be the time over the first point of the route to which the flight plan relates.

NOTE 3: The term “aerodrome” where used in the flight plan is intended to cover also sites other than aerodromes which may be used by certain types of aircraft; e.g., helicopters or balloons.

3.3.3 Completion of a Flight Plan

3.3.3.1 Whatever the purpose for which it is submitted, a flight plan shall contain information, as applicable, on relevant items up to and including “Alternate aerodrome(s)” regarding the whole route or the portion thereof for which the flight plan is submitted.

3.3.3.2 It shall, in addition, contain information, as applicable, on all other items when so prescribed by the appropriate ATS authority or when otherwise deemed necessary by the person submitting the flight plan.

3.3.4 Changes to a Flight Plan

Subject to the provisions of 3.6.2.2, all changes to a flight plan submitted for an IFR flight, or a VFR flight operated as a controlled flight, shall be reported as soon as practicable to the appropriate air traffic services unit. For other VFR flights, significant changes to a flight plan shall be reported as soon as practicable to the appropriate air traffic services unit.

NOTE 1: Information submitted prior to departure regarding fuel endurance or total number of persons carried on board, if incorrect at time of departure, constitutes a significant change to the flight plan and as such must be reported.

NOTE 2: Procedures for submission of changes to repetitive flight plans are contained in the PANS-ATM (Doc 4444). (see AIR TRAFFIC CONTROL – International Civil Aviation Organization Air Traffic Management)

3.3.5 Closing a Flight Plan

3.3.5.1 Unless otherwise prescribed by the appropriate ATS authority, a report of arrival shall be made in person, by radiotelephony or via data link at the earliest possible moment after landing, to the appropriate air traffic services unit at the arrival aerodrome, by any flight for which a flight plan has been submitted covering the entire flight or the remaining portion of a flight to the destination aerodrome.

3.3.5.2 When a flight plan has been submitted only in respect of a portion of a flight, other than the remaining portion of a flight to destination, it shall, when required, be closed by an appropriate report to the relevant air traffic services unit.

3.3.5.3 When no air traffic services unit exists at the arrival aerodrome, the arrival report, when required, shall be made as soon as practicable after landing and by the quickest means available to the nearest air traffic services unit.

3.3.5.4 When communication facilities at the arrival aerodrome are known to be inadequate and alternate arrangements for the handling of arrival reports on the ground are not available, the following action shall be taken. Immediately prior to landing the aircraft shall, if practicable, transmit to the appropriate air traffic services unit, a message comparable to an arrival report, where such a report is required. Normally, this transmission shall be made to the aeronautical station serving the air traffic services unit in charge of the flight information region in which the aircraft is operated.

3.3.5.5 Arrival reports made by aircraft shall contain the following elements of information:

a. aircraft identification;

b. departure aerodrome;

c. destination aerodrome (only in the case of a diversionary landing);

d. arrival aerodrome;

e. time of arrival.

> *NOTE: Whenever an arrival report is required, failure to comply with these provisions may cause serious disruption in the air traffic services and incur great expense in carrying out unnecessary search and rescue operations.*

3.4 SIGNALS

3.4.1 Upon observing or receiving any of the signals given in Appendix 1, aircraft shall take such action as may be required by the interpretation of the signal given in that Appendix.

3.4.2 The signals of Appendix 1 shall, when used, have the meaning indicated therein. They shall be used only for the purpose indicated and no other signals likely to be confused with them shall be used.

3.5 TIME

3.5.1 Coordinated Universal Time (UTC) shall be used and shall be expressed in hours and minutes and, when required, seconds of the 24-hour day beginning at midnight.

3.5.2 A time check shall be obtained prior to operating a controlled flight and at such other times during the flight as may be necessary.

NOTE: Such time check is normally obtained from an air traffic services unit unless other arrangements have been made by the operator or by the appropriate ATS authority.

3.5.3 Whenever time is utilized in the application of data link communications, it shall be accurate to within 1 second of UTC.

3.6 AIR TRAFFIC CONTROL SERVICE

3.6.1 Air Traffic Control Clearances

3.6.1.1 An air traffic control clearance shall be obtained prior to operating a controlled flight, or a portion of a flight as a controlled flight. Such clearance shall be requested through the submission of a flight plan to an air traffic control unit.

NOTE 1: A flight plan may cover only part of a flight, as necessary, to describe that portion of the flight or those manoeuvres which are subject to air traffic control. A clearance may cover only part of a current flight plan, as indicated in a clearance limit or by reference to specific manoeuvres such as taxiing, landing or taking off.

NOTE 2: If an air traffic control clearance is not satisfactory to a pilot-in-command of an aircraft, the pilot-in-command may request and, if practicable, will be issued an amended clearance.

3.6.1.2 Whenever an aircraft has requested a clearance involving priority, a report explaining the necessity for such priority shall be submitted, if requested by the appropriate air traffic control unit.

3.6.1.3 Potential Reclearance in Flight

If prior to departure it is anticipated that depending on fuel endurance and subject to reclearance in flight, a decision may be taken to proceed to a revised destination aerodrome, the appropriate air traffic control units shall be so notified by the insertion in the flight plan of information concerning the revised route (where known) and the revised destination.

NOTE: The intent of this provision is to facilitate a reclearance to a revised destination, normally beyond the filed destination aerodrome.

3.6.1.4 An aircraft operated on a controlled aerodrome shall not taxi on the manoeuvring area without clearance from the aerodrome control tower and shall comply with any instructions given by that unit.

3.6.2 Adherence to Current Flight Plan

3.6.2.1 Except as provided for in 3.6.2.4, an aircraft shall adhere to the current flight plan or the applicable portion of a current flight plan for a controlled flight within the tolerances defined in paragraphs 3.6.2.1.1 to 3.6.2.2 unless a request for a change has been made and clearance obtained from the appropriate air traffic control unit, or unless an emergency situation arises which necessitates immediate action by the aircraft, in which event as soon as circumstances permit, after such emergency authority is exercised, the appropriate air traffic services unit shall be notified of the action taken and that this action has been taken under emergency authority.

3.6.2.1.1 Unless otherwise authorized by the appropriate ATS authority or directed by the appropriate air traffic control unit, controlled flights shall, in so far as practicable:

a. when on an established ATS route, operate along the defined centre line of that route; or

b. when on any other route operate directly between the navigation facilities and/or points defining that route.

3.6.2.1.2 Subject to the overriding requirement in 3.6.2.1.1, an aircraft operating along an ATS route segment defined by reference to very high frequency omnidirectional radio ranges shall change over for its primary navigation guidance from the facility behind the aircraft to that ahead of it at, or as close as operationally feasible to, the change-over point, where established.

3.6.2.1.3 Deviation from the requirements in 3.6.2.1.1 shall be notified to the appropriate air traffic services unit.

3.6.2.2 *Deviations from the current flight plan.* In the event that a controlled flight deviates from its current flight plan, the following action shall be taken:

a. *Deviation from track:* If the aircraft is off track, action shall be taken forthwith to adjust the heading of the aircraft to regain track as soon as practicable.

b. *Deviation from ATC assigned Mach number/indicated airspeed:* The appropriate air traffic services unit shall be informed immediately.

c. *Deviation from Mach number/true airspeed:* If the sustained Mach number/true airspeed at cruising level varies by plus or minus Mach 0.02 or more, or plus or minus 19km/h (10 kt) true airspeed or more from the current flight plan, the appropriate air traffic unit shall be so informed.

d. *Change in time estimate:* Except where ADS-C is activated and serviceable in airspace where ADS-C services are provided, if the time estimate for the next applicable reporting point, flight information region boundary or destination airport, whichever comes first, changes in excess of 2 minutes from that previously notified to air traffic services, or such other period of time as is prescribed by the appropriate ATS authority or on the basis of regional air navigation agreements, the flight crew shall notify the appropriate air traffic services unit as soon as possible.

3.6.2.2.1 When ADS-C services are provided and ADS-C is activated, the air traffic services unit shall be informed automatically via data link whenever changes occur beyond the threshold values stipulated by the ADS event contract.

3.6.2.3 *Change Requests.* Requests for current flight plan changes shall include information as indicated hereunder:

a. *Change of cruising level:* Aircraft identification; requested new cruising level and cruising Mach number/true airspeed at this level; revised time estimates (when applicable) at subsequent reporting points or flight information region boundaries.

b. *Change of Mach number/true airspeed:* Aircraft identification, requested Mach number/true airspeed.

c. *Change of route:*

   1. *Destination unchanged:* Aircraft identification; flight rules; description of new route of flight including related flight plan data beginning with the position from which requested change of route is to commence; revised time estimates; any other pertinent information.

   2. *Destination changed:* Aircraft identification; flight rules; description of revised route of flight to revised destination airport including related flight plan data, beginning with the position from which requested change of route is to commence; revised time estimates; alternate airport(s); any other pertinent information.

3.6.2.4 Weather Deterioration Below the VMC

When it becomes evident that flight in VMC in accordance with its current flight plan will not be practicable, a VFR flight operated as a controlled flight shall:

a. request an amended clearance enabling the aircraft to continue in VMC to destination or to an alternative aerodrome, or to leave the airspace within which an ATC clearance is required; or

b. if no clearance in accordance with a. can be obtained, continue to operate in VMC and notify the appropriate ATC unit of the action being taken either to leave the airspace concerned or to land at the nearest suitable aerodrome; or

c. if operated within a control zone, request authorization to operate as a special VFR flight; or

d. request clearance to operate in accordance with the instrument flight rules.

3.6.3 Position Reports

3.6.3.1 Unless exempted by the appropriate ATS authority or by the appropriate air traffic services unit under conditions specified by that authority, a controlled flight shall report to the appropriate air traffic services unit, as soon as possible, the time and level of passing each designated compulsory reporting point, together with any other required information. Position reports shall similarly be made in relation to additional points when requested by the appropriate air traffic services unit. In the absence of designated reporting points, position reports shall be made at intervals prescribed by the appropriate ATS authority or specified by the appropriate air traffic services unit.

3.6.3.1.1 Controlled flights providing position information to the appropriate air traffic services unit via data link communications shall only provide voice position reports when requested.

NOTE: The conditions and circumstances in which ADS-B or SSR Mode C transmission of pressure-altitude satisfies the requirement for level information in position reports are indicated in the PANS-RAC, Part II (Doc 4444). (See AIR TRAFFIC CONTROL — International Civil Aviation Organization Air Traffic Management.)

3.6.4 Termination of Control

A controlled flight shall, except when landing at a controlled aerodrome, advise the appropriate ATC unit as soon as it ceases to be subject to air traffic control service.

3.6.5 Communications

3.6.5.1 An aircraft operated as a controlled flight shall maintain continuous air-ground voice communication watch on the appropriate communication channel of, and establish two-way communication as necessary with, the appropriate air traffic control unit, except as may be prescribed by the appropriate ATS authority in respect of aircraft forming part of aerodrome traffic at a controlled aerodrome.

NOTE 1: SELCAL or similar automatic signaling devices satisfy the requirement to maintain an air-ground voice communication watch.

NOTE 2: The requirement for an aircraft to maintain an air-ground voice communication watch remains in effect after CPDLC has been established.

3.6.5.2 Communications Failure

See EMERGENCY Section for related Communication Failure Information.

3.7 UNLAWFUL INTERFERENCE

See EMERGENCY Section for related Unlawful Interference Information.

NOTE: Responsibility of ATS units in situations of unlawful interference is contained in Annex 11 (not published herein).

3.8 INTERCEPTION

NOTE: The word “interception” in this context does not include intercept and escort service provided, on request, to an aircraft in distress, in accordance with the International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual (DOC 9731) (not published herein).

3.8.1 Interception of civil aircraft shall be governed by appropriate regulations and administrative directives issued by contracting States in compliance with the Convention on International Civil Aviation, and in particular Article 3(d) under which contracting States undertake, when issuing regulations for their State aircraft, to have due regard for the safety of navigation of civil aircraft.

Convention on International Civil Aviation (Montreal Protocol — Article 3 bis (b))

Article 3bis[1]

a. The contracting States recognize that every State must refrain from resorting to the use of weapons against civil aircraft in flight and that, in case of interception, the lives of persons on board and the safety of aircraft must not be endangered. This provision shall not be interpreted as modifying in any way the rights and obligations of States set forth in the Charter of the United Nations.

b. The contracting States recognize that every State, in the exercise of its sovereignty, is entitled to require the landing at some designated airport of a civil aircraft flying above its territory without authority or if there are reasonable grounds to conclude that it is being used for any purpose inconsistent with the aims of this Convention; it may also give such aircraft any other instructions to put an end to such violations. For this purpose, the contracting States may resort to any appropriate means consistent with relevant rules of international law, including the relevant provisions of this Convention, specifically paragraph a) of this Article. Each contracting State agrees to publish its regulations in force regarding the interception of civil aircraft.

c. Every civil aircraft shall comply with an order given in conformity with paragraph b) of this Article. To this end each contracting State shall establish all necessary provisions in its national laws or regulations to make such compliance mandatory for any civil aircraft registered in that State or operated by an operator who has his principal place of business or permanent residence in that State. Each contracting State shall make any violation of such applicable laws or regulations punishable by severe penalties and shall submit the case to its competent authorities in accordance with its laws or regulations.

d. Each contracting State shall take appropriate measures to prohibit the deliberate use of any civil aircraft registered in that State or operated by an operator who has his principal place of business or permanent residence in that State for any purpose inconsistent with the aims of this Convention. This provision shall not affect paragraph a) or derogate from paragraphs b) and c) of this Article.

[1] Added by amendment 1984-05-10, entered into force 1998-10-01.

See EMERGENCY Section for related Interception Information.

3.9 VMC VISIBILITY AND DISTANCE FROM CLOUDS MINIMA

VMC visibility and distance from clouds minima are contained in Table 3-1.

TABLE 3-1* (see 4.1)

Altitude band	Airspace class	Flight visibility	Distance from cloud
At and above 3050m (10,000 ft) AMSL	“A”*** “B” “C” “D” “E” “F” “G”	8km	1500m horizontally 300m (1000 ft) vertically
Below 3050m (10,000 ft) AMSL and above 900m (3000 ft) AMSL, or above 300m (1000 ft) above terrain, whichever is the higher	“A”*** “B” “C” “D” “E” “F” “G”	5km	1500m horizontally 300m (1000 ft) vertically
At and below 900m (3000 ft) AMSL, or 300m (1000 ft) above terrain, whichever is the higher	“A”*** “B” “C” “D” “E”	5km	1500m horizontally 300m (1000 ft) vertically
	“F” “G”	5km**	Clear of cloud and with the surface in sight

TABLE 3-1* (see 4.1) (continued)

<table>
<tr><th>Altitude band</th><th>Airspace class</th><th>Flight visibility</th><th>Distance from cloud</th></tr>
<tr><td colspan="4">* When the height of the transition altitude is lower than 3050m (10,000 ft) AMSL, FL100 should be used in lieu of 10,000 ft.
** When so prescribed by the appropriate ATS authority:
a) flight visibilities reduced to not less than 1500m may be permitted for flights operating:
1) at speeds that, in the prevailing visibility, will give adequate opportunity to observe other traffic or any obstacles in time to avoid collision; or
2) in circumstances in which the probability of encounters with other traffic would normally be low, e.g. in areas of low volume traffic and for aerial work at low levels.
b) HELICOPTERS may be permitted to operate in less than 1500m flight visibility, if manoeuvred at a speed that will give adequate opportunity to observe other traffic or any obstacles in time to avoid collision.
***The VMC minima in Class "A" airspace are included for guidance to pilots and do not imply acceptance of VFR flights in Class "A" airspace.</td></tr>
</table>

CHAPTER 4 — VISUAL FLIGHT RULES

4.1 Except when operating as a special VFR flight, VFR flights shall be conducted so that the aircraft is flown in conditions of visibility and distance from clouds equal to or greater than those specified in Table 3-1.

4.2 Except when a clearance is obtained from an air traffic control unit, VFR flights shall not take off or land at an aerodrome within a control zone, or enter the aerodrome traffic zone or traffic pattern:

a. when the ceiling is less than 450m (1500 ft); or

b. when the ground visibility is less than 5km.

4.3 VFR flights between sunset and sunrise, or such other period between sunset and sunrise as may be prescribed by the appropriate ATS authority, shall be operated in accordance with the conditions prescribed by such authority.

4.4 Unless authorized by the appropriate ATS authority, VFR flights shall not be operated:

a. above FL200;

b. at transonic and supersonic speeds.

4.5 Authorization for VFR flights to operate above FL290 shall not be granted in areas where a vertical separation minimum of 300m (1000 ft) is applied above FL290.

4.6 Except when necessary for take-off or landing, or except by permission from the appropriate authority, a VFR flight shall not be flown:

a. over the congested areas of cities, towns or settlements or over an open-air assembly of persons at a height less than 300m (1000 ft) above the highest obstacle within a radius of 600m from the aircraft;

b. elsewhere than as specified in 4.6a., at a height less than 150m (500 ft) above the ground or water.

NOTE: See also 3.1.2.

4.7 Except where otherwise indicated in air traffic control clearances or specified by the appropriate ATS authority, VFR flights in level cruising flight when operated above 900m (3000 ft) from the ground or water, or a higher datum as specified by the appropriate ATS authority, shall be conducted at a flight level appropriate to the track as specified in the Tables of cruising levels in Appendix 3.

4.8 VFR flights shall comply with the provisions of 3.6:

a. when operated within Classes “B”, “C” and “D” airspace;

b. when forming part of aerodrome traffic at controlled aerodromes; or

c. when operated as special VFR flights.

4.9 A VFR flight operating within or into areas, or along routes, designated by the appropriate ATS authority in accordance with 3.3.1.2c. or d., shall maintain continuous air-ground voice communication watch on the appropriate communication channel of, and report its position as necessary to, the air traffic services unit providing flight information service.

NOTE: See Note following 3.6.5.1.

4.10 An aircraft operated in accordance with the visual flight rules which wishes to change to compliance with the instrument flight rules shall:

a. if a flight plan was submitted, communicate the necessary changes to be effected to its current flight plan, or

b. when so required by 3.3.1.2, submit a flight plan to the appropriate air traffic services unit and obtain a clearance prior to proceeding IFR when in controlled airspace.

CHAPTER 5 — INSTRUMENT FLIGHT RULES

5.1 RULES APPLICABLE TO ALL IFR FLIGHTS

5.1.1 Aircraft Equipment

Aircraft shall be equipped with suitable instruments and with navigation equipment appropriate to the route to be flown.

5.1.2 Minimum Levels

Except when necessary for take-off or landing, or except when specifically authorized by the appropriate authority, an IFR flight shall be flown at a level which is not below the minimum flight altitude established by the State whose territory is overflown, or, where no such minimum flight altitude has been established:

a. over high terrain or in mountainous areas, at a level which is at least 600m (2000 ft) above the highest obstacle located within 8km of the estimated position of the aircraft;

b. elsewhere than as specified in a., at a level which is at least 300m (1000 ft) above the highest obstacle located within 8km of the estimated position of the aircraft.

NOTE 1: The estimated position of the aircraft will take account of the navigational accuracy which can be achieved on the relevant route segment, having regard to the navigational facilities available on the ground and in the aircraft.

NOTE 2: See also 3.1.2.

5.1.3 Change from IFR Flight to VFR Flight

5.1.3.1 An aircraft electing to change the conduct of its flight from compliance with the instrument flight rules to compliance with the visual flight rules shall, if a flight plan was submitted, notify the appropriate air traffic services unit specifically that the IFR flight is canceled and communicate thereto the changes to be made to its current flight plan.

5.1.3.2 When an aircraft operating under the instrument flight rules is flown in or encounters visual meteorological conditions it shall not cancel its IFR flight unless it is anticipated, and intended, that the flight will be continued for a reasonable period of time in uninterrupted visual meteorological conditions.

5.2 RULES APPLICABLE TO IFR FLIGHTS WITHIN CONTROLLED AIRSPACE

5.2.1 IFR flights shall comply with the provisions of 3.6 when operated in controlled airspace.

5.2.2 An IFR flight operating in cruising flight in controlled airspace shall be flown at a cruising level, or, if authorized to employ cruise climb techniques, between two levels or above a level, selected from:

a. the Tables of cruising levels in Appendix 3; or

b. a modified table of cruising levels, when so prescribed in accordance with Appendix 3 for flight above FL410;

except that the correlation of levels to track prescribed therein shall not apply whenever otherwise indicated in air traffic control clearances or specified by the appropriate ATS authority in Aeronautical Information Publications.

5.3 RULES APPLICABLE TO IFR FLIGHTS OUTSIDE CONTROLLED AIRSPACE

5.3.1 Cruising Levels

An IFR flight operating in level cruising flight outside of controlled airspace shall be flown at a cruising level appropriate to its track as specified in:

a. the Tables of cruising levels in Appendix 3, except when otherwise specified by the appropriate ATS authority for flight at or below 900m (3000 ft) above mean sea level; or

b. a modified table of cruising levels, when so prescribed in accordance with Appendix 3 for flight above FL410.

NOTE: This provision does not preclude the use of cruise climb techniques by aircraft in supersonic flight.

5.3.2 Communications

An IFR flight operating outside controlled airspace but within or into areas, or along routes, designated by the appropriate ATS authority in accordance with 3.3.1.2c. or d., shall maintain an air-ground voice communication watch on the appropriate communication channel and establish two-way communication, as necessary, with the air traffic services unit providing flight information service.

NOTE: See Note following 3.6.5.1.

5.3.3 Position Reports

An IFR flight operating outside controlled airspace and required by the appropriate ATS authority to:

- submit a flight plan;
- maintain an air-ground voice communication watch on the appropriate communication channel and establish two-way communication, as necessary, with the air traffic services unit providing flight information service;

shall report position as specified in 3.6.3 for controlled flights.

NOTE: Aircraft electing to use the air traffic advisory service whilst operating IFR within specified advisory airspace are expected to comply with the provisions of 3.6, except that the flight plan and changes thereto are not subjected to clearances and that two-way communication will be maintained with the unit providing the air traffic advisory service.

APPENDIX 1 — SIGNALS

NOTE: See Chapter 3, para 3.4 of the Annex.

1 DISTRESS AND URGENCY SIGNALS

See EMERGENCY Section for complete information.

NOTE: None of the provisions contained in the Emergency Section shall prevent the use, by an aircraft in distress, of any means at its disposal to attract attention, make known its position and obtain help.

2 SIGNALS FOR USE IN THE EVENT OF INTERCEPTION

See EMERGENCY Section for complete information.

3 VISUAL SIGNALS USED TO WARN AN UNAUTHORIZED AIRCRAFT FLYING IN, OR ABOUT TO ENTER A RESTRICTED, PROHIBITED OR DANGER AREA

By day and by night, a series of projectiles discharged from the ground at intervals of 10 seconds, each showing, on bursting, red and green lights or stars will indicate to an unauthorized aircraft that it is flying in or about to enter a restricted, prohibited or danger area, and that the aircraft is to take such remedial action as may be necessary.

4 SIGNALS FOR AERODROME TRAFFIC

4.1 LIGHT AND PYROTECHNIC SIGNALS

4.1.1 Instructions

Light signals are directed from Aerodrome Control to aircraft concerned. (See Figure 4-1.)

LIGHT SIGNAL	AIRCRAFT IN FLIGHT	AIRCRAFT ON THE GROUND
Steady green	Cleared to land	Cleared for take-off
Steady red	Give way to other aircraft and continue circling	Stop
Series of green flashes	Return for landing*	Cleared to taxi
Series of red flashes	Aerodrome unsafe, do not land	Taxi clear of landing area in use
Series of white flashes	Land at this aerodrome and proceed to apron*	Return to starting point on the aerodrome
Red pyrotechnic	Notwithstanding any previous instructions do not land for the time being	
*Clearances to land and to taxi will be given in due course.		

4.1.2 Acknowledgment by an Aircraft —

a. When in flight:

1. during the hours of daylight:
   - by rocking the aircraft's wings;

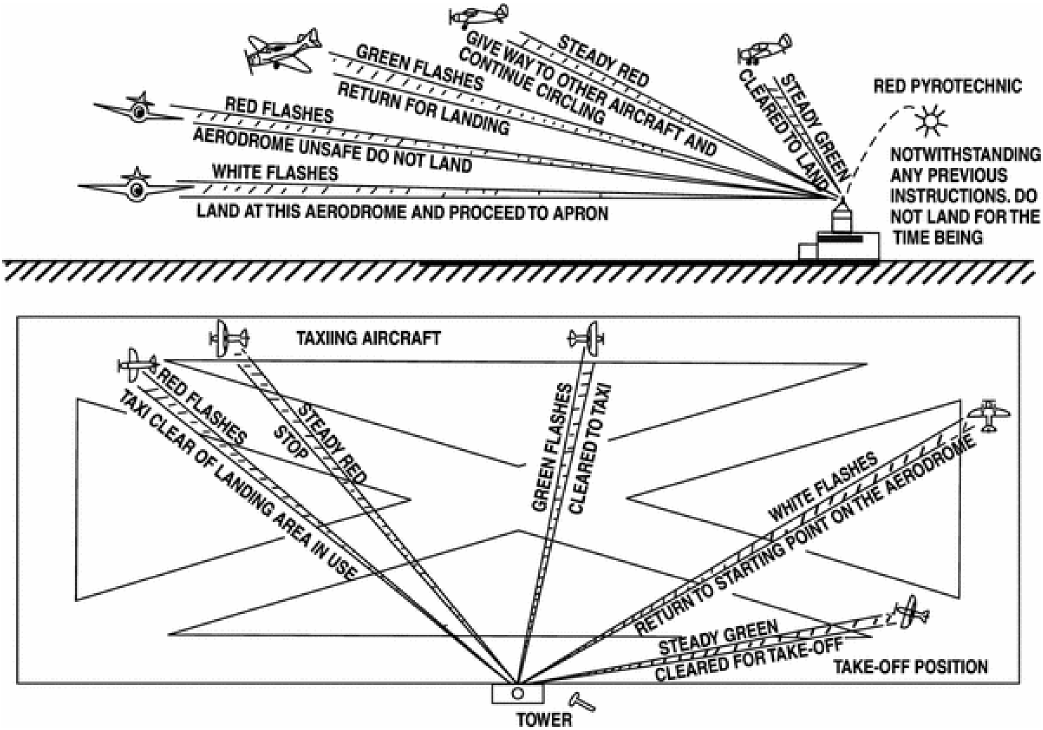
   NOTE: This signal should not be expected on the base and final legs of the approach.
2. during the hours of darkness:
   - by flashing on and off twice the aircraft's landing lights or, if not so equipped, by switching on and off twice its navigation lights.

b. When on the ground:

1. during the hours of daylight:

   - by moving the aircraft's ailerons or rudder;
2. during the hours of darkness:
   - by flashing on and off twice the aircraft's landing lights or, if not so equipped, by switching on and off twice its navigation lights.

Figure 4-1 (see 4.1.1)



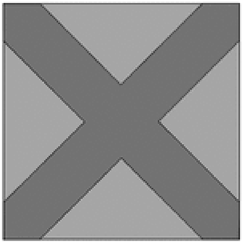
4.2 VISUAL GROUND SIGNALS

NOTE: For details of visual ground aids, see Annex 14 (not published herein).

4.2.1 Prohibition of Landing

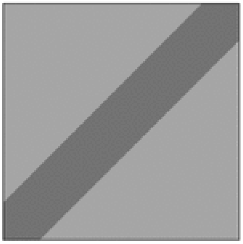
A horizontal red square panel with yellow diagonals when displayed in a signal area indicates that landings are prohibited and that the prohibition is liable to be prolonged.

ICAO RULES OF THE AIR - ANNEX 2



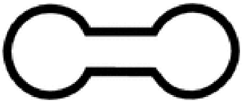
4.2.2 Need for Special Precautions While Approaching or Landing

A horizontal red square panel with one yellow diagonal when displayed in a signal area indicates that owing to the bad state of the manoeuvring area, or for any other reason, special precautions must be observed in approaching to land or in landing.

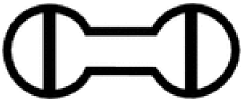


4.2.3 Use of Runways and Taxiways

4.2.3.1 A horizontal white dumb-bell when displayed in a signal area indicates that aircraft are required to land, take-off and taxi on runways and taxiways only.

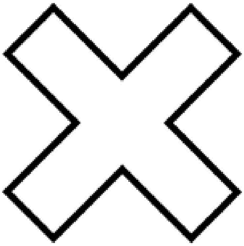


4.2.3.2 The same horizontal white dumb-bell as in 4.2.3.1 but with a black bar placed perpendicular to the shaft across each circular portion of the dumb-bell when displayed in a signal area indicates that aircraft are required to land and take-off on runways only, but other manoeuvres need not be confined to runways and taxiways.



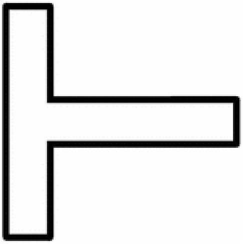
4.2.4 Closed Runways or Taxiways

Crosses of a single contrasting color, yellow or white, displayed horizontally on runways and taxiways or parts thereof indicate an area unfit for movement of aircraft.



4.2.5 Directions for Landing or Take-off

4.2.5.1 A horizontal white or orange landing T indicates the direction to be used by aircraft for landing and take-off, which shall be in a direction parallel to the shaft of the T towards the cross arm.

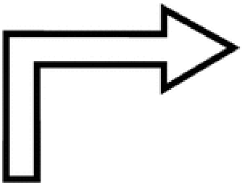


NOTE: When used at night, the landing T is either illuminated or outlined in white colored lights.

4.2.5.2 A set of two digits displayed vertically at or near the aerodrome control tower indicates to aircraft on the manoeuvring area the direction for take-off, expressed in units of 10 degrees to the nearest 10 degrees of the magnetic compass.

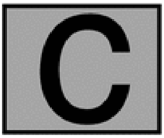
4.2.6 Right-Hand Traffic

When displayed in a signal area, or horizontally at the end of the runway or strip in use, a right-hand arrow of conspicuous color indicates that turns are to be made to the right before landing and after take-off.



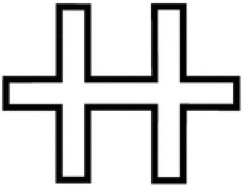
4.2.7 Air Traffic Services Reporting Office

The letter C displayed vertically in black against a yellow background indicates the location of the air traffic services reporting office.



4.2.8 Glider Flights in Operation

A double white cross displayed horizontally in the signal area indicates that the aerodrome is being used by gliders and that glider flights are being performed.



5 MARSHALLING SIGNALS

5.1 FROM A SIGNALMAN TO AN AIRCRAFT

NOTE 1: These signals are designed for use by the signalman, with hands illuminated as necessary to facilitate observation by the pilot, and facing the aircraft in a position:

- *a) for fixed wing aircraft: on left side of aircraft where best seen by the pilot; and*
- *b) for helicopters: where the signalman can best be seen by the pilot.*

NOTE 2: The meaning of the relevant signals remains the same if bats, illuminated wands or torchlights are held.

NOTE 3: The aircraft engines are numbered for the signalman facing the aircraft, from right to left (i.e., No.1 engine being the port outer engine).

NOTE 4: Signals marked with an asterisk are designed for use by hovering helicopters.

NOTE 5: References to wands may also be read to refer to daylight-fluorescent table-tennis bats or gloves (daytime only).

NOTE 6: References to the signalman may also be read to refer to marshaller.

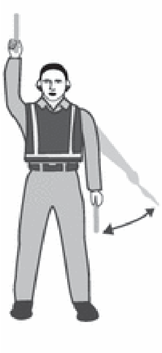
5.1.1 Prior to using the following signals, the signalman shall ascertain that the area within which an aircraft is to be guided is clear of objects which the aircraft, in complying with 3.4.1, might otherwise strike.

NOTE: The design of many aircraft is such that the path of the wing tips, engines and other extremities cannot always be monitored visually from the flight deck while the aircraft is being manoeuvred on the ground.

5.1.1.1 Wingwalker/guide

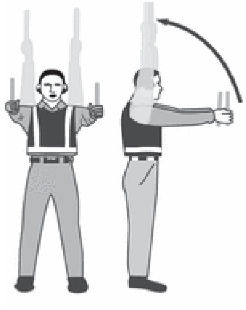
Raise right hand above head level with wand pointing up; move left-hand wand pointing down toward body.

NOTE: This signal provides an indication by a person positioned at the aircraft wing tip, to the pilot/marshaller/push-back operator, that the aircraft movement on/off a parking position would be unobstructed.



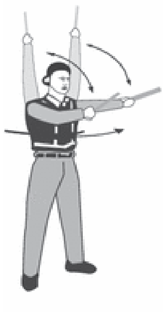
5.1.1.2 Identify Gate

Raise fully extended arms straight above head with wands pointing up.



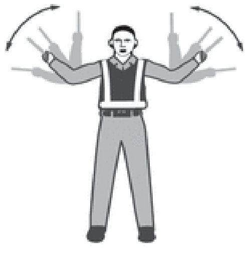
5.1.1.3 Proceed To Next Signalman or as Directed by Tower/Ground Control

Point both arms upward; move and extend arms outward to sides of body and point with wands to direction of next signalman or taxi area.



5.1.1.4 Straight Ahead

Bend extended arms at elbows and move wands up and down from chest height to head.



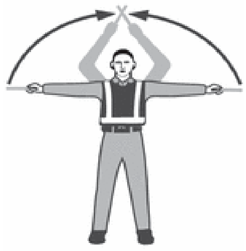
5.1.1.5 Turn

a) *Turn left (from pilot's point of view):* With right arm and wand extended at a 90-degree angle to body, make "come ahead" signal with left hand. The rate of signal motion indicates to pilot the rate of aircraft turn.

b) *Turn right (from pilot's point of view):* With left arm and wand extended at a 90-degree angle to body, make "come ahead" signal with right hand. The rate of signal motion indicates to pilot the rate of aircraft turn.

5.1.1.6 Stop

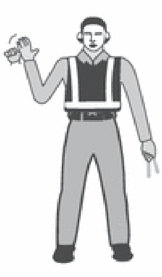
a) *Normal stop:* Fully extend arms and wands at a 90-degree angle to sides and slowly move to above head until wands cross.



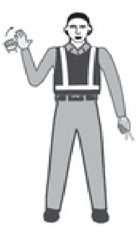
b) *Emergency stop:* Abruptly extend arms and wands to top of head, crossing wands.

5.1.1.7 Brakes

a) *Set brakes:* Raise hand just above shoulder height with open palm. Ensuring eye contact with flight crew, close hand into a fist. **Do not** move until receipt of “thumbs up” acknowledgement from flight crew.

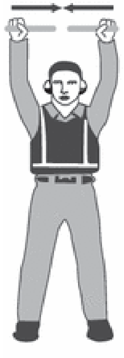


b) *Release brakes:* Raise hand just above shoulder height with hand closed in a fist. Ensuring eye contact with flight crew, open palm. **Do not** move until receipt of “thumbs up” acknowledgement from flight crew.



5.1.1.8 Chocks

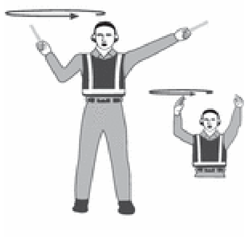
a) *Chocks inserted:* With arms and wands fully extended above head, move wands inward in a “jabbing” motion until wands touch. **Ensure** acknowledgement is received from flight crew.



b) *Chocks removed:* With arms and wands fully extended above head, move wands outward in a “jabbing” motion. **Do not** remove chocks until authorized by flight crew.

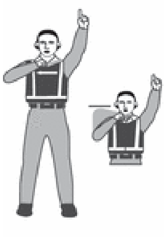
5.1.1.9 Start Engine(s)

Raise right arm to head level with wand pointing up and start a circular motion with hand; at the same time, with left arm raised above head level, point to engine to be started.



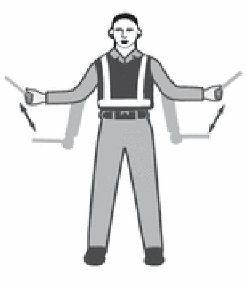
5.1.1.10 Cut Engines

Extend arm with wand forward of body at shoulder level; move hand and wand to top of left shoulder and draw wand to top of right shoulder in a slicing motion across throat.



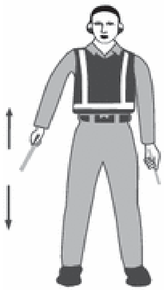
5.1.1.11 Slow Down

Move extended arms downwards in a “patting” gesture, moving wands up and down from waist to knees.



5.1.1.12 Slow Down Engine(s) on Indicated Side

With arms down and wands toward ground, wave either *right* or *left* wand up and down indicating engine(s) on *left* or *right* side respectively should be slowed down.

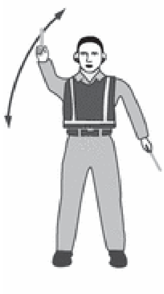


5.1.1.13 Move Back

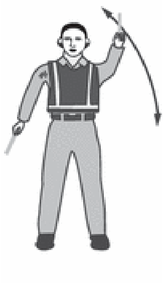
With arms in front of body at waist height, rotate arms in a forward motion. To stop rearward movement, use signal 5.1.1.6 a) or b).

5.1.1.14 Turns While Backing

a) *For tail to starboard:* Point left arm with wand down and bring right arm from overhead vertical position to horizontal forward position, repeating right-arm movement.



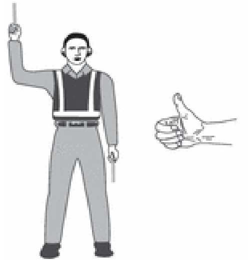
b) *For tail to port:* Point right arm with wand down and bring left arm from overhead vertical position to horizontal forward position, repeating left-arm movement.



5.1.1.15 Affirmative/All Clear

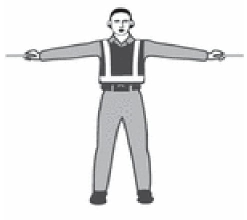
Raise right arm to head level with wand pointing up or display hand with "thumbs up"; left arm remains at side by knee.

NOTE: This signal is also used as a technical/servicing communication signal.



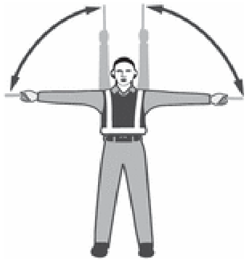
5.1.1.16 Hover

Fully extend arms and wands at a 90-degree angle to sides.



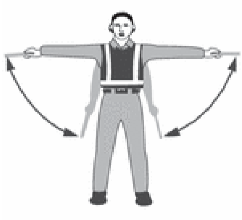
5.1.1.17 Move Upwards

Fully extend arms and wands at a 90-degree angle to sides and, with palms turned up, move hands upwards. Speed of movement indicates rate of ascent.



5.1.1.18 Move Downwards

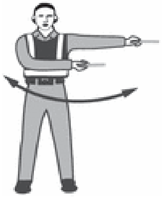
Fully extend arms and wands at a 90-degree angle to sides and, with palms turned down, move hands downwards. Speed of movement indicates rate of descent.



5.1.1.19 Move Horizontally

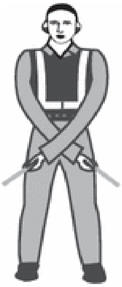
a) *Left (from pilot's point of view):* Extend arm horizontally at a 90-degree angle to right side of body. Move other arm in same direction in a sweeping motion.

b) *Right (from pilot's point of view):* Extend arm horizontally at a 90-degree angle to left side of body. Move other arm in same direction in a sweeping motion.



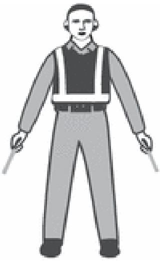
5.1.1.20 Land

Cross arms with wands downwards and in front of body.



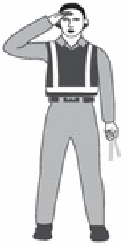
5.1.1.21 Hold Position/Stand By

Fully extend arms and wands downwards at a 45-degree angle to sides. Hold position until aircraft is clear for next manoeuvre.



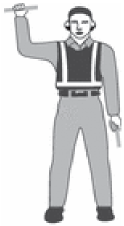
5.1.1.22 Dispatch Aircraft

Perform a standard salute with right hand and/or wand to dispatch the aircraft. Maintain eye contact with flight crew until aircraft has begun to taxi.



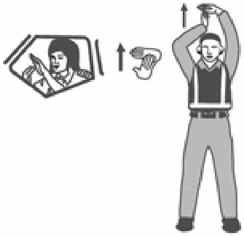
5.1.1.23 Do Not Touch Controls (Technical/Servicing Communication Signal)

Extend right arm fully above head and close fist or hold wand in horizontal position; left arm remains at side by knee.



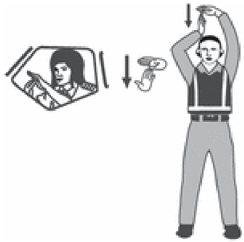
5.1.1.24 Connect Ground Power (Technical/Servicing Communication Signal)

Hold arms fully extended above head; open left hand horizontally and move finger tips of right hand into and touch open palm of left hand (forming a “T”). At night, illuminated wands can also be used to form the “T” above head.



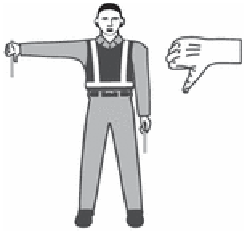
5.1.1.25 Disconnect power (Technical/Servicing Communication Signal)

Hold arms fully extended above head with finger tips of right hand touching open horizontal palm of left hand (forming a “T”); then move right hand away from the left. **Do not** disconnect power until authorized by flight crew. At night, illuminated wands can also be used to form the “T” above head.



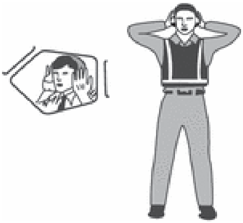
5.1.1.26 Negative (Technical/Servicing Communication Signal)

Hold right arm straight out at 90 degrees from shoulder and point wand down to ground or display hand with “thumbs down”; left hand remains at side by knee.



5.1.1.27 Establish Communication Via Interphone (Technical/Servicing Communication Signal)

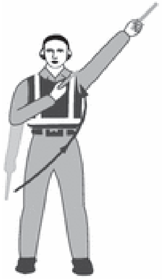
Extend both arms at 90 degrees from body and move hands to cup both ears.



5.1.1.28 Open/Close Stairs (Technical/Servicing Communication Signal)

With right arm at side and left arm raised above head at a 45-degree angle, move right arm in a sweeping motion towards top of left shoulder.

NOTE: This signal is intended mainly for aircraft with the set of integral stairs at the front.



5.2 FROM THE PILOT OF AN AIRCRAFT TO A SIGNALMAN

NOTE:

a. *These signals are designed for use by a pilot in the cockpit with hands plainly visible to the signalman, and illuminated as necessary to facilitate observation by the signalman.*

b. *The aircraft engines are numbered in relation to the signalman facing the aircraft, from right to left (i.e., No. 1 engine being the port outer engine).*

5.2.1 Brakes

NOTE: The moment the fist is clenched or the fingers are extended indicates, respectively, the moment of brake engagement or release.

a. *Brakes engaged:* Raise arm and hand, with fingers extended, horizontally in front of face, then clench fist.

b. *Brakes released:* Raise arm, with fist clenched, horizontally in front of face, then extend fingers.

5.2.2 Chocks

a. *Insert chocks:* Arms extended, palms outwards, move hands inwards to cross in front of face.

b. *Remove chocks:* Hands crossed in front of face, palms outwards, move arms outwards.

5.2.3 Ready to Start Engine(s)

Raise the appropriate number of fingers on one hand indicating the number of the engine to be started.

5.3 TECHNICAL/SERVICING COMMUNICATION SIGNALS

5.3.1 Manual signals shall only be used when verbal communication is not possible with respect to technical/servicing communication signals.

5.3.2 Signalmen shall ensure that an acknowledgement is received from the flight crew with respect to technical/servicing communication signals.

NOTE: The technical/servicing communication signals are included to standardize the use of hand signals used to communicate to flight crews during the aircraft movement process that relate to servicing or handling functions.

6. STANDARD EMERGENCY HAND SIGNALS

The following hand signals are established as the minimum required for emergency communication between the aircraft rescue and firefighting (ARFF) incident commander/ARFF firefighters and the cockpit and/or cabin crews of the incident aircraft. ARFF emergency hand signals should be given from the left front side of the aircraft for the flight crew.

NOTE: In order to communicate more effectively with the cabin crew, emergency hand signals may be given by ARFF firefighters from other positions.

6.1 *Recommend evacuation*

Evacuation recommended based on ARFF and incident commander's assessment of external situation.

Arm extended from body and held horizontal with hand upraised at eye level. Execute beckoning arm motion angled backward. Non-beckoning arm held against body.

Night — same with wands.

6.2 *Recommended stop*

Recommend evacuation in progress be halted. Stop aircraft movement or other activity in progress.

Arms in front of head, crossed at wrists.

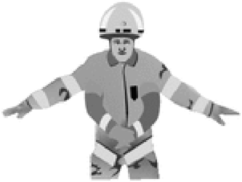
Night — same with wands.

6.3 *Emergency contained*

No outside evidence of dangerous conditions or “all-clear”

Arms extended outward and down at a 45–degree angle. Arms moved inward below waistline simultaneously until wrists crossed, then extended outward to starting position (umpire's “safe” signal).

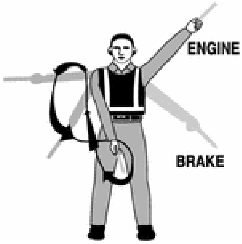
Night — same with wands.



6.4 *Fire*

Move right hand in a "fanning" motion from shoulder to knee, while at the same time pointing with left hand to area of fire.

Night — same with wands.



APPENDIX 2 — INTERCEPTION OF CIVIL AIRCRAFT

1 PRINCIPLES TO BE OBSERVED BY STATES

1.1 To achieve the uniformity in regulations which is necessary for the safety of navigation of civil aircraft due regard shall be had by Contracting States to the following principles when developing regulations and administrative directives:

a. Interception of civil aircraft will be undertaken only as a last resort;

b. If undertaken, an interception will be limited to determining the identity of the aircraft, unless it is necessary to return the aircraft to its planned track, direct it beyond the boundaries of national airspace, guide it away from a prohibited, restricted or danger area or instruct it to effect a landing at a designated aerodrome;

c. Practice interception of civil aircraft will not be undertaken;

d. Navigational guidance and related information will be given to an intercepted aircraft by radiotelephony, whenever radio contact can be established; and

e. In the case where an intercepted civil aircraft is required to land in the territory overflown, the aerodrome designated for the landing is to be suitable for the safe landing of the aircraft type concerned.

NOTE: In the unanimous adoption by the 25th Session (Extraordinary) of the ICAO Assembly on 10 May 1984 of Article 3 bis to the Convention on International Civil Aviation, the Con-

tracting States have recognized that "every State must refrain from resorting to the use of weapons against civil aircraft in flight".

1.2 Contracting States shall publish a standard method that has been established for the manoeuvring of aircraft intercepting a civil aircraft. Such method shall be designed to avoid any hazard for the intercepted aircraft.

1.3 Contracting States shall ensure that provision is made for the use of secondary surveillance radar, where available, to identify civil aircraft in areas where they may be subject to interception.

2 ACTION BY INTERCEPTED AIRCRAFT

See EMERGENCY Section for related information.

3 RADIO COMMUNICATION DURING INTERCEPTION

See EMERGENCY Section for related information.

APPENDIX 3 — TABLES OF CRUISING LEVELS

The cruising levels to be observed when so required by this Annex are as follows:

RVSM — FEET

In areas where feet are used for altitude and where, in accordance with regional air navigation agreements, a vertical separation minimum of 1000 ft is applied between FL290 and FL410 inclusive:*

TRACK **											
From* 000° *to* 179° **						***From* 180° *to* 359° *****					
IFR Flights			**VFR Flights**			**IFR Flights**			**VFR Flights**		
Level			**Level**			**Level**			**Level**		
FL	***Feet***	***Meters***	**FL**	***Feet***	***Meters***	**FL**	***Feet***	***Meters***	**FL**	***Feet***	***Meters***
010	1000	300	—	—	—	020	2000	600	—	—	—
030	3000	900	035	3500	1050	040	4000	1200	045	4500	1350
050	5000	1500	055	5500	1700	060	6000	1850	065	6500	2000
070	7000	2150	075	7500	2300	080	8000	2450	085	8500	2600
090	9000	2750	095	9500	2900	100	10,000	3050	105	10,500	3200
110	11,000	3350	115	11,500	3500	120	12,000	3650	125	12,500	3800
130	13,000	3950	135	13,500	4100	140	14,000	4250	145	14,500	4400
150	15,000	4550	155	15,500	4700	160	16,000	4900	165	16,500	5050
170	17,000	5200	175	17,500	5350	180	18,000	5500	185	18,500	5650
190	19,000	5800	195	19,500	5950	200	20,000	6100	205	20,500	6250

RVSM — FEET

In areas where feet are used for altitude and where, in accordance with regional air navigation agreements, a vertical separation minimum of 1000 ft is applied between FL290 and FL410 inclusive:*

TRACK **											
From* 000° *to* 179° **						***From* 180° *to* 359° *****					
IFR Flights			**VFR Flights**			**IFR Flights**			**VFR Flights**		
Level			**Level**			**Level**			**Level**		
FL	***Feet***	***Meters***	**FL**	***Feet***	***Meters***	**FL**	***Feet***	***Meters***	**FL**	***Feet***	***Meters***
210	21,000	6400	215	21,500	6550	220	22,000	6700	225	22,500	6850
230	23,000	7000	235	23,500	7150	240	24,000	7300	245	24,500	7450
250	25,000	7600	255	25,500	7750	260	26,000	7900	265	26,500	8100
270	27,000	8250	275	27,500	8400	280	28,000	8550	285	28,500	8700
290	29,000	8850				300	30,000	9150			
310	31,000	9450				320	32,000	9750			
330	33,000	10,050				340	34,000	10,350			
350	35,000	10,650				360	36,000	10,950			
370	37,000	11,300				380	38,000	11,600			
390	39,000	11,900				400	40,000	12,200			
410	41,000	12,500				430	43,000	13,100			
450	45,000	13,700				470	47,000	14,350			
490	49,000	14,950				510	51,000	15,550			
etc.	etc.	etc.				etc.	etc.	etc.			

* Except when, on the basis of regional air navigation agreements, a modified table of cruising levels based on a nominal vertical separation minimum of 1000 ft (300m) is prescribed for use, under specified conditions, by aircraft operating above FL410 within designated portions of the airspace.

** Magnetic track, or in polar areas at latitudes higher than 70 degrees and within such extensions to those areas as may be prescribed by the appropriate ATS authorities, grid tracks as determined by a network of lines parallel to the Greenwich Meridian superimposed on a polar stereographic chart in which the direction towards the North Pole is employed as the Grid North.

RVSM — FEET

In areas where feet are used for altitude and where, in accordance with regional air navigation agreements, a vertical separation minimum of 1000 ft is applied between FL290 and FL410 inclusive:*

TRACK **											
From **000°** ***to*** **179° *****						***From*** **180°** ***to*** **359° *****					
IFR Flights			**VFR Flights**			**IFR Flights**			**VFR Flights**		
Level			**Level**			**Level**			**Level**		
FL	***Feet***	***Meters***	**FL**	***Feet***	***Meters***	**FL**	***Feet***	***Meters***	**FL**	***Feet***	***Meters***

*** Except where, on the basis of regional air navigation agreements, from 090 to 269 degrees and from 270 to 089 degrees is prescribed to accommodate predominant traffic directions and appropriate transition procedures to be associated therewith are specified.

NOTE: Guidance material relating to vertical separation is contained in the ***Manual on Implementation of a 300m (1000 ft) Vertical Separation Minimum Between FL290 and FL410 Inclusive (Doc 9574)*** *(not published herein).*

RVSM — METERS

In areas where meters are used for altitude and where, in accordance with regional air navigation agreements, a vertical separation minimum of 300m is applied between 8900m and 12,500m inclusive:*

TRACK**											
From **000°** ***to*** **179° *****						***From*** **180°** ***to*** **359° *****					
IFR Flights			**VFR Flights**			**IFR Flights**			**VFR Flights**		
Level			**Level**			**Level**			**Level**		
Std Metric	***Meters***	***Feet***	**Std Metric**	***Meters***	***Feet***	**Std Metric**	***Meters***	***Feet***	**Std Metric**	***Meters***	***Feet***
0030	300	1000	—	—	—	0060	600	2000	—	—	—
0090	900	3000	0105	1050	3500	0120	1200	3900	0135	1350	4400
0150	1500	4900	0165	1650	5400	0180	1800	5900	0195	1950	6400
0210	2100	6900	0225	2250	7400	0240	2400	7900	0255	2550	8400
0270	2700	8900	0285	2850	9400	0300	3000	9800	0315	3150	10,300
0330	3300	10,800	0345	3450	11,300	0360	3600	11,800	0375	3750	12,300
0390	3900	12,800	0405	4050	13,300	0420	4200	13,800	0435	4350	14,300
0450	4500	14,800	0465	4650	15,300	0480	4800	15,700	0495	4950	16,200

ICAO RULES OF THE AIR - ANNEX 2

RVSM — METERS

In areas where meters are used for altitude and where, in accordance with regional air navigation agreements, a vertical separation minimum of 300m is applied between 8900m and 12,500m inclusive:*

TRACK**											
From* 000° *to* 179° **						***From* 180° *to* 359° *****					
IFR Flights Level			**VFR Flights Level**			**IFR Flights Level**			**VFR Flights Level**		
Std Metric	***Meters***	***Feet***	**Std Metric**	***Meters***	***Feet***	**Std Metric**	***Meters***	***Feet***	**Std Metric**	***Meters***	***Feet***
0510	5100	16,700	0525	5250	17,200	0540	5400	17,700	0555	5550	18,200
0570	5700	18,700	0585	5850	19,200	0600	6000	19,700	0615	6150	20,200
0630	6300	20,700	0645	6450	21,200	0660	6600	21,700	0675	6750	22,100
0690	6900	22,600	0705	7050	23,100	0720	7200	23,600	0735	7350	24,100
0750	7500	24,600	0765	7650	25,100	0780	7800	25,600	0795	7950	26,100
0810	8100	26,600	0825	8250	27,100	0840	8400	27,600	0855	8550	28,100
0890	8900	29,100				0920	9200	30,100			
0950	9500	31,100				0980	9800	32,100			
1010	10,100	33,100				1040	10,400	34,100			
1070	10,700	35,100				1100	11,000	36,100			
1130	11,300	37,100				1160	11,600	38,100			
1190	11,900	39,100				1220	12,200	40,100			
1250	12,500	41,100				1310	13,100	43,000			
1370	13,700	44,900				1430	14,300	46,900			
1490	14,900	48,900				1550	15,500	50,900			
etc.	etc.	etc.				etc.	etc.	etc.			

* Except when, on the basis of regional air navigation agreements, a modified table of cruising levels based on a nominal vertical separation minimum of 1000 ft (300m) is prescribed for use, under specified conditions, by aircraft operating above FL410 within designated portions of the airspace.

RVSM — METERS

In areas where meters are used for altitude and where, in accordance with regional air navigation agreements, a vertical separation minimum of 300m is applied between 8900m and 12,500m inclusive:*

TRACK**

From* 000° *to* 179° **						***From* 180° *to* 359° *****					
IFR Flights			**VFR Flights**			**IFR Flights**			**VFR Flights**		
Level			**Level**			**Level**			**Level**		
Std Metric	***Meters***	***Feet***	**Std Metric**	***Meters***	***Feet***	**Std Metric**	***Meters***	***Feet***	**Std Metric**	***Meters***	***Feet***

** Magnetic track, or in polar areas at latitudes higher than 70 degrees and within such extensions to those areas as may be prescribed by the appropriate ATS authorities, grid tracks as determined by a network of lines parallel to the Greenwich Meridian superimposed on a polar stereographic chart in which the direction towards the North Pole is employed as the Grid North.

*** Except where, on the basis of regional air navigation agreements, from 090 to 269 degrees and from 270 to 089 degrees is prescribed to accommodate predominant traffic directions and appropriate transition procedures to be associated therewith are specified.

NOTE: Guidance material relating to vertical separation is contained in the ***Manual on Implementation of a 300m (1000 ft) Vertical Separation Minimum Between FL290 and FL410 Inclusive (Doc 9574)*** *(not published herein).*

Non-RVSM — FEET

In other areas where feet are the primary unit of measurement for altitude:

TRACK*

From* 000° *to* 179° *						***From* 180° *to* 359° ****					
IFR Flights			**VFR Flights**			**IFR Flights**			**VFR Flights**		
Level			**Level**			**Level**			**Level**		
FL	***Feet***	***Meters***	**FL**	***Feet***	***Meters***	**FL**	***Feet***	***Meters***	**FL**	***Feet***	***Meters***
010	1000	300	—	—	—	020	2000	600	—	—	—
030	3000	900	035	3500	1050	040	4000	1200	045	4500	1350
050	5000	1500	055	5500	1700	060	6000	1850	065	6500	2000
070	7000	2150	075	7500	2300	080	8000	2450	085	8500	2600
090	9000	2750	095	9500	2900	100	10,000	3050	105	10,500	3200

Non-RVSM — FEET

In other areas where feet are the primary unit of measurement for altitude:

TRACK*

From* 000° *to* 179° *						***From* 180° *to* 359° ****					
IFR Flights			**VFR Flights**			**IFR Flights**			**VFR Flights**		
Level			**Level**			**Level**			**Level**		
FL	***Feet***	***Meters***	**FL**	***Feet***	***Meters***	**FL**	***Feet***	***Meters***	**FL**	***Feet***	***Meters***
110	11,000	3350	115	11,500	3500	120	12,000	3650	125	12,500	3800
130	13,000	3950	135	13,500	4100	140	14,000	4250	145	14,500	4400
150	15,000	4550	155	15,500	4700	160	16,000	4900	165	16,500	5050
170	17,000	5200	175	17,500	5350	180	18,000	5500	185	18,500	5650
190	19,000	5800	195	19,500	5950	200	20,000	6100	205	20,500	6250
210	21,000	6400	215	21,500	6550	220	22,000	6700	225	22,500	6850
230	23,000	7000	235	23,500	7150	240	24,000	7300	245	24,500	7450
250	25,000	7600	255	25,500	7750	260	26,000	7900	265	26,500	8100
270	27,000	8250	275	27,500	8400	280	28,000	8550	285	28,500	8700
290	29,000	8850	300	30,000	9150	310	31,000	9450	320	32,000	9750
330	33,000	10,050	340	34,000	10,350	350	35,000	10,650	360	36,000	10,950
370	37,000	11,300	380	38,000	11,600	390	39,000	11,900	400	40,000	12,200
410	41,000	12,500	420	42,000	12,800	430	43,000	13,100	440	44,000	13,400
450	45,000	13,700	460	46,000	14,000	470	47,000	14,350	480	48,000	14,650
490	49,000	14,950	500	50,000	15,250	510	51,000	15,550	520	52,000	15,850
etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.

* Magnetic track, or in polar areas at latitudes higher than 70 degrees and within such extensions to those areas as may be prescribed by the appropriate ATS authorities, grid tracks as determined by a network of lines parallel to the Greenwich Meridian superimposed on a polar stereographic chart in which the direction towards the North Pole is employed as the Grid North.

Non-RVSM — FEET

In other areas where feet are the primary unit of measurement for altitude:

TRACK*											
From* 000° *to* 179° *						***From* 180° *to* 359° ****					
IFR Flights			**VFR Flights**			**IFR Flights**			**VFR Flights**		
Level			**Level**			**Level**			**Level**		
FL	***Feet***	***Meters***	**FL**	***Feet***	***Meters***	**FL**	***Feet***	***Meters***	**FL**	***Feet***	***Meters***

** Except where, on the basis of regional air navigation agreements, from 090 to 269 degrees and from 270 to 089 degrees is prescribed to accommodate predominant traffic directions and appropriate transition procedures to be associated therewith are specified.

*NOTE: Guidance material relating to vertical separation is contained in the **Manual on Implementation of a 300m (1000 ft) Vertical Separation Minimum Between FL290 and FL410 Inclusive (Doc 9574)** (not published herein).*

Non-RVSM — METERS

In other areas where meters are the primary unit of measurement for altitude:

TRACK*											
From* 000° *to* 179° *						***From* 180° *to* 359° ****					
IFR Flights			**VFR Flights**			**IFR Flights**			**VFR Flights**		
Level			**Level**			**Level**			**Level**		
Std Metric	***Meters***	***Feet***	**Std Metric**	***Meters***	***Feet***	**Std Metric**	***Meters***	***Feet***	**Std Metric**	***Meters***	***Feet***
0030	300	1000	—	—	—	0060	600	2000	—	—	—
0090	900	3000	0105	1050	3500	0120	1200	3900	0135	1350	4400
0150	1500	4900	0165	1650	5400	0180	1800	5900	0195	1950	6400
0210	2100	6900	0225	2250	7400	0240	2400	7900	0255	2550	8400
0270	2700	8900	0285	2850	9400	0300	3000	9800	0315	3150	10,300
0330	3300	10,800	0345	3450	11,300	0360	3600	11,800	0375	3750	12,300
0390	3900	12,800	0405	4050	13,300	0420	4200	13,800	0435	4350	14,300
0450	4500	14,800	0465	4650	15,300	0480	4800	15,700	0495	4950	16,200
0510	5100	16,700	0525	5250	17,200	0540	5400	17,700	0555	5500	18,200
0570	5700	18,700	0585	5850	19,200	0600	6000	19,700	0615	6150	20,200
0630	6300	20,700	0645	6450	21,200	0660	6600	21,700	0675	6750	22,100

Non-RVSM — METERS

In other areas where meters are the primary unit of measurement for altitude:

TRACK*											
From* 000° *to* 179° *						***From* 180° *to* 359° ****					
IFR Flights			**VFR Flights**			**IFR Flights**			**VFR Flights**		
Level			**Level**			**Level**			**Level**		
Std Metric	***Meters***	***Feet***	**Std Metric**	***Meters***	***Feet***	**Std Metric**	***Meters***	***Feet***	**Std Metric**	***Meters***	***Feet***
0690	6900	22,600	0705	7050	23,100	0720	7200	23,600	0735	7350	24,100
0750	7500	24,600	0765	7650	25,100	0780	7800	25,600	0795	7950	26,100
0810	8100	26,600	0825	8250	27,100	0840	8400	27,600	0855	8550	28,100
0890	8900	29,100	0920	9200	30,100	0950	9500	31,100	0980	9800	32,100
1010	10,100	33,100	1040	10,400	34,100	1070	10,700	35,100	1100	11,000	36,100
1130	11,300	37,100	1160	11,600	38,100	1190	11,900	39,100	1220	12,200	40,100
1250	12,500	41,100	1280	12,800	42,100	1310	13,100	43,000	1370	13,400	44,000
1370	13,700	44,900	1400	14,000	46,100	1430	14,300	46,900	1460	14,600	47,900
1490	14,900	48,900	1520	15,200	49,900	1550	15,500	50,900	1580	15,800	51,900
etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.

* Magnetic track, or in polar areas at latitudes higher than 70 degrees and within such extensions to those areas as may be prescribed by the appropriate ATS authorities, grid tracks as determined by a network of lines parallel to the Greenwich Meridian superimposed on a polar stereographic chart in which the direction towards the North Pole is employed as the Grid North.

** Except where, on the basis of regional air navigation agreements, from 090 to 269 degrees and from 270 to 089 degrees is prescribed 10 accommodate predominant traffic directions and appropriate transition procedures to be associated therewith are specified.

NOTE: Guidance material relating to vertical separation is contained in the ***Manual on Implementation of a 300m (1000 ft) Vertical Separation Minimum Between FL290 and FL410 Inclusive (Doc 9574)*** *(not published herein).*

APPENDIX 4 — REMOTELY PILOTED AIRCRAFT SYSTEMS

NOTE: See Chapter 3, para 3.1.9 of the Annex (not published herein).

NOTE: The Manual on Remotely Piloted Aircraft Systems (RPAS) (Doc 10019) contains explanatory information related to remotely piloted aircraft systems (not published herein).

1 GENERAL OPERATING RULES

1.1 A remotely piloted aircraft system (RPAS) engaged in international air navigation shall not be operated without appropriate authorization from the State from which the take-off of the remotely piloted aircraft (RPA) is made.

1.2 An RPA shall not be operated across the territory of another State without special authorization issued by each State in which the flight is to operate. This authorization may be in the form of agreements between the States involved.

1.3 An RPA shall not be operated over the high seas without prior coordination with the appropriate ATS authority.

1.4 The authorization and coordination referred to in 1.2 and 1.3 shall be obtained prior to take-off if there is reasonable expectation, when planning the operation, that the aircraft may enter the airspace concerned.

1.5 An RPAS shall be operated in accordance with conditions specified by the State of Registry, the State of the Operator, if different, and the State(s) in which the flight is to operate.

1.6 Flight plans shall be submitted in accordance with Chapter 3 of this Annex or as otherwise mandated by the State(s) in which the flight is to operate.

1.7 RPAS shall meet the performance and equipment carriage requirements for the specific airspace in which the flight is to operate.

APPENDIX 5 — UNMANNED FREE BALLOONS

NOTE: See Chapter 3, para 3.1.10 of the Annex (not published herein).

1 CLASSIFICATION OF UNMANNED FREE BALLOONS

Unmanned free balloons shall be classified as:

a. *light:* an unmanned free balloon which carries a payload of one or more packages with a combined mass of less than 4kg, unless qualifying as a heavy balloon in accordance with c. (2), (3) or (4) below; or

b. *medium:* an unmanned free balloon which carries a payload of two or more packages with a combined mass of 4kg or more, but less than 6kg, unless qualifying as a heavy balloon in accordance with c.(2), (3) or (4) below; or

c. *heavy:* an unmanned free balloon which carries a payload which:

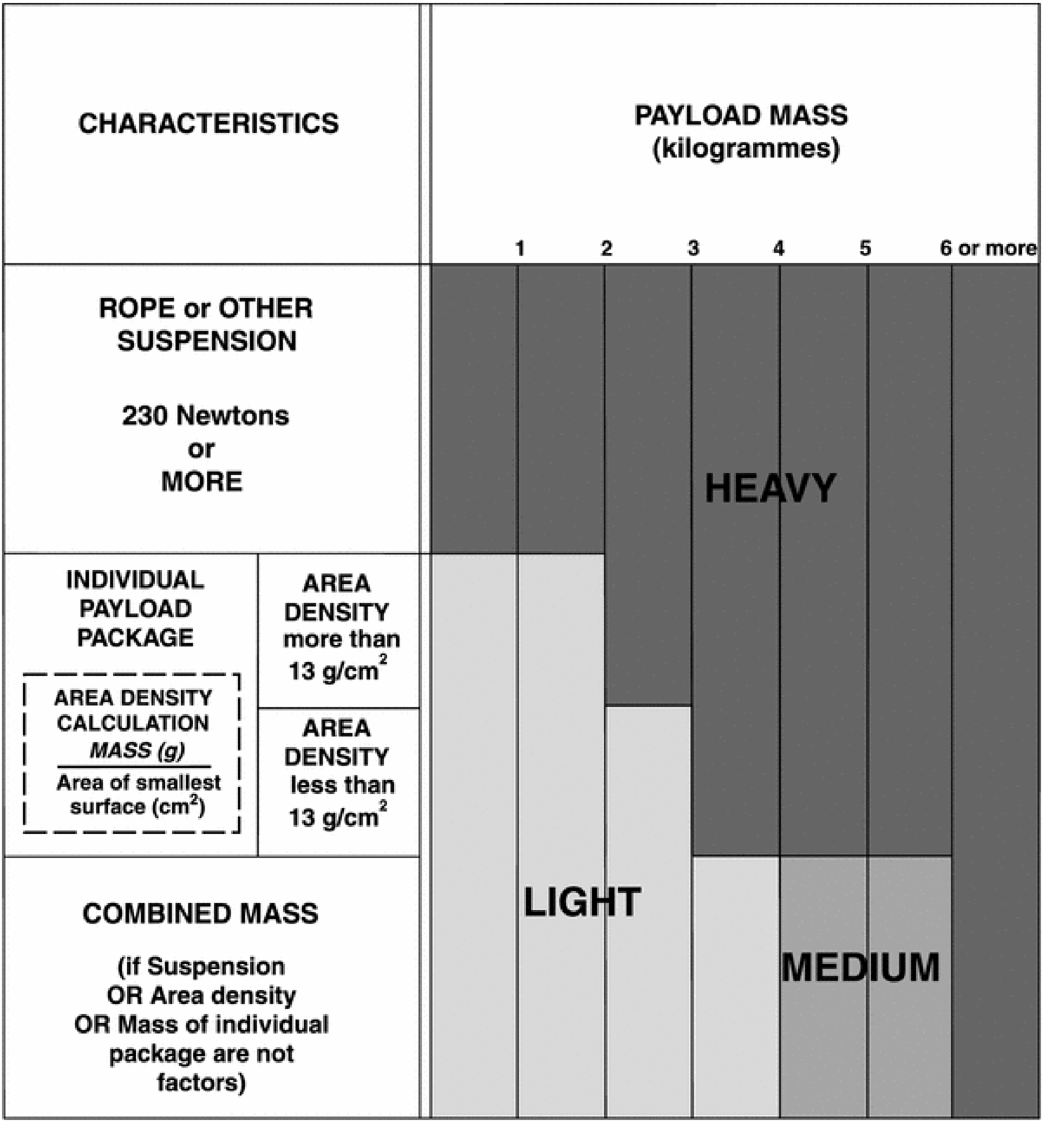
   1. has a combined mass of 6kg or more; or
   2. includes a package of 3kg or more; or
   3. includes a package of 2kg or more with an area density of more than 13g per square centimeter; or
   4. uses a rope or other device for suspension of the payload that requires an impact force of 230 N or more to separate the suspended payload from the balloon.

   NOTE:

ICAO RULES OF THE AIR - ANNEX 2

a. *The area density referred to in c.(3) is determined by dividing the total mass in grams of the payload package by the area in square centimeters of its smallest surface.*

b. *See the following figure.*


CHARACTERISTICS
PAYLOAD MASS (kilogrammes)
1
2
3
4
5
6 or more
ROPE or OTHER SUSPENSION
230 Newtons or MORE
INDIVIDUAL PAYLOAD PACKAGE
AREA DENSITY CALCULATION
MASS (g)
Area of smallest surface (cm²)
AREA DENSITY more than 13 g/cm²
AREA DENSITY less than 13 g/cm²
COMBINED MASS
(if Suspension OR Area density OR Mass of individual package are not factors)
HEAVY
LIGHT
MEDIUM

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International Civil Aviation Organization - ATS Airspace Classifications - Annex 11

ICAO ATS AIRSPACE CLASSIFICATIONS -- ANNEX 11

2 GENERAL

2.6 CLASSIFICATION OF AIRSPACES

2.6.1 ATS airspaces shall be classified and designated in accordance with the following:

Class "A" — IFR flights only are permitted, all flights are provided with air traffic control service and are separated from each other.

Class "B" — IFR and VFR flights are permitted, all flights are provided with air traffic control service and are separated from each other.

Class "C" — IFR and VFR flights are permitted, all flights are provided with air traffic control service and IFR flights are separated from other IFR flights and from VFR flights. VFR flights are separated from IFR flights and receive traffic information in respect of other VFR flights.

Class "D" — IFR and VFR flights are permitted and all flights are provided with air traffic control service, IFR flights are separated from other IFR flights and receive traffic information in respect of VFR flights, VFR flights receive traffic information in respect of all other flights.

Class "E" — IFR and VFR flights are permitted, IFR flights are provided with air traffic control service and are separated from other IFR flights. All flights receive traffic information as far as is practical. Class "E" shall not be used for control zones.

Class "F" — IFR and VFR flights are permitted, all participating IFR flights receive an air traffic advisory service and all flights receive flight information service if requested.

NOTE: Where air traffic advisory service is implemented, this is considered normally as a temporary measure only until such time as it can be replaced by air traffic control.

Class "G" — IFR and VFR flights are permitted and receive flight information service if requested.

2.6.2 States shall select those airspace classes appropriate to their needs.

2.6.3 The requirements for flights within each class of airspace shall be as shown in the following table.

NOTE: Where the ATS airspaces adjoin vertically, i.e., one above the other, flights at a common level would comply with the requirements of, and be given services applicable to, the less restrictive class of airspace. In applying these criteria, Class "B" airspace is therefore considered less restrictive than Class "A" airspace; Class "C" airspace less restrictive than Class "B" airspace, etc.

Class	Type of flight	Separation provided	Service provided	Speed limitation*	Radio communication requirement	Subject to an ATC clearance
"A"	IFR only	All aircraft	Air traffic control service	Not applicable	Continuous two-way	Yes
"B"	IFR	All aircraft	Air traffic control service	Not applicable	Continuous two-way	Yes

ICAO ATS AIRSPACE CLASSIFICATIONS -- ANNEX 11

Class	Type of flight	Separation provided	Service provided	Speed limitation*	Radio communication requirement	Subject to an ATC clearance
	VFR	All aircraft	Air traffic control service	Not applicable	Continuous two-way	Yes
"C"	IFR	IFR from IFR IFR from VFR	Air traffic control service	Not applicable	Continuous two-way	Yes
	VFR	VFR from IFR	a. Air traffic control service for separation from IFR; b. VFR/VFR traffic information (and traffic avoidance advice on request);	250 KT IAS below 3,050m (10,000 ft) AMSL	Continuous two-way	Yes
"D"	IFR	IFR from IFR	Air traffic control service, traffic information about VFR flights (and traffic avoidance advice on request)	250 KT IAS below 3,050m (10,000 ft) AMSL	Continuous two-way	Yes
	VFR	Nil	IFR/VFR and VFR/VFR traffic information (and traffic avoidance advice on request)	250 KT IAS below 3,050m (10,000 ft) AMSL	Continuous two-way	Yes
"E"	IFR	IFR from IFR	Air traffic control service and, as far as practical, traffic information about VFR flights	250 KT IAS below 3,050m (10,000 ft) AMSL	Continuous two-way	Yes
	VFR	Nil	Traffic information as far as practical	250 KT IAS below 3,050m (10,000 ft) AMSL	No	No

ICAO ATS AIRSPACE CLASSIFICATIONS -- ANNEX 11

Class	Type of flight	Separation provided	Service provided	Speed limitation*	Radio communication requirement	Subject to an ATC clearance
"F"	IFR	IFR from IFR as far as practical	Air traffic advisory service; flight information service	250 KT IAS below 3,050m (10,000 ft) AMSL	Continuous two-way	No
	VFR	Nil	Flight information service	250 KT IAS below 3,050m (10,000 ft) AMSL	No	No
"G"	IFR	Nil	Flight information service	250 KT IAS below 3,050m (10,000 ft) AMSL	Continuous two-way	No
	VFR	Nil	Flight information service	250 KT IAS below 3,050m (10,000 ft) AMSL	No	No

* When the height of the transition altitude is lower than 3,050m (10,000 ft) AMSL, FL 100 should be used in lieu of 10,000 ft.

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International Civil Aviation Organization - TIBA - Annex 11

Extracted from ICAO Annex 11 — Air Traffic Services — Annexes to DOC 7300 (Attachment B)

1 INTRODUCTION AND APPLICABILITY OF BROADCASTS

1.1 Traffic information broadcasts by aircraft are intended to permit reports and relevant supplementary information of an advisory nature to be transmitted by pilots on a designated VHF radiotelephone (RTF) frequency for the information of pilots of other aircraft in the vicinity.

1.2 TIBAs should be introduced only when necessary and as a temporary measure.

1.3 The broadcast procedures should be applied in designated airspace where:

a. there is a need to supplement collision hazard information provided by air traffic services outside controlled airspace; or

b. there is a temporary disruption of normal air traffic services.

1.4 Such airspaces should be identified by the States responsible for provision of air traffic services within these airspaces, if necessary with the assistance of the appropriate ICAO Regional Office(s), and duly promulgated in aeronautical information publications or NOTAM, together with the VHF RTF frequency, the message formats and the procedures to be used. Where, in the case of 1.3 a., more than one State is involved, the airspace should be designated on the basis of regional air navigation agreements and promulgated in Doc 7030.

1.5 When establishing a designated airspace, dates for the review of its applicability at intervals not exceeding 12 months should be agreed by the appropriate ATC authority(ies).

2 DETAILS OF BROADCASTS

2.1 VHF RTF FREQUENCY TO BE USED

2.1.1 The VHF RTF frequency to be used should be determined and promulgated on a regional basis. However, in the case of temporary disruption occurring in controlled airspace, the States responsible may promulgate, as the VHF RTF frequency to be used within the limits of that airspace, a frequency used normally for the provision of air traffic control service within that airspace.

2.1.2 Where VHF is used for air-ground communications with ATS and an aircraft has only two serviceable VHF sets, one should be tuned to the appropriate ATS frequency and the other to the TIBA frequency.

2.2 LISTENING WATCH

A listening watch should be maintained on the TIBA frequency 10 minutes before entering the designated airspace until leaving this airspace. For an aircraft taking off from an aerodrome located within the lateral limits of the designated airspace listening watch should start as soon as appropriate after take-off and be maintained until leaving the airspace.

2.3 TIME OF BROADCASTS

A broadcast should be made:

a. 10 minutes before entering the designated airspace or, for a pilot taking off from an aerodrome located within the lateral limits of the designated airspace, as soon as appropriate after take-off;
b. 10 minutes prior to crossing a reporting point;
c. 10 minutes prior to crossing or joining an ATS route;
d. at 20-minute intervals between distant reporting points;
e. 2 to 5 minutes, where possible, before a change in flight level;
f. at the time of a change in flight level; and
g. at any other time considered necessary by the pilot.

2.4 FORMS OF BROADCAST

2.4.1 The broadcasts other than those indicating changes in flight level, i.e. the broadcasts referred to in 2.3 a., b., c., d. and g., should be in the following form:

ALL STATIONS (necessary to identify a traffic information broadcast)

(call sign)

FLIGHT LEVEL (number) (or CLIMBING[1] TO FLIGHT LEVEL (number))

(direction)

(ATS route) (or DIRECT FROM (position) TO (position))

POSITION (position[2]) AT (time)

ESTIMATING (next reporting point, or the point of crossing or joining a designated ATS route) AT (time)

(call sign)

FLIGHT LEVEL (number)

(direction)

Fictitious example:

"ALL STATIONS WINDAR 671 FLIGHT LEVEL 350 NORTHWEST BOUND DIRECT FROM PUNTA SAGA TO PAMPA POSITION 5040 SOUTH 2010 EAST AT 2358 ESTIMATING CROSSING ROUTE LIMA THREE ONE AT 4930 SOUTH 1920 EAST AT 0012 WINDAR 671 FLIGHT LEVEL 350 NORTHWEST BOUND OUT"

[1] For the broadcast referred to in 2.3 a. in the case of an aircraft taking off from an aerodrome located within the lateral limits of the designated airspace.

[2] For broadcasts made when the aircraft is not near an ATS significant point, the position should be given as accurately as possible and in any case to the nearest 30 minutes of latitude and longitude.

2.4.2 Before a change in flight level, the broadcast (referred to in 2.3 e.) should be in the following form:

ALL STATIONS
(call sign)
(direction)
(ATS route) (or DIRECT FROM (position) TO (position))
LEAVING FLIGHT LEVEL (number) FOR FLIGHT LEVEL (number) AT (position and time)

2.4.3 Except as provided in 2.4.4, the broadcast at the time of a change in flight level (referred to in 2.3 f.) should be in the following form:

ALL STATIONS
(call sign)
(direction)
(ATS route) (or DIRECT FROM (position) TO (position))
LEAVING FLIGHT LEVEL (number) NOW FOR FLIGHT LEVEL (number)

followed by:

ALL STATIONS
(call sign)
MAINTAINING FLIGHT LEVEL (number)

2.4.4 Broadcasts reporting a temporary flight level change to avoid an imminent collision risk should be in the following form:

ALL STATIONS
(call sign)
LEAVING FLIGHT LEVEL (number) NOW FOR FLIGHT LEVEL (number)

followed as soon as practicable by:

ALL STATIONS
(call sign)
RETURNING TO FLIGHT LEVEL (number) NOW

2.5 ACKNOWLEDGEMENT OF THE BROADCASTS

The broadcasts should not be acknowledged unless a potential collision risk is perceived.

3 RELATED OPERATING PROCEDURES

3.1 CHANGE OF CRUISING LEVEL

3.1.1 Cruising level changes should not be made within the designated airspace, unless considered necessary by pilots to avoid traffic conflicts, for weather avoidance of for other valid operational reasons.

3.1.2 When cruising level changes are unavoidable, all available aircraft lighting which would improve the visual detection of the aircraft should be displayed while changing levels.

3.2 COLLISION AVOIDANCE

If, on receipt of a traffic information broadcast from another aircraft, a pilot decides that immediate action is necessary to avoid an imminent collision risk, and this cannot be achieved in accordance with the right-of-way provisions of Annex 2, the pilot should:

a. unless an alternative manoeuvre appears more appropriate, immediately descend 150 m (500 ft), or 300 m (1000 ft) if above FL 290 in an area where a vertical separation minimum of 600 m (2000 ft) is applied;

b. display all available aircraft lighting which would improve the visual detection of the aircraft;

c. as soon as possible, reply to the broadcast advising action being taken;

d. notify the action taken on the appropriate ATS frequency; and

e. as soon as practicable, resume normal flight level, notifying the action on the appropriate ATS frequency.

3.3 NORMAL POSITION REPORTING PROCEDURES

Normal position reporting procedures should be continued at all times, regardless of any action taken to initiate or acknowledge a traffic information broadcast.

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AIR TRAFFIC MANAGEMENT (DOC 4444)

Extracted from ICAO Document 4444, Sixteenth Edition, PROCEDURES FOR AIR NAVIGATION SERVICES — AIR TRAFFIC MANAGEMENT, herein known as PANS-ATM.

1 DEFINITIONS

Refer to 'International Civil Aviation Organization Definitions' chapter.

4 GENERAL PROVISIONS FOR AIR TRAFFIC SERVICES

4.4 FLIGHT PLAN

4.4.1 Flight Plan Form

NOTE: Procedures for the use of repetitive flight plans are contained in Chapter 16, Section 16.4.

4.4.1.1 A flight plan form based on the model in Appendix 2 should be provided and should be used by operators and air traffic services units for the purpose of completing flight plans.

NOTE: A different form may be provided for use in completing repetitive flight plan listings.

4.4.1.2 The flight plan form should be printed and should include an English text in addition to the language(s) of the State concerned.

4.4.1.3 Operators and air traffic services units should comply with:

a. the instructions for completion of a flight plan form and the repetitive flight plan listing form given in Appendix 2; and
b. any constraints identified in relevant Aeronautical Information Publications (AIPs).

NOTE 1: Failure to adhere to the provisions of Appendix 2 or any constraint identified in relevant AIPs may result in data being rejected, processed incorrectly or lost.

NOTE 2: The instructions for completing the flight plan form given in Appendix 2 may be conveniently printed on the inside cover of flight plan form pads, or posted in briefing rooms.

4.4.1.4 An operator shall, prior to departure:

a. ensure that, where the flight is intended to operate on a route or in an area where a navigation specification is prescribed, it has an appropriate RNP approval, and that all conditions applying to that approval will be satisfied;
b. ensure that, where the flight is intended to operate in reduced vertical separation minimum (RVSM) airspace, it has the required RVSM approval;
c. ensure that, where the flight is intended to operate where an RCP specification is prescribed, it has an appropriate approval, and that all conditions applying to that approval will be satisfied.
d. ensure that, where the flight is intended to operate where an RSP specification is prescribed, it has an appropriate RSP approval, and that all conditions applying to that approval will be satisfied.

4.4.2 Submission of a Flight Plan

4.4.2.1 Prior to Departure

4.4.2.1.1 Flight plans shall not be submitted more than 120 hours before the estimated off-block time of a flight.

4.4.2.1.2 Except when other arrangements have been made for submission of repetitive flight plans, a flight plan submitted prior to departure should be submitted to the air traffic services reporting office at the departure aerodrome. If no such unit exists at the departure aerodrome, the flight plan should be submitted to the unit serving or designated to serve the departure aerodrome.

4.4.2.1.3 In the event of a delay of 30 minutes in excess of the estimated off-block time for a controlled flight or a delay of one hour for an uncontrolled flight for which a flight plan has been submitted, the flight plan should be amended or a new flight plan submitted and the old flight plan cancelled, whichever is applicable.

4.4.2.2 During Flight

4.4.2.2.1 A flight plan to be submitted during flight should normally be transmitted to the ATS unit in charge of the FIR, control area, advisory area or advisory route in or on which the aircraft is flying, or in or through which the aircraft wishes to fly or to the aeronautical telecommunication station serving the air traffic services unit concerned. When this is not practicable, it should be transmitted to another ATS unit or aeronautical telecommunication station for retransmission as required to the appropriate air traffic services unit.

NOTE: If the flight plan is submitted for the purpose of obtaining air traffic control service, the aircraft is required to wait for an air traffic control clearance prior to proceeding under the conditions requiring compliance with air traffic control procedures. If the flight plan is submitted for the purpose of obtaining air traffic advisory service, the aircraft is required to wait for acknowledgment of receipt by the unit providing the service.

4.4.3 Acceptance of a Flight Plan

4.4.3.1 The first ATS unit receiving a flight plan, or change thereto, shall:

a. check it for compliance with the format and data conventions;

b. check it for completeness and, to the extent possible, for accuracy;

c. take action, if necessary, to make it acceptable to the air traffic services; and

d. indicate acceptance of the flight plan or change thereto, to the originator.

4.5 AIR TRAFFIC CONTROL CLEARANCES

4.5.1 Scope and Purpose

4.5.1.1 Clearances are issued solely for expediting and separating air traffic and are based on known traffic conditions which affect safety in aircraft operations. Such traffic conditions include not only aircraft in the air and on the manoeuvring area over which control is being exercised, but also any vehicular traffic or other obstructions not permanently installed on the manoeuvring area in use.

4.5.1.2 If an air traffic control clearance is not suitable to the pilot-in-command of an aircraft, the flight crew may request and, if practicable, obtain an amended clearance.

4.5.1.3 The issuance of air traffic control clearances by air traffic control units constitutes authority for an aircraft to proceed only in so far as known air traffic is concerned. ATC clearances do not constitute authority to violate any applicable regulations for promoting the safety of flight operations or for any other purpose; neither do clearances relieve a pilot-in-command of any responsibility whatsoever in connection with a possible violation of applicable rules and regulations.

4.5.1.4 ATC units shall issue such ATC clearances as are necessary to prevent collisions and to expedite and maintain an orderly flow of air traffic.

4.5.1.5 ATC clearances must be issued early enough to ensure that they are transmitted to the aircraft in sufficient time for it to comply with them.

4.5.2 Aircraft Subject to ATC for Part of Flight

4.5.2.1 When a flight plan specifies that the initial portion of a flight will be uncontrolled, and that the subsequent portion of the flight will be subject to ATC, the aircraft shall be advised to obtain its clearance from the ATC unit in whose area controlled flight will be commenced.

4.5.2.2 When a flight plan specifies that the first portion of a flight will be subject to ATC, and that the subsequent portion will be uncontrolled, the aircraft shall normally be cleared to the point at which the controlled flight terminates.

4.5.3 Flights Through Intermediate Stops

4.5.3.1 When an aircraft files, at the departure aerodrome, flight plans for the various stages of flight through intermediate stops, the initial clearance limit will be the first destination aerodrome and new clearances shall be issued for each subsequent portion of flight.

4.5.3.2 The flight plan for the second stage, and each subsequent stage, of a flight through intermediate stops will become active for ATS and search and rescue (SAR) purposes only when the appropriate ATS unit has received notification that the aircraft has departed from the relevant departure aerodrome, except as provided for in 4.5.3.3.

4.5.3.3 By prior arrangement between ATC units and the operators, aircraft operating on an established schedule may, if the proposed route of flight is through more than one control area, be cleared through intermediate stops within other control areas but only after coordination between the ACCs concerned.

4.5.6 En-route Aircraft

4.5.6.1 General

4.5.6.1.2 After the initial clearance has been issued to an aircraft at the point of departure, it will be the responsibility of the appropriate ATC unit to issue an amended clearance whenever necessary and to issue traffic information, if required.

4.5.6.1.3 When so requested by the flight crew, an aircraft shall be cleared for cruise climb whenever traffic conditions and coordination procedures permit. Such clearance shall be for cruise climb either above a specified level or between specified levels.

4.5.7 Description of Air Traffic Control Clearances

4.5.7.1 Clearance Limit

4.5.7.1.1 A clearance limit shall be described by specifying the name of the appropriate significant point, or aerodrome, or controlled airspace boundary.

4.5.7.1.3 If an aircraft has been cleared to an intermediate point in adjacent controlled airspace, the appropriate ATC unit will then be responsible for issuing, as soon as practicable, an amended clearance to the destination aerodrome.

4.5.7.1.4 When the destination aerodrome is outside controlled airspace, the ATC unit responsible for the last controlled airspace through which an aircraft will pass shall issue the appropriate clearance for flight to the limit of that controlled airspace.

4.5.7.2 Route of Flight

4.5.7.2.1 The route of flight shall be detailed in each clearance when deemed necessary. The phrase “cleared flight planned route” may be used to describe any route or portion thereof, provided the route or portion thereof is identical to that filed in the flight plan and sufficient routing details are given to definitely establish the aircraft on its route. The phrases “cleared (designation) departure” or “cleared (designation) arrival” may be used when standard departure or arrival routes have been established by the appropriate ATS authority and published in Aeronautical Information Publications (AIPs).

NOTE: See 6.3.2.3 pertaining to standard clearances for departing aircraft and 6.5.2.3 pertaining to clearances for arriving aircraft.

4.5.7.2.2 The phrase “cleared flight planned route” shall not be used when granting a re-clearance.

4.5.7.5 Readback of Clearances

4.5.7.5.1 The flight crew shall read back to the air traffic controller safety-related parts of ATC clearances and instructions which are transmitted by voice. The following items shall always be read back:

a. ATC route clearances;

b. clearances and instructions to enter, land on, take off from, hold short of, cross, taxi and backtrack on any runway; and

c. runway-in-use, altimeter settings, SSR codes, level instructions, heading and speed instructions and, whether issued by the controller or contained in automatic terminal information service (ATIS) broadcasts, transition levels.

NOTE: If the level of an aircraft is reported in relation to standard pressure 1 013.2 hPa, the words “FLIGHT LEVEL” precede the level figures. If the level of the aircraft is reported in *relation to QNH/QFE, the figures are followed by the word "METRES" or "FEET", as appropriate.*

4.5.7.5.1.1 Other clearances or instructions, including conditional clearances, shall be read back or acknowledged in a manner to clearly indicate that they have been understood and will be complied with.

4.5.7.5.2 The controller shall listen to the readback to ascertain that the clearance or instruction has been correctly acknowledged by the flight crew and shall take immediate action to correct any discrepancies revealed by the readback.

4.5.7.5.2.1 Unless specified by the appropriate ATS authority, voice readback of controller-pilot data link communications (CPDLC) messages shall not be required.

NOTE: The procedures and provisions relating to the exchange and acknowledgement of CPDLC messages are contained in Annex 10, Volume II and the PANS-ATM, Chapter 14.

4.6 HORIZONTAL SPEED CONTROL INSTRUCTIONS

4.6.1 General

4.6.1.1 In order to facilitate a safe and orderly flow of traffic, aircraft may, subject to conditions specified by the appropriate authority, be instructed to adjust speed in a specified manner. Flight crews should be given adequate notice of planned speed control.

NOTE 1: Application of speed control over a long period of time may affect aircraft fuel reserves.

NOTE 2: Provisions concerning longitudinal separation using the Mach number technique are contained in Chapter 5, Separation Methods and Minima.

4.6.1.2 Speed control instructions shall remain in effect unless explicitly cancelled or amended by the controller.

NOTE: Cancellation of any speed control instruction does not relieve the flight crew of compliance with speed limitations associated with airspace classifications as specified in Annex 11 — Air Traffic Services, Appendix 4.

4.6.1.3 Speed control shall not be applied to aircraft entering or established in a holding pattern.

4.6.1.4 Speed adjustments should be limited to those necessary to establish and/or maintain a desired separation minimum or spacing. Instructions involving frequent changes of speed, including alternate speed increases and decreases, should be avoided.

4.6.1.5 The flight crew shall inform the ATC unit concerned if at any time they are unable to comply with a speed instruction. In such cases, the controller shall apply an alternative method to achieve the desired spacing between the aircraft concerned.

4.6.1.6 At levels at or above 7600m (FL250), speed adjustments should be expressed in multiples of 0.01 Mach; at levels below 7600m (FL250), speed adjustments should be expressed in multiples of 20km/h (10 kt) based on indicated airspeed (IAS).

NOTE 1: Mach 0.01 equals approximately 11km/h (6 kt) IAS at higher flight levels.

NOTE 2: When an aircraft is heavily loaded and at a high level, its ability to change speed may, in cases, be very limited.

4.6.1.7 Aircraft shall be advised when a speed control restriction is no longer required.

4.6.2 Methods of Application

4.6.2.1 In order to establish a desired spacing between two or more successive aircraft, the controller should first either reduce the speed of the last aircraft, or increase the speed of the lead aircraft, then adjust the speed(s) of the other aircraft in order.

4.6.2.2 In order to maintain a desired spacing using speed control techniques, specific speeds need to be assigned to all the aircraft concerned.

NOTE 1: The true airspeed (TAS) of an aircraft will decrease during descent when maintaining a constant IAS. When two descending aircraft maintain the same IAS, and the leading aircraft is at the lower level, the TAS of the leading aircraft will be lower than that of the following aircraft. The distance between the two aircraft will thus be reduced, unless a sufficient speed differential is applied. For the purpose of calculating a desired speed differential between two succeeding aircraft, 11km/h (6 kt) IAS per 300m (1000 ft) height difference may be used as a general rule. At levels below 2450m (FL80) the difference between IAS and TAS is negligible for speed control purposes.

NOTE 2: Time and distance required to achieve a desired spacing will increase with higher levels, higher speeds, and when the aircraft is in a clean configuration.

4.6.3 Descending and Arriving Aircraft

4.6.3.1 An aircraft should, when practicable, be authorized to absorb a period of notified terminal delay by cruising at a reduced speed for the latter portion of its flight.

4.6.3.2 An arriving aircraft may be instructed to maintain its “maximum speed”, “minimum clean speed”, “minimum speed”, or a specified speed.

NOTE: “Minimum clean speed” signifies the minimum speed at which an aircraft can be flown in a clean configuration, i.e. without deployment of lift-augmentation devices, speed brakes or landing gear.

4.6.3.3 Speed reductions to less than 460km/h (250 kt) IAS for turbojet aircraft during initial descent from cruising level should be applied only with the concurrence of the flight crew.

4.6.3.4 Instructions for an aircraft to simultaneously maintain a high rate of descent and reduce its speed should be avoided as such manoeuvres are normally not compatible. Any significant speed reduction during descent may require the aircraft to temporarily level off to reduce speed before continuing descent.

4.6.3.5 Arriving aircraft should be permitted to operate in a clean configuration for as long as possible. Below 4550m (FL150), speed reductions for turbojet aircraft to not less than 410km/h (220 kt) IAS, which will normally be very close to the minimum speed of turbojet aircraft in a clean configuration, may be used.

4.6.3.6 Only minor speed adjustments not exceeding plus/minus 40km/h (20 kt) IAS should be used for aircraft on intermediate and final approach.

4.6.3.7 Speed control should not be applied to aircraft after passing a point 7km (4 NM) from the threshold on final approach.

NOTE: The flight crew has a requirement to fly a stabilized approach (airspeed and configuration) typically by 5km (3 NM) from the threshold (Doc 8168, PANS-OPS, Volume I Part III Section 4, Chapter 3, 3.3 refers).

4.6.4 SID and STAR

The flight crew shall comply with published SID and STAR speed restrictions unless the restrictions are explicitly cancelled or amended by the controller.

NOTE 1: Some SID and STAR speed restrictions ensure containment within RNAV departure or arrival procedure (e.g. maximum speed associated with a constant radius arc to a fix (RF) leg).

NOTE 2: See 6.3.2.4 pertaining to clearances on a SID and 6.5.2.4 pertaining to clearances on a STAR.

4.7 VERTICAL SPEED CONTROL INSTRUCTIONS

4.7.1 General

4.7.1.1 In order to facilitate a safe and orderly flow of traffic, aircraft may be instructed to adjust rate of climb or rate of descent. Vertical speed control may be applied between two climbing aircraft or two descending aircraft in order to establish or maintain-a specific vertical separation minimum.

4.7.1.2 Vertical speed adjustments should be limited to those necessary to establish and/or maintain a desired separation minimum. Instructions involving frequent changes of climb/descent rates should be avoided.

4.7.1.3 The flight crew shall inform the ATC unit concerned if unable, at any time, to comply with a specified rate of climb or descent. In such cases, the controller shall apply an alternative method to achieve an appropriate separation minimum between aircraft, without delay.

4.7.1.4 Aircraft shall be advised when a rate of climb/descent restriction is no longer required.

4.7.2 Methods of Application

4.7.2.1 An aircraft may be instructed to expedite climb or descent as appropriate to or through a specified level, or may be instructed to reduce its rate of climb or rate of descent.

4.7.2.2 Climbing aircraft may be instructed to maintain a specified rate of climb, a rate of climb equal to or greater than a specified value or a rate of climb equal to or less than a specified value.

4.7.2.3 Descending aircraft may be instructed to maintain a specified rate of descent, a rate of descent equal to or greater than a specified value or a rate of descent equal to or less than a specified value.

4.7.2.4 In applying vertical speed control, the controller should ascertain to which level(s) climbing aircraft can sustain a specified rate of climb or, in the case of descending aircraft, the specified rate of descent which can be sustained, and shall ensure that alternative methods of maintaining separation can be applied in a timely manner, if required.

NOTE: Controllers need to be aware of aircraft performance characteristics and limitations in relation to a simultaneous application of horizontal and vertical speed limitations.

4.8 CHANGE FROM IFR TO VFR FLIGHT

4.8.1 Change from instrument flight rules (IFR) flight to visual flight rules (VFR) flight is only acceptable when a message initiated by the pilot-in-command containing the specific expression “CANCELLING MY IFR FLIGHT”, together with the changes, if any, to be made to the current flight plan, is received by an air traffic services unit. No invitation to change from IFR flight to VFR flight is to be made either directly or by inference.

4.8.2 No reply, other than the acknowledgment “IFR FLIGHT CANCELLED AT . . . (time)”, should normally be made by an air traffic services unit.

4.8.3 When an ATS unit is in possession of information that instrument meteorological conditions are likely to be encountered along the route of flight, a pilot changing from IFR flight to VFR flight should, if practicable, be so advised.

4.9 WAKE TURBULENCE

4.9.1 Wake Turbulence Categories of Aircraft

4.9.1.1 Except as provided for in 4.9.1.2, wake turbulence separation minima shall be based on a grouping of aircraft types into four categories according to the maximum certificated take-off mass as follows:

a. SUPER (J) – aircraft types specified as such in Doc 8643, *Aircraft Type Designators*;

b. HEAVY (H) – aircraft types of 136,000kg or more, with the exception of aircraft types listed in Doc 8643 in the SUPER (J) category;

c. MEDIUM (M) – aircraft types less than 136,000kg but more than 7000kg; and

d. LIGHT (L) – aircraft types of 7000kg or less.

NOTE: The wake turbulence category for each aircraft type is contained in Doc 8643, Aircraft Type Designators (not published herein).

4.9.1.2 When approved by the appropriate ATS authority, wake turbulence separation minima may be applied utilizing wake turbulence groups and shall be based on wake generation and resistance characteristics of the aircraft. These depend primarily on maximum certificated take-off mass, wing characteristics and speeds. The group designators are described as follows:

a. GROUP A – aircraft types of 136,000kg or more, and a wing span less than or equal to 80m but greater than 74.68m;

b. GROUP B – aircraft types of 136,000kg or more, and a wing span less than or equal to 74.68m but greater than 53.34m;

c. GROUP C – aircraft types of 136,000kg or more, and a wing span less than or equal to 53.34m but greater than 38.1m;

d. GROUP D – aircraft types less than 136,000kg but more than 18,600kg, and a wing span greater than 32m;

e. GROUP E – aircraft types less than 136,000kg but more than 18,600kg, and a wing span less than or equal to 32m but greater than 27.43m;

f. GROUP F – aircraft types less than 136,000kg but more than 18,600kg, and a wing span less than or equal to 27.43m;

g. GROUP G – aircraft types of 18,600kg or less (without wing span criterion).

NOTE 1: Information on the wake turbulence group for each aircraft type is contained in Doc 8643, Aircraft Type Designators (not published herein).

NOTE 2: Guidance on the implementation of wake turbulence separation between wake turbulence groups can be found in the Manual on Implementation of Wake Turbulence Separation Minima (Doc 10122) (not published herein).

4.9.1.2.1 Essential information, including the wake turbulence group designator as necessary, shall be provided to the controller when separation based on wake turbulence groups is to be applied.

4.9.2 Indication of Super or Heavy Wake Turbulence Category

For aircraft in the SUPER or HEAVY wake turbulence categories, the word “super” or “heavy” shall be included, as appropriate, immediately after the aircraft call sign in the initial radiotelephony contact between such aircraft and ATS units.

NOTE 1: Wake turbulence categories are specified in the instructions for completing Item 9 of the flight plan in Appendix 2.

NOTE 2: Wake turbulence Group A is equivalent to the SUPER wake turbulence category, and Groups B and C are equivalent to the HEAVY category.

4.10 ALTIMETER SETTING PROCEDURES

4.10.1 Expression of Vertical Position of Aircraft

4.10.1.1 For flights in the vicinity of aerodromes and within terminal control areas, the vertical position of aircraft shall, except as provided for in 4.10.1.2, be expressed in terms of altitudes at or below the transition altitude and in terms of flight levels at or above the transition level. While passing through the transition layer, vertical position shall be expressed in terms of flight levels when climbing and in terms of altitudes when descending.

4.10.1.2 When an aircraft which has been given clearance to land is completing its approach using atmospheric pressure at aerodrome elevation (QFE), the vertical position of the aircraft shall be expressed in terms of height above aerodrome elevation during that portion of its flight for which QFE may be used, except that it shall be expressed in terms of height above runway threshold elevation:

a. for instrument runways, if the threshold is 2 metres (7 feet) or more below the aerodrome elevation; and

b. for precision approach runways.

4.10.1.3 For flights en route, the vertical position of aircraft shall be expressed in terms of:

a. flight levels at or above the lowest usable flight level;

b. altitudes below the lowest usable flight level;

except where, on the basis of regional air navigation agreements, a transition altitude has been established for a specified area, in which case the provisions of 4.10.1.1 shall apply.

4.11 POSITION REPORTING

4.11.1 Transmission of Position Reports

4.11.1.1 On routes defined by designated significant points, position reports shall be made when over, or as soon as possible after passing, each designated compulsory reporting point, except as provided in 4.11.1.3. Additional reports over other points may be requested by the appropriate ATS unit.

4.11.1.2 On routes not defined by designated significant points, position reports shall be made by the aircraft as soon as possible after the first half hour of flight and at hourly intervals thereafter, except as provided in 4.11.1.3. Additional reports at shorter intervals of time may be requested by the appropriate ATS unit.

4.11.1.3 Under conditions specified by the appropriate ATS authority, flights may be exempted from the requirement to make position reports at each designated compulsory reporting point or interval. In applying this, account should be taken of the meteorological requirement for the making and reporting of routine aircraft observations.

NOTE: This is intended to apply in cases where adequate flight progress data are available from other sources; e.g., radar, or ADS-B (see Chapter 8, 8.6.4.4), or ADS-C (see Chapter 13), and in other circumstances where the omission of routine reports from selected flights is found to be acceptable.

4.11.1.4 The position reports required by 4.11.1.1 and 4.11.1.2 shall be made to the ATS unit serving the airspace in which the aircraft is operated. In addition, when so prescribed by the appropriate ATS authority in aeronautical information publications or requested by the appropriate ATS unit, the last position report before passing from one FIR or control area to an adjacent FIR or control area shall be made to the ATS unit serving the airspace about to be entered.

4.11.2 Contents of Voice Position Reports

4.11.2.1 The position reports required by 4.11.1.1 and 4.11.1.2 shall contain the following elements of information, except that elements d., e. and f. may be omitted from position reports transmitted by radiotelephony, when so prescribed on the basis of regional air navigation agreements:

a. aircraft identification;

b. position;

c. time;

d. flight level or altitude, including passing level and cleared level if not maintaining the cleared level;

e. next position and time over; and

f. ensuing significant point.

4.11.2.1.1 Element d., flight level or altitude, shall, however, be included in the initial call after a change of air-ground voice communication channel.

4.11.2.2 When assigned a speed to maintain, the flight crew shall include this speed in their position reports. The assigned speed shall also be included in the initial call after a change of air-ground voice communication channel, whether or not a full position report is required.

NOTE: Omission of element d. may be possible when flight level or altitude, as appropriate, derived from pressure-altitude information can be made continuously available to controllers in labels associated with the position indication of aircraft and when adequate procedures have been developed to guarantee the safe and efficient use of this altitude information.

4.11.3 Radiotelephony Procedures for Air-Ground Voice Communication Channel Changeover

When so prescribed by the appropriate ATS authority, the initial call to an ATC unit after a change of air-ground voice communication channel shall contain the following elements:

a. designation of the station being called;

b. call sign and, for aircraft in the SUPER or HEAVY wake turbulence categories, the word “super” or “heavy” respectively;

c. level, including passing and cleared levels if not maintaining the cleared level;

d. speed, if assigned by ATC; and

e. additional elements, as required by the appropriate ATS authority.

4.11.4 Transmission of ADS-C Reports

The position reports shall be made automatically to the ATS unit serving the airspace in which the aircraft is operating. The requirements for the transmission and contents of automatic dependent surveillance-contract (ADS-C) reports shall be established by the controlling ATC unit on the basis of current operational conditions and communicated to the aircraft and acknowledged through an ADS-C agreement.

4.11.5 Contents of ADS-C Reports

4.11.5.1 ADS-C reports shall be composed of data blocks selected from the following:

a. **Aircraft Identification**

b. **Basic ADS-C:**

  latitude

  longitude

altitude

time

figure of merit

NOTE: The basic ADS-C block is mandatory and is included in all ADS-C reports.

c. **Ground Vector:**

track

ground speed

rate of climb or descent

d. **Air Vector:**

heading

Mach or IAS

rate of climb or descent

e. **Projected Profile:**

next way-point

estimated altitude at next way-point

estimated time at next way-point

(next + 1) way-point

estimated altitude at (next + 1) way-point

estimated time at (next + 1) way-point

f. **Meteorological Information:**

wind speed

wind direction

wind quality flag (if available)

temperature

turbulence (if available)

humidity (if available)

NOTE: The specifications for the elements in the meteorological information data block, including their ranges and resolutions, are shown in Appendix 3 to Annex 3 (not published herein).

g. **Short-term Intent:**

latitude at projected intent point

longitude at projected intent point

altitude at projected intent point

time of projection

If an altitude, track or speed change is predicted to occur between the aircraft's current position and the projected intent point, additional information would be provided in an intermediate intent block as follows:

distance from current point to change point

track from current point to change point

altitude at change point

predicted time to change point

4.11.5.2 The basic ADS-C data block shall be required from all ADS-C-equipped aircraft. Remaining ADS-C data blocks shall be included as necessary. In addition to any requirements concerning its transmission for ATS purposes, data block f) (Meteorological information) shall be transmitted in accordance with Annex 3, 5.3.1 (not published herein). ADS-C emergency and/or urgency reports shall include the emergency and/or urgency status in addition to the relevant ADS-C report information.

4.12 REPORTING OF OPERATIONAL AND METEOROLOGICAL INFORMATION

4.12.1 General

4.12.1.1 When operational and/or routine meteorological information is to be reported, using data link, by an aircraft en route at times where position reports are required in accordance with 4.11.1.1 and 4.11.1.2, the position report shall be given in accordance with 4.11.5.2 (requirements concerning transmission of meteorological information from ADS-C equipped aircraft), in the form of a routine air-report. Special aircraft observations shall be reported as special air-reports. All air-reports shall be reported as soon as is practicable.

4.12.2 Contents of Routine Air-Reports

4.12.2.1 Routine air-reports transmitted by data link, when ADS-C is not being applied, shall give information relating to such of the following elements as are necessary for compliance with 4.12.2.2:

– *Section 1 — Position Information:*

1. Aircraft identification
2. Position
3. Time
4. Flight level or altitude
5. Next position and time over
6. Ensuing significant point.

– *Section 2 — Operational Information:*

7. Estimated time of arrival
8. Endurance.

– *Section 3 — Meteorological Information:*

9. Wind direction
10. Wind speed
11. Wind quality flag
12. Air temperature
13. Turbulence (if available)
14. Humidity (if available).

4.12.2.2 Section 1 of the air-report is obligatory, except that elements (5) and (6) thereof may be omitted when so prescribed on the basis of regional air navigation agreements. Section 2 of the air-report, or a portion thereof, shall only be transmitted when so requested by the operator or a designated representative, or when deemed necessary by the pilot-in-command. Section 3 of the air-report shall be transmitted in accordance with Annex 3, Chapter 5.

NOTE: While element 4., flight level or altitude, may, in accordance with 4.11.2.1, be omitted from the contents of a position report transmitted by radiotelephony when so prescribed on the basis of regional air navigation agreements, that element may not be omitted from Section 1 of an air-report.

4.12.3 Contents of Special Air-Reports

4.12.3.1 Special air-reports shall be made by all aircraft whenever the following conditions are encountered or observed:

a. moderate or severe turbulence; or
b. moderate or severe icing; or
c. severe mountain wave; or
d. thunderstorms, without hail that are obscured, embedded, widespread or in squall-lines; or
e. thunderstorms, with hail that are obscured, embedded, widespread or in squall-lines; or
f. heavy dust storm or heavy sandstorm; or
g. volcanic ash cloud; or
h. pre-eruption volcanic activity or a volcanic eruption; or
i. as of 5 November 2020 runway braking action encountered is not as good as reported.

NOTE: Pre-eruption volcanic activity in this context means unusual and/or increasing volcanic activity which could presage a volcanic eruption.

In addition, in the case of transonic and supersonic flight:

j. moderate turbulence; or

k. hail; or

l. cumulonimbus clouds.

4.12.3.2 When air-ground data link is used, special air-reports shall contain the following elements:

– Message type designator

– Aircraft identification

– Data block 1:

- Latitude
- Longitude
- Pressure-altitude
- Time

– Data block 2:

- Wind direction
- Wind speed
- Wind quality flag
- Air temperature
- Turbulence (if available)
- Humidity (if available)

– Data block 3:

- Condition prompting the issuance of the special air-report; to be selected from the list a. to k. presented under 4.12.3.1.

4.12.3.3 When voice communications are used, special air-reports shall contain the following elements:

– Message type designator

– *Section 1 — Position Information:*

1. Aircraft identification
2. Position
3. Time
4. Flight level or altitude

– *Section 3 — Meteorological Information:*

5. Condition prompting the issuance of the special air-report; to be selected from the list a. to k. presented under 4.12.3.1.

4.12.4 Compilation and Transmission of Air-Reports by Voice Communications

4.12.4.1 Forms based on the model AIREP SPECIAL form at Appendix 1 shall be provided for the use of flight crews in compiling the reports. The detailed instructions for reporting as given at Appendix 1, shall be complied with.

4.12.4.2 The detailed instructions, including the formats of messages and the phraseologies given at Appendix 1, shall be used by flight crews when transmitting air-reports and by air traffic services units when retransmitting such reports.

NOTE: Increasing use of air-reports in automated systems makes it essential that the elements of such reports be transmitted in the order and form prescribed.

4.12.5 Recording of Special Air-Reports of Volcanic Activity

Special air-reports containing observations of volcanic activity shall be recorded on the special air- report of volcanic activity form. Forms based on the model form for special air-reports of volcanic activity at Appendix 1 shall be provided for flight crews operating on routes which could be affected by volcanic ash clouds.

NOTE: The recording and reporting instructions may conveniently be printed on the back of the special air-report of volcanic activity form.

4.15 DATA LINK COMMUNICATIONS INITIATION PROCEDURES

4.15.1 General

4.15.1.1 Before entering an airspace where data link applications are used by the ATS unit, data link communications shall be initiated between the aircraft and the ATS unit in order to register the aircraft and, when necessary, allow the start of a data link application. This shall be initiated by the aircraft, either automatically or by the pilot, or by the ATS unit on address forwarding.

4.15.2 Aircraft Initiation

On receipt of a valid data link initiation request from an aircraft approaching or within a data link service area, the ATS unit shall accept the request and, if able to correlate it with a flight plan, shall establish a connection with the aircraft.

4.15.4 Failure

4.15.4.1 In the case of a data link initiation failure, the data link system shall provide an indication of the failure to the appropriate ATS unit(s). The data link system shall also provide an indication of the failure to the flight crew when a data link initiation failure results from a logon initiated by the flight crew.

NOTE: When the aircraft's logon request results from responding to a contact request by a transferring ATS unit, then both ATS units will receive the indication.

4.15.4.3 The aircraft operator shall establish procedures to resolve, as soon as practicable, initiation failures. Procedures should include, as a minimum, that the pilot:

a. verify the correctness and consistency of the flight plan information available in the FMS or equipment from which the data link is initiated, and where differences are detected make the necessary changes;

b. verify the correct address of the ATS unit; then

c. re-initiate data link.

5 SEPARATION METHODS AND MINIMA

5.8 TIME-BASED WAKE TURBULENCE LONGITUDINAL SEPARATION MINIMA

5.8.1 Applicability

5.8.1.1 The ATC unit concerned shall not be required to apply wake turbulence separation:

a. for arriving VFR flights landing on the same runway as a preceding landing SUPER, HEAVY or MEDIUM aircraft; and

b. between arriving IFR flights executing visual approach when the aircraft has reported the preceding aircraft in sight and has been instructed to follow and maintain own separation from that aircraft.

5.8.1.2 The ATC unit shall, in respect of the flights specified in 5.8.1.1 a. and b., as well as when otherwise deemed necessary, issue a caution of possible wake turbulence. The pilot-in-command of the aircraft concerned shall be responsible for ensuring that the spacing from a preceding aircraft of a heavier wake turbulence category is acceptable. If it is determined that additional spacing is required, the flight crew shall inform the ATC unit accordingly, stating their requirements.

5.8.2 Arriving Aircraft

5.8.2.1 Except as provided for in 5.8.1.1 a. and b., the following minima shall be applied to aircraft landing behind a SUPER, a HEAVY or a MEDIUM aircraft:

a. HEAVY aircraft landing behind SUPER aircraft — 2 minutes;

b. MEDIUM aircraft landing behind SUPER aircraft — 3 minutes;

c. MEDIUM aircraft landing behind HEAVY aircraft — 2 minutes;

d. LIGHT aircraft landing behind SUPER aircraft — 4 minutes;

e. LIGHT aircraft landing behind a HEAVY or MEDIUM aircraft — 3 minutes.

5.8.3 Departing Aircraft

5.8.3.1 When using wake turbulence categories contained in Chapter 4, 4.9.1.1 and when the aircraft are using:

a. the same runway (see Figure 5-42);

b. parallel runways separated by less than 760m (2500 ft) (see Figure 5-42);

c. crossing runways if the projected flight path of the second aircraft will cross the projected flight path of the first aircraft at the same altitude or less than 300m (1000 ft) below (see Figure 5-43);

d. parallel runways separated by 760m (2500 ft) or more, if the projected flight path of the second aircraft will cross the projected flight path of the first aircraft at the same altitude or less than 300m (1000 ft) below (see Figure 5-43).

the following minimum separations shall be applied:

1. HEAVY aircraft taking off behind a SUPER aircraft — 2 minutes;
2. LIGHT or MEDIUM aircraft taking off behind a SUPER aircraft — 3 minutes;
3. LIGHT or MEDIUM aircraft taking off behind a HEAVY aircraft — 2 minutes;
4. LIGHT aircraft taking off behind a MEDIUM aircraft — 2 minutes.

5.8.3.2 When using wake turbulence groups contained in Chapter 4,4.9.1.2 and when the aircraft are using:

a. the same runway (see Figure 5-42);

b. parallel runways separated by less than 760m (2500 ft) (see Figure 5-42);

c. crossing runways if the projected flight path of the second aircraft will cross the projected flight path of the first aircraft at the same altitude or less than 300m (1000 ft) below (see Figure 5-43);

d. parallel runways separated by 760m (2500 ft) or more, if the projected flight path of the second aircraft will cross the projected flight path of the first aircraft at the same altitude or less than 300m (1000 ft) below (see Figure 5-43);

the following minimum separations shall be applied:

Preceding aircraft wake turbulence group	Succeeding aircraft wake turbulence group	Time-based wake turbulence separation minima
A	B	100 seconds
	C	120 seconds
	D	140 seconds
	E	160 seconds
	F	160 seconds
	G	180 seconds
B	D	100 seconds
	E	120 seconds
	F	120 seconds

Preceding aircraft wake turbulence group	Succeeding aircraft wake turbulence group	Time-based wake turbulence separation minima
	G	140 seconds
C	D	80 seconds
	E	100 seconds
	F	100 seconds
	G	120 seconds
D	G	120 seconds
E	G	100 seconds

Figure 5-42 — Wake Turbulence Separation for Following Aircraft (see 5.8.3.1 a. and b. and 5.8.3.2 a. and b.)

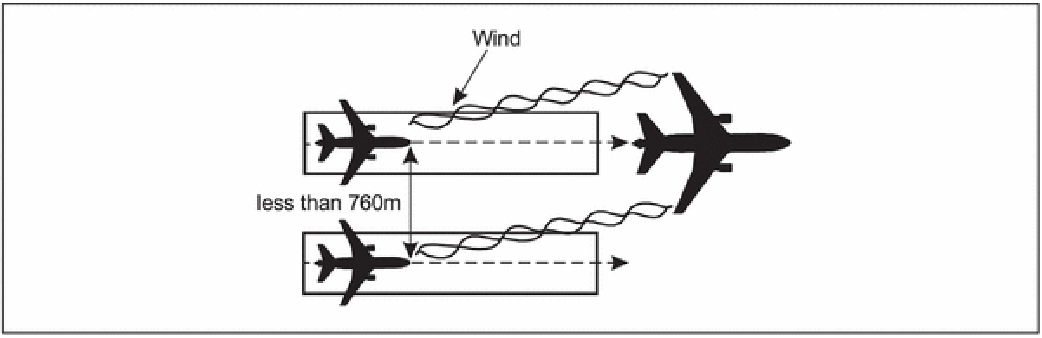
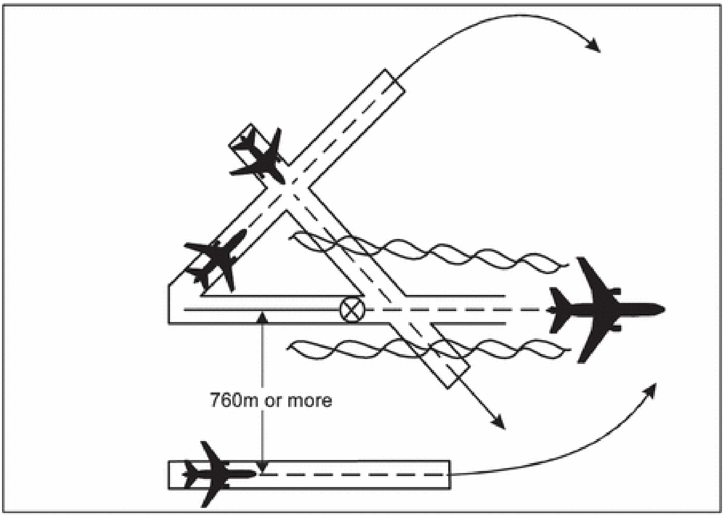


Figure 5-43 — Wake Turbulence Separation for Crossing Aircraft (see 5.8.3.1 c. and d. and 5.8.3.2 c. and d.)



5.8.3.3 When using wake turbulence categories contained in Chapter 4, 4.9.1.1 for aircraft taking off from an intermediate part of the same runway or an intermediate part of a parallel runway separated by less than 760m (2500 ft) (see Figure 5-44), the following minimum separations shall be applied:

a. HEAVY aircraft taking off behind a SUPER aircraft — 3 minutes;

b. LIGHT or MEDIUM aircraft taking off behind a SUPER aircraft — 4 minutes;

c. LIGHT or MEDIUM aircraft taking off behind a HEAVY aircraft — 3 minutes;

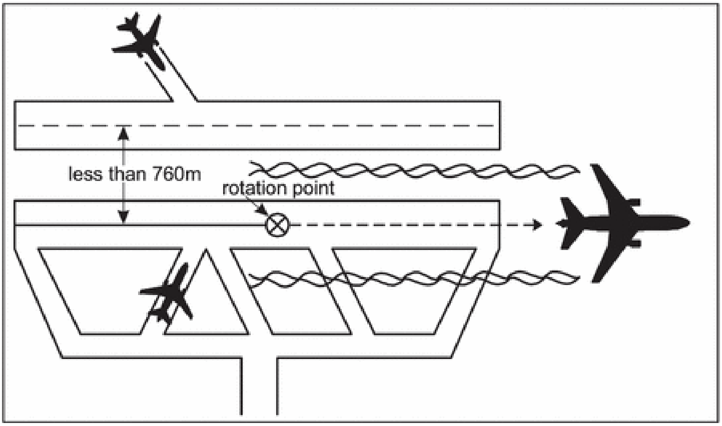
d. LIGHT aircraft taking off behind a MEDIUM aircraft — 3 minutes.

5.8.3.4 When applying the wake turbulence groups in Chapter 4, 4.9.1.2 for aircraft taking off from an intermediate part of the same runway or an intermediate part of a parallel runway separated by less than 760m (2500 ft) (see Figure 5-44), the following minimum separations shall be applied:

Preceding aircraft wake turbulence group	Succeeding aircraft wake turbulence group	Time-based wake turbulence separation minima
A	B	160 seconds
	C	180 seconds
	D	200 seconds
	E	220 seconds

Preceding aircraft wake turbulence group	Succeeding aircraft wake turbulence group	Time-based wake turbulence separation minima
	F	220 seconds
	G	240 seconds
B	D	160 seconds
	E	180 seconds
	F	180 seconds
	G	200 seconds
C	D	140 seconds
	E	160 seconds
	F	160 seconds
	G	180 seconds
D	G	180 seconds
E	G	160 seconds

Figure 5-44 — Wake Turbulence Separation for Following Aircraft (see 5.8.3.3 and 5.8.3.4)



5.8.4 Displaced Landing Threshold

5.8.4.1 When using wake turbulence categories contained in Chapter 4, 4.9.1.1 and when operating a displaced landing threshold, the following minimum separations shall be applied if the projected flight paths are expected to cross:

a. a departing HEAVY aircraft following a SUPER aircraft arrival — 2 minutes;

b. a departing LIGHT or MEDIUM aircraft following a SUPER aircraft arrival — 3 minutes;
c. a departing LIGHT or MEDIUM aircraft following a HEAVY aircraft arrival — 2 minutes;
d. a departing LIGHT aircraft following a MEDIUM aircraft arrival — 2 minutes;
e. a HEAVY aircraft arrival following a SUPER aircraft departure — 2 minutes;
f. a LIGHT or MEDIUM aircraft arrival following a SUPER aircraft departure — 3 minutes;
g. a LIGHT or MEDIUM aircraft arrival following a HEAVY aircraft departure — 2 minutes;
h. a LIGHT aircraft arrival following a MEDIUM aircraft departure — 2 minutes.

5.8.4.2 When using wake turbulence groups contained in Chapter 4, 4.9.1.2 and when operating a displaced landing threshold, the following minimum separations shall be applied when a departing aircraft follows an arriving aircraft. if the projected flight paths are expected to cross:

Preceding arriving aircraft group	Succeeding departing aircraft group	Time-based wake turbulence separation minima
A	B	100 seconds
	C	120 seconds
	D	140 seconds
	E	160 seconds
	F	160 seconds
	G	180 seconds
B	D	100 seconds
	E	120 seconds
	F	120 seconds
	G	140 seconds
C	D	80 seconds
	E	100 seconds
	F	100 seconds
	G	120 seconds
D	G	120 seconds
E	G	100 seconds

5.8.4.3 When using wake turbulence groups contained in Chapter 4, 4.9.1.2 and when operating a displaced landing threshold. the following minimum separations shall be applied when an arriving aircraft follows a departing aircraft, if their projected flight paths are expected to cross:

Preceding departing aircraft group	Succeeding arriving aircraft group	Time-based wake turbulence separation minima
A	B	100 seconds
	C	120 seconds
	D	140 seconds
	E	160 seconds
	F	160 seconds
	G	180 seconds
B	D	100 seconds
	E	120 seconds
	F	120 seconds
	G	140 seconds
C	D	80 seconds
	E	100 seconds
	F	100 seconds
	G	120 seconds
D	G	120 seconds
E	G	100 seconds

5.8.5 Opposite Direction

5.8.5.1 When using wake turbulence categories contained in Chapter 4, 4.9.1.1 for a heavier aircraft making a low or missed approach and when the lighter aircraft is:

a. using an opposite-direction runway for take-off (see Figure 5-45); or

b. landing on the same runway in the opposite direction, or on a parallel opposite-direction runway separated by less than 760m (2500 ft) (see Figure 5-46);

the following minimum separations shall be used:

1. between a HEAVY aircraft and a SUPER aircraft — 3 minutes;
2. between a LIGHT or MEDIUM aircraft and a SUPER aircraft — 4 minutes;
3. between a LIGHT or MEDIUM aircraft and a HEAVY aircraft — 3 minutes;
4. between a LIGHT aircraft and a MEDIUM aircraft — 3 minutes.

5.8.5.2 When applying the wake turbulence groups in Chapter 4, 4.9.1.2 and a heavier aircraft is making a low or missed approach and the lighter aircraft is:

a. utilizing an opposite-direction runway for take-off (see Figure 5-45); or

b. landing on the same runway in the opposite direction, or on a parallel opposite-direction runway separated by less than 760m (2500 ft) (see Figure 5-46),

the following minimum separations shall be used:

Preceding aircraft group	Succeeding aircraft group	Time-based wake turbulence separation minima
A	B	160 seconds
	C	180 seconds
	D	200 seconds
	E	220 seconds
	F	220 seconds
	G	240 seconds
B	D	160 seconds
	E	180 seconds
	F	180 seconds
	G	200 seconds
C	D	140 seconds
	E	160 seconds
	F	160 seconds
	G	180 seconds
D	G	180 seconds
E	G	160 seconds

Figure 5-45 — Wake Turbulence Separation for Opposite-Direction Take-off (see 5.8.5.1 a. and 5.8.5.2 a.)

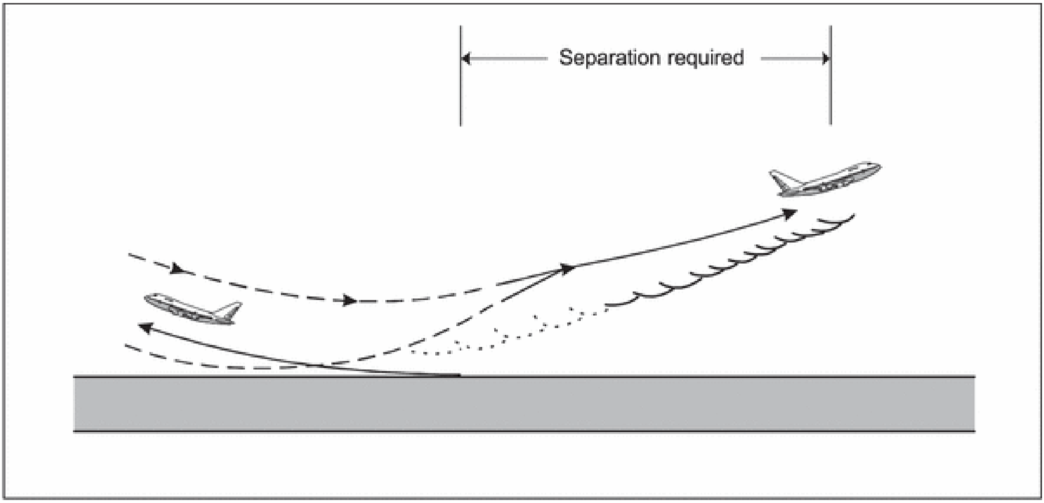
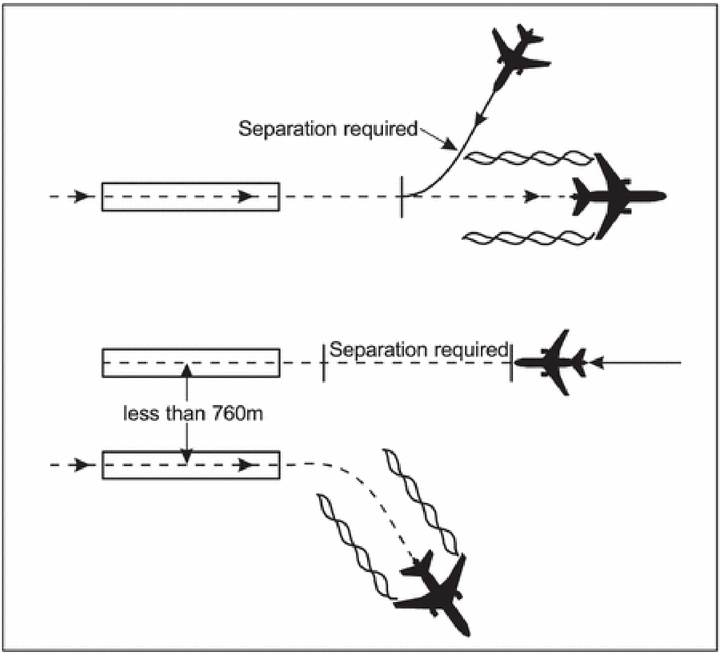


Figure 5-46 — Wake Turbulence Separation for Opposite-Direction Landing (see 5.8.5.1 b. and 5.8.5.2 b.)



5.9 CLEARANCES TO FLY MAINTAINING OWN SEPARATION WHILE IN VISUAL METEOROLOGICAL CONDITIONS

NOTE 1: As indicated in this Section, the provision of vertical or horizontal separation by an air traffic control unit is not applicable in respect of any specified portion of a flight cleared subject to maintaining own separation and remaining in visual meteorological conditions. It is for the flight so cleared to ensure, for the duration of the clearance, that it is not operated in such proximity to other flights as to create a collision hazard.

NOTE 2: It is axiomatic that a VFR flight must remain in visual meteorological conditions at all times. Accordingly, the issuance of a clearance to a VFR flight to fly subject to maintaining own separation and remaining in visual meteorological conditions has no other object than to signify that, for the duration of the clearance, the provision of separation by air traffic control is not entailed.

When so requested by an aircraft and provided it is agreed by the pilot of the other aircraft and so authorized by the appropriate ATS authority, an ATC unit may clear a controlled flight, including departing and arriving flights, operating in airspace Classes D and E in visual meteorological conditions during the hours of daylight to fly subject to maintaining own separation to one other aircraft and remaining in visual meteorological conditions. When a controlled flight is so cleared, the following shall apply:

a. the clearance shall be for a specified portion of the flight at or below 3050m (10,000 ft), during climb or descent and subject to further restrictions as and when prescribed on the basis of regional air navigation agreements;

b. if there is a possibility that flight under visual meteorological conditions may become impracticable, an IFR flight shall be provided with alternative instructions to be complied with in the event that flight in visual meteorological conditions (VMC) cannot be maintained for the term of the clearance;

c. the pilot of an IFR flight, on observing that conditions are deteriorating and considering that operation in VMC will become impossible, shall inform ATC before entering instrument meteorological conditions (IMC) and shall proceed in accordance with the alternative instructions given.

NOTE: See also 5.10.1.2.

5.10 ESSENTIAL TRAFFIC INFORMATION

5.10.1 General

5.10.1.1 Essential traffic is that controlled traffic to which the provision of separation by ATC is applicable, but which, in relation to a particular controlled flight is not, or will not be, separated from other controlled traffic by the appropriate separation minimum.

5.10.1.2 Essential traffic information shall be given to controlled flights concerned whenever they constitute essential traffic to each other.

NOTE: This information will inevitably relate to controlled flights cleared subject to maintaining own separation and remaining in visual meteorological conditions and also whenever the intended separation minimum has been infringed.

5.10.2 Information to Be Provided

Essential traffic information shall include:

a. direction of flight of aircraft concerned;

b. type and wake turbulence category (if relevant) of aircraft concerned;

c. cruising level of aircraft concerned; and

   1. estimated time over the reporting point nearest to where the level will be crossed; or
   2. relative bearing of the aircraft concerned in terms of the 12-hour clock as well as distance from the conflicting traffic; or
   3. actual or estimated position of the aircraft concerned.

6 SEPARATION IN THE VICINITY OF AERODROMES

6.3 PROCEDURES FOR DEPARTING AIRCRAFT

6.3.2 Standard Clearances for Departing Aircraft

6.3.2.1 General

The appropriate ATS authority should, wherever possible, establish standardized procedures for transfer of control between the ATC units concerned, and standard clearances for departing aircraft.

6.3.2.3 Contents

Standard clearances for departing aircraft shall contain the following items:

a. aircraft identification;

b. clearance limit, normally destination aerodrome;

c. designator of the assigned SID, if applicable;

d. cleared level;

e. allocated SSR code;

f. any other necessary instructions or information not contained in the SID description, e.g. instructions relating to change of frequency.

NOTE 1: See 6.3.2.4.1 for clearances to aircraft on SID.

NOTE 2: The use of a SID designator without a cleared level does not authorize the aircraft to climb on the SID vertical profile.

6.3.2.4 Clearance on a SID

6.3.2.4.1 Clearances to aircraft on a SID with remaining published level and/or speed restrictions shall indicate if such restrictions are to be followed or are cancelled. The following phraseologies shall be used with the following meanings:

a. CLIMB VIA SID TO *(level)*:
   1. climb to the cleared level and comply with published level restrictions;
   2. follow the lateral profile of the SID; and
   3. comply with published speed restrictions or ATC-issued speed control instructions as applicable.

b. CLIMB VIA SID TO *(level)*, CANCEL LEVEL RESTRICTION(S):
   1. climb to the cleared level; published level restrictions are cancelled;
   2. follow the lateral profile of the SID; and
   3. comply with published speed restrictions or ATC-issued speed control instructions as applicable.

c. CLIMB VIA SID TO *(level)*, CANCEL LEVEL RESTRICTION(S) AT *(point(s))*:
   1. climb to the cleared level; published level restriction(s) at the specified point(s) are cancelled;
   2. follow the lateral profile of the SID; and
   3. comply with published speed restrictions or ATC-issued speed control instructions as applicable.

d. CLIMB VIA SID TO *(level)*, CANCEL SPEED RESTRICTION(S):
   1. climb to the cleared level and comply with published level restrictions;
   2. follow the lateral profile of the SID; and
   3. published speed restrictions and ATC-issued speed control instructions are cancelled.

e. CLIMB VIA SID TO *(level)*, CANCEL SPEED RESTRICTION(S) AT *(point(s))*:
   1. climb to the cleared level and comply with published level restrictions;
   2. follow the lateral profile of the SID; and
   3. published speed restrictions are cancelled at the specified point(s).

f. CLIMB UNRESTRICTED TO *(level)* or CLIMB TO *(level)*, CANCEL LEVEL AND SPEED RESTRICTION(S):
   1. climb to the cleared level; published level restrictions are cancelled;
   2. follow the lateral profile of the SID; and
   3. published speed restrictions and ATC-issued speed control instructions are cancelled.

6.3.2.4.2 If there are no remaining published level or speed restrictions on the SID, the phrase CLIMB TO *(level)* should be used.

6.3.2.4.3 When subsequent speed restriction instructions are issued, and if the cleared level is unchanged, the phrase CLIMB VIA SID TO *(level)* should be omitted.

6.3.2.4.4 When a departing aircraft is cleared to proceed direct to a published waypoint on the SID, the speed and level restrictions associated with the bypassed waypoints are cancelled. All remaining published speed and level restrictions shall remain applicable.

6.3.2.4.5 When a departing aircraft is vectored or cleared to proceed to a point that is not on the SID, all the published speed and level restrictions of the SID are cancelled and the controller shall:

a. reiterate the cleared level;
b. provide speed and level restrictions as necessary; and
c. notify the pilot if it is expected that the aircraft will be instructed to subsequently rejoin the SID.

NOTE: See also 8.6.5.2 regarding prescribed obstacle clearance.

6.3.2.4.6 ATC instructions to an aircraft to rejoin a SID shall include:

a. the designator of the SID to be rejoin, unless advance notification of rejoin has been provided in accordance with 6.3.2.4.5;

b. the cleared level in accordance with 6.3.2.4.1; and

c. the position at which it is expected to rejoin the SID.

NOTE: See 12.3.3.1 for phraseology on rejoin instructions.

6.3.2.5 Communication Failure

6.3.2.5.1 Clearances for departing aircraft may specify a cleared level other than that indicated in the filed flight plan for the en-route phase of flight, without a time or geographical limit for the cleared level. Such clearances will normally be used to facilitate the application of tactical control methods by ATC, normally through the use of an ATS surveillance system.

6.3.2.5.2 Where clearances for departing aircraft contain no time or geographical limit for a cleared level, action to be taken by an aircraft experiencing air-ground communication failure in the event the aircraft has been radar vectored away from the route specified in its current flight plan should be prescribed on the basis of a regional air navigation agreement and included in the SID description or published in AIPs.

6.3.3 Departure Sequence

6.3.3.1 Departing aircraft may be expedited by suggesting a take-off direction which is not into the wind. It is the responsibility of the pilot-in-command of an aircraft to decide between making such a take-off or waiting for normal take-off in a preferred direction.

6.5 PROCEDURES FOR ARRIVING AIRCRAFT

6.5.2 Standard Clearances for Arriving Aircraft

6.5.2.3 Contents

Standard clearances for arriving aircraft shall contain the following items:

a. aircraft identification;

b. designator of the assigned STAR if applicable;

c. runway-in-use, except when part of the STAR description;

d. cleared level; and

e. any other necessary instructions or information not contained in the STAR description, e.g. change of communications.

NOTE 1: See 6.5.2.4.1 for clearances on a STAR.

NOTE 2: The use of a STAR designator without a cleared level does not authorize the aircraft to descend on the STAR vertical profile.

6.5.2.4 Clearance on a STAR

6.5.2.4.1 Clearances to aircraft on a STAR with remaining published level and/or speed restrictions shall indicate if such restrictions are to be followed or are cancelled. The following phraseologies shall be used with the following meaning:

a. DESCEND VIA STAR TO *(level)*:
   1. descend to the cleared level and comply with published level restrictions;
   2. follow the lateral profile of the STAR; and
   3. comply with published speed restrictions or ATC-issued speed control instructions as applicable.

b. DESCEND VIA STAR TO *(level)*, CANCEL LEVEL RESTRICTION(S):
   1. descend to the cleared level; published level restrictions are cancelled;
   2. follow the lateral profile of the STAR; and
   3. comply with published speed restrictions or ATC-issued speed control instructions as applicable.

c. DESCEND VIA STAR TO *(level)*, CANCEL LEVEL RESTRICTION(S) AT *(point(s))*:
   1. descend to the cleared level; published level restriction(s) at the specified point(s) are cancelled;
   2. follow the lateral profile of the STAR; and
   3. comply with published speed restrictions or ATC-issued speed control instructions as applicable.

d. DESCEND VIA STAR TO *(level)*, CANCEL SPEED RESTRICTION(S):
   1. descend to the cleared level and comply with published level restrictions;
   2. follow the lateral profile of the STAR; and
   3. published speed restrictions and ATC-issued speed control instructions are cancelled.

e. DESCEND VIA STAR TO *(level)*, CANCEL SPEED RESTRICTION(S) AT *(point(s))*:
   1. descend to the cleared level and comply with published level restrictions;
   2. follow the lateral profile of the STAR; and
   3. published speed restrictions are cancelled at the specified point(s).

f. DESCEND UNRESTRICTED TO *(level)* or DESCEND TO *(level)*, CANCEL LEVEL AND SPEED RESTRICTION(S):
   1. descend to the cleared level; published level restrictions are cancelled;
   2. follow the lateral profile of the STAR; and
   3. published speed restrictions and ATC-issued speed control instructions are cancelled.

6.5.2.4.2 If there are no remaining published level or speed restrictions on the STAR, the phrase DESCEND TO *(level)* should be used.

6.5.2.4.3 When subsequent speed restriction instructions are issued and if the cleared level is unchanged, the phrase DESCEND VIA STAR TO *(level)* should be omitted.

6.5.2.4.4 When an arriving aircraft is cleared to proceed direct to a published waypoint on the STAR, the speed and level restrictions associated with the bypassed waypoints are cancelled. All remaining published speed and level restrictions shall remain applicable.

6.5.2.4.5 When an arriving aircraft is vectored or cleared to proceed to a point that is not on the STAR, all the published speed and level restrictions of the STAR are cancelled and the controller shall:

a. reiterate the cleared level;

b. provide speed and level restrictions as necessary; and

c. notify the pilot if it is expected that the aircraft will be instructed to subsequently rejoin the STAR.

NOTE: See 8.6.5.2 regarding prescribed obstacle clearance.

6.5.2.4.6 ATC instructions to an aircraft to rejoin a STAR shall include:

a. the designator of the STAR to be rejoined, unless advance notification of rejoin has been provided in accordance with 6.5.2.4.5;

b. the cleared level on rejoining the STAR in accordance with 6.5.2.4.1; and

c. the position at which it is expected to rejoin the STAR.

NOTE: See 12. 3. 3. 2 for phraseology on rejoin instructions.

6.5.3 Visual Approach

6.5.3.1 Subject to the conditions in 6.5.3.3, clearance for an IFR flight to execute a visual approach may be requested by a flight crew or initiated by the controller. In the latter case, the concurrence of the flight crew shall be required.

6.5.3.3 An IFR flight may be cleared to execute a visual approach provided that the pilot can maintain visual reference to the terrain and;

a. the reported ceiling is at or above the level of the beginning of the initial approach segment for the aircraft so cleared; or

b. the pilot reports at the level of the beginning of the initial approach segment or at any time during the instrument approach procedure that the meteorological conditions are such that with reasonable assurance a visual approach and landing can be completed.

6.5.3.4 Separation shall be provided between an aircraft cleared to execute a visual approach and other arriving and departing aircraft.

6.5.3.5 For successive visual approaches, separation shall be maintained by the controller until the pilot of a succeeding aircraft reports having the preceding aircraft in sight. The aircraft shall then be instructed to follow and maintain own separation from the preceding aircraft. When both aircraft are of a heavy wake turbulence category, or the preceding aircraft is of a heavier wake turbulence category than the following, and the distance between the aircraft is less than the appropriate wake turbulence minimum, the controller shall issue a caution of possible wake turbulence. The pilot-in-command of the aircraft concerned shall be responsible for ensuring that the spacing from a preceding aircraft of a heavier wake turbulence category is acceptable. If it is determined that additional spacing is required, the flight crew shall inform the ATC unit accordingly, stating their requirements.

6.5.4 Instrument Approach

6.5.4.1 The approach control unit shall specify the instrument approach procedure to be used by arriving aircraft. A flight crew may request an alternative procedure and, if circumstances permit, should be cleared accordingly.

6.5.4.3 If visual reference to terrain is established before completion of the approach procedure, the entire procedure must nevertheless be executed unless the aircraft requests and is cleared for a visual approach.

6.5.5 Holding

6.5.5.5 Holding and holding pattern entry shall be accomplished in accordance with procedures established by the appropriate ATS authority and published in AIPs. If entry and holding procedures have not been published, or if the procedures are not known to a flight crew, the appropriate air traffic control unit shall specify the designator of the location or aid to be used, the inbound track, radial or bearing, direction of turn in the holding pattern as well as the time of the outbound leg or the distances between which to hold.

6.5.5.9 If an aircraft is unable to comply with the published or cleared holding procedure, alternative instructions shall be issued.

6.5.6 Approach Sequence

6.5.6.1 General

The following procedures shall be applied whenever approaches are in progress:

6.5.6.1.1 The approach sequence shall be established in a manner which will facilitate arrival of the maximum number of aircraft with the least average delay. Priority shall be given to:

a. an aircraft which anticipates being compelled to land because of factors affecting the safe operation of the aircraft (engine failure, shortage of fuel, etc.);

b. hospital aircraft or aircraft carrying any sick or seriously injured person requiring urgent medical attention.

c. aircraft engaged in search and rescue operations; and

d. other aircraft as may be determined by the appropriate authority.

6.5.6.1.2 Succeeding aircraft shall be cleared for approach:

a. when the preceding aircraft has reported that it is able to complete its approach without encountering instrument meteorological conditions; or

b. when the preceding aircraft is in communication with and sighted by the aerodrome control tower and reasonable assurance exists that a normal landing can be accomplished; or

c. when timed approaches are used, the preceding aircraft has passed the defined point inbound and reasonable assurance exists that a normal landing can be accomplished;

NOTE: See 6.5.6.2.1 concerning timed approach procedures.

d. when the use of an ATS surveillance system confirms that the required longitudinal spacing between succeeding aircraft has been established.

6.5.6.1.4 If the pilot of an aircraft in an approach sequence has indicated an intention to hold for weather improvement, or for other reasons, such action shall be approved. However, when other holding aircraft indicate intention to continue their approach-to-land, the pilot desiring to hold will be cleared to an adjacent fix for holding awaiting weather change or re-routing. Alternatively, the aircraft should be given a clearance to place it at the top of the approach sequence so that other holding aircraft may be permitted to land. Coordination shall be effected with any adjacent ATC unit or control sector, when required, to avoid conflict with the traffic under the jurisdiction of that unit or sector.

6.5.6.2 Sequencing and Spacing of Instrument Approaches

6.5.6.2.1 TIMED APPROACH PROCEDURES

6.5.6.2.1.1 Subject to approval by the appropriate ATS authority, the following procedure should be utilized as necessary to expedite the approaches of a number of arriving aircraft:

a. a suitable point on the approach path, which shall be capable of being accurately determined by the pilot, shall be specified, to serve as a check point in timing successive approaches;

b. aircraft shall be given a time at which to pass the specified point inbound, which time shall be determined with the aim of achieving the desired interval between successive landings on the runway while respecting the applicable separation minima at all times, including the period of runway occupancy.

6.5.6.2.1.2 The time at which aircraft should pass the specified point shall be determined by the unit providing approach control service and notified to the aircraft sufficiently in advance to permit the pilot to arrange the flight path accordingly.

6.5.6.2.1.3 Each aircraft in the approach sequence shall be cleared to pass the specified point inbound at the previously notified time, or any revision thereof, after the preceding aircraft has reported passing the point inbound.

6.6 INFORMATION FOR ARRIVING AIRCRAFT

6.6.1 As early as practicable after an aircraft has established communication with the unit providing approach control service, the following elements of information, in the order listed, shall be transmitted to the aircraft, with the exception of such elements which it is known the aircraft has already received:

a. type of approach and runway-in-use

b. meteorological information, as follows:

   1. surface wind direction and speed, including significant variations;
   2. visibility and, when applicable, runway visual range (RVR);
   3. present weather;
   4. cloud below 1500m (5000 ft) or below the highest minimum sector altitude, whichever is greater; cumulonimbus; if the sky is obscured, vertical visibility when available;
   5. air temperature;
   6. dew point temperature, inclusion determined on the basis of a regional air navigation agreement;
   7. altimeter setting(s);
   8. any available information on significant meteorological phenomena in the approach area; and
   9. trend-type landing forecast, when available.

c. current runway surface conditions, in case of precipitants or other temporary hazards;

d. changes in the operational status of visual and non visual aids essential for approach and landing.

6.6.4 At the commencement of final approach, the following information shall be transmitted to aircraft:

a. significant changes in the mean surface wind direction and speed;

   NOTE: Significant changes are specified in Annex 3, Chapter 4. However, if the controller possesses wind information in the form of components, the significant changes are:

   – *Mean head-wind component: 19km/h (10 kt)*

   – *Mean tail-wind component: 4km/h (2 kt)*

   – *Mean cross-wind component: 9km/h (5 kt)*

b. the latest information, if any, on wind shear and/or turbulence in the final approach area;

c. the current visibility representative of the direction of approach and landing or, when provided, the current runway visual range value(s) and the trend.

6.6.5 During final approach, the following information shall be transmitted without delay:

a. the sudden occurrence of hazards (e.g. unauthorized traffic on the runway);

b. significant variations in the current surface wind, expressed in terms of minimum and maximum values;

c. significant changes in runway surface conditions;

d. changes in the operational status of required visual or non-visual aids;

e. changes in observed RVR value(s), in accordance with the reported scale in use, or changes in the visibility representative of the direction of approach and landing.

6.7 OPERATIONS ON PARALLEL OR NEAR-PARALLEL RUNWAYS

6.7.2 Departing Aircraft

6.7.2.1 Types of Operation

Parallel runways may be used for independent instrument departures as follows:

a. both runways are used exclusively for departures (independent departures);

b. one runway is used exclusively for departures while the other runway is used for a mixture of arrivals and departures (semi-mixed operation); and

c. both runways are used for mixed arrivals and departures (mixed operation).

6.7.2.2 Requirements and Procedures for Independent Parallel Departures

Independent IFR departures may be conducted from parallel runways provided:

a. the runway centre lines are spaced by a minimum distance of 760m (2500 ft) (see Annex 14, Volume I);

b. the nominal departure tracks diverge by at least:

   1. 15 degrees immediately after take-off; or
   2. 10 degrees, where:

      i) both aircraft are flying an RNAV or RNP instrument departure; and

      ii) the turn commences no more than 3.7km (2.0 NM) from the departure end of the runway;

c. a suitable ATS surveillance system capable of identification of the aircraft within 1.9km (1.0 NM) from the end of the runway is available; and

d. ATS operational procedures ensure that the required track divergence is achieved.

NOTE: For further details refer to Circular 350, Guidelines for the Implementation of Reduced Divergence Departures (not published herein).

6.7.3 Arriving Aircraft

6.7.3.1 Types of Operations

6.7.3.1.1 Parallel runways may be used for simultaneous instrument operations for:

a. independent parallel approaches; or

b. dependent parallel approaches; or

c. segregated parallel operations.

6.7.3.2 Requirements and Procedures for Independent Parallel Approaches

6.7.3.2.1 Independent parallel approaches may be conducted to parallel runways provided that:

a. the runway centre lines are spaced by the distance specified in Table 6-1 (see Annex 14, Volume I) and the surveillance criteria contained in Table 6-1 are met;

Table 6-1. ATS Surveillance System Criteria for Different Runway Spacings

Runway Centre Line Spacing	ATS Surveillance System Criteria
Less than 1310m (4300 ft) but not less than 1035m (3400 ft)	a) a minimum accuracy for an ATS surveillance system as follows: 1) for SSR, an azimuth accuracy of 0.06 degrees (one sigma); or 2) for MLAT or ADS-B, an accuracy of 30m (100 ft); b) an update period of 2.5 seconds or less; and c) a high resolution display providing position prediction and deviation alert is available.
Less than 1525m (5000 ft) but not less than 1310m (4300 ft)	a) an ATS surveillance system with performance specifications other than those above, but equal to or better than: 1) for SSR, a minimum azimuth accuracy of 0.3 degrees (one sigma); or 2) for MLAT or ADS-B, a performance capability equivalent to or better than the SSR requirement can be demonstrated; b) an update period of 5 seconds or less; and c) when it is determined that the safety of aircraft operations would not be adversely affected.
1525m (5000 ft) or more	a) a minimum SSR azimuth accuracy of 0.3 degrees (one sigma), or for MLAT or ADS-B, a performance capability equivalent to or better than the SSR requirement can be demonstrated; and b) an update period of 5 seconds or less.

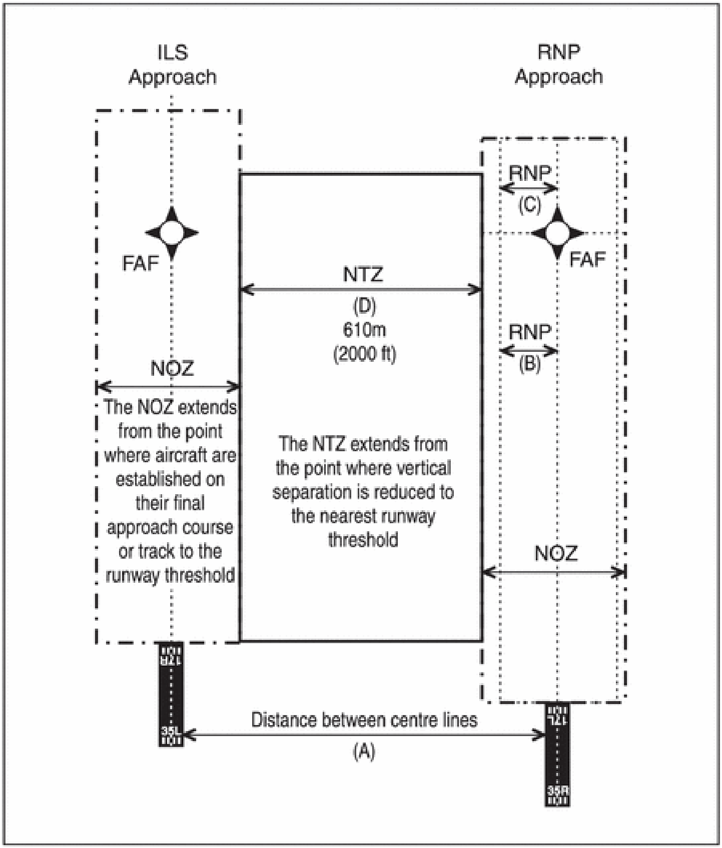
NOTE 1: Information pertaining to use of ADS-B and MLAT and their system performance is contained in the Assessment of ADS-B and Multilateration Surveillance to Support Air Traffic Services and Guidelines for Implementation (Circ 326).

NOTE 2: Refer to Chapter 2, Section 2.6.2 f) on ADS-B implementation that envisages reliance upon a common source for surveillance and/or navigation.

b. the instrument approach procedures that align the aircraft with the extended runway centre line are any combination of the following:

   1. a precision approach procedure; or
   2. except as provided in 6.7.3.2.1 b. 3., an approach with vertical guidance (APV) designed using the RNP AR APCH specification where:
      - i) the RNP value for B, and the RNP value for C if that segment of the approach is within the horizontal separation minimum of a parallel approach, do not exceed one-quarter of the distance between runway centre lines (A), (Figure 6-1 refers); and
      - ii) the RNP value for B, and the RNP value for C if that part of the approach is within the horizontal separation minimum of a parallel approach, do not exceed (A-D)/2, (Figure 6-1 refers); or
   3. an APV procedure designed using either the RNP APCH or RNP AR APCH navigation specification, provided that:
      - i) an appropriate, documented safety risk assessment has shown that an acceptable level of safety can be met;
      - ii) operations are approved by the appropriate ATS authority (Note 1 refers); and
      - iii) the instrument approach is demonstrated to protect the NTZ from infringement during normal operations.

Figure 6-1. Distance between Centre Lines, NTZ and NOZ



NOTE 1: The demonstration of the safety of an APV procedure designed using either RNP APCH or RNP AR APCH navigation specification during simultaneous approaches may consider: the collision risk from normal and residual (not mitigated) atypical errors; likelihood of ACAS nuisance alerting during normal operations; wake hazard; monitoring and available levels of system automation; database management; flight management system input and related crew workload; impacts of meteorological conditions and other environmental factors; training and published ATC break-out procedures.

NOTE 2: For examples of the approach types and scenarios applicable to 6.7.3.2.1 b. see Manual on Simultaneous Operations on Parallel or Near-Parallel Instrument Runways (SOIR) (Doc 9643), Table 2-2 and Appendix C.

c. the nominal tracks of the missed approach procedures diverge by at least 30 degrees;

d. an obstacle survey and evaluation is completed, as appropriate, for the areas adjacent to the final approach segments;

e. aircraft are advised as early as possible, of the assigned runway, instrument approach procedure and any additional information considered necessary to confirm correct selection;

f. the final approach course or track, is intercepted by use of:

   1. vectoring; or
   2. a published arrival and approach procedure that intercepts with the IAF or IF;

g. a no-transgression zone (NTZ) at least 610m (2000 ft) wide is established equidistant between extended runway centre lines and is depicted on the ATS surveillance system situation display;

h. the approaches are monitored by:

   1. a separate monitoring controller for each runway; or
   2. a single monitoring controller for no more than two runways, if determined by a safety risk assessment and approved by the appropriate ATS authority (6.7.3.2.2 refers);

i. monitoring ensures that when the 300m (1000 ft) vertical separation is reduced:

   1. aircraft do not penetrate the depicted NTZ; and
   2. the applicable minimum longitudinal separation between aircraft on the same final approach course or track is maintained; and

j. if no dedicated radio channels are available for the controllers to control the aircraft until landing:

   1. transfer of communication of aircraft to the respective aerodrome controller's channel is effected before either of the two aircraft on adjacent final approach tracks intercepts the glide path or vertical path for the selected instrument approach procedure; and
   2. the controller(s) monitoring the approaches to each runway are provided with the capability to override transmissions of aerodrome control on the respective radio channels for each arrival flow.

6.7.3.2.2 States conducting safety risk assessments to enable the monitoring of not more than two runways by a single controller (6.7.3.2.1 h. refers) should review factors such as, but not limited to: complexity, times of operation, traffic mix and density, arrival rate, available levels of system automation, availability of backup systems, impacts of meteorological conditions and other environmental factors.

6.7.3.2.9 When an aircraft is observed to overshoot the turn-on or to continue on a track which will penetrate the NTZ, the aircraft shall be instructed to return immediately to the correct track.

6.7.3.2.10 When an aircraft is observed penetrating the NTZ, the aircraft on the adjacent ILS localizer course or MLS final approach course or track shall be instructed to immediately climb and turn to the assigned altitude/height and heading (break-out procedures) in order to avoid the deviating aircraft. Where parallel approach obstacle assessment surfaces (PAOAS) criteria are applied for the obstacle assessment, the monitoring controller shall not issue the heading instruction to the aircraft below 120m (400 ft) above the runway threshold elevation, and the heading instruction shall not exceed 45 degrees track difference with the final approach course or track.

6.7.3.2.11 Flight path monitoring using ATS surveillance system shall not be terminated until:

a. visual separation is applied, provided procedures ensure that both controllers are advised whenever visual separation is applied;

b. the aircraft has landed, or in the case of a missed approach, is at least 1.9km (1.0 NM) beyond the departure end of the runway and adequate separation with any other traffic is established.

NOTE: There is no requirement to advise the aircraft that flight path monitoring using radar is terminated.

6.7.3.4 Requirements and Procedures for Dependent Parallel Approaches

6.7.3.4.1 Dependent parallel approaches may be conducted to parallel runways provided;

a. the runway centre lines are spaced by 915m (3000 ft) or more (see Annex 14, Volume I);

b. the final approach course or track is intercepted by use of:

   1. vectoring; or
   2. a published arrival and approach procedure that intercepts with the IAF or IF;

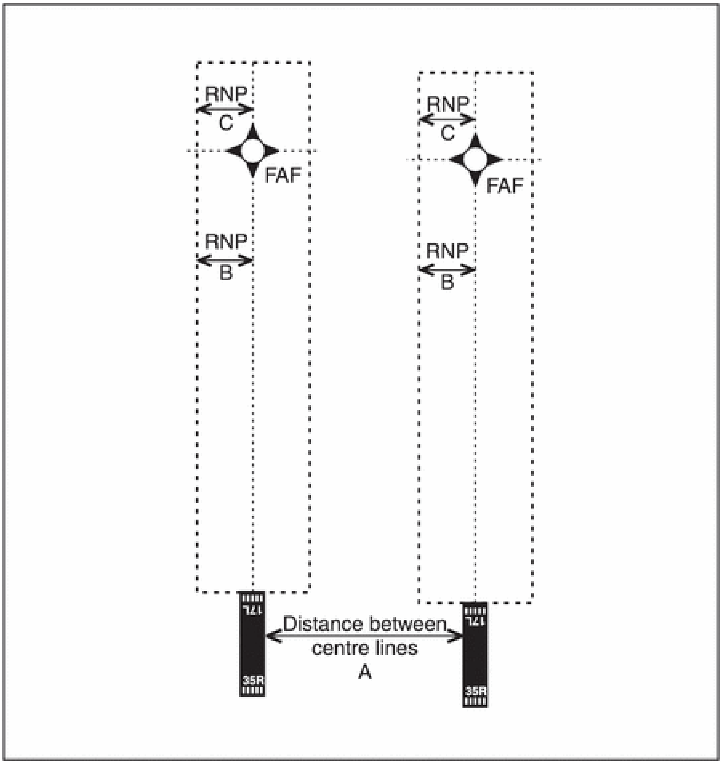
c. an ATS surveillance system with a minimum SSR azimuth accuracy of 0.3 degrees (one sigma), or for MLAT or ADS-B, a performance capability equivalent to or better than the SSR requirement can be demonstrated and an update period of 5 seconds or less is available;

d. the instrument flight procedures that align the aircraft with the extended runway centre line are any combination of the following:

   1. a precision approach procedure;
   2. an APV procedure designed using the RNP AR APCH navigation specification, provided that the RNP value for B, and the RNP value for C if that segment of the approach is within the horizontal separation minimum of a parallel approach, does not exceed one quarter of the distance between runway centre lines (A) (Figure 6-2 refers); and

AIR TRAFFIC MANAGEMENT (DOC 4444)

Figure 6-2. RNP value and distance between centre lines



3. an APV procedure designed using the RNP AR APCH navigation specification that does not meet the provisions in d) 2) or an RNP APCH, provided that:
   i) an appropriate, documented safety risk assessment has shown that an acceptable level of safety can be met; and
   ii) operations are approved by the appropriate ATS authority (Note 1 refers).

NOTE 1: The demonstration of the safety of an APV procedure designed using either RNP APCH or RNP AR APCH navigation specification during simultaneous approaches may consider: the collision risk from normal and residual (not mitigated) atypical errors; likelihood of ACAS nuisance alerting during normal operations; wake hazard; monitoring and available levels of system automation; database management; flight management system input and related crew workload; impacts of meteorological conditions and other environmental factors; training; and published ATC break-out procedures.

NOTE 2: For examples of approach types and scenarios that meet the requirements of 6.7.3.4.1 d., see Manual on Simultaneous Operations on Parallel or Near-Parallel Instrument Runways (SOIR) (Doc 9643) Table 2-3 and Appendix C.

e. aircraft are advised that approaches are in use to both runways (this information may be provided through the ATIS);

f. the nominal tracks of the missed approach procedures diverge by at least 30 degrees; and

g. approach control has a frequency override capability to aerodrome control.

6.7.3.5 Determination that an Aircraft is Established on RNP AR APCH

6.7.3.5.1 In addition to the requirements specified under 6.7.3.2, for the purposes of applying 6.7.3.2.5 b., an aircraft conducting an RNP AR APCH procedure is considered to be established for the entire approach procedure after the IAF/IF provided that:

a. the aircraft confirms that it is established on the RNP AR APCH procedure prior to a designated point, the location of such point to be determined by the appropriate ATS authority;

b. the designated point shall be positioned on the RNP AR APCH to ensure the applicable horizontal separation minimum (e.g. 5.6km (3 NM)) from the adjacent approach procedure (Figure 6-6 refers). The designated point may normally be coincident with the IAF; and

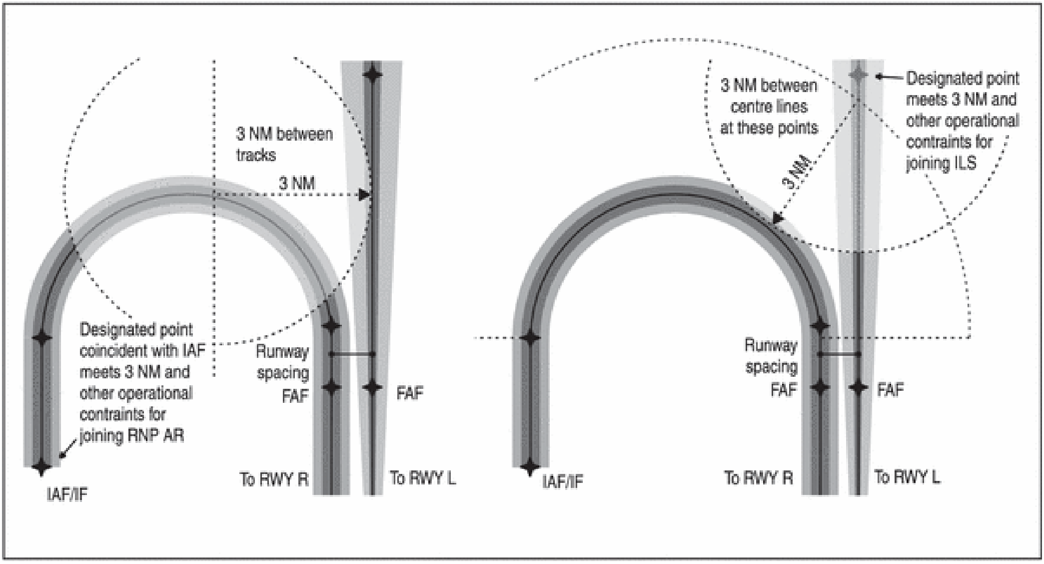
c. to facilitate the application of the procedure, the designated point shall be readily apparent to the approach and monitoring controllers. The designated point may be depicted on the situation display.

6.7.3.5.2 Appropriate wake turbulence separation shall be applied between aircraft on the same approach.

6.7.3.5.3 If, after reporting that it is established on the RNP AR APCH procedure, the aircraft is unable to execute the procedure, the pilot shall notify the controller immediately with a proposed course of action, and thereafter follow ATC instructions (e.g. break-out procedure).

NOTE: Break-out procedures are described in the Manual on Simultaneous Operations on Parallel or Near-Parallel Instrument Runways (SOIR) (Doc 9643).

Figure 6-6. Established on RNP AR APCH Concept (RNP AR APCH/Precision Approach with 3 NM Separation Minimum Example)



6.7.3.5.4 In circumstances where a break-out procedure becomes necessary during the application of the independent parallel approach procedure (for example, an aircraft penetrating the NTZ), the controller may issue climb and/or heading instructions to an aircraft established on an RNP AR APCH.

6.7.3.5.5 To support a break-out instruction, an obstacle assessment shall be completed.

NOTE: Guidance on obstacle assessment is provided in the Manual on Simultaneous Operations on Parallel or Near-Parallel Instrument Runways (SOIR) (Doc 9643).

6.7.3.5.6 Break-out procedures shall be prescribed in the AIP and local instructions.

6.7.3.5.7 The monitoring controller shall protect the NTZ in accordance with 6.7.3.2.1 i.

6.7.3.6 Requirements and Procedures for Segregated Parallel Operations

6.7.3.6.1 Segregated parallel operations may be conducted on parallel runways provided:

a. the runway centre lines are spaced by a minimum of 760m (2500 ft) (see Annex 14, Volume I); and

b. the nominal departure track diverges immediately after take-off by at least 30 degrees from the missed approach track of the adjacent approach.

7 PROCEDURES FOR AERODROME CONTROL SERVICE

7.3 INITIAL CALL TO AERODROME CONTROL TOWER

For aircraft being provided with aerodrome control service, the initial call shall contain:

a. designation of the station being called;

b. call sign and, for aircraft in the SUPER or HEAVY wake turbulence category, the word “super” or “heavy”;

c. position; and

d. additional elements, as required by the appropriate ATS authority.

7.4 INFORMATION TO AIRCRAFT BY AERODROME CONTROL TOWERS

7.4.1 Information Related to the Operation of Aircraft

7.4.1.4 Runway Incursion or Obstructed Runway

7.4.1.4.2 Pilots and air traffic controllers shall report any occurrence involving an obstruction on the runway or a runway incursion.

NOTE 1: Information regarding runway incursions’ reporting forms together with instructions for their completion are contained in the Manual on the Prevention of Runway Incursions (Doc 9870). Attention is drawn to the guidance for analysis, data collection and sharing of data related to runway incursions (see Chapter 5 of Doc 9870).

NOTE 2: The provisions in 7.4.1.4.2 have the objective of supporting the State’s safety programme and safety management system (SMS).

7.4.1.5 Uncertainty of Position on the Manoeuvring Area

7.4.1.5.1 Except as provided for in 7.4.1.5.2, a pilot in doubt as to the position of the aircraft with respect to the manoeuvring area shall immediately:

a. stop the aircraft; and

b. simultaneously notify the appropriate ATS unit of the circumstances (including the last known position).

7.4.1.5.2 In those situations where a pilot is in doubt as to the position of the aircraft with respect to the manoeuvring area, but recognizes that the aircraft is on a runway, the pilot shall immediately:

a. notify the appropriate ATS unit of the circumstances (including the last known position);

b. if able to locate a nearby suitable taxiway, vacate the runway as expeditiously as possible, unless otherwise instructed by the ATS unit; and then,

c. stop the aircraft.

7.6 CONTROL OF AERODROME TRAFFIC

7.6.1 General

As the view from the flight deck of an aircraft is normally restricted, the controller shall ensure that instructions and information which require the flight crew to employ visual detection, recognition and observation are phrased in a clear, concise and complete manner.

7.6.2 Designated Positions of Aircraft in the Aerodrome Traffic and Taxi Circuits

The following positions of aircraft in the traffic and taxi circuits are the positions where the aircraft normally receive aerodrome control tower clearances. Aircraft should be watched closely as they approach these positions so that proper clearances may be issued without delay. Where practicable, all clearances should be issued without waiting for the aircraft to initiate the call.

- *Position 1.* Aircraft initiates call to taxi for departing flight. Runway-in-use information and taxi clearances given.
- *Position 2.* If there is conflicting traffic, the departing aircraft will be held at this position. Engine run-up will, when required, normally be performed here.
- *Position 3.* Take-off clearance is issued here, if not practicable at position 2.
- *Position 4.* Clearance to land is issued here as practicable.
- *Position 5.* Clearance to taxi to apron is issued here.
- *Position 6.* Parking information issued here, if necessary.

NOTE 1: Arriving aircraft executing an instrument approach procedure will normally enter the traffic circuit on final except when visual manoeuvring to the landing runway is required.

NOTE 2: See Figure 7-1.

7.6.3 Traffic on the Manoeuvring Area

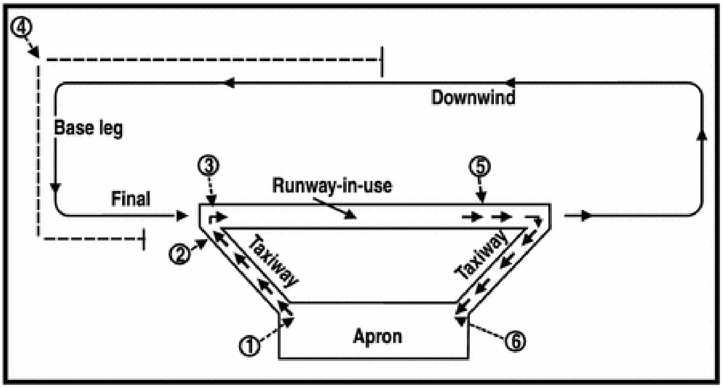
7.6.3.1 Control of Taxiing Aircraft

7.6.3.1.3 USE OF RUNWAY-HOLDING POSITIONS

7.6.3.1.3.1 Except as provided in 7.6.3.1.3.2 or as prescribed by the appropriate ATS authority, aircraft shall not be held closer to a runway-in-use than at a runway-holding position.

7.6.3.1.3.2 Aircraft shall not be permitted to line up and hold on the approach end of a runway-in-use whenever another aircraft is effecting a landing, until the landing aircraft has passed the point of intended holding.

Figure 7-1 — Designated Positions of Aircraft From an Aerodrome Control Tower Viewpoint (see 7.6.2)



7.7 CONTROL OF TRAFFIC IN THE TRAFFIC CIRCUIT

7.7.3 Priority for Landing

7.7.3.2 In cases of emergency it may be necessary, in the interests of safety, for an aircraft to enter a traffic circuit and effect a landing without proper authorization. Controllers should recognize the possibilities of emergency action and render all assistance possible.

7.7.3.3 Priority shall be given to:

a. an aircraft which anticipates being compelled to land because of factors affecting the safe operation of the aircraft (engine failure, shortage of fuel, etc.);

b. hospital aircraft or aircraft carrying any sick or seriously injured persons requiring urgent medical attention;

c. aircraft engaged in search and rescue operations; and

d. other aircraft as may be determined by the appropriate authority.

NOTE: An aircraft which has encountered an emergency is handled as outlined in Chapter 15, Section 15.1.

7.9 CONTROL OF DEPARTING AIRCRAFT

7.9.3 Take-off Clearance

7.9.3.1 Take-off clearance may be issued to an aircraft when there is reasonable assurance that the separation in 7.9.2 (not published herein), or prescribed in accordance with 7.11, will exist when the aircraft commences take-off.

7.9.3.2 When an ATC clearance is required prior to take-off, the take-off clearance shall not be issued until the ATC clearance has been transmitted to and acknowledged by the aircraft concerned. The ATC clearance shall be forwarded to the aerodrome control tower with the least possible delay after receipt of a request made by the tower or prior to such request if practicable.

7.9.3.3 The expression TAKE-OFF shall only be used in radiotelephony when an aircraft is cleared for take-off or when cancelling a take-off clearance.

NOTE: The expression TORA, pronounced TOR-AH, may be used to indicate take-off run available.

7.9.3.4 Subject to 7.9.3.2, the take-off clearance shall be issued when the aircraft is ready for take-off and at or approaching the departure runway, and the traffic situation permits. To reduce the potential for misunderstanding, the take-off clearance shall include the designator of the departure runway.

7.9.3.5 In the interest of expediting traffic, a clearance for immediate take-off may be issued to an aircraft before it enters the runway. On acceptance of such clearance the aircraft shall taxi out to the runway and take off in one continuous movement.

7.11 REDUCED RUNWAY SEPARATION MINIMA BETWEEN AIRCRAFT USING THE SAME RUNWAY

7.11.1 Provided that an appropriate, documented safety risk assessment has shown that an acceptable level of safety can be met, lower minima than those in 7.9.2 and 7.10.1 (not published herein) may be prescribed by the appropriate ATS authority, after consultation with the operators. The safety risk assessment shall be carried out for each runway for which the reduced minima are intended, taking into account factors such as:

a. runway length;

b. aerodrome layout; and

c. types/categories of aircraft involved.

7.11.2 All applicable procedures related to the application of reduced runway separation minima shall be published in the Aeronautical Information Publication as well as in local air traffic control instructions. Controllers shall be provided with appropriate and adequate training in the use of the procedures.

7.11.3 Reduced runway separation minima shall only be applied during the hours of daylight from 30 minutes after local sunrise to 30 minutes before local sunset.

7.11.4 For the purpose of reduced runway separation, aircraft shall be classified as follows:

a. *Category 1 aircraft*: single-engine propeller aircraft with a maximum certificated take-off mass of 2000kg or less;

b. *Category 2 aircraft*: single-engine propeller aircraft with a maximum certificated take-off mass of more than 2000kg but less than 7000kg; and twin-engine propeller aircraft with a maximum certificated take-off mass of less than 7000kg;

c. *Category 3 aircraft*: all other aircraft.

7.11.5 Reduced runway separation minima shall not apply between a departing aircraft and a preceding landing aircraft.

7.11.6 Reduced runway separation minima shall be subject to the following conditions:

a. wake turbulence separation minima shall be applied;

b. visibility shall be at least 5km and ceiling shall not be lower than 300m (1000 ft);

c. tailwind component shall not exceed 5 kt;

d. there shall be available means, such as suitable landmarks, to assist the controller in assessing the distances between aircraft. A surface surveillance system that provides the air traffic controller with position information on aircraft may be utilized, provided that approval for operational use of such equipment includes a safety assessment to ensure that all requisite operational and performance requirements are met;

e. minimum separation continues to exist between two departing aircraft immediately after take-off of the second aircraft;

f. traffic information shall be provided to the flight crew of the succeeding aircraft concerned; and

g. the braking action shall not be adversely affected by runway contaminants such as ice, slush, snow and water.

7.11.7 Reduced runway separation minima which may be applied at an aerodrome shall be determined for each separate runway. The separation to be applied shall in no case be less than the following minima:

a. landing aircraft:

   1) a succeeding landing Category 1 aircraft may cross the runway threshold when the preceding aircraft is a Category 1 or 2 aircraft which either:

      i) has landed and has passed a point at least 600m from the threshold of the runway, is in motion and will vacate the runway without backtracking; or

      ii) is airborne and has passed a point at least 600m from the threshold of the runway.

   2) a succeeding landing Category 2 aircraft may cross the runway threshold when the preceding aircraft is a Category 1 or 2 aircraft which either:

      i) has landed and has passed a point at least 1500m from the threshold of the runway, is in motion and will vacate the runway without backtracking; or

      ii) is airborne and has passed a point at least 1500m from the threshold of the runway;

   3) a succeeding landing aircraft may cross the runway threshold when a preceding Category 3 aircraft:

      i) has landed and has passed a point at least 2400m from the threshold of the runway, is in motion and will vacate the runway without backtracking; or

ii) is airborne and has passed a point at least 2400m from the threshold of the runway.

b. departing aircraft:

1) a Category 1 aircraft may be cleared for take-off when the preceding departing aircraft is a Category 1 or 2 aircraft which is airborne and has passed a point at least 600m from the position of the succeeding aircraft;

2) a Category 2 aircraft may be cleared for take-off when the preceding departing aircraft is a Category 1 or 2 aircraft which is airborne and has passed a point at least 1500m from the position of the succeeding aircraft; and

3) an aircraft may be cleared for take-off when a preceding departing Category 3 aircraft is airborne and has passed a point at least 2400m from the position of the succeeding aircraft.

7.11.7.1 Consideration should be given to increased separation between high performance single-engine aircraft and preceding Category 1 or 2 aircraft.

8 ATS SURVEILLANCE SERVICES

8.3 COMMUNICATIONS

8.3.2 Direct pilot-controller communications shall be established prior to the provision of ATS surveillance services, unless special circumstances, such as emergencies, dictate otherwise.

8.5 USE OF SSR TRANSPONDERS AND ADS-B TRANSMITTERS

8.5.1 To ensure the safe and efficient use of ATS surveillance services, pilots and controllers shall strictly adhere to published operating procedures and standard radiotelephony phraseology shall be used. The correct setting of transponder codes and/or aircraft identification shall be ensured at all times.

8.5.2 SSR Code Management

8.5.2.1 Codes 7700, 7600 and 7500 shall be reserved internationally for use by pilots encountering a state of emergency, radio communication failure or unlawful interference, respectively.

8.5.3 Operation of SSR Transponders

8.5.3.3 Aircraft equipped with Mode S having an aircraft identification feature shall transmit the aircraft identification as specified in Item 7 of the ICAO flight plan or, when no flight plan has been filed, the aircraft registration.

NOTE: All Mode S-equipped aircraft engaged in international civil aviation are required to have an aircraft identification feature.

9 FLIGHT INFORMATION SERVICE AND ALERTING SERVICE

9.1 FLIGHT INFORMATION SERVICE

9.1.4 Air Traffic Advisory Service

9.1.4.2 Aircraft

9.1.4.2.1 AIRCRAFT USING THE AIR TRAFFIC ADVISORY SERVICE

IFR flights electing to use or required by the appropriate ATS authority on the basis of regional air navigation agreements to use the air traffic advisory service when operating within Class F airspace are expected to comply with the same procedures as those applying to controlled flights except that:

a. the flight plan and changes thereto are not subjected to a clearance, since the unit furnishing air traffic advisory service will only provide advice on the presence of essential traffic or suggestions as to a possible course of action;

b. it is for the aircraft to decide whether or not it will comply with the advice or suggestion received and to inform the unit providing air traffic advisory service, without delay, of its decision;

c. air-ground contacts shall be made with the air traffic services unit designated to provide air traffic advisory service within the advisory airspace or portion thereof.

NOTE: See Chapter 4, 4.4.2, for procedures governing submission of a flight plan.

9.1.4.2.2 AIRCRAFT NOT USING THE AIR TRAFFIC ADVISORY SERVICE

9.1.4.2.2.1 Aircraft wishing to conduct IFR flights within advisory airspace, but not electing to use the air traffic advisory service, shall nevertheless submit a flight plan, and notify changes made thereto to the unit providing that service.

NOTE: See Chapter 4, 4.4.2, for procedures governing submission of a flight plan.

9.1.4.2.2.2 IFR flights intending to cross an advisory route should do so as nearly as possible at an angle of 90 degrees to the direction of the route and at a level, appropriate to its track, selected from the table of cruising levels prescribed for use by IFR flights operating outside controlled airspace.

9.2 ALERTING SERVICE

9.2.1 Aircraft

NOTE: Whenever applied, the procedures for the provision of air traffic control service or air traffic advisory service take the place of the following procedures, except when relevant procedures do not call for more than hourly position reports, in which case the Operations normal procedure applies.

9.2.1.1 When so required by the appropriate ATS authority to facilitate the provision of alerting and search and rescue services, an aircraft, prior to and when operating within or into designated areas or along designated routes, shall comply with the provisions detailed in Annex 2, Chapter 3, concerning the submission, completion, changing and closing of a flight plan.

9.2.1.2 In addition to the above, aircraft equipped with suitable two-way radio communications shall report during the period twenty to forty minutes following the time of last contact, whatever the purpose of such contact, merely to indicate that the flight is progressing according to plan, such report to comprise identification of the aircraft and the words “Operations normal” or the signal QRU.

9.2.1.3 The “Operations normal” message shall be transmitted air-ground to an appropriate air traffic services unit (e.g., normally to the aeronautical telecommunication station serving the air traffic services unit in charge of the FIR in which the aircraft is flying, otherwise to another aeronautical telecommunication station to be retransmitted as required to the air traffic services unit in charge of the FIR).

9.2.1.4 It may be advisable, in case of a SAR operation of a substantial duration, to promulgate by NOTAM the lateral and vertical limits of the area of SAR action, and to warn aircraft not engaged in actual SAR operations and not controlled by air traffic control to avoid such areas unless otherwise authorized by the appropriate ATS unit.

12 PHRASEOLOGIES

12.2 GENERAL

12.2.1 Most phraseologies contained in Section 12.3 of this Chapter show the text of a complete message without call signs. They are not intended to be exhaustive, and when circumstances differ, pilots, ATS personnel and other ground personnel will be expected to use plain language which should be as clear and concise as possible, to the level specified in the ICAO language proficiency requirements contained in Annex 1—*Personnel Licensing* (not published herein), in order to avoid possible confusion by those persons using a language other than one of their national languages.

12.2.2 The phraseologies are grouped according to types of air traffic service for convenience of reference. However, users shall be familiar with, and use as necessary, phraseologies from groups other than those referring specifically to the type of air traffic service being provided. All phraseologies shall be used in conjunction with call signs (aircraft, ground vehicle, ATC or other) as appropriate. In order that the phraseologies listed should be readily discernible in Section 12.3, call signs have been omitted. Provisions for the compilation of RTF messages, call signs and procedures are contained in Annex 10, Volume II, Chapter 5.

12.2.3 Section 12.3 includes phrases for use by pilots, ATS personnel and other ground personnel.

12.2.4 During operations in or vertical transit through reduced vertical separation minimum (RVSM) airspace with aircraft not approved for RVSM operations, pilots shall report non-approved status in accordance with 12.3.1.12 c. as follows:

a. at initial call on any channel within RVSM airspace;

b. in all requests for level changes; and

c. in all read-backs of level clearances.

12.2.5 Air traffic controllers shall explicitly acknowledge receipt of messages from aircraft reporting RVSM non-approved status.

12.2.6 Phraseologies for the movement of vehicles on the manoeuvring area shall be the same as those used for the movement of aircraft, with the exception of taxi instructions, in which case the word "PROCEED" shall be substituted for the word "TAXI" when communicating with vehicles.

12.2.7 Conditional phrases, such as "behind landing aircraft" or "after departing aircraft", shall not be used for movements affecting the active runway(s), except when the aircraft or vehicles concerned are seen by the appropriate controller and pilot. The aircraft or vehicle causing the condition in the clearance issued shall be the first aircraft/vehicle to pass in front of the other aircraft concerned. In all cases a conditional clearance shall be given in the following order and consist of:

a. identification;

b. the condition;

c. the clearance; and.

d. brief reiteration of the condition,

For Example: "SAS 941, BEHIND DC9 ON SHORT FINAL, LINE UP BEHIND".

NOTE: This implies the need for the aircraft receiving the conditional clearance to identify the aircraft or vehicle causing the conditional clearance.

12.2.8 The phraseology in Section 12.3 does not include phrases and regular radiotelephony procedure words contained in Annex 10, Volume II.

12.2.9 Words in parentheses indicate that specific information, such as a level, a place or a time, etc., must be inserted to complete the phrase, or alternatively that optional phrases may be used. Words in square parentheses indicate optional additional words or information that may be necessary in specific instances.

12.2.10 Examples of the application of the phraseologies may be found in the *Manual of Radiotelephony* (Doc 9432).

12.3 ATC PHRASEOLOGIES

12.3.1 General

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
12.3.1.1 ***Description of Levels (subsequently referred to as "(level)")***	a. FLIGHT LEVEL *(number)*; or b. *(number)* METRES; or c. *(number)* FEET.
12.3.1.2 ***Level Changes, Reports and Rates***	a. CLIMB (*or* DESCEND); *followed as necessary by:* 1. TO (*level*);
. . . instruction that a climb (or descent) to a level within the vertical range defined is to commence	2. TO AND MAINTAIN BLOCK (*level*) TO (*level*);
	3. TO REACH (*level*) AT (*or* BY) (*time or significant point*);
	4. REPORT LEAVING (*or* REACHING, *or* PASSING) (*level*);
	5. AT (*number*) METRES PER SECOND (*or* FEET PER MINUTE) [OR GREATER (*or* OR LESS)];
. . . for SST aircraft only	6. REPORT STARTING ACCELERATION (*or* DECELERATION).
	b. MAINTAIN AT LEAST (*number*) METRES (*or* FEET) ABOVE (*or* BELOW) (*aircraft call sign*);
	c. REQUEST LEVEL (*or* FLIGHT LEVEL *or* ALTITUDE) CHANGE FROM (*name of unit*) [AT (*time or significant point*)];
	d. STOP CLIMB (*or* DESCENT) AT (*level*);
	e. CONTINUE CLIMB (*or* DESCENT) TO (*level*);
	f. EXPEDITE CLIMB (*or* DESCENT) [UNTIL PASSING (*level*)];
	g. WHEN READY CLIMB (*or* DESCEND) TO (*level*);
	h. EXPECT CLIMB (*or* DESCENT) AT (*time or significant point*);
	i. **REQUEST DESCENT AT (*time*)**;

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
. . . to require action at a specific time or place	j. IMMEDIATELY; k. AFTER PASSING (*significant point*); l. AT (*time or significant point*);
. . . to require action when convenient	m. WHEN READY (*instruction*);
. . . to require an aircraft to climb or descend maintaining own separation and VMC	n. MAINTAIN OWN SEPARATION AND VMC [FROM (*level*)] [TO (*level*)]; o. MAINTAIN OWN SEPARATION AND VMC ABOVE (*or* BELOW, *or* TO) (*level*);
. . . when there is doubt that an aircraft can comply with a clearance or instruction	p. IF UNABLE (*alternative instructions*) AND ADVISE;
. . . when a pilot is unable to comply with a clearance or instruction	q. **UNABLE;**
. . . after a flight crew starts to deviate from any ATC clearance or instruction to comply with an ACAS resolution advisory (pilot and controller interchange)	r. **TCAS RA** s. ROGER;
. . . after the response to an ACAS RA is completed and a return to the ATC clearance or instruction is initiated (pilot and controller interchange)	t. **CLEAR OF CONFLICT, RETURNING TO** (*assigned clearance*); u. ROGER (*or alternative instructions*);
. . . after the response to an ACAS RA is completed and the assigned ATC clearance or instruction has been resumed (Pilot and controller interchange)	v. **CLEAR OF CONFLICT** (*assigned clearance*), **RESUMED;** w. ROGER (*or alternative instructions*);

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CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
. . . after an ATC clearance or instruction contradictory to the ACAS RA is received, the flight crew will follow the RA and inform ATC directly (Pilot and controller interchange)	x. **UNABLE, TCAS RA;** y. ROGER;
. . . clearance to climb on a SID which has published level and/or speed restrictions, where the pilot is to climb to the cleared level and comply with published level restrictions, follow the lateral profile of the SID and comply with published speed restrictions or ATC issued speed control instructions as applicable .	z. CLIMB VIA SID TO (*level*).
. . . clearance to cancel level restriction(s) of the vertical profile of a SID during climb	aa. [CLIMB VIA SID TO (*level*)], CANCEL LEVEL RESTRICTION(S);
. . . clearance to cancel level restriction(s) of the vertical profile of a STAR during descent	bb. [CLIMB VIA SID TO (*level*)], RESTRICTION(S) AT (*point(s)*);
. . . clearance to cancel speed restrictions of a SID during climb	cc. [CLIMB VIA SID TO (*level*)], CANCEL SPEED RESTRICTION(S);
. . . clearance to cancel specific speed restrictions of a SID during climb	dd. [CLIMB VIA SID TO (*level*)], CANCEL SPEED RESTRICTION(S) AT (*point(s)*);
. . . clearance to climb and to cancel speed and level restrictions of a SID	ee. CLIMB UNRESTRICTED TO (*level*) (*or*) CLIMB TO (*level*), CANCEL LEVEL AND SPEED RESTRICTIONS;

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
. . . clearance to descend on a STAR which has published level and/or speed restrictions, where the pilot is to descend to the cleared level and comply with published level restrictions, follow the lateral profile of the STAR and comply with published speed restrictions or ATC issued speed control instructions.	ff. DESCEND VIA STAR TO (*level*);
. . . clearance to cancel level restrictions of a STAR during descent	gg. [DESCEND VIA STAR TO (*level*)] , CANCEL LEVEL RESTRICTION(S);
. . . clearance to cancel specific level restrictions of a STAR during descent	hh. [DESCEND VIA STAR TO (*level*)], CANCEL LEVEL RESTRICTION(S) AT (*point(s)*);
. . . clearance to cancel speed restrictions of a STAR during descent	ii. [DESCEND VIA STAR TO (*level*)] , CANCEL SPEED RESTRICTION(S);
. . . clearance to cancel specific speed restrictions of a STAR during descent	jj. [DESCEND VIA STAR TO (*level*)], CANCEL SPEED RESTRICTION(S) AT (*point(s)*);
. . . clearance to descend and to cancel speed and level restrictions of a STAR	kk. DESCEND UNRESTRICTED TO (*level*) or DESCEND TO (*level*), CANCEL LEVEL AND SPEED RESTRICTIONS.
12.3.1.3 ***Minimum Fuel***	
. . . indication of minimum fuel	a. **MINIMUM FUEL** b. ROGER [NO DELAY EXPECTED ***or*** EXPECT ***(delay information)***].
12.3.1.4 ***Transfer of Control and/or Frequency Change***	a. CONTACT (*unit call sign*) (*frequency*) [NOW]; b. AT (*or* OVER) (*time or place*) [*or* WHEN] [PASSING/LEAVING/REACHING (*level*)] CONTACT (*unit call sign*) (*frequency*); c. IF NO CONTACT (*instructions*);

	CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
	NOTE: An aircraft may be requested to "STAND BY" on a frequency when it is intended that the ATS unit will initiate communications soon and to "MONITOR" a frequency when information is being broadcast thereon.	d. STAND-BY FOR (*unit call sign*) (*frequency*); e. **REQUEST CHANGE TO (*frequency*)**; f. FREQUENCY CHANGE APPROVED; g. MONITOR (*unit call sign*) (*frequency*); h. **MONITORING (*frequency*)**; i. WHEN READY CONTACT (*unit call sign*) (*frequency*); j. REMAIN THIS FREQUENCY.
12.3.1.5	***8.33 kHz Channel Spacing*** *NOTE: In this paragraph, the term "point" is used only in the context of naming the 8.33 kHz channel spacing concept and does not constitute any change to existing ICAO provisions or phraseology regarding the use of the term "decimal."*	
	. . . to request confirmation of 8.33 kHz capability	a. CONFIRM EIGHT POINT THREE THREE;
	. . . to indicate 8.33 kHz capability	b. **AFFIRM EIGHT POINT THREE THREE;**
	. . . to indicate lack of 8.33 kHz capability	c. **NEGATIVE EIGHT POINT THREE THREE;**
	. . . to request UHF capability	d. CONFIRM UHF;
	. . . to indicate UHF capability	e. **AFFIRM UHF;**
	. . . to indicate lack of UHF capability	f. **NEGATIVE UHF;**
	. . . to request status in respect of 8.33 kHz exemption	g. CONFIRM EIGHT POINT THREE THREE EXEMPTED;
	. . . to indicate 8.33 kHz exempted status	h. **AFFIRM EIGHT POINT THREE THREE EXEMPTED;**
	. . . to indicate 8.33 kHz non-exempted status	i. **NEGATIVE EIGHT POINT THREE THREE EXEMPTED.**

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
. . . to indicate that a certain clearance is given because otherwise a non-equipped and/or non-exempted aircraft would enter airspace of mandatory carriage	j. DUE EIGHT POINT THREE THREE REQUIREMENT.
12.3.1.6 ***Change of Call Sign***	
. . . to instruct an aircraft to change its type of call sign	a. CHANGE YOUR CALL SIGN TO (*new call sign*) [UNTIL FURTHER ADVISED];
. . . to advise an aircraft to revert to the call sign indicated in the flight plan	b. REVERT TO FLIGHT PLAN CALL SIGN (*call sign*) [AT (*significant point*)].
12.3.1.7 ***Traffic Information***	a. TRAFFIC (*information*);
. . . to pass traffic information	b. NO REPORTED TRAFFIC;
. . . to acknowledge traffic information	c. **LOOKING OUT**; d. **TRAFFIC IN SIGHT**; e. **NEGATIVE CONTACT [*reasons*]**; f. [ADDITIONAL] TRAFFIC (*direction*) BOUND (*type of aircraft*) (*level*) ESTIMATED (*or* OVER) (*significant point*) AT (*time*); g. TRAFFIC IS (*classification*) UNMANNED FREE BALLOON(S) WAS [*or* ESTIMATED] OVER (*place*) AT (*time*) REPORTED (*level(s)*) [*or* LEVEL UNKNOWN] MOVING (*direction*) (*other pertinent information, if any*).

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
12.3.1.8 ***Meteorological Conditions***	a. [SURFACE] WIND (*number*) DEGREES (*speed*) (*units*); b. WIND AT (*level*) (*number*) DEGREES (*number*) KILOMETRES PER HOUR (*or* KNOTS); *NOTE: Wind is always expressed by giving the mean direction and speed and any significant variations thereof.* c. VISIBILITY (*distance*) (*units*) [*direction*]; d. RUNWAY VISUAL RANGE (*or* RVR) [RUNWAY (*number*)] (*distance*) (*units*); e. RUNWAY VISUAL RANGE (*or* RVR) [RUNWAY (*number*)] NOT AVAILABLE (*or* NOT REPORTED);
. . . for multiple RVR observations	f. RUNWAY VISUAL RANGE (*or* RVR) [RUNWAY (*number*)] (*first position*) (*distance*) (*units*), (*second position*) (*distance*) (*units*), (*third position*) (*distance*) (*units*); *NOTE 1: Multiple RVR observations are always representative of the touchdown zone, midpoint zone and the roll-out / stop end zone respectively.* *NOTE 2: Where reports for three locations are given, the indication of these locations may be omitted, provided that the reports are passed in the order of touchdown zone, followed by the midpoint zone and ending with the roll-out/stop end zone report.*
. . . in the event that RVR information on any one position is not available this information will be included in the appropriate sequence	g. RUNWAY VISUAL RANGE (*or* RVR) [RUNWAY (*number*)] (*first position*) (*distance*) (*units*), (*second position*) NOT AVAILABLE, (*third position*) (*distance*) (*units*); h. PRESENT WEATHER (*details*);

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
	i. CLOUD (*amount*, [(*type*)] *and height of base*) (*units*) (*or* SKY CLEAR); *NOTE: Details of the means to describe the amount and type of cloud are in Chapter 11, 11.4.3.2.3.* j. CAVOK; *NOTE: CAVOK pronounced CAV-O-KAY.* k. TEMPERATURE [MINUS] (*number*) (*and/or* DEW-POINT [MINUS] (*number*)); l. QNH (*number*) [(*units*)]; m. QFE (*number*) [(*units*)]; n. (*aircraft type*) REPORTED (*description*) ICING (*or* TURBULENCE) [IN CLOUD] (*area*) (*time*); o. REPORT FLIGHT CONDITIONS.
12.3.1.9 ***Position Reporting***	a. NEXT REPORT AT (*significant point*);
. . . to omit position reports until a specified position	b. OMIT POSITION REPORTS [UNTIL (*specify*)]; c. RESUME POSITION REPORTING.
12.3.1.10 ***Additional Reports***	a. REPORT PASSING (*significant point*);
. . . to request a report at a specified place or distance	b. REPORT (*distance*) MILES (GNSS *or* DME) FROM (*name of DME station*) (*or significant point*);
. . . to report at a specified place or distance	c. (***distance***) **MILES (GNSS *or* DME) FROM** (***name of DME station***) (***or significant point***); d. REPORT PASSING (*three digits*) RADIAL (*name of VOR*) VOR;
. . . to request a report of present position	e. REPORT (GNSS *or* DME) DISTANCE FROM (*significant point*) or (*name of DME station*);
. . . to report present position	f. (***distance***) **MILES (GNSS *or* DME) FROM** (***name of DME station***) (***or significant point***).

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
12.3.1.11 ***Aerodrome Information*** *(Applicable as of 5 November 2020)* *NOTE 1: — See 11.4.3.4.3 for requirements for passing runway condition reports (RCRs) to pilots.* *NOTE 2: — This information is provided for runway thirds or the full runway, as applicable.*	a. [(*location*)] RUNWAY (*number*) SURFACE CONDITION [CODE (*three digit number*)] *followed as necessary by:* 1. ISSUED AT (*date and time UTC;*) 2. DRY, *or* WET ICE, *or* WATER ON TOP OF COMPACTED SNOW, *or* DRY SNOW, *or* DRY SNOW ON TOP OF ICE, *or* WET SNOW ON TOP OF ICE, *or* ICE, *or* SLUSH, *or* STANDING WATER, *or* COMPACTED SNOW, *or* WET SNOW, *or* DRY SNOW ON TOP OF COMPACTED SNOW, *or* WET SNOW ON TOP OF COMPACTED SNOW, *or* WET, *or* FROST; 3. DEPTH ((depth of deposit) MILLIMETERS or NOT REPORTED); 4. COVERAGE ((number) PERCENT or NOT REPORTED); 5. ESTIMATED SURFACE FRICTION (GOOD, or GOOD TO MEDIUM, or MEDIUM, or MEDIUM TO POOR, or POOR, or LESS THAN POOR); 6. AVAILABLE WIDTH (number) METERS; 7. LENGTH REDUCED TO (number) METERS; 8. DRIFTING SNOW; 9. LOOSE SAND; 10. CHEMICALLY TREATED; 11. SNOWBANK (number) METERS [LEFT, or RIGHT, or LEFT AND RIGHT] [OF or FROM] CENTERLINE; 12. TAXIWAY (identification of taxiway) SNOWBANK (number) METERS [LEFT, or RIGHT, or LEFT AND RIGHT] [OF or FROM] CENTERLINE; 13. ADJACENT SNOWBANKS;

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
	14. TAXIWAY (identification of taxiway) POOR; 15. APRON (identification of apron) POOR; 16. Plain language remarks; b. [(*location*)] RUNWAY SURFACE CONDITION RUNWAY (*number*) NOT CURRENT; c. LANDING SURFACE (*condition*); d. CAUTION CONSTRUCTION WORK (*location*); e. CAUTION (*specify reasons*) RIGHT (*or* LEFT), (*or* BOTH SIDES) OF RUNWAY [(*number*)]; f. CAUTION WORK IN PROGRESS (*or* OBSTRUCTION) (*position and any necessary advice*); g. BRAKING ACTION REPORTED BY (*aircraft type*) AT (*time*) GOOD (*or* GOOD TO MEDIUM, *or* MEDIUM, *or* MEDIUM TO POOR, *or* POOR); h. TAXIWAY (*identification of taxiway*) WET [*or* STANDING WATER, *or* SNOW REMOVED (*length and width as applicable*), *or* CHEMICALLY TREATED, *or* COVERED WITH PATCHES OF DRY SNOW (*or* WET SNOW, *or* COMPACTED SNOW, *or* SLUSH, *or* FROZEN SLUSH, *or* ICE, *or* WET ICE, *or* ICE UNDERNEATH, *or* ICE AND SNOW, *or* SNOWDRIFTS, *or* FROZEN RUTS AND RIDGES *or* LOOSE SAND)]; i. TOWER OBSERVES (*weather information*); j. PILOT REPORTS (*weather information*);

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
12.3.1.12 ***Operational Status of Visual and Non-Visual Aids***	a. (*specify visual or non-visual aid*) RUNWAY (*number*) (*description of deficiency*); b. *(type)* LIGHTING *(unserviceability)* c. GBAS/SBAS/MLS/ILS CATEGORY (*category*) (*serviceability state*); d. TAXIWAY LIGHTING (*description of deficiency*); e. (*type of visual approach slope indicator*) RUNWAY (*number*) (*description of deficiency*);
12.3.1.13 ***Reduced Vertical Separation Minimum (RVSM) Operations***	
. . . to ascertain RVSM approval status of an aircraft	a. CONFIRM RVSM APPROVED;
. . . to report RVSM approved status	b. **AFFIRM RVSM;**
. . . to report RVSM non-approved status followed by supplementary information	c. **NEGATIVE RVSM** [(*supplementary information, e.g. State Aircraft*)];
NOTE: See 12.2.4 and 12.2.5 for procedures relating to operations in RVSM airspace by aircraft with non-approved status.	
. . . to deny ATC clearance into RVSM airspace	d. UNABLE ISSUE CLEARANCE INTO RVSM AIRSPACE, MAINTAIN [*or* DESCEND TO, *or* CLIMB TO] (*level*);
. . . to report when severe turbulence affects the capability of an aircraft to maintain height-keeping requirements for RVSM	e. **UNABLE RVSM DUE TURBULENCE;**
. . . to report that the equipment of an aircraft has degraded below minimum aviation system performance standards	f. **UNABLE RVSM DUE EQUIPMENT;**

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
. . . to request an aircraft to provide information as soon as RVSM-approved status has been regained or the pilot is ready to resume RVSM operations	g. REPORT WHEN ABLE TO RESUME RVSM;
. . . to request confirmation that an aircraft has regained RVSM-approved status or a pilot is ready to resume RVSM operations	h. CONFIRM ABLE TO RESUME RVSM;
. . . to report ability to resume RVSM operations after an equipment or weather-related contingency	i. **READY TO RESUME RVSM.**
12.3.1.14 ***GNSS Service Status***	a. GNSS REPORTED UNRELIABLE (*or* GNSS MAY NOT BE AVAILABLE [DUE TO INTERFERENCE]); 1. IN THE VICINITY OF (*location*) (*radius*) [BETWEEN (*levels*)]; or 2. IN THE AREA OF (*description*) (or IN (*name*) FIR) [BETWEEN (*levels*)]; b. BASIC GNSS (*or* SBAS, *or* GBAS) UNAVAILABLE FOR (*specify operation*) [FROM (*time*) TO (*time*) (*or* UNTIL FURTHER NOTICE)]; c. **BASIC GNSS UNAVAILABLE** [**DUE TO** (*reason, e.g.* **LOSS OF RAIM** *or* **RAIM ALERT**)]; d. **GBAS** (*or* **SBAS**) **UNAVAILABLE**; e. CONFIRM GNSS NAVIGATION; and f. **AFFIRM GNSS NAVIGATION.**
12.3.1.15 ***Degradation of Aircraft Navigation Performance***	UNABLE RNP (*specify type*) (*or* RNAV) [DUE TO (*reason, e.g.* LOSS OF RAIM *or* RAIM ALERT)].

12.3.2 Area Control Services

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
12.3.2.1 ***Issuance of a Clearance***	a. (*name of unit*) CLEARS (*aircraft call sign*); b. (*aircraft call sign*) CLEARED TO; c. RECLEARED (*amended clearance details*) [REST OF CLEARANCE UNCHANGED]; d. RECLEARED (*amended route portion*) TO (*significant point of original route*) [REST OF CLEARANCE UNCHANGED]; e. ENTER CONTROLLED AIRSPACE (*or* CONTROL ZONE) [VIA (*significant point or route*)] AT (*level*) [AT (*time*)]; f. LEAVE CONTROLLED AIRSPACE (*or* CONTROL ZONE) [VIA (*significant point or route*)] AT (*level*) (*or* CLIMBING, *or* DESCENDING); g. JOIN (*specify*) AT (*significant point*) AT (*level*) [AT (*time*)].
12.3.2.2 ***Indication of Route and Clearance Limit***	a. FROM (*location*) TO (*location*); b. TO (*location*), *followed as necessary by*: 1. DIRECT; 2. VIA (*route and/or significant points*); 3. FLIGHT PLANNED ROUTE; *NOTE: Conditions associated with the use of this phrase are in Chapter 4, 4.5.7.2.* 4. VIA (*distance*) DME ARC (*direction*) OF (*name of DME station*); c. (*route*) NOT AVAILABLE DUE (*reason*) ALTERNATIVE[S] IS/ARE (*routes*) ADVISE.

AIR TRAFFIC MANAGEMENT (DOC 4444)

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
12.3.2.3 ***Maintenance of Specified Levels***	a. MAINTAIN (*level*) [TO (*significant point*)]; b. MAINTAIN (*level*) UNTIL PASSING (*significant point*); c. MAINTAIN (*level*) UNTIL (*minutes*) AFTER PASSING (*significant point*); d. MAINTAIN (*level*) UNTIL (*time*); e. MAINTAIN (*level*) UNTIL ADVISED BY (*name of unit*); f. MAINTAIN (*level*) UNTIL FURTHER ADVISED; g. MAINTAIN (*level*) WHILE IN CONTROLLED AIRSPACE; h. MAINTAIN BLOCK (*level*) TO (*level*). *NOTE: The term “MAINTAIN” is not to be used in lieu of “DESCEND” or “CLIMB” when instructing an aircraft to change level.*
12.3.2.4 ***Specification of Cruising Levels***	a. CROSS (*significant point*) AT (*or* ABOVE, *or* BELOW) (*level*); b. CROSS (*significant point*) AT (*time*) OR LATER (*or* BEFORE) AT (*level*); c. CRUISE CLIMB BETWEEN (*levels*) (*or* ABOVE) (*level*); d. CROSS (*distance*) MILES, (GNSS *or* DME) [(*direction*)] OF (*name of DME station*) OR (*distance*) [(*direction*)] OF (*significant point*) AT (*or* ABOVE *or* BELOW) (*level*).
12.3.2.5 ***Emergency Descent***	a. **EMERGENCY DESCENT (*intentions*)**; b. ATTENTION ALL AIRCRAFT IN THE VICINITY OF [*or* AT] (*significant point or location*) EMERGENCY DESCENT IN PROGRESS FROM (*level*) (followed as necessary by specific instructions, clearances, traffic information, etc.).
12.3.2.6 ***If Clearance Cannot be Issued Immediately upon Request***	EXPECT CLEARANCE (*or type of clearance*) AT (*time*).

CIRCUMSTANCES		PHRASEOLOGIES (Pilot Transmissions in Bold Type)
12.3.2.7	***When Clearance for Deviation Cannot be Issued***	UNABLE, TRAFFIC (*direction*) BOUND (*type of aircraft*) (*level*) ESTIMATED (*or* OVER) (*significant point*) AT (*time*) CALL SIGN (*call sign*) ADVISE INTENTIONS.
12.3.2.8	***Separation Instructions***	a. CROSS (*significant point*) AT (*time*) [OR LATER (*or* OR BEFORE)]; b. ADVISE IF ABLE TO CROSS (*significant point*) AT (*time*); c. MAINTAIN MACH (*number*) [OR GREATER (*or* OR LESS)] [UNTIL (*significant point*)]; d. DO NOT EXCEED MACH (*number*); e. CONFIRM ESTABLISHED ON THE TRACK BETWEEN (*significant point*) AND (*significant point*) [WITH ZERO OFFSET]; f. **ESTABLISHED ON THE TRACK BETWEEN (*significant point*) AND (*significant point*) [WITH ZERO OFFSET]**; g. MAINTAIN TRACK BETWEEN (*significant point*) AND (*significant point*). REPORT ESTABLISHED ON THE TRACK; h. **ESTABLISHED ON THE TRACK;**
	NOTE: When used to apply a lateral VOR/GNSS separation confirmation of zero offset is required.	i. CONFIRM ZERO OFFSET; j. **AFFIRM ZERO OFFSET.**
12.3.2.9	***Instructions Associated with Flying a Track (Offset), Parallel to the Cleared Route***	a. ADVISE IF ABLE TO PROCEED PARALLEL OFFSET; b. PROCEED OFFSET (distance) RIGHT/LEFT OF (route) (track) [CENTRE LINE] [AT (significant point or time)] [UNTIL (significant point or time)]; c. CANCEL OFFSET (*instructions to rejoin cleared flight route or other information*).

12.3.3 Approach Control Services

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
12.3.3.1 ***Departure Instructions***	a. [AFTER DEPARTURE] TURN RIGHT (*or* LEFT) HEADING (*three digits*) (*or* CONTINUE RUNWAY HEADING) (*or* TRACK EXTENDED CENTRE LINE) TO (*level or significant point*) [(*other instructions as required*)]; b. AFTER REACHING (*or* PASSING) (*level or significant point*) (*instructions*); c. TURN RIGHT (*or* LEFT) HEADING (*three digits*) TO (*level*) [TO INTERCEPT (*track, route, airway, etc.*)]; d. (*standard departure name and number*) DEPARTURE; e. TRACK (*three digits*) DEGREES [MAGNETIC (*or* TRUE)] TO (*or* FROM) (*significant point*) UNTIL (*time, or* REACHING (*fix or significant point or level*)) [BEFORE PROCEEDING ON COURSE]; f. CLEARED (*designation*) DEPARTURE; *NOTE: Conditions associated with the use of this phrase are in Chapter 4, 4.5.7.2.*
. . . clearance to proceed direct with advance notice of a future instruction to rejoin the SID	g. CLEARED DIRECT (*waypoint*), CLIMB TO (*level*), EXPECT TO REJOIN SID [(*SID designator*)] [AT (*waypoint*)], *then* REJOIN SID (*SID designator*) AT (*waypoint*); h. CLEARED DIRECT (*waypoint*), CLIMB TO (*level*), *then* REJOIN SID (*SID designator*) AT (*waypoint*).
12.3.3.2 ***Approach Instructions***	a. CLEARED (*designation*) ARRIVAL; b. CLEARED TO (*clearance limit*) (*designation*); c. CLEARED (*or* PROCEED) (*details of route to be followed*);

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
. . . clearance to proceed direct with advance notice of a future instruction to rejoin the STAR	d. CLEARED DIRECT (*waypoint*), DESCEND TO (level), EXPECT TO REJOIN STAR [(*STAR designator*)] AT (*waypoint*), *then* REJOIN STAR [(*STAR designator*)] [AT (*waypoint*)]; e. CLEARED DIRECT (*waypoint*), DESCEND TO (*level*), *then* REJOIN STAR (*STAR designator*) AT (*waypoint*); f. CLEARED (*type of approach*) APPROACH [RUNWAY (*number*)]; g. CLEARED (*type of approach*) RUNWAY (*number*) FOLLOWED BY CIRCLING TO RUNWAY (*number*); h. CLEARED APPROACH [RUNWAY (*number*)]; i. COMMENCE APPROACH AT (*time*); j. **REQUEST STRAIGHT-IN [(*type of approach*)] APPROACH [RUNWAY (*number*)]**; k. CLEARED STRAIGHT-IN [(*type of approach*)] APPROACH [RUNWAY *(number)];* l. REPORT VISUAL: m. REPORT RUNWAY [LIGHTS] IN SIGHT;
. . . when a pilot requests a visual approach	n. **REQUEST VISUAL APPROACH;** o. CLEARED VISUAL APPROACH RUNWAY (*number*);
. . . to request if a pilot is able to accept a visual approach *NOTE: See 6.5.3 for provisions relating to visual approach procedures.*	p. ADVISE ABLE TO ACCEPT VISUAL APPROACH RUNWAY (*number*);

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
. . . in case of successive visual approaches when the pilot of a succeeding aircraft has reported having the preceding aircraft in sight	q. CLEARED VISUAL APPROACH RUNWAY (*number*), MAINTAIN OWN SEPARATION FROM PRECEDING (*aircraft type and wake turbulence category as appropriate*) [CAUTION WAKE TURBULENCE]; r. REPORT (*significant point*); [OUTBOUND, *or* INBOUND]; s. REPORT COMMENCING PROCEDURE TURN; t. **REQUEST VMC DESCENT;** u. MAINTAIN OWN SEPARATION; v. MAINTAIN VMC; w. ARE YOU FAMILIAR WITH (*name*) APPROACH PROCEDURE; x. **REQUEST** (***type of approach***) **APPROACH [RUNWAY** (***number***)]; y. **REQUEST (MLS/RNAV plain-language designator);** z. CLEARED (*MLS/RNAV plain-language designator*).
12.3.3.3 ***Holding Clearances***	
. . . visual	a. HOLD VISUAL [OVER] (*position*), (*or* BETWEEN (*two prominent landmarks)*);
. . . published holding procedure over a facility or fix	b. CLEARED (*or* PROCEED) TO (*significant point, name of facility or fix*) [MAINTAIN (or CLIMB or DESCEND TO) (*level*) HOLD [(direction)] AS PUBLISHED EXPECT APPROACH CLEARANCE (*or* FURTHER CLEARANCE) AT (*time*); c. **REQUEST HOLDING INSTRUCTIONS;**

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
. . . when a detailed holding clearance is required	d. CLEARED (*or* PROCEED) TO (*significant point, name of facility or fix*) [(MAINTAIN (*or* CLIMB *or* DESCEND TO) (*level*)] HOLD [(*direction*)] [(*specified*) RADIAL, COURSE, INBOUND TRACK (*three digits*) DEGREES] [RIGHT (*or* LEFT) HAND PATTERN] [OUTBOUND TIME (*number*) MINUTES] EXPECT APPROACH CLEARANCE (*or* FURTHER CLEARANCE) AT (*time*) (*additional instructions, if necessary*); e. CLEARED TO THE (*three digits*) RADIAL OF THE (*name*) VOR AT (*distance*) DME FIX [MAINTAIN (*or* CLIMB *or* DESCEND TO) (*level*)] HOLD [(*direction*)] [RIGHT (*or* LEFT) HAND PATTERN] [OUTBOUND TIME (*number*) MINUTES] EXPECT APPROACH CLEARANCE (*or* FURTHER CLEARANCE) AT (*time*) (*additional instructions, if necessary*); f. CLEARED TO THE (*three digits*) RADIAL OF THE (*name*) VOR AT (*distance*) DME FIX [MAINTAIN (*or* CLIMB *or* DESCEND TO) (*level*)] HOLD BETWEEN (*distance*) AND (*distance*) DME [RIGHT (*or* LEFT) HAND PATTERN] EXPECT APPROACH CLEARANCE (*or* FURTHER CLEARANCE) AT (*time*) (*additional instructions, if necessary*);
12.3.3.4 ***Expected Approach Time***	a. NO DELAY EXPECTED; b. EXPECTED APPROACH TIME (*time*); c. REVISED EXPECTED APPROACH TIME (*time*); d. DELAY NOT DETERMINED (*reasons*).

12.3.4 Phraseologies for use on and in the Vicinity of the Aerodrome

	CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
12.3.4.1	***Identification of Aircraft***	SHOW LANDING LIGHTS.
12.3.4.2	***Acknowledgment by Visual Means***	a. ACKNOWLEDGE BY MOVING AILERONS (*or* RUDDER); b. ACKNOWLEDGE BY ROCKING WINGS; c. ACKNOWLEDGE BY FLASHING LANDING LIGHTS.
12.3.4.3	***Starting Procedures***	
	. . . to request permission to start engines	a. **[*aircraft location*] REQUEST START UP;** b. **[*aircraft location*] REQUEST START UP, INFORMATION (*ATIS identification*);**
	. . . ATC replies	c. START UP APPROVED; d. START UP AT (*time*); e. EXPECT START UP AT (*time*); f. START UP AT OWN DISCRETION; g. EXPECT DEPARTURE (*time*) START UP AT OWN DISCRETION.
12.3.4.4	***Pushback Procedures*** *NOTE: When local procedures so prescribe, authorization for pushback should be obtained from the control tower.*	
	. . . aircraft/ATC	a. **[*aircraft location*] REQUEST PUSHBACK;** b. PUSHBACK APPROVED; c. STANDBY; d. PUSHBACK AT OWN DISCRETION; e. EXPECT (*number*) MINUTES DELAY DUE (*reason*);
12.3.4.5	***Towing Procedures***	a. *** REQUEST TOW [*company name*] (*aircraft type*) FROM (*location*) TO (*location*)**;

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
. . . ATC response	b. TOW APPROVED VIA (*specific routing to be followed*); c. HOLD POSITION; d. STANDBY. ** Denotes Transmission from Aircraft/Tow Vehicle Combination*
12.3.4.6 ***To Request Time Check and/or Aerodrome Data for Departure***	a. **REQUEST TIME CHECK;** b. TIME (*time*)
. . . when no ATIS broadcast is available	c. **REQUEST DEPARTURE INFORMATION;** d. RUNWAY (*number*), WIND (*direction and speed*) (*units*), QNH (*or* QFE) (*number*) [(*units*)] TEMPERATURE [MINUS] (*number*), [VISIBILITY (*distance*) (*units*) (*or* RUNWAY VISUAL RANGE (*or* RVR) (*distance*) (*units*))] [(TIME (*time*)]. *NOTE: If multiple visibility and RVR observations are available, those that represent the roll-out/stop end zone should be used for take-off.*
12.3.4.7 ***Taxi Procedures***	
. . . for departure	a. **[*aircraft type*] [*wake turbulence category if "super" or "heavy"*] [*aircraft location*] REQUEST TAXI [*intentions*]**; b. **[*aircraft type*] [*wake turbulence category if "super" or "heavy"*] [*aircraft location*] (*flight rules*) TO (*aerodrome of destination*) REQUEST TAXI [*intentions*]**; c. TAXI TO HOLDING POINT [*number*] [RUNWAY (*number*)] [HOLD SHORT OF RUNWAY (*number*) (*or* CROSS RUNWAY (*number*))] [TIME (*time*)];

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
. . . where detailed taxi instructions are required	d. **[*aircraft type*] [*wake turbulence category if "super" or "heavy"*] REQUEST DETAILED TAXI INSTRUCTIONS;**
	e. TAXI TO HOLDING POINT [(*number*)] [RUNWAY (number)] VIA (*specific route to be followed*) [TIME (*time*)] [HOLD SHORT OF RUNWAY (*number*)] (*or* CROSS RUNWAY (*number*))];
. . . where aerodrome information is not available from an alternative source such as ATIS	f. TAXI TO HOLDING POINT [(*number*)] (*followed by aerodrome information as applicable*) [TIME (*minutes*)];
	g. TAKE (*or* TURN) FIRST (*or* SECOND) LEFT (*or* RIGHT);
	h. TAXI VIA (*identification of taxiway*);
	i. TAXI VIA RUNWAY (*number*);
	j. TAXI TO TERMINAL (*or other location, e.g.* GENERAL AVIATION AREA) [STAND (*number*)];
. . . for helicopter operations	k. **REQUEST AIR-TAXIING FROM (*or* VIA) TO (*location or routing as appropriate*);**
	l. AIR-TAXI TO (*or* VIA) (*location or routing as appropriate)* [CAUTION (*dust, blowing snow, loose debris, taxiing light aircraft, personnel, etc.)*];
	m. AIR-TAXI VIA (*direct, as requested, or specified route*) TO (*location, heliport, operating or movement area, active or inactive runway*). AVOID (*aircraft or vehicles or personnel*);
. . . after landing	n. **REQUEST BACKTRACK;**
	o. BACKTRACK APPROVED;
	p. BACKTRACK RUNWAY (*number*);

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
. . . general	q. **[*aircraft location*] REQUEST TAXI TO (*destination on aerodrome*);** r. TAXI STRAIGHT AHEAD; s. TAXI WITH CAUTION; t. GIVE WAY TO (*description and position of other aircraft*); u. **GIVING WAY TO (*traffic*);** v. **TRAFFIC (*or type of aircraft*) IN SIGHT;** w. TAXI INTO HOLDING BAY; x. FOLLOW (*description of other aircraft or vehicle*); y. VACATE RUNWAY; z. **RUNWAY VACATED;** aa. EXPEDITE TAXI [*reason*]; bb. **EXPEDITING;** cc. [CAUTION] TAXI SLOWER [*reason*]; dd. **SLOWING DOWN.**
12.3.4.8 *Holding* . . . to hold not closer to a runway than specified in Chapter 7, 7.6.3.1.3.1.	a. *HOLD (*direction*) OF (*position, runway number, etc.*); b. *HOLD POSITION; c. *HOLD (*distance*) FROM (*position*); d. *HOLD SHORT OF (*position*); e. ****HOLDING** f. ****HOLDING SHORT.** ** Requires specific acknowledgment from the pilot.* *** The procedure words ROGER and WILCO are insufficient acknowledgment of the instructions HOLD, HOLD POSITION and HOLD SHORT OF (position). In each case the acknowledgment shall be by the phraseology HOLDING or HOLDING SHORT, as appropriate.*

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
12.3.4.9 ***To Cross a Runway***	a. **REQUEST CROSS RUNWAY (*number*)**; *NOTE: If the control tower is unable to see the crossing aircraft (e.g., night, low visibility), the instruction should always be accompanied by a request to report when the aircraft has vacated the runway.*
	b. CROSS RUNWAY (*number*) [REPORT VACATED];
	c. EXPEDITE CROSSING RUNWAY (*number*) TRAFFIC (*aircraft type*) (*distance*) KILOMETERS (*or* MILES) FINAL;
	d. TAXI TO HOLDING POSITION [number] [RUNWAY (number)] VIA (specific route to be followed), [HOLD SHORT OF RUNWAY (number)] or [CROSS RUNWAY (number)];
NOTE: The pilot will, when requested, report "RUNWAY VACATED" when the entire aircraft is beyond the relevant runway-holding position.	e. **RUNWAY VACATED.**
12.3.4.10 ***Preparation for Take-Off***	a. UNABLE TO ISSUE (*designator*) DEPARTURE (*reasons*);
	b. REPORT WHEN READY [FOR DEPARTURE];
	c. ARE YOU READY [FOR DEPARTURE]?;
	d. ARE YOU READY FOR IMMEDIATE DEPARTURE?;
	e. **READY:**
. . . clearance to enter runway and await take-off clearance	f. LINE UP [AND WAIT]*;*
	g. *LINE UP RUNWAY (*number*);
	h. LINE UP. BE READY FOR IMMEDIATE DEPARTURE;
. . . conditional clearances	i. **(*condition*) LINE UP (*brief reiteration of the condition*):
. . . acknowledgment of a conditional clearance	j. ***(condition) LINING UP (brief reiteration of the condition)***;

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
. . . confirmation or otherwise of the readback of conditional clearance	k. [THAT IS] CORRECT (*or* NEGATIVE) [I SAY AGAIN]... (*as appropriate*). ** When there is the possibility of confusion during multiple runway operations.* *** Provisions concerning the use of conditional clearances are contained in 12.2.7.*
12.3.4.11 ***Take-off Clearance***	a. RUNWAY (*number*) CLEARED FOR TAKE-OFF [REPORT AIRBORNE];
. . . when reduced runway separation is used	b. *(traffic information)* RUNWAY (*number*) CLEARED FOR TAKE-OFF;
. . . when take-off clearance has not been complied with	c. TAKE OFF IMMEDIATELY OR VACATE RUNWAY [(*instructions*)]; d. TAKE OFF IMMEDIATELY OR HOLD SHORT OF RUNWAY;
. . . to cancel a take-off clearance	e. HOLD POSITION, CANCEL TAKE-OFF I SAY AGAIN CANCEL TAKE-OFF (*reasons*); f. ***HOLDING;**
. . . to stop a take-off after an aircraft has commenced take-off roll	g. STOP IMMEDIATELY [(*repeat aircraft call sign*) STOP IMMEDIATELY]; h. ***STOPPING;**
. . . for helicopter operations	i. CLEARED FOR TAKE-OFF [FROM (*location*)] (*present position, taxiway, final approach and take-off area, runway and number*); j. **REQUEST DEPARTURE INSTRUCTIONS;** k. AFTER DEPARTURE TURN RIGHT (*or* LEFT, *or* CLIMB) (*instructions as appropriate*). ** HOLDING and STOPPING are the procedural responses to e. and g respectively.*
12.3.4.12 ***Turn or Climb Instructions After Take-Off***	a. **REQUEST RIGHT (*or* LEFT) TURN**; b. RIGHT (*or* LEFT) TURN APPROVED; c. WILL ADVISE LATER FOR RIGHT (*or* LEFT) TURN;

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
. . . to request airborne time	d. REPORT AIRBORNE; e. AIRBORNE (*time*); f. AFTER PASSING (*level*) (*instructions*);
. . . heading to be followed	g. CONTINUE RUNWAY HEADING (*instructions*);
. . . when a specific track is to be followed	h. TRACK EXTENDED CENTRE LINE (*instructions*); i. CLIMB STRAIGHT AHEAD (*instructions*).
12.3.4.13 ***Entering an Aerodrome Traffic Circuit***	a. **[*aircraft type*] (*position*) (*level*) FOR LANDING**; b. JOIN (*direction of circuit*) (*position in circuit*) (*runway number*) [SURFACE] WIND (*direction and speed*) (*units*) [TEMPERATURE [MINUS] (*number*)] QNH (*or* QFE) (*number*) [(*units*)] [TRAFFIC (*detail*)]; c. MAKE STRAIGHT-IN APPROACH, RUNWAY (*number*) [SURFACE] WIND (*direction and speed*) (*units*) [TEMPERATURE [MINUS] (*number*)] QNH (*or* QFE) (*number*) [(*units*)] [TRAFFIC (*detail*)];
. . . when ATIS information is available	d. **(*aircraft type*) (*position*) (*level*) INFORMATION (*ATIS identification*) FOR LANDING**; e. JOIN (*position in circuit*) [RUNWAY (*number*) QNH (*or* QFE) (*number*) [(*units*)] [TRAFFIC (*detail*)].
12.3.4.14 ***In the Circuit***	a. **(*position in circuit, e.g.* DOWNWIND/FINAL)**; b. NUMBER . . . FOLLOW *(aircraft type and position) [additional instructions if required]*.
12.3.4.15 ***Approach Instructions***	a. MAKE SHORT APPROACH;

CIRCUMSTANCES		PHRASEOLOGIES (Pilot Transmissions in Bold Type)
	NOTE: The report "LONG FINAL" is made when aircraft turn on to final approach at a distance greater than 7km (4 NM) from touchdown or when an aircraft on a straight-in approach is 15km (8 NM) from touchdown. In both cases a report "FINAL" is required at 7km (4 NM) from touchdown.	b. MAKE LONG APPROACH (*or* EXTEND DOWNWIND); c. REPORT BASE (*or* FINAL, *or* LONG FINAL); d. CONTINUE APPROACH [PREPARE FOR POSSIBLE GO AROUND].
12.3.4.16	***Landing Clearance***	a. RUNWAY (*number*) CLEARED TO LAND;
	. . . when reduced runway separation is used	b. (*traffic information*) RUNWAY (*number*) CLEARED TO LAND;
	. . . special operations	c. CLEARED TOUCH AND GO; d. MAKE FULL STOP;
	. . . to make an approach along, or parallel to a runway, descending to an agreed minimum level	e. **REQUEST LOW APPROACH (*reasons*)**; f. CLEARED LOW APPROACH [RUNWAY (*number*)] [(*altitude restriction if required*) (*go around instructions*)];
	. . . to fly past the control tower or other observation point for the purpose of visual inspection by persons on the ground	g. **REQUEST LOW PASS (*reasons*)**; h. CLEARED LOW PASS *[as in f.]*;
	. . . for helicopter operations	i. **REQUEST STRAIGHT-IN (*or* CIRCLING APPROACH, LEFT (*or* RIGHT) TURN TO (*location*));** j. MAKE STRAIGHT-IN (*or* CIRCLING APPROACH, LEFT (*or* RIGHT) TURN TO (*location, runway, taxiway, final approach and take-off area*) [ARRIVAL (*or* ARRIVAL ROUTE) (*number, name or code*)]. [HOLD SHORT OF (*active runway, extended runway centre line, other*)]. [REMAIN (*direction or distance*) FROM (*runway, runway centre line, other helicopter or aircraft*)]. [CAUTION (*power lines, unlighted obstructions, wake turbulence, etc.*)]. CLEARED TO LAND.

AIR TRAFFIC MANAGEMENT (DOC 4444)

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
12.3.4.17 ***Delaying Aircraft***	a. CIRCLE THE AERODROME; b. ORBIT (RIGHT, *or* LEFT) [FROM PRESENT POSITION]; c. MAKE ANOTHER CIRCUIT.
12.3.4.18 ***Missed Approach***	a. GO AROUND; b. **GOING AROUND.**
12.3.4.19 ***Information to Aircraft***	
. . . when pilot requested visual inspection of landing gear	a. LANDING GEAR APPEARS DOWN; b. RIGHT (*or* LEFT, *or* NOSE) WHEEL APPEARS UP (*or* DOWN); c. WHEELS APPEAR UP; d. RIGHT (*or* LEFT, *or* NOSE) WHEEL DOES NOT APPEAR UP (*or* DOWN);
. . . wake turbulence	e. CAUTION WAKE TURBULENCE [FROM ARRIVING (OR DEPARTING) (type of aircraft)] [(additional information as required)];
. . . jet blast on apron or taxiway	f. CAUTION JET BLAST;
. . . propeller-driven aircraft slipstream	g. CAUTION SLIPSTREAM.
12.3.4.20 ***Runway Vacating and Communications After Landing***	a. CONTACT GROUND (*frequency*); b. WHEN VACATED CONTACT GROUND (*frequency*); c. EXPEDITE VACATING; d. YOUR STAND (*or* GATE) (*designation*); e. TAKE (*or* TURN) FIRST (*or* SECOND, *or* CONVENIENT) LEFT *(or* RIGHT) AND CONTACT GROUND (*frequency*).
. . . for helicopter operations	f. AIR-TAXI TO HELICOPTER STAND (*or)* HELICOPTER PARKING POSITION (*area*);

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
	g. AIR-TAXI TO (*or* VIA) (*location or routing as appropriate)* [CAUTION (*dust, blowing snow, loose debris, taxiing light aircraft, personnel, etc.*); h. AIR TAXI VIA (*direct, as requested, or specified route*) TO (*location, heliport, operating or movement area, active or inactive runway*). AVOID (*aircraft or vehicles or personnel*).

12.4 ATS SURVEILLANCE SERVICE PHRASEOLOGIES

NOTE: The following comprise phraseologies specifically applicable when an ATS surveillance system is used in the provision of air traffic services. The phraseologies detailed in the sections above for use in the provision of air traffic services are also applicable, as appropriate, when an ATS surveillance system is used.

12.4.1 General ATS Surveillance Service Phraseologies

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
12.4.1.1 ***Identification of Aircraft***	a. REPORT HEADING [AND FLIGHT LEVEL (*or* ALTITUDE)]; b. FOR IDENTIFICATION TURN LEFT (*or* RIGHT) HEADING *(three digits)*; c. TRANSMIT FOR IDENTIFICATION AND REPORT HEADING; d. RADAR CONTACT *[position]*; e. IDENTIFIED *[position]*; f. NOT IDENTIFIED *[reason]*, [RESUME (*or* CONTINUE) OWN NAVIGATION].
12.4.1.2 ***Position Information***	POSITION *(distance) (direction)* OF *(significant point)* (*or* OVER *or* ABEAM *(significant point)*).

CIRCUMSTANCES		PHRASEOLOGIES (Pilot Transmissions in Bold Type)
12.4.1.3	***Vectoring Instructions***	a. LEAVE *(significant point)* HEADING *(three digits)*; b. CONTINUE HEADING *(three digits)*; c. CONTINUE PRESENT HEADING; d. FLY HEADING *(three digits)*; e. TURN LEFT (*or* RIGHT) HEADING *(three digits) [reason]*; f. TURN LEFT (*or* RIGHT) (number of degrees) DEGREES *[reason]*; g. STOP TURN HEADING *(three digits)*; h. FLY HEADING *(three digits)*, WHEN ABLE PROCEED DIRECT *(name) (significant point)*; i. HEADING IS GOOD.
12.4.1.4	***Termination of Vectoring***	a. RESUME OWN NAVIGATION *(position of aircraft) (specific instructions)*; b. RESUME OWN NAVIGATION [DIRECT] *(significant point)* [MAGNETIC TRACK *(three digits)* DISTANCE *(number)* KILOMETRES (*or* MILES)].
12.4.1.5	***Manoeuvres***	a. MAKE A THREE SIXTY TURN LEFT (*or* RIGHT) *[reason]*; b. ORBIT LEFT (*or* RIGHT) *[reason]*;
	. . . (in case of unreliable directional instruments on board aircraft)	c. MAKE ALL TURNS RATE ONE (*or* RATE HALF, or *(number)* DEGREES PER SECOND) START AND STOP ALL TURNS ON THE COMMAND "NOW";

	CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
	NOTE: When it is necessary to specify a reason for vectoring or for the above manoeuvres, the following phraseologies should be used: a. *DUE TRAFFIC ;* b. *FOR SPACING;* c. *FOR DELAY;* d. *FOR DOWNWIND (or BASE, or FINAL).*	d. TURN LEFT (*or* RIGHT) NOW; e. STOP TURN NOW.
12.4.1. 6	***Speed Control***	a. REPORT SPEED; b. **SPEED *(number)* KILOMETRES PER HOUR (*or* KNOTS)**; c. MAINTAIN *(number)* KILOMETRES PER HOUR (*or* KNOTS) [OR GREATER (*or* OR LESS)] [UNTIL *(significant point)*]; d. DO NOT EXCEED *(number)* KILOMETRES PER HOUR (*or* KNOTS); e. MAINTAIN PRESENT SPEED; f. INCREASE (*or* REDUCE) SPEED TO *(number)* KILOMETRES PER HOUR (*or* KNOTS) [OR GREATER (*or* OR LESS)]; g. INCREASE (*or* REDUCE) SPEED BY *(number)* KILOMETRES PER HOUR (*or* KNOTS); h. RESUME NORMAL SPEED; i. REDUCE TO MINIMUM APPROACH SPEED; j. REDUCE TO MINIMUM CLEAN SPEED; k. RESUME PUBLISHED SPEED; l. NO [ATC] SPEED RESTRICTIONS.
12.4.1. 7	***Position Reporting***	

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
. . . to omit position reports	a. OMIT POSITION REPORTS [UNTIL *(specify)*]; b. NEXT REPORT AT *(significant point)*; c. REPORTS REQUIRED ONLY AT *(significant point(s))*; d. RESUME POSITION REPORTING.
12.4.1.8 ***Traffic Information and Avoiding Action***	a. TRAFFIC *(number)* O'CLOCK *(distance) (direction of flight) [any other pertinent information]*: 1. UNKNOWN; 2. SLOW MOVING; 3. FAST MOVING; 4. CLOSING; 5. OPPOSITE (*or* SAME) DIRECTION; 6. OVERTAKING; 7. CROSSING LEFT TO RIGHT (*or* RIGHT TO LEFT);
. . . (if known)	8. *(aircraft type)*; 9. *(level)*; 10. CLIMBING (*or* DESCENDING);
. . . to request avoiding action	b. **REQUEST VECTORS**; c. DO YOU WANT VECTORS?;
. . . when passing unknown traffic	d. CLEAR OF TRAFFIC *[appropriate instructions]*;
. . . for avoiding action	e. TURN LEFT (*or* RIGHT) IMMEDIATELY HEADING *(three digits)* TO AVOID [UNIDENTIFIED] TRAFFIC *(bearing by clock-reference and distance)*; f. TURN LEFT (*or* RIGHT) *(number of degrees)* DEGREES IMMEDIATELY TO AVOID [UNIDENTIFIED] TRAFFIC AT *(bearing by clock-reference and distance)*.

CIRCUMSTANCES		PHRASEOLOGIES (Pilot Transmissions in Bold Type)
12.4.1.9	***Communications and Loss of Communications***	a. [IF] RADIO CONTACT LOST *(instructions)*; b. IF NO TRANSMISSIONS RECEIVED FOR *(number)* MINUTES (*or* SECONDS) *(instructions)*; c. REPLY NOT RECEIVED *(instructions)*;
	. . . if loss of communications suspected	d. IF YOU READ *[manoeuvre instructions or SQUAWK (code or IDENT)]*; e. (*manoeuvre*, SQUAWK *or* IDENT) OBSERVED. POSITION *(position of aircraft)*. *[(instructions)]*.
12.4.1.10	***Termination of Radar and/or ADS-B Service***	a. RADAR SERVICE (*or* IDENTIFICATION) TERMINATED [DUE *(reason)*] *[(instructions)]*; b. WILL SHORTLY LOSE IDENTIFICATION *(appropriate instructions or information)*; c. IDENTIFICATION LOST *[reasons]* *(instructions)*.
12.4.1.11	***Radar and/or/ADS-B Equipment Degradation***	a. SECONDARY RADAR OUT OF SERVICE *(appropriate information as necessary)*; b. PRIMARY RADAR OUT OF SERVICE *(appropriate information as necessary)*; c. ADS-B OUT OF SERVICE *(appropriate information as necessary)*.

12.4.2 Radar in Approach Control Service

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmission in Bold Type)
12.4.2.1 ***Vectoring for Approach***	a. VECTORING FOR *(type of pilot-interpreted aid)* APPROACH RUNWAY *(number)*; b. VECTORING FOR VISUAL APPROACH RUNWAY *(number)* REPORT FIELD (*or* RUNWAY) IN SIGHT; c. VECTORING FOR *(positioning in the circuit)*; d. VECTORING FOR SURVEILLANCE RADAR APPROACH RUNWAY *(number)*; e. VECTORING FOR PRECISION APPROACH RUNWAY *(number)*; f. *(type)* APPROACH NOT AVAILABLE DUE *(reason) (alternative instructions)*.
12.4.2.2 ***Vectoring for ILS and Other Pilot-Interpreted Aids***	a. POSITION *(number)* KILOMETRES (*or* MILES) from *(fix)*. TURN LEFT (*or* RIGHT) HEADING *(three digits)*; b. YOU WILL INTERCEPT *(radio aid or track) (distance)* FROM (*significant point or* TOUCHDOWN);
. . . when a pilot wishes to be positioned a specific distance from touchdown	c. **REQUEST *(distance)* FINAL**; d. CLEARED FOR *(type of approach)* APPROACH RUNWAY *(number)*; .
. . . instructions and information	e. REPORT ESTABLISHED ON [ILS] LOCALIZER (*or* ON GBAS/SBAS/MLS APPROACH COURSE); f. CLOSING FROM LEFT (*or* RIGHT) [REPORT ESTABLISHED]; g. TURN LEFT (*or* RIGHT) HEADING *(three digits)* [TO INTERCEPT] *or* [REPORT ESTABLISHED];

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmission in Bold Type)
	h. EXPECT VECTOR ACROSS *(localizer course or radio aid) (reason)*; i. THIS TURN WILL TAKE YOU THROUGH *(localizer course or radio aid) [reason]*; j. TAKING YOU THROUGH *(localizer course or radio aid) [reason]*; k. MAINTAIN *(altitude)* UNTIL GLIDE PATH INTERCEPTION; l. REPORT ESTABLISHED ON GLIDE PATH; m. INTERCEPT *(localizer course or radio aid)* [REPORT ESTABLISHED].
12.4.2.3 ***Manoeuvre During Independent and Dependent Parallel Approaches***	a. CLEARED FOR *(type of approach)* APPROACH RUNWAY *(number)* LEFT (*or* RIGHT); b. YOU HAVE CROSSED THE LOCALIZER (*or* GBAS/SBAS/MLS FINAL APPROACH COURSE). TURN LEFT (*or* RIGHT) IMMEDIATELY AND RETURN TO THE LOCALIZER (*or* GBAS/SBAS/MLS FINAL APPROACH COURSE); c. ILS (*or* MLS) RUNWAY *(number)* LEFT (*or* RIGHT) LOCALIZER (*or* MLS) FREQUENCY IS *(frequency)*;
... for avoidance action when an aircraft is observed penetrating the NTZ	d. TURN LEFT (*or* RIGHT) *(number)* DEGREES (*or* HEADING) *(three digits)* IMMEDIATELY TO AVOID TRAFFIC [DEVIATING FROM ADJACENT APPROACH], CLIMB TO *(altitude)*;
... for avoidance action below 120 m (400 ft) above the runway threshold elevation where parallel approach obstacle assessment surfaces (PAOAS) criteria are being applied	e. CLIMB TO *(altitude)* IMMEDIATELY TO AVOID TRAFFIC [DEVIATING FROM ADJACENT APPROACH] *(further instructions)*.
12.4.2.4 ***Surveillance Radar Approach***	

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmission in Bold Type)
12.4.2.4.1 ***Provision of Service***	a. THIS WILL BE A SURVEILLANCE RADAR APPROACH RUNWAY *(number)* TERMINATING AT *(distance)* FROM TOUCHDOWN, OBSTACLE CLEARANCE ALTITUDE (*or* HEIGHT) *(number)* METRES (*or* FEET) CHECK YOUR MINIMA [IN CASE OF GO AROUND *(instructions)*]; b. APPROACH INSTRUCTIONS WILL BE TERMINATED AT *(distance)* FROM TOUCHDOWN.
12.4.2.4.2 ***Elevation***	a. COMMENCE DESCENT NOW [TO MAINTAIN A *(number)* DEGREE GLIDE PATH]; b. *(distance)* FROM TOUCHDOWN ALTITUDE (*or* HEIGHT) SHOULD BE *(numbers and units)*.
12.4.2.4.3 ***Position***	*(distance)* FROM TOUCHDOWN.
12.4.2.4.4 ***Checks***	a. CHECK GEAR DOWN [AND LOCKED]; b. OVER THRESHOLD.
12.4.2.4.5 ***Completion of Approach***	a. REPORT VISUAL; b. REPORT RUNWAY [LIGHTS] IN SIGHT; c. APPROACH COMPLETED [CONTACT *(unit)*].
12.4.2.5 ***PAR Approach***	
12.4.2.5.1 ***Provision of Service***	a. THIS WILL BE A PRECISION RADAR APPROACH RUNWAY *(number)*; b. PRECISION APPROACH NOT AVAILABLE DUE *(reason) (alternative instructions)*; c. IN CASE OF GO AROUND *(instructions)*.
12.4.2.5.2 ***Communications***	a. DO NOT ACKNOWLEDGE FURTHER TRANSMISSIONS; b. REPLY NOT RECEIVED. WILL CONTINUE INSTRUCTIONS.

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CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmission in Bold Type)
12.4.2.5.3 ***Azimuth***	a. CLOSING [SLOWLY (*or* QUICKLY)] [FROM THE LEFT (*or* FROM THE RIGHT)]; b. HEADING IS GOOD; c. ON TRACK; d. SLIGHTLY (*or* WELL, *or* GOING) LEFT (*or* RIGHT) OF TRACK; e. *(number)* METRES LEFT (*or* RIGHT) OF TRACK.
12.4.2.5.4 ***Elevation***	a. APPROACHING GLIDE PATH; b. COMMENCE DESCENT NOW [AT *(number)* METRES PER SECOND OR *(number)* FEET PER MINUTE (*or* ESTABLISH A *(number)* DEGREE GLIDE PATH)]; c. RATE OF DESCENT IS GOOD; d. ON GLIDE PATH; e. SLIGHTLY (*or* WELL, *or* GOING) ABOVE (*or* BELOW) GLIDE PATH; f. [STILL] *(number)* METRES (*or* FEET) TOO HIGH (*or* TOO LOW); g. ADJUST RATE OF DESCENT; h. COMING BACK [SLOWLY (*or* QUICKLY)] TO THE GLIDE PATH; i. RESUME NORMAL RATE OF DESCENT; j. ELEVATION ELEMENT UNSERVICEABLE *(to be followed by appropriate instructions)*; k. *(distance)* FROM TOUCHDOWN. ALTITUDE (*or* HEIGHT) SHOULD BE *(numbers and units)*.
12.4.2.5.5 Position	a. *(distance)* FROM TOUCHDOWN; b. OVER APPROACH LIGHTS; c. OVER THRESHOLD.
12.4.2.5.6 ***Checks***	a. CHECK GEAR DOWN AND LOCKED; b. CHECK DECISION ALTITUDE (*or* HEIGHT).

CIRCUMSTANCES		PHRASEOLOGIES (Pilot Transmission in Bold Type)
12.4.2.5.7	*Completion of Approach*	a. REPORT VISUAL; b. REPORT RUNWAY [LIGHTS] IN SIGHT; c. APPROACH COMPLETED [CONTACT *(unit)*].
12.4.2.5.8	*Missed Approach*	a. CONTINUE VISUALLY OR GO AROUND *[missed approach instructions]*; b. GO AROUND IMMEDIATELY *[missed approach . instructions] (reason)*; c. ARE YOU GOING AROUND?; d. IF GOING AROUND *(appropriate instructions)*; e. **GOING AROUND**.

12.4.3 Secondary Surveillance Radar (SSR) and ADS-B Phraseologies

CIRCUMSTANCES		PHRASEOLOGIES (Pilot Transmissions in Bold Type)
12.4.3.1	*To Request the Capability of the SSR Equipment*	a. ADVISE TRANSPONDER CAPABILITY; b. **TRANSPONDER (*as shown in the flight plan*)**; c. **NEGATIVE TRANSPONDER.**
12.4.3.2	*To Request the Capability of the ADS-B Equipment*	a. ADVISE ADS-B CAPABILITY; b. **ADS-B TRANSMITTER *(data link)***; c. **ADS-B RECEIVER *(data link)***; d. **NEGATIVE ADS-B**.
12.4.3.3	*To Instruct Setting of Transponder*	a. FOR DEPARTURE SQUAWK (*code*); b. SQUAWK (*code*).
12.4.3.4	*To Request the Pilot to Reselect the Assigned Mode and Code*	a. RESET SQUAWK [(*mode*)] (*code*); b. **RESETTING (*mode*) (*code*)**.
12.4.3.5	*To Request Reselection of Aircraft Identification*	RE-ENTER [ADS-B *or* MODE S] AIRCRAFT IDENTIFICATION.
12.4.3.6	*To Request the Pilot to Confirm the Code Selected on the Aircraft's Transponder*	a. CONFIRM SQUAWK (*code*); b. **SQUAWKING (*code*)**.

CIRCUMSTANCES		PHRASEOLOGIES (Pilot Transmissions in Bold Type)
12.4.3.7	***To Request the Operation of the IDENT Feature***	a. SQUAWK [(*code*)] [AND] IDENT; b. SQUAWK LOW; c. SQUAWK NORMAL; d. TRANSMIT ADS-B IDENT.
12.4.3.8	***To Request Temporary Suspension of Transponder Operation***	SQUAWK STANDBY.
12.4.3.9	***To Request Emergency Code***	SQUAWK MAYDAY [CODE SEVEN-SEVEN-ZERO-ZERO].
12.4.3.10*	***To Request Termination of Transponder and/or ADS-B Transmitter Operation***	a. STOP SQUAWK [TRANSMIT ADS-B ONLY]; b. STOP ADS-B TRANSMISSION [SQUAWK (*code*) ONLY].
12.4.3.11	***To Request Transmission of Pressure–Altitude***	a. SQUAWK CHARLIE; b. TRANSMIT ADS-B ALTITUDE.
12.4.3.12	***To Request Pressure Setting Check and Confirmation of Level***	CHECK ALTIMETER SETTING AND CONFIRM (*level*).
12.4.3.13*	***To Request Termination of Pressure–Altitude Transmission Because of Faulty Operation***	a. STOP SQUAWK CHARLIE WRONG INDICATION; b. STOP ADS-B ALTITUDE TRANSMISSION [(WRONG INDICATION, *or reason*)].
12.4.3.14	***To Request Altitude Check***	CONFIRM *(level)*
**NOTE: Independent operations of Mode S transponder and ADS-B may not be possible in all aircraft (e.g. where ADS-B is solely provided by 1 090 MHz extended squitter emitted from the transponder). In such cases, aircraft may not be able to comply with ATC instructions related to ADS-B operation.*		

12.5 AUTOMATIC DEPENDENT SURVEILLANCE – CONTRACT (ADS-C) PHRASEOLOGIES

12.5.1 General ADS-C Phraseologies

CIRCUMSTANCES	PHRASEOLOGIES
12.5.1.1 ***ADS-C Degradation***	ADS-C (*or* ADS-CONTRACT) OUT OF SERVICE *(appropriate information as necessary)*.

12.6 ALERTING PHRASEOLOGIES

12.6.1 Alerting Phraseologies

CIRCUMSTANCES	PHRASEOLOGIES
12.6.1.1 ***Low Altitude Warning***	*(aircraft call sign)* LOW ALTITUDE WARNING, CHECK YOUR ALTITUDE IMMEDIATELY, QNH IS (number) [(units)]. [THE MINIMUM FLIGHT ALTITUDE IS *(altitude)*].
12.6.1.2 ***Terrain Alert***	*(aircraft call sign)* TERRAIN ALERT, *(suggested pilot action, if possible)*.

12.7 GROUND CREW/FLIGHT CREW PHRASEOLOGIES

12.7.1 Ground Crew/Flight Crew Phraseologies

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
12.7.1.1 ***Starting Procedures (Ground Crew/Cockpit)***	a. [ARE YOU] READY TO START UP?; b. **STARTING NUMBER *(engine number(s))***. *NOTE 1: The ground crew should follow this exchange by either a reply on the intercom or a distinct visual signal to indicate that all is clear and that the start-up as indicated may proceed.* *NOTE 2: Unambiguous identification of the parties concerned is essential in any communications between ground crew and pilots.*
12.7.1.2 ***Pushback Procedures*** . . . (ground crew/cockpit)	a. ARE YOU READY FOR PUSHBACK?; b. **READY FOR PUSHBACK**; c. CONFIRM BRAKES RELEASED; d. **BRAKES RELEASED**; e. COMMENCING PUSHBACK; f. PUSHBACK COMPLETED; g. **STOP PUSHBACK**; h. CONFIRM BRAKES SET; i. **BRAKES SET**; j. **DISCONNECT**; k. DISCONNECTING STAND BY FOR VISUAL AT YOUR LEFT (*or* RIGHT). *NOTE: — This exchange is followed by a visual signal to the pilot to indicate that disconnect is completed and all is clear for taxiing.*

12.7.2 De/Anti-Icing Operations

	CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
12.7.2.1	*Prior to De-Icing/Anti-Icing (Ground Crew (Iceman)/ Flight Crew)*	a. STANDING BY TO DE-ICE. CONFIRM BRAKES SET AND TREATMENT REQUIRED; b. **[AFFIRM] BRAKES SET, REQUEST (*type of de/anti-icing treatment and areas to be treated*);**
	. . . aircraft configuration confirmation	c. HOLD POSITION AND CONFIRM AIRCRAFT CONFIGURED; d. **[AFFIRM] AIRCRAFT CONFIGURED, READY FOR DE-ICING;** e. DE-ICING STARTS NOW.
12.7.2.2	*Upon Concluding De-Icing/ Anti-Icing Procedure*	
	. . . for de-icing operation	a. DE-ICING ON (*areas treated*) COMPLETE. ADVISE WHEN READY FOR INFORMATION; b. TYPE OF FLUID (Type I *or* II *or* III *or* IV); c. HOLDOVER TIME STARTED AT (*time*); d. ANTI-ICING CODE (*appropriate anti-icing code*) *NOTE: Anti-icing code example:*
	. . . for a two-step de-icing/anti-icing operation	*A de-icing/anti-icing procedure whose last step is the use of a mixture of 75% of a Type II fluid and 25% water, commencing at 13:35 local time, is recorded as follows:* a. *TYPE II/75 13:35 (followed by complete name of anti-icing fluid)* e. FINAL STEP STARTED AT (*time*);
	. . . De-icing/anti-icing complete	f. POST DE-ICING CHECK COMPLETED; g. PERSONNEL AND EQUIPMENT CLEAR OF AIRCRAFT;
12.7.2.3	*Abnormal Operations*	

CIRCUMSTANCES	PHRASEOLOGIES (Pilot Transmissions in Bold Type)
. . . for spray nozzle proximity sensor activation	a. BE ADVISED NOZZLE PROXIMITY ACTIVATION ON (*significant point on aircraft*) [NO VISUAL DAMAGE or DAMAGE (*description of damage*) OBSERVED] [SAY INTENTIONS];
. . . for other aircraft having an emergency on the de-icing bay	b. EMERGENCY IN DE-ICING BAY (*de-icing bay number*) [SHUT DOWN ENGINES or STANDBY FOR FURTHER INSTRUCTIONS].

13 AUTOMATIC DEPENDENT SURVEILLANCE-CONTRACT (ADS-C) SERVICES

13.1 GENERAL

The provision of air traffic services to aircraft, based on information received from aircraft via ADS-C, is generally referred to as the provision of ADS-C services.

13.2 ADS-C GROUND SYSTEM CAPABILITIES

13.2.3 Several significant functional requirements are necessary to permit the effective implementation of an ADS-C service in a CNS/ATM environment. Ground systems shall provide for:

a. the transmitting, receiving, processing and displaying of ADS-C messages related to flights equipped for and operating within environments where ADS-C services are being provided;

b. the display of safety-related alerts and warnings;

c. position monitoring (the aircraft's current position as derived from ADS-C reports is displayed to the controller for air traffic situation monitoring);

d. conformance monitoring (the ADS-C reported current position or projected profile is compared to the expected aircraft position, which is based on the current flight plan. Along track, lateral and vertical deviations that exceed a pre-defined tolerance limit will permit an out-of-conformance alert to be issued to the controller);

e. flight plan update (e.g. longitudinal variations that exceed pre-defined tolerance limits will be used to adjust expected arrival times at subsequent fixes);

f. intent validation (intent data contained in ADS-C reports, such as extended projected profile, are compared with the current clearance and discrepancies are identified);

g. conflict detection (the ADS-C data can be used by the ADS-C ground system automation to identify violations of separation minima);

h. conflict prediction (the ADS-C position data can be used by the ADS-C ground system automation to identify potential violations of separation minima);

i. tracking (the tracking function is intended to extrapolate the current position of the aircraft based on ADS-C reports);

j. wind estimation (ADS-C reports containing wind data may be used to update wind forecasts and hence expected arrival times at waypoints); and

k. flight management (ADS-C reports may assist automation in generating optimum conflict-free clearances to support possible fuel-saving techniques, such as cruise climbs, requested by the operators).

13.4 USE OF ADS-C IN THE PROVISION OF AIR TRAFFIC CONTROL SERVICE

13.4.1 General

13.4.1.1 ADS-C may be used in the provision of an air traffic control service, provided identification of the aircraft is unambiguously established.

13.4.1.2 Flight data processing of ADS-C data may be used in the provision of an air traffic control service, provided the correlation between the ADS-C data downlinked by that aircraft and the flight plan details held for the aircraft has been accomplished.

NOTE: A combination of information received from the aircraft may be necessary to ensure unambiguous correlation, e.g. departure aerodrome, estimated off-block time (EOBT), and destination aerodrome might be used.

14 CONTROLLER-PILOT DATA LINK COMMUNICATIONS (CPDLC)

14.1 GENERAL

14.1.1 CPDLC application provides a means of communication between the controller and pilot, using data link for ATC communication.

14.1.2 This application includes a set of clearance/information/request message elements which correspond to the phraseologies used in the radiotelephony environment.

NOTE: Message element intent and text and associated procedures are, in general, consistent with Chapter 12 — Phraseologies. It is, however, recognized that the CPDLC message set and the associated procedures differ somewhat from the voice equivalent used because of the differences between the two media.

14.1.3 The pilot and the controller shall be provided with the capability to exchange messages which include standard message elements, free text message elements or combinations of both.

14.1.4 Ground and airborne systems shall allow for messages to be appropriately displayed, printed when required and stored in a manner that permits timely and convenient retrieval should such action be necessary.

14.1.5 Whenever textual presentation is required, the English language shall be displayed as a minimum.

14.2 ESTABLISHMENT OF CPDLC

14.2.1 CPDLC shall be established in sufficient time to ensure that the aircraft is communicating with the appropriate ATC unit. Information concerning when and, where applicable, where, the air or ground systems should establish CPDLC, shall be published in Aeronautical Information Publications.

14.2.2 Airborne-Initiated CPDLC

14.2.2.1 When an ATC unit receives an unexpected request for CPDLC from an aircraft, the circumstances leading to the request shall be obtained from the aircraft to determine further action.

14.2.2.2 When the ATC unit rejects a request for CPDLC, it shall provide the pilot with the reason for the rejection using an appropriate CPDLC message

14.2.3 ATC Unit-Initiated CPDLC

14.2.3.1 An ATC unit shall only establish CPDLC with an aircraft if the aircraft has no CPDLC link established, or when authorized by the ATC unit currently having CPDLC established with the aircraft.

14.2.3.2 When a request for CPDLC is rejected by an aircraft, the reason for the rejection shall be provided using CPDLC downlink message element NOT CURRENT DATA AUTHORITY or message element NOT AUTHORIZED NEXT DATA AUTHORITY, as appropriate. Local procedures shall dictate whether the reason for rejection is presented to the controller. No other reasons for airborne rejection of ATC unit-initiation of CPDLC shall be permitted.

15 PROCEDURES RELATED TO EMERGENCIES, COMMUNICATION FAILURE AND CONTINGENCIES

[See EMERGENCY Section for related information]

15.1 EMERGENCY PROCEDURES

15.1.1 General

15.1.1.1 The various circumstances surrounding each emergency situation preclude the establishment of exact detailed procedures to be followed. The procedures outlined herein are intended as a general guide to air traffic services personnel. Air traffic control units shall maintain full and complete co-ordination, and personnel shall use their best in handling emergency situations.

15.1.2 Priority

An aircraft known or believed to be in a state of emergency, including being subjected to unlawful interference, shall be given priority over other aircraft.

15.1.3 Unlawful Interference and Aircraft Bomb Threat

15.1.3.1 Air traffic services personnel shall be prepared to recognize any indication of the occurrence of unlawful interference with an aircraft.

15.1.3.2 Whenever unlawful interference with an aircraft is suspected, and where automatic distinct display of SSR Mode A Code 7500 and Code 7700 is not provided, the radar controller shall attempt to verify his/her suspicion by setting the SSR decoder to Mode A Code 7500 and thereafter to Code 7700.

NOTE: An aircraft equipped with an SSR transponder is expected to operate the transponder on Mode A Code 7500 to indicate specifically that it is the subject of unlawful interference. The aircraft may operate the transponder on Mode A Code 7700, to indicate that it is threatened by grave and imminent danger and requires immediate assistance. An aircraft equipped with other surveillance system transmitters, including ADS-B and ADS-C, might send the emergency and/or urgency signal by all of the available means.

15.1.3.3 Whenever unlawful interference with an aircraft is known or suspected or a bomb threat warning has been received, ATS units shall promptly attend to requests by, or to anticipated needs of, the aircraft, including requests for relevant information relating to air navigation facilities, procedures and services along the route of flight and at any aerodrome of intended landing, and shall take such action as is necessary to expedite the conduct of all phases of the flight.

15.1.3.3.1 ATS units shall also:

a. transmit, and continue to transmit, information pertinent to the safe conduct of the flight, without expecting a reply from the aircraft;

b. monitor and plot the progress of the flight with the means available and coordinate transfer of control with adjacent ATS units without requiring transmissions or other responses from the aircraft, unless communication with the aircraft remains normal;

c. inform, and continue to keep informed, appropriate ATS units, including those in adjacent FIRs, which may be concerned with the progress of the flight;

   NOTE: In applying this provision, account must be taken of all the factors which may affect the progress of the flight, including fuel endurance and the possibility of sudden changes in route and destination. The objective is to provide, as far in advance as is practicable in the circumstances, each ATS unit with appropriate information as to the expected or possible penetration of the aircraft into its area of responsibility.

d. notify:

   1. the operator or its designated representative;

   2. the appropriate rescue coordination centre in accordance with appropriate alerting procedures;

   3. the appropriate authority designated by the State;

      NOTE: It is assumed that the designated security authority and/or the operator will in turn notify other parties concerned in accordance with pre-established procedures.

e. relay appropriate messages, relating to the circumstances associated with the unlawful interference, between the aircraft and designated authorities.

15.1.4 Emergency Descent

15.1.4.1 Action by the ATS Unit

Upon recognition that an aircraft is making an emergency descent, all appropriate action shall be taken immediately to safeguard all aircraft concerned. Appropriate actions may include the following, in the order appropriate for the circumstance:

a. broadcasting an emergency message;

b. issuing traffic information and/or instructions to aircraft affected by the descent;

c. advising the minimum flight altitude and altimeter setting for the area of operation; and

d. informing any other ATS units which may be affected by the emergency descent.

15.1.4.2 Action by the Pilot of the Aircraft in an Emergency Descent

The pilot shall take the following steps as soon as practicable in the order appropriate for the circumstance:

a. navigate as deemed appropriate by the pilot;

b. advise the appropriate ATS unit of the emergency descent and, if able, intentions;

c. set transponder to Code 7700 and, if applicable, select the appropriate emergency mode on ADS-B and/or ADS-C;

d. turn on aircraft exterior lights (commensurate with appropriate operating limitations);

e. watch for conflicting traffic both visually and by reference to ACAS (if equipped); and

f. when emergency descent is complete, coordinate further intentions with the appropriate ATS unit.

NOTE: Procedures for the use of ACAS are contained in PANS-OPS, Volume I, Part III, Section 3, Chapter 3.

15.1.4.3 Action by the Pilot of the Aircraft Receiving Emergency Descent Broadcast

Unless specifically instructed by the ATS unit to clear the area or threatened by immediate danger, the pilot shall take the following actions:

a. continue according to current clearance and maintain listening watch on the frequency in use for any further instructions from the ATS unit; and

b. watch for conflicting traffic both visually and by reference to ACAS (if equipped).

15.2 SPECIAL PROCEDURES FOR IN-FLIGHT CONTINGENCIES IN OCEANIC AIRSPACE

15.2.1 Introduction

15.2.1.1 Although all possible contingencies cannot be covered, the procedures in 15.2.2, 15.2.3 and 15.2.4 provide for the more frequent cases such as:

a. the inability to comply with assigned clearance due to meteorological conditions (15.2.4 refers);

b. enroute diversion across the prevailing traffic flow (for example, due to medical emergencies (15.2.2. and 15.2.3 refer)); and

c. the loss of, or significant reduction in, the required navigation capability when operating in an airspace where the navigation performance accuracy is a prerequisite to the safe conduct of flight operations, or pressurization failure (15.2.2. and 15.2.3 refer).

15.2.1.2 The pilot shall take actions as necessary to ensure the safety of the aircraft, and the pilot's judgement shall determine the sequence of actions to be taken, having regard to the prevailing circumstances. Air traffic control shall render all possible assistance.

15.2.2 General Procedures

NOTE: Figure 15-1 provides an aid for understanding and applying the contingency procedures contained in Sections 15.2.2 and 15.2.3.

15.2.2.1 If an aircraft is unable to continue the flight in accordance with its ATC clearance, a revised clearance shall be obtained, whenever possible, prior to initiating any action.

15.2.2.2 If prior clearance cannot be obtained, the following contingency procedures should be employed until a revised clearance is received. In general terms, the aircraft should be flown at an offset level and on an offset track where other aircraft are less likely to be encountered. Specifically, the pilot shall:

a. leave the cleared track or ATS route by initially turning at least 30 degrees to the right or to the left, in order to establish and maintain a parallel, same direction track or ATS route offset 5 NM (9.3km). The direction of the turn should be based on one or more of the following factors:
   1. aircraft position relative to any organized track or ATS route system;
   2. the direction of flights and flight levels allocated on adjacent tracks;
   3. the direction to an alternate airport; and
   4. any strategic lateral offset being flown; and
   5. terrain clearance;

b. maintain a watch for conflicting traffic both visually and by reference to ACAS (if equipped), leaving ACAS in RA mode at all times, unless aircraft operating limitations dictate otherwise;

c. turn on all aircraft exterior lights (commensurate with appropriate operating limitations);

d. keep the SSR transponder on at all times and, when able, squawk 7700, as appropriate and, if equipped with ADS-B or ADS-C, select the appropriate emergency functionality;

e. as soon as practicable, advise air traffic control of any deviation from their assigned clearance;

f. use means as appropriate (i.e. voice and/or CPDLC) to communicate during a contingency or emergency;

g. if voice communication is used, the radiotelephony distress signal (MAYDAY) or urgency signal (PAN PAN) preferably spoken three times, shall be used, as appropriate;

h. when emergency situations are communicated via CPDLC, the controller may respond via CPDLC. However, the controller may also attempt to make voice contact with the aircraft;

NOTE: Guidance on emergency procedures for controllers, radio operators, and flight crew in data link operations can be found in the Global Operational Data Link (GOLD) Manual (Doc 10037).

i. establish communications with and alert nearby aircraft by broadcasting on the frequencies in use and at suitable intervals on 121.5 MHz (or, as a backup, on the inter-pilot air-to-air frequency 123.45 MHz): aircraft identification, the nature of the distress condition, intention of the pilot, position (including the ATS route designator or the track code, as appropriate) and flight level; and

j. the controller should attempt to determine the nature of the emergency and ascertain any assistance that may be required. Subsequent ATC action with respect to that aircraft shall be based on the intentions of the pilot and overall traffic situation.

15.2.3 Actions to be Taken Once Offset from Track

NOTE: The pilot's judgement of the situation and the need to ensure the safety of the aircraft will determine the actions outlined to be taken. Factors for the pilot to consider when deviating from the cleared track or ATS route or level without an ATC clearance include, but are not limited to:

a. operation within a parallel track system;

b. the potential for user preferred routes (UPRs) parallel to the aircraft's track or ATS route;

c. the nature of the contingency (e.g. aircraft system malfunction); and

d. weather factors (e.g. convective weather at lower flight levels).

15.2.3.1 If possible, maintain the assigned flight level until established on the 9.3km (5.0 NM) parallel, same direction track or ATS route offset. If unable, initially minimize the rate of descent to the extent that is operationally feasible.

15.2.3.2 Once established on a parallel, same direction track or ATS route offset by 9.3km (5.0 NM), either:

a. descend below FL290, and establish a 150m (500 ft) vertical offset from those flight levels normally used, and proceed as required by the operational situation or if an ATC clearance has been obtained, in accordance with the clearance; or

NOTE 1: Flight levels normally used are those contained in Annex 2 — Rules of the Air, Appendix 3.

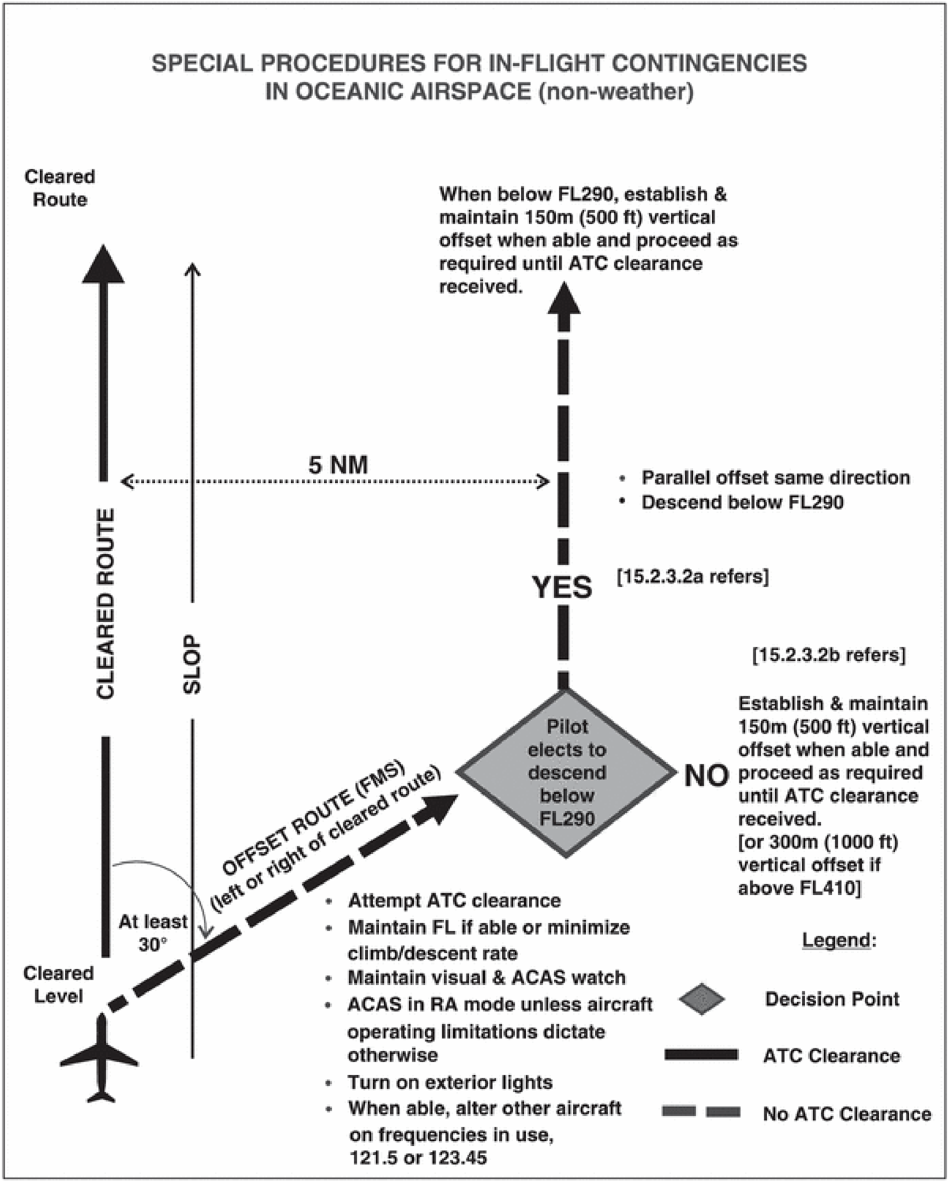
NOTE 2: Descent below FL290 is considered particularly applicable to operations where there is a predominant traffic flow (e.g. east-west) or parallel track system where the air-

craft's diversion path will likely cross adjacent tracks or ATS routes. A descent below FL290 can decrease the likelihood of conflict with other aircraft, ACAS RA events and delays in obtaining a revised ATC clearance.

b. establish a 150m (500 ft) vertical offset (or 300m (1000 ft) vertical offset if above FL410) from those flight levels normally used, and proceed as required by the operational situation, or if an ATC clearance has been obtained, in accordance with the clearance.

NOTE: Altimetry system errors (ASE) may result in less than 150m (500 ft) vertical spacing (less than 300m (1000 ft) above FL410) when the above contingency procedure is applied.

Figure 15-1. Visual Aid for Contingency Procedures Guidance



SPECIAL PROCEDURES FOR IN-FLIGHT CONTINGENCIES IN OCEANIC AIRSPACE (non-weather)

When below FL290, establish & maintain 150m (500 ft) vertical offset when able and proceed as required until ATC clearance received.

- Parallel offset same direction
- Descend below FL290

[15.2.3.2a refers]

[15.2.3.2b refers]

Establish & maintain 150m (500 ft) vertical offset when able and proceed as required until ATC clearance received.
[or 300m (1000 ft) vertical offset if above FL410]

- Attempt ATC clearance
- Maintain FL if able or minimize climb/descent rate
- Maintain visual & ACAS watch
- ACAS in RA mode unless aircraft operating limitations dictate otherwise
- Turn on exterior lights
- When able, alter other aircraft on frequencies in use, 121.5 or 123.45

Legend:

◆	Decision Point
▬	ATC Clearance
▬ ▬	No ATC Clearance

15.2.4 Weather Deviation Procedures

15.2.4.1 General

NOTE: The following procedures are intended for deviations around adverse meteorological conditions.

15.2.4.1.1 When weather deviation is required, the pilot should initiate communications with ATC via voice or CPDLC. A rapid response may be obtained by either:

a. stating "WEATHER DEVIATION REQUIRED" to indicate that priority is desired on the frequency and for ATC response; or

b. requesting a weather deviation using a CPDLC lateral downlink message.

15.2.4.1.2 When necessary, the pilot should initiate the communications using the urgency call "PAN PAN" (preferably spoken three times) or by using a CPDLC urgency downlink message.

15.2.4.1.3 The pilot shall inform ATC when weather deviation is no longer required, or when a weather deviation has been completed and the aircraft has returned to its cleared route.

15.2.4.2 Actions to be Taken When Controller-Pilot Communications are Established

15.2.4.2.1 The pilot should notify ATC and request clearance to deviate from track or ATS route, advising, when possible, the extent of the deviation requested. The flight crew will use whatever means are appropriate (i.e. voice and/or CPDLC) to communicate during a weather deviation.

NOTE: Pilots are advised to contact ATC as soon as possible with requests for clearance in order to provide adequate time for the request to be assessed and acted upon.

15.2.4.2.3 The pilot should take the following actions:

a. comply with the ATC clearance issued; or

b. advise ATC of intentions and execute the procedures detailed in 15.2.4.3.

15.2.4.3 Actions to be Taken if a Revised ATC Clearance Cannot be Obtained

NOTE: The provisions of this section apply to situations where a pilot needs to exercise the authority of a pilot-in-command under the provisions of Annex 2, 2.3.1.

15.2.4.3.1 If the aircraft is required to deviate from track or ATS route to avoid adverse meteorological conditions and prior clearance cannot be obtained, an ATC clearance shall be obtained at the earliest possible time. Until an ATC clearance is received, the pilot shall take the following actions:

a. if possible, deviate away from an organized track or ATS route system;

b. establish communications with and alert nearby aircraft by broadcasting, at suitable intervals: aircraft identification, flight level, position (including ATS route designator or the track code) and intentions, on the frequency in use and on 121.5 MHz (or, as a back-up, on the inter-pilot air-to-air frequency 123.45 MHz);

c. watch for conflicting traffic both visually and by reference to ACAS (if equipped);

d. turn on all aircraft exterior lights (commensurate with appropriate operating limitations);

e. for deviations of less than 9.3km (5.0 NM) from the originally cleared track or ATS route, remain at a level assigned by ATC;

f. for deviations greater than, or equal to 9.3km (5.0 NM), from the originally cleared track or ATS route, when the aircraft is approximately 9.3km (5.0 NM) from track, initiate a level change in accordance with Table 15-1;

Table 15-1

Originally cleared track or ATS route center line	Deviations ≥ 9.3km (5.0 NM)	Level change
EAST	LEFT	DESCEND 90m (300 ft)
(000° – 179° magnetic)	RIGHT	CLIMB 90m (300 ft)
WEST	LEFT	CLIMB 90m (300 ft)
(180° – 359° magnetic)	RIGHT	DESCEND 90m (300 ft)

g. if the pilot receives clearance to deviate from cleared track or ATS route for a specified distance and, subsequently, requests, but cannot obtain a clearance to deviate beyond that distance, the pilot should apply an altitude offset in accordance with Table 15-1 before deviating beyond the cleared distance;

h. when returning to track or ATS route, be at its assigned flight level when the aircraft is within approximately 9.3km (5.0 NM) of the center line; and

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

NOTE: If, as a result of actions taken under the provisions of 15.2.4.3.1, the pilot determines that there is another aircraft at or near the same flight level with which a conflict may occur, then the pilot is expected to adjust the path of the aircraft, as necessary, to avoid conflict.

15.3 AIR-GROUND COMMUNICATION FAILURE

15.3.1 Action by air traffic control units when unable to maintain two-way communication with an aircraft operating in a control area or control zone shall be as outlined in the paragraphs which follow.

15.3.2 As soon as it is known that two-way communication has failed, action shall be taken to ascertain whether the aircraft is able to receive transmissions from the air traffic control unit by requesting it to execute a specified manoeuvre which can be observed by an ATS surveillance system or to transmit, if possible, a specified signal in order to indicate acknowledgment.

15.3.3 If the aircraft fails to indicate that it is able to receive and acknowledge transmissions, separation shall be maintained between the aircraft having the communication failure and other aircraft, based on the assumption that the aircraft will:

a. If in visual meteorological conditions:
   1. continue to fly in visual meteorological conditions;
   2. land at the nearest suitable aerodrome; and
   3. report its arrival by the most expeditious means to the appropriate air traffic control unit; or

b. If in instrument meteorological conditions or when conditions are such that it does not appear likely that the pilot will complete the flight in accordance with a.:
   1. unless otherwise prescribed on the basis of a regional air navigation agreement, in airspace where procedural separation is being applied, maintain the last assigned speed and level, or a minimum flight altitude if higher, for a period of 20 minutes following the aircraft's failure to report its position over a compulsory reporting point and thereafter adjust level and speed in accordance with the filed flight plan; or
   2. in airspace where an ATS surveillance system is used in the provision of air traffic control, maintain the last assigned speed and level, or minimum flight altitude if higher, for a period of 7 minutes following:
      i. the time the last assigned level or minimum flight altitude is reached; or
      ii. the time the transponder is set to Code 7600 or the ADS-B transmitter is set to indicate the loss of air-ground communications; or
      iii. the aircraft's failure to report its position over a compulsory reporting point;

      whichever is later and thereafter adjust level and speed in accordance with the filed flight plan;
   3. when being vectored or having been directed by ATC to proceed offset using RNAV without a specified limit, proceed in the most direct manner possible to rejoin the current flight plan route no later than the next significant point, taking into consideration the applicable minimum flight altitude;
   4. proceed according to the current flight plan route to the appropriate designated navigation aid or fix serving the destination aerodrome and, when required to ensure compliance with 5, hold over this aid or fix until commencement of descent;
   5. commence descent from the navigation aid or fix specified in 4. at, or as close as possible to, the expected approach time last received and acknowledged; or, if no expected approach time has been received and acknowledged, at, or as close as possible to, the estimated time of arrival resulting from the current flight plan;
   6. complete a normal instrument approach procedure as specified for the designated navigation aid or fix; and
   7. land, if possible, within 30 minutes after the estimated time of arrival specified in 5. or the last acknowledged expected approach time, whichever is later.

NOTE: As evidenced by the meteorological conditions prescribed therein, 15.3.3 a. relates to all controlled flights, whereas 15.3.3 b. relates only to IFR flights.

15.3.4 Action taken to ensure suitable separation shall cease to be based on the assumption stated in 15.3.3 when:

a. it is determined that the aircraft is following a procedure differing from that in 15.3.3; or

b. through the use of electronic or other aids, air traffic control units determine that action differing from that required by 15.3.3 may be taken without impairing safety; or

c. positive information is received that the aircraft has landed.

15.3.5 As soon as it is known that two-way communication has failed, appropriate information describing the action taken by the air traffic control unit, or instructions justified by any emergency situation, shall be transmitted blind for the attention of the aircraft concerned, on the frequencies available on which the aircraft is believed to be listening, including the voice frequencies of available radio navigation or approach aids. Information shall also be given concerning:

a. meteorological conditions favorable to a cloud-breaking procedure in areas where congested traffic may be avoided; and

b. meteorological conditions at suitable aerodromes.

15.3.6 Pertinent information shall be given to other aircraft in the vicinity of the presumed position of the aircraft experiencing the failure.

15.3.10 If the aircraft has not reported within thirty minutes after:

a. the estimated time of arrival furnished by the pilot;

b. the estimated time of arrival calculated by the ACC; or

c. the last acknowledged expected approach time;

whichever is latest, pertinent information concerning the aircraft shall be forwarded to aircraft operators, or their designated representatives, and pilots-in-command of any aircraft concerned and normal control resumed if they so desire. It is the responsibility of the aircraft operators, or their designated representatives, and pilots-in-command of aircraft to determine whether they will resume normal operations or take other action.

15.5 OTHER IN-FLIGHT CONTINGENCIES

15.5.3 Fuel Dumping

15.5.3.1 General

15.5.3.1.1 An aircraft in an emergency or other urgent situations may need to dump fuel so as to reduce to maximum landing mass in order to effect a safe landing.

15.5.3.1.2 When an aircraft operating within controlled airspace needs to dump fuel, the flight crew shall advise ATC. The ATC unit should then coordinate with the flight crew the following:

a. the route to be flown, which, if possible, should be clear of cities and towns, preferably over water and away from areas where thunderstorms have been reported or are expected;

b. the level to be used, which should be not less than 1800m (6000 ft); and

c. the duration of the fuel dumping.

15.7 OTHER ATC CONTINGENCY PROCEDURES

15.7.3 Procedures in Regard to Aircraft Equipped with Airborne Collision Avoidance Systems (ACAS)

15.7.3.1 The procedures to be applied for the provision of air traffic services to aircraft equipped with ACAS shall be identical to those applicable to non-ACAS equipped aircraft. In particular, the prevention of collisions, the establishment of appropriate separation and the information which might be provided in relation to conflicting traffic and to possible avoiding action shall conform with the normal ATS procedures and shall exclude consideration of aircraft capabilities dependent on ACAS equipment.

15.7.3.2 When a pilot reports an ACAS resolution advisory (RA), the controller shall not attempt to modify the aircraft flight path until the pilot reports “clear of conflict”.

15.7.3.3 Once an aircraft departs from its ATC clearance or instruction in compliance with an RA, or a pilot reports an RA, the controller ceases to be responsible for providing separation between that aircraft and any other aircraft affected as a direct consequence of the manoeuvre induced by the RA. The controller shall resume responsibility for providing separation for all the affected aircraft when:

a. the controller acknowledges a report from the flight crew that the aircraft has resumed the current clearance; or

b. the controller acknowledges a report from the flight crew that the aircraft is resuming the current clearance and issues an alternative clearance which is acknowledged by the flight crew.

NOTE: Pilots are required to report RAs which require a deviation from the current ATC clearance or instruction (see PANS-OPS (Doc 8168), Volume I, Part III, Section 3, Chapter 3, 3.2 c) 4).). This report informs the controller that a deviation from clearance or instruction is taking place in response to an ACAS RA.

15.7.3.6 Following a significant ACAS event, pilots and controllers should complete an air traffic incident report.

NOTE 1: The ACAS capability of an aircraft may not be known to air traffic controllers.

NOTE 2: Operating procedures for use of ACAS are contained in PANS-OPS Doc 8168, Vol I, Part III, Section 3, Chapter 3 .

NOTE 3: The phraseology to be used by controllers and pilots is contained in Chapter 12, 12.3.1.2.

16 MISCELLANEOUS PROCEDURES

16.3 AIR TRAFFIC INCIDENT REPORT

16.3.1 An air traffic incident report shall be submitted, normally to the air traffic services unit concerned, for incidents specifically related to the provision of air traffic services involving such occurrences as aircraft proximity (AIRPROX), or other serious difficulty resulting in a hazard to aircraft, caused by, among others, faulty procedures, non-compliance with procedures, or failure of ground facilities.

16.3.2 Procedures should be established for the reporting of aircraft proximity incidents and their investigation to promote the safety of aircraft. The degree of risk involved in an aircraft proximity should be determined in the incident investigation and classified as “risk of collision”, “safety not assured”, “no risk of collision” or “risk not determined”.

16.3.3 When an accident / incident investigative authority conducts an investigation of an aircraft proximity incident, the air traffic services aspects should be included.

NOTE: A model air traffic incident report form together with instructions for its completion is at Appendix 4. Further information regarding air traffic incidents is contained in the Air Traffic Services Planning Manual, Doc 9426 (not published herein).

16.4 USE OF REPETITIVE FLIGHT PLANS (RPLs)

16.4.1 General

16.4.1.1 RPLs shall not be used for flights other than IFR flights operated regularly on the same day(s) of consecutive weeks and on at least ten occasions or every day over a period of at least ten consecutive days. The elements of each flight plan shall have a high degree of stability.

NOTE: For permissible incidental changes to RPL data affecting the operation for one particular day, and not intended to be a modification of the listed RPL, see 16.4.4.2.2 and 16.4.4.2.3.

16.4.1.2 RPLs shall cover the entire flight from the departure aerodrome to the destination aerodrome. RPL procedures shall be applied only when all ATS authorities concerned with the flights have agreed to accept RPLs.

16.4.1.3 The use by States of RPLs for international flight shall be subject to the provision that the affected adjacent States either already use RPLs or will use them at the same time. The procedures for use between States shall be the subject of bilateral, multilateral or regional air navigation agreement as appropriate.

16.4.2 Procedures for Submission of RPLs by Operators

16.4.2.1 Conditions governing submission, notification of changes, or cancellation of RPLs shall be the subject of appropriate arrangements between operators and the ATS authority concerned or of regional air navigation agreements.

16.4.2.2 An RPL shall comprise information regarding such of the following items as are considered relevant by the appropriate ATS authority:

- validity period of the flight plan
- days of operation
- aircraft identification
- aircraft type and wake turbulence category
- MLS capability

- departure aerodrome
- off-block time
- cruising speed(s)
- cruising level(s)
- route to be followed
- destination aerodrome
- total estimated elapsed time
- indication of the location where the following information may be obtained immediately upon request:
  - alternate aerodromes
  - fuel endurance
  - total number of persons on board
  - emergency equipment
- other information

16.4.3 Submission of Total Listings

16.4.3.1 RPLs shall be submitted in the form of listings containing the required flight plan data using an RPL listing form specially designed for the purpose or by means of other media suitable for electronic data processing. The method of submission shall be determined by local or regional agreement.

NOTE: A model RPL listing form is contained in Appendix 2.

16.4.3.2 Initial submission of complete RPL listings and any subsequent seasonal resubmission of complete listings shall be made in sufficient time to permit the data to be properly assimilated by the ATS organization. The minimum lead time required for the submission of such listings shall be established by the administrations concerned and published in their AIPs. This minimum lead time shall be at least two weeks.

16.4.3.3 Operators shall submit listings to the designated agency for distribution to the appropriate air traffic services units.

16.4.3.4 The information normally to be provided shall be that listed in 16.4.2.2 except that administrations may also require the provision of estimate information of FIR boundaries and the primary alternate aerodrome. If so required, such information shall be provided as indicated on a repetitive flight plan listing form specially designed for the purpose.

16.4.3.5 Information regarding alternate aerodrome(s) and supplementary flight plan data (information normally provided under Item 19 of the ICAO flight plan form) shall be kept readily available by the operator at the departure aerodrome or another agreed location, so that, on request by ATS units, it can be supplied without delay. The name of the office from which the information can be obtained shall be recorded on the RPL listing form.

16.4.3.6 Acknowledgment of receipt of listings of flight plan data and/or amendment thereto shall not be required except by agreement between operators and the appropriate agency.

16.4.4 Changes to RPL Listings

16.4.4.1 Changes of a Permanent Nature

16.4.4.1.1 Changes of a permanent nature involving the inclusion of new flights and the deletion or modification of currently listed flights shall be submitted in the form of amendment listings. These listings shall reach the air traffic services agency concerned at least seven days prior to the change becoming effective.

16.4.4.1.2 Where RPL listings have been initially submitted by the use of media suitable for electronic data processing, it shall be permissible by mutual agreement between the operator and the appropriate authority for some changes to be submitted by means of RPL listing forms.

16.4.4.1.3 All RPL changes shall be submitted in accordance with the instructions for preparation of RPL listings.

16.4.4.2 Changes of a Temporary Nature

16.4.4.2.1 Changes of a temporary, non-recurring nature relating to RPLs concerning aircraft type and wake turbulence category, speed and/or cruising level shall be notified for each individual flight as early as possible and not later than 30 minutes before departure to the ATS reporting office responsible for the departure aerodrome. A change of cruising level only may be notified by radiotelephony on initial contact with the ATS unit.

16.4.4.2.2 In case of an incidental change in the aircraft identification, the departure aerodrome, the route and/or the destination aerodrome, the RPL shall be cancelled for the day concerned and an individual flight plan shall be submitted.

16.4.4.2.3 Whenever it is expected by the operator that a specific flight, for which an RPL has been submitted, is likely to encounter a delay of 30 minutes or more in excess of the off-block time stated in that flight plan, the ATS unit responsible for the departure aerodrome shall be notified immediately.

NOTE: Because of the stringent requirements of flow control, failure by operators to comply with this procedure may result in the automatic cancellation of the RPL for that specific flight at one or more of the ATS units concerned.

16.4.4.2.4 Whenever it is known to the operator that any flight for which an RPL has been submitted is cancelled, the ATS unit responsible for the departure aerodrome shall be notified.

16.4.4.3 Operator/Pilot Liaison

The operator shall ensure that the latest flight plan information, including permanent and incidental changes, pertaining to a particular flight and duly notified to the appropriate agency, is made available to the pilot-in-command.

16.5 STRATEGIC LATERAL OFFSET PROCEDURES (SLOP)

NOTE 1: — SLOP are approved procedures that allow aircraft to fly on a parallel track to the right of the centerline relative to the direction of flight to mitigate the lateral overlap probability due to increased navigation accuracy and wake turbulence encounters. Unless specified in the separation standard, an aircraft's use of these procedures does not affect the application of prescribed separation standards.

NOTE 2: — Annex 2, 3.6.2.1.1 (See AIR TRAFFIC CONTROL — ICAO Rules of the Air — Annex 2, 3.6.2.1.1), requires authorization for the application of strategic lateral offsets from the appropriate ATS authority responsible for the airspace concerned.

16.5.1 Implementation of strategic lateral offset procedures shall be coordinated among the States involved.

NOTE: Information concerning the implementation of strategic lateral offset procedures is contained in the Implementation of Strategic Lateral Offset Procedures (Circular 331) (not published herein).

16.5.2 Strategic lateral offsets shall be authorized only in en-route airspace as follows:

a. where the lateral separation minima or spacing between route centerlines is 28km (15 NM) or more, offsets to the right of the centerline relative to the direction of flight in tenths of a nautical mile up to a maximum of 3.7km (2 NM); and

b. where the lateral separation minima or spacing between route centerlines is 19km (10 NM) or more and less than 28km (15 NM), while one aircraft climbs/descends through the level of another aircraft, offsets to the right of the centerline relative to the direction of flight in tenths of a nautical mile up to a maximum of 3.7km (2 NM).

c. where the lateral separation minima or spacing between route centerlines is 11.1km (6 NM) or more and less than 28km (15 NM), offsets to the right of the centerline relative to the direction of flight in tenths of a nautical mile up to a maximum of 0.9km (0.5 NM).

16.5.3 The routes or airspace where application of strategic lateral offsets is authorized, and the procedures to be followed by pilots shall be promulgated in aeronautical information publications (AIPs). In some instances, it may be necessary to impose restrictions on the use of strategic lateral offsets, e.g. where their application may be inappropriate for reasons related to obstacle clearance. Route conformance monitoring systems shall account for the application of SLOP.

16.5.4 The decision to apply a strategic lateral offset shall be the responsibility of the flight crew. The flight crew shall only apply strategic lateral offsets in airspace where such offsets have been authorized by the appropriate ATS authority and when the aircraft is equipped with automatic offset tracking capability.

NOTE 1: — Pilots may contact other aircraft on the inter-pilot air-to-air frequency 123.45 MHz to coordinate offsets.

NOTE 2: — The strategic lateral offset procedure has been designed to include offsets to mitigate the effects of wake turbulence of preceding aircraft. If wake turbulence needs to be avoided, an offset to the right and within the limits specified in 16.5.2 may be used.

NOTE 3: — Pilots are not required to inform ATC that a strategic lateral offset is being applied.

16.6 NOTIFICATION OF SUSPECTED COMMUNICABLE DISEASES, OR OTHER PUBLIC HEALTH RISK, ON BOARD AN AIRCRAFT

16.6.1 The flight crew of an en-route aircraft shall, upon identifying a suspected case(s) of communicable disease, or other public health risk, on board the aircraft, promptly notify the ATS unit with which the pilot is communicating, the information listed below:

a. aircraft identification;
b. departure aerodrome;
c. destination aerodrome;
d. estimated time of arrival;
e. number of persons on board;
f. number of suspected case(s) on board; and
g. nature of the public health risk, if known.

16.6.2 The ATS unit, upon receipt of information from a pilot regarding suspected case(s) of communicable disease, or other public health risk, on board the aircraft, shall forward a message as soon as possible to the ATS unit serving the destination/departure, unless procedures exist to notify the appropriate authority designated by the State, and the aircraft operator or its designated representative.

16.6.3 When a report of a suspected case(s) of communicable disease, or other public health risk, on board an aircraft is received by an ATS unit serving the destination/departure, from another ATS unit or from an aircraft or an aircraft operator, the unit concerned shall forward a message as soon as possible to the public health authority (PHA) or the appropriate authority designated by the State as well as the aircraft operator or its designated representative, and the aerodrome authority.

NOTE 1: — See Annex 9 — Facilitation, Chapter 1 (Definitions), Chapter 8, 8.12 and 8.15, and Appendix 1, for relevant additional information related to the subject of communicable disease and public health risk on board an aircraft (not published herein).

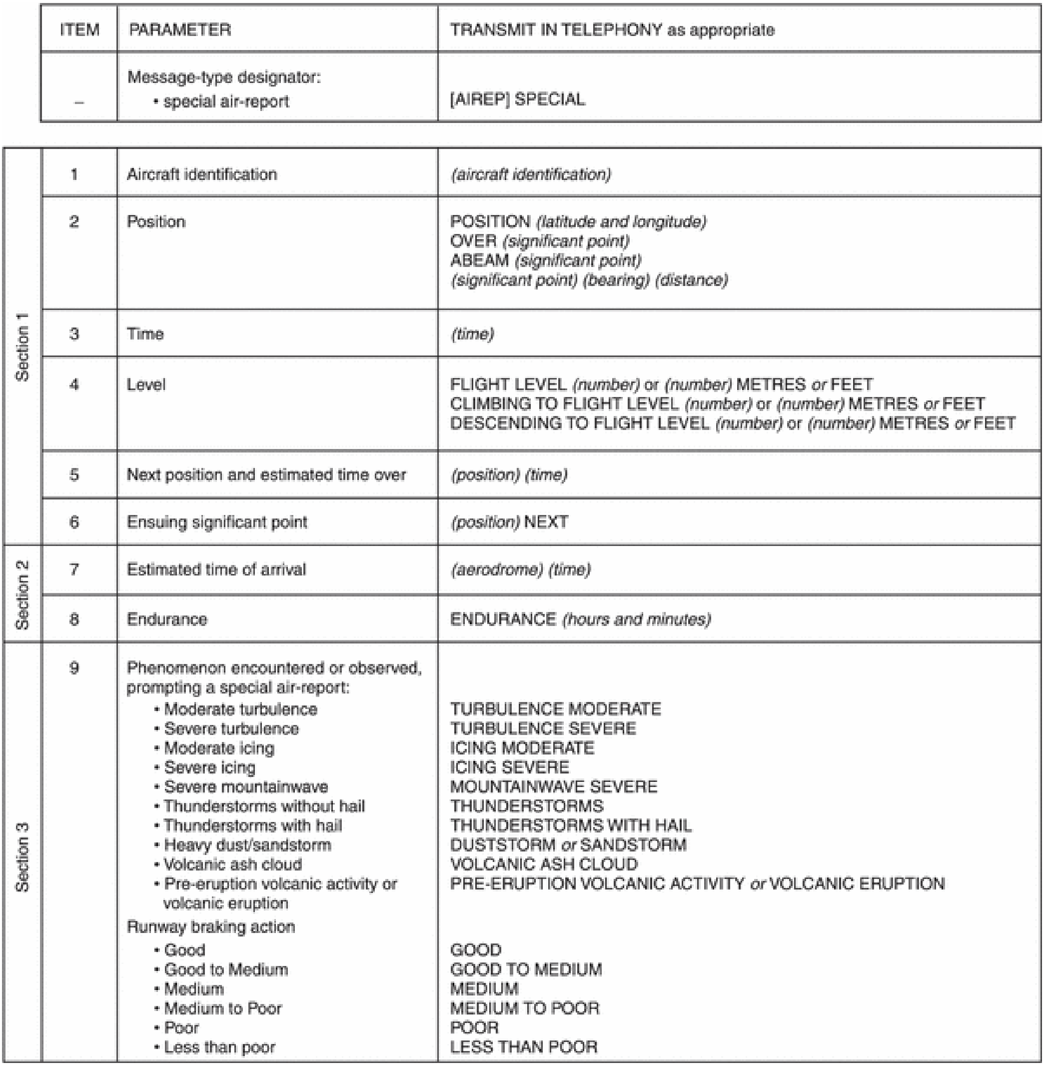
NOTE 2: — The PHA is expected to contact the airline representative or operating agency and aerodrome authority, if applicable, for subsequent coordination with the aircraft concerning clinical details and aerodrome preparation. Depending on the communications facilities available to the airline representative or operating agency, it may not be possible to communicate with the aircraft until it is closer to its destination. Apart from the initial notification to the ATS unit whilst en-route, ATC communications channels are to be avoided.

NOTE 3: — The information to be provided to the departure aerodrome will prevent the potential spread of communicable disease, or other public health risk, through other aircraft departing from the same aerodrome.

NOTE 4: — AFTN (urgency message), telephone, facsimile or other means of transmission may be used.

REPORTING INSTRUCTIONS

MODEL AIREP SPECIAL



ITEM	PARAMETER	TRANSMIT IN TELEPHONY as appropriate
–	Message-type designator: • special air-report	[AIREP] SPECIAL

Section 1	1	Aircraft identification	*(aircraft identification)*
	2	Position	POSITION *(latitude and longitude)* OVER *(significant point)* ABEAM *(significant point)* *(significant point) (bearing) (distance)*
	3	Time	*(time)*
	4	Level	FLIGHT LEVEL *(number)* or *(number)* METRES *or* FEET CLIMBING TO FLIGHT LEVEL *(number)* or *(number)* METRES *or* FEET DESCENDING TO FLIGHT LEVEL *(number)* or *(number)* METRES *or* FEET
	5	Next position and estimated time over	*(position) (time)*
	6	Ensuing significant point	*(position)* NEXT
Section 2	7	Estimated time of arrival	*(aerodrome) (time)*
	8	Endurance	ENDURANCE *(hours and minutes)*
Section 3	9	Phenomenon encountered or observed, prompting a special air-report: • Moderate turbulence • Severe turbulence • Moderate icing • Severe icing • Severe mountainwave • Thunderstorms without hail • Thunderstorms with hail • Heavy dust/sandstorm • Volcanic ash cloud • Pre-eruption volcanic activity or volcanic eruption Runway braking action • Good • Good to Medium • Medium • Medium to Poor • Poor • Less than poor	 TURBULENCE MODERATE TURBULENCE SEVERE ICING MODERATE ICING SEVERE MOUNTAINWAVE SEVERE THUNDERSTORMS THUNDERSTORMS WITH HAIL DUSTSTORM *or* SANDSTORM VOLCANIC ASH CLOUD PRE-ERUPTION VOLCANIC ACTIVITY *or* VOLCANIC ERUPTION GOOD GOOD TO MEDIUM MEDIUM MEDIUM TO POOR POOR LESS THAN POOR

1. POSITION REPORTS AND SPECIAL AIR-REPORTS

1.1 Section 1 is obligatory for position reports and special air-reports, although Items 5 and 6 thereof may be omitted when prescribed in *Regional Supplementary Procedures;* Section 2 shall be added, in whole or in part, only when so requested by the operator or his designated representative, or when deemed necessary by the pilot-in-command; Section 3 shall be included in special air-reports.

1.2 Special air-reports shall be made whenever any of the phenomena listed under Item 15 are observed or encountered. Items 1 to 4 of Section 1 and the appropriate phenomenon specified in Section 3, Item 15, are required from all aircraft. The phenomena listed under "SST" shall be reported only by supersonic transport at transonic and supersonic cruising levels.

1.3 In the case of special air-reports containing information on volcanic activity, a post-flight report shall be made on the volcanic activity reporting form (Model VAR). All elements which are observed shall be recorded and indicated respectively in the appropriate places on the form Model VAR.

1.4 Special air-reports shall be made as soon as practicable after a phenomenon calling for a special air-report has been observed.

1.5 If a phenomenon warranting the making of a special air-report is observed at or near the time or place where a routine air-report is to be made, a special air-report shall be made instead.

2. DETAILED REPORTING INSTRUCTIONS

2.1 Items of an air-report shall be reported in the order in which they are listed in the model AIREP SPECIAL form.

- MESSAGE TYPE DESIGNATOR. Report “SPECIAL” for a special air-report.
- **Section 1**
  - **Item 1** – AIRCRAFT IDENTIFICATION. Report the aircraft radiotelephony call sign as prescribed in Annex 10, Volume II, Chapter 5.
  - **Item 2** – POSITION. Report position in latitude (degrees as 2 numerics or degrees and minutes as 4 numerics, followed by “North” or “South”) and longitude (degrees as 3 numerics or degrees and minutes as 5 numerics, followed by “East” or “West”), or as a significant point identified by a coded designator (2 to 5 characters), or as a significant point followed by magnetic bearing (3 numerics) and distance in nautical miles from the point (e.g.,

    “4620North07805West”, “4620North07800West”, “4600North07800West”, LN (“LIMA NOVEMBER”), “MAY”, “HADDY” or “DUB 180 DEGREES 40 MILES”). Precede significant point by “ABEAM”, if applicable.
  - **Item 3** – TIME. Report time in hours and minutes UTC (4 numerics) unless reporting time in minutes past the hour (2 numerics) is prescribed on the basis of regional air navigation agreements. The time reported must be the actual time of the aircraft at the position and not the time of origination or transmission of the report. Time shall always be reported in hours and minutes UTC when making a special air-report.

- **Item 4** – FLIGHT LEVEL OR ALTITUDE. Report flight level by 3 numerics (e.g., “FLIGHT LEVEL 310”), when on standard pressure altimeter setting. Report altitude in metres followed by “METRES” or in feet followed by “FEET”, when on QNH. Report “CLIMBING” (followed by the level) when climbing, or “DESCENDING” (followed by the level) when descending, to a new level after passing the significant point.
- **Item 5** – NEXT POSITION AND ESTIMATED TIME OVER. Report the next reporting point and the estimated time over such reporting point, or report the estimated position that will be reached one hour later, according to the position reporting procedures in force. Use the data conventions specified in Item 2 for position. Report the estimated time over this position. Report time in hours and minutes UTC (4 numerics) unless reporting time in minutes past the hour (2 numerics) as prescribed on the basis of regional air navigation agreements.
- **Item 6** – ENSUING SIGNIFICANT POINT. Report the ensuing significant point following the “next position and estimated time over”.

– **Section 2**

- **Item 7** – ESTIMATED TIME OF ARRIVAL. Report the name of the aerodrome of the first intended landing, followed by the estimated time of arrival at this aerodrome in hours and minutes UTC (4 numerics).
- **Item 8** – ENDURANCE. Report “ENDURANCE” followed by fuel endurance in hours and minutes (4 numerics).

– **Section 3**

- **Item 9** – PHENOMENON PROMPTING A SPECIAL AIR-REPORT. Report one of the following phenomena encountered or observed:
- moderate turbulence as "TURBULENCE MODERATE"
- severe turbulence as "TURBULENCE SEVERE"

  The following specifications apply:

  - Moderate – Conditions in which moderate changes in aircraft attitude and/or altitude may occur but the aircraft remains in positive control at all times. Usually, small variations in air speed. Changes in accelerometer readings of 0.5g to 1.0g at the aircraft’s centre of gravity. Difficulty in walking. Occupants feel strain against seat belts. Loose objects move about.
  - Severe – Conditions in which abrupt changes in aircraft attitude and/or altitude occur; aircraft may be out of control for short periods. Usually, large variations in air speed. Changes in accelerometer readings greater than 1.0g at the aircraft’s centre of gravity. Occupants are forced violently against seat belts. Loose objects are tossed about.
- moderate icing as "ICING MODERATE"
- severe icing as "ICING SEVERE"

  The following specifications apply:

  - Moderate – Conditions in which change of heading and/or altitude may be considered desirable.
  - Severe – Conditions in which immediate change of heading and/or altitude is considered essential.

- severe mountainwave as “MOUNTAINWAVE SEVERE”.

  The following specification applies:

  - Severe – Conditions in which the accompanying downdraft is 3.0 m/s (600 ft/min) or more and/or severe turbulence is encountered.

- thunderstorm without hail as “THUNDERSTORM”.
- thunderstorm with hail as “THUNDERSTORM WITH HAIL”.

  The following specification applies:

  Only report those thunderstorms which are:

  - obscured in haze; or
  - embedded in cloud; or
  - widespread; or
  - forming a squall-line.

- heavy duststorm or sandstorm as “DUSTSTORM *or* SANDSTORM HEAVY”.
- volcanic ash cloud as “VOLCANIC ASH CLOUD”.
- pre-eruption volcanic activity or a volcanic eruption as “PRE-ERUPTION VOLCANIC ACTIVITY *or* VOLCANIC ERUPTION”.

  The following specifications apply:

  Pre-eruption volcanic activity in this context means unusual and/or increasing volcanic activity which could presage a volcanic eruption.

  NOTE: In case of volcanic ash cloud, pre-eruption volcanic activity or volcanic eruption, in accordance with Chapter 4, 4.12.3, a post flight report shall also be made on the special air-report of volcanic activity form (Model VAR).

- Good braking action as “BRAKING ACTION GOOD”.
- Good to medium braking action as “BRAKING ACTION GOOD TO MEDIUM”.
- Medium braking action as “BRAKING ACTION MEDIUM”.
- Medium to poor braking action as “BRAKING ACTION MEDIUM TO POOR”.
- Poor braking action as “BRAKING ACTION POOR”.
- Less than poor braking action as “BRAKING ACTION LESS THAN POOR”.

The following specifications apply:

Good — Braking deceleration is normal for the wheel braking effort applied and directional control is normal.

Good to medium — Braking deceleration or directional control is between Good and Medium.

Medium — Braking deceleration is noticeably reduced for the wheel braking effort applied or directional control is noticeably reduced.

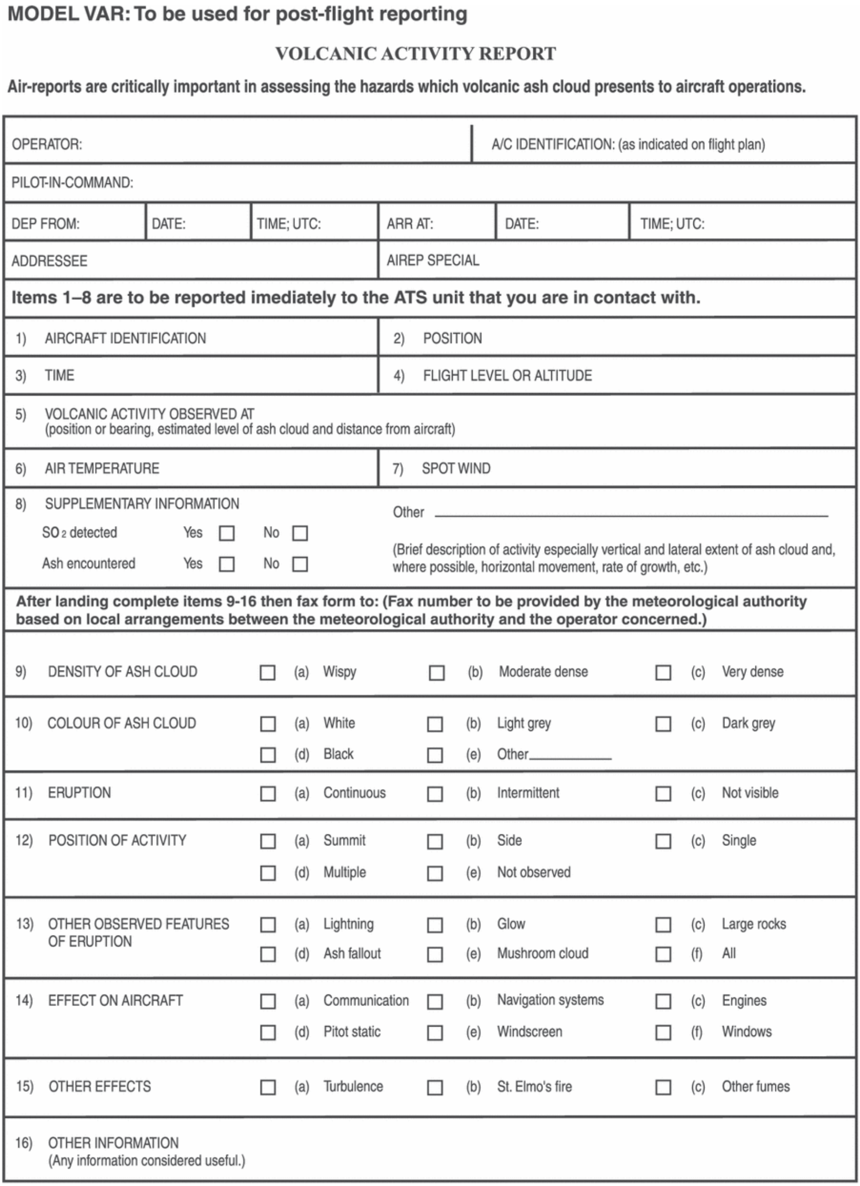
Medium to poor — Braking deceleration or directional control is between Medium and Poor.

Poor — Braking deceleration is significantly reduced for the wheel braking effort applied or directional control is significantly reduced.

Less than poor — Braking deceleration is minimal to non-existent for the wheel braking effort applied or directional control is uncertain.

2.2 Information recorded on the volcanic activity reporting form (Model VAR) is not for transmission by RTF but, on arrival at an aerodrome, is to be delivered without delay by the operator or a flight crew member to the aerodrome meteorological office. If such an office is not easily accessible, the completed form shall be delivered in accordance with local arrangements made between the Meteorological and ATS Authorities and the operator.

Special Air-Report Of Volcanic Activity Form (Model VAR)



MODEL VAR: To be used for post-flight reporting

VOLCANIC ACTIVITY REPORT

Air-reports are critically important in assessing the hazards which volcanic ash cloud presents to aircraft operations.

OPERATOR:			A/C IDENTIFICATION: (as indicated on flight plan)		
PILOT-IN-COMMAND:					
DEP FROM:	DATE:	TIME; UTC:	ARR AT:	DATE:	TIME; UTC:
ADDRESSEE			AIREP SPECIAL		

Items 1–8 are to be reported imediately to the ATS unit that you are in contact with.

1) AIRCRAFT IDENTIFICATION	2) POSITION
3) TIME	4) FLIGHT LEVEL OR ALTITUDE
5) VOLCANIC ACTIVITY OBSERVED AT (position or bearing, estimated level of ash cloud and distance from aircraft)	
6) AIR TEMPERATURE	7) SPOT WIND

8) SUPPLEMENTARY INFORMATION

SO_2 detected Yes ☐ No ☐

Ash encountered Yes ☐ No ☐

Other ______________________________

(Brief description of activity especially vertical and lateral extent of ash cloud and, where possible, horizontal movement, rate of growth, etc.)

After landing complete items 9-16 then fax form to: (Fax number to be provided by the meteorological authority based on local arrangements between the meteorological authority and the operator concerned.)

9) DENSITY OF ASH CLOUD	☐ (a) Wispy	☐ (b) Moderate dense	☐ (c) Very dense
10) COLOUR OF ASH CLOUD	☐ (a) White	☐ (b) Light grey	☐ (c) Dark grey
	☐ (d) Black	☐ (e) Other__________	
11) ERUPTION	☐ (a) Continuous	☐ (b) Intermittent	☐ (c) Not visible
12) POSITION OF ACTIVITY	☐ (a) Summit	☐ (b) Side	☐ (c) Single
	☐ (d) Multiple	☐ (e) Not observed	
13) OTHER OBSERVED FEATURES OF ERUPTION	☐ (a) Lightning	☐ (b) Glow	☐ (c) Large rocks
	☐ (d) Ash fallout	☐ (e) Mushroom cloud	☐ (f) All
14) EFFECT ON AIRCRAFT	☐ (a) Communication	☐ (b) Navigation systems	☐ (c) Engines
	☐ (d) Pitot static	☐ (e) Windscreen	☐ (f) Windows
15) OTHER EFFECTS	☐ (a) Turbulence	☐ (b) St. Elmo's fire	☐ (c) Other fumes
16) OTHER INFORMATION (Any information considered useful.)			

EXAMPLES

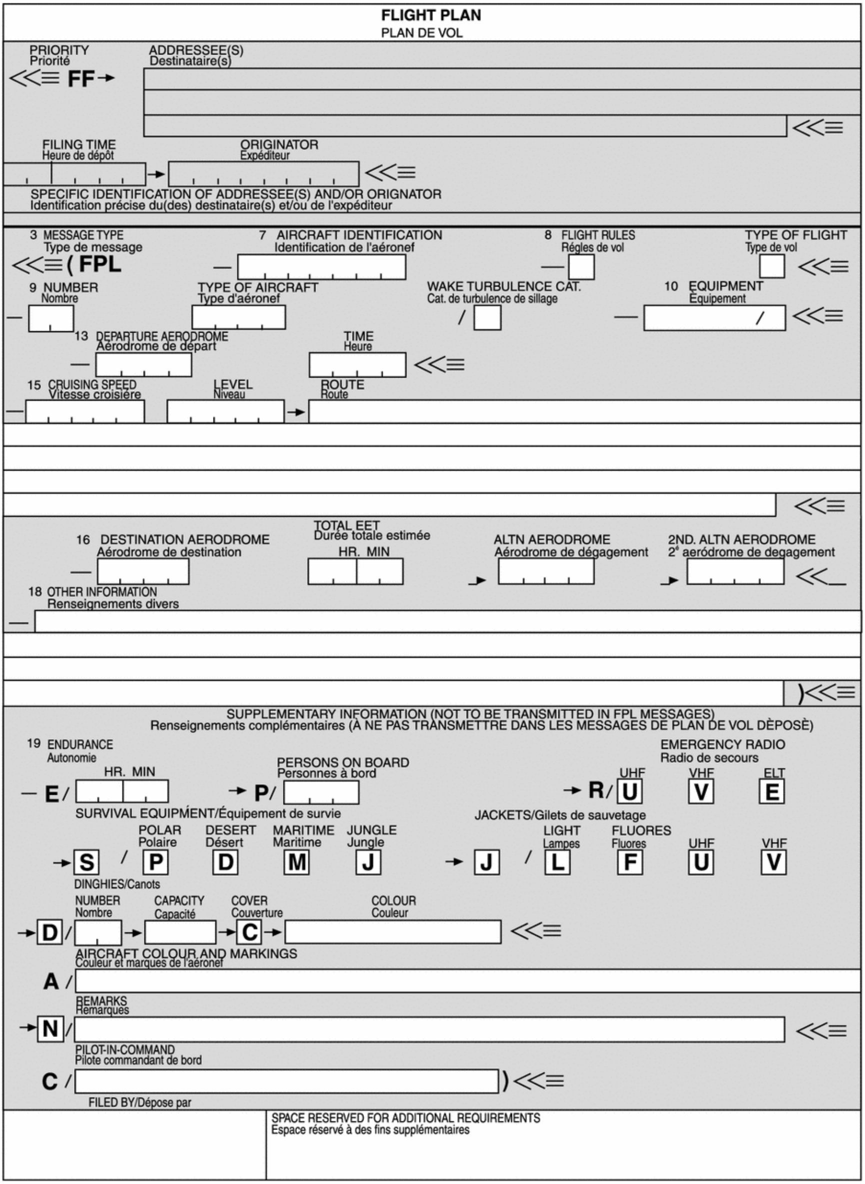
	AS SPOKEN IN RADIOTELEPHONY	AS RECORDED BY THE AIR TRAFFIC SERVICES UNIT AND FORWARDED TO THE METEOROLOGICAL OFFICE CONCERNED
I.[1]	AIREP SPECIAL CLIPPER WUN ZERO WUN POSITION FIFE ZERO FOWer FIFE NORTH ZERO TOO ZERO WUN FIFE WEST AT WUN FIFE TREE SIX FLIGHT LEVEL TREE WUN ZERO CLIMBING TO FLIGHT LEVEL TREE FIFE ZERO THUNDERSTORM WITH HAIL	I. ARS PAA101 5045N02015W 1536 F310 ASC F350 TSGR
II.[2]	SPECIAL NIUGINI TOO SEVen TREE OVER MADANG AT ZERO AIT FOWer SIX WUN NINer TOUSAND FEET TURBULENCE SEVERE	II. ARS ANG273 MD 0846 19000FT TURB SEV

[1] A special air-report which is required because of the occurrence of widespread thunderstorms with hail.

[2] A special air-report which is required because of severe turbulence. The aircraft is on QNH altimeter setting.

APPENDIX 2 - FLIGHT PLAN

1 ICAO MODEL FLIGHT PLAN FORM



FLIGHT PLAN
PLAN DE VOL

PRIORITY
Priorité
<<≡ **FF** →

ADDRESSEE(S)
Destinataire(s)
<<≡

FILING TIME
Heure de dépôt

ORIGINATOR
Expéditeur
<<≡

SPECIFIC IDENTIFICATION OF ADDRESSEE(S) AND/OR ORIGNATOR
Identification précise du(des) destinataire(s) et/ou de l'expéditeur

3 MESSAGE TYPE
Type de message
<<≡ **(FPL**

7 AIRCRAFT IDENTIFICATION
Identification de l'aéronef
—

8 FLIGHT RULES
Régles de vol
—

TYPE OF FLIGHT
Type de vol
<<≡

9 NUMBER
Nombre
—

TYPE OF AIRCRAFT
Type d'aéronef

WAKE TURBULENCE CAT.
Cat. de turbulence de sillage
/

10 EQUIPMENT
Équipement
— / <<≡

13 DEPARTURE AERODROME
Aérodrome de départ
—

TIME
Heure
<<≡

15 CRUISING SPEED
Vitesse croisière
—

LEVEL
Niveau
→

ROUTE
Route

<<≡

16 DESTINATION AERODROME
Aérodrome de destination
—

TOTAL EET
Durée totale estimée
HR. MIN

ALTN AERODROME
Aérodrome de dégagement
→

2ND. ALTN AERODROME
2e aeródrome de degagement
→ <<_

18 OTHER INFORMATION
Renseignements divers
—

)<<≡

SUPPLEMENTARY INFORMATION (NOT TO BE TRANSMITTED IN FPL MESSAGES)
Renseignements complémentaires (À NE PAS TRANSMETTRE DANS LES MESSAGES DE PLAN DE VOL DÈPOSÈ)

19 ENDURANCE
Autonomie
HR. MIN
— **E** /

PERSONS ON BOARD
Personnes à bord
→ **P** /

EMERGENCY RADIO
Radio de secours
UHF VHF ELT
→ **R** / **U** **V** **E**

SURVIVAL EQUIPMENT/Équipement de survie
POLAR Polaire DESERT Désert MARITIME Maritime JUNGLE Jungle
→ **S** / **P** **D** **M** **J**

JACKETS/Gilets de sauvetage
LIGHT Lampes FLUORES Fluores UHF VHF
→ **J** / **L** **F** **U** **V**

DINGHIES/Canots
NUMBER Nombre CAPACITY Capacité COVER Couverture COLOUR Couleur
→ **D** / → → **C** → <<≡

AIRCRAFT COLOUR AND MARKINGS
Couleur et marques de l'aéronef
A /

REMARKS
Remarques
→ **N** / <<≡

PILOT-IN-COMMAND
Pilote commandant de bord
C /) <<≡

FILED BY/Dépose par

SPACE RESERVED FOR ADDITIONAL REQUIREMENTS
Espace réservé à des fins supplémentaires

2 INSTRUCTIONS FOR THE COMPLETION OF THE FLIGHT PLAN FORM

2.1 GENERAL

Adhere closely to the prescribed formats and manner of specifying data.

Commence inserting data in the first space provided. Where excess space is available leave unused spaces blank.

Insert all clock times in *4 figures UTC*.

Insert all estimated elapsed times in 4 figures (hours and minutes).

Shaded area preceding Item 3 — to be completed by ATS and COM services, unless the responsibility for originating flight plan messages has been delegated.

NOTE: term "aerodrome" where used in the flight plan is intended to cover also sites other than aerodromes which may be used by certain types of aircraft; e.g., helicopters or balloons.

2.2 INSTRUCTIONS FOR INSERTION OF ATS DATA

Complete Items 7 to 18 as indicated hereunder.

Complete also Item 19 as indicated hereunder, when so required by the appropriate ATS authority or when otherwise deemed necessary.

NOTE 1: Item numbers on the form are not consecutive, as they correspond to Field Type numbers in ATS messages.

NOTE 2: Air traffic services data systems may impose communications or processing constraints on information in filed flight plans. Possible constraints may, for example, be limits with regard to item length, number of elements in the route item or total flight plan length. Significant constraints are documented in the relevant Aeronautical Information Publication.

ITEM 7: AIRCRAFT IDENTIFICATION

(MAXIMUM 7 CHARACTERS)

INSERT one of the following aircraft identifications, not exceeding 7 alphanumeric characters and without hyphens or symbols:

a. the ICAO designator for the aircraft operating agency followed by the flight identification (e.g., KLM511, NGA213, JTR25) when in radiotele-phony the call sign to be used by the aircraft will consist of the ICAO telephony designator for the operating agency followed by the flight identification (e.g., KLM511, NIGERIA 213, JESTER 25).

OR

b. the nationality or common mark and registration mark of the aircraft (e.g., EIAKO, 4XBCD, N2567GA), when:

1. in radiotelephony the call sign to be used by the aircraft will consist of this identification alone (e.g., CGAJS), or preceded by the ICAO telephony designator for the aircraft operating agency (e.g., BLIZZARD CGAJS);
2. the aircraft is not equipped with radio.

NOTE 1: Standard for nationality, common and registration marks to be used are contained in Annex 7, Chapter 2.

NOTE 2: Provisions for the use of radiotelephony call signs are contained in Annex 10, Volume II, Chapter 5 (not published herein). ICAO designators and telephony designators for aircraft operating agencies are contained in Doc 8585 — Designators for Aircraft Operating Agencies, Aeronautical Authorities and Services (not published herein).

ITEM 8: FLIGHT RULES AND TYPE OF FLIGHT

(ONE OR TWO CHARACTERS)

– **Flight rules**

INSERT one of the following letters to denote the category of flight rules with which the pilot intends to comply:

I	if it is intended that the entire flight will be operated under the IFR
V	if it is intended that the entire flight will be operated under the VFR
Y	if the flight initially will be operated under the IFR, followed by one or more subsequent changes of flight rules or
Z	if the flight initially will be operated under the VFR, followed by one or more subsequent changes of flight rules

Specify in Item 15 the point or points at which a change of flight rules is planned.

– **Type of flight**

INSERT one of the following letters to denote the type of flight when so required by the appropriate ATS authority:

S	if scheduled air service
N	if non-scheduled air transport operation
G	if general aviation
M	if military
X	if other than any of the defined categories above.

Specify status of a flight following the indicator STS in Item 18, or when necessary to denote other reasons for specific handling by ATS, indicate the reason following the indicator RMK in Item 18.

ITEM 9: NUMBER AND TYPE OF AIRCRAFT AND WAKE TURBULENCE CATEGORY

– **Number of aircraft (1 or 2 characters)**

INSERT the number of aircraft, if more than one.

– **Type of aircraft (2 to 4 characters)**

INSERT the appropriate designator as specified in ICAO Doc 8643, *Aircraft Type Designators* (not published herein)

OR if no such designator has been assigned, or in case of formation flights comprising more than one type;

INSERT ZZZZ, and *SPECIFY* in Item 18, the (numbers and) type(s) of aircraft preceded by TYP/.

– **Wake turbulence category (1 character)**

INSERT an oblique stroke followed by one of the following letters to indicate the wake turbulence category of the aircraft:

J —	SUPER, to indicate an aircraft type specified as such in Doc 8643, *Aircraft Type Designators* (not published herein);
H —	HEAVY, to indicate an aircraft type with a maximum certificated take-off mass of 136,000kg or more, with the exception of aircraft types listed in Doc 8643 in the SUPER (J) category;
M —	MEDIUM, to indicate an aircraft type with a maximum certificated take-off mass of less than 136,000kg but more than 7000kg;
L —	LIGHT, to indicate an aircraft type with a maximum certificated take-off mass of 7000kg or less.

ITEM 10: EQUIPMENT AND CAPABILITIES

Capabilities comprise the following elements:

a. presence of relevant serviceable equipment on board the aircraft;

b. equipment and capabilities commensurate with flight crew qualifications; and

c. where applicable, authorization from the appropriate authority.

– **Radio communication, navigation and approach aid equipment**

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:

A	GBAS landing system
B	LPV (APV with SBAS)
C	LORAN C
D	DME
E1	FMC WPR ACARS
E2	D-FIS ACARS
E3	PDC ACARS
F	ADF
G	GNSS. If any portion of the flight is planned to be conducted under IFR, it refers to GNSS receivers that comply with the requirements of Annex 10, Volume I *(see Note 2).*
H	HF RTF
I	Inertial Navigation
J1	CPDLC ATN VDL Mode 2 *(see Note 3)*
J2	CPDLC FANS 1/A HFDL
J3	CPDLC FANS 1/A VDL Mode A
J4	CPDLC FANS 1/A VDL Mode 2
J5	CPDLC FANS 1/A SATCOM (INMARSAT)
J6	CPDLC FANS 1/A SATCOM (MTSAT)
J7	CPDLC FANS 1/A SATCOM (Iridium)
K	MLS
L	ILS
M1	ATC SATVOICE (INMARSAT)
M2	ATC SATVOICE (MTSAT)
M3	ATC SATVOICE (Iridium)
O	VOR
P1	CPDLC RCP 400 *(See Note 7)*
P2	CPDLC RCP 240 *(See Note 7)*
P3	SATVOICE RCP 400 *(See Note 7)*
P4–P9	Reserved for RCP
R	PBN approved *(see Note 4)*
T	TACAN
U	UHF RTF
V	VHF RTF
W	RVSM approved
X	MNPS approved
Y	VHF with 8.33 kHz channel spacing capability
Z	Other equipment carried or other capabilities *(See Note 5)*

Any alphanumeric characters not indicated above are reserved.

NOTE 1: If the letter S is used, standard equipment is considered to be VHF RTF, VOR and ILS, unless another combination is prescribed by the appropriate ATS authority.

NOTE 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.

NOTE 3: See RTCA/EUROCAE Interoperability Requirements Standard for ATN Baseline 1(ATN B1 INTEROP Standard — DO-280B/ED-110B) (not published herein) for data link services air traffic control clearance and information/air traffic control communications management/air traffic control microphone check.

NOTE 4: If the letter R is used, the performance-based navigation levels that can be met are specified in Item 18 following the indicator PBN/. Guidance material on the application of performance-based navigation to a specific route segment, route or area is contained in the Performance-based Navigation (PBN) Manual (Doc 9613) (not published herein).

NOTE 5: If the letter Z is used, specify in Item 18 the other equipment carried or other capabilities, preceded by COM/, NAV/ and/or DAT, as appropriate.

NOTE 6: Information on navigation capability is provided to ATC for clearance and routing purposes.

NOTE 7: Guidance material on the application of performance-based communication, which prescribes RCP to an air traffic service in a specific area, is contained in the Performance-based Communication and Surveillance (PBCS) Manual (Doc 9869) (not published herein).

– **Surveillance equipment and capabilities**

INSERT N if no surveillance equipment for the route to be flown is carried, or the equipment is unserviceable,

OR

INSERT one or more of the following descriptors, to a maximum of 20 characters, to describe the serviceable surveillance equipment and/or capabilities on board:

SSR Modes A and C

A Transponder — Mode A (4 digits — 4096 codes)

C Transponder — Mode A (4 digits — 4096 codes) and Mode C

SSR Mode S

E Transponder — Mode S, including aircraft identification, pressure-altitude and extended squitter (ADS-B) capability

H Transponder — Mode S, including aircraft identification, pressure-altitude and enhanced surveillance capability

I Transponder — Mode S, including aircraft identification, but no pressure-altitude capability

L Transponder — Mode S, including aircraft identification, pressure-altitude, extended squitter (ADS-B) and enhanced surveillance capability

P	Transponder — Mode S, including pressure-altitude, but no aircraft identification capability
S	Transponder — Mode S, including both pressure-altitude and aircraft identification capability
X	Transponder — Mode S with neither aircraft identification nor pressure-altitude capability

NOTE: Enhanced surveillance capability is the ability of the aircraft to down-link aircraft derived data via a Mode S transponder.

ADS-B

B1	ADS-B with dedicated 1 090 MHz ADS-B “out” capability
B2	ADS-B with dedicated 1 090 MHz ADS-B “out” and “in” capability
U1	ADS-B “out” capability using UAT
U2	ADS-B “out” and “in” capability using UAT
V1	ADS-B “out” capability using VDL Mode 4
V2	ADS-B “out” and “in” capability using VDL Mode 4

ADS-C

D1	ADS-C with FANS 1/A capabilities
G1	ADS-C with ATN capabilities

Alphanumeric characters not indicated above are reserved.

EXAMPLE: ADE3RV/HB2U2V2G1

NOTE 1: The RSP specification(s), if applicable, will be listed in Item 18 following the indicator SUR/. Guidance material on the application of performance-based surveillance, which prescribes RSP to an air traffic service in a specific area, is contained in the Performance-based Communication and Surveillance (PBCS) Manual (Doc 9869) (not published herein).

NOTE 2: Additional surveillance equipment or capabilities will be listed in Item 18 following the indicator SUR/, as required by the appropriate ATS authority.

ITEM 13: DEPARTURE AERODROME AND TIME

(8 CHARACTERS)

INSERT the ICAO four-letter location indicator of the departure aerodrome as specified in Doc 7910, *Location Indicators* (not published herein),

OR, if no location indicator has been assigned,

INSERT ZZZZ and *SPECIFY*, in Item 18, the name and location of the aerodrome preceded by DEP/, *OR,* the first point of the route or the marker radio beacon preceded by DEP/..., if the aircraft has not taken off from the aerodrome,

OR, if the flight plan is received from an aircraft in flight,

INSERT AFIL, and *SPECIFY*, in Item 18, the ICAO four-letter location indicator of the location of the ATS unit from which supplementary flight plan data can be obtained, preceded by DEP/ .

THEN, WITHOUT A SPACE,

INSERT for a flight plan submitted before departure, the estimated off-block time (EOBT),

OR, for a flight plan received from an aircraft in flight, the actual or estimated time over the first point of the route to which the flight plan applies.

ITEM 15: ROUTE

INSERT the *first cruising speed* as in a. and the *first cruising level* as in b., without a space between them.

THEN, following the arrow, *INSERT* the route description as in c.

a. **Cruising speed (maximum 5 characters)**

   INSERT the *True Air Speed* for the first or the whole cruising portion of the flight, in terms of:

   - *Kilometers per hour*, expressed as K followed by 4 figures (e.g., K0830); or
   - *Knots*, expressed as N followed by 4 figures (e.g., N0485); or
   - *True Mach number*, when so prescribed by the appropriate ATS authority, to the nearest hundredth of unit Mach, expressed as M followed by 3 figures (e.g., M082).

b. **Cruising level (maximum 5 characters)**

   INSERT the planned cruising level for the first or the whole portion of the route to be flown, in terms of:

   - *Flight level*, expressed as F followed by 3 figures (e.g., F085; F330); or
   - **Standard Metric Level in tens of metres*, expressed as S followed by 4 figures (e.g., S1130); or
   - *Altitude in hundreds of feet*, expressed as A followed by 3 figures (e.g., A045; A100); or
   - *Altitude in tens of metres*, expressed as M followed by 4 figures (e.g., M0840); or
   - *For uncontrolled VFR flights, the letters VFR.*

c. **Route (Including Changes of Speed, Level and/or Flight Rules)**

   Flights Along Designated ATS Routes

   INSERT if the departure aerodrome is located on, or connected to the ATS route, the designator of the first ATS route;

OR, if the departure aerodrome is not on or connected to the ATS route, the letters DCT followed by the point of joining the first ATS route, followed by the designator of the ATS route.

THEN

INSERT each point at which either a change of speed and/or level is planned to commence, or, a change of ATS route, and/or a change of flight rules is planned,

NOTE: When a transition is planned between a lower and upper ATS route and the routes are oriented in the same direction, the point of transition need not be inserted.

FOLLOWED IN EACH CASE

by the designator of the next ATS route segment, even if the same as the previous one;

OR, by DCT, if the flight to the next point will be outside a designated route, unless both points are defined by geographical coordinates.

Flights Outside Designated ATS Routes

INSERT points normally not more than 30 minutes flying time or 370km (200 NM) apart, including each point at which a change of speed or level, a change of track, or a change of flight rules is planned;

OR, when required by appropriate ATS authority(ies),

DEFINE the track of flights operating predominantly in an east-west direction between 70°N and 70°S by reference to significant points formed by the intersections of half or whole degrees of latitude with meridians spaced at intervals of 10 degrees of longitude. For flights operating in areas outside those latitudes the tracks shall be defined by significant points formed by the intersection of parallels of latitude with meridians normally spaced at 20 degrees of longitude. The distance between significant points shall, as far as possible, not exceed one hour's flight time. Additional significant points shall be established as deemed necessary.

For flights operating predominantly in a north-south direction, define tracks by reference to significant points formed by the intersection of whole degrees of longitude with specified parallels of latitude which are spaced at 5 degrees.

INSERT DCT between successive points unless both points are defined by geographical coordinates or by bearing and distance.

USE ONLY the conventions in 1. to 5. below and *SEPARATE* each sub-item by a space.

1. ***ATS Route*** (2 to 7 Characters)

   The coded designator assigned to the route or route segment including, where appropriate, the coded designator assigned to the standard departure or arrival route (e.g., BCN1, B1, R14, UB10, KODAP2A).

   NOTE: Provisions for the application of route designators are contained in Annex 11, Appendix 1 (not published herein).

2. ***Significant Point*** (2 to 11 Characters)

The coded designator (2 to 5 characters) assigned to the point (e.g., LN, MAY, HADDY); *or*

if no coded designator has been assigned, one of the following ways:

– *Degrees only* (7 characters):

2 figures describing latitude in degrees, followed by “N” (North) or “S” (South), followed by 3 figures describing longitude in degrees, followed by “E” (East) or “W” (West). Make up the correct number of figures, where necessary, by insertion of zeros; e.g., 46N078W.

– *Degrees and minutes* (11 characters):

4 figures describing latitude in degrees and tens and units of minutes followed by “N” (North) or “S” (South), followed by 5 figures describing longitude in degrees and tens and units of minutes, followed by “E” (East) or “W” (West). Make up the correct number of figures, where necessary, by insertion of zeros; e.g., 4620N07805W.

– *Bearing and distance from a reference point*:

The identification of the reference point, followed by the bearing from the point in the form of 3 figures giving degrees magnetic, followed by the distance from the point in the form of 3 figures expressing nautical miles. In areas of high latitude where it is determined by the appropriate authority that reference to degrees magnetic is impractical, degrees true may be used. Make up the correct number of figures, where necessary, by insertion of zeros; e.g., a point 180° magnetic at a distance of 40 nautical miles from VOR “DUB” should be expressed as DUB180040.

3. ***Change of Speed or Level*** *(Maximum 21 Characters)*

The point at which a change of speed (5% TAS or 0.01 Mach or more) or a change of level is planned to commence, expressed exactly as in 2. above, followed by an *oblique stroke and both the cruising speed and the cruising level*, expressed exactly as in a. and b. above, without a space between them, *even when only one of these quantities will be changed.*

EXAMPLE: LN/N0284A045

MAY/N0305F180

HADDY/N0420F330

4602N07805W/N0500F350

46N078W/M082F330

DUB180040/N0350M0840

4. ***Change of Flight Rules*** *(Maximum 3 Characters)*

The point at which the change of flight rules is planned, expressed exactly as in 2. or 3. above as appropriate, *followed by a space and one of the following*:

(a) VFR if from IFR to VFR

(b) IFR if from VFR to IFR

EXAMPLE: LN VFR

LN/N0284A050 IFR

5. ***Cruise Climb*** *(Maximum 28 Characters)*

   The letter C followed by an *oblique stroke; THEN the point at which cruise climb is planned to start,* expressed exactly as in 2. above, *followed by an oblique stroke; THEN the speed to be maintained during cruise climb,* expressed exactly as in a. above, followed by *the two levels defining the layer to be occupied during cruise climb,* each level expressed exactly as in b. above, *or the level above which cruise climb is planned followed by the letters "PLUS",* without a space between them.

   EXAMPLE: C/48N050W/M082F290F350

   C/48N050W/M082F290PLUS

   C/52N050W/M220F580F620.

ITEM 16: DESTINATION AERODROME AND TOTAL ESTIMATED ELAPSED TIME, DESTINATION ALTERNATE AERODROME(S)

– **Destination aerodrome and total estimated elapsed time (8 characters)**

INSERT the ICAO four-letter location indicator of the destination aerodrome as specified in Doc 7910, *Location Indicators* (not published herein),

OR, if no location indicator has been assigned,

INSERT ZZZZ and *SPECIFY* in Item 18 the name and location of the aerodrome, preceded by DEST/.

THEN WITHOUT A SPACE

INSERT the total estimated elapsed time.

NOTE: For a flight plan received from an aircraft in flight, the total estimated elapsed time is the estimated time from the first point of the route to which the flight plan applies to the termination point of the flight plan.

– **Destination alternate aerodrome(s)**

INSERT the ICAO four-letter location indicator(s) of not more than two destination alternate aerodromes as specified in Doc 7910, *Location Indicators* (not published herein), separated by a space,

OR, if no location indicator has been assigned to the destination alternate aerodrome(s),

INSERT ZZZZ and *SPECIFY* in Item 18 the name and location of the destination alternate aerodrome(s), preceded by ALTN/.

ITEM 18: OTHER INFORMATION

NOTE: Use of indicators not included under this item may result in data being rejected, processed incorrectly or lost.

Hyphens or oblique strokes should only be used as prescribed below.

INSERT 0 (zero) if no other information,

OR, any other necessary information in the sequence shown hereunder, in the form of the appropriate indicator selected from those defined hereunder followed by an oblique stroke and the information to be recorded:

STS/ Reason for special handling by ATS, e.g., a search and rescue mission, as follows:

ALTRV:	for a flight operated in accordance with all altitude reservation;
ATFMX:	for a flight approved for exemption from ATFM measures by the appropriate ATS authority;
FFR:	fire-fighting;
FLTCK:	flight check for calibration of navaids;
HAZMAT:	for a flight carrying hazardous material;
HEAD:	a flight with Head of State status;
HOSP:	for a medical flight declared by medical authorities;
HUM:	for a flight operating on a humanitarian mission;
MARSA:	for a flight for which a military entity assumes responsibility for separation of military aircraft;
MEDEVAC:	for a life critical medical emergency evacuation;
NONRVSM:	for a non-RVSM capable flight intending to operate in RVSM airspace;
SAR:	for a flight engaged in a search and rescue mission; and
STATE:	for a flight engaged in military, customs or police services.

Other reasons for special handling by ATS shall be denoted under the designator RMK/.

PBN/ Indication of RNAV and/or RNP capabilities. Include as many of the descriptors below, as apply to the flight, up to a maximum of 8 entries, i.e. a total of not more than 16 characters.

	RNAV SPECIFICATIONS
A1	RNAV 10 (RNP 10)
B1	RNAV 5 all permitted sensors
B2	RNAV 5 GNSS
B3	RNAV 5 DME/DME

B4	RNAV 5 VOR/DME
B5	RNAV 5 INS or IRS
B6	RNAV 5 LORANC
C1	RNAV 2 all permitted sensors
C2	RNAV 2 GNSS
C3	RNAV 2 DME/DME
C4	RNAV 2 DME/DME/IRU
D1	RNAV 1 all permitted sensors
D2	RNAV 1 GNSS
D3	RNAV 1 DME/DME
D4	RNAV 1 DME/DME/IRU
	RNP SPECIFICATIONS
L1	RNP 4
O1	Basic RNP 1 all permitted sensors
O2	Basic RNP 1 GNSS
O3	Basic RNP 1 DME/DME
O4	Basic RNP 1 DME/DME/IRU
S1	RNP APCH
S2	RNP APCH with BARO-VNAV
T1	RNP AR APCH with RF (special authorization required)
T2	RNP AR APCH without RF (special authorization required)

Combinations of alphanumeric characters not indicated above are reserved.

NAV/	Significant data related to navigation equipment, other than specified in PBN/, as required by the appropriate ATS authority. Indicate GNSS augmentation under this indicator, with a space between two or more methods of augmentation; e.g., NAV/ GBAS SBAS.
COM/	Indicate communications equipment and capabilities not specified in Item 10 a).
DAT/	Indicate data applications or capabilities not specified in Item 10 a).
SUR/	Include surveillance equipment and capabilities not specified in Item 10 b). Indicate as many RSP specification(s) as apply to the flight, using designator(s) with no space. Multiple RSP specifications are separated by a space. Example: RSP180 RSP400.

DEP/	Name and location of departure aerodrome, if ZZZZ is inserted in Item 13, or the ATS unit from which supplementary flight plan data can be obtained, if AFIL is inserted in Item 13. For aerodromes not listed in the relevant Aeronautical Information Publication, indicate location as follows: With 4 figures describing latitude in degrees and tens and units of minutes followed by “N” (North) or “S” (South), followed by 5 figures describing longitude in degrees and tens and units of minutes, followed by “E” (East) or “W” (West). Make up the correct number of figures, where necessary, by insertion of zeros; e.g., 4620N07805W (11 characters).
OR,	Bearing and distance from the nearest significant point, as follows: The identification of the significant point followed by the bearing from the point in the form of 3 figures giving degrees magnetic, followed by the distance from the point in the form of 3 figures expressing nautical miles. In areas of high latitude where it is determined by the appropriate authority that reference to degrees magnetic is impractical, degrees true may be used. Make up the correct number of figures, where necessary, by insertion of zeros; e.g., a point of 180° magnetic at a distance of 40 nautical miles from VOR “DUB” should be expressed as DUB180040.
OR,	The first point of the route (name or LAT/LONG) or the marker radio beacon, if the aircraft has not taken off from an aerodrome.
DEST/	Name and location of destination aerodrome, if ZZZZ is inserted in Item 16. For aerodromes not listed in the relevant Aeronautical Information Publication, indicate location in LAT/LONG or bearing and distance from the nearest significant point, as described under DEP/ above.
DOF/	The date of flight departure in a six-figure formal (YYMMDD, where YY equals the year, MM equals the month and DD equals the day).
REG/	The nationality or common mark and registration markings of the aircraft, if different from the aircraft identification in Item 7.
EET/	Significant points or FIR boundary designators and accumulated estimated elapsed times from take-off to such points or FIR boundaries, when so prescribed on the basis of regional air navigation agreements, or by the appropriate ATS authority. EXAMPLE: EET/CAP0745 XYZ0830 EET/EINN0204
SEL/	SELCAL Code, for aircraft so equipped.
TYP/	Type(s) of aircraft, preceded if necessary without a space by number(s) of aircraft and separated by one space, if ZZZZ is inserted in Item 9. EXAMPLE: TYP/2F15 5F5 3B2

CODE/	Aircraft address (expressed in the form of an alphanumerical code of six hexadecimal characters) when required by the appropriate ATS authority. Example: “F00001” is the lowest aircraft address contained in the specific block administered by ICAO.
DLE/	Enroute delay or holding, insert the significant point(s) on the route where a delay is planned to occur, followed by the length of delay using four-figure time in hours and minutes (hhmm). EXAMPLE: DLE/MDG0030
OPR/	ICAO designation or name of the aircraft operator agency, if different from the aircraft identification in Item 7.
ORGN/	The originator’s 8 letter AFTN address or other appropriate contact details, in cases where the originator of the flight plan may not be readily identified, as required by the appropriate ATS authority. *NOTE: In some cases, flight plan reception centres may insert the ORGN/ identifier and originator’s AFTN address automatically.*
PER/	Aircraft performance data, indicated by a single letter as specified in the *Procedures for Air Navigation Services — Aircraft Operations* (PANS-OPS, Doc 8168), *Volume I — Flight Procedures* (not published herein) (see Jeppesen ATC Flight Procedures (Doc 8168)), if so prescribed by the appropriate ATS authority.
ALTN/	Name of destination alternate aerodrome(s), if ZZZZ is inserted in Item 16. For aerodromes not listed in the relevant Aeronautical Information Publication, indicate location in LAT/LONG or bearing and distance from the nearest significant point, as described in DEP/ above.
RALT/	ICAO four letter indicator(s) for en-route alternate(s), as specified in Doc 7910, *Location Indicators* (not published herein), or name(s) of en-route alternate aerodrome(s), if no indicator is allocated. For aerodromes not listed in the relevant Aeronautical Information Publication, indicate location in LAT/LONG or bearing and distance from the nearest significant point, as described in DEP/ above.
TALT/	ICAO four letter indicator(s) for take-off alternate, as specified in Doc 7910, *Location Indicators* (not published herein), or name of take-off alternate aerodrome, if no indicator is allocated. For aerodromes not listed in the relevant Aeronautical Information Publication, indicate location in LAT/LONG or bearing and distance from the nearest significant point, as described in DEP/ above.
RIF/	The route details to the revised destination aerodrome, followed by the ICAO four-letter location indicator of the aerodrome. The revised route is subject to reclearance in flight. EXAMPLE: RIF/DTA HEC KLAX RIF/ESP G94 CLA YPPH

RMK/	Any other plain language remarks when required by the appropriate ATS authority or deemed necessary.

ITEM 19: SUPPLEMENTARY INFORMATION

- **Endurance**

  After E/ *INSERT* a 4-figure group giving the fuel endurance in hours and minutes.

- **Persons on board**

  After P/ *INSERT* the total number of persons (passengers and crew) on board, when required by the appropriate ATS authority.

  INSERT TBN (to be notified) if the total number of persons is not known at the time of filing.

- **Emergency and survival equipment**

R/ (RADIO)	*CROSS OUT* U if UHF on frequency 243.0 MHz is not available.
	CROSS OUT V if VHF on frequency 121.5 MHz is not available.
	CROSS OUT E if emergency locator transmitter (ELT) is not available.
S/ (SURVIVAL EQUIPMENT)	*CROSS OUT* all indicators if survival equipment is not carried.
	CROSS OUT P if polar survival equipment is not carried
	CROSS OUT D if desert survival equipment is not carried.
	CROSS OUT M if maritime survival equipment is not carried.
	CROSS OUT J if jungle survival equipment is not carried.
J/ (JACKETS)	*CROSS OUT* all indicators if life jackets are not carried.
	CROSS OUT L if life jackets are not equipped with lights.
	CROSS OUT F if life jackets are not equipped with fluorescein.
	CROSS OUT U or V or both as in R/ above to indicate radio capability of jackets, if any.
D/ (DINGHIES)	*CROSS OUT* indicators D and C if no dinghies are carried, or
(NUMBER)	*INSERT* number of dinghies carried; and
(CAPACITY)	*INSERT* total capacity, in persons, of all dinghies carried; and
(COVER)	*CROSS OUT* indicator C if dinghies are not covered; and

(COLOUR)	*INSERT* colour of dinghies if carried.
A/ (AIRCRAFT COLOUR AND MARKINGS)	*INSERT* colour of aircraft and significant markings.
N/ (REMARKS)	*CROSS OUT* indicator N if no remarks, or *INDICATE* any other survival equipment carried and any other remarks regarding survival equipment.
C/ (PILOT)	*INSERT* name of pilot-in-command.

2.3 FILED BY

INSERT the name of the unit, agency or person filing the flight plan.

2.4 ACCEPTANCE OF THE FLIGHT PLAN

Indicate acceptance of the flight plan in the manner prescribed by the appropriate ATS authority.

2.5 INSTRUCTIONS FOR INSERTION OF COM DATA

Items to be completed

COMPLETE the top two shaded lines of the form, and *COMPLETE* the third shaded line only when necessary, in accordance with the provisions in PANS-ATM, Chapter 11, 11.2.1.2, unless ATS prescribes otherwise.

3 INSTRUCTIONS FOR THE TRANSMISSION OF A FILED FLIGHT PLAN (FPL) MESSAGE

Correction of obvious errors

Unless otherwise prescribed, *CORRECT* obvious format errors and/or omissions (i.e. oblique strokes) to ensure adherence as specified in Section 2.

Items to be transmitted

TRANSMIT items as indicated hereunder, unless otherwise prescribed:

a. the items in the shaded lines, above Item 3;

b. commencing with <<≡ (FPL of Item 3:

   all symbols and data in the unshaded boxes down to the)<<≡ at the end of Item 18,

   additional alignment functions as necessary to prevent the inclusion of more than 69 characters in any line of Items 15 or 18. The alignment function is to be inserted only in lieu of a space so as not to break up a group of data,

   letter shifts and figure shifts (not preprinted on the form) as necessary;

c. the AFTN Ending, as described below:

   End-of-Text Signal

   a) one LETTER SHIFT

b) two CARRIAGE RETURNS, one LINE FEED

Page-feed Sequence

– Seven LINE FEEDS

End-of-Message Signal

– Four of the letter N.

4 INSTRUCTIONS FOR THE TRANSMISSION OF A SUPPLEMENTARY FLIGHT PLAN (SPL) MESSAGE

Items to be transmitted

Transmit items as indicated hereunder, unless otherwise prescribed:

a. AFTN Priority Indicator, Addressee Indicators <<≡, Filing Time, Originator Indicator <<≡ and, if necessary, specific identification of addressees and/or originator;

b. commencing with <<≡ (SPL:

all symbols and data in the unshaded areas of boxes 7, 13, 16 and 18, except that the ')' at the end of box 18 is *not* to be transmitted, and then the symbols in the unshaded area of box 19 down to and including the)<<≡ of box 19,

additional alignment functions as necessary to prevent the inclusion of more than 69 characters in any line of Items 18 and 19. The alignment function is to be inserted only in lieu of a space so as not to break up a group of data,

letter shifts and figure shifts (not preprinted on the form) as necessary;

c. the AFTN Ending, as described below:

End-of-Text Signal

a) one LETTER SHIFT

b) two CARRIAGE RETURNS, one LINE FEED

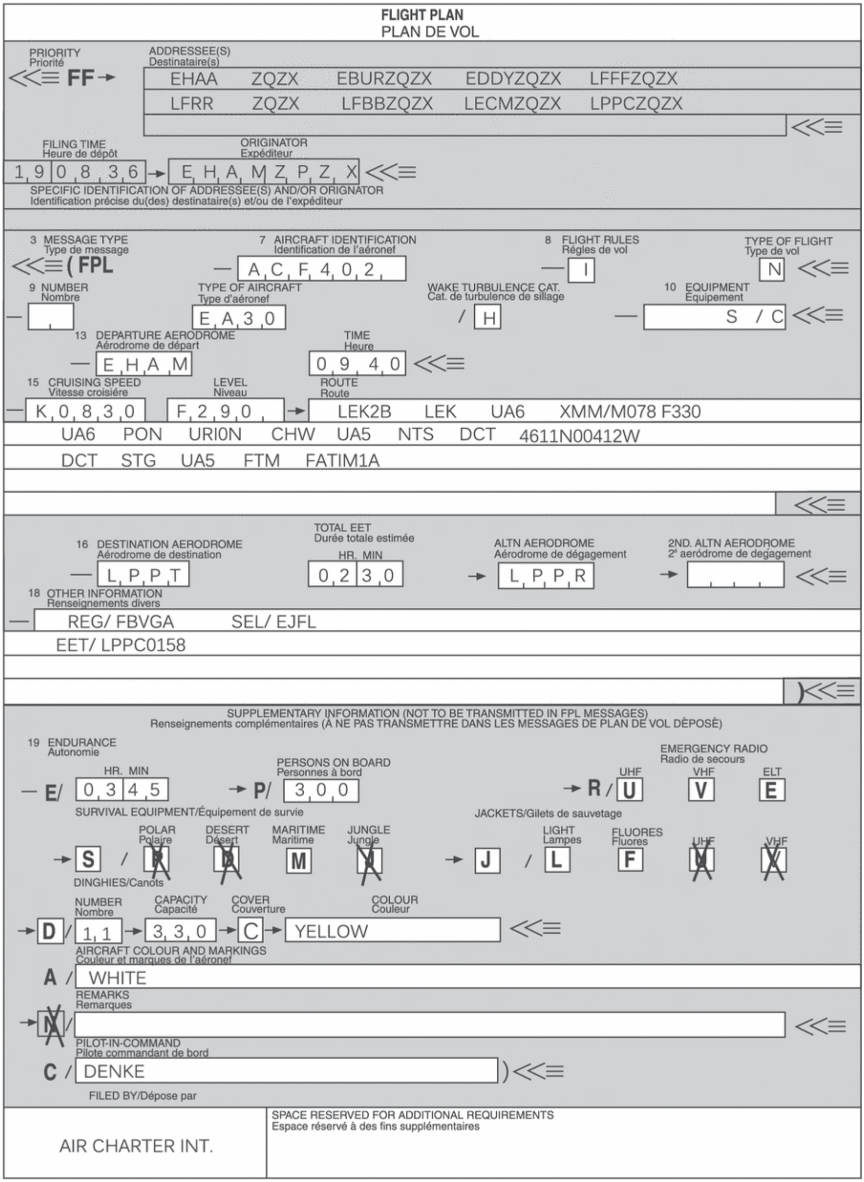
Page-feed Sequence

– Seven LINE FEEDS

End-of-Message Signal

– Four of the letter N.

5 EXAMPLE OF COMPLETED FLIGHT PLAN FORM



FLIGHT PLAN
PLAN DE VOL

PRIORITY / Priorité: <<≡ **FF** →

ADDRESSEE(S) / Destinataire(s):
EHAA ZQZX EBURZQZX EDDYZQZX LFFFZQZX
LFRR ZQZX LFBBZQZX LECMZQZX LPPCZQZX
<<≡

FILING TIME / Heure de dépôt: 1 9 0 8 3 6 →
ORIGINATOR / Expéditeur: E H A M Z P Z X <<≡

SPECIFIC IDENTIFICATION OF ADDRESSEE(S) AND/OR ORIGINATOR
Identification précise du(des) destinataire(s) et/ou de l'expéditeur

3 MESSAGE TYPE / Type de message: <<≡ **(FPL**
7 AIRCRAFT IDENTIFICATION / Identification de l'aéronef: — A C F 4 0 2
8 FLIGHT RULES / Règles de vol: — I
TYPE OF FLIGHT / Type de vol: N <<≡

9 NUMBER / Nombre: —
TYPE OF AIRCRAFT / Type d'aéronef: E A 3 0
WAKE TURBULENCE CAT. / Cat. de turbulence de sillage: / H
10 EQUIPMENT / Équipement: — S / C <<≡

13 DEPARTURE AERODROME / Aérodrome de départ: — E H A M
TIME / Heure: 0 9 4 0 <<≡

15 CRUISING SPEED / Vitesse croisière: — K 0 8 3 0
LEVEL / Niveau: F 2 9 0 →
ROUTE / Route:
LEK2B LEK UA6 XMM/M078 F330
UA6 PON URI0N CHW UA5 NTS DCT 4611N00412W
DCT STG UA5 FTM FATIM1A
<<≡

16 DESTINATION AERODROME / Aérodrome de destination: — L P P T
TOTAL EET / Durée totale estimée (HR. MIN): 0 2 3 0
ALTN AERODROME / Aérodrome de dégagement: → L P P R
2ND. ALTN AERODROME / 2ᵉ aérodrome de dégagement: → <<≡

18 OTHER INFORMATION / Renseignements divers:
— REG/ FBVGA SEL/ EJFL
EET/ LPPC0158
)<<≡

SUPPLEMENTARY INFORMATION (NOT TO BE TRANSMITTED IN FPL MESSAGES)
Renseignements complémentaires (À NE PAS TRANSMETTRE DANS LES MESSAGES DE PLAN DE VOL DÈPOSÈ)

19 ENDURANCE / Autonomie (HR. MIN): — **E/** 0 3 4 5
PERSONS ON BOARD / Personnes à bord: → **P/** 3 0 0
EMERGENCY RADIO / Radio de secours: → **R** / UHF **U** VHF **V** ELT **E**

SURVIVAL EQUIPMENT/Équipement de survie: → **S** / POLAR Polaire ~~P~~ DESERT Désert ~~D~~ MARITIME Maritime **M** JUNGLE Jungle ~~J~~
JACKETS/Gilets de sauvetage: → **J** / LIGHT Lampes **L** FLUORES Fluores **F** UHF ~~U~~ VHF ~~V~~

DINGHIES/Canots: → **D** / NUMBER Nombre 1 1 → CAPACITY Capacité 3 3 0 → COVER Couverture C → COLOUR Couleur YELLOW <<≡

AIRCRAFT COLOUR AND MARKINGS / Couleur et marques de l'aéronef: **A** / WHITE

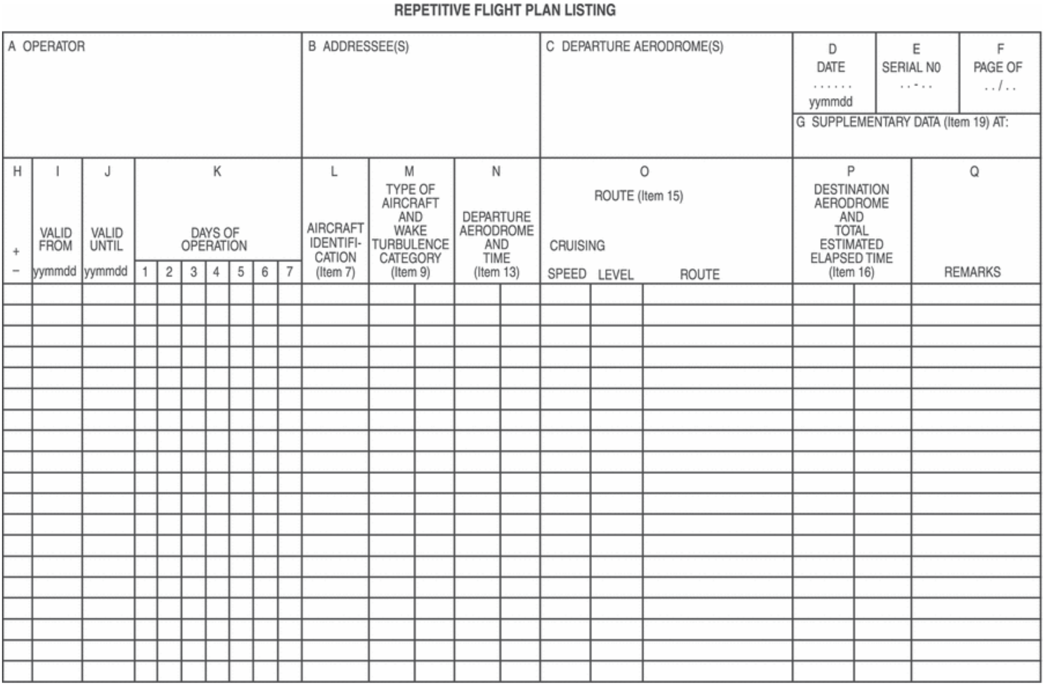
REMARKS / Remarques: → ~~N~~ / <<≡

PILOT-IN-COMMAND / Pilote commandant de bord: **C** / DENKE)<<≡

FILED BY/Dépose par: AIR CHARTER INT.

SPACE RESERVED FOR ADDITIONAL REQUIREMENTS
Espace réservé à des fins supplémentaires

6 ICAO MODEL REPETITIVE FLIGHT PLAN (RPL) LISTING FORM



REPETITIVE FLIGHT PLAN LISTING

A OPERATOR	B ADDRESSEE(S)	C DEPARTURE AERODROME(S)	D DATE ...... yymmdd	E SERIAL N0 ..-..	F PAGE OF ../..
			G SUPPLEMENTARY DATA (Item 19) AT:		

H	I	J	K							L	M		N		O			P		Q
+ −	VALID FROM yymmdd	VALID UNTIL yymmdd	DAYS OF OPERATION							AIRCRAFT IDENTIFI-CATION (Item 7)	TYPE OF AIRCRAFT AND WAKE TURBULENCE CATEGORY (Item 9)		DEPARTURE AERODROME AND TIME (Item 13)		ROUTE (Item 15)			DESTINATION AERODROME AND TOTAL ESTIMATED ELAPSED TIME (Item 16)		REMARKS
			1	2	3	4	5	6	7						CRUISING SPEED	LEVEL	ROUTE			

7 INSTRUCTIONS FOR THE COMPLETION OF THE REPETITIVE FLIGHT PLAN (RPL) LISTING FORM

7.1 GENERAL

List only flight plans that will operate in accordance with IFR. (Flight rules I in FPL format).

It is assumed that all aircraft are operating as scheduled flights (Type of flight S in FPL format), otherwise *notify* in Q (Remarks).

It is assumed that all aircraft operating on RPLs are equipped with 4096-code transponders with Modes A and C. Otherwise, *notify* in Q (Remarks).

List flight plan in *alphabetical order of the location indicator of the departure aerodrome*.

List flight plans for each departure aerodrome in chronological order of estimated off-block times.

Adhere closely to the data conventions as indicated for the Flight Plan Form (Appendix 3, 1.6) unless otherwise specifically indicated in 7.4.

INSERT all clock times in 4 figures UTC.

INSERT all estimated elapsed times in 4 figures (hours and minutes).

INSERT data on a separate line for each segment of operations with one or more stops; i.e., from any departure aerodrome to the next destination aerodrome even though call sign or flight number is the same for multiple segments.

Clearly identify additions and deletions in accordance with Item H at 7.4. Subsequent listings shall list the corrected and added data, and deleted flight plans shall be omitted.

Number pages by indicating number of page and total number of pages in submission.

Utilize more than one line for any RPL where the space provided for items O and Q on one line is not sufficient.

7.2 A flight shall be cancelled as follows:

a. Indicate a minus sign in Item H followed by all other items of the cancelled flight;

b. Insert a subsequent entry denoted by a plus sign in Item H and the date of the last flight in Item J, with all other items of the cancelled flight unchanged.

7.3 Modification to a flight shall be made as follows:

a. Carry out the cancellation as indicated in 7.2; and

b. Insert a third entry giving the new flight plan(s) with the appropriate items modified as necessary, including the new validity dates in Items I and J.

NOTE: All entries related to the same flight will be inserted in succession in the order specified above.

7.4 INSTRUCTIONS FOR INSERTION OF RPL DATA

Complete Items A to Q as indicated hereunder.

ITEM A: OPERATOR

INSERT name of operator.

ITEM B: ADDRESSEE(S)

INSERT name of agency(ies) designated by States to administer RPLs for FIRs or areas of responsibility concerned with the route of flight.

ITEM C: DEPARTURE AERODROME(S)

INSERT location indicator(s) of departure aerodrome(s).

ITEM D: DATE

INSERT on each page of submission the date (year, month, day) in a 6-figure group that the listing was submitted.

ITEM E: SERIAL NO.

INSERT serial number of submission (2 numerics) indicating last two digits of year, a dash, and the sequential no. of the submission for the year indicated (start with numeral 1 each new year).

ITEM F: PAGE OF

INSERT page number and total number of pages submitted.

ITEM G: SUPPLEMENTARY DATA AT

INSERT name of contact where information normally provided under Item 19 of the FPL is kept readily available and can be supplied without delay.

ITEM H: ENTRY TYPE

INSERT a minus sign (-) for each flight plan that is to be deleted from the listing.

INSERT a plus sign (+) for each initial listing and, in the case of subsequent submissions, for each flight plan not listed in the previous submission.

NOTE: No information is required under this item for any flight plan which is unchanged from the previous submission.

ITEM I: VALID FROM

INSERT first date (year, month, day) upon which the flight is scheduled to operate.

ITEM J: VALID UNTIL

INSERT last date (year, month, day) upon which the flight is scheduled to operate as listed, or

UFN if the duration is unknown.

ITEM K: DAYS OF OPERATION

INSERT number corresponding to the day of the week in the appropriate column; Monday = 1 through Sunday = 7.

INSERT 0 for each day of non-operation in the appropriate column.

ITEM L: AIRCRAFT IDENTIFICATION

(Item 7 of the ICAO flight plan)

INSERT aircraft identification to be used for the flight.

ITEM M: TYPE OF AIRCRAFT AND WAKE TURBULENCE CATEGORY

(Item 9 of the ICAO flight plan)

INSERT appropriate ICAO designator as specified in ICAO Document 8643 — *Aircraft Type Designators* (not published herein).

INSERT J, H, M or L indicator as appropriate:

J —	SUPER, to indicate an aircraft type specified as such in Doc 8643, *Aircraft Type Designators* (not published herein);
H —	HEAVY to indicate an aircraft type with a maximum certificated take-off mass of 136,000kg or more, with the exception of aircraft types listed in Doc 8643 in the SUPER (J) category;
M —	MEDIUM to indicate an aircraft type with a maximum certificated take-off mass of less than 136,000kg but more than 7000kg,
L —	LIGHT to indicate an aircraft type with a maximum certificated take-off mass of 7000kg or less.

ITEM N: DEPARTURE AERODROME AND TIME

(Item 13 of the ICAO flight plan)

INSERT location indicator of the departure aerodrome.

INSERT the off-block time; i.e., the estimated time that the aircraft will commence movement associated with departure.

ITEM O: ROUTE

(Item 15 of the ICAO flight plan)

a. **Cruising Speed**

   INSERT the true airspeed for the first or whole cruising portion of the flight in accordance with Item 15A. of the ICAO flight plan.

b. **Cruising Level**

   INSERT the planned cruising level for the first or whole portion of the route in accordance with Item 15B. of the ICAO flight plan.

c. **Route**

   INSERT the entire route in accordance with Item 15C. of the ICAO flight plan.

ITEM P: DESTINATION AERODROME AND TOTAL ESTIMATED ELAPSED TIME

(Item 16 of the ICAO flight plan)

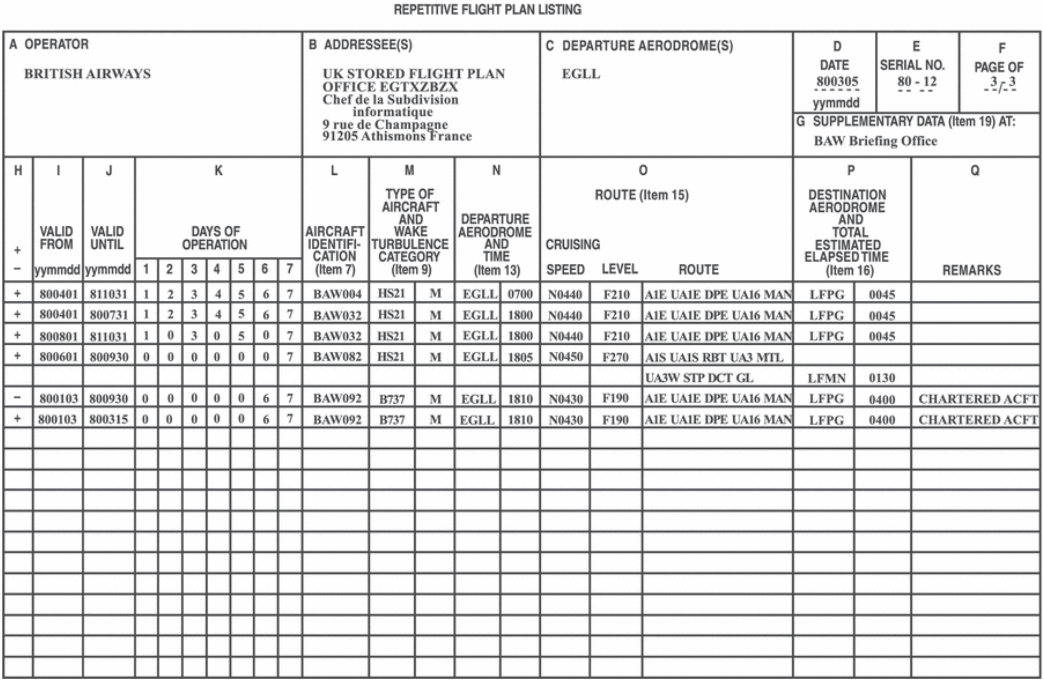
INSERT location indicator of the destination aerodrome.

INSERT the total estimated elapsed time.

ITEM Q: REMARKS

INSERT items of information as required by the appropriate ATS authority, items normally notified in Item 18 of the ICAO flight plan and any other information pertinent to the flight of concern to ATS.

8 EXAMPLE OF A COMPLETED REPETITIVE FLIGHT PLAN (RPL)



REPETITIVE FLIGHT PLAN LISTING

A OPERATOR
BRITISH AIRWAYS

B ADDRESSEE(S)
UK STORED FLIGHT PLAN
OFFICE EGTXZBZX
Chef de la Subdivision
informatique
9 rue de Champagne
91205 Athismons France

C DEPARTURE AERODROME(S)
EGLL

D DATE 800305 yymmdd

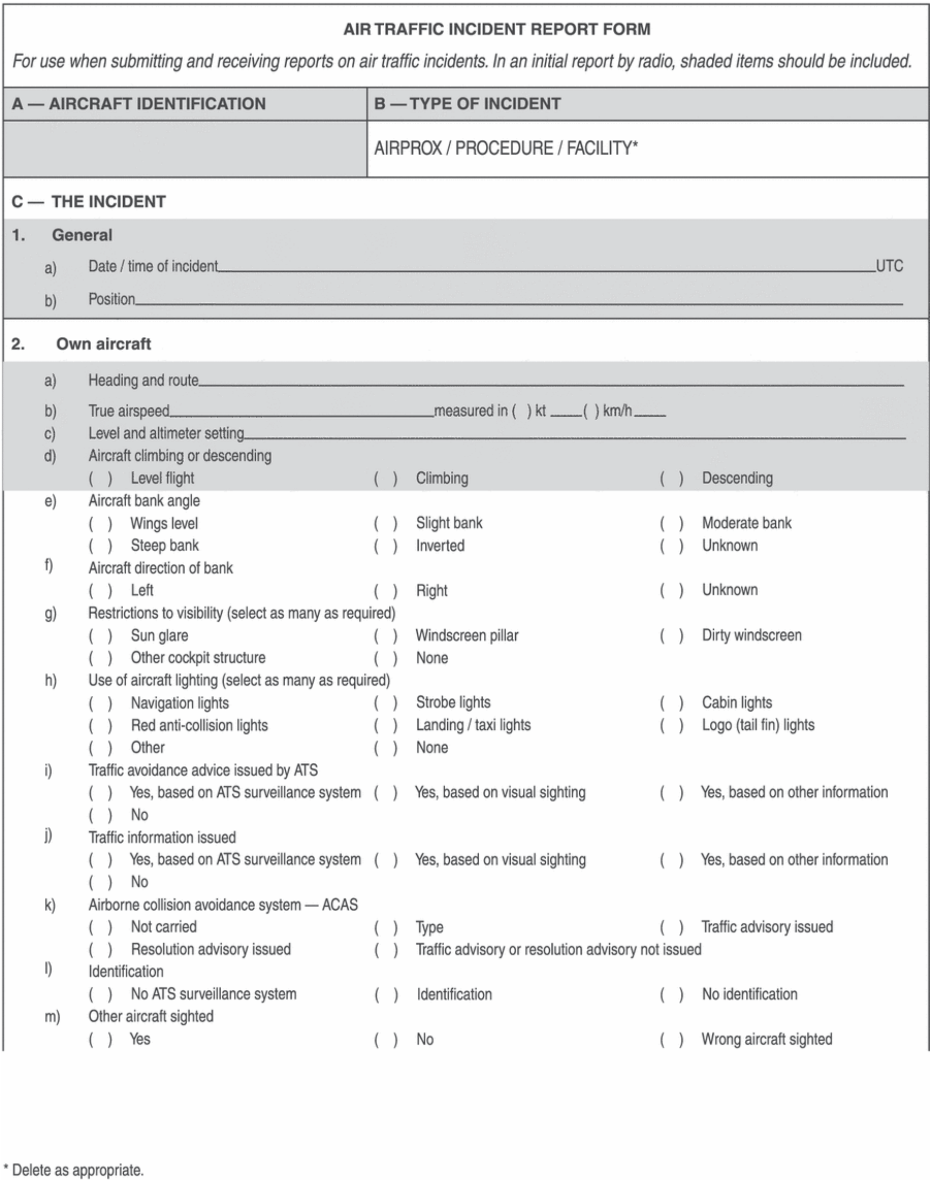
E SERIAL NO. 80 - 12

F PAGE OF 3 / 3

G SUPPLEMENTARY DATA (Item 19) AT:
BAW Briefing Office

H	I	J	K							L	M		N		O			P		Q
+ −	VALID FROM yymmdd	VALID UNTIL yymmdd	DAYS OF OPERATION 1	2	3	4	5	6	7	AIRCRAFT IDENTIFI-CATION (Item 7)	TYPE OF AIRCRAFT AND WAKE TURBULENCE CATEGORY (Item 9)		DEPARTURE AERODROME AND TIME (Item 13)		ROUTE (Item 15) CRUISING SPEED	LEVEL	ROUTE	DESTINATION AERODROME AND TOTAL ESTIMATED ELAPSED TIME (Item 16)		REMARKS
+	800401	811031	1	2	3	4	5	6	7	BAW004	HS21	M	EGLL	0700	N0440	F210	A1E UA1E DPE UA16 MAN	LFPG	0045	
+	800401	800731	1	2	3	4	5	6	7	BAW032	HS21	M	EGLL	1800	N0440	F210	A1E UA1E DPE UA16 MAN	LFPG	0045	
+	800801	811031	1	0	3	0	5	0	7	BAW032	HS21	M	EGLL	1800	N0440	F210	A1E UA1E DPE UA16 MAN	LFPG	0045	
+	800601	800930	0	0	0	0	0	0	7	BAW082	HS21	M	EGLL	1805	N0450	F270	A1S UA1S RBT UA3 MTL			
																	UA3W STP DCT GL	LFMN	0130	
−	800103	800930	0	0	0	0	0	6	7	BAW092	B737	M	EGLL	1810	N0430	F190	A1E UA1E DPE UA16 MAN	LFPG	0400	CHARTERED ACFT
+	800103	800315	0	0	0	0	0	6	7	BAW092	B737	M	EGLL	1810	N0430	F190	A1E UA1E DPE UA16 MAN	LFPG	0400	CHARTERED ACFT

1 ICAO MODEL AIR TRAFFIC INCIDENT REPORT FORM



AIR TRAFFIC INCIDENT REPORT FORM

For use when submitting and receiving reports on air traffic incidents. In an initial report by radio, shaded items should be included.

A — AIRCRAFT IDENTIFICATION	B — TYPE OF INCIDENT
	AIRPROX / PROCEDURE / FACILITY*

C — THE INCIDENT

1. General

a) Date / time of incident____________________UTC

b) Position____________________

2. Own aircraft

a) Heading and route____________________

b) True airspeed____________measured in ( ) kt ____( ) km/h____

c) Level and altimeter setting____________________

d) Aircraft climbing or descending

( ) Level flight
( ) Climbing
( ) Descending

e) Aircraft bank angle

( ) Wings level
( ) Slight bank
( ) Moderate bank
( ) Steep bank
( ) Inverted
( ) Unknown

f) Aircraft direction of bank

( ) Left
( ) Right
( ) Unknown

g) Restrictions to visibility (select as many as required)

( ) Sun glare
( ) Windscreen pillar
( ) Dirty windscreen
( ) Other cockpit structure
( ) None

h) Use of aircraft lighting (select as many as required)

( ) Navigation lights
( ) Strobe lights
( ) Cabin lights
( ) Red anti-collision lights
( ) Landing / taxi lights
( ) Logo (tail fin) lights
( ) Other
( ) None

i) Traffic avoidance advice issued by ATS

( ) Yes, based on ATS surveillance system
( ) Yes, based on visual sighting
( ) Yes, based on other information
( ) No

j) Traffic information issued

( ) Yes, based on ATS surveillance system
( ) Yes, based on visual sighting
( ) Yes, based on other information
( ) No

k) Airborne collision avoidance system — ACAS

( ) Not carried
( ) Type
( ) Traffic advisory issued
( ) Resolution advisory issued
( ) Traffic advisory or resolution advisory not issued

l) Identification

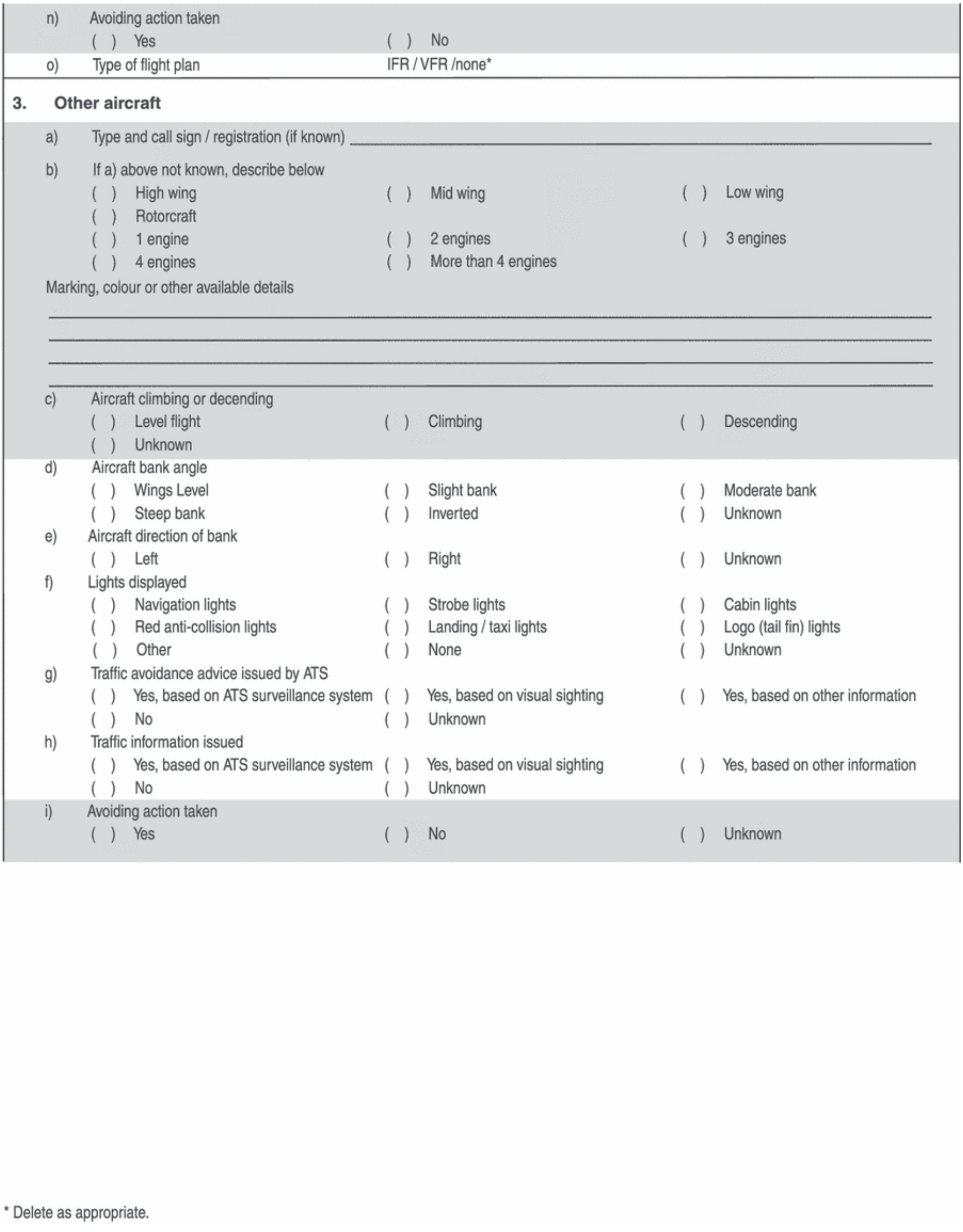
( ) No ATS surveillance system
( ) Identification
( ) No identification

m) Other aircraft sighted

( ) Yes
( ) No
( ) Wrong aircraft sighted

* Delete as appropriate.

AIR TRAFFIC MANAGEMENT (DOC 4444) - APPENDIX 4 - AIR TRAFFIC INCIDENT REPORT



n) Avoiding action taken
( ) Yes ( ) No

o) Type of flight plan IFR / VFR /none*

3. Other aircraft

a) Type and call sign / registration (if known) ____________________

b) If a) above not known, describe below
( ) High wing ( ) Mid wing ( ) Low wing
( ) Rotorcraft
( ) 1 engine ( ) 2 engines ( ) 3 engines
( ) 4 engines ( ) More than 4 engines

Marking, colour or other available details
____
____
____
____

c) Aircraft climbing or decending
( ) Level flight ( ) Climbing ( ) Descending
( ) Unknown

d) Aircraft bank angle
( ) Wings Level ( ) Slight bank ( ) Moderate bank
( ) Steep bank ( ) Inverted ( ) Unknown

e) Aircraft direction of bank
( ) Left ( ) Right ( ) Unknown

f) Lights displayed
( ) Navigation lights ( ) Strobe lights ( ) Cabin lights
( ) Red anti-collision lights ( ) Landing / taxi lights ( ) Logo (tail fin) lights
( ) Other ( ) None ( ) Unknown

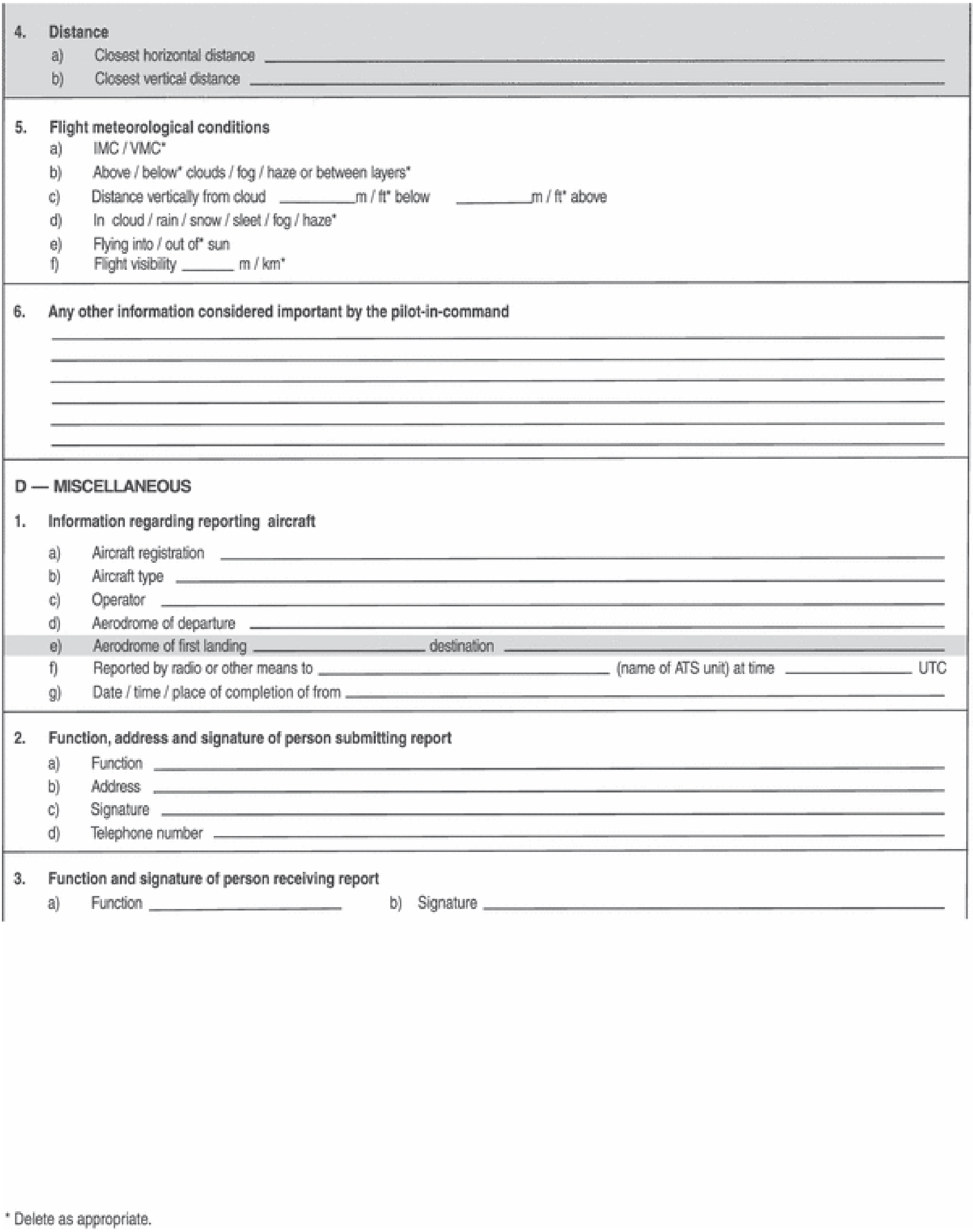
g) Traffic avoidance advice issued by ATS
( ) Yes, based on ATS surveillance system ( ) Yes, based on visual sighting ( ) Yes, based on other information
( ) No ( ) Unknown

h) Traffic information issued
( ) Yes, based on ATS surveillance system ( ) Yes, based on visual sighting ( ) Yes, based on other information
( ) No ( ) Unknown

i) Avoiding action taken
( ) Yes ( ) No ( ) Unknown

* Delete as appropriate.

AIR TRAFFIC MANAGEMENT (DOC 4444) - APPENDIX 4 - AIR TRAFFIC INCIDENT REPORT



4. Distance

a) Closest horizontal distance ______

b) Closest vertical distance ______

5. Flight meteorological conditions

a) IMC / VMC*

b) Above / below* clouds / fog / haze or between layers*

c) Distance vertically from cloud ______m / ft* below ______m / ft* above

d) In cloud / rain / snow / sleet / fog / haze*

e) Flying into / out of* sun

f) Flight visibility ______ m / km*

6. Any other information considered important by the pilot-in-command

______

______

______

______

______

______

D — MISCELLANEOUS

1. Information regarding reporting aircraft

a) Aircraft registration ______

b) Aircraft type ______

c) Operator ______

d) Aerodrome of departure ______

e) Aerodrome of first landing ______ destination ______

f) Reported by radio or other means to ______ (name of ATS unit) at time ______ UTC

g) Date / time / place of completion of from ______

2. Function, address and signature of person submitting report

a) Function ______

b) Address ______

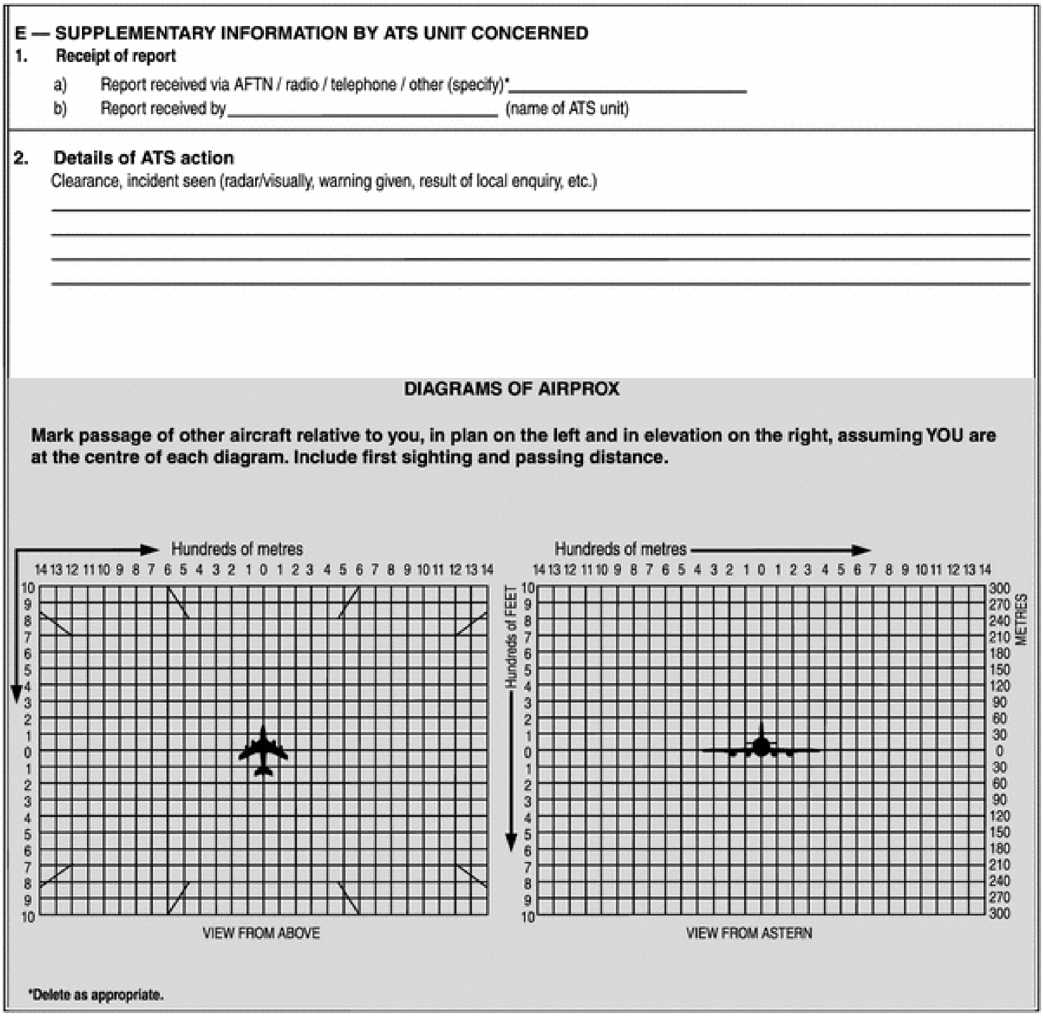
c) Signature ______

d) Telephone number ______

3. Function and signature of person receiving report

a) Function ______ b) Signature ______

* Delete as appropriate.



E — SUPPLEMENTARY INFORMATION BY ATS UNIT CONCERNED

1. Receipt of report

a) Report received via AFTN / radio / telephone / other (specify)*______________________

b) Report received by ______________________ (name of ATS unit)

2. Details of ATS action

Clearance, incident seen (radar/visually, warning given, result of local enquiry, etc.)

____

____

____

____

DIAGRAMS OF AIRPROX

Mark passage of other aircraft relative to you, in plan on the left and in elevation on the right, assuming YOU are at the centre of each diagram. Include first sighting and passing distance.

***Delete as appropriate.**

2 INSTRUCTIONS FOR THE COMPLETION OF THE AIR TRAFFIC INCIDENT REPORT FORM

Item	
A	Aircraft identification of the aircraft filing the report.
B	An AIRPROX report should be filed immediately by radio.

C1	Date/time UTC and position in bearing and distance from a navigation aid or in LAT/LONG.
C2	Information regarding aircraft filing the report, tick as necessary.
C2 c)	E.g, FL 350/1013 hPa or 2,500 ft/QNH 1007 hPa or 1,200 ft/QFE 998 hPa.
C3	Information regarding the other aircraft involved.
C4	Passing distance — state units used.
C6	Attach additional papers as required. The diagrams may be used to show aircraft's positions.
D1 f)	State name of ATS unit and date/time in UTC.
D1 g)	Date and time in UTC and place of completion of form.
E2	Include details of ATS unit such as service provided, radiotelephony frequency, SSR codes assigned and altimeter setting. Use diagram to show the aircraft's position and attach additional papers as required.

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Air Traffic Control

International Civil Aviation Organization - Aeronautical Telecommunications - Annex 10

AERONAUTICAL TELECOMMUNICATIONS

Extracted from ICAO ANNEX 10 (Vol. II) Seventh Edition — AERONAUTICAL TELECOMMUNICATIONS.

5 AERONAUTICAL MOBILE SERVICE — VOICE COMMUNICATIONS

5.2 RADIOTELEPHONY PROCEDURES

5.2.1 General

5.2.1.2 Language to be Used

5.2.1.2.1 The air-ground radiotelephony communications shall be conducted in the language normally used by the station on the ground or in the English language.

NOTE 1: The language normally used by the station on the ground may not necessarily be the language of the State in which it is located. A common language may be agreed upon regionally as a requirement for stations on the ground in that region.

NOTE 2: The level of language proficiency required for aeronautical radiotelephony communications is specified in the Appendix to Annex 1.

5.2.1.2.2 The English language shall be available, on request from any aircraft station, at all stations on the ground serving designated airports and routes used by international air services.

5.2.1.2.3 The languages available at a given station on the ground shall form part of the Aeronautical Information Publications and other published aeronautical information concerning such facilities.

5.2.1.4 Transmission of Numbers in Radiotelephony

5.2.1.4.1 TRANSMISSION OF NUMBERS

5.2.1.4.1.1 All numbers, except as prescribed in 5.2.1.4.1.2 to 5.2.1.4.1.6, shall be transmitted by pronouncing each digit separately.

5.2.1.4.1.2 Flight levels shall be transmitted by pronouncing each digit separately except for the case of flight levels in whole hundreds, which shall be transmitted by pronouncing the digit of the whole hundred followed by the word HUNDRED.

NOTE: The following examples illustrate the application of this procedure (see 5.2.1.4.3.1 for pronunciation).

flight levels	*transmitted as*
FL180	flight level **one eight zero**
FL200	flight level **two hundred**

5.2.1.4.1.3 The altimeter setting shall be transmitted by pronouncing each digit separately except for the case of a setting of 1000 hPa which shall be transmitted as ONE THOUSAND.

NOTE: The following examples illustrate the application of this procedure (see 5.2.1.4.3.1 for pronunciation).

altimeter setting	*transmitted as*
1009	QNH **one zero zero nine**
1000	QNH **one thousand**
993	QNH **nine nine three**

5.2.1.4.1.4 All numbers used in the transmission of transponder codes shall be transmitted by pronouncing each digit separately except that, when the transponder codes contain whole thousands only, the information shall be transmitted by pronouncing the digit in the number of thousands followed by the word THOUSAND.

NOTE: The following examples illustrate the application of this procedure (see 5.2.1.4.3.1 for pronunciation).

transponder codes	*transmitted as*
2400	squawk **two four zero zero**
1000	squawk **one thousand**
2000	squawk **two thousand**

5.2.1.4.1.5 All numbers used in the transmission of altitude, cloud height, visibility and runway visual range (RVR), which contain whole hundreds and whole thousands, shall be transmitted by pronouncing each digit in the number of hundreds or thousands followed by the word HUNDRED or THOUSAND as appropriate. Combinations of thousands and whole hundreds shall be transmitted by pronouncing each digit in the number of thousands followed by the word THOUSAND followed by the number of hundreds followed by the word HUNDRED.

NOTE: The following examples illustrate the application of this procedure (see 5.2.1.4.3.1 for pronunciation.

altitude	*transmitted as*
800	**eight hundred**
3400	**three thousand four hundred**
12000	**one two thousand**
cloud height	*transmitted as*
2200	**two thousand two hundred**
4300	**four thousand three hundred**
visibility	*transmitted as*

1000	visibility **one thousand**
700	visibility **seven hundred**
runway visual range	*transmitted as*
600	RVR **six hundred**
1700	RVR **one thousand seven hundred**

5.2.1.4.1.6 When providing information regarding relative bearing to an object or to conflicting traffic in terms of the 12-hour clock, the information shall be given pronouncing the double digits as TEN, ELEVEN, or TWELVE [O'CLOCK].

5.2.1.4.1.7 Numbers containing a decimal point shall be transmitted as prescribed in 5.2.1.4.1.1, with the decimal point in appropriate sequence being indicated by the word DECIMAL.

NOTE: The following examples illustrate the application of this procedure.

Number	*Transmitted as*
100.3	ONE ZERO ZERO DECIMAL THREE
38143.9	THREE EIGHT ONE FOUR THREE DECIMAL NINE

NOTE: For identification of VHF frequencies the number of digits after the decimal point are determined on the basis of channel spacing (5.2.1.7.3.4.3 refers to frequencies separated by 25 kHz, 5.2.1.7.3.4.4 refers to frequencies separated by 8.33 kHz.

5.2.1.4.1.8 **PANS** — When transmitting time, only the minutes of the hour should normally be required. Each digit should be pronounced separately. However, the hour should be included when any possibility of confusion is likely to result.

NOTE: The following examples illustrate the application of this procedure when applying the provisions of 5.2.1.2.2.

Time	*Statement*
0920 *(9:20 A.M.)*	TOO ZE-RO or ZE-RO NIN-er TOO ZERO
1643 *(4:43 P.M.)*	FOW-er TREE or WUN SIX FOW-er TREE

5.2.1.7 Calling

5.2.1.7.3 RADIOTELEPHONY PROCEDURES

5.2.1.7.3.4 Indication of Transmitting Frequency

5.2.1.7.3.4.3 PANS — Except as specified in 5.2.1.7.3.4.4 all six digits of the numerical designator should be used to identify the transmitting channel in VHF radiotelephony communications, except in the case of both the fifth and sixth digits being zeros, in which case only the first four digits should be used.

NOTE 1: The following examples illustrate the application of the procedure in 5.2.1.7.3.4.3:

Channel	*Transmitted as*
118.000	ONE ONE EIGHT DECIMAL ZERO
118.005	ONE ONE EIGHT DECIMAL ZERO ZERO FIVE
118.010	ONE ONE EIGHT DECIMAL ZERO ONE ZERO
118.025	ONE ONE EIGHT DECIMAL ZERO TWO FIVE
118.050	ONE ONE EIGHT DECIMAL ZERO FIVE ZERO
118.100	ONE ONE EIGHT DECIMAL ONE

NOTE 2: Caution must be exercised with respect to the indication of transmitting channels in VHF radiotelephony communications when all six digits of the numerical designator are used in airspace where communication channels are separated by 25 kHz, because on aircraft installations with a channel separation capability of 25 kHz or more, it is only possible to select the first five digits of the numerical designator on the radio management panel.

NOTE 3: The numerical designator corresponds to the channel identification in Annex 10, Volume V, Table 4-1 (not published herein).

5.2.1.7.3.4.4 PANS — In airspace where all VHF voice communications channels are separated by 25 kHz or more and the use of six digits as in 5.2.1.7.3.4.3 is not substantiated by the operational requirement determined by the appropriate authorities, the first five digits of the numerical designator should be used, except in the case of both the fifth and sixth digits being zeros, in which case only the first four digits should be used.

NOTE 1: The following examples illustrate the application of the procedure in 5.2.1.7.3.4.4 and the associated settings of the aircraft radio management panel for communication equipment with channel separation capabilities of 25 kHz and 8.33/25 kHz.

Channel	*Transmitted as*	*Radio management panel setting for communication equipment with*	
		25 kHz (5 digits)	*8.33/25 kHz (6 digits)*

118.000	ONE ONE EIGHT DECIMAL ZERO	118.00	118.000
118.025	ONE ONE EIGHT DECIMAL ZERO TWO	118.02	118.025
118.050	ONE ONE EIGHT DECIMAL ZERO FIVE	118.05	118.050
118.075	ONE ONE EIGHT DECIMAL ZERO SEVEN	118.07	118.075
118.100	ONE ONE EIGHT DECIMAL ONE	118.10	118.100

NOTE 2: Caution must be exercised with respect to the indication of transmitting channels in VHF radiotelephony communications when five digits of the numerical designator are used in airspace where aircraft are also operated with channel separation capabilities of 8.33/25 kHz. On aircraft installations with a channel separation capability of 8.33 kHz and more, it is possible to select six digits on the radio management panel. It should therefore be ensured that the fifth and sixth digits are set to 25 kHz channels (see Note 1).

NOTE 3: The numerical designator corresponds to the channel identification in Annex 10, Volume V, Table 4-1 (not published herein).

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Air Traffic Control

Air Traffic Management - General Data

1 INTRODUCTION

1.1 The term "Mach number technique" is used to describe the technique of clearing turbo-jet aircraft operating along the same route to maintain specified Mach numbers in order to maintain adequate longitudinal separation between successive aircraft at, or climbing or descending to, the same level.

2 OBJECTIVES

2.1 The principal objectives of the use of the Mach number technique are:

a. to ensure continued longitudinal separation between successive aircraft on long route segments with a minimum of Air Traffic Control (ATC) intervention;

b. to obtain improved utilization of such routes, thus contributing to the economy of flight operations of traffic concerned.

2.2 To achieve these objectives the speeds of aircraft operating along the same track at the same level or climbing or descending to operate at the same level are stabilized. This stability permits reasonably accurate projections of the expected longitudinal separation between aircraft to points well beyond the point where separation is first confirmed, which reduces the need for frequent ATC intervention.

2.3 Practical experience in the North Atlantic (NAT) region has confirmed the assumptions made above. It has been found that successive aircraft operating along the same track at the same level and aircraft climbing or descending to operate at the same level as another aircraft and maintaining the same Mach number also maintain a reasonably constant time interval between each other, when checked by position reports over the same point. This is due to the fact that the aircraft concerned are normally subject to approximately the same wind and temperature conditions. Minor variations in speed which might temporarily increase or decrease the spacing between aircraft tend to be neutralized over prolonged periods of flight.

3 PREREQUISITES

3.1 AREA OF APPLICATION

3.1.1 The application of the Mach number technique is particularly suitable for areas where the environment is such that position reporting and ATC intervention with individual flights can, at times, be subject to delay. In addition, the following represent typical characteristics of the route structure and environment which make the use of a given area suitable for the application of the Mach number technique:

a. aircraft in the area generally follow the same or diverging tracks until they are provided with other forms of separation;

b. operations conducted in the area comprise a significantly large phase of stable flight (e.g., not less than one hour) and the aircraft concerned have normally reached an operationally suitable level when entering the area.

3.2 AIRCRAFT INSTRUMENTATION

3.2.1 The use of the Mach number technique in a given area is based on the assumption that the relevant instruments used by aircraft to which this technique is applied have been calibrated in accordance with applicable airworthiness practices. Therefore, both States of Registry and operators concerned should take the necessary measures to ensure continued compliance with this prerequisite.

3.3 FLIGHT PROGRESS INFORMATION FOR ATC

3.3.1 ATC units using the Mach number technique must have at their disposal the latest forecast upper wind information, or position information obtained from previous aircraft. Such information is necessary in order to permit ATC to prepare (either manually or by means of a computer) flight progress strips showing calculated estimated times over significant points up to and including the exit point from the area wherein the technique is applied in order to confirm that the required longitudinal separation will exist at the exit point.

3.4 ADHERENCE TO ASSIGNED MACH NUMBER

3.4.1 Unless otherwise advised by the pilot concerned, ATC will assume that the last assigned Mach number will be maintained both in cruise and in any cleared step-climbs or step-descents made in the course of the flight.

4 GENERAL PROCEDURES

4.1 Application of the Mach number technique should always be based on the true Mach number.

The airspeeds and altitudes planned to be used should be specified in flight plan as follows:

a. True airspeed and altitude immediately preceding the initial domestic portion of the route of flight.

b. True Mach number and altitude immediately preceding oceanic portion of the route of flight.

Example of field 15 of ICAO Flight Plan: 0450F340 MOLOKAI2 CLUTS/M084F340 R465 CLUKK SFO.

4.2 The ATC clearance must include the assigned Mach number which is to be maintained. It is therefore necessary that information on the desired Mach number be included in the flight plans by pilots intending to operate along routes in the area concerned.

4.3 ATC has a requirement to calculate estimated times at which aircraft will pass significant points along their track. These calculations are necessary both for the provision of longitudinal separation between aircraft on crossing tracks, and for coordination with adjacent ATC units. Therefore ATC must be provided with necessary data to do this.

4.4 It is very important that the estimates for the entry point to the area provided by pilots are as accurate as possible since they form the basis for the advance planning of longitudinal separation between aircraft.

4.5 The prescribed longitudinal separation between successive aircraft flying at the same level must be provided over the entry point and on a particular track or tracks, or exist when climb or descent to the level of another aircraft is accomplished into the area concerned. Standard longitudinal separation is 15 minutes.

4.6 Thereafter, provided that aircraft maintain their last assigned Mach numbers, intervention by ATC for the portion of flight where the Mach number technique is used, should normally only be necessary if an aircraft, for some reason, is obliged to change its number or if there is conflicting traffic on crossing tracks or a flight level change is intended.

4.7 The Mach number technique requires that pilots strictly adhere to the following procedures:

a. aircraft must strictly adhere to the last assigned Mach number;

b. if essential to make an immediate temporary change in Mach number (e.g., due to turbulence) the appropriate ATC unit should be notified as soon as possible of that change;

c. when required by the appropriate ATC unit, the current true Mach number should be included in routine position reports.

4.8 Due account must be taken of problems which may be caused at entry and exit points if the longitudinal separation minima used in adjacent airspace differ from those used in the area where the Mach number technique is used.

4.9 For a list of ATS routes and areas where the Mach number technique is used, see the individual ATC “State Page” under the heading Mach Number Technique (MNT).

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Air Traffic Control

Performance Based Communication and Surveillance (PBCS) - Doc 9869

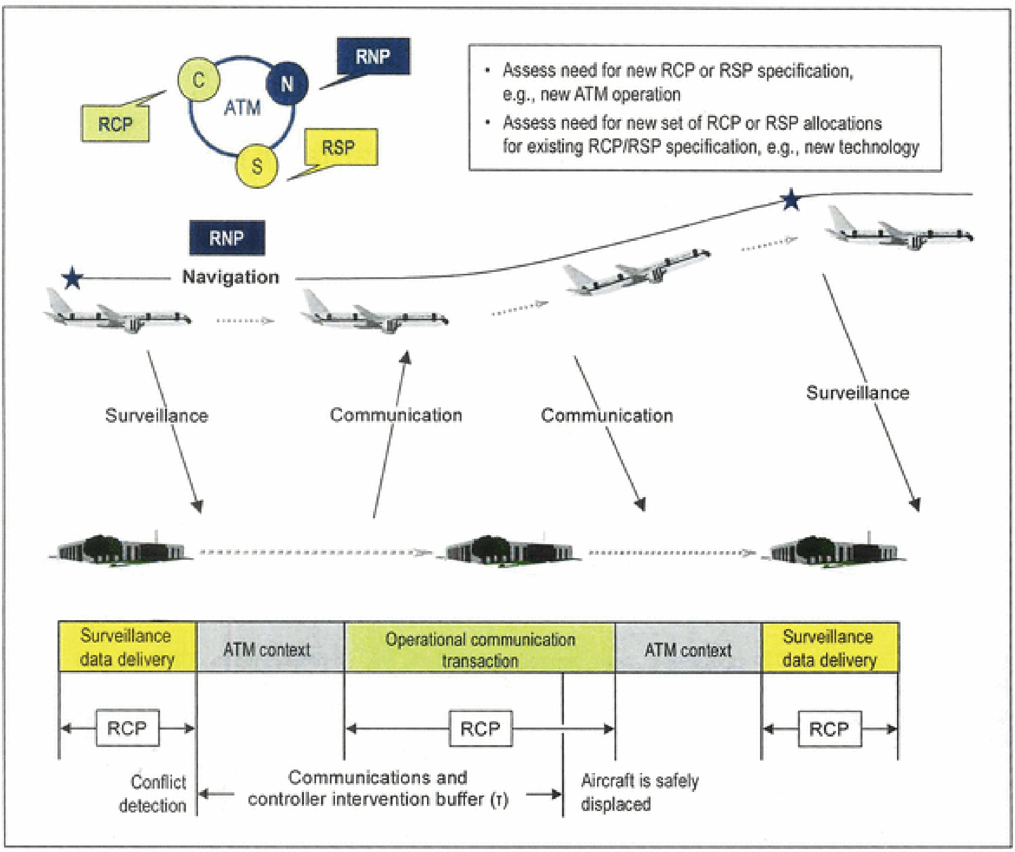
PERFORMANCE BASED COMMUNICATION AND SURVEILLANCE (PBCS)

BASIC INFORMATION

Performance Based Communication (PBC) and Performance Based Surveillance (PBS) refers to communication and surveillance based on performance specifications applied to the provision of air traffic services. The standards and procedures for an air traffic management (ATM) operation that are predicated on communication and surveillance capabilities, such as the application of reduced separation minima, must refer to the appropriate Required Communication Performance (RCP) and Required Surveillance Performance (RSP) specification.

The RCP and RSP specifications are a set of requirements for air traffic service provision and associated ground equipment, aircraft capability and operations needed to support performance based communication and surveillance.

Operational context of communication and surveillance capability and performance



RCP SPECIFICATIONS

General

The operational requirements of an RCP specification apply to the controller's communication and intervention capability. These requirements also define parameter values for operational (end-to-end) RCP transaction times, RCP continuity, RCP availability and RCP integrity, as well as their allocated values (e.g. required communication monitored performance (RCMP), required communication technical performance (RCTP) and, when applicable, human performance). An underlying assumption in the application of RCP is the compatibility and interoperability of the supporting system components, in accordance with interoperability standards.

An RCP specification is identified by a designator (e.g. RCP 240) to simplify the RCP designator naming convention and to make the RCP transaction time readily apparent to airspace planners, aircraft manufacturers and operators. The designator represents the maximum communication transaction time after which the initiator should revert to an alternative procedure (or RCP expiration time).

RCP type parameters

The set of requirements for an RCP specification are based on the following parameters:

– RCP transaction time - The maximum time for the completion of the operational communication transaction after which the initiator should revert to an alternative procedure.

– RCP continuity - The minimum proportion of operational communication transactions to be completed within the specified RCP transaction time, given that the service was available at the start of the transaction.

– RCP availability - The required probability that an operational communication transaction can be initiated.

– RCP integrity - The required probability that an operational communication transaction is completed with no undetected errors.

Currently, the number of specifications is limited to two (RCP 240 and RCP 400) in airspace where procedural separation is applied. Other RCP specifications may be added, pending the introduction of new ATM operations or the use of new communication technologies.

RCP Specification	RCP Transaction Time (seconds)	RCP Continuity (probability)	RCP Availability (probability)	RCP integrity (acceptable rate / Flight Hours)
RCP 240	240	0.999	0.999	10^{-5}
RCP 400	400	0.999	0.999	10^{-5}

RCP 240 may be applied to maintain the performance for normal means of communication, which supports controller intervention capability in procedurally controlled airspace, where the separation minimum applied is predicated on communication performance.

RCP 400 may be applied to maintain the performance for emerging technology (e.g. satellite voice) used to provide normal means of communication supporting controller intervention capability in procedurally controlled airspace, where the separation minimum applied is based on position reporting at compulsory reporting points. RCP 400 may also be applied to maintain the performance required for emerging technologies used to provide alternative means of communication, that may be required in combination with the normal means of communication, to which RCP 240 is applied.

RCP transaction time and allocations

There may be multiple operational communication transactions that support an ATM operation. These transactions are therefore assessed to determine which is the most stringent. The value for the RCP transaction time is based on the time needed to complete the most stringent transaction for controller intervention.

The assessment would take into consideration the time needed to safely execute the contingency procedure and can include simulations, demonstrations, operational trials and analysis of empirical data applicable to the RCP communication transaction times for the ATM operation.

For separation assurance, the RCP transaction time can be determined by collision risk modelling. Collision risk modelling considers the RCP transaction times in the communications and controller intervention buffer supporting separation assurance. Figure “Operational context of communication and surveillance capability and performance” illustrates the operational communication transaction in the context of communications and controller intervention buffer.

RSP SPECIFICATIONS

General

The operational requirements of an RSP specification apply to the surveillance services and define parameter values for surveillance data transit times, RSP continuity, RSP availability and RSP integrity, as well as allocated values (e.g. required surveillance monitored performance (RSMP), required surveillance technical performance (RSTP) and, when applicable, human performance). When applying RSP, it is assumed that that the supporting system components are compatible and interoperable, in accordance with interoperability standards.

An RSP specification is identified by a designator (e.g. RSP 180) in order to simplify the designator naming convention and to make the required surveillance data delivery time readily apparent to airspace planners, aircraft manufacturers and operators. The designator represents the value for the surveillance data delivery time when the surveillance data delivery is considered overdue.

RSP type parameters

The set of requirements for an RSP specification are based on the following parameters:

- RSP surveillance data transit time - Maximum time for the reception of the surveillance data after which the controller should revert to an alternative procedure.
- RSP continuity - The minimum proportion of surveillance data delivery to be completed within the specified RSP surveillance data delivery time, given that the service was available at the start of the delivery.
- RSP availability - The required probability that surveillance data can be provided.
- RSP integrity - The required probability that surveillance data delivery is completed with no ‘undetected’ errors.

Currently, the number of specifications is limited to two (RSP 180 and RSP 400) in airspace where procedural separation applies. Other RSP specifications may be added, pending the introduction of new ATM operations or the use of new surveillance technologies.

RSP Specification	RSP Delivery Time (seconds)	RSP Continuity (probability)	RSP Availability (probability)	RSP integrity (acceptable rate / Flight Hours)
RSP 180	180	0.999	0.999	FOM=Navigation Specification Time at Position Accuracy +/-1 Sec Data integrity (malfunction) = 10^{-5}
RSP 400	400	0.999	0.999	FOM=Navigation Specification Time at Position Accuracy +/-30 Sec Data integrity (malfunction) = 10^{-5}

RSP 180 may be applied to maintain the performance for normal means of surveillance, which supports controller intervention capability in procedurally controlled airspace, where the separation minimum applied is predicated on surveillance performance.

RSP 400 may be applied to maintain the performance for emerging technology (e.g. satellite voice) used to provide normal means of surveillance supporting controller intervention capability in procedurally controlled airspace, where the separation minimum being applied is based on position reporting at compulsory reporting points. RSP 400 might also be applied to maintain the performance required for emerging technologies used to provide alternative means of surveillance, that may be required in combination with the normal means of surveillance, to which RSP 180 is applied.

RSP data delivery time and allocations

The value for the RSP data delivery time is based on the time when the surveillance data delivery is considered overdue.

The assessment would take into consideration the time needed to safely execute the contingency procedure and can include an analysis of empirical data applicable to the RSP data delivery times for the ATM operation.

For separation assurance, the RSP data delivery can be determined by collision risk modelling. This method considers the RSP delivery times in the surveillance data delivery supporting separation assurance. Figure “Operational context of communication and surveillance capability and performance” illustrates the surveillance data delivery in the context of surveillance capabilities.

COMPLYING WITH AN RCP/RSP SPECIFICATION

Aircraft operator eligibility

The aircraft operator should meet the requirements established by the State of the Operator or State of Registry to be eligible for PBCS operations.

The aircraft operator should consider the guidance in this section as it applies to flight crew training and qualification, the aircraft system, MEL, continued airworthiness, user modifiable software and Communication Service Provider (CSP) service agreements.

The aircraft operator should ensure that procedures are established and the flight crews and other personnel (e.g. aircraft maintenance, flight operations officer/flight dispatcher) are trained and qualified for PBCS operations. The flight crew procedures and training should include normal operations, as well as those associated with alerts provided by the aircraft system to indicate failures when the aircraft is no longer capable of meeting the RCP/RSP specification prescribed for the associated ATM operations.

The aircraft operator should ensure that contracted services, such as those with CSPs, are bound by contractual arrangements stipulating the RCP/RSP allocations, including any monitoring or recording requirements.

The aircraft operator should ensure that contractual arrangements include a provision for the CSP to notify the appropriate ATS units for the route system of the aircraft operator in case failure conditions impact PBCS operations.

The aircraft operator should ensure that the aircraft system has been approved for the intended use, in accordance with the appropriate RCP/RSP specification(s) and guidelines.

The aircraft operator should ensure that the aircraft system is properly maintained, including configuring user-modifiable software, such as those used to manage communication media and routing policies, to meet the appropriate RCP/RSP specification(s).

The aircraft operator should participate in local and regional PBCS monitoring programmes, which are applicable to the aircraft operator's route system, and should provide the following information to the appropriate PBCS monitoring entities specified in AIPs (or equivalent publications):

a. operator name;

b. operator contact details; and

c. other coordination information.

The aircraft operator should advise the appropriate PBCS monitoring entities of any changes to the information listed above.

The aircraft operator should establish procedures to report problems, identified either by the flight crew or other personnel, to the appropriate PBCS monitoring entities associated with the route of flight on which the problem occurred.

The aircraft operator should ensure procedures are established for the timely disclosure and delivery of operational data, including data from its CSPs/SSPs, to the appropriate PBCS monitoring entity when requested for the purposes of investigating a reported problem.

FLIGHT PLAN REQUIREMENTS

When filing RCP/RSP capabilities, the aircraft operator should ensure that the planned use of associated communication and surveillance capabilities for the flight will be in accordance with regulations, policies and procedures in control areas for the flight, as published by the applicable States in their AIPs (or equivalent publications).

NOTE: RCP/RSP capabilities are inserted only when the descriptors J2 through J7 for CPDLC, M1 through M3 for SATVOICE, and/or D1 for ADS-C, are also inserted. While RCP/RSP capability denotes performance, the descriptors J2 through J7, M1 through M3 and D1 in Item 10 (see Table below) denote the interoperability for the aircraft equipment.

In Item 10 of the flight plan, the aircraft operator should insert one or more descriptors, as appropriate, listed in Table below, to identify an aircraft's RCP capability:

Descriptors for RCP capability in flight plan - Item 10

Item 10a - Radio communication, navigation and approach aid equipment and capabilities	Descriptor
CPDLC RCP 400	P1
CPDLC RCP 240	P2
SATVOICE RCP 400	P3

In Item 18 of the flight plan, the aircraft operator should file the RSP capability by inserting the indicator SUR/ followed by the appropriate designator, with no spaces, for the RSP specification (e.g. RSP 400 or RSP 180).

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Air Traffic Control

Aerodrome Operating Minimums - EASA Air Operations

AERODROME OPERATING MINIMA - EASA AIR OPERATIONS

General and Aeroplane Specific Material (2016)

1 GENERAL

On 5 October 2012 the Commission Regulation (EU) No 965/2012 and related documents were published, laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council.

The European Aviation Safety Agency (EASA) publishes Regulations on Air Operations with the associated Decisions containing Acceptable Means of Compliance (AMC) and Guidance Material (GM).

On JEPPESEN approach and aerodrome charts an inverse printed **“Standard”** label in the upper left corner of the minimums band indicates that the minimums are derived according to the requirements described in EASA Air Operations documents.

TERPS change 20 was harmonized with the EASA minimum tables for CAT I, APV and NPA (CAT C and D aircraft only). Those procedures with the TERPS label are therefore EASA AIR OPS compliant for CAT C and D aircraft operators.

The following explanation is an excerpt to summarize only the relevant parts of the EASA Air Operations (EASA Air OPS) regarding the methods used to determine Aerodrome Operating Minimums (Rules, AMC or GM). It is not intended to provide all the requirements of the EASA Air OPS related documents.

The publication of EASA Air Operations landing and take-off minimums on Jeppesen charts does not constitute authority for their use by every operator. Each individual operator is responsible for validating that the appropriate approval has been obtained for their use.

In addition, the minimums are only considered applicable if:

- the required ground equipment for the intended procedure is operative; and
- the required aircraft systems for the type of approach are operative; and
- the required aircraft performance criteria are met; and
- the crew is qualified accordingly.

2 TERMINOLOGY

Acceptable Means of Compliance (AMC) — means non-binding standards adopted by the Agency to illustrate means to establish compliance with Regulation (EC) No 216/2008 and its Implementing Rules.

CAT.OP.MPA.xxx — Implementing rule (IR) from regulation for PART-CAT (Commercial Air Transport Operations)

SPA.LVO.xxx — Implementing rule from regulation for PART-SPA (Specific Approvals)

AMC1 CAT.OP.MPA.115 — Acceptable Means of Compliance to the related IR CAT.OP.MPA. 115

GM1 CAT.OP.MPA.110 — Guidance Material to the related IR CAT.OP.MPA.110

3 OPERATORS RESPONSIBILITY

CAT.OP.MPA.110 Aerodrome operating minimums

a. An operator shall establish aerodrome operating minimums for each departure, destination or alternate aerodrome planned to be used. These minimums shall not be lower than those established for such aerodromes by the State in which the aerodrome is located, except when specifically approved by that State. Any increment specified by the competent authority shall be added to the minimums.

b. The use of a head-up display (HUD), head-up guidance landing system (HUDLS) or enhanced vision system (EVS) may allow operations with lower visibilities than the established aerodrome operating minimums if approved in accordance with SPA.LVO.

c. When establishing aerodrome operating minimums, the operator shall take the following into account:

   1. the type, performance and handling characteristics of the aircraft;
   2. the composition, competence and experience of the flight crew;
   3. the dimensions and characteristics of the runways/final approach and take-off areas (FATO) that may be selected for use;
   4. the adequacy and performance of the available visual and non-visual ground aids;
   5. the equipment available on the aircraft for navigation and/or control of the flight path during the take-off, the approach, the flare, the landing, the roll-out and the missed approach;
   6. for the determination of obstacle clearance, the obstacles in the approach, missed approach and the climb-out areas necessary for the execution of the contingency procedures;
   7. the obstacle clearance altitude/height for the instrument approach procedure;
   8. the means to determine and report meteorological conditions; and
   9. the flight technique to be used during the final approach.

d. The operator shall specify the method of determining aerodrome operating minimums in the operations manual.

e. The minimums for a specific approach and landing procedure shall only be used if all the following conditions are met:

   1. the ground equipment shown on the chart required for the intended procedure is operative;
   2. the aircraft systems required for the type of approach are operative;
   3. the required aircraft performance criteria are met; and
   4. the crew is appropriately qualified.

GM1 CAT.OP.MPA.110(a) Aerodrome operating minimums

INCREMENTS SPECIFIED BY THE COMPETENT AUTHORITY

Additional increments to the published minimums may be specified by the competent authority to take into account certain operations, such as downwind approaches and single-pilot operations.

4 LOW VISIBILITY OPERATIONS

SPA.LVO.100 Low visibility operations

The operator shall only conduct the following low visibility operations (LVO) when approved by the competent authority:

a. low visibility take-off (LVTO) operation;

b. lower than standard category I (LTS CAT I) operation;

c. standard category II (Cat II) operation;

d. other than standard category II (OTS CAT II) operation;

e. standard category III (CAT III) operation;

f. approach operation utilising enhanced vision systems (EVS) for which an operational credit is applied to reduce the runway visual range (RVR) minimums by no more than one third of the published RVR.

SPA.LVO.115 Aerodrome related requirements

a. The operator shall not use an aerodrome for LVOs below a visibility of 800m unless:
   1. the aerodrome has been approved for such operations by the State of the aerodrome; and
   2. low visibility procedures (LVP) have been established.

b. If the operator selects an aerodrome where the term LVP is not used, the operator shall ensure that there are equivalent procedures that adhere to the requirements of LVP at the aerodrome. This situation shall be clearly noted in the operations manual or procedures manual including guidance to the flight crew on how to determine that the equivalent LVP are in effect.

5 APPROACH FLIGHT TECHNIQUE

CAT.OP.MPA.115 Approach flight technique - aeroplanes

a. All approaches shall be flown as stabilised approaches unless otherwise approved by the competent authority for a particular approach to a particular runway.

b. Non-precision approaches:
   1. The continuous descent final approach (CDFA) technique shall be used for all non-precision approaches.
   2. Nothwithstanding 1., another approach flight technique may be used for a particular approach/runway combination if approved by the competent authority. In such cases, the applicable minimum runway visual range (RVR):

  i. shall be increased by 200m for category A and B aeroplanes and by 400m for category C and D aeroplanes; or
  ii. for aerodromes where there is a public interest to maintain current operations and the CDFA technique cannot be applied, shall be established and regularly reviewed by the competent authority taking into account the operator's experience, training programme and flight crew qualification.

AMC1 CAT.OP.MPA.115 Approach flight technique - aeroplanes

CONTINUOUS DESCENT FINAL APPROACH (CDFA)

a. Flight techniques:
  1. The CDFA technique should ensure that an approach can be flown on the desired vertical path and track in a stabilized manner, without significant vertical path changes during the final approach segment descent to the runway. This technique applies to an approach with no vertical guidance and controls the descent path until the DA/H. This descent path can be either:
    i. a recommended descent rate, based on estimated ground speed;
    ii. a descent path depicted on the approach chart; or
    iii. a descent path coded in the flight management system in accordance with the approach chart descent path.
  2. The operator should either provide charts which depict the appropriate cross check altitudes/heights with the corresponding appropriate range information, or such information should be calculated and provided to the flight crew in an appropriate and usable format. Generally, the MAPt is published on the chart.
  4. The required descent path should be flown to the DA/H, observing any stepdown crossing altitudes if applicable.
  5. This DA/H should take into account any add-on to the published minimums as identified by the operator's management system and should be specified in the OM (aerodrome operating minimums).
  7. The operator should establish a procedure to ensure that an appropriate callout is made when the aeroplane is approaching DA/H. If the required visual references are not established at DA/H, the missed approach procedure is to be executed promptly.
  9. The missed approach should be initiated no later than reaching the MAPt or at the DA/H, whichever comes first. The lateral part of the missed approach should be flown via the MAPt unless otherwise stated on the approach chart.

AMC2 CAT.OP.MPA.115 Approach flight technique - aeroplanes

NPA OPERATIONS WITHOUT APPLYING THE CDFA TECHNIQUE

a. In case the CDFA technique is not used, the approach should be flown to an altitude/height at or above the MDA/H where a level flight segment at or above MDA/H may be flown to the MAPt.

e. The procedures that are flown with level flight at/or above MDA/H should be listed in the OM.

6 MET VISIBILITY/RVR/CMV

CAT.OP.MPA.305 - Commencement and continuation of approach

c. Where the RVR is not available, RVR values may be derived by converting the reported visibility.

AMC10 CAT.OP.MPA.110 Aerodrome operating minimums

CONVERSION OF REPORTED METEOROLOGICAL VISIBILITY TO RVR

a. A conversion from meteorological visibility to RVR/CMV should not be used:
    1. when reported RVR is available;
    2. for calculating take-off minimums; and
    3. for any RVR minimums less than 800m.

b. If the RVR is reported as being above the maximum value assessed by the aerodrome operator, e.g. “RVR more than 1500m”, it should not be considered as a reported value for a.1.

c. When converting meteorological visibility to RVR in circumstances other than those in a., the conversion factors specified in Table 8 should be used.

AMC10 CAT.OP.MPA.110 Table 8 Conversion of reported MET VIS to CMV

Light Elements in Operation	CMV = Reported Meteorological Visibility x Conversion Factor	
	Day	Night
High intensity approach and runway lights	1.5	2.0
Any type of light installation other than above	1.0	1.5
No lights	1.0	Not applicable

7 APPROACH LIGHT SYSTEMS

AMC5 CAT.OP.MPA.110 Aerodrome operating minimums

APPROACH LIGHTING SYSTEMS

AMC5 CAT.OP.MPA.110 Table 4 Approach Lighting Systems

Class of Lighting Facilities	Length, Configuration and Intensity of Approach Lights
FALS	CAT I approach lighting system (HIALS ≥ 720m) distance coded centerline, Barrette centerline
IALS	Simple approach lighting system (HIALS 420-719m) single source, Barrette
BALS	Any other approach lighting system (HIALS or MIALS or ALS 210-419m)
NALS	Any other approach lighting system (HIALS, MIALS or ALS < 210m) or no approach lights

8 DETERMINATION OF AOM FOR TAKE-OFF

AMC1 CAT.OP.MPA.110 Aerodrome operating minimums

TAKE-OFF OPERATIONS - AEROPLANES

a. General

1. Take-off minimums should be expressed as visibility or runway visual range (RVR) limits, taking into account all relevant factors for each aerodrome planned to be used and aircraft characteristics. Where there is a specific need to see and avoid obstacles on departure and/or for a forced landing, additional conditions, e.g. ceiling, should be specified.
2. The commander should not commence take-off unless the weather conditions at the aerodrome of departure are equal to or better than the applicable minimums for landing at that aerodrome unless a weather-permissible take-off alternate aerodrome is available.
3. When the reported meteorological visibility (VIS) is below that required for take-off and RVR is not reported, a take-off should only be commenced if the commander can determine that the visibility along the take-off runway is equal to or better than the required minimum.
4. When no reported meteorological visibility or RVR is available, a take-off should only be commenced if the commander can determine that the visibility along the take-off runway is equal to or better than the required minimum.

VISUAL REFERENCE

AMC1 CAT.OP.MPA.110 Aerodrome operating minimums

TAKE-OFF OPERATIONS - AEROPLANES

b. Visual Reference

1. The take-off minimums should be selected to ensure sufficient guidance to control the aircraft in the event of both a rejected take-off in adverse circumstances and a continued take-off after failure of the critical engine.
2. For night operations, ground lights should be available to illuminate the runway and any obstacles.

REQUIRED RVR/VIS

AMC1 CAT.OP.MPA.110 Aerodrome operating minimums

TAKE-OFF OPERATIONS - AEROPLANES

c. Required RVR/VIS - aeroplane

   1. For multi-engined aeroplanes, with performance such that in the event of a critical engine failure at any point during take-off the aeroplane can either stop or continue that take-off to a height of 1500ft above the aerodrome while clearing obstacles by the required margins, the take-off minimums specified by the operator should be expressed as RVR/VIS values not lower than those specified in Table 1.A.
   2. For multi-engined aeroplanes without the performance to comply with the conditions in c.1. in the event of a critical engine failure, there may be a need to re-land immediately and to see and avoid obstacles in the take-off area. Such aeroplanes may be operated to the following take-off minimums provided they are able to comply with the applicable obstacle clearance criteria, assuming engine failure at the height specified. The take-off minimums specified by the operator should be based upon the height from which the one-engine-inoperative (OEI) net take-off flight path can be constructed. The RVR minimums used should not be lower than either of the values specified in Table 1.A or Table 2.A.

AMC1 CAT.OP.MPA.110 Table 1.A Take-off RVR/VIS - Aeroplanes (without an Approval for Low Visibility Take-off)

Facilities		RVR/VIS
Day only	NIL	500m
Day	at least runway edge lights or centerline marking	400m
Night	at least runway edge lights and runway end lights or runway centerline lights and runway end lights	

The reported RVR/VIS value representative of the initial part of the take-off run can be replaced by the pilot assessment.

During day with Nil facilities: The pilot is able to continuously identify the take-off surface and maintain directional control.

AERODROME OPERATING MINIMA - EASA AIR OPERATIONS

AMC1 CAT.OP.MPA.110 Table 2.A Take-off - AeroplanesAssumed Engine Failure Height above the Runway versus RVR/VIS

Assumed Engine Failure Height above the Take-off Runway	RVR/VIS
≤ 50ft	400m (200m with LVTO approval)
51ft-100ft	400m (300m with LVTO approval)
101ft-150ft	400m
151ft-200ft	500m
201ft-300ft	1000m
More than 300ft	1500m

1500m is also applicable if no positive take-off flight path can be constructed.

The reported RVR/VIS value representative of the initial part of the take-off run can be replaced by pilot assessment.

AMC1 SPA.LVO.100 Low visibility operations

LVTO OPERATIONS - AEROPLANES

For a low visibility take-off (LVTO) with an aeroplane the following provisions should apply:

a. for an LVTO with a runway visual range (RVR) below 400m the criteria specified in Table 1.A below;

b. for an LVTO with an RVR below 150m but not less than 125m:

   1. high intensity runway centerline lights spaced 15m or less apart and high intensity edge lights spaced 60m or less apart that are in operation;
   2. a 90m visual segment that is available from the flight crew compartment at the start of the take-off run; and
   3. the required RVR value is achieved for all of the relevant RVR reporting points;

c. for an LVTO with an RVR below 125m but not less than 75m:

   1. runway protection and facilities equivalent to CAT III landing operations are available; and
   2. the aircraft is equipped with an approved lateral guidance system.

AMC1 SPA.LVO.100 Table 1.A LVTO - Aeroplanes

Facilities	RVR
Day: runway edge lights and runway centerline markings	300m
Night: runway edge lights and runway end lights or runway centerline lights and runway end lights	

AMC1 SPA.LVO.100 Table 1.A LVTO - Aeroplanes (continued)

Facilities	RVR
Runway edge lights and runway centerline lights	200m
Runway edge lights and runway centerline lights and relevant RVR	TDZ, MID, rollout 150m
High intensity runway centerline lights spaced 15m or less and high intensity edge lights spaced 60m or less are in operation	TDZ, MID, rollout 125m
Runway protection and facilities equivalent to CAT III landing operations are available **and** the aircraft is equipped either with an approved lateral guidance system or an approved HUD/HUDLS for take-off	TDZ, MID, rollout 75m

The reported RVR value representative of the initial part of the take-off run can be replaced by pilot assessment.

The RVR values are valid for multi-engined aeroplanes that in the event of an engine failure at any point during take-off can either stop or continue the take-off to a height of 1500ft above the aerodrome while clearing obstacles by the required margin.

The required RVR value to be achieved for all relevant RVRs.

9 DETERMINATION OF AOM FOR CIRCLING

AMC7 CAT.OP.MPA.110 Aerodrome operating minimums

CIRCLING OPERATIONS - AEROPLANES

a. Circling Minimums

   The following standards should apply for establishing circling minimums for operations with aeroplanes:

   1. The MDH for circling operation should not be lower than the highest of:
      i. the published circling OCH for the aeroplane category;
      ii. the minimum circling height derived from Table 7; or
      iii. the DH/MDH of the preceding instrument approach procedure;
   2. The MDA for circling should be calculated by adding the published aerodrome elevation to the MDH, as determined by a.1.; and
   3. The minimum visibility for circling should be the highest of:
      i. the circling visibility for the aeroplane category, if published;
      ii. the minimum visibility derived from Table 7; or

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iii. the RVR/CMV derived from Tables 5 and 6.A for the preceding instrument approach procedure.

AMC7 CAT.OP.MPA.110 Table 7 Circling - Aeroplanes MDH and Minimum Visibility vs. Aeroplane Category

Aircraft Category	A	B	C	D
MDH (ft)	400	500	600	700
VIS (m)	1500	1600	2400	3600

b. Conduct of flight - general
   1. The MDH and OCH included in the procedure are referenced to aerodrome elevation;
   2. The MDA is referenced to Mean Sea Level;
   3. For these procedures, the applicable visibility is the meteorological visibility; and
   4. Operators should provide tabular guidance of the relationship between height above threshold and the in-flight visibility required to obtain and sustain visual conduct during the circling maneuver.

c. Instrument approach followed by visual manoeuvring (circling) without prescribed tracks
   1. When the aeroplane is on the initial instrument approach, before visual reference is stabilised, but not below MDA/H, the aeroplane should follow the corresponding instrument approach procedure until the appropriate instrument MAPt is reached.
   2. At the beginning of the level flight phase at or above the MDA/H, the instrument approach track determined by radio navigation aids, RNAV, RNP, ILS, MLS or GLS should be maintained until the pilot:
      i. estimates that, in all probability, visual contact with the runway of intended landing or the runway environment will be maintained during the entire circling procedure;
      ii. estimates that the aeroplane is within the circling area before commencing circling; and
      iii. is able to determine the aeroplane's position in relation to the runway of intended landing with the aid of the appropriate external references.
   5. Flight maneuvers should be carried out at an altitude/height that is not less than the circling MDA/H.
   6. Descent below MDA/H should not be initiated until the threshold of the runway to be used has been appropriately identified. The aeroplane should be in a position to continue with a normal rate of descent and land within the touchdown zone.

d. Instrument approach followed by a visual manoeuvring (circling) with prescribed tracks

1. The aeroplane should remain on the initial instrument approach procedure until one of the following is reached:
   i. the prescribed divergence point to commence circling on the prescribed track; or
   ii. the MAPt.
4. When commencing the prescribed circling maneuver at the published divergence point, the subsequent maneuvers should be conducted to comply with the published routing and published heights/altitudes.

AMC9 CAT.OP.MPA.110 Aerodrome operating minimums

VISUAL APPROACH OPERATIONS

The operator should not use an RVR of less than 800m for a visual approach operation.

10 DETERMINATION OF AOM FOR CAT I PRECISION, APV AND NON-PRECISION APPROACHES

DECISION HEIGHT/MINIMUM DESCENT HEIGHT

AMC3 CAT.OP.MPA.110 Aerodrome operating minimums

NPA, APV, CAT I OPERATIONS

a. The decision height (DH) to be used for a non-precision approach (NPA) flown with the continuous descent final approach (CDFA) technique, approach procedure with vertical guidance (APV) or CAT I operation should not be lower than the highest of:
   1. the minimum height to which the approach aid can be used without the required visual reference;
   2. the obstacle clearance height (OCH) for the category of aircraft;
   3. the published approach procedure DH where applicable;
   4. the system minimum specified in Table 3; or
   5. the minimum DH specified in the aircraft flight manual (AFM) or equivalent document, if stated.
b. The minimum descent height (MDH) for an NPA operation flown without the CDFA technique should not be lower than the highest of:
   1. the OCH for the category of aircraft;
   2. the system minimum specified in Table 3; or
   3. the minimum MDH specified in the AFM, if stated.

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AMC3 CAT.OP.MPA.110 Table 3 System Minimums

Facility	Lowest DH/MDH (ft)
ILS/MLS/GLS/PAR GNSS/SBAS CAT I (LPV)	200
GNSS (LNAV) GNSS/Baro-VNAV (LNAV/VNAV) LOC with or without DME SRA (terminating at 0.5nm) VOR/DME	250
SRA (terminating at 1nm) VOR NDB/DME	300
SRA (terminating at 2nm or more) NDB VDF	350

GM3 CAT.OP.MPA.110 Aerodrome operating minimums

SBAS OPERATIONS

a. SBAS CAT I operations with a DH of 200ft depend on an SBAS system approved for operations down to a DH of 200ft.

REQUIRED RVR

AMC4 CAT.OP.MPA.110 Aerodrome operating minimums

CRITERIA FOR ESTABLISHING RVR/CMV

a. Aeroplanes

   The following criteria for establishing RVR/CMV should apply:

   1. In order to qualify for the lowest allowable values of RVR/CMV specified in Table 6.A the instrument approach should meet at least the following facility specifications and associated conditions:

      i. Instrument approaches with designated vertical profile up to and including 4.5° for category A and B aeroplanes, or 3.77° for category C and D aeroplanes where the facilities are:

         A. ILS/MLS/GLS/PAR or

         B. APV; and

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where the final approach track is offset by not more than 15° for category A and B aeroplanes or by not more than 5° for category C and D aeroplanes.

- ii. Instrument approach operations flown using the CDFA technique with a nominal vertical profile, up to and including 4.5° for category A and B aeroplanes, or 3.77° for category C and D aeroplanes, where the facilities are NDB, NDB/DME, VOR, VOR/DME, LOC, LOC/DME, VDF, SRA or GNSS/LNAV, with a final approach segment of at least 3NM, which also fulfil the following criteria:
  - A. the final approach track is offset by not more than 15° for category A and B aeroplanes or by not more than 5° for category C and D aeroplanes;
  - B. the final approach fix (FAF) or another appropriate fix where the descent is initiated is available, or distance to threshold (THR) is available by flight management system/GNSS (FMS/GNSS) or DME; and
  - C. if missed approach point (MAPt) is determined by timing, the distance from FAF or another appropriate fix to THR is ≤ 8nm.
- iii. Instrument approaches where the facilities are NDB, NDB/DME, VOR, VOR/DME, LOC, LOC/DME, VDF, SRA or GNSS/LNAV, not fulfilling the criteria in a.1.ii., or with an MDH ≥ 1200ft.

AMC5 CAT.OP.MPA.110 Aerodrome operating minimums

DETERMINATION OF RVR/CMV MINIMUMS FOR NPA, APV, CAT I - AEROPLANES

a. Aeroplanes

The RVR/CMV/VIS minimums for NPA, APV and CAT I operations should be determined as follows:

1. The minimum RVR/CMV should be the highest of the values specified in Table 5 or Table 6.A but not greater than the maximum values specified in Table 6.A, where applicable.
3. If the approach is flown with a level flight segment at or above MDA/H, 200m should be added for category A and B aeroplanes and 400m for category C and D aeroplanes to the minimum RVR/CMV value resulting from the application of Tables 5 and 6.A.
4. An RVR of less than 750m as indicated in Table 5 may be used:
   - i. for CAT I operations to runways with full approach lighting systems (FALS), runway touchdown zone lights (RTZL) and runway centerline lights (RCLL);
   - ii. for CAT I operations to runways without RTZL and RCLL when using an approved head-up guidance landing system (HUDLS), or equivalent approved system, or when conducting a coupled approach or flight-director flown approach to a DH. The ILS should not be published as a restricted facility; and
   - iii. for APV operations to runways with FALS, RTZL and RCLL when using an approved head-up display (HUD).

AERODROME OPERATING MINIMA - EASA AIR OPERATIONS

5. Lower values than those specified in Table 5, for HUDLS and auto-land operations may be used if approved in accordance with Annex V (Part-SPA), Subpart E (SPA.LVO) of the regulation.

RVR RELATED TO DH/MDH AND LIGHTING SYSTEM

AMC5 CAT.OP.MPA.110 Table 5 RVR vs. DH/MDH and Lights - All Aircraft Categories

	RVR (m) depending on Class of Lighting Facilities			
DH or MDH (ft)	**FALS**	**IALS**	**BALS**	**NALS**
200-210	550	750	1000	1200
211-220	550	800	1000	1200
221-230	550	800	1000	1200
231-240	550	800	1000	1200
241-250	550	800	1000	1300
251-260	600	800	1100	1300
261-280	600	900	1100	1300
281-300	650	900	1200	1400
301-320	700	1000	1200	1400
321-340	800	1100	1300	1500
341-360	900	1200	1400	1600
361-380	1000	1300	1500	1700
381-400	1100	1400	1600	1800
401-420	1200	1500	1700	1900
421-440	1300	1600	1800	2000
441-460	1400	1700	1900	2100
461-480	1500	1800	2000	2200
481-500	1500	1800	2100	2300
501-520	1600	1900	2100	2400
521-540	1700	2000	2200	2400
541-560	1800	2100	2300	2500
561-580	1900	2200	2400	2600
581-600	2000	2300	2500	2700
601-620	2100	2400	2600	2800

AERODROME OPERATING MINIMA - EASA AIR OPERATIONS

AMC5 CAT.OP.MPA.110 Table 5 RVR vs. DH/MDH and Lights - All Aircraft Categories (continued)

	RVR (m) depending on Class of Lighting Facilities			
DH or MDH (ft)	FALS	IALS	BALS	NALS
621-640	2200	2500	2700	2900
641-660	2300	2600	2800	3000
661-680	2400	2700	2900	3100
681-700	2500	2800	3000	3200
701-720	2600	2900	3100	3300
721-740	2700	3000	3200	3400
741-760	2700	3000	3300	3500
761-800	2900	3200	3400	3600
801-850	3100	3400	3600	3800
851-900	3300	3600	3800	4000
901-950	3600	3900	4100	4300
951-1000	3800	4100	4300	4500
1001-1100	4100	4400	4600	4900
1101-1200	4600	4900	5000	5000
1200 and above	5000	5000	5000	5000

AMC5 CAT.OP.MPA.110 Table 6.A CAT I, APV, NPA - AeroplanesMinimum and Maximum applicable RVR (lower and upper Cut-off Limits)

Facility/Conditions	RVR (m)	Aeroplane Category			
		A	B	C	D
ILS, MLS, GLS, PAR, GNSS/SBAS, GNSS/VNAV	Min	According to AMC5 CAT.OP.MPA.110 Table 5			
	Max	1500	1500	2400	2400
NDB, NDB/DME, VOR, VOR/DME, LOC, LOC/DME, VDF, SRA, GNSS/LNAV with a procedure that fulfils the criteria in AMC4 CAT.OP.MPA.110 a.1.(ii)	Min	750	750	750	750
	Max	1500	1500	2400	2400
NDB, NDB/DME, VOR, VOR/DME, LOC, LOC/	Min	1000	1000	1200	1200

AERODROME OPERATING MINIMA - EASA AIR OPERATIONS

AMC5 CAT.OP.MPA.110 Table 6.A CAT I, APV, NPA - AeroplanesMinimum and Maximum applicable RVR (lower and upper Cut-off Limits) (continued)

Facility/Conditions	RVR (m)	Aeroplane Category			
		A	B	C	D
DME, VDF, SRA, GNSS/ LNAV: – not fulfilling the criteria in AMC4 CAT.OP.MPA.110 a.1.(ii); or – with a DH or MDH ≥ 1200ft.	Max	According to AMC5 CAT.OP.MPA.110 Table 5 if flown using the CDFA technique, otherwise an add-on of 200m for category A and B aeroplanes and 400m for category C and D aeroplanes applies to the values in AMC5 CAT.OP.MPA.110 Table 5 but not to result in a value exceeding 5000m.			

11 DETERMINATION OF AOM FOR LOWER THAN STANDARD CAT I OPERATIONS

SPA.LVO.100 Low visibility operations

The operator shall only conduct the following low visibility operations (LVO) when approved by the competent authority:

b. Lower than standard category I (LTS CAT I) operations.

SPA.LVO.110 General operating requirements

a. The operator shall only conduct LTS CAT I operations if:
    1. each aircraft concerned is certified for operations to conduct CAT II operations; and
    2. the approach is flown:
        i. auto-coupled to an auto-land that needs to be approved for CAT IIIA operations; or
        ii. using an approved head-up display landing system (HUDLS) to at least 150ft above the threshold.

SPA.LVO.115 Aerodrome related requirements

a. The operator shall not use an aerodrome for LVOs below a visibility of 800m unless:
    1. the aerodrome has been approved for such operations by the State of the aerodrome; and
    2. low visibility procedures (LVP) have been established.

AMC3 SPA.LVO.100 Low visibility operations

LTS CAT I OPERATIONS

a. For lower than standard category I (LTS CAT I) operations the following provisions should apply:

1. The decision height (DH) of an LTS CAT I operation should not be lower than the highest of:
   1. the minimum DH specified in the AFM, if stated;
   2. the minimum height to which the precision approach aid can be used without the specified visual reference;
   3. the applicable obstacle clearance height (OCH) for the category of aeroplane;
   4. the DH to which the flight crew is qualified to operate; or
   5. 200ft.
2. An instrument landing system/microwave landing system (ILS/MLS) that supports an LTS CAT I operation should be an unrestricted facility with a straight-in course ≤ 3° offset, and the ILS should be certified to:
   1. class I/T/1 for operations to a minimum of 450m RVR; or
   2. class II/D/2 for operations to less than 450m RVR.

   Single ILS facilities are only acceptable if level 2 performance is provided.
3. The following visual aids should be available:
   1. standard runway day markings, approach lights, runway edge lights, threshold lights and runway end lights;
   2. for operations with an RVR below 450m, additionally touch-down zone and/or runway centerline lights.
4. The lowest RVR minimums to be used are specified in Table 2.

AMC3 SPA.LVO.100 Table 2 RVR LTS CAT I Operation MinimumsRVR vs. Approach Lighting System

DH (ft)	RVR (m) depending on Class of Light Facility			
	FALS	IALS	BALS	NALS
200-210	400	500	600	750
211-220	450	550	650	800
221-230	500	600	700	900
231-240	500	650	750	1000
241-249	550	700	800	1100

12 DETERMINATION OF AOM FOR STANDARD AND OTHER THAN STANDARD CAT II OPERATIONS

SPA.LVO.110 General operating requirements

b. The operator shall only conduct CAT II, OTS CAT II … operations if:

AERODROME OPERATING MINIMA - EASA AIR OPERATIONS

1. each aircraft concerned is certified for operations with a decision height (DH) below 200ft, or no DH, and equipped in accordance with the applicable airworthiness requirements;
2. a system for recording approach and/or automatic landing success and failure is established and maintained to monitor the overall safety of the operation;
3. the DH is determined by means of a radio altimeter;
4. the flight crew consists of at least two pilots;
5. all height call-outs below 200ft above the aerodrome threshold elevation are determined by a radio altimeter.

AMC4 SPA.LVO.100 Low visibility operations

CAT II AND OTS CAT II OPERATIONS

a. For CAT II and other than standard category II (OTS CAT II) operations the following provisions should apply:
   1. The ILS/MLS that supports OTS CAT II operation should be an unrestricted facility with a straight-in course ≤ 3° offset and the ILS should be certified to class II/D/2.

      Single ILS facilities are only acceptable if level 2 performance is provided.
   2. The DH for CAT II and OTS CAT II operation should not be lower than the highest of:
      i. the minimum DH specified in the AFM, if stated;
      ii. the minimum height to which the precision approach aid can be used without the specified visual reference;
      iii. the applicable OCH for the category of aeroplane;
      iv. the DH to which the flight crew is qualified to operate; or
      v. 100ft.
   3. The following visual aids should be available:
      i. standard runway day markings and approach and the following runway lights: runway edge lights, threshold lights and runway end lights;
      ii. for operations in RVR below 450m, additionally touch-down zone and/or runway centerline lights;
      iii. for operations with an RVR of 400m or less, additionally centerline lights.
   4. The lowest RVR minimums to be used are specified:
      i. for CAT II operations in Table 3; and
      ii. for OTS CAT II operations in Table 4.

b. For OTS CAT II operations, the terrain ahead of the runway threshold should have been surveyed.

AERODROME OPERATING MINIMA - EASA AIR OPERATIONS

AMC4 SPA.LVO.100 Table 3 CAT II Operation MinimumsRVR vs. DH

DH (ft)	RVR (m)	
	CAT A, B, C	CAT D
100-120	300	300/350
121-140	400	
141-199	450	

Auto-coupled or approved HUDLS to below DH - This means continued use of the automatic flight control system or the HUDLS down to a height of 80% of the DH.

An RVR of 300m instead of 350m may be used for CAT D aircraft conducting an auto-land.

AMC4 SPA.LVO.100 Table 4 OTS CAT II Operation MinimumsRVR vs. Aproach Lighting System

DH (ft)	RVR (m)				
	FALS		IALS	BALS	NALS
	CAT A-C	CAT D	CAT A-D	CAT A-D	CAT A-D
100-120	350	400	450	600	700
121-140	400	450	500	600	700
141-160	450[1]	500	500	600	750
161-199	450[1]	500	550	650	750

[1] The EASA table shows 400m, but this would be lower than the Standard CAT II operations. This is already reported, but not yet corrected by EASA.

Auto-land or approved HUDLS utilised to touchdown.

13 DETERMINATION OF AOM FOR CAT III OPERATIONS

SPA.LVO.110 General operating requirements

b. The operator shall only conduct … CAT III operations if:

  1. each aircraft concerned is certified for operations with a decision height (DH) below 200ft, or no DH, and equipped in accordance with the applicable airworthiness requirements;
  2. a system for recording approach and/or automatic landing success and failure is established and maintained to monitor the overall safety of the operation;
  3. the DH is determined by means of a radio altimeter;
  4. the flight crew consists of at least two pilots;

5. all height call-outs below 200ft above the aerodrome threshold elevation are determined by a radio altimeter.

AMC5 SPA.LVO.100 Low visibility operations

CAT III OPERATIONS

The following provisions should apply to CAT III operations:

a. Where the DH and RVR do not fall within the same category, the RVR should determine in which category the operation is to be considered.
b. For operations in which a DH is used, the DH should not be lower than:
    1. the minimum DH specified in the AFM, if stated;
    2. the minimum height to which the precision approach aid can be used without the specified visual reference; or
    3. the DH to which the flight crew is qualified to operate.
c. Operations with no DH should only be conducted if:
    1. the operation with no DH is specified in the AFM;
    2. the approach aid and the aerodrome facilities can support operations with no DH; and
    3. the flight crew is qualified to operate with no DH.
d. The lowest RVR minimums to be used are specified in Table 5.

AMC5 SPA.LVO.100 Table 5 CAT III Operations MinimumsRVR vs. DH and Rollout Control/ Guidance System

CAT	DH (ft)	Rollout Control/Guidance System	RVR (m)
IIIA	Less than 100	Not required	200
IIIB	Less than 100	Fail-passive	150
IIIB	Less than 50	Fail-passive	125
IIIB	Less than 50 or no DH	Fail-operational	75

Flight control system redundancy is determined under CS-AWO by the minimum certified DH.

RVR 150m is valid for aeroplanes certified in accordance with CS-AWO 321(b)(3) or equivalent.

The fail-operational system referred to may consist of a fail-operational hybrid system.

14 FAILED OR DOWNGRADED EQUIPMENT

CAT.OP.MPA.110 Aerodrome operating minimums

c. When establishing aerodrome operating minimums, the operator shall the following take-into account:

   4. the adequacy and performance of the available visual and non-visual ground aids;

e. The minimums for a specific approach and landing procedure shall only be used if all the following conditions are met:

   1. The ground equipment shown on the chart required for the intended procedure is operative.

AMC11 CAT.OP.MPA.110 Aerodrome operating minimums

EFFECT ON LANDING MINIMUMS OF TEMPORARILY FAILED OR DOWNGRADED GROUND EQUIPMENT

AMC11 CAT.OP.MPA.110 Table 9 Failed or Downgraded Equipment - Effect on Landing Minimums Operations without a Low Visibility Operations Approval

Failed or Downgraded Equipment	Effect on Landing Minimums	
	CAT I	APV, NPA
ILS/MLS stand-by transmitter	No effect	
Outer Marker	Not allowed except if replaced by height check at 1000ft	APV - not applicable
		NPA with FAF - no effect unless used as FAF
		If the FAF cannot be identified (e.g. no method available for timing of descent), non-precision operations cannot be conducted
Middle Marker	No effect	No effect unless used as MAPt
RVR Assessment Systems	No effect	
Approach lights	Minimums as for NALS	
Approach lights except the last 210m	Minimums as for BALS	
Approach lights except the last 420m	Minimums as for IALS	
Standby power for approach lights	No effect	
Edge lights, threshold lights and runway end lights	Day: no effect Night: not allowed	
Centerline lights	No effect if F/D, HUDLS or autoland; otherwise RVR 750m	No effect

AMC11 CAT.OP.MPA.110 Table 9 Failed or Downgraded Equipment - Effect on Landing Minimums Operations without a Low Visibility Operations Approval (continued)

Failed or Downgraded Equipment	Effect on Landing Minimums	
	CAT I	APV, NPA
Centerline lights spacing increased to 30m	No effect	
Touchdown zone lights	No effect if F/D, HUDLS or autoland; otherwise RVR 750m	No effect
Taxiway lighting system	No effect	

AMC7 SPA.LVO.100 Low visibility operations

EFFECT ON LANDING MINIMUMS OF TEMPORARILY FAILED OR DOWNGRADED GROUND EQUIPMENT

AMC7 SPA.LVO.100 Table 7 Failed or downgraded Equipment - Effect on Landing Minimums Operations with an LVO Approval

Failed or downgraded equipment	Effect on Landing Minimums			
	CAT IIIB (no DH)	CAT IIIB	CAT IIIA	CAT II
ILS/MLS stand-by transmitter	Not allowed	RVR 200m	No effect	
Outer marker	No effect if replaced by height check at 1000ft			
Middle marker	No effect			
RVR assessment systems	At least one RVR value to be available on the aerodrome	On runways equipped with 2 or more RVR assessment units, one may be inoperative		
Approach lights	No effect	Not allowed for operations with DH > 50ft		Not allowed
Approach lights except the last 210m	No effect			Not allowed
Approach lights except the last 420m	No effect			

AMC7 SPA.LVO.100 Table 7 Failed or downgraded Equipment - Effect on Landing Minimums Operations with an LVO Approval (continued)

Failed or downgraded equipment	Effect on Landing Minimums			
	CAT IIIB (no DH)	CAT IIIB	CAT IIIA	CAT II
Stand-by power for approach lights	No effect			
Edge lights, threshold lights and runway end lights	No effect		Day: No effect	Day: No effect
			Night: RVR 550m	Night: Not allowed
Centerline lights	Day: RVR 200m	Not allowed	Day: RVR 300m	Day: RVR 350m
	Night: Not allowed		Night: RVR 400m	Night: RVR 550m (RVR 400m with HUDLS or auto-land)
Centerline lights Spacing increased to 30m	RVR 150m		No effect	
Touchdown zone lights	No effect	Day: RVR 200m	Day: RVR 300m	
		Night: RVR 300m	Night: RVR 550m (RVR 350m with HUDLS or auto-land)	
Taxiway light system	No effect			

15 ENHANCED VISION SYSTEMS - RVR REDUCTION

CAT.OP.MPA.110 Aerodrome operating minimums

b. The use of a head-up display (HUD), head-up guidance landing system (HUDLS) or enhanced vision system (EVS) may allow operations with lower visibilities than the established aerodrome operating minimums if approved in accordance with SPA.LVO.

SPA.LVO.110 General operating requirements

c. The operator shall only conduct approach operations utilising an EVS if:

    1. the EVS is certified for the purpose of this subpart and combines infra-red sensor image and flight information on the HUD;

    2. for operations with an RVR below 550m, the flight crew consists of at least two pilots;

3. for CAT I operations, natural visual reference to runway cues is attained at least at 100ft above the aerodrome threshold elevation;
4. for approach procedure with vertical guidance (APV) and non-precision (NPA) operations flown with CDFA technique, natural visual reference to runway cues is attained at least at 200ft above the aerodrome threshold elevation and the following requirements are complied with:
   i. the approach is flown using an approved vertical flight path guidance mode;
   ii. the approach segment from final approach fix (FAF) to runway threshold is straight and the difference between the final approach course and the runway centerline is not greater than 2°;
   iii. the final approach path is published and not greater than 3.7°;
   iv. the maximum cross-wind components established during certification of the EVS are not exceeded.

AMC6 SPA.LVO.100 Low visibility operations

OPERATIONS UTILISING EVS

The pilot using a certified enhanced vision system (EVS) in accordance with the procedures and limitations of the AFM:

a. may reduce the RVR value in column 1 to the value in column 2 of Table 6 below for CAT I operations, APV operations and NPA operations flown with the CDFA technique;
b. for CAT I operations:
   1. may continue an approach below DH to 100ft above the runway threshold elevation provided that a visual reference is displayed and identifiable on the EVS image; and
   2. should only continue an approach below 100ft above the runway threshold elevation provided that a visual reference is distinctly visible and identifiable to the pilot without reliance on the EVS;
c. for APV operations and NPA operations flown with the CDFA technique:
   1. may continue an approach below DH to 200ft above the runway threshold elevation provided that a visual reference is displayed and identifiable on the EVS image; and
   2. should only continue an approach below 200ft above the runway threshold elevation provided that a visual reference is distinctly visible and identifiable to the pilot without reliance on the EVS.

AMC6 SPA.LVO.100 Table 6 Operations utilising EVS - RVR Reduction vs. Normal RVR

Required RVR (m)	Reduced RVR (m) when using EVS
550	350
600	400

AERODROME OPERATING MINIMA - EASA AIR OPERATIONS

AMC6 SPA.LVO.100 Table 6 Operations utilising EVS - RVR Reduction vs. Normal RVR (continued)

Required RVR (m)	Reduced RVR (m) when using EVS
650	450
700	450
750	500
800	550
900	600
1000	650
1100	750
1200	800
1300	900
1400	900
1500	1000
1600	1100
1700	1100
1800	1200
1900	1300
2000	1300
2100	1400
2200	1500
2300	1500
2400	1600
2500	1700
2600	1700
2700	1800
2800	1900
2900	1900
3000	2000
3100	2000
3200	2100

AERODROME OPERATING MINIMA - EASA AIR OPERATIONS

AMC6 SPA.LVO.100 Table 6 Operations utilising EVS - RVR Reduction vs. Normal RVR (continued)

Required RVR (m)	Reduced RVR (m) when using EVS
3300	2200
3400	2200
3500	2300
3600	2400
3700	2400
3800	2500
3900	2600
4000	2600
4100	2700
4200	2800
4300	2800
4400	2900
4500	3000
4600	3000
4700	3100
4800	3200
4900	3200
5000	3300

16 SINGLE PILOT OPERATIONS - ADDITIONAL CRITERIA

AMC5 CAT.OP.MPA.110 Aerodrome operating minimums

DETERMINATION OF RVR MINIMUMS FOR NPA, APV, CAT I - AEROPLANES

a. Aeroplanes

The RVR minimums for NPA, APV and CAT I operations should be determined as follows:

8. For single pilot operations, the minimum RVR should be calculated in accordance with the following additional criteria:

   i. An RVR of less than 800m as indicated in CAT.OP.MPA.110 Table 5 may be used for CAT I approaches provided any of the following is used at least down to the applicable DH:

        A. a suitable autopilot, coupled to an ILS, MLS or GLS that is not published as restricted; or
        B. an approved HUDLS, including, where appropriate, enhanced vision system (EVS), or equivalent approved system;
    ii. where RTZL and/or RCLL are not available, the minimum RVR should not be less than 600m; and
    iii. an RVR of less than 800m as indicated in CAT.OP.MPA.110 Table 5 may be used for APV operations to runways with FALS, RTZL and RCLL when using an approved HUDLS, or equivalent approved system, or when conducting a coupled approach to a DH equal to or greater than 250ft.

17 PLANNING MINIMUMS

CAT.OP.MPA.185 Planning minimums for IFR flights - aeroplanes

a. **Planning Minimums for a Take-off Alternate Aerodrome**

The operator shall only select an aerodrome as a take-off alternate aerodrome when the appropriate weather reports and/or forecasts indicate that, during a period commencing one hour before and ending one hour after the estimated time of arrival at the aerodrome, the weather conditions will be at or above the applicable landing minimums specified in accordance with CAT.OP.MPA.110. The ceiling shall be taken into account when the only approach operations available are non-precision approaches (NPA) and/or circling operations. Any limitation related to OEI (one engine inoperative) operations shall be taken into account.

b. **Planning Minimums for a Destination Aerodrome, other than an Isolated Destination Aerodrome**

The operator shall only select the destination aerodrome when:

1. the appropriate weather reports and/or forecasts indicate that, during a period commencing one hour before and ending one hour after the estimated time of arrival at the aerodrome, the weather conditions will be at or above the applicable planning minimums as follows:
    i. RVR/visibility (VIS) specified in accordance with CAT.OP.MPA.110; and
    ii. for an NPA or a circling operation, the ceiling at or above MDH;

   or
2. two destination alternate aerodromes are selected.

c. **Planning Minimums for a Destination Alternate Aerodrome, Isolated Aerodrome, Fuel Enroute Alternate (fuel ERA) Aerodrome, Enroute Alternate (ERA) Aerodrome**

The operator shall only select an aerodrome for one of these purposes when the appropriate weather reports and/or forecasts indicate that, during a period commencing one hour before and ending one hour after the estimated time of arrival at the aerodrome, the weather conditions will be at or above the planning minimums in Table 1.

AERODROME OPERATING MINIMA - EASA AIR OPERATIONS

CAT.OP.MPA185 Table 1 Destination Alternate Aerodrome, Isolated Destination Aerodrome, Fuel ERA and ERA Aerodrome

Type of Approach	Planning Minimums
CAT II and III	CAT I RVR
CAT I	NPA RVR/VIS Ceiling shall be at or above MDH
NPA	NPA RVR/VIS + 1000m Ceiling shall be at or above MDH + 200ft
Circling	Circling

GM1 CAT.OP.MPA.185 Planning minimums for IFR flights - aeroplanes

PLANNING MINIMUMS FOR ALTERNATE AERODROMES

As Table 1 does not include planning minimums requirements for APV, LTS CAT I and OTS CAT II operations, the operator may use the following minimums:

a. for APV operations - NPA or CAT I minimums, depending on the DH/MDH;

b. for LTS CAT I operations - CAT I minimums; and

c. for OTS CAT II operations - CAT II minimums.

SPA.ETOPS.115 ETOPS enroute alternate aerodrome planning minimums

a. The operator shall only select an aerodrome as an ETOPS enroute alternate aerodrome when the appropriate weather reports or forecasts, or any combination thereof, indicate that, between the anticipated time of landing until one hour after the latest possible time of landing, conditions will exist at or above the planning minimums calculated by adding the additional limits of Table 1 below.

b. The operator shall include in the operations manual the method for determining the operating minimums at the planned ETOPS enroute alternate aerodrome.

SPA.ETOPS.115 Table 1 Planning Minimums for ETOPS Enroute Alternate Aerodrome

Type of Approach	Planning Minimums
Precision approach	DA/H + 200ft RVR/VIS + 800m
Non-precision approach or circling approach	MDA/H + 400ft RVR/VIS + 1500m

18 COMMENCEMENT AND CONTINUATION OF APPROACH (APPROACH BAN)

CAT.OP.MPA.305 - Commencement and continuation of approach

a. The commander or the pilot to whom conduct of the flight has been delegated may commence an instrument approach regardless of the reported RVR/VIS.

b. If the reported RVR/VIS is less than the applicable minimum the approach shall not be continued:

   1. below 1000ft above the aerodrome; or
   2. into the final approach segment in the case where DA/H or MDA/H is more than 1000ft above the aerodrome.

c. Where the RVR is not available, RVR values may be derived by converting the reported visibility.

d. If, after passing 1000ft above the aerodrome, the reported RVR/VIS falls below the applicable minimum, the approach may be continued to DA/H or MDA/H.

e. The approach may be continued below DA/H or MDA/H and the landing may be completed, provided that the visual reference adequate for the type of approach operation and for the intended runway is established at the DA/H or MDA/H and is maintained.

f. The touchdown zone RVR shall always be controlling. If reported and relevant, the midpoint and stopend RVR shall also be controlling. The minimum RVR value for the midpoint shall be 125m or the RVR required for the touchdown zone if less, and 75m for the stopend. For aircraft equipped with a rollout guidance control system, the minimum RVR value for the midpoint shall be 75m.

AMC1 CAT.OP.MPA.305(e) - Commencement and continuation of approach

VISUAL REFERENCES FOR INSTRUMENT APPROACH OPERATIONS

a. NPA, APV and CAT I operations

   At DH or MDH, at least one of the visual references specified below should be distinctly visible and identifiable to the pilot:

   1. elements of the approach lighting system;
   2. threshold;
   3. threshold markings;
   4. threshold lights;
   5. threshold identification lights;
   6. visual glide slope indicator;
   7. touchdown zone or touchdown zone markings;
   8. touchdown zone lights;
   9. FATO/runway edge lights; or
   10. other visual references specified in the operations manual.

b. Lower than Standard CAT I (LTS CAT I) operations

AERODROME OPERATING MINIMA - EASA AIR OPERATIONS

At DH, the visual references specified below should be distinctly visible and identifiable to the pilot:

1. a segment of at least three consecutive lights, being the centerline of the approach lights, or touchdown zone lights, or runway centerline lights, or runway edge lights, or a combination of these;
2. this visual reference should include a lateral element of the ground pattern, such as an approach light crossbar or the landing threshold or a barrette of the touchdown zone light unless the operation is conducted utilising an approved HUDLS useable to at least 150ft.

c. CAT II or OTS CAT II operations

At DH, the visual references specified below should be distinctly visible and identifiable to the pilot:

1. a segment of at least three consecutive lights, being the centerline of the approach lights, or touchdown zone lights, or runway centerline lights, or runway edge lights, or a combination of these;
2. this visual reference should include a lateral element of the ground pattern, such as an approach light crossbar or the landing threshold or a barrette of the touchdown zone light unless the operation is conducted utilising an approved HUDLS to touchdown.

d. CAT III operations

1. For CAT IIIA operations and for CAT IIIB operations conducted either with fail-passive flight control systems or with the use of an approved HUDLS: at DH, a segment of at least three consecutive lights being the centerline of the approach lights, or touchdown zone lights, or runway centerline lights, or runway edge lights, or a combination of these is attained and can be maintained by the pilot.
2. For CAT IIIB operations conducted either with fail-operational flight control systems or with a fail-operational hybrid landing system using a DH: at DH, at least one centerline light is attained and can be maintained by the pilot.
3. For CAT IIIB with no DH there is no specification for visual reference with the runway prior to touchdown.

e. Approach operations utilising EVS - CAT I operations

1. At DH, the following visual references should be displayed and identifiable to the pilot on the EVS image:
    - i. Elements of the approach light; or
    - ii. The runway threshold, identified by at least one of the following:
        - A. the beginning of the runway landing surface; or
        - B. the threshold lights, the threshold identification lights; or

AERODROME OPERATING MINIMA - EASA AIR OPERATIONS

C. the touchdown zone, identified by at least one of the following: the runway touchdown zone lights, the touchdown zone markings or the runway lights.

2. At 100ft above runway threshold elevation at least one of the visual references specified below should be distinctly visible and identifiable to the pilot without reliance on the EVS:
   - i. the lights or markings of the threshold; or
   - ii. the lights or markings of the touchdown zone.

f. Approach operations utilising EVS - APV and NPA operations flown with the CDFA technique

1. At DH/MDH, visual reference should be displayed and identifiable to the pilot on the EVS image as specified under a.
2. At 200ft above runway threshold elevation, at least one of the visual references specified under a. should be distinctly visible and identifiable to the pilot without reliance on the EVS.

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Air Traffic Control

Aerodrome Operating Minimums - Jeppesen

JEPPESEN AOM POLICY

WITH STATE-PROVIDED MINIMUMS

State-provided minimums will be charted.

Missing minimums will be determined according to the guidance in ICAO Doc 9365, but not lower than any State-provided value.

WITHOUT STATE-PROVIDED MINIMUMS

Minimums will be determined according to the guidance in ICAO Doc 9365.

ICAO DOC 9365 (TABLES AND RULES)

APPROACH LIGHTING SYSTEMS

Approach lights will be classified as FALS, IALS, BALS and NALS as shown in Table B-1 below. Landing minimums depend on available approach lights.

NOTE: Classification of approach lights will not be shown on Jeppesen charts.

Table B-1: Approach lights classification

Class of Facility	Length, Configuration and Intensity of Approach Lights
FALS (full approach lighting system) (see Annex 14)	Precision approach CAT I lighting system (HIALS ≥ 720m) Distance coded centerline, barrette centerline
IALS (intermediate approach lighting system) (see Annex 14)	Simple approach lighting system (HIALS 420m to 719m) single source, barrette
BALS (basic approach lighting system)	Any other approach lighting system (HIALS, MIALS or ALS 210m to 419m)
NALS (no approach lighting system)	Any other approach lighting system (HIALS, MIALS or ALS < 210m) or no approach lights

TAKE-OFF MINIMUMS

Take-off minimums depend on available runway lighting and marking, and availability of an approved lateral guidance system as shown in Table 6-1.

Lowest RVR of 75m is only shown if this information is provided by State source or if the runway is approved for CAT IIIB operations with an RVR of 75m.

Take-off minimums should not be less than the applicable minimums for landing at the aerodrome unless a suitable take-off alternate aerodrome is available.

Table 6-1: Take-off Minimums

Facilities	RVR/VIS (1)
Adequate visual reference (day only) (2)	500m/1600ft
Runway edge lights or runway centerline markings (3)	400m/1200ft
Runway edge lights and runway centerline markings (3)	300m/1000ft
Runway edge lights and runway centerline lights	200m/600ft
Runway edge lights and runway centerline lights and relevant RVR information (4)	TDZ 150m/500ft MID 150m/500ft Stop-end 150m/500ft
High intensity runway edge lights and runway centerline lights (spacing 15m or less) and relevant RVR information (4)	TDZ 125m/400ft MID 125m/400ft Stop-end 125m/400ft
High intensity runway edge lights and runway centerline lights (spacing 15m or less), approved lateral guidance system and relevant RVR information (4)	TDZ 75m/300ft MID 75m/300ft Stop-end 75m/300ft

(1) The TDZ RVR/VIS may be assessed by the pilot.

(2) Adequate visual reference means that a pilot is able to continuously identify the take-off surface and maintain directional control.

(3) For night operations, at least runway edge lights or centerline lights and runway end lights are available.

(4) The required RVR is achieved for all relevant RVRs.

Rule

a. Take-off minimums are determined according to the best available runway lighting conditions for the airport.

b. There will be a single box only unless State-provided restrictions require to differentiate between the available runways. In such cases the box will show runway specific take-off minimums.

CIRCLING MINIMUMS

Circling minimums depend on Procedure Design Criteria (PANS-OPS, TERPS), Circling OCH/MDH and aircraft category as shown in Table 6-2.

Approach lights have no effect on circling minimums.

Table 6-2: Circling Minimums

	CAT A	CAT B	CAT C	CAT D
Max IAS	100kt	135kt	180kt	205kt
Lowest MDH	400ft	500ft	600ft	700ft
Minimum meteorological visibility	1500m	1600m	2400m	3600m

a. Speeds are according to PANS-OPS, Volume I (Doc 8168).

b. The circling visibilities differ from those in PANS-OPS, Volume I (Doc 8168) since the visual maneuvering (circling) values in Table II-5-6-1 of Doc 8168 are not intended for establishment of operating Minimums.

Rules

a. Minimum Descent Height (MDH) should be the higher of:
   1. the published circling OCH for the aircraft category; or
   2. the minimum circling height derived from the Table 6-2; or
   3. the DH/MDH of the preceding instrument approach procedure.

b. The MDA for circling must be calculated by adding the published airport elevation to the MDH.

c. The minimum visibility for circling should be the higher of:
   1. the circling visibility for the aircraft category, if published; or
   2. the minimum visibility derived from the Table 6-2; or
   3. the RVR minimums for the preceding instrument approach procedure.

d. If circling minimums are lower than straight-in minimums, a note is added to indicate that higher straight-in minimums (descent limit and/or visibility) apply.

PRECISION CAT I, APV AND NON-PRECISION MINIMUMS (NPA)

Approach minimums depend on the OCH/DH/MDH of the approach procedure, the available runway lights, specific procedure requirements and on the flight technique to be used (CDFA vs non-CDFA) on non-precision approaches.

Table 6-3: RVR for CAT I, APV and NPA

DH or MDH (ft)			*Class of lighting facility*			
			FALS	**IALS**	**BALS**	**NALS**
			RVR (meters)			
200	-	210	550	750	1000	1200
211	-	220	550	800	1000	1200
221	-	230	550	800	1000	1200
231	-	240	550	800	1000	1200
241	-	250	550	800	1000	1300
251	-	260	600	800	1100	1300
261	-	280	600	900	1100	1300
281	-	300	650	900	1200	1400
301	-	320	700	1000	1200	1400
321	-	340	800	1100	1300	1500
341	-	360	900	1200	1400	1600
361	-	380	1000	1300	1500	1700
381	-	400	1100	1400	1600	1800
401	-	420	1200	1500	1700	1900
421	-	440	1300	1600	1800	2000
441	-	460	1400	1700	1900	2100
461	-	480	1500	1800	2000	2200
481	-	500	1500	1800	2100	2300
501	-	520	1600	1900	2100	2400
521	-	540	1700	2000	2200	2400
541	-	560	1800	2100	2300	2500
561	-	580	1900	2200	2400	2600
581	-	600	2000	2300	2500	2700
601	-	620	2100	2400	2600	2800
621	-	640	2200	2500	2700	2900
641	-	660	2300	2600	2800	3000
661	-	680	2400	2700	2900	3100

Table 6-3: RVR for CAT I, APV and NPA (continued)

681	-	700	2500	2800	3000	3200
701	-	720	2600	2900	3100	3300
721	-	740	2700	3000	3200	3400
741	-	760	2700	3000	3300	3500
761	-	800	2900	3200	3400	3600
801	-	850	3100	3400	3600	3800
851	-	900	3300	3600	3800	4000
901	-	950	3600	3900	4100	4300
951	-	1000	3800	4100	4300	4500
1001	-	1100	4100	4400	4600	4900
1101	-	1200	4600	4900	5000	5000
1201 and above			5000	5000	5000	5000

Rules

a. In order to qualify for the lowest allowable values of RVR as detailed in Table 6-3, the instrument approach procedure should be flown as 3D approach and landing operation and needs to meet the following facility requirements and associated conditions:

1. Precision or APV instrument approach procedure with a designated vertical profile which do not require a rate of descent greater than 1000ft/min, unless other approach angles are approved by the authority;
2. Non-precision instrument approach procedures flown using the CDFA technique with a nominal vertical profile which do not require a rate of descent greater than 1000ft/min, unless other approach angles are approved by the authority, where the facilities are NDB, NDB DME, VOR, VOR DME, LOC, LOC DME, VDF, SRA or LNAV/VNAV, with a final approach segment of at least 3NM, which also fulfil the following criteria:
   (a) The final approach track is offset by not more than 15 degrees for CAT A & B aircraft or by not more than 5 degrees for CAT C & D aircraft; and
   (b) The FAF or another appropriate fix where descent is initiated is available, or distance to threshold is available by FMS/RNAV or DME; and
   (c) If the MAP is determined by timing, the distance from FAF to threshold is less than 8NM.

   NOTE: The limiting approach path angle for CAT A & B would be 4.5 degrees and 3.77 degrees for CAT C & D aircraft.

b. An RVR as low as 550m as indicated in Table 6-3 may be used for:

   1. CAT I operations to runways with FALS, runway touchdown zone lights and runway centerline lights; or
   2. CAT I operations to runways without runway touchdown zone lights and/or runway centerline lights when using an approved HUDLS, or equivalent approved system, or when conducting a coupled approach or flight-director flown approach to DH.

c. Values in Table 6-3 exceeding 1500m (CAT A & B) or 2400m (CAT C & D) do not have to be applied if:
   1. The instrument approach operation is based on precision or APV instrument approach procedure; or
   2. If the approach operation is based on NDB, NDB DME, VOR, VOR DME, LOC, LOC DME, VDF, SRA or RNAV without approved vertical guidance but fulfilling the criteria from rule a.2. above.

d. Values in Table 6-3 which are less than 1000m may not be applied if the approach operation is based on NDB, NDB DME, VOR, VOR DME, LOC, LOC DME, VDF, SRA or RNAV without approved vertical guidance if:
   1. The criteria in rule a.2. are not fulfilled; or
   2. The DH or MDH is 1200ft or higher.

e. Some States recommend to increase the RVR Minimums by 200m for CAT A & B and by 400m for CAT C & D aircraft when executing a non-precision approach procedure without using a CDFA flight technique.

Remarks:

For CAT I precision approaches without TDZ and/or CL, the lowest minimums (e.g. R550m) are shown and the higher values (R750m) with the less requirements are shown as note only.

For non-precision approach minimums based on CDFA, the descent label is shown as DA/MDA(H). **This DA/MDA(H) value does not include any add-on to compensate for height-loss.** If the State requires or suggests a specific height loss, a note will be added to indicate this situation.

A DA(H) is shown on non-precision approaches only if published as such on State-provided procedure source. In this case it is assumed that the State of the Aerodrome has incorporated a height loss value.

An MDA(H) is shown on all non-CDFA non-precision approaches, or if the State published an MDA(H) value on procedure source.

PRECISION CAT II MINIMUMS

CAT II precision approach minimums depend on the OCH/DH of the approach procedure, the available runway lights and specific procedure requirements as shown in Table 6-4.

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Table 6-4: Approach Minimums CAT II

Decision Height (ft)	CAT A, B & C	CAT D
100-120	RVR 300m	RVR 300m/350m (1)
121-140	RVR 400m	RVR 400m
141-199	RVR 450m	RVR 450m
Remark: CAT II operations coupled to below DH. (1) For CAT D aircraft conducting an autoland, RVR 300m may be used.		

Rules

RVR values will be shown according to Table 6-4. RVR 350m for CAT D will only be shown as note at the bottom of the minimums box, if applicable.

An RA value is shown for every DA(H) if provided by procedure source, or if a Precision Approach Terrain Chart (PATC) is available (PANS-OPS procedures). If no RA is shown, then the operator may have to apply an additional height-loss for using barometric altimeter (refer to ICAO Doc 8168 PANS-OPS).

PRECISION CAT III MINIMUMS

CAT III precision approach minimums (Table 6-5) depend on runway and aircraft equipment. There must be a clear statement on procedure source that a specific runway is approved for CAT III operations.

Table 6-5: Approach Minimums CAT III

Category	Decision height	Roll-out control/guidance system	RVR
IIIA	Less than 100ft	Not required	175m
IIIB	Less than 100ft	Fail-passive	150m
IIIB	Less than 50ft	Fail-passive	125m
IIIB	Less than 50ft or no DH	Fail-operational (1)	75m
(1) The fail-operational system referred to may consist of a fail-operational hybrid system.			

Rules

a. In the case of a CAT III runway, it may be assumed that operations with no DH can be supported unless specifically restricted as published in the AIP or NOTAM.

b. Depending on source, lowest CAT III, CAT III B & CAT IIIA, or only CAT IIIA minimums are shown.

c. A DH or the requirement for a DH is only shown if this is required by the State of the Aerodrome.

ALTERNATE MINIMUMS

Table D-1: Alternate Minimums

Approach facility configuration	*Ceiling DA/H or MDA/H*	*RVR*
For airports supporting one approach and landing operation.	Authorized DA/H or MDA/H plus an increment of 125m (400ft).	Authorized visibility plus an increment of 1500m.
For airports supporting at least two approach and landing operations, each providing a straight-in approach and landing operation to different, suitable runways.	Authorized DA/H or MDA/H plus an increment of 60m (200ft).	Authorized visibility plus an increment of 800m.
For airports with a published CAT II or CAT III approach and landing operation, and at least two approach and landing operations, each providing a straight-in approach and landing operation to different, suitable runway.	For CAT II procedures, a ceiling of at least 90m (300ft), or for CAT III procedures, a ceiling of at least 60m (200ft).	For CAT II, a visibility of at least RVR 1200m or, for CAT III, a visibility of at least RVR 550m.

Rule

Alternate minimums will not be shown, unless alternate minimum values are published by the State of the aerodrome.

CONVERSION OF REPORTED METEOROLOGICAL VISIBILITY TO CMV

The conversion (Table E-1) has to be applied by the pilot if the horizontal minimum is charted differently to what is reported by ATC (reported VIS versus RVR on chart).

Table E-1: Conversion factors (VIS to CMV)

Lighting elements in operation	CMV = reported meteorological visibility multiplied by:	
	Day	Night
High intensity approach and runway lighting	1.5	2.0*
Any type of lighting installation other than above	1.0	1.5*
No lighting	1.0	Not applicable

Table E-1: Conversion factors (VIS to CMV) (continued)

* The relationship between reported visibility and RVR/CMV at night is under review by ICAO.

Rules

a. All charted values will be labelled as R (= RVR), V (= VIS), C (= CMV) or R/V (= RVR and/or VIS). CMV is only charted if published by the State of the Aerodrome.

b. An operator must ensure that a meteorological visibility to CMV conversion is not used for take-off, for calculating any other required RVR minimum less than 800m, or when reported RVR is available. If a landing minimum is charted as R550m (up to R750m) and there is no RVR reported, the minimum VIS for landing is 800m.

c. Pilot action:

Charted minimum	Reported by ATC	Pilot action
RVR	VIS	Convert reported VIS into CMV. CMV has to be equal to or higher than charted RVR minimum.
RVR and VIS	RVR	Compare reported RVR against charted RVR minimum. No conversion allowed.
	VIS	Compare reported VIS against charted VIS minimum. No conversion allowed.
VIS	RVR	Compare reported RVR against charted VIS minimum. No conversion allowed.
CMV	VIS	Convert reported VIS into CMV, compare against charted CMV minimum.
CMV	RVR	Compare reported RVR against charted CMV minimum.

SYSTEM MINIMUMS

If the procedure source provided OCH is less than the system minimum, the DH/MDH is increased to the value as shown in Table F-1.

Table F-1: System Minimums

Instrument approach procedure	*Lowest DH/MDH*
ILS/MLS/GLS/SBAS CAT I	200ft (60m) [1]
GNSS (SBAS)	250ft (75m)
GNSS (LNAV/VNAV)	250ft (75m)

Table F-1: System Minimums (continued)

Instrument approach procedure	*Lowest DH/MDH*
Localizer with or without DME	250ft (75m)
SRA (terminating at 1/2NM)	250ft (75m)
SRA (terminating at 1NM)	300ft (90m)
SRA (terminating at 2NM or more)	350ft (105m)
GNSS (LNAV)	250ft (75m)
VOR	300ft (90m)
VOR/DME	250ft (75m)
NDB	350ft (105m)
NDB/DME	300ft (90m)
VDF	350ft (105m)

[1] The lowest authorized DH for CAT I operations is 200ft (60m) unless an equivalent level of safety can be achieved through use of additional procedural or operational requirements.

VISIBILITY CREDIT FOR ENHANCED VISION SYSTEMS (EVS)

Table G-1: RVR reduction for EVS equipped aircraft

RVR normally required	*RVR for approach utilizing EVS*	*RVR normally required*	*RVR for approach utilizing EVS*
550	350	2700	1800
600	400	2800	1900
650	450	2900	1900
700	450	3000	2000
750	500	3100	2000
800	550	3200	2100
900	600	3300	2200
1000	650	3400	2200
1100	750	3500	2300
1200	800	3600	2400
1300	900	3700	2400
1400	900	3800	2500

Table G-1: RVR reduction for EVS equipped aircraft (continued)

RVR normally required	*RVR for approach utilizing EVS*	*RVR normally required*	*RVR for approach utilizing EVS*
1500	1000	3900	2600
1600	1100	4000	2600
1700	1100	4100	2700
1800	1200	4200	2800
1900	1300	4300	2800
2000	1300	4400	2900
2100	1400	4500	3000
2200	1500	4600	3000
2300	1500	4700	3100
2400	1600	4800	3200
2500	1700	4900	3200
2600	1700	5000	3300

Rule

Visibility credit for EVS is not applied on Jeppesen Standard charts.

COMPARISON OF AOM CONCEPTS

The table below compares AOM concepts which are defined as being “similar” to ICAO Doc 9365 according to Jeppesen AOM rules. The table is intended to make operators aware of the deviations from Doc 9365 to provide guidance to the pilots.

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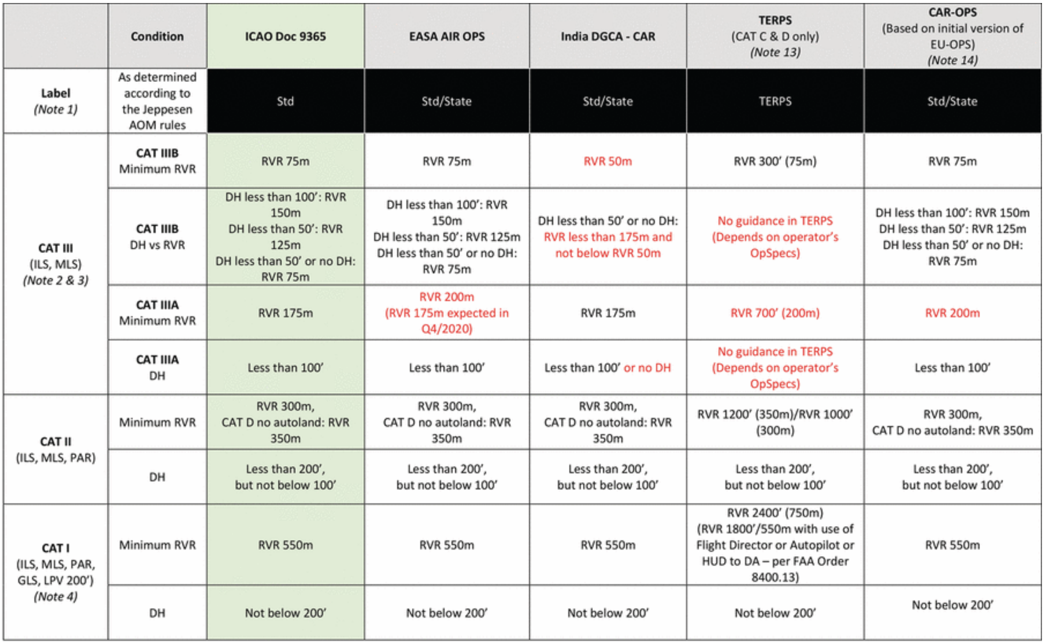

	Condition	**ICAO Doc 9365**	**EASA AIR OPS**	**India DGCA - CAR**	**TERPS** (CAT C & D only) *(Note 13)*	**CAR-OPS** (Based on initial version of EU-OPS) *(Note 14)*
Label *(Note 1)*	As determined according to the Jeppesen AOM rules	Std	Std/State	Std/State	TERPS	Std/State
CAT III (ILS, MLS) *(Note 2 & 3)*	**CAT IIIB** Minimum RVR	RVR 75m	RVR 75m	RVR 50m	RVR 300' (75m)	RVR 75m
	CAT IIIB DH vs RVR	DH less than 100': RVR 150m DH less than 50': RVR 125m DH less than 50' or no DH: RVR 75m	DH less than 100': RVR 150m DH less than 50': RVR 125m DH less than 50' or no DH: RVR 75m	DH less than 50' or no DH: RVR less than 175m and not below RVR 50m	No guidance in TERPS (Depends on operator's OpSpecs)	DH less than 100': RVR 150m DH less than 50': RVR 125m DH less than 50' or no DH: RVR 75m
	CAT IIIA Minimum RVR	RVR 175m	RVR 200m (RVR 175m expected in Q4/2020)	RVR 175m	RVR 700' (200m)	RVR 200m
	CAT IIIA DH	Less than 100'	Less than 100'	Less than 100' or no DH	No guidance in TERPS (Depends on operator's OpSpecs)	Less than 100'
CAT II (ILS, MLS, PAR)	Minimum RVR	RVR 300m, CAT D no autoland: RVR 350m	RVR 300m, CAT D no autoland: RVR 350m	RVR 300m, CAT D no autoland: RVR 350m	RVR 1200' (350m)/RVR 1000' (300m)	RVR 300m, CAT D no autoland: RVR 350m
	DH	Less than 200', but not below 100'	Less than 200', but not below 100'	Less than 200', but not below 100'	Less than 200', but not below 100'	Less than 200', but not below 100'
CAT I (ILS, MLS, PAR, GLS, LPV 200') *(Note 4)*	Minimum RVR	RVR 550m	RVR 550m	RVR 550m	RVR 2400' (750m) (RVR 1800'/550m with use of Flight Director or Autopilot or HUD to DA – per FAA Order 8400.13)	RVR 550m
	DH	Not below 200'	Not below 200'	Not below 200'	Not below 200'	Not below 200'

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	Condition	**ICAO Doc 9365**	**EASA AIR OPS**	**India DGCA - CAR**	**TERPS** (CAT C & D only) *(Note 13)*	**CAR-OPS** (Based on initial version of EU-OPS) *(Note 14)*
APV (LNAV/VNAV, LPV 250')	Minimum RVR	RVR 750m	RVR 550m	RVR 550m	RVR 2400' (750m)	RVR 600m
	DH	Not below 250'	Not below 250'	Not below 250'	Not below 250'	Not below 250'
NPA (LOC, VOR, NDB, VDF, LNAV, SRA, etc...)	Minimum RVR	RVR 750m	RVR 750m	RVR 750m	RVR 2400' (750m)	RVR 750m
	MDH	250', 300', 350'	250', 300', 350'	250', 300', 350' LNAV = 300'	250', 300', 350'	250', 300', 350' LNAV = 300'
	VNAV DA(H) instead of MDA(H)	Depends on operator	Depends on operator	At least 50' add on required	Depends on operator's OpSpecs – OpSpec C073 in FAA Order 8900.1 CHG 238 (Volume 3, Chapter 18, Section 5, Part C)	Depends on operator
	CDFA vs non-CDFA	CDFA recommended, **no** add-on requirement on non-CDFA	CDFA required, otherwise add-on 200m/400m	CDFA required, otherwise add-on 200m/400m	CDFA recommended (FAA Advisory Circular AC 120-108)	CDFA required, otherwise add-on 200m/400m
Circling *(Note 5)*	Minimum VIS	A/B/C/D 1500m/1600m/2400m/ 3600m	A/B/C/D 1500m/1600m/2400m/ 3600m	DGCA approval required	A/B/C/D 1sm/1sm/1.5sm/2sm (1600m/1600m/2400m/ 3200m)	A/B/C/D 1500m/1600m/2400m/ 3600m
	MDH	A/B/C/D 400'/500'/600'/700'	A/B/C/D 400'/500'/600'/700'	DGCA approval required	A/B/C/D 350'/450'/450'/550'	A/B/C/D 400'/500'/600'/700'
SA CAT I *(Note 6)*	**Guidance**	no guidance	no guidance/expected in Q4/2020	no guidance	RA/DH 150' RVR 1400' (Special OpSpec, MSpec, or LoA Approval req & use of HUD to DH – per FAA Order 8400.13D)	no guidance

	Condition	**ICAO Doc 9365**	**EASA AIR OPS**	**India DGCA - CAR**	**TERPS** (CAT C & D only) *(Note 13)*	**CAR-OPS** (Based on initial version of EU-OPS) *(Note 14)*
SA CAT II *(Note 6)*	**Guidance**	no guidance	no guidance/expected in Q4/2020	no guidance	RA/DH 100' RVR 1200' (Special OpSpec, MSpec, or LoA Approval req & use of Autoland or HUD to DH – per FAA Order 8400.13D)	no guidance
LTS CAT I *(Note 7)*	**Guidance**	no guidance	AMC3 SPA.LVO.100	no guidance	no guidance	EASA AIR OPS tables
OTS CAT II *(Note 7)*	**Guidance**	no guidance	AMC4 SPA.LVO.100	no guidance	no guidance	EASA AIR OPS tables
Take-off *(Note 8)*	**Minimum RVR**	RVR 125m, RVR 75m with approved guidance system or HUD/HUDLS	RVR 125m, RVR 75m with approved guidance system or HUD/HUDLS	RVR 125m, RVR 75m with approved guidance system or HUD/HUDLS	RVR 500' (150m), RVR 300' (75m) with approved guidance system or HUD/HUDLS	ABC/D RVR 125m/RVR 150m, RVR 75m with approved guidance system or HUD/HUDLS
Conversion of reported VIS into CMV/RVR *(Note 9)*	**Guidance**	yes	yes	yes	VIS or RVR/VIS minimums published, **no** conversion of reported VIS	yes
Low Visibility Procedures (LVP) *(Note 10)*	**Guidance**	Below RVR 550m (paragraph 3.2.17)	SPA.LVO.115 Below VIS 800m (RVR 550m)	Below RVR 550m/VIS 800m	No specific reference to the term "LVP", but similar procedures in low visibility conditions may exist (SMGCS)	During LTS CAT I, OTS CAT II, CAT II, CAT III and LVTO
Low Visibility Take-off (LVTO) *(Note 11)*	**Guidance**	no guidance (European Regulation only)	AMC1 SPA.LVO.100 Below RVR 400m	Below RVR 400m	no guidance	Below RVR 400m
EVS RVR reduction *(Note 12)*	**Guidance**	Table G-1	AMC6 SPA.LVO.100	No guidance	no guidance	Yes, EASA AIR OPS table

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NOTE 1: "Std" label is used for AOM based purely on ICAO Doc 9365 rules. "Std/State" indicates that there are only a small number of differences to the ICAO Doc 9365 as indicated in the table above. "TERPS" indicates that the minimums are based on TERPS. Operators have to analyze the differences to provide guidance to the pilots.

NOTE 2: Some countries publish a minimum RVR for CAT III only, not for CAT IIIB and/or CAT IIIA. For those countries Jeppesen will not differentiate between CAT IIIB and CAT IIIA. Pilots have to compare the charted RVR against the approved company minimum.

NOTE 3: On some CAT III operations a DH is required. Because the DH depends on several factors which might be operator specific, the operator has to provide guidance to the pilots. A specific DH is only charted if it is published by the State for the applicable CAT III procedure.

NOTE 4: An LPV might be designed as CAT I or as APV approach procedure. Because of the differences in CAT I and APV minimums, the procedure header in the minimums box will be shown as "LPV CAT I" for European charts. Operators have to provide guidance to the pilots whether the LPV procedures can be flown or not.

NOTE 5: For PANS-OPS and TERPS circling procedures the circling speeds and circling areas are different. Operators have to analyze the differences to provide guidance to the pilots.

NOTE 6: SA CAT I and SA CAT II procedures are mainly published in the United States. Operators need a specific approval and have to provide guidance to the pilots.

NOTE 7: LTS CAT I and OTS CAT II are mainly published in the European Region. Operators need a specific approval and have to provide guidance to the pilots. Currently LTS CAT I minimums are only displayed on tailored charts on customer request. OTS CAT II minimums are only displayed if such a procedure is published in the AIP. EASA plans to remove LTS CAT I and OTS CAT II from the regulation in Q4/2020 and will provide new guidance for SA CAT I and SA CAT II procedures.

NOTE 8: Jeppesen charts will provide the lowest possible minimums for the airport. The normal take-off minimums box will not differentiate between the runways, which may have different runway lighting, unless required because of State-provided minimums. Pilots are reminded that for all take-off minimums below RVR 550m/VIS 800m low visibility procedures might be required. Pilots are also reminded that for take-offs in RVR below 400m a specific approval might be required. Operators which still have an approval according to a CAR-OPS version which is based on earlier EASA AMC/GM (CAT C and D aircraft have different minimums) have to analyze the differences to provide guidance to the pilots.

NOTE 9: The minimums are charted as RVR unless a State provides VIS or CMV values as minimums for the approach procedure. Depending on the available lighting an ATC reported visibility can be converted into a CMV to compare it against a charted RVR/CMV. Whenever a VIS value is charted in the minimums box, an ATC reported visibility must not be converted. An ATC reported RVR can be compared against a charted RVR/CMV.

NOTE 10: It is the operator/pilot responsibility to verify that low visibility procedures (LVP) are in force if they are required. Some States do not use the term "low visibility procedures" or they do *not publish the procedures within the AIP. If CAT II/III operations are in progress, then low visibility procedures are in force.*

NOTE 11: Operators need a specific approval for low visibility take-off operations and have to provide guidance to the pilots. "Low Visibility Take-off" is only shown in the take-off boxes based on EASA AIR OPS or Indian CAR rules.

NOTE 12: Operators may reduce the required RVR if using an Enhanced Vision System if they are approved for doing this. Jeppesen does not chart EVS RVR minimums.

NOTE 13: The comparison is only valid for CAT C and D aircraft because the harmonized TERPS Table 3-3-1 excludes CAT A and B aircraft.

NOTE 14: The initial version published by EASA (EU-OPS 1) contained the old JAR-OPS take-off minimums, where the lowest RVR for CAT C and D is different (125m vs 150m). The rules from this publication were applied by several State Authorities but not updated with the latest changes on EASA AIR OPS rules. Therefore the take-off minimums are different to the take-off minimums provided in ICAO Doc 9365.

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Air Traffic Control

Controller Pilot Data Link Communication (CPDLC)

DATA LINK OPERATIONS

Extracted from Doc 10037 - Global Operational Data Link (GOLD) Manual – First Edition

GENERAL

These pages provide guidance and information concerning data link aspects of aeronautical activity and is intended to facilitate the uniform application of Standards and Recommended Practices contained in Annex 2 — Rules of the Air and in Annex 11 — Air Traffic Services, the provisions in the Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444) and, when necessary, the Regional Supplementary Procedures (Doc 7030).

4. FLIGHT CREW PROCEDURES

4.1 OVERVIEW

4.1.1 General

4.1.1.1 The operator may be required to obtain a necessary approval by the State of the Operator or State of Registry to use CPDLC and ADS-C services. This chapter provides guidance on procedures for the flight crew in airspace where data link services are available.

4.1.1.2 These procedures are intended to assist operators in the development of:

a. operating procedures and associated documentation; and

b. appropriate training programs.

4.1.1.3 Flight crews should be knowledgeable in operating manuals for use of the data link system specific to the aircraft type.

4.1.1.4 Flight crews should be knowledgeable in data link operations.

4.1.2 Operational Differences between Voice Communications and CPDLC

4.1.2.1 Development, testing, and operational experience have highlighted fundamental differences between voice communications and CPDLC. These differences need to be considered when developing or approving flight crew procedures involving the use of CPDLC.

4.1.2.2 For example, when using voice communications, each flight crew member hears an incoming or outgoing ATS transmission. With voice, the natural ability for each flight crew member to understand incoming and outgoing transmissions for their own aircraft has provided a certain level of situational awareness among the flight crew. With CPDLC, flight crew procedures need to ensure that the flight crew has an equivalent level of situational awareness associated with understanding the content and intent of a message in the same way.

4.1.2.3 Each flight crew member (e.g. pilot flying and pilot monitoring) should individually review each CPDLC uplink message prior to responding to and/or executing any clearance, and individually review each CPDLC downlink message prior to transmission. Reading a message individually is a key element to ensuring that each flight crew member does not infer any preconceived intent different from what is intended or appropriate. Reading the message aloud would bias the other flight crew member and could lead to the error of 'reading' what was read aloud as opposed to what was actually displayed.

4.1.2.4 Some uplink messages, such as complex or conditional clearances, require special attention to prevent the flight crew from responding to a clearance with RSPD-1 WILCO, but not complying with that clearance. To minimize errors, when responding to a clearance with RSPD-1 WILCO, each flight crew member should read the uplink message individually (silently) before initiating a discussion about whether and how to act on the message.

4.1.2.5 In a similar manner, each flight crew member should individually review CPDLC downlink messages before the message is sent. Having one flight crew member (e.g. the pilot monitoring) input the message and having a different flight crew member (pilot flying) review the message before it is sent provides an adequate level of situational awareness comparable to or better than voice communication.

4.1.2.6 If an operator uses augmented crews, the flight crew carrying out the 'handover' briefing should thoroughly brief the 'changeover' flight crew or flight crew member on the status of ADS-C and CPDLC connections and messages, including a review of any pertinent uplink and downlink CPDLC messages (e.g. conditional clearances).

4.1.2.7 The flight crew should coordinate uplink and downlink messages using the appropriate flight deck displays. Unless otherwise authorized, the flight crew should not use printer-based information to verify CPDLC messages as printers are not usually intended for this specific purpose.

NOTE: For aircraft that have CPDLC message printing capabilities, there are constraints associated with the use of the flight deck printer. Printers may not produce an exact copy of the displayed clearance with the required reliability, and should not be used as the primary display for CPDLC. However, in some cases, printed copies may assist the flight crew with clearances and other information that are displayed on more than one page, conditional clearances and crew handover briefings.

4.1.3 When to use Voice and when to use CPDLC

4.1.3.1 When operating within airspace beyond the range of DCPC VHF voice communication, CPDLC is available and local ATC procedures do not state otherwise, the flight crew should normally choose CPDLC as the means of communication. The flight crew would use voice as an alternative means of communication (e.g. VHF, HF or SATVOICE direct or via a radio operator). However, in any case, the flight crew will determine the appropriate communication medium to use at any given time.

4.1.3.2 In airspace where both DCPC VHF voice and CPDLC communication services are provided, and local ATC procedures do not state otherwise, the flight crew will determine the communication medium to use at any given time.

NOTE: ICAO Doc 4444, paragraph 8.3.2, requires that DCPC be established prior to the provision of ATS surveillance services, unless special circumstances, such as emergencies, dictate otherwise. This does not prevent the use of CPDLC for ATC communications, voice being immediately available for intervention and to address non-routine and time critical situations.

4.1.3.3 To minimize pilot head down time and potential distractions during critical phases of flight, the flight crew should use voice for ATC communications when operating below 10000ft AGL.

4.1.3.4 While the CPDLC message set, as defined in Appendix A, generally provides message elements for common ATC communications, the flight crew may determine voice to be a more appropriate means depending on the circumstances (e.g. some types of non-routine communications).

NOTE: Refer to paragraph 4.6 for guidelines on use of voice and data communications in emergency and non-routine situations.

4.1.3.5 During an emergency, the flight crew would normally revert to voice communications. However, the flight crew may use CPDLC for emergency communications if it is either more expedient or if voice contact cannot be established. Refer to paragraph 4.6.2 for guidelines on use.

NOTE: For ATN B1 aircraft, emergency message elements are not supported. See Appendix A, paragraph A.4.9, for a list of emergency message elements.

4.1.3.6 Except as provided in paragraph 4.6.1.2, the flight crew should respond to a CPDLC message via CPDLC, and should respond to a voice message via voice.

NOTE: This will lessen the opportunity for messages to get lost, discarded or unanswered between the ATS unit and the flight crew and cause unintended consequences.

4.1.3.7 If the intent of an uplink message is uncertain, the flight crew should respond to the uplink message with RSPD-2 UNABLE and obtain clarification using voice.

NOTE: For FANS 1/A aircraft, some uplink messages do not have a DM 1 UNABLE response. On these aircraft, the flight crew should respond with DM 3 ROGER and then obtain clarification via voice.

4.1.3.8 Regardless of whether CPDLC is being used, the flight crew should continuously monitor VHF/HF/UHF guard frequency. In addition, the flight crew should continuously maintain a listening or SELCAL watch on the specified backup or secondary frequency (frequencies).

4.2 LOGON

4.2.1 General

4.2.1.1 A CPDLC connection requires a successfully completed logon before the ATS unit can establish a CPDLC connection with the aircraft.

4.2.1.2 Prior to initiating the logon, the flight crew should verify the following:

a. the aircraft identification provided when initiating the logon exactly matches the aircraft identification (Item 7) of the filed flight plan;

b. the flight plan contains the correct aircraft registration in Item 18 prefixed by REG/;

c. the flight plan contains the correct aircraft address in Item 18 prefixed by CODE/, when required;

d. the flight plan contains the correct departure and destination aerodromes in Items 13 and 16, when required; and

e. the aircraft registration provided when initiating the logon exactly matches the aircraft placard, when the flight crew manually enters the aircraft registration.

NOTE 1: If a logon request has been initiated with incorrect aircraft identification and aircraft registration, the logon process will fail. The flight crew will need to correct the information and reinitiate the logon request.

NOTE 2: For operators who do not provide an actual copy of the filed flight plan to the flight crew, the required information will be available to the flight crew in equivalent flight planning documents.

4.2.1.3 If any of the items in paragraph 4.2.1.2 do not match, the flight crew will need to contact AOC or ATC, as appropriate, to resolve the discrepancy.

NOTE 1: In accordance with ICAO Doc 4444. the aircraft identification is either the:

a. ICAO designator for the aircraft operating agency followed by the flight identification; or

b. aircraft registration.

NOTE 2: The aircraft registration entered into the aircraft system can include a hyphen (-), even though the aircraft registration in the flight plan message cannot include a hyphen.

NOTE 3: The ATSU correlates the data sent in a logon request message with flight plan data. If the data does not match, the ATSU will reject the logon request.

NOTE 4: For operators who do not provide an actual copy of the filed flight plan to the flight crew, items found in error may be corrected by AOC, provided that the flight crew is notified of the changes.

4.2.1.4 The flight crew should then manually initiate a logon using the logon address.

NOTE 1: Often the logon address is the same as the 4-letter FIR location identifier but in some airspace a different CPDLC logon address is used. Refer to Appendix B.

NOTE 2: Some aircraft implement FANS 1/A and ATN B1 capabilities as separate systems and do not comply with ED154A/DO305A. For these aircraft, the flight crew will have to select the appropriate system (FANS 1/A or ATN B1) to initiate the logon.

4.2.1.5 If there are no indications that the logon procedure was unsuccessful, the flight crew can assume that the system is functioning normally and that they will receive a CPDLC connection prior to entry into the next ATS unit's airspace.

4.2.1.6 If an indication that the logon procedure was unsuccessful is received, the flight crew should reconfirm that the logon information is correct per paragraphs 4.2.1.2 and 4.2.1.4 and reinitiate a logon.

NOTE: If the logon information is correct and the logon process fails, see paragraph 4.7.3 for more information.

4.2.1.7 Each time a CPDLC connection is established, the flight crew should ensure the identifier displayed on the aircraft system matches the logon address for the controlling authority.

4.2.1.8 In the event of an unexpected CPDLC disconnect, the flight crew may attempt to reinitiate a logon to resume data link operations.

4.2.1.9 The flight crew may receive a CPDLC free text message from the ATS unit or a flight deck indication regarding the use of the message latency monitor on FANS 1/A+ aircraft. When this message is received, the flight crew should respond as described in Table 4-1 and in accordance with procedures for the specific aircraft type.

NOTE 1: Procedures associated with the message latency monitor are applicable only in the European Region and are described in Appendix B, B.2.3.2.

NOTE 2: FANS 1/A aircraft do not support the message latency monitor.

Table 4-1. Messages and indications regarding use of message latency monitor

	Instruction to switch message latency monitor off	
ATS unit	TXTU-1 CONFIRM MAX UPLINK DELAY VALUE IS NOT SET	
Flight crew	**FANS 1/A+ aircraft**	**Message latency monitor not available**
	The flight crew should: a. confirm that the message latency monitor is off (or not set), and b. respond to the uplink [free text] message with DM 3 ROGER.	The flight crew should respond to the CPDLC (free text) message with RSPD-4 ROGER.
	Instruction to set the maximum uplink delay value	
ATS unit	SYSU-6 LATENCY TIME VALUE (latency value) where the (latency value) is an integer value, e.g., 40	
Flight crew	**FANS 1/A+ aircraft**	**Message latency monitor not available**
	The flight crew should: a. set the value; and b. respond to the uplink message with DM 3 ROGER.	The flight crew should respond to the uplink (free text) message with RSPD-4 ROGER and append the TXTD-2 TIMER NOT AVAILABLE.
	Indication of delayed CPDLC uplink message (some FANS 1/A+ aircraft only)	
ATS unit/ aircraft system	(any CPDLC uplink message displayed with indication of delayed message)	
Flight crew	**Some FANS 1/A+ aircraft only**	

Table 4-1. Messages and indications regarding use of message latency monitor (continued)

	The flight crew should: a. revert to voice communications to notify the ATS unit of the delayed message received and to request clarification of the intent of the CPDLC message (paragraph 4.7.2.2 refers); and b. respond, appropriately, to close the message per the instructions of the controller.

4.2.2 When to log on initially for data link services

4.2.2.1 When operating outside data link airspace, the flight crew should initiate a logon 10 to 25 minutes prior to entry into airspace where data link services are provided.

NOTE: When departing an aerodrome close to or within such airspace, this may require the logon to be initiated prior to departure.

4.2.2.2 Where a data link service is only provided in upper airspace and where local procedures do not dictate otherwise, the flight crew should log on to that ATS unit in whose airspace a data link service will first be used.

4.2.2.3 When failure of a data link connection is detected, the flight crew should terminate the connection and then initiate a new logon with the current ATS unit.

4.2.3 Automatic transfer of CPDLC and ADS-C services between ATS units

4.2.3.1 Under normal circumstances, the current and next ATS units automatically transfer CPDLC and ADS-C services. The transfer is seamless to the flight crew.

NOTE: The flight crew should not need to reinitiate a logon.

4.2.3.2 The flight crew should promptly respond to CPDLC uplinks to minimize the risk of an open CPDLC uplink message when transferring to the next ATS unit.

NOTE: If a flight is transferred to a new ATS unit with an open CPDLC message, the message status will change to ABORTED. If the flight crew has not yet received a response from the controller, the downlink request will also display the ABORTED status.

4.2.3.3 Prior to the point at which the current ATS unit will transfer CPDLC and/or ADS-C services, the flight crew may receive a response to close any open CPDLC messages.

4.2.3.4 When entering the next ATS unit's airspace, the flight crew should confirm the successful transfer from the current ATS unit to the next ATS unit by observing the change in the active ATS unit indication provided by the aircraft system.

4.2.3.5 When required by local procedures, the flight crew should send RTED-5 POSITION REPORT (position report). Alternatively, the flight crew may be required to respond to a CPDLC message exchange initiated by the ATS unit.

NOTE: Since FANS 1/A aircraft do not report that the downstream ATS unit has become the CDA, the only way to confirm that it has taken place is for the ATS unit to receive a CPDLC message from the aircraft (refer to Appendix B).

4.2.4 Transfer voice communications with the CPDLC connection transfer

4.2.4.1 Prior to crossing the boundary, the active ATS unit may initiate transfer of voice communications with the CPDLC connection transfer using any of the message elements containing CONTACT or MONITOR.

4.2.4.2 A CONTACT or MONITOR message instructs the flight crew to change to the specified frequency and may include a position or time for when to change to the new frequency.

a. When a MONITOR message is received, the flight crew should change to the specified frequency upon receipt of the instruction or at the specified time or position. The flight crew should not establish voice contact on the frequency.

b. When a CONTACT message is received, the flight crew should change to the specified frequency upon receipt of the instruction or at the specified time or position, and establish voice contact on the frequency.

NOTE 1: Some States do not require HF SELCAL checks. If, following a MONITOR instruction, a SELCAL check is specifically required by operator procedures, this will usually be accommodated on the allocated frequency.

NOTE 2: If the next ATS unit provides CPDLC services, the flight crew should not expect that CPDLC will be terminated or suspended once voice contact is established per receipt of a CONTACT message, unless otherwise advised.

NOTE 3: CONTACT/MONITOR messages may specify a SATVOICE number.

4.2.4.3 If the ATS unit assigns a single HF frequency, the flight crew should select a secondary frequency from the same ‘family’.

NOTE: In areas of poor radio coverage, the controller may append COMU-4 SECONDARY FREQUENCY (frequency) to specify a secondary frequency.

4.2.5 Exiting CPDLC and ADS-C service areas

4.2.5.1 Approximately 15 minutes after exiting CPDLC and/or ADS-C service areas, the flight crew should ensure there are no active CPDLC or ADS-C connections. Ensuring that connections are not active eliminates the possibility of inadvertent or inappropriate use of the connections.

4.2.5.2 The flight crew should consult the current ATS unit prior to the manual termination of any ADS contract, even if it is suspected to be unnecessary or that its termination has failed.

4.2.5.3 In the event that the connection termination has failed, the flight crew should contact the ATS unit via voice or any other appropriate means.

NOTE: ADS contracts are managed (e.g. established and terminated) by ATS units.

4.3 CPDLC – UPLINK MESSAGES

4.3.1 General

4.3.1.1 When a CPDLC uplink is received, each flight crew member (e.g. pilot flying and pilot monitoring) should read the message from the flight deck displays individually to ensure situational awareness is maintained. Once the message has been individually read, the flight crew should then discuss whether to respond to the message with RSPD-1 WILCO or RSPD-4 ROGER, as appropriate, or RSPD-2 UNABLE.

4.3.1.2 When processing a multi-element uplink message, the flight crew should ensure that the entire uplink has been read and understood in the correct sequence prior to responding.

NOTE: A CPDLC multi-element message is one that contains multiple clearances and/or instructions. The display may only show part of a CPDLC multi-element message and require flight crew interaction to see the entire message.

Example:

Controller	LVLU-6 CLIMB TO FL350 LVLU-23 REPORT LEAVING FL330 LVLU-24 REPORT MAINTAINING FL350
Flight crew	RSPD-1 WILCO

4.3.1.3 If multiple clearances are received in a single message, the flight crew should only respond with RSPD-1 WILCO if all the clearances in the entire message can be complied with.

4.3.1.4 If the flight crew cannot comply with any portion of a multi-element message, the flight crew should respond to the entire message with RSPD-2 UNABLE.

NOTE: The flight crew can only provide a single response to the entire multi-element uplink message. The flight crew cannot respond to individual elements of a multi-element message and should not execute any clearance contained in the message.

4.3.1.5 When an uplink responded to with RSPD-1 WILCO or RSPD-4 ROGER, the flight crew should take appropriate action to comply with the clearance or instruction.

NOTE: Although a RSPD-1 WILCO or RSPD-4 ROGER response technically closes the uplink message, in some cases, other responses may follow to provide additional information, as requested, to operationally close the message.

4.3.1.6 The flight crew should respond to an uplink message with the appropriate response(s), as provided in Appendix A.

NOTE 1: The flight crew may need to perform some action before a subsequent CPDLC message can be displayed.

NOTE 2: For ATN-B1 systems, if the ground system does not receive a response within 120 seconds from the time the uplink message was sent, the ATS unit will send an ERROR message for display to the flight crew and both the aircraft and ground system close the dialogue.

4.3.1.7 When a message is received containing only TXTU-1 free text element, or a TXTU-1 free text element combined with elements that do not require a response, the flight crew should respond to the message with RSPD-4 ROGER before responding to any query that may be contained in the free text message element.

4.3.2 Flight crew response times for CPDLC uplink messages

4.3.2.1 System performance requirements have been established to support reduced separation standards. Specific latency times have been allocated to the technical performance, and flight crew and controller response times. Regional/State monitoring agencies analyze actual performance to ensure the technical and operational components of the system meet required standards. For example, to support RCP 240 operations, the flight crew is expected to be able to respond to a CPDLC uplink message within one minute.

4.3.2.2 For an ATN-B1 aircraft, the flight crew should respond to a CPDLC uplink message within 100 seconds to prevent the CPDLC uplink message from automatically timing out.

NOTE: ATN-B1 aircraft use a CPDLC message response timer, which is set at 100 seconds upon receipt of the CPDLC uplink message. If the flight crew has not sent a response within this time:

a. *the flight crew is no longer provided with any response prompts for the message;*

b. *the aircraft sends an ERROR message for display to the controller; and*

c. *the aircraft and ground systems close the dialogue.*

4.3.2.3 When a CPDLC uplink message automatically times out, the flight crew should contact ATC by voice.

4.3.2.4 The flight crew should respond to CPDLC messages as soon as practical after they are received. For most messages, the flight crew will have adequate time to read and respond within one minute. However, the flight crew should not be pressured to respond without taking adequate time to fully understand the CPDLC message and to satisfy other higher priority operational demands. If additional time is needed, the flight crew should send a RSPD-3 STANDBY response.

NOTE: For ATN B1 aircraft systems, if the flight crew does not send an operational response within 100 seconds after the RSPD-3 STANDBY was sent, the CPDLC uplink message will time out (refer to paragraph 4.3.2.3).

4.3.2.5 If a RSPD-3 STANDBY response has been sent, the flight crew should provide a subsequent closure response to the CPDLC message.

NOTE 1: In the case of a RSPD-3 STANDBY response, the uplink message remains open until the flight crew responds with a RSPD-1 WILCO or RSPD-2 UNABLE. If the closure response is not received within a reasonable period of time, the controller is expected to query the flight crew.

NOTE 2: Transmission times for messages may vary for a number of reasons including the type of transmission media, network loading, or the criteria for transitioning from one media to another (e.g. VHF/Satcom). Operational response times may vary depending on workload and complexity of the instruction or clearance.

4.3.3 Conditional clearances

4.3.3.1 Conditional clearances require special attention by the flight crew, particularly for a non-native English speaking flight crew. A conditional clearance is an ATC clearance given to an aircraft with certain conditions or restrictions such as changing a flight level based on a time or place. Conditional clearances add to the operational efficiency of the airspace. Conditional clearances, however, have been associated with a large number of operational errors. Following guidelines provided in paragraphs 4.1.2 and 4.3.1, such as a) each flight crew member individually reading the uplinked clearances and b) conducting briefings with augmented crews, should aid in reducing errors.

4.3.3.2 The flight crew should correctly respond to conditional clearances containing "AT" or "BY", taking into account the intended meaning and any automation features provided by the aircraft systems. Table 4-2 clarifies the intended meaning for conditional clearance message elements. (Refer also to Appendix A.)

Table 4-2. Conditional clearance clarification of vertical clearances

Message Intent	Message element
Instruction that at the specified time a climb to the specified level or vertical range is to commence and once reached the specified level is to be maintained. *NOTE 1: Instruction that, NOT BEFORE the specified time, a climb to the specified level is to commence and, once reached, the specified level is to be maintained.* *NOTE 2: This message element would be preceded with LVLU-5 MAINTAIN (level), to prevent the premature execution of the instruction.*	LVLU-7 AT TIME (time) CLIMB TO (level)
Instruction that at the specified position a climb to the specified level or vertical range is to commence and once reached the specified level is to be maintained. *NOTE 1: Instruction that, AFTER PASSING the specified position, a climb to the specified level is to commence and, once reached, the specified level is to be maintained.* *NOTE 2: This message element would be preceded with LVLU-5 MAINTAIN (level), to prevent the premature execution of the instruction.*	LVLU-8 AT (position) CLIMB TO (level)

Table 4-2. Conditional clearance clarification of vertical clearances (continued)

Message Intent	Message element
Instruction that at a specified time a descent to a specified level or vertical range is to commence and once reached the specified level is to be maintained. *NOTE 1: Instruction that, NOT BEFORE the specified time, a descent to the specified level is to commence and, once reached, the specified level is to be maintained.* *NOTE 2: This message element would be preceded with LVLU-5 MAINTAIN (level), to prevent the premature execution of the instruction.*	LVLU-10 AT TIME (time) DESCEND TO (level)
Instruction that at the specified position a descent to the specified level or vertical range is to commence and once reached the specified level is to be maintained. *NOTE 1: Instruction that, AFTER PASSING the specified position, a descent to the specified level is to commence and, once reached, the specified level is to be maintained.* *NOTE 2: This message element would be preceded with LVLU-5 MAINTAIN (level), to prevent the premature execution of the instruction.*	LVLU-11 AT (position) DESCEND TO (level)
Instruction that a climb is to commence at a rate such that the specified level is reached at or before the specified position. When this message element is not concatenated with another vertical clearance, the level specified is the assigned level which is to be maintained.	LVLU-12 CLIMB TO REACH (level single) BEFORE TIME (time)
Instruction that a climb is to commence at a rate such that the specified level is reached before passing the specified position.	LVLU-13 CLIMB TO REACH (level single) BEFORE PASSING (position)
Instruction that a descent is to commence at a rate such that the specified level is reached before the specified time.	LVLU-14 DESCEND TO REACH (level single) BEFORE TIME (time)
Instruction that a descent is to commence at a rate such that the specified level is reached at or before the specified position.	LVLU-15 DESCEND TO REACH (level single) BEFORE PASSING (position)

4.3.4 “EXPECT” uplink messages

4.3.4.1 “EXPECT” uplink messages are typically received in response to a flight crew request, and, in some cases, when procedurally required.

4.3.4.2 When receiving an EXPECT uplink message, the flight crew should respond with RSPD-4 ROGER, meaning that the message was received and understood.

NOTE 1: The flight crew should NOT comply with an EXPECT message as if it was a clearance.

NOTE 2: The FANS 1/A CPDLC message set contains EXPECT uplink message elements that the controller should NOT use because of potential misinterpretation in the event of a total communication failure. See Appendix A and Appendix B, B.4.1.3 for specific message elements that are not supported.

4.3.5 Uplinks messages containing FMS-loadable data

4.3.5.1 CPDLC allows aircraft systems to be capable of loading route clearance information from CPDLC messages directly into an FMS. The flight crew can use this capability to minimize the potential for data entry errors when executing clearances involving loadable data. It also enables advanced ATS supported by data link, such as a re-route or a tailored arrival, which otherwise may not be possible via voice.

NOTE: Not all aircraft have the capability to load information from CPDLC message directly into the FMS.

4.3.5.2 If a clearance is received that can be automatically loaded into the FMS, the flight crew should load the clearance into the FMS and review it before responding with RSPD-1 WILCO.

4.3.5.3 The flight crew should verify that the route modification in the FMS is consistent with the CPDLC route clearance. A discontinuity in a CPDLC route clearance is not necessarily a reason to respond to the clearance with RSPD-2 UNABLE, as these can be appropriate in some circumstances.

4.3.5.4 The flight crew should respond to the clearance with RSPD-2 UNABLE when:

a. the FMS indicates that it cannot load the clearance (e.g. partial clearance loaded or unable to load); or

   NOTE: The FMS checks the clearance to ensure it is correctly formatted and compatible with the FMS navigation database.

b. the FMS indicates any inconsistencies or discontinuities with the route modification that are not addressed by AIP (or other appropriate publication) or cannot be resolved by the flight crew.

4.3.5.5 The flight crew should use CPDLC or voice to clarify any clearance that was responded to with RSPD-2 UNABLE due to any loading failures, route discontinuities or inconsistencies.

4.3.5.6 If the clearance loads successfully and is acceptable, the flight crew may execute an FMS route modification and respond to the clearance with RSPD-1 WILCO.

NOTE: The flight crew will ensure the route in the FMC matches the ATC clearance.

4.4 CPDLC – Downlink Messages

4.4.1 General

4.4.1.1 Downlink messages can only be sent to the ATS unit that holds the active CPDLC connection. To provide situational awareness, procedures should ensure that each flight crew member has read each downlink message before it is sent.

4.4.1.2 When the aircraft has an active CPDLC connection with an ATS unit, the flight crew should downlink a clearance request only if the flight is in that ATS unit's airspace.

4.4.1.3 The flight crew should use standard downlink message elements to compose and send clearance requests, CPDLC position reports, and other requested reports. Additional qualifying standard message elements, such as SUPD-1 DUE TO (specified reason downlink) or DUE TO WEATHER, should also be used as needed.

NOTE: The use of standard message elements will minimize the risk of input errors, misunderstandings, and confusion, and facilitate use by a non-native English speaking flight crew. The use of standard message elements allows the aircraft and ground systems to automatically process the information in the messages that are exchanged. For example, the flight crew can automatically load clearance information into the FMS and review the clearance, the ground system can automatically update flight plan data for route conformance monitoring, and both aircraft and ground systems can associate responses to messages.

4.4.1.4 To avoid potential ambiguity, the flight crew should avoid sending multiple clearance requests in a single downlink message. For example, the flight crew should send separate downlink messages for LVLD-2 REQUEST CLIMB TO [level] and RTED-1 REQUEST DIRECT TO [position] unless there is an operational need to combine them in a single message (i.e., the flight crew does not want to climb unless they can reroute).

4.4.1.5 When a closure response to an open CPDLC downlink message is not received within a reasonable time period, the flight crew should:

a. for a FANS 1/A aircraft, send a query using one of the 'WHEN CAN WE EXPECT ... " messages or a TXTD-2 (free text) message rather than resending the downlink message. Alternatively, the flight crew may use voice communication to clarify the status of the open CPDLC downlink message; or

b. for an ATN-B1 aircraft, the flight crew should use voice communication to resolve the operational situation resulting from the timed out CPDLC downlink message.

NOTE 1: A closure response is a response that operationally closes the dialogue. A RSPU-2 STANDBY response to an open CPDLC downlink message does not operationally close the dialogue.

NOTE 2: The use of a CPDLC free text message by a FANS 1/A aircraft avoids multiple open messages involving the same downlink message.

NOTE 3: ATN-B1 ground systems will reject duplicate requests and return an ERROR message for display to the flight crew TOO MANY (dialogue type) REQUESTS - EXPECT ONLY ONE REPLY.

Example:

Flight crew	LVLD-2 REQUEST CLIMB TO FL350
	Reasonable period of time has passed
Flight crew	LVLD-7 WHEN CAN WE EXPECT HIGHER LEVEL or TXTD-2 WHEN CAN WE EXPECT CLIMB TO FL350

4.4.1.6 If the flight crew receives an indication of non-delivery of a downlink message, they may elect to re-send an identical message within a reasonable amount of time or as required. Alternatively, they may use voice communication to clarify the status of the downlink message.

4.4.2 Free text

NOTE: Provisions concerning the use of free text messages elements are contained in Annex 10, Volume II,8.2.11 and Doc 4444, 14.3.4.

4.4.2.1 While the use of free text should generally be avoided, the flight crew may use the free text message element in accordance with the guidelines provided in this section.

NOTE 1: The use of standard message elements is intended to reduce the possibility of misinterpretation and ambiguity.

NOTE 2: A free text message (such as TXTD-2 REVISED ETA (position) (time)) does not require a response from the ATS unit.

4.4.2.2 The flight crew should only use a free text message element when an appropriate standard message element does not exist.

4.4.2.3 When composing a free text message, the flight crew should use standard ATS phraseology and format and avoid nonessential words and phrases. Abbreviations should only be included in free text messages when they form part of standard ICAO phraseology, for example, ETA.

4.4.3 Unsupported messages and voice responses to CPDLC requests

4.4.3.1 While ATS units should provide CPDLC service using the complete message set provided in Appendix A, some ATS units provide a CPDLC service using a limited message set. The flight crew should be are aware of any unsupported downlink message elements that are described in regional or State documentation.

4.4.3.2 If a downlink message, containing a message element that is not supported by the ATSU, is sent, the flight crew will typically receive the uplink message, SYSU-3 MESSAGE NOT SUPPORTED BY THIS ATC UNIT. If this message is received, the flight crew should respond to the message with RSPD-4 ROGER and use voice for the communication transaction.

4.4.3.3 In circumstances where a CPDLC downlink message contains a request that can only be responded to verbally, the flight crew will typically receive the CPDLC free text message TXTU-1 REQUEST RECEIVED EXPECT VOICE RESPONSE to indicate that the operational response will be via voice and to close the CPDLC dialogue. If this message is received, the flight crew should respond to the message with RSPD-4 ROGER.

Example:

Controller	TXTU-1 REQUEST RECEIVED EXPECT VOICE RESPONSE
Flight crew	RSPD-4 ROGER

4.4.4 CPDLC reports and confirmation requests

4.4.4.1 The flight crew should respond to CPDLC reports and confirmation requests, when appropriate.

4.4.4.2 ATS units may send a CPDLC message that combines a REPORT instruction with a clearance. The flight crew may use automation, procedures, and/or a combination to remind them when to send the reports requested in the CPDLC message.

Example:

Controller	LVLU-6 CLIMB TO FL350 LVLU-23 REPORT LEAVING FL330 LVLU-24 REPORT MAINTAINING FL350
Flight crew	RSPD-1 WILCO

4.4.4.3 The controller may send a CPDLC message to request the flight crew to advise intentions when ADS-C indicates the aircraft has deviated from its cleared route, level or assigned speed.

4.4.5 Weather deviations and offsets

4.4.5.1 General

4.4.5.1.1 The flight crew may use CPDLC to request a weather deviation clearance or an offset clearance. The difference between a weather deviation and an offset are portrayed in Figure 4-2.

a. a weather deviation clearance authorizes the flight crew to deviate up to the specified distance at their discretion in the specified direction from the route in the flight plan; and

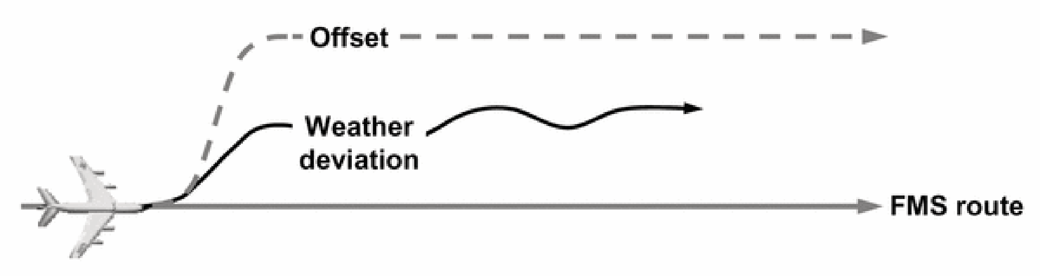
b. an offset clearance authorizes the flight crew to operate at the specified distance in the specified direction from the route in the flight plan. A clearance is required to deviate from this offset route.

NOTE: CPDLC offers more timely coordination of weather deviation clearances. However, the flight crew may deviate due to weather under the provisions of ICAO Doc 4444, paragraph 15.2.3. The extent to which weather deviations are conducted may be a consideration when applying reduced separations.

4.4.5.1.2 Flight crews should use the correct message element when requesting an off-route clearance.

NOTE: The difference between a weather deviation and an offset affects how ATC separate aircraft.

Figure 4-2. Offset and weather deviation



4.4.5.2 Weather deviation requests and offsets

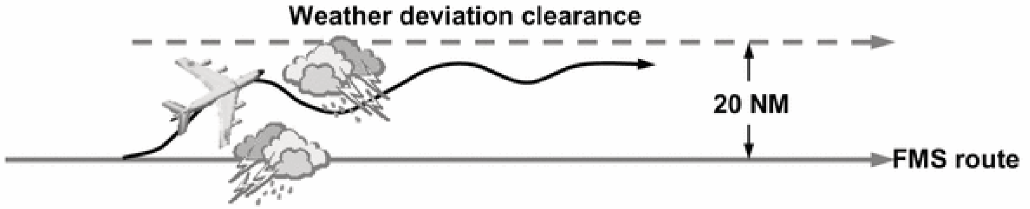
When requesting a weather deviation or offset clearance, the flight crew should specify the distance off route with respect to the cleared route of the aircraft. If the flight crew has received a off-route clearance and then requests and receives a subsequent off-route clearance, the new clearance supersedes the previous clearance (i.e. only the most recent clearance is valid).

NOTE: When an off-route clearance has been received, the flight crew will need to ensure that waypoints are sequenced correctly per paragraph 4.5.1.6.

EXAMPLE 1: As shown in Figure 4-3, the flight crew requests a weather deviation clearance to operate up to 20NM (37km) left of route. The controller issues the appropriate clearance.

Flight crew	LATD-2 REQUEST WEATHER DEVIATION UP TO 20NM LEFT OF ROUTE
Controller	LATU-10 CLEARED TO DEVIATE UP TO 20NM LEFT OF ROUTE LATU-18 REPORT BACK ON ROUTE
Flight crew	RSPD-1 WILCO

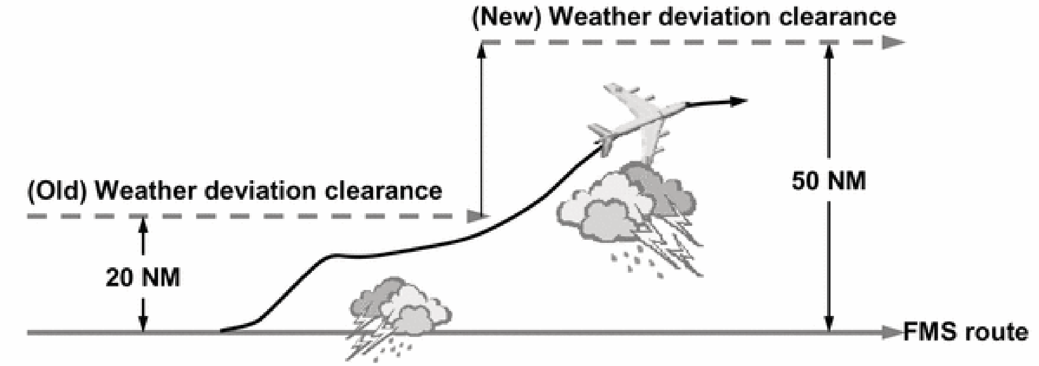
Figure 4-3. Weather deviation clearance up to 20NM (37km) left of route



EXAMPLE 2: As shown in Figure 4-4, the flight crew is operating on a weather deviation clearance up to 20NM (37km) left of route and then requests another weather deviation clearance to operate up to a further 30NM (55.5km) left of route. They specify the deviation distance in the clearance request based on the cleared route rather in relation to the current weather deviation clearance. The controller issues the appropriate clearance.

Flight crew	LATD-2 REQUEST WEATHER DEVIATION UP TO 50NM LEFT OF ROUTE
Controller	LATU-10 CLEARED TO DEVIATE UP TO 50NM LEFT OF ROUTE LATU-18 REPORT BACK ON ROUTE
Flight crew	RSPD-1 WILCO

Figure 4-4. Subsequent weather deviation clearance up to 50NM (93km) left of route

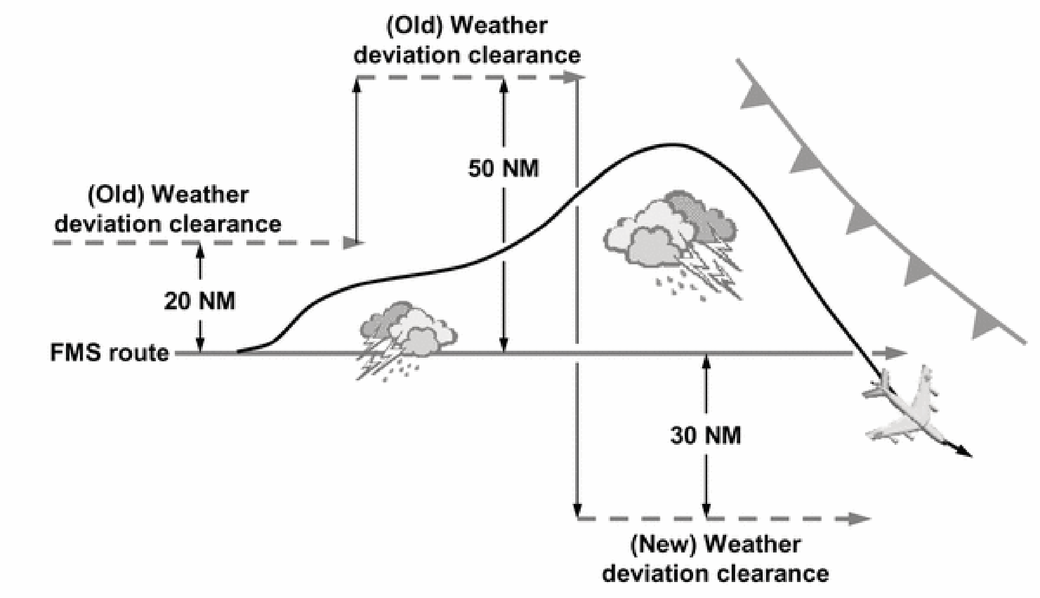


EXAMPLE 3: As shown in Figure 4-5 the aircraft then requests a weather deviation clearance to operate 30NM (55.5km) right of route. The controller issues the appropriate clearance. The flight crew expeditiously navigates from one side of route to the other in accordance with the below clearance.

NOTE: The ATS unit applies the appropriate separation standards during the maneuvers.

Flight crew	LATD-2 REQUEST WEATHER DEVIATION UP TO 30NM RIGHT OF ROUTE
Controller	LATU-10 CLEARED TO DEVIATE UP TO 30NM RIGHT OF ROUTE LATU-18 REPORT BACK ON ROUTE
Flight crew	RSPD-1 WILCO

Figure 4-5. Subsequent weather deviation clearance up to 30NM (55.5km) right of route



4.4.5.3 *Deviations either side of route*

When requesting a deviation on either side of route, the flight crew should request a weather deviation left and right of route using LATD-2 REQUEST WEATHER DEVIATION UP TO (lateral deviation) OF ROUTE.

EXAMPLE: The flight crew requests a deviation left and right of route. The controller issues the appropriate clearance.

Flight crew	LATD-2 REQUEST WEATHER DEVIATION UP TO 20NM LEFT OF ROUTE
Controller	LATU-10 CLEARED TO DEVIATE UP TO 20NM EITHER SIDE OF ROUTE LATU-18 REPORT BACK ON ROUTE
Flight crew	RSPD-1 WILCO

4.4.5.4 Reporting back on route

When the flight crew no longer needs the deviation clearance and is back on the cleared route, the flight crew should send the report LATD-4 BACK ON ROUTE.

a. If during the weather deviation, the flight crew receives a clearance to proceed direct to a waypoint – and the flight crew responds to the clearance with RSPD-1 WILCO – the aircraft is considered to be on the cleared route. Therefore, the flight crew should send a LATD-4 BACK ON ROUTE report after they execute the "direct to" clearance; and

b. If the aircraft is off route during a weather deviation clearance and proceeding direct to a waypoint on the cleared route, the flight crew should send a LATD-4 BACK ON ROUTE report after the aircraft has sequenced the waypoint on the cleared route.

NOTE: If a LATD-4 BACK ON ROUTE report is received while the aircraft is still off route, the incorrect information provided to ATC may affect the separation standards in use. Alternatively, the flight crew may consider requesting a clearance direct to the waypoint – on receipt of the uplink clearance, the procedure specified in item a) above applies.

4.4.6 CPDLC Postion Reporting

4.4.6.1 General

When using CPDLC to provide position information, the flight crew should report unnamed waypoints (latitudes/longitudes) using the ICAO format of nn[N/S]nnn[EIW] or, if both degrees and minutes are required, nnnn[N/S]nnnnn[E/W].

NOTE: The flight crew and flight operations officers/dispatchers should not use the ARINC 424 format. ARINC 424 describes a five-character latitude/longitude format for aircraft navigation databases (e.g. 10N40 describes a lat/long of 10N140W). The ATS unit may reject or be unable to process any downlink message containing waypoint names in the ARINC 424 format.

4.4.6.2 Position reporting in a non-ADS-C environment

4.4.6.2.1 When ADS-C is not available, the flight crew should conduct position reporting by voice or CPDLC. When using CPDLC, the flight crew should send RTED-5 POSITION REPORT [position report] whenever an ATC waypoint is sequenced, (or passed abeam when offset flight is in progress).

4.4.6.2.2 When using CPDLC for position reporting, the flight crew should send position reports only at compulsory reporting points and ensure that the position and next position information applies to compulsory reporting points, unless requested otherwise by ATC. The ensuing significant point after the next position may be either a compulsory or non-compulsory reporting point (Refer AIREP form ICAO Doc 4444, Appendix 1).

4.4.6.3 Position reporting in an ADS-C environment

NOTE: In an ADS-C environment, the flight crew should not provide position reports or revised waypoint estimates by CPDLC or voice, unless otherwise instructed or under conditions in certain airspace as stipulated in Regional Supplementary Procedures or AIP (or other appropriate publication).

4.4.6.3.1 If required by regional supplementary procedures or AIP (or other appropriate publication), the flight crew should provide a CPDLC position report when either of the following events occurs:

a. an initial CPDLC connection is established; or

b. the CPDLC connection transfer has been completed (i.e. at the associated boundary entry position).

NOTE: Some ANSPs require a single CPDLC position report, even when in an ADS-C environment, to provide the controlling ATSU confirmation that it is the CDA and the only ATSU able to communicate with the aircraft via CPDLC.

4.4.6.3.2 The flight crew should include only ATC waypoints in cleared segments of the aircraft active flight plan. However, when an ATC clearance eliminates a waypoint, it is permissible to retain and report the point abeam of that waypoint since this ensures retention of meteorological data associated with the eliminated waypoint.

NOTE: If the flight crew inserts non-ATC waypoints (e.g. mid-points) into the aircraft active flight plan and activates the change, the aircraft system may trigger an ADS-C waypoint change event report at the non-ATC waypoint, or include information about the non-ATC waypoint in the predicted route group, as well as the intermediate and fixed projected intent groups. As a result, the ADS-C report will include information about the non-ATC waypoint, which is not expected by the ATC ground system.

4.4.6.3.3 The flight crew should maintain the active route in the aircraft system to be the same as the ATC cleared route of flight.

NOTE: If the flight crew activates a non-ATC cleared route into the aircraft system, the ADS-C reports will include information that will indicate the aircraft is flying a route that is deviating from the cleared route.

4.4.6.3.4 When reporting by ADS-C only, the flight crew should include ATC waypoints in the aircraft active flight plan even if they are not compulsory reporting points.

4.5 AUTOMATIC DEPENDANT SURVEILLANCE – CONTRACT (ADS-C)

4.5.1 General

4.5.1.1 ADS-C allows the ATS unit to obtain position reports from the aircraft without flight crew action to update the current flight plan, to check conformance and to provide emergency alerting.

NOTE: In airspace where ADS-C services are available, the flight crew need not send position reports via voice or CPDLC, except as described in paragraph 4.4.6.3 or when required by regional supplementary procedures or AIP (or other appropriate publication).

4.5.1.2 When using ADS-C services, the flight crew should check to ensure ADS-C is armed prior to initiating a logon with an ATS unit.

NOTE: The flight crew can switch ADS-C off, which will cancel any ADS-C connections with the aircraft. While ADS-C is disabled, the ground system will not be able to establish an ADS-C connection.

4.5.1.3 Normally, the flight crew should leave ADS-C armed for the entire flight. However, in airspace where ADS-C services are available, if the flight crew switches ADS-C off for any reason, or they receive indication of avionics failure leading to loss of ADS-C service, the flight crew should advise ATC and follow alternative procedures for position reporting per paragraphs 4.4.6 and 4.7.4.5.

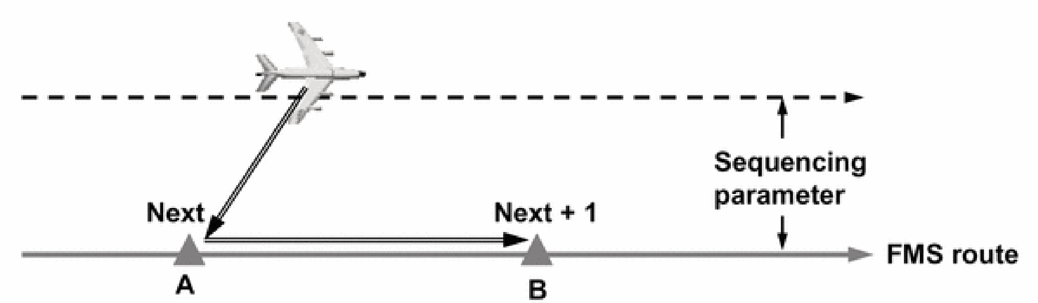
4.5.1.4 In airspace where ADS-C is not available, the flight crew may switch ADS-C off to cancel inadvertent ADS-C connections. In such cases, the flight crew should ensure that ADS-C is armed when re-entering airspace where ADS-C is again available.

4.5.1.5 If ADS-C is disabled in an ADS-C environment, the ATS unit may send the flight crew an inquiry per paragraph 4.7.4.7.

4.5.1.6 The flight crew should ensure that waypoints are sequenced correctly. If an aircraft passes abeam a waypoint by more than the aircraft FMS waypoint sequencing parameter, the flight crew should sequence the waypoints in the FMS, as appropriate.

NOTE: As shown in Figure 4-2, when an aircraft passes abeam a waypoint in excess of the defined sequencing parameter for specific aircraft types, the FMS will not sequence the active waypoint. If the flight crew does not sequence the waypoint, incorrect information will be contained in ADS-C reports, CPDLC position reports and FMC waypoint position reports – the next waypoint in these reports will actually be the waypoint that the aircraft has already passed.

Figure 4-6. Waypoint sequencing anomaly



4.6 EMERGENCY PROCEDURES

4.6.1 General

4.6.1.1 In accordance with established emergency procedures, the ATS unit within whose airspace the aircraft is operating remains in control of the flight. If the flight crew takes action contrary to a clearance that the controller has already coordinated with another sector or ATS unit and further coordination is not possible in the time available, then the flight crew performs this action under their emergency command authority.

4.6.1.2 The flight crew will use whatever means are appropriate (i.e. CPDLC and/or voice) to communicate during an emergency.

4.6.1.3 During an emergency, the flight crew would normally revert to voice communications. However, the flight crew may use CPDLC for emergency communications if it is either more expedient or if voice contact cannot be established.

NOTE: For ATN B1 aircraft, emergency message elements are not supported. See Appendix A, A.4.9, for a list of emergency message elements.

4.6.2 CPDLC and ADS-C emergency

4.6.2.1 When using CPDLC to indicate an emergency situation or degraded operations to an ATS unit, the flight crew should use the CPDLC emergency downlink message, either EMGD-2 MAYDAY MAYDAY MAYDAY or EMGD-1 PAN PAN PAN.

NOTE 1: The flight crew may enter PERSONS on BOARD during preflight preparation, prior to initiating a logon, or prior to sending the emergency message.

NOTE 2: The CPDLC emergency downlink message will automatically select the ADS-C function to emergency mode. When a situation prohibits sending a CPDLC emergency message (e.g. in an ADS-C only environment), the flight crew may activate ADS-C emergency mode directly via ADS-C control functions.

4.6.2.2 If a CPDLC emergency downlink message is inadvertently sent or the emergency situation is resolved, the flight crew should send EMGD-4 CANCEL EMERGENCY as soon as possible to advise the controller and automatically set the ADS-C emergency mode to off. After sending EMGD-4 CANCEL EMERGENCY, the flight crew should confirm the status of the flight and their intentions via either voice or CPDLC.

4.6.2.3 To check for inadvertent activation of the ADS-C emergency mode using CPDLC, the controller may send the following CPDLC free text uplink or use equivalent voice phraseology. The flight crew should then check the status of the aircraft's ADS-C emergency mode and if the emergency mode has been activated inadvertently, the flight crew should select ADS-C emergency mode to off and advise the controller either by voice or by the following CPDLC messages.

Controller	EMGU-3 CONFIRM ADS-C EMERGENCY
Flight crew	RSPD-4 ROGER, then (free text) TXTD-2 ADS-C RESET

4.7 NON-ROUTINE PROCEDURES

4.7.1 General

NOTE: Provisions concerning complete communications failure (CPDLC and voice) are contained in Annex 2, 3.6.5.2, Annex 10, Volume II, 5.2.2.7 and Doc 4444, 15.3.

4.7.2 Voice communications related to data link

4.7.2.1 When CPDLC fails and open messages existed at the time of failure, the flight crew should recommence any dialogues involving those messages by voice

4.7.2.2 The flight crew should use the standard voice phraseology under certain conditions as indicated in Table 4-3.

4.7.2.3 Voice communication procedures related to data link operations are not standardized among the regions. Refer to Appendix B, for additional voice communication procedures for a specific region.

Table4-3. Voice phraseology related to CPDLC

Condition	Voice phraseology
To notify ATC of a correction to a CPDLC message. (Doc 4444)	DISREGARD CPDLC (message type) MESSAGE, BREAK (correct information or request)
To notify ATC of a single CPDLC message failure. (Doc 4444)	CPDLC MESSAGE FAILURE (appropriate information or request)
To notify ATC of an aircraft data link system or CPDLC connection failure. (Doc 4444)	CPDLC FAILURE (requests/notifications) *NOTE: This phraseology is included only with the first transmission made for this reason.* EXAMPLE: CPDLC FAILURE. CONTINUING ON VOICE.
To advise ATC that the CPDLC connection is being terminated manually and logon procedure is being initiated with the next ATSU.	DISCONNECTED CPDLC WITH (facility designation). LOGGING ON TO (facility designation) *NOTE: The facility designation is the ICAO four-character facility code or facility name.*
To advise ATC that a logon procedure is being initiated following restoration of data link service.	LOGGING ON TO (facility designation)
To advise ATC that a delayed CPDLC uplink has been received and to request clarification of the intent of the CPDLC message.	DELAYED CPDLC MESSAGE RECEIVED (requests) *NOTE: See paragraph 4.2.1.9 for associated procedures.*

4.7.3 Data link initiation failure

NOTE: Provisions concerning the data link initiation failure are contained in Annex 10, Volume II, 8. 1.1.4 and Doc 4444, 4.15.4.

4.7.3.1 In the event of a logon failure, the flight crew should confirm the aircraft identification matches the information provided in the FPL and, as appropriate:

a. make the necessary corrections; and then

b. re-initiate the logon.

4.7.3.2 If no reason for the failure is evident, the flight crew should:

a. contact the ATSU by voice to advise of the failure; and

b. contact AOC to advise of the failure.

NOTE: The ATS unit will attempt to resolve the problem.

4.7.3.3 The flight crew should report log-on failures to the appropriate local/regional monitoring agency in accordance with procedures established by the operator.

4.7.4 Data link system failures

4.7.4.1 When SATCOM is not serviceable, the flight crew may use CPDLC within VHF coverage unless restricted by State AIP and/or SUPPS.

4.7.4.2 When operating CPDLC and the aircraft data link system provides an indication of degraded performance resulting from a failure or loss of connectivity, the flight crew should notify the ATSU of the failure as soon as practicable, including:

a. when operating outside of VHF coverage area and the SATCOM data link system fails; and

b. when operating in airspace where ATS surveillance services are provided and the VHF data link system fails.

NOTE: Timely notification is appropriate to ensure that the ATS unit has time to assess the situation and apply a revised separation standard, if necessary.

4.7.4.3 If an automatic transfer of the CPDLC connection does not occur at the boundary, the flight crew should contact the transferring ATS unit by sending TXTD-2 CPDLC TRANSFER FAILURE (or voice equivalent), advising them that the transfer has not occurred. The flight crew may be instructed to reinitiate a logon.

4.7.4.4. In the event of an aircraft data link system failure, the flight crew should notify the ATSU of the situation using the following voice phraseology:

Flight crew	CPDLC FAILURE. CONTINUING ON VOICE
Controller	ROGER. CONTINUE ON VOICE

NOTE: The flight crew continues to use voice until the functionality of the aircraft system can be re-established.

4.7.4.5 When the ATS unit provides notification that the CPDLC service has failed or will be shut down, the flight crew should follow the instructions provided in the notification (e.g. disconnect CPDLC and continue on voice until informed by the ATSU that the data link system has resumed normal CPDLC operations).

4.7.4.6 If only the ADS-C service is terminated, then during that time period, the flight crew should conduct position reporting by other means (e.g. CPDLC, if available, or via voice).

4.7.4.7 If the ATS unit cannot establish ADS contracts with an aircraft, or if ADS-C reporting from an aircraft ceases, the flight crew may have inadvertently switched ADS-C off. If CPDLC is still available and the flight crew receives the CPDLC message ADVU-16 ACTIVATE ADS-C (or voice equivalent), the crew should check to ensure that ADS-C is not switched off and respond to the controller as follows:

Controller	ADVU-16 ACTIVATE ADS-C
Flight crew	RSPD-4 ROGER

4.7.4.8 If the aircraft is operating on a vertical profile that is different from the profile programmed in the FMS, the time estimates in the ADS-C report will be inaccurate. If the flight crew receives the message TXTU-1 ADS-C ESTIMATES APPEAR INACCURATE. CHECK FMS, the flight crew should check the FMS, correct any the discrepancy and respond to the CPDLC message with RSPD-4 ROGER.

4.7.5 Using CPDLC to relay messages

4.7.5.1 When an ATS unit and an aircraft cannot communicate, the controller may use CPDLC or voice to relay messages. When it had been determined to use CPDLC, the controller may first confirm that the CPDLC-capable aircraft is in contact with the subject aircraft. The flight crew should concur that they will act as an intermediary.

4.7.5.2 When using CPDLC to relay messages, the flight crew should:

a. Only respond with RSPD-4 ROGER to CPDLC messages consisting entirely of free text; and

b. Respond with RSPD-2 UNABLE to any CPDLC message containing standard message elements to avoid confusion.

4.7.5.3 After sending RSPD-4 ROGER, the flight crew should only use free text to respond to the controller's uplink free text message.

Example, using:

a. ADVU-18 RELAY TO (aircraft identification) (unit name) (relay text) (frequency(O)); and

b. COMD-2 RELAY FROM (aircraft identification) (relayed text response); where:

   1. (aircraft identification) is expressed as the radiotelephony call sign, rather than the ICAO three letter or IATA two letter designator; and

   2. (relay text) conform to the guidelines provided paragraph 4.4.2.3.

Controller	ADVU-18 RELAY TO UNITED345 OAKLAND CLEARS UNITED345 CLIMB TO AND MAINTAIN FL340
Flight crew	RSPD-4 ROGER
Flight crew	COMD-2 RELAY FROM UNITED345 CLIMBING FL340

Appendix A -DLIC AND CPDLC MESSAGE ELEMENTS

A.1 - General

A.1.1 This appendix contains the CPDLC message elements for the FANS 1/A, ATN B1, and ATN B1-FANS 1/A data link systems. The CPDLC message elements are based on the CPDLC message set in Doc 4444, Amendment 7.

A.1.2 The following guidelines apply:

a. “operational definition columns” are taken from Doc 4444 (e.g. message element intended use, format for message element display and message response attribute). The message elements shaded in grey indicate that they are currently under consideration for inclusion as part of future amendments to Doc 4444.

b. the “CPDLC message sets” columns indicate which message element in each CPDLC message set, i.e. FANS 1/A, ATN B1, or ATN B1-FANS 1/A supports the message element indicated in Doc 4444. The annotation N/A in the “CPDLC message set” column indicates that the corresponding CPDLC message set does not support the message element defined in Doc 4444.

c. where there are differences with Doc 4444 in regard to format for message element display, the recommended choice indicated in Doc 4444 should be used for new implementations. The others shown in the technology-specific columns indicate legacy implementations that are considered acceptable.

NOTE: When a FANS 1/A and/or ATN B1 free text message element is used to provide the operational intended use equivalent to a standard message element as defined in Doc 4444, this manual provides the recommended content for the free text message element in the FANS 1/A and/or ATN B1 columns. In some cases, this guidance might differ from the content specified in the supporting interoperability standards.

d. a FANS 1/A and/or ATN B1 message element that does not have an equivalent message element in Doc 4444 should not be used. New FANS 1/A and/or ATN B1 implementations may reject these message elements, indicating they are not supported.

e. The CPDLC message set in use will depend on the aircraft system and ground system capabilities and is shown as follows:

		Aircraft system		
		FANS 1/A	**ATN B1**	**FANS 1/A-ATN B1**[1]
Ground System	**FANS 1/A**	FANS 1/A	N/A	FANS 1/A
	ATN B1	N/A	ATN B1	ATN B1

		Aircraft system		
	FANS 1/A - ATN B1	FANS 1/A - ATN B1[2]	ATN B1	ATN B1 or FANS 1/A-ATN B1 [2]

[1] A FANS 1/A-ATN B1 aircraft system fully supports FANS 1/A and ATN B1 CPDLC message sets.

[2] The FANS 1/A-ATN B1 message set is the equivalent of an ATN B1 message set either through the use of:

a) free text message elements (e.g. UM 169, DM 67); and/or

b) other message elements that are operationally equivalent.

A.2 MESSAGES FOR DLIC AND CPDLC CONNECTION ESTABLISHMENT/ TERMINATION

A.2.1 Air-ground data link messages for DLIC

Generic message name	Purpose	FANS 1/A	ATN B1
Air-ground logon procedure			
Logon Request	To provide the ATSU with information to confirm the identity of the aircraft and its data link capabilities, and to notify the ATSU of the flight crew's intention to use data link services.	FN_CON	CM_LOGON_REQUEST
Logon response	To notify the aircraft of the status of its logon request.	FN_AK	CM_LOGON_RESPONSE
Air-ground address forwarding procedure			
Contact Request	To instruct the aircraft to send a logon request to the specified ATSU.	FN_CAD	CM_CONTACT

Generic message name	Purpose	FANS 1/A	ATN B1
Contact Response	To indicate to the initiating ATSU that the logon request will be sent to the specified ATSU.	FN_RESP	No ATN equivalent
Contact Complete	To provide to the initiating ATSU the status of the logon request to the specified ATSU.	FN_COMP	CM_CONTACT_RESPONSE

A.3 - RESPONSE ATTRIBUTE OF CPDLC MESSAGE ELEMENT

Response Attribute	Description
	For Uplink Message
W/U	Response required. Valid responses. WILCO, UNABLE, STANDBY, NOT CURRENT DATA AUTHORITY, NOT AUTHORIZED NEXT DATA AUTHORITY, LOGICAL ACKNOWLEDGEMENT (only if required), ERROR *NOTE: WILCO, UNABLE, NOT CURRENT DATA AUTHORITY, NOT AUTHORIZED NEXT DATA AUTHORITY and ERROR will close the uplink message.* *FANS 1/A. — WILCO, UNABLE, STANDBY, ERROR, NOT CURRENT DATA AUTHORITY.*
A/N	Response required. Valid responses. AFFIRM, NEGATIVE, STANDBY, NOT CURRENT DATA AUTHORITY, NOT AUTHORIZED NEXT DATA AUTHORITY, LOGICAL ACKNOWLEDGEMENT (only if required), ERROR *NOTE: AFFIRM, NEGATIVE, NOT CURRENT DATA AUTHORITY, NOT AUTHORIZED NEXT DATA AUTHORITY and ERROR will close the uplink message.* *FANS 1/A. — AFFIRM, NEGATIVE, STANDBY, ERROR, NOT CURRENT DATA AUTHORITY.*

Response Attribute	**Description**
	For Uplink Message
R	Response required. Valid responses. ROGER, UNABLE, STANDBY, NOT CURRENT DATA AUTHORITY, NOT AUTHORIZED NEXT DATA AUTHORITY, LOGICAL ACKNOWLEDGEMENT (only if required), ERROR *NOTE: ROGER, NOT CURRENT DATA AUTHORITY, NOT AUTHORIZED NEXT DATA AUTHORITY and ERROR will close the uplink message.* *FANS 1/A. — ROGER, STANDBY, ERROR, NOT CURRENT DATA AUTHORITY. FANS 1/A aircraft do not have the capability to send UNABLE in response to an uplink message containing message elements with an “R” response attribute. For these aircraft, the flight crew may use alternative means to UNABLE the message. These alternative means will need to be taken into consideration to ensure proper technical and operational closure of the communication transaction.*
Y	Response required. Valid responses: Any CPDLC downlink message, LOGICAL ACKNOWLEDGEMENT (only if required).
N	No response required unless logical acknowledgement required. Valid Responses (only if LOGICAL ACKNOWLEDGEMENT is required). LOGICAL ACKNOWLEDGEMENT, NOT CURRENT DATA AUTHORITY, NOT AUTHORIZED NEXT DATA AUTHORITY, ERROR *FANS 1/A. — "N" is defined as “no response is required,“ but not used. Under some circumstances, an ERROR message will also close an uplink message.*
NE	[Not defined in ICAO Doc 4444] *FANS 1/A. — The WILCO, UNABLE, AFFIRM, NEGATIVE, ROGER, and STANDBY responses are not enabled (NE) for flight crew selection. An uplink message with a response attribute NE is considered to be closed even though a response may be required operationally. Under some circumstances, a downlink error message may be linked to an uplink message with a NE attribute.*
	For Downlink Messages

Response Attribute	Description
	For Uplink Message
Y	Response required. Yes Valid responses. Any CPDLC uplink message, LOGICAL ACKNOWLEDGEMENT (only if required).
N	Response required. No, unless logical acknowledgement required. Valid responses (only if LOGICAL ACKNOWLEDGEMENT is required). LOGICAL ACKNOWLEDGEMENT, SERVICE UNAVAILABLE, FLIGHT PLAN NOT HELD, ERROR *FANS 1/A. — Aircraft do not have the capability to receive technical responses to downlink message elements with an "N" response attribute (other than LACK or ERROR for ATN B1 aircraft). In some cases, the response attribute is different between FANS 1/A aircraft and ICAO Doc 4444. As an example, most emergency messages have an "N" response attribute for FANS 1/A whereas ICAO Doc 4444 defines a "Y" response attribute for them. As a consequence, for FANS 1/A aircraft, the ATC will need to use alternative means to acknowledge to the flight crew that an emergency message has been received.*

A.4 – CPDLC MESSAGE ELEMENTS

NOTE 1: The [O] attached to a parameter indicates that the provision of this parameter in the message element is optional.

NOTE 2: The message text within parenthesis (e.g. (TERMINATE AT (position Atw[O])) as part of SPCU-11) indicates that the provision of this text and associated parameter in the message element is optional.

A.4.1 Route message elements

Route uplink message elements (RTEU)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**

Route uplink message elements (RTEU) (continued)

RTEU-1	Instruction to proceed via the specified departure clearance.	(departure clearance)	W/U	UM169 (free text) *NOTE: UM169 may be combined with UM158 ATIS (atis code) and/or UM123 SQUAWK (beacon) code) and/or UM19 MAINTAIN (altitude).*	N/A
RTEU-2	Instruction to proceed directly to the specified position.	PROCEED DIRECT TO (position)	W/U	UM74 PROCEED DIRECT TO (position)	UM74 PROCEED DIRECT TO (position)
				UM75 WHEN ABLE PROCEED DIRECT TO (position) *NOTE: This message element is equivalent to SUPU-5 plus RTEU-2 in Doc 4444.*	N/A
RTEU-3	Instruction to proceed, at the specified time, directly to the specified position.	AT TIME (time) PROCEED DIRECT TO (position)	W/U	UM76 AT (time) PROCEED DIRECT TO (position)	N/A
RTEU-4	Instruction to proceed, at the specified position, directly to the next specified position.	AT (position) PROCEED DIRECT TO (position)	W/U	UM77 AT (position) PROCEED DIRECT TO (position)	N/A

Route uplink message elements (RTEU) (continued)

RTEU-5	Instruction to proceed upon reaching the specified level, directly to the specified position.	AT (level single) PROCEED DIRECT TO (position)	W/U	UM78 AT (altitude) PROCEED DIRECT to (position)	N/A
RTEU-6	Instruction to proceed to the specified position via the specified route.	CLEARED TO (position) VIA (departure data[O]) (en-route data)	W/U	UM79 CLEARED TO (position) VIA (route clearance)	UM79 CLEARED TO (position) VIA (route clearance)
RTEU-7	Instruction to proceed via the specified route.	CLEARED (departure data[O]) (en-route data) (arrival approach data)	W/U	UM80 CLEARED (route clearance)	UM80 CLEARED (route clearance)
RTEU-8	Instruction to proceed in accordance with the specified procedure.	CLEARED (procedure name)	W/U	UM81 CLEARED (procedure name)	N/A
RTEU-9	Instruction to proceed from the specified position via the specified route.	AT (position) CLEARED (en-route data) (arrival approach data)	W/U	UM83 AT (position) CLEARED (route clearance)	N/A
RTEU-10	Instruction to proceed from the specified position via the specified procedure.	AT (position) CLEARED (procedure name)	W/U	UM84 AT (position) CLEARED (procedure name)	N/A

Route uplink message elements (RTEU) (continued)

RTEU-11	Instruction to enter a holding pattern at the specified position in accordance with the specified instructions. *NOTE: RTEU-13 EXPECT FURTHER CLEARANCE AT TIME (time) is appended to this message when an extended hold is anticipated.*	AT (position) HOLD INBOUND TRACK (degrees) (direction) TURNS (leg type) LEGS	W/U	UM91 HOLD AT (position) MAINTAIN (altitude) INBOUND TRACK (degrees) (direction) TURN LEG TIME (leg type)	N/A
RTEU-12	Instruction to enter a holding pattern at the specified position in accordance with the published holding instructions. *NOTE: RTEU-13 EXPECT FURTHER CLEARANCE AT TIME (time) is appended to this message when an extended hold is anticipated.*	AT (position) HOLD AS PUBLISHED	W/U	UM92 HOLD AT (position) AS PUBLISHED MAINTAIN (altitude)	UM92 HOLD AT (position) AS PUBLISHED MAINTAIN (level)
RTEU-13	Notification that an onwards clearance may be issued at the specified time.	EXPECT FURTHER CLEARANCE AT TIME (time)	R	UM93 EXPECT FURTHER CLEARANCE AT (time)	N/A

Route uplink message elements (RTEU) (continued)

RTEU-14	Notification that a clearance may be issued for the aircraft to fly the specified procedure or clearance name.	EXPECT (named instruction)	R	UM99 EXPECT (procedure name) *NOTE: Used when a published procedure is designated.* UM169 'EXPECT (clearance name)' *NOTE: Used when an unpublished clearance/procedure name is designated.*	N/A
RTEU-15	Request to confirm the assigned route.	CONFIRM ASSIGNED ROUTE	Y	UM137 CONFIRM ASSIGNED ROUTE *NOTE: NE response attribute.*	N/A
RTEU-16	Request to make a position report.	REQUEST POSITION REPORT	Y	UM147 REQUEST POSITION REPORT	N/A
RTEU-17	Request to provide the estimated time of arrival at the specified position.	ADVISE ETA (position)	Y	UM169 'ADVISE ETA (position)'	N/A

Route downlink message elements (RTED)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
RTED-1	Request for a direct clearance to the specified position.	REQUEST DIRECT TO (position)	Y	DM22 REQUEST DIRECT TO (position)	DM22 REQUEST DIRECT TO (position)
RTED-2	Request for the specified procedure or clearance name.	REQUEST (named instruction)	Y	DM23 REQUEST (procedure name)	N/A
RTED-3	Request for the specified route.	REQUEST CLEARANCE departure data[O]) (en-route data) (arrival approach data[O])	Y	DM24 REQUEST (route clearance)	N/A
RTED-4	Request for the specified clearance.	REQUEST (clearance type) CLEARANCE	Y	DM25 REQUEST CLEARANCE	N/A
RTED-5	Position report.	POSITION REPORT (position report)	N	DM48 POSITION REPORT (position report)	N/A
RTED-6	Request for the specified heading.	REQUEST HEADING (degrees)	Y	DM70 REQUEST HEADING (degrees)	N/A
RTED-7	Request for the specified ground track.	REQUEST GROUND TRACK (degrees)	Y	DM71 REQUEST GROUND TRACK (degrees)	N/A
RTED-8	Request for the time or position that can be expected to rejoin the cleared route.	WHEN CAN WE EXPECT BACK ON ROUTE	Y	DM51 WHEN CAN WE EXPECT BACK ON ROUTE	N/A

Route downlink message elements (RTED) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
RTED-9	Confirmation that the assigned route is the specified route.	ASSIGNED ROUTE (departure data[O]) (en-route data) (arrival approach data[O])	N	DM40 ASSIGNED ROUTE (route clearance)	N/A
RTED-10	Notification of estimated time of arrival at the specified position.	ETA (position) TIME (time)	N	DM67 'ETA (position) TIME (time)'	N/A

A.4.2 Lateral message elements

Lateral uplink message elements (LATU)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
LATU-1	Instruction to fly a parallel track to the cleared route at a displacement of the specified distance in the specified direction.	OFFSET (specified distance) (direction) OF ROUTE	W/U	UM64 OFFSET (distance offset) (direction) OF ROUTE	UM64 OFFSET (specified distance) (direction) OF ROUTE

Lateral uplink message elements (LATU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
LATU-2	Instruction to fly a parallel track to the cleared route at a displacement of the specified distance in the specified direction and commencing at the specified position.	AT (position) OFFSET specified distance) (direction) OF ROUTE	W/U	UM65 AT (position) OFFSET (distance offset) (direction) OF ROUTE	N/A
LATU-3	Instruction to fly a parallel track to the cleared route at a displacement of the specified distance in the specified direction and commencing at the specified time.	AT TIME (time) OFFSET (specified distance) (direction) OF ROUTE	W/U	UM66 AT (time) OFFSET (distance offset) (direction) OF ROUTE	N/A
LATU-4	Instruction to rejoin the cleared route.	REJOIN ROUTE	W/U	UM67 PROCEED BACK ON ROUTE	N/A
LATU-5	Instruction to rejoin the cleared route before passing the specified position.	REJOIN ROUTE BEFORE PASSING (position)	W/U	UM68 REJOIN ROUTE BY (position)	N/A
LATU-6	Instruction to rejoin the cleared route before the specified time.	REJOIN ROUTE BEFORE TIME (time)	W/U	UM69 REJOIN ROUTE BY (time)	N/A

Lateral uplink message elements (LATU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
LATU-7	Notification that a clearance may be issued to enable the aircraft to rejoin the cleared route before passing the specified position.	EXPECT BACK ON ROUTE BEFORE PASSING (position)	R	UM70 EXPECT BACK ON ROUTE BY (position)	N/A
LATU-8	Notification that a clearance may be issued to enable the aircraft to rejoin the cleared route before the specified time.	EXPECT BACK ON ROUTE BEFORE TIME (time)	R	UM71 EXPECT BACK ON ROUTE BY (time)	N/A
LATU-9	Instruction to resume own navigation following a period of tracking or heading clearances. May be used in conjunction with an instruction on how or where to rejoin the cleared route.	RESUME OWN NAVIGATION	W/U	UM72 RESUME OWN NAVIGATION	UM72 RESUME OWN NAVIGATION
LATU-10	Instruction allowing deviation up to the specified distance(s) from the cleared route in the specified direction(s).	CLEARED TO DEVIATE UP TO (lateral deviation) OF ROUTE	W/U	UM82 CLEARED TO DEVIATE UP TO (distance offset) (direction) OF ROUTE	UM82 CLEARED TO DEVIATE UP TO TO (specified distance) (direction) OF ROUTE

Lateral uplink message elements (LATU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
LATU-11	Instruction to turn left or right as specified on to the specified heading.	TURN (direction) HEADING (degrees)	W/U	UM94 TURN (direction) HEADING (degrees)	UM94 TURN (direction) HEADING (degrees)
				UM98 IMMEDIATELY TURN (direction) HEADING (degrees) Note. - This message element is equivalent to EMGU-2 plus LATU-11 in Doc 4444.	N/A
LATU-12	Instruction to turn left or right as specified on to the specified track.	TURN (direction) GROUND TRACK (degrees)	W/U	UM95 TURN (direction) GROUND TRACK (degrees)	N/A
LATU-13	Instruction to turn left or specified number of degrees left or right.	TURN (direction) (number of degrees) DEGREES	W/U	N/A	UM215 TURN (direction) (degrees)
LATU-14	Instruction to continue to fly the present heading.	CONTINUE PRESENT HEADING	W/U	UM96 FLY PRESENT HEADING	UM96 CONTINUE PRESENT HEADING
LATU-15	Instruction to fly the specified heading upon reaching the specified position.	AT (position) FLY HEADING (degrees)	W/U	UM97 AT (position) FLY HEADING (degrees)	N/A
LATU-16	Instruction to fly the specified heading.	FLY HEADING (degrees)	W/U	N/A	UM190 FLY HEADING (degrees)

Lateral uplink message elements (LATU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
LATU-17	Instruction to report when clear of weather.	REPORT CLEAR OF WEATHER	W/U	UM169 'REPORT CLEAR OF WEATHER' *NOTE: R response attribute.*	N/A
LATU-18	Instruction to report when the aircraft is back on the cleared route.	REPORT BACK ON ROUTE	W/U	UM127 REPORT BACK ON ROUTE *NOTE: R response attribute.*	N/A
LATU-19	Instruction to report upon passing the specified position.	REPORT PASSING (position)	W/U	UM130 REPORT PASSING (position) *NOTE: R response attribute.*	N/A

Lateral downlink message elements (LATD)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
LATD-1	Request for a parallel track from the cleared route at a displacement of the specified distance in the specified direction.	REQUEST OFFSET (specified distance) (direction) OF ROUTE	Y	DM15 REQUEST OFFSET (specified distance) (direction) OF ROUTE	N/A
LATD-2	Request for a weather deviation up to the specified distance(s) off track in the specified direction(s).	REQUEST WEATHER DEVIATION UP TO (lateral deviation) OF ROUTE	Y	DM27 REQUEST WEATHER DEVIATION UP TO (specified distance) (direction) OF ROUTE	DM27 REQUEST WEATHER DEVIATION UP TO (specified distance) (direction) OF ROUTE

Lateral downlink message elements (LATD) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
LATD-3	Report indicating that the aircraft is clear of weather.	CLEAR OF WEATHER	N	DM69 'CLEAR OF WEATHER'	N/A
LATD-4	Report indicating that the cleared route has been rejoined.	BACK ON ROUTE	N	DM41 BACK ON ROUTE	N/A
LATD-5	Report indicating diverting to the specified position via the specified route, which may be sent without any previous coordination done with ATC.	DIVERTING TO (position) VIA (en-route data) (arrival approach data[O])	Y	DM59 DIVERTING TO (position) VIA (route clearance) *NOTE 1: H alert attribute.* *NOTE 2: N response attribute.*	N/A
LATD-6	Report indicating that the aircraft is offsetting to a parallel track at the specified distance in the specified direction off from the cleared route.	OFFSETTING (specified distance) (direction) OF ROUTE	Y	DM60 OFFSETTING (distance offset) (direction) OF ROUTE *NOTE 1: H alert attribute.* *NOTE 2: N response attribute.*	N/A
LATD-7	Report indicating deviating specified distance or degrees in the specified direction from the cleared route.	DEVIATING (specified Deviation) (direction) OF ROUTE	Y	DM80 DEVIATING (deviation Offset) (direction) OF ROUTE *NOTE 1: H alert attribute.* *NOTE 2: N response attribute.*	N/A
LATD-8	Report indicating passing the specified position.	PASSING (position)	N	DM31 PASSING (position)	N/A

A.4.3 Level message elements

Level uplink message elements (LVLU)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
LVLU-1	Notification that an instruction may be expected for the aircraft to commence climb at the specified time.	EXPECT HIGHER AT TIME (time)	R	UM7 EXPECT CLIMB AT (time)	N/A
LVLU-2	Notification that an instruction may be expected for the aircraft to commence climb at the specified position.	EXPECT HIGHER AT (position)	R	UM8 EXPECT CLIMB AT (position)	N/A
LVLU-3	Notification that an instruction may be expected for the aircraft to commence descent at the specified time.	EXPECT LOWER AT TIME (time)	R	UM9 EXPECT DESCENT AT (time)	N/A
LVLU-4	Notification that an instruction may be expected for the aircraft to commence descent at the specified position.	EXPECT LOWER AT (position)	R	UM10 EXPECT DESCENT AT (position)	N/A
LVLU-5	Instruction to maintain the specified level or vertical range.	MAINTAIN (level)	W/U	UM19 MAINTAIN (altitude) *NOTE: Used for a single level.*	UM19 MAINTAIN (level)

Level uplink message elements (LVLU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
				UM30 MAINTAIN BLOCK (altitude) TO (altitude) *NOTE: Used for a vertical range.*	
LVLU-6	Instruction that a climb to the specified level or vertical range is to commence and once reached is to be maintained.	CLIMB TO (level)	W/U	UM20 CLIMB TO AND MAINTAIN (altitude) *NOTE: Used for a single level.*	UM20 CLIMB TO (level)
				UM31 CLIMB TO AND MAINTAIN BLOCK (altitude) TO (altitude) *NOTE: Used for a vertical range.*	
				UM36 EXPEDITE CLIMB TO (altitude) *NOTE: This message element is equivalent to SUPU-3 plus LVLU-6 in Doc 4444.*	N/A
				UM38 IMMEDIATELY CLIMB TO (altitude) *NOTE: This message element is equivalent to EMGU-2 plus LVLU-6 in Doc 4444.*	N/A

Level uplink message elements (LVLU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
LVLU-7	Instruction that at the specified time a climb to the specified level or vertical range is to commence and once reached is to be maintained. *NOTE: This message element would be preceded with LVLU-5 MAINTAIN (level) to prevent the premature execution of the instruction.*	AT TIME (time) CLIMB TO (level)	W/U	UM21 AT (time) CLIMB TO AND MAINTAIN (altitude) *NOTE: A vertical range can not be provided.*	N/A
LVLU-8	Instruction that at the specified position a climb to the specified level or vertical range is to commence and once reached is to be maintained. *NOTE: This message element would be preceded with LVLU-5 MAINTAIN (level) to prevent the premature execution of the instruction.*	AT (position) CLIMB TO (level)	W/U	UM22 AT (position) CLIMB TO AND MAINTAIN (altitude) *NOTE: A vertical range can not be provided.*	N/A

Level uplink message elements (LVLU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
LVLU-9	Instruction that a descent to the specified level or vertical range is to commence and once reached is to be maintained.	DESCEND TO (level)	W/U	UM23 DESCEND TO AND MAINTAIN (altitude) *NOTE: Used for a single level.*	UM23 DESCEND TO (level)
				UM32 DESCEND TO. AND MAINTAIN BLOCK (altitude) TO (altitude) *NOTE: Used for a vertical range.*	
				UM37 EXPEDITE DESCENT TO (altitude)	
				UM39 IMMEDIATELY DESCEND TO (altitude) *NOTE: This message element is equivalent to EM-GU-2 plus LVLU-9 in Doc 4444.*	N/A
LVLU-10	Instruction that at the specified time a descent to the specified level or vertical range is to commence and once reached is to be maintained.	AT TIME (time) DESCEND TO (level)	W/U	UM24 AT (time) DESCEND TO AND MAINTAIN (altitude) *NOTE: A vertical range can not be provided.*	N/A

Level uplink message elements (LVLU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
LVLU-11	Instruction that at the specified position a descent to the specified level or vertical range is to commence and once reached is to be maintained.	AT (position) DESCEND TO (level)	W/U	UM25 AT (position) DESCEND TO AND MAINTAIN (altitude) *NOTE: A vertical range can not be provided.*	N/A
LVLU-12	Instruction that a climb is to be completed such that the specified level is reached before the specified time.	CLIMB TO REACH (level single) BEFORE TIME (time)	W/U	UM26 CLIMB TO REACH (altitude) BY (time)	UM26 CLIMB TO REACH (level) BY (time)
LVLU-13	Instruction that a climb is to be completed such that the specified level is reached before the specified position.	CLIMB TO REACH (level single) BEFORE PASSING (position)	W/U	UM27 CLIMB TO REACH (altitude) BY (position)	UM27 CLIMB TO REACH (level) BY (position)
LVLU-14	Instruction that a descent is to be completed such that the specified level is reached before the specified time.	DESCEND TO REACH (level single) BEFORE TIME (time)	W/U	UM28 DESCEND TO REACH (altitude) BY (time)	UM28 DESCEND TO REACH (level) BY (time)
LVLU-15	Instruction that a descent is to be completed such that the specified level is reached before the specified position.	DESCEND TO REACH (level single) BEFORE PASSING (position)	W/U	UM29 DESCEND TO REACH (altitude) BY (position)	UM29 DESCEND TO REACH (level) BY (position)

Level uplink message elements (LVLU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
LVLU-16	Instruction to stop the climb at the specified level and, once reached, this level is to be maintained. The specified level will be below the previously assigned level. This instruction should only be issued when the controller can confirm that the previously assigned level has not yet been reached.	STOP CLIMB AT (level single)	W/U	UM169 'STOP CLIMB AT (altitude)' *NOTE: R response attribute.*	N/A
LVLU-17	Instruction to stop the descent at the specified level and, once reached, this level is to be maintained. The specified level will be above the previously assigned level. This instruction should only be issued when the controller can confirm that the previously assigned level has	STOP DESCENT AT (level single)	W/U	UM169 'STOP DESCENT AT (altitude)' *NOTE: R response attribute.*	N/A

Level uplink message elements (LVLU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
LVLU-18	Instruction to climb at the specified rate or greater.	CLIMB AT (vertical rate) OR GREATER	W/U	UM171 CLIMB AT (vertical rate) MINIMUM	UM171 CLIMB AT (vertical rate) MINIMUM
LVLU-19	Instruction to climb at the specified rate or less.	CLIMB AT (vertical rate) OR LESS	W/U	UM172 CLIMB AT (vertical rate) MAXIMUM	UM172 CLIMB AT (vertical rate) MAXIMUM
LVLU-20	Instruction to descent at the specified rate or greater.	DESCEND AT (vertical rate) OR GREATER	W/U	UM173 DESCEND AT (vertical rate) MINIMUM	UM173 DESCEND AT (vertical rate) MINIMUM
LVLU-21	Instruction to descent at the specified rate or less.	DESCEND AT (vertical rate) OR LESS	W/U	UM174 DESCEND AT (vertical rate) MAXIMUM	UM174 DESCEND AT (vertical rate) MAXIMUM
LVLU-22	Notification that a clearance may be issued for the aircraft to commence a climb to the specified level at the specified number of minutes after departure.	EXPECT (level single) (number of minutes) AFTER DEPARTURE	R	UM169 ‘EXPECT (level single) (number of minutes) AFTER DEPARTURE’	N/A
LVLU-23	Instruction to report upon leaving the specified level.	REPORT LEAVING (level single)	W/U	UM128 REPORT LEAVING (altitude) *NOTE: R response attribute.*	N/A
LVLU-24	Instruction to report upon maintaining the specified level.	REPORT MAINTAINING (level single)	W/U	UM129 REPORT LEVEL (altitude) *NOTE: R response attribute.*	N/A
LVLU-25	Instruction to report the present level.	REPORT PRESENT LEVEL	Y	N/A *NOTE: Refer to A. 6*	UM133 REPORT PRESENT LEVEL

Level uplink message elements (LVLU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
LVLU-26	Instruction to report upon reaching the specified vertical range.	REPORT REACHING BLOCK (level single) TO (level single)	W/U	UM180 REACHING BLOCK (altitude) TO (altitude) *NOTE: R response attribute.*	N/A
LVLU-27	Request to confirm the assigned level.	CONFIRM ASSIGNED LEVEL	Y	UM135 CONFIRM ASSIGNED ALTITUDE *NOTE: NE response attribute.*	N/A
LVLU-28	Request to provide the preferred level.	ADVISE PREFERRED LEVEL	Y	UM169 ‘ADVISE PREFERRED LEVEL’ *NOTE: R response attribute.*	UM231 STATE PREFERRED LEVEL
LVLU-29	Request to provide the preferred time and/or position to commence descent to the aerodrome of intended arrival.	ADVISE TOP OF DESCENT	Y	UM169 ‘ADVISE TOP OF DESCENT’ *NOTE: R response attribute.*	UM232 STATE TOP OF DESCENT
LVLU-30	Request for the earliest time or position when the specified level can be accepted.	WHEN CAN YOU ACCEPT (level single)	Y	UM148 WHEN CAN YOU ACCEPT (altitude) *NOTE: NE response attribute.*	UM148 WHEN CAN YOU ACCEPT (level)

Level uplink message elements (LVLU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
LVLU-31	Request to indicate whether or not the specified level can be accepted at the specified position.	CAN YOU ACCEPT (level single) AT (position)	A/N	UM149 CAN YOU ACCEPT (altitude) AT (position)	N/A
LVLU-32	Request to indicate whether or not the specified level can be accepted at the specified time.	CAN YOU ACCEPT (level single) AT TIME (time)	A/N	UM150 CAN YOU ACCEPT (altitude) AT (time)	N/A

Level downlink message elements (LVLD)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
LVLD-1	Request to fly at the specified level or vertical range.	REQUEST (level)	Y	DM6 REQUEST (altitude) *NOTE: Used for a single level.* DM7 REQUEST BLOCK (altitude) TO (altitude) *NOTE: Used for a vertical range.*	DM6 REQUEST (level)
LVLD-2	Request for a climb to the specified level or vertical range.	REQUEST CLIMB TO (level)	Y	DM6 REQUEST (level) *NOTE: Use of DM7 REQUEST BLOCK (altitude) TO (altitude) to request to climb at a vertical range.*	DM9 REQUEST CLIMB TO (level)

Level downlink message elements (LVLD) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
LVLD-3	Request for a descent to the specified level or vertical range.	REQUEST DESCENT TO (level)	Y	DM10 REQUEST DESCENT TO (altitude) *NOTE: Use of DM7 REQUEST BLOCK (altitude) TO (altitude) to request to descend at a vertical range.*	DM10 REQUEST DESCENT TO (level)
LVLD-4	Request for a climb/descent to the specified level or vertical range to commence at the specified position.	AT (position) REQUEST (level)	Y	DM11 AT (position) REQUEST CLIMB TO (altitude) *NOTE: A vertical range cannot be requested.*	N/A
				DM12 AT (position) REQUEST DESCENT TO (altitude) *NOTE: A vertical range cannot be requested.*	
LVLD-5	Request for a climb/descent to the specified level or vertical range to commence at the specified time.	AT TIME (time) REQUEST (level)	Y	DM13 AT TIME (time) REQUEST CLIMB TO (altitude) *NOTE: A vertical range cannot be requested.*	N/A

Level downlink message elements (LVLD) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
				DM14 AT TIME (time) REQUEST DESCENT TO (altitude) *NOTE: A vertical range cannot be requested.*	
LVLD-6	Request for the earliest time or position that a descent can be expected.	WHEN CAN WE EXPECT LOWER LEVEL	Y	DM52 WHEN CAN WE EXPECT LOWER ALTITUDE	N/A
LVLD-7	Request for the earliest time or position that a climb can be expected.	WHEN CAN WE EXPECT HIGHER LEVEL	Y	DM53 WHEN CAN WE EXPECT HIGHER ALTITUDE	N/A
LVLD-8	Report indicating leaving the specified level.	LEAVING (level single)	N	DM28 LEAVING (altitude)	N/A
LVLD-9	Report indicating that the specified level is being maintained.	MAINTAINING (level single)	N	DM37 LEVEL (altitude)	N/A
LVLD-10	Report indicating reaching the specified vertical range.	REACHING BLOCK (level single) TO (level single)	N	DM76 REACHING BLOCK (altitude) TO (altitude)	N/A
LVLD-11	Confirmation that the assigned level or vertical range is the specified level or vertical range.	ASSIGNED LEVEL (level)	N	DM38 ASSIGNED ALTITUDE (altitude) *NOTE: Used for a single level.*	DM38 ASSIGNED LEVEL (level)

Level downlink message elements (LVLD) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
				DM77 ASSIGNED BLOCK (altitude) TO (altitude) *NOTE: Used for a vertical range.*	
LVLD-12	Report indicating that the aircraft's preferred level is the specified level.	PREFERRED LEVEL (level single)	N	DM67 'PREFERRED LEVEL (altitude)' *NOTE 1: Response to free text UM169 'ADVISE PREFERRED LEVEL'.* *NOTE 2: When pre-formatting of the downlink message is not available, the flight crew can shorten to: FL(altitude).*	DM106 PREFERRED LEVEL (level) *NOTE: A vertical range may be provided.*
LVLD-13	Report indicating climbing to the specified level.	CLIMBING TO (level single)	N	DM29 CLIMBING TO (altitude)	N/A
LVLD-14	Report indicating descent to the specified level.	DESCENDING TO (level single)	N	DM30 DESCENDING TO (altitude) *NOTE: N alert attribute.*	N/A
				DM61 DESCENDING TO (altitude) *NOTE: Urgent alert attribute.*	

Level downlink message elements (LVLD) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
LVLD-15	Indication that the specified level can be accepted at the specified time.	WE CAN ACCEPT (level single) AT TIME (time)	N	DM67 'WE CAN ACCEPT (altitude) AT TIME (time)'	DM81 WE CAN ACCEPT (level) AT (time) *NOTE: A vertical range may be provided.*
LVLD-16	Indication that the specified level can be accepted at the specified position.	WE CAN ACCEPT (level single) AT (position)	N	DM67 'WE CAN ACCEPT (altitude) AT (position)'	N/A
LVLD-17	Indication that the specified level cannot be accepted.	WE CANNOT ACCEPT (level single)	N	DM67. 'WE CANNOT ACCEPT (altitude)'	DM82 WE CANNOT ACCEPT (level) *NOTE: A vertical range may be provided.*
LVLD-18	Notification of the preferred time and position to commence descent for approach.	TOP OF DESCENT (position) TIME (time)	N	DM67 'TOP OF DESCENT (time)' *NOTE: When preformatting of the downlink message is not available, the flight crew can shorten to: TOD (time).*	DM109 TOP OF DESCENT (time)
LVLD-19	Notification of the present level.	Present level (single level)	N	N/A *NOTE: Refer to A. 6*	DM32 PRESENT LEVEL (altitude)

A.4.4 Crossing constraint message elements

Crossing constraints (CSTU)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
CSTU-1	Instruction that the specified position is to be crossed at the specified level or within the specified vertical range.	CROSS (position) AT (level)	W/U	UM46 CROSS (position) AT (altitude) *NOTE: Used for a single level.*	UM46 CROSS (position) AT (level)
				UM50 CROSS (position) BETWEEN (altitude) AND (altitude) *NOTE: Used for a vertical range.*	
				UM49 CROSS (position) AT AND MAINTAIN (altitude) *NOTE 1: A vertical range cannot be provided.* *NOTE 2: This message element is equivalent to CSTU-1 plus LVLU-5 in Doc 4444.*	N/A
CSTU-2	Instruction that the specified position is to be crossed at or above the specified level.	CROSS (position) AT OR ABOVE (level single)	W/U	UM47 CROSS (position) AT OR ABOVE (altitude)	UM47 CROSS (position) AT OR ABOVE (level)

Crossing constraints (CSTU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
CSTU-3	Instruction that the specified position is to be crossed at or below the specified level.	CROSS (position) AT OR BELOW (level single)	W/U	UM48 CROSS (position) AT OR BELOW (altitude)	UM48 CROSS (position) AT OR BELOW (level)
CSTU-4	Instruction that the specified position is to be crossed at the specified time.	CROSS (position) AT TIME (time)	W/U	UM51 CROSS (position) AT (time)	UM51 CROSS (position) AT (time)
CSTU-5	Instruction that the specified position is to be crossed before the specified time.	CROSS (position) BEFORE TIME (time)	W/U	UM52 CROSS (position) AT OR BEFORE (time)	UM52 CROSS (position) AT OR BEFORE (time)
CSTU-6	Instruction that the specified position is to be crossed after the specified time.	CROSS (position) AFTER TIME (time)	W/U	UM53 CROSS (position) AT OR AFTER (time)	UM53 CROSS (position) AT OR AFTER (time)
CSTU-7	Instruction that the specified position is to be crossed between the specified times.	CROSS (position) BETWEEN TIME (time) AND TIME (time)	W/U	UM54 CROSS (position) BETWEEN (time) AND (time)	UM54 CROSS (position) BETWEEN (time) AND (time)
CSTU-8	Instruction that the specified position is to be crossed at the specified times.	CROSS (position) AT (speed)	W/U	UM55 CROSS (position) AT (speed)	UM55 CROSS (position) AT (speed)

Crossing constraints (CSTU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
CSTU-9	Instruction that the specified position is to be crossed at or less than the specified times.	CROSS (position) AT (speed) OR LESS	W/U	UM56 CROSS (position) AT OR LESS THAN (speed)	N/A
CSTU-10	Instruction that the specified position is to be crossed at or greater than the specified times.	CROSS (position) AT (speed) OR GREATER	W/U	UM57 CROSS (position) AT OR GREATER THAN (speed)	N/A
CSTU-11	Instruction that the specified position is to be crossed at the specified time and at the level or within the vertical range as specified.	CROSS (position) AT TIME (time) AT (level)	W/U	UM58 CROSS (position) AT (time) AT (altitude) *NOTE: A vertical range cannot be provided.*	N/A
				UM62 AT (time) CROSS (position) AT AND MAINTAIN (altitude) *NOTE 1: A vertical range cannot be provided.* *NOTE 2: This message element is equivalent to CSTU-11 plus LVLU-5 in Doc 4444.*	

Crossing constraints (CSTU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
CSTU-12	Instruction that the specified position is to be crossed before the specified time and at the level or within the vertical range as specified.	CROSS (position) BEFORE TIME (time) AT (level)	W/U	UM59 CROSS (position) AT OR BEFORE (time) AT (altitude) *NOTE: A vertical range cannot be provided.*	N/A
CSTU-13	Instruction that the specified position is to be crossed after the specified time and at the level or within the vertical range as specified.	CROSS (position) AFTER TIME (time) AT (level)	W/U	UM60 CROSS (position) AT OR AFTER (time) AT (altitude) *NOTE: A vertical range cannot be provided.*	N/A

Crossing constraints (CSTU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
CSTU-14	Instruction that the specified position is to be crossed at the level within the vertical range as specified, and at the specified speed.	CROSS (position) AT (level) AT (speed)	W/U	UM61 CROSS (position) AT AND MAINTAIN (altitude) AT (speed) *NOTE 1: A vertical range cannot be provided.* *NOTE 2: This message element is equivalent to CSTU-14 plus LVLU-5 in Doc 4444.*	UM61 CROSS (position) AT AND MAINTAIN (level) AT (speed)
CSTU-15	Instruction that the specified position is to be crossed at the specified time at the level or within the vertical range, as specified, and at the specified speed.	CROSS (position) AT TIME (time) AT (level) AT (speed)	W/U	UM63 AT (time) CROSS (position) AT AND MAINTAIN (altitude) AT (speed) *NOTE 1: A vertical range cannot be level or within the vertical provided.* *NOTE 2: This message element is equivalent to CSTU-15 plus LVLU-5 in Doc 4444.*	N/A

A.4.5 Speed message elements

Speed uplink message elements (SPDU)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
SPDU-1	Notification that a speed instruction may be issued to take effect at the specified time.	EXPECT SPEED CHANGE AT TIME (time)	R	UM100 AT (time) EXPECT (speed)	N/A
SPDU-2	Notification that a speed instruction may be issued to take effect at the specified position.	EXPECT SPEED CHANGE AT (position)	R	UM101 AT (position) EXPECT (speed)	N/A
SPDU-3	Notification that a speed instruction may be issued to take effect at the specified level.	EXPECT SPEED CHANGE AT (level single)	R	UM102 AT (altitude) EXPECT (speed)	N/A
SPDU-4	Instruction to maintain the specified speed	MAINTAIN (speed)	W/U	UM106 MAINTAIN (speed)	UM106 MAINTAIN (speed)
SPDU-5	Instruction to maintain the present speed.	MAINTAIN PRESENT SPEED	W/U	UM107 MAINTAIN PRESENT SPEED	UM107 MAINTAIN PRESENT SPEED
SPDU-6	Instruction to maintain the specified speed or greater.	MAINTAIN (speed) OR GREATER	W/U	UM108 MAINTAIN (speed) OR GREATER	UM108 MAINTAIN (speed) OR GREATER
SPDU-7	Instruction to maintain the specified speed or less.	MAINTAIN (speed) OR LESS	W/U	UM109 MAINTAIN (speed) OR LESS	UM109 MAINTAIN (speed) OR LESS

Speed uplink message elements (SPDU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
SPDU-8	Instruction to maintain the specified speed range.	MAINTAIN (speed) TO (speed)	W/U	UM110 MAINTAIN (speed) TO (speed)	N/A
SPDU-9	Instruction that the present speed is to be increased to the specified speed and maintained until further advised.	INCREASE SPEED TO (speed)	W/U	UM111 INCREASE SPEED TO (speed)	N/A
SPDU-10	Instruction that the present speed is to be increased to the specified speed or greater, and maintained at or above the specified speed until further advised.	INCREASE SPEED TO (speed) OR GREATER	W/U	UM112 INCREASE SPEED TO (speed) OR GREATER	N/A
SPDU-11	Instruction that the present speed is to be reduced to the specified speed and maintained until further advised.	REDUCE SPEED TO (speed)	W/U	UM113 REDUCE SPEED TO (speed)	N/A

Speed uplink message elements (SPDU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
SPDU-12	Instruction that the present speed is to be reduced to the specified speed or less, and maintained at or below the specified speed until further advised.	REDUCE SPEED TO (speed) OR LESS	W/U	UM114 REDUCE SPEED TO (speed) OR LESS	N/A
SPDU-13	Instruction to resume a normal speed. The aircraft no longer needs to comply with a previously issued speed restriction.	RESUME NORMAL SPEED	W/U	UM116 RESUME NORMAL SPEED	UM116 RESUME NORMAL SPEED
SPDU-14	Indication that the preferred speed may be flown without restriction.	NO SPEED RESTRICTION	R	UM169 'NO SPEED RESTRICTION'	UM222 NO SPEED RESTRICTION
SPDU-15	Request to report the speed defined by the speed type(s).	REPORT (speed types) SPEED	Y	UM134 CONFIRM SPEED *NOTE: NE response attribute.* UM169 'REPORT GROUND SPEED' *NOTE 1: Used when the controller is requesting the flight crew to report the present ground speed.* *NOTE 2: R response attribute.*	N/A

Speed uplink message elements (SPDU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
SPDU-16	Request to confirm the assigned speed.	CONFIRM ASSIGNED SPEED	Y	UM136 CONFIRM ASSIGNED SPEED *NOTE: NE response attribute.*	N/A
SPDU-17	Request for the earliest time or position when the specified speed can be accepted.	WHEN CAN YOU ACCEPT (speed)	Y	UM151 WHEN CAN YOU ACCEPT (speed) *NOTE: NE response attribute.*	N/A

Speed downlink message elements (SPDD)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
SPDD-1	Request for the specified speed.	REQUEST (speed)	Y	DM18 REQUEST (speed)	DM18 REQUEST (speed)
SPDD-2	Request for the earliest time or position that the specified speed can be expected.	WHEN CAN WE EXPECT (speed)	Y	DM49 WHEN CAN WE EXPECT (speed)	N/A
SPDD-3	Report indicating the speed defined by the specified speed types is the specified speed.	(speed types) SPEED (speed)	N	DM34 PRESENT SPEED (speed)	N/A

Speed downlink message elements (SPDD) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
				DM67 'GROUND SPEED (speed)' *NOTE 1: Used when the controller is requesting the flight crew to report the present ground speed.* *NOTE 2: When pre-formatting of the downlink message is not available, the flight crew can shorten to: GS (speed).*	
SPDD-4	Confirmation that the assigned speed is the specified speed.	ASSIGNED SPEED (speed)	N	DM39 ASSIGNED SPEED (speed)	N/A
SPDD-5	Indication that the specified speed can be accepted at the specified time.	WE CAN ACCEPT (speed) AT TIME (time)	N	DM67 'WE AN ACCEPT (speed) AT TIME (time)'	N/A
SPDD-6	Indication that the specified speed cannot be accepted.	WE CANNOT ACCEPT (speed)	N	DM67 'WE CANNOT ACCEPT (speed)'	N/A

A.4.6 Air traffic advisory message elements

Air traffic advisory uplink message elements (ADVU)

Operational definition in PANS-ATM (Doc 4444)				**CPDLC message sets**	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
ADVU-1	Advisory providing the specified altimeter setting for the specified facility.	(facility designation) ALTIMETER (altimeter setting)	R	UM153 ALTIMETER (altimeter) *NOTE: The facility designation and the time of measurement cannot be provided.* UM169 '(facility designation) ALTIMETER (altimeter setting)'	UM213 (facility designation) ALTIMETER (altimeter) *NOTE: The facility designation is always provided and the time of measurement cannot be provided.*
ADVU-2	Advisory that the ATS surveillance service is terminated.	SURVEILLANCE SERVICE TERMINATED	R	UM154 RADAR SERVICES TERMINATED UM169 'SURVEILLANCE SERVICE TERMINATED' *NOTE: ATS advisory that the radar and/or ADS-B service is terminated.*	N/A
ADVU-3	Advisory that ATS surveillance service has been established. A position may be specified position.	IDENTIFIED (position[O])	R	UM155 RADAR CONTACT (position) *NOTE: The provision of the position is required.*	N/A

Air traffic advisory uplink message elements (ADVU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
ADVU-4	Advisory that ATS surveillance contact has been lost.	IDENTIFICATION LOST	R	UM156 RADAR CONTACT LOST	N/A
ADVU-5	ATS advisory that the current ATIS code is as specified.	ATIS (ATIS code)	R	UM158 ATIS (atis code) *NOTE: The airport is not provided.*	N/A
ADVU-6	Advisory to request again with next ATC unit.	REQUEST AGAIN WITH NEXT ATC UNIT	N	UM169 'REQUEST AGAIN WITH NEXT ATC UNIT' *NOTE: R response attribute.*	UM237 REQUEST AGAIN WITH NEXT ATC UNIT
ADVU-7	Advisory of traffic significant to the flight.	TRAFFIC IS (traffic description)	R	UM169 'TRAFFIC IS (traffic description)' *NOTE: R response attribute.*	N/A
ADVU-8	Instruction to report that the specified traffic has been visually sighted and passed. The instruction may indicate the estimated time of passing.	REPORT SIGHTING AND PASSING OPPOSITE DIRECTION (aircraft type[O]) (traffic location) (ETP time[O])	W/U	UM169 'REPORT SIGHTING AND PASSING OPPOSITE DIRECTION (traffic description) (ETP (time))' *NOTE: ETP Time is included when available.*	N/A
ADVU-9	Instruction to select the specified SSR code.	SQUAWK (SSR code)	W/U	UM123 SQUAWK (beacon code)	UM123 SQUAWK (code)
ADVU-10	Instruction to disable SSR transponder responses.	STOP SQUAWK	W/U	UM124 STOP SQUAWK	N/A

Air traffic advisory uplink message elements (ADVU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
ADVU-11	Instruction to stop ADS-B transmissions.	STOP ADS-B TRANSMISSION	W/U	UM169 'STOP ADS-B TRANSMISSION' *NOTE: R response attribute.*	N/A
ADVU-12	Instruction to include level information in the SSR transponder responses.	SQUAWK MODE C	W/U	UM125 SQUAWK ALTITUDE	N/A
ADVU-13	Instruction to stop including level information in the SSR transponder responses.	STOP SQUAWK MODE C	W/U	UM126 STOP ALTITUDE SQUAWK	N/A
ADVU-14	Request to confirm the selected SSR code.	CONFIRM SQUAWK CODE	Y	UM144 CONFIRM SQUAWK *NOTE: NE response attribute.*	N/A
ADVU-15	Instruction that the 'ident' function on the SSR transponder is to be actuated.	SQUAWK IDENT	W/U	UM179 SQUAWK IDENT	UM179 SQUAWK IDENT
ADVU-16	Instruction to activate the ADS-C capability.	ACTIVATE ADS-C	W/U	UM169 'ACTIVATE ADS C' *NOTE: R response attribute.*	N/A

Air traffic advisory uplink message elements (ADVU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
ADVU-17	Instruction to transmit voice position reports, as specified, due to ADS-C being out of service.	ADS-C OUT OF SERVICE REVERT TO VOICE POSITION REPORTS	W/U	UM169 'ADS-C OUT OF SERVICE REVERT TO CPDLC POSITION REPORTS' UM169 'ADS-C OUT OF SERVICE REVERT TO VOICE POSITION REPORTS' *NOTE: R response attribute.*	N/A
ADVU-18	Instruction to intermediary aircraft to relay the specified message to the specified aircraft on the specified frequency, when provided.	RELAY TO (aircraft identification) (unit name) (relay text) (frequency[O])	W/U	UM169 'RELAY TO (call sign) (unit name) (text of message to be relayed) ((frequency))' *NOTE 1: R response attribute.* *NOTE 2: Frequency is included when available.*	N/A

Air traffic advisory uplink message elements (ADVU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
ADVU-19	Request to check the aircraft lateral position, level or speed, due to the ATC unit detecting a deviation from the clearance.	(deviation type) DEVIATION DETECTED. VERIFY AND ADVISE	W/U	UM169 'LATERAL POSITION DEVIATION DETECTED. VERIFY AND ADVISE' UM169 'LEVEL DEVIATION DETECTED. VERIFY AND ADVISE' UM169 'SPEED DEVIATION DETECTED. VERIFY AND ADVISE' *NOTE: R response attribute.*	N/A
ADVU-20	Notification that the CPDLC transfer is expected at the specified time.	EXPECT CPDLC TRANSFER AT TIME (time)	R	UM 169 'EXPECT CPDLC TRANSFER AT TIME (time)' *NOTE: R response attribute.*	N/A
ADVU-21	Notification that the first specified ATS unit will not establish CPDLC and the NDA is expected to be the second specified ATS unit.	CPDLC WITH (unit name) NOT REQUIRED EXPECT NEXT CPDLC FACILITY (unit name)	R	UM 169 CPDLC WITH (unit name) NOT REQUIRED EXPECT NEXT CPDLC FACILITY (unit name) *NOTE: R response attribute.*	N/A

Air Traffic Advisory Downlink message elements (ADVD)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
ADVD-1	Report indicating that the aircraft is squawking the specified SSR code.	SQUAWKING (SSR code)	N	DM47 SQUAWKING (code)	N/A
ADVD-2	Report indicating that whether or not traffic has been visually sighted and if so, if it has been passed. May provide a description and/or location of the aircraft.	TRAFFIC (aircraft type[O]) (traffic location) (traffic visibility)	N	DM67 ‘(traffic identification) SIGHTED AND PASSED’ DM67 ‘(traffic identification) NOT SIGHTED’ DM67 ‘TRAFFIC SIGHTED’	N/A

A.4.7 Voice communications message elements

Voice communications uplink message elements (COMU)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
COMU-1	Instruction to establish voice contact with the specified ATS unit on the specified frequency.	CONTACT (unit name) (frequency)	W/U	UM117 CONTACT (ICAO unit name) (frequency)	UM117 CONTACT (unit name) (frequency)

Voice communications uplink message elements (COMU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
COMU-2	Instruction at the specified position to establish voice contact with the specified ATS unit on the specified frequency.	AT (position) CONTACT (unit name) (frequency)	W/U	UM118 AT (position) CONTACT (ICAO unit name) (frequency)	N/A
COMU-3	Instruction at the specified time to establish voice contact with the specified ATS unit on the specified frequency.	AT TIME (time) CONTACT (unit name) (frequency)	W/U	UM119 AT (time) CONTACT (ICAO unit name) (frequency)	N/A
COMU-4	Advisory of the secondary frequency.	SECONDARY FREQUENCY (frequency)	R	UM169 ‘SECONDARY FREQUENCY (frequency)’	N/A
COMU-5	Instruction to monitor the specified ATS unit on the specified frequency. The flight crew is not required to establish voice contact on the frequency.	MONITOR (unit name) (frequency)	W/U	UM120 MONITOR (ICAO unit name) (frequency)	UM120 MONITOR (unit name) (frequency)

Voice communications uplink message elements (COMU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
COMU-6	Instruction at the specified position to monitor the specified ATS unit on the specified frequency. The flight crew is not required to establish voice contact on the frequency.	AT (position) MONITOR (unit name) (frequency)	W/U	UM121 AT (position) MONITOR (ICAO unit name) (frequency)	N/A
COMU-7	Instruction at the specified time to monitor the specified ATS unit on the specified frequency. The flight crew is not required to establish voice contact on the frequency.	AT TIME (time) MONITOR (unit name) (frequency)	W/U	UM122 AT (time) MONITOR (ICAO unit name) (frequency)	N/A
COMU-8	Instruction to check the microphone due to detection of a continuous transmission on the specified frequency.	CHECK STUCK MICROPHONE (frequency)	N	UM157 CHECK STUCK MICROPHONE (frequency) *NOTE: R response attribute.*	UM157 CHECK STUCK MICROPHONE (frequency)
COMU-9	Advisory of the name of the current ATC unit.	CURRENT ATC UNIT (unit name)	N	N/A	UM183 ‘CURRENT ATC UNIT (unit name)’

Voice communications downlink message elements (COMD)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
COMD-1	Request for voice contact on the specified frequency.	REQUEST VOICE CONTACT (frequency)	Y	DM20 REQUEST VOICE CONTACT *NOTE: Used when a frequency is not required.*	N/A
				DM21 REQUEST VOICE CONTACT (frequency) *NOTE: Used when a frequency is required.*	
COMD-2	Notification from the intermediary aircraft of the specified response from the specified aircraft.	RELAY FROM (aircraft identification) (relayed text response)	N	DM67 'RELAY FROM (call sign) (response parameters)'	N/A

A.4.8 Spacing message elements

Spacing Uplink message elements (SPCU)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
SPCU-1	ATS acknowledgement for the pilot use of the in-trail procedure when the ITP aircraft is behind the reference aircraft. This message element is always concatenated with a vertical clearance.	ITP BEHIND (aircraft identification)	N	UM169 'ITP BEHIND (aircraft identification)' *NOTE: R response attribute.*	N/A
SPCU-2	ATS acknowledgement for the pilot use of the in-trail procedure when the ITP aircraft is ahead of the reference aircraft. This message element is always concatenated with a vertical clearance.	ITP AHEAD OF (aircraft identification)	N	UM169 'ITP AHEAD OF (aircraft identification)' *NOTE: R response attribute.*	N/A

Spacing Uplink message elements (SPCU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
SPCU-3	ATS acknowledgement for the pilot use of the in-trail procedure when the ITP aircraft is behind both reference aircraft. This message element is always concatenated with a vertical clearance.	ITP BEHIND (aircraft identification) AND BEHIND (aircraft identification)	N	UM169 'ITP BEHIND (aircraft identification) AND BEHIND (aircraft identification)' *NOTE: R response attribute.*	N/A

Spacing Uplink message elements (SPCU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
SPCU-4	ATS acknowledgement for the pilot use of the in-trail procedure when the ITP aircraft is ahead of both reference aircraft. This message element is always concatenated with a vertical clearance.	ITP AHEAD OF (aircraft identification) AND AHEAD OF (aircraft identification)	N	UM169 'ITP AHEAD OF (aircraft identification) AND AHEAD OF (aircraft identification)' *NOTE: R response attribute.*	N/A
SPCU-5	ATS acknowledgement for the pilot use of the in-trail procedure when the ITP aircraft is behind one reference aircraft and ahead of one reference aircraft. This message element is always concatenated with a vertical clearance.	ITP BEHIND (aircraft identification) AND AHEAD OF (aircraft identification)'	N	UM169 'ITP BEHIND (aircraft identification) AND AHEAD OF (aircraft identification)' *NOTE: R response attribute.*	N/A

Spacing downlink message elements (SPCD)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
SPCD-1	Advisory indicating that the pilot has the ITP equipment, and provides the specified distance to the reference aircraft, including aircraft identification. This message element is always concatenated with a vertical request.	ITP (specified distance) BEHIND (aircraft identification)	N	DM67 'ITP (distance) BEHIND (aircraft identification)'	N/A
SPCD-2	Advisory indicating that the pilot has the ITP equipment, and provides the specified distance to the reference aircraft, including aircraft identification. This message element is always concatenated with a vertical request.	ITP (specified distance) AHEAD OF (aircraft identification)'	N	DM67 'ITP (distance) AHEAD OF (aircraft identification)'	N/A

Spacing downlink message elements (SPCD) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
SPCD-3	Advisory indicating that the pilot has the ITP equipment, and provides the specified distance to both reference aircraft, including aircraft identification. This message element is always concatenated with a vertical request.	ITP (specified distance) BEHIND (aircraft identification) AND (specified distance) BEHIND (aircraft identification)’	N	DM67 ‘ITP (distance) BEHIND (aircraft identification) AND (distance) BEHIND (aircraft identification)’ *NOTE: Used with a vertical request, indicating an ITP request when there are two reference aircraft, both behind.*	N/A

Spacing downlink message elements (SPCD) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
SPCD-4	Advisory indicating that the pilot has the ITP equipment, and provides the specified distance to both reference aircraft, including aircraft identification. This message element is always concatenated with a vertical request.	ITP (specified distance) AHEAD OF (aircraft identification) AND (specified distance) AHEAD OF (aircraft identification)’	N	DM67 ‘ITP (distance) AHEAD OF (aircraft identification) AND (distance) AHEAD OF (aircraft identification)’ *NOTE: Used with a vertical request, indicating an ITP request when there are two reference aircraft, both ahead.*	N/A
SPCD-5	Advisory indicating that the pilot has the ITP equipment, and provides the specified distance to one reference aircraft and the specified distance from another reference aircraft, including aircraft identification. This message element is always concatenated with a vertical request.	ITP (specified distance) BEHIND (aircraft identification) AND (specified distance) AHEAD OF (aircraft identification)	N	DM67 ‘ITP (distance) BEHIND (aircraft identification) AND (distance) AHEAD OF (aircraft identification)’ *NOTE: Used with a vertical request, indicating an ITP request when there are two reference aircraft, one behind and the other ahead.*	N/A

A.4.9 Emergency/urgency message elements

Emergency/urgency uplink message elements (EMGU)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
EMGU-1	Request to provide the fuel remaining (time) and the number of persons on board.	REPORT ENDURANCE AND PERSONS ON BOARD	Y	UM131 REPORT REMAINING FUEL AND SOULS ON BOARD *NOTE: NE response attribute.*	N/A
EMGU-2	Instruction to immediately comply with the associated instruction to avoid imminent situation.	IMMEDIATELY	N	Used in combination with LVLU-6 and LVLU-9, which is implemented in FANS 1/A as: – UM38 IMMEDIATELY CLIMB TO (altitude) – UM39 IMMEDIATELY DESCEND TO (altitude)	N/A
EMGU-3	Request to confirm an ADS-C indicated emergency.	CONFIRM ADS-C EMERGENCY	A/N	UM169 ‘CONFIRM ADS-C EMERGENCY’ *NOTE: R response attribute.*	N/A

Emergency/urgency downlink message elements (EMGD)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
EMGD-1	Indication of an urgent situation.	PAN PAN PAN	Y	DM55 PAN PAN PAN *NOTE: N response attribute.*	N/A
EMGD-2	Indication of an emergency situation.	MAYDAY MAYDAY MAYDAY	Y	DM56 MAYDAY MAYDAY MAYDAY *NOTE: N response attribute.*	N/A
EMGD-3	Report indicating fuel remaining (time) and number of persons on board.	(remaining fuel) ENDURANCE AND (persons on board) PERSONS ON BOARD	Y	DM57 (remaining fuel) OF FUEL REMAINING AND (remaining souls) SOULS ON BOARD *NOTE: N response attribute.*	N/A
EMGD-4	Indication that the emergency situation is cancelled.	CANCEL EMERGENCY	Y	DM58 CANCEL EMERGENCY *NOTE: N response attribute.*	N/A

A.4.10 Standard response message elements

Standard response uplink message elements (RSPU)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
RSPU-1	Indication that the message cannot be complied with.	UNABLE	N	UM0 UNABLE	UM0 UNABLE

Standard response uplink message elements (RSPU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
RSPU-2	Indication that the message will be responded to shortly.	STANDBY	N	UM1 STANDBY	UM1 STANDBY
RSPU-3	Indication that a long-term delay in response can be expected.	REQUEST DEFERRED	N	UM2 REQUEST DEFERRED	N/A
RSPU-4	Indication that the message is received.	ROGER	N	UM3 ROGER	UM3 ROGER
				UM169 'ROGER MAYDAY' *NOTE 1: R response attribute.* *NOTE 2: Used to acknowledge emergency downlink reports.*	
				UM169 'ROGER PAN' *NOTE 1: R response attribute.* *NOTE 2: Used to acknowledge urgency downlink reports.*	
RSPU-5	Indication that ATC is responding positively to the message.	AFFIRM	N	UM4 AFFIRM	UM4 AFFIRM
RSPU-6	Indication that ATC is responding negatively to the message.	NEGATIVE	N	UM5 NEGATIVE	UM5 NEGATIVE

Standard response uplink message elements (RSPU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
RSPU-7	Indication that the request has been forwarded to the next control unit.	REQUEST FORWARDED	N	UM169 ‘REQUEST FORWARDED’ *NOTE: R response attribute.*	UM211 REQUEST FORWARDED
RSPU-8	Request to confirm the referenced request since the initial request was not understood. The request should be clarified and resubmitted.	CONFIRM REQUEST	N	UM143 CONFIRM REQUEST	N/A

Standard response downlink message elements (RSPD)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
RSPD-1	Indication that the instruction is understood and will be complied with.	WILCO	N	DM0 WILCO	DM0 WILCO
RSPD-2	Indication that the instruction cannot be complied with.	UNABLE	N	DM1 UNABLE	DM1 UNABLE
RSPD-3	Indication that the message will be responded to shortly.	STANDBY	N	DM2 STANDBY	DM2 STANDBY

Standard response downlink message elements (RSPD) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
RSPD-4	Indication that the message is received.	ROGER	N	DM3 ROGER *NOTE: ROGER is the only correct response to an uplink free text message.*	DM3 ROGER
RSPD-5	Indication of a positive response to a message.	AFFIRM	N	DM4 AFFIRM	DM4 AFFIRM
RSPD-6	Indication of a negative response to a message.	NEGATIVE	N	DM5 NEGATIVE	DM5 NEGATIVE

A.4.11 Supplemental message elements

Supplemental uplink message elements (SUPU)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
SUPU-1	Indication that the associated instruction is to be executed when the flight crew is ready.	WHEN READY	N	UM164 WHEN READY	N/A
SUPU-2	Indication that the associated message is issued due to the specified reason.	DUE TO (specified reason uplink)	N	UM166 DUE TO TRAFFIC	N/A
				UM167 DUE TO AIRSPACE RESTRICTION	

Supplemental uplink message elements (SUPU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
SUPU-3	Instruction to execute the associated instruction at the aircraft's best performance rate.	EXPEDITE	N	Used in combination with LVLU-6, which is implemented in FANS 1/A as: UM36 EXPEDITE CLIMB TO (altitude).	N/A
SUPU-4	Indication that the associated instruction is either a revision to a previously issued instruction or is different from the requested clearance.	REVISED (revision reason[O])	N	UM170 ‘REVISED (revision reason[O])’ *NOTE: R response attribute.*	N/A
SUPU-5	Indication that the associated instruction is to be executed at the earliest point when the flight crew is able.	WHEN ABLE	N	N/A *NOTE: This message element is part of UM75.*	N/A

Supplemental downlink message elements (SUPD)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
SUPD-1	Indication that the associated message is issued due to specified reason.	DUE TO (specified reason downlink)	N	DM65 DUE TO WEATHER	DM65 DUE TO WEATHER
				DM66 DUE TO AIRCRAFT PERFORMANCE	DM66 DUE TO AIRCRAFT PERFORMANCE

A.4.12 Free text message elements

Free text uplink message elements (TXTU)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
TXTU-1		(free text) *NOTE: M alert attribute.*	R	UM169 (free text)	UM203 (free text)
TXTU-2		(free text) *NOTE: M alert attribute.*	N	UM169 (free text) *NOTE: R response attribute.*	UM183 (free text)
TXTU-3		(free text) *NOTE: N alert attribute.*	N	UM169 (free text) *NOTE: R response attribute.*	N/A
TXTU-4		(free text) *NOTE: M alert attribute.*	W/U	UM169 (free text) *NOTE: R response attribute.*	UM196 (free text)
TXTU-5		(free text) *NOTE: M alert attribute.*	A/N	UM169 (free text) *NOTE: R response attribute.*	UM205 (free text)

Free text downlink message elements (TXTD)

Operational definition in PANS-ATM (Doc 4444)				**CPDLC message sets**	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
TXTD-1		(free text) *NOTE: M alert attribute.*	Y	DM68 (free text) *NOTE 1: Urgency or Distress Air (M)* *NOTE 2: Selecting any of the emergency message elements will result in this message element being enabled for the flight crew to include in the emergency message at their discretion.*	N/A
TXTD-2		(free text) *NOTE: M alert attribute.*	N	DM67 (free text)	DM98 (free text)

A.4.13 System management message elements

System management uplink message elements (SYSU)

Operational definition in PANS-ATM (Doc 4444)				**CPDLC message sets**	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
SYSU-1	System-generated notification of an error.	ERROR (error information)	N	UM159 ERROR (error information)	UM159 ERROR (error information)

System management uplink message elements (SYSU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
SYSU-2	System-generated notification of the next data authority or the cancellation thereof.	NEXT DATA AUTHORITY (designation[O])	N	UM160 NEXT DATA AUTHORITY (ICAO facility designation) *NOTE: The facility designation is required.*	UM160 NEXT DATA AUTHORITY (facility) *NOTE: Facility parameter can specify a facility designation or no facility.*
SYSU-3	System-generated notification that received message is not supported.	MESSAGE NOT SUPPORTED BY THIS ATC UNIT	N	UM169 'MESSAGE NOT SUPPORTED BY THIS ATC UNIT' *NOTE: R response attribute.*	UM162 MESSAGE NOT SUPPORTED BY THIS ATC UNIT
SYSU-4	System-generated notification that received is acceptable for display.	LOGICAL ACKNOWLEDGEMENT	N	N/A	UM227 LOGICAL ACKNOWLEDGEMENT
SYSU-5	System-generated message indicating that requests for logical acknowledgements are not permitted.	USE OF LOGICAL ACKNOWLEDGEMENT PROHIBITED	N	N/A	UM233 USE OF LOGICAL ACKNOWLEDGEMENT PROHIBITED *NOTE: ATN B1 ground systems may not use UM (as par ETSI CS) since the use of LACK is required.*

System management uplink message elements (SYSU) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
SYSU-6	Advisory providing the maximum one-way uplink message transmission delay.	LATENCY TIME VALUE (latency value)	N	UM169 'SET MAX UPLINK DELAY VALUE TO (delayed message parameter) SEC' *NOTE 1: R response attribute.* *NOTE 2: On FANS 1/A aircraft, this message requires specific action from the flight crew to manually set the latency value.*	N/A
SYSU-7	Indication that the received message has a latency greater than the requirement.	MESSAGE RECEIVED TOO LATE, RESEND MESSAGE OR CONTACT BY VOICE	N	N/A	UM159 ERROR (error information) + UM183 'DOWNLINK DELAYED USE - VOICE' *NOTE: The error information is set to the value (2).*

System management downlink message elements (SYSD)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
Message element identifier	**Message element intended use**	**Format for message element display**	**Resp.**	**FANS 1/A**	**ATN B1**
SYSD-1	System-generated notification of an error.	ERROR (error information)	N	DM62 ERROR (error information)	DM62 ERROR (error information)
SYSD-2	System-generated notification that the received message is acceptable for display.	LOGICAL ACKNOWLEDGEMENT	N	N/A	DM100 LOGICAL ACKNOWLEDGEMENT

System management downlink message elements (SYSD) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
SYSD-3	System-generated rejection of any CPDLC message sent from a ground facility that is not the current data authority.	NOT CURRENT DATA AUTHORITY	N	DM63 NOT CURRENT DATA AUTHORITY	DM63 NOT CURRENT DATA AUTHORITY
SYSD-4	System-generated notification that the ground facility is now the current data authority.	CURRENT DATA AUTHORITY	N	N/A	DM99 CURRENT DATA AUTHORITY
SYSD-5	System-generated notification that the ground system is not designated as the next data authority (NDA), indicating the identity of the current data authority (CDA). Identity of the NDA, if any, is also reported.	NOT AUTHORIZED NEXT DATA AUTHORITY (facility designation) (facility designation[O])	N	DM64 (ICAO facility designation) *NOTE: Use by FANS 1/A aircraft in B1 environments.*	DM107 NOT AUTHORIZED NEXT DATA AUTHORITY *NOTE: CDA and NDA cannot be provided.*

System management downlink message elements (SYSD) (continued)

Operational definition in PANS-ATM (Doc 4444)				CPDLC message sets	
SYSD-6	Indication that the received message has a latency greater than the requirement.	MESSAGE RECEIVED TOO LATE, RESEND MESSAGE OR CONTACT BY VOICE	N	DM67 'MESSAGE RECEIVED TOO LATE, RESEND MESSAGE OR CONTACT BY VOICE' *NOTE: Sent with DM62.*	DM98 'MESSAGE RECEIVED TOO LATE, RESEND MESSAGE OR CONTACT BY VOICE' *NOTE: Sent with DM62.*
SYSD-7	System-generated notification that the aircraft is in the inhibited state.	AIRCRAFT CPDLC INHIBITED	N	N/A	DM 98 'AIRCRAFT CPDLC INHIBITED'

A.6 MESSAGE ELEMENTS RECOMMENDED NOT TO USE

A.6.1 FANS 1/A uplink message elements

Message element	Justification
UM49 CROSS (position) AT AND MAINTAIN (altitude)	Avoid use of this message due to inability of aircraft automation to maintain the altitude restriction.
UM62 AT (time) CROSS (position) AT AND MAINTAIN (altitude)	
UM85 EXPECT (route clearance)	Avoid use of this message element due to potential misinterpretation.
UM86 AT (position) EXPECT (route clearance)	
UM87 EXPECT DIRECT TO (position)	
UM88 AT (position) EXPECT DIRECT TO (position)	
UM89 AT (time) EXPECT DIRECT TO (position)	
UM90 AT (altitude) EXPECT DIRECT TO (position)	
UM162 SERVICE UNAVAILABLE	
UM6 EXPECT (altitude)	

Message element	Justification
UM11 EXPECT CRUISE CLIMB AT (time)	
UM12 EXPECT CRUISE CLIMB AT (position)	
UM13 AT (time) EXPECT CLIMB TO (altitude)	
UM14 AT (position) EXPECT CLIMB TO (altitude)	
UM15 AT (time) EXPECT DESCENT TO (altitude)	
UM16 AT (position) EXPECT DESCENT TO (altitude)	
UM17 AT (time) EXPECT CRUISE CLIMB TO (altitude)	
UM18 AT (position) EXPECT CRUISE CLIMB TO (altitude)	
UM33 CRUISE (altitude)	
UM34 CRUISE CLIMB TO (altitude)	
UM35 CRUISE CLIMB ABOVE (altitude)	
UM40 IMMEDIATELY STOP CLIMB AT (altitude)	
UM41 IMMEDIATELY STOP DESCENT AT (altitude)	
UM175 REPORT REACHING (altitude)	
UM42 EXPECT TO CROSS (position) AT (altitude)	
UM43 EXPECT TO CROSS (position) AT OR ABOVE (altitude)	
UM44 EXPECT TO CROSS (position) AT OR BELOW (altitude)	
UM45 EXPECT TO CROSS (position) AT AND MAINTAIN (altitude)	
UM103 AT (time) EXPECT (speed) TO (speed)	
UM104 AT (position) EXPECT (speed) TO (speed)	

Message element	Justification
UM105 AT (altitude) EXPECT (speed) TO (speed)	
UM165 THEN	
UM235 ROGER 7500	
UM168 DISREGARD	Not operationally required. *NOTE: These messages have been excluded from future B2 implementation.*
UM176 MAINTAIN OWN SEPARATION AND VMC	
UM152 WHEN CAN YOU ACCEPT (specified distance) (direction) OFFSET	
UM115 DO NOT EXCEED (speed)	
UM182 CONFIRM ATIS CODE	
UM169 ‘TRANSMIT ADS-B IDENT’	Use of SQUAWK IDENT is recommended.
UM169 ‘IDENTIFICATION TERMINATED’	Use of SURVEILLANCE SERVICE TERMINATED is recommended.
UM132 CONFIRM POSITION	Use of ADS-C is recommended.
UM133 CONFIRM ALTITUDE	
UM138 CONFIRM TIME OVER REPORTED WAYPOINT	
UM139 CONFIRM REPORTED WAYPOINT	
UM140 CONFIRM NEXT WAYPOINT	
UM141 CONFIRM NEXT WAYPOINT ETA	
UM142 CONFIRM ENSUING WAYPOINT	
UM146 REPORT GROUND TRACK	
UM181 REPORT DISTANCE (to/from) (position)	
UM145 CONFIRM HEADING	
UM177 AT PILOTS DISCRETION	Not globally accepted. See Appendix B, 3.2.1 for its use.

A.6.2 FANS 1/A downlink message elements

Message element	Justification
DM69 REQUEST VMC DESCENT	Avoid use of this message element due to potential misinterpretation.
DM75 AT PILOTS DISCRETION	
DM67 'WHEN CAN WE EXPECT DESCENT TO (altitude)'	Avoid use of this message due to potential misinterpretation of subsequent response. Use of LVLD-6 WHEN CAN WE EXPECT HIGHER LEVEL and LVLD-7 WHEN CAN WE LOWER HIGHER LEVEL is recommended.
DM67 'WHEN CAN WE EXPECT CLIMB TO (altitude)'	
DM74 REQUEST TO MAINTAIN OWN SEPARATION AND VMC	Not operationally required. *NOTE: These messages have been excluded from future B2 implementation.*
DM8 REQUEST CRUISE CLIMB TO (altitude)	
DM54 WHEN CAN WE EXPECT CRUISE CLIMB TO (altitude)	
DM72 REACHING (altitude)	
DM79 ATIS (atis code)	
DM67 'MONITORING (unit name) (frequency)'	
DM16 AT (position) REQUEST OFFSET (specified distance) (direction) OF ROUTE	
DM17 AT (time) REQUEST OFFSET (specified distance) (direction) OF ROUTE	
DM26 REQUEST WEATHER DEVIATION TO (position) VIA (route clearance)	
DM33 PRESENT POSITION (position)	Use of ADS-C is recommended.
DM36 PRESENT GROUND TRACK (degrees)	
DM42 NEXT WAYPOINT (position)	
DM43 NEXT WAYPOINT ETA (time)	
DM44 ENSUING WAYPOINT (position)	
DM45 REPORTED WAYPOINT (position)	
DM46 REPORTED WAYPOINT (time)	

Message element	Justification
DM78 AT (time) (distance) (to/from) (position)	
DM32 PRESENT ALTITUDE (altitude)	
DM35 PRESENT HEADING (degrees)	
DM19 REQUEST (speed) TO (speed)	Use of SPDD-1 REQUEST (speed) is recommended.
DM50 WHEN CAN WE EXPECT (speed) TO (speed)	

A.6.3 ATN B1 uplink message element

Message element	Justification
UM165 THEN	Avoid use of this message element due to potential misinterpretation.

A.6.4 ATN B1 downlink message element

Message element	Justification
DM89 MONITORING (unit name) (frequency)	Not operationally required. *NOTE: This message has been excluded from future B2 implementation.*

Appendix BREGIONAL/STATE - SPECIFIC INFORMATION

B.1 GENERAL

This Appendix provides Regional/State specific information grouped per ICAO Regions pertaining to the data link operations.

B.2 European (EUR) Region

B.2.1 Administrative Provisions related to Data Link Operations

B.2.1.1 ANSP Service Provision

B.2.1.1.2 European regulations require ATN B1 data link services be provided above FL285, however individual states are free to provide services below that level. Refer to the AIP of each State for details.

B.2.1.1.3 The use of CPDLC is conducted at the discretion of each responsible ACC and at the initiative of the flight crew. CPDLC is used for routine exchanges during enroute operations in the upper airspace and is not for time-critical situations. Communication exchanges by voice have priority over CPDLC exchanges at all times.

B.2.1.2 EUR - NSAP Address Registry

B.2.1.2.1 In order to allow the air crew to perform a first LOGON with any of the participating ATN B1 ACCs, Context Management application addressing information of the ATS units involved in the ATN/OSI based Air/Ground Data Link Communications, is required in the ATN avionics system.

B.2.1.2.2 The ATN NSAP addresses for all EUR ACCs are published in EUR Doc 028 - EUR NSAP Address Registry.

B.2.1.2.3 The focal point for the EUR NSAP Address Registry is the EUR/NAT ICAO Regional Office. All requests, modifications and proposals concerning should be forwarded to:

http://icaoeurnat@paris.icao.int

NOTE 1: The ICAO EUR/NAT Office ensures that the information is forwarded to the appropriate working groups (e.g. AFSG Planning Group).

NOTE 2: The EUR NSAP Address Registry is available at the ICAO website: http://www.icao.int/EURNAT/Pages/EUR-and-NAT-Document.aspx.

B.2.1.3 Flight Plan Provisions

B.2.1.3.1 In the EUR airspace where ATN B1 CPDLC is available and aircraft are equipped and capable ATN B1 CPDLC, J1 shall be included in Item 10a of the flight plan:

a. Operators of FANS 1/A-ATN B1 (independent or integrated) equipped aircraft shall insert one or more of the appropriate indicators among J1-J7 in Item 10a.

b. For flights conducted wholly or partly in the EUR airspace where ATN B1 CPDLC is available but not equipped with CPDLC capabilities but which have been granted an exemption, the letter Z shall be included in Item 10A and the indicator DAT/CPDLCX shall be included in Item18 of the flight plan.

B.2.1.3.2 For a flight operating based on a repetitive flight plan (RPL), during which the pilot intends to use CPDLC, a modification message (CHG) shall be submitted to indicate that the flight is capable of, and authorized for CPDLC.

B.2.1.3.3 When there is a change to the CPDLC capability status, the operator should send a modification message (CHG) with the appropriate indications in the relevant items of the ICAO flight plan form, including any change to the aircraft address. A modification message for the day of operation should be sent not earlier than 20 hours before the estimated off-block time.

B.2.1.4 Logon Criteria

B.2.1.4.1 In addition to the logon FPL correlation criteria the CPDLC aircraft equipment capabilities in Item 10a are also used as criterion for a successful logon. Absence of item J1 and/or one or more of the items J2 to J7 in Item 10a will lead to a logon rejection.

B.2.1.5 Lack Timer

B.2.1.5.1 Logical Acknowledgement (LACK) messages (downlink message element DM 100 and uplink message element UM 227 are used in ATN B1 based ACL and ACM message exchanges.

NOTE 1: Ground systems do not request a LACK for the messages ERROR UM 159, Service Unavailable UM 162 and LACK UM 227.

NOTE 2: When a LACK is received after expiry of the LACK timer, the LACK may be discarded.

B.2.3 Flight Crew Procedures

B.2.3.1 General

B.2.3.1.1 Reception of uplink messages received by FANS 1/A aircraft

B.2.3.1.1.1 Some of the FANS 1/A-ATN B1 ATS units ‘prepend’ a free text message UM 169, containing the FID, to each uplink message, sent to a FANS 1/A aircraft.

B.2.3.1.1.2 Flight crew should verify that the ‘prepended’ FID matches with the aircraft’s FID as filed in the flight plan, Item 7a.

B.2.3.1.1.3 In case the FID doesn’t match, the flight crew should reject the uplinked message, revert to voice communications to notify the ATS unit of the misdelivered message.

B.2.3.1.2 Reverting from CPDLC to voice

B.2.3.1.2.1 The following circumstances describe potential situations where the flight crew communications should revert to voice:

a. When it is required to clarify the meaning or the intent of any unexpected, inappropriate or ambiguous CPDLC message;

b. Whenever corrective actions are required with respect to unintended or spurious request that have been sent using CPDLC. The flight crew should be aware that once a message is sent via CPDLC, no means exist to cancel or to recall that message. The following actions should be taken by the flight crew after the controller has reverted to voice:

1. If response to the referred CPDLC message was sent, cancel any action initiated on the basis of the initial CPDLC message and comply with the voice message;
2. If the referred message is not responded to or not displayed, let the dialogue close on time-out. Since it may be possible to be asked to ignore a message that was not yet displayed, the flight crew should take all measures to ensure that the message is no longer valid;
3. In case the flight crew has already received an operational response to the initial CPDLC message, he/she shall use appropriate voice phrases to stop/cancel the actions of the addressee; and

NOTE: In case of reversion to voice, flight crew should be aware of the possibility that the CPDLC message they want the addressee to ignore may not be yet displayed to the addressee.

c. Whenever a system generates a time-out or an error for a CPDLC message.

B.2.3.1.3 Use of concatenated messages - air initiated

B.2.3.1.3.1 Aircraft and ground systems should allow for a downlink concatenated message containing a maximum of two message elements.

B.2.3.1.3.2 The only downlink concatenated messages, which ground systems are required to support, are those that result from a concatenation of one message element from the left column and one message element from the right column.

First Message Element in Message	Second Message Element in Message
DM 6 REQUEST (level)	DM 65 DUE TO WEATHER
DM 9 REQUEST CLIMB TO (level)	DM 66 DUE TO AIRCRAFT PERFORMANCE
DM 10 REQUEST DESCENT TO (level)	
DM 22 REQUEST DIRECT TO (position)	

B.2.3.1.4 Responding to concatenated message elements with response attribute other than Y

B.2.3.1.4.1 The permitted response will be messages containing one of the following message elements: DM 100 LOGICAL ACKNOWLEDGMENT (if required), DM 2 STANDBY, DM 0 WILCO, DM 1 UNABLE, DM 63 NOT CURRENT DATA AUTHORITY, DM 107 NOT AUTHORIZED NEXT DATA AUTHORITY or DM 62 ERROR message element.

B.2.3.1.4.2 The closure response message will be a message containing one of the following message elements: DM 0 WILCO, DM 1 UNABLE, DM 63 NOT CURRENT DATA AUTHORITY, DM 107 NOT AUTHORIZED NEXT DATA AUTHORITY or DM 62 ERROR message element.

B.2.3.1.4.3 The DM 0 WILCO or DM 1 UNABLE response messages will operationally apply to the entire uplink concatenated message.

B.2.3.1.4.4 As responses to a ground initiated dialogue, ground systems are required to also support the following downlink concatenated messages:

First Message Element in Message	Second Message Element in Message
DM 1 UNABLE	DM 65 DUE TO WEATHER
DM 82 WE CANNOT ACCEPT (level)	DM 66 DUE TO AIRCRAFT PERFORMANCE

B.2.3.2 Latency Time Monitor (LTM)

B.2.3.2.1 In accordance with safety requirement SR-ACL-13 of ED120/DO290, the message latency monitor defined in ED100A/DO258A, paragraph 4.6.6.9, and ED110B/DO280B (ATN), paragraph 3.3.4, provides to the ANSP a means to mitigate the effects of an excessively delayed CPDLC message. In Europe, this message latency monitor is referred to as the Latency Time Monitor (LTM).

NOTE: The LTM function is not used by FANS 1/A+ aircraft.

B.2.3.2.2 An ATN B1 compliant aircraft has a Latency Time Monitor (LTM) function in the form of a hard-coded LTM value in the avionics. The LTM value is set at 40 seconds.

B.2.3.2.3 Upon activation of the LTM, the aircraft system will:

Upon activation of LTM, the aircraft system will:

a. Display the message to the flight crew with a delayed message indication. The flight crew should contact the controller and advise him/her of the situation and/or request verification of ATC intent; or

b. Discard the message without any indication to the flight crew and notify the controller with a message consisting of DM 62 ERROR (error information) and DM 98 (UPLINK DELAYED IN NETWORK AND REJECTED. RESEND OR CONTACT BY VOICE). The controller should revert to voice to clarify the situation.

B.2.3.3 Operational use of LACK

B.2.3.3.1 Each time the flight crew downlinks an operational message, the ATN B1 ground system returns a UM 227 logical acknowledgement (LACK).

B.2.3.3.2 The LACK timer value should be set by the aircraft system at 40 seconds.

B.2.3.3.3 If the aircraft system does not receive a UM 227 LACK within 40 seconds, the flight crew will be notified.

NOTE 1: The aircraft system does not request a UM 227 LACK for messages DM 62 (ERROR), DM 63 NOT CURRENT DATA AUTHORITY), DM 100 (LACK) and DM 107 (NOT AUTHORIZED NEXT DATA AUTHORITY).

NOTE 2: Local implementers may decide whether the flight crew is notified on the receipt of each LACK (positive feedback) or is only notified upon a LACK time out (negative feedback).

NOTE 3: When a UM 227 LACK is received after expiry of the LACK timer, the UM 227 LACK may be discarded.

B.2.3.4 Operational Timers used by the Aircraft

B.2.3.4.1 Controller initiated dialogue

B.2.3.4.1.1 When an ATN B1 aircraft system receives an uplink message, requiring a response, it starts the timer-responder (ttr), whose value for the response to be sent is set at 100 seconds.

a. The ttr expires if the flight crew fails to respond within 100 seconds. The flight crew is notified and reverts to voice to complete the dialogue;

   NOTE: FANS 1/A aircraft do not have a ttr timer.

b. The ATN B1 aircraft system closes the dialogue and sends an error response ‘AIRSYSTEM TIME-OUT’. The error response ensures that the dialogue will also be closed within the ATS unit.

   NOTE: In normal circumstances, the aircraft-timer (ttr) expires before the ground-timer (tts) expires.

B.2.3.4.1.2 If the flight crew responds to a clearance with a DM 2 STANDBY, the aircraft- and ground timers are re-started.

B.2.3.4.2 Flight crew initiated dialogue

B.2.3.4.2.1 When the flight crew sends a CPDLC request, requiring an operational response, and when implemented, the ATN B1 aircraft system starts the tts. If used, the timer value for the operational response to be received is set at 270 seconds.

a. The tts expires, if no operational response has been received by the aircraft system within 270 seconds. The flight crew is notified and reverts to voice to resolve the situation.

b. The dialogue is closed locally by the aircraft system, ensuring that the dialogue doesn’t remain open at the aircraft side.

   NOTE: ATN B1 ground systems have implemented ground-timer. In normal circumstances, the ground-timer (ttr) expires before the aircraft-timer (tts) expires.

B.2.3.4.2.2 If the controller responds to a request with a UM 1 STANDBY, the aircraft and ground timers are re-started.

B.2.3.5 Use of Degrees in ACL Messages

B.2.3.5.1 The display of (degrees) parameter is used in the following three CPDLC messages:

a. UM 94 TURN (direction) HEADING (degrees)

b. UM 190 FLY HEADING (degrees)

c. UM 215 TURN (direction) (degrees) DEGREES

B.2.3.5.2 UM 94 and UM 190 represent an absolute change towards the instructed HEADING, while UM 215 is a relative change with reference to the current HEADING.

B.2.3.5.3 ICAO requires that the HEADING in UM 94 and UM 190 is expressed in 3 digits (e.g. 015°) and should be displayed accordingly.

B.2.3.5.4 Flight crews should be aware that Airframe and avionics manufacturers are adding a leading ‘0’ for degrees less than 100° for UM 94 and UM 190.

B.2.3.5.5 However, UM 215 is expressed in two digits (e.g. 15 degrees). To ensure that flight crews execute UM 215 as a relative change, UM 215 is displayed as TURN (direction) (degrees) DEGREES (e.g. TURN RIGHT 15 DEGREES).

B.2.3.6 Transfer of Data Communications with open Dialogues

B.2.3.6.1 Open air-initiated dialogues

B.2.3.6.1.1 When there are open air-initiated dialogues, the ground system closes each of these dialogues with a closure response before sending the transfer instruction. The closure uplink responses are one of the following:

a. UNABLE (UM 0), or

b. REQUEST AGAIN WITH NEXT UNIT (UM 237), or

c. Concatenated message ‘ERROR’ (UM 159) + REQUEST AGAIN WITH NEXT UNIT (UM 183 - free text), or

d. REQUEST AGAIN WITH NEXT UNIT (UM 183 - free text)

B.2.3.6.1.2 When there are open air-initiated dialogues, and the flight crew responds to the transfer instruction with a DM 0 WILCO, the airborne system cancels all open air initiated dialogues. When responding with DM 1 UNABLE or DM 2 STANDBY, the aircraft system maintains the open dialogues.

B.2.3.7 Multiple Open Requests for a same Type

To avoid ambiguity and request being discarded by the ATS unit, the flight crew should avoid sending multiple requests for a same type of dialogue, dialogue type being one of the following: a) level; b) heading; c) speed; d) route.

NOTE: The flight crew should be aware that only one downlink request for a single type will be presented to the controller and that this open dialogue must be closed before a second request of that type may be treated.

B.2.3.8 Abnormal Situations

B.2.3.8.1 Inability to contact the assigned voice communication channel

B.2.3.8.1.1 When the flight crew is unable to contact the assigned voice communication channel when instructed to do so by the transferring controller via CPDLC, the flight crew should revert to the voice communication channel of the transferring ATC unit for instructions.

B.2.3.8.2 Use of CPDLC in the event of voice radio communication failure

B.2.3.8.2.1 The existence of a CPDLC connection between the ATS unit and the aircraft should not preempt the flight crew and ACC from applying all the ICAO provisions in the event of radio communication failure.

B.2.3.8.2.2 When the flight crew cannot comply with the requirement above, it will have to apply the provisions stipulated for the event of radio communication failure.

B.2.3.8.3 Flight crew-commanded CPDLC termination

B.2.3.8.3.1 When flight crew initiates CPDLC termination, the ATN B1 airborne system sends a CPDLC user-abort to the ground system. The controller is notified of the abort.

NOTE: Subject to local designs, ground systems may not provide facilities for CPDLC connect request to be re-issued upon notification by the flight crew that they want to resume CPDLC with the ground.

B.2.3.8.3.2 To reinstate CPDLC after a flight crew-initiated commanded termination, the flight crew initiates a CM-logon request.

B.2.3.9 Uplink Error Messages

B.2.3.9.1 ATN B1 systems use a set of error messages, when the ATN B1 ground system does not behave according to the ATN B1 requirements or local constraints prevent an operational response.

B.2.3.9.2 Table B-EUR-3 provides a list of operational error messages displayed to the flight crew.

B.2.3.9.3 When receiving an ‘ERROR’ (UM 159) + free text message (UM 183) in response to operational downlink messages, the flight crew should revert to voice to clarify the situation with the controller.

Table B-EUR-3. Operational Error Uplink Messages

Free Text Message	Description	Procedure
DOWNLINK MESSAGE REQUEST REJECTED - SEND (number) ELEMENTS	The ground system receives a message that contains more message elements than it can support in a message. EXAMPLE: The flight crew sends a combined message (DM 6 REQUEST (level), DM 70 REQUEST HEADING (degrees), DM 65 DUE TO WEATHER) and the ground system accepts only a maximum of two message elements. *NOTE: It is a local choice of the ground system to reject downlink messages containing more than 1, 2 or 3 message elements or to accept up to 5 message elements.*	The flight crew may resend the request in the form of separate messages, or make the request/s by voice.
(Dialogue type) NOT AVAILABLE AT THIS TIME - USE VOICE Dialogue type is one of the following: LEVEL, HEADING, SPEED, ROUTE REQUEST	The ground system receives a downlink message that is discarded because the associated dialogue type is disabled.	The flight crew should make the request by voice.

Table B-EUR-3. Operational Error Uplink Messages (continued)

Free Text Message	Description	Procedure
ELEMENT COMBINATION REJECTED - USE VOICE	The ground system receives a concatenated downlink message that it does not support (invalid element combination, or at least one message element is not supported, or invalid element order). *NOTE: Whether a combination of message elements is valid or not, is determined through local choice of the ground system. Examples of obvious invalid combinations: Request Climb To + Request Descend To; WILCO + UNABLE, etc.*	The flight crew may resend the message/request in the form of separate messages, or make the request/s by voice.
TOO MANY (dialogue type) REQUESTS - EXPECT ONLY ONE REPLY Dialogue type is one of the following: LEVEL, HEADING, SPEED, ROUTE.	The ground system receives a downlink request, and there is an existing open downlink request containing the same type and it discards the second request.	The flight crew should be aware that only one downlink request for a single type will be presented to the controller, and that this open dialogue must be closed before a second request of that type may be treated.
REQUEST REJECTED - REPLY TO (dialogue type) UPLINK FIRST Dialogue type is one of the following: LEVEL, HEADING, SPEED, ROUTE	The ground system receives a downlink request, and there is an existing open uplink containing the same type. The downlink request is discarded. *NOTE: Ground systems only accept one data link exchange of a given type at the same moment.*	The flight crew must respond to the uplink before being able to send a downlink request of this type.

Table B-EUR-3. Operational Error Uplink Messages (continued)

Free Text Message	Description	Procedure
TOO MANY CPDLC REQUESTS - USE VOICE	The ground system receives a downlink request, and discards a message because the maximum number of open operational dialogues with the aircraft is exceeded and there is no pending uplink message. *NOTE: The total number of data link exchanges with an aircraft may be limited by some ground systems. This means that further requests will be rejected.*	The flight crew should make the request/s by voice. If there are only downlink requests, the flight crew cannot do anything about it. If there is at least one uplink expecting a response, the flight crew can respond to that clearance first to enable reception of a downlink request.
CPDLC TRANSFER NOT COMPLETED - REPEAT REQUEST	Until CPDLC is enabled, the ground system rejects any downlink message; except DM 99 (CURRENT DATA AUTHORITY), DM 89 (MONITORING), DM 62 (ERROR), and DM 62 concatenated with DM 98 (ERROR + Free text).	The flight crew cannot use data link now, but when CPDLC is fully operational, a CPDLC message is uplinked and displayed to the flight crew, indicating the name and function of the current ATC unit. The flight crew should not attempt to repeat the request until the CPDLC transfer has been completed and they are under the control of the ACC, being the CDA.
ATC TIME OUT - REPEAT REQUEST	If the controller fails to respond within 250 seconds the timer-responder (ttr) expires. The ground system closes the dialogue and automatically uplinks an error message in response to the downlink message request.	The flight crew is notified that the controller has not responded in the due time. The flight crew should repeat the request/s by voice.
DOWNLINK DELAYED - USE VOICE	The ground system receives a message and discards the message because it contains a timestamp that is older than the allowed limit.	The flight crew should revert to voice.

Table B-EUR-3. Operational Error Uplink Messages (continued)

Free Text Message	Description	Procedure
DOWNLINK DELAYED - USE VOICE	Upon activation of the latency time monitor, the ground system automatically uplinks an error message. *NOTE: The use of the LTM function for the ATSU is a recommendation.*	The flight crew should revert to voice.
DOWNLINK TIMESTAMP INDICATES FUTURE TIME	The ground system receives a message timestamp that indicates a future time greater than 2 seconds from the current time.	The flight crew should revert to voice.
MESSAGE NOT SUPPORTED BY THIS ATS UNIT	The ground system receives a downlink message that it does not support, whether or not the message contains a message reference number, and discards the received message.	The flight crew should revert to voice.
FREE TEXT MESSAGE TOO LARGE - USE VOICE	The ground system receives a downlink free text message element containing more than 80 characters, and the system cannot support the number of characters in a free text message element, and discard the received message.	The flight crew should revert to voice. *NOTE: Ground systems may not accept downlink free text messages, or may not display them to the controller.*
CPDLC MESSAGE FAILED - USE VOICE	A CPDLC downlink message is received that results in an error that is not already covered in the ATN SARPs, and the ground system discards the message.	The flight crew should revert to voice.

Table B-EUR-3. Operational Error Uplink Messages (continued)

Free Text Message	Description	Procedure
INVALID USE OF FREE TEXT MESSAGE - CONTACT ATC	The ground system does not support a message containing a free text message element because the message does not also contain the DM 62 ERROR (error information) message element and discards the message.	The flight crew should revert to voice.
RADAR TRACKING TERMINATED - TERMINATING CPDLC	The ground system decides to terminate a CPDLC connection with an aircraft because it has lost radar data.	The flight crew should revert to voice.
CPDLC FOR (dialogue type) FAILED - USE VOICE Dialogue type is one of the following: LEVEL, HEADING, SPEED, ROUTE	The ground system receives a downlink message containing a dialogue type that it does not support and discards the message.	The flight crew should revert to voice.
MESSAGE DOES NOT CONTAIN FACILITY NAME	The ground system receives a downlink message that contains the unitname data type, but rejects the message because it does not also contain the facilityname data type and discards the message.	The flight crew should revert to voice.

B.3 NORTH-AMERICA (NAM) REGION

B.3.3 Flight Crew Procedures

B.3.3.1 Use of AT PILOTS DISCRETION

In airspace managed by the United States, when the flight crew receives UM 177 AT PILOTS DISCRETION in conjunction with altitude assignments, the associated instruction to climb or descend may be executed when convenient and at any preferred rate. The aircraft may temporarily maintain intermediate levels but once the aircraft has vacated a level it may not return to that level.

B.4 NORTH ATLANTIC (NAT) REGION

B.4.1.4 Reporting Requirements in NAT Airspace where ADS-C is available

B.4.1.4.1 In the NAT Region, if the estimated time for the next position last provided to air traffic control is found to be in error by 3 minutes or more, the flight crew should provide a revised estimated time.

B.4.1.4.2 The flight crew may assume that the estimate for the next waypoint, shown on the FMS at the time a waypoint is crossed, is the estimate transmitted to ATC.

B.4.1.4.3 The flight crew should provide the revised estimate to the controlling ATS unit as soon as possible via voice or CPDLC using free text DM 67 REVISED ETA (position) (time).

B.4.3 Flight crew procedures

B.4.3.1 Voice Communication Procedures

B.4.3.1.1 Flight crew – contact with radio station

B.4.3.1.1.1 The integrity of the ATC service remains wholly dependent on establishing and maintaining HF or VHF voice communications with each ATS unit along the route of flight. The procedures in this section are applicable only in NAT airspace and pertain only to ATS data link operations.

B.4.3.1.1.2 Prior to or upon entering each NAT oceanic CTA, the flight crew should contact the appropriate radio station.

B.4.3.1.1.3 If the flight enters an oceanic CTA followed by another oceanic CTA, the flight crew should on initial contact:

a. Not include a position report;

b. After the radio operator responds, request a SELCAL check and state the next CTA.

   NOTE: The radio operator will assign primary and secondary frequencies, perform the SELCAL check and designate the position and frequencies to contact the aeronautical radio station serving the next oceanic CTA.

c. If the communications instructions are not issued at this stage, assume that the frequencies to use prior or upon entering the next CTA will be delivered at a later time by CPDLC or voice.

Example (initial contact from eastbound flight entering Gander Oceanic):

GANDER RADIO, AIRLINE 123, SELCAL CHECK, SHANWICK NEXT

AIRLINE 123, GANDER RADIO, HF PRIMARY 5616 SECONDARY 2899, AT 30 WEST CONTACT SHANWICK RADIO HF PRIMARY 8891 SECONDARY 4675 (SELCAL TRANSMITTED)

GANDER RADIO, AIRLINE 123, SELCAL OKAY, HF PRIMARY 5616 SECONDARY 2899. AT 30 WEST CONTACT SHANWICK RADIO, HF PRIMARY 8891 SECONDARY 4675

B.4.3.1.1.4 If the flight will exit an oceanic CTA into continental airspace or surveillance airspace, on initial contact with the oceanic CTA, the flight crew should:

a. not include a position report;

b. after the radio operator responds, request a SELCAL check.

Example (Initial contact from an eastbound flight about to enter the Shanwick Oceanic)

SHANWICK RADIO, AIRLINE 123, SELCAL CHECK

AIRLINE 123, HF PRIMARY 2899 SECONDARY 5616 (SELCAL TRANSMITTED)

SHANWICK RADIO, AIRLINE 123, SELCAL OKAY, HL PRIMARY 2899 SECONDARY 5616

B.4.3.1.1.5 Depending on which data link services are offered in the oceanic CTA and the operational status of those services, the radio operator will provide appropriate information and instructions to the flight crew.

B.4.3.1.1.6 If a data link connection cannot be established, maintain normal voice communication procedures. In the event of data link connection failure in a NAT CTA after a successful logon, revert to voice and notify the appropriate radio station and AOC in accordance with established problem reporting procedures.

B.4.3.1.1.7 For ADS-C flights, the flight crew should not submit position reports via voice to reduce frequency congestion, unless otherwise advised by the aeronautical radio operator.

B.4.3.1.1.8 ADS-C flights are exempt from all routine voice meteorological reporting, however the flight crew should use voice to report unusual meteorological conditions such as severe turbulence to the aeronautical radio station.

B.4.3.1.1.9 The flight crew should use CPDLC for any inquiries regarding the status of ADS-C connections. Should the ATS unit fail to receive an expected position report, the controller will follow guidelines for late or missing ADS-C report.

B.4.3.1.1.10 When leaving CPDLC/ADS-C or ADS-C-only airspace, the flight crew should comply with all communication requirements applicable to the airspace being entered.

B.4.3.1.1.11 If the flight crew does not receive its domestic frequency assignment by 10 minutes prior to the flight's entry into the next CTA, the flight crew should contact the aeronautical radio station and request the frequency, stating the current CTA exit fix or coordinates.

B.5 PACIFIC (PAC) REGION

B.5.1.2 Exchange of Turbulence Information in Fukuoka FIR

B.5.1.2.1 In the Fukuoka FIR, the flight crew should report moderate or severe turbulence information. Turbulence information is provided for aircraft which fly around location of observation within height difference of ±4,000 feet from altitude of observation and will pass within two hours from time of observation.

B.5.1.2.2 The flight crew may use CPDLC for reporting and receiving moderate or severe turbulence information. For aircraft which does not have a CPDLC connection, the exchange of turbulence information is implemented by voice. The turbulence information provided to flight crews, whether by CPDLC or voice, will be the same.

B.5.1.2.3 Report of turbulence information by CPDLC

When reporting turbulence information via CPDLC, aircraft should downlink in the following form by free text message:

DM 67 (MOD or SEV) TURB (location of observation) (altitude of observation) (time of observation) Z.

NOTE 1: Aircraft should report location of observation in the following form. When observing turbulence continuously, aircraft is able to report location of observation in the following form; "[beginning location of observation] [end location of observation]".

a. *FIX (e.g. "NIPPI")*

b. *Distance and radial from FIX (e.g. "20NM SW NIPPI")*

c. *Latitude and longitude (e.g. "4020N14532E")*

d. *When observing turbulence continuously (e.g. "RIPKI GARRY")*

NOTE 2: When observing turbulence while cruising, aircraft is able to report by omitting altitude of observation. When observing turbulence continuously while climbing or descending, aircraft should report altitude of observation in the following form; "[lower limit altitude of observation] [upper limit altitude of observation]" (e.g. "FL330 FL350").

NOTE 3: When reporting turbulence information within 5 minutes after observing, aircraft is able to report by omitting time of observation.

Examples of downlink messages:

"SEV TURB 35N160E FL330 0924Z"

"MOD TURB 20NM N ASEDA 35NM S ASEDA FL350 1152Z"

"MOD TURB NIPPI 2114Z"

"SEV TURB 3530N15451E FL370 FL390 0304Z"

"SEV TURB POXED FL320"

"MOD TURB CELIN"

B.5.1.2.4 Provision of turbulence information by CPDLC

B.5.1.2.4.1 When providing via CPDLC, turbulence information is uplinked in the following form by free text message:

UM 169 (MOD or SEV) TURB (location of observation) (altitude of observation) (time of observation) Z (type of aircraft)

B.5.1.2.4.2 The downlink response DM 3 ROGER should be used to acknowledge receipt of turbulence information issued.

Examples of uplink messages:

"MOD TURB NIPPI F360 0130Z B772"

"SEV TURB FM 37N160E TO 37N158E F320 0418Z A332"

“MOD TURB 20NM N ASEDA F330F350 1152Z B744”

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Emergency Data - International Civil Aviation Authority

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO)

Extracted from the following ICAO publications:

RULES OF THE AIR, ANNEX 2

AIRCRAFT OPERATIONS, ANNEX 6

AERONAUTICAL TELECOMMUNICATIONS, ANNEX 10, VOLUMES I II

SEARCH AND RESCUE, ANNEX 12

PROCEDURES FOR AIR NAVIGATION SERVICES — AIR TRAFFIC MANAGEMENT, PANS-ATM (Doc 4444)

PROCEDURES FOR AIR NAVIGATION SERVICES — AIRCRAFT OPERATIONS, PANS-OPS (Doc 8168)

Within this chapter, references to the following ICAO Documents are made, however they are not published herein:

REGIONAL SUPPLEMENTARY PROCEDURES (Doc 7030)

INTERNATIONAL AERONAUTICAL AND MARITIME SEARCH AND RESCUE (IAMSAR) MANUAL (DOC 9731)

1 DEFINITIONS

Refer to Introduction/Chart Glossary.

2 EMERGENCY PROCEDURES

2.1 GENERAL

2.1.1 The various circumstances surrounding each emergency situation preclude the establishment of exact detailed procedures to be followed. *(Doc 4444, 15.1.1)*

2.1.2 Air traffic control units shall maintain full and complete coordination, and personnel shall use their best judgement in handling emergency situations. *(Doc 4444, Part III, 16.1.1)*

NOTE: To indicate that it is in a state of emergency, an aircraft equipped with an SSR transponder might operate the equipment as follows:

- *a. on Mode A, Code 7700; or*
- *b. on Mode A, Code 7500, to indicate specifically that it is being subjected to unlawful interference.*

2.2 PRIORITY

2.2.1 An aircraft known or believed to be in a state of emergency, including being subjected to unlawful interference, shall be given priority over other aircraft. *(Doc 4444, 15.1.2)*

2.3 DISTRESS FREQUENCIES

2.3.1 The ICAO Communication Procedures require that an aircraft in distress when it is airborne should use the frequency in use for normal communications with aeronautical stations at the time. However, it is recognized that, after an aircraft has crashed or ditched, there is a need for designating a particular frequency or frequencies to be used in order that uniformity may be attained on a world-wide basis, and so that a guard may be maintained or set up by as many stations as possible including direction-finding stations, and stations of the Maritime Mobile Service.

2.3.2 The frequency 2182 kHz is the international distress frequency for radiotelephony to be used for that purpose by ship, aircraft and survival craft stations when requesting assistance from the maritime service.

2.3.3 The frequency 4125 kHz is also authorized to enable communications between stations in the maritime mobile service and aircraft stations in distress.

2.3.4 Similarly, the frequency 500 kHz is the international distress frequency for radiotelegraphy to be used for that purpose by ship, aircraft and survival craft stations when requesting assistance from the maritime service.

2.3.5 With respect to survival craft stations the following emergency / distress frequencies are provided:

a. VHF — 121.5 MHz;

b. UHF — 243.0 MHz;

c. HF — 500 kHz, 2182 kHz, 8364 kHz.

(Annex 10, Vol V, Chapter 2 Introduction)

2.4 TRANSPONDER OPERATIONS — EMERGENCY

2.4.1 The pilot of an aircraft in a state of emergency shall set the transponder to Mode A Code 7700 unless ATC has previously directed the pilot to operate the transponder on a specified code. In the latter case, the pilot shall continue to use the specified code unless otherwise advised by ATC. However, a pilot may select Mode A Code 7700 whenever there is a specific reason to believe that this would be the best course of action. *(Doc 8168, Vol I, Part III, Section 3, Chapter 1, 1.4)*.

2.5 DISTRESS AND URGENCY SIGNALS

NOTE: None of the provisions in this section shall prevent the use, by an aircraft in distress, of any means at its disposal to attract attention, make known its position and obtain help.

2.5.1 Distress Signals

2.5.1.1 The following signals, used either together or separately, mean that grave and imminent danger threatens, and immediate assistance is requested:

a. a signal made by radiotelegraphy or by any other signalling method consisting of the group **SOS** (**. . . - - - . . .** in the Morse Code);

b. a radiotelephony distress signal consisting of the spoken word **MAYDAY**;

c. a distress message sent via data link which transmits the intent of the word **MAYDAY**;

d. rockets or shells throwing red lights, fired one at a time at short intervals;

e. a parachute flare showing a red light.

(Annex 2, Appendix 1, 1.1)

2.5.2 Urgency Signals

2.5.2.1 The following signals, used either together or separately, mean that an aircraft wishes to give notice of difficulties which compel it to land without requiring immediate assistance:

a. the repeated switching on and off of the landing lights; or

b. the repeated switching on and off of the navigation lights in such a manner as to be distinct from flashing navigation lights.

(Annex 2, Appendix 1, 1.2.1)

2.5.2.2 The following signals, used either together or separately, mean that an aircraft has a very urgent message to transmit concerning the safety of a ship, aircraft or other vehicle, or of some person on board or within sight;

a. a signal made by radiotelegraphy or by any other signalling method consisting of the group **XXX**;

b. a radiotelephony urgency signal consisting of the spoken words **PAN, PAN.**

c. an urgency message sent via data link which transmits the intent of the words **PAN, PAN.**

(Annex 2, Appendix 1, 1.2.2)

3 UNLAWFUL INTERFERENCE

3.1 GENERAL

3.1.1 An aircraft which is being subjected to unlawful interference shall endeavor to notify the appropriate ATS unit of this fact, any significant circumstances associated therewith and any deviation from the current flight plan necessitated by the circumstances, in order to enable the ATS unit to give priority to the aircraft and to minimize conflict with other aircraft. *(Annex 2, 3.7)*

3.1.2 When an air traffic services unit knows or believes that an aircraft is being subjected to unlawful interference, no reference shall be made in ATS air-ground communications to the nature of the emergency unless it has first been referred to in communications from the aircraft involved and it is certain that such reference will not aggravate the situation. *(Annex 11, 5.6.2)*

3.2 TRANSPONDER OPERATIONS — UNLAWFUL INTERFERENCE WITH AIRCRAFT IN FLIGHT

3.2.1 If there is unlawful interference with an aircraft in flight, the pilot-in-command shall attempt to set the transponder to Mode A Code 7500 in order to indicate the situation: If circumstances so warrant, Code 7700 should be used instead. *(Doc 8168, Vol I, Part III, Section 3, Chapter 1, 1.6.1)*.

3.2.2 If a pilot has selected Mode A Code 7500 and has been requested to confirm this code by ATC (in accordance with 1.1.5), the pilot shall, according to circumstances, either confirm this or not reply at all. *(Doc 8168, Vol I)*

NOTE: If the pilot does not reply, ATC will take this as confirmation that the use of Code 7500 is not an inadvertent false code selection.

3.3 PROCEDURES

3.3.1 The following procedures are intended as guidance for use by aircraft when unlawful interference occurs and the aircraft is unable to notify an ATS unit of this fact. *(Annex 2, Attachment B)*

3.3.2 Unless considerations aboard the aircraft dictate otherwise, the pilot-in-command should attempt to continue flying on the assigned track and at the assigned cruising level at least until able to notify an ATS unit or within radar coverage. *(Annex 2, Attachment B, 2.1)*

3.3.3 When an aircraft subjected to an act of unlawful interference must depart from its assigned track or its assigned cruising level without being able to make radiotelephony contact with ATS, the pilot-in-command should, whenever possible;

a. attempt to broadcast warnings on the VHF emergency frequency and other appropriate frequencies, unless considerations aboard the aircraft dictate otherwise. Other equipment such as on-board transponders, data links, etc., should also be used when it is advantageous to do so and circumstances permit; and

b. proceed in accordance with applicable special procedures for in-flight contingencies, where such procedures have been established and promulgated in ICAO Document 7030 — *Regional Supplementary Procedures;* or

c. if no applicable regional procedures have been established, proceed at a level which differs from the cruising levels normally used for IFR flight by:

    1. 150m (500 ft) in an area where a vertical separation minimum of 300m (1000 ft) is applied; or

    2. 300m (1000 ft) in an area where a vertical separation minimum of 600m (2000 ft) is applied.

(Annex 2, Attachment B, 2.2)

4 EMERGENCY DESCENT

4.1 INITIAL ACTION BY THE AIR TRAFFIC CONTROL UNIT

4.1.1 Upon receipt of advice that an aircraft is making an emergency descent through other traffic, all possible action shall be taken immediately to safeguard all aircraft concerned. When deemed necessary, air traffic control units shall immediately broadcast by means of the appropriate radio aids, or if not possible, request the appropriate communications stations immediately to broadcast an emergency message. *(Doc 4444, Part III, 15.1.4)*

4.2 ACTION BY THE PILOT-IN-COMMAND

4.2.1 It is expected that aircraft receiving such a broadcast will clear the specified areas and standby on the appropriate radio frequency for further clearances from the air traffic control unit. *(Doc 4444 Part III, 15.1.4)*

4.3 SUBSEQUENT ACTION BY THE AIR TRAFFIC CONTROL UNIT

4.3.1 Immediately after such an emergency broadcast has been made the area control center, the approach control office, or the aerodrome control tower concerned shall forward further clearances to all aircraft involved as to additional procedures to be followed during and subsequent to the emergency descent. The ATS unit concerned shall additionally inform any other ATS units and control sectors which may be affected. *(Doc 4444, Part III, 15.1.4)*

5 DISTRESS AND URGENCY RADIOTELEPHONY COMMUNICATION PROCEDURES

5.1 GENERAL

5.1.1 The radiotelephony distress signal **MAYDAY** and the radiotelephony urgency signal **PAN PAN** shall be used at the commencement of the first distress and urgency communication respectively. *(Annex 10, Vol II, 5.3.1.2)*

5.1.1.1 At the commencement of any *subsequent* communication in distress and urgency traffic, it shall be permissible to use the radiotelephony distress and urgency signals. *(Annex 10, Vol II, 5.3.1.2.1)*

5.1.2 The originator of messages addressed to an aircraft in distress or urgency condition shall restrict to the minimum the number and volume and content of such messages as required by the condition. *(Annex 10, Vol II, 5.3.1.3)*

5.1.3 If no acknowledgement of the distress or urgency message is made by the station addressed by the aircraft, other stations shall render assistance, as prescribed in 5.2.2 and 5.3.2 respectively. *(Annex 10, Vol II, 5.3.1.4)*

NOTE: “Other stations” is intended to refer to any other station which has received the distress or urgency message and has become aware that it has not been acknowledged by the station addressed.

5.1.4 Distress and urgency traffic shall normally be maintained on the frequency on which such traffic was initiated until it is considered that better assistance can be provided by transferring that traffic to another frequency. *(Annex 10, Vol II, 5.3.1.5)*

NOTE: 121.5 MHz or alternative available VHF or HF frequencies may be used as appropriate.

5.1.5 In cases of distress and urgency communications, in general, the transmissions by radiotelephony shall be made slowly and distinctly, each word being clearly pronounced to facilitate transcription. *(Annex 10, Vol II, 5.3.1.6)*

5.2 RADIOTELEPHONY DISTRESS COMMUNICATIONS

5.2.1 Action by the Aircraft in Distress

5.2.1.1 In addition to being preceded by the radiotelephony distress signal **MAYDAY**, preferably spoken three times, the distress message to be sent by an aircraft in distress shall:

a. be on the air-ground frequency in use at the time;

b. consist of as many as possible of the following elements spoken distinctly and, if possible, in the following order:
   1. name of the station addressed (time and circumstances permitting);
   2. the identification of the aircraft;
   3. the nature of the distress condition;
   4. intention of the person in command;
   5. present position, level (i.e., flight level, altitude, etc., as appropriate) and heading.

(Annex 10, Vol II, 5.3.2.1.1)

NOTE:

a. The foregoing provisions may be supplemented by the following measures;
   1. *the distress message of an aircraft in distress being made on the emergency frequency 121.5 MHz or another aeronautical mobile frequency, if considered necessary or desirable. Not all aeronautical stations maintain a continuous guard on the emergency frequency;*
   2. *the distress message of an aircraft in distress being broadcast, if time and circumstances make this course preferable;*
   3. *the aircraft transmitting on the maritime mobile service radiotelephony calling frequencies;*
   4. *the aircraft using any means at its disposal to attract attention and make known its conditions (including the activation of the appropriate SSR mode and code);*
   5. *any station taking any means at its disposal to assist an aircraft in distress;*
   6. *any variation on the elements listed under b. above, when the transmitting station is not itself in distress, provided that such circumstance is clearly stated in the distress message.*

b. The station addressed will normally be that station communicating with the aircraft or in whose area of responsibility the aircraft is operating.

5.2.2 Action by the Station Addressed or First Station Acknowledging the Distress Message

5.2.2.1 The station addressed by aircraft in distress, or first station acknowledging the distress message shall:

a. immediately acknowledge the distress message;

b. take control of the communications or specifically and clearly transfer that responsibility, advising the aircraft if a transfer is made;

c. take immediate action to ensure that all necessary information is made available, as soon as possible, to:

   1. the ATS unit concerned;
   2. the aircraft operating agency concerned, or its representative, in accordance with pre-established arrangements;

      NOTE: The requirement to inform the aircraft operating agency concerned does not have priority over any other action which involves the safety of the flight in distress, or of any other flight in the area, or which might affect the progress of expected flights in the area.

d. warn other stations, as appropriate, in order to prevent the transfer of traffic to the frequency of the distress communication.

(Annex 10, Vol II, 5.3.2.2.1)

5.2.3 Imposition of Silence

5.2.3.1 The station in distress, or the station in control of distress traffic, shall be permitted to impose silence, either on all stations of the mobile service in the area or on any station which interferes with the distress traffic. It shall address these instructions “to all stations”, or to one station only, according to circumstances. In either case, it shall use:

– **STOP TRANSMITTING;**

– the radiotelephony distress signal **MAYDAY**.

(Annex 10, Vol II, 5.3.2.3.1)

5.2.3.2 The use of the signals specified in 5.2.3.1shall be reserved for the aircraft in distress and for the station controlling the distress traffic. *(Annex 10, Vol II, 5.3.2.3.2)*

5.2.4 Action by All Other Stations

5.2.4.1 The distress communications have absolute priority over all other communications, and a station aware of them shall not transmit on the frequency concerned, unless:

a. the distress is cancelled or the distress traffic is terminated;

b. all distress traffic has been transferred to other frequencies;

c. the station controlling communications gives permission;

d. it has itself to render assistance.

(Annex 10, Vol II, 5.3.2.4.1)

5.2.4.2 Any station which has knowledge of distress traffic, and which cannot itself assist the station in distress, shall nevertheless continue listening to such traffic until it is evident that assistance is being provided. *(Annex 10, Vol II, 5.3.2.4.2)*

5.2.5 Termination of Distress Communications and of Silence

5.2.5.1 When an aircraft is no longer in distress, it shall transmit a message cancelling the distress condition. *(Annex 10, Vol II, 5.3.2.5.1)*

5.2.5.2 When the station which has controlled the distress communication traffic becomes aware that the distress condition is ended, it shall take immediate action to ensure that this information is made available, as soon as possible, to:

a. the ATS unit concerned;

b. the aircraft operating agency concerned, or its representative, in accordance with pre-established arrangements.

(Annex 10, Vol II, 5.3.2.5.2)

5.2.5.3 The distress communication and silence conditions shall be terminated by transmitting a message, including the words "**DISTRESS TRAFFIC ENDED**", on the frequency or frequencies being used for the distress traffic. This message shall be originated only by the station controlling the communications when, after the reception of the message prescribed in 5.2.5.1 , it is authorized to do so by the appropriate authority. *(Annex 10, Vol II, 5.3.2.5.3)*

5.3 RADIOTELEPHONY URGENCY COMMUNICATIONS

5.3.1 Action by the Aircraft Reporting an Urgency Condition (except Medical Transports)

5.3.1.1 In addition to being preceded by the radiotelephony urgency signal **PAN PAN**, preferably spoken three times and each word of the group pronounced as the French word "panne", the urgency message to be sent by an aircraft reporting an urgency condition shall:

a. be on the air-ground frequency in use at the time;

b. consist of as many as required of the following elements spoken distinctly and, if possible, in the following order:

   1. the name of the station addressed;
   2. the identification of the aircraft;
   3. the nature of the urgency condition;
   4. the intention of the person in command;
   5. present position, level (i.e., flight level, altitude, etc., as appropriate) and heading;
   6. any other useful information.

(Annex 10, Vol II, 5.3.3.1.1)

NOTE:

a. The foregoing provisions are not intended to prevent an aircraft broadcasting an urgency message, if time and circumstances make this course preferable.

b. The station addressed will normally be that station communicating with the aircraft or in whose area of responsibility the aircraft is operating.

5.3.2 Action by the Station Addressed or First Station Acknowledging the Urgency Message

5.3.2.1 The station addressed by an aircraft reporting an urgency condition, or first station acknowledging the urgency message, shall:

a. acknowledge the urgency message;

b. take immediate action to ensure that all necessary information is made available, as soon as possible, to:

   1. the ATS unit concerned;

   2. the aircraft operating agency concerned, or its representative, in accordance with pre-established arrangements;

      NOTE: The requirement to inform the aircraft operating agency concerned does not have priority over any other action which involves the safety of the flight in distress, or of any other flight in the area, or which might affect the progress of expected flights in the area.

c. if necessary, exercise control of communications.

(Annex 10, Vol II, 5.3.3.2.1)

5.3.3 Action by Other Stations

5.3.3.1 The urgency communications have priority over all other communications, except distress, and all stations shall take care not to interfere with the transmission of urgency traffic. *(Annex 10, Vol II, 5.3.3.3.1)*

5.3.4 Action by an Aircraft Used for Medical Transports

5.3.4.1 The use of the signal described in 5.3.4.2, shall indicate that the message which follows concerns a protected medical transport pursuant to the 1949 Geneva Conventions and Additional Protocols. *(Annex 10, Vol II, 5.3.3.4.1)*

5.3.4.2 For the purpose of announcing and identifying aircraft used for medical transports, a transmission of the radiotelephony urgency signal **PAN PAN**, preferably spoken three times, and each word of the group pronounced as the French word “panne”, shall be followed by the radiotelephony signal for medical transports **MAY-DEE-CAL,** pronounced as in the French “medical”. The use of the signals described above indicates that the message which follows concerns a protected medical transport. The message shall convey the following data:

a. the call sign or other recognized means of identification of the medical transports;

b. position of the medical transports;

c. number and type of medical transports;

d. intended route;

e. estimated time enroute and of departure and arrival, as appropriate; and

f. any other information such as flight altitude, radio frequencies guarded, languages used and secondary surveillance radar modes and codes.

(Annex 10, Vol II, 5.3.3.4.2)

5.3.5 Action by the Station Addressed or by Other Stations Receiving a Medical Transports Message

5.3.5.1 The provisions of 5.3.2 and 5.3.3 shall apply as appropriate to stations receiving a medical transports message. *(Annex 10, Vol II, 5.3.3.5.1)*

6 COMMUNICATIONS FAILURE

6.1 GENERAL RULES

6.1.1 An aircraft operated as a controlled flight shall maintain continuous air-ground voice communication watch on the appropriate communication channel of, and establish two-way communication as necessary with, the appropriate air traffic control unit, except as may be prescribed by the appropriate ATS authority in respect of aircraft forming part of aerodrome traffic at a controlled aerodrome. *(Annex 2, 3.6.5.1)*

NOTE 1: SELCAL or similar automatic signalling devices satisfy the requirement to maintain a listening watch.

NOTE 2: The requirement for an aircraft to maintain an air-ground voice communication watch remains in affect after CPDLC has been established.

6.1.2 If a communication failure precludes compliance with 6.1.1, the aircraft shall comply with the communication failure procedures in 6.2 below, and with such of the following procedures as are appropriate. The aircraft shall attempt to establish communications with the appropriate air traffic control unit using all other available means. In addition, the aircraft, when forming part of the aerodrome traffic at a controlled aerodrome, shall keep a watch for such instructions as may be issued by visual signals. *(Annex 2, 3.6.5.2)*

6.1.2.1 If in visual meteorological conditions, the aircraft shall:

a. continue to fly in visual meteorological conditions;

b. land at the nearest suitable aerodrome; and

c. report its arrival by the most expeditious means to the appropriate air traffic control unit.

(Annex 2, 3.6.5.2.1)

6.1.2.2 If in instrument meteorological conditions or when the pilot of an IFR flight considers it inadvisable to complete the flight in accordance with 6.1.2.1 the aircraft shall:

a. unless otherwise prescribed on the basis of regional air navigation agreement, in airspace where radar is not used in the provision of air traffic control, maintain the last assigned speed and level, or minimum flight altitude if higher, for a period of 20 minutes following the aircraft's failure to report its position over a compulsory reporting point and thereafter adjust level and speed in accordance with the filed flight plan;

b. in airspace where radar is used in the provision of air traffic control, maintain the last assigned speed and level, or minimum flight altitude if higher, for a period of 7 minutes following:

   1. the time the last assigned level or minimum flight altitude is reached; or
   2. the time the transponder is set to Code 7600; or
   3. the aircraft's failure to report its position over a compulsory reporting point;

   whichever is later, and thereafter adjust level and speed in accordance with the filed flight plan;

c. when being radar vectored or having been directed by ATC to proceed offset using RNAV without a specified limit, rejoin the current flight plan route no later than the next significant point, taking into consideration the applicable minimum flight altitude;

d. proceed according to the current flight plan route to the appropriate designated navigation aid or fix serving the destination aerodrome and, when required to ensure compliance with e. below, hold over this aid or fix until commencement of descent;

e. commence descent from the navigation aid or fix specified in d. at, or as close as possible to, the expected approach time last received and acknowledged; or, if no expected approach time has been received and acknowledged, at, or as close as possible to, the estimated time of arrival resulting from the current flight plan;

f. complete a normal instrument approach procedure as specified for the designated navigation aid or fix; and

g. land, if possible, within thirty minutes after the estimated time of arrival specified in e. or the last acknowledged expected approach time, whichever is later.

NOTE:

a. The provision of air traffic control service to other flights operating in the airspace concerned will be based on the assumption that an aircraft experiencing radio failure will comply with the rules in 6.1.2.2.

b. See also ***AIR TRAFFIC CONTROL*** *— International Civil Aviation Organization Rules of the Air.*

(Annex 2, 3.6.5.2.2)

6.2 AIR-GROUND COMMUNICATIONS FAILURE

6.2.1 When an aircraft station fails to establish contact with the aeronautical station on the designated frequency, it shall attempt to establish contact on another frequency appropriate to the route. If this attempt fails, the aircraft station shall attempt to establish communication with other aircraft or other aeronautical stations on frequencies appropriate to the route. In addition, an aircraft operating within a network shall monitor the appropriate VHF frequency for calls from nearby aircraft. *(Annex 10, Vol II, 5.2.2.7.1.1)*

6.2.2 If the attempts specified under 6.2.1 fail, the aircraft station shall transmit its message twice on the designated frequency(ies), preceded by the phrase **“TRANSMITTING BLIND”** and, if necessary, include the addressee(s) for which the message is intended. *(Annex 10, Vol II, 5.2.2.7.1.2)*

***Procedures for Air Navigation Services (PANS) Recommendation** — In network operation, a message which is transmitted blind should be transmitted twice on both primary and secondary frequencies. Before changing frequency, the aircraft station should announce the frequency to which it is changing. (Annex 10, Vol II, 5.2.2.7.1.2.1)*

6.3 RECEIVER FAILURE

6.3.1 When an aircraft station is unable to establish communication due to receiver failure, it shall transmit reports at the scheduled times, or positions, on the frequency in use, preceded by the phrase **“TRANSMITTING BLIND DUE TO RECEIVER FAILURE**”. The aircraft station shall transmit the intended message, following this by a complete repetition. During this procedure, the aircraft shall also advise the time of its next intended transmission. *(Annex 10, Vol II, 5.2.2.7.1.3.1)*

6.3.2 An aircraft which is provided with air traffic control or advisory service shall, in addition to complying with 6.3.1, transmit information regarding the intention of the pilot-in-command with respect to the continuation of the flight of the aircraft. *(Annex 10, Vol II, 5.2.2.7.1.3.2)*

6.3.3 When an aircraft is unable to establish communication due to airborne equipment failure it shall, when so equipped, select the appropriate SSR code to indicate radio failure. *(Annex 10, Vol II, 5.2.2.7.1.3.3)*

7 INTERCEPTION

See ATC — ICAO RULES OF THE AIR — ANNEX 2, Section 3.8.1 for related Montreal Protocol — Article 3bis (b) information relating to Interception.

7.1 GENERAL

NOTE: The word “interception” in this context does not include intercept and escort service provided, on request, to an aircraft in distress, in accordance with the Search and Rescue Manual (Annex 2, 3.8).

7.1.1 Interception of civil aircraft shall be governed by appropriate regulations and administrative directives issued by contracting States in compliance with the Convention on International Civil Aviation, and in particular Article 3(d) under which contracting States undertake, when issuing regulations for their State aircraft, to have due regard for the safety of navigation of civil aircraft. Accordingly, in drafting appropriate regulations and administrative directives due regard shall be had to the provisions contained in the AIR TRAFFIC CONTROL — International Civil Aviation Organization Rules of the Air, and the following paragraphs. *(Annex 2, 3.8.1)*

7.2 ACTION BY INTERCEPTED AIRCRAFT

7.2.1 An aircraft which is intercepted by another aircraft shall immediately:

a. follow the instructions given by the intercepting aircraft, interpreting and responding to visual signals in accordance with the specifications in paragraph 7.4;

b. notify, if possible, the appropriate air traffic services unit;

c. attempt to establish radiocommunication with the intercepting aircraft or with the appropriate intercept control unit, by making a general call on the emergency frequency 121.5 MHz, giving the identity of the intercepted aircraft and the nature of the flight; and if no contact has been established and if practicable, repeating this call on the emergency frequency 243.0 MHz;

d. if equipped with SSR transponder, select Mode A, Code 7700, unless otherwise instructed by the appropriate air traffic services unit.

e. if equipped with ADS-B or ADS-C, select the appropriate emergency functionality, if available, unless otherwise instructed by the appropriate air traffic services unit.

(Annex 2, Appendix 2, 2.1)

7.2.2 If any instructions received by radio from any sources conflict with those given by the intercepting aircraft by visual signals, the intercepted aircraft shall request immediate clarification while continuing to comply with the visual instructions given by the intercepting aircraft. *(Annex 2, Appendix 2, 2.2)*

7.2.3 If any instructions received by radio from any sources conflict with those given by the intercepting aircraft by radio, the intercepted aircraft shall request immediate clarification while continuing to comply with the radio instructions given by the intercepting aircraft. *(Annex 2, Appendix 2, 2.3)*

7.3 RADIOCOMMUNICATION DURING INTERCEPTION

7.3.1 If radio contact is established during interception but communication in a common language is not possible, attempts shall be made to convey instructions, acknowledgement of instructions and essential information by using the phrases and pronunciations in paragraph 7.5 and transmitting each phrase twice. *(Annex 2, Appendix 2, 3)*

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO)

7.4

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO)

SIGNALS FOR USE IN THE EVENT OF INTERCEPTION

7.4.1 Signals Initiated by Intercepting Aircraft and Responses by Intercepted Aircraft (Annex 2, Appendix 1, 2.1)

SERIES	INTERCEPTING Aircraft Signals	MEANING	INTERCEPTED Aircraft Responds	MEANING
1	DAY or NIGHT — Rocking aircraft and flashing navigational lights at irregular intervals (and landing lights in the case of a helicopter) from a position slightly above and ahead of, and normally to the left of, the intercepted aircraft (or to the right if the intercepted aircraft is a helicopter) and, after acknowledgement, a slow level turn, normally to the left, (or to the right in the case of a helicopter) onto the desired heading. *NOTE:* *a. Meteorological conditions or terrain may require the intercepting aircraft to reverse the positions and direction of turn given above in series 1.* *b. If the intercepted aircraft is not able to keep pace with the intercepting aircraft, the latter is expected to fly a series of racetrack patterns and to rock the aircraft each time it passes the intercepted aircraft.*	You have been intercepted. Follow me.	DAY or NIGHT — Rocking aircraft, flashing navigational lights at irregular intervals and following. *NOTE: Additional action required to be taken by intercepted aircraft is prescribed in paragraph 7.2.*	Understood, will comply.

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SERIES	INTERCEPTING Aircraft Signals	MEANING	INTERCEPTED Aircraft Responds	MEANING
2	DAY or NIGHT — An abrupt breakaway maneuver from the intercepted aircraft consisting of a climbing turn of 90 degrees or more without crossing the line of flight of the intercepted aircraft.	You may proceed.	DAY or NIGHT — Rocking the aircraft.	Understood, will comply.
3	DAY or NIGHT — Lowering landing gear (if fitted), showing steady landing lights and overflying runway in use or, if the intercepted aircraft is a helicopter, overflying the helicopter landing area. In the case of helicopters, the intercepting helicopter makes a landing approach, coming to hover near to the landing area.	Land at this aerodrome.	DAY or NIGHT — Lowering landing gear, (if fitted), showing steady landing lights and following the intercepting aircraft and, if, after overflying the runway in use or helicopter landing area, landing is considered safe, proceeding to land.	Understood, will comply.

7.4.2 Signals Initiated by Intercepted Aircraft and Responses by Intercepting Aircraft (Annex 2 Appendix 1, 2.2)

SERIES	INTERCEPTED Aircraft Signals	MEANING	INTERCEPTING Aircraft Responds	MEANING
4	DAY or NIGHT — Raising landing gear (if fitted) and flashing landing lights while passing over runway in use or helicopter landing area at a height exceeding 300m (1000') but not exceeding 600m (2000') (in the case of a helicopter, at a height exceeding 50m (170') but not exceeding 100m (330') above the aerodrome level, and continuing to circle runway in use or helicopter landing area. If unable to flash land-	Aerodrome you have designated is inadequate.	DAY or NIGHT — If it is desired that the intercepted aircraft follow the intercepting aircraft to an alternate aerodrome, the intercepting aircraft raises its landing gear (if fitted) and uses the Series 1 signals prescribed for intercepting aircraft.	Understood, follow me.

SERIES	INTERCEPTED Aircraft Signals	MEANING	INTERCEPTING Aircraft Responds	MEANING
	ing lights, flash any other lights available.		If it is decided to release the intercepted aircraft, the intercepting aircraft uses the Series 2 signals prescribed for intercepting aircraft.	Understood, you may proceed.
5	DAY or NIGHT — Regular switching on and off of all available lights but in such a manner as to be distinct from flashing lights.	Cannot comply.	DAY or NIGHT — Use Series 2 signals prescribed for intercepting aircraft.	Understood.
6	DAY or NIGHT — Irregular flashing of all available lights.	In distress.	DAY or NIGHT — Use Series 2 signals prescribed for intercepting aircraft.	Understood.

7.5 INTERCEPTION PHRASEOLOGIES (Annex 2, Appendix 2, Table 2.1)

Phrases for use by INTERCEPTING Aircraft			Phrases for use by INTERCEPTED Aircraft		
Phrase	***Pronunciation***[1]	***Meaning***	***Phrase***	***Pronunciation***[1]	***Meaning***
CALL SIGN	**KOL** SA-IN	What is your call sign?	CALL SIGN (call sign)[2]	**KOL** SA-IN (call sign)	My call sign is (call sign)
FOLLOW	**FOL**-LO	Follow me	WILCO	**VILL**-KO	Understood will comply
DESCEND	DEE-**SEND**	Descend for landing	CAN NOT	**KANN** NOTT	Unable to comply
YOU LAND	**YOU LAAND**	Land at this aerodrome	REPEAT	REE-**PEET**	Repeat your instruction
PROCEED	PRO-**SEED**	You may proceed	AM LOST	AM LOSST	Position unknown
			MAYDAY	MAYDAY	I am in distress
			HIJACK[3]	**HI**-**JACK**	I have been hijacked

Phrases for use by INTERCEPTING Aircraft			Phrases for use by INTERCEPTED Aircraft		
Phrase	***Pronunciation***[1]	***Meaning***	***Phrase***	***Pronunciation***[1]	***Meaning***
			LAND (place name)	LAAND (place name)	I request to land at (place name)
			DESCEND	DEE-**SEND**	I require descent

[1] In the Pronunciation column, syllables to be emphasized are bold / underlined.

[2] The call sign required to be given is that used in radiotelephony communications with air traffic services units and corresponding to the aircraft identification in the flight plan.

[3] Circumstances may not always permit, nor make desirable, the use of the phrase “HIJACK”.

8 SEARCH AND RESCUE

8.1 COMMUNICATION FREQUENCIES

8.1.1 Where there is a requirement for the use of high frequencies for search and rescue scene of action coordination purposes, the frequencies 3023 kHz and 5680 kHz shall be employed. *(Annex 10, Vol V, 2.2.1)*

NOTE: Where civil commercial aircraft take part in search and rescue operations, they will normally communicate on the appropriate enroute channels with the flight information center associated with the rescue co-ordination center concerned.

8.2 PROCEDURES FOR A PILOT-IN-COMMAND INTERCEPTING A DISTRESS TRANSMISSION

8.2.1 Whenever a distress transmission is intercepted by a pilot-in-command of an aircraft, the pilot shall, if feasible:

a. acknowledge the distress transmission;

b. record the position of the craft in distress if given;

c. take a bearing on the transmission;

d. inform the appropriate rescue coordination centre or air traffic services unit of the distress transmission, giving all available information; and

e. at the pilot’s discretion, while awaiting instructions, proceed to the position given in the transmission.

(Annex 12, 5.7)

8.3 PROCEDURES FOR A PILOT-IN-COMMAND AT THE SCENE OF AN ACCIDENT

8.3.1 When a pilot-in-command observes that either another aircraft or a surface craft is in distress, the pilot shall, if possible and unless considered unreasonable or unnecessary:

a. keep the craft in distress in sight until compelled to leave the scene or advised by the rescue coordination centre that it is no longer necessary;

b. determine the position of the craft in distress;

c. as appropriate, report to the rescue coordination centre or air traffic services unit as much of the following information as possible.

   - type of craft in distress, its identification and condition;
   - its position, expressed in geographical co-ordinates or in distance and true bearing from a distinctive landmark or from a radio navigation aid;
   - time of observation expressed in hours and minutes UTC;
   - number of persons observed;
   - whether persons have been seen to abandon the craft in distress;
   - on-scene weather conditions;
   - apparent physical condition of survivors;
   - apparent best ground access route to the distress site; and

d. act as instructed by the rescue co-ordination center or the air traffic services unit.

(Annex 12, 5.6.2)

8.3.2 If the first aircraft to reach the scene of an accident is not a search and rescue aircraft it shall take charge of on-scene activities of all other aircraft subsequently arriving until the first search and rescue aircraft reaches the scene of the accident. If, in the meantime, such aircraft is unable to establish communication with the appropriate rescue co-ordination center or air traffic services unit, it shall, by mutual agreement, hand over to an aircraft capable of establishing and maintaining such communications until the arrival of the first search and rescue aircraft. *(Annex 12, 5.6.2.1)*

8.3.3 When it is necessary for an aircraft to direct a surface craft to the place where an aircraft or surface craft is in distress, the aircraft shall do so by transmitting precise instructions by any means at its disposal. If no radio communication can be established the aircraft shall use the appropriate visual signal in paragraph 8.4. *(Annex 12, 5.6.5)*

8.3.4 When it is necessary for an aircraft to convey information to survivors or surface rescue units, and two-way communication is not available, it shall, if practicable, drop communication equipment that would enable direct contact to be established, or convey the information by dropping a hard copy message. *(Annex 12, 5.6.3)*

8.3.5 When a ground signal has been displayed, the aircraft shall indicate whether the signal has been understood or not by the means described in 8.3.4 or, if this is not practicable, by use of the appropriate visual signal in paragraph 8.4. *(Annex 12, 5.6.4)*

8.4 SEARCH AND RESCUE SIGNALS

8.4.1 General

8.4.1.1 The air-to-surface and surface-to-air visual signals in this section shall, when used, have the meaning indicated therein. They shall be used only for the purpose indicated and no other signals likely to be confused with them shall be used. *(Annex 12, 5.8.1)*

8.4.1.2 Upon observing any of the signals given in this section, aircraft shall take such action as may be required by the interpretation of the signal given. *(Annex 12, 5.8.2)*

8.4.2 Signals with Surface Craft

NOTE: The following replies may be made by surface craft to the signal in 8.4.2.1:

- ***For acknowledging receipt of signals:***
  - *a. the hoisting of the “Code pennant” (vertical red and white stripes) close up (meaning understood);*
  - *b. the flashing of a succession of “T’s” by signal lamp in the Morse code;*
  - *c. the changing of heading to follow the aircraft.*
- ***For indicating inability to comply:***
  - *a. the hoisting of the international flag “N” (a blue and white checkered square);*
  - *b. the flashing of a succession of “N’s” in the Morse code.*

8.4.2.1 The following maneuvers performed in sequence by an aircraft mean that the aircraft wishes to direct a surface craft towards an aircraft or a surface craft in distress:

a. circling the surface craft at least once;

b. crossing the projected course of the surface craft close ahead at low altitude and:

   1. rocking the wings; or
   2. opening and closing the throttle; or
   3. changing the propeller pitch.

   NOTE: Due to high noise level on-board surface craft, the sound signals in (2) and (3) may be less effective than the visual signal in (1) and are regarded as alternative means of attracting attention.

c. heading in the direction in which the surface craft is to be directed.

Repetition of such maneuvers has the same meaning. *(Annex 12, Appendix A, 1.1)*

8.4.2.2 The following maneuver by an aircraft means that the assistance of the surface craft to which the signal is directed is no longer required:

– crossing the wake of the surface craft close astern at a low altitude and:

  a. rocking the wings; or

  b. opening and closing the throttle; or

  c. changing the propeller pitch.

(Annex 12, Appendix A, 1.2)

NOTE: See Note following 8.4.2.1b.

8.4.3 Ground-Air Visual Signal Code

8.4.3.1 Symbols shall be at least 2.5m (8') long and shall be made as conspicuous as possible. *(Annex 12, Appendix A, 2.3)*

NOTE:

a. Symbols may be formed by any means such as: strips of fabric, parachute material, pieces of wood, stones or such like material; marking the surface by tramping, or staining with oil, etc.

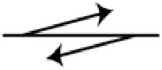
b. Attention to the signals may be attracted by other means such as radio, flares, smoke, reflected light, etc.

8.4.3.2 Ground-air Visual Signal Code For Use By Survivors (Annex 12, Appendix A, 2.1)

No.	MESSAGE	CODE SYMBOL
1	Require assistance	**V**
2	Require medical assistance	**X**
3	No or Negative	**N**
4	Yes or Affirmative	**Y**
5	Proceeding in this direction	↑

8.4.3.3 Ground-air Visual Signal Code For Use By Rescue Units (Annex 12, Appendix A, 2.2)

No.	MESSAGE	CODE SYMBOL
1	Operation completed	**LLL**
2	We have found all personnel	**<u>LL</u>**
3	We have found only some personnel	**++**

No.	MESSAGE	CODE SYMBOL
4	We are not able to continue. Returning to base	**XX**
5	Have divided into two groups. Each proceeding in direction indicated	
6	Information received that aircraft is in this direction	→→
7	Nothing found. Will continue to search	**NN**

8.4.3.4 Air-to-ground Signals

8.4.3.4.1 The following signals by aircraft mean that the ground signals have been understood:

a. during the hours of daylight:
   - by rocking the aircraft's wings;

b. during the hours of darkness:
   - flashing on and off twice the aircraft's landing lights or, if not so equipped, by switching on and off twice its navigation lights. *(Annex 12, Appendix A, 3.1)*

8.4.3.4.2 Lack of the above signal indicates that the ground signal is not understood. *(Annex 12, Appendix A, 3.2)*

9 IN-FLIGHT FUEL MANAGEMENT

9.1 The pilot-in-command shall advise ATC of a minimum fuel state by declaring MINIMUM FUEL when, having committed to land at a specific aerodrome, the pilot calculates that any change to the existing clearance to that aerodrome may result in landing with less than planned final reserve fuel.

NOTE: The declaration of MINIMUM FUEL informs ATC that all planned aerodrome options have been reduced to a specific aerodrome of intended landing and any change to the existing clearance may result in landing with less than planned final reserve fuel. This is not an emergency situation but an indication that an emergency situation is possible should any additional delay occur.

9.2 The pilot-in-command shall declare a situation of fuel emergency by broadcasting MAYDAY MAYDAY MAYDAY FUEL, when the calculated usable fuel predicted to be available upon landing at the nearest aerodrome where a safe landing can be made is less than the planned final reserve fuel.

NOTE: This is an emergency and the aircraft shall be given priority over other traffic in the landing sequence. The aircraft will be committed to a landing, as in the event of any delay or a go-around, there may be insufficient fuel remaining for a safe landing

9.3 STANDARD PHRASEOLOGY

9.3.1 The standard phraseology shall be used in a MINIMUM FUEL or FUEL EMERGENCY event is as follows:

Pilot transmission	*(c/s) MINIMUM FUEL*
Controller transmission	*ROGER [NO DELAY EXPECTED or EXPECT (delay information)]*
Pilot transmission	*(c/s) MAYDAY, MAYDAY, MAYDAY FUEL*
Controller transmission	*(c/s) MAYDAY FUEL ROGER*

NOTE: (c/s - Aircraft callsign)

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Airport Directory

Airport Data - General

1 LOCATION (AIRPORT), APT OF ENTRY (IF APPLICABLE)

Airports are listed alphabetically by location name, with airport name in parentheses when different than location name. A cross index by airport name is provided.

2 ELEVATION, JEPPESEN NAVDATA (ICAO) IDENTIFIER, IATA IDENTIFIER (IF APPLICABLE), TIME ZONE (1) COORDINATES

(1) — Time Zone in numeric format, observed by the airport as stated in the source and indicating the standard difference of each zone from Universal Time Coordinated (UTC).

*** —** indicated that the airport observes Daylight Savings or Summer Time.

3 TELEPHONE/TELEFAX NUMBERS

Telephone/Telefax numbers are provided for contact with the airport, where available.

4 RUNWAY DATA AND RUNWAY/APPROACH LIGHTS

All usable runways are listed indicating the following items:

a. Runway designators.

b. Total runway length, excluding stopways, overruns or clearways.

c. TORA and LDA if not identical with total runway length. TODA and ASDA when longer than take-off run (TORA) and provided by controlling authority. For explanation see below.

d. Type of runway surface.

e. Runway bearing strength.

Load classification number (LCN) supplemented (if known) by:

- r (rigid pavement) - radius of relative strength in inches

  f (flexible pavement) - thickness in inches
- Load Classification Group (LCG)
- Wheel and/or aircraft loads in thousands of pounds

  SIWL — Single Isolated Wheel Load times number of main wheels = allowable aircraft weight.

  ESWL — Equivalent Single Wheel Load, a calculated value for multiwheel legs. The resultant value is considered to be the same as SIWL for determining LCN as indicated below.

  S or SW — (allowable aircraft weight) for single wheel per leg configuration.

  T or DW — (allowable aircraft weight) for tandem or dual wheel per leg configuration.

  TT or DDW — (allowable aircraft weight) for twin tandem or double dual wheel per leg configuration.

  TDT — Runway weight bearing capacity for aircraft with twin delta tandem landing gear.

DDT — Runway weight bearing capacity for aircraft with double dual tandem type landing gear.

AUW — All Up Weight (without regard to wheel configuration).

MTOW — Maximum Take-Off Weight

– Load allowed on each main landing gear leg for different wheel configurations in thousands of pounds

S/L — (load per leg) for single wheel per leg configuration.

T/L — (load per leg) for twin or tandem wheel per leg configuration.

TT/L — (load per leg) for bogie or twin tandem wheel per leg configuration.

– Type of aircraft (represents a maximum load factor).

– ACN/PCN system - see explanation below.

Information predicated on maximum pounds per square inch tire pressure is shown as “000 psi”. Estimated information is prefaced with “E”.

f. Runway edge and approach lights are indicated as the best available system from the following sequence.

HIRL — high intensity runway lights

MIRL — medium intensity runway lights

RL — low intensity runway lights

PORT-RL — portable electric runway lights

FLARES — flare pots or goosenecks

HIALS — high intensity approach lights

MIALS — medium intensity approach lights

ALS — low intensity approach lights

LDIN — sequenced flashing lead-in lights

RAIL — runway alignment indicator lights (sequenced flashing)

5 HOURS & RESTRICTIONS

Airport hours of operation, restrictions for certain types of users or aircraft. All times are UTC unless otherwise indicated.

Abbreviations used for airport hours and restrictions have the following meaning:

SR — Sunrise

SS — Sunset

H24 — Continuous operation

HX — Irregular times

O/R — On Request

O/T — Other times

PNR — Prior Notice Required

PPO — Prior Permission Only

PPR — Prior Permission Required

PTO — Part Time Operation

ATND/SKD — Attended Schedule

NOTE: Civil aircraft require prior permission for the use of military airports.

6 CUSTOMS

“Customs” without further explanation indicates that Customs are available during airport hours. Other Customs conditions are explained, as appropriate.

NOTE: Availability at destination should be checked before departure.

7 FUEL

U — Fuel Services/Type unknown

7.1 JEPPESEN CODE AVGAS (GASOLINE) FUEL CATEGORY

F — Piston engine fuel (grade not specified)

F-1 — 73 octane

F-1 — 78 octane

F-2 — 80/87 octane (equal to MIL F-12)

F-7 — 91/96 octane, unleaded (no MIL spec)

F-7 — 91/115 octane

F-7 — 100 octane

F-3 — 100LL octane, low lead (equal to MIL F-18)

F-4 — 100/130 octane

F-5 — 115/145 octane (equal to MIL F-22)

F-6 — MOGAS

F-6 — Diesel

7.2 JET (KEROSENE) FUEL CATEGORY

J — Jet turbine fuel (grade not specified)

Jet A — Kerosene without FS-II*, FP** minus 40°C

Jet A+ — Kerosene with FS-II*, FP** minus 40°C

Jet A-1 — Kerosene without FS-II*, FP** minus 47°C (equal to MIL F-35/JP-1***)

Jet A-1+ — Kerosene with FS-II*, FP** minus 47°C (equal to MIL F-34/JP-8)

Jet B — Wide-cut turbine fuel without FS-II*, FP** minus 50°C (equal to JP-4 with the exception of certain additives)

Jet B+ — Wide-cut turbine fuel with FS-II*, FP** minus 50°C

JP-4 — Wide-cut turbine fuel for MIL aircraft, FP** minus 58°C (designation F-40 is also used)

JP-5 — Kersone with FS-II*, FP** minus 46°C used for aircraft operating from naval aircraft carriers (designation F-43/F-44 also used)

JP-8+100 — Kerosene with FS-II*, FP** minus 47°C with fuel additive package that improves thermo stability characteristics

*** —** Fuel System Icing Inhibitor

**** —** Freeze Point

***** —** The obsolete term JP1 is still used in some countries.

Availability for JASU (jet aircraft starting units) and Oxygen is also provided.

NOTE: Fuel and servicing hours may ***not*** *be identical with airport hours. At military fields fuel and/or oxygen may not be available for civil operators. Availability at destination should be checked before departure.*

8 BEACON

The abbreviations “ABN” and “IBN” indicate the availability of an aerodrome light beacon or aerodrome identification beacon.

9 DECLARED RUNWAY DISTANCES AS SPECIFIED BY ICAO

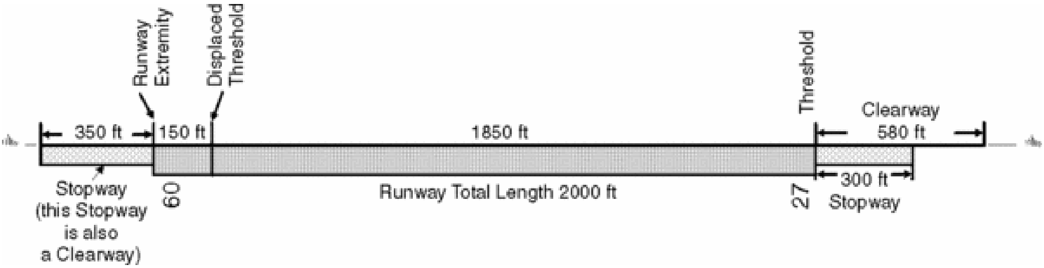
Take-off Run Available (TORA), that is, the length of runway which is declared available and suitable for the ground run of an aeroplane taking off.

Accelerate Stop Distance Available (ASDA), that is, the length of the take-off run available plus the length of stopway available (if stopway is provided).

Take-off Distance Available (TODA), that is, the length of the take-off run available plus the length of clearway available (if clearway is provided).

Landing Distance Available (LDA), that is, the length of runway which is declared available and suitable for the ground run of an aeroplane landing. The landing distance available commences at the threshold and extends for the length of runway after the threshold. However, the threshold may be displaced from the extremity of the runway when it is considered necessary to make a corresponding displacement of the approach surface by reason of obstacles in the approach path to the runway.

RUNWAY	TORA	ASDA	TODA	LDA
	ft	ft	ft	ft
09	2000	2300	2580	1850
27	2000	2350	2350	2000



10 RESCUE AND FIRE FIGHTING SYSTEM

Airport categories for rescue and fire fighting are based on the over-all length of the longest aeroplane normally using the airport and its maximum fuselage width as detailed in table 1.1.

Table 1.2. shows the minimum usable amounts of extinguishing agents related to the airport categories. They will be shown in the airport listings as “Fire” followed by the category number (e.g. Fire 5).

Where fire fighting equipment is available but the category is not defined, the letter U (Uncategorized) will be published (e.g. Fire U).

Where fire fighting equipment is not available, the letter N will be published.

If different category numbers are published for one airport, the lowest category number will be shown. The higher category number with the relevant note (e.g. Fire 7 PTO, Fire 7 PPR ... etc.) can be found within the airport information block.

Table 1.1. Airport Category for Rescue and Fire Fighting

Airport Cat.[1]			
ICAO	**FAA**	**Aeroplane Over-all Length (ft/*m*)**	**Maximum Fuselage Width (ft/*m*)**
1	A	0 up to but not including 30/*9*	7/*2*
2		30/*9* up to but not including 39/*12*	7/*2*
3		39/*12* up to but not including 59/*18*	10/*3*
4		59/*18* up to but not including 79/*24*	13/*4*
5		79/*24* up to but not including 92/*28*	13/*4*

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Table 1.1. Airport Category for Rescue and Fire Fighting (continued)

Airport Cat.[1]			
ICAO	**FAA**	**Aeroplane Over-all Length (ft/*m*)**	**Maximum Fuselage Width (ft/*m*)**
6	B	92/*28* up to but not including 128/*39*	16/*5*
7	C	128/*39* up to but not including 161/*49*	16/*5*
8	D	161/*49* up to but not including 200/*61*	23/*7*
9	E	200/*61* up to but not including 249/*76*	23/*7*
10		249/*76* up to but not including 295/*90*	26/*8*

[1] The airport category shown in the tabulation above should be considered as guideline only. To determine the exact rescue and fire airport category refer to ICAO DOC 9137 Chapter 2/(2.1.6) & FAA regulations §139.315, §139.317.

Table 1.2. Minimum usable Amounts of extinguishing Agents

Airport Category		Foam Meeting Performance Level A		Foam Meeting Performance Level B		Foam Meeting Performance Level C		Complementary Agents	
ICAO	**FAA** 1	**Water Gal/*L***	**Discharge Rate Foam Solution/ Minute Gal/*L***	**Water Gal/*L***	**Discharge Rate Foam Solution/ Minute Gal/*L***	**Water Gal/*L***	**Discharge Rate Foam Solution/ Minute Gal/*L***	**Dry chemicals Lbs/*Kg***	**Discharge Rate per Second Lbs/*Kg***
1	A	90/*350*	90/*350*	60/*230*	60/*230*	40/*160*	40/*160*	100/*45*	5/*2.25*
2		220/*1000*	210/*800*	180/*670*	150/*550*	120/*460*	95/*360*	200/*90*	5/*2.25*
3		400/*1800*	340/*1300*	320/*1200*	240/*900*	220/*820*	165/*630*	300/*135*	5/*2.25*
4		790/*3600*	690/*2600*	630/*2400*	480/*1800*	450/*1700*	290/*1100*	300/*135*	5/*2.25*
5		1780/*8100*	1190/*4500*	1430/*5400*	790/*3000*	1030/*3900*	580/*2200*	400/*180*	5/*2.25*
6	B	2600/*11800*	1590/*6000*	2090/*7900*	1060/*4000*	1530/*5800*	770/*2900*	500/*225*	5/*2.25*

Table 1.2. Minimum usable Amounts of extinguishing Agents (continued)

Airport Category		Foam Meeting Performance Level A		Foam Meeting Performance Level B		Foam Meeting Performance Level C		Complementary Agents	
ICAO	**FAA** [1]	**Water Gal/*L***	**Discharge Rate Foam Solution/ Minute Gal/*L***	**Water Gal/*L***	**Discharge Rate Foam Solution/ Minute Gal/*L***	**Water Gal/*L***	**Discharge Rate Foam Solution/ Minute Gal/*L***	**Dry chemicals Lbs/*Kg***	**Discharge Rate per Second Lbs/*Kg***
7	C	4800/*18200*	2090/*7900*	3200/*12100*	1400/*5300*	2320/*8800*	1000/*3800*	500/*225*	5/*2.25*
8	D	7210/*27300*	2850/*10800*	4810/*18200*	1900/*7200*	3380/*12800*	1350/*5100*	1000/*450*	9.9/*4.5*
9	E	9620/*36400*	3570/*13500*	6420/*24300*	2380/*9000*	4520/*17100*	1660/*6300*	1000/*450*	9.9/*4.5*
10		12730/*48200*	4390/*16600*	8530/*32300*	2960/*11200*	6020/*22800*	2090/*7900*	1000/*450*	9.9/*4.5*

[1] The FAA fire fighting categories requires equipment similar to the ICAO fire fighting equipment shown in the table above.

The principal extinguishing agent should be:

- a foam meeting the minimum performance level A; or
- a foam meeting the minimum performance level B; or
- a foam meeting the minimum performance level C; or
- a combination of these agents.

11 LOAD CLASSIFICATION OF RUNWAYS AND AIRCRAFT ALIGNMENT CHART

At some airports the bearing strength of runway pavement is defined by Load Classification Number (LCN)/Load Classification Group (LCG). The LCN/LCG has to be determined for a given aircraft and compared with the specific runway LCN/LCG. Normally the LCN/LCG of an aircraft should not be above that of the runway on which a landing is contemplated. Pre-arranged exceptions may be allowed by airport authorities.

The aircraft LCN/LCG can be determined as follows:

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a. Obtain Single Isolated Wheel Load (SIWL/ESWL) for the aircraft from Aircraft Operations Manual and locate this figure in pounds or tons, on the left scale of the chart.

b. Locate tire pressure on the scale to the right.

c. Connect the points found in 1 and 2 with a straight line. Where this line crosses the center scale read your aircraft LCN/LCG.

d. This LCN/LCG should not be above the published runway LCN/LCG.

NOTE: LCG reformulates LCN only; there is no correlation with other methods of expressing runway strength nor is any correlation possible.

EXAMPLE: Aircraft SIWL = 36500lbs or 16.5t

Tire pressure = 70psi or 4.9kg/cm^2

Aircraft LCN = 32, LCG = IV.

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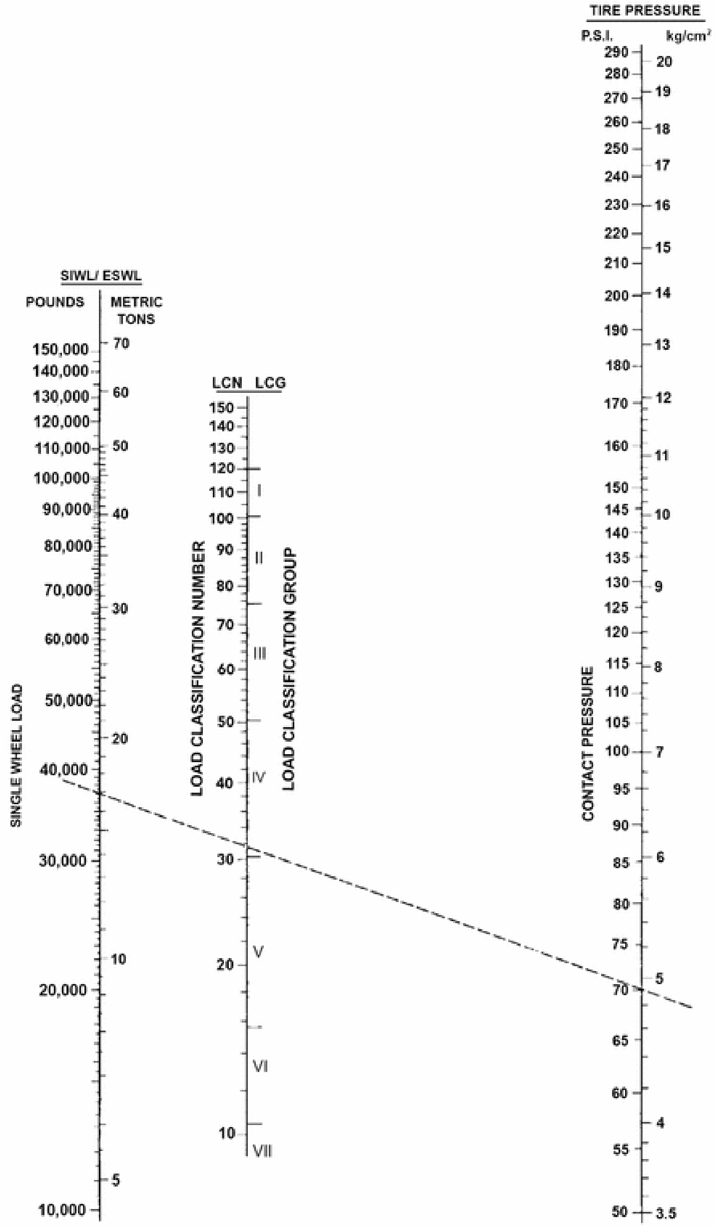

12 ACN/PCN SYSTEM

a. The ICAO introduced the ACN/PCN System as a method to classify pavement bearing strength for aircraft with an All-up Mass of more than 12500lbs (5700kg). For lighter aircraft see item e.

DEFINITIONS:

ACN (Aircraft Classification Number) — A number expressing the relative effect of an aircraft on a pavement for a specified standard subgrade category.

NOTE: The aircraft classification number is calculated with respect to the center of gravity (CG) position which yields the critical loading on the critical gear. Normally the aftmost CG appropriate to the maximum gross apron (ramp) mass is used to calculate the ACN. In exceptional cases the forwardmost CG position may result in the nose gear loading being more critical.

CBR (California Bearing Ratio) — The bearing ratio of soil determined by comparing the penetration load of the soil to that of a standard material. The method covers evaluation of the relative quality of subgrade soils but is applicable to sub-base and some base course materials.

K — Westergaard’s modulus of subgrade reaction in MN/m3.

MN/m^3 (Mega Newtons per cubic meter) — A measure of force in millions of Newtons per cubic meter.

MPa (Mega Pascals) — A measure of pressure or stress in millions of Pascals.

N (Newton) — The force which, when applied to a body having a mass of 1 kilogram gives it an acceleration of 1 meter per second squared.

Pa (Pascal) — The pressure of stress of 1 Newton per square meter.

PCN (Pavement Classification Number) — A number expressing the bearing strength of a pavement for unrestricted operations.

b. ACN for selected aircraft types currently in use have been provided by aircraft manufacturers or ICAO and the results are presented in tables shown on the following pages. Examples of ACN table usage are shown below. ICAO reference documents are Annex 14, Attachment B and Doc 9157-AN/901, Part 3.

c. PCN will be determined and reported by the appropriate authority. PCN will be qualified by type of pavement, subgrade strength, tire pressure and calculation method information, using the following codes:

1. The Pavement Classification Number:

   The reported PCN indicates that an aircraft with an ACN equal to or less than the reported PCN can operate on the pavement subject to any limitation on the tire pressure.

2. The type of pavement:

   R — Rigid

F — Flexible

3. The subgrade strength category:

   A — High

   B — Medium

   C — Low

   D — Ultra-low

4. The tire pressure category:

   W — Unlimited, no pressure limit

   X — High, limited to 1.75MPa (254psi)

   Y — Medium, limited to 1.25MPa (181psi)

   Z — Low, limited to 0.50MPa (73psi)

5. Pavement calculation method:

   T — Technical evaluation

   U — Using aircraft experience

EXAMPLE: Coding - PCN 80/R/B/W/T

The bearing strength of a rigid pavement, resting on a medium strength subgrade, has been assessed by technical evaluation to be PCN 80 and there is no tire pressure limitation.

d. The appropriate authority may establish criteria to regulate the use of a pavement by aircraft with an ACN higher than the PCN reported for that pavement.

   NOTE: If the reported PCN is below the ACN for the Maximum Apron Mass, then an All-up Mass can be calculated which is suitable to the lower reported PCN. The ACN varies linearly between the Operating Mass Empty and the Maximum Apron Mass.

e. The bearing strength of a pavement for aircraft with an All-up Mass EQUAL TO OR LESS than 12500lbs (5700kg) shall be made available by reporting the following information in plain language:

   1. Maximum allowable aircraft mass, and
   2. Maximum allowable tire pressure.

   EXAMPLE: 4000kg (8800lbs)/0.50MPa (73psi)

f. Occasional minor overloading operations are acceptable for:

   Where overload operations are conducted the appropriate authority should be consulted.

   1. flexible pavements by aircraft with ACN not exceeding 10 per cent above the PCN;
   2. rigid or composite pavements by aircraft with ACN not exceeding 5 per cent above the PCN;

3. unknown pavement structure, a 5 per cent limitation above the PCN should apply.

12.1 EXAMPLES OF ACN TABLE USAGE

EXAMPLE 1: Find the ACN of a B777-200LR with a mass of 348359kg on a rigid pavement resting on a medium strength subgrade (i.e., K = 80MN/m^3). Tire pressure of the main wheels is 1.50MPa.

Solution: ACN = 82

EXAMPLE 2: An AIP contains the following information related to a runway pavement:

PCN of the pavement = 80

Determine whether the pavement can accept the following aircraft at the indicated operating masses and tire pressures:

	Mass (kg)	**Tire Pressure (MPa)**
A380-800	571000	1.50
B747-400B	398345	1.38
IL-96	231000	1.08
EMB ERJ 145ER	20700	0.95

Solution: ACNs of these aircraft are 67, 63, 43 and 12.9 respectively. Since the pavement in question has a PCN of 80, it can accept all of the aircraft types cited.

EXAMPLE: Find the ACN of a B777-300 with a mass of 280400kg on a flexible pavement resting on a medium strength subgrade (CBR-10%). The tire pressure of the main wheels is 1.48MPa.

Solution:

$$\begin{aligned}
\text{ACN} &= \text{ACN}_{\text{max}} - \frac{(\text{Max. Take-off Mass - Actual Mass})}{(\text{Max. Take-off Mass - Empty Mass})} \times (\text{ACN}_{\text{max}} - \text{ACN}_{\text{empty}}) \\
&= 59 - \frac{(300278 - 280400)}{(300278 - 159150)} \times (59 - 25) \\
&= 59 - (0.14) \times (34) \\
\text{ACN} &= 54
\end{aligned}$$

NOTE: The two All-up Masses required are shown in columns 2 or 3 of the following pages for each aircraft type listed.

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A300-B2	304014 192371	137900 87259	47.0	174	12.2	1.20	34 19	41 22	49 26	57 31	35 20	39 21	47 24	62 32
Airbus A300-B2	315037 193676	142900 87851	47.0	186	13.1	1.28	37 20	44 23	53 27	60 31	37 20	41 22	50 25	65 33
Airbus A300-B4	332674 202858	150900 92016	47.0	203	14.3	1.40	41 22	49 25	58 29	66 34	41 22	45 23	54 26	70 35
Airbus A300-B4	339288 197052	153900 89382	47.0	203	14.3	1.40	43 21	51 24	59 28	68 33	42 21	46 22	56 25	72 34
Airbus A300-B4	349209 200848	158400 91104	47.0	215	15.1	1.48	45 22	54 25	63 29	71 34	43 22	48 23	59 26	75 35

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A300-B4	349209 200848	158400 91104	47.0	177	12.4	1.22	42 20	51 23	60 28	69 33	43 21	48 23	58 26	75 35
Airbus A300-B4	349209 200848	158400 91104	47.0	160	11.2	1.10	40 19	49 23	59 27	68 32	42 21	47 22	58 26	75 35
Airbus A300-B4	365743 200667	165900 91022	47.0	212	14.9	1.46	48 22	57 25	67 29	75 34	46 22	51 23	63 26	80 35
Airbus A300-B4	365743 200667	165900 91022	47.0	186	13.1	1.28	46 21	55 24	65 28	74 33	45 21	51 23	63 26	80 35
Airbus A300-B4	365743 200667	165900 91022	47.0	168	11.8	1.16	44 20	53 23	64 27	73 32	45 21	51 22	62 26	79 35

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A300-600 B4	365743 201840	165900 91554	47.5	186	13.1	1.28	46 21	56 24	66 29	75 34	46 22	52 23	64 27	81 35
Airbus A300-600 B4	365743 201840	165900 91554	47.5	168	11.8	1.16	45 20	54 24	65 28	74 33	46 21	52 23	63 26	81 35
Airbus A300-600 C4	365743 202292	165900 91759	47.0	186	13.1	1.28	46 21	55 24	65 29	74 33	45 21	51 23	63 26	80 35
Airbus A300-600 C4	365743 202292	165900 91759	47.0	168	11.8	1.16	44 20	53 23	64 28	73 32	45 21	51 23	62 26	79 35
Airbus A300-600R B4F	377868 199684	171400 90576	47.5	194	13.7	1.34	50 21	59 24	70 29	79 33	48 22	55 23	67 26	84 35

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A300-600R B4	377868 204408	171400 92719	47.5	194	13.7	1.34	50 22	59 25	70 30	79 34	48 22	55 24	67 27	84 36
Airbus A300-600R B4	380514 204532	172600 92775	47.5	194	13.7	1.34	50 22	60 25	70 30	79 34	49 22	55 24	67 27	85 36
Airbus A300-600R B4	380514 204532	172600 92775	47.5	175	12.3	1.21	48 21	58 24	69 29	78 34	48 22	55 23	67 27	85 36
Airbus A310-300F	277559 176108	125900 79882	46.7	170	11.9	1.17	30 17	36 19	43 23	50 27	31 18	34 19	41 21	55 28
Airbus A310-200F	292991 178288	132900 80871	46.7	178	12.5	1.23	33 17	39 20	47 24	54 28	34 18	37 19	45 22	59 29

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A310-200F	292991 178288	132900 80871	46.7	148	10.4	1.02	30 16	37 19	45 22	52 26	33 18	36 19	44 22	59 29
Airbus A310-300F	299605 170012	135900 77117	46.7	178	12.5	1.23	34 17	40 19	48 22	55 26	35 17	38 18	46 20	61 27
Airbus A310-300F	307542 176013	139500 79839	47.2	189	13.3	1.30	36 18	43 20	51 24	59 28	37 18	40 19	49 22	64 29
Airbus A310-300F	307542 176013	139500 79839	47.2	157	11.0	1.08	34 17	41 19	49 23	57 27	36 18	40 19	49 22	64 29
Airbus A310-200	315037 178837	142900 81120	46.7	193	13.6	1.33	37 18	45 21	53 24	60 28	37 18	41 20	50 22	65 29

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A310-200	315037 178837	142900 81120	46.7	160	11.2	1.10	35 17	42 19	50 23	58 27	37 18	41 19	50 22	65 29
Airbus A310-300	339288 181849	153900 82486	47.2	212	14.9	1.46	44 19	52 22	60 26	69 30	42 19	47 20	57 23	73 30
Airbus A310-300	339288 181849	153900 82486	47.2	174	12.2	1.20	40 18	49 21	58 24	66 29	41 19	46 20	56 23	73 30
Airbus A310-300	348106 184966	157900 83900	47.2	215	15.1	1.48	45 20	54 23	63 26	71 30	44 20	48 21	59 23	75 31
Airbus A310-300	348106 184966	157900 83900	47.2	180	12.6	1.24	42 19	51 21	61 25	69 29	43 19	48 20	59 23	75 31

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A310-300	354720 183866	160900 83401	47.2	183	12.8	1.26	44 19	53 21	62 25	71 29	44 19	49 20	60 23	77 31
Airbus A310-300	363539 187314	164900 84965	47.2	187	13.2	1.29	46 19	55 22	65 26	74 30	45 20	51 21	62 24	80 32
Airbus A318-100	124339 85578	56400 38818	45.1	148	10.4	1.02	27 18	29 19	32 20	33 22	26 17	27 17	30 19	35 22
Airbus A318-100	130953 85578	59400 38818	44.9	165	11.6	1.14	30 18	32 20	34 21	36 22	28 17	29 17	32 19	37 22
Airbus A318-100	135362 85578	61400 38818	44.7	165	11.6	1.14	31 18	33 19	35 21	37 22	29 17	30 17	33 19	38 22
Airbus A318-100	136465 85578	61900 38818	44.6	165	11.6	1.14	31 18	33 19	36 21	37 22	29 17	30 17	33 19	38 22

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A318-100	139772 85578	63400 38818	44.5	165	11.6	1.14	32 18	34 19	36 21	38 22	30 17	31 17	34 19	39 21
Airbus A318-100	150795 85578	68400 38818	44.5	180	12.6	1.24	36 19	38 20	41 21	43 22	33 17	34 17	37 19	43 22
Airbus A319-100 (CG 36%)	137567 90389	62400 41000	45.7	173	12.1	1.19	33 20	35 22	37 23	39 24	30 19	31 19	34 21	40 24
Airbus A319-100 (CG 39%)	137567 90389	62400 41000	46.3	173	12.1	1.19	33 20	36 22	38 23	40 25	31 19	32 19	35 21	41 24
Airbus A319-100 (CG 36%)	141976 90389	64400 41000	45.7	173	12.1	1.19	34 20	37 22	39 23	41 24	32 19	32 19	36 21	41 24

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A319-100 (CG 39%)	141976	64400	46.3	173	12.1	1.19	35	37	39	41	32	33	36	42
	90389	41000					20	22	23	25	19	19	21	24
Airbus A319-100 (CG 36%)	146385	66400	45.7	181	12.7	1.25	36	38	41	42	33	34	37	43
	90389	41000					20	22	23	24	19	19	21	24
Airbus A319-100 (CG 38.8%)	146385	66400	46.2	181	12.7	1.25	37	39	41	43	33	34	38	44
	90389	41000					21	22	24	25	19	19	21	24
Airbus A319-100 (CG 36%)	150795	68400	45.7	181	12.7	1.25	37	40	42	44	34	35	39	44
	90389	41000					20	22	23	24	19	19	21	24
Airbus A319-100 (CG 38.1%)	150795	68400	46.1	181	12.7	1.25	38	40	42	44	34	35	39	45
	90389	41000					21	22	23	25	19	19	21	24

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/c m^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A319-100 (CG 36%)	155204	70400	45.7	187	13.1	1.29	39	41	44	46	35	36	40	46
	90389	41000					21	22	23	25	19	19	21	24
Airbus A319-100 (CG 37.5%)	155204	70400	46.0	187	13.1	1.29	39	42	44	46	35	36	41	46
	90389	41000					21	22	24	25	19	19	21	24
Airbus A319-100 (CG 36%)	162920	73900	45.7	194	13.7	1.34	42	44	47	49	37	39	43	49
	90389	41000					21	22	24	25	19	19	21	24
Airbus A319-100 (CG 36.52%)	162920	73900	45.8	194	13.7	1.34	42	44	47	49	37	39	43	49
	90389	41000					21	22	24	25	19	19	21	24
Airbus A319-100	167329	75900	45.7	200	14.1	1.38	44	46	48	51	39	40	45	50
	90389	41000					21	22	24	25	19	19	21	24

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A319-CJ	155204	70400	45.8	200	14.1	1.38	40	42	44	46	36	37	40	46
	90389	41000					21	22	24	25	19	19	21	24
Airbus A319-CJ	167329	75900	45.8	200	14.1	1.38	44	46	49	51	39	40	45	50
	90389	41000					21	22	24	25	19	19	21	24
Airbus A319-CJ	169534	76900	45.8	200	14.1	1.38	44	47	49	51	39	41	45	51
	90389	41000					21	22	24	25	19	19	21	24
Airbus A319 Neo (CG 34%)	141976	64400	45.3	173	12.1	1.19	34	36	38	40	31	32	35	41
	90389	41000					20	21	23	24	19	19	20	24
Airbus A319 Neo	141976	64400	46.3	173	12.1	1.19	35	37	39	41	32	33	36	42
	90389	41000					20	22	23	25	19	19	21	24
Airbus A319 Neo	155204	70400	46.0	187	13.2	1.29	39	42	44	46	35	36	41	46
	90389	41000					21	22	24	25	19	19	21	24

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A319 Neo (CG 34%)	167329	75900	45.3	200	14.1	1.38	43	46	48	50	38	40	44	50
	90389	41000					21	22	24	25	19	19	21	24
Airbus A319 Neo	167329	75900	45.7	200	14.1	1.38	44	46	49	51	39	40	45	50
	90389	41000					21	22	24	25	19	19	21	24
Airbus A320-100	146385	66400	47.1	178	12.5	1.23	37	40	42	44	34	35	39	45
	90927	41244					21	23	24	25	20	20	22	25
Airbus A320-100	150795	68400	47.1	186	13.1	1.28	39	41	44	46	35	36	40	46
	90927	41244					22	23	24	26	20	20	22	25
Airbus A320-200	146385	66400	47.5	178	12.5	1.23	37	40	42	44	34	35	39	45
	92593	42000					22	23	25	26	20	21	22	26
Airbus A320-200	148590	67400	47.5	186	13.1	1.28	39	41	43	45	35	36	40	46
	92593	42000					22	24	25	26	21	21	22	26

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A320-200	150795	68400	47.5	186	13.1	1.28	39	42	44	46	35	36	41	47
	92593	42000					22	24	25	26	21	21	22	26
Airbus A320-200	155204	70400	47.4	186	13.1	1.28	41	43	46	48	37	38	42	48
	92593	42000					22	24	25	26	20	21	22	26
Airbus A320-200	158511	71900	47.3	200	14.1	1.38	42	45	47	49	38	39	43	49
	92593	42000					23	24	27	26	20	21	22	26
Airbus A320-200	162920	73900	47.0	200	14.1	1.38	44	46	48	50	39	40	44	50
	92593	42000					22	24	25	26	20	20	22	26
Airbus A320-200	167329	75900	46.8	200	14.1	1.38	45	47	50	52	40	41	46	52
	92593	42000					22	24	25	26	20	20	22	25
Airbus A320-200	170636	77400	46.6	209	14.7	1.44	46	49	51	53	41	42	47	53
	92593	42000					23	24	25	26	20	21	22	25

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A320-200	172841	78400	46.4	209	14.7	1.44	47	49	52	54	41	43	47	53
	92593	42000					22	24	25	26	20	20	22	25
Airbus A320-200 Bogie	162920	73900	46.9	177	12.4	1.22	18	21	25	28	18	19	22	31
	92593	42000					9	10	12	13	9	9	10	13
Airbus A320 Neo	155204	70400	47.2	186	13.1	1.28	41	43	46	48	36	37	42	48
	92593	42000					22	24	25	26	20	21	22	26
Airbus A320 Neo	162920	73900	47.0	200	14.1	1.38	44	46	48	50	39	40	44	50
	92593	42000					22	24	25	26	20	20	22	26
Airbus A320 Neo	170636	77400	46.6	209	14.7	1.44	46	49	51	53	41	42	47	53
	92593	42000					23	24	25	26	20	21	22	25
Airbus A320 Neo	175045	79400	46.3	210	14.8	1.45	48	50	53	55	41	44	48	54
	92593	42000					22	24	25	26	20	20	22	25

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A321-100	172841	78400	47.8	186	13.1	1.28	47	50	52	54	42	44	49	55
	103526	46959					25	27	29	30	23	24	26	30
Airbus A321-100	183864	83400	47.8	197	13.9	1.36	51	54	57	59	45	48	53	59
	103526	46959					26	28	29	31	23	24	26	30
Airbus A321-100	188273	85400	47.8	202	14.2	1.39	53	56	59	61	47	49	55	61
	103526	46959					26	28	29	31	23	24	26	30
Airbus A321-100	197091	89400	47.4	212	14.9	1.46	56	59	62	64	49	52	58	63
	103526	46959					26	28	29	31	23	24	26	30
Airbus A321-200	172841	78400	47.8	186	13.1	1.28	47	50	52	54	42	44	49	55
	103526	46959					25	27	29	30	23	24	26	30
Airbus A321-200	177250	80400	47.8	197	13.9	1.36	49	52	54	57	43	45	51	56
	103526	46959					26	28	29	31	23	24	26	30

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A321-200	183864	83400	47.7	197	13.9	1.36	51	54	57	59	45	47	53	59
	103526	46959					26	27	29	30	23	24	26	30
Airbus A321-200	188273	85400	47.6	202	14.2	1.39	53	56	58	61	46	49	54	60
	103526	46959					26	28	29	30	23	24	26	30
Airbus A321-200	197091	89400	47.5	212	14.9	1.46	56	59	62	64	49	52	58	63
	103526	46959					26	28	29	31	23	24	26	30
Airbus A321-200	205910	93400	47.6	218	15.3	1.50	60	63	66	68	52	55	61	67
	103526	46959					27	28	30	31	24	24	26	30
Airbus A321-200	207012	93900	47.6	218	15.3	1.50	61	64	66	69	53	56	61	67
	103526	46959					27	28	30	31	24	24	26	30
Airbus A321 Neo	197093	89400	47.8	212	14.9	1.46	57	60	62	65	50	52	58	64
	103617	47000					27	28	30	31	24	24	26	30

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A321 Neo	207014	93900	47.6	218	15.3	1.50	61	64	66	69	53	56	61	67
	103617	47000					27	28	30	31	24	24	26	30
Airbus A321 Neo	177252	80400	47.7	197	13.9	1.36	49	52	54	56	43	45	50	56
	103617	47000					26	27	29	30	23	24	26	30
Airbus A330-200	425272	192900	47.5	206	14.5	1.42	43	49	57	67	46	49	56	75
	264555	120000					28	27	31	35	26	27	30	37
Airbus A330-200	447318	202900	47.5	206	14.5	1.42	45	52	61	71	49	52	60	80
	264555	120000					28	27	31	35	26	27	30	37

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A330-200	464955 264555	210900 120000	47.4	206	14.5	1.42	47 28	54 27	64 31	75 35	51 26	55 27	63 30	85 37
Airbus A330-200	480387 264555	217900 120000	47.4	206	14.5	1.42	48 28	57 27	67 31	78 35	53 26	57 27	66 30	89 37
Airbus A330-200	487001 264555	220900 120000	47.4	206	14.5	1.42	49 28	58 27	68 31	80 35	54 26	58 27	67 30	91 36
Airbus A330-200	509047 264555	230900 120000	47.3	206	14.5	1.42	53 28	61 27	72 30	85 35	57 26	62 27	71 30	97 36

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A330-200	515661 264555	233900 120000	47.3	206	14.5	1.42	54 28	62 27	74 30	86 35	58 26	63 27	73 30	98 36
Airbus A330-200	522275 264555	236900 120000	46.7	206	14.5	1.42	54 27	62 27	74 30	86 34	58 26	63 27	73 29	98 36
Airbus A330-200	526684 264555	238900 120000	46.3	206	14.5	1.42	54 27	62 26	74 30	86 34	58 25	63 26	73 29	98 35
Airbus A330-200	526684 264555	238900 120000	46.8	213	15.0	1.47	55 28	64 27	75 30	88 35	59 26	64 27	74 29	100 36

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A330-200	531094 264555	240900 120000	46.5	213	15.0	1.47	55 28	64 27	76 30	88 35	59 26	64 27	74 29	100 36
Airbus A330-200	535503 264555	242900 120000	46.3	213	15.0	1.47	56 27	64 27	76 30	89 34	59 26	64 27	74 29	101 35
Airbus A330-200F	502434 264555	227900 120000	47.3	206	14.5	1.42	52 28	60 27	71 30	83 35	56 26	61 27	70 30	95 36
Airbus A330-200F	515661 264555	233900 120000	47.3	206	14.5	1.42	54 28	62 27	74 30	86 35	58 26	63 27	73 30	98 36

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A330-300	407635 275578	184900 125000	47.9	190	13.4	1.31	40 28	45 28	53 32	62 37	44 28	47 29	53 32	71 39
Airbus A330-300	469359 275578	212900 125000	47.4	190	13.4	1.31	46 28	53 27	63 31	75 36	51 27	55 28	64 31	86 39
Airbus A330-300	453932 275578	205900 125000	47.9	193	13.6	1.33	45 28	52 28	62 32	72 37	50 27	54 29	62 32	83 39
Airbus A330-300	462750 275578	209900 125000	47.8	193	13.6	1.33	46 28	53 28	63 32	74 37	51 27	55 29	63 32	85 39

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A330-300	469364 275578	212900 125000	47.8	193	13.6	1.33	47 28	54 28	65 32	76 37	52 27	56 29	64 32	87 39
Airbus A330-300	475973 275578	215900 125000	47.2	193	13.6	1.33	47 28	54 27	65 31	76 36	52 27	56 28	65 31	87 38
Airbus A330-300	475973 275578	215900 125000	47.8	193	13.6	1.33	47 28	55 28	66 32	77 37	53 27	57 29	66 32	89 39
Airbus A330-300 (CG 33.5%)	480382 275578	217900 125000	47.0	193	13.6	1.33	47 28	55 27	65 31	76 36	52 27	56 28	65 31	88 38

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A330-300 (CG 39.13%)	480382 275578	217900 125000	47.8	193	13.6	1.33	48 28	56 28	67 32	78 37	53 27	58 29	67 32	90 39
Airbus A330-300	482592 275578	218900 125000	47.8	193	13.6	1.33	48 28	56 28	67 32	79 37	54 27	58 29	67 32	91 39
Airbus A330-300	438500 275578	198900 125000	47.9	206	14.5	1.42	45 29	51 29	60 33	70 38	48 28	52 29	59 32	79 39
Airbus A330-300	453932 275578	205900 125000	47.9	206	14.5	1.42	46 29	53 29	63 33	73 38	50 28	54 29	62 32	83 39

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A330-300	480384 275578	217900 125000	47.8	206	14.5	1.42	49 29	57 29	68 33	79 37	54 28	58 29	67 32	90 39
Airbus A330-300	509047 275578	230900 125000	47.8	206	14.5	1.42	53 29	62 29	73 32	86 37	58 28	62 29	72 32	98 39
Airbus A330-300	407635 275578	184900 125000	47.8	210	14.8	1.45	42 29	47 29	55 33	64 38	44 28	47 29	53 32	71 39
Airbus A330-300	420863 275578	190900 125000	47.9	210	14.8	1.45	43 29	49 29	57 33	67 38	46 28	49 29	56 32	74 39

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A330-300	438500 275578	198900 125000	47.9	210	14.8	1.45	45 29	51 29	60 33	70 38	48 28	52 29	59 32	79 39
Airbus A330-300	440704 275578	199900 125000	47.9	210	14.8	1.45	45 29	52 29	61 33	71 38	49 28	52 29	59 32	80 39
Airbus A330-300	453932 275578	205900 125000	47.9	210	14.8	1.45	47 29	54 29	63 33	74 38	50 28	54 29	62 32	83 39
Airbus A330-300	469364 275578	212900 125000	47.8	210	14.8	1.45	48 29	56 29	66 33	77 38	52 28	56 29	65 32	87 39

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A330-300	475978 275578	215900 125000	47.8	210	14.8	1.45	49 29	57 29	67 33	79 38	53 28	57 29	66 32	89 39
Airbus A330-300	480387 275578	217900 125000	47.8	210	14.8	1.45	49 29	58 29	68 33	80 38	54 28	58 29	67 32	90 39
Airbus A330-300	509047 275578	230900 125000	47.8	210	14.8	1.45	54 29	62 29	74 33	86 38	58 28	62 29	72 32	98 39
Airbus A330-300	515661 275578	233900 125000	47.7	210	14.8	1.45	55 29	63 29	75 33	87 38	59 28	63 29	74 32	100 39

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A330-300	520071 275578	235900 125000	47.3	210	14.8	1.45	55 29	63 28	75 32	87 37	59 27	63 29	74 31	100 39
Airbus A330-300	526684 275578	238900 125000	47.3	216	15.2	1.49	56 29	65 29	77 33	89 37	60 27	64 29	75 31	101 39
Airbus A330-300	531094 275578	240900 125000	47.1	216	15.2	1.49	56 29	65 29	77 32	90 37	60 27	65 28	75 31	102 38
Airbus A330-300	535503 275578	242900 125000	46.9	216	15.2	1.49	57 29	66 28	78 32	90 37	60 27	65 28	76 31	103 38

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A330-800	509047 297624	230900 135000	47.3	213	15.0	1.47	54 31	62 31	73 36	85 41	57 30	62 31	71 34	97 43
Airbus A330-800	517866 297624	234900 135000	47.2	213	15.0	1.47	55 31	63 31	75 36	87 41	58 30	63 31	73 34	99 43
Airbus A330-800	526684 297624	238900 135000	46.8	213	15.0	1.47	55 31	64 31	75 35	88 41	59 30	64 31	74 34	100 43
Airbus A330-800	535503 297624	242900 135000	46.3	213	15.0	1.47	56 30	64 31	76 35	89 40	59 29	64 31	74 33	101 42

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A330-900	509047 308647	230900 140000	47.8	216	15.2	1.49	55 32	63 33	74 38	86 44	58 32	63 33	72 37	98 46
Airbus A330-900	517866 308647	234900 140000	47.6	216	15.2	1.49	56 32	64 33	76 38	88 44	59 32	64 33	74 36	100 46
Airbus A330-900	526684 308647	238900 140000	47.3	216	15.2	1.49	56 32	65 33	77 38	89 43	60 31	64 33	75 36	101 46
Airbus A330-900	535503 308647	242900 140000	46.9	216	15.2	1.49	57 32	66 33	76 37	90 43	60 31	65 32	76 36	103 45

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A340-200	560850 276109	254400 125242	39.1	189	13.3	1.30	45 22	52 24	62 25	73 28	50 22	54 22	62 25	84 30
Airbus A340-200	575180 276109	260900 125242	39.2	191	13.5	1.32	47 23	54 23	65 25	76 29	52 22	56 23	65 25	88 30
Airbus A340-200	608249 276109	275900 125242	39.7	206	14.5	1.42	53 23	61 25	73 26	85 30	57 22	62 23	72 25	97 30
Airbus A340-300	560850 276109	254400 125242	39.4	190	13.4	1.31	46 20	53 23	63 25	74 29	51 22	55 23	63 25	85 30

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A340-300	568566 276109	257900 125242	39.4	191	13.5	1.32	47 19	54 23	64 25	76 29	52 22	56 23	64 25	87 30
Airbus A340-300	575180 276109	260900 125242	39.1	191	13.5	1.32	47 23	54 24	65 25	76 28	52 22	56 23	65 25	87 30
Airbus A340-300	575180 276109	260900 125242	40.0	206	14.5	1.42	50 24	58 25	68 26	80 30	54 23	58 23	67 25	90 31
Airbus A340-300	579589 276109	262900 125242	40.0	206	14.5	1.42	49 24	58 25	69 26	80 30	54 23	59 23	68 25	91 31

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A340-300	599431 276109	271900 125242	40.0	206	14.5	1.42	52 24	61 25	72 26	84 30	57 23	61 23	71 25	96 31
Airbus A340-300	608249 276109	275900 125242	40.0	206	14.5	1.42	53 24	62 25	73 26	86 30	58 23	62 23	72 25	98 31
Airbus A340-300	611556 276109	277400 125242	39.7	206	14.5	1.42	53 23	62 25	73 26	85 30	57 22	62 23	72 25	98 30
Airbus A340-500	813938 375598	369200 170370	32.0	234	16.4	1.61	61 27	71 28	83 30	96 34	64 25	69 26	80 28	108 35

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A340-500	822757 375598	373200 170370	32.0	234	16.4	1.61	62 27	72 28	85 30	98 34	65 25	70 26	82 28	110 35
Airbus A340-500 HGW	840394 375598	381200 170370	31.6	234	16.4	1.61	63 27	73 29	86 30	99 34	66 25	71 26	83 28	111 34
Airbus A340-600	807325 388812	366200 176364	32.2	234	16.4	1.61	61 28	71 29	83 32	96 36	64 26	69 28	80 30	108 37
Airbus A340-600	813938 388812	369200 176364	32.2	234	16.4	1.61	62 28	71 29	84 32	97 36	64 26	69 28	81 30	109 37

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A340-600	840394 388812	381200 176364	31.7	234	16.4	1.61	63 28	73 28	86 31	100 36	66 26	71 27	83 29	112 36
Airbus A350-900	464954 308647	210900 140000	47.3	197	13.9	1.36	45 30	49 31	56 34	66 38	48 30	51 31	57 34	76 41
Airbus A350-900	480387 308647	217900 140000	47.3	197	13.9	1.36	47 30	51 31	59 34	69 38	50 30	53 31	60 34	79 41
Airbus A350-900	520070 308647	235900 140000	48.4	220	15.5	1.52	55 32	60 33	70 36	81 41	57 31	61 32	69 35	93 42

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A350-900	534094 308647	240900 140000	48.4	220	15.5	1.52	56 32	61 33	72 36	84 41	59 31	62 32	71 35	96 42
Airbus A350-900	553140 308647	250900 140000	48.1	241	16.9	1.66	60 33	66 34	77 37	89 41	62 31	66 32	74 35	102 42
Airbus A350-900	564163 308647	255900 140000	48.0	241	16.9	1.66	61 33	68 33	79 36	91 41	63 31	67 32	76 34	104 42
Airbus A350-900	575186 308647	260900 140000	47.9	241	16.9	1.66	63 32	69 33	81 36	94 41	65 31	68 32	78 34	107 42

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A350-900 (CG 33%)	592824 308647	268900 140000	46.8	241	16.9	1.66	63 32	70 33	82 35	95 40	65 30	69 31	79 33	108 40
Airbus A350-900	592824 308647	268900 140000	47.7	241	16.9	1.66	64 32	72 33	84 36	97 41	67 31	71 32	81 34	111 41
Airbus A350-900 (CG 36,39%)	601642 308647	272900 140000	47.4	244	17.1	1.68	62 32	73 33	85 36	98 41	68 31	72 32	82 34	113 41
Airbus A350-900 (CG 36,40%)	601642 308647	272900 140000	47.4	244	17.1	1.68	65 32	73 33	85 36	98 41	68 31	72 32	82 34	113 41

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A350-900 (CG 36,83%)	601642 308647	272900 140000	47.5	244	17.1	1.68	65 32	73 33	85 36	99 41	68 31	72 32	82 34	113 41
Airbus A350-900 (CG 37,07%)	601642 308647	272900 140000	47.5	244	17.1	1.68	65 32	73 33	85 36	99 41	68 31	72 32	82 34	113 41
Airbus A350-900	608255 308647	275900 140000	46.9	244	17.1	1.68	63 32	73 33	85 36	98 40	68 30	72 31	82 33	113 40
Airbus A350-900 (CG 34,83%)	608255 308647	275900 140000	47.1	244	17.1	1.68	65 32	73 33	85 36	99 40	68 30	72 31	82 34	114 41

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A350-900 (CG 31,15%)	612665 308647	277900 140000	46.5	244	17.1	1.68	65 32	73 32	85 35	98 40	68 30	72 31	82 33	113 40
Airbus A350-900 (CG 33,27%)	612665 308647	277900 140000	46.9	244	17.1	1.68	66 32	74 33	86 36	99 40	68 30	72 31	83 33	114 40
Airbus A350-900	614869 308647	278900 140000	46.9	248	17.4	1.71	65 32	74 33	86 36	100 40	69 30	73 31	83 33	115 40
Airbus A350-900	619278 308647	280900 140000	46.6	248	17.4	1.71	66 32	74 33	87 35	100 40	69 30	73 31	83 33	115 40

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Airbus A350-1000	681008	308900	47.1	220	15.5	1.52	56	72	92	111	55	61	75	104
	352740	160000					27	27	33	42	23	25	28	38
Airbus A350-1000	687622	311900	47.1	220	15.5	1.52	57	73	93	113	55	62	76	105
	352740	160000					27	27	33	42	23	25	28	38
Airbus A380-800	1062628	482000	19.0 (WLG)	218	15.3	1.50	47	54	63	74	48	52	60	83
	661387	300000					27	29	34	39	27	29	31	40
			28.5 (BLG)				46	54	69	87	45	50	59	84
							29	29	34	42	25	27	30	40
Airbus A380-800	1084674	492000	19.0 (WLG)	203	14.3	1.40	46	54	64	75	49	53	62	85
	661387						26	29	33	38	27	28	31	40

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		300000	28.5 (BLG)				46 28	54 28	70 33	89 42	47 25	51 27	61 30	87 40
Airbus A380-800	1128766 661387	512000	19.0 (WLG)	203	14.3	1.40	49 26	57 29	68 33	79 38	51 27	56 28	66 31	90 40
		300000	28.5 (BLG)				48 28	57 28	75 33	94 42	49 25	54 27	65 30	92 40
Airbus A380-800	1238997 661387	562000	19.0 (WLG)	218	15.3	1.50	56 27	66 29	78 34	91 39	59 27	64 29	75 31	102 40
		300000	28.5 (BLG)				55 29	68 29	88 34	110 42	56 25	62 27	75 30	106 40
Airbus A380-800	1258839 661387	571000	18.9 (WLG)	218	15.3	1.50	57 27	67 29	79 33	91 38	59 27	64 28	76 31	104 40
		300000												

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			28.3 (BLG)				56	69	89	111	57	63	76	107
							28	29	34	42	25	26	30	39
Airbus A380-800	1267658	575000	18.9 (WLG)	218	15.3	1.50	58	67	80	92	60	65	77	105
	661387	300000					27	29	33	38	27	28	31	40
			28.3 (BLG)				56	69	90	113	57	63	77	108
							28	29	34	42	25	26	30	39
Airbus A380-800	1272067	577000	18.9 (WLG)	218	15.3	1.50	58	68	80	93	60	65	77	105
	661387	300000					27	29	33	38	27	28	31	40
			28.3 (BLG)				56	70	91	113	58	64	77	108
							28	29	34	42	25	26	30	39
Antonov An-12	141100	64000	46.33	120	8.46	0.83	16	19	22	26	16	18	21	26
	70550	32000					7	7	9	10	7	7	8	10

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Antonov An-22	501600 261200	227500 118500	43.55	71	5.00	0.49	24 11	24 13	25 15	35 15	22 10	27 11	32 13	45 17
Antonov An-24	46300 30860	21000 14000	46.6	86	6.02	0.59	9 6	10 6	11 7	12 7	8 5	9 6	11 7	13 8
Antonov An-26	53420 33070	24230 15000	46.6	57	3.97	0.39	9 5	11 6	12 7	13 7	7 4	9 5	12 7	15 8
Antonov An-32	62830 41890	28500 19000	46.75	71	5.00	0.49	13 8	14 9	15 10	16 10	11 6	13 8	16 9	19 12
Antonov An-38-200	22000 13120	9980 5950	43.75	93	6.53	0.64	7 4	7 4	7 4	7 4	7 4	7 4	8 5	8 5

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm²	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Antonov An-70	320800 158700	145500 72000	45.6	128	8.97	0.88	20 11	27 11	37 12	46 16	22 9	24 9	29 11	39 14
Antonov An-72-100	77490 41890	35150 19000	47.2	86	6.01	0.59	13 7	15 8	16 8	17 9	12 6	13 7	15 8	17 9
Antonov An-74T	81240 48720	36850 22100	46.8	100	7.03	0.69	15 9	17 9	18 10	19 11	13 8	15 9	16 9	19 10
Antonov An-74TK-300	83440 48500	37850 22000	46.5	100	7.03	0.69	15 9	17 9	18 10	19 10	13 7	15 8	16 9	19 10
Antonov An-124-100	877400 396800	398000 180000	45.8	157	11.01	1.08	34 14	45 14	67 18	93 23	38 13	44 14	56 17	78 23

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/c m^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Antonov An-124-100M -150	877400 396800	398000 180000	45.8	157	11.01	1.08	34 14	45 14	67 18	93 23	38 13	44 14	56 17	78 23
Antonov An-124-100M -150	899500 396800	408000 180000	45.8	171	12.03	1.18	37 14	49 15	72 18	98 24	40 13	46 14	58 17	81 23
Antonov An-140	46300 28660	21000 13000	46.4	120	8.46	0.83	11 6	12 7	13 7	13 8	10 6	11 6	12 7	14 8
Antonov An-140-100	47620 28660	21600 13000	46.4	120	8.46	0.83	12 6	12 7	13 7	14 8	10 6	11 6	12 7	14 8
Antonov An-148-100A	86200 52910	39100 24000	44.75	142	10.00	0.98	22 12	23 13	25 14	26 15	19 11	21 11	24 13	26 15

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Antono	86200	39100	44.75	142	10.00	0.98	22	23	25	26	19	21	24	26
An-148-200A	52910	24000					12	13	14	15	11	11	13	15
Antonov	92810	42100	44.45	149	10.50	1.03	24	26	27	28	22	23	26	28
An-148-100B	52910	24000					12	13	14	15	11	11	13	15
Antonov	92810	42100	44.45	149	10.50	1.03	24	26	27	28	22	23	26	28
An-148-200B	52910	24000					12	13	14	15	11	11	13	15
Antonov	96670	43850	43.75	164	11.52	1.13	26	27	28	29	22	24	27	29
An-148-100E	52910	24000					12	13	14	15	11	11	12	15
Antonov	96670	43850	43.75	164	11.52	1.13	26	27	28	29	22	24	27	29
An-148-100EA	52910	24000					12	13	14	15	11	11	12	15
Antonov	96670	43850	43.75	164	11.52	1.13	26	27	28	29	22	24	27	29
An-148-100EM	52910	24000					12	13	14	15	11	11	12	15

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Antonov	96670	43850	44.75	164	11.52	1.13	26	27	28	29	22	24	27	29
An-148-200E	52910	24000					12	13	14	15	11	11	12	15
Antonov	96670	43850	43.25	164	11.52	1.13	26	27	28	29	23	24	27	29
An-158	52910	24000					13	13	14	15	11	11	13	15
Antonov	1433000	650000	46.1	178	12.54	1.23	46	61	92	132	51	59	77	110
An-225	595200	270000					16	17	20	27	15	16	19	27
ATR 42	36861	16720	46.2	109	7.66	0.75	9	10	10	11	8	9	10	11
Basic Tires	22675	10285					5	5	6	6	4	5	5	6
ATR 42	36861	16720	46.2	75	5.27	0.52	8	9	9	10	6	8	9	11
Low Pressure Tires	22758	10323					4	5	6	6	3	4	5	6

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ATR 72	47466	21530	47.8	114	8.01	0.79	13	13	14	15	11	12	14	15
Basic Tires	26896	12200					6	7	7	8	5	6	7	8
Avro RJ70[2]	84500	38329	46.0	119	8.17	0.82	18.9	20.5	22.0	23.3	17.1	18.7	21.2	24.8
Standard Tires	49500	22453					10.0	10.9	11.8	12.6	9.3	10.1	10.9	12.9
Avro RJ70[2]	84500	38329	46.0	81	5.59	0.56	16.4	18.3	20.1	21.6	14.3	17.5	20.2	24.4
Low Pressure Tires	49500	22453					8.6	9.7	10.7	11.6	7.5	9.0	10.4	12.7
Avro RJ70[2]	84500	38329	46.0	76	5.23	0.52	15.9	18.0	19.8	21.3	13.7	16.8	20.1	24.4
Low Pressure Tires	49500	22453					8.4	9.5	10.5	11.4	7.1	8.9	10.3	12.6
Avro RJ85[2]	93500	42411	47.1	135	9.32	0.93	22.7	24.4	26.0	27.3	20.6	21.9	24.9	28.5
Standard Tires	51300	23269					11.2	12.1	13.0	13.8	10.3	10.9	11.9	13.9

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Avro RJ85 [2]	93500	42411	47.1	99	6.81	0.68	20.4	22.4	24.2	25.7	18.2	21.5	23.8	28.2
Low Pressure Tires	51300	23269					10.0	11.0	12.0	12.9	8.9	10.4	11.4	13.8
Avro RJ100 [2]	98000	44452	47.2	143	9.89	0.99	24.7	26.5	28.1	29.4	22.5	23.6	26.8	30.4
Standard Tires	53700	24358					12.2	13.1	14.0	14.8	11.1	11.6	12.7	14.8
Avro RJ100 [2]	98000	44452	47.2	108	7.42	0.74	22.5	24.5	26.4	27.9	20.4	23.0	26.1	30.2
Low Pressure Tires	53700	24358					11.0	12.0	13.0	13.9	10.0	11.4	12.2	14.7
BAe ATP	50550	22929	46.5	86	6.02	0.59	8.8	10.7	12.5	14.7	10.5	11.6	12.5	13.4
	32000	14515					4.9	5.9	6.7	8.1	5.9	6.5	7.1	7.7
BAe 1-11	87500	39600	47.5	135	9.48	0.93	25	26	28	29	22	24	27	29
Series 400	49600	22498					13	13	14	15	11	12	13	15

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
BAe 1-11 Series 475	98500	44679	47.5	83	5.81	0.57	22	25	27	28	19	24	28	31
	51700	23451					10	11	12	13	9	10	12	15
BAe 1-11 Series 500	105500	47400	47.5	157	11.01	1.08	32	34	35	36	29	30	33	35
	54580	24757					15	16	16	17	13	13	15	17
BAe 125-400	23370	10600	45.5	112	7.85	0.77	6	6	7	7	5	5	6	7
	12529	5683					3	3	3	3	2	3	3	3
BAe 125-600	25000	11340	45.5	120	8.64	0.83	7	7	7	8	5	6	7	8
	12529	5683					3	3	3	3	2	3	3	3
BAe 125-800 Low Pressure Tires	25500	11567		92	6.48	0.63	5.2	6.2	7.0	7.9	6.3	6.8	7.1	7.4
	15500	7031					1.6	2.7	3.6	4.2	3.0	3.4	3.7	3.9
BAe 125-800 Standard Tires	27400	12428		130	9.15	0.90	6.4	6.9	7.9	8.6	7.5	8.1	8.4	8.7
	15500	7031					2.4	2.9	3.5	4.3	3.3	3.6	3.8	4.2

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
BAe 146-100[3] Standard Tires	84500	38329	46.0	117	8.23	0.81	16.8	18.3	20.7	24.4	18.8	20.4	21.9	23.1
	49500	22453					9.2	10.0	10.9	12.8	10.1	11.1	12.0	12.7
BAe 146-100[3] Low Pressure Tires	84500	38329	46.0	77	5.41	0.53	13.8	16.7	19.6	23.7	15.9	17.8	19.7	21.2
	49500	22453					7.4	8.9	10.2	12.6	8.7	9.6	10.7	11.6
BAe 146-200[3] Standard Tires	93500	42411	47.1	133	9.35	0.92	20.4	21.7	24.6	28.4	23.1	24.9	26.4	27.7
	51300	23269					10.1	10.7	11.7	13.6	11.5	12.3	13.2	13.9

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
BAe 146-200[3] Low Pressure Tires	93500 51300	42411 23269	47.1	95	6.68	0.66	18.0 8.7	21.0 10.1	23.8 11.1	28.0 13.5	20.3 9.9	22.3 11.0	24.1 11.9	25.7 12.8
BAe 146-300[3] Standard Tires	95500 53700	43318 24358	47.2	137	9.64	0.95	21.1 10.8	22.4 11.4	25.3 12.4	29.2 14.5	24.0 12.2	25.8 13.2	27.3 14.0	28.7 14.8
BAe 146-300[3] Low Pressure Tires	95500 53700	43318 24358	47.2	99	6.96	0.68	19.0 9.5	21.8 10.9	24.6 11.9	28.8 14.4	21.2 10.7	23.2 11.8	25.0 12.8	26.6 13.7
BAe 748	46500 26859	21092 12183	43.6	86	6.02	0.59	10 5	11 5	11 6	12 6	8 4	9 5	11 6	13 7

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B707-320C (Freighter)	336000 135500	152407 61462	46.7	180	12.66	1.24	41 13	49 14	58 17	66 19	41 13	46 14	55 16	71 20
B707-320C (Convertible)	336000 155100	152407 70352	46.7	180	12.66	1.24	41 15	49 17	58 20	66 23	41 16	46 16	55 18	71 24
B707-320/420	316000 142600	143335 64682	46.1	180	12.66	1.24	37 14	44 15	52 18	59 21	37 14	41 15	50 16	64 21
B717-200	122000 68500	55338 31071	47.2	164	11.53	1.13	35 17	37 19	38 20	40 20	31 16	33 16	37 18	40 21
B720B	235000 115000	106594 52163	46.4	145	10.19	1.00	25 10	31 12	37 14	43 16	27 11	29 11	36 13	47 17

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B727-100	170000	77111	47.6	165	11.6	1.14	46	49	51	53	42	43	49	54
	87700	39780					21	22	24	25	19	20	22	25
B727-200 (Standard)	173000	78471	48.5	165	11.6	1.14	48	51	53	56	43	45	51	57
	97700	44316					24	26	27	29	22	23	25	29
B727-200 (Basic)	185800	84277	48.0	148	10.41	1.02	50	53	56	59	46	48	55	60
	97600	44271					23	25	26	28	21	22	25	29
B727-200 (Advanced)	210000	95254	46.5	173	12.16	1.19	58	61	64	67	52	55	62	67
	100700	45677					24	26	27	29	22	23	25	29
B737-100 (Option 1)	97800	44361	46.2	138	9.7	0.95	23	24	26	27	21	22	25	29
	58600	26581					12	13	14	15	12	12	13	15
B737-100 (Option 2)	111000	50349	45.9	157	11.04	1.08	27	29	31	32	25	26	29	33
	62000	28123					14	15	16	17	13	13	14	16

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B737-200 (Advanced)	117500 64500	53297 29257	46.4	166	11.67	1.14	30 15	32 16	34 17	35 18	27 14	28 14	32 15	36 17
B737-200 (Advanced) (Low Pressure Tires)	117500 64500	53297 29257	46.4	96	6.75	0.66	25 12	27 13	30 15	32 16	22 11	27 13	30 14	35 17
B737-200/200C/200QC (Advanced)	128600 65700	58332 29801	46.0	182	12.8	1.25	34 15	36 16	38 17	39 18	30 14	31 14	35 15	39 18
B737-300 (Low Pressure Tires)	139000 72600	63049 32931	45.8	169	11.88	1.17	36 17	39 18	41 19	42 20	33 16	34 16	38 17	43 20
B737-300	140000 72600	63503 32931	45.4	201	14.13	1.39	38 18	40 19	42 20	44 21	33 16	35 16	39 17	43 20

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B737-400	144000	65317	47.0	211	14.83	1.45	41	43	45	46	35	37	41	45
(Option 1)	74200	33657					19	20	21	22	16	17	18	21
B737-400	150500	68266	46.9	185	13.01	1.28	42	45	47	48	37	39	44	48
(Option 2)	74200	33657					18	19	21	21	16	17	18	21
B737-500	136500	61915	46.1	196	13.78	1.35	37	39	41	43	33	34	38	42
	69100	31343					17	18	19	20	15	15	16	19
B737-600	146000	66224	45.3	182	12.8	1.25	37	39	41	43	33	34	38	43
	80200	36378					18	19	21	22	17	17	18	21
B737-700	155000	70307	45.8	197	13.85	1.36	41	43	46	47	36	38	42	47
	83000	37648					20	21	22	23	18	18	19	22
B737-700C	171500	77791	45.8	196	13.78	1.35	46	49	51	53	41	43	48	53
	83000	37648					20	21	22	23	18	18	19	22

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B737-800	174900	79333	46.6	205	14.38	1.41	49	52	54	56	43	45	50	55
	91300	41413					23	24	25	27	20	21	22	26
B737-900	174700	79243	46.7	205	14.38	1.41	49	52	54	56	43	45	50	55
	94600	42910					24	25	27	28	21	22	23	27
B737-900ER	188200	85366	47.2	220	15.50	1.52	56	58	61	63	48	51	56	61
	98500	44679					26	27	29	30	23	23	25	29
B737 MAX 7	177500	80513	46.7	205	14.38	1.41	50	53	55	57	44	46	51	56
	138700[4]	62913[4]					37	39	41	43	33	34	37	43
B737 MAX 8	181700	82417	46.7	210	14.76	1.45	52	54	57	59	45	48	53	58
	105535	47870					27	28	30	31	24	25	27	31
B737 MAX 200	181700	82417	46.7	210	14.76	1.45	52	54	57	59	45	48	53	58
	145400[4]	65952[4]					40	42	44	45	35	36	40	45

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B737 MAX 9	195200 95000[5]	88541 43091[5]	47.1	230	16.21	1.59	59 25	61 26	64 28	65 29	50 22	53 22	58 24	63 27
B737 BBJ	171500 93000	77791 42184	45.8	196	13.78	1.35	46 22	49 24	51 25	53 26	41 20	43 20	48 22	53 26
B737 BBJ2	174700 94600	79243 42910	46.7	205	14.38	1.41	49 24	52 25	54 27	56 28	43 21	45 22	50 23	55 27
B737 BBJ3	188200 98500	85366 44679	47.2	220	15.50	1.52	56 26	58 27	61 29	63 30	48 23	51 23	56 25	61 29
B747-100B SR	603000 359200	273516 162930	24.1	162	11.39	1.12	30 17	36 19	44 22	52 26	33 18	36 19	43 21	59 27

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B747-100B	753000 379000	341555 171912	23.1	192	13.5	1.32	42 18	49 20	59 23	68 27	43 19	47 20	57 22	76 28
B747 SP	703000 326300	318875 148007	21.9	205	14.38	1.41	38 15	45 16	53 19	61 22	38 15	42 16	49 17	67 21
B747-200B	836000 376100	379203 170596	22.7	190	13.36	1.31	47 18	56 19	67 22	77 26	48 18	53 19	65 21	86 27
B747-200C (All Passengers)	803000 390800	364235 177264	23.3	205	14.38	1.41	47 19	56 21	66 25	76 29	47 20	52 21	63 23	84 29

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B747-200C (Freighter)	836000 393900	379203 178670	22.7	190	13.36	1.31	47 19	56 21	67 24	77 28	48 19	53 20	65 22	86 29
B747-200F (Freighter)	836000 345300	379203 156671	22.7	190	13.36	1.31	47 16	56 18	67 20	77 23	48 16	53 17	65 19	86 23
B747-300 Comb	836000 385500	379203 174860	22.7	190	13.36	1.31	47 18	56 20	67 23	77 27	48 19	53 19	65 22	86 28
B747-400	878200 407000	398345 184612	23.3	200	14.06	1.38	53 20	63 22	75 26	85 30	53 21	59 22	73 24	94 31

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B747-400 Comb	877000 403400	397801 182979	23.3	228	16.03	1.57	56 21	66 23	77 27	87 31	54 21	60 22	73 24	94 31
B747-400F (Freighter)	877000 364000	397801 165108	23.3	200	14.06	1.38	53 18	63 19	75 23	85 26	53 18	59 19	73 21	94 26
B747-400ER	913000 406900	414130 184567	23.4	228	16.03	1.57	59 21	70 24	82 27	92 31	57 21	63 22	78 24	100 31
B747-400ERF (Freighter)	913000 362400	414130 164382	23.4	228	16.03	1.57	59 19	70 20	82 23	93 27	57 18	63 19	78 21	100 26

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B747-8	990000 485300	449060 220130	23.7	221	15.50	1.52	65 26	77 29	91 34	103 39	63 26	71 27	89 31	112 41
B747-8F	990000 434600	449060 197130	23.6	221	15.50	1.52	65 23	77 25	90 29	102 34	63 23	71 24	88 26	111 35
B757-200	256000 137000	116120 62142	45.6	183	12.87	1.26	31 14	37 16	43 18	49 21	30 14	33 14	40 16	53 22
B757-200PF	256000 114000	116120 51710	45.6	183	12.87	1.26	31 11	37 12	43 14	49 17	30 11	33 12	40 13	53 16

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B757-300	273500 142000	124058 64410	46.4	200	14.06	1.38	36 15	42 17	49 20	56 23	33 15	37 16	46 18	59 23
B767-200	361000 181500	163747 82327	45.8	190	13.36	1.31	39 17	46 19	55 22	64 25	40 18	44 18	52 20	72 26
B767-200ER	396000 181700	179623 82418	45.4	190	13.36	1.31	43 17	52 19	62 21	71 25	45 17	50 18	60 20	80 25
B767-300	345000 190000	156489 86183	47.5	200	14.06	1.38	40 19	46 21	56 24	64 28	40 19	45 20	53 23	71 29
B767-300	361000 190000	163747 86183	47.5	200	14.06	1.38	42 19	49 21	59 24	68 28	42 19	47 20	56 23	75 29

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B767-300ER	413000 198500	187334 90038	46.2	200	14.06	1.38	48 19	57 22	68 25	78 29	49 20	54 21	66 23	88 30
B767-300F (Freighter)	413000 189000	187334 85729	46.1	200	14.06	1.38	48 18	57 20	68 23	78 27	49 19	54 20	66 22	87 28
B767-400ER	451000 228000	204570 103419	47.0	213	14.98	1.47	58 24	69 27	81 32	92 37	57 24	63 25	79 29	100 39
B777-200	547000 302170	248120 137060	46.8	182	12.85	1.26	38 21	47 21	61 25	77 31	39 18	44 20	53 23	75 30

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m³	Medium K = 80 MN/m³	Low K = 40 MN/m³	Ultra-low K = 20 MN/m³	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm²	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B777-200ER	632500 313500	286897 142200	45.9	205	14.38	1.41	48 22	60 22	78 26	96 33	48 19	53 20	65 23	90 30
B777-200ER	656000 313500	297557 142200	45.9	205	14.38	1.41	50 22	63 22	82 26	101 33	49 19	56 20	68 23	95 30
B777-200ER	658000 313500	298460 142200	45.9	205	14.38	1.41	50 22	63 22	82 26	101 33	49 19	56 20	68 23	95 30
B777-200LR	768000 320000	348358 145150	45.9	218	15.33	1.50	64 23	82 23	105 27	127 34	62 20	69 21	87 24	117 31

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B777-300	662000 350870	300278 159150	47.4	215	15.09	1.48	54 26	68 27	88 33	108 41	53 23	59 25	72 28	100 38
B777-300ER	777000 370000	352441 167829	46.2	221	15.50	1.52	66 27	85 28	109 34	131 43	64 24	71 25	89 29	120 40
B777-9	777000 350000	352442 158757	47.15	229	16.11	1.58	69 24	90 27	114 33	137 41	66 23	74 24	92 28	124 37
B777F (Freighter)	768800 318000	348722 144242	45.8	221	15.50	1.52	65 23	82 23	105 27	127 34	62 19	69 21	87 23	117 31

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B787-8	503500 250000[5]	228383 113398[5]	45.6	228	16.01	1.57	61 26	71 28	84 32	96 37	60 25	66 27	81 30	106 39
B787-9	561500 250000[5]	254692 113398[5]	46.2	226	15.91	1.56	65 25	76 27	90 30	104 35	66 25	73 26	88 28	118 35
B787-10	561500 250000[5]	254692 113398[5]	46.6	226	15.91	1.56	66 26	77 27	91 31	105 35	67 25	74 26	89 29	119 36
Canadair CL 44	211000 89000	95708 40370	47.5	162	11.42	1.12	25 9	30 10	35 11	40 13	27 9	30 10	36 11	47 14

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CRJ-100	51251	23247	46.6	168	11.36	1.16	14.2	15.0	15.7	16.2	12.5	13.2	14.9	16.2
	30100	13653					8.1	8.5	8.9	9.3	6.9	7.1	7.9	9.1
CRJ-700	75250	34132	47.5	153	10.76	1.05	19.5	20.8	21.9	22.9	17.18	18.13	20.5	23.17
	42990	19500					11	11	12	13	9	10	11	12
CRJ-900ER	82500	37421		162	11.42	1.12	22.7	23.7	24.9	25.9	19.7	20.6	23.4	26.0
	48160	21845					12	13	14	14	11	11	12	14
CRJ-900LR	85000	38555		162	11.42	1.12	22.8	23.8	25.0	26.0	19.9	20.7	23.5	26.2
	48160	21845					12	13	14	14	11	11	12	14
CRJ-1000ER	92300	41867		199	13.99	1.37	25.2	26.6	27.8	28.8	21.7	22.6	25.1	28.4
	51100	23179					12	13	14	14	11	11	12	14
DC-8-63	358000	162386	48.1	196	13.78	1.35	48	60	70	78	48	55	66	81
	158800	72030					17	20	23	26	17	18	21	27

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DC-10-10/-10 CF	458000 245000	207745 111130	46.7	195	13.71	1.34	48 23	56 25	68 29	79 34	52 24	56 25	66 28	91 35
DC-10-30/-40 /-30CF/-40CF	583000 236500	264444 107275	37.5	177	12.44	1.22	47 17	56 18	68 20	80 24	52 18	57 18	68 20	94 24
MD-11ER	633000 291200	287124 132086	38.8	206	14.48	1.42	59 24	70 26	83 29	96 34	62 24	68 25	82 28	110 35
MD-83	161000 79700	73028 36151	47.4	195	13.71	1.34	49 21	51 22	53 24	55 24	42 18	46 19	50 21	53 24

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
MD-87	141000	63957	47.4	170	11.95	1.17	40	42	44	46	36	38	42	46
	73300	33248					18	20	21	22	17	17	19	22
MD-90-30ER	168500	76430	47.0	193	13.57	1.33	51	54	56	57	44	48	52	55
	89100	40415					24	25	26	28	21	22	24	27
DASH7	43800	19867	46.75	107	7.55	0.74	11	12	13	13	10	11	12	14
	26000	11793					6	6	7	7	5	6	6	8
DASH8 Series 100 Standard Tires	34700	15740	47.1	131	9.21	0.90	9	9	10	10	8	8	9	11
	22000	9979					5	5	6	6	4	5	5	6
DASH8 Series 100 Optional Tires	34700	15740	47.1	77	5.41	0.53	8	8	9	10	6	7	9	10
	22000	9979					4	5	5	6	3	4	5	6

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DASH8 Series 400 Standard Tires	64700 37886	29347 17185		227	15.95	1.56	19 9	20 10	21 10	21 11	16 8	17 8	18 9	20 10
DASH8 Series 400 Optional Tires	64700 37886	29347 17185		141	9.91	0.97	18 8	18 9	19 10	20 10	15 7	16 8	19 9	20 10
Dornier 228-101/201	13250 8224	6010 3730	44.2	70	4.9	0.48	3.8 2.4	4.0 2.5	4.1 2.6	4.2 2.6	3.1 1.9	3.8 2.4	4.6 2.8	4.9 3.0
Dornier 228-202	13734 8354	6230 3789	45.1	74	5.1	0.50	4.1 2.5	4.3 2.6	4.4 2.7	4.5 2.8	3.4 2.1	4.1 2.5	4.9 3.0	5.1 3.1
Dornier 228-212	14175 8398	6430 3809	45.1	75	5.2	0.51	4.3 2.6	4.4 2.7	4.6 2.7	4.7 2.8	3.6 2.1	4.3 2.6	5.1 3.0	5.3 3.1

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Dornier 328-100	30247	13720	46.2	116	8.15	0.80	7.6	8.1	8.5	8.9	6.3	7.0	8.1	9.1
	19423	8810					4.5	4.8	5.1	5.4	3.8	4.1	4.5	5.5
Embraer EMB 120 RT	25529	11580	47.4	115	8.09	0.80	6.4	6.8	7.2	7.5	5.3	5.8	6.6	7.7
	17066	7750					3.9	4.2	4.5	4.7	3.3	3.6	4.0	4.8
Embraer EMB 120 ER	26609	12070	47.4	127	8.93	0.88	6.9	7.3	7.7	8.0	5.8	6.1	7.0	8.0
	17213	7808					4.1	4.4	4.6	4.9	3.4	3.7	4.1	4.8
Embraer ERJ 135 ER	42108	19100	92.42	134	9.42	0.92	10.7	11.3	12.0	13.0	9.2	9.8	11.2	13.0
	25353	11500					5.7	6.0	6.3	7.0	4.8	5.1	5.6	7.0
Embraer ERJ 135 LR	44313	20100	93.42	148	10.41	1.02	11.7	12.3	12.9	14.0	10.0	10.5	12.0	14.0
	25353	11500					5.7	6.1	6.5	7.0	5.0	5.2	5.7	7.0
Embraer ERJ 140 ER	44533	20200	93.7	145	10.19	1.00	11.7	12.4	13.0	14.0	10.0	10.5	12.0	14.0
	26455	12000					6.2	6.5	7.0	7.0	5.1	5.3	6.2	7.0

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Embraer ERJ 140 LR	46738	21200	93.7	148	10.41	1.02	12.6	13.1	13.7	14.0	10.7	11.1	12.6	14.0
	26455	12000					6.3	6.7	7.0	7.0	5.1	5.3	6.2	7.0
Embraer ERJ 145 EP	46495	21090	94.4	142	9.98	0.98	12.5	13.3	13.8	15.0	10.8	11.4	13.1	15.0
	25772	11690					6.2	6.6	7.0	7.0	5.3	5.7	6.2	7.0
Embraer ERJ 145 ER	45635	20700	47.2	139	9.77	0.95	12.2	12.9	13.6	14.0	10.5	11.1	12.7	14.0
	25573	11600					6.1	6.5	6.9	7.0	5.3	5.6	6.1	7.0
Embraer ERJ 145 EU	44291	20090	94.4	139	9.77	0.95	11.8	12.5	13.1	14.0	10.2	10.7	12.3	13.0
	25772	11690					6.1	6.5	6.9	7.0	5.3	5.6	6.1	7.0
Embraer ERJ 145 LR/LU	48722	22100	93.8	150	10.55	1.03	13.4	14.2	14.8	15.0	11.6	12.2	13.8	16.0
	27227	12350					6.7	7.0	7.5	8.0	3.5	3.7	4.0	5.0
Embraer ERJ 145 MK	44291	20090	93.8	150	10.55	1.03	10.2	10.7	12.2	14.0	10.2	10.7	12.2	14.0
	29321	13300					5.7	5.9	6.6	8.0	5.7	5.9	6.5	8.0

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Embraer ERJ 145 MP	46495	21090	93.8	147	10.34	1.01	12.1	12.8	13.5	14.0	10.5	11.1	12.6	14.0
	28219	12800					6.3	6.7	7.2	8.0	5.4	5.7	6.3	7.0
Embraer ERJ 145 XR	53131	24100	93.47	175	12.30	1.21	15.0	15.7	16.4	17.0	12.8	13.2	15.1	17.0
	28219	12800					7.1	7.6	7.9	8.0	6.1	6.2	6.9	8.0
Embraer E 170 AR	85451	38760	45.55	136	9.56	0.94	19.7	21.2	22.6	24.0	17.8	18.8	21.3	25.0
	48061	21800	44.47				9.7	10.5	11.2	12.0	8.9	9.4	10.2	12.0
Embraer E 170 LR	82365	37360	45.8	131	9.21	0.90	18.7	20.2	21.6	23.0	17.1	18.0	20.4	24.0
	48061	21800	42.75				9.2	9.9	10.7	11.0	8.4	8.9	9.7	11.0
Embraer E 170 STD	79697	36150	45.8	131	9.21	0.90	18.0	19.4	20.8	22.0	16.5	17.3	19.5	23.0
	48061	21800	42.75				9.2	9.9	10.7	11.0	8.4	8.9	9.7	11.0
Embraer E 175 AR	89353	40530	46.01	141	9.91	0.97	21.2	22.8	24.3	26.0	19.3	20.2	22.8	26.0
	49604	22500	43.21				9.9	10.6	11.4	12.0	9.1	9.4	10.3	12.0

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Embraer E 175 LR	85870	38950	45.8	136	9.56	0.94	19.9	21.5	22.9	24.0	18.0	19.1	21.6	25.0
	49604	22500	43.25				9.8	10.5	11.3	12.0	9.0	9.4	10.3	12.0
Embraer E 175 STD	83026	37660	45.94	136	9.56	0.94	19.2	20.7	22.0	23.0	17.3	18.4	20.7	24.0
	49604	22500	43.25				9.8	10.5	11.3	12.0	9.0	9.4	10.3	12.0
Embraer E 175 E2	98767	44800	45.37	150	10.55	1.03	23.2	25.0	26.6	28.0	21.3	22.1	24.9	29.0
	57761	26200	44.99				12.3	13.2	14.1	15.0	11.4	11.7	12.8	15.0
Embraer E 190 AR	114552	51960	46.1	151	10.62	1.04	26.4	28.4	30.3	32.0	24.5	25.4	28.2	33.0
	65036	29500	44.9				13.2	14.2	15.3	16.0	12.3	12.5	13.6	15.0
Embraer E 190 LR	111245	50460	46.2	151	10.62	1.04	25.5	27.5	29.4	31.0	23.7	24.6	27.2	32.0
	65036	29500	44.9				13.2	14.2	15.3	16.0	12.3	12.5	13.6	15.0
Embraer E 190 STD	105712	47950	46.3	151	10.62	1.04	24.1	26.0	27.7	29.0	22.4	23.1	25.5	30.0
	65037	29500	44.9				13.2	14.2	15.3	16.0	12.3	12.5	13.6	15.0

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Embraer E 190 E2	124782	56600		152	10.69	1.05	29.2	31.4	33.5	35.0	27.1	28.1	31.4	37.0
	72091	32700					15.0	16.1	17.3	18.0	14.3	14.6	15.8	18.0
Embraer E 195 AR	115632	52450	46.8	154	10.83	1.06	27.4	29.4	31.4	33.0	25.3	26.2	29.2	34.0
	65037	29500	45.2				13.4	14.4	15.4	16.0	12.7	13.0	14.0	16.0
Embraer E 195 LR	112326	50950	46.8	154	10.83	1.06	26.5	28.4	30.3	32.0	24.5	25.4	28.2	33.0
	65037	29500	45.2				13.4	14.4	15.4	16.0	12.7	13.0	14.0	16.0
Embraer E 195 E2	136025	61700	46.45	170	11.95	1.17	34.0	36.3	38.4	40.0	31.1	32.0	35.8	41.0
	76500	34700	46.0				17.1	18.3	19.4	21.0	16.1	16.1	17.5	20.0
Embraer ERJ 195 STD	107916	48950	46.8	154	10.82	1.06	25.2	27.1	28.9	31.0	23.4	24.2	26.8	31.0
	65037	29500	45.2				13.4	14.4	15.4	16.0	12.7	13.0	14.0	16.0

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Fokker 27 Standard Mk 200/400/500/600	45000	20412	47.35	80	5.62	0.55	10	11	12	13	8	10	12	14
	25000	11340					5	5	6	6	4	5	6	7
Fokker 27 RFV Mk 200/400/500/600	45000	20412	47.3	58	4.08	0.40	8	9	10	11	6	8	11	13
	25000	11340					4	5	5	6	3	4	5	6
Fokker 28 Mk 1000 High Tire Pressure	66500	30164	46.4	100	7.03	0.69	15	16	17	18	12	15	17	20
	35000	15876					7	8	8	9	6	7	8	10
Fokker 28 Mk 1000 Low Tire Pressure	66500	30164	46.4	70	4.92	0.48	13	14	16	17	10	13	16	19
	33500	15876					6	7	7	8	5	6	7	9

ACN TABLES

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							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Fokker 28	65000	29484	46.9	102	7.17	0.70	15	17	17	19	13	15	18	20
Mk 2000 High Tire Pressure	35000	15876					7	7	8	9	6	7	8	9
Fokker 28	65000	29484	46.9	71	5.00	0.49	13	15	16	17	10	13	17	20
Mk 2000 Low Tire Pressure	35000	15876					6	7	8	8	5	6	7	9
Fokker 28	73000	33113	46.5	101	7.10	0.70	17	18	19	20	14	17	19	22
Mk 3000/4000 High Tire Pressure	38000	17240					8	8	9	10	7	8	9	10
Fokker 28	73000	33113	46.5	78	5.48	0.54	15	17	18	19	13	16	19	22
Mk 3000/4000 Low Tire Pressure	38000	17240					7	8	8	9	6	7	8	10

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Fokker 50	45900	20820	47.8	{85	5.98	0.59}	10	11	12	13	8	10	12	14
High Tire Pressure	27886	12649		80	5.62	0.55	6	6	7	7	5	5	6	8
Fokker 50	45900	20820	47.8	60	4.22	0.41	9	10	11	12	6	9	11	14
Low Tire Pressure	27886	12649					5	5	6	7	4	5	6	8
Fokker 100	98500	44680	47.8	142	9.98	0.98	28	29	31	32	25	27	30	32
	53736	24375					13	14	15	16	12	13	14	16
Lockheed	155800	70670	24.1	105	7.38	0.72	30	33	36	38	27	31	33	38
L-100-20	75409	34205					14	15	16	17	12	14	15	16
Lockheed	155800	70670	24.2	105	7.38	0.72	30	33	36	38	27	31	33	39
L-100-30	76502	34701					14	15	16	17	12	14	15	17

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm²	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Lockheed L-1011-1	432000 240000	195952 108862	47.4	193	13.56	1.33	45 24	52 25	62 28	73 33	52 25	56 27	66 29	91 38
Lockheed L-1011-100/200	468000 244682	212281 110986	46.8	175	12.34	1.21	46 23	55 24	66 28	78 32	56 25	61 26	73 30	100 38
Lockheed L-1011-500	498000 240136	225889 108924	46.2	184	12.95	1.27	50 23	59 24	72 27	84 31	60 25	65 26	79 28	107 36
YS-11A	51800 34170	23500 15500	45.11	77	5.40	0.53	9 5	10 5	11 6	12 6	8 6	10 7	11 8	13 9

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm²	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ilyushin IL-18	142197 73854	64500 33500	47.0	133	9.38	0.92	16 7	20 8	24 10	27 11	18 8	19 8	24 9	31 13
Ilyushin IL-62M	370373 157408	168000 71400	47.0	157	11.01	1.08	43 16	52 17	62 19	71 22	50 17	57 18	67 20	83 26
Ilyushin IL-62	358468 146387	162600 66400	47.0	157	11.01	1.08	42 14	50 15	60 18	69 20	47 16	54 16	64 18	79 24
Ilyushin IL-76T	376986 184745	171000 83800	23.5	86	6.02	0.59	29 10	29 13	32 13	33 14	24 9	27 10	34 12	45 16
Ilyushin IL-76TD	421078 192241	191000 87200	23.5	100	7.03	0.69	35 12	35 14	36 15	40 16	29 10	32 11	40 13	53 17

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ilyushin IL-86	477295	216500	31.2	135	9.48	0.93	26	31	38	45	34	36	44	61
	244094	110700					14	15	17	20	16	17	19	23
Ilyushin IL-96	509355	231000	31.7	157	11.00	1.08	35	43	52	61	42	46	57	76
	245858	111500					15	16	19	23	17	18	20	26
Ilyushin IL-114	50164	22750	47.5	86	6.02	0.59	11	12	13	14	9	11	13	15
	31973	14500					6	7	8	8	5	6	7	9
Saab 340B	28800	13065	46.5	115	8.09	0.79	7.4	7.9	8.3	8.6	6.1	6.8	7.8	9.0
	17715	8035					4.6	4.8	5.1	5.3	3.8	4.2	4.8	5.5
Saab 2000	50706	23000	47.5	165	11.62	1.14	14.5	15.2	15.8	16.2	12.5	13.1	14.8	16.2
	30203	13700					7.8	8.2	8.7	9.1	6.8	7.1	7.8	9.0

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sukhoi SSJ 100-95	101413	46000		161	11.32	1.11	27.0	28.6	30.1	31.3	23.8	24.8	28.0	31.5
	60627	27500					13.5	14.5	15.4	16.2	12.2	12.5	13.7	16.0
Sukhoi SSJ 100-75	88185	40000		161	11.32	1.11	22.1	23.5	24.8	26.0	19.8	20.4	22.9	26.3
	60627	27500					13.5	14.5	15.4	16.2	12.2	12.5	13.7	16.0
Tupolev TU-134A	104940	47600	45.6	120	8.50	0.83	11	13	16	19	12	13	16	21
	64705	29350					7	8	9	10	7	8	9	12
Tupolev TU-154B	216050	98000	45.1	135	9.50	0.93	19	25	32	38	20	24	30	38
	117946	53500					8	10	13	17	10	11	13	18
Tupolev TU-204	206130	93500	45.4	199	13.97	1.37	23	27	32	37	25	28	33	43
	121187	54970					12	14	16	18	13	14	15	20
Yakovlev YAK-40	35274	16000	44.0	56	3.97	0.39	9	9	10	10	7	9	11	13
	21385	9700					6	6	6	6	4	5	7	8

ACN TABLES

Aircraft Type	All-up Mass[1] (Maximum Apron Mass) (Operating Mass Empty)		Load on one main gear leg (%)	Standard Aircraft Tire Pressure			ACN relative to							
							Rigid Pavement Subgrades				Flexible Pavement Subgrades			
							High K = 150 MN/m^3	Medium K = 80 MN/m^3	Low K = 40 MN/m^3	Ultra-low K = 20 MN/m^3	High CBR = 15%	Medium CBR = 10%	Low CBR = 6%	Very low CBR = 3%
	lbs	kgs		psi	kg/cm^2	mPa	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Yakovlev YAK-42	124560	56500	47.0	127	8.97	0.88	13	16	20	23	15	16	20	26
	70106	31800					6	7	9	10	7	8	9	11

[1] The two all-up masses shown in columns 2 and 3 for each aircraft type are respectively the Maximum Apron (ramp) Mass and a representative Operating Mass Empty. To compute the ACN for any intermediate value, proceed on the assumption that the ACN varies linearly between the Operating Mass Empty and the Maximum Apron Mass.

[2] Values reflect tire speeds up to 160 MPH (257 KMH). Higher tire pressure and higher speeds result in greater ACN.

[3] The tire pressure used are for tires with a maximum allowable ground speed of 160 MPH (257 KMH). Tires available for ground speeds over 160 MPH (257 KHM) require tire pressure about 10.5% higher for standard tires and 17% higher for low pressure tires.

[4] Maximim Zero Fuel Weight. Operating Mass Empty not defined yet.

[5] Minimum weight used solely as a baseline for ACN curve generation. Operating Mass Empty not defined yet.

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Terminal Procedures - General Information

VERTICAL DESCENT PLANNING

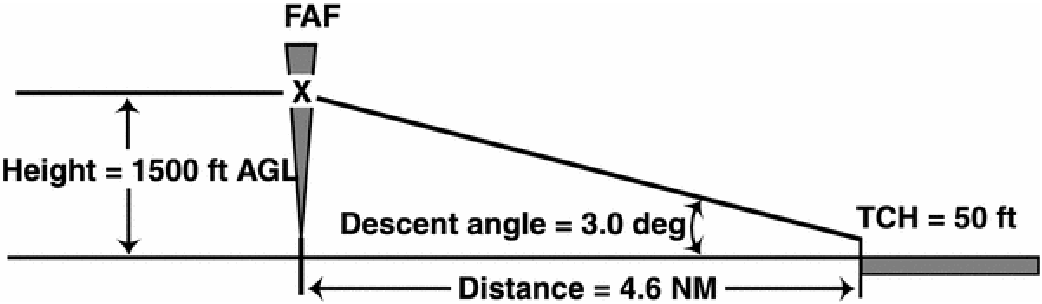
Vertical descent planning is a key component of the Constant Descent Final Approach (CDFA) concept. When not otherwise included on an instrument approach chart, this reference table provides a method to easily determine a vertical descent angle with respect to a defined Height at the FAF (**Above Ground Level – AGL**) and the Distance to the Runway Threshold (**Nautical Miles – NM**). The table includes a range of angles between 2.5 and 3.8 degrees.

To determine a vertical descent angle based upon a pre-defined combination of FAF Height (AGL) and Distance to Runway Threshold, match the FAF height (AGL) value in the left column to the corresponding Distance to Runway Threshold value in the top row. The value shown in the box where the two lines cross represents the vertical descent angle (**in Degrees**).

FAF Height (AGL)	DISTANCE FAF TO RUNWAY THRESHOLD (NM)																
	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0	5.2	5.4	5.6	5.8	6.0
900	2.9	2.7	2.5														
950	3.0	2.8	2.7	2.5													
1000	3.2	3.0	2.8	2.6	2.5												
1050	3.4	3.1	2.9	2.8	2.6	2.5											
1100	3.5	3.3	3.1	2.9	2.8	2.6	2.5										
1150	3.8	3.4	3.2	3.0	2.9	2.7	2.6	2.6									
1200		3.6	3.4	3.2	3.0	2.9	2.7	2.6	2.5								
1250			3.5	3.3	3.1	3.0	2.8	2.7	2.6	2.5							
1300				3.5	3.3	3.1	2.9	2.8	2.7	2.6	2.5						
1350				3.7	3.4	3.2	3.1	2.9	2.8	2.7	2.6	2.5					
1400					3.5	3.3	3.2	3.0	2.9	2.8	2.7	2.6	2.5				
1450					3.7	3.5	3.3	3.1	3.0	2.9	2.7	2.6	2.5	2.5			
1500						3.6	3.4	3.3	3.1	3.0	2.8	2.7	2.6	2.5	2.5		
1550							3.5	3.4	3.2	3.1	2.9	2.8	2.7	2.6	2.5	2.5	
1600							3.7	3.5	3.3	3.2	3.0	2.9	2.8	2.7	2.6	2.5	2.5
1650								3.6	3.4	3.3	3.1	3.0	2.9	2.8	2.7	2.6	2.5
1700								3.7	3.5	3.4	3.2	3.1	3.0	2.9	2.8	2.7	2.6
1750									3.6	3.5	3.3	3.2	3.1	3.0	2.9	2.8	2.7
1800										3.6	3.4	3.3	3.2	3.1	2.9	2.8	2.8
1850										3.7	3.5	3.4	3.3	3.2	3.0	2.9	2.8
1900											3.6	3.5	3.3	3.2	3.1	3.0	2.9
1950											3.8	3.6	3.4	3.3	3.2	3.1	3.0
2000												3.7	3.5	3.4	3.3	3.2	3.1

EXAMPLE:

VERTICAL DESCENT ANGLE REFERENCE TABLE



The table may also be used to determine a Height (AGL) at the FAF that would provide an optimum descent angle of 3.0 degrees. First, determine the Distance FAF to Runway Threshold (NM) in the top row, and then move down the table to the 3.0 degree value. Finally, move to the left to determine the optimum FAF Height (AGL). (Refer to Note 4 below).

IMPORTANT NOTES:

NOTE 1: Angles are predicated on an assumed Threshold Crossing Height (TCH) of 50 feet.

NOTE 2: To determine the FAF Altitude as an Above Mean Sea Level value (AMSL), add the FAF Height (AGL value) and the Touchdown Zone Elevation (TDZE).

NOTE 3: Vertical descent angle information obtained from this table is for REFERENCE USE ONLY.

NOTE 4: ANY USE OF A HIGHER-THAN-PUBLISHED HEIGHT/ALTITUDE AT THE FINAL APPROACH FIX (FAF) IS CONTINGENT UPON PRIOR APPROVAL BY AIR TRAFFIC CONTROL AND/OR CONFORMANCE WITH APPLICABLE OPERATING PROCEDURES.

GRADIENT TO RATE TABLE

GROUNDSPEED IN KNOTS TO FEET PER NAUTICAL MILE

This table provides a rate of climb or descent in feet per minute below the GROUNDSPEED IN KNOTS for the gradient shown in FEET PER NAUTICAL MILE at the left. Table accuracy is within one foot per nautical mile. This table is for use in climbs, descents from altitude and non-precision instrument approach procedures. This table does not consider the earth's curvature as a factor. The earth's curvature is considered when using fixed glide slope (ILS/PAR). Procedures utilizing a fixed glide slope have slightly higher figures to reflect the earth's curvature.

GRADIENT	GROUNDSPEED IN KNOTS											
FEET PER NM	70	75	90	100	120	140	150	160	180	200	250	300
152	177	190	228	253	304	355	380	405	456	507	633	760
160	187	200	240	267	320	373	400	427	480	533	667	800
170	198	213	255	283	340	397	425	453	510	567	708	850
180	210	225	270	300	360	420	450	480	540	600	750	900
190	222	238	285	317	380	443	475	507	570	633	792	950
200	233	250	300	333	400	467	500	533	600	667	833	1000
210	245	263	315	350	420	490	525	560	630	700	875	1050
220	257	275	330	367	440	513	550	587	660	733	917	1100
230	268	288	345	383	460	537	575	613	690	767	958	1150
240	280	300	360	400	480	560	600	640	720	800	1000	1200
250	292	313	375	417	500	583	625	667	750	833	1042	1250
260	303	325	390	433	520	607	650	693	780	867	1083	1300
270	315	338	405	450	540	630	675	720	810	900	1125	1350
280	327	350	420	467	560	653	700	747	840	933	1167	1400
290	338	363	435	483	580	677	725	773	870	967	1208	1450
300	350	375	450	500	600	700	750	800	900	1000	1250	1500
310	362	388	465	517	620	723	775	827	930	1033	1292	1550
320	373	400	480	533	640	747	800	853	960	1067	1333	1600
330	385	413	495	550	660	770	825	880	990	1100	1375	1650
340	397	425	510	567	680	793	850	907	1020	1133	1417	1700
350	408	438	525	583	700	817	875	933	1050	1167	1458	1750
360	420	450	540	600	720	840	900	960	1080	1200	1500	1800
370	432	463	555	617	740	863	925	987	1110	1233	1542	1850

GRADIENT TO RATE TABLE

GRADIENT	GROUNDSPEED IN KNOTS											
FEET PER NM	70	75	90	100	120	140	150	160	180	200	250	300
380	443	475	570	633	760	887	950	1013	1140	1267	1583	1900
390	455	488	585	650	780	910	975	1040	1170	1300	1625	1950
400	467	500	600	667	800	933	1000	1067	1200	1333	1667	2000
410	478	513	615	683	820	957	1025	1093	1230	1367	1708	2050
420	490	525	630	700	840	980	1050	1120	1260	1400	1750	2100
430	502	538	645	717	860	1003	1075	1147	1290	1433	1792	2150
440	513	550	660	733	880	1027	1100	1173	1320	1467	1833	2200
450	525	563	675	750	900	1050	1125	1200	1350	1500	1875	2250
460	537	575	690	767	920	1073	1150	1227	1380	1533	1917	2300
470	548	588	705	783	940	1097	1175	1253	1410	1567	1958	2350
480	560	600	720	800	960	1120	1200	1280	1440	1600	2000	2400
490	572	613	735	817	980	1143	1225	1307	1470	1633	2042	2450
500	583	625	750	833	1000	1167	1250	1333	1500	1667	2083	2500
510	595	638	765	850	1020	1190	1275	1360	1530	1700	2125	2550
520	607	650	780	867	1040	1213	1300	1387	1560	1733	2167	2600
530	618	663	795	883	1060	1237	1325	1413	1590	1767	2208	2650
540	630	675	810	900	1080	1260	1350	1440	1620	1800	2250	2700
550	642	688	825	917	1100	1283	1375	1467	1650	1833	2292	2750
560	653	700	840	933	1120	1307	1400	1493	1680	1867	2333	2800
570	665	713	855	950	1140	1330	1425	1520	1710	1900	2375	2850
580	677	725	870	967	1160	1353	1450	1547	1740	1933	2417	2900
590	688	738	885	983	1180	1377	1475	1573	1770	1967	2458	2950
600	700	750	900	1000	1200	1400	1500	1600	1800	2000	2500	3000
610	712	763	915	1017	1220	1423	1525	1627	1830	2033	2542	3050
620	723	775	930	1033	1240	1447	1550	1653	1860	2067	2583	3100
630	735	788	945	1050	1260	1470	1575	1680	1890	2100	2625	3150
640	747	800	960	1067	1280	1493	1600	1707	1920	2133	2667	3200
650	758	813	975	1083	1300	1517	1625	1733	1950	2167	2708	3250
660	770	825	990	1100	1320	1540	1650	1760	1980	2200	2750	3300

GRADIENT TO RATE TABLE

GRADIENT	GROUNDSPEED IN KNOTS											
FEET PER NM	70	75	90	100	120	140	150	160	180	200	250	300
670	782	838	1005	1117	1340	1563	1675	1787	2010	2233	2792	3350
680	793	850	1020	1133	1360	1587	1700	1813	2040	2267	2833	3400
690	805	863	1035	1150	1380	1610	1725	1840	2070	2300	2875	3450
700	817	875	1050	1167	1400	1633	1750	1867	2100	2333	2917	3500
710	828	888	1065	1183	1420	1657	1775	1893	2130	2367	2958	3550
720	840	900	1080	1200	1440	1680	1800	1920	2160	2400	3000	3600

GROUNDSPEED IN KNOTS TO GRADIENT IN PERCENTAGE

This table provides a rate of climb or descent in feet per minute below the GROUNDSPEED IN KNOTS for the gradient shown in PERCENT (%) at the left. This table is for use in climbs, descents from altitude and non-precision instrument approach procedures. Table accuracy is within four feet per nautical mile. This table does not consider the earth's curvature as a factor. The earth's curvature is considered when using fixed glide slopes (ILS/PAR). Procedures utilizing a fixed glide slope have slightly higher figures to reflect the earth's curvature.

GRADIENT	GROUNDSPEED IN KNOTS											
%	70	75	90	100	120	140	150	160	180	200	250	300
2.5	177	190	228	253	304	354	380	405	456	506	633	760
2.6	184	197	237	263	316	369	395	421	474	527	658	790
2.7	191	205	246	273	328	383	410	437	492	547	684	820
2.8	198	213	255	284	340	397	425	454	510	567	709	851
2.9	206	220	264	294	352	411	441	470	529	587	734	881
3.0	213	228	273	304	365	425	456	486	547	608	760	911
3.1	220	235	283	314	377	440	471	502	565	628	785	942
3.2	227	243	292	324	389	454	486	519	583	648	810	972
3.3	234	251	301	334	401	468	501	535	602	668	835	1003
3.4	241	258	310	344	413	482	516	551	620	689	861	1033
3.5	248	266	319	354	425	496	532	567	638	709	886	1063
3.6	255	273	328	365	437	510	547	583	656	729	911	1094
3.7	262	281	337	375	450	525	562	600	674	749	937	1124
3.8	269	289	346	385	462	539	577	616	693	770	962	1155

GRADIENT TO RATE TABLE

GRADIENT	GROUNDSPEED IN KNOTS										
%	70	75	90	100	120	140	150	160	180	200	250	300
3.9	276	296	355	395	474	553	592	632	711	790	987	1185
4.0	284	304	365	405	486	567	608	648	729	810	1013	1215
4.1	291	311	374	415	498	581	623	664	747	830	1038	1246
4.2	298	319	383	425	510	595	638	681	766	851	1063	1276
4.3	305	327	392	435	523	610	653	697	784	871	1089	1306
4.4	312	334	401	446	535	624	668	713	802	891	1114	1337
4.5	319	342	410	456	547	638	684	729	820	911	1139	1367
4.6	326	349	419	466	559	652	699	745	839	932	1165	1398
4.7	333	357	428	476	571	666	714	762	857	952	1190	1428
4.8	340	365	437	486	583	681	729	778	875	972	1215	1458
4.9	347	372	447	496	595	695	744	794	893	992	1241	1489
5.0	354	380	456	506	608	709	760	810	911	1013	1266	1519
5.1	362	387	465	516	620	723	775	826	930	1033	1291	1549
5.2	369	395	474	527	632	737	790	843	948	1053	1317	1580
5.3	376	403	483	537	644	751	805	859	966	1073	1342	1610
5.4	383	410	492	547	656	766	820	875	984	1094	1367	1641
5.5	390	418	501	557	668	780	835	891	1003	1114	1392	1671
5.6	397	425	510	567	681	794	851	907	1021	1134	1418	1701
5.7	404	433	520	577	693	808	866	924	1039	1155	1443	1732
5.8	411	441	529	587	705	822	881	940	1057	1175	1468	1762
5.9	418	448	538	597	717	836	896	956	1075	1195	1494	1792
6.0	425	456	547	608	729	851	911	972	1094	1215	1519	1823
6.1	432	463	556	618	741	865	927	988	1112	1235	1544	1853
6.2	440	471	565	628	753	879	942	1005	1130	1256	1570	1884
6.3	447	479	574	638	766	893	957	1021	1148	1276	1595	1914
6.4	454	486	583	648	778	907	972	1037	1167	1296	1620	1944
6.5	461	494	592	658	790	922	987	1053	1185	1317	1646	1975
6.6	468	501	602	668	802	936	1003	1069	1203	1337	1671	2005

GRADIENT TO RATE TABLE

GRADIENT	GROUNDSPEED IN KNOTS										
%	70	75	90	100	120	140	150	160	180	200	250	300
6.7	475	509	611	679	814	950	1018	1086	1221	1357	1696	2036
6.8	482	516	620	689	826	964	1033	1102	1240	1377	1722	2066
6.9	489	524	629	699	839	978	1048	1118	1258	1398	1747	2096
7.0	496	532	638	709	851	992	1063	1134	1276	1418	1772	2127
7.1	503	539	647	719	863	1007	1079	1150	1294	1438	1798	2157
7.2	510	547	656	729	875	1021	1094	1167	1312	1458	1823	2187
7.3	517	554	665	739	887	1035	1109	1183	1331	1479	1848	2218
7.4	525	562	674	749	899	1049	1124	1199	1349	1499	1873	2248
7.5	532	570	684	760	911	1063	1139	1215	1367	1519	1899	2279
7.6	539	577	693	770	924	1078	1154	1231	1385	1539	1924	2309
7.7	546	585	702	780	936	1092	1170	1248	1404	1560	1949	2339
7.8	553	592	711	790	948	1106	1185	1264	1422	1580	1975	2370
7.9	560	600	720	800	960	1120	1200	1280	1440	1600	2000	2400
8.0	567	608	729	810	972	1134	1215	1296	1458	1620	2025	2430
8.1	574	615	738	820	984	1148	1230	1312	1477	1641	2051	2461
8.2	581	623	747	830	996	1163	1246	1329	1495	1661	2076	2491
8.3	588	630	756	841	1009	1177	1261	1345	1513	1681	2101	2522
8.4	595	638	766	851	1021	1191	1276	1361	1531	1701	2127	2552
8.5	603	646	775	861	1033	1205	1291	1377	1549	1722	2152	2582
8.6	610	653	784	871	1045	1219	1306	1393	1568	1742	2177	2613
8.7	617	661	793	881	1057	1233	1322	1410	1586	1762	2203	2643
8.8	624	668	802	891	1069	1248	1337	1426	1604	1782	2228	2674
8.9	631	676	811	901	1082	1262	1352	1442	1622	1803	2253	2704
9.0	638	684	820	911	1094	1276	1367	1458	1641	1823	2279	2734
9.1	645	691	829	922	1106	1290	1382	1474	1659	1843	2304	2765
9.2	652	699	839	932	1118	1304	1398	1491	1677	1863	2329	2795
9.3	659	706	848	942	1130	1319	1413	1507	1695	1884	2355	2825
9.4	666	714	857	952	1142	1333	1428	1523	1713	1904	2380	2856

GRADIENT TO RATE TABLE

GRADIENT	GROUNDSPEED IN KNOTS											
%	70	75	90	100	120	140	150	160	180	200	250	300
9.5	673	722	866	962	1154	1347	1443	1539	1732	1924	2405	2886
9.6	681	729	875	972	1167	1361	1458	1556	1750	1944	2430	2917
9.7	688	737	884	982	1179	1375	1473	1572	1768	1965	2456	2947
9.8	695	744	893	992	1191	1389	1489	1588	1786	1985	2481	2977
9.9	702	752	902	1003	1203	1404	1504	1604	1805	2005	2506	3008
10.0	709	760	911	1013	1215	1418	1519	1620	1823	2025	2532	3038
10.1	716	767	921	1023	1227	1432	1534	1637	1841	2046	2557	3068
10.2	723	775	930	1033	1240	1446	1549	1653	1859	2066	2582	3099
10.3	730	782	939	1043	1252	1460	1565	1669	1878	2086	2608	3129
10.4	737	790	948	1053	1264	1474	1580	1685	1896	2106	2633	3160
10.5	744	798	957	1063	1276	1489	1595	1701	1914	2127	2658	3190
10.6	751	805	966	1073	1288	1503	1610	1718	1932	2147	2684	3220
10.7	759	813	975	1084	1300	1517	1625	1734	1950	2167	2709	3251
10.8	766	820	984	1094	1312	1531	1641	1750	1969	2187	2734	3281
10.9	773	828	993	1104	1325	1545	1656	1766	1987	2208	2760	3312
11.0	780	835	1003	1114	1337	1560	1671	1782	2005	2228	2785	3342
11.1	787	843	1012	1124	1349	1574	1686	1799	2023	2248	2810	3372
11.2	794	851	1021	1134	1361	1588	1701	1815	2042	2268	2836	3403
11.3	801	858	1030	1144	1373	1602	1717	1831	2060	2289	2861	3433
11.4	808	866	1039	1154	1385	1616	1732	1847	2078	2309	2886	3463
11.5	815	873	1048	1165	1398	1630	1747	1863	2096	2329	2912	3494
11.6	822	881	1057	1175	1410	1645	1762	1880	2115	2349	2937	3524
11.7	829	889	1066	1185	1422	1659	1777	1896	2133	2370	2962	3555
11.8	836	896	1075	1195	1434	1673	1792	1912	2151	2390	2987	3585
11.9	844	904	1085	1205	1446	1687	1808	1928	2169	2410	3013	3615
12.0	851	911	1094	1215	1458	1701	1823	1944	2187	2430	3038	3646
12.1	858	919	1103	1225	1470	1716	1838	1961	2206	2451	3063	3676
12.2	865	927	1112	1235	1483	1730	1853	1977	2224	2471	3089	3706

GRADIENT TO RATE TABLE

GRADIENT	GROUNDSPEED IN KNOTS											
%	70	75	90	100	120	140	150	160	180	200	250	300
12.3	872	934	1121	1246	1495	1744	1868	1993	2242	2491	3114	3737
12.4	879	942	1130	1256	1507	1758	1884	2009	2260	2511	3139	3767
12.5	886	949	1139	1266	1519	1772	1899	2025	2279	2532	3165	3798
12.6	893	957	1148	1276	1531	1786	1914	2042	2297	2552	3190	3828
12.7	900	965	1158	1286	1543	1801	1929	2058	2315	2572	3215	3858
12.8	907	972	1167	1296	1556	1815	1944	2074	2333	2593	3241	3889
12.9	914	980	1176	1306	1568	1829	1960	2090	2351	2613	3266	3919
13.0	922	987	1185	1317	1580	1843	1975	2106	2370	2633	3291	3950
13.1	929	995	1194	1327	1592	1857	1990	2123	2388	2653	3317	3980
13.2	936	1003	1203	1337	1604	1871	2005	2139	2406	2674	3342	4010
13.3	943	1010	1212	1347	1616	1886	2020	2155	2424	2694	3367	4041
13.4	950	1018	1221	1357	1628	1900	2036	2171	2443	2714	3393	4071
13.5	957	1025	1230	1367	1641	1914	2051	2187	2461	2734	3418	4101
13.6	964	1033	1240	1377	1653	1928	2066	2204	2479	2754	3443	4132
13.8	978	1048	1258	1397	1677	1956	2096	2236	2515	2795	3494	4192
14.0	992	1063	1276	1418	1701	1985	2127	2268	2552	2835	3544	4253
14.2	1007	1078	1294	1438	1726	2013	2157	2301	2588	2876	3595	4314
14.4	1021	1094	1312	1458	1750	2042	2187	2333	2625	2916	3646	4375
14.6	1035	1109	1331	1478	1774	2070	2218	2366	2661	2957	3696	4435
14.8	1049	1124	1349	1499	1798	2098	2248	2398	2698	2997	3747	4496
15.0	1063	1139	1367	1519	1823	2127	2279	2430	2734	3038	3798	4557
15.2	1007	1154	1385	1539	1847	2155	2309	2463	2771	3079	3848	4618
15.4	1092	1170	1404	1560	1871	2183	2339	2495	2807	3119	3899	4679
15.6	1106	1185	1422	1580	1896	2212	2370	2528	2844	3160	3949	4739
15.8	1120	1200	1440	1600	1920	2240	2400	2560	2880	3200	4000	4800
16.0	1134	1215	1458	1620	1944	2268	2430	2592	2916	3241	4051	4861
16.2	1148	1230	1476	1641	1969	2297	2461	2625	2953	3281	4101	4922
16.4	1163	1246	1495	1661	1993	2325	2491	2657	2989	3322	4152	4982

GRADIENT TO RATE TABLE

GRADIENT	GROUNDSPEED IN KNOTS											
%	70	75	90	100	120	140	150	160	180	200	250	300
16.6	1177	1261	1513	1681	2017	2353	2522	2690	3026	3362	4203	5043
16.8	1191	1276	1531	1701	2042	2382	2552	2722	3062	3403	4253	5104
17.0	1205	1291	1549	1722	2066	2410	2582	2754	3099	3443	4304	5165
17.2	1219	1306	1568	1742	2090	2439	2613	2787	3135	3484	4354	5225
17.4	1233	1322	1586	1762	2114	2467	2643	2819	3172	3524	4405	5286
17.6	1248	1337	1604	1782	2139	2495	2673	2852	3208	3565	4456	5347
17.8	1262	1352	1622	1803	2163	2524	2704	2884	3245	3605	4506	5408
18.0	1276	1367	1641	1823	2187	2552	2734	2916	3281	3646	4557	5468
18.2	1290	1382	1659	1843	2212	2580	2765	2949	3317	3686	4608	5529
18.4	1304	1397	1677	1863	2236	2609	2795	2981	3354	3727	4658	5590
18.6	1318	1413	1695	1884	2260	2637	2825	3014	3390	3767	4709	5651
18.8	1333	1428	1713	1904	2285	2665	2856	3046	3427	3808	4760	5711
19.0	1347	1443	1732	1924	2309	2694	2886	3079	3463	3848	4810	5772

HECTOPASCAL/MILLIBAR EQUIVALENT FOR AIRPORT ELEVATION

CORRECTION FACTOR

This table provides a correction factor in Hectopascals or Millibars for elevations on an airport. Application of the factor in this table will provide a QFE altimeter setting. To use the table, determine the correction factor by finding the elevation in hundreds of feet in the left column and reading across to the nearest ten feet. For example 1220 feet equals -43.9. Subtract 43.9 from your current Hectopascal or Millibar altimeter setting and your altimeter shall read "zero" on the surface.

Elev	**-200**	**-190**	**-180**	**-170**	**-160**	**-150**	**-140**	**-130**	**-120**	**-110**
	7.3	**7.0**	**6.6**	**6.2**	**5.9**	**5.5**	**5.1**	**4.8**	**4.4**	**4.0**
Elev	**-100**	**-90**	**-80**	**-70**	**-60**	**-50**	**-40**	**-30**	**-20**	**-10**
	3.7	**3.3**	**2.9**	**2.6**	**2.2**	**1.8**	**1.5**	**1.1**	**0.7**	**0.4**
Elev	**+00**	**+10**	**+20**	**+30**	**+40**	**+50**	**+60**	**+70**	**+80**	**+90**
0	0.0	-0.4	-0.7	-1.1	-1.5	-1.8	-2.2	-2.6	-2.9	-3.3
100	-3.7	-4.0	-4.4	-4.8	-5.1	-5.5	-5.8	-6.2	-6.6	-6.9
200	-7.3	-7.7	-8.0	-8.4	-8.8	-9.1	-9.5	-9.8	-10.2	-10.6
300	-10.9	-11.3	-11.7	-12.0	-12.4	-12.8	-13.1	-13.5	-13.8	-14.2
400	-14.6	-14.9	-15.3	-15.6	-16.0	-16.4	-16.7	-17.1	-17.5	-17.8
500	-18.2	-18.5	-18.9	-19.3	-19.6	-20.0	-20.3	-20.7	-21.1	-21.4
600	-21.8	-22.1	-22.5	-22.9	-23.2	-23.6	-23.9	-24.3	-24.7	-25.0
700	-25.4	-25.7	-26.1	-26.4	-26.8	-27.2	-27.5	-27.9	-28.2	-28.6
800	-29.0	-29.3	-29.7	-30.0	-30.4	-30.7	-31.1	-31.5	-31.8	-32.2
900	-32.5	-32.9	-33.2	-33.6	-33.9	-34.3	-34.7	-35.0	-35.4	-35.7
1000	-36.1	-36.4	-36.8	-37.2	-37.5	37.9	-38.2	-38.6	-38.9	-39.3
1100	-39.6	-40.0	-40.3	-40.7	-41.1	-41.4	-41.8	-42.1	-42.5	-42.8
1200	-43.2	-43.5	-43.9	-44.2	-44.6	-44.9	-45.3	-45.6	-46.0	-46.4
1300	-46.7	-47.1	-47.4	-47.8	-48.1	-48.5	-48.8	-49.2	-49.5	-49.9
1400	-50.2	-50.6	-50.9	-51.3	-51.6	-52.0	-52.3	-52.7	-53.0	-53.4
1500	-53.7	-54.1	-54.4	-54.8	-55.1	-55.5	-55.8	-56.2	-56.5	-56.9
1600	-57.2	-57.6	-57.9	-58.3	-58.6	-59.0	-59.3	-59.7	-60.0	-60.4
1700	-60.7	-61.1	-61.4	-61.8	-62.1	-62.5	-62.8	-63.2	-63.5	-63.8
1800	-64.2	-64.5	-64.9	-65.2	-65.6	-65.9	-66.3	-66.6	-67.0	-67.3
1900	-67.7	-68.0	-68.4	-68.7	-69.0	-69.4	-69.7	-70.1	-70.4	70.8

HECTOPASCAL/MILLIBAR EQUIVALENT FOR AIRPORT ELEVATION

Elev	**-200**	**-190**	**-180**	**-170**	**-160**	**-150**	**-140**	**-130**	**-120**	**-110**
	7.3	**7.0**	**6.6**	**6.2**	**5.9**	**5.5**	**5.1**	**4.8**	**4.4**	**4.0**
Elev	**-100**	**-90**	**-80**	**-70**	**-60**	**-50**	**-40**	**-30**	**-20**	**-10**
	3.7	**3.3**	**2.9**	**2.6**	**2.2**	**1.8**	**1.5**	**1.1**	**0.7**	**0.4**
Elev	**+00**	**+10**	**+20**	**+30**	**+40**	**+50**	**+60**	**+70**	**+80**	**+90**
2000	-71.1	-71.5	-71.8	-72.2	-72.5	-72.8	-73.2	-73.5	-73.9	-74.2
2100	-74.6	-74.9	-75.3	-75.6	-75.9	-76.3	-76.6	-77.0	-77.3	-77.7
2200	-78.0	-78.3	-78.7	-79.0	-79.4	-79.7	-80.1	-80.4	-80.7	-81.1
2300	-81.4	-81.8	-82.1	-82.5	-82.8	-83.1	-83.5	-83.8	-84.2	-84.5
2400	-84.8	-85.2	-85.5	-85.9	-86.2	-86.6	-86.9	-87.2	-87.6	-87.9
2500	-88.3	-88.6	-88.9	-89.3	-89.6	-90.0	-90.3	-90.6	-91.0	-91.3
2600	-91.6	-92.0	-92.3	-92.7	-93.0	-93.3	-93.7	-94.0	-94.4	-94.7
2700	-95.0	-95.4	-95.7	-96.0	-96.4	-96.7	-97.1	-97.4	-97.7	-98.1
2800	-98.4	-98.7	-99.1	-99.4	-99.8	-100.1	-100.4	-100.8	-101.1	-101.4
2900	-101.8	-102.1	-102.4	-102.8	-103.1	-103.5	-103.8	-104.1	-104.5	-104.8
3000	-105.1	-105.5	-105.8	-106.1	-106.5	-106.8	-107.1	-107.5	-107.8	-108.1
3100	-108.5	-108.8	-109.1	-109.5	-109.8	-110.1	-110.5	-110.8	-111.1	-111.5
3200	-111.8	-112.1	-112.5	-112.8	-113.1	-113.5	-113.8	-114.1	-114.5	-114.8
3300	-115.1	-115.5	-115.8	-116.1	-116.5	-116.8	-117.1	-117.5	-117.8	-118.1
3400	-118.5	-118.8	-119.1	-119.4	-119.8	-120.1	-120.4	-120.8	-121.1	-121.4
3500	-121.8	-122.1	-122.4	-122.8	-123.1	-123.4	-123.7	-124.1	-124.4	-124.7
3600	-125.1	-125.4	-125.7	-126.0	-126.4	-126.7	-127.0	-127.4	-127.7	-128.0
3700	-128.3	-128.7	-129.0	-129.3	-129.7	-130.0	-130.3	-130.6	-131.0	-131.3
3800	-131.6	-131.9	-132.3	-132.6	-132.9	-133.3	-133.6	-133.9	-134.2	-134.5
3900	-134.9	-135.2	-135.5	-135.9	-136.2	-136.5	-136.8	-137.2	-137.5	-137.8
4000	-138.1	-138.5	-138.8	-139.1	-139.4	-139.8	-140.1	-140.4	-140.7	-141.1
4100	-141.4	-141.7	-142.0	-142.4	-142.7	-143.0	-143.3	-143.7	-144.0	-144.3
4200	-144.6	-145.0	-145.3	-145.6	-145.9	-146.2	-146.6	-146.9	-147.2	-147.5
4300	-147.9	-148.2	-148.5	-148.8	-149.1	-149.5	-149.8	-150.1	-150.4	-150.8
4400	-151.1	-151.4	-151.7	-152.0	-152.4	-152.7	-153.0	-153.3	-153.6	-154.0
4500	-154.3	-154.6	-154.9	-155.2	-155.6	-155.9	-156.2	-156.5	-156.8	-157.2

HECTOPASCAL/MILLIBAR EQUIVALENT FOR AIRPORT ELEVATION

Elev	-200	-190	-180	-170	-160	-150	-140	-130	-120	-110
	7.3	7.0	6.6	6.2	5.9	5.5	5.1	4.8	4.4	4.0
Elev	-100	-90	-80	-70	-60	-50	-40	-30	-20	-10
	3.7	3.3	2.9	2.6	2.2	1.8	1.5	1.1	0.7	0.4
Elev	+00	+10	+20	+30	+40	+50	+60	+70	+80	+90
4600	-157.5	-157.8	-158.1	-158.4	-158.8	-159.1	-159.4	-159.7	-160.0	-160.4
4700	-160.7	-161.0	-161.3	-161.6	-161.9	-162.3	-162.6	-162.9	-163.2	-163.5
4800	-163.8	-164.2	-164.5	-164.8	-165.1	-165.4	-165.8	-166.1	-166.4	-166.7
4900	-167.0	-167.3	-167.7	-168.0	-168.3	-168.6	-168.9	-169.2	-169.5	-169.9
5000	-170.2	-170.5	-170.8	-171.1	-171.4	-171.8	-172.1	-172.4	-172.7	-173.0
5100	-173.3	-173.6	-174.0	-174.3	-174.6	-174.9	-175.2	-175.5	-175.8	-176.2
5200	-176.5	-176.8	-177.1	-177.4	-177.7	-178.0	-178.3	-178.7	-179.0	-179.3
5300	-179.6	-179.9	-180.2	-180.5	-180.8	-181.2	-181.5	-181.8	-182.1	-182.4
5400	-182.7	-183.0	-183.3	-183.7	-184.0	-184.3	-184.6	-184.9	-185.2	-185.5
5500	-185.8	-186.1	-186.5	-186.8	-187.1	-187.4	-187.7	-188.0	-188.3	-188.6
5600	-188.9	-189.2	-189.6	-189.9	-190.2	-190.5	-190.8	-191.1	-191.4	-191.7
5700	-192,0	-192.3	-192.6	-193.0	-193.3	-193.6	-193.9	-194.2	-194.5	-194.8
5800	-195.1	-195.4	-195.7	-196.0	-196.3	-196.7	-197.0	-197.3	-197.6	-197.9
5900	-198.2	-198.5	-198.8	-199.1	-199.4	-199.7	-200.0	-200.3	-200.6	-200.9
6000	-201.3	-201.6	-201.9	-202.2	-202.5	-202.8	-203.1	-203.4	-203.7	-204.0
6100	-204.3	-204.6	-204.9	-205.2	-205.5	-205.8	-206.1	-206.4	-206.7	-207.1
6200	-207.4	-207.7	-208.0	-208.3	-208.6	-208.9	-209.2	-209.5	-209.8	-210.1
6300	-210.4	-210.7	-211.0	-211.3	-211.6	-211.9	-212.2	-212.5	-212.8	-213.1
6400	-213.4	-213.7	-214.0	-214.3	-214.6	-214.9	-215.2	-215.5	-215.8	-216.1
6500	-216.4	-216.7	-217.0	-217.3	-217.6	-217.9	-218.2	-218.5	-218.8	-219.1
6600	-219.5	-219.8	-220.1	-220.4	-220.7	-221.0	-221.3	-221.6	-221.9	-222.2
6700	-222.5	-222.7	-223.0	-223.3	-223.6	-223.9	-224.2	-224.5	-224.8	-225.1
6800	-225.4	-225.7	-226.0	-226.3	-226.6	-226.9	-227.2	-227.5	-227.8	-228.1
6900	-228.4	-228.7	-229.0	-229.3	-229.6	-229.9	-230.2	-230.5	-230.8	-231.1
7000	-231.4	-231.7	-232.0	-232.3	-232.6	-232.9	-233.2	-233.5	-233.8	-234.1
7100	-234.4	-234.7	-235.0	-235.2	-235.5	-235.8	-236.1	-236.4	-236.7	-237.0

HECTOPASCAL/MILLIBAR EQUIVALENT FOR AIRPORT ELEVATION

Elev	-200	-190	-180	-170	-160	-150	-140	-130	-120	-110
	7.3	7.0	6.6	6.2	5.9	5.5	5.1	4.8	4.4	4.0
Elev	-100	-90	-80	-70	-60	-50	-40	-30	-20	-10
	3.7	3.3	2.9	2.6	2.2	1.8	1.5	1.1	0.7	0.4
Elev	+00	+10	+20	+30	+40	+50	+60	+70	+80	+90
7200	-237.3	-237.6	-237.9	-238.2	-238.5	-238.8	-239.1	-239.4	-239.7	-240.0
7300	-240.3	-240.6	-240.8	-241.1	-241.4	-241.7	-242.0	-242.3	-242.6	-242.9
7400	-243.2	-243.5	-243.8	-244.1	-244.4	-244.7	-245.0	-245.2	-245.5	-245.8
7500	-246.1	-246.4	-246.7	-247.0	-247.3	-247.6	-247.9	-248.2	-248.5	-248.8
7600	-249.0	-249.3	-249.6	-249.9	-250.2	-250.5	-250.8	-251.1	-251.4	-251.7
7700	-252.0	-252.2	-252.5	-252.8	-253.1	-253.4	-253.7	-254.0	-254.3	-254.6
7800	-254.9	-255.1	-255.4	-255.7	-256.0	-256.3	-256.6	-256.9	-257.2	-257.5
7900	-257.7	-258.0	-258.3	-258.6	-258.9	-259.2	-259.5	-259.8	-260.1	-260.3
8000	-260.6	-260.9	-261.2	-261.5	-261.8	-262.1	-262.4	-262.6	-262.9	-263.2
8100	-263.5	-263.8	-264.1	-264.4	-264.6	-264.9	-265.2	-265.5	-265.8	-266.1
8200	-266.4	-266.7	-266.9	-267.2	-267.5	-267.8	-268.1	-268.4	-268.7	-268.9
8300	-269.2	-269.5	-269.8	-270.1	-270.4	-270.6	-270.9	-271.2	-271.5	-271.8
8400	-272.1	-272.4	-272.6	-272.9	-273.2	-273.5	-273.8	-274.1	-274.3	-274.6
8500	-274.9	-275.2	-275.5	-275.8	-276.0	-276.3	-276.6	-276.9	-277.2	-277.5
8600	-277.7	-278.0	-278.3	-278.6	-278.9	-279.1	-279.4	-279.7	-280.0	-280.3
8700	-280.6	-280.8	-281.1	-281.4	-281.7	-282.0	-282.2	-282.5	-282.8	-283.1
8800	-283.4	-283.6	-283.9	-284.2	-284.5	-284.8	-285.1	-285.3	-285.6	-285.9
8900	-286.2	-286.5	-286.7	-287.0	-287.3	-287.6	-287.8	-288.1	-288.4	-288.7
9000	-289.0	-289.2	-289.5	-289.8	-290.1	-290.4	-290.6	-290.9	-291.2	-291.5
9100	-291.8	-292.0	-292.3	-292.6	-292.9	-293.1	-293.4	-293.7	-294.0	-294.3
9200	-294.5	-294.8	-295.1	-295.4	-295.6	-295.9	-296.2	-296.5	-296.7	-297.0
9300	-297.3	-297.6	-297.8	-298.1	-298.4	-298.7	-299.0	-299.2	-299.5	-299.8
9400	-300.1	-300.3	-300.6	-300.9	-301.2	-301.4	-301.7	-302.0	-302.3	-302.5
9500	-302.8	-303.1	-303.4	-303.6	-303.9	-304.2	-304.5	-304.7	-305.0	-305.3
9600	-305.5	-305.8	-306.1	-306.4	-306.6	-306.9	-307.2	-307.5	-307.7	-308.0
9700	-308.3	-308.6	-308.8	-309.1	-309.4	-309.6	-309.9	-310.2	-310.5	-310.7

HECTOPASCAL/MILLIBAR EQUIVALENT FOR AIRPORT ELEVATION

Elev	**-200**	**-190**	**-180**	**-170**	**-160**	**-150**	**-140**	**-130**	**-120**	**-110**
	7.3	**7.0**	**6.6**	**6.2**	**5.9**	**5.5**	**5.1**	**4.8**	**4.4**	**4.0**
Elev	**-100**	**-90**	**-80**	**-70**	**-60**	**-50**	**-40**	**-30**	**-20**	**-10**
	3.7	**3.3**	**2.9**	**2.6**	**2.2**	**1.8**	**1.5**	**1.1**	**0.7**	**0.4**
Elev	**+00**	**+10**	**+20**	**+30**	**+40**	**+50**	**+60**	**+70**	**+80**	**+90**
9800	-311.0	-311.3	-311.6	-311.8	-312.1	-312.4	-312.6	-312.9	-313.2	-313.5
9900	-313.7	-314.0	-314.3	-314.5	-314.8	-315.1	-315.4	-315.6	-315.9	-316.2
10000	-316.4	-316.7	-317.0	-317.2	-317.5	-317.8	-318.1	-318.3	-318.6	-318.9
10100	-319.1	-319.4	-319.7	-319.9	-320.2	-320.5	-320.7	-321.0	-321.3	-321.6
10200	-321.8	-322.1	-322.4	-322.6	-322.9	-323.2	-323.4	-323.7	-324.0	-324.2
10300	-324.5	-324.8	-325.0	-325.3	-325.6	-325.8	-326.1	-326.4	-326.6	-326.9
10400	-327.2	-327.4	-327.7	-328.0	-328.2	-328.5	-328.8	-329.0	-329.3	-329.6
10500	-329.8	-330.1	-330.4	-330.6	-330.9	-331.2	-331.4	-331.7	-332.0	-332.2
10600	-332.5	-332.8	-333.0	-333.3	-333.6	-333.8	-334.1	-334.4	-334.6	-334.9
10700	-335.2	-335.4	-335.7	-335.9	-336.2	-336.5	-336.7	-337.0	-337.3	-337.5
10800	-337.8	-338.1	-338.3	-338.6	-338.8	-339.1	-339.4	-339.6	-339.9	-340.2
10900	-340.4	-340.7	-341.0	-341.2	-341.5	-341.7	-342.0	-342.3	-342.5	-342.8
11000	-343.1	-343.3	-343.6	-343.8	-344.1	-344.4	-344.6	-344.9	-345.1	-345.4
11100	-345.7	-345.9	-346.2	-346.5	-346.7	-347.0	-347.2	-347.5	-347.8	-348.0
11200	-348.3	-348.5	-348.8	-349.1	-349.3	-349.6	-349.8	-350.1	-350.4	-350.6
11300	-350.9	-351.1	-351.4	-351.7	-351.9	-352.2	-352.4	-352.7	-352.9	-353.2
11400	-353.5	-353.7	-354.0	-354.2	-354.5	-354.8	-355.0	-355.3	-355.5	-355.8
11500	-356.0	-356.3	-356.6	-356.8	-357.1	-357.3	-357.6	-357.9	-358.1	-358.4
11600	-358.6	-358.9	-359.1	-359.4	-359.7	-359.9	-360.2	-360.4	-360.7	-360.9
11700	-361.2	-361.4	-361.7	-362.0	-362.2	-362.5	-362.7	-363.0	-363.2	-363.5
11800	-363.7	-364.0	-364.3	-364.5	-364.8	-365.0	-365.3	-365.5	-365.8	-366.0
11900	-366.3	-366.6	-366.8	-367.1	-367.3	-367.6	-367.8	-368.1	-368.3	-368.6
12000	-368.8	-369.1	-369.3	-369.6	-369.9	-370.1	-370.4	-370.6	-370.9	-371.1
12100	-371.4	-371.6	-371.9	-372.1	-372.4	-372.6	-372.9	-373.1	-373.4	-373.6
12200	-373.9	-374.2	-374.4	-374.7	-374.9	-375.2	-375.4	-375.7	-375.9	-376.2
12300	-376.4	-376.7	-376.9	-377.2	-377.4	-377.7	-377.9	-378.2	-378.4	-378.7

HECTOPASCAL/MILLIBAR EQUIVALENT FOR AIRPORT ELEVATION

Elev	-200	-190	-180	-170	-160	-150	-140	-130	-120	-110
	7.3	7.0	6.6	6.2	5.9	5.5	5.1	4.8	4.4	4.0
Elev	**-100**	**-90**	**-80**	**-70**	**-60**	**-50**	**-40**	**-30**	**-20**	**-10**
	3.7	**3.3**	**2.9**	**2.6**	**2.2**	**1.8**	**1.5**	**1.1**	**0.7**	**0.4**
Elev	**+00**	**+10**	**+20**	**+30**	**+40**	**+50**	**+60**	**+70**	**+80**	**+90**
12400	-378.9	-379.2	-379.4	-379.7	-379.9	-380.2	-380.4	-380.7	-380.9	-381.2
12500	-381.4	-381.7	-381.9	-382.2	-382.4	-382.7	-382.9	-383.2	-383.4	-383.7
12600	-383.9	-384.2	-384.4	-384.7	-384.9	-385.2	-385.4	-385.7	-385.9	-386.2
12700	-386.4	-386.7	-386.9	-387.2	-387.4	-387.7	-387.9	-388.1	-388.4	-388.6
12800	-388.9	-389.1	-389.4	-389.6	-389.9	-390.1	-390.4	-390.6	-390.9	-391.1
12900	-391.4	-391.6	-391.9	-392.1	-392.3	-392.6	-392.8	-393.1	-393.3	-393.6
13000	-393.8	-394.1	-394.3	-394.6	-394.8	-395.0	-395.3	-395.5	-395.8	-396.0
13100	-396.3	-396.5	-396.8	-397.0	-397.3	397.5	-397.7	-398.0	-398.2	-398.5
13200	-398.7	-399.0	-399.2	-399.5	-399.7	-399.9	-400.2	-400.4	-400.7	-400.9
13300	-401.2	-401.4	-401.6	-401.9	-402.1	-402.4	-402.6	-402.9	-403.1	-403.3
13400	-403.6	-403.8	-404.1	-404.3	-404.6	-404.8	-405.0	-405.3	-405.5	-405.8
13500	-406.0	-406.3	-406.5	-406.7	-407.0	-407.2	-407.5	-407.7	-407.9	-408.2