Aviation System Standards

Flight Inspection Operations Group

FLIGHT INSPECTION HANDBOOK

TI 8200.52

November 2007

RECORD OF CHANGES

DIRECTIVE NO. **TI 8200.52**

CHANGE TO BASIC	DATE	NAME	CHANGE TO BASIC	DATE POSTED	NAME
1					
2					

CHANGE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

Chg 3 to TI 8200.52

9/14/09

SUBJ: Flight Inspection Handbook

1. Purpose of This Change. This change transmits revisions to Technical Issuance 8200.52, Flight Inspection Handbook, dated November 5, 2007.

2. Who This Change Affects. This change is distributed to offices in the Flight Inspection Operations Group in Aviation System Standards, including all Flight Inspection Offices, as well as special military addressees.

3. Where Can I Find This Change? Go to the Airman's Information File (AIF), http://avnnet.jccbi.gov/aifs/index.html

4. Cancellations. The following documents are canceled:

a. Bulletin 08-11, RNAV FOMS Pack When ICAO "K" Changes to "J", dated September 26, 2008.

b. Bulletin 09-01, AFIS Receiver Differential and LR60 Glide Slope Signal Strength, dated January 11, 2009.

c. Bulletin 09-02, VOR 5º Offset Radials and RHO-THETA Coverage, dated January 12, 2009.

d. Bulletin 09-03, RNAV Approach Procedures with Localizer Performance (LP), dated March 13, 2009.

e. Bulletin 09-04, Eliminating Periodic Inspections of Approach Path Monitors, dated April 13, 2009.

f. Bulletin 09-05, RNAV WAAS Glidepath Fly-Up Verification, dated April 20, 2009.

g. Bulletin 09-06, Notices to Airmen Affecting High Impact Airports (TI 8200.52, Chapter 5), dated May 26, 2009.

h. Bulletin 09-07, "Gold Standard" Flight Inspection and the FAA Custom Navigation Database for Flight Management Systems (FMS) (TI 8200.52, Chapter 13 and Appendix 1), dated July 20, 2009.

Distribution: Special Addressees

Initiated By: Aviation System Standards
Flight Inspection Operations
Flight Inspection Policy (AJW-331)

5. Explanation of Policy Changes. Updated Flight Inspection Policy name and deleted Aircraft Configuration tables throughout handbook.

a. Chapter 4, Paragraph 4.25, Table 4-1. Deleted row for "APM". Eliminated Periodic Inspection of APM(s) and replaced it with "by request" Special Inspection. A study of data for a three-year period covering FY06 through FY08 revealed there were 4,390 APM flight inspections completed with 140 reports requiring further investigation for minor notations. These investigations conducted by the Minimum Safe Warning Quality Assurance Team determine the reports were not a factor and resulted in no operational APM changes.

b. Chapter 5:

(1) Paragraph 5.12b(3). Clarified that the FICO will brief the **Director of Operations** regarding the potential impact on flight operations of NOTAM(s) affecting high impact airports.

(2) Paragraph 5.12b(4). Added instructions for Missed Runs, Out-of-Tolerance Conditions Found during QC or Product Review.

c. Chapter 6:

(1) Paragraph 6.10c(8) deleted. Guidance deleted was not applicable in all cases.

(2) Paragraph 6.12c(11). GPWS guidance clarified to match Order 8200.1C.

d. Chapter 11:

(1) Figure 11-3. Deleted Aircraft Configuration table.

(2) Figure 11-4. Deleted Aircraft Configuration table.

(3) Paragraph 11.20f(6). Changed to clarify VOR 5° offset checks.

(4) Figure 11-5. Deleted Aircraft Configuration table.

(5) Figure 11-6. Deleted Aircraft Configuration table.

(6) Paragraph 11.20g(2)(b), 5th sentence. Change to read, "Restriction lateral limits may be defined by orbital means" for clarification.

(7) Paragraph 11.21e(1). 2nd sentence added to clarify VOR Polarization requirements for Commissioning and Antenna Change inspections.

(8) Paragraph 11.54. Deleted Periodic Inspection requirement for VOT reference point (editorial change).

e. Chapter 12:

(1) Figure 12-2. Deleted Aircraft Configuration table.

(2) Paragraph 12.21. Changed reference for Daily Flight Log reporting to "Appendix 12".

f. Chapter 13. Throughout the chapter, added information about the FAA custom navigation database for the FMS-equipped aircraft that AVN will use to meet the requirements of the "Gold Standard".

(1) Paragraph 13.11b, NOTE 2 added.

(2) Section 4. Added requirements for inspection of Offset and Point-in-Space Localizer Performance with Vertical Guidance/ Localizer Performance (LPV/ LP) Procedures to applicable paragraphs.

(3) Paragraph 13.42d(1)(k). Updated instructions for setting up AFIS.

(4) Paragraph 13.42d. Deleted "HP" from "Spectrum Analyzer".

(5) Paragraph 13.42e(6). Guidance provided to enable the flight inspector to confirm full scale Fly-up while the flight inspection aircraft is positioned in the intermediate or final approach segments.

(6) Paragraph 13.44, Table 13-5. Added Footnote 1 to clarify LP approach procedure inspection guidance. Added Footnote 2 to clarify ranging information.

g. Chapter 14:

(1) Section 1. Throughout the section, the term General Terrain Map was changed to General Terrain Monitor, as applicable.

(2) Paragraph 14.10d(1). General Terrain (formerly Map) Monitor (GTM) description within Surveillance Radar & Air Traffic Control Radar Beacon Systems was changed to more accurately describe it.

(3) Paragraph 14.11b. Reference to the MSAW website deleted, as the MSAW team will no longer maintain the website listed.

(4) Paragraph 14.13. Modified checklist entry for MSAW (removed GTM limitation) and replaced corresponding Footnote (2). Periodic inspections of APM(s) are eliminated and replaced with "by request" Special Inspection. This change leaves the requirement to check GTM functionality during both commissioning and periodic airport surveillance radar flight inspections, and ends the previous practice of scheduling periodic APM(s) with standard instrument approach procedures.

(5) Figure 14-3. Deleted Aircraft Configuration table.

(6) Figure 14-9. Deleted Aircraft Configuration table.

(7) Paragraph 14.14p. ATCRBS coverage information added and paragraph clarified.

(8) Figure 14-10. Deleted Aircraft Configuration table.

(9) **Paragraph 14.15.** Tolerance/ Limit column for Accuracy Fix/ Map clarified.

(10) **Figure 14-17.** Deleted Aircraft Configuration table.

(11) **Figure 14-18.** Deleted Aircraft Configuration table.

(12) **Paragraphs 14.23c(1)(a)2 and 14.23d(2)(d).** Changed AFIS maneuvering on-path-/ on-course call to the Mission Specialist, instead of the pilot not flying, pressing the ON-PATH/ ON-COURSE key once per each ATC call-out,

h. Chapter 15.

(1) **Paragraphs 15.12a and c.** Added "identification" to ILS-1 Arc Flight Profile. Deleted Aircraft Configuration table from Flight Inspection Arc ILS Front or Back Course diagram.

(2) **Paragraph 15.12c(3)(c).** Added subparagraph to clarify when aircraft is considered On-Course/ on-Path.

(3) **Paragraph 15.14c(2), Figure 15-2B, Dual Frequency Localizer.** Added "Course/ Clearance" in front of "Wide Monitor Reference". **Figure 15-2D, Capture Effect Glide Slope.** Deleted main SBO ADV & RET as required measurement for total references. **Figure 15-2E, Sideband Reference Glide Slope.** Clarified "Wide Monitor Reference" by deleting "Modulation", adjusted Phaser Setting and Attenuator.

(4) **Paragraph 15.15b(1) and (2),.** Updated paragraph references in checklists.

(5) **Paragraph 15.15b(5).** Clarified "Measurements Required" for "Mean Width".

(6) **Paragraph 15.21i(2) Note 1.** Added 2nd sentence guidance for RF power.

(7) **Paragraph 15.21i(5)(a) and (b).** Roll-Out Procedure guidance added for "Site, Commissioning, Reconfiguration, and Categorization Inspection of Centerline Oriented Facilities" and "Periodic or Special Inspections which require Structure Analysis".

(8) **Paragraph 15.21m.** Note 4 added to clarify Step 3 being used for localizer Zone 1 structure analysis for RF Power Monitor Reference.

(9) **Paragraph 15.30d(3)(a).** Paragraph references updated for Capture Effect Airborne Phase Verification Procedure.

(10) **Paragraph 15.30e.** Table at bottom of Page 15-85, Step 2 Analysis, "Measure the angle – should be 3º"(editorial change from 2º).

(11) **Paragraph 15.30h(2).** Instructions under ILS-3 Zone 2 Actual Path Angle clarified regarding confirming out-of-tolerance angles found during ILS-2 maneuvers for Category I glide slopes.

(12) **Paragraph 15.30s.** Clarified maneuvering requirements for RF Power Monitor Reference.

(13) **Paragraph 15.60a.** Updated paragraph reference for tolerance/ limit of modulation level.

(14) **Paragraph 15.60b.** Deleted periodic requirement for Tilt in Glide Slopes tolerance table.

i. **Appendix 1.** Glossary entry for MSAW Approach Path Monitor (APM) updated to be more consistent with a glossary entry, leaving detailed description in Chapter 13. Glossary entry and acronym entries for GTM changed from General Terrain Map to General Terrain Monitor and definition updated.

j. **Appendix 8.** Hawker aircraft guidance removed and Appendix 8 marked as "Reserved".

k. **Appendix 9, Paragraph A9.1c.** Added website for aeronautical survey data for airports.

k. **Appendix 10.** Deleted all references to Sierra and BAe-800 aircraft.

(1) **Paragraph A10.1a(9).** Replaced paragraph to update guidance for AFIS receiver differences.

(2) **Paragraph A10.1b(1)(f).** Note added to provide instructions for inputting receiver calibration data.

(3) **Paragraph A10.1g(3)(e).** Note deleted. Aircraft have all been modified with new receivers, eliminating the need for the provision of the Note.

(4) **Paragraph A10.2.** NCU position update is no longer applicable and does not affect the reliability or accuracy of results.

(5) **Paragraph A10.2a.** Updated antenna position guidance.

l. **Appendix 12:**

(1) **Paragraph A12.3i(6) NOTE 2.** Wide Area Multilateration (WAM) and ASDE/X added.

(2) **Paragraph A12.3k, Table 1.** "Airport Surface Detection Equipment (ASDE), WAM, and ASDE/ X added to the Facility/ Procedures Code Table.

(3) **Paragraph A12.4.** "Sequencing (2)" added under "APL".

6. **DISPOSAL OF TRANSMITTAL.** After filing the revised pages, the change transmittal should be retained.

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/s/

Peter W. Gretsch
Director of Operations
Flight Inspection Operations Group
Aviation System Standards

CHANGE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

Chg 2 to
TI 8200.52

9/22/08

SUBJ: Flight Inspection Handbook

1. Purpose of This Change. This change transmits revisions to Technical Issuance 8200.52, Flight Inspection Handbook, dated November 5, 2007.

2. Who This Change Affects. This change is distributed to offices in the Flight Inspection Operations Group in Aviation System Standards, including all Flight Inspection Offices, as well as special military addressees.

3. Where Can I Find This Change? Go to the Airman's Information File (AIF), http://avnnet.jccbi.gov/aifs/index.html

4. Cancellations. The following documents are canceled:

a. Bulletin 08-07, Change to Chapters 4 and 13 of TI 8200.52, Flight Inspection Handbook, dated May 30, 2008.

b. Bulletin 08-08, Change to Chapter 13 of TI 8200.52, Flight Inspection Handbook, dated July 11, 2008.

c. Bulletin 08-09, Change to Chapter 6 of TI 8200.52, Flight Inspection Handbook, dated July 18, 2008.

d. Bulletin 08-10, Chang to Chapter 15 of TI 8200.52, Flight Inspection Handbook, dated July 25, 2008.

5. Explanation of Policy Changes:

a. Chapter 2:

(1) Paragraph 2.12b. Updated the office responsible for obtaining source data

(2) Paragraph 2.12c(2)(c)3. Updated the office responsible for record retention

Distribution: Special Addressees

Initiated By: Aviation System Standards
Flight Inspection Operations
Flight Inspection Policy, Practices,
and Training Team (AJW-3310)

b. **Chapter 4:**

(1) **Table 4-1.** Corrected Table number from 4-2 to 4-1.

(2) **Table 4-1, Note 5.** Incorporates Bulletin 08-07 and changes the words “public RNAV” to “GPS based” to correct terminology.

(3) **Paragraph 4.34b.** Updated point of contact for obtaining flight inspection recordings from FICO TSS to Flight Inspection Records Team.

(4) **Paragraph 4.34f.** Updated office responsible for reconciling facility data discrepancies from FICO TSS to Aeronautical Data Services Team.

(5) **Paragraph 4.35e.** Updated offices responsible for notifying the National Flight Data Center of publication changes.

c. **Chapter 6.** Incorporated Bulletin 08-09.

d. **Chapter 7, Paragraph 7.21d(1).** Replaced the word “radios” with “runways” to correct typographical error.

e. **Chapter 11, Figure 11-5.** Moved text box that was obscuring text in the NOTE.

f. **Chapter 13:**

(1) **Paragraph 13.12b, NOTE 3.** Incorporates Bulletin 08-07.

(2) **Paragraph 13.42b, NOTE 2.** Incorporates Bulletin 08-07.

g. **Chapter 14, Paragraph 14.14e(1)(a).** Added omitted AFIS/ Equipment setup of “Flt Insp Select: ON”.

h. **Chapter 15:**

(1) **Table of Contents.** Added the word “alternate” to align flight inspection terminology with Order JO 6750.49, ILS Maintenance Handbook.

(2) **Paragraph 15.10b.** Updated the office responsible for researching ILS facilities requested to be used for a higher category of service.

(3) **Paragraph 15.12b(1).** Added the last sentence, incorporating Bulletin 08-10.

(4) **Paragraph 15.12b(3)(c).** Deleted information concerning aircraft equipped with the Sierra flight inspection system.

(5) **Paragraphs 15.13a(2)and (3).** Updated verbiage to align with terminology contained in Order JO 6750.49, ILS Maintenance Handbook. This is an editorial change and does not conflict with FAA Order 8200.1.

(6) Paragraph 15.13b. Updated verbiage to align with terminology contained in Order JO 6750.49, ILS Maintenance Handbook. This is an editorial change and does not conflict with FAA Order 8200.1.

(7) Paragraph 15.14b. Updated verbiage to align with terminology contained in Order JO 6750.49, ILS Maintenance Handbook. This is an editorial change and does not conflict with FAA Order 8200.1.

(8) Paragraph 15.14c(1)(i). Updated verbiage to align with terminology contained in Order JO 6750.49, ILS Maintenance Handbook. This is an editorial change and does not conflict with FAA Order 8200.1.

(9) Figure 15-2C, D. Deleted (1 TX) in numerous locations. Facilities maintained using Order JO 6750.49 require monitor inspections on one transmitter only.

(10) Figure 15-2D. In ILS Reference Change column, removed Commissioning. In the Required Airborne Measurement Column, deleted requirement to check Main SBO Advance/ Retard, as this is not a maintenance traceable reference.

(11) Paragraph 15.15b. Updated verbiage to align with terminology contained in Order JO 6750.49, ILS Maintenance Handbook. This is an editorial change and does not conflict with FAA Order 8200.1.

(12) Paragraph 15.21h(2)(b) and (c). Updated tables to reflect same guidance contained in FAA Order 8200.1.

(13) Paragraph 15.30h(1). Added last bullet to incorporated Bulletin 08-10.

(14) Paragraph 15.30q. Updated verbiage to align with terminology contained in Order JO 6750.49, ILS Maintenance Handbook. This is an editorial change and does not conflict with FAA Order 8200.1.

(15) Paragraph 15.30s. In the “Maneuvering” column, added last sentence to correct omission from previous publication. In the “Glide slope” column, updated verbiage to align with terminology contained in Order JO 6750.49, ILS Maintenance Handbook.

(16) Paragraph 15.30s. In the first bullet of “Other Considerations”, rewrote sentence to match guidance contained in FAA Order 8200.1.

i. Chapter 23, Paragraph 23.14a(2). Added caution box to match placard onboard the aircraft.

j. Appendix 1. Added definition for National Flight Procedures Office.

k. Appendix 12, Table 3. Added the word “special” in front of “procedural” for clarification.

6. DISPOSAL OF TRANSMITTAL. After filing the revised pages, the change transmittal should be retained.

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/s/

Peter W. Gretsch
Director of Operations
Flight Inspection Operations Group
Aviation System Standards

CHANGE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

Chg 1 to TI 8200.52

4/14/08

SUBJ: Flight Inspection Handbook

1. PURPOSE. This change transmits revisions to Technical Issuance 8200.52, Flight Inspection Handbook, dated November 5, 2007.

2. DISTRIBUTION. This change is distributed to offices in the Flight Inspection Operations Group in Aviation System Standards, including all Flight Inspection Offices, as well as special military addressees.

3. EFFECTIVE DATE. This change is effective April 14, 2008.

4. CANCELLATIONS. The following documents are canceled:

a. **Notice VN200 8200.38,** Scheduling, Conducting, and Reporting SIAP Inspections and ROC Checks, dated January 30, 2007.

b. **Bulletin 08-01,** Use of AFIS When Evaluating PAR Course (Azimuth) Alignment, dated January 2, 2008.

c. **Bulletin 08-02,** Night Evaluation of Lighting Systems, dated January 2, 2008.

d. **Bulletin 08-03,** CRC Errors and AFIS Airport Data for LPV Flight Inspection, dated January 14, 2008.

e. **Bulletin 08-04,** Flight Inspection DME Facilities Supporting Area Navigation (RNAV)(Chapter 13), dated February 4, 2008

f. **Bulletin 08-05,** Airborne Phase Verification Procedures, dated February 7, 2008.

g. **Bulletin 08-06,** Coding and Packing of Area Navigation (RNAV) Approach Procedures, dated March 28, 2008.

h. **Policy Memo,** Flight Inspection Recordings, dated June 18, 2007.

i. **Policy Memo,** TI 8200.52, FI Handbook, clarification, dated December 13, 2007.

j. **Policy Memo,** Flight Inspection System Distance Measure Equipment (DME), dated August 7, 2006.

Distribution: Special Addressees

Initiated By: Aviation System Standards
Flight Inspection Operations
Flight Inspection Policy, Practices,
and Training Team (AJW-3310)

k. **Policy Memo,** ILS-2 Level Run Established Altitude, dated March 1, 2007.

l. **Policy Memo,** AFIS Positioning Modes, dated July 20, 2007.

m. **Policy Memo,** LR60 Glide Slope Signal Strength, dated August 31, 2007.

5. EXPLANATION OF CHANGES:

a. **Chapter 1, Paragraph 1.13**. Incorporated Policy Memo, TI 8200.52, FI Handbook Clarification, dated December 13, 2007

b. **Chapter 5, Paragraph 5.21c.** Incorporated Policy Memo, Flight Inspection Recordings, dated June 18, 2007.

c. **Chapter 6, Paragraph 6.12g(3)(c)1.** Incorporated Bulletin 08-02, Night Evaluation of Lighting Systems, dated January 2, 2008.

d. **Chapter 7:**

(1) **Table 7-3.** Reformatted table and corrected two conversion errors for 2.58 and 3.58 degrees.

(2) **Paragraph 7.14b(3).** Corrected paragraph numbering.

(3) **Paragraph 7.20d, e, f.** Incorporated Bulletin 08-02.

(4) **Paragraph 7.21a(3), (5), (6).** Incorporated Bulletin 08-02.

e. **Chapter 8, Paragraph 8.14a.** Corrected paragraph reference.

f. **Chapter 11:**

(1) **Table 11-2.** Corrected Table name.

(2) **Paragraph 11.70.** Moved tables intersection tables from Chapter 11 to Chapter 22.

g. **Chapter 13:**

(1) **Paragraph 13.11b.** Incorporated Bulletin 08-06.

(2) **Paragraph 13.31c.** Incorporated Bulletin 08-04.

(3) **Paragraph 13.41e.** Incorporated Bulletin 08-03.

(4) **Paragraph 13.42e(6).** Added last sentence for safety clarification.

h. **Chapter 14:**

(1) **Paragraph 14.12.** Added paragraph omitted in the original release of TI 8200.52.

(2) **Paragraph 14.13.** Corrected paragraph references.

(3) **Paragraph 14.15.** Corrected paragraph references.

(4) **Paragraph 14.23c, and c(1)(a)2.** Incorporated Bulletin 08-01.

i. Chapter 15:

(1) **Paragraph 15.12c.** Incorporated Policy Memo, ILS-2 Level Run Established Altitude, dated March 1, 2007.

(2) **Paragraph 15.21i(5).** Added flowchart and additional information about rollout procedures.

(3) **Paragraph 15.30d(3)(a).** Incorporated Bulletin 08-05.

(4) **Paragraph 15.30q.** In the "Analysis" column, added omitted verbiage and reference to Figure 15-4. In "Other Considerations", deleted first bullet to remove redundancy. Added figure number to Transverse Structure Analysis graphic.

j. Chapter 22:

(1) **Paragraph 22.11a.** Corrected table reference.

(2) **Paragraph 22.11b(1).** Rewrote second note for clarity.

(3) **Paragraph 22.11b(2).** Rewrote second note for clarity.

(4) **Paragraph 22.13.** Added tables previously in Chapter 11.

k. Appendix 2, Paragraph A2.2h, i, and A2.6b. Added figures as visual aids.

l. Appendix 10:

(1) **Paragraph A10.1a(9).** Incorporated Policy Memo, LR60 Glide Slope Signal Strength, dated August 31, 2007.

(2) **Paragraph A10g.1g(3).** Incorporated Policy Memo, Flight Inspection System Distance Measuring Equipment (DME) Policy Memo, dated August 7, 2006.

m. Appendix 12:

(1) **Paragraph A12.3h.** Added helicopter requirements.

(2) **Paragraph A12.3k.** Added previously omitted verbiage to 4th sentence.

(3) **Paragraph A12.3l.** Rewrote sentence for clarity.

(4) **Table 3.** Added new suffix in support of Gold Standard implementation.

(5) **Paragraph A12.4.** Added new discrepancy codes for airports and procedures.

(6) **Paragraph A12.6a.** Removed the requirement to assign an aircraft number.

(7) **Paragraph A12.6b.** Added Paragraph A12.6b to incorporate helicopter requirements.

6. DISPOSAL OF TRANSMITTAL. After filing the revised pages, the change transmittal should be retained.

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/s/

Peter W. Gretsch
Director of Operations
Flight Inspection Operations Group
Aviation System Standards

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

TI 8200.52

Effective Date:
11/05/07

SUBJ: Flight Inspection Handbook

The Flight Inspection Handbook is applicable to all personnel conducting flight inspection operations. It provides instructions for accomplishing the flight inspection mission requirement. This order also provides guidance in using the AVN Inspection System (AVNIS). It contains information and procedures intended for use by aircrew personnel whose duties involve the inspection and certification of navigational aids supporting the National Airspace System and other United States aviation interests. The information and procedures contained herein will provide continuity between various offices and aircrews performing flight inspections.

All references to manuals, orders, or technical issuances (TI(s)) pertain to the latest revision or change of those documents. All current Notices must also be considered when applying the information in this order.

/s/

David H. Boulter
Director of Operations
Flight Inspection Operations Group
Aviation System Standards

Distribution: Aviation System Standards
Flight Inspection Operations Crewmembers

Initiated By: Aviation System Standards
Flight Inspection Operations
Flight Inspection Policy, Practices,
and Training Team (AJW-3310)

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CHAPTER 1

INTRODUCTION

1.10 PURPOSE. This technical issuance is referred to as a handbook and contains the standardized procedures and best practices for flight inspection of air navigation services, instrument flight procedures, and FAA VFR Aeronautical Charts. Flight Inspection crew deviations from the standardized procedures and best practices set forth in this handbook will be briefed prior to execution.

1.11 DISTRIBUTION. This handbook is distributed to offices in the Flight Inspection Operations Group in Aviation Systems Standards, including all Flight Inspection Offices, as well as special military addressees.

1.12 CANCELLATIONS

a. **Order VN200 8240.52,** dated October 1, 2005, and Change 1, dated February 1, 2007.

b. **Order VN200 8240.4F,** Daily Flight Log (DFL), FAA Form 4040-5, dated August 1, 2006.

c. **Notice N VN200 8200.37,** Changes to Daily Flight Log (DFL), FAA Form 4040-5 (Order VN200 8240.4F), dated January 30, 2007.

1.13 BACKGROUND. The Flight Inspection mission is comprised of many elements with associated source documents. To facilitate efficient and effective use of resources, there was a need to compile the information from the source documents and maintain it in one location. This handbook was created for that purpose. In the event there is a conflict between this handbook and the associated source document, the source document will take precedence. Compliance with the information in this handbook is not a substitute for common sense and sound judgment. Nothing in this handbook will be construed to relieve Flight Inspection crews or supervisory personnel of the responsibility for exercising initiative in the execution of the mission, or from taking such emergency action as the situation warrants. A current paper or electronic copy of this handbook must be carried aboard the aircraft for all Flight Inspection missions. Since this handbook is a required document, carrying FAA Order 8200.1, USSFIM is optional.

1.14 DEFINITIONS. This handbook contains policy statements and guidance material. Directive verbs are used.

a. **Use MUST** when an action is **mandatory.**

b. **Use WILL** when it is **understood the action will be taken.**

c. **Use SHOULD** when an action is **desirable but not mandatory.**

d. **Use MAY** when an action is **permissible.**

1.15 UNIT OF MEASUREMENT. Unless otherwise stated, the following references are used throughout this order:

Term(s)	**Referenced to**
Mile	Nautical Miles
Airspeeds and Ground Speeds	Knots
Bearings, Headings, Azimuths, Radials Direction Information and Instructions	Magnetic North
RNAV Tracks	True North
Altitudes	Absolute Altitude True Altitude

CHAPTER 2

FLIGHT INSPECTION AUTHORITY, RESPONSIBILITIES, AND CREW DUTIES

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CHAPTER 2

FLIGHT INSPECTION AUTHORITY, RESPONSIBILITIES, AND CREW DUTIES

2.10 AUTHORITY. The flight inspection crew is authorized to:

a. **Perform flight inspections** of air navigation systems to determine that such systems meet applicable tolerances contained in this handbook and that the facility will support the associated instrument flight procedures.

b. **Perform surveillance of aeronautical services.**

c. **Issue NOTAM(s)** subject to the limitations contained in Chapter 5, Section 1**.**

d. **Certify the signal-in-space** of a facility based on the result of the flight inspection.

e. **Report hazards** encountered during a flight inspection of any type.

f. **Take appropriate procedural actions.**

g. **Review, Verify, and Edit** topographic, cultural, and obstruction data depicted on FAA VFR Aeronautical Charts for accuracy and navigational usefulness.

2.11 RESPONSIBILITY. The flight inspection crew is responsible for:

a. **Conducting flight inspections** in accordance with the procedures established by this handbook.

b. **Determining the adequacy of the system** to meet its required functions.

c. **Analyzing and evaluating** the flight inspection data to enable a status classification to be assigned.

d. **Certifying the signal-in-space of a NAVAID** in accordance with the tolerances prescribed in this handbook.

e. **Coordinating with engineering,** maintenance, and/or Air Traffic Operations personnel.

f. **Reporting the flight inspection results** and status of the system to the appropriate authority.

g. **Providing the technical details** for NOTAM(s) based on the flight inspection data.

h. **Making recommendations to military installation commanders** regarding NOTAM(s) for military services.

i. **Verifying the accuracy of NOTAM(s)** and published information.

j. **Flight inspecting instrument flight procedures** prior to their publication.

k. **Optimizing facility performance** during flight inspections requiring adjustments.

l. **Determining that RNAV procedural leg types meet the intent** of the instrument procedure.

m. **Conducting flight inspection of non-public procedures** IAW this handbook and proponent's approved criteria. Documenting findings for Flight Standards Service (AFS) use in approving or denying the procedure.

2.12 DUTIES

a. **Pre-Mission Procedures.** Prior to departing on a flight inspection mission, the following must be accomplished:

(1) PIC Duties:

(a) Ensure that all necessary pre-mission briefings, flight release, and coordination are accomplished.

(b) Brief aircrew, to include flight inspection specific profiles

(c) Obtain flight release from Flight Inspection Central Operations

(d) Coordinate as necessary with Technical Operations

(e) Coordinate as necessary with Air Traffic

(f) Conduct safety briefing

(g) Comply with any additional requirements of TI 4040.50

(h) Ensure that all documentation necessary to accomplish special flight inspection is aboard the aircraft (e.g., special requests and procedures packages).

(i) Check publications IAW Chapter 4, Paragraph 4.34. The PIC may delegate this responsibility to SIC or Mission Specialist.

(2) SIC Duties: Perform those duties as assigned by the PIC.

(3) **Mission Specialist Duties**. On board the aircraft assigned the Mission Specialist will:

(a) **Before *Departure***

1 Ensure the operational status of the aircraft Flight Inspection System (FIS) and associated equipment to support the scheduled mission, i.e., plotter/ recorder, oscilloscope, receivers, spectrum analyzer, television positioning system, RFI tracking equipment, etc.

2 Review the Aircraft Flight Log (AFL), VN Form 4100-8, for aircraft equipment discrepancy write-ups, and recent maintenance actions that might impact the FIS capability.

3 Verify that current navigational aid facility data and AFIS software are available and loaded into the AFIS memory.

4 Ensure that necessary auxiliary equipment and supplies are operational and stowed aboard the aircraft to support the scheduled mission.

5 Ensure that all documentation required to support the scheduled mission is aboard the aircraft.

6 Ensure the calibration book is aboard the aircraft and is current.

7 Check escape hatches

8 Check flight inspection equipment circuit breakers

9 Check oxygen mask

10 Conduct AFIS self-test

11 Stow movable work surfaces

12 Clear cabin aisle

13 Secure seatbelt/ shoulder harness

14 Brief trainee/ passenger

15 Assist the PIC as directed

(b) **Before *Landing***

1 Stow moveable work surfaces

2 Secure cabin

3 Secure seatbelt/shoulder harness

b. **Mission Procedures.** The following procedures must be accomplished during a flight inspection mission:

(1) **Flight Inspection Coordination.** When conducting flight inspection operations in controlled airspace, proper coordination is imperative for safe and efficient operations. Specific requirements for coordination with air traffic are contained in FAA Order 8240.41, Flight Inspection/ Air Traffic Coordination. Additional guidance is provided in FAA Orders 8200.1, United States Standard Flight Inspection Manual (USSFIM), and 8240.32, Request for Flight Inspection Services. All crewmembers must comply with the requirements of these orders, using the specified terminology/ phraseology for all flight inspection activities.

(2) **Data Validity.** If validity of data is suspect, contact the Aeronautical Data Services Team. Use data provided by the Aeronautical Data Services Team only.

(3) **Pilot & Co-Pilot Crew Procedures:**

(a) The left-seat pilot will maneuver the aircraft, assist with communications/ coordination, and maintain air traffic vigilance.

(b) The right-seat pilot will assist in looking for other air traffic, communicate and coordinate maneuvers with Air Traffic Control (ATC), program the Area Navigation (RNAV) and Flight Management System (FMS), and file flight plans.

(c) To ensure the most accurate measurement of the navigational signal-in-space, it is imperative that the aircraft be maneuvered in a smooth and stable manner. When possible, operate the aircraft coupled to the flight director and autopilot system. When viable data cannot be obtained due to weather conditions, terminate the inspection of that facility until more favorable conditions prevail.

(4) Mission Specialist Procedures are as follow:

(a) Program AFIS operations for all flight inspection measurements in coordination with the PIC/ SIC and document AFIS results. AFIS default plots on the plot control page constitute the MINIMUM recorder traces required for all inspections. If any default traces are turned off, annotate the recordings, stating the reason and that the PIC was advised.

(b) Analyze facility performance data. Manually analyze and report as necessary facility parameters in areas not measured by AFIS. Results that require facility adjustment, or any out-of-tolerance results, should be coordinated with the PIC before reporting to facilities maintenance.

(c) Conduct flight inspection air/ ground communications with facility maintenance personnel as required to complete mission.

(d) Ensure all parameters requiring AFIS operation during the flight inspection mission are completed to fulfill the requirements listed in this document and other appropriate directives.

(e) Flight inspection without a back-up flight inspection navigational receiver is permissible; however, FAA maintenance must defer the discrepancy before the aircraft is operated. If a receiver fails in flight, the inspection may continue and the discrepancy deferred once the aircraft is on the ground. Ensure all receivers required for the mission pass the self-test. Back-up receivers should be operational before a commissioning inspection is attempted.

(f) During Radio Frequency Interference (RFI) missions, the Mission Specialist will operate the RFI tracking equipment, relaying bearing information to the pilots, allowing them to maneuver the aircraft toward the area generating the RFI.

(g) Aural verification of ILS or VTAC transmitted identification is required. The Pilot may perform the check, but the Mission Specialist retains responsibility. Aural monitoring is required as follows:

1 Localizer ILS-1 maneuvers (See Chapter 15) in worst case configuration during all inspections, in normal configuration during Periodic inspections, and on all runs for Standard Service Volume and Expanded Service Volume during Commissioning and Reconfiguration inspections.

2 VOR/ TAC (See Chapter 11)during coverage inspections and on at least one procedural radial or ARR on all types of inspections.

c. Post Mission Procedures

(1) Post Mission Briefing and Coordination:

(a) The PIC must ensure that all flight inspection results and facility performance parameters are provided to the responsible facility maintenance and/ or air traffic personnel. Every effort should be made to restrict, rather than remove from service, a facility or instrument procedures when out-of-tolerance conditions are found. The PIC must take Notices to Airmen (NOTAM) action as necessary. This action should be accomplished through a Flight Service Station (FSS), Flight Inspection Operations Center, National Flight Procedures Group, or appropriate military authority if applicable. For specific guidance see Chapter 5, Paragraph 5.12. If a NOTAM is issued, the PIC must verify issuance within 24 hours..

(b) The Mission Specialist must participate in, or conduct briefings with facility maintenance personnel regarding the technical aspects of facility performance when required.

(2) Records and Reports. After flight inspection of a navigational aid facility, record and report the results in accordance with Order 8200.1; Order 8240.36, Flight Inspection Report Processing System; and guidance specified by the Flight Inspection Policy Team. The division of post mission responsibilities will be as follows:

(a) The PIC must:

1 Determine the acceptability of procedure packages and decide if the navigational aid supported the instrument procedure.

2 Ensure all Aircraft Log Book (ALB) entries reflect aircraft status, and Daily Flight Logs (DFLs) accurately reflect facility status and the flight inspection work completed.

3 Ensure all Facilities and Equipment (F&E) job numbers and/ or reimbursable Memorandum of Agreement (MOA) information is annotated on the DFL.

4 Submit a flight inspection report for those facilities that do not require recordings or input from the Mission Specialist, i.e., radar, NDB facilities, etc.

5 Sign all the Flight Procedures Control Forms (PCs), the Expanded Service Volume Form 6050-4, and other appropriate documents and FAX them, along with the DFL (if not submitted online), to Flight Inspection Central Operations (FICO).

(b) **The SIC must** perform duties as directed by the PIC to assist in the completion of the Flight Inspection Itinerary.

(c) **The Mission Specialist must**:

1 Ensure all recordings and supporting documentation are complete and accurately reflect facility performance.

2 Complete a flight inspection report for the co-signature of the PIC in accordance with Order 8240.36 for those facilities that require recorded data.

3 Ensure all flight inspection recorded data are properly annotated and forwarded to the Flight Inspection Records Team in accordance with Order 8200.1, Chapter 5.

4 Perform other duties as directed by the PIC to assist in the completion of the Flight Inspection Itinerary.

(d) **Facility Data Sheet.** When flight inspection data results require a change in the Airport/ NAVAID (AVNIS) Database or the National Flight Data Center (NFDC) Database, (i.e. change in facility status, restrictions, receiver checkpoints, etc), complete form 8240-20 IAW Appendix 2 of Order 8240.52, Aeronautical Data Management.

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CHAPTER 3

SPECIAL REQUIREMENTS

3.10 INTRODUCTION. This chapter describes the concept for the special requirements of the aircraft, flight inspection crewmembers, and airborne and ground support equipment used for flight Inspection.

3.11 AIRCRAFT. Aviation System Standards and the U.S. Military must identify specific requirements based on their operational needs. Appropriately equipped aircraft and helicopters, from service proponent or other sources, may be used when required to complete flight inspection requirements. The general characteristics of a flight inspection aircraft should be as follows:

a. **Equipped** for night and instrument flight.

b. **Sufficient capacity** for a flight inspection crew, observers, ground maintenance and/or installation personnel, and required electronic equipment with spares.

c. **Sufficient range and endurance** for a normal mission without reservicing.

d. **Aerodynamically stable** throughout the speed range.

e. **Low noise and vibration level.**

f. **Adequate and stable electrical system** capable of operating required electronic and recording equipment and other aircraft equipment.

g. **Wide speed and altitude range** to allow the conduct of flight inspections under normal conditions as encountered by the users.

h. **Appropriate for modifications** for flight inspection of new and improved navigation services.

3.12 FLIGHT INSPECTION CREWMEMBERS No person may serve as Pilot-In-Command (PIC) or Mission Specialist of a Flight Inspection aircraft engaged in flight inspection activities unless they meet the following requirements:

a. Each person must have completed the prescribed Flight Inspection Training. They must hold a Certificate of Authority, FAA Form 8430-9.

b. Meet recent flight experience requirements of TI 4040.50, Aviation System Standards Operations Manual.

c. The appropriate Manager/ Chief Pilot must determine a crewmember's recency of experience and ability to accomplish the assigned scheduled mission requirements.

3.13 AIRBORNE AND GROUND SUPPORT flight inspection equipment must be calibrated to a standard traceable to the National Institute of Standard and Technology.

a. **Automated Flight Inspection System (AFIS).** AFIS with GPS position updating is to be considered the primary flight inspection method. See TI 4040.55, AFIS Technician's User Manual, and 4040.56, AFIS Pilot Users Manual, for AFIS operation.

b. The calibrated flight inspection receivers are the standard and must be used for all applicable evaluations of flight inspection tolerances.

c. **Other AVN Approved Systems (Portable/Utility Class) and Methods (Theodolite, RTT, DGPS or Manual)** may be used unless prohibited by other guidance for flight inspection. These systems/ methods must not be used solely to bypass the need for facility data of sufficient accuracy to support AFIS. Portable/ Utility class equipment, installed in aircraft for the purpose of conducting flight inspections, must be installed in accordance with AVN approved procedures.

CHAPTER 4

FLIGHT INSPECTION TYPES, PRIORITIES, INTERVALS, PROCEDURES

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CHAPTER 4

FLIGHT INSPECTION TYPES, PRIORITIES, INTERVALS, PROCEDURES

SECTION 1

TYPES AND PRIORITIES OF FLIGHT INSPECTIONS

4.10 INTRODUCTION. Official flight inspections are of five basic types: site evaluation, commissioning, periodic, special, and surveillance.

4.11 SITE EVALUATION: A flight inspection to determine the suitability of a proposed site for the permanent installation of a facility. It may include checks normally made during a commissioning inspection and any additional tests which may be required.

4.12 COMMISSIONING: A comprehensive flight inspection designed to obtain complete information as to system performance and to establish that the system will support its operational requirements.

Commissioning of Facilities or Services on Incomplete Runways. Occasionally, a commissioning inspection is performed prior to the completion of runway construction activities, including but not limited to, painting and lighting. When this occurs, a Special Flight Inspection should be performed after completion of the runway work and before the facility is placed into service. The flight inspector performing the commissioning check must request the Special inspection, specifying the items needing inspection. If, in the flight inspector's judgment, the remaining runway work is negligible and no Special inspection is required before facility use, the condition must be documented on the Daily Flight Log.

4.13 PERIODIC: A regularly scheduled flight inspection to determine that the system meets standards and supports the operational requirements.

4.14 SPECIAL FLIGHT INSPECTIONS are inspections performed outside the normal periodic interval. They may be used to define/evaluate performance characteristics of systems, subsystems, or individual facilities. Facilities maintenance personnel must be responsible for coordinating with flight inspection which checks are to be accomplished, based on their requirements and type of maintenance performed on the equipment. Special inspections are also performed when radio frequency interference (RFI) degrades intended facility services.

a. **USAF Air Traffic Control and Landing System (ATCALS) evaluation requirements.** ATCALS evaluation inspections require a minimum of a periodic-with-monitors type profile for ILS and periodic-type profile for all other facilities.

b. **USAF Deployable (Mobile) ATCALS (DATCALS).** Flight inspections of DATCALS deployed to support an exercise or operational readiness inspection (ORI), and **not intended for actual use**, are considered special inspections. These facilities will be inspected to the extent necessary to assess the mobile unit's deployment capability. The procedures and checklists contained in Chapter 24 will normally be accomplished. The ORI/exercise team chief will be responsible, after consulting with the flight inspector, for assessing the facility and determining if the unit could operate during an actual deployment. The facility classification will be "unusable" due to the limited nature of the check.

c. **Unapproved Facilities.** Inspections of facilities not approved for use (equipment under test, facilities without monitors, etc.) will be special inspections. Since these facilities cannot be commissioned for IFR use, the status will be unusable. Items inspected will be largely dependent on the customer's request.

d. **Facility Removal and Replacement.** When the equipment replaced is the same type and configuration as the former and located on the same physical site, including antenna location, a special check is required. Required items for an antenna change in each chapter must be accomplished as a minimum. Additional requirements of such a check will be jointly determined by the flight inspector and facilities maintenance.

e. **New or Modified Equipment Testing.** All testing of new or modified types of equipment that require flight inspection support must be coordinated with Flight Inspection Policy. Flight Inspection Policy will determine if personnel from that office will participate in the testing to both ensure the adequacy of the testing and scope of any flight inspection procedural changes required to support the equipment. This encompasses Operational Testing and Evaluation (OT&E), First Article Testing, Developmental Test and Evaluation (DT&E), and similar formal testing; it does not include normal flight inspection of subsequent installations. If any doubt exists about the need for coordination, contact Flight Inspection Policy.

f. **Radio Frequency Interference (RFI).** All inspections to confirm or locate natural or man-made interference to Communication, Navigation, or Surveillance (CNS) systems using flight inspection aircraft must be performed by qualified flight inspection personnel; spectrum management specialists may assist in the mission as necessary. A flight inspection report on the affected system must be completed.

g. After Accident. This inspection is performed at the request of the accident coordinator/investigator to verify that system performance is satisfactory and continues to support instrument flight procedure(s).

(1) Response. This inspection has a priority of 1a and should be accomplished as soon as possible.

(2) Preflight Requirements. The flight inspector must obtain the following information:

(a) Equipment configuration at the time of the accident, i.e., the receiver(s), transmitter(s), or radar channel(s) in operation.

(b) Instrument flight procedure(s) used.

(c) Any additional information that may aid in the inspection analysis.

(3) Inspection Procedure(s)

(a) Coordinate with maintenance to configure the system as indicated in paragraph b(1).

(b) Complete periodic checklist requirements. Only the equipment and instrument flight procedures used by the accident aircraft need to be checked. A VOR or TACAN alignment orbit is not required. Do not make any facility adjustments during the after accident inspection. Any adjustments must require a separate special inspection.

(c) If a system or procedure has no periodic inspection requirements, evaluate performance in the area in which the accident occurred.

(d) Complete any additional items requested by maintenance, air traffic control personnel, the accident coordinator, or the commander at a military facility.

(e) Where an accident involves contact with the terrain or a manmade obstruction, confirm the procedural controlling obstruction by map study or flight evaluation.

(4) Dissemination of After Accident Information. All flight inspection findings or other pertinent accident investigation information must be restricted to the cognizant accident coordinator/ investigator, maintenance, and air traffic personnel. Results of the flight inspection must be given to the FAA Inspector-in-Charge (IIC) as soon as possible. A flight inspection report must be filed in accordance with current directives.

h. **Reconfiguration.** A special flight inspection requested by maintenance when modifications or the relocation of a facility affect the radiation pattern of the facility. Antenna changes to different type antennas must be classified as a reconfiguration inspection. All commissioning checks should be performed following a facility reconfiguration, except those that are not required as determined jointly by flight inspection and facilities maintenance personnel. Commissioning tolerances must be applied.

i. **Inspections of Shipboard TACAN(s)** are considered complete at the termination of the inspection. Any subsequent inspection must be a new "special" inspection.

4.15 SURVEILLANCE. An ongoing observation of individual components of commissioned systems, procedures, or services. This inspection encompasses spot checks of individual components observed during normal flight operations. No reporting is required unless a discrepancy is found. An out-of-tolerance or unsatisfactory condition found on a surveillance inspection requires a Daily Flight Log entry, report, and, if necessary, NOTAM action. **Surveillance of Aeronautical Services.** During the course of routine flight operations, flight inspection personnel must be alert for items which are unusual, substandard, or possibly hazardous.

a. **Inspections.** Inspections may include, but are not limited to, the following:

(1) Condition of runways, taxiways, and ramp areas.

(2) Runway, taxiway paint markings, and position signs missing or deteriorated to the extent that visual guidance is obscured or missing.

(3) Conditions which may lead to runway incursion by aircraft, vehicles, or pedestrians.

(4) Construction activity at airports which is a hazardous condition or might affect NAVAID performance.

(5) New obstructions in the instrument approach area which might become the controlling obstruction or constitute a hazardous condition.

(6) Brush or tree growth obstructing the view of approach lights.

(7) Obscured or broken runway or obstruction lights.

(8) Other hazardous situations (e.g., bird hazards).

(9) Air traffic services (e.g., clearances, flight plans, communications).

(10) Other services (e.g., weather bureau services or other airport support services).

b. **Reports.** See FAA Order 8240.36, Flight Inspection Report Processing System (latest edition).

4.16 PRIORITIES OF FLIGHT INSPECTIONS. The priorities listed below must be used to determine which mission will be supported first when two or more requirements are competing for limited flight inspection resources. All inspections should be scheduled to make the most effective use of aircraft and aircrew. Schedulers should consider weather; maintenance team availability; other facilities enroute; impact on both the airport and NAS; and Technical Operations Facilities, Service, and Equipment Profile (FSEP) Response Codes when scheduling missions.

Priority	Type of Service
1a	Accident Investigation, RFI impacting NAS services, any facility which has exceeded its inspection interval, inspection of facilities in support of military contingencies, or other nationally directed military deployments.
1b	Restoration of a commissioned facility after an unscheduled outage, restoration of CAT II/ III ILS approach minimums, or inspection of NAVAID(s) in support of military operational readiness and JCS directed exercises.
1c	Flight inspection of reported malfunctions.
1d	Restoration of a commissioned facility following a scheduled shutdown or inspections supporting DOD NAVAID evaluations (USAF TRACALS).
2a	Site evaluation.
2b	Commissioning inspection of a new facility or new instrument flight procedures.
3a	Periodic inspections.
3b	Restoration of standby equipment (except CAT II/ III ILS, see priority lb).
3c	Navigational Aids Signal Evaluator (NASE) evaluations
3d	Restoration of VFR training facilities following a scheduled or unscheduled outage.

SECTION 2

FREQUENCY OF PERIODIC FLIGHT INSPECTIONS

4.20 INTRODUCTION. This section prescribes the minimum frequency of periodic flight inspections. More frequent inspections may be made when deemed necessary or as requested by the owner or organization responsible for the operation of the facility.

a. Intervals. Table 4-1 specifies the intervals between scheduled periodic flight inspections. Due dates for periodic inspections are based on this schedule. Military, foreign, and MOA systems, facilities, and procedures may have unique requirements and non-standard inspection intervals. All records and reports will reflect the actual date(s) of the inspection and will specifically denote the date of completion. The next periodic inspection will be predicated on the actual date of completion.

(1) Due date window for facilities with a 90-day periodicity is from 15 days before to 15 days after the due date.

(2) Due date window for all other facilities, systems, and procedures is from 60 days before to 60 days after the due date.

(3) Due date window for VFR Aeronautical Charts is from 120 days before to 120 days after the due date.

NOTE: The VFR Flight Inspection Program will implement VFR Chart periodicity over a period of years.

For the contiguous United States, the chart periodicity is being implemented over the next several years. The periodic due date for each individual Sectional Aeronautical Chart and its associated Terminal Area and Flyway Chart is being established as the chart is inspected. Inspection and periodicity for the Aeronautical Charts outside the contiguous United States will be implemented in the future. Helicopter and Special VFR Charts have no periodicity and are updated as determined by NACO.

b. Scheduling

(1) NAVAID(s) such as VORTAC, VOR/ DME, ILS, MLS, etc., must be flight inspected as a service with the same due date and inspection interval for all component facilities.

(2) The inspection priority must be raised to 1a when the system, facility, or procedure has exceeded the end of the due date window.

(3) Periodic inspections are considered complete when all scheduled checks are accomplished except as noted below. When flight inspection of all Standard Instrument Approach Procedures (SIAP(s)) cannot be completed within the periodic window and extension, the periodic inspection will be documented as complete, as directed by the Flight Inspection Central Operations (FICO) Manager.

Special inspections must be established to ensure the remaining SIAP(s) are completed. In the event the SIAP(s) are not checked by the end of the periodic window/ extension, the FICO must initiate NOTAM action to remove them from service. The SIAP(s) must be restored by a special flight inspection.

(4) **Progressive Inspections.** The requirements for periodic inspections are specified in a checklist in each chapter of this handbook. Partial or progressive inspections may be conducted, provided all of the individual periodic checklist items are satisfied within the due date window.

4.21 EXTENSION OF SERVICES OVERDUE PERIODIC INSPECTION. When the inspection of a commissioned NAVAID or SIAP is not completed within the due date window, the window may be extended. The flight inspection priority of a NAVAID or SIAP in an extension is the same as an overdue NAVAID or procedure.

a. **The periodic flight inspection window for a ground NAVAID** may be extended an additional seven (7) calendar days if the FICO and regional facility maintenance engineering agree that no conditions exist which could adversely affect the safety of flight.

b. **The periodic flight inspection window for all SIAP(s)** may be extended an additional thirty (30) calendar days providing:

(1) A review of the SIAP is accomplished by a Flight Inspector and;

(2) Flight Inspection Central Operations (FICO), by coordination with regional or local airport personnel can determine that no known environmental (i.e., construction or natural growth) changes have occurred which could adversely affect the procedure and;

(3) The National Flight Procedures Office agrees that an extension of the window will not adversely affect the safety of flight.

4.22 NAVAIDS TEMPORARILY OUT-OF-SERVICE

a. **Use the priority listed in Section 1 of this chapter when a restoration inspection is required.** The next periodic inspection must be predicated on the completion date of an inspection which satisfies all periodic checklist requirements.

b. **When a portion of a NAVAID is restored to service**, the periodic due dates must be established in accordance with Paragraphs 4.20a and 4.23.

c. **Standby Equipment or Associated NAVAID.** When flight inspection of standby equipment or an associated NAVAID is required but cannot be accomplished, the periodic inspection will be considered complete if the standby equipment or associated NAVAID is out-of-service (awaiting parts, etc.), or removed from service (due to an uncorrectable discrepancy, etc.)

The standby equipment or associated NAVAID must be restored to service by the successful completion of a flight inspection which satisfies all periodic requirements (including monitors, where applicable).

4.23 RHO-THETA RECEIVER CHECKPOINTS. When periodic or special flight inspections of ground or airborne receiver checkpoints cannot be completed, the inspection must be considered complete. The following actions will be taken:

a. **The flight crew will document** the required inspection as complete on both the Daily Flight Log (DFL) and the flight inspection report. Enter in Remarks those checkpoints that were not checked.

b. **The FICO will:**

(1) Schedule a special inspection to complete the checkpoints within the established facility periodicity.

(2) Take appropriate NOTAM action to remove the receiver checkpoints from service if the special inspection is not completed within the established facility periodicity. Notify the airport manager that the ground receiver checkpoints must be removed or covered.

4.24 PERIODIC FLIGHT INSPECTION INTERVALS. The schedule for periodic flight inspections will be in accordance with Table 4-1. **Establishing the Interval:**

a. **Commissioning.** Inspect newly commissioned precision facilities initially at a 90, 180, and 270-day interval and then maintain the schedule established in Table 4-1. For PAR, each runway served and alternate angle or touchdown point used must be inspected on the 90 and 180-day checks. For ILS, a Periodic with Monitor check is required for the initial 90, 180, and 270-day checks. This requirement also applies to the glide slope, but not the localizer when a glide slope is added to a localizer-only or LDA/ SDF facility.

b. **Specials other than reconfigurations.** Facilities may be restored to the existing periodicity without further checks once the special is complete and deemed satisfactory by Air Traffic Technical Operations engineering or maintenance personnel. The periodic due date may be updated if all system periodic requirements for the next scheduled periodic inspection are completed during any special inspection.

c. **Reconfiguration of Precision Approach Services.** Reconfigured precision approach services must initially be checked at 90 days. For ILS, a full periodic with monitor reference check on both localizer and glide slope facilities must be scheduled as part of this special, and the periodic with monitors must be updated on the Daily Flight Log (DFL). The next periodic due date will be at the 270-day interval. For PAR, each runway served and alternate angle or touchdown point used must be inspected on this check.

4.25 ILS MONITOR (OR REFERENCE) INTERVALS. ILS monitor inspection intervals are twice the established facility periodic interval listed in Table 4-1.

Table 4-1
Basic Schedule for Periodic Flight Inspection
(all intervals are in days)

Approach Obstacle Verification	540
SIAP	540 (5)

Facility	**Interval**
ILS/ LDA/ SDF w/GS	270 (2)
Localizer Clearances at LSA	1,080
MLS	270
MMLS	180 (3)
PAR	270
ASR	540
DF	540
LDA/ SDF/ LOC only	540 (2)
NDB (UHF, LF/ MF)	540
VOR, VORTAC, TAC	540 (1)
VOR, VORTAC, TAC	1,080 (4)
VOT	540
DME, NDB facilities associated with an Instrument Approach Procedure, Marker Beacons, Communications, VGSI, and Approach Lighting Systems	Inspect these facilities at the same interval as the system or procedure they support.

VFR Aeronautical Charts:

Sectional Aeronautical Chart and its associated Terminal Area and Flyway Chart	1,080

NOTES:

(1) 540 days for facilities (VOR or TACAN of a VORTAC) which support a SIAP or receiver checkpoint. An alignment orbit is required every 1,080 days for all facilities.

(2) Monitors required every other inspection. See Paragraph 4.25.

(3) SIAP check required every 360 days.

(4) 1,080 days for facilities that do not support a SIAP or receiver checkpoint

(5) Except for an obstacle evaluation, GPS-based SIAP(s) have no periodic inspection requirement. The periodic requirement to conduct an obstacle verification may be evaluated independent of a SIAP inspection.

SECTION 3

GENERAL FLIGHT INSPECTION PROCEDURES

4.30 INTRODUCTION. Sequence of events encountered by the flight inspector in the performance of the flight inspection mission is generally as follows:

a. Request for flight inspection

b. Scheduling of flight inspection

c. Preflight preparation

d. Actual flight inspection

e. Analysis and evaluation

f. Post flight review and reporting

4.31 REQUEST FOR FLIGHT INSPECTION. Site, commissioning, and some special flight inspections must be requested by authorized personnel. Requests are not required for periodic flight inspections.

a. Status of Equipment. Initiate the flight inspection request when the inspection requirement is known and finalize the schedule when the facility is ready for flight inspection.

b. Notification. Flight Inspection Central Operations (FICO) will notify the appropriate facility maintenance personnel of the estimated time of arrival (ETA) of the flight inspection aircraft. As much advance notification as possible should be provided for a site evaluation, commissioning inspection, periodic with monitors, or inspections requiring maintenance support.

An ILS periodic inspection without monitors does not require pre-coordination with maintenance personnel. This inspection should be conducted on the transmitter in operation. If an out-of-tolerance condition is found, notify maintenance of the discrepancy(ies) found and inspect the standby equipment. NOTAM(s) must be issued if discrepancies are not corrected**.**

4.32 PREFLIGHT INSPECTION PREPARATION. A thorough and complete understanding between Facilities Maintenance and the flight inspection crew is essential for a successful flight inspection. The flight inspector and the person-in-charge of the facility are jointly responsible for the required coordination before, during, and after the flight inspection. The flight inspector will brief the Facilities Maintenance personnel of intended actions prior to commissioning flight inspections and for special circumstances.

Prior to each VFR Aeronautical Chart flight inspection mission, the inspector(s) will meet with the NACO VFIP coordinator and cartographers to discuss any issues pertinent to the inspection.

a. Facilities Maintenance Personnel. Efficient and expeditious flight inspections require preflight preparations and actions of facilities maintenance personnel. These preparations include the following actions:

(1) Ensure Air Traffic is notified when a facility will be unusable during a flight inspection and an appropriate NOTAM or ATIS information alerts users that flight inspection is in progress.

(2) Provide adequate two-way radio communications equipment and power source at facility sites.

(3) Ensure that all facility equipment is calibrated in accordance with technical orders.

(4) Ensure personnel will be available to make corrections and adjustments.

(5) Provide transportation to move flight inspection equipment and personnel.

(6) Provide accurate facility data for new or relocated facilities.

b. Flight Personnel. The following actions must be accomplished prior to the flight inspection:

(1) Ensure that all flight inspection equipment is calibrated and operational.

(2) Brief Facilities Maintenance personnel.

(3) Conduct crew briefing.

(4) Obtain maps, charts, equipment, data sheets, etc.

(5) Review the status, limitations, and characteristics of the facility. Ensure that all publications and records agree with the results of the latest flight inspection, and all applicable restrictions are accurate.

(6) Brief the air traffic control (ATC) personnel about the areas and altitudes to be flown during the flight inspection maneuvers and of possible transmitter changes.

4.33 FLIGHT INSPECTION. Perform the flight inspection in accordance with the procedures in Chapter 6 of this handbook.

a. Operator Proficiency. During flight inspections, qualified personnel will be assigned so operator deviations will not be confused with equipment performance.

b. Standby Equipment. It is necessary to know which system or transmitter is operating so the performance of each can be determined.

(1) When one unit of a dual equipped facility is found out-of-tolerance, it must be identified and removed from service. The unit can be identified as transmitter number 1 or 2, channel A or B, serial number, etc.

(2) Some inspections may only require the checking of one equipment. The details for each type of facility are included in the appropriate facility checklists.

c. Standby Power

(1) The flight inspector must check the facility on standby power during a commissioning flight inspection if standby power is installed. If a standby power system is installed after the commissioning flight inspection, the flight inspector must check the facility on standby power during the next regularly scheduled periodic inspection. The flight inspector must make comparative measurements to ensure that facility performance is not derogated on the standby power system and that all tolerance parameters for the specific inspection are met. Standby power checks are not required on facilities powered by batteries that are constantly charged by another power source.

(2) It is not necessary to recheck a facility when the standby power source is changed.

d. On-Station Philosophy. Flight inspectors will assist in resolving facility deficiencies and restoring the facility to service prior to departure.

e. Restrictions. When a facility parameter does not meet established tolerances or standards, the flight inspector must perform sufficient checks to determine the usable area of the facility. This data will be the basis of restrictions, NOTAM(s), and procedural redesign.

f. Spectrum Engineering Services Restrictions. Facilities assigned a spectrum management restriction will be classified as “Restricted” and identified on the Facility Data Sheet. This restriction remains in effect even when the facility performance indicates no interference exists. Do not remove published spectrum management restrictions based on flight inspection results.

g. **Adjustments.** Requests for adjustment must be specific. The flight inspection crew will furnish sufficient information to enable maintenance personnel to make adjustments. Adjustments which affect facility performance must be rechecked by flight inspection. Flight inspection certification must be based on facility performance after all adjustments are completed.

h. **Incomplete Inspections.** When an inspection on a commissioned facility is halted with the equipment in an abnormal condition due to aircraft malfunction, weather, etc., maintenance personnel and the flight crew will discuss the facility condition and the remaining checks. If the facility maintenance handbooks allow adjustments of the facility parameter without flight check, and adequate references provide the ability to return to a previously certified setting, the equipment may be returned to service. The inspection will be classified as incomplete until the remainder of the checks is completed. When a prescribed inspection checklist item cannot be adjusted within tolerance, the inspection will be terminated, facility status changed to unusable, and the inspection classified as incomplete until the remainder of the checks are completed.

i. **Hazardous and Misleading Information (HMI).** During some flight inspections, ground equipment is configured in abnormal conditions radiating false information that may be misleading to the pilot. Some of these conditions do not produce a "flag" indication. For ILS facilities, studies have shown that the most effective warnings to the pilot are those that produce a flag. IAW FAA Order 6750.49, FAA localizers are required to be turned OFF when glide slopes are transmitting HMI, and glide slopes must be OFF when the localizer is producing HMI. This practice does not apply to routine monitor checks (PM). These actions are backed up by NOTAM action verified by other than the NOTAM originator. Checks requiring these configurations are identified in this handbook with the following placard:

WARNING
HAZARDOUSLY MISLEADING INFORMATION
Misleading information is produced by this configuration. Ensure NOTAM is active. Monitor ATC communications for improper approach clearance to other aircraft.
WARNING

Flight inspection crews must check for applicable NOTAM(s) remind Maintenance of required shutdowns as needed, and monitor ATC communications to other aircraft. If ATC clears an aircraft to use the NAVAID, immediately notify them of the facility's unusable status.

4.34 ANALYSIS AND EVALUATION

a. **Flight inspection data must be analyzed and evaluated by flight inspection** using the tolerances specified in this handbook. Recordings made during the flight inspections are the permanent records of facility performance.

b. **Copies of flight inspection recordings for engineering analysis** may be obtained from the Flight Inspection Records Team. This is a limited capability and should not be used routinely.

c. **VFR Aeronautical Chart inspectors must record their notes** on a NACO-annotated VFR chart field sheet. Field sheets are considered source data and must be retained and archived by NACO.

d. **Alignment Convention.** The alignment error of omni-directional type facilities (VOR, TACAN, DF, NDB, ASR, etc.) will be computed through algebraic addition. The azimuth reference (AFIS, theodolite, map) will be assigned a Positive (+) value, and the azimuth determined by the ground facility will be assigned a Negative (-) value. Thus, with a received VOR radial value of 090.5 and an AFIS/map position of 090.0, the facility error would be –0.5°. Alignment errors may also be referred to as clockwise (positive) and counterclockwise (negative).

e. **System Evaluations.** Flight inspectors must make maximum use of the capability of the flight inspection system. When a special inspection encompasses only one part of a system, i.e., VTAC/ V, ILS/ G, or MLS/ A, the other parts of the system, i.e., VTAC/ T, ILS/ L, Markers, MLS/ E, and DME must be recorded and analyzed on a surveillance basis during appropriate maneuvers. Recorder traces that are set by default to the ON position should not be turned OFF unless they obscure other traces. No additional checks are needed to inspect the additional components, unless an out-of-tolerance condition is found.

f. **Publications Review.** As part of a periodic inspection, the flight inspector must review NOTAM(s) as well as the Airport/ Facility Directory (A/ FD), DOD IFR Supplement, U.S. Government-produced Approach Charts, and En Route Charts applicable to the facility/ procedure. The information available to users must be compared with Facility Data Sheets and chart legends to ensure accuracy of presentation. Report facility data discrepancies to Aeronautical Data Services Team and charting errors to the National Flight Procedures Office for correction.

4.35 POST FLIGHT INSPECTION ACTIONS. Upon completion of the flight inspection, the flight inspection crew must perform the following actions:

a. **Brief Facilities Maintenance personnel** concerning results of the flight inspection. Flight inspection must report all facility outages to appropriate personnel.

b. **Determine facility status.** Flight inspection must assign a status for the facility (see Chapter 5). Flight inspection must also notify the appropriate personnel of the facility status.

c. **Prescribe the issuance and/or cancellation of NOTAM(s)** based on the flight inspection (See Chapter 5).

d. **Prepare flight inspection reports** that are accurate and describe facility performance and characteristics. Reports must be completed in accordance with FAA Order 8240.36, Flight Inspection Report Processing System, latest revision.

e. **Ensure flight information is published.** The flight inspector must provide information for publication to the Aeronautical Data Services Team or the National Flight Procedures Office. They will notify the National Flight Data Center.

f. **Flight Information**

(1) **Receiver Checkpoints.** The following information must be provided for receiver checkpoints:

(a) Airport name

(b) Bearing in degrees magnetic from the VOR/ TACAN

(c) Location and description

(d) Distance and altitude

NOTE: Examples

1. Ground Checkpoint. Central City, Utah, (Municipal): 130^{o}, 4.5nm, runup pad Rwy 14.

2. Airborne Checkpoint. Mudville, Ohio, (Jones): 148^{o}, 5.7nm, over int Rwys 20 and 13; 3,300.

(2) **VOR Test Facilities (VOT).** The following information must be provided for a VOT:

(a) Facility name (and airport name)

(b) VOT frequency

(c) Type facility (area or airport)

(d) Information describing usable area

g. **VFR Aeronautical Charts**

(1) Consolidate and transfer all field notes to a clean chart, provided by NACO, for use by NACO cartographers.

(2) The consolidated notes will be turned over to NACO cartographers. Any issues arising from the inspection should be resolved with the NACO VFIP Manager and cartographers.

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CHAPTER 5

FACILITY STATUS CLASSIFICATION, NOTICES TO AIRMEN (NOTAM), RECORDS, AND REPORTS

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SECTION 1

FACILITIES STATUS CLASSIFICATION AND NOTICES TO AIRMEN (NOTAM)

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SECTION 2

RECORDS AND REPORTS

CHAPTER 5

FACILITY STATUS CLASSIFICATION, NOTICES TO AIRMEN (NOTAM), RECORDS, AND REPORTS

SECTION 1

FACILITY STATUS CLASSIFICATION AND NOTICES TO AIRMEN (NOTAM)

5.10 INTRODUCTION. Facility status classification and NOTAM(s) will indicate restriction(s) to the expected service volume and use of these facilities. This classification is directed only to the maintenance and/or operating agency. The NOTAM advises the user of any restriction to facility usage.

5.11 FACILITY STATUS CLASSIFICATION

a. **Operational Status**. The legal facility status of Usable or Unusable is broken down as follows:

(1) **Usable**. The facility is available for operational use and is either:

(a) **Unrestricted**. Providing safe, accurate signals-in-space conforming to established standards within the coverage area of the facility

(b) **Restricted.** Providing signals-in-space not conforming to established standards in all respects or in all sectors of the coverage area, but safe for use within the restrictions defined.

(2) **Unusable.** The facility is not available for operational use because it may provide potentially unsafe or erroneous signals, or signals of unknown quality.

b. **Flight Inspection Status (as reported on flight inspection reports)**. An assessment of the conformance of the facility performance to the required standards. Flight Inspection Status terminology mirrors that used by Operational Status, categorizing the facility performance as Unrestricted, Restricted, or Unusable (reference Paragraph 5.11a).

c. **International Facilities.** The FAA performs flight inspection of international facilities on a contract or agreement basis and for NAVAID(s) supporting U.S.-controlled instrument procedures. International facilities are maintained using the manufacturer's instructions manual and may have no procedures for accomplishing some checks required by this order. Checks performed under these conditions, while meeting the owning nation's procedural and maintenance certification requirements, do not encompass all checklist items required of U.S. facilities. Special procedures apply for checks performed under these conditions.

(1) **For facilities for which the FAA has flight inspection responsibility,** and **all checklist items** appropriate for the inspection **have been completed**, the flight inspector must assign a facility status.

(2) **For facilities for which the FAA has flight inspection responsibility, and all checklist items** appropriate for the inspection have **not been completed,** the flight inspector must discuss the uncompleted items with the facility manager and annotate the report with a statement that the assigned status applies only to the ICAO Annex 10 signal requirements in the as-left configuration. The assigned facility status must be as applied to usability.

(3) **If the check does not meet the requirements of this order or ensure the standards of ICAO Annex 10,** the host nation must assign the facility status.

(4) **For facilities inspected only to the extent that they support U.S. instrument procedures,** no status must be assigned, and the report must be annotated as to the limited inspection.

(5) **If any checklist items are not completed,** they must be listed on the report.

d. **Facility Coverage in Limited Areas.** When facility coverage throughout the flight inspection standard service volume cannot be checked due to inability to penetrate national borders or restricted airspace, the facility will be classified as RESTRICTED, with the report annotated as to the limited coverage flown. NOTAM and publications action will show the facility as UNUSABLE in the areas not checked.

5.12 NOTAM(s)

a. **General.** When a flight inspection necessitates NOTAM action, the flight inspector is responsible for initiating the NOTAM(s). All NOTAM(s), or proposed NOTAM(s), will be listed on the DFL. The flight inspector must verify within 24 hours that the appropriate NOTAM(s) were issued, amended, or cancelled. The inspector must verify that NOTAM(s) are published in the appropriate agency publication.

b. **Facility NOTAM(s), (NOTAM D).** The inspector must immediately initiate NOTAM action whenever a facility restriction is found or revised. Follow the procedures listed here when initiating NOTAM action for facilities that are part of the NAS.

NOTE: "High Impact" airports are generally the OEP airports, but for the purposes of this Order, they are as directed by FICO, and will normally correspond to the Operational Network (OPSNET) airports listed in Appendix 12, Daily Flight Log.

(1) **Safety of Flight (critical).** The flight inspector should initiate NOTAM action while airborne through a Flight Service Station (FSS), or other means as able. If the NOTAM(s) affect a High Impact airport, contact FICO as soon as practical (land if necessary).

(2) **Post Flight.** In a timely manner after landing, the flight inspector will pass the NOTAM and facility information to FICO. FICO will ensure the appropriate Operations Control Center (OCC) has been notified. When new facility restrictions are issued, or existing restrictions are changed or cancelled, FICO will notify the National Flight Procedures Group (NFPG). The NFPG will assess the impact on existing flight procedures.

NOTE: When a flight inspection results in new or changed facility data, the flight inspector must provide information for publication to the NFPG Data Office, initially by any means, but ultimately using FAA Form 8240-20, AVNIS Data Change Submission.

(3) **NOTAM(s) Affecting High Impact Airports.** Delay issuing non-critical NOTAM(s) until briefing FICO. FICO will brief Aviation System Standards Flight Inspections Operations Group **Director of Operations** of the potential impact on flight operations at the affected airport(s) and, in coordination with the flight inspector, determine what further action to follow.

(4) **Missed Runs, Out-of-Tolerance Conditions Found during QC or Product Review.** When a reviewer, during the QC process of reports or a product review, finds missed runs and/or out-of-tolerance conditions, they will immediately contact Flight Inspection Policy to get a second opinion on the finding(s). If a NOTAM is required, Flight Inspection Policy will contact the FICO for NOTAM initiation. If the NOTAM will affect a High Impact Airport, the FICO will immediately brief the Flight Inspection Operations Group Director of Operations prior to issuing the NOTAM. After the NOTAM is issued, the FICO will brief the appropriate OCC, Air Traffic, the NFPG, and the Technical Operations ground maintenance personnel of the affected facility. The FICO must verify within 24 hours that the NOTAM is available to a a pilot by normal means of dissemination.

c. **FDC NOTAM(s).** Flight Data Center (FDC) NOTAM(s) must be issued if a restriction affects instrument flight procedures, approach minimums, or category (CAT) II or III authorizations. The flight inspector will initiate any flight instrument procedure NOTAM(s) through the NFPG. This should be accomplished through the FICO, which will facilitate contact between the flight inspector and the appropriate flight procedures specialist. Internal processes are in place between FICO, the National Operations Control Center and the NFPG to ensure FDC NOTAM(s) resulting from reported facility outages, flight inspection results, or restriction changes are issued. The OCC automatically notifies the NFPG when there is a facility outage or restoration. The FICO will notify the NFPG when a flight inspection results in a new or canceled facility restriction.

d. **Facilities not requiring NOTAM(s).** Do not issue a NOTAM to reflect restrictions found during the flight check of radar or direction finding facilities; however, review the instrument flight procedures to ensure that those requiring ground radar are amended or suspended. Coordinate this action with the procedures specialists.

e. **Expanded Service Volume (ESV) Facilities.** When a facility no longer supports an ESV, the facility is not restricted, but a NOTAM must be issued for the instrument flight procedures predicated on that ESV. Forward ESV data to the NFPG Data Office and coordinate appropriate FDC NOTAM(s) with the NFPG or other procedures office.

f. **Out-of-Tolerance Standby Equipment.** Where one of two transmitters of a facility is restricted due to out-of-tolerance parameters and the other is satisfactory, the satisfactory transmitter may be operated without a NOTAM. However, NOTAM data describing the restriction must be provided to facilities maintenance personnel. In the event the restricted transmitter is used, the operating agency must issue the NOTAM.

g. NOTAM(s) on Military Facilities (including ships)

(1) The military installation commander has the final authority and responsibility for NOTAM issuance and for facility operations of all military facilities which are not part of the National Airspace System (NAS). The commander may elect to use "For Military Use Only" facilities found unsatisfactory for continued NAS usage.

(2) NOTAM(s) involving military facilities or procedures should be recommended to the appropriate military authority for the airfield, facility, or instrument procedure in question. NOTAM(s) for U.S. Army instrument procedures within the United States should be initiated through the NFPG. Any NOTAM action involving U.S. military instrument procedures or facilities overseas should be initiated through the appropriate military authority at the location involved. Military units will issue NOTAM(s) according to existing military regulations and letters of agreement with the appropriate host nation International NOTAM Office.

(3) NOTAM(s) are not issued on shipboard facilities.

h. Preparation of NOTAM(s)

(1) NOTAM(s) must include facility name, type, component, and the unusable area/ altitude. The absence of a specific altitude or distance will denote all altitudes and distances. It is important to include specific information to avoid confusion. The reason for the restriction (e.g., lack of signal, frequency interference, course structure, alignment, unlocks) serves no useful purpose and must not be included in the text of the NOTAM.

(2) Restrictions to TACAN azimuth are not included in agency publications, but are referred to the military for dissemination as they consider necessary. A copy of each NOTAM issued or recommended for TACAN azimuth restrictions must be retained in the facility file for reference during subsequent flight inspections. The NOTAM preparation for the TACAN azimuth component of a VORTAC is identical to the VOR.

i. Facility Restrictions. Every effort should be made to restrict rather than remove from service a facility, or instrument procedure, when out of tolerance conditions are found. Apply the following rules for restricted facility use:

(1) Describe the radials or bearings that are unusable.

(2) Describe the altitude and mileages that are unusable.

(3) VOR/ TACAN/ VOT/ DME/ DF/ NDB/ ASR. Describe radial/ bearing from the station in a clockwise (CW) direction, altitude in terms of **above** or **below** an MSL altitude, and distance in terms of **beyond** or **within** a nautical mile distance.

(4) **Localizer/ LDA/ SDF/ TLS Azimuth.** Describe laterally in terms of degrees left or right of inbound course and in nautical miles from threshold if the restriction affects the limit of usable signal closest to the threshold. Use distance in nautical miles from the antenna to describe restrictions affecting the usable distance of the facility. Describe altitude in terms of above or below an MSL altitude. Additional reference to DME distances may be used if the DME is part of the SIAP.

(5) **Glide Slope/ TLS Elevation.** Describe in terms of degrees left or right of inbound course and nautical miles from threshold; restrictions pertaining to altitude must be in terms of above or below an MSL altitude. Ensure the restriction correctly reflects the service volume origin. Additional reference to DME distances may be used if the DME is part of the SIAP.

(6) **MLS.** Describe in azimuth terms of inbound magnetic courses, using clockwise (CW) references, starting at the restricted portion closest to the inbound right-hand edge of the service volume. Describe elevation terms in degrees when restricting an entire azimuth sector and in terms of feet MSL when restricting a sector beyond a distance. Define elevation restriction affecting decision height in feet MSL. Define distances in DME.

(7) **VGSI.** For VGSI, describe in terms of nautical miles from threshold and/ or degrees left and right of runway centerline any areas of coverage where the facility is unusable.

(8) **Published NOTAM(s) will usually omit, but may include the CW reference.** This does not constitute an erroneous NOTAM. Published NOTAM(s) and restrictions must be reviewed by the flight inspector to ensure they convey the correct meaning.

j. **NOTAM Examples.** The following are examples of conditions and prescribed NOTAM(s):

(1) **Condition 1.** All components of a VORTAC are unusable in a specific sector due to out-of-tolerance VOR and TACAN course structure and unusable DME. **NOTAM**, Chicago VORTAC: VOR, DME, and TACAN azimuth unusable, 025° cw 075° beyond 25 nm below 3,500 ft.

(2) **Condition 2.** A VOR does not provide adequate signal to 40 miles at the required altitudes in various areas. **NOTAM** Altoona VOR: VOR unusable, 080° cw 100° beyond 18 nm below 3,500 ft; 100° cw 200° beyond 30 nm below 3,500 ft; 200° cw 300° beyond 30 nm below 4,500 ft; 300° cw 350° beyond 15 nm; 350° cw 010° beyond 30 nm below 4,000 ft.

(3) **Condition 3.** VOR is unusable in various areas below one altitude. Also, the DME is unusable in one sector. **NOTAM,** Yardley VORTAC: VOR unusable below 1,700 feet in the following areas: 250 cw 265° beyond 17 nm; 265 cw 280° beyond 10 nm; and 280 cw 290° beyond 17 nm. DME unusable 225 cw 275° in the following areas: Beyond 15 nm below 2,400 ft and beyond 30 nm below 5,000 ft.

(4) **Condition 4.** A Nondirectional radio beacon is not usable in the Southeast quadrant. **NOTAM** Bradford NDB: unusable 090 cw 180° beyond 15 nm.

(5) **Condition 5.** Glide slope tolerances are exceeded at a specific point on the glidepath. **NOTAM**, Ashville Regional, NC: Rwy 16 ILS glide slope unusable below 2,310 ft MSL.

(6) **Condition 6.** An ILS localizer exceeds tolerances at 1/2 mile from the runway threshold. **NOTAM,** Hartsville Muni, SC, Rwy 16 ILS unusable from 1/2 nm inbound.

(7) **Condition 7.** Cat II ILS ceases to meet CAT II criteria. FDC, FI/(P or T), **NOTAM** William B. Hartsfield, Atlanta Int'l, GA: ILS Rwy 9R, CAT II NA.

NOTE: FI/ P means permanent, and FI/ T means temporary flight information.

(8) **Condition 8.** CAT III ILS localizer exceeds CAT III tolerances in Zone 4. **FDC, FI/P NOTAM** Charleston AFB/Int'l SC: Rwy 15 ILS, CAT III NA.

(9) **Condition 9.** CAT II ILS localizer exceeds tolerances in Zone 4. **NOTAM,** New Orleans Int'l, LA: Rwy 28 ILS LOC unusable inside runway threshold.

NOTE: The localizer is unrestricted.

(10) **Condition 10.** CAT III ILS localizer exceeds tolerances in Zone 5. **NOTAM,** New Orleans Int'l, LA: Rwy 28 ILS LOC unusable for rollout guidance.

(11) **Condition 11.** Glide slope does not meet change/reversal tolerances below a point on the glidepath. **NOTAM,** Ashville Regional, NC: Rwy 16, ILS glide slope unusable for coupled approaches below 2,000 ft MSL.

(12) **Condition 12.** Localizer does not meet tolerances in the vertical plane. NOTAM, Wellsville Municipal Arpt., Tarantine Field Arpt., Wellsville, NY: ELZ LOC Rwy 28, LOC unusable beyond OM above 3,500, at threshold above 500.

(13) **Condition 13.** Beyond 5° left of LOC course, there are no glide slope clearances above path, and a glidepath is not provided. NOTAM, Charlotte/Douglas Int'l, NC: Rwy 36R ILS glide slope unusable beyond 5° left of LOC course.

(14) **Condition 14**

(a) MLS Azimuth Unusable. Because an unusable approach azimuth renders the elevation unusable, refer to any unusable azimuth segment as "MLS unusable". Describe the limits using **inbound courses;** e.g.:

1 UMP MLS unusable 196 cw 206°.

2 UMP MLS unusable 196 cw 206° below 4°.

3 UMP MLS unusable 196 cw 206° beyond 15 DME below 4,000 ft MSL.

(b) Elevation. Refer to any unusable segment as "MLS elevation unusable"; e.g.,

1 UMP MLS elevation unusable 151 cw 156° below 3.5°.

2 UMP MLS elevation unusable 151 cw 156° beyond 15 DME below 7,000 ft MSL.

(c) MLS DME unusable. Refer to any area of unusable DME as "UMP MLS DME unusable".

(15) **Condition 15.** PAPI lights are baffled and unusable beyond 5° right of centerline due to obstructions: **NOTAM** Heber City-Russ McDonald Fld, UT, RWY 21 PAPI unusable beyond 5° right of runway centerline.

k. **Required Advisories for Local NOTAM(s).** The flight inspector must notify Air Traffic (AT) personnel when the facility is not authorized for use because of flight inspection actions.

SECTION 2

RECORDS AND REPORTS

5.20 INTRODUCTION. This section provides policy for flight inspection reports and records. The flight inspection report provides permanent, historical interpretation of a system's performance. The report must accurately reflect the operational status of the system, the quality of the signal in space, the instrument flight procedure, and revised obstacle, topographical, and cultural data.

5.21 RECORDS. Flight inspection files are Federal record material. The standards for their retention and destruction are contained in FAA Order 1350.15, Records Organization, Transfer, and Destruction Standards. A facility Reconfiguration (Special/ RF) inspection that meets all the commissioning requirements is considered a Commissioning type inspection for record keeping purposes. Flight inspection reports and the **source material for reports** on all electronically radiated facilities inspected constitute report files that must be archived. Such material must contain, but is not limited to, recorder charts showing facility data used, system status, and self-test results, receiver outputs, and crew inputs affecting measurements. Other material may include data items which are necessary for flight inspection purposes, such as horizon profiles, site drawings, topographic charts, instrument approach/ departure procedure charts, photographs, electronic media, data sheets, aircraft logbooks, VFR Chart field sheets, and obstacle records. PAR, VGSI, and NDB source material is not required to be retained once the report has been archived.

a. **General Information.** Ensure that any information that is included in the facility file is annotated with the following information:

(1) **Facility identification/ type of facility**

(2) **Date(s) of inspection**

(3) **Type of inspection (e.g., periodic)**

(4) **Aircraft tail number**

(5) **Crew initials and numbers**

(6) **Recorder calibration**

(7) **Equipment-required flight inspection self-test**

(8) **Airborne flight inspection system calibrations (i.e., TVPS, system setup, and receiver calibrations)**

b. **Data logger files** must be archived for all inspections utilizing AFIS conducted with a functioning data logger. Every effort should be made to ensure a functioning data logger is available prior to the inspection. When logger files are not available for archive, either due to none being recorded or data corruption post flight, state such in the Remarks block of the report. A central repository has been established and is used to archive all logger files. Use the following instructions to upload logger files with the data indexing application.

- Sign in to the AVN dashboard (http://avnokcprd.amc.faa.gov/dashboard)
- On the top menu bar scroll over FI and select FOMS. This will launch the FOMS homepage.
- From the menu on the left, under "Applications" select "Data Indexing".
- A new window will open entitled "Flight Inspection Data Indexer"
- Under the drop-down menu for Itineraries, select the desired itinerary name. This drop-down menu contains all itineraries covering a three-week period.
- In order to display a range of itineraries outside the three-week window or to narrow the list, select the "Filter Itineraries" bar. This will open a new window that will accept wild card entries. Any part of the itinerary name can be entered for retrieval. For example: If "BTL" is entered, all itineraries containing "BTL" will appear.
- Once the desired itinerary is selected, click on "Select Log Directory".
- A new window will open that allows selection of the location of the log files. Most commonly this will be the drive where the electronic storage media is inserted, unless the files were saved to a different location.
- Open the folder where the files are contained.
- Once the correct file location is selected, click on "Start Sending". This will upload all the files from the itinerary.
- After files are uploaded, they can be retrieved by clicking on "Itinerary" under the "Searches" menu on the FOMS homepage.
- Enter desired search criteria and click on "Query". This will open the "Itinerary Search Results" page.
- Once the correct itinerary is found, there will be a link on the right side of the page under the "Data" column. That link will open to the location where the files are stored and can be retrieved.

  NOTE: If there are multiple versions of Java on the computer being used for the file upload, the data indexing utility will not work properly. If an error is received, use the following instructions:

- On the computer, select the "Start" menu
- Go to "Settings", then "Control Panel".
- In the control panel window, select "Java"
- In the Java Control Panel window, select the "Java" tab.
- On the bottom pane under "Java Application Runtime Settings", select "View"
- In the new window that opens, ensure only version (Product) 1.5.0_6 is checked "Enabled". Uncheck any other versions that may be enabled.

- Select “OK”
- On the Java Control Panel, select “Apply”
- The data indexing function should work. If it still does not, restart the computer.

c. **Lost Flight Inspection Recordings**. Lost recordings will not be the sole reason for repeating an inspection when a valid flight inspection report has been completed. Electronic data files that encompass all of the inspection requirements are a valid substitute for lost recordings. Subsequent inspections may also be used to waive the archive requirements for missing recordings. The following guidelines should be followed when it becomes apparent recordings are lost:

(1) Lost recordings must be reported to the FIFO Manager. Final resolution will be approved by the Chief Flight Inspector (CFI) or designee.

(2) The “Lost Recordings Coordination” (LRC) form (VN200 8200-1, available as a fill and print form in FIRPS) must be originated by the Mission Specialist, signed by the PIC and the Office Manager, then routed to the Chief Flight Inspector’s Office.

Other Considerations

The following examples should be followed when completing the LRC form:

- “Data Index Name (FOMS):” This should be the itinerary name used when the files were uploaded into the Flight Operations Management System (FOMS) Data Index.
- “Resolution”: Statement explaining why a new flight inspection is not needed.

Examples:

“Flight Inspection report completed before loss of recordings” or
“Subsequent flight inspection verified facility to be in operational status”

d. **Facility Data Sheets.** The flight inspector must ensure that the facility data reflects the most current information and is sufficient to complete the flight check requirements.

5.22 REPORTS. The flight inspection report serves as the primary means of documentation and dissemination of the results of each flight inspection. Requirements for the use, completion, and distribution of standard FAA and suitable military flight inspection forms are contained in FAA Order 8240.36, Flight Inspection Report Processing System (latest revision).

a. Military Facilities

(1) Changing a Facility Classification to Restricted or Unusable or Altering a Restriction. When the results of the flight inspection indicate that the facility classification is to be changed to "restricted" or "unusable" or that facility restrictions have changed, land the aircraft, if practical, and discuss the reasons and recommended action with appropriate representatives of the base commander. If it is impractical to land, give a status report to the control tower (on ground or tower frequency) indicating the exact status of the facility (unrestricted, restricted, or unusable) and all discrepancies found. Provide them with suggested wording for any required NOTAM(s). Request acknowledgement of the information.

(2) Where there has been no change in facility performance, inform the control tower (on ground or tower frequency) of the exact facility classification. Again, request acknowledgement.

(3) If a military installation does not have a control tower, attempt to pass the information over any other available air-to-ground frequency that would ensure dissemination of the flight check results. If no appropriate air-to-ground frequency is available and it is impractical to land, notify the appropriate personnel as soon as possible.

(4) In any of the above cases, inform the appropriate military maintenance personnel of any discrepancies discovered, and the resulting facility classification.

b. Reports Submitted by Military Flight Inspectors.

(1) Flight inspection reports of facilities inspected by military flight inspection crews, who have been delegated the authority for execution of the flight inspection mission, must be accepted by the FAA as official flight inspection reports.

(2) Military flight inspectors must assign a classification or status to those facilities for which they have flight inspection responsibility.

NOTE: Coordination may be in the form of a letter of agreement or may be handled on a case-by-case basis. Coordination with AVN constitutes full flight inspection authority for the respective facility.

c. VFR Aeronautical Chart field sheet notes and obstacle evaluations are a record of having performed the flight inspection and will be archived at NACO.

CHAPTER 6

FLIGHT INSPECTION OF INSTRUMENT FLIGHT PROCEDURES

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CHAPTER 6

FLIGHT INSPECTION OF INSTRUMENT FLIGHT PROCEDURES

6.10 INTRODUCTION

a. **General.** Instrument flight procedures specify standard routings, maneuvering areas, minimum and/or procedural altitudes, and visibility minimums for instrument flight rules (IFR) operations.

b. **Characteristics**. Instrument flight procedures include airways, jet routes, off-airway routes, standard instrument approach procedures (SIAP(s)), Special Aircraft and Aircrew Authorization Required (SAAAR) procedures, standard instrument departures (SID(s)), departure procedures (DP(s)), standard terminal approach routes (STAR(s)), and charted visual flight procedures (CVFP(s)).

c. **Evaluation Considerations.** The objective of evaluating instrument flight procedures is to ensure safety and flyability. The following items are included in this evaluation:

(1) **Aircraft maneuvering** is consistent with safe operating practices for the category of aircraft intending to use the procedure.

(2) **Cockpit workload** is acceptable.

(3) **Existing procedures evaluated for errors** in printing and navigation charts properly portray the procedure and are easily interpreted.

(4) **The applicable systems (NAVAID(s), satellite, FMS, etc.) support the procedure**. References in this section are for clarification only and do not supersede instructions, criteria, or tolerances for facilities or systems contained elsewhere in this handbook and in FAA Order 8200.1.

(5) **A restricted NAVAID may still support** an instrument flight procedure when the procedure does not use the out-of-tolerance area. Those areas must be reflected on the flight inspection report and on the facility data sheet where performance will restrict or limit the expected procedure.

(6) **A DME arc segment** may be used in areas of unusable VOR radial information, provided that the DME, the radial where the arc starts, the lead radial, the final approach radial, and any other radial used in the procedure meet required tolerances.

(7) **The flight inspection of an instrument flight procedure** and verification of the SIAP obstacle data may be conducted during the applicable system inspection if the inspection is conducted during daylight hours and in VMC conditions.

(8) **On preflight review of an amended procedure,** it is not necessary to refly amended segments if the minimum altitudes are raised. Ensure descent gradient and maximum reception altitudes remain in compliance with guidance.

(9) **Human Factors.** Consideration of human factors in instrument flight procedures seeks to optimize the relationship between people and their activities. In the context of flight inspection, a determination is made as to whether a flight procedure is operationally safe and flyable for a minimally qualified sole pilot flying an aircraft with basic IFR instrumentation in IMC using standard navigation charting.

d. **Inspector Authority**. At commissioning, the flight inspector has the discretion to reject the procedure if it does not constitute a satisfactory maneuver from a human factors/ flyability standpoint. Concerns must be resolved with the procedure specialist and/or supervisory personnel prior to commissioning. During subsequent checks of a commissioned procedure, new obstructions, signal problems, or other safety concerns constitute reason for a flight inspector to deny or modify a procedure by NOTAM. Human factors/ flyability concerns during subsequent checks must be resolved with the procedure specialist and/or supervisory personnel before any changes are issued.

e. **Cartographic Standards.** Changes to cartographic standards are the responsibility of the Interagency Air Cartographic Committee and the Intra-Agency Committee for Flight Information. Recommendations for changes to these standards should be sent to the Office of Aviation System Standards, Flight Inspection Operations Division, AJW-3300, for consolidation and forwarding to the appropriate committee.

6.11 PREFLIGHT REQUIREMENTS

a. Data and Procedure Package Requirements

(1) **The office initiating the procedure must forward all data necessary** for conducting the flight inspection to the FICO who, in turn, will forward the information to the flight inspector responsible for the inspection. If there are special factors relative to the procedure, the FICO should set up a briefing by the procedure specialist, or designee, for the flight inspector. For additional information, see Order VN 8200.6, Flight Inspection Package.

(2) **Procedural data must include** the following as a minimum:

(a) **Charts of sufficient detail** to safely navigate and identify considerable terrain, obstacles, and obstructions.

(b) **Identification of controlling terrain/ obstructions** for each segment.

(c) **Minimum (and maximum where applicable) altitudes** determined to be usable from map study and data base information for each segment of the procedure.

(d) **Narrative description of the procedure.**

(e) **Plan and profile views for SIAP(s).**

(f) **Data for each fix and holding pattern.**

(g) **Airport markings and any special local operational procedure** (e.g., noise abatement, non-standard traffic patterns, lighting, lighting activation, etc.)

(3) **Current forms** are acceptable from established organizations involved in the development of instrument flight procedures. If the procedures package as delivered to the FICO is inconsistent with this section, the package will be returned intact to the developing organization. If, after the package is found to be inconsistent with this section, the flight inspector must return it intact to the FICO who must return it to the developing organization. The FICO/ flight inspector must identify deficiencies on a comment sheet to accompany the returned procedure package.

b. Applicable Navigation System Support. The variation in systems dictates a progressive approach in determining evaluation methods. Study of the procedure by the flight crew prior to flight will normally reveal the type of system(s) verification required. For complex procedures, additional flyability evaluations may be required in a proponent's simulator or aircraft.

Prior to flight, the flight inspector must verify that all supporting equipment or systems are in place and functioning.

c. **General Evaluation of Procedure Design.** The criteria used to develop instrument flight procedures represent many factors such as positioning requirements, protected airspace, system and avionics capabilities, etc. Human factors such as cockpit workload, pilot error, and memory limitations have been considered. Sensory, perceptual, and cognitive restrictions historically have been incorporated in the criteria only to a limited extent; e.g. length of approach segments, descent rates, turn angles, etc. These are products of subjective judgments in procedural development and cartographic standards. It is incumbent upon the flight inspector to apply the principals of human factors when certifying an original or amended procedure. The following factors must be evaluated:

(1) **Practical.** The procedure should be practical. Segment lengths for approach and missed approach segments should be appropriate for the category of aircraft using the procedure. Procedures must not require excessive aircraft maneuvering to remain on lateral and vertical path.

(2) **Complexity.** The procedure should be as simple as possible. It should not impose an excessive workload on a sole pilot flying a minimally equipped aircraft.

(3) **Interpretability**

(a) The final approach course should be clearly identifiable, with the primary guidance system or NAVAID unmistakable.

(b) The procedure should clearly indicate which runway the approach serves and indicate which runway(s) circling maneuvers apply to.

(c) Fix naming must be readable and clearly understood. Fixes/ waypoints with similar sounding identifiers should not be used in the same procedure.

(d) Areas not to be used for maneuvering must be clearly defined.

(e) Significant terrain features must be displayed on approach charts.

(f) Operations into a "black hole" effect should be noted.

(4) **Human Memory Considerations.** Pilots must be able to extract information quickly and accurately during an instrument approach. Multiple tasks complicate the memory process and tend to produce prioritization decisions during stressful phases of flight. Workload reduction can be accomplished through methodical chart layout that encourages the pilot to periodically refer to the depicted procedure rather than trying to memorize complex maneuvers.

6.12 FLIGHT INSPECTION PROCEDURES. The methods used to evaluate signal quality and RNAV systems are detailed in other sections of this handbook. Configure AFIS and/ or aircraft equipment for analysis of the facility to be inspected in accordance with the appropriate section of this handbook. Requirements of this section are primarily concerned with procedural aspects.

a. General. The objective of evaluating instrument flight procedures is to ensure safety, flyability, human factors, and workload. The following items are included in this evaluation:

(1) Procedure design meets the required obstacle clearance per applicable FAA 8260.XX orders or approved criteria.

(2) The applicable navigation system(s) (NAVAID, Satellite, RADAR, etc) supports the procedure.

(3) Procedure design must be simple. Chart complexity should be kept to a minimum for human memory considerations.

(4) Navigation charts must properly portray the procedure and be easily interpreted.

(5) Aircraft maneuvering must be consistent with safe operating practices for the category of aircraft intending to use the procedure.

(6) Cockpit workload is acceptable.

(7) Runway marking and lighting meet requirements.

(8) Communications meet requirements.

(9) RADAR coverage is available, where required.

b. Checklist

Check	Ref. Para.	C	P
Obstacle Verification	6.12	X	X, 2
Final Approach Segment	6.12	X	X, 2
Missed Approach Segment	6.12	X	X, 2
Circling Segment	6.12	X	1
En route and Terminal Segments (i.e., SID, DP, STAR)	6.12	X	1
Holding Pattern	6.12	X	1
Air/ Ground Communications	6.12	X	1
RADAR	6.12	X	1
Charted Visual	6.12	X	

NOTE:

1. Surveillance
2. Public RNAV SIAP(s) have no periodic inspection requirement; however, a periodic obstacle verification must still be completed for the runway(s) serviced.

c. Obstacle Verification Evaluations. The following procedures apply to the obstacle check only and not to the facility inspection associated with the procedure. Both pilots look outside to identify the controlling obstacle. If any doubt regarding an obstacle arises, investigate as necessary and comply with Order 8200.1 paragraphs for determining the altitude and location of a given obstacle. Use appropriate FAA Order 8260 series procedure development criteria or equivalent guidance for ROC values. The minimum required obstacle clearance for each procedural segment can be located on FAA Form 8260-9, Standard Instrument Approach Procedure Data Record, contained in the procedure package.

(1) For obstacle checks of new or amended procedures, use the following guidance:

(a) Feeder and Initial Segments of a procedure. Fly the procedural azimuth in either direction, identifying the controlling obstacle and comparing its height with other obstacles in the segment. Fly this segment at procedural altitudes, minus 100 ft, and deviate as required to accomplish the evaluation.

(b) Intermediate Segment of a procedure (ROC of 500 ft). Fly the procedural azimuth in either direction, identifying the controlling obstacle and comparing its height with other obstacles in the segment. Fly this segment at procedural altitudes, minus 100 ft, and deviate as required to accomplish the evaluation.

(c) Final Without Vertical Guidance - Approach segment (ROC less than 500 ft). Fly the procedural azimuth in either direction at the designed procedural altitudes, minus 100 ft, and deviate as required to accomplish the evaluation. Use the controlling obstacle as a basis for comparing its height with other obstacles in the segment.

(d) Final with Vertical Guidance – Approach segment (using Obstacle Clearance Slope (OCS)). Fly the approach in either direction at the designed glide path, maintaining safe obstacle clearance.

(e) Missed Approach segment should be flown in the direction of intended use, beginning at the MAP/ DH/ DA at either the MAP altitude or the DH/ DA altitude and climbing at a rate of 152 ft/ nm or higher, if required, until reaching the designed altitude or altitude clear of any potential obstacles.

(2) **During obstacle verification inspections (other than commissioning inspections),** it is not necessary to visually identify the controlling obstacle, but rather to verify that the required obstacle clearance is provided by the minimum procedural altitude(s) for the final segment. Part of the preflight preparation for the obstacle check of a runway at any given airport will include a determination by the PIC if multiple approaches to the same runway may be combined into one single obstruction check. If combining approaches into a "single obstruction check", the altitude flown must be the lowest altitude of any of the combined approaches. The trapezoids of combined approaches should overlap, but under no circumstance can the approach azimuth of the different approaches differ by more than 10°. If all the approaches to a given runway cannot be combined, a separate obstacle check for approaches outside the criteria must be completed. Annotate the DFL if combining the obstacle check is not feasible.

(a) **Final Without Vertical Guidance –** Approach segment (ROC less than 500 ft). Fly the procedural azimuth in either direction at the designed procedural altitudes, minus 100 ft, and deviate as required to accomplish the evaluation. Visually verify the integrity of the required obstacle clearance surface/ slope while flying inbound or outbound.

(b) **Final With Vertical Guidance –** Approach segment (using OCS). Fly the approach in either direction at the designed procedural altitudes, maintaining safe obstacle clearance. Visually verify the integrity of the required obstacle clearance surface/ slope.

(c) **Missed Approach** segment should be flown in the direction of intended use, beginning at the MAP/ DH/ DA at either the MAP altitude, or the DH/ DA altitude and climbing at a rate o f 152 ft/ nm or higher, if required, until reaching the designed altitude or altitude clear of any potential obstacles. During a periodic obstacle verification inspection, fly the missed approach procedure to a point where the flight inspector can identify any obstacle that could be a potential hazard.

(3) **For approach with vertical guidance segments** with sloping obstacle clearance surfaces, only surveyed data should be used when considering obstructions unless newly identified obstacles clearly penetrate such surfaces.

(4) **On commissioning checks, if the controlling obstacle is listed as terrain/ trees** or as an adverse assumption obstacle (AAO), it is not necessary to verify which tree or terrain feature is controlling, only that no higher obstacle is present in the protected airspace.

(5) **On commissioning checks, if unable to confirm that the declared controlling obstacle is the highest obstacle in the segment,** list the location, type, and approximate elevation of any obstacles and pass this information to the procedure specialist for consideration.

(6) **If a controlling obstacle has been dismantled or eliminated,** pass this information to the procedure specialist for consideration.

(7) **The flight inspector retains the responsibility** to ensure that the procedure provides the required obstacle clearance and may use his or her discretion to vary the flight pattern to best suit the evaluation.

(8) **Conduct obstacle evaluations in VMC and daylight only.**

(9) **Identification of New Obstacles**

(a) In most instances, accurate information concerning the location, description, and heights of tall towers and other considerable obstacles is available from the FAA database and/or other governmental sources. When a new obstruction is identified and may become the controlling obstruction for the segment, the procedure will be denied until the procedure specialist can analyze the impact of the obstacle on the overall procedure.

(b) **Obstacle locations should be noted in latitude/ longitude** as determined from aircraft or flight inspection equipment, or radial/ bearing and distance from a navigation facility. If these methods are not available, an accurate description on an aeronautical chart may be used.

(c) **Estimated obstacle height will be ascertained via** the safest and most expeditious method available. Obstacle heights measured in flight will not be used unless the actual height of the obstruction cannot be determined by other methods. If in-flight height determination is required, accurate altimeter setting and altitude references must be used to obtain precise results. Where possible, note both the MSL and AGL elevation.

(d) **An alternative method for determining obstacle height i**s to select another obstacle in the near vicinity that has a known or published elevation. Fly abeam the uppermost point on the known obstacle and set the copilot's altimeter to read the same MSL elevation as the known obstacle's height. Without resetting the altimeter, fly abeam the obstacle for which the height is unknown and note the altimeter reading.

(e) **Pass all information about newly identified obstacles to the procedure specialist.** The obstacle information and the method of height determination will be documented on the flight inspection report and DFL.

(10) **The Terminal Arrival Areas (TAA)** of some Area Navigation (RNAV) SIAP(s) may have controlling obstacles that do not lie within the primary or secondary areas of Initial approach segments. There is no requirement to verify that the identified controlling obstacle is the highest obstacle in the entire TAA segment but, while transiting the segment, observe the area for obstacles that may exceed the height of the controlling obstacle. If any such obstacles are identified, pass this information to the procedure specialist for consideration.

(11) **Some Ground Proximity Warning Systems (GPWS(s))** may alert while flying over irregular or rapidly rising terrain at altitudes providing the required obstacle clearance. If GPWS alerts are received while inspecting procedures at the minimum procedural altitude, repeat the maneuver. If the alert is repeatable, notify the procedure specialist.

(12) In all cases where it is determined that the minimum procedural altitude of a published segment does not provide at least the required obstacle clearance, action must be taken by the flight inspector to notify the procedure specialist and to ensure that a procedural NOTAM is issued to amend or deny the use of the procedural segment.

d. Airways, Jet Routes, and other Routes

(1) Maneuvering

(a) As appropriate, evaluate the radials and/or bearings that make up the route (airway, jet route, or en route) segment to midpoint or other specified COP.

(b) **If a Minimum Obstruction Clearance Altitude (MOCA) is specified for the route,** perform the evaluation at the MOCA (TRUE) altitude within 22 nm of the facility; otherwise, perform the evaluation at the MEA (TRUE) altitude for the airway or route.

(c) During the initial inspection of a low altitude airway or route segment, ensure that the MOCA (or Minimum En route Altitude (MEA) if no MOCA is specified) provides the required obstacle clearance.

(2) Analysis

(a) **The published MEA is predicated upon the MOCA** (if applicable), the Minimum Reception Altitude (MRA), airspace, air traffic, and communications requirements. Flight inspection will determine the MRA, minimum communications altitude, and verify the MOCA. The flight inspector will coordinate MEA changes with the procedure specialist to ensure that flight inspection requirements are met.

(b) **If a facility will not support an airway or route to the midpoint or specified COP**, an effort will be made by the flight inspector to determine a revised COP at the altitude requested. This may require that the facility providing guidance beyond the midpoint or COP also be evaluated. If a usable COP cannot be established, determine if raising the MEA can provide a usable airway or route and, if so, consider evaluating the facilities at the higher altitude.

(c) **In some cases, a Maximum Authorized Altitude (MAA)** is specified. MAA(s) are limitations based on airspace restrictions, system performance characteristics, or interference predictions. If the MAA is based on an interference problem, the source of the interference should be identified and corrective action initiated where possible to eliminate the MAA.

(3) Special Considerations

(a) FAA Order 8260.3, U.S. Standard for TERPS, authorizes, under specific conditions, route MEA gaps in facility signal reception. The use of an MEA gap may allow for a usable airway or route at a lower altitude. The development of an MEA gap must be coordinated with the procedure specialist.

(b) Ensure that all ESV(s) are processed and approved.

(c) Satisfactory communications coverage over the entire route segment at the MEA must be available with an ATC facility.

(d) The minimum required obstacle clearance for each route segment can be derived from FAA Form 8260-16, Transmittal of Airways/Route Data. In most cases, en route ROC is 1,000 ft (2,000 ft in designated mountainous terrain).

e. Fixes. Navigation fixes can be established by intersections, DME, and RNAV waypoints. The procedure specialist must provide FAA Form 8260-2, Radio Fix and Holding Data Record), for the requested fix. This form provides information on fix make-up, additional facilities that can be used at the fix, holding pattern information, coordinates, fix use, and other information.

(1) Maneuvering. The required maneuvering is determined by the appropriate chapter of this handbook, and whether or not the fix lies within the SSV of the facility to be inspected.

(2) Analysis

(a) An MRA will be determined for each navigation facility used for fix makeup. For GPS derived fixes, the procedure specialist establishes the minimum altitude for the GPS fix.

(b) An MRA will be determined for any other navigational facilities used at the fix (usually for SIAP use, such as feeder segments, or for substitute routes).

(c) The minimum ATC communications altitude will be determined for the fix. Verify satisfactory communications are available with each ATC facility shown on FAA Form 8260-2 at the minimum communications altitude, usually established at the lowest MRA of any navigational facility used at the fix.

(3) Special Considerations

(a) Ensure that required ESV(s) are processed and approved.

(b) Air/ ground communications with ATC must be satisfactory at the minimum altitude for each SIAP initial approach fix, and also at the missed approach altitude and holding fix. At lower altitude, air/ ground communications may be required where essential for the safe and efficient use of airspace.

(c) Ensure that any amended MRA(s), communications altitudes, or other changes determined as a result of the flight inspection are forwarded to the procedures specialist.

f. Holding Patterns

(1) Maneuvering

(a) Data for the holding pattern is found on FAA Form 8260-2, provided by the procedures specialist.

(b) If facility performance and obstacle data are on file, flight inspection of the holding pattern is not required.

(c) Within the contiguous U.S., an obstacle check for a high altitude holding pattern is not required.

(d) If flight inspection is required, maneuver the aircraft through the requested holding pattern at the minimum holding altitude.

(e) For VOR or TACAN, ensure usable signal strength through the turn to the inbound leg of the holding pattern.

(2) Analysis

(a) For low altitude holding patterns, verify that the minimum holding altitude provides the required obstacle clearance in the same manner as a feeder route.

(b) As appropriate, evaluate the radial or bearing that establishes the holding pattern.

(3) Special Considerations

(a) Holding patterns that allow "climb-in-hold" are evaluated differently in the TERPS process. If it appears that the holding pattern requires a "climb-in-hold" evaluation (usually in missed approach or departure holding), verify that such an evaluation was accomplished from the Remarks section of FAA Form 8260-2 or from the procedures specialist.

(b) **The minimum required obstacle clearance required** for a holding pattern may be found on FAA Form 8260-2. In most cases, en route holding ROC is 1,000 ft (2, 000 ft in mountainous terrain). Controlling obstacles must be verified to ensure the adequacy of minimum holding altitude (MHA). System performance will be evaluated to ensure conformance with appropriate tolerance chapters of this handbook. If system performance and obstacle clearance data are on file, flight inspection of the procedure is not required.

g. **SIAP(s).** All SIAP(s) intended for publication must be in-flight evaluated. Misalignment or inaccurate data indications will be forwarded to the procedure developer for further review prior to commissioning the procedure.

(1) Maneuvering

(a) New SIAP. Fly all procedural segments at the minimum procedural altitude (true). All initial, intermediate, final, and missed approach segments must be flown in the intended direction of procedural use.

(b) Amended SIAP. Fly all amended segments covering a new ground track at the minimum procedural altitude (true).

(2) Analysis

(a) **Feeder, Initial, and Intermediate Segments.** Evaluate each new or amended terminal route for required obstacle clearance and flyability.

(b) **Final Approach Segment.** Evaluate each new or amended final segment for required obstacle clearance and flyability.

1 **For non-precision SIAP(s),** the final segment must be flown to an altitude 100 feet below the MDA.

2 **Precision and APV final approaches** must be flown to the DA or DH.

3 **The final approach course** must deliver the aircraft to the desired aiming point. The aiming point varies with the type of system providing procedural guidance and will be determined by the procedure specialist.

4 **For commissioning inspections,** misaligned or inaccurate data indications will be forwarded to the procedure specialist for further review prior to the commissioning of the procedure.

<u>**5**</u> **After flight inspection verifies the aiming point,** it will not be changed without the concurrence of the procedures specialist. When the system no longer delivers the aircraft to the established aiming point and the system cannot be adjusted to regain the desired alignment, consideration should be given to amending the procedure.

(c) **Circling Area.** The flight inspector must verify each new or amended proposed circling maneuvers are safe for each of the aircraft categories proposed. Ensure that required obstacle clearance is provided throughout the circling area.

(d) **Visual Segment.** Helicopter point-in-space and some other procedures have extensive visual segments between the MAP and the landing area. Evaluate the new or amended segment for operational suitability and safety. Recommend procedural adjustments when buildings or obstructions obscure access to the landing area. Each procedure with a “Fly visual” segment proposed for night use must be evaluated at night prior to commissioning, or must be restricted from night use until the evaluation is completed.

(e) **Missed Approach Segment.** Flight inspection of the new or amended missed approach segment must assure that the designed procedural altitudes provide required obstacle clearance. During periodic inspections, fly the missed approach procedure at least to a point where the flight inspector can identify any obstacles that could be a hazard.

(3) **Night Evaluation.** Conduct a night evaluation in the following situations:

(a) Procedures developed for airports with no prior IFR service and procedures to newly constructed runways, and procedures to runways lengthened or shortened require a night flight inspection to determine the adequacy of airport lighting systems prior to authorizing night minimums.

(b) Inspect **initial** installation of approach light systems during the hours of darkness. Evaluate the light system for:

<u>**1**</u> Correct light pattern as charted.

<u>**2**</u> Operation in the manner proposed (e.g., photocell, radio control);

<u>**3**</u> Local lighting patterns in the area surrounding the airport do not distract, confuse, or incorrectly identify the runway environment.

(c) **Addition or reconfiguration** of lights to an existing system already approved for IFR service.

1 An approach lighting system may require a night evaluation. See Paragraph 7.20d.

2 A runway lighting system may be evaluated day or night.

3 REIL requires a night evaluation.

(4) Special Considerations

(a) **Communications.** Air/ ground communications with ATC must be satisfactory at the minimum approved altitude for each SIAP IAF and at the missed approach altitude and holding fix.

(c) **Radio Altimeter.** CAT II/ III SIAP(s) require the use of radio altimeter. Irregular terrain features could cause erratic radio altimeter indications. For commissioning, report the radio altimeter indication at CAT II DA. For periodic inspections, record the radio altimeter indications for engineering analysis purposes.

(d) **Airport Environment.** The airport environment must be evaluated for its suitability to support the SIAP. Unsatisfactory or confusing airport markings, non-standard or confusing lighting aids, or lack of ATC communication at critical flight phases may be grounds for denying the use of the procedure. In all cases where an unsatisfactory airport environment is identified on a published procedure, the procedure specialist must be apprised of the unsatisfactory condition and appropriate NOTAM action initiated.

(e) When an airport environment is undergoing change and uninterrupted IFR service is required during the interim, instrument flight procedures may be developed to an existing runway or to a designated temporary runway. In order to meet publication date requirements, the procedure may be validated and approved for publication using non-standard indicators to identify where the runway markings will be painted. The Flight Inspector may be required to coordinate with Airfield Management on the type and location of temporary markings as follows:

Temporary markers for unpainted runways must meet the following minimum requirements:

1 Non-precision approaches:

a Runway threshold (or displaced threshold)

b Aiming Point

2 Precision approaches (except ILS facilities that require a roll-out procedure):

a Runway threshold (or displaced threshold) visible to AFIS TVPS

b Touchdown Zone

c Aiming Point

d Stop-end of runway visible to AFIS TVPS

Prior to final certification, the runway markings must have been painted at their final locations and the procedure and airport environment must be flight inspected to ensure compliance with Order 8200.1C. If the procedure and airport environment have not been confirmed by flight inspection prior to the publication date, the National Flight Procedures Office (NFPO) will issue a NOTAM effective on the date of publication designating the procedure NA. The FICO will act as the point of contact for all parties concerned until the entire task is completed.

Landings, roll-out procedures, or takeoffs will not be conducted on unfinished runways. Except for the approach lighting system, the runway environment must be complete and certified for flight operations by the appropriate authority prior to conducting these types of operations. This may entail a separate night flight inspection to commission runway lights, etc., before an ILS CAT II/ III can be commissioned. Instrument flight procedures will not be certified for use until the applicable runway environment satisfies the requirements in Order 8200.1C.

(f) **Periodic Reviews.** In addition to the in-flight evaluation of each SIAP during a periodic check, conduct a detailed evaluation of each standard or special instrument approach procedure. A similar review of military instrument procedures with available information will be conducted. Notify the National Flight Procedures Office, appropriate military authorities, or private owner of any discrepancies found for possible NOTAM action and correction, and document significant discrepancies on the applicable flight inspection report. Instrument approach procedure discrepancies may not render a procedure unsafe or unusable; the flight inspector is expected to use good judgment and discretion in the evaluation of a procedure. The review should include at least the following:

1 Validity of altimeter setting source

2 Validity of published notes

3 A review of any published FDC NOTAM(s) on the approach procedure for currency and validity.

h. **Flyability.** For procedures with a note stating **"Applicable to Turbojet Aircraft Only",** an appropriately equipped turbojet flight inspection aircraft must be used for flyability evaluation. For complex procedures, additional flyability evaluations may be required in a proponent's simulator or aircraft. Flyability should be evaluated with the aircraft coupled to the autopilot and may require additional evaluation by hand flying. RNAV procedures developed with other than Track-to-Fix (TF) and Direct-to-Fix (DF) leg path/ terminators must be flight checked by an appropriately equipped FMS aircraft. Correct implementation of RNAV leg path/ terminator is critical for route containment and requires evaluation for meeting the intent of the procedure and flyability.

(1) Standard Instrument Departures (SID(s))/ Departure Procedures (DP(s)):

(a) Climb gradient considerations should be applied throughout the departure procedure. Leg length in relation to altitude change versus altitude crossing restrictions (transitioning from "at" or "at or below" to "at" or "at above altitude") needs to be reviewed carefully. For FAA procedures, FAA Order 8260.46, Departure Procedure (DP) Program, states, "**DP(s) requiring a climb gradient** in excess of 500 ft/ nm, either for obstacle clearance or air traffic control restrictions, need approval from Flight Standards Service." In some circumstances, climb gradients up to 500 ft/ nm **may be excessive**. This is directly dependent upon the aircraft types which will use the procedure.

NOTE: USAF/ USN procedures do not require waiver action or approval of any departure climb gradient.

(b) Speed restrictions can also severely limit the usability of a procedure. Any speed restriction has to be compatible with the performance capability of the aircraft expected to comply with the departure. An airspeed restriction below 200 kts should be **extremely limited** in application as to airport, runway, and aircraft.

(c) "Track-to-Fix" (great circle) routes are the predominant leg path/ terminator used in RNAV procedure development. However, significant course/ track changes are being applied independently and in combination with climb gradients and/ or speed restrictions. Public procedures should be designed such that completion of turn limitations, minimum turn radii, and imposed bank angles allow for normal aircraft operating procedures in the accomplishment of the departure.

(2) Standard Terminal Arrival Route (STAR):

(a) The STAR procedure should be designed to standardize descents from the high altitude en route stratum to the terminal environment with a descent gradient of 318 ft per nautical mile (FPNM) or 3°. Below 10,000 ft MSL, the maximum descent gradient should not exceed 330 FPNM.

NOTE: Procedure design may require descent gradients that exceed 330 FPNM. Although not desirable, the procedure may be flyable if appropriate deceleration leg lengths are included to mitigate the effects of high descent gradients.

(b) In addition to using the recommended descent gradients identified in Paragraph (a), the procedure must also allow for deceleration at any waypoint that has a speed restriction and deceleration to transition below 10,000 ft MSL. As a general guideline, deceleration considerations should add 1 nm for each 10 kts of speed reduction required.

The flight inspection evaluation for flyability should be based on 300 – 310 KIAS at 10,000 ft and above and 250 KIAS below 10,000 ft. Where deceleration is necessary, use a 10 kt per nautical mile rate of deceleration to arrive at the required speed.

Vertical path should be easily tracked without use of aircraft drag devices. Use of drag devices should only be required with tailwind conditions in excess of 50 kts. Procedures requiring use of drag devices should have the vertical path redesigned.

A STAR connecting to an initial approach should provide for deceleration to arrive at the initial fix at 200 kts.

(c) Standard Terminal Arrival Route (STAR) procedures must be evaluated to where the route intercepts a portion of an established SIAP or point from which a normal descent and landing can be accomplished. STAR design guidance can be found in FAA Order 7100.9( ), Appendix 2.

(3) Approach. Deceleration considerations should be applied through the initial and intermediate approach segments. The procedure should provide for deceleration to arrive at the FAF at 150 kts.

(a) For a straight-in approach, an initial/ intermediate segment descent gradient not exceeding 250 ft/ nm allows the aircraft to decelerate without having level segments. This provides a continuous, stable descent, and the aircraft can be configured without using extraordinary pilot actions. A straight-in initial/ intermediate segment designed with the maximum gradient of 318 ft/ nm requires the incorporation of a deceleration segment of 1 nm per 10 kts of deceleration to 150 kts at any FAF or an approach without a designated FAF.

(b) For any approach procedure incorporating a turn to the intermediate segment exceeding 35° of turn, the maximum descent gradient of the intermediate segment should not exceed 160 ft/ nm.

(4) Calculating Deceleration Segment Length (Vertical Flyability). FAA Order 7100.9( ), Standard Terminal Arrival Program and Procedures, provides guidance on arrival descent gradients and deceleration segments accepted by both the FAA and air transportation industry. This information should be used as a baseline for evaluating the vertical flyability of arrival and approach procedures. This standard should not be applied to private procedures that may be designed specifically for a proponent's aircraft and its capabilities.

Example: (may be applied to STAR or Initial/ Intermediate approach segments)

An RNAV STAR begins at waypoint ALPHA at 17,000 MSL and 310 kts and requires the aircraft to descend to and cross waypoint BRAVO at 9,000 MSL and 240 kts. The minimum leg length between ALPHA and BRAVO is computed as follows:

(17,000 – 9,000)/ 318 = Minimum leg length using a 3° descent gradient,

8,000/ 318 = 25.157 nm
Plus
(310 kts – 240 kts)/ 10 = Deceleration segment
70/ 10 = 7 nm
25.157 + 7 = 32.157 nm (round to 32.2 nm)

NOTE: Applicable TERPS criteria **may** allow for a shorter deceleration segment.

i. **SID(s) and DP(s).** For RNAV SID(s) and DP(s), see Chapter 13 also.

(1) **Maneuvering**

(a) **For the initial part of the departure procedure,** fly over the departure end of each specified runway at approximately 35 ft and establish an initial a climb at either 200 ft per nautical mile or the minimum rate established for the SID or DP, whichever is higher. Continue the climb to 400 ft, or higher if specified, above the departure end of the runway before initiating any turns, and fly the route until it crosses a common fix or route structure on the SID or DP.

(b) **Considering obstacles and flyability,** fly the most adverse runway routing from over the runway through to an established NAVAID or fix, or to a point where en route obstacle clearance has been established. Climb at either 200 ft per nautical mile or the minimum rate established for the SID or DP.

(c) **Fly all transitions at the MOCA or MEA altitudes as specified** by the procedural forms. If necessary, consider raising segment MEA(s) or changing COP(s) to establish usable transitions.

(d) When required, program the aircraft FMS or GPS unit with the route waypoints and/or fixes. Care must be taken when programming, as different type waypoints are occasionally used.

(2) Analysis

(a) Evaluate required obstruction clearance using the minimum climb gradient through the departure routing.

(b) Evaluate the initial turns and headings to join courses.

(c) Evaluate the flyability of crossing restrictions, climb gradients, and turns, basing the evaluation on the type of aircraft expected to fly the procedure.

(d) Verify course, distance, radial, and altitude information presented on procedural forms.

(3) Special Considerations

(a) Heading and turn radius established by TERPS may result in headings that will not intercept procedurally specified courses. Determine flyable headings to intercept courses and forward to the procedure specialist for consideration.

(b) Verify that required ESV(s) are approved and processed.

(c) Consider that the procedure may have very low MEA(s) predicated only on obstacles and not account for airspace or aircraft capability. This is particularly the case with RNAV SID(s), as NAVAID performance is usually not a requirement.

(d) To the maximum extent possible, emulate the speeds and performance expectations of aircraft expected to use the procedure.

(e) In some cases, it may be necessary to have the procedure performed in an aircraft certified for the procedure with the flight inspector aboard and in a position where an evaluation can be accomplished.

j. Runway Marking and Lighting. The flight inspector must evaluate the suitability of the airport to support the procedure. Unsatisfactory or confusing airport markings, or non-standard or confusing lighting aids may be grounds for denying the procedure. In all cases, the procedure developer will be apprised of the conditions discovered during the flight inspection.

k. Air/ Ground Communications. Air/ ground communications with ATC must be satisfactory at the initial approach fix (IAF) minimum altitude and at the missed approach altitude and holding fix. Satisfactory communications coverage over the entire airway or route segment at minimum en route IFR altitudes must be available with an ATC facility. Where ATC operations require continuity in communication coverage and ATC requests verification, flight inspection must evaluate that coverage in accordance with appropriate chapters of this handbook.

l. **RADAR Coverage.** RADAR coverage must be verified for any procedure that requires RADAR.

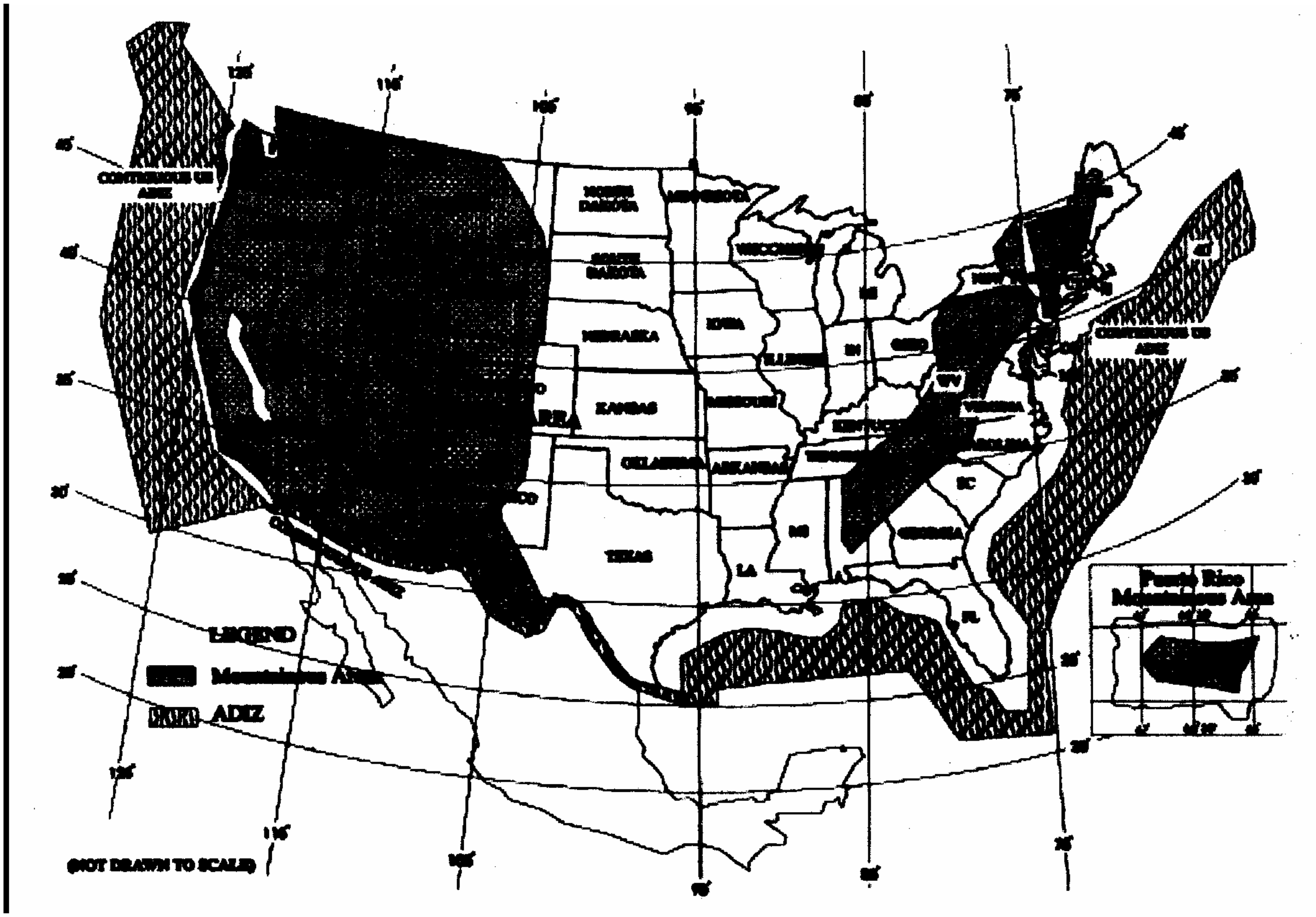
m. **Charted Visual Approaches.** A commissioning check of charted visual procedures is required. Determine flyability and ensure that depicted landmarks are visible in both day and night visual conditions. Flyability is determined by difficulty of aircraft placement, cockpit workload, landmark identification, location and visibility, and VFR obstacle clearance. A night evaluation must be completed prior to authorizing night use.

n. **Maximum Authorized Altitudes (MAA).** MAA(s) are limitations based on airspace restrictions, system performance characteristics, or interference predictions. If the MAA(s) are based on an interference problem, the source of the interference must be identified and corrective action initiated where possible.

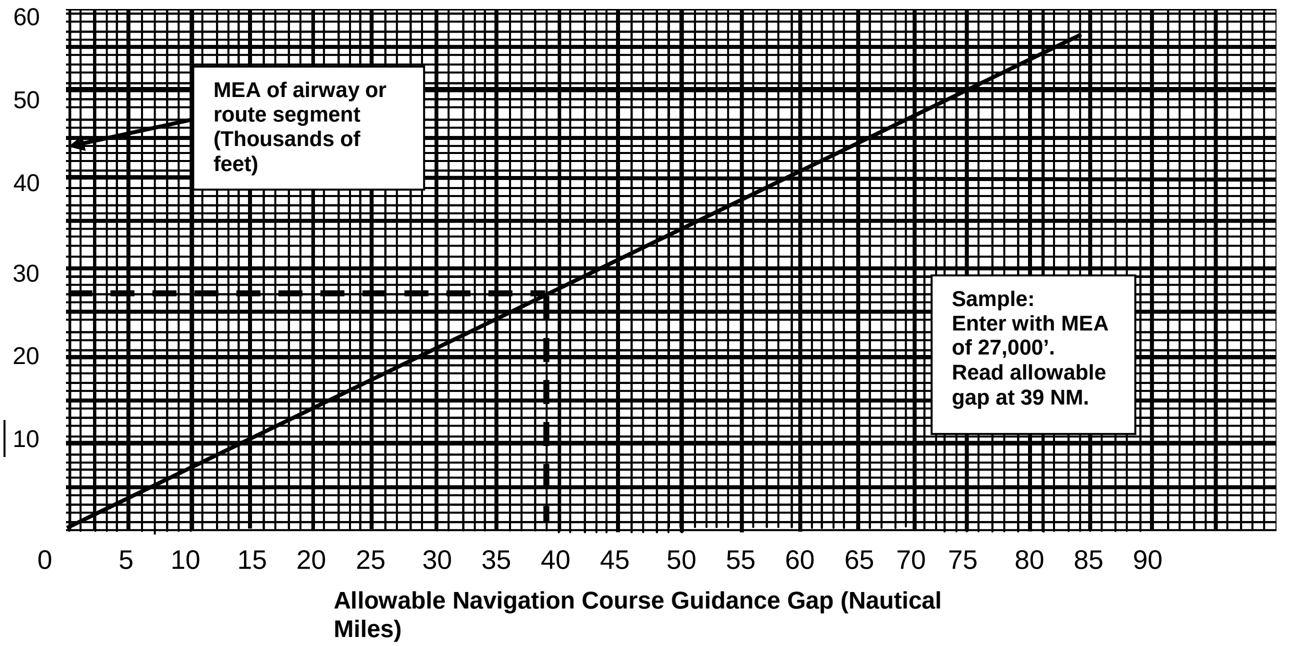
6.13 TOLERANCES. The procedure must be safe, practical, flyable, and easily interpreted with minimal additional cockpit workload. Supporting facilities/ systems must meet tolerances of the appropriate chapters of this handbook and not contribute to operational confusion.

6.14 TABLES AND SUPPLEMENTAL INFORMATION

a. Designated Mountainous Areas



b. MEA Gap Criteria



CHAPTER 7

LIGHTING SYSTEMS

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CHAPTER 7

LIGHTING SYSTEMS

SECTION 1

VISUAL GLIDE SLOPE INDICATOR (VGSI)

7.10 INTRODUCTION

a. **General.** The Visual Glide Slope Indicators (VGSI(s)) are ground devices that use lights to define a vertical approach path during the final approach to a runway. The visual signal consists of at least two and not more than four colors. Allowable colors are red, amber, green, or white. Only red is used to indicate the lowest below-path sector of the system.

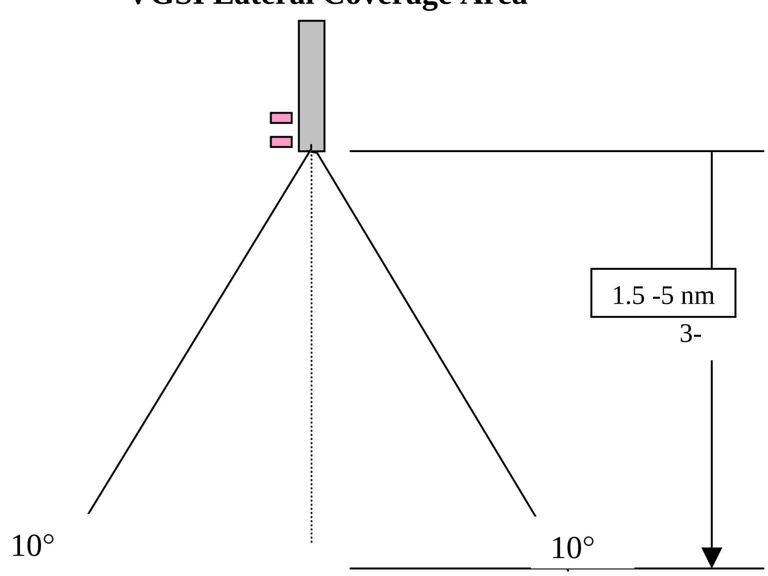
Many factors such as snow, dust, precipitation, color of background, terrain, etc., affect the color interpretation of the VGSI. Some deterioration of system guidance may occur as the pilot approaches the runway threshold, due to the spread of light sources and narrowing of individual colors.

Valid runway and VGSI data must be available to validate VGSI angles. Systems without valid Flight Inspection data cannot be commissioned.

b. **Characteristics:**

(1) VGSI(s) are aligned to provide a glide path of at least 1.0° above obstacles. Unrestricted VGSI(s) provide coverage to 10° either side of the runway centerline extended measured from the runway threshold to a distance specified for the system, usually 4 miles. Lateral guidance is obtained by reference to either visual cues or electronic aids.

Figure 7-1
VGSI Lateral Coverage Area



(2) VGSI(s) provide vertical guidance for a VFR approach or for the visual portion of an instrument approach. The angle established by the VGSI is referred to as the Visual Glide Path Angle.

The visual glide path angle is normally 3.0°. Siting criteria or operational needs may require installations with other than the standard angle, i.e. high cockpit aircraft (FAA Order 6850.2, Height Group 4). Setting the required visual angle is the responsibility of ground installation personnel. This angle is normally published in the Airport/ Facility Directory.

The signal formats used to establish the visual glide path angles are:

- Single light source
- Two or Three light sources in a longitudinal array
- Three, four, or more light sources in a longitudinal, and/or lateral array.

(3) Depending on the type of VGSI(s) and system design, the light intensity can be either manually or automatically controlled for daylight or nighttime operations. Some systems have three settings allowing for day, twilight, and nighttime operations. On certain types of systems, maintenance can select other options for nighttime operations to accommodate local site conditions. The normal intensity setting for daylight is 100 percent, for twilight periods 30 percent, and for hours of darkness, 10 percent.

(4) Visual Approach Slope Indicator System (VASI) or Precision Approach Path Indicator System (PAPI) light boxes are numbered starting at (1), with the box nearest the runway on each side and working outboard. For international use, this numbering process is reversed.

Figure 7-2

VASI

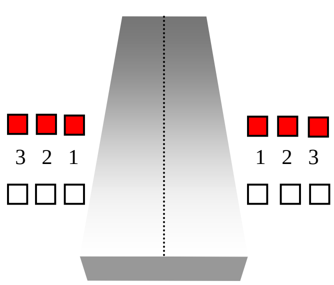
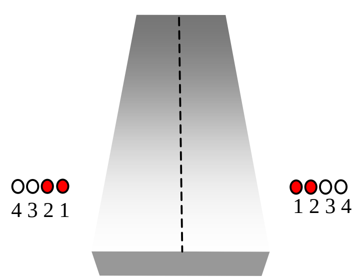


Figure 7 -3

PAPI



(5) Threshold Crossing Height (TCH) is the height of the lowest on-path signal at the threshold. The minimum TCH is determined by the most critical aircraft that normally operates at that runway. The TCH of VGSI(s) will normally be 25 to 75 ft. Specific TCH criteria for each type system is located in FAA Order 6850.2, Visual Guidance Lighting Systems.

c. **Type.** There are several types of VGSI(s) in use today. The primary systems are:

- Visual Approach Slope indicators (VASI)
- Precision Approach Path Indicators (PAPI)
- Pulsating Visual Approach Slope Indicators (PVASI)
- T-VASI
- Tri-color VASI
- Helicopter Approach Path Indicator (HAPI)

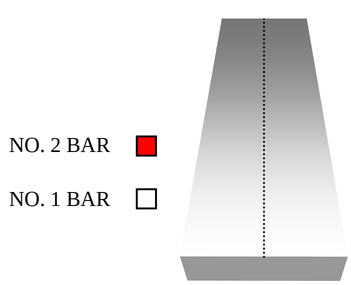
Each of these types presents a different visual indication to the pilot and requires different in-flight interpretation.

7.11 DETAILED DESCRIPTION OF VGSI(s)

a. **Visual Approach Slope Indicator System (VASI)** consists of either two or three light bars placed perpendicular to the runway. The light bars consist of one, two, or three boxes aligned on the left or both sides of the runway. Each box contains three high intensity lamps behind a horizontally divided filter with red colored and clear portions. The basic configurations of VASI are described below:

(1) **VASI-2** consists of two light boxes. This system provides descent information under daytime conditions to a distance of 3 miles.

Figure 7-4
VASI - 2

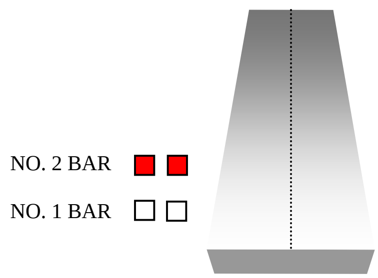


(2) **Simplified Abbreviated Visual Approach Slope Indicator System (SAVASI-2)** consists of two light boxes with a single lamp in each box. This system is designed for non-jet, utility runways, and provides descent information under daytime conditions to a distance of 1.5 miles.

(3) **VASI-4** consists of two light bars and four light boxes. This system provides descent information under daytime conditions to a distance of 4 miles.

Figure 7-5

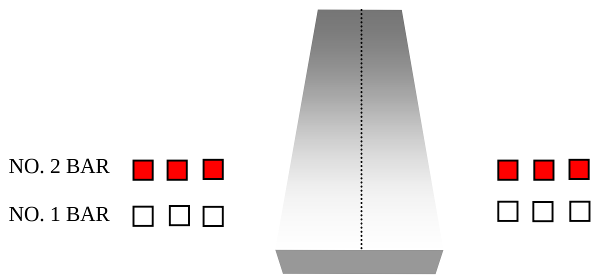
VASI - 4



(4) **VASI-12** consists of two light bars and 12 light boxes. This system provides descent information under daytime conditions to a distance of 5 miles.

Figure 7-6

VASI - 12

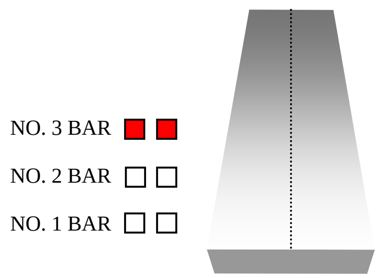


(5) **VASI-8**, which consists of eight lights, is the 12-box system with the outer four boxes removed and provides descent information under daytime conditions to a distance of 5 miles. It is located on both sides of runway.

(6) **Walker 3-Bar VASI-6 is a 3-bar system.** Each bar consists of two light boxes aligned on the left side of the runway. The system provides two visual glide paths, the lower glide path normally set at 3.0° and the higher glide path is normally set 1/4° higher, to accommodate high cockpit aircraft out to a distance of 3 miles.

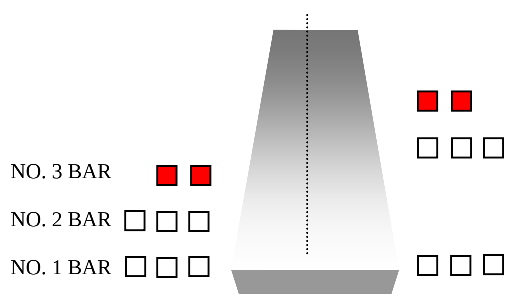
Figure 7-7

WALKER 3-BAR
VASI - 6



(7) **Walker 3-Bar VASI-16** consists of 16 light boxes installed is a VASI-12 with the addition of an upwind 2-box light bar on each side of the runway. This provides an additional visual glide path above and almost parallel to the normal path. The upper path is designed for high cockpit aircraft, ensuring a safe, minimum wheel clearance over the runway threshold. This system provides descent information under daytime conditions to a distance of 5 miles. Light bars are located on both sides of runway.

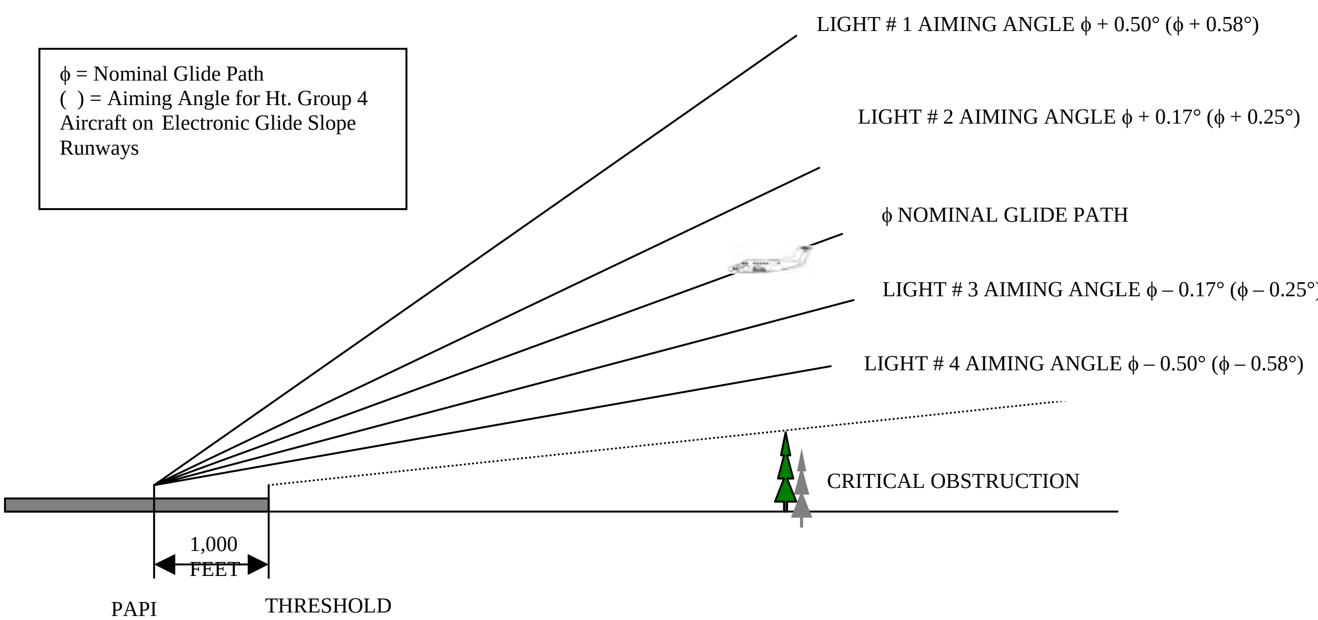
Figure 7-8
WALKER 3-BAR
VASI - 16



b. **Precision Approach Path Indicator System (PAPI)** uses a two-color light projector system that produces a visual glide path. Each light box consists of at least two optical projectors that produce a single beam of light. The upper part of the beam is WHITE and the lower part RED. When passing through the beams, the transition from one color to the other is almost instantaneous.

Figure 7-9

PAPI APPROACH PATH



There are two basic configurations of PAPI(s) that are described below:

(1) **Four-Box System.** The glide path angle of a 4-box system is the midpoint of the angular setting of the center pair of light boxes. The on-path width is the difference between the angles of light boxes 2 and 3. Normal installation requires 0.33° between light box settings 1 and 2, 2 and 3, and 3 and 4. Systems that support large aircraft require 0.50° between light boxes 2 and 3.

Table 7-1

HEIGHT GROUPS 1 - 3 AIRCRAFT

BOX	2.50	2.60	2.70	2.80	2.90	3.00	3.10	3.20	3.30	3.40	3.50	3.60	3.70	3.80	3.90	4.00
1	3.00	3.10	3.20	3.30	3.40	3.50	3.60	3.70	3.80	3.90	4.00	4.10	4.20	4.30	4.40	4.50
2	2.67	2.77	2.87	2.97	3.07	3.17	3.27	3.37	3.47	3.57	3.67	3.77	3.87	3.97	4.07	4.17
3	2.33	2.43	2.53	2.63	2.73	2.83	2.93	3.03	3.13	3.23	3.33	3.43	3.53	3.63	3.73	3.83
4	2.00	2.10	2.20	2.30	2.40	2.50	2.60	2.70	2.80	2.90	3.00	3.10	3.20	3.30	3.40	3.50

Table 7-2

HEIGHT GROUP 4 AIRCRAFT

BOX	2.50	2.60	2.70	2.80	2.90	3.00	3.10	3.20	3.30	3.40	3.50	3.60	3.70	3.80	3.90	4.00
1	3.08	3.18	3.28	3.38	3.48	3.58	3.68	3.78	3.88	3.98	4.08	4.18	4.28	4.38	4.48	4.58
2	2.75	2.85	2.95	3.05	3.15	3.25	3.35	3.45	3.55	3.65	3.75	3.85	3.95	4.05	4.15	4.25
3	2.25	2.35	2.45	2.55	2.65	2.75	2.85	2.95	3.05	3.15	3.25	3.35	3.45	3.55	3.65	3.75
4	1.92	2.02	2.12	2.22	2.32	2.42	2.52	2.62	2.72	2.82	2.92	3.02	3.12	3.22	3.32	3.42

NOTE: Maintenance establishes the alignment of the individual boxes using a degrees, minutes, seconds format instead of the above angle format. This has caused confusion between maintenance and flight inspection crews. The following charts contain the angles and the conversion to degrees, minutes, seconds. Use these charts to aid in setting the angle alignment.

Table 7-3
VGSI Angle Conversion

D.DD°	D° MIN' SEC"	D° MIN.MIN'	D.DD°	D° MIN' SEC"	D° MIN.MIN'
2.00	2° 00' 00"	2° 0.0'	2.08	2° 04' 48"	2° 4.8'
2.01	2° 00' 36"	2° 0.6'	2.09	2° 05' 24"	2° 5.4'
2.02	2° 01' 12"	2° 1.2'	2.10	2° 06' 00"	2° 6.0'
2.03	2° 01' 48"	2° 1.8'	2.11	2° 06' 36"	2° 6.6'
2.04	2° 02' 24"	2° 2.4'	2.12	2° 07' 12"	2° 7.2'
2.05	2° 03' 00"	2° 3.0'	2.13	2° 07' 48"	2° 7.8'
2.06	2° 03' 36"	2° 3.6'	2.14	2° 08' 24"	2° 8.4'
2.07	2° 04' 12"	2° 4.2'	2.15	2° 09' 00"	2° 9.0'

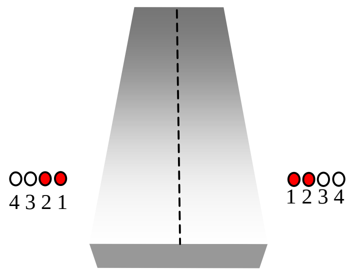
D.DD°	D° MIN' SEC"	D° MIN.MIN'	D.DD°	D° MIN' SEC"	D° MIN.MIN'
2.16	2° 09' 36"	2° 9.6'	2.58	2° 34' 48"	2° 34.8'
2.17	2° 10' 12"	2° 10.2'	2.59	2° 35' 24"	2° 35.4'
2.18	2° 10' 48"	2° 10.8'	2.60	2° 36' 00"	2° 36.0'
2.19	2° 11' 24"	2° 11.4'	2.61	2° 36' 36"	2° 36.6'
2.20	2° 12' 00"	2° 12.0'	2.62	2° 37' 12"	2° 37.2'
2.21	2° 12' 36"	2° 12.6'	2.63	2° 37' 48"	2° 37.8'
2.22	2° 13' 12"	2° 13.2'	2.64	2° 38' 24"	2° 38.4'
2.23	2° 13' 48"	2° 13.8'	2.65	2° 39' 00"	2° 39.0'
2.24	2° 14' 24"	2° 14.4'	2.66	2° 39' 36"	2° 39.6'
2.25	2° 15' 00"	2° 15.0'	2.67	2° 40' 12"	2° 40.2'
2.26	2° 15' 36"	2° 15.6'	2.68	2° 40' 48"	2° 40.8'
2.27	2° 16' 12"	2° 16.2'	2.69	2° 41' 24"	2° 41.4'
2.28	2° 16' 48"	2° 16.8'	2.70	2° 42' 00"	2° 42.0'
2.29	2° 17' 24"	2° 17.4'	2.71	2° 42' 36"	2° 42.6'
2.30	2° 18' 00"	2° 18.0'	2.72	2° 43' 12"	2° 43.2'
2.31	2° 18' 36"	2° 18.6'	2.73	2° 43' 48"	2° 43.8'
2.32	2° 19' 12"	2° 19.2'	2.74	2° 44' 24"	2° 44.4'
2.33	2° 19' 48"	2° 19.8'	2.75	2° 45' 00'	2° 45.0'
2.34	2° 20' 24"	2° 20.4'	2.76	2° 45' 36"	2° 45.6'
2.35	2° 21' 00"	2° 21.0'	2.77	2° 46' 12"	2° 46.2'
2.36	2° 21' 36"	2° 21.6'	2.78	2° 46' 48"	2° 46.8'
2.37	2° 22' 12"	2° 22.2'	2.79	2° 47' 24"	2° 47.4'
2.38	2° 22' 48"	2° 22.8'	2.80	2° 48' 00"	2° 48.0'
2.39	2° 23' 24"	2° 23.4'	2.81	2° 49' 36"	2° 48.6'
2.40	2° 24' 00"	2° 24.0'	2.82	2° 49' 12"	2° 49.2'
2.41	2° 24' 36"	2° 24.6'	2.83	2° 49' 48"	2° 49.8'
2.42	2° 25' 12"	2° 25.2'	2.84	2° 50 24"	2° 50.4'
2.43	2° 25' 48"	2° 25.8'	2.85	2° 51' 00"	2° 51.0'
2.44	2° 26' 24"	2° 26.4'	2.86	2° 51' 36"	2° 51.6'
2.45	2° 27' 00"	2° 27.0'	2.87	2° 52' 12"	2° 52.2'
2.46	2° 27' 36"	2° 27.6'	2.88	2° 52' 48"	2° 52.8'
2.47	2° 28' 12"	2° 28.2'	2.89	2° 53' 24"	2° 53.4'
2.48	2° 28' 48"	2° 28.8'	2.90	2° 54' 00"	2° 54.0'
2.49	2° 29' 24"	2° 29.4'	2.91	2° 54' 36"	2° 54.6'
2.50	2° 30' 00"	2° 30.0'	2.92	2° 55' 12"	2° 55.2'
2.51	2° 30' 36"	2° 30.6'	2.93	2° 55' 48"	2° 55.8'
2.52	2° 31' 12"	2° 31.2'	2.94	2° 56' 24"	2° 56.4'
2.53	2° 31' 48"	2° 31.8'	2.95	2° 57' 00"	2° 57.0'
2.54	2° 32' 24"	2° 32.4'	2.96	2° 57' 36"	2°57.6'
2.55	2° 33' 30"	2° 33.0'	2.97	2° 58' 12"	2° 58.2'
2.56	2° 33' 36"	2° 33.6'	2.98	2° 58' 48"	2° 58.8'
2.57	2° 34' 12"	2° 34.2'	2.99	2° 59' 24"	2° 59.4'

D.DD°	D° MIN' SEC"	D° MIN.MIN'	D.DD°	D° MIN' SEC"	D° MIN.MIN'
3.00	3° 00' 00"	3° 0.0	3.51	3° 30' 36"	3° 30.6'
3.01	3° 00' 36"	3° 0.6'	3.52	3° 31' 12"	3° 31.2'
3.02	3° 01' 12"	3° 1.2'	3.53	3° 31' 48"	3° 31.8'
3.03	3° 01' 48"	3° 1.8'	3.54	3° 32' 24"	3° 32.4'
3.04	3° 02' 24"	3° 2.4'	3.55	3° 33' 30"	3° 33.0'
3.05	3° 03' 00"	3° 3.0'	3.56	3° 33' 36"	3° 33.6'
3.06	3° 03' 36"	3° 3.6'	3.57	3° 34' 12"	3° 34.2'
3.07	3° 04' 12"	3° 4.2'	3.58	3° 34' 48"	3° 34.8'
3.08	3° 04' 48"	3° 4.8'	3.59	3° 35' 24"	3° 35.4'
3.09	3° 05' 24"	3° 5.4'	3.60	3° 36' 00"	3° 36.0'
3.10	3° 06' 00"	3° 6.0'	3.61	3° 36' 36"	3° 36.6'
3.11	3° 06' 36"	3° 6.6'	3.62	3° 37' 12"	3° 37.2'
3.12	3° 07' 12"	3° 7.2'	3.63	3° 37' 48"	3° 37.8'
3.13	3° 07' 48"	3° 7.8'	3.64	3° 38' 24"	3° 38.4'
3.14	3° 08' 24"	3° 8.4'	3.65	3° 39' 00"	3° 39.0'
3.15	3° 09' 00"	3° 9.0'	3.66	3° 39' 36"	3° 39.6'
3.16	3° 09' 36"	3° 9.6'	3.67	3° 40' 12"	3° 40.2'
3.17	3° 10' 12"	3° 10.2'	3.68	3° 40' 48"	3° 40.8'
3.18	3° 10' 48"	3° 10.8'	3.69	3° 41' 24"	3° 41.4'
3.19	3° 11' 24"	3° 11.4'	3.70	3° 42' 00"	3° 42.0'
3.20	3° 12' 00"	3° 12.0'	3.71	3° 42' 36"	3° 42.6'
3.21	3° 12' 36"	3° 12.6'	3.72	3° 43' 12"	3° 43.2'
3.22	3° 13' 12"	3° 13.2'	3.73	3° 43' 48"	3° 43.8'
3.23	3° 13' 48"	3° 13.8'	3.74	3° 44' 24"	3° 44.4'
3.24	3° 14' 24"	3° 14.4'	3.75	3° 45' 00'	3° 45.0'
3.25	3° 15' 00"	3° 15.0'	3.76	3° 45' 36"	3° 45.6'
3.26	3° 15' 36"	3° 15.6'	3.77	3° 46' 12"	3° 46.2'
3.27	3° 16' 12"	3° 16.2'	3.78	3° 46' 48"	3° 46.8'
3.28	3° 16' 48"	3° 16.8'	3.79	3° 47' 24"	3° 47.4'
3.29	3° 17' 24"	3° 17.4'	3.80	3° 48' 00"	3° 48.0'
3.30	3° 18' 00"	3° 18.0'	3.81	3° 49' 36"	3° 48.6'
3.31	3° 18' 36"	3° 18.6'	3.82	3° 49' 12"	3° 49.2'
3.32	3° 19' 12"	3° 19.2'	3.83	3° 49' 48"	3° 49.8'
3.33	3° 19' 48"	3° 19.8'	3.84	3° 50 24"	3° 50.4'
3.34	3° 20' 24"	3° 20.4'	3.85	3° 51' 00"	3° 51.0'
3.35	3° 21' 00"	3° 21.0'	3.86	3° 51' 36"	3° 51.6'
3.36	3° 21' 36"	3° 21.6'	3.87	3° 52' 12"	3° 52.2'
3.37	3° 22' 12"	3° 22.2'	3.88	3° 52' 48"	3° 52.8'
3.38	3° 22' 48"	3° 22.8'	3.89	3° 53' 24"	3° 53.4'
3.39	3° 23' 24"	3° 23.4'	3.90	3° 54' 00"	3° 54.0'
3.40	3° 24' 00"	3° 24.0'	3.91	3° 54' 36"	3° 54.6'
3.41	3° 24' 36"	3° 24.6'	3.92	3° 55' 12"	3° 55.2'
3.42	3° 25' 12"	3° 25.2'	3.93	3° 55' 48"	3° 55.8'
3.43	3° 25' 48"	3° 25.8'	3.94	3° 56' 24"	3° 56.4'
3.44	3° 26' 24"	3° 26.4'	3.95	3° 57' 00"	3° 57.0'
3.45	3° 27' 00"	3° 27.0'	3.96	3° 57' 36"	3° 57.6'
3.46	3° 27' 36"	3° 27.6'	3.97	3° 58' 12"	3° 58.2'
3.47	3° 28' 12"	3° 28.2'	3.98	3° 58' 48"	3° 58.8'
3.48	3° 28' 48"	3° 28.8'	3.99	3° 59' 24"	3° 59.4'
3.49	3° 29' 24"	3° 29.4'	4.00	4° 00' 00"	4° 0.0
3.50	3° 30' 00"	3° 30.0'			

The on-glide path indication is two RED and two WHITE lights on the light bar. When the aircraft goes below the glide path, the pilot sees a progressively increasing number of RED lights, and if the aircraft goes above the glide slope, the number of WHITE lights increases. This system provides descent information under daytime conditions to a distance of 4 miles.

Figure 7-10

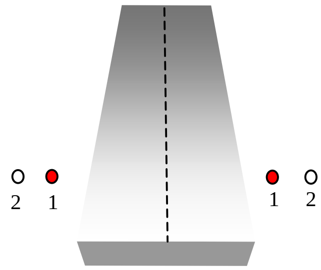
4 – BOX PAPI



(2) **Two-Box System.** This system is designed for utility type runways. The glide path angle is the midpoint between the angular settings of the two light boxes. The on-path width of this system is normally 0.50°, but may be reduced to provide obstacle clearance. The on-glide path indication is one RED and one WHITE light. When the aircraft goes below the glide path, the pilot sees two RED lights and two WHITE lights above glide path. This system provides descent information under daytime conditions to a distance of 2 miles. The system is normally installed on the left side of the runway, but may be on the right or on both sides.

Figure 7-11

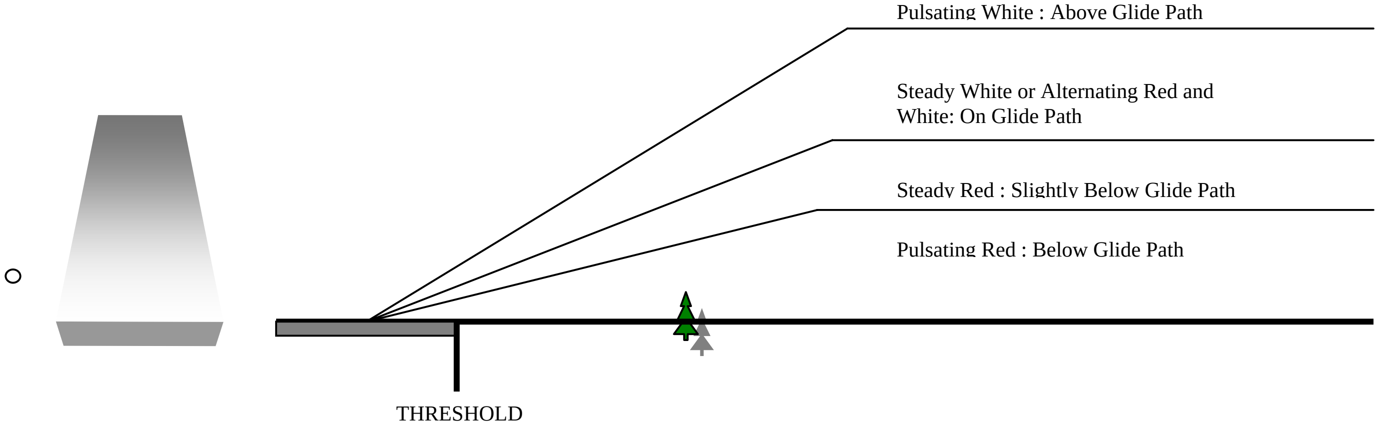
2 – BOX PAPI



c. **Pulsating Visual Approach Slope Indicator System (PVASI(s))** normally consist of a single light unit, projecting a two-color visual approach path. The below glide path indication may be pulsating or steady RED, and the above glide path indication is normally pulsating WHITE. The above and below path pulsating lights appear to pulse faster the farther off path the pilot flies. The on-glide-path indication for one system is a steady WHITE light, and for another system, the on-glide-path indication is an alternating RED and WHITE light. The on-path width of the steady WHITE light is approximately 0.35°. This system provides descent information under daytime conditions to a distance of 4 miles.

NOTE: Since the PVASI consists of a single light source, which could possibly be confused with other light sources, pilots should exercise care to properly locate and identify the light signal.

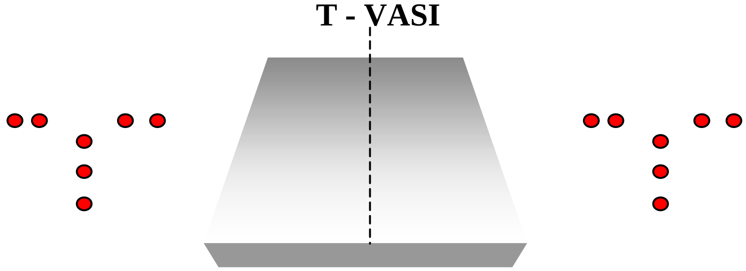
Figure 7-12
PULSATING VISUAL APPROACH SLOPE INDICATOR



d. **The T-VASI** presents a T-shaped light configuration. The standard version has 10 lights on each side of the runway; the abbreviated AT-VASI is installed on only one side. If the aircraft is above the path, the vertical 'stem' of the T appears inverted above the horizontal path. The length of the stem is relative to the amount the aircraft is above the angle. As the aircraft nears the glide angle, the stem length decreases until it is not visible at the glide angle. As the aircraft goes below the glide angle, the stem of the T appears below the horizontal lights. When the aircraft reaches 1.9°, the lights turn RED, indicating well below glide path. When above the path, the fly-up lights should not be visible, and when below the path, the fly-down lights should not be visible.

Figure 7-13

T - VASI



BELOW GLIDE PATH INDICATION

e. **Tri-Color VASI** (TRCV) normally consists of a single light unit projecting a three-color visual approach path into the final approach area of the runway upon which the indicator is installed.

- Above glide path indication – AMBER
- On glide path indication – GREEN
- Below glide path indication – RED

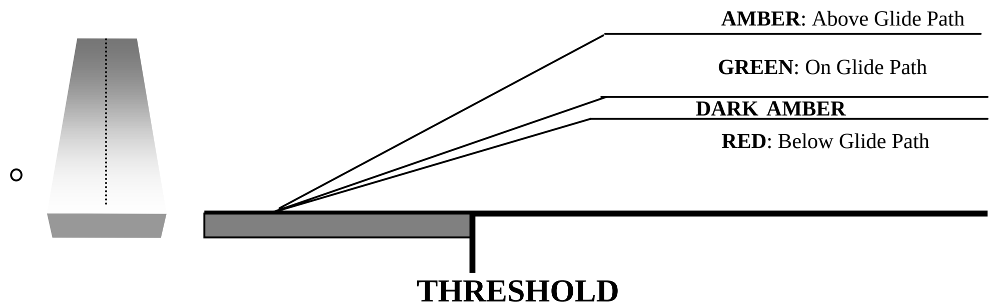
These types of indicators have a useful range of approximately ½ to 1 mile during the day and up to 5 miles at night, depending upon the visibility conditions.

Note (1): Since the tri-color VASI consists of a single light source, which could possibly be confused with other light sources, pilots should exercise care to properly locate and identify the light signal.

Note (2): When the aircraft descends from GREEN to RED, the pilot may see a dark AMBER color during that transition.

Figure 7-14

TRI – COLOR VASI

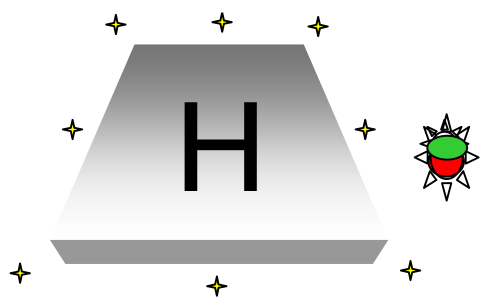


f. **The Helicopter Approach Path Indicator (HAPI)** system provides angular indications by changing light color between red and green and by pulsing the light. The on-path indication is a steady green light and, as the angle increases, the light flashes at a rate of at least 2 flashes/second (2 Hz). The slightly below path indication is a steady red indication, which turns to a flashing red indication at well below path.

The width of the on-path should be 0.75°, and the width of the slightly below indication should be 0.25°.

Figure 7-15

HAPI



7.12 PREFLIGHT REQUIREMENTS

a. **Ground Maintenance Personnel.** In addition to preparations specified in Chapter 4, Section 3, the Facilities Maintenance personnel must:

(1) Ensure that all lamps are operating.

(2) Check the lamps for blackening and the lenses for cleanliness.

(3) Check the setting of each box to determine proper angular adjustment.

(4) Inform the flight inspection personnel of any unique siting conditions such as visual screening, waivers, or local restrictions.

b. **Flight Personnel.** The flight inspector will comply with the preparations specified in Chapter 4, Section 3.

7.13 CHECKLIST. A commissioning inspection is required for all new VGSI(s) with an associated IFR procedure (to include circling approaches). Many existing VGSI(s) were placed into service without flight inspection; they may remain in service without a commissioning-type inspection until reconfigured to new systems or the addition of electronic vertical guidance to that runway. Approved VGSI facility data IAW FAA Order 8240.52, Aeronautical Data Management, is required for any VGSI inspection except Surveillance. Do not attempt to conduct the inspection using data from other facilities on that runway, (e.g., ILS data).

Type Check	Reference Paragraph	C
Light Intensity	7.14a	X
Glidepath Angle	7.14b	X
Angular Coverage	7.14c	X
Obstruction Clearance	7.14d	X
System Identification/ Contrast	7.14e	X
Radio Control	7.14f	X
Coincidence with electronic glidepath	7.14g	X

NOTE: There is no periodic inspection requirement for VGSI facilities. However, surveillance of safe operation will be accomplished in conjunction with other flight inspections involving the associated runway.

7.14 FLIGHT INSPECTION PROCEDURES

a. Light Intensity

(1) Description. This procedure is used to ensure all lights operate at the same relative intensity at each setting.

(2) Maneuvering. For facilities that are manually controlled, fly inbound while the controller changes the intensity settings to all operating ranges. Systems that use automatic intensity settings should be checked in the same manner as the manual systems.

(3) **Analysis:** Intensity should be observed throughout the flight inspection. Ensure all lamps (boxes or bars) are operating and are at the same relatively perceived intensity for each setting.

(4) **Other Considerations.** Bright sunlight may reduce the effectiveness of the VGSI(s). The normal intensity setting for daytime operation is 100%, 30% for twilight operations, and 10% for hours of darkness.

Slow transitions (see Appendix 1 for definition) from red to white, or vice versa, may be an indication of poor focusing. Past results of systems with this problem were low angles.

b. Glide Path Angle

(1) **Level Run Method:**

(a) **Description.** The level run method may be used to determine the path angle of all VGSI types. Average the results of at least two runs for commissioning type inspections. Keeping a constant altitude and airspeed, the flight inspector marks the appropriate indications for the VGSI type.

(b) **AFIS/ Equipment Setup.** The Mission Specialist will select PAR/ VGSI mode and setup per TI 4040.55.

(c) **Maneuvering:**

1 Position the aircraft inbound on the runway centerline in the below path sector at the procedural intercept altitude or 1,000 ft AGL, whichever is higher.

2 Proceed inbound at a distance applicable for the type of system (5.0 - 1.5 nm) while maintaining constant airspeed and altitude, in the landing configuration.

3 Using the Mission Specialist’s ON-PATH key or co-pilot’s LORAN WPT (if equipped) button, actuate an event mark as each box changes from RED to WHITE.

4 Descend and execute normal runway updating, (50 foot run), using co-pilot’s runway update button or Television Positioning System (TVPS).

(d) **Analysis.** Check for normal sequence of light box color changes. Check for proper angle adjustment.

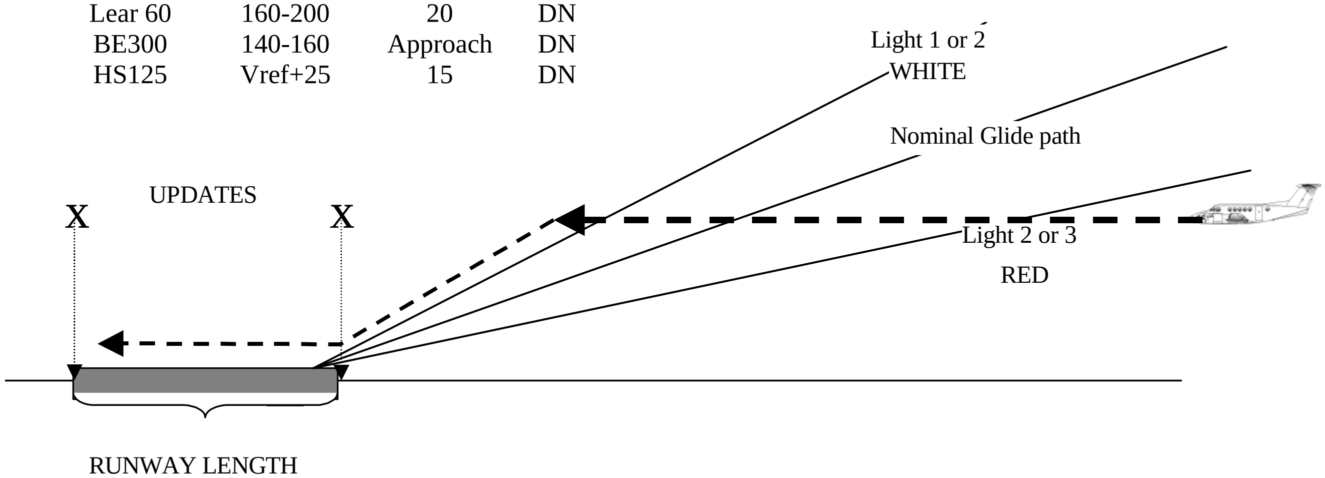
(e) **Other Considerations.** If an ILS, MLS, or PAR serve the same runway, the visual approach glide path should coincide with the one produced electronically. Non-coincidence of angles is allowed, provided it is published as such.

Figure 7-16

Level Run Profile

Aircraft Configuration

A/C	Speed KIAS	Flaps	Gear
CL601/ 4	150-180	20	DN
Lear 60	160-200	20	DN
BE300	140-160	Approach	DN
HS125	Vref+25	15	DN



(2) **On-Path Method for VGSI (non-PAPI):**

(a) **Description.** The on-path method, using AFIS or theodolite, may be used to determine the path angle of all VGSI types other than PAPI. If theodolite is used, the operator tracks the pilot's window and notes the angles when the pilot reports the desired indication.

(b) **AFIS/ Equipment Setup.** The Mission Specialist will select PAR/ VGSI mode and setup per TI 4040.55.

(c) Maneuvering:

1 Position the aircraft inbound at a starting distance of 5.0 nm on the runway centerline in the below path sector while in the landing configuration.

2 Start at the procedural intercept altitude or 1,000 ft AGL, whichever is higher.

3 Upon reaching the glide path indications, begin a descent and keep the aircraft in the center of the on-glide path indication while maintaining constant airspeed.

4 Using the Mission Specialist's ON-PATH key or co-pilot's LORAN WPT (if equipped) button, actuate an event mark at each point the pilot judges the indication to be "ON-PATH".

5 Descend and execute normal runway updating, (50 foot run), using co-pilot's runway update button or Television Positioning System (TVPS).

(d) Analysis. Check for normal sequence of light box color changes. Check for proper angle alignment. The path angle is the average of the corrected ON-PATH angles.

(e) Other Considerations. If an ILS, MLS, or PAR serve the same runway, the visual approach glide path may coincide with the one produced electronically. Non-coincidence of angles is allowed, provided it is published as such. This method is acceptable for all types of inspections.

(3) Theodolite Method

(a) Maneuvering:

1 Position the theodolite beside the runway so the imaginary glide path, originating from a point abeam the runway reference point (RRP), will pass through the theodolite eyepiece.

NOTE: The RRP is the point on the runway where the visual glide path intercepts the surface.

2 Position the aircraft inbound on the runway centerline in the below path sector in the landing configuration.

3 Start at the procedural intercept altitude or 1,000 ft AGL, whichever is higher.

4 The operator tracks the aircraft during the level run. The pilot calls when passing the desired indications, and the theodolite operator notes the angles. The center of the on-path indications is used as the glide path angle. For PAPI, the glide angle is the average of the angles measured when the two boxes (Boxes 2 and 3 on 4-box systems) change from RED to WHITE.

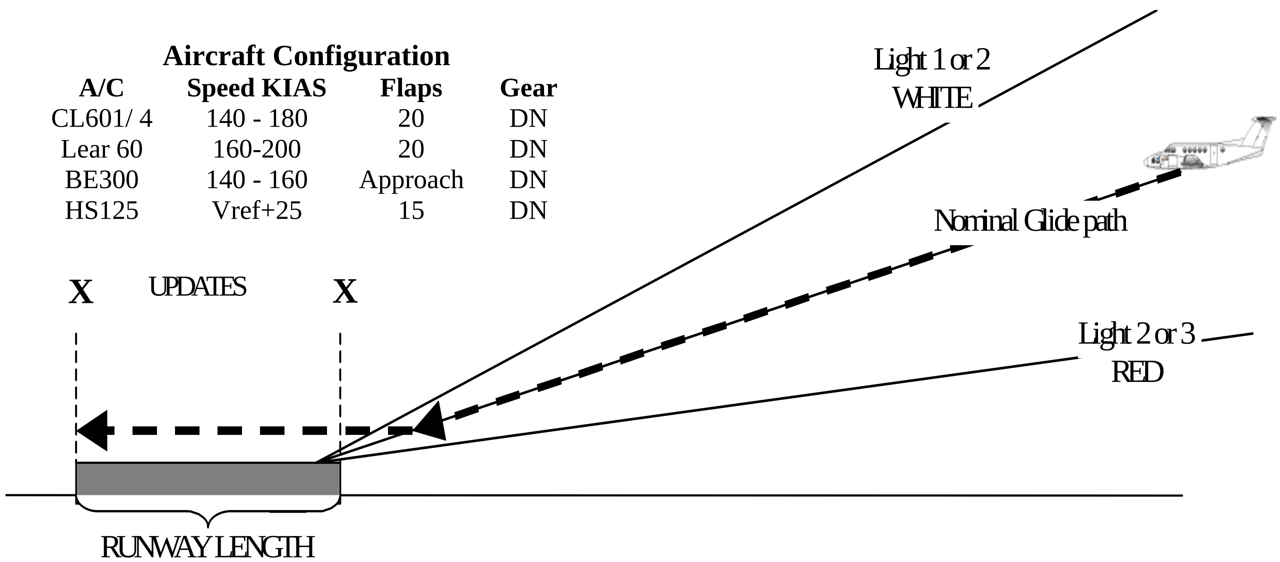
NOTE: Average the results of at least two runs for commissioning-type inspections.

Figure 7-17

ON PATH Profile (Non-PAPI)

Aircraft Configuration

A/C	Speed KIAS	Flaps	Gear
CL601/ 4	140 - 180	20	DN
Lear 60	160-200	20	DN
BE300	140 - 160	Approach	DN
HS125	Vref+25	15	DN



(4) **Multiple Transition Method:**

(a) **Description.** The multiple transition method uses slight changes in pitch attitude to measure the angles at which a box changes from a low to high and a high to low indication. This method is acceptable for all PAPI inspections, including commissioning. When measuring individual boxes, an average of equal numbers of white/ red and red/ white transitions is required. Confirm out-of-tolerance conditions with individual measurements of each box.

(b) **AFIS/ Equipment Setup.** The Mission Specialist will select PAR/ VGSI mode and setup per TI 4040.55.

(c) **Maneuvering:**

1 Starting from below-path inbound on-course at a distance of 5.0 nm from threshold, fly through the RED-WHITE change, then slightly increase the rate of descent to see a WHITE to RED transition of the box being checked.

2 Repeat the process to ensure that there are an equal number of transitions in each direction; otherwise, the calculation will be skewed.

3 At each transition point use the Mission Specialist's ON-PATH key or co-pilot's LORAN WPT (if equipped) button to actuate and event mark.

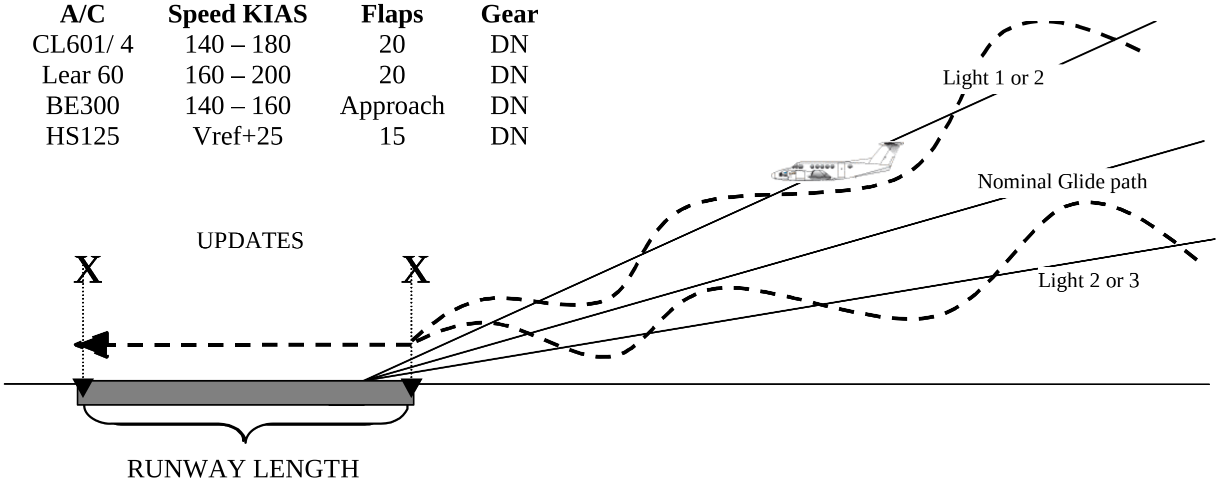
4 Descend and execute normal runway updating, (50 foot run), using the co-pilot's runway update button or Television Positioning System (TVPS).

(d) **Analysis**. Check for normal sequence of light box color changes. Check for proper angle alignment. System angle is the average of box 2 and box 3 angles (PAPI-4) or of box 1 and box 2 angles (PAPI-2).

Figure 7-18
PAPI Multiple Transition Profile

Aircraft Configuration

A/C	Speed KIAS	Flaps	Gear
CL601/ 4	140 – 180	20	DN
Lear 60	160 – 200	20	DN
BE300	140 – 160	Approach	DN
HS125	Vref+25	15	DN



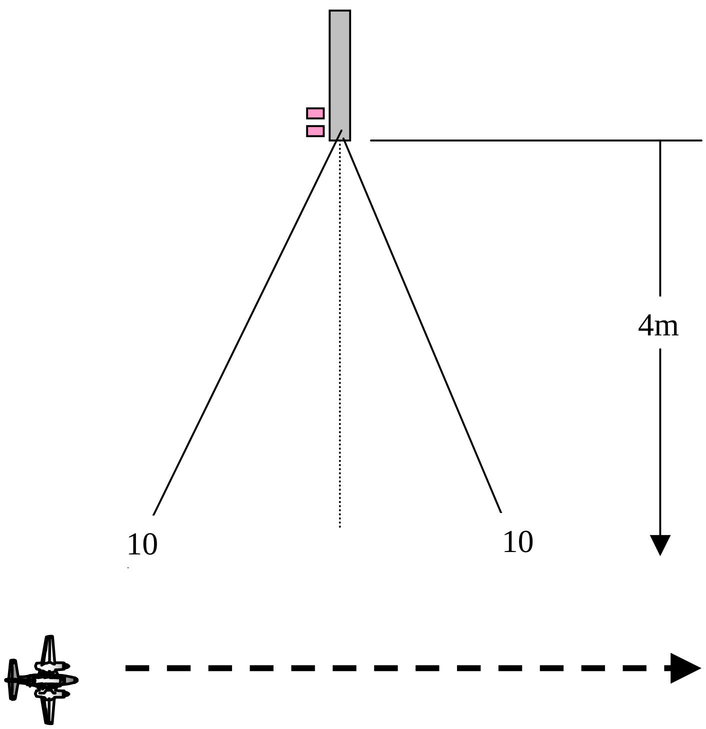
CAUTION
Pilot-induced oscillations could be dangerous. Use extreme caution while conducting this maneuver—never put the crew and aircraft in danger.

c. Angular Coverage

(1) Description. Unrestricted VGSI(s) provide coverage/ obstacle clearance 10° either side of the runway centerline extended, measured from the runway threshold when using the AFIS PAR/VGSI mode. The lateral coverage may be reduced for obstacles by the use of blanking devices or baffles; in this case, the facility is restricted.

(2) AFIS/ Equipment Setup. The Mission Specialist will select PAR/ VGSI mode and setup per TI 4040.55.

Figure 7-19
Coverage Flight Profile



Aircraft Configuration

A/C	Speed KIAS	Flaps	Gear
CL601/ 4	170- 250	UP	UP
Lear 60	160 – 200	20	UP
BE300	140 – 160	UP	UP
HS125	Vref+25-220	15	UP

(3) Maneuvering:

(a) During commissioning inspections, fly a perpendicular crossing to determine the horizontal angular coverage of the VGSI(s).

(b) Lateral coverage is measured by flying either a clockwise or counterclockwise arc at a distance sufficient to enable the flight inspector to observe any shielding effect on the system. Conduct the maneuver at an altitude that provides on-path indication.

(c) **With the AFIS set up,** the Pilot announces when the VGSI(s) are first and last usable.

(d) **The Mission Specialist will** read and record the lateral angle left and right of centerline.

(4) **Analysis.** Observe the point where the VGSI becomes usable or unusable. The usable area is the angular coverage. When coverage or obstacle clearance is less than 10° either side of the runway centerline, restrict the facility, issue a NOTAM, and ensure publication in the Airport/ Facility Directory.

(5) **Other Considerations.** If an offset ILS/ MLS is installed on the same runway as a VGSI (the VGSI will be aligned to the runway), the angular relationships must be carefully analyzed to determine the coverage suitability. For a system installed on only one side to be considered usable, all lights must be visible. For dual side installations, coverage from either side is required.

d. **Obstruction Clearance**

(1) **Description.** The VGSI(s) must provide clearance above all obstacles within the commissioned operational service volume. Flight Inspection verifies that specific VGSI below path indications clear all obstacles within the commissioned service volume. The below-path approach is conducted during commissioning inspections, and anytime there is a questionable obstruction, to determine satisfactory guidance and obstruction clearances. A theodolite may be required to verify a critical obstacle. Obstruction clearance at the lateral coverage extremities may be evaluated during the coverage arc. Confirm questionable clearance by inbound flight.

(2) **AFIS/ Equipment Setup:** The Mission Specialist will select PAR/ VGSI mode and setup per TI 4040.55.

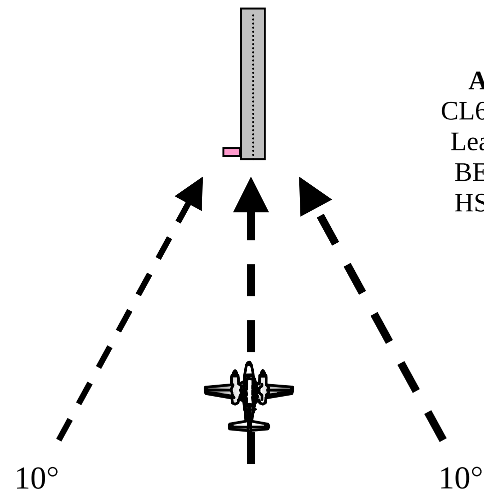
(3) **Maneuvering:**

(a) Position the aircraft outside of the normal glide slope intercept distance below the glide path.

(b) While proceeding inbound, a definite below path indication must be visible on the VGSI(s) while maintaining clearance above all obstacles in the approach path.

(c) Conduct below path approaches on runway centerline extended and along each side of the angular coverage from the point where the VGSI's angle intercepts 1,000 ft AGL or procedural altitude, whichever is higher. If the lateral coverage extremities can be checked for obstacle clearance while flying the runway centerline track, a single inbound run may be used.

Figure 7-20
VGSI Obstruction Clearance Area



Aircraft Configuration

A/C	Speed KIAS	Flaps	Gear
CL601/ 4	150 – 180	20	DN
Lear 60	160 – 200	20	DN
BE300	140 – 160	Approach	DN
HS125	Vref+25	15	DN

(4) **Analysis.** Verify that specific VGSI below path indications clear all obstacles within the commissioned operational service volume. A definite climb indication must be visible while maintaining clearance above all obstacles. The visual glide path should be at least 1° above all obstacles in the service volume of the VGSI.

(5) **Other Considerations.** Definite climb indications are:

(a) **VASI.** A definite RED/ RED light must be visible on both upwind and downwind bars while maintaining clearance above all obstacles.

(b) **PAPI.** A definite RED must be visible on all light boxes while maintaining clearance above all obstacles.

(c) **PVASI/ HAPI.** A definite flashing RED must be visible on the light unit while maintaining clearance above all obstacles.

(d) T**-VASI.** A definite RED must be observed on all 4 horizontal and all 3 vertical lights while maintaining clearance above all obstacles.

e. System Identification/ Contrast

(1) Description. VGSI(s) must provide a glide path that is easily identifiable and readily distinguishable from other visual aids and aeronautical lights within the runway threshold and touchdown zone area.

(2) Maneuvering. This evaluation is conducted in conjunction with the other inspections.

(3) Analysis. Observe if any surrounding lights or aircraft on taxiways interfere with the identification or use of the installed system. If there is any question of misidentification or interference, the VGSI should be checked at night. If a specific problem can be identified during the day, there is no requirement to confirm it at night.

(4) Other Considerations: Misidentifying or failure to readily acquire the VGSI system will result in an unusable status designation.

f. Radio Control of Lighting

(1) Description. Radio control of lighting is available at selected airports to provide airborne control of lights by keying the aircraft's microphone. All lighting systems that are radio controlled at an airport, whether on a single runway or multiple runways, operate on the same radio frequency.

(2) Maneuvering. The aircraft should be positioned 4 to 5 miles from the airport at minimum line-of-sight altitude.

(3) Analysis. The sensitivity of the VGSI's ground radio control should be adjusted to allow facility activation when a proper radio signal is transmitted. Check for standardization of radio controlled lighting operations, as depicted in the Airmen's Information Manual.

(4) Other Considerations. If Pilot-Controlled Lighting is inoperative, initiate NOTAM action and attempt to contact airport authority to have the lights manually activated for night or IFR use**.** Some lighting systems have a photocell that prevents operation during daylight hours. Flight inspectors will verify this with airport authorities before initiating NOTAM action. This information will be added to airport data sheets.

g. Coincidence

(1) (ILS/ MLS/ PAR)

(a) Description. When VGSI(s) and ILS, MLS, or PAR serve the same runway, the visual approach glide path should coincide with the one produced electronically. VGSI installations are engineered to provide close Runway Reference Point (RRP) coincidence with the Runway Point of Intercept (RPI), using the same commissioned angle for both systems. Siting conditions affecting the electronic aid's achieved RPI may result in achieved RPI/ RRP coincidence values beyond installation specifications, but satisfactory for use. Non-coincidence of angles and/or intercept points may be allowed, provided they are published as such. Approved waivers to electronic glide slopes must apply to VGSI systems. Some PAPI and PVASI systems are installed to serve aircraft in Height Group 4 aircraft. The RRP of these systems is engineered to be 300 – 350 ft down the runway from the electronic RPI. PAPI or PVASI systems sited for Height Group 4 aircraft must be identified in Airport/ Facility Directory or similar publications.

(b) AFIS/ Equipment Setup: The Mission Specialist will select PAR/ VGSI mode and setup per TI 4040.55.

(c) Maneuvering:

1 Fly the **electronic glide slope** from approximately 2 nm to threshold for systems installed to support aircraft in Height Groups 1, 2, and 3. For PAPI/ PVASI installed for Height Group 4, independently fly both the electronic and visual glide slopes.

2 While flying the **visual glide slope,** monitor or record the ILS/ MLS glide slope for expected ILS/ MLS displacement at the 6,000 ft and 1,000 ft points.

(d) Analysis. Compare the electronic and visual glide slopes in the area between 6,000 ft and 1,000 ft prior to threshold for coincidence of runway point-of-intercept.

(e) Other Considerations. For PAPI/ PVASI sited for Height Group 4 aircraft, compare the achieved runway intersection points of both systems.

(2) Barometric Vertical Navigation (VNAV). When VGSI(s) and SIAP(s) with Baro VNAV glidepath information serve the same runway, the visual approach path should coincide with the SIAP glidepath(s). Non-coincidence of angles and/or intercept points is acceptable, provided they are published as such.

7.15 TOLERANCES. The flight inspector is responsible for assigning facility classification based on flight inspection results. All systems must meet these tolerances for an unrestricted classification. USAF/ USN may commission facilities that do not meet the criteria for visual glidepath angle, glidepath coincidence, or RRP. VGSI system angle and the runway served are included in the routine FSS/ commissioning message for appropriate publication.

a. Light intensity. All lights must operate at the same relative intensity at each setting.

b. Visual Glidepath Angle

(1) The visual glidepath is normally 3.0°, unless a different angle is necessary for obstacle clearance or special operations. The angle must be published in the Airport/ Facility Directory or similar publication.

(2) The effective glidepath angle must be within 0.20° of the established or desired angle.

(3) The visual and electronic glide slopes must coincide in the area between 6,000 ft and 1,000 ft prior to threshold such that there are no conflicting indications that may result in pilot confusion. For PAPI/ PVASI sited to support aircraft in Height Group 4, coincidence must be considered satisfactory if the visual glide slope intersects the runway 300 to 350 ft past the point where the electronic glide slope intersects the runway.

c. Angular Coverage. The VGSI(s) must provide guidance relative to the approach angle over a horizontal angle of not less than 10° either side of the runway centerline extended. When coverage or obstacle clearance is less than 10° either side of runway centerline, restrict the facility, issue a NOTAM, and ensure publication in the Airport/ Facility Directory.

d. Obstacle Clearance. A definite fly-up indication must be visible while maintaining clearance above all obstacles within the approach area.

e. Airfield/ System Contrast. The system must provide a glidepath signal which is easily identifiable and readily distinguishable from other visual aids and aeronautical lights within the installed environment. Misidentifying or failure to readily acquire the VGSI system will require an unusable status designation.

7.16 ADJUSTMENTS. See Chapter 4, Section 3.

SECTION 2

APPROACH AND RUNWAY LIGHTS

7.20 INTRODUCTION. An approach lighting system is a configuration of lights positioned symmetrically about the runway centerline extended, starting at the runway threshold and extending outward into the approach zone. This system provides visual information on runway alignment, height perception, roll guidance, and horizontal reference. Approach lighting systems are designed to improve operational capability and safety of aircraft during approach and landing operations, particularly during the hours of darkness and/or reduced visibility. Although these facilities are considered visual navigational facilities, they are used with electronic landing aids, and generally will support reduced visibility minimums.

a. **Commissioning** flight inspection is required for all runway and approach lighting systems that support a public-use or military instrument approach procedure. These systems may include approach lights, runway end identifier lights (REIL), runway edge lights, runway centerline and threshold lighting, and pilot control features of these systems.

b. **Periodic** or recurring inspections will be conducted concurrently with the periodic inspection of the primary navigational facility that the lighting supports. The periodic inspection of the primary facility will be considered complete if circumstances prohibit inspection of the lighting systems, provided all other checklist items contained in this handbook have been accomplished satisfactorily.

c. **Night evaluation of an airport with no prior IFR service.** A night flight inspection will be conducted to determine the adequacy of the lighting systems to support the procedure. Night IFR operations will not be authorized until the night evaluation is completed (See Chapter 6).

d. **Night evaluation of new or changed approach lighting systems.** Commissioning inspections of approach lighting systems must include a night evaluation.

A subsequent night evaluation may be required when lighting systems have been modified, replaced, or reconfigured, depending on the type of lighting and the extent of the modifications. For example, if an SSALR is converted to a MALSR, there is no difference in light configurations, the only difference being the number of available intensity settings (SSALR will have 3 or 5; MALSR will have 2 or 3). A simple check of the step operation during the daytime would satisfy inspection requirements. However, if an ALSF-1 is replaced with an SSAL system, the shortened length will significantly affect the nighttime appearance of the system and it should be evaluated at night. It would be appropriate for a flight inspector to use his or her judgment on the necessity of a night evaluation when strobe lights are added to an existing system (going from an MALS to an MALSF for example), or they are rearranged to go from an MALSF to an SSALR.

More details about approach lighting configurations and brightness intensities can be found in FAA Order 6850.2, Visual Guidance Lighting Systems.

e. **Night evaluation of existing runway lighting systems.** Modifications to runway (vice approach) lighting may be conducted during day or night.

f. **Night evaluation of REILS.** REILS have a unique purpose to help identify the runway end in a "confusing" light environment. Consequently, the first-time installation of REILS must be evaluated at night. Repairs or modifications to existing REILS, that in the flight inspector's opinion would have no significant impact on night operations, may be evaluated during the daytime.

g. **Lighting systems restrictions**. It is not intended that runway and approach lighting systems be classified as unrestricted, restricted, or unusable unless a hazard to safety exists.

h. **Maintenance personnel** should make every effort to correct discrepancies discovered on an approach lighting system during commissioning flight inspection of the primary navigation aid or procedure. Where a hazard to safety exists, correction of discrepancies will be made prior to public use of the system; otherwise, correction of minor deficiencies will be made as soon as possible.

7.21 LIGHTING SYSTEMS

a. **Approach Lighting System.** Standard U.S. lighting systems consist of the following:

(1) **Sequenced Flashing Lights (SFL)**

(a) Sequenced Flashing Lights may be installed on each centerline bar of an approach lighting system beginning 1,000 ft from the threshold and extending outward the length of the lighting system. Sequenced Flashing Lights on USAF systems will commence 200 ft from the runway threshold. Sequenced Flashing Lights sequence toward the threshold at a rate of twice per second. They appear as a ball of light traveling in the direction of the landing threshold at a very high rate of speed.

(b) Sequenced Flashing Lights are standard with ALSF systems.

(c) Sequenced Flashing Lights may augment a SSALS or MALS to become a SSALF or MALSF, respectively.

(2) **Runway Alignment Indicator Lights (RAIL)**

(a) The standard RAIL system consists of five sequenced flashing lights installed 200 ft apart on the runway centerline extended, beginning 200 ft beyond the outer end of the approach lighting system.

(b) Runway Alignment Indicator Lights may augment a SSALS or MALS to become a SSALR or MALSR, respectively.

(3) **RAIL vs. SFL.** RAIL and SFL are the same type of strobe lights. The difference between the two is where the strobe lights stop. In the case of sequenced flashing lights (like MALSF), the strobes are located between the steady burning light bars and go all the way to the decision bar. However, RAIL configurations (like MALSR and SSALR), have the strobe lights arranged prior to the steady burning approach lights. In other words, they end where the white approach light bars begin. See Figure 7-23.

(4) **Approach Lighting System (ALS):** Installed with SFL(s) and designated as either ALSF-1 or ALSF-2, depending upon the configuration. ALSF-1 is the standard Category I system; ALSF-2 is the standard Category II and Category III system.

(a) A**LSF-1.** The ALSF-1 (See Figure 7-21) is the standard Category I approach lighting system with sequenced flasher lights. The ALSF-1 can also support Category II approaches. It consists of a light bar containing five lamps at each 100-ft interval starting 300 ft from the runway threshold and continuing out to 3,000 ft (total of 28 centerline bars). Light bars are installed perpendicular to the runway centerline extended and all lights are aimed away from the runway threshold. The centerline light bar at 1,000 ft from the threshold is supplemented with eight additional lights on either side, forming a light bar 100 ft long and containing 21 lights. This bar is called the 1,000-ft bar. All of the aforementioned lights are white in color. The terminating bar, installed 200 ft from the threshold, is 50 ft long and contains 11 red lights. Wing bars or pre-threshold bars, each containing 5 red lights, are located 100 ft from the threshold, one on either side of the runway. The innermost light (nearest runway centerline) of each wing is located in-line with the runway edge lights. The threshold bar is a row of green lights spaced 5 to 10 ft apart that are located near the threshold and extended across the runway threshold to approximately 45 ft from the runway edge on either side of the runway. The ALSF-1 operates on five intensity settings of 100%, 20%, 4%, 0.8%, and 0.16%.

This system may be authorized for approval of Category II minima by appropriate authority.

(b) **ALSF-2.** The ALSF-2 (See Figure 7-22) is the standard Category II approach lighting system and differs from the ALSF-1 system only in the inner 1,000 ft (nearest the runway threshold) with the outer 2,000 ft being identical for both. The terminating bar and wing bars of the ALSF-1 configuration are replaced with centerline bars of 5 white lights each. In addition, there are side row bars containing 3 red lights each on either side of the centerline bars at each light station in the inner 1,000 ft. Also, this system has an additional light bar (4 white lights each) on either side of the centerline bar 500 ft from the threshold. These lights form a crossbar referred to as the 500-ft bar. The ALSF-2 operates on five intensity settings of 100%, 20%, 4%, 0.8%, and 0.16%.

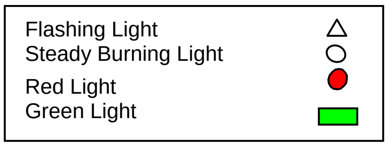


Figure 7-21

ALSF-1

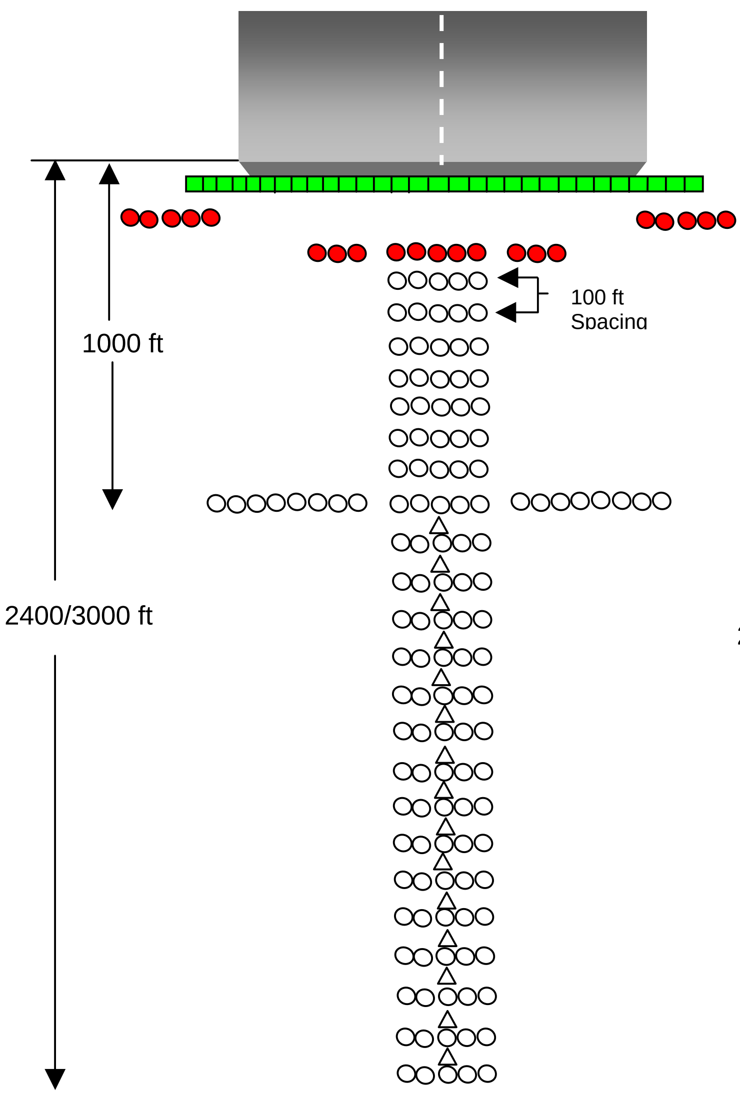
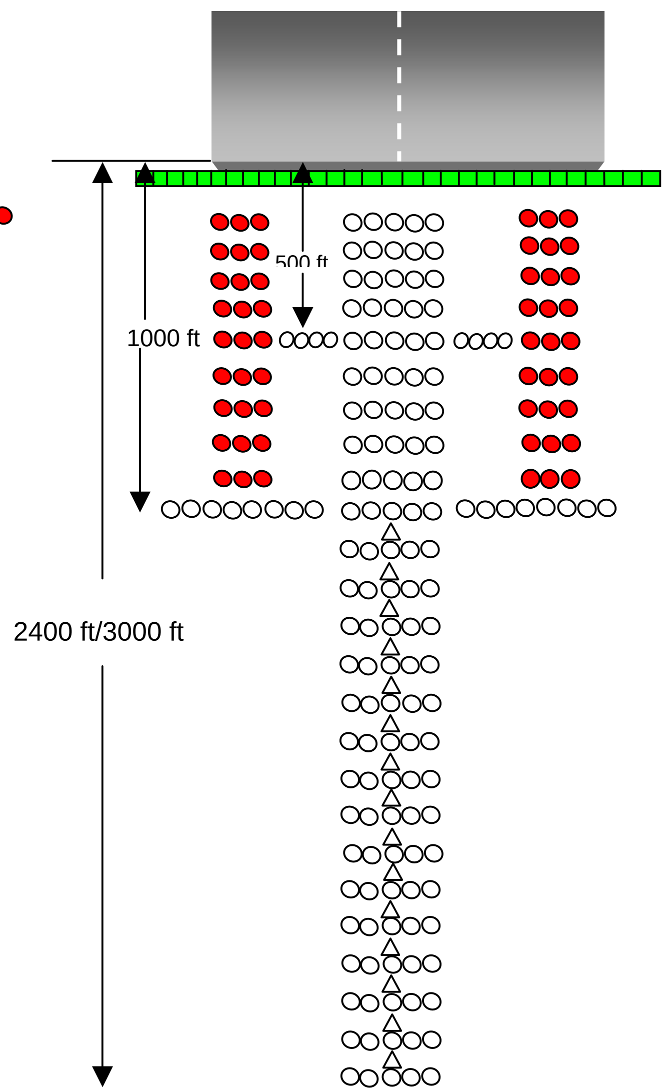


Figure 7-22

ALSF-2



(5) **Simplified Short Approach Lighting System (SSALS)**. Usually installed with SFL and designated as SSALF, or installed with Runway Alignment Indicator Lights (RAIL) and designated as SSALR. SSALS supports Category I systems.
(See Figure 7-23) This is a 1,400-ft system and utilizes the standard ALS centerline light bar hardware and is capable of being upgraded to a standard 3,000-ft system. It consists of seven light bars of five white lamps each, spaced 200 ft apart, beginning 200 ft from the threshold. Two additional light bars, containing five white lamps each, are located on either side of the centerline bar at 1,000 ft from the runway threshold forming a crossbar 70 ft long. All lights in this system operate on at least three intensity settings of approximately 100%, 20%, and 4%. SSALR(s) incorporated as part of an ALSF system will have all five intensity settings, 100%, 20%, 4%, 0.8%, and 0.16%. During IFR conditions, the full ALSF-2 system must be operating.

NOTE: Some part-time control towers will leave just the SSALR(s) operational since Category II operations and subsequent use of ALSF-2 lights require a manned control tower.

(a) **SSALSF (SSALR with SFL).** This system is identical to the SSALS system, except for the addition of three sequenced flashers located on the runway centerline at the outer three light bar stations. These flashers assist pilots in making early identification of the system in areas of extensive ambient background light. The sequenced flashers have an "on-off" switch and will operate on all intensity settings of the steady burning lights.

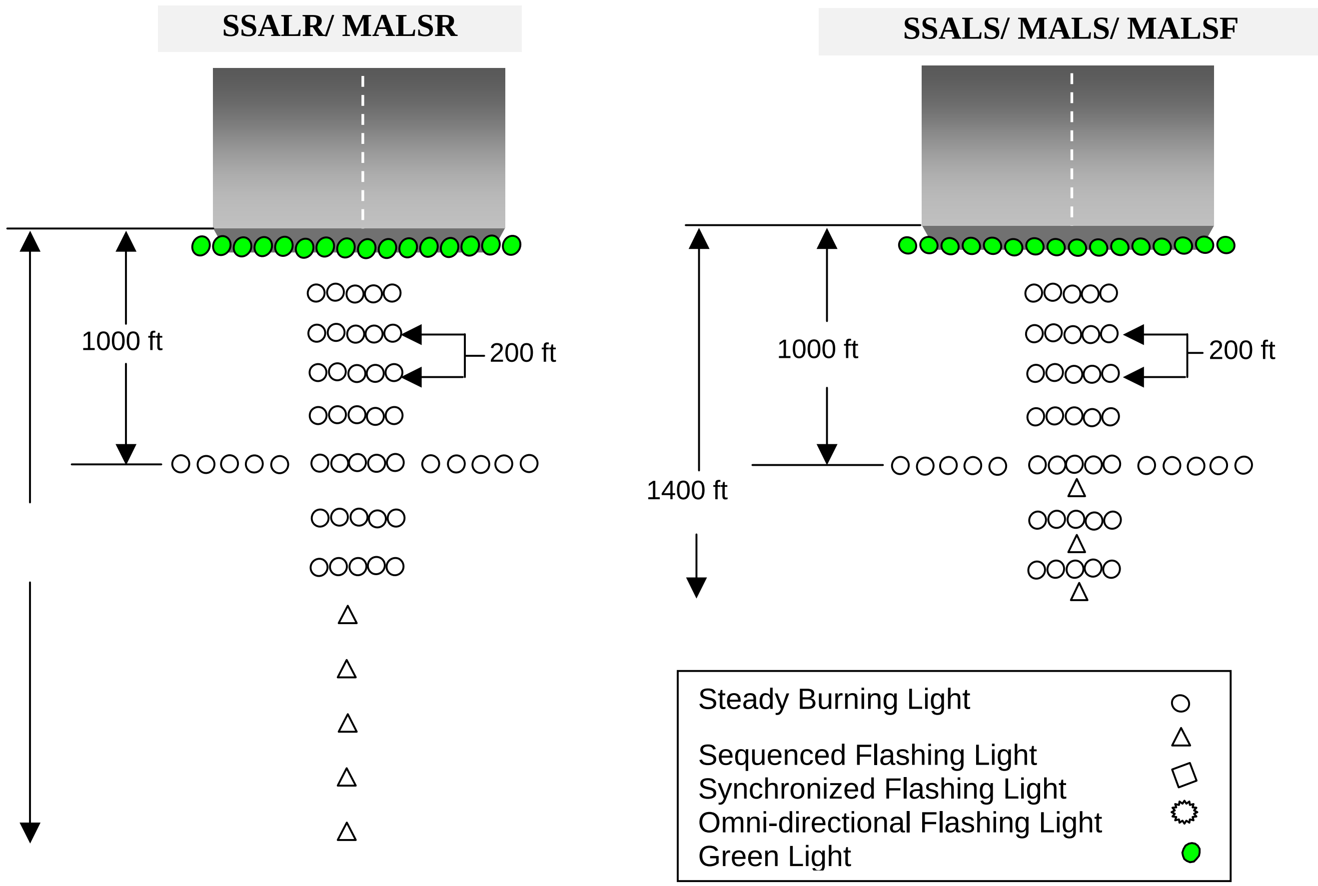
(b) **SSALR (SSALS with RAIL).** This is a 3,000-ft system and is identical to the SSALS, except that five sequenced flasher lights spaced 200 ft apart are added on the centerline, beginning 200 ft beyond the end of the SSALS system. The sequenced flashers have a separate on-off switch but do not have a separate intensity control; they operate with all intensity settings of the steady burning lights and runway edge lights.

(6) Medium Intensity Approach Lighting System (MALS). Usually installed with SFL and designated as MALSF, or installed with RAIL and designated as MALSR. MALS supports Category I systems and non-precision approaches. This system is 1,400 ft in length, consisting of seven light bars of five lamps each, located on the runway centerline, extended and spaced 200 ft apart. Two additional light bars are located on either side of the centerline bar at 1,000 ft from the runway threshold. All lights in this system have a minimum of two intensity settings. Three intensity settings, 100%, 20%, and 4% are desirable.

(a) MALSF (MALS with SFL). This system is identical to the MALS, except that three sequenced flasher lights are located at the outer three light bar stations. These sequenced flashers do not have an intensity control; they operate on both intensity settings of the steady burning lights.

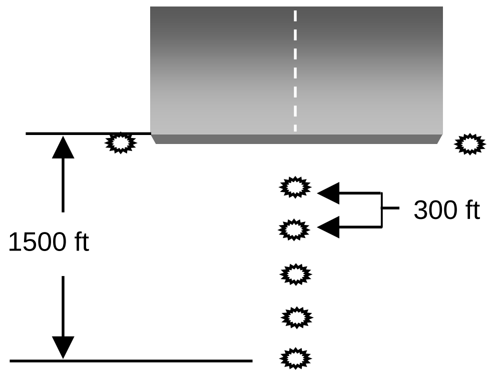
(b) MALSR (MALS with RAIL). This system is the same as a MALS configuration, except that five sequenced flashers are added on the extended runway centerline, beginning 200 ft beyond the outer end of the MALS system and extending out at 200-ft intervals to 3,000 ft. The MALSR and SSALR may have an overall length of 2,400 ft at locations where the glideslope is greater than 2.75°. The MALSR may be used with precision navigation aids, i.e., PAR, ILS.

Figure 7-23


SSALR/ MALSR
1000 ft
200 ft
SSALS/ MALS/ MALSF
1000 ft
200 ft
1400 ft
Steady Burning Light
Sequenced Flashing Light
Synchronized Flashing Light
Omni-directional Flashing Light
Green Light

(7) **Omni-directional Approach Lighting System (ODALS)** supports non-precision approaches. ODALS consists of seven omnidirectional flashing lights. Five lights are located on the runway centerline extended, with the first light located 300 ft from the threshold and extending at equal intervals up to 1,500 ft from the threshold. The other two lights are located, one on each side of the runway threshold. They should flash in sequence toward the runway threshold at a rate of once per second, with the two lights located on each side of the runway flashing simultaneously.

Figure 7-24
ODALS



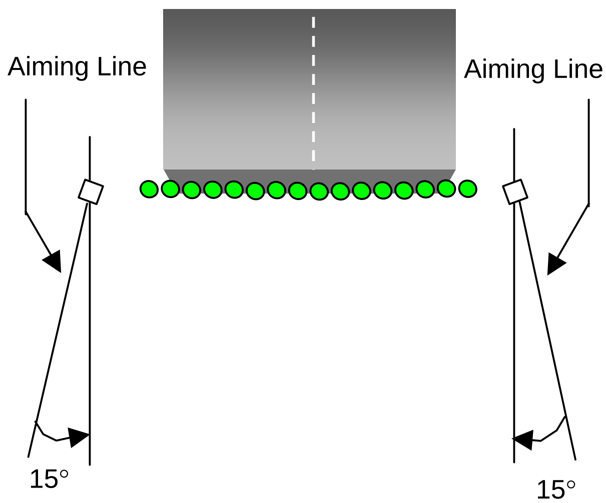
(8) **Runway End Identifier Lights (REIL)** provide rapid and positive identification of the approach end of a particular runway. REIL do not provide course alignment, descent, or altitude information. The system consists of a pair of synchronized flashing lights located laterally on each side of the runway threshold. REIL systems may be either omni-directional or unidirectional facing the approach area.

(a) **Unidirectional REIL (Figure 7-P).** Unidirectional REIL are installed where environmental conditions require that the area affected by the flash from the REIL will be greatly limited. Unidirectional REIL systems have a flash rate of 120 flashes per minute (± 10%), and a beam pattern of 10° vertical and 30° horizontal. Installation instructions call for the beam axis of an unbaffled unit to be aligned 15° outward from a line parallel to the runway and inclined at an angle 10° above the horizontal. If this standard setting is operationally objectionable, optical baffles are provided and the beam axis of the unit is oriented 10° outward from a line parallel to the runway centerline and inclined at an angle of 3°above horizontal.

(b) **Omni-directional REIL, (OD REIL)** system provides good circling guidance and is the preferred system. OD REIL systems have a flash rate of 60 flashes per minute (± 10%), and a beam pattern from 2 to 10° above horizontal.

NOTE: These approach lighting system configurations are identified as the United States Standard. While there are other lighting system configurations in existence, no attempt has been made to describe all systems in this section since they are considered nonstandard lighting systems. Where it is necessary to make an in-flight evaluation of non-standard systems, the flight inspector must determine that they fulfill the operational requirements for which they are installed and do not create signals that might be misleading or hazardous.

Figure 7-25
REILS



b. Runway Lighting Systems. Runway lighting is used to outline the edges of runways during periods of darkness or restricted visibility. These light systems are classified according to the intensity they are capable of producing.

(1) Runway Edge Lighting

(a) Standard runway edge lights are white, except on instrument runways where amber lights replace the white lights on the last 2,000 ft (or one half the runway length, whichever is less) to form a caution zone for landings. Only one side of the light is amber; the other side remains white, allowing use for both ends of the runway for landing. They are classified as one of the following: High Intensity Runway Lights (HIRL), Medium Intensity Runway Lights (MIRL), or Low Intensity Runway Lights (LIRL)

(b) The lights marking the ends of the runway emit red lights toward the runway to indicate the end of the runway toward departing aircraft, and emit green lights toward aircraft on approach to indicate the threshold to landing aircraft.

(c) Displaced runway thresholds have the threshold lights installed laterally outside the edges of the runway.

(2) **Centerline Lighting (CL).** Runway centerline lights are located along the centerline of the runway length. To prevent conflict with the centerline pavement markings, centerline lights may be offset by as much as 2 ft either side of the marking. To prevent possible interference with aircraft exiting the runway, on major taxiway turnoffs the lighting should be located on the opposite side of the centerline pavement marking. Until the last 3,000 ft of runway, the centerline lights are white. The last 3,000 ft of the lighting is color-coded as alternating red and white lights (from 3,000-1,000 ft of remaining runway) or red lights (last 1,000 ft of runway) to aircraft approaching the runway end. They appear as white lights to aircraft proceeding in the other direction on the runway.

(3) **Touchdown Zone Lighting (TDZL).** Touchdown zone lighting consists a series of two rows of light bars, each consisting of three lights each, located symmetrically about the runway centerline with the first light bars located 100 ft from the runway threshold. The bars are spaced 100 ft apart and are installed on the first 3,000 ft of runway or, for runways less than 6,000 ft in length, on the first half of the runway.

c. **Other Airport Lighting**

(1) **Other airport lighting installed may include** taxiway edge lights, taxiway centerline lights, taxiway lead-off lights, land and hold short lights, apron lights, runway guard lights, stop bar lights, clearance bar lights, or airport beacons.

(a) Some airports have "Surface Movement Guidance and Control System" (SMGCS) or similar systems installed for low visibility operations.

(b) Details of these lighting systems, which do not normally required flight inspection, are contained in various Advisory Circulars available on FAA websites.

d. Pilot Control of Airport Lighting

(1) Radio control of lighting is available at selected airports to provide airborne control of lights by keying the aircraft's transmitter. Normally, all lighting systems that are radio controlled at an airport, whether on a single runway or multiple runways, operate on the same radio frequency.

(2) The control system consists of a 3-step control responsive to 7, 5, and/or 3 transmitter clicks.

(3) Lighting is normally set up to remain illuminated for a period of 15 minutes. All lighting is illuminated from the most recent time of activation and may not be extinguished prior to the end of the cycle (except for 1-step and 2-step REIL(s) that may be turned off when desired by keying the transmitter 5 or 3 times respectively).

Table 7-4

RUNWAYS WITH APPROACH LIGHTS

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

† Predetermined intensity step.

◊ Low intensity for night use. High intensity for day use as determined by photocell control.

Table 7-5

RUNWAYS WITHOUT APPROACH LIGHTS

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

◊ Low intensity for night use. High intensity for day use as determined by photocell control.

✩ The control of VASI and/or REIL may be independent of other lighting systems.

7.22 PRE-FLIGHT REQUIREMENTS

a. **Facilities Maintenance.** In addition to preparations contained in Chapter 4, Section 3, Facilities Maintenance personnel should ensure that all light units are operating, aimed at the proper angle, and in a clean condition.

b. **Air.** The flight inspector should consult with appropriate personnel to determine local operational procedures and the correct transmitter keying sequence for Radio Controlled Lights. Also see Chapter 4, Section 3.

7.23 CHECKLIST. The following checks will be performed on flight inspections of approach lighting systems and runway end identifier lights.

Light Intensity
Lamp Alignment
Inoperative Lights
Radio Controlled Lights

7.24 FLIGHT INSPECTION PROCEDURES

a. **Approach Lighting Systems**

(1) **Maneuvering.** For a precision approach, fly the final segment on the precision glideslope. For a non-precision approach, fly at the lowest MDA to a point where an approximate 3.00° glidepath begins, transitioning to the approximate 3.00° glidepath, observe that the light system gives appropriate indication for safe pilotage.

(2) **AFIS/ Equipment Setup.** There is no requirement for AFIS. It may be helpful to program the ILS-3 mode with ILS associated with the lighting system for distance and degrees offset information. GPS mode may sometimes be used for airports without a precision approach.

(3) **Analysis**

(a) Evaluate light intensity by sequencing through the normal intensity settings to determine that the relative brightness of each intensity setting is uniform. All light units should be operating with the proper filters in place, corresponding to the type of system installed.

(b) Determine if each light and light bar is properly aimed for associated approach type. The flight inspector will identify any lights or light bars that are inoperative or misaligned. Improper alignment, up or down, can be detected by positioning the aircraft above and below the normal approach path.

(c) Evaluate the pilot control lighting feature for satisfactory operation on commissioning and subsequent inspections.

(4) Other Considerations

(a) Inoperative approach lighting systems may increase the visibility minimums of SIAP(s). Inoperative sequenced flashing lights, apart from the basic approach lighting system, may also cause an increase in visibility minimums. Once a lighting aid NOTAM is issued, there is no need for the issuance of procedural NOTAM, as the SIAP Inoperative Table or separately published minimums provides pilots with the necessary adjustments.

(b) If the pilot control lighting feature is inoperative, initiate NOTAM action and attempt to contact the airport authority to have the lights manually activated for night or IMC use.

(c) Approach lights, except semi-flush lights, are aimed vertically to a point on the ILS or PAR glide path 1,600 ft in advance of the light; therefore, it is necessary that the aircraft be positioned on the glide path for proper evaluation. For non-precision type navigational facilities, a three-degree glide path angle is simulated for aiming purposes.

(d) **Radio Controlled Lighting Systems.** All radio controlled lighting systems associated with either a precision or non-precision Instrument Approach Procedure will be flight checked for satisfactory operation on commissioning and during subsequent periodic inspections. These light systems are activated and controlled by radio signals generated from an aircraft or a ground facility. If Pilot-Controlled Lighting is inoperative, initiate NOTAM action and attempt to contact airport authority to have the lights manually activated for night or IFR use. Some lighting systems have a photocell that prevents operation during daylight hours. Flight inspectors will verify this with airport authorities before initiating NOTAM action. This information will be added to airport data sheets.

Table 7-6

RUNWAYS WITH APPROACH LIGHTS

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

† Predetermined intensity step.
◊ Low intensity for night use. High intensity for day use as determined by photocell control.

Table 7-7

RUNWAYS WITHOUT APPROACH LIGHTS

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

◊ Low intensity for night use. High intensity for day use as determined by photocell control.
✫ The control of VASI and/or REIL may be independent of other lighting systems.

b. Runway Lighting Systems

(1) Maneuvering. Position the aircraft as needed to evaluate the lighting system as it will be seen by any aircraft using the system during normal operations.

(2) A**FIS/ Equipment Setup.** There is no requirement for AFIS. It may be helpful to program the ILS-3 mode with ILS associated with the lighting system for distance and degrees offset information. GPS mode may sometimes be used for airports without a precision approach.

(3) Analysis

(a) Evaluate light intensity by having the runway lighting system sequenced through the intensity settings to determine that the relative brightness of each intensity setting is uniform. All light units should be operating with the proper filters in place, depending upon the system installed.

(b) Evaluate the pilot control lighting feature for satisfactory operation on commissioning and subsequent inspections.

(4) Special Considerations. If the pilot control lighting (PCL) feature is inoperative, initiate NOTAM action and attempt to contact the airport authority to have the lights manually activated for night or IMC use.

7.25 TOLERANCES

a. Approach Lighting Systems, Runway Edge Lights, Touchdown Zone, and Runway Centerline Lights will meet the following tolerances. It is not intended that these facilities be classified in accordance with Chapter 5, Section 1 unless a hazard to safety exists.

(1) Light Intensity. The system must be capable of operating on all light intensity settings; the relative intensity of all lights must be uniform on each individual setting. Light intensity should be checked by pilot control function and controller operation.

(2) Lamp Alignment. All lamps must be aimed in both vertical and horizontal axes to provide the proper guidance along an electronic glide path of approximately 3.0°.

(3) Inoperative Lights. For a commissioning inspection, all lights of each system must be operative, and proper filters must be in place. During routine inspection if inoperative, obscured, or misaligned lights are detected, the number and location must be noted in as much detail as practicable and this information reported to the operating or maintenance authority for corrective action.

(4) **Touchdown Zone and Centerline Lighting Systems.** These systems are integral parts of the Category II ILS and will conform to specified criteria. When reduced minimums have been authorized on the basis of these systems being available and operative, compliance with the below criteria is required for the application of reduced minimums. Whenever the system fails to meet the following requirements, out-of-tolerance conditions exist and the system automatically reverts to application of Category I minima.

(a) No more than 10% of the lights of the Centerline Lighting System may be inoperative.

(b) No more than 10% of the lights on either side of the Touchdown Zone Lighting System may be inoperative.

(c) No more than four consecutive lights of the Centerline Lighting system may be inoperative.

(d) More than one bar (three-light fixture) of the touchdown zone system may be inoperative; however, two adjacent bars on the same side of the system may not be inoperative. A bar is considered inoperative when all of its lights are out.

b. **Runway End Identifier Lights (REIL)** will meet the following tolerances. It is not intended that the facility be classified in accordance with Chapter 5, Section 1 unless a hazard to safety exists.

(1) **Light Intensity.** The lights must be oriented so that the light intensity is substantially uniform on the runway centerline extended. The character of appearance of the light must be aviation white or xenon ARC. No color is permitted, and both lights must be operative. The flashing rate can be measured best by observation from the ground; however, the flight inspector should observe this feature for grossly rapid or slow flashing rate.

(2) **Lamp Alignment.** The system must be aligned or shielded so as to be unobjectionable to a pilot on final approach within 1,500 ft of the runway threshold on an approach path of 2.5° or higher. If the REIL lights produce an unacceptable glare within 1,500 ft of the runway threshold, the flight inspector must request that the aiming of the lamps be adjusted.

7.26 Adjustments. Maintenance personnel should make every effort to correct any discrepancies discovered on an approach lighting system or a REIL system during the conduct of the flight inspection of the primary navigational facility. Where a hazard to safety exists, correction of discrepancies will be made prior to further use of the system; otherwise, correction of minor deficiencies will be made as soon as possible (See Chapter 4, Section 3).

CHAPTER 8

COMMUNICATIONS

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CHAPTER 8

COMMUNICATIONS

SECTION 1
ULTRA –HIGH FREQUENCY (UHF)/
VERY HIGH FREQUENCY (VHF)

8.10 INTRODUCTION. Air/ ground communications services within the NAS are classified according to function. En route communications (ECOM) is the service provided between ARTCC controllers and pilots, and includes Remote Center Air/ Ground Communications (RCAG) and Backup Emergency Communications (BUEC) facilities. Terminal communications (TCOM) is the service provided between approach and departure controllers and pilots in terminal airspace, including RCF and ATCT facilities. FSS communications (FCOM) is the service provided between the FSS and the pilot and is advisory in nature, such as EFAS. Other advisory services include ATIS, AWOS, and ASOS, all of which may be transmitted on a NAVAID or a discrete communications frequency.

8.11 PREFLIGHT REQUIREMENTS. The flight inspector must prepare for the flight inspection in accordance with the procedures outlined in Chapter 4. Coverage requirements, including tailored sector definitions, must be provided by local facility maintenance and air traffic personnel.

8.12 FLIGHT INSPECTION PROCEDURES. The performance of communications facilities is accurately predicted by computer-aided modeling. Therefore, commissioning inspections are only required when requested by facilities maintenance engineering. Periodic inspections must be conducted on a surveillance basis in conjunction with evaluation of associated navigation and air traffic control facilities.

a. Checklist

Type Check	Reference Paragraph	C	P
TCOM	8.12(6)	1	2
ECOM	8.12(7)	1	2
ATIS	8.12(8)	1, 3	2, 3
AWOS/ ASOS	8.12(9)	1, 3	2, 3
TWEB	8.12g(10)	1, 3	2, 3

FOOTNOTES:

1. When requested.
2. Surveillance inspections conducted during other inspection evaluations**.**
3. If the NAVAID has no other voice services, verify that the voice broadcast effect on the navigation signal is within applicable tolerances.

b. Detailed Procedures

(1) Coverage. When coverage cannot be predicted by facility engineering, a flight inspection will be requested. Evaluate facilities where the minimum en route altitude (MEA) is determined by communications coverage. During requested commissioning inspections, coverage must be determined by the air traffic service requirements established locally**.**

(2) Flight profiles may vary according to the local requirements and could include an orbit or a detailed sector evaluation. Communications for fixes, hand-off positions, changeover points, or controlled airspace must be checked.

(3) Additional frequencies assigned to the same service requirement will not require a complete inspection, but should be evaluated on a surveillance basis.

(4) Light Gun Signals must be checked for adequate coverage on the ground and in flight.

(5) Standby equipment must be checked during any requested commissioning inspection.

(6) Terminal Communications (TCOM) includes tower, ground control, clearance delivery, departure, arrival, and light gun communications. Commissioning inspections, when requested, must be conducted at the extremities of the airport to determine if there are blind spots and adequate coverage. Departure and arrival frequencies must be checked to verify service throughout the established sector volume.

(7) En route Communications (ECOM) includes VHF and UHF air/ground frequencies and BUEC channels. When requested, these frequencies must be evaluated throughout the established sector service volume.

(8) Automatic Terminal Information Service (ATIS) broadcast on a NAVAID facility must be commissioned and reported with that NAVAID. Coverage should be the same as the NAVAID. When commissioning is requested, ATIS broadcast on a discrete communications frequency must be checked in accordance with local requirements, but not to exceed a maximum of 60 nm and 25,000ft AGL. Departure ATIS must be verified at the airport extremities.

(9) **Automated Weather Observing System (AWOS)/Automated Surface Aviation Observing System (ASOS).** These systems provide local weather observations and may be broadcast on a NAVAID or a discrete VHF communications frequency. Transmission on a NAVAID must be verified.. Local altimeter settings from these systems can result in lower minimums for standard instrument approach procedures. Whenever this occurs, ensure that the associated procedure has been flight inspected to the new minimum prior to publication. When AWOS/ ASOS is used as the primary airport altimeter source, flight inspection must verify reception at or before the initial approach fix (IAF).

(10) **Transcribed Weather Broadcast (TWEB).** This system broadcasts route-oriented data with specially prepared National Weather Service forecasts, inflight advisories, and winds aloft plus pre-selected current information, such as routine or special weather reports (METAR/SPECI), NOTAM(s), and special notices. The data is broadcast continuously over selected L/MF and H NDB(s) and/or VOR(s).

8.13 ANALYSIS. Unsatisfactory conditions must be brought to the attention of the appropriate air traffic control and facilities maintenance personnel.

8.14 TOLERANCES

a. **Maximum Recommended Coverage.** Communications frequencies are engineered for distinct volumes of airspace, which are guaranteed to be free from a preset level of interference from an undesired source. Each specific function has its own frequency protected service volume. Some are cylinders, and others are odd multi-point geometric shapes. These odd shapes are normally required for en route ATC services. Following is a table of maximum altitude and radius dimensions recommended for each type of service. Under no circumstances will a service volume be approved at an altitude and distance greater than the radio line of sight (RLOS) distance (reference Figure A2-1).

	Maximum Dimensions	
Service	**Altitude**	**Distance**
ECOM		
Low Altitude	Surface to 23,000	60
Intermediate Altitude	11,000 to 25,000	60
High Altitude	24,000 to 35,000	150
Ultra-High Altitude	35,000 and above	150
TCOM		
Ground Control	100	5
Clearance Delivery	100	5
PAR (Military)	5,000	15
Helicopter	5,000	30
Local Control	25,000	30
Approach Control	25,000	60
Departure Control	25,000	60
ATIS		
Arrival	25,000	60
Departure	100	5
AWOS/ ASOS	10,000	25
NAVAID	Chapter 11 or 12	
Discrete Comm	At or before the IAF	
TWEB	Chapter 11 or 12	

b. **Local Requirements.** Communications service volume requirements are established by the controlling Air Traffic facility based on local operational requirements. When a flight inspection is requested, these local requirements must be validated and adjusted, if necessary, for satisfactory operation. Communications must be clear and readable.

c. **Restrictions.** USAF air traffic control facilities will not be restricted due to unusable radios unless the ability to provide required service is severely limited; the loss of 50% or more of published frequencies or loss of VHF/ UHF emergency capability is considered a severe limitation. Document inoperative or unusable radios and frequencies on the flight inspection report. The inoperative or unusable radio or frequency can be returned to service after a satisfactory operational check is conducted by local aircraft at a distance of maximum intended use and altitude of MVA/ MEA.

d. **Light Gun Requirements**

(1) **Ground.** Ensure adequate coverage for operational control of ground traffic.

(2) **Air.** Three miles in all quadrants at the lowest traffic pattern altitude.

8.15 **ADJUSTMENTS.** All requests for facility adjustments must be specific. Flight inspection certification must be based on facility performance.

SECTION 2
DIRECTION FINDING STATIONS (DF)

8.20 INTRODUCTION. DF equipment is of particular value in locating disorientated aircraft. Direction finding stations use normal VHF or UHF transmissions from aircraft to determine bearing information from the ground station. DF equipment is usually installed and operated by Flight Service Stations (FSS). Most installations of DF allow for the selection of any VHF communications frequency, but flight inspections are conducted on those frequencies specified for FSS use in the DF service volume. In some locations, DF facilities have the capability of providing an emergency approach procedure to an airport.

8.21 MAINTENANCE ACTIONS AND FLIGHT INSPECTION REQUIREMENTS

a. Activities *Requiring* a Confirming Flight Inspection.

(1) The entire DF antenna array has been replaced, or any dipole elements have been repaired or replaced.

(2) Air Traffic personnel have received a pilot report that a facility has an error exceeding 6°, and the report has been verified by a bearing check of another aircraft in the same vicinity.

(3) The facility has been re-commissioned or certified following an extended interruption, modernization, or antenna relocation, or for any other reason determined by the region to justify flight inspection

b. Activities *Requiring* a Confirming Flight Inspection or *Regional Authorization*. Doppler DF antenna systems--when no more than three dipole elements of the array have been repaired or replaced, the requirement for a flight inspection may be waived by the region, provided the following conditions are met:

(1) The ground check is within initial tolerances.

(2) Satisfactory operation of the DF is confirmed through two or more aircraft targets-of-opportunity.

8.22 PREFLIGHT REQUIREMENTS

a. **Facilities Maintenance personnel** must prepare for flight inspection in accordance with procedures specified in Chapter 4, Section 3. For commissioning inspections, Facilities Maintenance personnel should:

(1) Prepare a detailed outline of any special information or procedure(s) desired as an outcome of the flight inspection;

(2) Prepare the desired sequence for the inspection;

(3) Optimize the facilities equipment.

(4) Ascertain that fully qualified operators and maintenance technicians are available.

b. **Flight Personnel** must prepare for the DF flight inspection in accordance with procedures specified in Chapter 4, Section 3. Aircrews must:

(1) For commissioning inspections, prepare a chart with the DF facility accurately plotted and appropriate radials and a 360^{o} orbit drawn. The scale of the chart should be 1:500,000 (Sectional) or larger, and the areas to be overflown evaluated per Chapter 6.

(2) Obtain information from Facilities Maintenance personnel pertinent to the planned inspection, including desired outcomes, expected performance, and sequence of events.

(3) For periodic inspections, obtain previous flight inspection data pertinent to the planned inspection.

8.23 FLIGHT INSPECTION PROCEDURES. The aircraft must be positioned precisely to determine bearing accuracy and service area. AFIS has the positioning capability to the accuracy standard required. Non-AFIS aircraft may perform the inspection if accurately plotted ground checkpoints are selected and the aircraft can be safely maneuvered over these checkpoints. Where neither AFIS nor ground checkpoint positioning is available, the theodolite must be used. The DF operator will be briefed to compute all bearings as from the DF facility, except for station passage and approach procedures.

a. Checklist. All of the checks listed below must be performed on the commissioning flight inspection. Special flight inspections may require any one or all of these checks, depending on the reason for the inspection. Periodic inspection of bearing accuracy will be conducted in conformance with this section.

Type of Check	Reference Paragraph	C	P
Preliminary Station Alignment	8.23c	X	
Bearing Accuracy	8.23d	X	X
Alignment Orbit	8.23e	X	
Communication and Coverage	8.23f	X	X
Station Passage	8.23g	X	
Operator Performance	8.23h	X	
Standby Power	8.23i	X	
DF Approaches	8.23j	X	

b. General Information

(1) The use of AFIS to determine aircraft azimuth is considered the best practice for DF checks.

(2) A DF periodic check will consist of at least one bearing accuracy check within the service volume and at a minimum distance of 20 nm. The check should be conducted at a minimum altitude of 1,500 ft above facility elevation, an altitude that provides obstacle clearance in the area, or the lowest radio line of site altitude for the position of the aircraft, whichever is higher. If needed due to weather or other circumstances, the check can be conducted at the minimum IFR altitude for the area.

(3) The mission specialist should key the radio for approximately five seconds. **Annotate the bearing at the end of the 5-second transmission.** After the transmission, the DF operator should transmit the indicated DF bearing to the aircraft.

(4) The flight inspector will brief the DF operator and, if used, the theodolite operator, to avoid confusion during the inspection.

(5) For commissioning inspections, prepare a chart with the DF facility accurately plotted and appropriate radials, orbital ground track, selected ground checkpoints and azimuth, or other information added as needed. If a plotting board is used, orient the chart to the magnetic variation of the facility. The scale of the chart should be 1:500,000 or larger.

c. Preliminary Station Alignment. This check establishes the initial equipment alignment during a commissioning inspection.

(1) Maneuver. Maneuver the aircraft at an altitude that will assure radio line of sight with the DF station. Conduct a bearing accuracy check. If the bearing is in tolerance, begin a coverage orbit.

(2) AFIS/ Equipment Setup. Select an azimuth from the DF facility to establish alignment reference.

(3) Analysis. If the DF bearings are out of tolerance, or if the trends of DF bearing errors indicate that the facility alignment should be optimized, have facility maintenance adjust the alignment. Repeat the preliminary station alignment check.

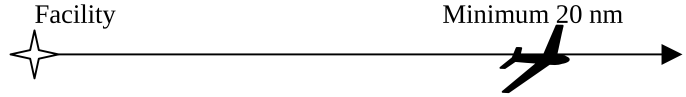
(4) Other Considerations. If the bearings throughout the first quadrant are satisfactory, proceed with the orbit check for at least 90° of azimuth.

d. Bearing Accuracy Check. The bearing accuracy check is conducted to determine the ability of the DF facility to furnish accurate bearings throughout the service area, and provides the reference for other checks. DF bearing accuracy will be determined by comparing the indicated bearing received from the DF operator with the actual aircraft azimuth as determined using AFIS, theodolite, or ground checkpoints.

(1) Maneuvering

(a) AFIS. Position the aircraft either inbound or outbound within the service volume at least 20 nm from the DF antenna. Make a DF transmission that lasts approximately 5 seconds and note the indicated bearing at the end of the transmission. The difference between what is annotated and what the DF operator reads back is the bearing error.

Figure 8-1
Bearing Accuracy Flight Profile



Aircraft Configuration

A/C	Speed KIAS	Flaps	Gear
CL601/ 4	170- 210	UP	UP
Lear 60	170- 200	UP	UP
BE300	170- 200	UP	UP
HS125	170- 200	UP	UP

(b) **Ground Checkpoints.** Position the aircraft over the selected ground checkpoint at the coverage altitude. Where possible, these checkpoints should be located at or near the limits of the DF and communication range to validate bearing accuracy and service volume simultaneously. Make a 5 second DF transmission and note the indicated bearing received from the operator at the end of the transmission and the plotted azimuth of the checkpoint.

(2) **AFIS/ Equipment Setup**

(a) **AFIS.** Program the AFIS FI Data page of the VORTAC mode with latitude, longitude, magnetic variation, and facility elevation. The AFIS system will be programmed for an RNAV radial flight path, either inbound or outbound.

(b) **Ground Checkpoints.** Select a prominent ground checkpoint that is identifiable from the air and plotted on the chart. Use the plotting board to determined the magnetic azimuth of the selected ground checkpoint.

(3) **Analysis.** Compare the determined actual azimuth with the indicated DF bearing received from the DF operator to determine the bearing error.

(4) **Special Considerations**

(a) DF coverage will not substantially exceed line-of-sight. Coverage is dependent on the aircraft transmitter power output, DF antenna height, terrain, and the effects of signal reflections.

(b) After completing a bearing accuracy check, station adjustment may be necessary to balance station error and keep all bearing within tolerance.

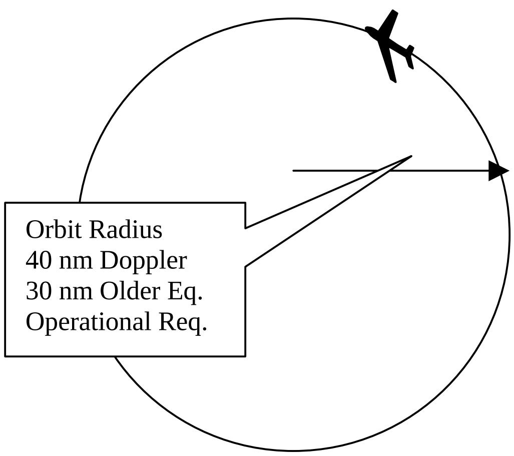
e. **Orbits.** Orbital inspections are used to determine individual bearing errors through various quadrants from the DF station. Actual aircraft azimuth is determined using AFIS, theodolite, or ground checkpoints. At least four bearing checks will be completed in each quadrant being inspected.

(1) **Maneuvering.** Orbit radius will be at the facility service volume or to satisfy operational requirements, whichever is less. For commissioning inspections, orbits will be flown at an altitude that will provide 1,500 ft. above facility elevation, 1,000 ft. (2,000 ft. in designated mountainous areas) of obstacle clearance, or the minimum altitude that will provide radio line of sight, whichever is higher.

(a) **AFIS.** Fly an AFIS RNAV, GPS, or FMS orbit. If using GPS or FMS for aircraft navigation, the facility coordinates will be loaded as a waypoint around which the orbit will be flown.

(b) **Ground Checkpoints.** Fly a GPS or FMS orbit, or establish a ground track using ground checkpoints at the orbit distance. If using GPS or FMS for aircraft navigation, the facility coordinates will be loaded as a waypoint around which the orbit will be flown. Position the aircraft over the predetermined checkpoints. Where possible, these checkpoints should be located at or near the limits of the DF and communication range capability to validate bearing accuracy and service area simultaneously. Proceed with the orbit of the facility at the appropriate range and altitudes, obtaining bearings as often as practical. After initial contact has been established, a 5 to 10 second radio signal is usually sufficient to obtain bearings. Because of the capability of almost instantaneous readout on the Doppler type DF, a five-second radio signal is usually sufficient to obtain bearings on this type facility.

Figure 8-2
Orbit Flight Profile



Aircraft Configuration

A/C	Speed KIAS	Flaps	Gear
CL601/4	170 - 200	UP	UP
Lear 60	170 - 200	UP	UP
BE300	170 - 200	UP	UP
HS125	170 - 200	UP	UP

(2) AFIS/ Equipment Setup

(a) AFIS. Program the AFIS FI Data page of the VORTAC mode with latitude, longitude, magnetic variation, and facility elevation. If desired, an event mark may be made on the recording at the position of each DF transmission; comparison can then be made to the 5° bearing marks on the recording.

(b) Ground Checkpoints. Select prominent ground checkpoints that are identifiable from the air and plotted on the chart. Use the plotting board to determine the magnetic azimuth of each selected ground checkpoint.

(c) Theodolite. The theodolite must be aligned to read magnetic bearings from the DF station. It should be located adjacent to the DF site at a position where the aircraft will be visible throughout as much of the orbit as possible. This position should be less than 300 ft from the site. The flight inspector should brief the DF operator and the theodolite operator to avoid confusion during the actual flight inspection.

(3) Analysis

(a) AFIS. Compare the indicated bearing received by the DF operator with the AFIS aircraft azimuth to determine bearing error.

(b) Ground Checkpoints. As the aircraft approaches the first ground checkpoint or measured bearing, the pilot must transmit a 10-second radio signal, timed so that the aircraft will be over the checkpoint in the middle of the transmission. Compare the bearing provided by the DF operator with the measured magnetic bearing. Note each DF bearing, magnetic bearing, error, radio frequency, altitude, and distance on he flight inspection report. Bearing errors must be computed in the same manner as VOR course alignment errors; i.e., when the aircraft bearing is less than the bearing reported by the DF operator, the error is negative.

(c) Theodolite. The theodolite operator must track the aircraft throughout the orbit and actuate one event mark (1020 Hz tone) at each 10° of azimuth. The pilot must transmit for a DF bearing at frequent intervals and actuate the pilot event mark on the opposite side of the recording during each such transmission. The airborne technician must label each of these event marks. The leading edge of the theodolite event mark will represent the actual bearing of the aircraft from the station, and the pilot event marks will represent the DF bearing. The airborne technician will label the DF bearing as reported by the DF operator and determine the error with the use of proportional ("Ten Point") dividers.

(4) Special Considerations

(a) If communications or bearing errors become unsatisfactory, climb to an altitude where communications can be satisfactorily established and/or bearing errors are satisfactory. If communications and bearing accuracy remain satisfactory on the next bearing check, descend to the minimum altitude that will provide satisfactory bearings and communications and continue the orbit. This procedure will define the lowest altitudes through the coverage area at which acceptable communications and bearing information can be expected, and will provide the basis for defining the usable service volume of the facility.

(b) Whenever bearing errors are very large in a particular area and normal elsewhere, it may be advisable to investigate the area further by checking radially or by partial orbits at different ranges.

(c) **When unsatisfactory conditions cannot be corrected,** the DF operator will be advised of the areas that are unusable. The unusable areas will be noted on the fight inspection report and the facility assigned a "restricted" classification. A NOTAM will not be issued, nor will the restriction be published elsewhere.

(d) **Analysis of Bearing Accuracy.** After completing the bearing accuracy check, station adjustment may be necessary to balance station error and keep all bearings within tolerance. Whenever orbital bearing errors are beyond ± 6° on any type of flight inspection, verify the errors radially. If, due to the availability of ground checkpoints, the exact azimuth found suspect in the orbit cannot be verified, radially fly another inbound/ outbound radial in the same 90° quadrant. When an out-of-tolerance condition cannot be corrected, the controller must be advised of the area(s) not to be used. The condition(s) will be noted on the flight inspection report and the facility assigned a "restricted" classification. A NOTAM will not be issued.

(e) **Periodic Inspections** will include a bearing accuracy check at a minimum distance of 20 nm and at a minimum altitude of 1500 ft, an altitude which will provide obstacle clearance in the area, or radio line of sight, whichever is highest. A minimum of one bearing check must be accomplished on each published frequency and, if available, the VHF emergency frequency.

(f) **Commissioning Inspection**

1 An orbit procedure, as outlined in this section, must be used to evaluate bearing accuracy for the commissioning flight inspection. Orbit radius must be the minimum of:

- 40 miles for Doppler DF facilities;
- 30 miles for older equipment;
- operational requirements

The altitude must be 1,500 ft above site elevation, the minimum altitude providing 1,000 ft of obstacle clearance (2,000 ft obstacle clearance in designated mountainous areas), or the minimum altitude which will provide radio line-of-sight, whichever is the higher.

2 AFIS or theodolite bearings may be taken at frequent intervals as close together as 10°. A minimum of four bearings must be taken for each quadrant, regardless of which orbit method is used.

f. Communications and Coverage. Voice communication is the means for getting DF information to a pilot, and quality of communications greatly affects the capability of the DF to provide service.

(1) Maneuvering

(a) During a commissioning inspection, all frequencies proposed for use will be checked. If available for use, the emergency frequencies will also be checked. These checks may be accomplished on the orbit or during radial flight at the extremes of coverage.

(b) For periodic inspections, voice communications will be checked on all specified frequencies if less than four are used for DF bearings. If more than four frequencies are available, at least four frequencies will be checked. If available for use, the emergency frequencies will also be checked.

(2) Analysis. Communications will be clear and readable throughout the service volume.

(3) Other Considerations. Specified frequencies are those normally used by the FSS in the geographical area.

g. Station Passage

(1) Maneuvering. Fly inbound to the DF antenna from a position at least 5 miles away from the DF antenna at an altitude of 1,500 feet above the antenna. Obtain sufficient steers from the DF operator to overfly the antenna.

(2) Analysis. Note the distance from the aircraft to the DF antenna when the operator reports station passage.

(3) Other Considerations. This check may be performed in conjunction with the DF approach procedure at the discretion of the pilot and DF operator.

h. **Operator Performance**. The flight inspector must determine that the overall system is safe and reliable.

(1) **Maneuvering.** Note the performance of the DF operator during the check. Request that the DF operator provide a steer to overfly the DF facility.

(2) **Analysis.** The operator must be able to direct the aircraft over the facility, report station passage and provide pertinent information relative to the use of the DF service.

(3) **Other Considerations.** The operator should be able to direct the aircraft to a position from which a safe landing can be made if the DF facility supports an emergency approach procedure (DF approaches are not SIAP(s)).

i. **Standby Power.** If standby power is installed, have the facility power source switched to the standby source for the check.

(1) **Maneuvering.** An orbit on standby power will be performed at the same distances and altitudes as those for a commissioning profile.

(2) **AFIS/ Equipment Setup.** Program the AFIS FI Data page of the VORTAC mode with latitude, longitude, magnetic variation, and facility elevation. If desired, an event mark may be made on the recording at the position of each DF transmission; comparison can then be made to the 5° bearing marks on the recording.

(3) **Analysis.** Compare the two orbits, and ensure that all applicable tolerances are met.

(4) **Other Considerations.** Standby power checks are not required for facilities powered by batteries that are constantly charged by another power source. The Facility Data Sheet should indicate the source of standby power.

j. **Emergency DF Approaches**

(1) **Maneuvering.** Conduct the approach in accordance with the DF operator's instructions and evaluate the obstacle clearance and flyability in accordance with Chapter 6.

(2) **AFIS/ Equipment Setup.** Not applicable to this check.

(3) **Analysis.** The flight inspector will note the position of the aircraft relative to the airport and determine whether it will permit a safe landing.

(4) Other Considerations

(a) DF approaches are conducted during a commissioning check.

(b) Airways facilities personnel or DF facility operators may request a check of the approach during any inspection if, in their opinion, verification of the procedure, obstructions, or equipment performance is desired.

(c) There is no periodic requirement to check an Emergency DF approach.

k. **Standby Equipment**. If standby equipment is available, during a commissioning inspection, evaluate preliminary station alignment, bearing accuracy, alignment orbit, communication and coverage, station passage, and DF approaches on the standby transmitter during a commissioning inspection.

8.24 TABLES AND SUPPLEMENTAL INFORMATION. (Reserved)

8.25 TOLERANCES. All DF stations must conform to these tolerances for an UNRESTRICTED classification. Classification of the facility is the responsibility of the flight inspector.

a. **Bearing Accuracy**

VHF/ DF, UHF/ DF: Each DF bearing must be within 10^{o} of the actual bearing.

VHF/ DF (doppler): Each DF bearing must be within 6^{o} of the actual bearing

b. **Coverage**

VHF/ DF UHF/ DF: 30 miles
VHF/ DF (doppler): 40 miles

c. **Communications.** Communications on all required frequencies must be clear **and readable throughout the coverage area.**

d. **Station Passage.** Station passage must be recognized within 1 1/2 miles at 1,500 ft AGL.

e. **Controller Performance.** Controllers must be capable of directing an aircraft to the station, reporting station passage, providing guidance for an emergency approach, and vectoring aircraft to avoid terrain and obstacles.

f. **Standby Power.** The DF facility will meet all tolerances in this chapter when operating on an alternate power source. See FAA Order 8200.1, Chapter 8.

g. **Emergency Approaches.** Where a DF approach procedure is established, the system must provide the capability of directing the aircraft to a position from which a safe landing can be made.

8.26 ADJUSTMENTS. Equipment adjustment must be made to balance the overall station error.

CHAPTERS 9 – 10

RESERVED

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CHAPTER 11

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CHAPTER 11

RHO-THETA SYSTEMS

SECTION 1

GENERAL

11.10 INTRODUCTION

a. **General.** A VOR operates in the VHF frequency range from 108 – 118 MHz. They share this frequency range with ILS Localizers, the Localizers operating on the odd (100 KHz) frequencies and the VOR operating on the even frequencies. TACAN and DME are separate components but operate in the same frequency range. TACAN/ DME operates in the UHF frequency range from 960 – 1215 MHz. A VOR and TACAN or DME are considered collocated as follows:

(1) **Standard VOR** used in terminal areas for approach procedures, the separation of the VOR antenna and the associated DME or TACAN antenna must not exceed 100 ft.

(2) **Doppler VOR** used in terminal areas for approach procedures, the separation of the VOR antenna and the associated DME or TACAN antenna must not exceed 260 ft.

(3) **Any non-terminal procedures,** where the highest position-fixing accuracy of the system is required, the antenna separation limits of subparagraphs (1) and (2) apply.

(4) **For all other procedures,** the separation of a VOR antenna and associated DME or TACAN antenna must not exceed 2,000 ft.

b. **Characteristics.** VOR, TACAN, and DME are “line of site” facilities; coverage is greatly affected by intervening terrain and objects that cause reflections of the radiated signal. The TACAN is comprised of two components, an azimuth and a DME. There are two unique channels for TACAN and DME transmitters, “X” and “Y” with X using 12 µs pulse spacing and Y using 30 µs pulse spacing, because of this difference in pulse spacing a TACAN or DME transmitter is capable of being one of 252 discreet channels with 1 MHz spacing, 126 X channels and 126 Y channels.

c. **Classification.** The classification for Rho-Theta systems is determined by the Standard Service Volume (SSV) as follows:

Table 11-1

SSV CLASS DESIGNATOR	ALTITUDE & RANGE BOUNDRIES
T (Terminal)	From 1,000’ AGL up to and including 12,000’ AGL at radial distances out to 25 nm.
L (Low Altitude)	From 1,000 AGL up to and including 18,000’ AGL at radial distances out to 40 nm
H (High Altitude)	From 1,000’ AGL up to and including 14,500’ AGL at radial distances out to 40 nm. From 14,500’ AGL up to and including 60,000’ AGL at radial distances out to 100 nm. From 18,000’ AGL up to and including 45,000’ AGL at radial distances out to 130 nm.

Figure 11-1A
Standard High Altitude Service Volume
(See Figure A11-2A for altitudes below 1,000 ft.)

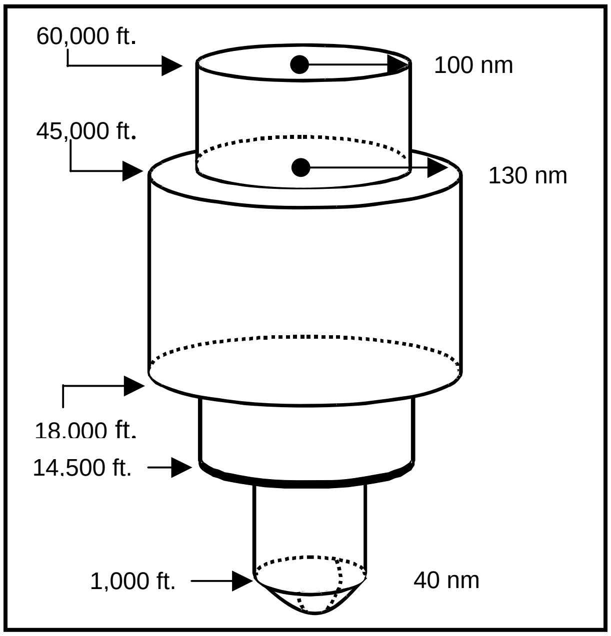


Figure 11-1B
Standard Low Altitude Service Volume
(See Figure A11-2A for altitudes below 1,000 ft.)

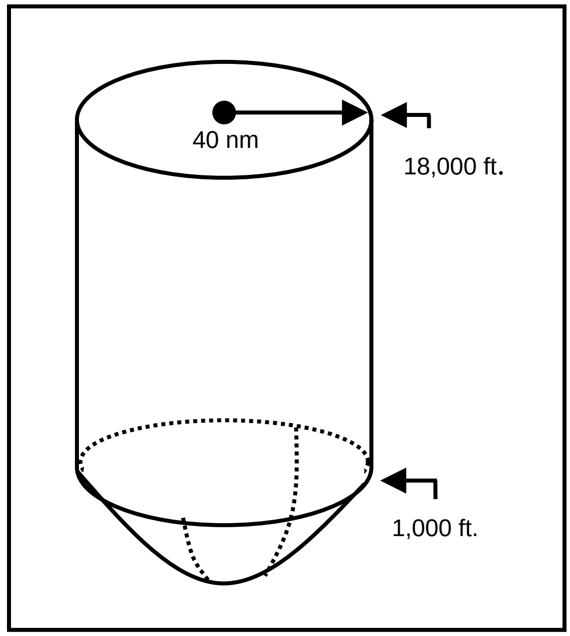


Figure 11-1C
Standard Terminal Service Volume
(See Figure A11-2B for altitudes below 1,000 ft.)

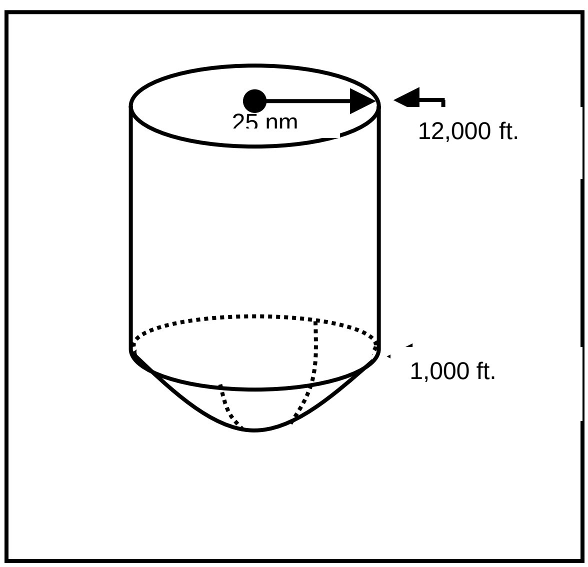


Figure 11-2A
Service Volume Lower Edge Standard High and Low Class

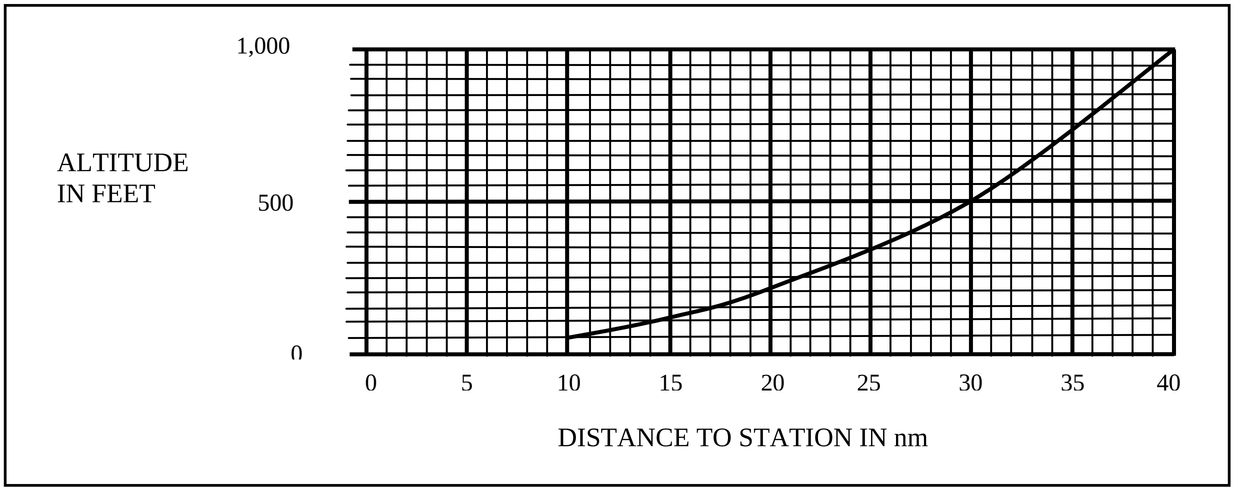
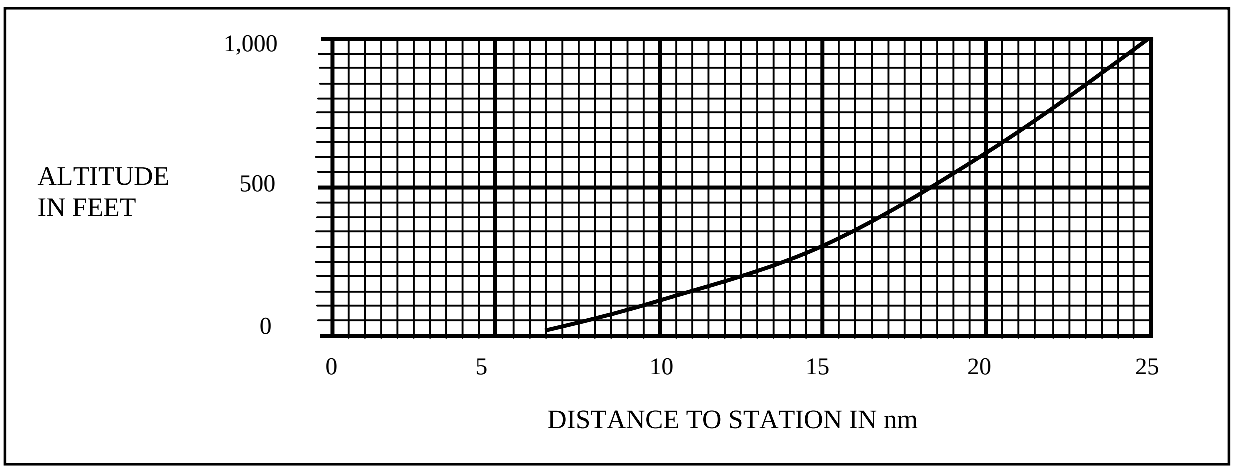


Figure 11-2B
Service Volume Lower Edge Standard Terminal Class



11.11 FLIGHT INSPECTION RHO-THETA

a. **General.** The accuracy of the Automatic Flight Inspection System (AFIS) measurement is dependent on precise aircraft positioning. Position updating is defaulted to the Hybrid Mode, Global Positioning System (GPS), and is the Preferred Flight Inspection positioning method for all Rho-Theta inspections. When using hybrid mode, AFIS may be used for measurement 5nm from the facility and beyond.

b. Alternate AFIS Positioning Modes:

(1) FI-DME. AFIS automatically selects DME facilities in the vicinity of the facility under test to provide position updates.

(2) MN-DME. The Mission Specialist manually enters DME for AFIS positioning.

The PIC may change to FI DME or MN DME Mode if the Hybrid Mode is not operable or suspect for position accuracy. Either mode will require flying at an altitude for adequate DME reception. When using FI-DME or MN DME mode, AFIS may be used for measurement 10 nm from the facility and beyond.

NOTE: When AFIS positioning is not available, use of Ground Checkpoint Method or Theodolite is acceptable**.**

11.12 PREFLIGHT REQUIREMENTS

Flight Personnel. During special Rho Theta inspections where coverage is performed, the flight inspection personnel should prepare charts, plot the position of the facility, and depict the orbit and radial checkpoints in addition to the preparation outlined in Chapter 2. VOT flight inspection preflight requirements are described in Section 3.

11.13 MAINTENANCE ACTIONS AND FLIGHT INSPECTION REQUIREMENTS

a. VOR, DVOR, VOR/ DME, and VORTAC

(1) Activities **Requiring** a Confirming Flight Inspection:

(a) Major changes in local obstructions or buildings which may affect the signal strength, coverage, or courses.

(b) Replacement or installation of the TAC/ DME antenna or RF subassemblies (excluding transmission lines) of the antenna.

(c) Modernization or corrective maintenance of a major nature to the counterpoise, such as extension of the counterpoise.

(d) A change in facility operating frequency.

(e) A change in output power level for the purpose of increasing or decreasing service volume.

(f) The installation and operation of the TACAN antenna (with no change to the VOR antenna system).

(g) Those activities stated in subparagraph (2) below, when standard ground references cannot be reestablished.

(h) The replacement or modification of the test generator if the tolerances for ground check cannot be met.

(i) Any adjustment of 1° or more and any adjustment which results in moving the ground check error away from the reference ground-check error curve in excess of 1° for VOR or more than 1° from a TACAN reference azimuth alignment.

(2) Activities that **Do Not Require** a Confirming Flight Inspection. Maintenance may accomplish the following without a confirming flight inspection:

(a) The replacement of any or all solid-state components.

(b) The replacement or repair of equipment components or units.

(c) The complete tuning of the transmitter.

(d) The measurement and adjustment of all modulation levels.

(e) Phasing adjustments

(f) The replacement of Doppler VOR distributor.

(g) The installation or relocation of the DME mast, the TAC monitoring pole, or a Remote Communications Outlet (RCO) antenna pole (if accomplished in accordance with current instructions).

(h) The replacement of the polarizer when reset to the previous setting, or readjustment of the polarizer when a portable ground polariscope is used to optimize the facility for minimum vertical polarization.

(i) The installation or replacement of obstruction lights, or the painting of the antenna shelter.

(j) The Replacement of the RTA-2 upper and lower bearings, the spin motor, and the radome.

(k) Accomplishment of other maintenance procedures, such as refurbishment of VOR/ DVOR counterpoise, wood decking, and/or terenplate, provided conditions are restored to those that existed at the time of the last flight inspection (as reflected in facility records) and ground check is within $\pm 0.2^0$ of the reference ground check.

(l) Accomplishment of other maintenance procedures, such as any or all of the following, provided conditions are restored to those that existed at the time of the last flight inspection (as reflected in facility records).

1 The repair, alignment, or replacement of the goniometer.

2 The repair, replacement, modification, or repositioning of any fixed field detector used for facility monitoring.

3 The replacement or modification of any signal evaluation element in the monitors.

4 The adjustment or replacement of the RF transmission lines (including feedlines, stubs, positioners, and bridges, either coaxial or hybrid).

5 The adjustment or replacement of the VOR antennas or components (including pedestals, loops, baluns, and supporting braces).

6 The replacement, repair, or modification of test equipment. (For the VOR/ DVOR, if unable to make before and after measurements, a confirming flight inspection will not be required if the tolerances for ground check are met.)

b. VHF Omni-Range Test Facilities (VOT)

(1) Activities **Requiring** a Confirming Flight Inspection:

(a) Changes in output power or attenuator settings that would affect station coverage.

(b) Replacement of the antenna.

(c) Major change in local airport obstructions, buildings, etc., that may affect the minimum signal strength and coverage.

(2) Activities **Not Requiring** a Confirming Flight Inspection:

(a) All maintenance activities, such as replacement or repair of modules, solid state components, and transmission lines in the transmitter, monitor, or remote status and control unit (RSCU).

(b) Adjustments to the transmitter, monitor, or RSCU, as long as all parameters are returned to the reference value.

11.14 FACILITY CHECKLIST. The checklist prescribes the items to be inspected on each specific type of inspection. When evaluating airways or expanded service volumes (ESV(s)) of a VORTAC or VDME, both VOR and TACAN/ DME must be recorded. When inspecting a VORTAC that has published VOR SIAP(s) but no published TACAN SIAP(s), record both the VOR and TACAN component. Report the VOR component of the SIAP, and the TACAN and VOR component of the ARR and alignment orbit. Due to antenna nulling, the TACAN azimuth may not support an approach that is satisfactory for VOR use. This inability to support a TACAN approach should not incur a facility restriction. Victor airways connect VOR, VORTAC, and VOR/ DME stations and are predicated on VOR signals. When evaluating an airway of a VORTAC, do not deny the use of a Victor airway due to an out-of-tolerance value found on the TACAN azimuth or DME. If a TACAN parameter is found out of tolerance within the flight inspection standard service volume, a facility restriction and NOTAM must be issued. VOT periodic requirements may be performed either on the ground or in the air within the areas approved for use.

RHO AND THETA SYSTEMS FLIGHT INSPECTION REQUIREMENTS

CHECK	REFERENCE PARAGRAPH	SITE EVALUATION	COMMISSIONING (12)	PERIODIC	ANTENNA CHANGE (9), (12)	FREQUENCY CHANGE (12)	FACILITY ROTATE (2), (11)
Reference Radial Check	11.20a 11.31		X	X	X, (8)	X	X
Monitors	11.20b		(3)		(3)	(3)	(3)
En Route Radials (10)	11.20c 11.31		X				
Intersection Radials/ DME Fixes (10)	11.20d 11.31		X	(5)	(5)	(5)	(5)
Terminal Radials	11.20f	X	X	X, (6)	X, (6)	X	X, (6)
Orbits	11.20g						
Coverage (10) (13)	11.20g(2)	X	X		(3), (7)	X	
Alignment (1)	11.20g(1)	X	X	(1)	X	X	X
Differential	11.20g		X		X		X
Ground Receiver Checkpoints	11.20h 11.20h(1)		X	X	X, (8)	X	X
Airborne Receiver Checkpoint	11.20h 11.20h(2)		X	X	X, (8)	X	X
Standby Transmitters	11.20i 4.33		X	X	X, (8)	X	X
Standby Power (10)	11.20j 4.33c		X				
Associated NAVAID(s)	11.20k		X	X	X	X	X
Identification	11.21a		X	X	X	X	X
Voice	11.21b		X	X	X	X	X
Sensing and Rotation	11.21c	X	X	X	X	X	X
Modulation Levels	11.21d 11.21h	X	X	X	X	X	X
Polarization (4) (10)	11.21e	X	X	X	X	X	X
Frequency Interference	11.21f	X	X	X	X	X	X
Course Structure	11.21g	X	X	X	X	X	X
Signal Strength	11.21h	X	X	X	X	X	X
DME	11.30 11.21i	X	X	X	X	X	X

FOOTNOTES:

(1) An alignment orbit (Paragraph 11.20g) is required for all facilities every 1,080 days, including those facilities where VOR and TACAN components do not support a SIAP or receiver checkpoint.

(2) Required if facility rotation is more than 1° from maintenance reference alignment.

(3) Maintenance request.

(4) TACAN requirement – Check and report polarization on at least one radial.

(5) Fixes depicted on a SIAP in final approach segment must be evaluated concurrently with the SIAP.

(6) Check final approach segment of the SIAP(s). SID(s), STAR(s), and DP(s) are not required.

(7) First time replacement with a new type antenna, such as a Low Power TACAN Antenna (LPTA) or DOD OE-258 electronic antenna requires a coverage orbit and revalidation of all ESV(s)supporting a procedure.

(8) Evaluate on DME antenna change (same type antenna).

(9) Also applies to a RANTEC TACAN Modulation Generator change.

(10) One transmitter only.

(11) For a Magnetic Variation Change, use the facility rotation checklist.

(12) VOR Polarization – Check at least one radial in each quadrant.

(13) ESV(s) must be revalidated any time a coverage orbit is required by this handbook.

SECTION 2

VHF OMNIRANGE (VOR) and TACAN/ DME FLIGHT INSPECTION PROCEDURES

11.20 FLIGHT INSPECTION PROCEDURES. AFIS is the preferred method for conducting a facility flight inspection using procedures contained in appropriate agency directives. If a theodolite is used to evaluate facility performance, it must be positioned and operated by a properly trained operator. The theodolite azimuth bearings must be referenced to magnetic bearings “from” the facility. Prior to performing the checks on the following pages, sensing and rotation must be verified.

a. Reference Radial Check. A Reference Radial (ARR) must be established when establishing an orbital reference and evaluated during subsequent checks. The AFIS segment or checkpoint will be used as a reference for subsequent checks of course alignment and airborne monitor evaluations. Evaluate the same segment in the same direction at the established altitude during subsequent inspections. An approach radial is recommended as the reference.

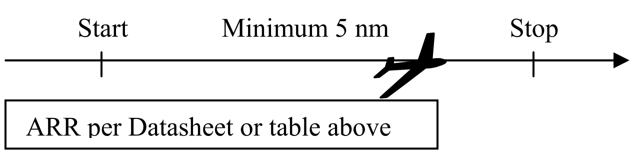
Establishment			
Maneuver	**VORTAC**	**AFIS**	**Analysis**
5 - 10 nm segment between 10 & 25 nm, (5 & 25 nm Hybrid mode)	Normal	Radial In or out	Ensure selected radial is within all applicable radial tolerances, and is representative of mean orbital alignment. If feasible, an approach radial at the same altitude as alignment orbit is recommended.

Periodic Check			
Maneuver	**VORTAC**	**AFIS**	**Analysis**
Distance, altitude, and direction from facility data sheet	Normal	Radial In or out as applicable	If alignment is found > 1° than previously established, perform an alignment orbit. If the orbit is satisfactory, find a new radial that better represents the orbital alignment, and re-establish both the reference radial and alignment orbit. Notify Maintenance when the ARR and orbit are re-established. Notification may be accomplished through Flight Inspection Central Operations if maintenance is not on site and/or abnormal delays occur.

(1) Maneuvering

(a) AFIS method. The aircraft must be coupled to the RNAV on the azimuth and altitude designated or being established.

Figure 11-3
AFIS Reference Radial Maneuver



(b) Ground Checkpoint method. If non-AFIS techniques are used, the alignment radial should lie over a well-defined ground landmark or be a theodolite bearing. After the landmark/ checkpoint has been selected, measure it to the nearest tenth of a degree. Round to the nearest degree of the measured bearing from the antenna, which overlies the checkpoint. This will establish a radial, which can be selected in the omnibearing selector (OBS). Fly the aircraft along the selected radial (usually at 1500' above the antenna), deviate temporarily to fly directly over the landmark/ checkpoint. Make an event directly over the checkpoint.

(c) Theodolite Method

1 **Adjust the theodolite** to sight along the bearing, which will coincide with the radial. Fly the aircraft along the radial at 1500' above the antenna. The theodolite operator will advise the pilot when the aircraft is drifting right or left of the selected azimuth.

<u>2</u> **The theodolite operator** will actuate the event mark with the 1020 Hz tone or verbal mark when the aircraft is observed on the correct bearing. Determine the value of deflection on the crosspointer and compute the alignment error.

<u>3</u> **The following alternate method** may be used: Fly the aircraft on-course with reference to the crosspointer, maintaining a constant altitude. The theodolite operator will track the airplane and mark the recording in the aircraft from the theodolite site. The bearing of the aircraft, as determined by the theodolite, will be the actual measured magnetic azimuth. The alignment of the radial can then be computed from the recording.

(2) Analysis. When using AFIS, the announced mean alignment is the ARR alignment. When course roughness or scalloping occurs during an alignment evaluation, the graphical average of the deviations must be used for manual analysis. This reference will be used for subsequent checks of course alignment and airborne monitor reference evaluation. Determine DME accuracy as described in Paragraph 11.31.

(3) If using FIDME mode for positioning, determine an altitude that will provide adequate DME positioning updates. Altitudes of 5,000' or higher above the antenna elevation may be required for optimum aircraft position accuracy.

NOTE: An FMS may have a different MAGVAR than the facility. An FMS or AFIS computed bearing may be used to navigate. Aircraft using FMS on the RNAV track for the ARR should verify the FMS is using the same magnetic variation value applied to the facility under inspection.

(4) For locations where DME updating is not available, use the FI FAC Manual Update function and fly outbound on that radial. Document this procedure on the Facility Data Sheet.

b. Monitor Reference Evaluation. This check establishes the reference value used by ground maintenance to set the minimum amount of azimuth course shift required to activate the ground facility monitor alarm system. Facilities that have dual parallel monitors require a monitor evaluation on one transmitter only. Facilities that have two individual monitors require evaluations on each transmitter.

(1) Maneuvering. Monitor references may be established either in the air or on the ground. Once established, it will become the reference for all subsequent checks.

(a) The ground procedure is the preferred method for monitor evaluations. (Record and document alignment and shift). Document the checkpoint location on the flight inspection report and on FAA Form 8240-20 for inclusion on the AVNIS data sheet.

Step	Maneuver	VORTAC	AFIS	Analysis
1	Ground Position no closer than 0.5 nm (GCP if available)	Normal	RMS recorder running	Establish reference alignment with stable cross pointer and in tolerance signal strength
2	Same as Step 1	Shifted to alarm one direction	Same as Step 1	Check for alignment shift from reference established in step 1 ≤ tolerances.
3	Same as Step 1	Shifted to alarm in opposite direction	Same as Step 1	Check for alignment shift from reference established in step 1 ≤ tolerances.
4	Same as Step 1	Normal	Same as Step 1	There is no requirement for the course return to the measurement in Step 1. Monitor shifts of more than 1° will be brought to the attention of appropriate engineering personnel to determine if environmental or equipment related. If shift is more than one degree, facility must be removed from service.

(b) Airborne Procedure:

Step	Maneuver	VORTAC	AFIS	Analysis
1	ARR normal alignment established IAW Para. 11.20a	Normal	RMS recorder running	Establish reference alignment with stable cross pointer and in tolerance signal strength
2	Holding pattern on ARR, with the aircraft coupled to the RNAV azimuth	Shifted to alarm one direction	Same as Step 1	Check for alignment shift from reference established in step 1 ≤ tolerances. Course shift is referenced to ARR normal alignment.
3	Same as Step 2	Shifted to alarm in opposite direction	Same as Step 1	Check for alignment shift from reference established in step 1 ≤ tolerances. Course shift is referenced to ARR normal alignment.
4	Same as Step 1	Normal	Same as Step 1	Verify that the mean alignment of the ARR segment is within the established reference limits.

NOTE: Instantaneous shifts measured on the error trace may be used to establish monitor references, provided roughness and/or bends do not render results different than expected from the airborne procedure.

c. **En Route Radials.** Inspect en route radials along the desired procedural azimuth and altitude requested, either inbound or outbound, throughout the area of intended use (ESV documentation may be required).

Table 11-2
En Route Radials

Maneuver	VORTAC	AFIS	Analysis
Radials to determine Flight Inspection Standard Service Volume (FISSV). must be flown at a minimum altitude of 1000' (2000' in designated mountainous terrain) above the site elevation or highest terrain or obstruction, to a distance of 40 nm for "L" and "H" class facilities, or 25 nm for "T" class facilities. The 40 mile and 25 mile distances are considered the FISSV coverage distance. **Radials supporting instrument flight procedures** must be checked for signal quality and accuracy. Fly Airways, Off-Airway Routes, or routes at or below the minimum requested altitudes. If these radials have procedural use beyond the FISSV distance, they must be inspected to the additional distance at the minimum requested altitudes. **Change-Over Points (COP).** The minimum en route altitude (MEA) for an airway COP must be the altitude where usable signals exist from the supporting stations. There is no requirement to check coverage beyond the COP. Fix displacement is not required.	Normal	RADIN/ OUT as required	For all types of en route radials evaluate azimuth alignment, course sensitivity or modulations, polarization, roughness and scalloping, bends, identification, voice features, sensing, and signal strength while flying desired azimuth.

d. Intersection Radials/ DME Fixes

(1) Intersections are used to identify azimuth positions in space. These intersections can be used for navigational fixes, reporting points, DME fixes, COP(s), etc. Establish a minimum Reception Altitude (MRA) for each intersection that does not meet the minimum en route IFR altitude (MEA). The MRA is the altitude where reliable signals can be received within the procedural design area.

(2) When Fixes are located within the FISSV, coverage throughout the fix displacement area can be predicted (fix displacement evaluation is not required). Inspect these fixes along the track used to define the fix at the proposed procedural use altitude. Evaluate azimuth alignment, course sensitivity or modulations, identification, roughness and scalloping, and signal strength along the radial track used to define the fix at the proposed procedural use altitude.

(3) When a fix is located beyond the FISSV of any facility that supports the fix, the appropriate fix displacement coverage evaluation must be accomplished for that facility. Refer to Chapter 22 for flight inspection procedures of ESV(s).

e. Crossing Radials. When a crossing radial is used to define a point in space (i.e., IAF, FAF, etc.), there is no requirement to fly it radially. The evaluation of the crossing radial is accomplished while the aircraft remains on the procedural track.

(1) For a commissioning, reconfiguration, or new procedure development, the crossing radial must be verified by recording trace analysis for azimuth alignment, course sensitivity or modulation, identification, roughness and scalloping, and signal strength. Alignment may be determined by manual crosspointer analysis of the crossing radial at the fix. There is no requirement to evaluate the fix displacement area. If the fix is not contained within the FISSV of either facility, an ESV must be established to support the procedure, and appropriate fix displacement area must be evaluated.

(2) For a periodic evaluation, verification may be accomplished by recording trace or analysis of the cockpit instrumentation.

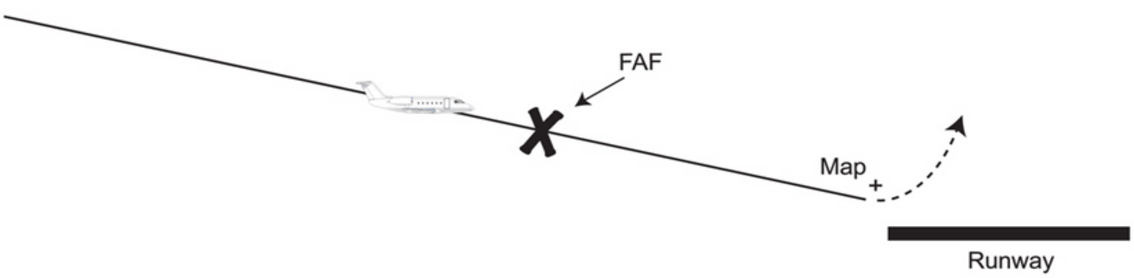
(3) AFIS Crossing Radial Setup: On System plot control page, toggle System C control to Auto On or Manual, toggle NCU Input to System receiver to be used for inspection, toggle system tune to Manual, toggle deviation offset to Manual and Execute page, enter radial to be checked in (OBS) deviation offset, Enter Frequency of system to be checked in ALT FREQ. Scratch pad to and execute page.

f. Terminal Radials/ Fixes (Approach, Missed Approach)

(1) Maneuvering: All evaluations must be conducted at the procedural altitudes except the final approach segment. This segment is evaluated from the FAF (or final descent point) descending to 100 ft below the lowest MDA to the MAP. In addition, descend to 100 ft below all stepdown fix altitudes inside the FAF.

(2) Analysis: Evaluate the radials for signal quality and accuracy. The final approach course must deliver the aircraft to the desired aiming point. Evaluate azimuth alignment, course sensitivity or modulations, polarization (when within 5 to 20 nm of the station), roughness and scalloping, bends, identification, and signal strength. When terminal fixes are located within the facility's FISSV or below the FISSV but within the standard service volume, coverage throughout the fix displacement area can be predicted, and fix displacement evaluation is not required.

Figure 11-4
Terminal Radials/ Fixes (Approach, Missed Approach) Maneuver



(3) Commissioning and Frequency Change Inspections. Evaluate all the radial segments that comprise the STAR, SID/ DP or SIAP throughout the depicted length. All final segments must be flown in the direction of intended use. Radials for facilities located within the airfield boundary must be evaluated from overhead the station outbound. If no termination point is depicted, the radial must be checked to where it joins the en route structure or the expected coverage limit of the facility category (i.e., 25 miles for a "T" class and 40 miles for "L" or "H" class). Terminal radials must be evaluated to include holding patterns, procedure turns, approach and missed approach, and departure routings. Terminal fixes located within the facility's FISSV or below the FISSV but within the standard service volume, coverage throughout the fix displacement area can be predicted; therefore fix displacement is not required. Ensure the procedure is compatible with human factors and navigational guidance is satisfactory.

(4) **Periodic, Antenna Change, and Facility Rotation Inspections**. Evaluate the final approach segment of the SIAP(s). Evaluate other terminal radials on a surveillance basis.

(5) **TACAN Azimuth Null Checks**. Nulls, defined as any repeatable out-of-tolerance cross pointer action or condition of unlock usually accompanied by rapid changes in the automatic gain control (AGC) and oscilloscope indication of a loss or distortion of the 15 and 135 HZ modulation components, are not permitted in this area. If a null is found, fly at an altitude 500 ft above or below the minimum FAF altitude. Inform maintenance so the problem can be corrected if possible. If the null cannot be corrected by antenna change or height adjustment, a new procedure will be developed which will avoid the affected area. Null checks are required on one transponder only. Nulls are not required when the TACAN facility is located at the FAF due to the effect of the station cone on azimuth performance.

On commissioning inspections, antenna change, new procedures, and changes in FAF altitude of 300 ft or more on existing procedures, fly the approach radial and 5° either side of the approach radial inbound or outbound on level flight from 3 miles outside to 3 miles inside the FAF at the lowest minimum altitude depicted for the FAF.

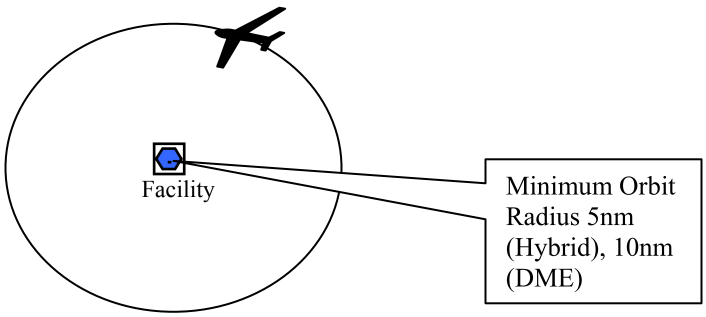
(6) **VOR 5° Offset Checks.** During site evaluation, commissioning, reconfiguration, antenna change, frequency change, lowering a FAF or the lowest MDA, extending the final approach segment, or changing the final approach radial, evaluate VOR radials 5° each side of the final approach radial. Evaluate the offset radials on one transmitter only at the same altitudes as the final approach radial segment. Inspect course sensitivity or modulations, roughness and scalloping, spectrum analysis, identification, and signal strength.

(7) **Facility Rotation for MAGVAR Change Inspections or Final Approach Radial Amendments**. Evaluate one TACAN null and VOR offset radial 5° beyond the final approach radial, to ensure a minimum of 5° has been checked each side of the published final approach radial. For example, when the published approach radial is changed from R090 to R087, fly R082 for the null/offset radial. R095 will have been flown previously to support the R090 approach, and provides the 5° minimum requirement.

g. **Orbital Evaluations** are used to determine azimuth error distribution and signal quality. Orbit data is used as reference information. Establish a reference alignment orbit during commissioning, antenna change, facility rotation, if no orbital reference exists, or if ARR and alignment dates on the AVNIS data sheet don’t match. Evaluate for deviation from the established reference during all subsequent orbital evaluations.

(1) **Alignment Orbit** is used to determine the accuracy and optimum error distribution of the azimuth. The objective of the check is to help Facilities Maintenance personnel determine environmental problems near the facility. The evaluation is conducted for 360° of azimuth. AFIS and GPS hybrid is the preferred method.

Figure 11-5
Alignment Orbit



(a) **Maneuvering.** When using AFIS an orbit radius of 5 nm and beyond may be flown when using GPS hybrid or equivalent for updating. Use 10 nm and beyond when using DME/ RNAV updating. The orbit may be flown clockwise (CW) or counterclockwise (CCW), but once established, it must be flown in the same direction, at the same distance and altitude, on each subsequent inspection (Figure 11-5).

NOTE: Counter-clockwise orbit is preferred to reduce error that may be generated when checking mechanically rotating TACAN antennas.

Compute a tapeline (TL) altitude to fly the orbit at a standard angle of 4° to 6° from the site.
Alignment Orbit Altitude Calculation:

TL = (TAN Ø)(Dist. Ft)
Earth Curvature (EC) = $(\text{Dist nm})^2 (0.883)$
Alignment Orbit Altitude = TL + EC + Antenna Elevation

The ratio between distance and altitude becomes critical when looking for low angle reflections or shadowing. Altitudes and distances may be modified when conditions prevent establishing them at the recommended 4° to 6° for air traffic requirements, engineering or maintenance support, and site conditions. Indicate deviations from the standard on the flight inspection report and AVNIS data sheet.

(b) **If alignment cannot be determined orbitally, it may be** measured by flying one radial in each quadrant. Determine the radial alignment from at least a 5 nm segment flown within the distance and angular parameters listed in the above paragraph. A partial orbit, augmented with radial alignment, is preferred over alignment determined solely by radial means. The Flight Inspection Policy, Practices, and Training Team must approve the use of radial flight in lieu of orbital alignment.

(c) **One orbit may be flown on dual transmitter** facilities during any inspection, except commissioning, by requesting transmitter changes. If sufficient transmitter changes cannot be made (at least one in every 40°), fly an orbit on each transmitter (see transmitter differential tolerances).

(d) **Course error distribution** must be determined prior to rotation (if required) to achieve optimum station balance. It is not necessary to refly the orbit after the facility rotation, provided the direction and magnitude of the adjustment can be confirmed by radial flight. Apply the confirmed azimuth shift to the alignment orbit for the final error spread determination and plotting. Complete the remaining facility rotation checklist items after the rotation.

(e) **Subsequent Inspections.** On periodic inspections, if a change in mean course alignment of more than 1.0° is found, contact Technical Operations Maintenance. They will conduct an evaluation to determine if the change in the facility was caused by a facility issue or an environmental change.

(f) **Ground Checkpoint Manual Mode Method.** Checkpoints charted on a sectional chart are desired every 20° of azimuth; however, acceptable results can be obtained with fewer checkpoints if a precise orbit track is maintained. Whenever possible, checkpoints should be selected that will occur near the crossing of a whole radial. If it is necessary to make major changes in altitude during the orbit, discontinue the orbit at a checkpoint and maneuver in that area while changing altitudes. Cross the last checkpoint at the new altitude and mark the checkpoint on the recording. Minor changes in altitude may be made without interrupting the orbit. Ground checkpoints may be established and used at locations where map or chart accuracy is questionable by verifying accuracy with a theodolite. Easily identifiable and permanent types of ground references should be used for checkpoints.

By establishing good ground checkpoints, the necessity for recurring theodolite use for periodic checks can be eliminated. Subsequent flight checks can be made using the appropriate chart marked with ground checkpoints.

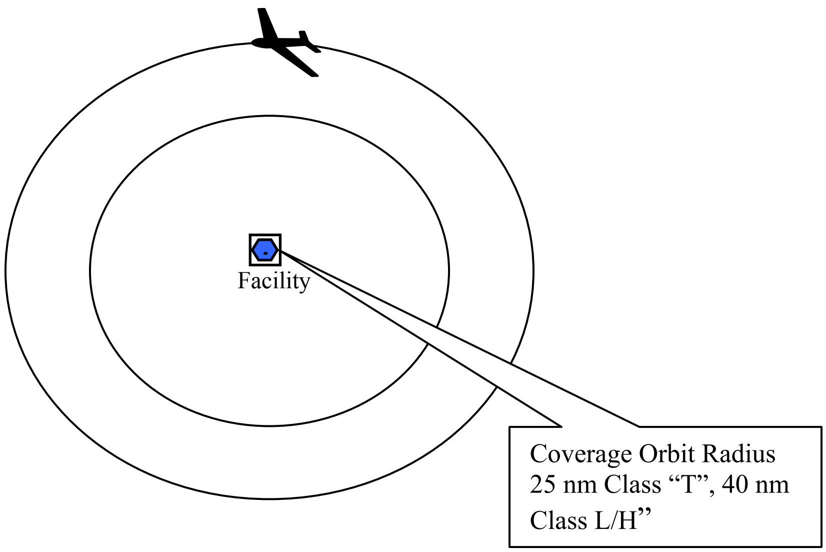
(g) **Theodolite Method.** The orbit radius must be at the maximum visual range for the theodolite operator. Advise the theodolite operator of the bearing, vertical angle, altitude, and range of the aircraft from the site when the aircraft is established on the orbit. After sighting the aircraft, the theodolite operator must preset the theodolite to the nearest 5° or 10° increments ahead of the aircraft and, at the preselected reference point on which the aircraft (engine, nose, etc) crosses the vertical crosshair, transmit the 1020 Hz tone or verbal mark to the aircraft (theodolite azimuth should also be transmitted). Rotate the theodolite to the next 5° or 10° azimuth increment and repeat the procedure. Repeat this procedure through complete orbit with an overlap of at least one transition. The combined receiver error and radial displacement at each 10° point where the course line crosses the center of the recording may be measured with 10-point dividers. Use the leading edges of the appropriate mark indication as a standard. Station error, corrected for receiver error, and theodolite offset, may be determined and plotted.

(h) **Analysis:** During the orbit evaluate azimuth alignment, course sensitivity or modulations, sensing and rotation, roughness and scalloping, identification, and signal strength. Out-of-tolerance conditions found during an orbital inspection must be confirmed by a radial evaluation before restricting a facility or issuing a NOTAM. The radial evaluations have priority. When optimizing the alignment, the mean orbital alignment should be within ± 0.5°, and the system differential between a collocated VOR and TACAN should not exceed 1.0°. For dual transmitter systems, use the primary transmitter as the reference.

(2) **Coverage Orbit.** This check is conducted to determine the facility's ability to support the Flight Inspection Standard Service Volume (FISSV). The FISSV must be established as follows: On "T" class facilities, the FISSV is 25 nm and 1,000 ft (2,000 ft in designated mountainous areas) above antenna elevation and intervening terrain as determined by map study. On "L" and "H" class facilities the distance extends to 40 nm, and the altitudes remain the same as for the "T" class facility. Establish facility restrictions and performance status based on the FISSV (Figure 11-6).

(a) **Maneuvering.** One complete orbit (one transmitter only) must be flown at an orbit distance of 25 nm for "T" class or 40 nm for "L" and "H" class facilities. Fly at an altitude 1,000 ft (2,000 ft in designated mountainous areas) above antenna elevation or intervening terrain. When in-tolerance signals are not obtained, fly at an altitude where tolerances are met. If these altitudes are higher than the FISSV altitudes, facility restrictions and NOTAM actions are required.

Figure 11-6
Coverage Orbit



NOTE: For fuel planning, use the formula 2 πR to find the distance around the orbit, i.e, 25 nm orbit (e.g., 2 x 3.1416 x 25 = 157 nm); 40 nm orbit is approximately 250 nm.

(b) **Analysis:** During the orbit, evaluate azimuth alignment, course sensitivity, modulations, sensing and rotation, roughness and scalloping, identification, and signal strength.

A restriction defines an area of unusable signal. When out-of-tolerance (OT) conditions are found, restriction distance and altitude will be defined by radial flight. Restriction lateral limits may be defined by orbital means. Radial inspection results have priority over orbital inspection data. In areas of multiple restricted segments, it may be appropriate to group those segments into larger, easier to understand restrictions. The advantages of this over-restriction in some areas must be weighed against user requirements. Fly an arc at the FISSV of the facility at the restricted altitude encompassing the restricted area to determine usable signal coverage. Report restrictions in CW direction, including distance and altitude. Restricted areas are generally not smaller than 10°. Example restriction: From 127 - 187, Beyond 12, Below 5,500'.

Procedures flown below or outside the FISSV, which are found unsatisfactory, must be denied, but a facility restriction is not required.

Revalidate ESV(s) anytime a coverage orbit is required by the facility checklist. If coverage is not required but is accomplished upon special request, ESV(s) are not required to be revalidated unless revalidation is part of the special flight inspection request.

h. **Receiver Checkpoints** are established to allow pilots to check the accuracy of their receivers. Inability of a facility to support receiver checkpoints must not result in a facility restriction.

(1) **Ground Receiver Checkpoints** will be established on the airport ramp or taxiways at points selected for easy access by aircraft, but where there will be no obstruction of other airport traffic. They normally will not be established at distances less than one-half mile from the facility, nor should they be established on non-paved areas.

(a) **Maneuvering**

1 **Commissioning** inspection or when a new ground checkpoint is established. Align the aircraft toward the facility, with the aircraft's receiving antenna over the selected checkpoint. Determine the correct facility radial and round off to the nearest whole degree. This radial will be published as the ground receiver checkpoint azimuth.

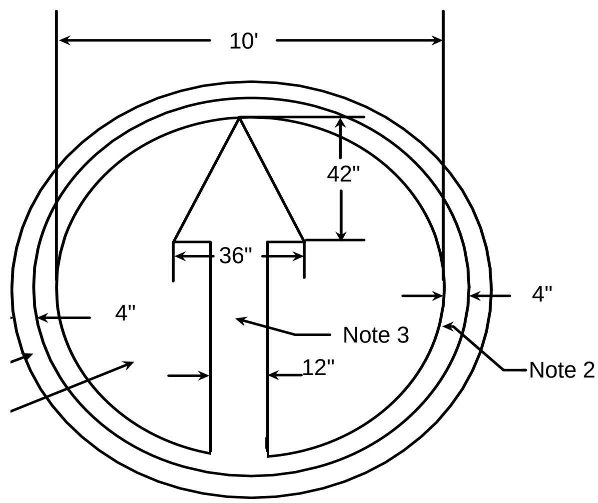
2 **Periodic** flight inspections will be evaluated with the aircraft's receiving antenna over the checkpoint. If the results of this check are unsatisfactory, then re-align the aircraft toward the facility with the aircraft's receiving antenna over the checkpoint to minimize aircraft position error. If this check is also unsatisfactory, remove the checkpoint from service.

(b) **Analysis.** All azimuth bearings must be stable and within prescribed azimuth tolerances. Check azimuth alignment, course sensitivity or modulations, roughness, scalloping, ID, sensing, and signal strength. If a stable signal and alignment cannot be obtained at a location, select another site or establish an airborne receiver checkpoint, if feasible.

(c) **Signage:** The ground receiver checkpoint signs and airport surface markings must be in accordance with Figure 11-7 below, prior to publishing new ground checkpoints. Signs and markings must be observed for continued maintenance during subsequent inspections of the NAVAID facility.

<u>**1**</u> **Airport Surface Markings:** The spot selected for the checkpoint must be marked by a painted circle 10 ft in diameter as illustrated below.

Figure 11-7
Airport Surface Markings



NOTES:

1. White (may be bordered on the inside and outside with 6-inch black band, if necessary, for contrast)
2. Yellow (Chrome yellow-taxiway aviation yellow).
3. Yellow arrow to be aligned toward facility and extended the full width of the inner edge of the circle.
4. Interior of circle black (concrete surfaces only)

2 **Receiver Check Point Signs** must show the facility identification, channel, course selected (published) for the check, and the plotted distance from the antenna.

Figure 11-8
Receiver Checkpoint Signs

DCA VTAC **116.3 (CH 110) 147/ 327** **DME 1.5 nm**

NOTE: The signs must be distinct, easy to read, and must not constitute a hazard to aircraft movement.

NOTE: For VORTAC(s), if either portion of the facility does not support the checkpoint, annotate the Facility Data Sheet and notify Airfield Management to remove that portion from the sign.

NOTE: Slight variances in airport surface markings and signage may be observed; however, that should not affect their acceptability unless, in the judgment of the flight inspector, they could affect the usability of the checkpoint.

(2) **Airborne Receiver Checkpoints** must be designated over prominent ground checkpoints (landmarks) at specific altitudes. It is preferred that such checkpoints be near an airport so they are easily accessible to users. However, consider selecting an area and altitude which will not interfere with normal traffic patterns.

(a) **Maneuvering.** The altitude specified for receiver checkpoints must be at least 1,000 ft AGL. The checkpoint should not be established at a distance less than 5 nm or more than 30 nm from the facility. Fly the aircraft directly over the selected checkpoint either toward or away from the facility and annotate on the recordings the whole DME reading prior to the checkpoint, the checkpoint, and the whole DME reading after the checkpoint. At a minimum, establish the aircraft on the radial 1 mile prior to the checkpoint.

(b) **Analysis.** Compare the electronic radial recorded with the plotted geographic azimuth. The electronic radial overlying the geographic checkpoint, rounded off to the nearest whole degree, will be the azimuth published as the receiver checkpoint. Compare the plotted distance (derived from map study) from the checkpoint to the facility antenna and the actual distance received when directly over the checkpoint. The electronic radial overlying the geographic checkpoint, rounded off to the nearest whole degree, will be the azimuth published as the receiver checkpoint.

i. **Standby Transmitters.** Both transmitters must be evaluated for each required checklist item except the coverage orbit and ESV(s), which are required on one transmitter only. Alignment evaluations may be made by changing transmitters during an evaluation and comparing the azimuth course shift. Transmitter changes must not be made inside the final approach fix, however transmitter changes made before the final approach fix are satisfactory for evaluation purposes. If comparison results are questionable, fly the final approach segment on each transmitter.

j. **Standby Power.** Standby power checks are not required for facilities powered by Floating Batteries (uninterruptible power supplies etc.) that are constantly charged by another power source. The AVNIS data sheet should indicate the source of standby power. With the facility operating on standby power, check the following on one transponder/transmitter only:

(1) **Maneuvering:** Inspections are to be performed when flying a radial with the facility operating on normal power and then repeating the check over the same ground track at the same altitude with the facility operating on standby power.

(2) **Analysis.** Check azimuth alignment (one radial), roughness, scalloping, identification, and distance accuracy.

NOTE: If a TACAN facility has a high power 3-phase antenna and the electrical phases of the generator are reversed, the TACAN antenna will spin backwards and cause rotation problems.

k. **Associated Facilities** are inspected concurrently with the inspection of the primary facility. These include marker beacons, lighting aids, communications, etc. which support the en route/ approach procedures and landing weather minimums of an associated approach procedure. Conduct inspections of these facilities in conformance with the detailed procedures and tolerances contained in this handbook

11.21 ANALYSIS. This section details the parameters to be inspected. Chapter 11 graphics display basic Flight Inspection maneuvers and general aircraft configuration.

a. **ID.** The Morse coded ID signals must be identifiable throughout the entire unrestricted VOR coverage area and ESV. Evaluate ID for correctness, clarity, and to ensure there is no adverse effect on the azimuth course structure. When it is difficult to determine what effect the ID has on the azimuth course structure due to roughness and scalloping, evaluate the same azimuth radial with the ID off and compare the results. When simultaneous voice and Morse coded ID are installed, the modulation levels should sound the same. These levels are approximately 30 and 8 percent respectively. When a voice broadcast feature is installed (ATIS, AWOS, etc), the voice ID feature is suppressed during voice transmissions, but the Morse coded ID should still be heard. When ID is unacceptable, take appropriate NOTAM action and notify Technical Operations facility maintenance.

NOTE: Facilities with standby transmitters and separate standby ID equipment use the Morse code ID to identify each transmitter. The primary transmitter has equal spacing between all characters of the coded ID. The spacing between the second and third characters of the standby transmitter is increased by one dot.

b. Voice. The voice broadcast feature, when installed, allows a user to receive live radio communications from FSS, weather and altimeter information, air traffic and airport advisories, etc., on the VOR frequency. Voice amplitude modulates the RF carrier by 30 percent. Advisory services that provide voice broadcast features include Automatic Terminal Information Service (ATIS), Automatic Weather Observation System (AWOS), Automated Surface Aviation Observing System (ASOS), Transcribed Weather Broadcast Equipment (TWEB), and Hazardous Inflight Weather Advisory Service (HIWAS). Some services may not be continuously available. Inspect only those services available.

(1) Maneuvering. Aircraft should be in level flight, tracking any convenient radial.

(2) Analysis of Voice. Inspect the voice for clarity and to ensure there is no adverse effect on the azimuth course. Ensure that all published remote sites can respond on the VOR frequency when contacted.

FSS-Associated VOR: Request a test count from FSS Radio while recording any convenient radial while watching for an adverse effect on radial structure or alignment.

Continuous Voice Broadcasts: Make periodic checks of the quality and coverage of the voice transmissions while operating in the VOR coverage area.

c. Sensing and Rotation checks are required at the beginning of each flight inspection.

(1) Sensing is checked by positioning the aircraft on a known radial. Select the azimuth of the radial to be flown. The OBS indicator will point towards the facility. For AFIS-equipped aircraft compare the computer-generated bearing with that being received. Sensing should be checked prior to rotation since incorrect sensing may cause station rotation to appear reversed.

(2) Rotation is checked after completion of sensing check by flying a partial orbit and checking to ensure that the radial bearings continually decrease for a counterclockwise orbit or continually increase for a clockwise orbit.

Figure 11-9
VOR Sensing and Rotation

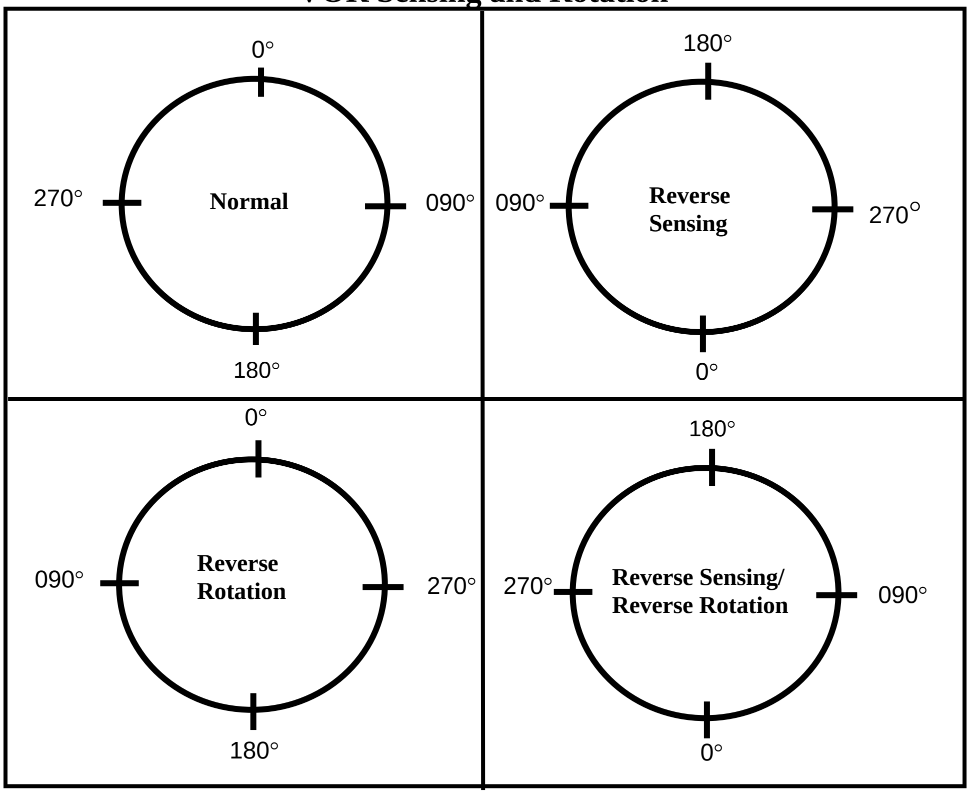
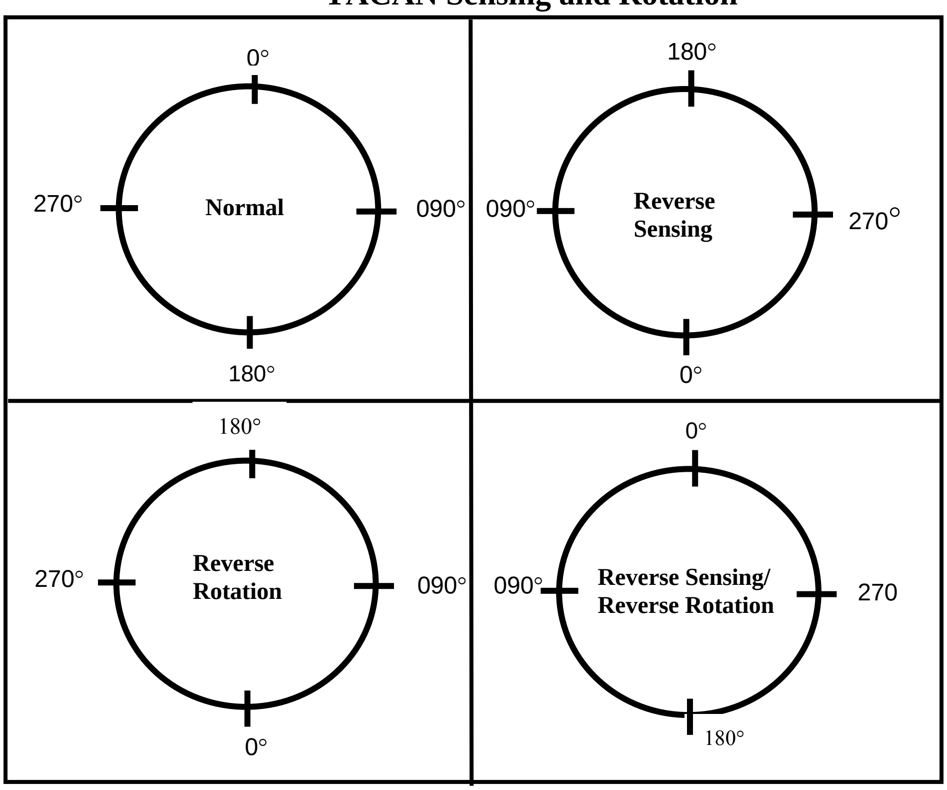


Figure 11-10
TACAN Sensing and Rotation



d. Modulation Levels. Modulation levels are monitored during all phases of the inspection; any out of tolerance conditions are recorded and reported. Adjustments of modulation levels may be made on any radial (within 10 to 25 nm of the facility). Determine the average modulation levels or the graphical average of the recorded modulation levels (when available) when fluctuations are encountered.

(1) VOR Modulations levels are 30 Hz AM, 30 Hz FM (9960 Hz subcarrier FM deviation), and 9960 Hz AM of RF carrier. Modulation levels must meet operational tolerances throughout the unrestricted service volume of a VOR.

(a) 30 Hz AM is optimized at 30% and is termed "variable phase on conventional VOR(s), and "reference phase" on Doppler VOR(s). 30 Hz AM is set by the power ratio between the separately radiated carrier and sideband signals.

(b) 30 Hz FM is optimized at 30% (a deviation ratio of 16 is equivalent to 30% modulation) and is termed "reference phase" on conventional VOR(s) and "variable phase" on Doppler VOR(s).

(c) 9960 HZ AM is optimized at 30%. The 9960 Hz AM of the RF carrier may cause receiver flag warnings when out of tolerance.

(2) TACAN Modulation Levels 15 Hz, and 135 Hz, Main Reference Group (MRG), Auxiliary Reference Group (ARG), ID. AFIS shall be used for analysis of TACAN signals. The following are analytical procedures and no facility restrictions are to be applied if adjustments cannot be made or if maintenance personnel are not available for adjustment. The composite video on the oscilloscope will yield considerable data about the TACAN facility. Measurements should fall within the following limits:

Table 11-3
TACAN Modulation Levels

Parameters	Limit	Remarks
15Hz Modulation	10 – 30%	Inform Maintenance if graphical average exceeds limits
135Hz Modulation	10 – 30%	Inform Maintenance if graphical average exceeds limits
Identification Pulse Spacing	740 microseconds	Synchronized with ARG
Reflections	N/A	No degradation of facility performance
MRG size	12 +/- 1 pulse pair	
ARG size	6 +/- 1 pulse pair	
ARG count	8 +/- 0 bursts	

15 and 135Hz Modulation levels are taken from AFIS. The oscilloscope may be used to verify modulation levels (measure the modulation of each component and calculate the percentage per Section 302.3). Notify maintenance if modulation limits are exceeded. For manual computation of TACAN modulation, see formula below.

Modulation Percentage 135 and 15 Hz

$$15 \text{ Hz modulation} = \frac{(V_1 + V_2) - (V_3 + V_4)}{(V_1 + V_2) + (V_3 + V_4)}$$

$$135 \text{ Hz modulation} = \frac{(V_1 + V_3) - (V_2 - V_4)}{(V_1 + V_2) + (V_3 + V_4)}$$

Where:

V_1 = Max of 135 Hz and 15 Hz
V_2 = Min of 135 Hz at max of 15 Hz
V_3 = Max of 135 Hz and 15 Hz at min 15 Hz
V_4 = Min 135 and 15 Hz at min 15 Hz

(a) **TACAN Components** are to be monitored during inspection using the oscilloscope. Advise Maintenance of any discrepancies found.

1 **Identification Train.** To measure the ID spacing group, adjust the oscilloscope so the MRG is on the left edge of the graticule. Adjust the Time/ Division as needed to measure 740 microseconds between ID pulse Pairs.

2 **MRG Size** refers to the number of pulse pairs in the MRG. For X channel, there should be 12 pulse pairs with a 30-microsecond spacing between pairs and a 12-microsecond spacing between pulses in a pair. For Y channel, there are 13 single pulses spaced 30 microseconds apart. AFIS and oscilloscope is used to identify and measure pulse number and spacing.

3 **ARG Size** refers to the number of pulse pairs in the ARG. For X channel, there should be 6 pulse pairs with a 24-microsecond spacing between pairs and a 12-microsecond spacing between pulses in a pair. For Y channel, there are 13 single pulses spaced 15 microseconds apart. The oscilloscope is used to identify and measure pulse number and spacing.

4 **ARG count** refers to the number of ARG(s) between MRG(s). There are eight ARG(s) between each MRG. Oscilloscope will be used to identify the correct number of ARG(s).

5 **Reflections.** Reflected signals may be detected by examining the composite video. Reflections may duplicate the normal pattern in an image pattern displaced slightly to the right. Reflections may be of sufficient amplitude to cause the pattern amplitude to oscillate at a sine wave frequency dependent on velocity and position of the aircraft.

e. **Polarization** causes azimuth course variations whenever the aircraft is banked around its longitudinal axis. It is caused by the radiation of a vertically polarized signal from the VOR antennas (horizontally polarized signal from a TACAN) or other reflective surfaces around the site.

(1) **Maneuvering.** Polarization is evaluated in radial flight. On a VOR, the check should be made any time radial work is accomplished. One VP must be completed in each quadrant during Commissioning and Antenna Change inspections. On a TACAN, polarization is required to be checked on only one radial. Polarization checks will be conducted (inbound or outbound) within 5 to 20 nm of the facility.

(a) **The preferred method** of evaluating polarization is to bank the aircraft 30° around the longitudinal axis (starting on either side), then banking 30° in the opposite direction, and returning to straight and level flight. During aircraft banking, particular attention should be paid to keeping tracking and heading changes to a minimum to ensure course errors due to aircraft positioning are not mistaken for polarization effects. The course deviations that occur during the 30° rolls may indicate polarization. A conformation check is required if out-of-tolerance conditions are discovered using this method.

(b) **Confirmation procedure.** Fly over a prominent ground checkpoint, located 5 – 20 nm from the facility. Execute a 30°-bank and turn, hold this attitude throughout 360°, and end this maneuver as close as possible to the same ground checkpoint as possible. Mark the recording at the beginning and end of each 90° change in azimuth heading. If polarization is not present, the course will indicate a smooth departure from and return to the "on-course" position, deviating only by the amount that the aircraft is displaced from the original azimuth.

(2) **Analysis.** The indications are similar to course roughness and scalloping but normally can be separated by relating the course deviations to the aircraft banking. When roughness and scalloping cannot be separated from polarization, select another radial. The evaluation should be conducted on another nearby radial in the same azimuth quadrant.

f. **Frequency Interference**

(1) The RF electromagnetic spectrum from 108 to 118 MHz is reserved for VOR and ILS localizer signals. Undesirable RF signals can be radiated in this frequency band that interfere with the VOR signals. Electromagnetic interference (EMI) signals can be produced by electrical manufacturing processes, power-generating facilities, etc., which may be sporadic. Radio frequency interference (RFI) may be caused by other VOR(s), harmonics of other frequencies, FM stations, etc., which are usually continuous.

(2) The VOR spectrum must be monitored for undesirable electromagnetic radiation when RF interference is suspected. When interfering radiation is observed, it is not justification for restricting the facility, unless other flight inspection tolerances are exceeded. Undesirable signals must be reported to Technical Operations facility maintenance.

(3) Facility restrictions and NOTAM(s) established by Spectrum Management must be identified on the AVNIS data sheet. These restrictions must not be removed by flight inspection alone.

g. Course Structure

(1) Roughness and Scalloping. Roughness will show as a series of ragged irregular deviations; scalloping as a series of smooth rhythmic deviations. The frequency of each is of a duration that is not flyable and must be "averaged out" to obtain a course.

(a) To measure the amplitude of roughness and scalloping, or the combination of the two, draw two lines on the recording that are tangential to and along each positive and negative peak of the raw crosspointer or error trace. The number of degrees or microamperes between these lines will be the total magnitude of course deviations; one-half of this magnitude will be the plus and minus deviations.

(b) A third line is drawn equidistant from these two lines to obtain the average "on course" from which course alignment is measured. Thus, the instantaneous alignment error of the course may be computed from the recordings at any point where an accurate checkpoint has been marked on the recording. Alignment error will be referred to in degrees to the nearest tenth. Misalignment in a clockwise direction is considered positive. Where the magnetic azimuth of the measured (ground) checkpoint is greater than the electronic radial, the error is positive.

(2) **A bend is similar to scalloping, except** its frequency is of a duration that enables an aircraft to be maneuvered throughout the aberration to obtain a centered crosspointer. Accordingly, a bend might be described as a brief misalignment of the course. Bends are sometimes difficult to discern, especially in those areas where good ground checkpoints or other means of aircraft positioning are not available. For this reason, it is important to the analysis of a bend to consider aircraft heading and radial alignment deviations. A smooth deviation of the course over a distance of 2 miles would manifest itself as a bend for a flight inspection aircraft at a ground speed of 150 knots. An aircraft of greater speed would not detect such smooth deviations of the course as a bend unless it was over a greater distance. In the analysis of bends, further consideration should be given to the flight levels and speeds of potential users. Since speed, altitude, system response, and other factors are important in the analysis of course structure, the flight inspector should carefully evaluate the flyability factor before assigning a final facility classification.

Figure 11-11A

BENDS

(Example – not drawn to scale)

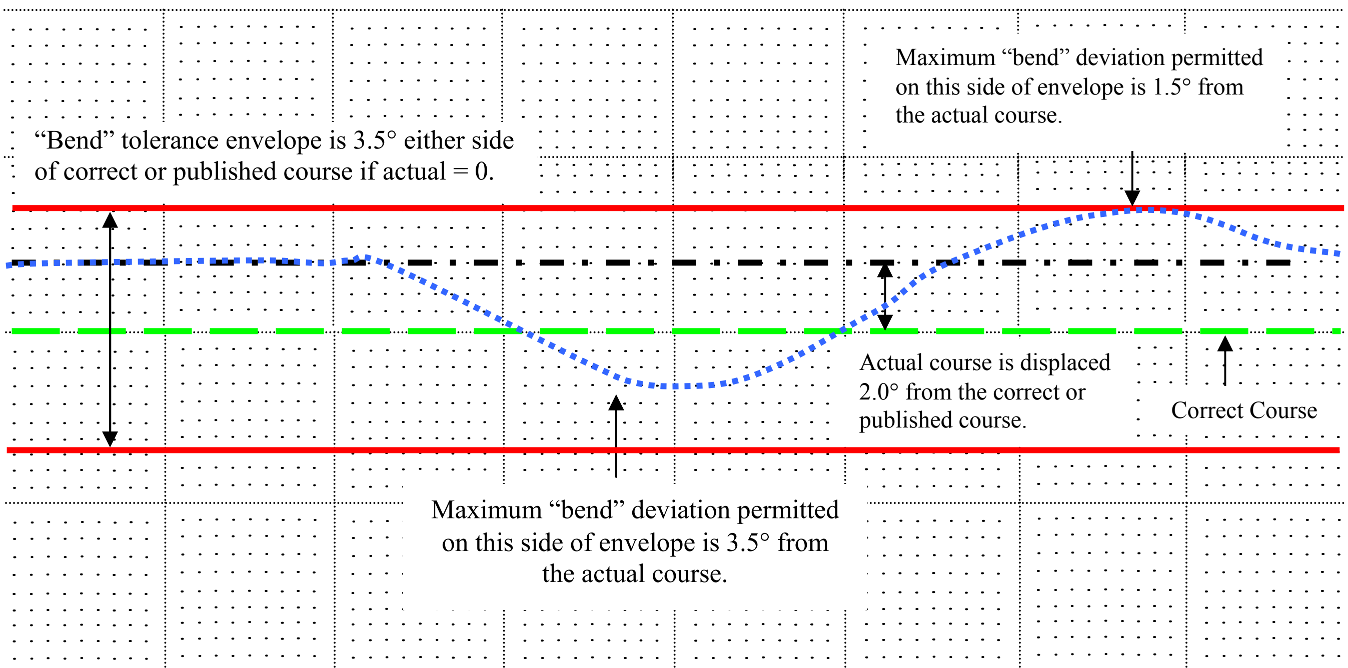
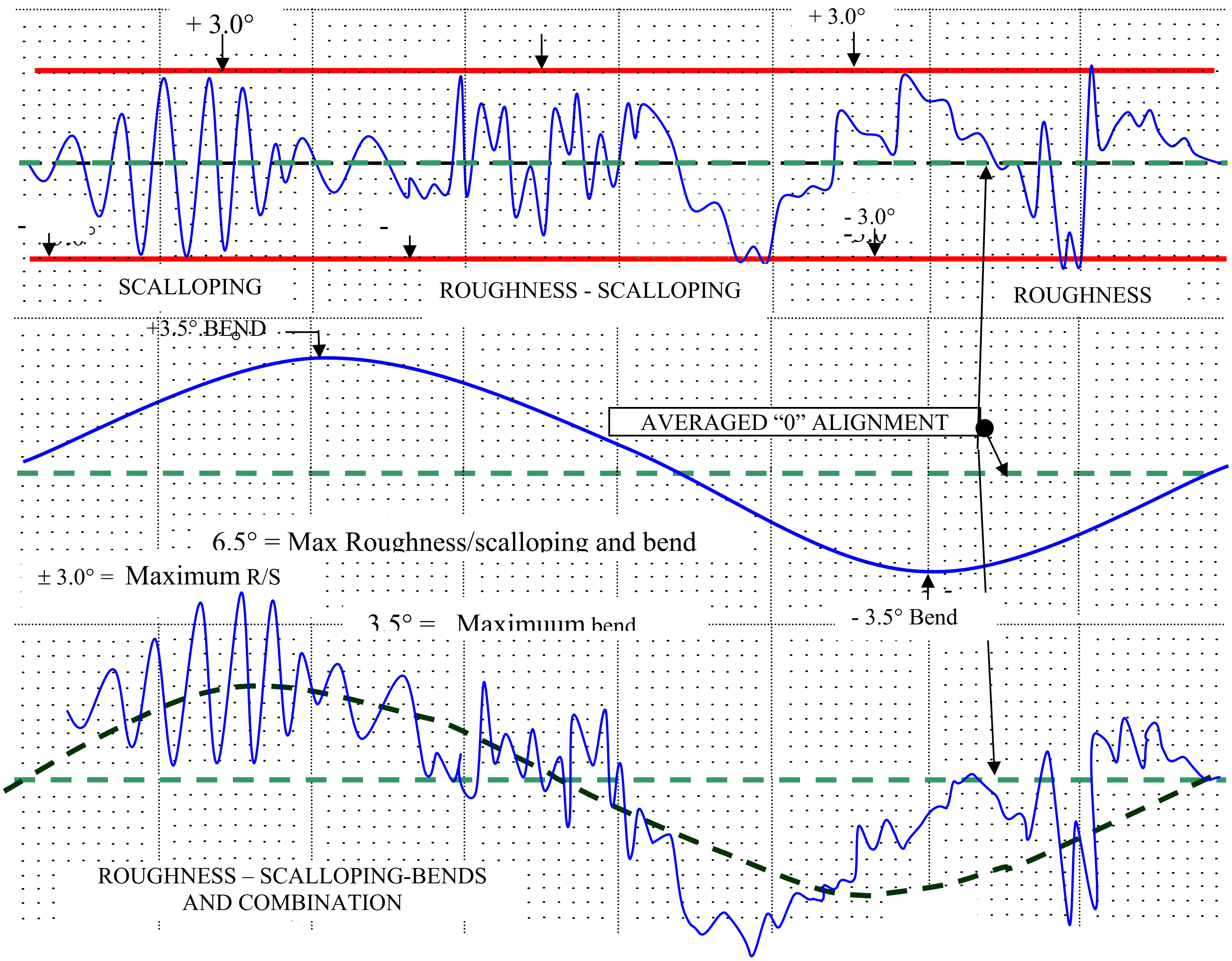


Figure 11-11B

STRUCTURE

(Example – not drawn to scale)



h. **Signal Strength.** VOR/ VOT signal strength must be evaluated during all flight inspection evaluations, and the received signal must be equal to or greater than the specified tolerance.

i. **DME Coverage** must be recorded or annotated and evaluated to the same coverage requirements as the service (ILS/VOR/NDB, etc.) it supports.

SECTION 3

DISTANCE MEASURING EQUIPMENT (DME)

11.30 INTRODUCTION. This section provides instructions and performance criteria for certifying standard DME.

The flight inspection of DME can be performed separately but is normally checked in conjunction with the more detailed check of the associated ILS, MLS, VOR, or TACAN facility. When conducting a flight inspection of DME, check the following:

- Accuracy
- Identification
- Coverage

11.31 FLIGHT INSPECTION PROCEDURES

a. Distance Accuracy

(1) Maneuvering. Check the accuracy of the TACAN/ DME distance information during inspection of the radials, orbits, approach procedures, and DME fixes.

(2) Analysis. AFIS DME error trace evaluation is the preferred method of analysis. (AFIS automatically converts slant range; therefore no further computations are required). The following is an alternate method of TACAN/ DME distance information. The mileage indication displayed on the distance indicators may be noted on the recordings. Comparison of the scaled distance on the chart (converted to slant range) to the distance indicated by the TACAN/ DME distance indicator at various points may be made for accuracy determination.

(3) Other Considerations. It is not necessary to compute the slant range for distances measured at altitudes below a vertical angle of 5° because the relative difference between slant and chart range is negligible (less than ½ to 1 percent). For ease of computation, a 5° angle is equivalent to approximately 1,000ft above antenna elevation at 2 nm, and 5,000ft above the antenna elevation at 10 nm. Above a 5° angle, a DME slant range mileage must be converted to chart distance. See formulas below.

Slant Range to Chart Distance

$$S = \frac{D}{\cos \angle}$$

Where:

D = Geodetic distance (ft)
S = Slant range distance (ft)
∠ = Slant Angle (degrees)

Chart Distance to Slant Range

$$D = S \cos \angle$$

Where:

D = Geodetic distance (ft)
S = Slant range distance (ft)

Slant Angle

$$\angle = \text{arc tan} \frac{A}{D}$$

Where:

A = Altitude above the horizontal (ft)
D = Geodetic distance (ft)
∠ = Slant Angle (degrees)
∠ = Slant angle (degrees)

(4) **Erroneous Distance Information.** If the ground facility is emitting false reply pulses, erroneous distance information may be present. This condition usually occurs within 25 miles of the antenna. Whenever actual false lock-ons are experienced, the offending facility must be removed from service until this condition is remedied.

b. **Identification.** The identification must be checked for correctness and clarity, with the aircraft either in orbital or radial flight. A DME with an associated facility will be checked for correct synchronization of the two identification signals.

c. **DME Coverage** must be recorded or annotated and evaluated to the same coverage requirements as the primary system (ILS/ VOR/ NDB, etc.) it supports. DME fixes located outside the FISSV must be evaluated for coverage ± 4 nm or 4.5° (whichever is greater) at 5 nm greater than the fix distance. Coverage is validated on one transponder only.

NOTE: Cardion (Air Force FRN-45) TACAN(s) require DME to be checked on both monitor “A” and monitor “B” during commissioning or reconfiguration type checks. Monitor “B” can only be checked by having maintenance turn off monitor “A”**.**

SECTION 4
SHIPBOARD TACAN

11.40 INTRODUCTION. The following guidance will be used when an inspection of a shipboard TACAN is accomplished.

11.41 FLIGHT INSPECTION PROCEDURES

a. **The flight inspection must be scheduled upon receipt of the following information:**

(1) Date and time of requested inspection.

(2) Name and hull number of the ship.

(3) TACAN channel.

(4) UHF primary and secondary communication frequency.

(5) Location of ships (latitude and longitude).

(6) Name and phone number of area coordinator.

b. **Conduct the inspection with the ship underway** and at a distance from shore that is sufficient to preclude interference or shielding of the signal by land mass during radial and orbital inspections.

c. **The ship's radar must be used as a basis to determine alignment.** Fire control radar is considered the most accurate and will be used when available. Search (CIC) radar may be used if fire control radar is not available. Fire control information is given as TRUE bearings, and search radar is MAGNETIC.

d. **Due to various antenna mount positions on ships** and possible shielding by other antennas, masts, etc., nulls and/or unusable sectors may occur. Suspected out-of-tolerance conditions must be confirmed by a second evaluation of the area in question. Any sector of the TACAN that does not provide azimuth or distance information must be reported immediately to the ship and documented in the flight inspection report.

11.42 CHECKLIST. The following must be inspected during shipboard inspections.

a. Identification

b. Sensing and rotation

c. Polarization

d. Radial alignment (minimum of one)

e. Coverage

f. Distance accuracy

g. Frequency interference

h. Alignment orbit

i. Approach radial

j. Standby equipment

k. Stabilization

l. Complete the checks in accordance with appropriate paragraphs of this chapter unless modified or changed by the following:

(1) Those items normally inspected during radial flight may be accomplished on a radial to or from the ship or during inspection of the approach radial.

(2) Identification. Shipboard TACAN identification consists of two Morse code letters transmitted every 30 or 37 ½ seconds.

(3) Coverage. Check a minimum of one radial for coverage to 40 nm during inbound or outbound flight at 700 MSL. Advise the ship if coverage is less than 40 nm.

(4) Frequency Interference. All of the ship's electronic equipment that is normally operating should be activated during the inspection.

(5) Alignment Orbit. The orbit must be flown beyond 7 nm from the ships and no lower than 700 ft MSL. On those ships using search radar (CIC) for alignment, the orbit must be flown below 2,000 ft MSL.

(6) Approach Radial. The ship's approach radial is the radial that will guide the aircraft to the stern of the ship and will vary depending on the heading of the ship. Fly the radial from a minimum of 7 nm and 700 ft MSL to pass over the ship at 300 ft MSL. Determine and report radial alignment and structure.

(7) Standby Equipment. CV, LPH, LHA, and LPD ships have dual TACAN equipment. Spot check the standby equipment during radial flight by requesting a change from primary to standby equipment.

(8) Equipment Stability. Stability of the TACAN equipment may be affected during a turn of the ship. Stability will be checked during radial inspections by requesting the ship to turn left 15° and then right 15°. Advise the ship's personnel of any change to azimuth or alignment during the turns. Standard TACAN tolerances apply.

SECTION 5

VOR TEST FACILITY (VOT)

11.50 INTRODUCTION. A VOT is a facility transmitting a test signal that is used to determine the operational status of an aircraft VOR receiver. This section describes the procedure used to inspect and certify a VOT.

11.51 GENERAL. VOT(s)/ VOR(s) operate in the VHF frequency range from 108 – 118 MHz. They share this frequency range with ILS Localizers, with the Localizers operating on the odd (100 KHz) frequencies and the VOT/ VOR operating on the even ones. (Example Localizer 108.1, 108.15 stopping at 111.95, VOT/VOR 108.2, 108.25 to117.95.)

11.52 CLASSIFICATION. There are two different classifications for VOT systems, “Standard” and “Area”.

Table 11-4
VOT Classification

CLASS DESIGNATOR	USAGE AREA
Standard	It should be checked on the ground at airport(s) in the area of intended use. Line of sight with transmitting antenna.
Area	Designed for use on the ground or in the air. It may be located to provide the test signal to one or more airports.

NOTE: At this time, VOT(s) do not have a specified service volume. VOT service is identified and controlled by the FAA service area office having jurisdiction of the airport where VOT service may be provided. Area VOT(s) are strategically installed to serve specific airports on the ground or in the air. The inspector must check all airports identified to receive ground and/or airborne service. If, as a result of the inspection, adequate VOT coverage is found at additional airports, the FAA Regional Office must be notified. If the Regional Office concurs that the additional airports should receive VOT service, then the inspector must include the additional airports on his report for publication.

11.54 CHECKLIST. Perform the checks as noted below. Periodic requirements may be performed either on the ground or in the air within the areas approved for use.

Parameter	Reference Paragraph	Inspection	
		C	P
Frequency Interference	11.55a	X	X
Identification	11.55b	X	X
Sensing	11.55c	X	X
Modulation Level	11.55d	X	X
VOT Reference Point	11.55e	X	
Alignment (Course Indication)	11.55f	X	X
Coverage	11.55g	X	X
Monitor	11.55h	(1)	
Standby Power	11.55i 4.33c	X	

FOOTNOTE:
(1) Maintenance request

11.55 FLIGHT INSPECTION PROCEDURES:

a. Frequency Interference (Spectrum Analysis). The electromagnetic spectrum from 108 to 118 MHz is reserved for VOT (VOR) and ILS localizer signals. Undesirable RF signals can be radiated in this frequency band that interfere with the VOT signals.

(1) Maneuvering. Position the aircraft as appropriate for the check being conducted.

(2) Analysis. Electromagnetic Interference (EMI) signals can be produced by electrical manufacturing processes, power generating facilities, and may be sporadic. Radio Frequency interferences (RFI) may be caused by other VOR(s), harmonics of other frequencies, commercial FM broadcast stations, etc., which are usually continuous. If interference is suspected, evaluate the electromagnetic spectrum using a spectrum analyzer. Record the measured frequency and detailed information on observed interference.

NOTE: When interference is observed, it is not necessary to restrict the facility, unless flight inspection tolerances are exceeded. Interference must be reported to Facilities Maintenance.

b. **Identification.** The purpose of this check is to assure that the correct tone and identification are transmitted. Two means of identification are used with these facilities, either a continuous series of dots, or a series of dots that cannot be interpreted as Morse code. Facilities Maintenance personnel should be consulted for the proper identification. Record the commissioned identification on the AVNIS data sheet.

Analysis. For both standard and area VOT(s), check the identification for correctness, clarity, and possible effects on the course indications throughout the areas of intended use (both in the air and on the ground).

c. **Sensing.** This check determines and/or establishes the correct ambiguity of the transmitted signal.

Analysis. While on the ground or in the air, check that the ambiguity indicates TO with 180° set in the OBS and FROM with 360° (000° for the NXT AFIS system) set in the OBS, throughout the areas of intended use.

d. **Modulation Levels.** Since minor variations of the 30 Hz AM, 30 Hz FM (9960 Hz subcarrier FM deviation), and 9960 Hz AM of RF carrier will affect flight data, modulation levels must meet operational tolerances throughout all areas of intended use.

(1) **Maneuvering:**

(a) **Ground.** Establish nominal values at the VOT reference point. Ensure that modulations remain within tolerance throughout all use areas.

(b) **Airborne.** Ensure that modulations remain in tolerance throughout all areas while conducting coverage maneuvers.

(2) **Adjustments** of modulation levels may be made any where within the area of intended use. Determine the average modulation levels or the graphical average of the recorded modulation levels (when available) when fluctuations are encountered.

e. VOT Reference Point. This check provides a designated area to begin an inspection or verify facility performance. The reference point must be documented on the Facility Data Sheet.

(1) Maneuvering:

(a) Standard VOT. This check should be performed on the ground. Position the aircraft in an area of normal use for the VOT. It is recommended that the area chosen be the furthest distance from the facility, maintaining line of site. When ground measurements are not practical, use the procedures outlined in Paragraph (c) below to establish the reference point.

(b) Area VOT. This check may be performed on the ground or in the air. Position the aircraft over a known geographical point at the furthest point of intended use from the facility, while maintaining line of site.

(c) For ground-use standard VOT(s) at airports not accessible to flight inspection aircraft, the reference point may be evaluated using a Portable ILS/ VOR Receiver (PIR). The Aviation System Standards Flight Inspection Policy, Practices, and Training Team must approve the use of these procedures on a case-by-case basis**.** This alternative is subject to the following conditions:

1 Wilcox Model 7010 PIR or equivalent, capable of displaying VOR bearing and modulations, must be used.

2 Calibration of the PIR must be current.

3 A mission specialist must accompany the maintenance technician to the VOT location. That person must record the detected course deviation, modulation levels, and signal strength from the PIR display.

4 A certified VOT maintenance technician must operate the PIR and verify the detected PIR information from Step (c) above.

NOTE: The "30 Hz" PIR readout is a measurement of 30 Hz AM modulation. Apply the 25 – 35% VOT modulation tolerance to the 30 Hz and 9960 PIR readouts. The PIR's "FM" output is an FM deviation ratio subject to a 14.8 – 17.2 modulation tolerance.

5 NOTAM procedures IAW Chapter 5, Section 1 of Order 8200.1 apply. The Pilot In Command (PIC) must initiate the NOTAM process, if required, and sign the flight inspection report. In the event a Mission Specialist is deployed without a PIC, the Flight Inspection Office Manager, or a designated PIC, must initiate any NOTAM process and sign the report.

(2) **Analysis**. Ensure signal quality and alignment are satisfactory IAW tolerances in this handbook.

f. Alignment. This check is performed to establish and/or verify the accuracy of the transmitted VOT courses throughout the coverage areas.

(1) **Maneuvering:**

(a) **Commissioning.** Establish the VOT course alignment at its optimum value (zero degree course error) at the VOT reference point.

(b) **Periodic.** Inspect the alignment of the VOT anywhere within the approved use areas. If the station alignment exceeds tolerances, recheck and reestablish the alignment (and monitors if necessary).

(2) **Analysis:**

(a) **Commissioning.** Ensure signal quality and alignment are satisfactory.

(b) **Periodic.** If the station alignment exceeds the tolerances, recheck and reestablish the alignment (and monitors if necessary).

g. Coverage. The purpose of this check is to ensure that adequate signal is received in all areas of intended use.

(1) **Maneuvering:**

(a) **Standard VOT.** Coverage is evaluated during a commissioning inspection, concurrent with establishing the standard VOT Reference Point. For periodic inspections, evaluate coverage anywhere within the approved area of use.

(b) **Area VOT.** Identify all the airports that the area VOT is to serve. Evaluate VOT performance at these airports in the air and/or ground, depending on intent of use.

1 **Ground coverage** is evaluated during a commissioning inspection, concurrent with establishing the area VOT Reference Point. For periodic inspections, evaluate coverage anywhere within the approved area at each airport served.

2 **Airborne Coverage.** Airborne coverage is evaluated during the commissioning inspection, concurrent with establishing the approved use area. Since there is no standard service volume, the area is predicated on the need for VOT service, facility performance, and frequency protection. Establishing an approved use area, which is a fixed radius around the VOT site, normally 10 to 15 miles, can provide the most beneficial service. An alternative to this method would be to fly a separate 3-mile orbit around each airport where VOT service will be provided.

During the commissioning type inspections, fly the orbits at the minimum and maximum altitudes at which VOT use will be authorized, normally between 1,000 and 5,000 ft. On periodic inspections, evaluate facility performance anywhere within the approved area of use.

NOTE 1: Maximum suggested coverage orbit speed is 250 KIAS.

NOTE 2: Restrictions to Coverage--Notify appropriate airport personnel of any areas within line-of-sight of the VOT where sufficient signal is not available, and issue any and all applicable NOTAM(s) IAW FAA Order (NOTAM Section).

h. **Monitor:** This check assures that a valid course is transmitted within specified values. For flight inspection purposes, the remote alarm unit must be considered a part of the monitor.

(1) **Maneuvering.** Conduct this check at the VOT reference point or at any point on the airport where a valid signal is received.

(2) **Analysis:**

(a) **Establish** a normal reference. Record and measure the course.

(b) **Facilities** Maintenance personnel should shift the course to the alignment monitor reference. Record and measure the course.

(c) **Facilities** Maintenance personnel should shift the course in the opposite direction to the alignment monitor reference. Record and measure the course, and ensure tolerance is met.

(d) **Facilities** Maintenance personnel should return the course to normal. Record and measure the course.

i. Standby Power:

(1) Maneuvering. Inspections are to be performed at the VOT reference point.

(2) Analysis. Check alignment, modulations, ID, sensing, and signal strength.

(3) Other considerations. Standby power checks are not required for facilities powered by floating batteries (Uninterruptible power supplies (UPS), etc.) that are constantly charged by another power source. The Facility Data Sheet should indicate the source of standby power.

SECTION 6

FLIGHT INSPECTION TOLERANCES

11.60 TOLERANCES. Facilities that meet tolerances throughout the flight inspection SSV are classified as UNRESTRICTED. Facilities that do not meet tolerances in the flight inspection SSV are classified as RESTRICTED. Appropriate NOTAM action must be taken to notify the user of the unusable areas (see Paragraph 5.12). Do not restrict a facility when it fails to meet tolerances outside the flight inspection SSV.

a. VOR Tolerances

Parameter	Reference Paragraph	Inspection C	Inspection P	Tolerance/Limit
Identification	11.21a	X	X	Morse code and voice identification must be correct, clear and identifiable. The audio levels of code and voice must sound similar. The course structure must not be affected by the identification.
Voice	11.21b	X	X	Voice transmissions must be clear and understandable. Simultaneous voice transmissions and code identification must sound similar. The voice identification must be suppressed during voice transmissions. Voice transmissions must not cause more than ± 0.5° of course deviations.
Sensing and Rotation	11.21c	X	X	The "To/From" sensing must be "From" when positioned on a selected radial, and the bearings must decrease in a counterclockwise direction around the station.
Modulation	11.21d	X	X	
30 Hz AM				25 – 35% (optimum 30%)
30 Hz FM				Deviation Ratio 14.8 – 17.2 (optimum 16.0)
9960 Hz				20 to 35% on transmitters with voice modulation 20 to 55% on transmitters without voice modulation **NOTE:** Modulation exceeding these limits is acceptable, using the following criteria: **.05 nm in any 1.0 nm segment from FAF to the MAP.** 0.25 nm in any 5 nm segment from sea level up to 10,000 ft MSL. 0.5 nm in any 10 nm segment from 10,001 to 20,000 ft MSL. 1.0 nm in any 20 nm segment above 20,000 ft MSL.

Parameter	Reference Paragraph	Inspection C	Inspection P	Tolerance/Limit
Polarization	11.21e	X	X	Less than or equal to 2.0°
Radials	11.20a	X	X	
Alignment				Alignment of all electronic radials must not exceed ± 2.5° of correct magnetic azimuth except: Deviations of the course due to bends must not exceed 3.5° from the correct magnetic azimuth and must not exceed 3.5° from the average electronic radial alignment.
Structure	11.21g			Roughness/ Scalloping/ Course Abberations: Deviations from the course, greater than 3.0° are acceptable, provided the aggregate does not exceed the following: **.05 nm in any 1.0 nm segment from FAF to the MAP.** 0.25 nm in any 5 nm segment from sea level up to 10,000 ft MSL. 0.5 nm in any 10 nm segment from 10,001 to 20,000 ft MSL. 1.0 nm in any 20 nm segment above 20,000 ft MSL. Flyability: The effects of any one, or combination of any alignment and/or structure criteria, even though individually in tolerance, must not render the radial unusable or unsafe.
Signal Strength	11.21h	X	X	Received RF signal strength must equal or exceed 5 µv or –93 dbm.
Receiver Checkpoints	11.20h	X	X	Airborne Receiver Checkpoints. All parameters must meet tolerances, and the alignment must be within ± 1.5° of the published azimuth. Ground receiver checkpoints must equal or exceed 15 µv or –83 dbm. Ground Receiver Checkpoints. All parameters must meet tolerances, and the alignment must be within ± 2.0° of the published azimuth. Inability of the facility to provide a ground or airborne receiver checkpoint according to the tolerances specified above must not cause a restriction to be placed on the facility.

Parameter	Reference Paragraph	Inspection C	Inspection P	Tolerance/Limit
Monitor	11.20b			The transmitter azimuth monitor reference must not exceed ± 1.0°.
Standby Equipment	11.20i 4.33	X	X	The standby transmitter must meet all tolerances and the difference in azimuth alignment between transmitters must not exceed 2.0°.
Standby Power	11.20j 4.33	X		Operation on standby power must not cause any parameters to exceed tolerances.
Orbital Alignment	11.20g		X	Notify maintenance if found to exceed ± 1° from the reference.

b. TACAN Tolerances

Parameter	Reference Paragraph	Inspection C	Inspection P	Tolerance/Limit
Identification	11.21a	X	X	Code identification must be correct, clear, distinct, without background noise, and not affect course characteristics throughout the coverage limits of the facility. TACAN/ DME identification must be correctly sequenced with the VOR identification when collocated.
Sensing and Rotation	11.21c	X	X	Sensing and rotation must be correct.
Distance Accuracy	11.30	X	X	0.20 nm.
Polarization	11.21e	X	X	Maximum ± 2.0° course deviation caused by horizontal polarization

Parameter	Reference Paragraph	Inspection C	Inspection P	Tolerance/Limit
Radials	11.20a	X	X	
Alignment				Alignment of all approach radials must not exceed ± 2.0° of the correct magnetic azimuth. Alignment of all electronic radials must not exceed ± 2.5° of correct magnetic azimuth except: Deviations of the course due to bends must not exceed 3.5° from the correct magnetic azimuth and must not exceed 3.5° from the average electronic radial alignment.
Structure	11.21g			Roughness/ Scalloping/ Course Abberations: Deviations from the course, greater than 3.0° are acceptable, provided the aggregate area does not exceed the following: 0.05 nm in any 1.0 nm segment from the FAF to the MAP. 0.25 nm in any 5 nm segment from sea level up to 10,000 ft MSL. 0.5 nm in any 10 nm segment from 10,001 to 20,000 ft MSL. 1.0 nm in any 20 nm segment above 20,000 ft MSL. Flyability: The effects of any one, or combination of any alignment and/or structure criteria, even though individually in tolerance, must not render the radial unusable or unsafe. Unlocks: Approach Radials: No condition of azimuth or distance unlock is permitted within the final segment. The only exception would be normal passage through the station cone. En route criteria should be applied to all other segments.

Parameter	Reference Paragraph	Inspection C	Inspection P	Tolerance/ Limit
				En route Radials: No more than one condition of azimuth unlock not to exceed 1 nm in a 5 nm segment and/or condition of distance unlock not to exceed 0.5 nm in a 5 nm segment.
				Note: Where airspace procedures depict a 10 DME or greater arc from the station to a final approach radial, en route tolerances must be applied to both azimuth and range functions, except that no conditions of unlock are permitted 5.0° either side of any radial depicted or proposed for procedural use (i.e., initial approach fix, intermediate approach fix, final approach radial, lead radial, crossing radial, reference, point, etc.)
Signal Strength	11.21h	X	X	The expected minimum signal strength is –80 dbm. However, a lesser signal must not be the sole determination for restricting or removing a facility from service if a solid stable DME or azimuth lock-on is present.
Receiver Checkpoints	11.20h	X	X	Receiver Checkpoint alignment must not exceed ± 1.5° of the published azimuth. Distance must be within 0.2 nm of the measured distance.
Monitor	11.20b			The transmitter azimuth monitor reference must not exceed ± 1.0°.
Standby Equipment	11.20i 4.33	X	X	Operative standby and primary equipment will meet the same tolerances. The difference in the alignment of the course formed by each transmitter must not exceed ± 1.5°. Distance differential between transmitters must not exceed 0.2 nm.
Standby Power	11.20j 4.33	X		Tolerances for a facility on standby power must be the same as those on primary power.
Orbital Alignment	11.20g		X	Notify maintenance if found to exceed ± 1° from the reference.
Coverage	11.31c	X	X	Solid stable DME lock-on is present throughout all areas of intended use.

c. **DME Tolerances**

Parameter	Reference Paragraph	Inspection C	Inspection P	Tolerance/Limit
Identification	11.31b	X	X	Morse code and voice identification must be correct, clear, and identifiable. The audio levels of code and voice must sound similar. The course structure must not be affected by the identification.
Signal Strength	11.21h	X	X	The expected minimum signal strength is –80 dbm. However, a lesser signal must not be the sole determination for restricting or removing a facility from service if a solid stable DME lock-on is present.
Distance Accuracy	11.31a	X	X	0.20 nm.
Receiver Checkpoints	11.20h	X	X	Distance must be within 0.2 nm of the measured distance.
Coverage	11.21i 11.31c	X	X	Solid stable DME lock-on is present throughout all areas of intended use. Unlocks: **Approach Radials:** No condition of distance unlock is permitted within the final segment if required procedurally. The only exception would be normal passage through the station cone. En route criteria should be applied to all other segments. **En route Radials:** No more than one condition of distance unlock not to exceed 0.5 nm in a 5 nm segment.

d. VOT Tolerances

VOT Ground Use and Area Service

Parameter	Reference Paragraph	Inspection C	Inspection P	Tolerance/ Limit
Frequency Interference	11.55a	X	X	Interference must not cause any out-of-tolerance condition.
Identification	11.55b	X	X	Correct, clear, without background noise. Readable throughout area of coverage. Identification must not affect course characteristics.
Sensing	11.55c	X	X	TO with OBS set at 180° FROM with OBS set at 360°
Modulation Level 30 Hz AM, 30 Hz FM (3) and 9960	11.55d	X	X	25 – 35% (optimum 30%)
Alignment	11.55f	X 	 X	0.0° 1.0° or less
Coverage (1) Ground (Normal use areas)	11.55g	 X	 X	 15 μV minimum
VOT Reference Point Ground Air	11.55e	 X X		 15 μV minimum 15 μV minimum throughout those areas/ altitudes approved for use
Monitor	11.55h	X	(2)	The course alignment monitor must alarm when the course shifts exceed 1.0°
Standby Power	11.55i 4.33	X		Tolerances for a facility on standby power should be the same as those on primary power.

(1) If the aircraft receiver is capable of measuring exact flag alarm current, apply a tolerance of 240 μA flag to all "coverage" checks.

(2) Maintenance request

(3) When the 30 Hz signal is reported as a deviation ratio, the tolerance is 14.8 – 17.

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11.70 TABLES. (Reserved)

CHAPTER 12

RADIO BEACONS

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RADIO BEACONS

SECTION 1

GENERAL

12.10 INTRODUCTION

a. **General.** An NDB is a low or medium frequency radio beacon that transmits non-directional signals in a frequency band of 190 to 535 kHz and 1,600 to 1,750 kHz, using a continuous carrier keyed with either 400 or 1,020 Hz modulation. In some installations, NDB(s) are collocated with DME or ILS marker beacons. The airborne receiver installation is usually called an Automatic Direction Finder (ADF).

b. **Characteristics.** Radio beacons are subject to disturbances that may result in erroneous bearing information. Disturbances include lightning and precipitation static, and nighttime interference from distant stations. Nearly all disturbances that affect the direction finding bearing also affect the facility identification being transmitted.

(1) **Antenna Current.** The signal strength obtained at any point throughout the rated coverage area is directly proportional to the current in the vertical radiator of the antenna. Doubling the antenna current will double the strength at a fixed point or double the range for a fixed value of signal strength.

(2) **Ground Conductivity.** The transmitter power necessary to drive a given current through the antenna and ground system varies with the soil conductivity at the antenna site. The signal strength of the ground wave also depends on the conductivity of the soil between the transmitter and receiver. The conductivity of seawater is higher than soil, hence the range over seawater is usually greater than over land.

(3) **Altitude.** An increase in signal strength can be expected as the aircraft height is increased, the effect being most marked over soil of poor conductivity, and almost negligible over seawater.

(4) **Noise.** The effective coverage is limited by the ratio of the strength of the steady (non-fading) signal received from the NDB to the total noise intercepted by the ADF receiver. If the signal-to-noise ratio is less than the limiting value, useful bearings cannot be obtained.

(5) **Night Effect.** The effective coverage of an NDB is also limited at night when a skywave, reflected from the ionosphere is present at the receiver in addition to the vertically polarized ground wave on which the system depends. The interaction of these two signals from the NDB results in bearing errors in the ADF. The effect is independent of transmitter power.

(6) **Terrain Effects.** Errors in ADF bearings are often produced over rugged terrain or where abrupt discontinuities occur in the ground surface conductivity. The effect results in an oscillating bearing and usually diminishes with increasing aircraft altitude.

c. **Classification.** NDB(s) are classified according to their intended use. When an NDB is used in conjunction with an ILS, it is called a Compass Locator. Compass Locators are often paired with marker beacons. For U.S. facilities, voice transmissions are made on radio beacons unless the letter “W” (without voice) is included in the class designator (e.g., HW). NDB classifications are:

(1) Compass Locators, including LOM and LMM, standard service volume of 15 nm. These facilities are installed at the marker sites associated with ILS facilities. The compass locator at the outer maker is designated as a LOM, (locator outer marker), and the one at the middle marker as a LMM, (locator middle marker). Output power is 25 watts or less.

NOTE: M and H class beacons can also be used as compass locators, in which case the standard service volume would increase to that class level, i.e., MLOM standard service volume is 25 nm, and a HLOM standard service volume is 50 nm.

(2) MH Facility, standard service volume of 25 nm. These facilities are used for short-range navigational purposes. The facility provides navigation information and, in some cases, communication service. Authorized output power is 50 watts or less.

(3) H Facility, standard service volume of 50 nm. These facilities are used for medium- to long-range navigation and are located along the airways where needed to provide suitable coverage. The facility provides navigation information and, in some cases, communication and weather broadcast service. Authorized output power is from 50 to 2,000 watts.

(4) HH Facility, standard service volume of 75 nm. These facilities are used for long-range and over-water navigation. The facility usually provides weather broadcasts, communication and navigation information. Authorized output power is 2,000 watts or more.

d. Identifier. Radio beacons transmit a continuous Morse code identifier. Some facilities have a voice feature. A voice feature may be live from a remote location, transcribed weather, or AWOS/ ASOS. A live voice feature may interrupt the facility identification.

(1) The Morse code identification of all classes of NDB facilities, except compass locators, is repeated 5 to 15 times per minute depending on equipment type. Compass locators are identified in the same manner, except the repetition rate is 7 to 20 times per minute.

(2) A three-letter code is used to identify all classes of NDB facilities except compass locators. All radio beacons except the compass locators transmit a continuous three-letter identification code except during voice transmissions.

A two-letter code is used to identify compass locator facilities. The code letters are obtained from the code of the associated ILS. The first two letters of the ILS identification are used to identify the outer compass locator (LOM), and the last two letters of the ILS identification are used to identify the middle compass locator (LMM).

e. Monitoring. All federal NDB facilities must have local monitor and shutdown capabilities. The remote monitor receiver will serve only as a remote status indicator.

12.11 MAINTENANCE ACTIONS REQUIRING FLIGHT INSPECTION AND SPECIFIC PREFLIGHT REQUIREMENTS

a. Activities Requiring a Confirming Flight Inspection:

(1) Major changes in local obstructions, buildings, etc., which may affect the signal strength and coverage.

(2) Replacing the antenna with a **different type** antenna. Modifications of the antenna or to the ground plane.

(3) Change in the antenna current to increase or decrease the service area.

(4) Frequency change.

b. Coordinate with facility maintenance to be on site for commissioning type inspections in order to adjust power during the coverage orbit, and change transmitters if dual transmitters are installed. For periodic inspections of dual transmitter facilities, coordinate to have the NDB operating on the transmitter not checked during the last periodic inspection. If a live voice feature is available, determine the necessary contact procedures to arrange a transmission during the inspection. If the inspection requires a coverage orbit, prepare a chart with coverage altitudes calculated for each segment of the orbit.

c. NDB(s) Without a SIAP. An NDB without any NDB SIAP(s) may still be used for IFR purposes (e.g., compass locator, feeder route to a localizer, or crossing bearing at a fix supporting another kind of SIAP). Only NDB(s) with NDB SIAP(s) or ones supporting an NDB airway are scheduled for periodic inspections by the FICO. There is no practical way to track which of the remaining NDB(s) might support other kinds of SIAP(s). Hence, it is the flight inspector's responsibility to examine every SIAP they inspect to determine: (1) If an NDB supports the procedure (not limiting the review to the final segment), and (2) if so, determine if that NDB is scheduled by the FICO for periodic inspections.

12.12 FACILITY CHECKLIST

Type Check	Reference Paragraph	C	P (5)	Antenna Change (3)	Frequency Change
Identification	12.20a	X	X	X	X
Voice	12. 20b	X	X	X	X
Coverage Orbit	12. 20c	X		X	X
Routes and Transitions	12. 20d	X	(1)	(4)	(1)
SIAP	12. 20e	X	(2)	(2)	(2)
Station Passage	12. 20f	X	X	X	X
Standby Transmitter	12. 20g	X			
Standby Power	12. 20h	X			

FOOTNOTES:

(1) Surveillance only incidental to other required checks.

(2) Final approach segment only.

(3) Required for change in antenna type, or when modifications are made to the antenna or to the ground plane, or a change in antenna current designed to change coverage area.

(4) Fly airways, routes, and transitions and reevaluate associated ESV(s).

(5) During periodic inspections, evaluate coverage on a surveillance basis, including verification of the minimum usable distance listed in Paragraph 12.30c.

SECTION 2

LOW AND MEDIUM FREQUENCY NONDIRECTIONAL BEACONS (NDB) FLIGHT INSPECTION PROCEDURES

12.20 FLIGHT INSPECTION PROCEDURES. The primary objectives of flight inspection are to determine the coverage and quality of the guidance provided by the NDB system and to check for interference from other stations. These assessments are to be made in all areas where coverage is required and with all operational procedures designed for the NDB, in order to determine the usability of the facility and to ensure that it meets the operational requirements for which it was installed. Note that tolerances are based on average atmospheric conditions. The flight inspector is expected to use good judgment in differentiating between facility performance and unusual atmospheric phenomena. Radio beacons are subject to disturbances from lightning, precipitation, static, etc. To establish good facility performance baselines, commissioning flight inspections should be conducted in weather conditions that will not derogate or enhance facility performance. For any inspection requiring a coverage orbit, the flight inspector must prepare a chart with the facility plotted and orbit depicted.

a. **Identification.** The facility identification is evaluated throughout the area of intended use, including any route, airway or transition that may extend beyond the normal service volume. The evaluation should be accomplished during all required checks.

(1) **Maneuvering.** No specific maneuver instructions.

(2) **AFIS/ Equipment Setup.** See Paragraph 12.20c(2).

(3) **Analysis.** The facility identification is out of tolerance when it is incorrect or not identifiable. The coded characters should be correct, clear, and properly spaced.

(4) **Other Considerations.** On aircraft so equipped, utilize the “Ident” feature on the ADF audio panel.

b. **Voice.** The voice feature (if installed) is evaluated within the standard service volume. The evaluation may be accomplished while other required checks are being performed.

(1) **Maneuvering.** No specific maneuver instructions.

(2) **AFIS/ Equipment Setup.** See Paragraph 12.20c(2).

(3) Analysis. The voice feature is out of tolerance if it renders the facility identification not decipherable (except live voice). The voice transmission should be evaluated for quality, modulation and freedom from interference. Record the maximum usable voice range on commissioning for future reference. The voice feature should be clear and recognizable for a minimum of two-thirds the standard service volume range. Notify maintenance anytime the voice reception distance is less than the required range. Facility restrictions are not determined by the voice feature. The voice feature should be removed from service if it adversely affects the facility identification.

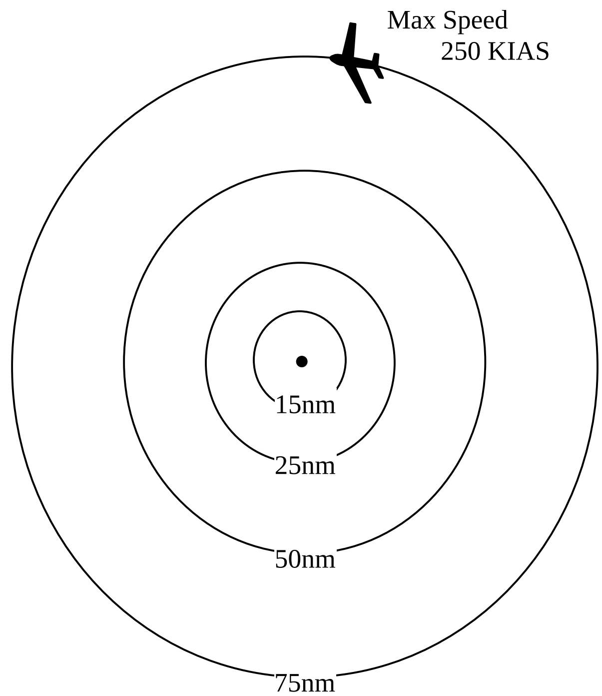
(4) Other Considerations. On aircraft so equipped, utilize the "Voice" function on the ADF audio panel.

c. Coverage Orbit. Standard service volume coverage is evaluated by flying orbits at the lowest coverage altitude. Facility Maintenance determines the reduced power output of the facility during coverage checks. At facilities where dual transmitters are installed, facility coverage for maximum useable distance may be evaluated by alternating transmitters. Switch transmitters at least every 30 degrees.

(1) Maneuvering. Fly an orbit about the facility at the maximum distance specified by the facility classification. The orbit altitude must be 1,500 ft above facility site elevation, or the minimum altitude which will provide 1,000 **(2,000 ft in designated mountainous areas) above intervening terrain or obstacles, whichever is higher as determined by map study.** Coverage orbits are usually completed counterclockwise, as the ADF navigation needle parks to the right if the signal has an unlock (this is true for mechanical instruments; however, the needle may disappear on electronic displays). Sectors found out of tolerance must be evaluated using orbits at reduced distances or increased altitudes in an attempt to determine facility restrictions. Monitor the facility identification during coverage checks, as the loss of the identifier usually corresponds with the loss of the NDB signal.

Figure 12-1
Coverage Orbit

Class	Coverage	Voice
Compass Locator	15 nm	10 nm
MH Facility	25 nm	16.7 nm
H Facility	50 nm	33.3 nm
HH Facility	75 nm	50 nm



(2) **AFIS/ Equipment Setup.** AFIS is not approved for NDB signal analysis; however, if needed to monitor the distance and bearing from the facility, an NDB can be selected on the AFIS. On the FI FAC page, enter the three-letter IDENT, followed by the appropriate type identifier IAW TI 4040.55. For example, the CMH compass locator would be selected by entering CMHO. After the facility is selected, ensure accuracy of the retrieved data by comparing it to the data sheet, making changes, if necessary. In some aircraft, the pilot can display the AFIS distance and bearing information on the flight deck CDU (FI NAV page). Alternatively, range and bearing distance can be obtained by programming the FMS or GPS by entering the facility coordinates from the Facility Data Sheet.

(3) **Analysis.** Evaluate the signal for out of tolerance needle oscillations, weak or garbled identification, and interference throughout the coverage area. If the facility performance does not meet tolerances to the SSV, the facility will have the status of restricted or unusable, and NOTAM action is required. If there is a suspicion the beacon carrier frequency is out of tune (off frequency), have ground maintenance check the transmitted frequency, or evaluate with the onboard spectrum analyzer.

(4) Other Considerations. NDB restrictions must be sectored as bearings from the facility. See Chapter 5 for examples of NDB restrictions.

Recommendation: The number of sectors should be kept to a minimum, and preferably should not exceed two.

d. Routes and Transitions. Coverage at greater than the orbital distance for specific fixes, airways, routes or transitions, may be evaluated on one transmitter. Establish at normal power. For more information on ESV(s), refer to Chapter 22.

e. Instrument Flight Procedures:

(1) Maneuvering:

(a) Commissioning or Evaluating Amended Procedures. Fly each new procedural segment that uses a facility bearing at the minimum procedural altitude. Fly final approach segments in the direction of intended use. After the procedure turn or FAF, descend to 100 feet below the minimum descent altitude for the segment. In addition, descend to 100 feet below all step-down fix altitudes inside the FAF. Evaluate holding patterns, airways, routes and transitions along the entire procedure at the minimum procedural altitude(s).

(b) Periodic Inspections. Evaluate all SIAP final approach segments. Evaluate other procedure coverage on a surveillance basis. For SIAP(s) with a FAF, cross the FAF at the minimum published altitude and descend to at least 100 feet below the minimum descent altitude for that segment. For SIAP(s) without a FAF, fly the final segment from the procedure turn distance at the minimum published procedure turn completion altitude and descend to at least 100 feet below the minimum descent altitude for that segment. In addition, descend to 100 feet below all step-down fix altitudes inside the FAF.

(2) AFIS/ Equipment Setup. See Paragraph 12.20c(2).

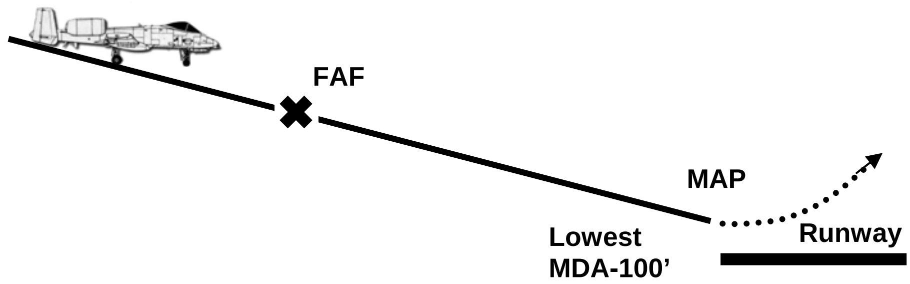
(3) Analysis. Evaluate the signal for out of tolerance needle oscillations, weak or garbled identification, and interference.

(4) Other considerations.

- Verify procedural FDC and facility NOTAM(s) and published data for the facility. Verify that new procedural bearings are not in sectors where the facility is restricted.
- Verify facility is operating at normal power.

Recommendation: Where two locators are used as supplements to an ILS, the frequency separation between the carriers of the two should be not less than 15 kHz to ensure correct operation of the radio compass, and preferably not more than 25 kHz in order to permit a quick tuning shift in cases where an aircraft has only one radio compass.

Figure 12-2
Low Approach



f. **Station Passage.** Needle reversal should occur when the aircraft passes directly over, or in very close proximity to the facility.

(1) **Maneuvering.** Overfly the antenna at the minimum procedural altitude.

(2) **AFIS/ Equipment Setup.** See Paragraph 12.20c(2).

(3) **Analysis.** Station passage is out of tolerance if any indication of false station passage occurs, or if station passage does not occur over the station. Momentary needle hunting while near or over the station does not in itself constitute false station passage.

g. **Standby Equipment.** If dual transmitters are installed, evaluate all required parameters for each transmitter during a commissioning inspection. When practical, for periodic inspections of dual transmitter facilities, conduct the inspection using the transmitter not checked during the pervious periodic inspection.

(1) **Maneuvering.** No specific maneuver instructions.

(2) **AFIS/ Equipment Setup.** See Paragraph 12.20c(2).

(3) **Analysis.** Evaluate the same as primary equipment.

(4) **Other Considerations**. See Chapter 5 for standby equipment NOTAM.

h. Standby Power. Standby power checks are not required for facilities powered by batteries that are constantly charged by another power source. If standby power is checked, have the facility power source switched to the standby source and repeat all the flight inspection checks (one transmitter only).

(1) Maneuvering. No specific maneuver instructions.

(2) AFIS/ Equipment Setup. See Paragraph 12.20c(2).

(3) Analysis. Evaluate the signal for out of tolerance needle oscillations, weak or garbled identification, and interference within the coverage area.

(4) Other considerations. The Facility Data Sheet should indicate the source of standby power.

i. Special Inspections:

(1) Antenna Change. A special inspection must be conducted when an antenna is replaced with a new type, or modifications are made to the antenna or to the ground plane, or there is a change in antenna current designed to change the coverage area. Evaluate coverage by flying a coverage orbit and the final segments of any SIAP(s). Fly any airways, routes, or transitions and re-evaluate any associated ESV(s). There is no requirement to conduct any checks on standby power or to check the standby transmitter if it is a dual transmitter facility.

(2) Transmitter Change. A flight inspection is not required if the transmitter equipment is replaced, provided ground maintenance can match the established antenna current reference. If ground maintenance does request flight inspection, follow the antenna change checklist requirements outlined in paragraph 12.12.

(3) Frequency Change. A special inspection must be conducted when a frequency change is made to the facility. Evaluate coverage by flying a coverage orbit and the final segments of any SIAP(s). A surveillance check of any airways, routes, or transitions should be made incidental to aircraft maneuvering to position for other required checks. There is no requirement to reevaluate ESV(s), or conduct any checks on standby power or to check the standby transmitter if it is a dual transmitter facility.

12.21 REPORTING. Refer to Appendix 12, FAA Form 4040-5, and FAA Order 8240.36, Flight Inspection Report Processing System (FIRPS).

12.22 SUPPLEMENTAL INFORMATION. See NDB Flight Inspection Worksheet, Appendix 11.

SECTION 3

FLIGHT INSPECTION TOLERANCES

12.30 TOLERANCES

a. **Morse Code Identification.** All facilities must have a Morse code identifier that is correct, clear, and identifiable throughout the area of intended use, including any route, airway, or transition that may extend beyond the normal service volume. If the Morse identifier is augmented with voice identification, the voice identification must adhere to the same tolerance as the associated Morse identifier.

b. **Voice Transmission.** Broadcast information should be clear and recognizable for a minimum of two-thirds of the NDB's usable distance.

c. **Usable Distance:**

(1) **The minimum usable distance must be:**

CLASS	COVERAGE
Compass Locator	15 nm
MH Facility	25 nm
H Facility	50 nm
HH Facility	75 nm

(2) **Maximum bearing deviation:** 20° (± 10°).

d. **NDB Approach.** Bearing indicator deviation in the final approach segment and holding pattern must not exceed: 10° (± 5°)

e. **Bearing Tolerance Deviation.** Short duration out-of-tolerance needle activity (including repetitive events) will be allowed when either:

(1) The duration does not exceed four seconds on an approach (flown at a nominal 130 knot ground speed), or

(2) The duration does not exceed eight seconds for en route and holding pattern use; but only if the out-of-tolerance activity cannot be construed as a station passage, and the activity is not generally one-sided when repetitive.

f. **Station Passage.** Station passage indications must be unambiguous. Momentary needle hunting while over the station will not be construed as false passage.

g. **Standby Equipment.** If installed, standby equipment must perform to all tolerances in this chapter.

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CHAPTER 13

AREA NAVIGATION (RNAV)

SECTION 1

AREA NAVIGATION (RNAV)

13.10 INTRODUCTION. Area Navigation (RNAV) is a method of navigation that permits aircraft operation on any desired course within the limits of a self-contained system capability. Many of these systems are capable of providing vertical guidance. Flight Management Systems (FMS) with multiple sensors and Global Positioning System (GPS) navigators are most common. These systems navigate with reference to geographic positions called waypoints.

Multi-sensor RNAV equipment determines aircraft position by processing data from various input sensors. Unlike early RNAV systems which used only VOR/ DME rho-theta for position fixing, multi-sensor navigation systems employ a variety of sensors, such as: distance measurements from two or more DME ground stations (DME/ DME), VOR/ DME, inertial reference unit (IRU), Loran-C, Space-Based Augmentation System (SBAS) (e.g., Wide Area Augmentation System (WAAS)), Ground-Based Augmentation Systems (GBAS) (e.g., Local Area Augmentation System (LAAS)), and GPS. These various sensors may be used by the navigation computer individually, or combined in various ways (based on internal software programming) to derive aircraft position. Navigation values, such as distance and bearing to a waypoint (WP), are computed from the derived latitude/ longitude and the coordinates of the waypoint. Course guidance is generally provided as a linear deviation from the desired track of a great circle route. RNAV procedures consist of sequenced ARINC 424 coded path and terminators and waypoints. The desired course may be pilot selectable (e.g., pseudo course or go direct) or may be determined by the navigation database, based on the ground track coded between successive waypoints. Use of a combination of different ARINC 424 leg path and terminators provides the desired ground track and vertical path of a procedure.
The FAA has developed a charting format for RNAV Procedures. This format maximizes the information available to the pilot for the safe and efficient conduct of the instrument procedure. Stand-alone FMS and GPS approach charts will be replaced with the RNAV charting format.

Many RNAV procedures now include vertical guidance (VNAV). Vertical guidance is provided as a linear deviation from the desired vertical path, defined by a line joining two waypoints with specified altitudes, or as a vertical angle from a specified waypoint. Computed positive vertical guidance is based on barometric, satellite elevation, or other approved systems determined by phase of flight. The desired vertical path may be pilot selectable, or may be determined by the VNAV computer, with computations based on the ARINC 424 coding in the navigation base. RNAV approaches with vertical guidance are classified as Approach with vertical guidance (APV).

a. **Flight Management System (FMS).** The FMS is a computer system that uses a navigation database to allow routes to be pre-programmed and fed into the system by means of a data loader. The FMS is constantly updated, with respect to position accuracy, by reference to ground and/ or space-based navigational sources. The FMS and its associated database ensure that the most appropriate navigation sensors are automatically selected during the information update cycle.

b. **Global Positioning System (GPS).** The Global Positioning System (GPS) is a Department of Defense (DoD) operated global coverage, satellite-based navigation system. It provides standard positioning service (SPS) to all equipped users, plus precision position service (PPS) to DoD and other specially equipped users. GPS is an Earth Referenced Navigation (ERN) system that consists of three distinct functional segments; the **space segment, control segment** and **user segment.**

(1) **The space segment** consists of a satellite constellation in six orbital planes at approximately 11,000 miles above the earth. This segment provides the signal structure necessary for user equipment to determine time, a position fix in terms of latitude and longitude, and altitude as required. The GPS constellation broadcasts a pseudo-random code-timing signal and data message that the airborne equipment processes to obtain satellite position and status data. By knowing the precise location of each satellite and precisely matching timing with the atomic clocks on the satellites, the airborne receiver can accurately measure the time each signal takes to arrive at the receiver and determine aircraft position.

The satellites radiate on two frequencies; L1 at 1575.42 MHz and L2 at 1227.6 MHz. The satellites transmit their signals using spread spectrum techniques, employing two different spreading functions: a 1.023 mbs coarse/ acquisition (C/A) code on L1 and a 10.23 Mbs precision (P) code on both L1 and L2 transmitted in phase quadrature. Total bandwidth around each carrier is 20.46 MHz. Superimposed on both the C/ A and P-code is the navigation message containing satellite ephemeral data, C/ A to P-code hand-off, atmospheric propagation correction data, and satellite clock-bias information. This data is transmitted at 50 bps. The minimum power level (signal strength) available at the output of the user antenna is -160 dbw.

(2) **The GPS control segment** is responsible for monitoring the status of each satellite and updating the navigation data transmitted by each satellite. This segment consists of the master control station, five monitoring stations, and three up-link antenna facilities. Satellite information is transmitted from the monitor stations to the master control station. The master control station uses this information to update the contents of the navigation data via the ground up-link antennas.

(3) **The user segment** consists of antennas and receiver-processors onboard the aircraft that provide position, velocity, and precise timing to the user. The GPS receiver calculates a position fix using a ranging technique. The user equipment determines the pseudo-ranges from at least four satellites to calculate the receiver's internal clock offset and the three-dimensional position fix. The signal transmitted by each satellite is modulated with data that defines the satellite's position (ephemeral), the GPS system time, its clock error, and the health and accuracy of the transmitted data. The user equipment is able to decode this information and determine where the satellite is located at any given time (pseudo-range).

c. **ARINC 424 Specification.** ARINC Specification 424 is a standard by which a navigation database is created to interface with an airborne navigation computer (i.e., FMS, GPS receiver, etc.). The navigation database will provide paths and termination points for the navigation computer to follow. ARINC 424 defines leg path and terminators. A limited number of the leg types can be used to define RNAV procedures. The leg types used to define RNP RNAV procedures are further limited.

13.11 PREFLIGHT REQUIREMENTS

a. **Aircraft.** The aircraft avionics configuration must be appropriate to support the procedure to be flight inspected. Flight Inspection of RNAV Standard Instrument Departure (SID(s)), airways, and Standard Terminal Arrival Route (STAR(s)) may be accomplished with any flight inspection aircraft capable of the procedure's ARINC 424 path and terminators. RNAV approach charts provide separate minima for Lateral Navigation (LNAV), Lateral and Vertical Navigation (LNAV/ VNAV), LP, LPV, and RNP. Inspection of an RNAV procedure with vertical guidance requires an appropriately equipped flight inspection aircraft. Flight inspection of a LNAV approach procedure (without vertical navigation) may be accomplished with any flight inspection aircraft capable of the procedure's ARINC 424 path and terminators.

Within Aviation System Standard's fleet of flight inspection aircraft, the LR-60 and CL-601 types equipped with the UNS-1 FMS are capable and authorized to commission every type of RNAV procedure supported by the FAA. Aircraft equipped with Rockwell Collins FMS are capable and authorized to commission RNAV procedures contained in the FAA custom navigation database. Flight inspection aircraft equipped with only the Trimble GPS are not authorized to commission RNAV approach procedures.

When data base suppliers started to implement ARINC Spec 15, it required a CA leg (a so called "glue leg") as the first leg after the missed approach point. The concept was to provide guidance below the DA/ MDA altitude. Consequently, the National Flight Procedures Group inserted the coding data. However, it was found that flight management systems did not need the extra "glue leg" and could use a direct-to-fix leg from the MAP to the first missed approach waypoint. ARINC Spec 16 corrected this coding issue. The "glue leg" is in effect, transparent to the aircraft's flight management system.

b. **Navigation Database.** Aviation System Standards is implementing a procedure development process, flight inspection/ validation process, and navigation database development process termed the "Gold Standard." It is a process of developing flight procedure data, flight inspection/ validation of the procedure using the procedural data, and creating a navigation database product, all without corruption or manual manipulation of the data in the process. It is the task of the Flight Inspection Operations Group to conduct flight inspection/ validation adhering to the "Gold Standard" process. For various reasons, not all flight procedures may meet the "Gold Standard".

Flight procedures to be inspected must be entered into the FMS/ GPS navigation system. The procedure may be on a custom navigation database, downloaded from an electronic media, or entered manually (Pilot-Defined) from official source documentation.

(1) **FAA custom navigation database (Preferred Method)**. The FAA navigation database is customized by adding new procedures for flight inspection/ validation. The FAA customized navigation database is the most desired source because it will contain a normal operational navigation database and new official source coded flight procedures for inspection/ validation. The FAA custom navigation database will also contain "Special" procedures that are non-public. The custom navigation database will be updated on a periodic schedule. New flight procedures will be added, and completed procedures will be deleted on each periodic update. The FAA custom navigation database can be accessed for updating the FMS on the KSN website or the Rockwell Collins and Universal Avionics Systems Corporation websites. Provided no changes are required from the flight inspection/ validation of a procedure, use of the custom navigation database meets the "Gold Standard" process.

Newly designed flight procedures are added into the navigation database. To prevent data conflicts, naming rules are applied to the airport identifiers. Note the indicator code in Table 13-1. To access a new flight procedure for inspection/ validation, the destination airport in the FMS flight plan must be entered in this format.

Table 13-1
Flight Inspection Indicator Code

Approach Multiple Indicator Title	Flight Inspection Indicator Code
NONE	J
Z	9
Y	8
X	7

Table 13-2
Procedure Identification

Original ICAO Ident	Approach Title	Flight Inspection Indicator (See Note)	FAA Ident		
		New Amended Procedures			
KOKC	RNAV (GPS) RWY 17L	J	O	K	C
KBWI	RNAV (GPS) 15L	J	B	W	I
KBWI	RNAV (GPS) Z RWY 15R	9	B	W	I
KBWI	RNAV (GPS) Z RWY 28	9	B	W	I
KBWI	RNAV (GPS) Y RWY 15R	8	B	W	I
KBWI	RNAV (GPS) Y RWY 28	8	B	W	I
12ME	RNAV (GPS) RWY ##	J	2	M	E

Note: The character "J" will be used as the first character for airport identifiers, unless a runway has multiple procedures (i.e., X, Y, Z). Then, a numerical value will be substituted as the first character for the procedure.

(2) **FOMS Itinerary "Pack" Function (Alternate Method).** For RNAV flight inspection, electronically pack RNAV approach procedures using the FOMS itinerary "Pack" function. This "Pack" function is used only for the non-WAAS UNS-1F FMS. Using the FOMS Itinerary "Pack" Function does not meet the "Gold Standard" process.

NOTE: When new procedures are created using either the FMS or electronically uploaded from packing software, they can only be assured to work properly when the underlying navigation database is the same, i.e., the same cycle date and same source. Procedures built using the NFD database should only be loaded into an aircraft FMS using the same NFD database. There is the real possibility that waypoints, including runway threshold coordinates, may be slightly different between NFD and a commercial navigation database, i.e., Jeppesen.

(3) Entered Manually (Use only when electronic data is unavailable). For RNAV procedures that cannot be electronically packed, manually entering the ARINC 424 coding into the FMS (applicable to UNS-1 FMS only) or using the UFP Flight Planner is acceptable. RNAV SID(s), STAR(s), RNAV RNP, and procedures not in IFP will have to be manually entered. All RNAV approach procedure flight inspection will be assigned to UNS-1 FMS equipped aircraft only. Manually entering data does not meet the "Gold Standard" process.

c. Pilot-Defined Procedure. RNAV procedures are designed (coded) using ARINC-424 path and terminators. Path and terminator combinations can result in different ground tracks; hence, requiring utmost compliance with the "official government source documentation".

Entering the RNAV procedure as a route does not adequately represent the ARINC 424 leg types used to define the procedure or provide for the intended ground track on which obstacle clearance and environmental requirements are based. A difference in the ARINC 424 coded data from the source documentation can result in very different FMS/ GPS performance and aircraft ground and vertical track.

(1) Waypoint resolution is critical. For approach procedures with vertical guidance and minimums, enter latitude/ longitude to a minimum of thousandths (1/ 1,000) of a minute.

(2) For vertically guided approaches, enter waypoint altitudes as provided by the official source. The end-of-approach (EOA) waypoint altitude at the threshold should be the actual runway threshold MSL altitude, plus the proposed TCH. For offset approach procedures, the end-of-approach (EOA) altitude is found by calculating the altitude at which the glide path angle (GPA) passes through the EOA waypoint.

d. Evaluation of Procedure Data. Prior to the procedure being flown, leg segment data accuracy must be evaluated by comparison of the procedural waypoint data to the flight plan waypoint data.

Verify **true** course to next waypoint, distances, and that the FPA indicated on the FMS or GPS accurately reflects the procedure design.

Table 13-3
Procedural Attributes that can be Observed from the FMS or Desktop Evaluation

Airport	Runway
Waypoint Name	Waypoint latitude/longitude
Fly-Over/ Fly-By Waypoint	Approach Transition (IAF/ IF)
FAF	Leg Type
Distance Between Waypoints	Track Bearing (True)
Course Bearing (Magnetic)	Heading (Magnetic)
Arc Radius	Turn Direction
Procedure Turn	Holding Pattern
Glide Path Angle	Glide Path Threshold Crossing Altitude

The procedure course must be displayed on the EFIS during the inspection.
The procedure depicted on the EFIS must agree with the chart.

NOTE: Radius-to-Fix legs and holding patterns do not display on all EFIS avionics.

When evaluating RNAV CF legs, including holding legs (HM, HF, HA), compare aircraft navigation performance with the instrument procedure design. Do not apply any tolerance to course-to-fix values. Confirmation of proper ARINC coding will be accomplished with either an appropriately equipped aircraft, or by a desktop evaluation of the current navigation database.

Out of tolerance values on suspicious ARINC 424 coding must be resolved with the procedure designer.

e. **Navigation System Status.** Determine the status of the required navigation system(s) (e.g., DME, GPS, LAAS, and WAAS) before every flight inspection and after an inspection that detects anomalies. NOTAM(s) and GPS Service Interruptions (interference testing) location and schedule should be considered.

13.12 FLIGHT INSPECTION PROCEDURES

a. **General.** The flight inspection of RNAV procedures will evaluate safety, flyability, human factors, and workload. Use appropriate FAA Order(s) (i.e., 8260.3, 8260.38, 8260.42, 8260.44, 8260.54) for required obstruction clearance criteria. Any anomalies found during inspection must be resolved before the procedure is approved.

Ground track path error performance varies with mode of flight guidance system coupling. It is imperative to evaluate new procedures coupled to the flight director and autopilot (when not prohibited). Evaluate for lateral and vertical disconnects from the autopilot/ flight director. Lateral and vertical transitions from departure, en route, descent, and approach must produce a seamless path that ensures flyability in a **consistent, smooth, predictable, and repeatable manner.**

(1) Equipment Configuration. For RNAV procedures supported by GPS, do not deselect any navigational sensors. Align IRU(s) to GPS position.

(2) Commissioning. The RNAV procedure must be entered into the FMS/ GPS navigation system.

(3) Periodic. The procedure must be loaded from the navigation system database. When the procedure is not resident in the database (i.e., private approach, unpublished, etc.), use the Commissioning procedure in Paragraph (2) above.

b. Checklist

Type Check	**Reference Paragraph**	**C**	**P (3)**
DP/ SID	13.12	X	
Route	13.12	X	
STAR	13.12	X	
Transition/ Feeder Route Segment	13.12	X	
Initial Approach Segment	13.12	X	
Intermediate Approach Segment	13.12	X	X (2)
Final Approach Segment	13.12	X	X (2)
Missed Approach Segment	13.12	X	X (2)
SIAP	Chapter 6	X	X
RFI	Chapter 23	1	1

NOTE 1: When Navigation System (DME, GPS, WAAS) parameters indicate possible RFI.

NOTE 2: Documentation of procedure-specified DME facilities is not required on a periodic inspection.

NOTE 3. Except for an obstacle evaluation, GPS-based procedures have no periodic inspection requirement.

c. **Maneuvering**

(1) **RNAV DP/ SID**

(a) **RNAV Departures ARINC 424 Coded from the Runway.** Verify the CDI is in terminal scaling. An RNAV DP/ SID should be flown from an actual takeoff. When runway limitations preclude a takeoff, a low approach method may be used, crossing the Departure End of Runway (DER) at 35 ft or the altitude specified in the procedure. Position the aircraft on course centerline. Fly in the direction of intended use at minimum climb gradient and altitudes specified by the procedure. The departure procedure will be flown to the point or fix at which an existing en route phase begins

NOTE: DME coverage evaluation may require an actual takeoff. See Section 3, DME/ DME Supported RNAV.

(b) **RNAV Departures that use RADAR Vectors to Join RNAV Routes.** Position the aircraft on course centerline. Fly at minimum altitudes specified by the procedure.

(2) **Routes.** Fly routes at minimum procedure altitude. Program waypoints as “fly-by”, unless otherwise designated. Confirmation of communications and RADAR coverage on all segments is required, unless otherwise specified by the procedure.

(3) **Standard Terminal Arrival Route (STAR).** Vertical navigation/ descent gradients, leg combinations, leg lengths, and human factors involving use of FMS operations require evaluation. When altitude and/ or airspeed constraints are shown on the procedure, fly the procedure at the specified altitudes/ speeds. If an altitude window is specified, fly the procedure using altitudes within the constraints that provide the steepest descent path to evaluate for excessive descent gradient. Refer to Chapter 6, Calculating Deceleration Segment Length (Vertical Flyability). The arrival procedure must be flown through transition to an instrument approach procedure, if terminating at an IF/ IAF. Fly STARS in the direction of intended use where a vertical profile is specified.

(4) **Initial and Intermediate segment evaluatio**n may be performed when flying by the waypoint if depicted as such on the procedure. Initial and Intermediate segments must be flown at procedural altitudes.

(5) RNAV Approach Procedure. Document DME coverage at the procedural (true) altitude(s) for all segments up to the Final Approach Fix. Fly the Final Approach Segment (FAS), descending on path to 100 ft below the lowest minima. The vertically guided RNAV approach procedure and the LNAV-only procedure are designed with different obstruction criteria. The final segment of the approach (FAWP to MAWP) may have different obstructions controlling the vertically guided Decision Altitude (DA) and LNAV Minimum Descent Altitude (MDA). The final segment may require repeated flights for obstacle evaluation. The final approach segment for approaches without vertical guidance must be flown to an altitude 100 ft below all step-down fix altitudes inside the FAF and 100 ft below the proposed minimum descent altitude. Approaches with vertical guidance must be evaluated on-path to the proposed decision or missed approach altitude.

NOTE: Loss of DME facility coverage between the FAF and the MAP is expected. The aircraft's inertial will provide navigation guidance to the MAP and throughout the missed approach segment.

(6) Missed Approach

(a) For a commissioning inspection, fly the missed approach segment(s) as depicted in the procedure.

(b) For a periodic inspection, fly the missed approach procedure to a point where the flight inspector can identify any obstacles that could be a potential hazard.

(7) Single Waypoints. DME coverage and accuracy will be verified based on an orbit centered on the waypoint coordinates. The radius of the orbit must be calculated based on the DME station farthest from the waypoint, using the formula contained in Appendix 2, or 3.0 nm, whichever is larger. DME coverage must be documented to 100 ft below the procedural (true) altitude.

d. Analysis. Flight inspection of RNAV procedures determines if the procedure is flyable and safe. ARINC 424 coded data will be used to compare coded path versus actual path to verify all data prior to release to the public and other database suppliers.

e. Other Considerations. If a new procedure is unsatisfactory, the Flight Inspector must coordinate with the procedures designer, ATC, and/ or the proponent of the procedure, as applicable, to determine the necessary changes. When existing procedures are found unsatisfactory, notify the procedures designer immediately for Notice to Airman (NOTAM) action. As applicable, the inspector should evaluate the following items:

(1) The controlling obstacles are verified.

(2) The procedure is technically sound. Specified aircraft approach categories are appropriate. Human factors, including situational awareness, complexity, memory considerations, interpretability, cockpit workload, pilot error, and autopilot operations are considered.

(3) Waypoint spacing is sufficient to allow the aircraft to stabilize on each leg segment without jumping over waypoints/ legs. Leg length must be sufficient to allow for aircraft deceleration or altitude change, if required.

(4) The RNAV procedure will satisfactorily deliver the aircraft to an established point, which terminates the procedure (en route, fix, IAF, MAWP, decision altitude, etc.).

(5) Procedural Design. The procedure must be evaluated to verify the geodetic coordinates (waypoints) and vertical path angles meet tolerances.

(6) Communications, navigation system performance, and RADAR coverage (if required) are adequate for the entire procedure.

(7) Surveillance inspection of airport lighting, runway/ taxiway markings, etc., will be accomplished during the flight inspection of the procedure.

(8) GPS Parameters. The following parameters must be documented at the time anomalies are found during any phase of the flight inspection. Forward recorded data to Flight Inspection Policy for analysis.

Parameter	**Expected Value**
$HDOP_{GPS}$	1.0 – 4.0
$VDOP_{GPS}$	1.0 – 4.0
HIL_{GPS}	0.3 or less
HFOM	≤ 22 meters
Satellites Tracked	5 minimum
SNR	30 dB/ Hz minimum

There are no flight inspection tolerances applied to these parameters. However, the values listed above provide a baseline for analysis of system signal anomalies or interference encountered.

f. **Interference.** The RF spectrum from 1,155 to 1,250 MHz and 1,555 to 1,595 MHz should be observed when GPS parameters indicate possible RF interference. Interfering signals are not restrictive, unless they affect the receiver/ sensor performance. The SNR values being recorded may indicate RF interference problems. The normal GPS signal strength is –130 to –123 dBm. Use the SNR values, along with the spectrum analyzer, to investigate the RF interference, the location of its occurrence, and possible sources. Particular attention must be given to harmonics on or within 20 MHz of GPS L1 (1,575.42 MHz), L5 (1,176.45 MHz), and those on or within 10 MHz of GPS L2 (1,227.6 MHz).

During an RNAV procedure, document all spectrum anomalies. Paper records **and** electronic collection of data are required.

NOTE: Report interference to the FICO, who will in turn forward the report to the ATCSCC/ Spectrum Assignment and Engineering Office at Herndon, Virginia.

3.13 TOLERANCES

Parameter	Reference Paragraph	Tolerance/ Limit
Procedure Design (FMS or AFIS calculated values)		
Route/ DP/ SID/ STAR	13.11	
True Course to next WP		± 1°
Distance to next WP		± 0.1 nm
Initial/ Intermediate Approach Segment	13.11	
True Course to next WP		± 1°
Distance to next WP		± 0.1 nm
Final Approach Segment	13.11	
True Course to next WP		± 1°
Distance to next WP		± 0.1 nm
Missed Approach Segment	13.11	
True Course to next WP		± 1°
Distance to next WP		± 0.1 nm
Vertical Path (VNAV)	13.11	± 0.1°
FMS/ GPS		
GPS Integrity	13.11	RAIM

13.14 DOCUMENTATION. RNAV reports must be completed in accordance with FAA Order 8240.36, Flight Inspection Report Processing System. All recordings and documentation (paper **and** electronic) must be retained and handled in accordance with current policy.

SECTION 2

REQUIRED NAVIGATION PERFORMANCE (RNP) RNAV

This section provides additional guidance to Section 1 of this chapter for inspection of RNP RNAV procedures.

13.20 INTRODUCTION. RNP is a statement of the navigation performance accuracy necessary for operation within a defined airspace.

RNP is stated as a number in nautical miles. This specifies how tight the avionics must contain Total System Error (TSE). RNP applies to navigation performance and includes the capability of both the available infrastructure (navigation systems) and the aircraft equipment. The RNP capability of an aircraft will vary depending upon the aircraft equipment and the navigation infrastructure. For example, an aircraft may be equipped and certified for RNP 1.0 but may not be capable of RNP 1.0 operations due to limited NAVAID coverage.

RNP levels address obstacle protection associated with RNP accuracy values. The RNP level (RNP x, where x=0.3, 1, 2, etc.), when applied to instrument procedure obstacle evaluation areas, is a variable used to determine a segment primary area half-width value, i.e., total width is ± a multiple of the value used to identify the level. Parallel lines normally bound obstruction clearance areas associated with RNP.

13.21 FLIGHT INSPECTION PROCEDURES. Inspect RNP RNAV procedures per Section 1. Use FAA Order 8260.51, U.S. Standard for RNP Instrument Approach Procedure Construction; FAA Order 8260.52, U.S. Standard for RNP Instrument Approach Procedures with Special Aircraft and Aircrew Authorization Required (SAAAR); or specified equivalent guidance for procedure design and required obstruction clearance criteria.

13.22 OBSTACLE VERIFICATION. When containment obstacle verification is required, fly a 2xRNP (containment limit) offset each side of centerline (i.e., RNP-0.3 segment, fly a 0.6 nm offset each side of course centerline). Fly in the intended direction of the procedure. Program the offset as a route or approach in the FMS. Assign altitudes to the offset waypoints as required for the vertical profile.

> **NOTE:** Containment limit obstacle verification is not required on segments that have the obstacle environment surveyed or on segments where obstacles against the RNP containment limit are not a factor. Use extreme caution when flying the containment limit. Obstructions (towers, terrain, etc.) may be against the edge of the containment limit.

SECTION 3

DME SUPPPORTED PROCEDURES

13.30 INTRODUCTION. This section provides supplemental guidance to Section 1 of this chapter for inspection of RNAV procedures requiring a DME/ DME infrastructure. For most aircraft with FMS installations that do not have a GPS sensor, DME is used to calculate position. The primary method is to calculate position from the crossing angles of 2 or more DME facilities. The FMS chooses DME facilities that intersect the aircraft between 30° and 150° crossing angle. The FMS database is searched every few minutes to choose the most optimum pair of DME facilities. The optimum pair of DME facilities will have a crossing angle closest to 90°. The FMS may have a "Scanning DME" function. This function allows multiple DME facilities to be scanned in a few seconds. The more DME facilities and the more widely they are dispersed, the greater the positioning accuracy. DME positioning may be able to provide a positioning accuracy to 0.1 nm at a location of optimal DME geometry.

13.31 FLIGHT INSPECTION PROCEDURES

a. AFIS/ Equipment Setup. A computer-screening model (RNAV PRO) identifies DME facilities, predicted to possess the accuracy, coverage, and geometry requirements needed to provide a navigation solution to support the procedure. AFIS software will allow up to five (5) DME facilities to be monitored and recorded. DME(s) to be checked over a designated area are specified in the RNAV PRO screening output file. Results are documented in a comma separated value (CSV) file. The CSV file is loaded into AFIS for inspection of the procedure.

NOTE: RNAV Pro DME screening CSV files are direction specific. The appropriate CSV file is required for direction of flight.

(1) Cockpit TCN Tune Auto/ Man button must be in Auto mode for AFIS DME/ DME operation.

(2) While the electronic data file will be used to determine coverage, it is important to annotate passage of each waypoint on the paper recording.

(3) For DP(s)/ SID(s), STAR(s), and Q Routes, use select function on Nav Test Ctrl Page 2 for selecting leg segments to be flown.

(4) Appropriate DME facility changes will be initiated based on the RNAV PRO file (see Section 3).

b. Maneuvering. All segments requiring vertical path change must be inspected in the intended direction of flight, using minimum climb gradients and minimum altitudes specified in the procedure package. Position aircraft on course centerline.

Use the Global Navigation Satellite System (GNSS) as the primary navigation sensor for the inspection. On one FMS, monitor the DME/ DME navigation solution by deselecting all navigation sensor(s) except DME.

For procedures constructed solely for DME/ DME/ Inertial Reference Unit (IRU) operations, monitor the navigation solution by deselecting all navigation sensor(s) except DME and Inertial Reference System (IRS).

During the inspection, if a Critical, or ESV designated DME appears not to be transmitting, verify with Air Traffic or a local Flight Service Station that the facility is in service. If a DME designated Critical is off the air, the inspection must be terminated and resumed after the facility is returned to service. When there are three or less DME(s) and one of the three is out of service, the check should be rescheduled.

Document location of any map shifts or anomalies as compared with GNSS navigation solution.

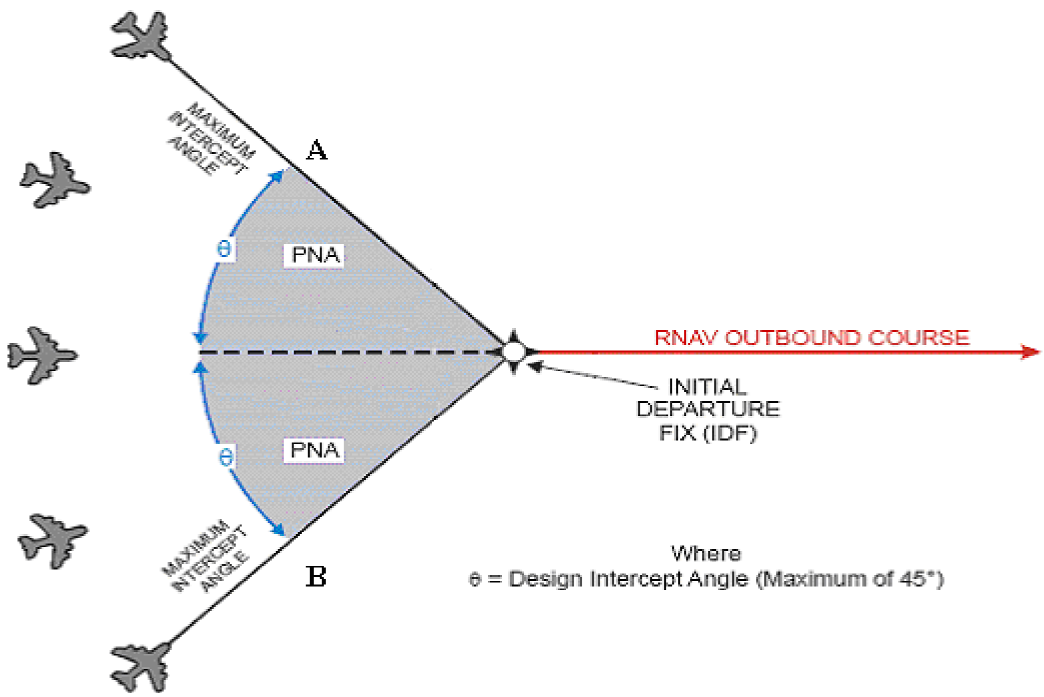
(1) RNAV Departure Procedure/ Standard Instrument Departure. Departures requiring a DME/ DME navigation solution at the earliest possible point from takeoff must be flown from an actual takeoff. Position the aircraft IAW with Section 1.

(a) Parallel Runways Departing to a Common Route: If parallel runways are separated by 3,400 ft or less, the DME evaluation may be accomplished by departing from either parallel, unless the DME screening identifies runway dependent DME(s).

(b) RNAV Departures that use RADAR Vectors to Join RNAV Routes (RDVA). The Pilot Navigation Area (PNA) is an area used to transition from radar vectoring to the area navigation route. It is defined by two perimeter boundaries and an arc radius referenced from the initial departure fix (IDF). See Figure 13-2. The PNA is developed by the procedures specialist and is specified on FAA Form 8260.15B, Graphic Departure Procedure, as bearings to the IDF with arc radius and minimum altitude. The bearings to the IDF are used as perimeter boundaries. Record DME facility coverage along each perimeter boundary between the IDF and the arc radius distance, either inbound or outbound, at the minimum altitude. Refer to FAA Order 8260.53, Standard Instrument Departures That Use RADAR Vectors to Join RNAV Routes, for procedure development criteria.

Figure 13-1

Example of Pilot Navigation Area (PNA)



(2) **Routes** can be flown in either direction. All routes will be flown on course centerline at the minimum altitude (true) specified in the procedure package.

(3) **RNAV Standard Terminal Arrivals.** Aircraft positioning is in accordance with Section 1 of this chapter.

(4) **Approach.** Document DME coverage at the procedural (true) altitude(s) for all segments. Fly the Final Approach Segment (FAS), descending on path to 100 ft below the lowest minima.

NOTE: Loss of DME facility coverage in the FAS is expected. The aircraft's IRU is expected to provide navigation guidance to the MAP and throughout the missed approach segment until a DME/ DME navigation solution is regained.

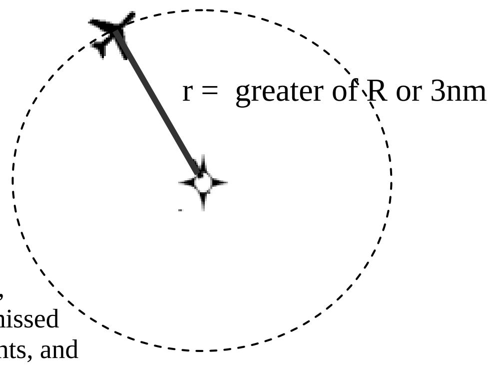
(5) **Missed Approach.** Aircraft positioning is in accordance with Section 1 of this chapter.

(6) **Single Waypoints.** DME coverage and accuracy will be verified based on an orbit centered on the waypoint coordinates. The radius of the orbit must be calculated based on the DME station farthest from the waypoint, using the formula contained in Appendix 2, or 3.0 nm, whichever is larger. Document DME coverage at 100 ft below the procedural (true) altitude.

Figure 13-2

Single Waypoint Flight Profile

R = 0.0125D +0.25NM + XTRK
Where:
R = Radius in nm of orbit or arc
D = Distance in nm from the DME station farthest from the waypoint.
XTRK = Waypoint design criteria from Order 8260.40



NOTE: The XTRK value is .6 nm for Initial Approach, Intermediate, Final Approach, Missed Approach, and missed approach holding waypoints, 2.0 nm for feeder waypoints, and 3.0 nm for en route waypoints.

c. **Analysis.** Final determination of the satisfactory status of a DME/ DME procedure requires post flight analysis of the inspection data. Upload CSV logger files from the inspection to 'U:\AVNCommon\FDBCalc\AVN200' and notify the FICO the files are available. The FICO will forward the files to the RNP/ RNAV Program Office (WAJR) for post flight inspection analysis. All logger and CSV files collected while on itinerary must be uploaded in Flight Operations Management System (FOMS) using the Data Indexing Application. The appropriate organizations will review the flight inspection coverage data and determine if DME/ DME is authorized. Submit the DME/ DME RNAV Flight Inspection Report in the normal manner and, when requested, send the recordings to Flight Inspection Records, AJW-335A.

On the PC Control and RNAV report form (FAA Form 8240-17), insert Remark(s) to qualify the procedure status. If the procedure is 'SAT', add note: **Procedure "SAT" based on GNSS. Procedure status based on DME/ DME is awaiting AFS/ WAJR approval.**

FAA Advisory Circular AC 90-100A (U.S. Terminal and En Route Area Navigation (RNAV) Operations) defines two DME/ DME infrastructure navigation performance levels:

(1) "RNAV 2 " RNAV SID(s)/ STAR(s)/ Routes require system performance currently met by GPS or DME/ DME RNAV systems. "RNAV 2" routes and procedures require a total system error of not more than ± 2 nm for 95% of the total flight time. The "RNAV 2" procedure **may** require an IRU to mitigate marginal DME/ DME infrastructure.

(2) "RNAV 1" RNAV SID(s)/ STAR(s)/ Routes require system performance currently met by GPS or DME/ DME/ IRU RNAV systems. "RNAV 1" routes and procedures require a total system error of not more than ± 1 nm for 95% of the total flight time.

d. Other Considerations

(1) RNAV procedures supported by a DME infrastructure will be inspected in accordance with Chapter 6. Documentation of all identified DME facilities will be accomplished through paper recordings **and** electronic collection of data (AFIS required).

(2) **Confirmation of communications and radar coverage** on all segments of RNAV "Q" Routes is required.

13.32 TOLERANCES

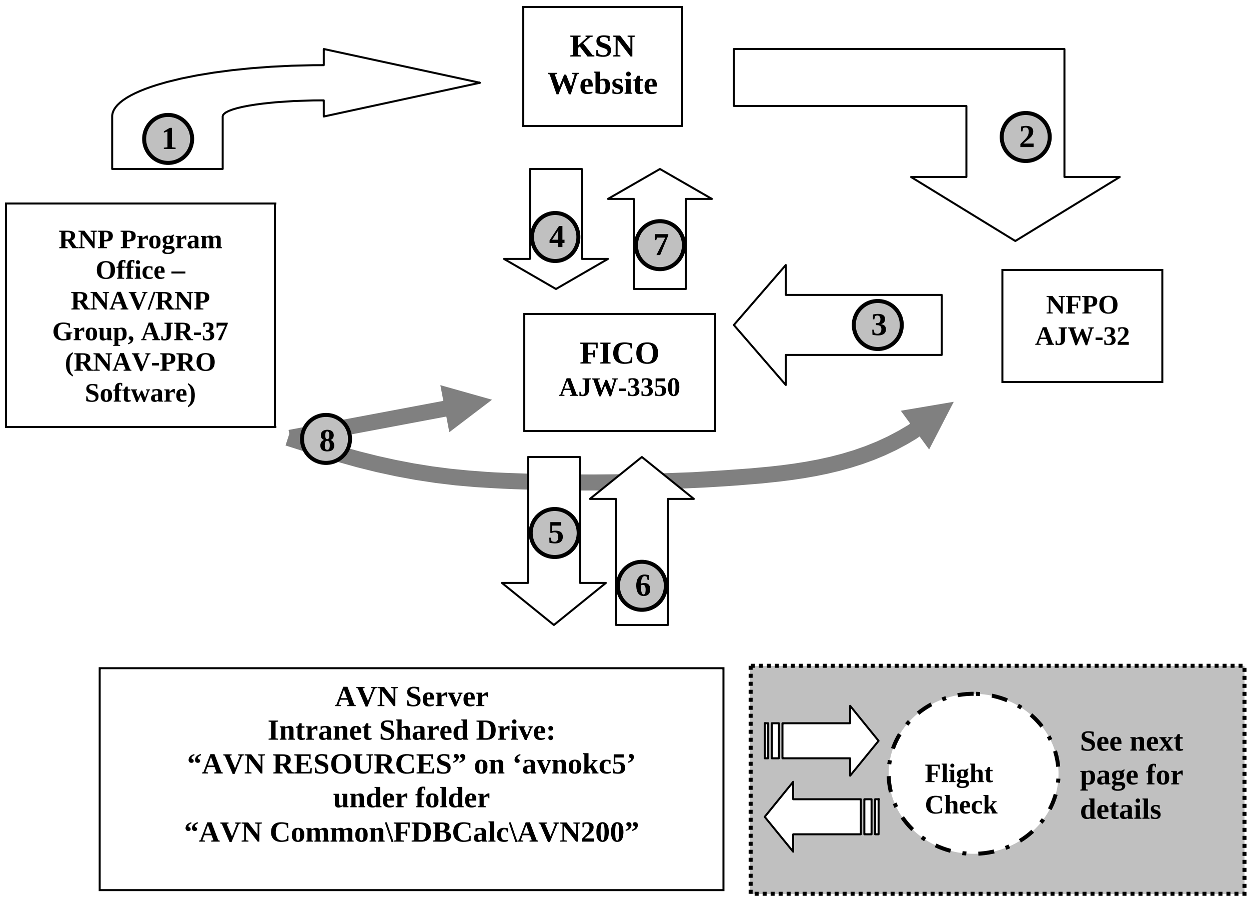
DME/ DME SUPPORTED RNAV		
Parameter	**Paragraph Reference**	**Tolerance**
DME Accuracy[1]	Chapter 11, Section 6	≤ 0.20 nm

[1]**NOTE.** DME facilities with range errors greater than 0.20 nm do not invalidate the DME/ DME procedure, unless it is a "critical" DME facility as identified in RNAV Pro.

13.33 TABLES AND SUPPLEMENTAL INFORMATION

DME/ DME RNAV Procedure Process

Diagram of how DME/ DME RNAV Procedure Information is Processed for Flight Inspection



Process Steps:

1. AJR-37 Posts a RNAV-PRO, DME/DME Analysis "flight plan" (a PDF file) and associated AFIS data files (EXCEL CSV files) on KSN site (aka RNP Office Procedures Site).

2. NFPO downloads DME/DME Analysis "flight plan."

3. NFPO groups the DME/DME Analysis "flight plan" with the DME/DME Procedure Package and forwards it to the FICO.

4. FICO downloads AFIS data files from KSN site.

5. FICO posts the files on the AVN Server (AVN RESOURCES on 'avnokc5' in a folder located under: AVNCommon\FDBCalc\AVN200.

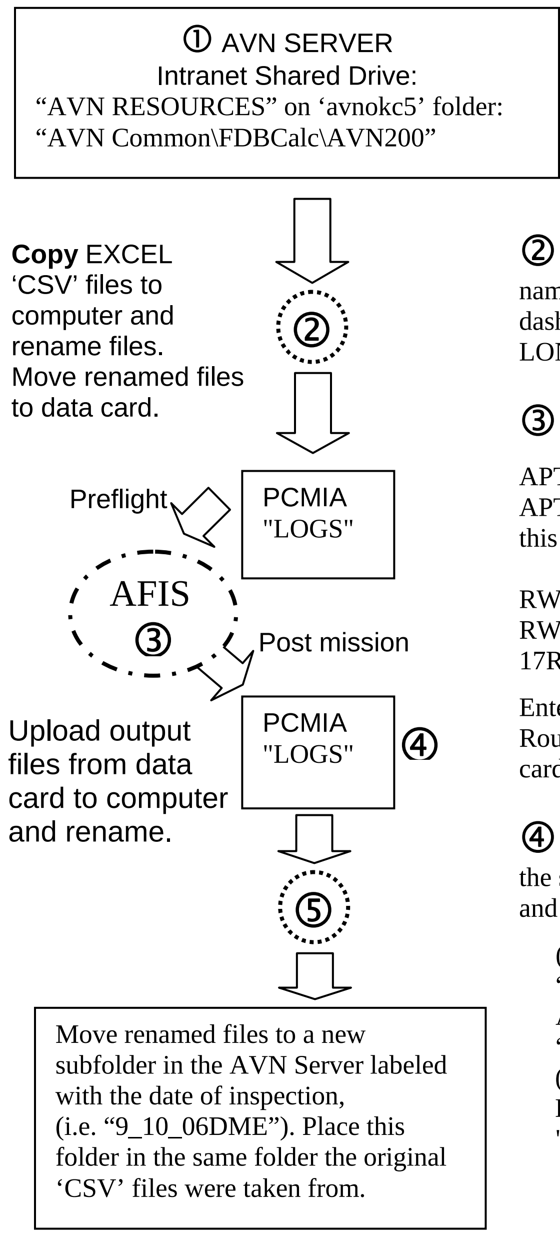
6. FICO, triggered by DFL, retrieves AFIS data file from AVN Server.

7. FICO sends AFIS data file to RNAV-PRO Group (AJR-37) for post processing, and sends signed PC to NFPO.

8. Email from RNAV-PRO Group (AJR-37) to FICO and NFPO provides official notification of RNAV PRO post evaluation results.

9. If Satisfactory, NFPO processes for publication. When found Unsatisfactory, FICO and NFPO will determine next course action. NFPO communicates plan for redesigning procedure to RNAV-PRO Group.

Details at Aviation System Standards Level for DME/DME Flight Inspection Data Files



① Look for a sub-folder named similar to the procedure, or the name could reflect a project name encompassing multiple procedures. Example file names (EXCEL CSV files):
  Q-24E FL200_AFIS
  LONNI OMN SK_AFIS

② After files are downloaded to PC, rename files with names no longer than 8 characters with no spaces or dashes (an AFIS requirement) e.g., Q24E.CSV, or LONOMN.CSV

③ AFIS output file names* (ref. Facility Data Page):

APT ID – When the Procedure is a SID or Approach, the APT ID is <u>required</u>. Note: AFIS drops the first letter in this block when labeling the output file.

RWY ID – When the Procedure is a SID or Approach, the RWY ID is <u>required</u>. This is the runway number, e.g., 17R.

Entering Information into APT ID & RWY ID for a Q-Route or STAR will label the Output on the PCMIA data card with no impact on the FACILITY DATA.

④ Each AFIS run produces 2 output file types both with the same '###' number. For example: DMLONZFP.041 and DMOUT041.CSV.

(1) One is a "log-file" containing raw data and labeled "DMaaarrr. ###", where "aaa" comes from the APT ID, and "rrr" comes from the RWY ID, and "###" is a AFIS assigned file number.
(2) The other is a DME data AFIS output file (in EXCEL format named) "DMOUT###.CSV". The "### " matches the raw data file.

⑤ **Rename DMOUT###.CSV files according to these rules:** Use the name of the procedure, the starting point, the ending point and file ### for example: DMOUT041.CSV would become LONNI_ZFP_HEATT041.CSV. The corresponding raw data file DMLONZFP.041 should then be changed to LONNI_ZFP_HEATT.041. (For a SID, rename the DMOUT###.CSV file with: name and runway, ending waypoint, and file ###, e.g., DMOUT018.CSV will be DAWGS26R_SPA_018.CSV.)

*** Examples of how AFIS names output log files**: For a SID or Approach, it should come out labeled with the APT ID and RWY ID like: DMOKC17R.028. For a Q Route, in APT ID enter a space + 3 letters for the route, e.g., Q24. For a STAR: in APT ID enter a space + first 3 letters of name, e.g., LON for LONNI Transition. The RWY ID is typically 3 letters to represent the starting waypoint e.g. "VRB" (Vero Beach VTAC) AFIS file label is DMLONVRB.041 (raw data) and DMOUT041.CSV (DME data).

SECTION 4

RNAV WIDE AREA AUGMENTATION SYSTEM (WAAS)

13.40 INTRODUCTION. The WAAS provides augmentation, including integrity broadcasts, differential corrections, and additional ranging signals to the standard GPS signal. It provides the accuracy, integrity, availability, and continuity required to support oceanic, remote-area, en route, terminal, nonprecision approach, and precision approach phases of flight.

WAAS utilizes a network of wide-area reference stations (WRS) that receive and monitor the GPS signals. Data from these reference stations are transmitted to one of two wide-area master stations (WMS), where the validity of the signals from each satellite is assessed and wide-area corrections are computed. These validity (integrity) messages and wide-area corrections are transmitted to aircraft via Geostationary Earth Orbit (GEO) communications satellites that serve as additional sources of GPS ranging signals, increasing the number of satellites available to the system users. The WAAS signal is transmitted on the same frequency (L1 – 1575.42 MHz) and with the same type of code-division multiplex modulation as the GPS Standard Positioning Service (SPS) signal, allowing a WAAS receiver to acquire and process both the GPS and WAAS broadcasts. An integrity message transmitted by the WAAS provides the user with a direct verification of the integrity of the signal from each satellite in view.

FAA Order 8260.54, The United States Standard for Area Navigation (RNAV), specifies design criteria for RNAV WAAS approach procedures. Approaches constructed under these criteria are termed “LP” or “LPV”. The lateral protection area is based on precision approach trapezoid dimensions criterion. RNAV WAAS LP procedures can be supported to HAT values ≥ 250 feet. LPV procedures can be support to HAT values ≥ 200 feet.

In addition to LP/ LPV procedures, WAAS supports LNAV and LNAV/ VNAV approaches. WAAS can be used to support the vertical guidance requirements for RNAV LNAV/ VNAV approach procedures at airports where BARO-VNAV is not authorized. Avionics systems using WAAS for vertical guidance are not limited by approach procedure BARO-VNAV temperature restrictions.

13.41 PREFLIGHT REQUIREMENTS

a. **Aircraft.** The flight inspection aircraft must be capable of supporting the required ARINC 424 leg type coding specified in the procedure package, have vertical navigation capability, and be equipped with a WAAS-capable GPS sensor integrated with the AFIS. AFIS “WAAS Mode” will be used for collecting WAAS data.

b. **Navigation Database.** The procedure may be on a supplied database, downloaded from an electronic media, or entered manually (Pilot Defined) from an official source documentation.

When an electronic database is not available for the WAAS LP/ LPV or point-in-space procedure, code the RNAV procedure, utilizing the "Pilot Defined" function of the FMS or a desktop software program.

For offset or point-in-space procedures, enter the FTP as the Missed Approach Point. The FTP is normally a named waypoint in the ARINC 424 coding.

c. **Pilot-Defined Procedure**. To define an LP/ LPV procedure, use the "GWS" approach type on PLT APPR 1/4 of the UNS-1 FMS. The "GWS" approach type initiates the requirement for the FMS to use the WAAS navigation sensor for the LP/ LPV procedure.

d. **Evaluation of Procedure Data.** Prior to the approach being flown, approach segment data accuracy must be evaluated by comparison of the procedural waypoint data to the flight plan waypoint data and Glide Path Angle (GPA) calculated by the UNS-1 FMS. Ensure courses, distance between waypoints and GPA accurately reflects the procedure design.

e. **LP/ LPV FAS Data Block Verification.** The LP/ LPV FAS data (data specified on FAA Form 8260-10) is developed and coded into binary files by the procedure designer. The FAS data files are saved into a network file for flight inspection access. Using the "FAS Pack" software tool, download the FAS data blocks ~~s~~ files required for the scheduled itinerary onto removable disk media. For a detailed explanation of each FAS data parameter, see FAA Order 8260.19.

When it is determined the LP/ LPV procedure was developed using "Pending" Airport Data, the Mission Specialist (MS) must update the Airport data in AFIS by manually entering the Pending Airport data from an AVNIS data sheet. Updating AFIS Airport data from a Pending AVNIS data sheet is an acceptable practice.

> **NOTE:** When using FAS Pack, the "Validate FAS" block should be checked. Using a current AFIS database, the "VIEW" function (expanded) will show any differences (errors) between FAS data and Active or Pending data. This will indicate which data was used to develop the procedure.

Prior to mission departure, the mission specialist should confirm AFIS access to the removable disk media. Access each individual FAS data file and confirm the Cyclic redundancy check (CRC) Remainder matches the FAA Form 8260-10 data. The CRC is an error detection algorithm capable of detecting changes in a block of data. Manual changes in AFIS to the FAS data to obtain a correct CRC remainder are not allowed. If the CRC does not match exactly between AFIS and FAA Form 8260-10, the procedure cannot be checked. When the CRC in AFIS does not match FAA Form 8260-10, contact the FICO representative for your area:

EAST:	ATL, ACY
CENTRAL:	BTL, OKC
WEST	ANC, SAC

This ensures no errors occurred during data transfer (data file integrity). Any corruption must be resolved prior to conducting the inspection. AFIS uses the FAS data to calculate course alignment and glide path angle.

f. **For Offset LP/ LPV and Point-in-Space procedures,** the **DGPS** should be turned on during preflight checks and while en route to check an LP/ LPV or point-in-space procedure. Press “I/O CHK” key and “Page Back” to display “DGPS POSITION INPUT DATA” page. When satellite data and aircraft position are displayed, aircraft DGPS receiver is operational. “GROUND LAT/ LON AND HGT” will display data matching the ground-based DGPS system position when the Synthesized Netlink Radio Data System (SNRDS) in the aircraft and ground station are operating correctly

g. **WAAS Status**. Determine WAAS status before every flight inspection and after an inspection that detects anomalies. WAAS NOTAM(s) and GPS Service Interruptions (interference testing) location and schedule should be considered. Solar storm activity may adversely affect WAAS availability. Inspection of WAAS procedures during periods of adverse GPS signal conditions should be rescheduled. The following websites can be used in the flight planning process.

(1) http://www.nstb.tc.faa.gov (for WAAS availability)

(2) http://www.sec.noaa.gov (for solar activity)

13.42 FLIGHT INSPECTION PROCEDURES. The RNAV WAAS LP/ LPV procedure must be inspected in accordance with Chapter 6, in addition to the requirements in this Chapter. Use FAA Order 8260.54 for design information and required obstruction clearance criteria.

a. **General.** For RNAV WAAS LP/ LPV, do not deselect any navigation sensors. The FMS will automatically deselect any sensors not valid for the procedure. Align the Inertial Reference Sensor (IRS) to the GPS position.

Paper recordings **and** electronic collection of data are required. During an RNAV WAAS/ LP/ LPV approach, document WAAS data starting from the intermediate waypoint inbound to the Landing Threshold Point (LTP)/ Fictitious Threshold Point (FTP). A flight inspection "low approach" is required to provide back corrections for data analysis. Also, document WAAS data on below-glide-path runs.

Offset LP/ LPV and Point-in-Space Differential GPS. Offset LP/ LPV and point-in-space procedures require DGPS. Set up the DGPS according to instructions detailed in TI 8200.52, Appendix 9 "AFIS Operations with Differential Global Positioning System (DGPS) Truth System". Set up DGPS at a surveyed location or a point derived from a surveyed location. The DGPS may be positioned up to a maximum of 30 nm distance, dependent upon terrain and environmental conditions.

b. **Checklist**

Type Check	Reference or Paragraph	C	P (2)
Transition/ Feeder Route Segment	Chapter 13, Section 1	X	
Initial Approach Segment	Chapter 13, Section 1	X	
Intermediate Approach Segment	Chapter 13, Section 1	X	X
Final Approach Segment	Chapter 13, Section 1	X	X
Missed Approach Segment	Chapter 13, Section 1	X	X
SIAP	Chapter 6	X	X
RFI	Chapter 13, Section 1 Chapter 23	1	1

NOTE 1: When GPS/ WAAS parameters indicate possible RFI.

NOTE 2: Except for an obstacle evaluation, RNAV LP/ LPV procedures have no periodic inspection requirement.

c. Maneuvering. Ground track path error performance varies with mode of flight guidance system coupling. It is imperative to evaluate procedures coupled to the flight director and autopilot, to the extent permitted by the aircraft flight manual. Additional evaluation may be accomplished by hand flying the inspection aircraft. Lateral and vertical transitions during the approach must produce a seamless path that ensures flyability in a consistent, smooth, predictable, and repeatable manner.

d. AFIS/ Equipment Setup

(1) AFIS Panel Setup

(a) SYSTEM SETUP page toggle WAAS ENABLED to "MMR"

(b) Using onboard aircraft calibration cards Check Aircraft Dimensions (Special Dimensions for LP/ LPV)

(c) On Service Page (MISC SERV), perform Self Test

(d) On Service Page (MISC SERV), select WAAS

(e) Go to FI WAAS Facility Data Page (FACIL DATA

(f) Insert Flash Card with FAS PACK Data & Enter:

1 APT ID example KCRQ

2 RWY ID example 24

3 SIAP ID example W24A

(g) Offset LP/ LPV and Point-in-Space Data

1 Select "WAAS" mode on "Service Page"

2 Proceed to "FI WAAS Facility Data" page

3 Load APT ID, RWY ID, and SIAP ID using standard practices. (The LPV FAS data is loaded from the "supfasdb" generated using "FAS Pack" during itinerary pre-planning.)

4 In the airport data block replace:

a TH LAT with LTP/ FTP LAT from FAS data block.

b TH LON with LTP/ FTP LON from FAS data block.

c RW BRG with line **3. FAC converted to TRUE bearing**: from FAA Form 8260-3 (or equivalent) approach description.

NOTE 1: LTP/ FTP LAT/ LON may also be found on .xml printout.

NOTE 2: Do not change TH ELLIP HGT. The course offset of 3º has negligible impact on ellipsoid elevations.

(h) Offset LP/ LPV and Point-in-Space AFIS DGPS:

1 Access the DME FIX page and toggle the FINAV MODE scratch pad to DGPS when within 30 nm of inspection airport.

2 Monitor WAAS NAV TEST CTRL DATA in lower right-hand corner.

a POSMODE will show DGPS and

b DGPS STAT will show "FIXED RTK" indicating AFIS is receiving updates from the ground station.

3 DGPS operation may be monitored using the "I/O CHK" key and paging back to find DGPS Position Input Date. LAT/ LON displayed in AFIS must match LAT/ LON programmed in ground station.

(i) Execute Page after inspection data is validated. If approach database fails to load from the PCMIA card, use the following guide:

1 The NCU must be rebooted.

2 Toggle the Miltope screen to any screen but MISC SERV.

Reason; If the reboot is successful the screen will automatically go to the MISC SER page and the Printer Plotter will reboot also.

3 On the AFIS CONTROL PANEL: Toggle NCU PWR from normal to reset.

4 If the NCU does not reboot (this usually happens when airborne):

On the AFIS PWR DIST circuit breaker panel PULL & RESEAT the **115VAC NCU 7½ amp** circuit breaker (LEAR 60 aircraft). (note; Do not pull the 26VAC NCU breaker)

5 MISC SERV page will appear. Go to facility data page and perform steps (g) and (h).

NOTE: CRC REMAINDER is the most important parameter. The facility database must match the 8260 –10 of the procedure package. Manual changes in AFIS to the FAS data to make the CRC remainder match are not allowed.

(h) On DME/FIX Update Control Page, toggle to DR VELOCITY HYBRID

(i) On TVPS Installation Page, ensure data is valid (matches the aircraft calibration book).

(j) On WAAS Plot Control Page (SYS PLOT), toggle GND SPEED to ON

(k) On WAAS NAV TEST CRTL (INSP CTL) Page 2; Change FAS DIST to "FAF TO MAP" distance from procedure package FAA Form 8260 series or equivalent. Validate the PFAF distance has changed from 5.00 to the new distance.

(2) **Spectrum Analyzer Setup**

(a) Top left-**SET FREQUENCY** (CENTER FREQ, NOT START FREQ)

(b) Key in **1575.42** (THIS IS L1)

(c) On right side select **MHz**

(d) On right side select **SPAN**

(e) Key in **5**

(f) On right side select **MHz**

(g) On left side select **TRACES**

(h) On right side select **MAX HOLD**

(i) Turn spectrum analyzer selector to "**TACAN**"

(3) Data Logger Supplemental Information

(a) After you have executed the START command verify, on the lower left part of the NAV TEST CTRL page, that the DATLG is showing “RUN”.

(b) If the DATA LOGGER is not running:

1 Toggle to MISC SERV page

2 On the top right of the page toggle DATA LOGGER to “RESET” and EXEC CMD.

3 Then toggle DATA LOGGER to “START” and EXEC CMD.

(c) If the DATA LOGGER fails again the Flash Card may be full. Replace the card and start at Step (3)(b) again.

NOTE: Once the approach data has been loaded by selecting the procedure to be inspected, an empty flash card may be used to collect data. When changing procedures the flash card with the data must be reinstalled.

(4) FMS Approach Programming. See FMS Reference Guides.

e. Aircraft Positioning

(1) Maneuver as required confirming obstacle clearance on procedure segments.

(2) Start the AFIS recording outside the IF/ IAF. Paper recordings and electronic collection of data is required from the IF/ IAF to the MAP.

(3) The Initial Approach Segment evaluation may be performed when flying by the waypoint if it is depicted as a “FLY BY” waypoint on the procedure.

(4) The Initial Approach Segment and Intermediate Approach Segment must be flown at procedural altitudes.

(5) The FAS positioning must be on course, on path. Evaluate the Glide Path Angle (GPA) course guidance, WAAS positioning, and delivery alignment throughout the final approach segment.

(6) Confirm WAAS glidepath full scale fly-up. This may be accomplished anytime the FMS in approach mode during the intermediate or final approach segments. Position the aircraft on course centerline at an altitude that produces full scale fly-up on the pilot’s CDI. Full scale fly-up will occur within approximately one half degree below procedural glidepath angle (GPA). Once full scale fly-up guidance is displayed on the CDI, the check is complete.

When possible, accomplish the WAAS full scale glidepath fly-up check while the aircraft is in the intermediate segment. This may save an additional approach run.

(7) Fly the missed approach segment(s) as depicted in the procedure.

(8) Offset LPV Aircraft Positioning. Final Approach Segment positioning must be on course, on path; so as to overfly the FTP. AFIS updating will be automatic, utilizing DGPS. This type procedure may be developed at a location where crossing the FTP at the designed TCH is **not** practical. Flight tests of the AFIS have confirmed that the FTP crossing height may be varied from the FTP TCH up to 750' above the FTP, as appropriate for safety, terrain, and environment.

f. **WAAS Interference:** If interference is suspected, record additional data from the two following runs. Paper recordings and electronic collection of data is required. Evaluation of the final approach segment for interference is accomplished by flying along the left and right edges of primary FAS obstruction trapezoid. (Create a route using 90° offset waypoints 0.3 nm from the PFAF and 0.1 nm from the Missed Approach Waypoint (MAWP), respectively, with a vertical angle at least one degree less than the procedure GPA (full scale fly-up) for LPV or at MDA for LP. This will provide lateral/ vertical guidance slightly outside the "W" obstacle clearance surface.) Assure that a full fly-up indication is provided below the approach GPA on FAS centerline and along edges of the primary FAS obstruction trapezoid.

13.43 FLIGHT INSPECTION ANALYSIS

a. **Obstructions.** The controlling obstacle clearance must be verified in accordance with FAA Order 8260.54.

b. **Procedural/ Design Database Integrity.** Evaluate the procedure to verify the waypoint coordinates are correct. Display the course and distance from each waypoint to the next in the flight plan. Many procedures are being amended to change the location of waypoints. In this situation, only fly the segments with azimuth adjustments greater than 2° and/or distance adjustments of 1.5nm. Obstacle validation must still be considered. Compare the course and distance values with the procedural design. Apply the tolerance requirements of this handbook. The ARINC 424 path and terminator coding must provide the intended ground track and vertical path for the procedure. FAS data must provide the designed course alignment and glide path.

c. **CRC Remainder**. A perfect match of the CRC will confirm the FAS data block integrity remainder documented on FAA Form 8260-10 and the CRC remainder as computed by AFIS.

d. **Standard Instrument Approach Procedure (SIAP).** Evaluate the instrument flight procedure to ensure flyability and safety. This evaluation and analysis must be performed in accordance with Chapter 6 of this handbook.

e. **Position Determination.** The RNAV WAAS LP procedure must satisfactorily deliver the aircraft to the minimum descent altitude(MDA) and MAWP that terminates the approach. The RNAV WAAS LPV procedure must satisfactorily deliver the aircraft to the Decision Altitude (DA) and MAWP that terminates the approach. Approach course alignment must be to the center of the runway at the threshold or to the MAWP.

f. **Communications and RADAR** coverage must be available, where required.

g. **WAAS Signal.** To the extent possible, monitor WAAS signal while en route and during approach for anomalies. Print AFIS WAAS IO pages when anomalies are observed. Activate the AFIS data logger during approach inspections, when WAAS anomalies are observed, and anytime GPS/ WAAS data may need additional evaluation.

If GPS interference is suspected, annotate on the flight inspection report any visual observation of radio, cellular or other facilities, which may be a possible source for emitting RFI.

NOTE: Report interference to the FICO, who will in turn forward the report to the ATCSCC/ Spectrum Assignment and Engineering Office at Herndon, Virginia.

h. **Parameters.** There are no flight inspection tolerances applied to these parameters. However, the values listed below (Table 13-4) provide a baseline for analysis of any WAAS signal anomalies or interference.

The parameters in Table 13-4 must be documented throughout the Intermediate and Final Approach Segments and whenever anomalies are found during any phase of the flight inspection.

Table 13-4
GPS WAAS Parameters

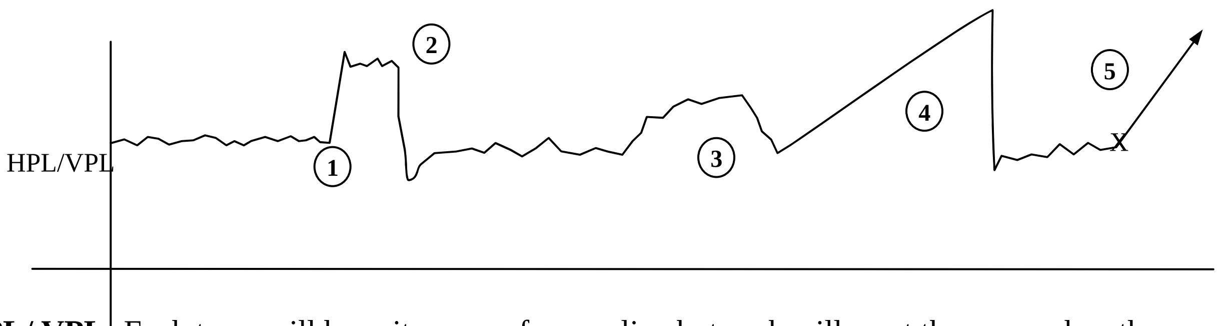
Parameter	**Expected Value**
HPL (1)	≤ 40 meters
VPL (1)	≤ 50 meters
HDOP	1.0 – 1.5
VDOP	1.0 – 1.5
WAAS Healthy Satellites	4 GPS & 1 GEO minimum
Satellites Tracked	4 GPS & 1 GEO minimum
Satellites in View	4 GPS & 1 GEO minimum
Geostationary Satellite SNR (2)	≥ 30 dB/ Hz
WAAS Sensor Status	“SBAS”

NOTES:

(1) Extreme solar storm activity may affect HPL/ VPL values and other WAAS signal parameters.

(2) SNR is not received from a WAAS GEO if it is not sending ranging messages. SNR value indicates “0” on AFIS if GEO is not sending ranging messages.

Example trace of flight inspection recording of WAAS HPL/ VPL anomalies:



HPL/ VPL: Each trace will have its own reference line but each will react the same when the following parameters change during check.

1. Loss of a GPS satellite.
2. Acquire a new GPS satellite.
3. Weak interference will inflate HPL/ VPL a little. Strong interference will cause loss of GPS or SBAS signals.
4. Ramp caused by missing some key SBAS messages.
5. “X” Loss of GEO – HPL/ VPL ramps up to undefined/ infinite.

13.44 TOLERANCES

Table 13-5
AFIS Announced Data for LP/ LPV

Parameter	Tolerance
WAAS Horizontal Protection Level (HPL)	≤ 40 m
WAAS Vertical Protection Level (VPL) (1)	≤ 35 meters (200 – 249' approach minima) ≤ 50 meters (≥250' approach minima)
SNR-W (2)	≥30 db/Hz
CRC Remainder	Perfect Match (No CRC Error)
Course Alignment	± 0.1° of true course
Glide Path Alignment (1)	± 0.09°
Threshold Crossing Height (1)	+ 12 ft -10 ft

Footnotes:
(1) Not applicable to LP. LP does not provide vertical guidance.
(2) Displayed only if satellite is sending ranging messages. Displays "0" if not ranging.

Table 13-6
AFIS Announced Data
(WAAS Supported LNAV/ VNAV without FAS Data)

Final Approach Segment (FAS)	
Parameter	**Tolerance**
WAAS Horizontal Protection Level (HPL) WAAS Vertical Protection Level (VPL)	≤ 556 m ≤ 50m
SNR-W	≥ 30 dB/ Hz

13.45 DOCUMENTATION. RNAV reports must be completed in accordance with FAA Order 8240.36, Flight Inspection Report Processing System. Retain and handle all recordings and documentation (paper **and** electronic) in accordance with current policy.

SECTION 5

LOCAL AREA AUGMENTATION SYSTEM (LAAS)

13.50 INTRODUCTION. LAAS is a safety-critical system consisting of the hardware and software that augments the GPS Standard Positioning Service (SPS) to provide for precision approach and landing capability. The positioning service provided by GPS is insufficient to meet the integrity, continuity, accuracy, and availability demands of precision approach and landing navigation. The LAAS Ground Facility (LGS) augments the GPS SPS in order to meet these requirements. These augmentations are based on differential GPS concepts.

LAAS will supplement the GPS to improve aircraft safety during airport approaches and landings. LAAS will yield the extremely high accuracy, availability, and integrity necessary for Category I, II, and III precision approaches. It is expected that the end-state configuration will pinpoint the aircraft's position to within one meter or less with a significant improvement in service flexibility and user operating costs.

LAAS is comprised of ground equipment and avionics. The ground equipment includes 4 reference receivers, a LAAS ground facility, and a VHF data broadcast (VDB) transmitter. This ground equipment is complemented by LAAS avionics installed on the aircraft. Signals from GPS satellites are received by the LAAS GPS Reference Receivers (4 receivers for each LAAS) at the LAAS-equipped airport. The reference receivers calculate their position using GPS.

The VDB broadcasts the LAAS corrected signal throughhout the LAAS coverage area to avionics in LAAS-equipped aircraft. The LAAS reference receivers independently measure GPS satellite pseudo-range and carrier phase and generate differential carrier-smoothed-code corrections that are eventually broadcast to the user via a VHF data broadcast (in the 108 – 118 MHz band) that also includes safety and approach geometry information. This information allows users within about 23 nautical miles of the LAAS ground station to perform GPS-based position fixes with 0.5-meter (95%) accuracy and to perform civil flight operations. Aircraft landing at a LAAS-equipped airport will be able to perform precision approach operations up to Category I or lower weather minima.

13.51 FLIGHT INSPECTION PROCEDURES. (Reserved)

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CHAPTER 14
RADAR

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FIGURES

CHAPTER 14

RADAR

SECTION 1

SURVEILLANCE RADAR and AIR TRAFFIC CONTROL RADAR BEACON SYSTEM (ATCRBS)

14.10 INTRODUCTION

a. General. This section outlines procedures for the flight inspection of surveillance radar and the air traffic control radar beacon system (ATCRBS), referred to as secondary radar. The procedures for radar flight inspection differ from the procedures for NAVAID(s) in that most of the data collection and analysis are conducted on the ground.

The flight inspector's role is primarily one of providing a known target in a designated area. Present digital techniques allow the evaluation of most radar parameters by sampling aircraft returns in the normal day-to-day radar environment. Certain requirements must be completed using a flight inspection aircraft. Facilities maintenance personnel will use targets-of-opportunity, radar data analysis software (RDAS) tools, and other test equipment to the extent practicable for completing all checklist requirements. Facilities maintenance personnel will normally evaluate and document all facility performance parameters, except those specifically evaluated by the flight inspector.

Air Traffic Technical Operations will prepare a radar inspection plan for all commissioning inspections, as well as all special inspections involving coordination outside the facility of concern. Joint use facility (radar data used by both FAA and DOD) inspection plans require coordination between the FAA region and the DOD user.

Two terms associated with these systems are **Airport Surveillance Radar (ASR)** and **Air Route Surveillance Radar (ARSR).**

ASR nominal range is normally out to 60nm and is more common in approach control facilities in the terminal environment.

An **ARSR** is a high gain, high power, air surveillance radar. In its track mode, it provides long-range coverage at altitudes up to 80,000 feet and distances to 200nm. In some areas, it can also be used in the terminal environment.

Conditions that may hamper a Radar Inspection:

Radar inspections should not be attempted during heavy precipitation, temperature inversions, or other atmospheric conditions that may change the coverage from normal. Whenever a system parameter does not meet tolerances and cannot be adjusted within a reasonable length of time, discontinue the flight inspection until the discrepancy is resolved. This does not preclude the continuation of tests in an effort to resolve the problems.

b. **Characteristics.** Radar types:

(1) **Primary Radar**. A radar system in which a minute portion of a radio pulse transmitted from a site is reflected by an object and then received back at that site for processing and display at an air traffic control facility.

(2) **Secondary (Surveillance) Radar**. This is also referred to as the Air Traffic Control Radar Beacon System, or ATCRBS. The ATCRBS normally provides improved coverage over primary radar. It is a radar system in which the object to be detected is fitted with cooperative equipment in the form of a radio receiver /transmitter (transponder). Radar pulses transmitted from the searching transmitter/ receiver (interrogator) site are received in the cooperative equipment and used to trigger a distinctive transmission from the transponder. This reply transmission, rather than a reflected signal, is then received back at the transmitter/receiver site for processing and display. **Three main components that make up the Secondary Radar System are**

(a) **The Interrogator**: The ground-based radar beacon transmitter-receiver that scans in synchronism with the primary radar and transmits discrete radio signals that repetitiously request all transponders in the mode being used to reply. The replies received are then mixed with the primary radar returns and both are displayed on the same radarscope.

(b) **The Transponder**. This airborne radar beacon transmitter-receiver automatically receives the signal 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. A mode is the letter or number assigned to a specific pulse spacing of radio signals transmitted or received by ground the ground interrogator/airborne transponder components of the ATCRBS. Mode A (Military Mode 3) and Mode C (Altitude Reporting) are used in Air Traffic Control.

An integral part of the ATCRBS ground equipment is the decoder. This equipment enables the controller to assign discrete transponder codes to each aircraft under his/her control. Assignments are made by the ARTCC computer on the basis of the National Beacon Code Allocation Plan (generic name for the National Airspace System and also includes Canada and Mexico). There are 4,096 aircraft transponder codes that can be assigned. An aircraft must be equipped with Civilian Mode A or Military Mode 3 capabilities to be assigned a transponder code. Another function of the decoder is that it is also designed to receive Mode C altitude information from an aircraft so equipped. This system converts aircraft altitude in 100-foot increments to coded digital information, which is transmitted together with Mode C framing pulses to the interrogating ground radar facility. When an air traffic controller tells a pilot to "squawk Ident", this means that the pilot should activate the Ident feature of the transponder, which causes the assigned code number to appear on the controller's radarscope.

(c) **The Radarscope** 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. With the ATCRBS, data blocks (alpha/ numeric display) show the flight number, altitude, ground speed, climb or descent, emergency, hand-off, loss of radar contact, and other information on the radarscope.

c. **Classification.** Radar, used by air traffic control facilities, is divided into two broad general categories. Both types can scan through 360° of azimuth and present target information on radar displays. In normal ATC operations, ASR and ARSR are combined with the ATCRBS (secondary surveillance radar), although ATCRBS can be utilized by itself.

(1) **Airport Surveillance Radar (ASR)** is designated to provide short-range (60 miles maximum) 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. Most medium-to-large radar facilities in the U.S. use some form of the Automated Radar Terminal System (ARTS) or Standard Terminal Automation Replacement System (STARS). This is the generic term for the functional capability afforded by several automated systems. Each differs in functional capabilities and equipment. In general, an ARTS displays for the terminal controller aircraft identification, flight plan data, and other information in conjunction with the radar presentation.

Normal radar co-exists with the alphanumeric display. In addition to enhancing visualization of the air traffic situation, ARTS facilitates intra and inter facility transfer and coordination of flight information. Each ARTS level has the capability of communicating with other ARTS types, as well as with ARTCC(s).

(2) **Air Route Surveillance Radar (ARSR)** generically refers to ARTCC radar, used primarily to detect and display an aircraft's position while en route between terminal areas. In some instances, ARSR may enable an ARTCC to provide terminal radar services similar to, but usually more limited than those provided by a radar approach control. En route coverage can extend up to 400 miles; however, 200 miles is the normal working range.

All ARTCC radars, as well as most airport surveillance radars in the United States, have the capability to interrogate Mode C and display altitude information to the controller. However, there are a small number of airport surveillance radars that are still two-dimensional (range and azimuth only); consequently, altitude information must be obtained from the pilot.

At some locations within the ATC environment, secondary 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. In the geographical areas serviced by secondary radar only, aircraft without transponders cannot be provided with radar service. Additionally, transponder-equipped aircraft cannot be provided with radar advisories concerning primary targets and weather.

(3) **Precision Approach Radar (PAR).** In the United States, Precision Approach Radar is mostly used by the military.

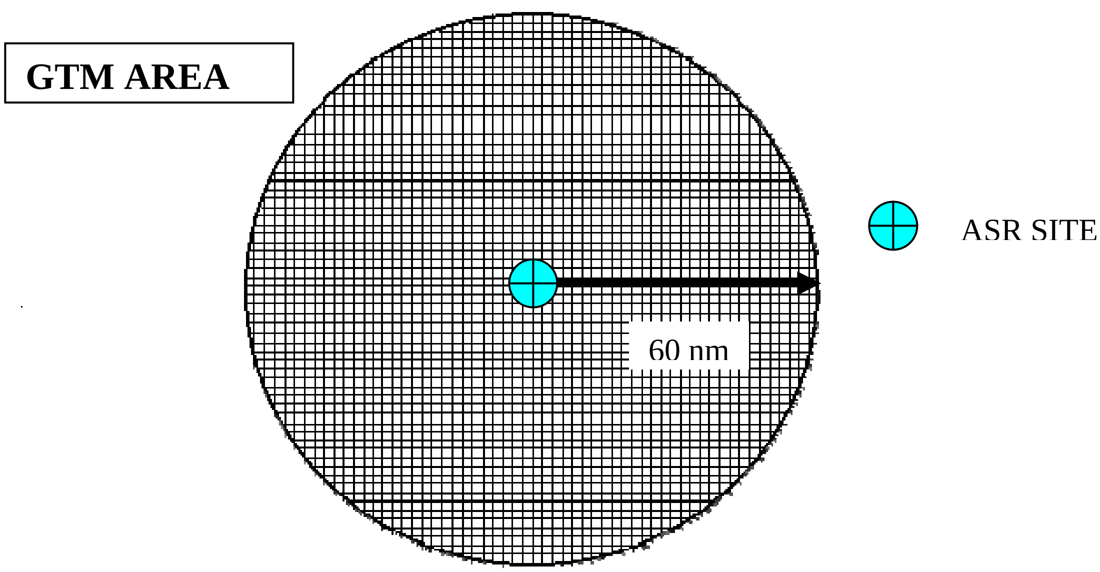
Radar equipment in some ATC facilities operated by the FAA and/or the military services at joint-use civil/military locations and separate military installations is used to detect and display azimuth, elevation, and range of aircraft on the final approach course to a runway. This equipment may be used to monitor certain non-radar approaches, but it is primarily used to conduct a ***precision*** instrument approach wherein the controller issues guidance instructions to the pilot, which is based on the aircraft's position in relation to the final approach course (azimuth), the glide path (elevation), and the distance (range) from the touchdown point on the runway, as displayed on the radarscope.

PAR systems typically have a range up to 20 miles, covering a sector of 20° in azimuth and up to 15° in elevation; consequently, only the final approach is covered. This differs from an ASR approach, which is non-precision (no elevation) and covers a broader area.

d. ASR Radar Software Functions. Minimum Safe Altitude Warning System (MSAW) is a software function of the Automated Radar Terminal System (ARTS) or Standard Terminal Automation Replacement System (STARS). ARTS refers to the entire radar system from radar unit through the computer processor to the radar display. A major function is its design to generate an alert when an aircraft with Mode-C is at, or predicted to be at, an unsafe altitude. MSAW monitors aircraft for terrain and obstacle separation and will generate an alert, both aural and visual, on the display of the air traffic controller. MSAW consists of two detection components: General Terrain Monitor (GTM) and Approach Path Monitor (APM).

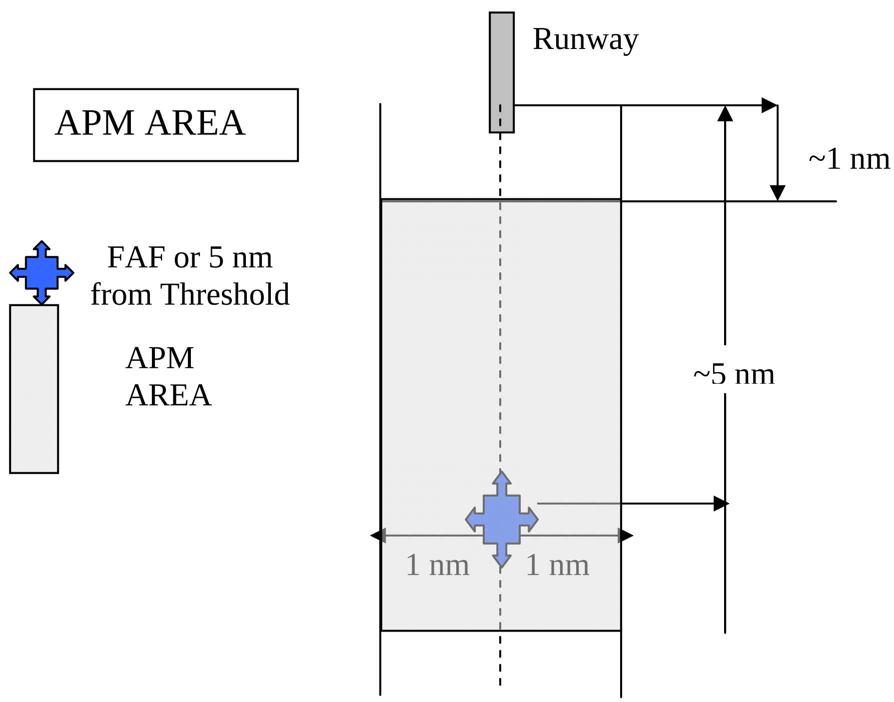
(1) General Terrain Monitor (GTM) exists within a radius of approximately 60 nm of the associated ASR site and consists of "bins" which are 2 nm square. Some locations may use half-mile square bins. Each bin is assigned an alert altitude determined by the highest terrain or obstacle that affects the bin *plus 500 ft*. When an aircraft is below, predicted to be below, or projected to go below the assigned bin altitude, an alert is generated on the radar display for the controller.

Figure 14-1
Generic General Terrain Monitor (GTM) Area



(2) **Approach Path Monitor (APM)**. An APM is normally 1 nm wide, either side of final approach course or runway heading. An APM starts at approximately 5 nm (or final approach fix) from the approach end of runway. The APM terminates at approximately 1 nm from the approach end of the runway. An altitude value is determined for obstruction clearance for each APM at the beginning and at the end of the APM. These two values provide MSAW protection as an aircraft descends along the approach path towards the runway. Parallel runways utilize the same APM. For a circling only SIAP, the APM starts at 5 nm (or final approach fix) from the closest landing surface and terminates 1 – 2 nm from the closest landing surface.

Figure 14-2
Approach Path Monitor (APM) Area



NOTE: Most Air Traffic Controllers are not aware of the difference between GTM and APM software. They use the term MSAW or "low altitude alert system" to include both systems.

Flight inspection of MSAW is a test of the ARTS or STARS software and <u>does not</u> affect the associated ASR status. There are **no** flight inspection tolerances.

14.11 MAINTENANCE ACTIONS AND PREFLIGHT REQUIREMENTS. The Technical Operations applicable service area maintenance engineering office and/or military equivalent is responsible for preparing the Operational Performance Inspection Plan in accordance with FAA Order 6300.13, Radar Systems Optimization and Flight Inspection. An inspection plan is required for all commissioning inspections and special inspections requiring coordination outside the facility of concern. Simple special inspections that do not require coordination outside the local AF/ Maintenance and AT offices may not require a formal inspection plan but should always be documented. Representatives of Air Combat Command (ACC) will participate in the planning and inspections of a Joint Surveillance Site (JSS).

a. Primary and Secondary Radar Facilities

(1) Activities **Requiring** a Confirming Flight Inspection:

(a) Anytime secondary radar directional output power is reduced below the minimum output power level, or the omni to directional power ratio is increased above the level previously flight inspected.

(b) When the responsible service area engineer, delegated by the service area technical operations division, deems it necessary to verify the operational capabilities of the equipment, due to circumstances affecting system performance.

(c) A flight inspection may be requested after installation of a new map, if displayed fixes are not coincident with those on the previously certified map. Fix/ map accuracy checks of FAA radar are not required after installation of a new map overlay, video map, or digital map, because of added or relocated navigational aids or fixes, if the controller is satisfied through evaluation of user traffic, that the new map is accurate. Controller/ maintenance personnel retain the option to request a special fix/map accuracy flight inspection.

NOTE: Initial evaluation of the facility will be conducted using targets-of-opportunity and radar data acquisition subsystems (RDAS). Final evaluation requires flight inspection.

b. Minimum Safe Altitude Warning (MSAW). Flight inspection of MSAW is a test of the ARTS or STARS software. There are no flight inspection tolerances.

The flight inspection crew will fly the detailed procedures as outlined in Paragraph 14.13q. Site specific data are available through the MSAW Quality Assurance Team. A General Terrain Monitor (GTM) check will be completed during the periodic interval. The flight inspection aircraft is a dedicated target for the alert check. Air Traffic/ AOS determines the final status of MSAW. The reported results will be based on the controller announcing that MSAW alerted or failed. Loss of radio or radar contact should be deemed an MSAW failure. Annotate on the DFL any MSAW alert failure. No MSAW flight inspection report is required. The FICO must report all MSAW alert failures to the Air Traffic Technical Operations Operational Support (AOS) MSAW Safety Team.

(1) **Preflight Coordination.** The flight inspector must ensure the following:

(a) When accessible, obtain site-specific data required for the check from the MSAW Web Site. If Internet access is not available, this data may be available from the FICO.

(b) Coordination with the air traffic representative has been accomplished prior to beginning an inspection.

(c) The altitudes to be flown and MSAW altitude alert points are clearly defined and understood.

(d) Conduct all flight inspection for MSAW in day VFR conditions.

(2) **MSAW is an ARTS or STARS software function.** MSAW results do not affect the associated ASR status.

c. **Facilities Maintenance Personnel.** The appointee preparing the inspection plan must coordinate with all associated offices. For en route sites, the attendees must be: Technical Operations representatives from the ARTCC and the remote site, AT representatives from the service area office and the ARTCC, and a flight inspection representative. The DOD user and appropriate ACC representative should attend planning meetings to identify operational requirements and evaluation objectives for a JSS. For terminal radar inspections, the appointed coordinators must include AT representatives from the region and local site, an AF representative from the systems maintenance office, and a flight inspection representative. Military offices must provide plan preparation and the required coordination for joint use and military sites.

The appointee for special plan preparation must be assisted by representatives from each office of concern. This assistance will be requested from specific offices when required. In addition to the procedures specified in Chapter 4, Facilities Maintenance personnel must ensure the following items are addressed in the inspection plan:

(1) **The Objectives of the Inspection.** These objectives will determine who must assist and provide input for the draft of the plan, the methods used to perform the various checks, and what checks will be performed by Facilities Maintenance personnel and flight inspection.

(2) **Prepare a List of Operational Requirements.** These requirements must describe in detail all routes, fixes, holding patterns, and approach and departure procedures. These details must include specified altitudes, distances, and other pertinent information. The list of routes, fixes, etc., may then be divided between evaluations using targets-of-opportunity and those requiring a flight inspection aircraft.

A flight inspection aircraft will normally be used in areas with low traffic activity, where siting criteria predicts marginal or no coverage, or where fix/ map accuracy must be determined. The flight inspection phase of the plan may be further divided into checks requiring an aircraft with a calibrated transponder and those which can be completed using a small aircraft equipped with an approved transponder. When assigned to inspect or evaluate a military/ JSS facility, the ACC representative must perform all coordination and notification requirements, complete the flight phase planning, and publish required documents.

(3) **Describe the Resources Required.** This list must include personnel, aircraft, special tools and equipment, equipment calibration, computer time and software, charts, graphs, maps, etc. The inspection plan must also include all data required to prepare, conduct, and document the inspection.

(4) **Flight Scheduling.** Recommend, if appropriate, the best flight period for evaluating coverage. The flight period will usually be a compromise between operational and engineering needs. This compromise is required because AT prefers to handle flight inspection aircraft during periods of low traffic activity; however, the AF engineer may require some portions of coverage checks during peak traffic periods.

(5) **Radar Equipment Performance.** Ensure the radar equipment is tuned to facility operational specifications prior to the flight inspection. A joint inspection is required to measure and optimize JSS equipment parameters.

(6) **Participating Personnel.** Ensure participating maintenance and operations personnel (including military) are experienced and familiar with the objectives of the inspection and the requirements of this order.

(7) **Inspection Plan.** Ensure the inspection plan includes a sequence of events to minimize aircraft flight time and the inconvenience to operating traffic. This portion of the plan must be used as a schedule of events during the inspection activities. Include a communications plan to cover the distances and altitudes to be flown during the vertical coverage profile.

(8) **Final Plan.** Ensure the final plan is reviewed and signed by representatives from AT, the FIFO, the military when appropriate, and Technical Operations.

(9) **Consolidated Inspection Data.** Consolidate and evaluate all inspection data obtained using targets-of-opportunity and advise the flight inspector of additional checks that require the use of a flight inspection aircraft.

(10) **Interrogator Calibration Values.** Furnish the interrogator power values (in watts at the antenna) for inclusion in the flight inspection report.

d. **Flight Personnel.** Prepare for the flight inspection in accordance with Chapter 4. In addition:

(1) **Flight Inspection Coordinator.** The FICO must ensure a qualified flight inspection representative is appointed as coordinator for each commissioning radar inspection and special inspection as required, in accordance with Paragraph 14.11a.

(2) **Inspection Plan.** A copy of the inspection plan and a current briefing concerning the operational requirements, expected facility performance, and the performance evaluations obtained using targets-of-opportunity must be provided to the flight inspector. This information will be used to determine the extent of the flight inspection.

(3) **Checklist Requirements.** Assist Facilities Maintenance personnel in determining which checklist requirements have been completed. The role of the flight inspector will vary greatly depending upon the type, sophistication, intended use, and location of the radar facility. For instance, an FAA en route radar may only require the flight inspector complete a portion of the vertical coverage check, whereas a mobile terminal radar may require a dedicated aircraft for all the checklist requirements.

(4) **Aircraft Requirements.** Flight inspection aircraft used for ATCRBS checks are equipped with a transponder that has been FAA-calibrated in accordance with applicable avionics maintenance standards. The transponder power output and sensitivity are pilot-selectable per the following table.

FLIGHT INSPECTION TRANSPONDER SWITCH SETTINGS		**FLIGHT INSPECTION TRANSPONDER PARAMETERS**	
Flt Insp Select	**Lo-Power Select**	**Rx Sensitivity**	**Tx Power**
OFF	OFF	Normal (-75 dBm)	Normal (350 watts)
ON (barber pole lit)	OFF	Low (-69 dBm)	Normal (350 watts)
ON (barber pole lit)	ON (barber pole lit)	Low (-69 dBm)	Low (88 watts)

(5) Transponder Requirements. Flight inspection aircraft are equipped with the ability to mimic two different classes of aircraft transponder equipment. Both ICAO and FAA allow for different equipment specifications depending on whether the aircraft is designed to operate above 15,000'MSL or not. Aircraft that operate above 15,000' MSL must have Class A transponders, and general aviation aircraft that only operate below 15,000'MSL can use less expensive Class B transponders. The major difference between the two Classes is output power, the strength of the reply signal sent back to the ground interrogator (ATCRBS). The maximum for both is 500 watts, but the minimum for Class A is 125 watts and the minimum for Class B is 70 watts. This can be simulated on FAA flight inspection aircraft by selecting the 'Lo-Power' mode on the transponder system. This cuts the output power from a nominal 350 watts to 88 watts, a nominal output power level for Class B (general aviation) aircraft. This ensures that the secondary surveillance radar system can see the less powerful transponders on general aviation aircraft. It also explains why the 'Lo-Power' mode is not used for flight inspection above 15,000'MSL.

Receiver sensitivity, or the Minimum Trigger Level (MTL) for an aircraft transponder is the same for all classes of transponders. It must fall in the range –69 dBm to –77 dBm. -77 dBm is a much weaker signal compared to –69 dBm. The transponders on the flight inspection aircraft have a nominal MTL of –75 dBm. When the 'Flt Insp Select' mode is switched on, it reduces the sensitivity so it takes at least –69 dBm to trigger the transponder. This models the worst case for the ground radar, requiring it to send out enough energy (the required power setting) so that the signal strength, by the time it reaches the aircraft, is at least –69 dBm. During a flight inspection, ATC may say that they can't see you when you are in flight inspection mode, but they can see all other aircraft just fine. The other aircraft they see probably have transponders with a MTL that is more sensitive than –69 dBm, while flight inspection is required to check the radar against the minimum standard as set forth in TSO-C74c, and ICAO SARPS. For further details on how transponders should be calibrated, see FAR Part 43, Appendix F.

14.12 FLIGHT INSPECTION PROCEDURES

a. Commissioning Inspections. The objective of the commissioning inspection is to evaluate system performance, determine and document the site coverage, and provide a baseline for the detection of a deterioration in equipment performance. Data obtained during this inspection will be used for daily comparison of facility performance, as well as future inspections. The commissioning is the most thorough inspection and requires a correspondingly detailed plan and report.

b. Periodic Inspections. ASR(s) with either surveillance approaches or MSAW function require a periodic flight inspection.

c. **Special Inspections.** Special inspections are conducted to fulfill a particular need and may be very limited in scope. The limited inspection may not require a formal written plan, and only a short inspection report. If equipment changes or modifications to commissioned facilities change the coverage pattern, document the changes in the inspection report. The new coverage pattern then becomes the basis for comparison during subsequent inspections. Coordination with appropriate military personnel is vital at joint-use sites. Special inspections include the following:

(1) **Engineering Support**. Engineering support is performed to help engineering and AT personnel determine if the radar meets equipment certification and operational requirements. This data may be used for commissioning purposes, provided no equipment modifications are made prior to the commissioning inspection. Requirements for specific checks will be determined by Facilities Maintenance personnel and need not conform to a specific format.

(2) **Antenna Change.** Paragraph 14.13, Checklist, identifies requirements for the installation of a new antenna of the same or different type. If there is a question concerning the characteristics or type of antenna being installed, the AF engineer in charge will determine which antenna change checklist applies. A flight inspection is not required following an antenna pedestal or rotary joint change, provided the ground measurements of the reflector position, feedhorn alignment, and antenna tilt of the replacement pedestal, are satisfactory. Refer to Paragraphs 14.14f(4)(d) and (e) for antenna change procedures.

(3) **Major Modifications** (other than antenna change). This inspection plan, inspection, and report should be confined to the parameters necessary to confirm facility performance. The radar engineer must determine the extent of a special inspection during preparation and coordination of the plan. Depending upon the extent of the modification, an inspection using RDAS tools and targets-of-opportunity may satisfy the inspection requirements.

(4) **Near-Midair-Collision Inspections.** These inspections are conducted at the request of the AT manager of the facility involved. The inspection determines the radar coverage in the area where the incident occurred. The flight inspection must be conducted as soon as possible following the near-midair-collision, duplicating the maneuvers, altitude, and direction of flight of the incident aircraft. The radar must be operated in the same configuration, to the extent practicable, as it was at the time of the incident. Near-midair flight inspection reports must be submitted in the same manner as after-accident reports (see Order 8240.36, Flight Inspection Report Processing System).

14.13 FACILITY CHECKLIST. The checks requiring a flight inspection aircraft are identified in the checklist and appropriate "detailed procedure" paragraphs. The procedures presented here may be used singly when a special inspection may be satisfied with one or more of the individual tests. The checklist items identified by an "X" are mandatory. Facilities Maintenance personnel must evaluate the data obtained using targets-of-opportunity to determine if further evaluation by a flight inspection aircraft is required. The flight inspector must consult with the radar engineer prior to departing the area to ensure that all checklist requirements have been completed. The following checklist items must be completed on each primary or secondary radar commissioning inspection.

CHECKLIST

	Para Ref	C	P	Antenna Change: Primary Same Type	Primary Diff Type	ATCRBS Same Type	ATCRBS Diff Type	Major Mods	Chapter-Settings: FI Transponder Lo-Pwr Select	Flt Insp Select
Orientation	14.14d	X		X	X	X	X	X	OFF	OFF
Tilt (3)	14.14e	X			X		X		OFF	ON
ATCRBS Power Optim	14.14f	X, 1					X, 1		OFF	ON
Primary Radar Optim	14.14g									
SLS/ ISLS	14.14h	X					X		OFF	ON
Modes/Codes	14.14i	X							OFF	ON
GTC/ STC	14.14j	X					X		ON	ON (Below 15,000 ft MSL)
									OFF	ON (Above 15,000 ft MSL)
Vertical Coverage	14.14k	X			X		X		ON	ON (Below 15,000 ft MSL)
									OFF	ON (Above 15,000 ft MSL)
Horiz Screening	14.14l								OFF	ON
Airways/ Route Coverage	14.14m	X,1							OFF	ON
Fix /Map Accuracy	14.14n	X							OFF	ON
Fixed Tgt Ident	14.14o	X							OFF	ON
Surveillance Apch	14.14p	X, 1	X,1	X, 1	X, 1				OFF	ON
MSAW (2)	14.14q	X	X						OFF	OFF
Communications	14.14b	X	X						As requested	
Standby Equip	14.14r	X							As requested	
Standby Power	14.14s	X							As requested	

FOOTNOTES: C = Commissioning P = Periodic

X Denotes mandatory check; see text for approved procedure. All other checks are at engineering/ maintenance/ controller request.

(1) Requires flight inspection aircraft for final evaluation. All other checks may be accomplished by software analysis using targets of opportunity or radar data acquisition subsystems (RDAS).

(2) Check existing GTM and APM features during commissioning. If either of these is not available during commissioning, they do not require a flight inspection prior to use. Only the GTM must be checked during a periodic inspection. APM checks are accomplished by request (e.g., a maintenance or ATC request).

(3) An ATCRBS power optimization must be performed with a flight inspection aircraft following an increase in antenna tilt.

14.14 DETAILED PROCEDURES. With the exception of an Airport Surveillance Approach (ASR), Flight Inspection aircraft act as a dedicated target for maintenance personnel in order to adjust or configure the RADAR equipment. Fly all requested maneuvers at cruise airspeed unless otherwise directed or at the Flight Inspector's discretion.

a. General. Facilities Maintenance personnel must use operational displays for target grading and guidance information. Facilities Maintenance personnel must configure the radar in its lowest usable configuration (the traditional worst case configuration, all enhancements on, may degrade newer "smart" radars to the point that they become unusable). Data from the operational displays and automation diagnostic and analysis programs will determine if the system supports operational requirements. When using targets-of-opportunity, multiple target returns are required to ensure accuracy. Verify questionable accuracy with a flight inspection aircraft. ATCRBS and primary radar must be evaluated simultaneously throughout the inspection whenever possible. If ATCRBS replies obscure the primary targets, the displayed ATCRBS should be offset slightly to allow evaluation of both replies.

b. Communications. Evaluate VHF/ UHF communications capability within the radar coverage area. When flight inspection aircraft are not equipped for UHF communications, the inspection can be completed using VHF only. UHF coverage may be confirmed by the appropriate air traffic facility via targets of opportunity.

c. Inspection Sequence. The Radar engineer must ensure the facility is operating according to design specifications before any inspection tests begin. The ATCBRS is normally inspected simultaneously with the primary radar system. Tests which can be completed without using a flight inspection aircraft should be conducted prior to the arrival of the flight inspection aircraft. The inspection should begin with:

- Orientation
- Tilt
- ATCRBS Power

NOTE: Parameter changes that occur during the flight inspection aircraft evaluation may require a repetition of previously conducted tests.

d. Orientation Check is accomplished to verify the radar azimuth corresponds with a known azimuth position and may be conducted with a flight inspection aircraft or ground check.

(1) AFIS/ Equipment Setup

(a) Enter Lat/ Long of Facility in AFIS to fly Reference Radial

(b) Flight Inspection Transponder settings:

Lo-Power Select: Off
Flt Insp Select: Off

(2) **Maneuvering.** Fly inbound or outbound radially over a well-defined ground checkpoint or position the aircraft using AFIS. The altitude and distance of the checkpoint should be well inside the radar coverage limits.

(3) **Analysis.** Compare the azimuth observed by the controller with the magnetic azimuth of the checkpoint.

NOTE: A radar permanent echo (PE), maintenance beacon, or moving target indicator (MTI) reflector of known location may be used to determine alignment of the radar azimuth in lieu of a flight inspection aircraft.

e. **Tilt Verification** is accomplished to verify the primary and secondary radar antenna tilt settings are optimum and the mechanical antenna tilt indicators are accurate.

(1) **AFIS/ Equipment Setup**

(a) Flight Inspection Transponder settings:

Lo-Power Select: Off
Flt Insp Select: On

(2) **Maneuvering.** Facilities maintenance personnel will direct the aircraft through the heaviest ground clutter within operational areas so the predetermined angle can be evaluated and adjustments made, if required.

(3) **Analysis.** The tilt selection process considers the interaction of various radar parameters and the final radar performance. The optimum tilt angle is a compromise between coverage, (With or without MTI), over clutter and range coverage.

Facilities maintenance personnel must direct the aircraft through the heaviest ground clutter within operational areas so the predetermined angle can be evaluated and adjustments made if required. If radar coverage is acceptable and the radar range is satisfactory, complete the remaining portions of the flight inspection.

If parameters are not acceptable, it will be necessary to reestablish the antenna tilt angle. In this case, re-accomplish any previously completed flight inspection procedures using the new antenna tilt angle.

NOTE: Checks may be accomplished by software analysis using targets of opportunity or radar data acquisition subsystems (RDAS).

f. **ATCRBS Power Optimization** (Flight Inspection Aircraft Required) is accomplished to reduce over-interrogation, over-suppression, False Replies Unsynchronous in Time (FRUIT), and false targets caused by reflections. Optimum ATCRBS power must be the *minimum* ATCRBS power to meet operational requirements.

(1) **AFIS/ Equipment Setup**

(a) Flight Inspection Transponder settings:

Lo-Power Select: Off
Flt Insp Select: On

(b) Enter the Lat/ Long of the RADAR antenna in AFIS VOR mode to generate arc data.

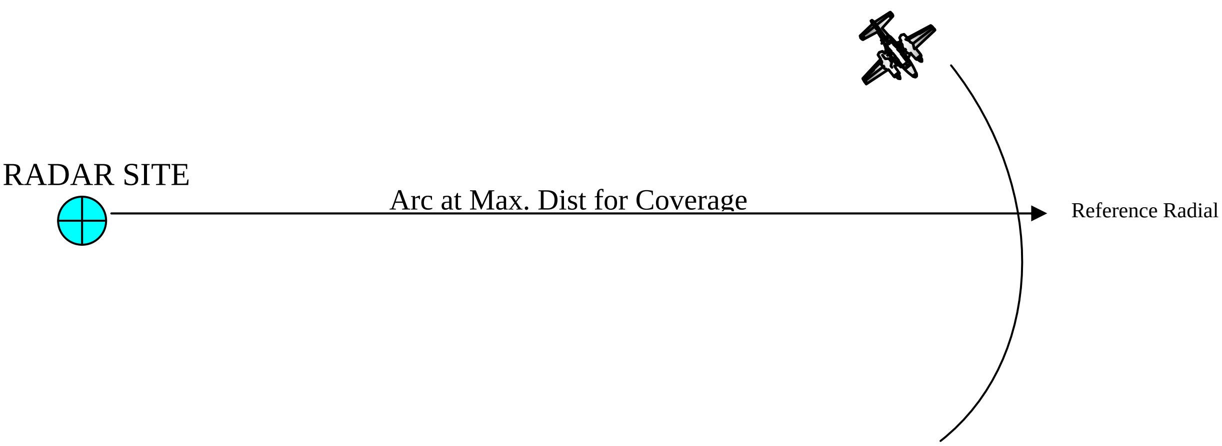
(2) **Maneuvering**

(a) Position the aircraft to fly an arc in the vicinity of the vertical coverage radial or mutually agreed to reference radial at maximum distance.

(b) The aircraft altitude will be 10,000 ft for ASR(s) and 30,000 ft for ARSR(s), or as close to these altitudes as operational conditions allow.

(c) The beacon transmitter power must be adjusted to the minimum value that produces a usable beacon reply or target. During this check, ensure that aircraft does not shield the aircraft transponder antenna.

Figure 14-3
ATCRBS Power Optimization Flight Profile



(3) Analysis. Facilities maintenance personnel must observe ATCRBS performance during the ATCRBS power optimization for a useable beacon reply. The beacon transmitter power should be adjusted to the minimum value that produces a usable beacon reply or target. Vertical coverage as flown by a flight inspection aircraft or targets-of-opportunity must be checked using the power level established in this paragraph. The beacon must be commissioned at this power level, plus 1 dB.

NOTE: Power optimization must be performed with a flight inspection aircraft following an increase in antenna tilt. Although this test may be accomplished during the vertical coverage check, any changes made in beacon power, as a result of this test, will invalidate any portion of the flight inspection checked previously.

g. Primary Radar Optimization is performed to aid in maximizing the radar's potential. Adjustments in Sensitivity Time Control (STC), beam gating, receiver sensitivity, pulse width, etc., may improve a radar's performance.

(1) AFIS / Equipment Setup: None

(2) Maneuvering. Facilities maintenance personnel will provide a detailed flight profile and observe the target display while adjusting the radar, as necessary. (See Supplemental section).

(3) Analysis. Facilities maintenance personnel will observe the target display and adjust the radar as necessary.

h. **Side-Lobe Suppression (SLS).** Sets transmitter power levels in the beacon SLS or Interrogation path SLS (ISLS) antenna elements. The use of SLS/ ISLS improves beacon performance, reducing or eliminating ring-around caused by the side lobes of the antenna pattern. ISLS also reduces false targets that are normally caused by close, vertical reflecting surfaces. This check may be accomplished using targets of opportunity or flight inspection aircraft. Facilities maintenance personnel must select azimuths to be checked in areas where side lobe problems have occurred in the past.

(1) **AFIS/ Equipment Setup.** Flight Inspection Transponder settings:

Lo-Power Select: Off
Flt Insp Select: On

(2) **Maneuvering.** Fly the selected radials at 1,000 ft above the radar site elevation to the coverage limits (normally line-of-sight).

(3) **Analysis.** Maintenance personnel must adjust the SLS or ISLS power levels while observing beacon inner-range coverage. The power levels must be adjusted for minimum ring-around and false target returns. After making final adjustments, ensure that inner range coverage is still satisfactory.

i. **ATCRBS Modes and Codes.** Verifies the proper decoding of ATCRBS reply pulses. Facilities maintenance personnel must ensure that all modes and codes are verified by equipment test procedures before requesting flight inspection. Codes 7500, 7600, and 7700 should not be used due to the possibility of alarming other facilities.

(1) **AFIS/ Equipment Setup.** Flight Inspection Transponder settings:

Lo-Power Select: Off
Flt Insp Select: On

(2) **Maneuvering.** Fly profiles or in areas as requested by maintenance personnel.

(3) **Analysis.** Maintenance personnel will monitor the flight inspection aircraft transponder replies or targets-of-opportunity throughout the vertical coverage, airway, route, and terminal checks to verify correct altitude readout.

NOTE: During these tests, facilities maintenance personnel may request the flight inspection aircraft use different modes or codes to sample various modes and code trains.

j. **ATCRBS Gain Time Control (GTC)/ Sensitivity Time Control (STC)** is conducted to evaluate the GTC/ STC setting. It must be adjusted prior to the flight inspection and confirmed during the vertical and airway/route coverage checks. GTC/ STC reduces the interrogator receiver gain, as the range to the station reduces, thereby reducing ring-around and false targets.

(1) **AFIS/ Equipment Setup**

(a) **Flight Inspection Transponder settings:**

(Below 15,000' MSL)	(Above 15,000' MSL)
Lo-Power Select: On	Lo-Power Select: Off
Flt Insp Select: On	Flt Insp Select: On

(b) Enter Lat/ Long of Facility in AFIS to fly Reference Radial.

(2) **Maneuvering**

(a) Position the aircraft on the vertical coverage radial or mutually agreed to reference radial.

(b) Either inbound or outbound.

(c) At 10,000 feet AGL for ASR(s) and at 30,000 ft AGL for ARSR(s) or as close to these altitudes as operational conditions allow.

(3) **Analysis.** Facilities maintenance personnel must examine the received beacon signal during the entire radial (fringe to fringe). Maintenance personnel must observe the display for minimum false ATCRBS targets or ring-around. A fairly constant signal level over the entire radial indicates correct GTC/ STC setting.

NOTE: Checks may be accomplished by software analysis using targets of opportunity or radar data acquisition subsystems (RDAS).

k. **Vertical Coverage.** Determines and documents the coverage in the vertical plane of the primary and ATCRBS antenna patterns. Evaluates the inner and outer fringes on all primary and secondary radars.

(1) **AFIS/ Equipment Setup**

(a) **Flight Inspection Transponder settings:**

(Below 15,000' MSL)	(Above 15,000' MSL)
Lo-Power Select: On	Lo-Power Select: Off
Flt Insp Select: On	Flt Insp Select: On

(b) Enter the Lat/ Long of the RADAR antenna in AFIS VOR mode to display reference radial data.

(2) **Maneuvering.** Facilities Maintenance should choose an azimuth from the radar antenna or coincident VOR/ TACAN radial from the radar antenna which is free of clutter, dense traffic, heavy population areas, and interference created by line-of-site obstructions. (Conduct the commissioning inspection and all subsequent inspections concerning facility performance, on the same azimuth). Should an ASR or ARSR require commissioning, use the following flight patterns at standard cruise speeds. Coordinate maneuvers with Maintenance and Air Traffic prior to flight.

Have Facilities Maintenance personnel determine the lowest usable radar configuration. Suggested configurations are:

System Parameter	Setting
Antenna Polarization	Circular
Diplex Systems	Simplex mode
Integrators/ Enhancers	OFF
Magnetron/ Amplitron Systems	Amplitron (See Note)
Video Processor (military mobile radar)	OFF
ASR-9 Display Video	Uncorrelated
ARSR-3 Target Threshold	91
ARSR-3 MTI: I & Q	"I"

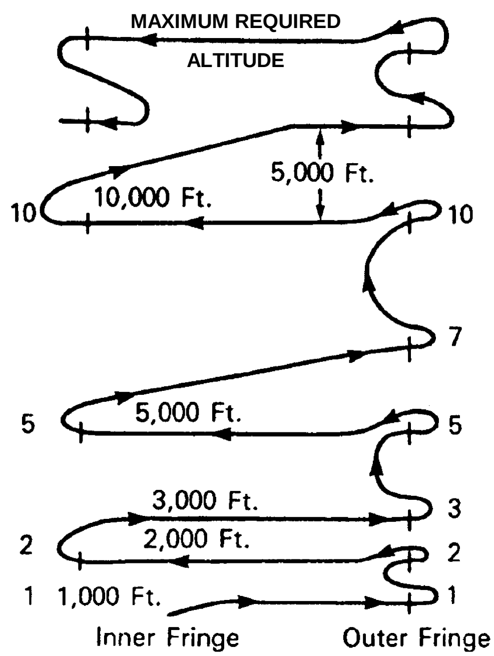
NOTE: At the request of engineering, conduct an additional vertical coverage check for the ARSR 1 & 2 with the Amplitron OFF. It is not necessary to conduct the entire vertical coverage; only a spot-check of altitudes and ranges, as specified by the engineer.

(3) **Mobile Military Facilities:**

NOTE: For inspections of USAF mobile facilities where the operational requirements do not dictate flying the profile to the outer fringe, or the complete coverage check is not requested, the coverage will be requested to operational range requirements plus at least 10%. A statement should be made in the Remarks Section that coverage was made to operational requirements plus 10%. The facility status will be restricted.

(a) **Commissioning Vertical Coverage Profile, ASR/ ATCRBS**

Figure 14-4
Commissioning Vertical Coverage Profile, ASR/ ATCRBS



<u>**1**</u> Determine the inner fringe at 1,000 ft. Then fly outbound at 1,000 ft and establish the outer fringe.

<u>**2**</u> Climb to 2,000 ft and establish the outer fringe. Then proceed inbound at 2,000 ft and establish the inner fringe.

<u>**3**</u> Climb to 3,000 ft and establish the outer fringe.

<u>**4**</u> Climb to 5,000 ft and establish the outer fringe.

<u>**5**</u> Repeat the outer fringe check at 5,000 ft (or lower if necessary) to evaluate radar auxiliary functions such as linear polarization, pin diode, integrators, etc., on the primary and GTC/STC on the secondary radar. Linear polarization normally increases the usable distance, so this check should be performed at an altitude where the change can be observed. Most auxiliary functions produce a decrease in receiver sensitivity, thereby decreasing the usable distance. Conduct these tests by establishing the outer fringe with the function on, and then off, and noting the difference in usable

6 Return the equipment to its original inspection configuration and proceed inbound at 5,000 ft and establish the inner fringe.

7 Climb to 7,000 ft and establish the outer fringe.

8 Climb to 10,000 ft and establish the outer fringe. Then proceed inbound at 10,000 ft and establish the inner fringe.

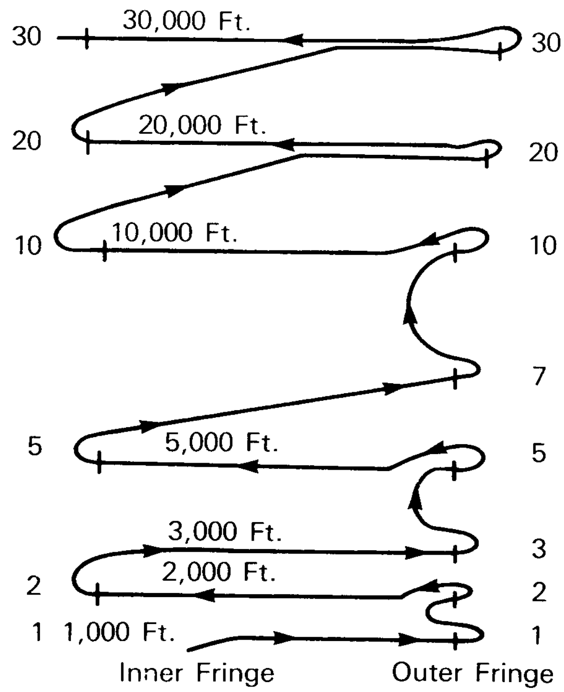
9 If the maximum required altitude is greater than 10,000 ft, check the outer fringe in 5,000-foot increments up to the maximum required altitude; e.g., if 17,000 ft, check the outer fringe at 15,000 and 17,000 ft, then proceed inbound at the maximum required altitude and establish the inner fringe. If satisfactory radar coverage is not maintained during this inbound run, conduct additional flights through the vertical coverage pattern and establish the maximum usable altitude.

10 Check the inner fringe at the altitudes used to establish the outer fringe stepping down in altitude to the 10,000-foot level.

NOTE: If the maximum required altitude is 10,000 ft or lower, do not inspect vertical coverage above this altitude unless requested.

(b) Commissioning Vertical Coverage Profile, ARSR/ ATCRBS

Figure 14-5
Commissioning Vertical Coverage Profile, ARSR/ ATCRBS



1 Complete steps (1) through (10) of the ASR commissioning requirements.

2 Climb to 20,000 ft and establish the outer fringe. Then proceed inbound at 20,000 ft and establish the inner fringe.

3 Climb to 30,000 ft and establish the outer fringe.

4 Repeat the outer fringe as required conducting auxiliary functions tests.

5 Then proceed inbound at 30,000 ft and establish the inner fringe.

If operational or engineering requirements are greater than 30,000 ft or 30,000 ft conflicts with air traffic, climb to a mutually agreeable altitude and establish the outer and inner fringes.

__6__ **Analysis.** When using flight inspection aircraft to verify questionable accuracy, determine the outer fringe coverage by evaluating tail-on targets and the inner fringe coverage by nose-on targets. Ask maintenance for the vertical coverage azimuth and maximum required altitude. Use map checkpoints, a NAVAID radial, AFIS, or radar vectors to remain on the vertical coverage azimuth. Fly all pattern altitudes as height above the radar antenna.

(c) Commissioning Military BRITE/ DBRITE Display. Inspect an ASR, which has the sole function of providing a video source for a BRITE/ DBRITE display, to operational requirements or 4,000 ft or 10 miles, whichever is greater.

__1__ **AFIS/ Equipment Setup**

__a__ Fight Inspection Transponder settings:
(Below 15,000' MSL)
Lo-Power Select: On
Flt Insp Select: On

__b__ Enter the Lat/ Long of the RADAR antenna in AFIS VOR mode to display reference radial data.

__2__ **Maneuvering.** Determine the inner and outer fringes at every 1,000-foot level up to 4,000 ft or the operational altitude.

__3__ **Analysis.** No comparative equipment auxiliary function configuration checks are required. Target definition will be from the BRITE display.

(d) **Primary Radar Antenna Change.** When the primary ASR or ARSR antenna is changed, fly the appropriate vertical coverage profile depicted below.

Figure 14-6
ASR- Terminal Radar Profile

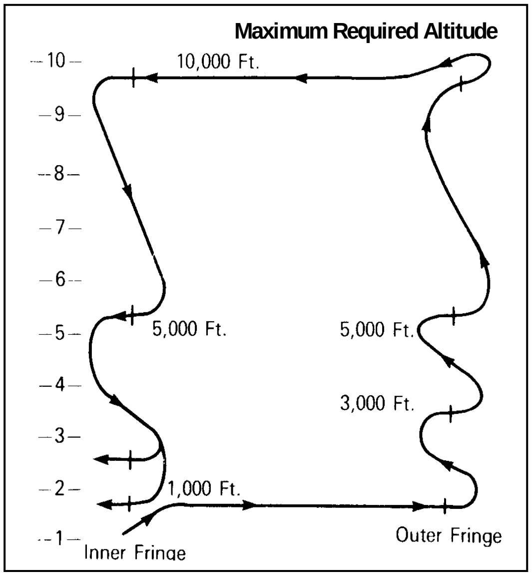
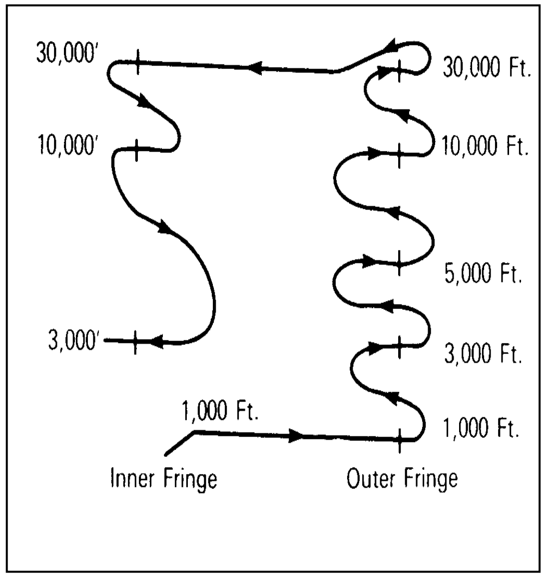


Figure 14-7
ARSR- En Route Radar Profile



1 **Maneuvering:**

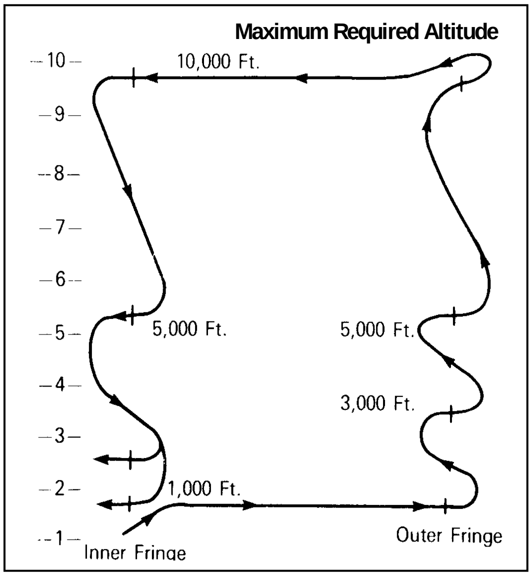
a After determining the outer fringe at 5,000 ft, repeat the outer fringe check, as required, to evaluate auxiliary functions if requested by maintenance.

b Conduct the remainder of the coverage check in the original configuration.

c Checks of additional facility equipment configurations and altitudes will be at the option of maintenance.

(e) ATCRBS Antenna Change. When replacing the antenna with the same type, all inspection requirements may be completed using targets-of-opportunity. When the antenna is replaced with a different type, checklist requirements must be completed using a flight inspection aircraft as required by the checklist.

Figure 14-8
ATCRBS Antenna Change Profile



1 **Maneuvering.** The profile is the same as Commissioning Vertical Coverage Profile, **ARSR/ ATCRBS,** above.

2 **Analysis.** Maintenance will record target strength on each scan, aircraft position every five miles, and aircraft altitude for each fringe check and level run and will document results of the vertical coverage check using analysis/ diagnostic programs (RDAS tools), when available, for inclusion in the facility report.

l. **Horizontal Screening** is accomplished to verify the indicated coverage on the horizontal screening charts. This test is optional, depending upon operational requirements and ground evaluation tools available. After reviewing the results of the vertical coverage check and other data, engineering personnel will determine if the horizontal coverage check is required.

(1) **AFIS/ Equipment Setup**

(a) Flight Inspection Transponder settings:

Lo-Power Select: Off
Flt Insp Select: On

(b) AFIS, DME, or vectors provided by the controller may be used to maintain the orbit.

(2) **Maneuvering.** Fly an orbit at an altitude and distance that corresponds to the lowest screening angle at which coverage is expected. Do not use an orbit radius of less than ten miles.

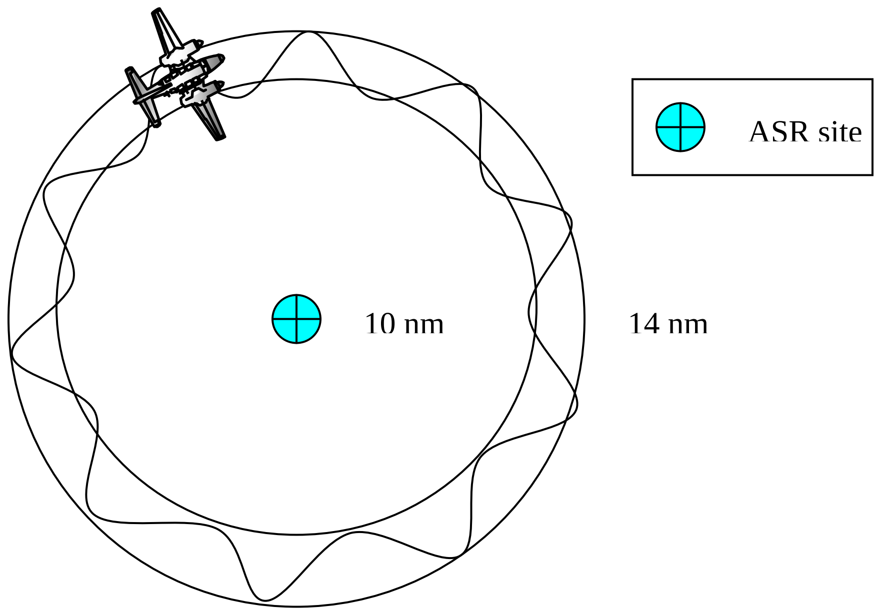
NOTE: MTI, if used, should be gated to a range inside the orbit radius, except where ground clutter obscures the targets unless MTI is used. If MTI is gated outside of the orbit, the radius of the orbit must be constantly changed to avoid target cancellation due to tangential blind speed. For example, vary the distance on a 12-mile orbit between 10 and 14 miles, flying oblique straight courses between the 10-mile and 14-mile orbits, so as to average a 12-mile orbital distance. (See Figure 14-1)

The blind speed formula is as follows: V=291(PRF)/F

Where:

V= Groundspeed (knots)
PRF= Pulse Repetition Frequency (pulses/sec)
F= Transmitter Frequency (MHz)

Figure 14-9
Horizontal Screening Flight Profile



(3) **Analysis.** Facilities Maintenance personnel must record target strength, azimuth and distance every scan. They must determine if the coverage supports operational requirements.

m. **Airway/Route Coverage.** Maintenance personnel must determine the extent of these evaluations, which determine the overall radar facility coverage and document coverage along routes and airways. Areas of intense clutter, poor target returns, or other potential problems identified in the inspection plan may be further evaluated to determine actual facility coverage. This check must be accomplished using targets-of-opportunity with the ***final commissioning check*** done with a flight inspection aircraft.

(1) **AFIS / Equipment Setup.** Flight Inspection Transponder settings:
Lo-Power Select: Off
Flt Insp Select: On

(2) **Maneuvering.** Configure the primary radar in "circular polarization". Fly the minimum altitude (not lower than MOCA) on airway centerline to determine at which altitudes satisfactory radar coverage exists. Fly terminal arrival and departure routes and other areas of interest at MOCA. Maintain course guidance by reference to AFIS, ground checkpoints, NAVAID signals, or radar vectors.

(3) Analysis. Coverage verification using linear polarization may be checked at the discretion of the test engineer or, if a joint use site, by the DOD agency. Facilities Maintenance personnel must determine if the facility coverage meets operational requirements.

n. Fix/ Map Accuracy. Used to verify all airways, routes, fixes, and runway centerlines on the video map display. Replacement map overlays, video maps, or digitally generated maps do not require a flight inspection if maintenance can determine, using targets-of-opportunity, that the new map is accurate. Flight inspection of radar map overlays used as a backup for a video map need not be accomplished, provided the overlay contains data which is identical to a video map display which has been satisfactorily inspected.

(1) AFIS/ Equipment Setup. Flight Inspection Transponder settings:

Lo-Power Select: Off
Flt Insp Select: On

(2) Maneuvering. Fly the minimum altitude where satisfactory radar coverage exists using NAVAID guidance, ground checkpoints, or AFIS to identify the airway, route, or fix.

(3) Analysis. Maintenance personnel will compare reported aircraft position relative to the airway, route, or fix with the video map presentation and apply the appropriate tolerance. Similarly, verify runway centerline to video map alignment by observing landing and departing aircraft.

o. Fixed Target Identification is accomplished to identify prominent, primary broadband targets used for range and azimuth accuracy checks when they cannot be identified by other means. This check may be accomplished using targets-of-opportunity or flight inspection aircraft.

(1) AFIS/ Equipment Setup. Flight Inspection Transponder settings:

Lo-Power Select: Off
Flt Insp Select: On

(2) Maneuvering. Maintenance will select identifiable features from a comparison of the ground clutter return and geographic maps (islands, mountain peaks, towers, etc.). They should direct the pilot to the PE return. If the pilot can identify and describe the ground target, and the target is a permanent feature, record the PE in the inspection report.

p. Surveillance Approaches. All ASR approaches must be checked for accuracy and coverage by a flight inspection aircraft during commissioning inspections or any time a new approach procedure is developed. ASR approaches are not authorized using ATCRBS only, and the ATCRBS display should be offset. However, Air Traffic regulations do allow for ATCRBS-only surveillance approaches in an emergency situation. ATCRBS coverage during an approach is not required, but the controller should be aware of any gaps in coverage and relay that information to the flight inspector for inclusion in the flight inspection report.

ASR approaches must also be checked on a periodic basis. Surveillance approaches must be evaluated using surveillance type radarscopes. Conducting an ASR approach on a PAR display <u>is not</u> acceptable for flight inspection purposes. However, it is not uncommon for military radar operators to conduct ASR approaches using a PAR radar where no ASR radar is available. While this is technically a PAR azimuth-only approach, it may not be documented as such.

(1) AFIS/ Equipment Setup. Flight Inspection Transponder settings:

Lo-Power Select: Off
Flt Insp Select: On

(2) Maneuvering

(a) Approach to a Runway. Fly a standard approach in the appropriate configuration and airspeed. Adhere to the final controllers instruction as stated. The approach course must coincide with the runway centerline extended and must meet accuracy and coverage tolerances.

(b) Approach to an Airport. Fly a standard approach in the appropriate configuration and airspeed. Adhere to the final controllers instruction as stated. The approach course must be aligned ***to the MAP*** as determined by procedures and maintenance personnel.

Helicopter-only final approach courses may be established to a MAP no farther than 2,600 ft from the center of the landing area.

For both approaches, the controller must provide vectors for a 10-mile ASR final approach. The flight inspector must fly at MVA until reaching the final approach segment. Prior to the final segment, compare published minimum descent altitude (MDA) with MDA provided by the air traffic controller. The final approach segment must be flown flying headings as provided by the air traffic controller. Descend to the minimum descent altitude and verify recommended altitudes on final.

(3) **Analysis.** While inbound, evaluate the approach procedure, obstacles, approach/ runway lights, aircraft position relative to the runway centerline extended/ airport, and if a landing can be made without excessive maneuvering. ASR approaches must meet flight inspection tolerances or be canceled by appropriate NOTAM action. The cancellation of an ASR approach does not constitute a restriction on the radar facility. When MTI is required for an ASR approach, information must be documented on the flight inspection report. The use of MTI does not constitute a facility restriction; however, ASR approaches that require MTI are NOT authorized when this feature is inoperative.

q. **Minimum Safe Altitude Warning (MSAW)/ General Terrain Monitor (GTM) Validation.** Confirm radar identification and MSAW check in progress with the air traffic controller. Perform all checks in Normal/ Normal transponder setting on an MSAW **uninhibited** beacon code.

(1) **AFIS/ Equipment Setup.** Flight Inspection Transponder settings:

Lo-Power Select: Off
Flt Insp Select: Off

(2) **Maneuvering**

(a) **Approach Path Monitor (APM):** Between the initial point 5 nm prior to approach end of the runway (AER) or FAF, whichever is first, and the APM cut-off point, descend below the normal approach path into the approach path monitor area. MSAW will alert at or prior to the monitored area, depending on rate of descent. The APM cut-off point will be 1 – 2 nm prior to AER. For a circling only SIAP, the APM starts at 5 nm (or FAF) from the closest landing surface, and terminates 1 – 2 nm from the closest landing surface.

(b) **General Terrain Monitor (GTM):** Within 55 nm of the ASR, descend from MVA at a safe but accelerated rate of descent. Depending on rate of descent, MSAW will alert at or prior to the assigned bin altitude. Perform the GTM check at least 10 nm from airports that have an APM. Ask the air traffic controller to verify that the MSAW alerted properly.

NOTE: Consult the MSAW data sheet and query the controller to ensure that the beacon code in use is not inhibited. (Certain beacon codes, like those "tagged" VFR, can be MSAW inhibited.) The MSAW data sheet will provide the exact dimensions of the APM alert area.

Most air traffic controllers are unfamiliar with the terms APM or GTM. Simply refer to these checks as "Low Altitude Alert tests" or simply "MSAW Check".

All alert failures (APM or GTM) must be documented on the Daily Flight Log and reported to Flight Inspection Central Operations. Record the required information on the DFL as described in Appendix 12.

r. **Standby Equipment.** The purpose of this check is to evaluate the performance of standby equipment, and may be accomplished during pre-inspection testing using targets-of-opportunity. If standby equipment is available but not working, the flight inspector must be notified. Some radar installations are engineered to meet reliability requirements by the use of redundant parallel units, instead of standby transmitters. Conduct flight inspection of these facilities while the system is operating in parallel. A separate check of each channel is not required. Some replacement radar units are collocated in the building with the primary radar and share the same waveguide and antenna during installation and checkout. In this case, the standby transmitter cannot be placed in operation without an extended facility shutdown. The pre-inspection testing of these systems must thoroughly test all redundant and standby units to ensure they meet or exceed tolerances established on the flight inspected channel. A standby antenna (duplicate) may be installed at selected locations to provide continued radar service, in the event of antenna failure. The commissioning requirements for a standby antenna will be completed using the antenna change checklist.

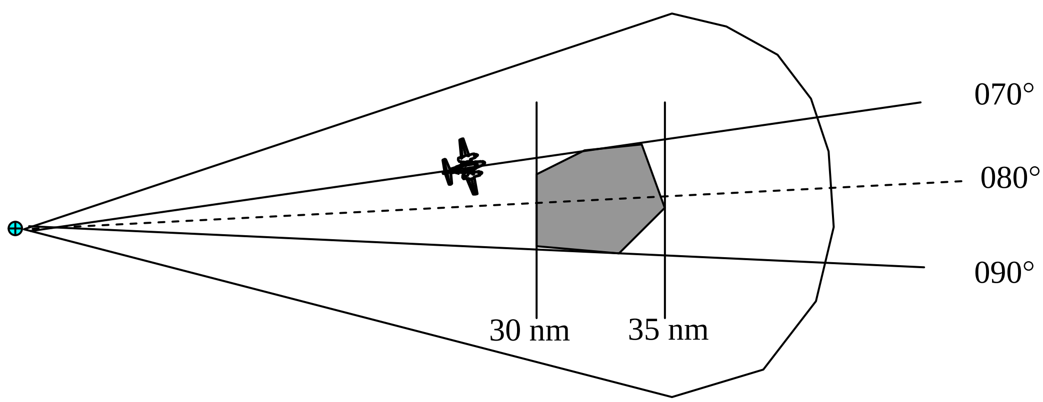
s. **Standby Power.** The purpose of this check is to evaluate radar performance on standby (engine generator) power and must be conducted during pre-inspection testing. Results are satisfactory when the engine generator monitor equipment detects a power failure, starts the engine, and switches to the engine power without manual intervention. Conduct this test with a simulated power failure by manually switching out the incoming commercial power.

t. Probing. Missed targets can be caused by antenna lobing, line-of-sight, aircraft altitude, or antenna tilt. Therefore, isolated or non-recurring target misses are to be expected. If three or more consecutive misses are experienced, determine if a hole exists in the radiation pattern and determine its size. If holes or poor coverage are discovered, they must be evaluated to determine the effect on the operational requirements. Holes in radar coverage are probed in a manner similar to rho-theta or TACAN techniques.

(1) Maneuvering. The following procedure may be used as a guide:

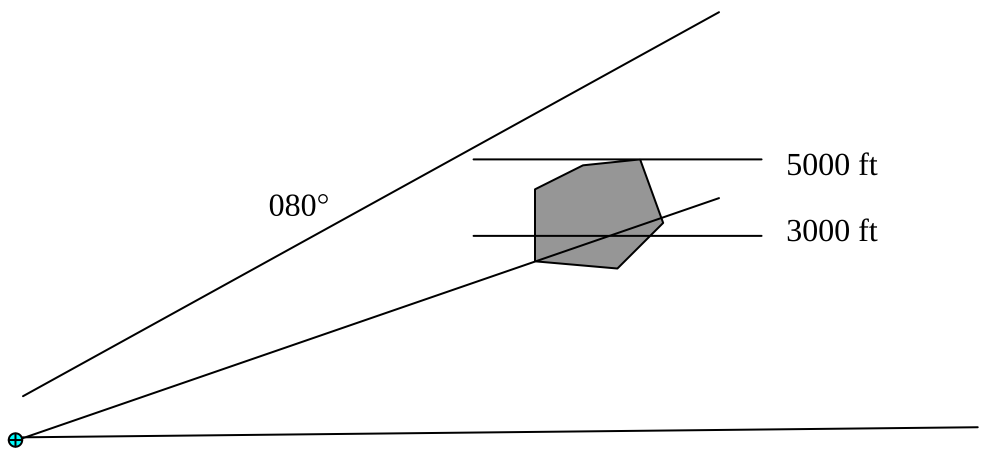
(a) Horizontal. Fly through the area of the suspected hole to determine the inner and outer boundaries. Vary the aircraft position every 10° of radar azimuth until the lateral limits are established.

Figure 14-10
Horizontal Probing



(b) **Vertical.** Fly through the center of the pattern established in the horizontal probing procedure at 1,000-foot increments to determine the upper and lower limits of the hole.

Figure 14-11
Vertical Probing



14.15 TOLERANCES

Parameter	Reference	Tolerance/Limit
Target Strengths Broadband/Reconstituted		
3—usable		Target leaves trail or persists from scan-to-scan without trail.
2—usable		Target shows each scan, remains on the display for at least 1/3 of the scan.
1—unusable		Weak target, barely visible, possible miss.
0—unusable		No visible target.
Narrowband		
1—usable		Visible target, satisfactory for ATC purposes.
0—unusable		No visible target, unsatisfactory for ATC.
Usable Target		Target which is not missed/ unusable on three or more consecutive scans.
Orientation Maximum azimuth difference between actual and indicated for broadband and narrowband radar systems.	14.14d	$\pm 2^0$
Tilt	14.14e	No airborne tolerance.
Coverage		
Vertical - from inner to outer fringe	14.14g	Meets operational requirements at all altitudes.
Horizontal	14.14l	No tolerance.
Approaches, airways, arrival and departure routes, and fixes route/ procedure	14.14m	A usable target return must be maintained along the entire route or throughout the procedure.
Accuracy		
Fix/map	14.14n	Within 3% of aircraft to antenna distance or 500' (1,000' for ATCRBS), whichever is greater. [3% exceeds 500 ft at distances over 2.74 nm.]
Approaches	14.14p	
Straight-in		Within 500' of runway edge at MAP.
Circling		Within a radius of the MAP which is 3% of the aircraft to the antenna distance or 500', whichever is greater.
Altitude Readout	14.14i	± 125' of altitude displayed in the cockpit relative to 29.92 in Hg.
ATCRBS Power	14.14f	No tolerance
GTC/STC	14.14j	No tolerance
Communications	Chapter 8	
Standby Equipment	14.14r	Same as main equipment
Standby Power	14.14s	

14.16 DOCUMENTATION. The AF regional office of concern, or military equivalent, will compile and complete the facility inspection performance report. It will be a detailed accounting of all coverage data obtained using ground testing data, flight inspection aircraft, targets-of-opportunity, RDAS tools, and all flight inspection report information. The report submitted by the flight inspector must contain only that information evaluated by the flight inspection crew. At joint use sites, a separate report will be published, under the direction of Air Combat Command and North American Aerospace Defense Command.

14.17 FACILITY PERFORMANCE. The facility inspection performance report must reflect an assessment of facility performance determined by the facility engineer in charge (or military equivalent). The flight inspection report must reflect a flight inspection status [unrestricted, restricted, or unusable] jointly determined by the flight inspector and Facilities Maintenance personnel. Inaccuracies beyond established tolerances in range and azimuth for fix/ map targets or surveillance approaches will be the basis for the flight inspector to restrict the system or to request that it be removed from service until the condition is corrected.

14.18 TABLES/ SUPPLEMENTAL INFORMATION

Sample Flight Inspection Plan for Tyndall AFB, Florida
AN/ GPN-20 ASR—Special (MR)

SITE INFORMATION	**Tyndall AFB FL (Panama City) KPAM**
Site Latitude	30° 04' 06.9" N (WGS-84)
Site Longitude	85° 33' 35.1" W (WGS-84)
Site Elevation	6.60 ft MSL
Airspace	Surface – FL230
Required Radar Coverage	60 nm
Estimated Flight Time	4 Hours
EQUIPMENT SETTINGS	
Equipment Type	AN/GPN-20 (ASR-8)
ASR Bore-sight Elevation	74.40 Feet MSL (67.80 ft AGL)
PSR Antenna Tilt	1.8° (electrical)
SSR Bore-sight Elevation	82.40 ft MSL (75.80 ft AGL)
SSR Antenna Tilt	0.0° (mechanical)
Antenna Speed (RPM)	16.27
Channel	B
Polarization	Circular
Features	STC, GTC on
Magnetic Variation	0.0°
TRANSPONDER POWER SETTINGS	
Below 15,000	ON (Low Power Selected) when required
Above 15,000	OFF (Normal Power Selected)
TRANSPONDER FLIGHT INSPECTION SELECT	Should be ON for all checks except MSAW (GTM/ APM)

1. Standby power and equipment verified as part of pre-inspection checks.
2. Beacon power and primary radar optimization accomplished using targets of opportunity.
3. Tilt determination accomplished using targets of opportunity.
4. Orientation verified by ground checks using permanent echoes and solar analysis.
5. Vertical coverage will be established by flight inspection using procedures below.

Side lobe suppression (SLS/ISLS) will be set prior to flight inspection and checked during vertical coverage.

GTC/ STC will be adjusted prior to flight inspection and confirmed during vertical coverage check.

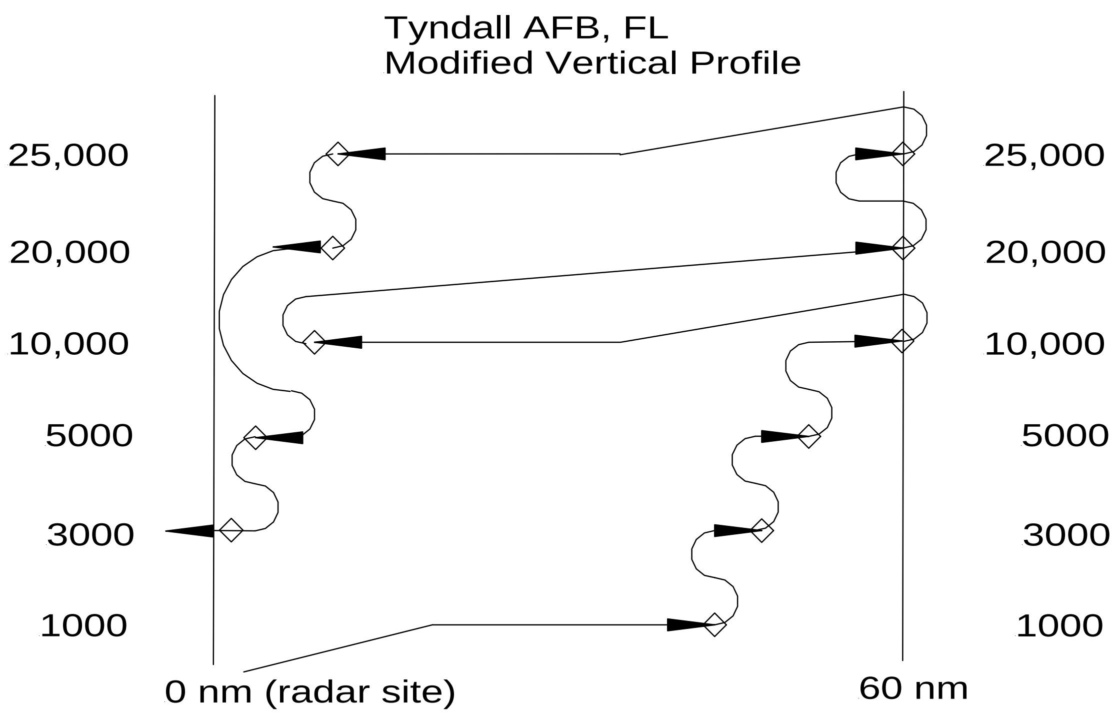
6. MSAW (GTM) is available.

SURVEILLANCE APPROACHES: None

VERTICAL PROFILE – 060 Radial (See Figure 14-12)

LEG	Altitude (ft MSL)	Heading (0.0° mag var)	Estimated coverage (nm)
Start altitude outbound (outer fringe)	1,000	60	0.5
Outbound (outer fringe)	3,000	60	45
Outbound (outer fringe)	5,000	60	50
Outbound (outer fringe)	10,000	60	60
Inbound (inner fringe)	10,000	240	3
Outbound (outer fringe)	FL 200	60	60
Outbound (outer fringe)	FL 250	60	60
Inbound (inner fringe)	FL 250	240	7
Inbound (inner fringe)	FL 200	240	5
Inbound (inner fringe)	5,000	240	1
Inbound (inner fringe)	3,000	240	1

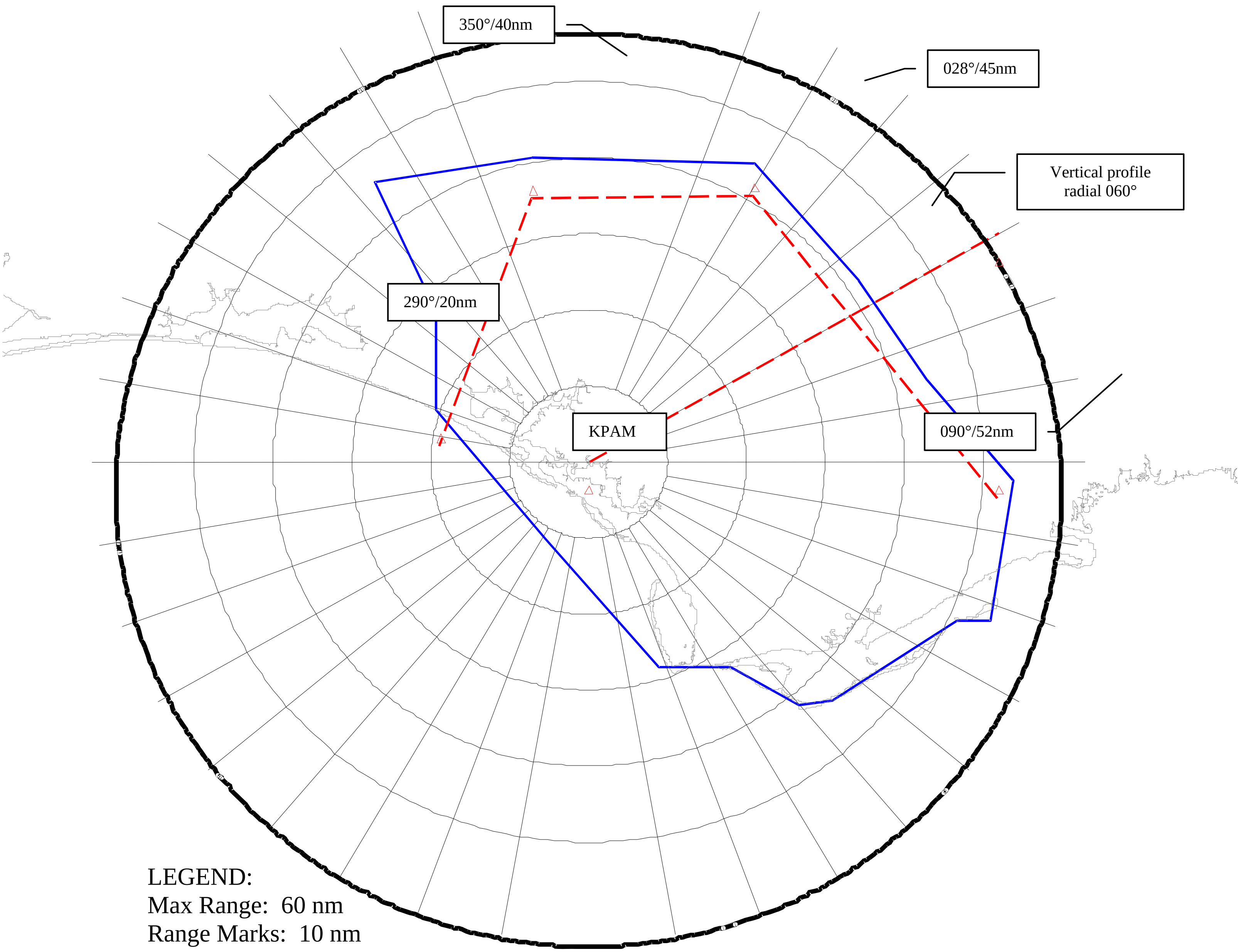
Figure 14-12



HORIZONTAL PROFILE (Screening Evaluation)

Leg	From	To	Alt: (ft MSL)
1	90°/52 DME	28°/45 DME	5000
2	28°/45 DME	350°/40 DME	5000
3	350°/40 DME	290°/20 DME	5000

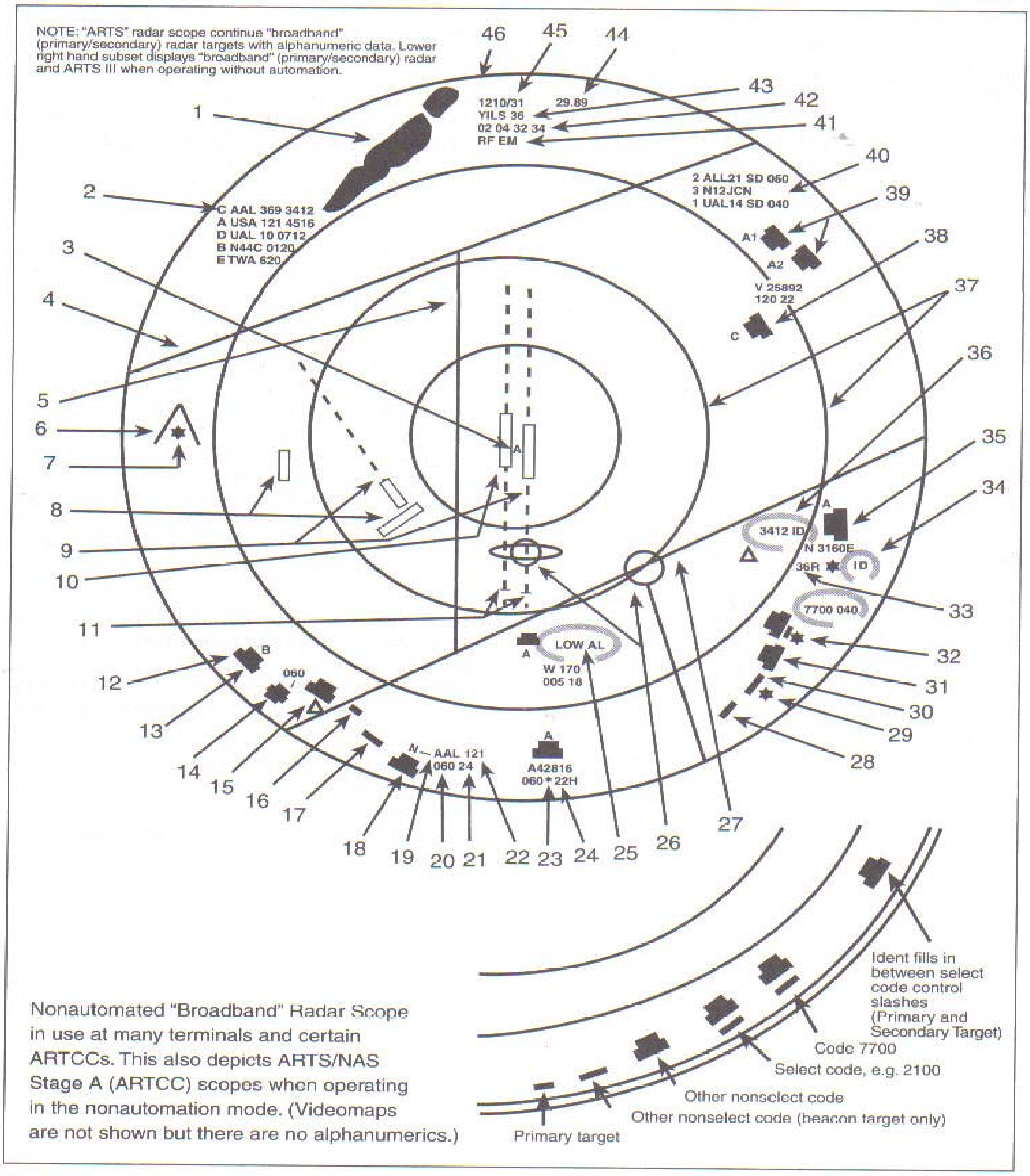
Figure 14-13
Horizontal Profile for Screening Evaluation



LEGEND:
Max Range: 60 nm
Range Marks: 10 nm
Azimuth Marks: 10 deg
Orientation: True north
———— line is Tyndall airspace
– – – – – – line is flight profile

Below is a picture of what a Radarscope may look like:

Figure 14-14
ARTS II Radar Scope with Alphanumeric Data



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 nonautomation mode, would also have similar displays and certain services based on automation may not be available.*

SECTION 2

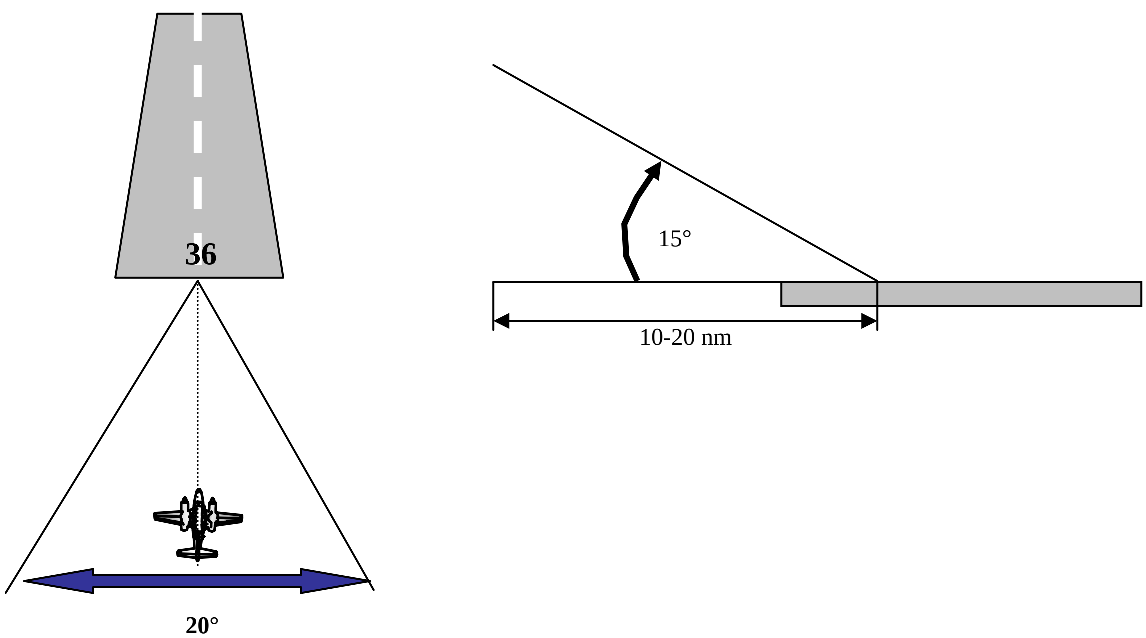
PRECISION APPROACH RADAR (PAR)

14.20 INTRODUCTION

a. **General.** The Precision Approach Radar (PAR) is designed to provide an approach path for precise alignment and descent guidance to an aircraft on final approach to a specific runway through interpretation and oral instructions by a ground based controller.

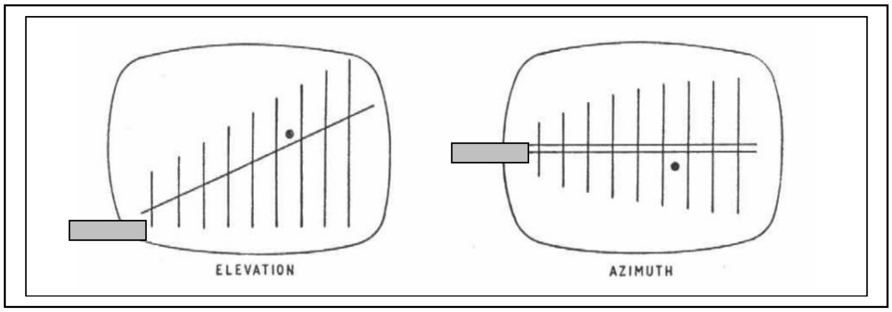
b. **Characteristics.** PAR(s) provide a very high degree of resolution in terms of range, azimuth and elevation by radiating a narrow pulse and beam width along a predetermined descent path for an approximate range of 10 to 20 miles, and covers a sector of 20° in azimuth and up to 15° in elevation.

Figure 14-15
Service Volume of Typical Precision Approach Radars



Target information is displayed on an azimuth and elevation display. The displays must provide accurate information regarding an aircraft's range, azimuth, and elevation angle.

Figure 14-16
Target Information Azimuth and Elevation Display



c. Classifications

(1) **Generic PAR (FPN-40, FPN-62/ 63, MPN-14, TPN-18, TPN-44).** This family of radars is characterized by mechanically scanned (moving) azimuth and elevation antennas. Displayed targets are not computer enhanced. The PAR may be part of a larger system containing an ASR.

(2) **GPN-22 andTPN-25.** These radars, which differ only in physical configuration and associated equipment, have an electrically scanned (non-moving) antenna. Displayed targets are computer generated. The system uses circular polarization only. The system consists of dual transmitters and dual receivers/ processors with EPROM cards. In normal use, selection of these units is automatic; for flight inspection, they must be manually selected at the radar site. Normal coverage is 20 nm.

(3) **TPN-22.** The AN/ TPN-22 Precision Approach Radar (PAR) is a transportable, computerized, pencil beam, 3-dimensional radar. The system is a track-while-scan radar. The radar uses phase and frequency scanning techniques with an electronically steered beam antenna array. The system uses circular polarization only. The system has additional capabilities requiring interface with specialized aircraft equipment; these features are not subject to flight inspection.

(4) **MPN-25, TPN-31, FPN-67 (U.S. Army), GCA-2000.** The MPN-25 (USAF)/ GCA 2000 PAR produces computer-generated targets but has no special inspection requirements. It does not have conventional MTI capability. The system does not have controllable antenna polarization but has RAIN MODE that performs the same function as Circular Polarization (CP) and Clear Mode that performs the same function as Linear Polarization (LP).

14.21 PREFLIGHT REQUIREMENTS

a. **Facilities Maintenance Personnel.** Prepare for flight inspection in accordance with the procedures outlined in Chapter 4.

b. **Flight Personnel.** The flight inspector will be in complete charge of the flight inspection. Flight personnel will prepare for the inspection in accordance with the procedure outlined in Chapter 4.

c. **Inspection Requirements.** Flight Inspection commissioning inspections will provide engineering, maintenance, and operations personnel with sufficient data to determine system performance. Data obtained from the commissioning inspection will be the basis for the comparison of facility performance on subsequent inspections. Requirements for special checks will be determined by engineering, maintenance, and operations personnel, and will be conducted as specified in Chapter 4. Flight inspection is required following an antenna change, change to the glide path angle, changes to reference (alignment) reflector height or placement, changes to cursor alignment voltages or settings, and any other action which will change the azimuth or elevation alignment.

d. **Special Equipment Requirements**. PAR glide slope angle will be determined by AFIS, unless theodolite method is applied, or the inspection is conducted in accordance with the requirements of a Military Contingency or Natural Disaster as described in Chapter 24. Aircraft with altimeters calibrated according to FAR 43, Appendix E, and FAR 91.170, or military specifications, may be used for PAR flight checks.

e. **Theodolite Procedures**. The RTT or theodolite will be positioned as follows:

(1) **Glidepath Angle**

(a) Place the theodolite as close to the runway as possible, forward of the RPI, to minimize or eliminate elevation differences between RPI (touchdown) and theodolite locations. The touchdown reflector is usually abeam the RPI, but not always. Therefore, the Facility Data Sheet must be checked to establish the exact RPI location. Aircraft operations will dictate how close to the runway the theodolite can be located.

NOTE: During the commissioning inspection of a new or relocated PAR, it is imperative that flight inspection personnel coordinate closely with the procedures specialist and installation personnel to locate the predetermined RPI.

(b) The distance the theodolite must be moved forward of the RPI to have the eye-piece aligned on the glidepath angle can be computed in the same manner as solving for ILS glidepath angles or tapeline altitudes. For example, a theodolite with the eye-piece set at 5 ft at a glidepath angle of 3.0° would be positioned 95.4 ft forward of the RPI.

(2) Lower Safe Angle

(a) If the lower safe angle emanates from the same RPI as the glidepath, the theodolite position will be the position determined for the glidepath.

(b) If the lower safe angle emanates from a point other than the RPI for the glidepath, the theodolite will be relocated. Position and align the theodolite in accordance with instructions for glidepath angle using the lower safe angle RPI.

(3) Course Alignment. Position the theodolite on runway centerline to evaluate course alignment at the runway threshold. Aircraft operations will dictate theodolite placement.

14.22 CHECKLISTS. The checklists below are to be used for the identified equipment. If the equipment to be inspected is different, the basic requirements for a "generic" PAR must be used and additional runs performed to check any special features specified by facility engineering or operations. At locations where approaches to more than one runway are provided, checks will be accomplished for each runway on commissioning inspections. Periodicity of checks must be accomplished in accordance with Chapter 4, alternating runways, assuring that all runways/ SIAP(s) that are associated with the PAR system are checked at least once each 540 days. The periodic must be considered complete each time the periodic checklist is complete and the Chapter 6 SIAP check is accomplished for the runway being inspected.

Legend for Checklists

AC - Antenna Change	**B Cursor** - The cursor defining the lower safe limit	**DBC -** Database Change (may be software or firmware
A Cursor - The cursor defining the normal glide angle	**C -** Commissioning	**P -** Periodic
ALS - Automatic Landing Subsystem	**CFAR -** Constant False Alarm Rate	

a. Generic PAR (FPN-40, FPN-62/ 63, MPN-14, TPN-18, TPN-44)

Type Check	Reference Paragraph	Inspection				CURSOR	Measurements Required								
												Alignment			
		C	AC AZ (3)	AC EL (3)	P	Cursor	Obstacle Clearance	Coverage	Range Accuracy	MTI /MTD	Angle Coincidence	AZ	GP	Deviation Accuracy	CP/ LP
Approach #1	14.23c 14.23j	X	X	X	X	A	X	X	X	X	X	X	X	X	X
Approach #2	14.23c 14.23l	X	X	X	X	B	X	X							
Lateral Coverage	14.23h	(1)	(1)	(1)		A	X	X							
Azimuth Only	14.23d	X	X				X	X				X			
Standby (2) Transmitter	14.23p	X X		 X	X X	A B	 X	X X	X	X		X	X		X
Standby Power	14.23q	X				A		X					X		
Alternate Angle	14.23j	X		X		A		X					X		
Lights	14.23n Chapter 7	X			X			X							
Comm	14.23o	X			X			X							

(1) Maintenance request

(2) For generic (non-computer generated) PAR(s), inspect both the A and B Cursors when checking the standby transmitter.

(3) Apply commissioning tolerances when conducting a special inspection for antenna change (AZ or EL).

b. GPN-22, TPN-25

Type Check	**Reference Paragraph**	**Inspection**				**Facility Configuration**	**Channel (5c)**	**Cursor**	**Measurements Required**							
		C (6, 7)	**AC (9)**	**P**	**DBC (7)**				**Obstacle Clearance**	**Coverage (2)**	**Range Accuracy**	**MTI/ MTD**	**Angle Coincidence**	**Alignment AZ**	**Alignment GP**	**Deviation Accuracy**
Approach #1	**14.23c 14.23j**	**X**	**X**	**X**	**X**	**(3)**	**A**	**A**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Approach #2	**14.23c**	**X**			**X**	**(4)**	**A**	**A**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Approach #3	**14.23p**	**X**	**X**	**X**		**(3)**	**B**	**A**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Approach #4	**14.23j 14.23l**	**X**	**X**	**X**		**(3)**	**B**	**B**	**X**	**X**						
Approach #5	**14.23l 14.23p**	**X**			**X**	**(3)**	**A**	**B**	**X**	**X**						
Azimuth Only	**14.23d**	**X**	**X**			**(3)**	**A**		**X**	**X**						
Lateral Coverage	**14.23h**	**(1)**	**(1)**			**(3)**	**A**	**A**	**X**	**X**						
Standby Equipment (5)	**14.23p**	**X**		**5a**		**(3)**		**A**		**X**	**X**	**X**				
Standby Power (8)	**14.23q**	**X**				**(3)**	**A**	**A**		**X**					**X**	
Alternate Angle	**14.23j**	**X**	**X**			**(3)**	**A**	**A**		**X**					**X**	
Lights	**14.23n Chapter 7**	**X**		**X**						**X**						
Comm	**14.23o**	**X**		**X**						**X**						

NOTES:

(1) Maintenance Request

(2) Normal Coverage is 20 nm. Establish coverage limits during commissioning (or at maintenance request) by flying a 20-mile final approach; thereafter, controller/ maintenance personnel must monitor coverage on a daily basis using targets of opportunity.

(3) Track Mode - NORMAL Close Control FTC-ON MTI - COHERENT

(4) Track Mode - BACKUPScan Only FTC-OFF MTI-NON-COHERENT

(5) Commissioning requirements for standby equipment (consisting of a complete separate channel) can be completed by flying Runs 1, 2, and 5 to any one of the runways served. If standby equipment is only a separate transmitter, fly Run 1 from 20 nm to satisfy commissioning requirements.

(a) Check both receivers/ processors during a periodic check.

(b) It is only necessary to check the operating radar transmitter and database during a periodic check. However, attempt to alternate which transmitter is checked from periodic to periodic inspection.

(c) A-Channel/ B-Channel refers to which receiver/ processor is on-line.

	C	**P**
Radar Receivers/Processors	X	X (5a)
Radar Transmitters	X	X (5b)
Database	X	X (5b)

(6) Parallel Runways. If one reference reflector and a common glidepath angle are used for parallel runways, only 5 runs are required for commissioning. Fly approaches # 1,# 2, and #3 on the left runway, #4 and #5 on the right runway and reverse the order for the opposite end. If each runway has a separate reference reflector and/or angle, fly approaches #1,# 2, and #3 on the left runway, #1, #4, and #5 on the right runway and reverse the order for the opposite end.

(7) Each database version requires a flight inspection prior to operational use in order to verify that the database data can be loaded into the PAR computer and that the data produces the correct results. Documentation required for commissioning and equipment/ database changes:

(a) Transmitter Power

(b) Receiver sensitivity in normal, Coherent MTI, and Non-Coherent MTI

(c) Firmware Version Numbers

(d) Clutter reject setting (if required for approaches).

(e) Digital MTI baseline limiting settings

(f) Usable radar range on 20 nm radar

(8) Evaluate the operation on standby power during any of Runs 1, 3, 4, or 5.

(9) Apply commissioning tolerances when conducting a special inspection for antenna change. These types of PAR(s) do not have separate AZ and EL antennas.

c. TPN-22

Type Check	Reference Paragraph	Inspection				ALS PAR Mode	VideoMode	Cursor	Measurements Required							
		C	AC	P	DBC				Obstacle Clearance	Coverage	Range Accuracy	MTI/ MTD	Angle Coincidence	Alignment AZ	Alignment GP	Deviation Accuracy
Approach #1	14.23c	X	X	X	X	Auto (2)	Linear	A	X	X, (5)	X	X	X	X	X	X
Approach #2	14.23l	X	X	X	X	Auto (2)	Linear	B	X	X, (5)					X	
Approach #3	14.23c	X	X	X	X	Auto	MTI	A	X	X, (5)	X	X	X	X	X	X
Approach #4	14.23l	X	X	X	X	Auto	MTI	B	X	X, (5)					X	
Approach #5	14.23c	X	X		X	Man	CFAR	A	X	X, (5)	X	X	X	X	X	X
Approach #6	14.23j	X	X		X	Man	CFAR & MTI	A	X	X, (5)					X	
Azimuth Only	14.23d	X				Auto (2)	Linear		X	X						
Lateral Coverage	14.23h	(1)	(1)					A	X	X						
Alternate Touchdown #1 (4)	14.23j	X		X	X	Auto (2)	Linear	A		X	X				X	
Alternate Touchdown #2 (4)	14.23j	X		X	X	Man	Linear	A		X	X				X	
Alternate Touchdown #3 (4)	14.23j 14.23l	X	X	X	X	Man	Linear	B		X	X				X	
Standby Power (3)	14.23q	X				Auto (2)	Linear	A		X						
Lights	14.23n Chapter 7	X		X						X						
Comm	14.23o	X		X						X						

NOTES:

(1) Maintenance request.

(2) A periodic check must be considered complete if Auto-Mode is inoperative. Note the condition on the flight inspection report. The PAR must be considered as "Restricted" and authorized for use in Manual-Mode only.

(3) IF EQUIPPED, standby power should be performed on the last run due to the extensive time required to reload the software and data.

(4) Alternate touch down (TD) points using the same glide angle may be available.

(5) Request usable distance from controller on each approach.

d. MPN-25, TPN-31, FPN-67 (U.S. Army), GCA-2000

Type Check	Reference Paragraph	Inspection					Facility Configuration (2)	Cursor	Measurements Required							
													Alignment			
		C	AC AZ (4)	AC EL (4)	P	DBC			Obstacle Clearance	Coverage	Range Accuracy	Angle Coincidence	AZ	GP	Deviation Accuracy	Rain/ Clear
Normal Approach	14.23c 14.23j	X	X	X	X	X	Rain Mode	A	X	X	X	X	X	X	X	X
Lower Safe	14.23l	X	X	X	X	X	Clear Mode	B	X	X						
Lateral Coverage	14.23h	(1)	(1)	(1)			Clear Mode	A	X	X						
Azimuth Only	14.23d	X	X				Clear Mode		X	X			X	X		
Standby (3) Transmitter	14.23p	X			X			A		X	X		X	X		
Standby Power	14.23q	X						A		X				X		
Alternate Angle	14.23j	X		X		X		A		X				X		
Lights	14.23n Chapter 7	X			X					X						
Comm	14.23o	X			X					X						

NOTES:

(1) Maintenance Request

(2) Not controllable in TPN-31 and FPN-67.

(3) Periodic inspections of computer generated PAR(s) do not require flying the B Cursor when checking the standby transmitter. However, attempt to alternate which transmitter is treated as the standby from periodic to periodic inspection.

(4) Apply commissioning tolerances when conducting a special inspection for antenna change (AZ or EL).

14.23 FLIGHT INSPECTION PROCEDURES

a. **General.** The flight inspection procedure for a PAR is divided into three parts--azimuth radar, elevation radar, overall system and controller performance (includes feature comparisons). Normally, all parts are inspected during each run. The basic method for checking a PAR is to have the controller vector the aircraft and provide guidance instructions to the flight inspector for evaluation of the facility and controller performance. Operational scopes will be used on all flight checks for target grading and guidance information. Data taken from the operational scopes must determine whether or not the facility meets the prescribed tolerances.

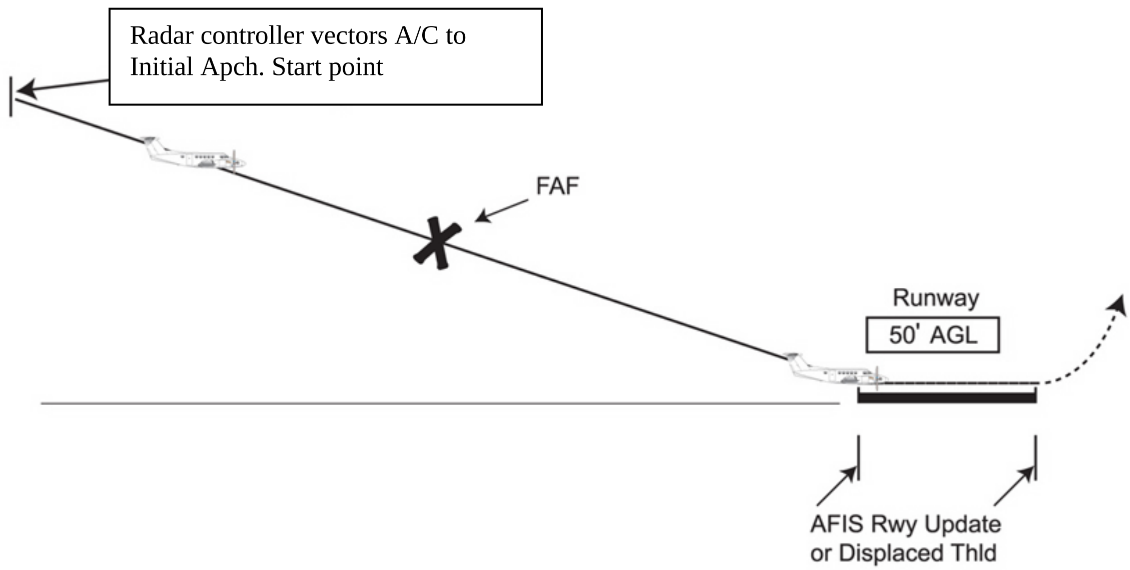
Normally, 2 runs per runway will be required. The first will be an “A” cursor run on the facility. This is the normal mode of operation and should produce a normal approach. The second, or “B” cursor run, is based upon the lower safe limit for the applicable approach. When inspecting generic PAR(s), evaluate both the “A” cursor and “B” cursor on each available channel.

Coincidence of the azimuths and glide paths of the PAR and ILS/ MLS/ VGSI is essential to preclude pilot confusion from different indications of the ILS/ MLS/ VGSI and PAR. Monitor the PAR approach using the ILS/ MLS/ VGSI for reference. Coincidence probably will not be maintained from Point “B” to touchdown due to the characteristics of the ILS glide slope inside Point “B.” Areas of non-coincidence of the azimuths and glide paths should be noted.

The Flight Inspector is responsible for determining that the PAR conforms to the specified tolerances. Any discrepancies found which could be attributable to controller technique should be brought to the attention of the ground supervisory personnel.

b. **Maintenance/ Engineering Personnel,** in cooperation with operations personnel, will spot check all features available on the PAR and advise the flight inspector if any of these features are not available or are unusable. These features include STC, FTC, CP, and CFAR. On computer-generated radars, additional features include: non-coherent MTI (rain reject), ACQ (high and low), track mode (normal and backup), STC (high and low), and power (high and low). PAR checks will be made using circular polarization (CP) if available, and spot checks of the facility will be made using linear polarization. On some computer-generated radars, CP is a fixed feature and is used at all times.

Figure 14-17
PAR Approach Flight Profile



NOTE: This is the basic profile for all PAR and ASR approaches described in this section. AFIS runway updates will be required on approaches when measuring angle or course alignment of PAR facilities.

c. Course Alignment and Coverage (Azimuth). The intent of inspecting a Precision Approach Radar is to ensure that the controller and equipment can guide an aircraft to the Runway Point of Intercept (RPI). Course alignment is most critical at touchdown. Ensure the alignment is satisfactory at runway threshold using AFIS, visual means, or theodolite. Along-track azimuth alignment at distances greater than threshold must be determined when AFIS measurement techniques are used. AFIS measurements of PAR azimuth alignment along the length of the final segment should be made when practical. Apply the along-track tolerance to the average of all on-course calls. Discuss any singular along-track errors with Air Traffic and/or PAR maintenance personnel for resolution. Any of the following methods may be used to determine course alignment:

(1) AFIS Method. This is the preferred method. The Mission Specialist should select PAR/ PAPI function and setup per TI 4040.55.

(a) Maneuvering

1 Follow the course commands from controller and maneuver the aircraft within the standard service volume, (± 10° FAC and 10 –20 nm).

2 At each ON-PATH/ ON-COURSE call, the Mission Specialist will press the corresponding ON-PATH/ ON-COURSE key once per each ATC callout. The range should be given every nautical mile. For the most accurate results, use events taken between 4 - 0.5 nm from threshold. The Mission Specialist should work with the pilot to record on-course azimuth hits as well as on-path glide slope hits. These data points should be spread out to capture a representative sampling of the final segment. Given that AFIS can only accept a limited number of hits per run, as a technique, it may be desirable to concentrate more on course hits during the B-cursor check.

3 Execute normal go-around and return to beginning point while the controller changes configurations for next run.

(b) **Analysis.** Check if alignment is within tolerance.

(2) **Course Alignment (Visual)**

(a) **Maneuvering**

1 Fly inbound at pattern/ intercept altitude from approximately 10 – 12 miles from the runway, on course, and on path.

2 Descend at a normal glide path angle with the final controller furnishing information to enable the flight inspector to fly on the centerline azimuth. This information is to be given as "left," "right," or "on-course." Range should be given at least every mile.

(b) **Analysis.** The flight inspector will determine, by visual reference to the runway, if the centerline is straight and if it coincides with the runway extended centerline.

(3) **Theodolite Method.** At some locations, it may be necessary to use a theodolite to supplement the pilot's observations, especially when the runway is extremely wide or poorly defined by surrounding terrain.

(a) **Maneuvering.** Proceed in-bound at pattern/ intercept altitude from 10 to 12 miles from the field. Have the final controller furnish information as to the aircraft's position relative to runway centerline. The theodolite operator will continuously track the aircraft and inform the pilot of the aircraft position relative to runway centerline.

(b) **Analysis.** Analyze theodolite readings to determine if the centerline is straight and if it coincides with the runway extended centerline.

Other Considerations. Check final approach course for obstacles, VGSI, and localizer coincidence, as appropriate. Ensure the alignment is satisfactory at runway threshold, (<30 ft from CL). Along track azimuth alignment at distances greater than threshold must be determined when AFIS measurement techniques are used (the greater of 30 ft or 0.6% of the aircraft to PAR antenna distance, referenced to runway centerline). Apply the along-track tolerance to the average of all on course calls. Discuss any singular along-track errors with Air Traffic and/or PAR maintenance personnel for resolution.

d. **Azimuth Only Procedures (PAR).** Some facilities have "AZ ONLY" or "PAR w/o GS" procedures published for use during outages of the elevation portion. Procedurally, the obstacle clearance area of the PAR is used and non-precision Required Obstacle Clearance (ROC) applied. An "AZ ONLY" approach may therefore have a lower MDA than an ASR approach to the same runway because the ASR runway obstacle clearance area is larger and may contain higher obstacles. Some military installations may also use a PAR system to provide an azimuth-only approach using approach minimums developed using ASR criteria and published as an ASR approach procedure.

(1) **AFIS/ Equipment Setup.** The use of AFIS is the preferred method of inspection. The Mission Specialist should select the PAR/ PAPI function and setup per TI 4040.55.

(2) **Maneuvering**

(a) Maneuver the aircraft within the standard service volume. Execute approaches in normal flight inspection landing configuration.

(b) Maintain procedural altitude until the final segment.

(c) At the Final Approach Fix, descend at a rate of 400 ft per mile until 100 ft below MDA and maintain until threshold.

(d) At each ON-PATH/ ON-COURSE call, the Mission Specialist will press the corresponding ON-PATH/ ON-COURSE key once per each ATC call-out.

(3) **Analysis.** Check the final approach course for obstacles, radar coverage, and localizer coincidence, as appropriate.

e. **Course Deviation Accuracy** is used to determine when the controller notices an off course condition.

(1) **AFIS/ Equipment Setup.** None

(2) **Maneuvering.** While flying inbound on course, deviate to the left and right of centerline.

(3) Analysis. Pay attention how far the aircraft must move off centerline before the controller notices movement. The controller needs only to state, slightly left or right of course. Target presentation must be coincident with aircraft position.

f. Range Accuracy is used to check the accuracy of the range information, both video and fixed.

(1) AFIS/ Equipment Setup. Use DME or AFIS information, per TI 4040.55, as necessary. In areas where there are no ground checkpoints or good electronic means of accurately measuring distance from the field, this check may be omitted.

(2) Maneuvering. If required, fly over checkpoints such as the outer marker or VOR or any well-surveyed checkpoint, provided its distance from the field can be established.

(3) Analysis. The range accuracy is satisfactory if it is ± 2% of true range.

(4) Other Considerations. All ranges are measured in nautical miles from touchdown. Normally, two checkpoints, one at 5 to 10 miles and one at ½ mile, are sufficient for checking range accuracy. Range accuracy checks of azimuth and elevation radar normally will be made simultaneously.

NOTE: Mileage information given by the radar operator should be the mileage from the touchdown point to the target aircraft. When erroneous mileage information appears to be given, the flight inspector should inquire if the range information obtained from the scope has been corrected to compensate for the distance from the antenna to the touchdown point.

g. Usable Distance is accomplished to check the usable distance or maximum range of the radar system.

(1) AFIS/ Equipment Setup. Use DME or AFIS information, per TI 4040.55, as necessary.

(2) Maneuvering

(a) Proceed inbound from the limit of radar coverage, 15 to 20 miles, during the course alignment check.

(b) Altitude should be at minimum vectoring altitude for that area.

(c) Have the controller give the mileage when the aircraft is first displayed on the scope.

(3) Analysis. Usable distance is satisfactory if it provides a minimum range of 7.5 nm from touchdown.

(4) Other Considerations. New radars have ranges of 15-20 miles, but because of small aircraft size, less coverage can be expected. Azimuth and elevation coverage can be inspected simultaneously. Coverage should be checked by alternately using normal and MTI configurations, if available. Periodic coverage checks need only be made in the area of operational use.

NOTE: Mileage information given by the radar operator should be the mileage from the touchdown point to the target aircraft. In case erroneous mileage information is given, the flight inspector should inquire if the range information obtained from the scope has been corrected to compensate for the distance from the antenna to the touchdown point.

h. Lateral Coverage. Using the AFIS coverage angle capability in the PAR/ VGSI mode is the preferred method of checking the lateral limits of the radar signal.

(1) AFIS/ Equipment Setup. Load the AFIS Facility Data Page, per TI 4040.55.

(2) Maneuvering

(a) Fly in clean configuration at altitude and distance determined by maintenance and/or controller.

(b) If radar target is lost before reaching expected limit, reversing the arc may be required to define the limit at target acquisition.

(c) Fly the requested arc clockwise or counterclockwise, starting AFIS data collection outside of expected coverage limit.

(d) Press the "ON COURSE" key when the radar operator calls the first hit centerline and when radar reply is lost.

(3) Analysis. The check is satisfactory if the lateral coverage is ± 10 ° from procedural centerline.

i. Moving Target Indicator (MTI)/ Moving Target Detector (MTD) systems are used to identify moving targets and targets through ground clutter. Blind speeds for PAR systems are usually quite high due to the high pulse repetition frequency (PRF) required for good target definition. It may be quite difficult to perform an MTI/ MTD check with certain types of small aircraft due to speed limitations. This check can be omitted if the speed range required is impossible to attain. The check can be performed at a later date when a faster aircraft is available. An airspeed notch of as much as plus or minus 20 knots may exist around the computed blind speed.

(1) AFIS/ Equipment Setup. Load the AFIS Facility Data Page, per TI 4040.55.

(2) Maneuvering

(a) During commissioning, request Maintenance provide the pre-computed blind speed for the radar.

(b) Determine the airspeed that will give the required ground speed.

(c) Fly in-bound from approximately 10 miles (ensure that MTI is gated beyond 10 miles) on a normal azimuth and elevation in the landing configuration.

(d) Vary the air speed slightly above and below the previously computed airspeed.

(3) Analysis. Maintenance will note the speed range within which a reduction of target brilliance occurs. The use of the MTI/ MTD system must not cause loss of usable target at other than blind speed. When MTI/ MTD is required on the final approach, this information must be noted on the flight inspection report. The requirements for MTI do not constitute a facility restriction. Both azimuth and elevation MTI/ MTD normally will be checked at the same time.

(4) Other Considerations. On radars with computer generated displays, the normal mode of operation is to use the synthetically generated symbols for approaches. The normal radar (scan) mode must be checked to determine its usability for approaches. If unusable for approaches, determine the inner limit of usability so that the feature can be used for control and traffic information outside of that point. Document the results of the scan-mode inspection in the Remarks section. If the scan mode is not usable for approaches, it will not cause a facility restriction but must be documented on the Facility Data Sheet.

j. Glide Path Alignment is accomplished to determine the glide path angle and the straightness of the glide path centerline. During the glide path alignment check, it is necessary to determine the glide path angle and the straightness of the glide path centerline. Some new military PAR(s) have the capability to provide controller selected multiple glide paths. For these radars, all published angles must be inspected prior to use; for periodic inspections, only the lowest angle must be evaluated. The AFIS method will be used to determine glide path alignment. If AFIS is unavailable, the Theodolite method may be used. Altimetry may only be used when the inspection is conducted in accordance with the requirements of a Military Contingency or Natural Disaster as described in Chapter 24.

(1) AFIS Method. Load the AFIS Facility Data Page, per TI 4040.55.

(a) Maneuvering

1 Follow the controller's heading and altitude directions to maintain course and glide path.

(2) At each ON-PATH call, the pilot not flying must press the correct cockpit event button (e.g., LORAN button in BE-300), or have the Mission Specialist press the ON-PATH AFIS key. For the most accurate results, use events taken between 4 - 0.5 nm from threshold.

(b) Analysis. Compare measured angle with commissioned angle and apply the appropriate tolerance.

(2) Theodolite Method. Position the theodolite according to instructions in Paragraph 14.21d. Communications on a common frequency are essential for the theodolite operator, final controller, and flight inspector.

(a) Maneuvering. Proceed in-bound from a point approximately 12 miles from touchdown and at the pattern altitude until the final controller advises that the aircraft is on the glide path. A descent is then commenced, maintaining the aircraft as nearly on the centerline or glide path as possible by using the information furnished by the controller. The pilot should maintain as constant an attitude as possible throughout the approach. Information should be given in terms of "above," "below," or "on glide path." The theodolite operator will track the aircraft from the start of the in-bound run, maintaining the horizontal cross-hair exactly on the aircraft as it descends on the glide path. As the aircraft proceeds in-bound, the theodolite operator should listen carefully to the glide path information issued by the controller and have an assistant record the angle each time the controller calls the aircraft "on glide path." Do not record calls taken inside of decision height. These angle readings should then be averaged to determine the actual glide path angle.

(b) Analysis. Compare measured angle with commissioned angle and apply the appropriate tolerance.

k. Application of Angle Tolerances. Prior to the commissioning inspection of PAR(s), operational personnel must determine the "desired" angle to which the PAR is to be commissioned. This angle is determined by obstacle clearance criteria and operational use requirements. The obstacle clearance criteria allows for operational deviation (periodic angle tolerance) of 0.2° from the commissioned angle. It is imperative that the reported commissioned angle be the angle for which obstacle clearance and operational criteria has been applied. The desired angle, the computed angle, and the commissioned angle are actually the same.

The allowable periodic deviation of 0.2° is applied to the desired/ computed angle and not the angle found during commissioning inspections. Because the periodic tolerance of 0.2° is applied to the commissioned angle, operations/ maintenance personnel must determine the acceptability of a facility which will require the application of an imbalanced periodic tolerance. An example of this situation is as follows: Desired/ commissioned angle = 3.00°, angle found during commissioning = 2.90°, allowable deviation = 3.00 ± .2° or 2.8 to 3.2°.

l. Lower Safe Limit Alignment is designed to allow clearance from all obstacles from Glide Slope Intercept (GSI) to runway threshold. The “B” cursor, lower safe limit, is normally set 0.5° below the “A” cursor, normal glide slope angle. Record the angle when commissioning a procedure. Measurement of an angle is not required on subsequent periodic inspections, only verification of continued obstacle clearance while on the “B” cursor.

(1) AFIS/ Equipment Setup. Load the AFIS Facility Data Page, per TI 4040.55.

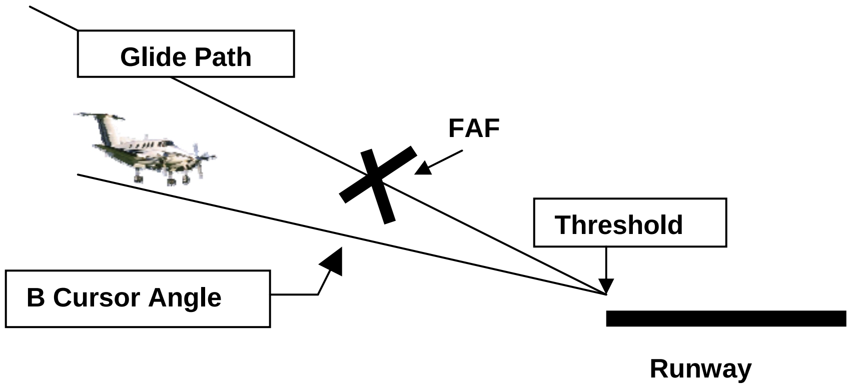
(2) Maneuvering

(a) Fly in-bound from 5 to 7 miles from the runway on the lower safe limit line and maintain “on-path” at the controller’s direction in the approach configuration.

(b) Maintain “on path” position to the runway, or until it becomes obvious that a pull-up is necessary to avoid obstacles.

(c) Ensure the aircraft is clear all obstacles prior to passing the runway threshold.

Figure 14-18
Lower Safe Limit Flight Profile



(3) **Analysis.** The Lower Safe Limit Angle is satisfactory if it provides clearance from all obstacles from the GSI to the threshold.

(4) **Other Considerations**. Scopes which do not have the lower safe limit line portrayed must be checked in the same manner as above. The controller will supply information to the flight inspector so that he can fly the lower safe limit altitudes (below which a missed approach would be necessary) and be clear of obstacles prior to passing the runway threshold.

m. **PAR Coincidence with Other Guidance.** Coincidence of the azimuths and glide paths of the PAR and ILS/ MLS/ VGSI is essential to preclude pilot confusion from different indications of the ILS/ MLS/ VGSI and PAR. Coincidence may be checked using the AFIS, theodolite, precision range mark procedure, or a microamp comparison with the ILS/ MLS/ VGSI. If any doubt exists as to glide angle coincidence, the theodolite or AFIS must be used. Perform a PAR approach as directed by the final controller and monitor the approach using the ILS/ MLS/ VGSI. Coincidence probably will not be maintained from Point "B" to touchdown due to the characteristics of the ILS glide slope inside Point "B." Areas of non-coincidence of the azimuths and glide paths should be noted.

n. **Lighting Systems.** Lights must be inspected in accordance with applicable chapters of this manual.

o. **Communications.** During commissioning inspections, check all required frequencies from the final controller position. When flight inspection aircraft are not equipped for UHF communications, the inspection can be completed using VHF only. UHF coverage may be confirmed by an operational check of the PAR using local aircraft. Evaluate both primary and standby radios for clarity and coverage. These checks may be done within or beyond the radar service area.

p. **Standby Equipment.** Checklists in Paragraph 4.22 specify the minimum checks for the standby equipment, if installed. For periodic inspections, review the previous report and attempt to perform the primary equipment checks on the equipment used as standby on the previous inspection. The standby equipment will be checked to ensure that it is functioning in a manner equal to the primary equipment.

q. **Standby Power.** Standby power can be checked on any approach required by the Paragraph 14.22 Checklist. It is not necessary to duplicate a run solely to check standby power.

(1) The flight inspector must check the facility on standby power during a commissioning flight inspection if standby power is installed. If a standby power system is installed after the commissioning flight inspection, the flight inspector must check the facility on standby power during the next regularly scheduled periodic inspection. The flight inspector must make comparative measurements to ensure that facility performance is not derogated on the standby power system and that all tolerance parameters for the specific inspection are met. Standby power checks are not required on facilities powered by batteries that are constantly charged by another power source.

(2) It is not necessary to recheck a facility when the standby power source is changed.

14.24 TOLERANCES. All precision approach radars must meet the tolerances set forth below for an unrestricted status. Assessment of facility performance and assignment of a flight inspection status based on flight inspection results is the responsibility of the flight inspector.

Chapter- PARAMETER	REF. PARA.	INSPECTION		TOLERANCE/LIMIT
		C	P	
Azimuth Course Alignment (at Threshold)	14.23c	X	X	30 ft referenced to runway centerline
Azimuth Course Alignment (along track) (1, 2)	14.23c	X	X	The greater of 30 ft or 0.6% of the aircraft to PAR antenna distance, referenced to runway centerline
Course Deviation Accuracy	14.23c	X	X	Target presentation must be coincident with aircraft position
Range Accuracy	14.23f	X	X	± 2% of true range
Usable Distance AZ and EL	14.23g	X	X	Minimum of 7.5 nm from touchdown
Lateral Coverage	14.23h	X	X	± 10° from procedural C/L
Moving Target Indicator (MTI)/ Moving Target Detector (MTD)	14.23i	X	X	Must not cause loss of usable target at other than blind speed
Glide Path Alignment (Angle)	14.23j	X		0.1° of published angle
			X	0.2° of published angle
PAR/ILS/MLS/VGSI Comparison of "as-found" PAR angle with published ILS/MLS/VGSI Angle	14.23m	X	X	0.2°
Lower Safe Limit Alignment (Angle)	14.23l	X	X	Clearance from all obstacles from GSI to runway threshold
Standby Equipment	14.23p	X	X	Same as primary

FOOTNOTES:

(1) 0.6% exceeds 30 ft at aircraft to PAR distances greater than 5,055 ft (0.83 nm)
(2) 0.34° is a constant azimuth angle error, representing 0.6% of any distance.

14.25 TABLES/ SUPPLEMENTAL INFORMATION. See PAR Worksheet, Appendix 11.

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CHAPTER 15

INSTRUMENT LANDING SYSTEM (ILS)

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CHAPTER 15

INSTRUMENT LANDING SYSTEM (ILS)

SECTION 1
GENERAL

15.10 INTRODUCTION. The ILS is designed to provide lateral and vertical guidance of an aircraft on final approach to a runway. The ground equipment consists of two directional transmitting systems. The directional transmitters are the localizer, that provides lateral guidance and glide slope, that provides vertical guidance.

The two basic types of localizers are single frequency and dual frequency. Localizers are normally sited along the extended centerline of the runway; however, some are offset from the extended centerline. Localizer type directional aids (LDA) may be located at various positions about the runway.

Another type of facility that provides azimuth guidance is the simplified directional facility (SDF). The two basic types of SDF facilities are the null reference type and the phase reference type.

The three basic image array glide slope systems are null reference, sideband reference, and capture effect.

The two non-image array systems are the endfire and the waveguide.

Flight inspection techniques using the FAA automated flight inspection system (AFIS) are detailed in other directives. Where AFIS is available, these techniques must be used to accomplish the approved procedures in this chapter.

a. **ILS Zones and Points.** ILS zones and points are defined in Appendix 1 and are illustrated in Figures 15-1.

b. **ILS Facilities Used for Higher Category Service.** Some Category I ILS(s) are used to support higher than normal category of service, IAW Order 8400.13, Procedures for the Approval of Special Authorization CAT II & Lowest Standard CAT I Operations. These facilities support SIAP(s) with authorized lower than Category I minima. These systems will be identified in the Facility Database. They must be evaluated fully to the standards and tolerances of the higher category. When a facility is initially identified for use at the higher category, Aviation System Standards Flight Inspection Policy will research the inspection history to determine which checks are required to bring the system to the higher standard.

c. **Category I ILS Facilities (Localizer and Glide Slope Installed) Used to Support lower than Category I Operations.** Many Category I ILS(s) are used below the standard Category I Decision Height of 200 ft through the use of autoland in Visual Meteorological Conditions (VMC), authorization of lower than Category I visibility minima, or published helicopter approaches. Use below Category I requires user knowledge of system suitability as indicated by the furthest ILS point where the localizer structure meets Category III standards.

(1) Qualifying Localizers must be evaluated for structure through Zone 5, and glide slope clearance below path must be evaluated to runway threshold. These limited checks are accomplished to evaluate the ILS's ability to provide service in the areas of expanded usage.

(2) The ILS is not evaluated to other Category II/ III tolerances since there will be no published Category II/ III procedures.

(3) Based on the results of the localizer structure checks, classification codes from FAA Order 6750.24, ILS and Ancillary Electronic Component and Performance Requirements, must be updated and published in the Airport/ Facility Directory. For example, when Category I Localizer structure is satisfactory through Zone 5, the Airport / Facility Directory for that facility will be upgraded to I/ E.

(4) If the Glide Slope clearance below path checks are not satisfactory to runway threshold, Localizer Zones 4 and 5 structure must still be evaluated for potential takeoff guidance through Zone 5 using the Rollout procedure.

15.11 PREFLIGHT REQUIREMENTS

a. ILS Facilities Maintenance Personnel. Prepare for flight inspection in accordance with Chapter 4, Section 3.

b. ILS Flight Check Personnel. Prepare for flight inspection in accordance with Chapter 4, Section 3.

c. ILS Special Equipment Requirements. AFIS is the standard system for ILS flight inspection and must be used for all commissioning checks except where RTT is required to support military contingencies. RTT may be used for all other checks; however, it should not be used solely to bypass the need for facility data of sufficient accuracy to support AFIS. AFIS or RTT must be used for all categorization or After-Accident checks. Except as limited by this paragraph, a standard theodolite may be used as indicated below:

(1) CAT I/ II/ III Localizer periodic or special checks

(2) CAT I Glide Slope periodic or special checks

(3) CAT II/ III Glide Slope checks not requiring determination of actual path angle or path structure

d. **ILS Glidepath Origination Point.** The glidepath origination point is required for AFIS-equipped aircraft. For image array glide slopes, engineering personnel must supply the latitude/ longitude of the antenna mast and the mean sea level elevation of the glidepath origination point. For non-image arrays, engineering personnel must supply the latitude, longitude, and mean sea level altitude of the glidepath origination point.

e. **ILS Angular Reference.** With the exception of Tilt Checks IAW Section 3 which are referenced to localizer deflection, all glide slope offset angular measurements are referenced to a point on a localizer centerline abeam the glide slope origination point.

ILS ZONES AND POINTS
Figure 15-1A(1)

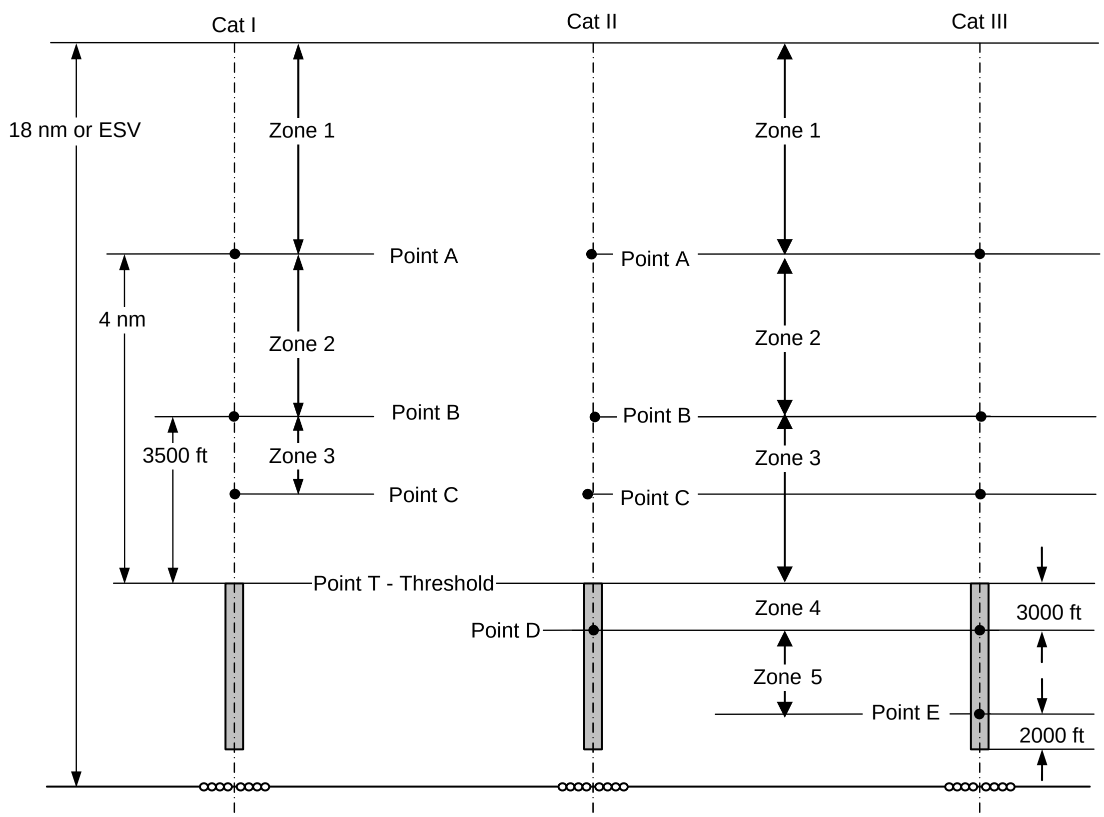


Figure 15-1A(2)
TYPICAL OFFSET ILS

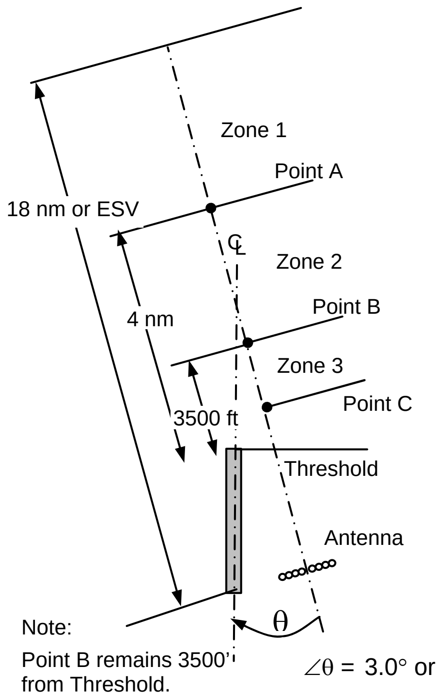
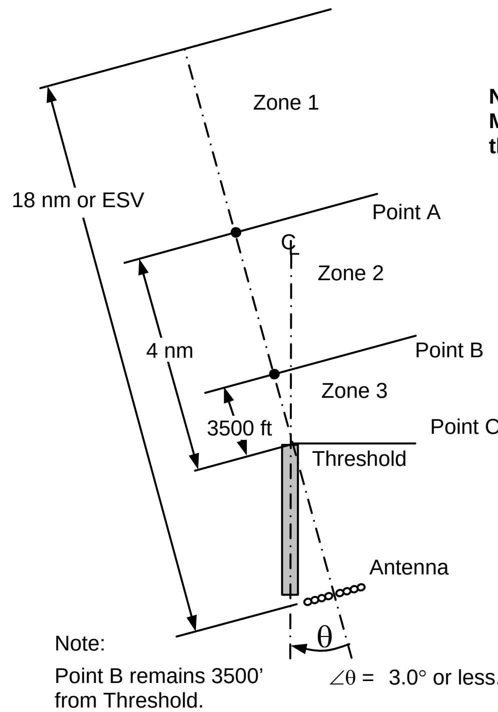


Figure 15-1A(3)
TYPICAL OFFSET LOCALIZER



LDA CONFIGURATIONS

Figure 15-1B(1)

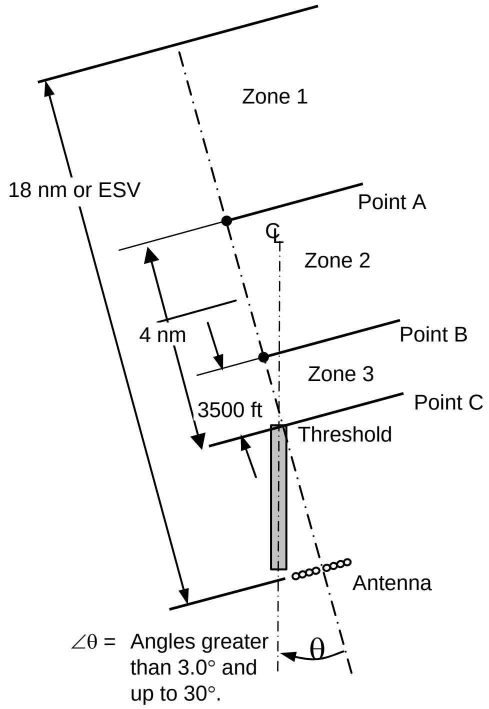


Figure 15-1B(2)

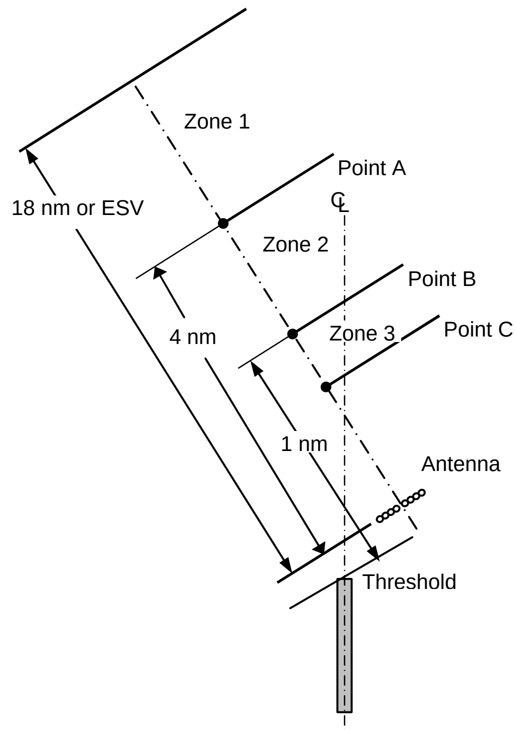


Figure 15-1B(3)
Back Course Localizer/ SDF

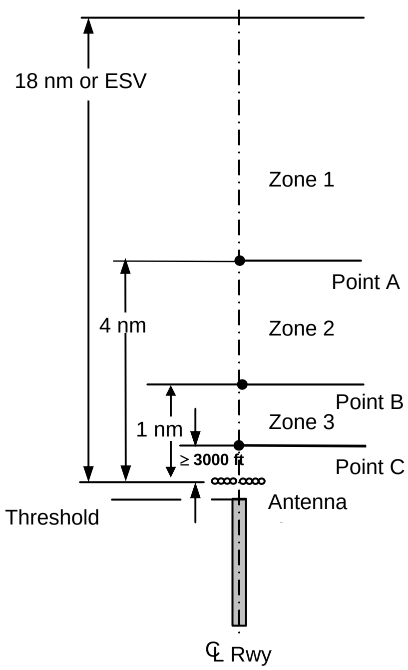
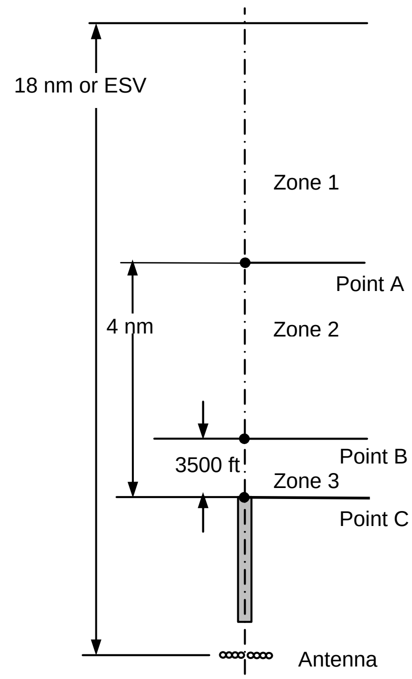


Figure 15-1B(4)
Localizer/ SDF Approach



NOTE: Point C is the MAP and may be prior to threshold

Figure 15-1C
LOCALIZER STANDARD SERVICE VOLUME

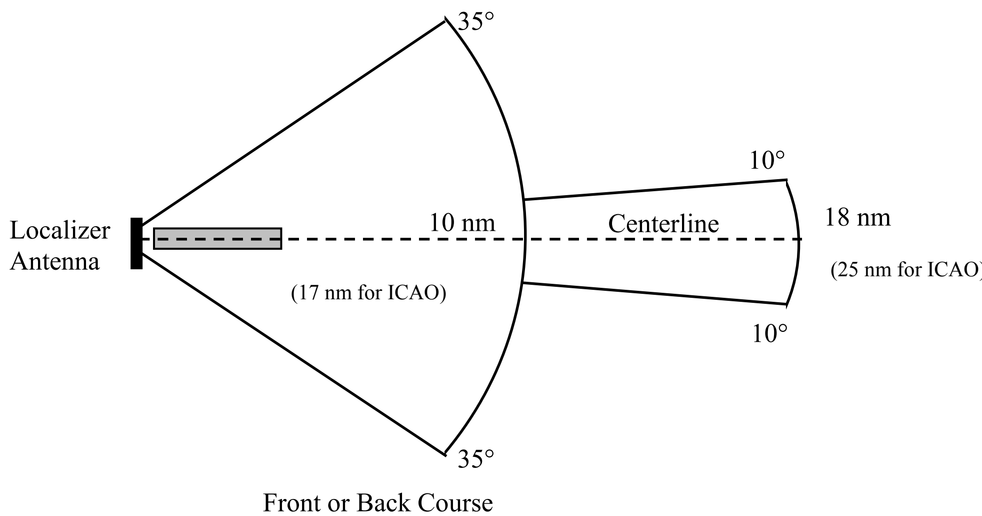
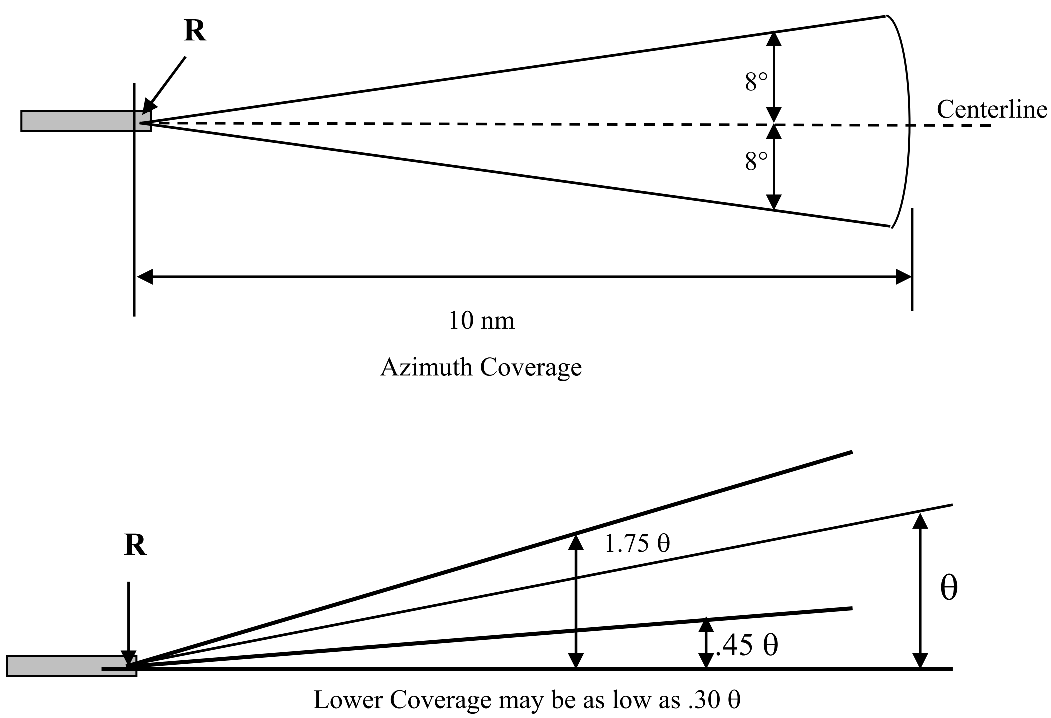


Figure 15-1D
GLIDE SLOPE STANDARD SERVICE VOLUME



R = Point where downward extended glide slope intersects runway centerline.

θ = Glide Path Angle

f. **ILS Theodolite Procedures.** The RTT or theodolite will be positioned in accordance with the following criteria:

(1) **Glide Slope Image Array Systems**

(a) **First Method**

1 Through engineering survey data or by use of the theodolite itself, determine the difference in elevation, to the nearest inch, between the ground plane at the base of the antenna mast and the center of the runway opposite the mast. This can be accomplished by sighting with the theodolite to a surveyor's marker pole placed at the center of the runway opposite the mast or vice versa. If the crown of the runway is higher than the ground level at the antenna, the difference is treated as a minus value; if lower, the difference is a plus value. If the elevation difference determined above (minus value only) provides a comfortable eyepiece height, the theodolite may be positioned at that height at the base of the antenna mast and steps 2 through 5 disregarded.

NOTE: Where the elevation of the base of the antenna mast is more than 62 inches lower than the center of the runway opposite the antenna, alternate procedures to theodolite positioning should be considered. One such alternate is to apply steps 1 through 5 using an image position for the antenna base on the side of the runway opposite the facility.

2 Place the theodolite at the base of the glide slope antenna mast with the eyepiece 62 inches above the ground.

3 Sight along a line between the antenna mast and the center of the runway threshold with the eyepiece set at the commissioned or desired vertical angle.

4 Using a marker pole, determine the position on the ground along the line in Step 3 which is exactly 124 inches, plus or minus the elevation difference obtained from Step 1. For example, if the runway is higher, subtract the elevation difference from 124 inches, if lower, add the elevation difference to 124 inches.

5 Establish the eyepiece height of the theodolite at 62 inches with the commissioned angle (or desired vertical angle) of the glidepath set in the theodolite.

(b) **Second Method.** This method applies to locations where the transverse slope between the glide slope antenna base and the runway edge is irregular, e.g., pedestal runway. The determination of the irregular transverse slope and use of this procedure must be made by engineering/ installation personnel.

1 Place the theodolite at the base of the glide slope antenna mast with the eyepiece 62 inches above the ground.

2 Sight along a line between the glide slope antenna mast and the center of the runway threshold with the eyepiece set at the commissioned angle (or desired vertical angle).

3 Using a marker pole, determine the position on the ground where the optical angle passes through the 124-inch point of the marker pole. Mark this position for future use.

4 This is the correct position for placing the theodolite with the eyepiece 62 inches above the ground. To verify that the theodolite barrel is aligned to the optical line of the glidepath, adjust the vertical reference to a negative glidepath angle, rotate the azimuth 180° and sight on the point established in Step 1(b)1. If this point is not aligned to the horizontal crosshair, an error in establishing the theodolite position has occurred and the procedure should be accomplished.

(2) **Waveguide Glide Slope**

(a) Due to the complexity of determining the proper location of the theodolite, engineering personnel must compute this location.

(b) The glidepath signal is considered to emanate from the mid-point of the array; therefore, the theodolite will be oriented to this plane.

(c) **Correction Factors.** Due to offset distance of the theodolite from the runway centerline and distance from the antenna array, parallax errors will be induced (dissimilar width sensitivities particularly in Zone 3). Engineering personnel must provide the flight inspection crew with correction factors to be applied to the RTT differential trace.

(3) Endfire Glide Slope

(a) The glidepath signal is considered to emanate from the phase center of the array and at the elevation plane determined by engineering personnel.

(b) **The theodolite must be positioned using the data in paragraph (3)(a) corrected for eyepiece height.**

(4) Localizer. The use of a theodolite, AFIS, or RTT is not required for any inspection on a localizer sited along runway centerline, regardless of category, providing performance can be satisfactorily evaluated by flying a visual centerline track.

The position of the theodolite, when used during localizer evaluations, will be placed on a line perpendicular to the localizer antenna array aligned so as to sight along the reciprocal of the calculated true course and at a point as close to the center of the array as possible.

(5) Aircraft Tracking

(a) **Glide Slope.** The optimum tracking point on the flight inspection aircraft is the glide slope antenna.

(b) **Localizer.** The optimum tracking point on the flight inspection aircraft is the localizer antenna.

g. **75 MHz Marker Facilities Maintenance Personnel.** The following information must be furnished to flight inspection prior to the commissioning check:

(1) The proposed operational configuration of any adjacent marker beacon facilities which could produce interference (e.g., simultaneous operation proposed or interlock device installed).

(2) Any facility alterations performed because of unique siting requirements (e.g., 8 KHz frequency separation between markers serving parallel approaches).

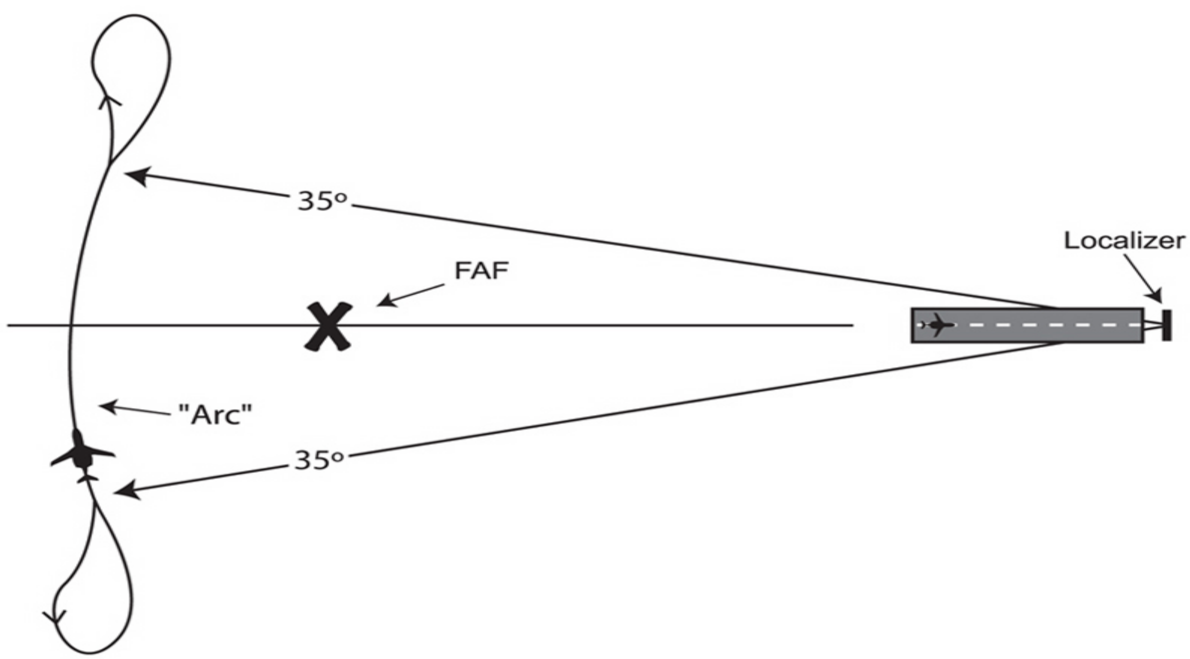
h. **75 MHz Marker Flight Check Personnel.** The calibration card must be used to obtain the milliampere equivalent of 1,700 microvolts (μV) required for each modulation frequency (400 Hz, 1,300 Hz, 3,000 Hz) (e.g., 1.8 milliampere (mA) may represent the 1,700 μV level instead of 2.0 mA). Determine the number of light lines which represent the 1,700 μV signal, and use this reference as the minimum acceptable signal level when evaluating marker beacon coverage.

15.12 FLIGHT INSPECTION PROFILES. ILS facilities are normally inspected along four types of flight paths or "profiles":

- **ILS-1** arc
- **ILS-2** in-bound level run
- **ILS-3** in-bound approach to threshold with level flight over the runway
- **CBP** clearance below path approach to threshold

a. ILS-1 Arc Flight Profile. This profile provides for inspection of the localizer front and back course width, symmetry, sector clearances, localizer signal strength, modulation, and identification. Perform localizer width reference limit (monitor) in this mode.

"FLIGHT INSPECTION ARC"
ILS Front or Back Course



(1) **Maneuvering.** The ILS-1 is an arc flown either clockwise or counterclockwise at a set distance from the facility. Measurements are normally made arcing across the course at the lower standard altitude (LSA) of 1,500 ft above the antenna or 500 ft above intervening terrain, whichever is higher, between 6 and 10 nm (10 nm being optimum) from the localizer antenna to include 35°on each side of the course, starting at approximately 40°. On periodic checks, course width may be checked at distances from 6 - 14 nm.

NOTE: Do not consider man-made obstacles for ILS-1 altitude determination unless the obstruction is in the flight path of the aircraft. Document any obstacles on the data sheet that come within 200 feet of LSA that could be a factor when maneuvering in the ILS-1 area. Maneuvering the aircraft inside or outside the man-made obstruction while maintaining visual separation is the preferred method rather than increasing the LSA altitude or restricting the localizer lateral coverage. Consult with Flight Inspection Policy before raising LSA for man-made obstacles.

(2) **AFIS.** On the MISC SERV page, select the ILS-1 mode. Configure the NAV/ TEST CTRL page IAW TI 4040.55, Section 4.

(3) **Other considerations.** When measuring course width only, an arc from 10° to 10° may be flown. During monitor checks, the final normal width may be flown from 10° to 10° if clearances meet tolerances for normal in the monitor configuration.

During commissioning inspections or when numerous adjustments to the width are anticipated, it may save time and fuel to fly 10° to 10° until a satisfactory width is attained, then continue with the required 35° to 35° runs to check the clearances.

Position is referenced to the Localizer. P-RNG in ILS 1 Mode is the distance from the localizer and P-BRG is degrees to the front course or back course bearing.

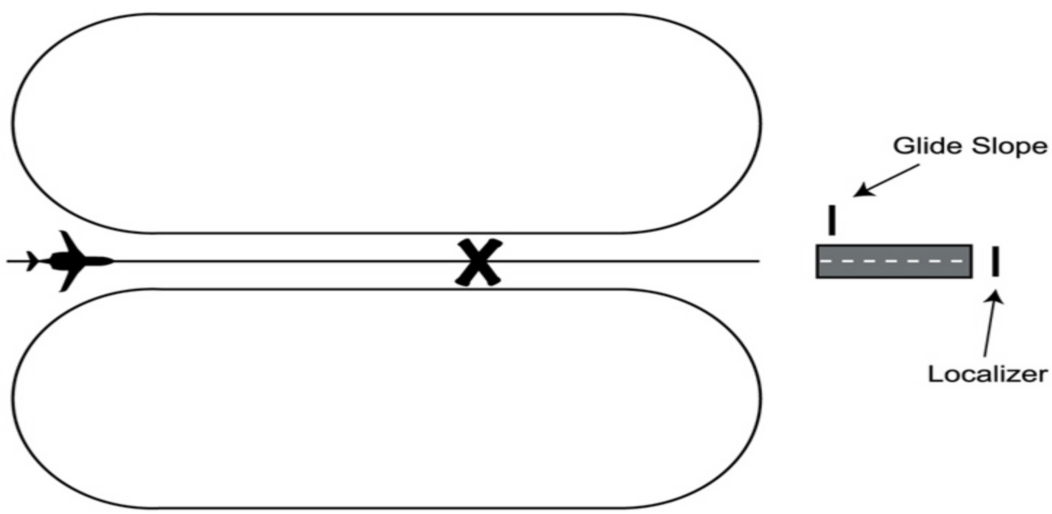
If the received results of an ILS-1 are not what was expected:

- Check that 0µA is received at the 0° bearing.
- Check the IRU status (IRU S/D).
- Ensure that the Facility data page is correct.
- Compare the traces of both receivers.

- Check left to right side antenna by flying CW and CCW arcs and comparing results (See Paragraph 15.21g).
- Check another facility.
- Compare AFIS results with manual analysis.

b. ILS-2 In-Bound Level Run Flight Profile. This maneuver measures glide slope angle, path width, symmetry, and clearance above path (CAP), structure-below-path (SBP), and signal strength. Perform glide slope width reference limit (monitor) checks in this mode.

"FLIGHT INSPECTION HOLDING PATTERN"
ILS Front course only



(1) **Maneuvering.** The ILS-2 profile is flown at a constant airspeed inbound along the runway bearing (desired course bearing for SOIA), from approximately 6 miles outside the Final Approach Fix (FAF) to approximately 2 miles inside the FAF. Starting distance must allow AFIS to capture the 190 µA fly up point. It also must be flown inbound far enough to ensure 150 µA fly-down occurs before the first false path. Left or right turns are at the discretion of Air Traffic. Fly the established level run altitude corrected to true at 1,500 ft above the antenna or 500 ft above terrain, whichever is higher. Another altitude may be established (e.g., airspace, unmeasurable crosspointer transitions, comparability to actual path angle, or a lower altitude to obtain 190 µA). For a periodic inspection, the level run altitude may be adjusted for weather.

(2) **AFIS.** On the MISC SERV page, select the ILS-2 mode. Configure the NAV/TEST CTRL page IAW TI 4040.55, Section 4.

(3) **Other considerations**

(a) AFIS will not execute until the aircraft heading is less than 45° from the RWY BRG. Position is referenced to the centerline abeam the Glide Slope. P-RNG is the distance from the Glide Slope and P-BRG is degrees to the front course bearing.

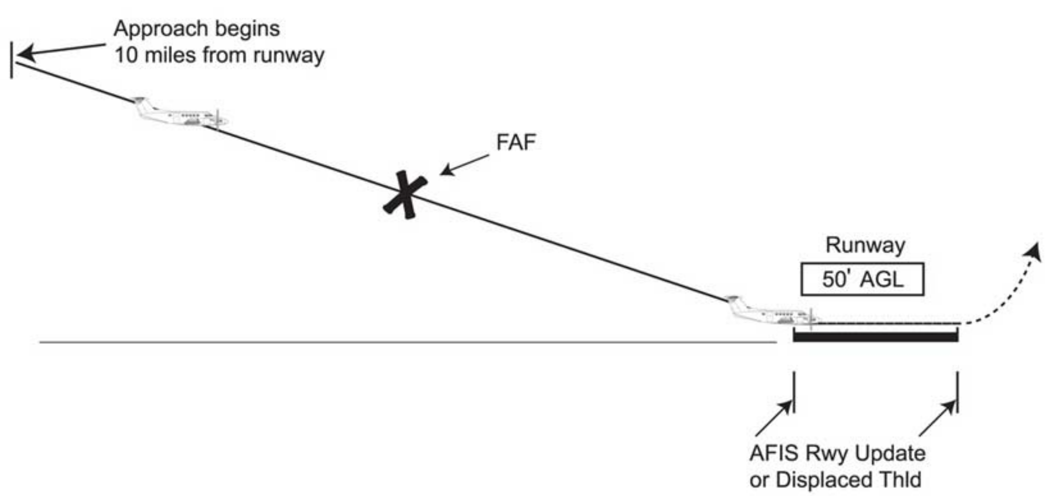
(b) If the received results of an ILS-2 are not as expected:

- Check the IRU status (IRU S/ D)
- Ensure that the facility data page is correct.
- Compare AFIS results with manual analysis.
- Compare the results from both receivers.
- Check another facility for repeatable AFIS results.
- Ensure correct facility configuration.

(c) An Excel Spreadsheet (ILS-2 Establish Alt Calc) is available on the Airman Information File (AIF) at Flight Inspection/ Related Document Links/ Policy in the event the outer marker distance is not updated on the data sheet.

c. **ILS-3 In-Bound Approach Flight Profile.** This profile provides for inspection of the localizer front or back course alignment, structure, signal strength, polarization, and modulation, glide slope angle, angle alignment, structure, signal strength, modulation, and identification, as well as marker beacon width and tone.

"FLIGHT INSPECTION LOW APPROACH"



(1) **Maneuvering.** This operation is for front or back course. Stabilize the aircraft inbound on-course at approximately 10 nm from the threshold. The aircraft must be stabilized on the localizer outside of the FAF to execute vertical polarization. Intercept the glide path 500 ft above the GSI altitude to allow the aircraft to be stabilized on the approach when transitioning and measuring the outer marker. All ILS-3 Mode maneuvers must be flown coupled in the approach mode to the extent allowed by the Aircraft/ Autopilot Limitations Handbook and TI 4040.50 (this does not preclude manually flying all ILS facilities in the event of coupling problems or other unusual circumstances). Continue the approach down the full length of the runway, 50 to 100 ft above the runway. Standard runway updates are from threshold (green lights) to runway end (red lights), unless the facility data sheet "Update-Dis" indicates a different value or if noted in the Airport/ Facility Directory. If any doubt exists, compare runway length with the "Update-Dis" on the facility data sheet and information in the Airport/ Facility Directory.

(2) **AFIS.** On the MISC SERV page, select the ILS-3 mode. Configure the NAV/TEST CTRL page. See TI 4040.55, Section 4.

(3) **Other Considerations:**

(a) P-RNG in the Front Course ILS 3 Mode is the distance to the threshold, and P-BRG is degrees to the front course bearing.

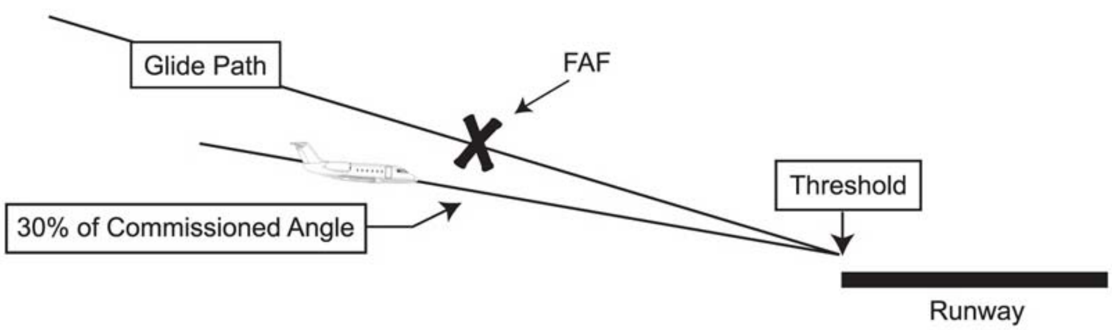
(b) P-RNG in the Back Course ILS-3 Mode is the distance to the localizer antenna, and P-BRG is degrees to the back course bearing.

(c) The aircraft is considered On-Course/ On-Path when within 22.5 µA of the course or path signal.

(d) If the received results of an ILS-3 are not what was expected:

- Ensure that the Facility data page is correct. Compare the AFIS UPDATE DIST (the distance from threshold to runway end or if the runway has a displaced threshold at the departure end, the distance will be from the threshold to the displaced threshold) to the UPDATE DIS on the data sheet.
- Check the IRU status (IRU S/D).
- Check another facility for repeatable AFIS results.

d. **Clearance Below Path approach (CBP):** This profile provides for inspection of the full fly-up signal below the Glide Path.



(1) **Maneuvering.** Fly the CBP profile along the runway bearing (or at the extremity of the localizer course for tilt checks) from outside the glide slope intercept (GSI) to the threshold. For any facility configuration where the 190 µA/ 150Hz structure below path point cannot be found, start the run from the edge of the glide slope service volume. Maintain obstacle clearance while remaining at or below the 180 µA point (150 µA point for alarm conditions). For a 3° glide slope, descend at a recommended angle of 1° to runway threshold, maintaining at least the minimum micro-amp level while the Mission Specialist reads the micro-amp deflection.

(2) **AFIS.** On the MISC SERV page, select the ILS-2 mode (maneuver is typical flown in ILS 2 Mode recording raw data). Prior to the GSI, press the PLOT ON/ OFF button to start printing raw data. The technician will read the micro-amp deflection to the pilot during the descent.

(3) **Other Considerations.** The CBP may be run in the ILS-3 mode. If the ILS-3 mode is used, the SYS PLOT page GS RAW CP baseline will need to be moved (e.g. 08.0) and/or the change the RAW CP SCALE to 100µA. These changes are required to keep the glide slope cross pointer on the paper.

15.13 GENERAL FLIGHT INSPECTION PROCEDURES

a. Types of Inspections and General Procedures

(1) **ILS Site Evaluations.** Site evaluations, if performed, are made prior to installation of permanent equipment. The need for a site evaluation, and additional requirements, must be determined by engineering personnel on the basis of individual site conditions.

(2) **Periodic Checks.** A periodic check without monitors must consist of an inspection of the transmitter that is on the air, plus the operating transmitter of the supporting NAVAID(s). If out-of-tolerance conditions are found, inspect the other equipment, if available.

(3) **Periodic with Monitors.** Normally consists of a periodic performed on both the reference and alternate transmitters, a monitor check on the reference transmitter, and a check on the operating transmitter of supporting NAVAID(s). Facilities that have dual parallel monitors require a monitor evaluation on the reference transmitter only. Verify that ground maintenance personnel configure monitors on the reference transmitter. Matching transmitter power and phasing parameters is a maintenance action verifiable without airborne measurements. Facilities gathering reference data may request a special flight inspection to include a monitor check on both transmitters. Dual transmitter facilities with separate and dedicated monitors for each transmitter require monitor evaluation on each transmitter. On the same transmitter that monitors are checked, perform a normal localizer course width and/ or glide slope path width prior to and after checking the monitor conditions.

(4) **Frequency Change.** Following a localizer, SDF, LDA or ILS frequency change, conduct a special inspection that fulfills the following requirements: Periodic with monitors (PM), RF power monitor reference, and spectrum analysis.

(5) **Other Component Changes.** See Chapter 4, Section 1.

(6) **Restrictions Based on Commissioning-Only Checks.** When a facility restriction is based on a configuration normally checked only on commissioning inspections (e.g., localizer clearances in narrow or coverage with reduced power), document the condition and configuration on the Facility Data Sheet. Conditions found in these configurations do not require revalidation on periodic inspections.

(7) **Restriction Removal.** Restricted facilities must be evaluated on each inspection with the goal of removing restrictions that are no longer valid. Do not check configurations beyond the scope of the scheduled inspection, unless restriction removal can be expected. If the results of the current and last periodic interval inspections indicate a potential for restriction removal, notify Flight Inspection Policy. They must review at least the last five years of inspection history. They must analyze the history and current results for maintenance actions, trends, seasonal differences, etc., to determine if restriction removal is appropriate. If an additional inspection is required, they must specify and schedule the required checks to be done with the next appropriate inspection. For those restrictions based on commissioning-only configurations, do not remove the restrictions without a check of those configurations.

(8) **Back Course Use.** A localizer back course used for missed approach guidance must meet the same checklist requirements and tolerances as one used for an approach.

(9) **ILS Critical Area Checks.** These checks are usually requested to determine the effects of permitting aircraft, vehicles, or other mobile objects to transition through ILS critical areas. The results of these flight inspections are valid only for the specific conditions existing at the time of the check and are not suitable for determination of facility performance status or reliability.

(10) **Maintenance Request Checks.** Items identified as "Maintenance Request" in the individual checklists are so labeled to support current FAA maintenance practices with current FAA equipment. They usually identify checks that can be performed using ground test equipment, as well as aircraft. While FAA maintenance may be able to do these checks, other maintenance activities may require flight inspection for these parameters. Flight inspection and maintenance personnel must discuss these items to ensure the adequacy of the flight check.

b. **Standby (Alternate) Equipment – Localizer/ Glide Slope.** Where dual equipment is installed, complete all checklist items for both sets of equipment, except as noted in the text of this chapter and the checklists. For FAA, U.S. non-Federal civil, U.S. Army, and U.S. Navy/ Marine Corps facilities, alternate transmitters should match the reference transmitter within the prescribed equality in normal maintenance limits during the same flight inspection. This applies to all type inspections when both reference and alternate transmitters are evaluated in normal. If Maintenance is unable to adjust the transmitter within equality limits and the transmitter meets Paragraph 15.60a and b flight inspection tolerances, the transmitter may remain in service unless Maintenance elects to remove it from service.

Dual Transmitter Equality in Normal Maintenance Limits	
Localizer (Normal Only)	
Alignment	± 3 µA
Width	± 0.10°
Clearance	± 15 µA
Glide Slope (Normal Only)	
Angle	± 0.03°
Width	± 0.03°
Structure Below Path	± 0.20°

c. **Standby Power – Localizer/ Glide Slope.** Refer to Chapter 4, Section 3. If required, make the following checks while operating on standby power.

(1) **Localizer.** Normal course width, alignment, symmetry, modulation, and identification.

(2) **Glide Slope.** Normal modulation, width, angle, symmetry, and structure below path.

d. **Expanded Service Volume (ESV).** Where an operational requirement exists to use either or both the glide slope and localizer to altitudes and/or distances beyond the standard service volume, the facility (ies) must be inspected to the expanded altitudes and/or distances (in accordance with Paragraph 22.11b) to determine that facility performance for the required parameters meets tolerances.

(1) **Localizer.** The localizer Standard Service Volume (SSV) is depicted in Figure 15-1C. Use beyond these limits requires an ESV approved by spectrum management and validated by flight inspection.

(2) **Glide Slope.** The glide slope SSV is depicted in Figure 15-1D.

e. **Supporting NAVAID(s).** These may consist of marker beacons, compass locator, DME, and/or lighting systems. Additionally, some locations may require other types of NAVAID(s) to support the approach procedures. Verify RHO-THETA crossing radials associated with an ILS approach IAW Chapter 11.

f. **Instrument Flight Procedures.** See Chapter 6.

15.14 ILS Maintenance Standards and Tolerances. Flight Inspection personnel should be knowledgeable of certain maintenance standards and tolerances to assist maintenance and to more effectively complete the flight inspection mission. The following paragraphs and tables outline pertinent information.

a. Flight Inspection Requirements Based on Maintenance Activities

(1) Reconfiguration. Reconfiguration Inspections encompass most, if not all, commissioning requirements. The following activities require this type inspection:

(a) System change out (i.e. Mark 1F to Mark-20, etc)

(b) Type change (i.e. Null Reference to Capture Effect, etc

(c) System relocation. (i.e. from one runway to another, etc)

(d) Antenna relocation (i.e. Loc antenna moved from offset to straight-in, etc)

(e) Any other maintenance activity that changes the radiation pattern of the facility.

(2) Activities Requiring a Confirming Inspection. The type of check and parameters inspected for a confirming flight inspection are determined on a case-by-case basis. The following activities specifically require a confirming flight inspection:

(a) Changes to obstructions, buildings, power lines, etc., that may affect the radiation signal.

(b) Construction, runway repairs, etc., that were performed in the general localizer or glide slope area, if there is any doubt about how they affect facility performance.

(c) A change in the facility-assigned operating frequency.

(d) Repositioning of any of the glide slope antennas on the mast.

(3) **Activities Requiring a Confirming Inspection or Technical Operations Service Area Authorization.** The responsible Technical Operations Service Area may authorize, on a case-by-case basis, facility restoration without a confirming inspection. This should include a telephone call from regional engineering, followed by a confirming letter. The restoration must be supported by a formal letter of authorization from the service area, which lists the before and after readings, until the log entries covering these activities are purged.

(a) Replacement of any transmit RF components, such as RF lines and antenna components, RF bridges, electronic modulators, power amplifier, power dividers, and transmitter as complete units provided:

1 They contain any of these critical components

2 The transmitter is of the same type

(b) Repair or replacement of any of the localizer antennas in the radiating array, provided reference null data (individual pair and composite) is available.

(c) Replacement, removal, repair or reinstallation of any of the glide slope antennas in the radiating array, provided the system is adjusted to the previously established reference H probe readings, i.e., phase and amplitude.

(4) **Activities that Do Not Require a Confirming Flight Inspection.** All other maintenance activities that meet the maintenance requirements of Order JO 6750.49 do not require a confirming flight inspection.

b. **ILS Maintenance Reference Values** are parameters established by Technical Operations Maintenance and evaluated by Flight Inspection. These parameters include, but are not limited to, power, modulation balance, and phasing. To ensure that the ILS will not exceed flight inspection tolerances during normal operation, Technical Operations Maintenance has established tighter reference tolerances. The two types of reference tolerances are “standard” and “initial.” Standard tolerances represent the facility operating at optimum. Initial tolerances represent a range of desired values for a particular parameter. IAW Order JO 6750.49, ILS Maintenance Handbook, FAA, U.S. non-Federal civil, U.S. Army and U.S. Navy/ Marine Corps facilities must meet initial tolerances any time a reference is established. Initial reference values must be established if maintenance adjusts the ILS to a new reference setting, the facility is found operating beyond periodic flight inspection tolerances IAW Paragraph 15.60 a or b, or when validating references. If, after repeated attempts, the results are beyond the initial tolerance but within flight inspection tolerances, continue the flight inspection if maintenance wishes to restore the facility.

Document the circumstances on the flight inspection report and the Daily Flight Log. The following tables include localizer and glide slope standard and initial maintenance reference tolerances. **Note that these are NOT flight inspection tolerances. Flight Inspectors cannot remove facilities from service if parameters exceed the standard or initial tolerances but are within flight inspection tolerances.**

Localizer Reference Tolerances

Parameter	**Standard (Optimum)**	**"Initial" Tolerance**
Width		
Normal	Commissioned Width	≤ 0.10°
Wide	≤ 10% of Commissioned Width	≤ 14% of Commissioned Width
Equality in Normal (Alternate Transmitter) (2)	Equal to Reference Transmitter	Standard ± 0.10°
Clearances		
Normal	≥ 175 µA	≥ 165 µA
Wide	≥ 160 µA	≥ 150 µA
Equality in Normal (Alternate Transmitter) (2)	Equal to Reference Transmitter	Standard ± 15 µA
Alignment (1)		
Front Course (CAT I/ II/ III), and SDF on CL	0 µA	≤ 3 µA
Back Course (Independently Monitored)	0 µA	≤ 10 µA
Back Course (Subordinate to Front Course)	0 µA	≤ 65 µA
Offset, Localizer, and SDF	0 µA	≤ 8 µA
LDA (3)	0 µA	≤ 8 µA
Equality in Normal (Alternate Transmitter) (2)	Equal to Reference Transmitter	Standard ± 3 µA

(1) The "Initial" alignment tolerance must be applied as the "Final" value on all Periodic with Monitor type checks.

(2) Dual Transmitter Sites: Applies during any inspection where the reference and alternate transmitters are both evaluated in normal. The alternate transmitter should match the reference transmitter within the prescribed equality tolerances during the same flight inspection. If Maintenance is unable to adjust the transmitter within equality limits and meets Paragraph 15.60a or b tolerances, the transmitter may remain in service unless Maintenance elects to remove it from service.

(3) The numerical value applies to those LDA(s) where alignment is measured by AFIS or theodolite. The SAT/ UNSAT criteria remains valid for those facilities such that AFIS is unsuitable and routine theodolite use is not warranted.

Glide Slope Reference Tolerances

Parameter	Standard (Optimum)	"Initial" Tolerance
Path Angle		
Normal	Commissioned Angle (CA)	CA ± 0.05°
High (EFGS)	CA + 0.05°	CA + 8.0%
Low (CEGS) (SBRGS)	CA – 0.05°	CA – 6.0%
Equality in Normal (Alternate Transmitter) (1)	Equal to Reference Transmitter	Standard ± 0.03°
All other abnormal conditions	**CA ± 0.10°**	**CA - 6.0% to + 8.0%**
Path Width		
Normal	0.70°	0.65° to 0.75°
Wide	0.80°	0.75° to 0.87°
Equality in Normal (Alternate Transmitter) (1)	Equal to Reference Transmitter	Standard ± 0.03°
All other abnormal conditions	**0.80°**	**0.53° to 0.87°**
Structure Below Path		
Normal	≥ 70% of CA	≥ 50% of CA
Equality in Normal (Alternate Transmitter) (1)	Equal to Reference Transmitter	Standard ± 0.20°
All other abnormal conditions	**≥ 60% of CA**	**≥ 40% of CA**
Symmetry		
CAT I	50%	60 to 40%
CAT II, III	50%	55 to 45%
De-phase (Advance and Retard)		
Main Sideband	≤ 30°	18° to 30°
Mid Ant (CEGS)	≤ 20°	10° to 20°
Upper Ant (SBRGS)	≤ 30°	18° to 30°
Upper Antenna Attenuation		
Sideband Reference	1 dB	≤2 dB
Capture Effect	5 dB	≤ 5 dB

(1) Dual Transmitter Sites: Applies during any inspection where the reference and alternate transmitters are both evaluated in normal. The alternate transmitter should match the reference transmitter within the prescribed equality tolerances during the same flight inspection. If Maintenance is unable to adjust the transmitter within equality limits and meets Paragraph 15.60a or b tolerances, the transmitter may remain in service unless Maintenance elects to remove it from service.

c. Airborne Measurements of ILS References

(1) Airborne Measurements of ILS References

(a) Even though an abnormal condition is used primarily to evaluate one parameter, such as glide slope width, the secondary measurements of angle and structure below path (SBP) must also meet the "Initial" tolerances. Likewise, Width and SBP are also required to remain within "Initial" values when Angle references are adjusted.

(b) Do not use the term "Alarm" on a reference inspection; instead use "Reference Value" when relaying the abnormal conditions.

(c) Provide Width, Angle (corrected by ILS-3), Symmetry (no tolerance in abnormal conditions), and SBP on all ILS-2 runs. If the angle correction factor is not established at the beginning of the check, ensure the corrected values are transmitted to maintenance before flight inspection departs the area.

(d) Provide width, symmetry (in Normal only), and low clearances on all ILS-1 runs.

(e) Provide the marker minor axis measurements when requested by maintenance.

(f) Request acknowledgement of all data transmitted to maintenance.

(g) If any report value changes as a result of a review during report preparation or quality review, contact the ground technician and provide the corrected numbers. This is to ensure that the recorded maintenance data matches the flight inspection report. **If the ILS maintenance data does not match the corresponding flight inspection results, the maintenance data is invalid pending another flight inspection**.

(h) Localizer alignment monitor references are not based on airborne measurements, IAW Order JO 6750.49; applicable Technical Operations Service Area approved special request is required.

(i) Dual Transmitter Facilities. Alternate transmitters should match the reference transmitter within the prescribed equality limits during the same flight inspection. This applies to any type inspection when both reference and alternate transmitters are evaluated. If Maintenance is unable to adjust transmitter within equality limits but meets flight inspection tolerances, the transmitter may remain in service unless Maintenance elects to remove it from service.

(2) Required Airborne Measurements per Facility Type

Figure 15-2A Single Frequency Localizer

ILS Reference Change	Required Airborne Measurements	Remarks / Tolerance
Alignment	Alignment & Structure FC, BC & IMBC*	(1) LDA and Offset ILS ≤ 8 µA
SBO Power: Normal or Width Monitor Ref ADJ	Normal Course Width/ Clearance (FC & IMBC*)	(2) (4)
	Wide Monitor Reference (FC& IMBC*)	(3) (5)
SBO Phase	Normal Course Width/ Clearance (FC & IMBC*)	(2) (4)
	Wide Monitor Reference (FC & IMBC*)	(3) (5)
Total References	Alignment & Structure (FC, BC& IMBC*)	(1) LDA and Offset ILS ≤ 8 µA
	Normal Course Width/ Clearance (FC & IMBC*)	(2) (4)
	Wide Monitor Reference (FC & IMBC*)	(3) (5)

*IMBC = Independently Monitored Backcourse

(1) Alignment ≤ 3 µA (FC), ≤ 65 µA (BC), ≤ 10 µA (IMBC*)

(2) Course Width ≤ 0.10° Commissioning Width

(3) Course Width ≤ 14 % Commissioned Width

(4) Clearances ≥ 165 µA

(5) Clearance ≥ 150 µA

Figure 15-2B Dual Frequency Localizer		
ILS Reference Change	**Required Airborne Measurements**	**Remarks / Tolerance**
Alignment	Alignment & Structure (FC, BC& IMBC*)	(1) LDA and Offset ILS ≤ 8 µA
Course/ Clearance SBO Power: Normal Or Width Monitor Ref ADJ	Normal Course Width/ Clearance (FC& IMBC*)	(2) (4)
	Course/ Clearance Wide Monitor Reference (FC & IMBC*)	(3) (5)
Course/Clearance SBO Phase	Normal Course Width/ Clearance (FC & IMBC*)	(2) (4)
	Course/Clearance Wide Monitor Reference (FC & IMBC*)	(3) (5)
Total References	Alignment & Structure FC, BC & IMBC*	(1) LDA and Offset ILS ≤ 8 µA
	Normal Course Width/ Clearance(FC & IMBC*)	(2) (4)
	Course/Clearance Wide Monitor Reference (FC & IMBC*)	(3) (5)

*IMBC = Independently Monitored Backcourse

(1) Alignment ≤ 3 µA (FC), ≤ 65 µA (BC), ≤ 10 µA (IMBC*)

(2) Course Width ≤ 0.10° Commissioning Width

(3) Course Width ≤ 14 % Commissioned Width

(4) Clearances ≥ 165 µA

(5) Clearance ≥ 150 µA

Figure 15-2C Null-Reference Glide Slope		
ILS Reference Change	**Required Airborne Measurements**	**Remarks / Tolerance**
SBO Power: Normal or Monitor Reference ADJ	Normal WAS*	(1) (4) (7) (8)
	Wide Monitor Reference	(2) (5) (9)
SBO Phase: Normal or Monitor Reference ADJ	Normal WAS*	(1) (4) (7) (8)
	Wide Monitor Reference	(2) (5) (9)
	Advance/ Retard main SBO	(2) (6) (9) Phaser Setting 18 – 30°
Total References	Normal WAS*	(1) (4) (7) (8)
	Wide Monitor Reference	(2) (5) (9)
	Advance/ Retard main SBO	(2) (6) (9) Phaser Setting 18 – 30°
	Actual Angle**	(3)
New Antenna Heights or **Modulation Balance ADJ**	Normal WAS*	(1) (4) (7) (8)
	Wide Monitor Reference	(2) (5) (9)
	Advance/Retard main SBO	(2) (6) (9) Phaser Setting 18 – 30°
	Actual Angle**	(3)

*WAS = Width, Angle, Structure Below Path Level Run
**Region Approval Required to Change Angle

(1) Path Angle = +10 % / -7.5 %
(2) Path Angle = Commissioned Angle +8 % / -6 %
(3) Path Angle = Commissioned ± 0.05°
(4) Path Width = 0.65 – 0.75°
(5) Path Width = 0.75 – 0.87°
(6) Path Width = 0.53 – 0.87°
(7) Symmetry (CAT I) = 40 – 60%, (CAT II/III) = 45 – 55%
(8) Structure Below Path = ≥ 50% Commissioned Angle
(9) Structure Below Path = ≥ 40% Commissioned Angle

Figure 15-2D Capture Effect Glide Slope		
ILS Reference Change	**Required Airborne Measurements**	**Remarks / Tolerance**
SBO Power: Normal or Monitor Reference ADJ	Normal WAS*	(1) (4) (7) (8)
	Course Wide/ Clearance Modulation Monitor Reference	(2) (5) (9)
Middle Antenna Phaser: Normal or Monitor Reference ADJ	Normal WAS*	(1) (4) (7) (8)
	Course Wide/ Clearance Modulation Monitor Reference	(2) (5) (9)
	ADV/ RTD Middle ANT Monitor Reference	(2) (6) (9) Phaser Setting 10 – 20°
***Main SBO Phaser**: Normal or Monitor Reference ADJ	Normal WAS*	(1) (4) (7) (8)
	Course Wide/ Clearance Modulation Monitor Reference	(2) (5) (9)
	Advance/ Retard Main SBO	(2) (6) (9) Phaser Setting 18 – 30°
Upper Antenna Attenuate Monitor Reference ADJ	Upper Antenna Attenuate Monitor Reference	(2) (6) (9) Attenuator ≤ 5 dB
Total References	Normal WAS*	(1) (4) (7) (8)
	Course Wide/ Clearance Modulation Monitor Reference	(2) (5) (9)
	ADV/RTD Middle ANT Monitor Reference	(2) (6) (9) Phaser Setting 10 – 20°
	Upper Antenna Attenuate Monitor Reference	(2) (6) (9) Attenuator ≤ 5 dB
	Actual Angle**	(3)
New Antenna Heights or **Modulation Balance ADJ**	Normal WAS*	(1) (4) (7) (8)
	Course Wide/ Clearance Modulation Monitor Reference	(2) (5) (9)
	ADV/ RTD Middle ANT Monitor Reference	(2) (6) (9) Phaser Setting 10 – 20°
	Advance/Retard Main SBO	(2) (6) (9) Phaser Setting 18 – 30°
	Upper Antenna Attenuate Monitor Reference	(2) (6) (9) Attenuator ≤ 5 dB
	Actual Angle**	(3)

*WAS = Width, Angle, Structure Below Path Level Run
**Region Approval Required to Change Angle
(1) Path Angle = +10 % / -7.5 %
(2) Path Angle = Commissioned Angle +8 % / -6 %
(3) Path Angle = Commissioned ± 0.05°
(4) Path Width = 0.65 – 0.75°
(5) Path Width = 0.75 – 0.87°
(6) Path Width = 0.53 – 0.87°
(7) Symmetry (CAT I) = 40 – 60%, (CAT II/III) = 45 – 55%
(8) Structure Below Path = ≥ 50% Commissioned Angle
(9) Structure Below Path = ≥ 40% Commissioned Angle

Figure 15-2E Sideband Reference Glide Slope		
ILS Reference Change	**Required Airborne Measurements**	**Remarks / Tolerance**
SBO Power: Normal or Monitor Reference ADJ	Normal WAS*	(1) (4) (7) (8)
	Wide Monitor Reference	(2) (5) (9)
Upper Antenna Phaser ***Monitor Reference ADJ***	Normal WAS*	(1) (4) (7) (8)
	Wide Monitor Reference	(2) (5) (9)
	ADV/ RTD Upper ANT Monitor Reference	(2) (6) (9) Phaser Setting 18 – 30°
	Actual Angle Check**	(3)
Low Angle Monitor Reference: ***Upper Antenna Attenuate***	Normal WAS*	(1) (4) (7) (8)
	Wide Monitor Reference	(2) (5) (9)
	Upper Antenna Attenuate Monitor Reference (Low Angle)	(2) (6) (9) Attenuator ≤ 2 dB
	Actual Angle Check**	(3)
Total References	Normal WAS*	(1) (4) (7) (8)
	Wide Monitor Reference	(2) (5) (9)
	ADV/ RTD Upper ANT Monitor Reference	(2) (6) (9) Phaser Setting 18 – 30°
	Upper Antenna Attenuate Monitor Reference (Low Angle)	(2) (6) (9) Attenuator ≤ 2 dB
	Actual Angle**	(3)
New Antenna Heights or **Modulation Balance Change, normal SBO Power Divider, or Upper Antenna Phase ADJ**	Normal WAS*	(1) (4) (7) (8)
	Wide Monitor Reference	(2) (5) (9)
	ADV/RTD Upper ANT Monitor Reference	(2) (6) (9) Phaser Setting 18 – 30°
	Upper Antenna Attenuate Monitor Reference (Low Angle)	(2) (6) (9) Attenuator ≤ 2 dB
	Actual Angle**	(3)

*WAS = Width, Angle, Structure Below Path Level Run
**Region Approval Required to Change Angle
(1) Path Angle = +10 % / -7.5 %
(2) Path Angle = Commissioned Angle +8 % / -6 %
(3) Path Angle = Commissioned ± 0.05°
(4) Path Width = 0.65 – 0.75°
(5) Path Width = 0.75 – 0.87°
(6) Path Width = 0.53 – 0.87°
(7) Symmetry (CAT I) = 40 – 60%, (CAT II/III) = 45 – 55%
(8) Structure Below Path = ≥ 50% Commissioned Angle
(9) Structure Below Path = ≥ 40% Commissioned Angle

Figure 15-2F Endfire Glide Slope

ILS Reference Change	**Required Airborne Measurements**	**Remarks / Tolerance**
SBO Power: Normal or Monitor Reference ADJ	Normal WAS*	(1) (4) (7) (8)
	Wide Monitor Reference	(2) (5) (9)
Main SBO Phaser: Normal or Monitor Reference ADJ	Normal WAS*	(1) (4) (7) (8)
	Wide Monitor Reference	(2) (5) (9)
	ADV/RTD SBO	(2) (6) (9)
Main Antenna Array Phaser: (High/ Low) Angle Reference ADJ	Normal WAS*	(1) (4) (7) (8)
	Wide Monitor Reference	(2) (5) (9)
	High Angle Monitor Reference	(6) (9) (10)
	Low Angle Monitor Reference	(6) (9) (11)
	Actual Angle Check**	(3)
Total References	Normal WAS*	(1) (4) (7) (8)
	Wide Monitor Reference	(2) (5) (9)
	ADV/RTD SBO	(2) (6) (9)
	High Angle Monitor Reference	(6) (9) (10)
	Low Angle Monitor Reference	(6) (9) (11)
	Actual Angle Check**	(3)
New Antenna Pedestal Positions (Transverse Structure ADJ), **Modulation Balance Change,** or **Normal Main Array Phaser (Z4) Setting Change**	Normal WAS*	(1) (4) (7) (8)
	Wide Monitor Reference	(2) (5) (9)
	ADV/RTD SBO	(2) (6) (9)
	High Angle Monitor Reference	(6) (9) (10)
	Low Angle Monitor Reference	(6) (9) (11)
	Actual Angle Check**	(3)

*WAS = Width, Angle, Structure Below Path Level Run
**Region Approval Required to Change Angle

(1) Path Angle = +10 % / -7.5 %
(2) Path Angle = Commissioned Angle +8 % / -6 %
(3) Path Angle = Commissioned ± 0.05°
(4) Path Width = 0.65 – 0.75°
(5) Path Width = 0.75 – 0.87°
(6) Path Width = 0.53 – 0.87°
(7) Symmetry (CAT I) = 40 – 60%, (CAT II/III) = 45 – 55%
(8) Structure Below Path = ≥ 50% Commissioned Angle
(9) Structure Below Path = ≥ 40% Commissioned Angle
(10) Path Angle = Commissioned Angle +8 %
(11) Path Angle = Commissioned Angle -6 %

15.15 CHECKLISTS

a. **General Checklist.** During a specific inspection, check the following items:

	A	E	C	PM	P
75 MHz Marker Beacons	X	-	X	X	X
Compass Locator	X	-	X	X	X
DME	X	-	X	X	X
Lighting Systems	X	-	X	X	X
Standard Instrument Approach Procedure (see Chapter 4, Section 2 and Chapter 6)	X	(1)	X	(1)	(1)

NOTE:

(1) As required by ground technical or flight inspection personnel.

b. **Facility Checklists by Type.** Flight inspection requirements are contained in the following checklists and in the discussion paragraphs in this chapter. The checklists are provided as a guide and do not necessarily indicate a sequence of checks. Consult the text to ensure a complete inspection.

Legend:

Fc = Localizer front course

Bc = Localizer back course

C = Commissioning or commissioning-type equipment.

E = Site evaluation

Pm = Periodic inspection with monitors

P = Periodic inspection without monitors

A = Annual

(1) Single Frequency Localizer, LDA(s), and SDF(s).

NOTE: Bc checks do not apply to uni-directional antennas.

TYPE CHECK	REFERENCE PARAGRAPH	INSPECTION				FACILITY CONFIGURATION	MEASUREMENTS REQUIRED					
		E	C (6)	Pm (7)	P		MODULATION	WIDTH	SYMMETRY	CLEARANCE	ALIGNMENT	STRUCTURE
Spectrum Analysis	15.21a	Reserved										
Ident. & Voice	15.21b	(1)	X	X	X							Fc&Bc
Modulation Level	15.21d	X	X	X	X	Normal	Fc					
Modulation Equality (2) Caution: HMI	15.21e	(1)	(1)			Carrier Only						
Phasing (3) Caution: HMI	15.21f	(1)	(1)			Quadrature	Set to Value of Modulation Equality					
Width & Clearance (9)	15.21g 15.21h	X	X	X	X	Normal	Fc&Bc	Fc&Bc	Fc&Bc	Fc&Bc		
Clearance Comparability (10)	15.21h(1)		X			As Required		Fc&Bc		Fc&Bc		
Alignment and Structure	15.21i	X	X	X	X	Normal	Fc&Bc				Fc&Bc	Fc&Bc
Localizer Only Minima	15.21i(4)	X	X			Normal	Fc&Bc					Fc&Bc
Polarization (10)	15.21j	X	X	X	X	Normal						Fc&Bc

TYPE CHECK	REFERENCE PARAGRAPH	INSPECTION				FACILITY CONFIGURATION	MEASUREMENTS REQUIRED					
		E	C (6)	Pm (7)	P		MODULATION	WIDTH	SYMMETRY	CLEARANCE	ALIGNMENT	STRUCTURE
Monitors (5) **Width**	**15.21k** **15.13a(3)**	**(1)**	**X, (11)**	**X**		**Wide**		**Fc&Bc**		**Fc&Bc**		
		(1)	**X, (11)**			**Narrow**		**Fc**		**Fc**		
Alignment **Caution: HMI**	**15.21l**	**(1)**	**(1)**			**Shifted Alignment**					**Fc**	
RF Power Monitor Reference (8)(10)	**15.21m**	**(1)**	**X**			**Reduced RF Power**				**Fc&Bc**		**Fc&Bc**
High Angle Clearance (10)	**15.21n**	**X**	**X**			**Normal**	**Fc&Bc**			**Fc&Bc**		
Standby (Alternate) Equipment	**15.13b** **4.33b**		**X**	**X**								
Standby Power (10)	**15.13c** **4.33c**		**X**			**Normal**	**Fc&Bc**	**Fc&Bc**	**Fc&Bc**		**Fc&Bc**	

FOOTNOTES:

(1) Maintenance request

(2) Adjustments to carrier modulation balance will require a subsequent check of course alignment.

(3) Width and clearance should be measured prior to the phasing check. If, after the quadrature phase check, the width has remained the same or has narrowed and/or the clearances have increased from the first width and clearance check, then the phasing has been improved. Final determination of optimum phase should be discussed with Facilities Maintenance personnel.

(4) (Reserved)

(5) Facilities with dual transmitters and single solid-state modulators—check both transmitters.

(6) Replacement of an antenna array with a different type (e.g., V-Ring elements to LDP element, 8-element to 14-element), require commissioning inspection checks, except for those checks not required, as determined jointly by flight inspection and Facilities Maintenance personnel.

(7) Same type antenna replacements require PM checks, in addition to all of Zone 1 structure (Paragraph 15.21i(2)) and localizer only structure checks (Paragraph 15.20i(4)). .

(8) Request RF level in watts from ground technician.

(9) Recheck clearances each 1,080 days at the lower standard altitude of 1,500 feet above the antenna or 500 feet above intervening terrain, whichever is higher.

(10) One XMTR Only

(11) Facilities maintained using Order JO 6750.49 require monitor checks on one XMTR only.

(2) Dual Frequency Localizer

TYPE CHECK	REFERENCE PARAGRAPH	INSPECTION				TRANSMITTER CONFIGURATION		MEASUREMENTS REQUIRED					
		E	C (4)	Pm(5)	P	COURSE XMTR	CLEARANCE XMTR	MODULATION	WIDTH	SYMMETRY	CLEARANCE	ALIGNMENT	STRUCTURE
Spectrum Analysis	15.21a	Reserved											
Ident. & Voice	15.21b	(1)	X	X	X								Fc&Bc
Power Ratio	15.21c	(1)	(1)			Reduced RF Pwr	Normal						
Modulation Level	15.21d	X	X			Normal	Off	Fc					
		X	X			Off	Normal	Fc					
		X	X	X	X	Normal	Normal	Fc					
Modulation Equality (2) Caution: HMI	15.21e	(1)	(1)			Carrier Only	Off	Fc	Balance Determined by Maintenance				
		(1)	(1)			Off	Carrier Only	Fc	Balance Determined by Maintenance				
Phasing (3) Caution: HMI	15.21f	(1)	(1)			Quad	Off		Set to Value of Modulation Equality				
		(1)	(1)			Off	Quad		Set to Value of Modulation Equality				
Width & Clearance	15.21g	(1)	(1)			Off	Normal	Fc	Fc				
	15.21h	X	X	X	X	Normal	Normal	Fc&Bc	Fc& Bc	Fc &B c	Fc& Bc		
Clearance Comparability (7)(8)	15.21h(1)		X			As Required	As Required		Fc& Bc		Fc& Bc		
Alignment and Structure	15.21i	X	X	X	X	Normal	Normal	Fc&Bc				Fc& Bc	Fc&Bc
Localizer Only Minima	15.21i(4)	X	X			Normal	Normal	Fc&Bc					Fc&Bc
Polarization (8)	15.21j	X	X	X	X	Normal	Normal						Fc&Bc
Monitors Width	15.21k 15.13a(3)		(1)			Wide	Normal		Fc				
		(1)	X, (9)			Narrow	Wide		Fc& Bc		Fc& Bc		
		(1)	X, (9)	X		Wide	Wide		Fc& Bc		Fc& Bc		

(2) Dual Frequency Localizer, continued

TYPE CHECKM	REFEREMCE PARAGRAPH	INSPECTION				TRANSMITTER CONFIGURATION							
		E	C (4)	Pm (5)	P	COURSE XMTR	CLEARANCE XMTR	MODULATION	WIDTH	SYMMETRY	CLEARANCE	ALIGNMENT	STRUCTURE
Dephase	15.21k		(1)			ADV Phase	Normal		Fc				
			(1)			RET Phase	Normal		Fc				
			(1)			Normal	ADV Phase		Fc		Fc		
			(1)			Normal	RET Phase		Fc		Fc		
Alignment Caution: HMI	15.21l		(1)			Shifted Alignmen t	Normal					Fc	
RF Power Monitor Reference (6)(8)	15.21m	(1)	X			Reduced RF Power	Reduced RF Power				Fc&Bc		Fc&Bc
High Angle Clearance (8)	15.21n	X	X			Normal	Normal	Fc&Bc			Fc&Bc		
Standby (Alternate) Equipment	15.13b 4.33b		X	X									
Standby Power (8)	15.13c 4.33c		X			Normal	Normal	Fc&Bc	Fc&Bc	Fc&Bc		Fc&Bc	

FOOTNOTES:

(1) Maintenance request

(2) Adjustments to carrier modulation balance will require a subsequent check of course alignment.

(3) Width and clearance should be measured prior to the phasing check. If, after the quadrature phase check, the width has remained the same or has narrowed and/or the clearances have increased from the first width and clearance check, then the phasing has been improved. Final determination of optimum phase should be discussed with Facilities Maintenance personnel.

(4) Replacement of an antenna array with a different type (e.g., V-Ring elements to LDP element, 8-element to 14-element) require commissioning inspection checks, except for those checks not required, as determined jointly by flight inspection and Facilities Maintenance personnel.

(5) Same type antenna replacements require PM checks, in addition to all of Zone 1 structure (Paragraph 15.21i(2)) and localizer only structure checks. (Paragraph 15.21i(4)).

(6) Request RF level in watts from ground technician.

(7) Recheck clearances each 1,080 days at the lower standard altitude of 1,500 feet above the antenna or 500 feet above intervening terrain, whichever is higher.

(8) One XMTR Only

(9) Facilities maintained using Order JO 6750.49 require monitor checks on one XMTR only.

(3) Null Reference Glide Slope

CODE: W/A/S = Width, Angle, Symmetry

TYPE CHECK	REFERENCE PARAGRAPH	INSPECTION				FACILITY CONFIGURATION	MEASUREMENTS REQUIRED						
		E	C	Pm	P		MODULATION	WIDTH	ANGLE	SYMMETRY	STRUC BELOW PATH	CLEARANCE	STRUCTURE
Spectrum Analysis	15.30a	Reserved											
Engineering Support Tests (5) Caution: HMI	15.30e 15.30f	(1)	(1)			As Required							
Modulation Level	15.30b	X	X	X	X	Normal	X						
Modulation Equality Caution: HMI	15.30c	(1)	(1)			Carrier Only	X						
Phasing Caution: HMI	15.30d	(1)	(1)			Quadrature	SET TO VALUE FOUND IN MODULATION EQUALITY						
Spurious Radiation	15.30g(3)	(1)	(1)			Dummy Load Radiating Signal							X
W/A/S	15.30i 15.30h 15.30j	X	X	X	X	Normal		X	X	X	X, (2)		
Structure	15.30o	X	X	X	X	Normal	X		X				X
Clearance (CBP One XMTR Only)	15.30l	X	X			Normal						X	
Tilt (5)	15.30m	X	X			Normal	X		X			X	
Mean Width (5)	15.30n	(1)	X			Normal		X		X			

(3) Null Reference Glide Slope (continued)

TYPE CHECK	REFERENCE PARAGRAPH	INSPECTION				FACILITY CONFIGURATION	MEASUREMENTS REQUIRED						
		E	C	Pm	P		MODULATION	WIDTH	ANGLE	SYMMETRY	STRUC BELOW PATH	CLEARANCE	STRUCTURE
Monitors Width	15.30r 15.13a(3)	(1)	X, (6)	X		ADV Phase		X	X		X, (2)	(3)	
		(1)	X, (6)	X		RET Phase		X	X		X, (2)	(3)	
		(1)	X, (6)	X		Wide		X	X		X, (2)	(3)	
			X, (6)			Narrow		X	X		X, (2)		
RF Power Monitor Reference (4) (5)	15.30s	(1)	X			Reduced RF Power							
Standby (Alternate) Equipment	15.13b 4.33b		X	X									
Standby Power	15.13c 4.33c		X			Normal	X	X	X	X	X, (2)		

FOOTNOTES:

(1) Maintenance request

(2) If structure below path tolerances cannot be met, clearance procedures and tolerances will be applied.

(3) Clearance Below Path (CBP) required on commissioning type inspections, one XMTR only.

(4) Request RF level in watts from ground technician.

(5) One XMTR Only

(6) Facilities maintained using Order JO 6750.49 require monitor checks on one XMTR only.

(4) Sideband Reference Glide Slope

CODE: W/A/S = Width, Angle, Symmetry

TYPE CHECK	REFERENCE PARAGRAPH	INSPECTION				FACILITY CONFIGURATION	MEASUREMENTS REQUIRED						
		E	C	Pm	P		MODULATION	WIDTH	ANGLE	SYMMETRY	STRUC BELOW PATH	CLEARANCE	STRUCTURE
Spectrum Analysis	15.30a	Reserved											
Engineering Support Tests (7) Caution: HMI	15.30e 15.30f	(1)	(1)			As Required							
Modulation Level	15.30b	X	X	X	X	Normal	X						
Modulation Equality Caution: HMI	15.30c	(1)	(1)			Carrier Only	X						
Phasing Caution: HMI	15.30d	(1)	(1)			As Required	SET TO VALUE FOUND IN MODULATION EQUALITY						
Spurious Radiation	15.30g	(1)	(1)			Dummy Load Radiating Signal							X
W/ A/ S	15.30i 15.30h 15.30j	X	X	X	X	Normal		X	X	X	X, (2)		
Structure	15.30o	X	X	X	X	Normal	X		X				X
Clearance (CBP One XMTR only)	15.30l	X	X			Normal						X	
Tilt (7)	15.30m	X	X			Normal	X		X			X	
Mean Width (7)	15.30n	(1)	X			Normal		X		X			

(4) Sideband Reference Glide Slope (Continued)

TYPE CHECK	REFERENCE PARAGRAPH.	INSPECTION E	INSPECTION C	INSPECTION Pm	INSPECTION P	FACILITY CONFIGURATION	MEASUREMENTS REQUIRED: MODULATION	WIDTH	ANGLE	SYMMETRY	STRUC BELOW PATH	CLEARANCE	STRUCTURE
Monitors (5) Angle	15.30r 15.13a(3)		(1)	(1)		High Angle (4)		X	X, (4)		X, (2)		
		(1)	X, (8)	X		Low Angle (4)		X	X, (4)		X, (2)	(3)	
Width						Upper Antenna:							
			X, (8)	X		ADV Phase		X	X		X, (2)	(3)	
			X, (8)	X		RET Phase		X	X		X, (2)	(3)	
						Main Sideband:							
			(1)			ADV Phase		X	X		X, (2)		
			(1)			RET Phase		X	X		X, (2)		
		(1)	X, (8)	X		Wide		X	X		X, (2)	(3)	
			X, (8)			Narrow		X	X		X, (2)		
RF Power Monitor Reference (6) (7)	15.30s	(1)	X			Reduced RF Power							
Standby (Alternate) Equipment	15.13b 4.33b		X	X									
Standby Power	15.13c 4.33c		X			Normal	X	X	X	X	X, (2)		

FOOTNOTES:

(1) Maintenance request

(2) If structure below path tolerances cannot be met, clearance procedures and tolerances will be applied.

(3) Clearance Below Path (CBP) required on commissioning type inspections, one XMTR only.

(4) Check on one transmitter only if equipment has a common power divider and parallel monitors.

(5) Perform a final actual angle check at the completion of any width or angle monitor inspection.

(6) Request RF level in watts from ground technician.

(7) One XMTR Only

(8) Facilities maintained using Order JO 6750.49 require monitor checks on one XMTR only.

(5) Capture Effect Glide Slope

CODE: W/A/S = Width, Angle, Symmetry

TYPE CHECK	REFERENCE PARAGRAPH	INSPECTION				FACILITY CONFIGURATION	MEASUREMENTS REQUIRED						
		E	C	Pm	P		MODULATION	WIDTH	ANGLE	SYMMETRY	STRUC TURE BELOW PATH	CLEARANCE	STRUCTURE
Spectrum Analysis	**15.30a**	**Reserved**											
Engineering Support Tests (7) **Caution: HMI**	**15.30e** **15.30f**	**(1)**	**(1)**			**As Required**							
Modulation Level	**15.30b**	**X**	**X**	**X**	**X**	**Normal:**	**X**						
Modulation Equality **Caution: HMI**	**15.30c**	**(1)**	**(1)**			**Carrier Only**	**X**						
Phasing Proc. 1 or 2 **Caution: HMI**	**15.30d(3)**	**(1)**	**(1)**			**As Required**	**SET TO VALUE FOUND IN MODULATION EQUALITY**						
Phase Verification (4)	**15.30d(3)**	**(1)**	**X**			**As Required**	**X**	**X**	**X**	**X**		**X**	
Spurious Radiation	**15.30g**	**(1)**	**(1)**			**Dummy Load Radiating Signal**							**X**
W/ A/ S	**15.30i** **15.30h** **15.30j**	**X**	**X**	**X**	**X**	**Normal**		**X**	**X**	**X**	**X, (2)**		
Structure	**15.30o**	**X**	**X**	**X**	**X**	**Normal**	**X**		**X**				**X**
Clearance **(CBP One XMTR only)**	**15.30l**	**X**	**X**			**Normal**						**X**	

(5) Capture Effect Glide Slope (continued)

TYPE CHECK	REFERENCE PARAGRAPH	INSPECTION E	INSPECTION C	INSPECTION Pm	INSPECTION P	FACILITY CONFIGURATION	MEASUREMENTS REQUIRED: MODULATION	WIDTH	ANGLE	SYMMETRY	STRUC TURE BELOW PATH	CLEARANCE	STRUCTURE
Tilt (7)	15.30m	X	X			Normal	X		X			X	
Mean Width (7)	15.30n	(1)	X			Normal		X		X			
Monitors Width	15.30r 15.13a(3)	(1)	X, (8)	X		Middle Antenna ADV Phase		X	X		X, (2)	(3) (5)	
		(1)	X, (8)	X		RET Phase		X	X		X, (2)	(3) (5)	
		(1)	X, (8)			Narrow		X	X		X, (2)		
		(1)	X, (8)	X		Primary XMTR wide and clearance XMTR reduced modulation		X	X		X, (2)	(3)	
		(1)	(1)			Middle Antenna Attenuate		X	X		X, (2)	(3)	
		(1)	X, (8)	X		Upper Antenna Attenuate		X	X		X, (2)		
RF Power Monitor Reference (6) (7)	15.30s	(1)	X			Reduced RF Power							
Standby (Alternate) Equipment	15.13b 4.33b		X	X									
Standby Power	15.13c 4.33c		X			Normal	X	X	X	X	X, (2)		

FOOTNOTES:

(1) Maintenance request

(2) If structure below path tolerances cannot be met, clearance procedures and tolerances will be applied.

(3) Clearance Below Path (CBP) required on commissioning type inspections, one XMTR only.

(4) Normally required on only one transmitter. Perform on second transmitter at maintenance request.

(5) CBP not required if the dephasing is equal to or less than the amount used for phase verification.

(6) Request RF level in watts from ground technician.

(7) One XMTR Only

(8) Facilities maintained using Order JO 6750.49 require monitor checks on one XMTR only.

(6) Waveguide Glide Slope with Auxiliary Waveguide Antennas

NOTE: For those waveguide glide slopes that do not have auxiliary waveguide antennas, complete all checklist items except the following monitor checks: Upper Auxiliary Waveguide—attenuate, advance and retard—dephase; Lower Auxiliary Waveguide—attenuate; Upper and Lower Waveguide—simultaneously advance and retard dephase.

CODE: W/ A/ S = Width, Angle, Symmetry

TYPE CHECK	REFERENCE PARAGRAPH.	INSPECTION				FACILITY CONFIGURATION	MEASUREMENTS REQUIRED						
		E	C	Pm	P		MODULATION	WIDTH	ANGLE	SYMMETRY	STRUC TURE BELOW PATH	CLEARANCE	STRUCTURE
Spectrum Analysis	15.30a	Reserved											
Engineering Support Tests (6) Caution: HMI	15.30e 15.30f	(1)	(1)			As Required							
Modulation Level	15.30b	X	X	X	X	Normal	X						
Modulation Equality Caution: HMI	15.30c	(1)	(1)			Carrier Only							
Spurious Radiation	15.30g	(1)	(1)			Dummy Load Radiating Signal							X
W/ A/ S	15.30i 15.30h 15.30j	X	X	X	X	Normal		X	X	X	X, (2)		
Structure	15.30o	X	X	X	X	Normal	X		X				X
Clearance (CBP One XMTR only)	15.30l	X	X			Normal						X	
Tilt (6)	15.30m	X	X			Normal	X		X			X	
Mean Width (6)	15.30n	(1)	X			Normal		X		X			

(6) Waveguide Glide Slope with Auxiliary Waveguide Antennas (continued)

TYPE CHECK	REFERENCE PARAGRAPH	INSPECTION				FACILITY CONFIGURATION	MEASUREMENTS REQUIRED						
		E	C	Pm	P		MODULATION	WIDTH	ANGLE	SYMMETRY	STRUC TURE BELOW PATH	CLEARANCE	STRUCTURE
Monitors													
Width	15.30r	(1)	X	X		Wide		X	X		X, (2)	(3)	
	15.13a		X			Narrow		X	X		X, (2)		
						Main Sideband:							
			X	X		ADV Phase		X	X		X, (2)	(3)	
			X	X		RET Phase		X	X		X, (2)	(3)	
(6)						Upper Auxiliary Waveguide:							
			X			Attenuate		X	X, (4)			X	X
			X			ADV Phase		X	X, (4)			X	X
			X			RET Phase		X	X, (4)			X	X
(6)						Lower Auxiliary Waveguide:							
			X			Attenuate		X	X, (4)			X	X
(6)						Upper & Lower Waveguide Simultaneously:							
			X			ADV Phase		X	X		X, (2)		X
			X			RET Phase		X	X		X, (2)		X
(6)						Main Waveguide Feed Phaser:							
			X	X		ADV Phase (4)		X	X		X, (2)	(3)	
			X	X		RET Phase (4)		X	X		X, (2)	(3)	
Angle (6)			X			Lower Main Waveguide Feed: Attenuate (High Angle)		X	X		X, (2)		
(6)			X			Upper Main Waveguide Feed: Attenuate (Low Angle)		X	X		X, (2)	(3)	
RF Power Monitor Reference (5) (6)	15.30s	(1)	X			Reduced RF Power							
Standby (Alternate) Equipment	15.13b 4.33b		X	X									
Standby Power	15.13c 4.33c		X			Normal	X	X	X	X	X, (2)		

FOOTNOTES:

(1) Maintenance request

(2) If structure below path tolerances cannot be met, clearance procedures and tolerances will be applied.

(3) Clearance Below Path (CBP) required on commissioning type inspections, one XMTR only.

(4) This check can be made on either the upper or lower main antenna feed, but both steps must be performed on the same feed.

(5) Request RF level in watts from ground technician.

(6) One XMTR Only

(7) Endfire Glide Slope Standard (capture effect in the horizontal plane)

CODE: W/ A/ S = Width, Angle, Symmetry

TYPE CHECK	REFERENCE PARAGRAPH	INSPECTION				FACILITY CONFIGURATION		MEASUREMENTS REQUIRED						
		E	C (4)	Pm (6)	P	PRIMARY XMTR	CLEARANCE XMTR	MODULATION	WIDTH	ANGLE	SYMMETRY	STRUCTURE BELOW PATH	CLEARANCE	STRUCTURE
Spectrum Analysis	15.30a	Reserved				Reserved								
Engineering Support Tests (10)	15.30e 15.30f	(1)	(1)			As Required								
Modulation Level	15.30b	X	X	X	X	Norm	Norm	X						
Modulation Equality Caution: HMI	15.30c	(1)	(1)			Carrier Only	OFF	X						
W/A/S	15.30i 15.30h 15.30j	X	X	X	X	Norm	Norm		X	X	X	X, (2)		
Structure	15.30o	X	X	X	X	Norm	Norm	X		X				X
Clearance (CBP One XMTR only)	15.30l	X	X			Norm	Norm						X	
Transverse Structure	15.30q	X	X	(1)		Norm	OFF							X
Transverse Structure (7)	15.30q	X	X	X		Norm	Norm							X

(7) **Endfire Glide Slope—Standard** (capture effect in the horizontal plane) (continued)

TYPE CHECK	REFERENCE PARAGRAPH	INSPECTION				FACILITY CONFIGURATION		MEASUREMENTS REQUIRED						
		E	C (4)	Pm (6)	P	PRIMARY XMTR	CLEARANCE XMTR	MODULATION	WIDTH	ANGLE	SYMMETRY	STRUCTURE BELOW PATH	CLEARANCE	STRUCTURE
Tilt (10)	15.30m	X	X			Norm	Norm	X		X			X	
Mean Width (10)	15.30n	(1)	X			Norm	Norm		X		X			
Transverse Structure (7)	15.30q	(1)	X	(1)		Norm	Reduced RF Power							X
Clearance at 5° of LCZR course on G/S equip side (5) (7)	15.11e 15.30l	(1)	X			Norm	Reduced RF Power						X	
Clearance at 8°of LCZR course on side opposite G/S equip (5) (7)	15.11e 15.30l	(1)	X			Norm	Reduced RF Power						X	
Spurious Radiation	15.30g	(1)	(1)			Dummy Load	Dummy Load							X
Monitors Width	15.30r 15.13a(3)	(1)	X (11)	X		Wide	Norm		X	X		X, (2)	(3)	
		(1)	X (11)			Narrow	Norm		X	X		X, (2)		
Phase	15.30q	(1)	X (11)	(4)		ADV Phase	Norm		X	X		X, (2)	(3)	
		(1)	X (11)	(4)		RTD Phase	Norm		X	X		X, (2)	(3)	
		(1)	X (11)	(1)		Main Array: Dephase for High Angle	Norm		X	X		X, (2)		
		(1)	X (11)	X		Main Array: Dephase for Low Angle	Norm		X	X		X, (2)	(3)	Angle
RF Power Monitor Reference (9) (10)	15.30s	(1)	X			Reduced RF Power	Reduced RF Power							

(7) Endfire Glide Slope—Standard (capture effect in the horizontal plane) (continued)

TYPE CHECK	REFERENCE PARAGRAPH	INSPECTION				FACILITY CONFIGURATION		MEASUREMENTS REQUIRED						
		E	C (4)	Pm (6)	P	PRIMARY XMTR	CLEARANCE XMTR	MODULATION	WIDTH	ANGLE	SYMMETRY	STRUCTURE BELOW PATH	CLEARANCE	STRUCTURE
Transverse Structure	**15.30q**		**(1) (8) (11)**			**Norm**	**ADV front CLR ANT Phase**							**X**
			(1)(8) (11)			**Norm**	**RET front CLR ANT Phase**							**X**
Standby (Alternate) Equipment	**15.13b 4.33b**		**X**	**X**										
Standby Power	**15.13c 4.33c**		**X**					**X**	**X**	**X**	**X**	**X, (2)**		

FOOTNOTES:

(1) Maintenance request

(2) If structure-below-path tolerances cannot be met, clearance procedures and techniques will be applied.

(3) Clearance Below Path (CBP) required on commissioning type inspections, one XMTR only.

(4) On facilities without a quadrature phase monitor (Path 2 Detector), conduct dephase check on the width monitor with main sideband dephasing of ± 15° or less. If a quadrature phase monitor is installed, a commissioning check is required, but no periodic dephase check is needed.

(5) Clearance above and below path required. (See Paragraph 15.30l(1) and (2))

(6) Perform a final actual angle check at the completion of any width or angle monitor inspection.

(7) Perform also after antenna repair, replacement, modification, or any adjustment maintenance expects will change transverse structure and/or clearances.

(8) Not applicable to Single Clearance Antennas.

(9) Request RF level in watts from ground technician.

(10) One XMTR Only

(11) Facilities maintained using Order JO 6750.49 require monitor checks on one XMTR only.

(8) **75 MHz Marker Beacon Checklist.** Markers are installed as a constituent part of some other primary aid; therefore, they are inspected concurrently with the primary aid.

ILS AND FAN MARKERS

Type Check	Reference Paragraph	Inspections: Commissioning	Inspections: Periodic	Inspections: Antenna and/or Transmission Lines Replacement/ Adjustment
Spectrum Analysis	15.41a	Reserved	Reserved	
Identification and Modulation Tone	15.41b	X	X	X
Coverage	15.41c			
Major Axis	15.41c(2)	X	-	X
Minor Axis	15.41c(1)	X	X	X
Proximity Check	15.41d	X	-	X
Holding Fixes	15.41e	X	-	X
Standby Equipment	15.41f 4.33b	X	-	-
Standby Power	15.41g 4.33c	X	-	-

SECTION 2
LOCALIZER

15.20 Introduction. A localizer is the component of an ILS that provides lateral guidance with respect to the runway centerline. The localizer transmits on VHF frequencies from 108.1 to 111.95 MHz.

a. Characteristics. The two types of localizers are single frequency and dual frequency. Localizers are normally sited along the extended runway centerline; however, some are offset from the extended centerline. Localizer Directional Aid (LDA) facilities may be located at various positions about the runway. Simplified Directional Aid (SDF) facilities will be one of two types, null reference or phase reference, and will have a width of either 6° or 12°.

b. Classification. Localizers are categorized as Category I, II, or III. Procedure use determines the facility category.

c. Identifier. The localizer and LDA transmit a coded three-letter identifier preceded by the letter "I", and the SDF transmits a coded three-letter identifier without the preceding "I".

15.21 Flight Inspection Procedures

a. Spectrum Analysis. Reserved.

b. Identification and Voice. This check ensures identification (and voice if installed) is received throughout the localizer service volume. The procedure below is applicable to both the front and back course (if it is procedurally used).

Maneuver	Localizer	AFIS	Analysis
ID is verified during all checks. Voice is checked, on-course at the maximum distance structure is evaluated	Course Normal, Clearance Normal		Ensure ID is clear, correct, and that the audio level of the voice is equal to the coded ID level.

Other Considerations:

- Localizer must be restricted if identification is not received in all areas of required coverage. Deny procedure use beyond the distance that identification is not received when checking an ESV.
- Localizers must not be restricted solely because the voice/ ATIS cannot be received. In this event, advise the procedures specialist and/or air traffic operations.

c. **Power Ratio.** This check measures the ratio of power between the course and clearance transmitters of a dual frequency localizer.

(1) Spectrum Analyzer Method

Maneuver	Localizer	AFIS	Analysis
On-course, in line-of-site of the localizer antenna, within 10 nm, or parked on the runway, on-course	Course RF Power Reference, Clearance Normal		Compare the relative signal strength of the course and clearance signals.

Other Considerations. The best practice is to use the Spectrum Analyzer.

(2) Signal Strength Method

Step	Maneuver	Localizer	AFIS	Analysis
1	On-course, in line-of-site of the localizer antenna (ILS 3), or parked on the runway, at or near the approach end of the runway	Course RF Power Alarm, Clearance Off	ILS-3	Record localizer signal strength or use an AGC meter
2	Same position as Step 1	Course Off, Clearance Normal	ILS-3	Record localizer signal strength or use an AGC meter

Other Considerations. Compute power ratio using the following formula:

$$dB = 20 \log \left(\frac{E_1}{E_2} \right)$$

Where:

dB = Power ratio (dB)

E_1 = Signal Strength of course transmitter as read or recorded from AFIS

E_2 = Signal Strength of clearance transmitter as read or recorded from AFIS

d. Modulation Level. This check measures the modulation level of the radiated signal.

(1) Modulation Level on Procedural Course

Maneuver (ILS 3)	Localizer	AFIS	Analysis
On-course on-path (at procedural altitude for localizer only facilities) between 10-3 miles from localizer antenna	As required by the checklist	ILS-3	Measure the average modulation percentage.

Other Considerations:

- Some dual frequency antennas do not provide enough clearance power to measure modulation on centerline. For these facilities, measure the clearance-only modulation level while inbound between 5° and 10° off-course at the LSA with the clearance transmitter in modulation balance configuration.
- Preliminary checks may be made when transitioning to on-course during course width and symmetry measurements; however, modulation must be validated while flying inbound on-course.
- On back courses subordinate to the front course, adjustments to the front course modulation affect the back course; therefore, adjustments are not required on the back course.
- Where a separate antenna provides clearance, as well as a back course (such as a waveguide system), modulation checks and adjustments of the clearance transmitter(s) are valid only while on the back course, unless the course transmitter is off.

(2) Modulation on normal clearance checks. Some receivers see excessive modulation as low clearances; modulation must be measured during normal clearance checks.

Maneuver (ILS 1)	Localizer	AFIS	Analysis
35°-35°, Front Course and Back Course	Course Normal, *Clearance Normal	ILS-1	Measure the average modulation percentage.

(* Dual Freq Only)

Other Considerations:

- Out-of-tolerance modulation is a basis for restrictions on facilities installed, relocated, reconfigured, or modified with new type antennas after January 1, 2000.
- Document the report and the facility data sheet with the results

e. **Modulation Equality.** This check verifies that the 90Hz and 150Hz signals are modulating the carrier equally. Use this measurement as a reference for phasing and alignment monitors.

Warning: Hazardous and Misleading Information
Misleading information is produced by this configuration. Ensure NOTAM is active.
Monitor ATC communications for improper clearances to other aircraft.

NOTE: FAA, U.S. non-Federal civil, U.S. Army, and U.S. Navy/ Marine Corps glide slopes must be OFF when the Localizer is producing HMI

Step	Maneuver	Localizer	AFIS	Analysis
1	On-course on-path (at the procedural altitude for localizer-only facilities) between 10-3 miles from localizer antenna	Course Carrier only, *Clearance Off	ILS-3	Measure localizer crosspointer
*2	Same position as Step 1	Course Off, *Clearance Carrier only	ILS-3	Measure localizer crosspointer

(* Dual Freq Only)

Other Considerations.

- Check course alignment after adjustments to modulation equality
- The angle of descent on an ILS must emulate the commissioned glide path when the glide slope is not radiating

f. **Phasing**. This check determines the phase relationship between the carrier and sideband signals are optimum.

Warning: Hazardous and Misleading Information
Misleading information is produced by this configuration. Ensure NOTAM is active.
Monitor ATC communications for improper clearances to other aircraft.

Step	Maneuver	Localizer	AFIS	Analysis
1	Fly inbound to the antenna at an altitude and azimuth, determined by maintenance, between 10 and 3 miles	Course Quadrature, *Clearance Off	ILS-3	Transmit crosspointer values to the ground technician to adjust phasing. Optimum is established when the crosspointer is the same value as modulation equality.
*2	Same position as Step 1	Course Off, *Clearance Quadrature	ILS-3	Same as Step 1

(* Dual Freq Only)

Other Considerations:

- The facility will normally be phased using ground procedures
- Obtain the correct azimuth for phasing from facility maintenance.
- These procedures apply to the back course if maintenance requests phasing on the back course.

g. Width and Symmetry. The purpose of this check is to establish and maintain a course sector width and ratio between half-course widths that will provide the desired displacement sensitivity at the procedural missed approach point (MAP) or threshold, and is within the limitations of the procedural protected area. There are three methods to measure width and symmetry; standard AFIS method, basic method, and theodolite or tracking device method.

STANDARD

Maneuver	Localizer	AFIS	Analysis
Check width and symmetry between 6-10 miles at LSA. 10 nm is the optimum distance. Periodic checks may be checked from 10 - 14 miles from the antenna. If the comparability check was completed satisfactory higher altitudes may be used.	Course Normal, *Clearance Normal	ILS-1	Width is measured in degrees between where the crosspointer crosses the 90hz and150hz 150µA points. Symmetry is determined by comparing the 90Hz half width (the width in degrees from the 90 Hz 150µA to the 0µA point) to the localizer width.

(* Dual Freq Only)

BASIC

Maneuver	Localizer	AFIS	Analysis
Crossing, perpendicular to the on-course made in each direction (to average out any wind component) over a checkpoint of a known distance from the localizer antenna, i.e., outer marker, FAF, etc. If ground speed or along-trackl outputs are available, only one crossing is required.	Course Normal, *Clearance Normal	N/A	Measure the course sector width and calculate the symmetry. $\text{Symmetry} = \left(\frac{\text{90 Hz half width}}{\text{width}}\right) \times 100$

THEODOLITE or TRACKING DEVICE METHOD

Maneuver	Localizer	AFIS	Analysis
Position the theodolite or tracking device in accordance with Paragraph 15.11f. Only one crossing is required at the maximum distance that permits theodolite tracking. Maintain a constant airspeed.	Course Normal, *Clearance Normal	N/A	Reference the course sector width to the azimuth reference marks of the theodolite (usually spaced 5° apart). Measure the course sector width using 10-point dividers, and calculate the symmetry. $\text{Symmetry} = \left(\frac{\text{90 Hz half width}}{\text{width}}\right) \text{X100}$

NOTE: An RTT may be used to track an aircraft throughout the course sector. Apply the course sector width received to the calibration of the RTT.

Other Considerations

- Any altitude from the LSA up to the altitude documented on the data sheet may be used, if a comparability check in the normal configuration was made (usually at commissioning) at LSA and the higher altitude, and the results were within tolerance and were within ± 0.2°
- If the commissioned width is changed, re-establish width monitor references at LSA If clearance comparability was satisfactory prior to the course width change, re-check Procedure 1/2 configurations at LSA. Further checks at the desired higher altitude are not required if the minimum clearance levels are met.
- This check applies to the front course (and back course if it is used for an approach or missed approach).
- Flight Inspection Policy, Practices, and Training must approve measurements inside 6 nm.
- Verify any unusual/out-of-tolerance indications at a distance of 10 nm or less. If the condition repeats, or if unable to verify due to weather or ATC restrictions, take appropriate NOTAM/ restriction action.
- Localizers, offset localizers, and LDA(s) must be tailored to a course sector width not greater than 6° and a linear sector width of 700 ft at the following points:
  - Point C for LDA and SDF
  - Point B for runways less than 4,000 ft long and for runways that do not conform to precision instrument design standards
  - Point T for facilities supporting all other applications

The tailoring requirement may be waived for facilities supporting other than CAT II or III operations if tailoring cannot be achieved due to siting constraints performance derogation, etc. However, the final width must be established as close as possible to the optimum. Include the justification on the flight inspection report. The decision to have other than a tailored course width is not a flight inspection function and must be made at the applicable service area or comparable military level. If the course sector width on a facility that supports a precision approach will not provide for at least 400 ft linear width at the runway threshold, the course must be restricted as unusable inside the point where the linear width is 400 ft. The commissioned course width of an SDF must be no greater than 12.0°. If the course width is adjustable, it must be tailored. Some facilities with course widths less than 3.00° have had problems associated with aircraft overshooting turns to the approach course; pay particular attention to flyablility on facilities with narrow widths.

- In some cases on commissioning type checks when the normal width does not repeat CW/ CCW within 2.5% of actual width measurements, it may be necessary to perform width measurements at an altitude higher than the lower standard altitude of 1,500 ft, or 500 ft above intervening terrain, for repeatability. In these cases, perform a width validation at a higher altitude(s). If CW/ CCW normal width can be validated at a higher altitude, all width measurements must be made at the validated higher altitude. Document the altitude on the AVNIS Datasheet. If CW/ CCW normal width difference exceeds 2.5% of actual width measurements at the higher altitude(s), the inspection should be terminated until cause of non-repeatability can be determined.
- Clearances must be checked at LSA at least every 1080 days.

(1) Course Width Formula

$$W = \frac{0.0159(ETAS)(T_{av})}{D}$$

Where:

W = Width (degrees)

ETAS = Effective True Airspeed (knots)

T_{av} = Time Average for course crossing (sec)

D = Distance from the localizer antenna to the point where the aircraft crosses the localizer course (nm to the nearest thousandth)

For manual calculation of width, average clockwise and counterclockwise runs to compensate for crosswind component.

Computed true airspeed (TAS) may be used if correction for crosswind component is applied

(2) Localizer Tailored Width Formula

$$W = 2\left(\text{arc tan}\left(\frac{350}{D}\right)\right)$$

Where:

W = Tailored Width (degrees)

D = Distance from the localizer antenna to the runway threshold (ft)

h. Clearance. Clearances ensure that the facility provides adequate off-course indications throughout the facility's service volume.

(1) General Information

Maneuver	Localizer	AFIS	Analysis
Conduct clearance checks between 6 and 10 miles from the antenna at LSA. Periodic checks may be checked up to 14 miles from the antenna.	Course Normal, *Clearance Normal	ILS-1	Clearances are the lowest crosspointer µA value between service volume and the course sector 1 linear increase.

(* Dual Freq Only)

Other Considerations

- Deviations in any sector to less than 100µA are not acceptable.
- Momentary crosspointer deflections to less than the tolerance are acceptable in sectors 2 and 3, provided the aggregate area does not exceed 3° of arc in one quadrant. One quadrant is defined as that area between the localizer on-course and a point 90° to the antenna. This exception is acceptable on the front course and back course and on both sides of the localizer course.
- Inspections to remove a restriction based on clearances must include a check of all clearance commissioning configurations.
- Clearance checks at the LSA are recommended and should be attempted on all inspections. Clearance checks above the LSA should be the exception.
- Verify clearances at LSA at least every 1,080 days. This determines if environmental changes affect clearances at the LSA while not affecting clearances at the higher altitudes. Fly a clearance run (normal or monitor reference) at LSA. Values less than 200 µA may indicate a potential clearance problem; however, if the minimum clearances required to authorize checks at higher altitudes are maintained at the LSA, higher altitudes may continue to be used.

- If a localizer is restricted in Sector 2, it may still support a procedure turn, as long as the instrument flight procedure does not use the restricted area and satisfactory performance of the procedure turn is confirmed by flight inspection.
- Verify unusual/out-of-tolerance indications at a distance of 10 nm or less. If the condition repeats, or if unable to verify due to weather or ATC restrictions, take appropriate NOTAM/ restriction action.
- During commissioning inspections, check clearances in both the normal and the monitor limit configurations described in the appropriate checklist.
- During monitor reference evaluations, check clearances in the monitor limit configurations described in the appropriate checklist. It is not necessary to check clearances in the normal configuration if the clearances found during the monitor checks are equal to or greater than the tolerances required for normal.
- Momentary deviations of the localizer cross pointer in Sector 1 can be averaged without further evaluation, provided the cross pointer deviation does not present a noticeable effect on flyability or create a possible false course. Reversals of trend or excessive irregular flattening of the course ("steps") require an evaluation of the effect on the procedure. When this condition occurs, refly the sector 1 arc on one transmitter at the standard service volume limit at 2,000 ft above the threshold elevation, or 1,000 ft above intervening terrain, whichever is higher at a maximum ground speed of 170 knots. Evaluate for noticeable effects on flyability and possible false course indications. Remove the procedure if reversals of trend have noticeable effects on flyability or flyable false course indications occur. If the check is satisfactory for flyability, document the facility data sheet.

(2) Clearance Comparability. Clearance comparability allows localizer width, symmetry, and clearances measurements at altitudes higher than LSA (e.g., weather, restricted airspace, ATC limitation, etc.). Clearance comparability is separated into two procedures, Procedure 1 and Procedure 2.

(a) General Information

1 Comparability is required in unrestricted areas of coverage and on one transmitter only.

2 Check comparability on commissioning and when a new type antenna is installed/ replaced.

3 After commissioning, subsequent inspections may be made at any altitude between the lower and higher altitudes if comparability results were satisfactory.

4 Document the AVNIS datasheet.

(b) Procedure 1. Use Procedure 1 for all facilities, unless the clearances at the desired higher altitude in the lowest clearance configuration are greater than in the same configuration at LSA.

Step	Maneuver	Localizer	AFIS	Analysis
1	Check clearances in normal at LSA.	Course Normal, *Clearance Normal	ILS-1	Sector 2 clearances ≤ 165µA, future checks must be performed at LSA
2	Check clearances at the monitor reference setting at LSA.	Course Wide, *Clearance Wide	ILS-1	Sector 2 clearances ≤ 150µA, future checks must be performed at LSA
3	Check clearances at the alarm setting at LSA.	Course Narrow, *Clearance Wide	ILS-1	Sector 2 clearances ≤ 150µA, future checks must be performed at LSA
4	Check clearances in the lowest clearance configuration at desired higher altitude	Lowest clearance configuration found in Step 2 or 3	ILS-1	Sector 2 clearances > the clearances found in Step 2 or 3, the check is UNSAT, proceed to comparability Procedure #2
5	Check clearances in normal at desired higher altitude. If high angle clearance altitude is the same as the desired higher altitude, this step is not required.	Course Normal, *Clearance Normal	ILS-1	This must be completed if Steps 1 through 4 are satisfactory.
6	Check clearances at the wide reference (course wide clearance wide for dual frequency facility) at desired higher altitude.	Course Wide, *Clearance Wide	ILS-1	This must be completed if Steps 1 through 4 are satisfactory, and if Step 4 is not Course Wide, *Clearance Wide.

(* Dual Freq Only)

(c) Procedure 2. Procedure 2 authorizes slightly higher clearances at the desired altitude than at LSA, but can only be used if the more stringent clearance tolerances are applied at the LSA.

Step	Maneuver	Localizer	AFIS	Analysis
1	Check clearances in normal	Course Normal, *Clearance Normal	ILS-1	Sector 2 clearances ≤ 180µA, future checks must be performed at LSA
2	Check clearances at the monitor reference setting at LSA	Course Wide, *Clearance Wide	ILS-1	Sector 2 clearances ≤ 160µA, future checks must be performed at LSA
3	Check clearances at the alarm setting at LSA	Course Narrow, *Clearance Wide	ILS-1	Sector 2 clearances ≤ 160µA, future checks must be performed at LSA
4	Check clearances in the lowest clearance configuration at desired higher altitude	Lowest clearance configuration found in Step 2	ILS-1	Sector 2 clearances > 20µA to the clearances found in Step 2 or 3, future checks must be performed at LSA
5	Check clearances in normal at desired higher altitude. If high angle clearance altitude is the same as the desired higher altitude, this step is not required.	Course Normal, *Clearance Normal	ILS-1	This must be completed if Steps 1 through 4 are satisfactory.
6	Check clearances at the wide reference (course wide clearance wide for dual frequency facility) at desired higher altitude.	Course Wide, *Clearance Wide	ILS-1	This must be completed if Steps 1 through 4 are satisfactory, and if Step 3 is not Course Wide, *Clearance Wide.

(* Dual Freq Only)

Other Considerations.

- Facilities documented with Procedure 2 comparability must be re-checked at LSA if clearances are less than 160µA in any configuration on any periodic check. If the re-check at LSA is satisfactory, the comparability check must be re-accomplished, or altitudes other than the LSA will not be used to check clearances.
- The normal or monitor reference condition that causes the lowest clearances will not always be a periodic monitor check condition. Document the flight inspection report and the data sheet with the configuration that produces the lowest clearance values. Inspections to remove a restriction based on clearances must include a check of all clearance commissioning configurations.

i. **Alignment and Structure.** These checks measure the quality and alignment of the on-course signal.

(1) **General Information**

(a) The alignment and structure checks are usually performed simultaneously; therefore, use the same procedures to check alignment and structure.

(b) Structure and alignment applies to the front course (and the back course if it is used for an approach or missed approach).

(c) For localizers aligned along the runway centerline, the aircraft may be positioned along the runway centerline by visual cues, or theodolite. Fly the localizer on-course signal when RTT or AFIS equipment is used.

(2) **ILS Structure Evaluations**

Maneuver	Localizer	AFIS	Analysis
Maneuver the same as in Paragraph 15.12c(1).	Course Normal, *Clearance Normal	ILS-3	For unrestricted facility operation (1): Category III check Zones 1,2,3,4,5 Category II check Zones 1,2,3,4 (2) Category I and other types of facilities and approaches, check Zones 1,2,3

(* Dual Freq Only)

NOTE 1: During site, commissioning, reconfiguration, categorization, antenna, and/or frequency change inspection, check all of Zone 1. This may be accomplished concurrently with the inbound RF power run (Paragraph 15.21m, Step 3), if RF power is required. For all other inspections (i.e., periodic, periodic with monitors, etc.), evaluate structure from GSI or the FAF (whichever is further) through all other required zones.

NOTE 2: Category II localizers failing to meet structure tolerance in Zone 4 will not be shown as restricted on the flight inspection report; however, a NOTAM will be issued. .

Other Considerations.

- All ILS localizers sited on the extended runway centerline must be inspected and analyzed through Zones 1, 2, 3, 4 and 5 (runways less than 5,000 ft long do not have Zone 5) on all inspections requiring alignment or structure validation. These localizers must be classified according to the furthest point at which the structure conforms to Category III structure tolerances. This classification is for autoland authorization. Other facilities must be inspected and analyzed in Zones 1, 2, and 3. If rollout has not been accomplished, facility cannot be classified higher than point "T".
- If structure in Zones 2 or 3 appears to have deteriorated since the previous inspection, or if out-of-tolerance structure is found, verify the results of this check by flying the procedure in Paragraph 15.21i(4).
- **Structure Tolerances (95% Rule).** Application of course structure analysis contained in this paragraph applies to all zones of localizers (1, 2, 3, 4, & 5) and SDF(s), including back courses. For Category II/ III facilities, the applicable service area or military command engineering staff must be notified of initial application of this criteria. If course tolerances are exceeded, analyze the course structure as follows:

(a) **Where course structure is out-of-tolerance in any region of the approach,** the flight recordings will be analyzed in distance intervals of 7,089 ft (1.17 nm) centered about the region where the out-of-tolerance or aggregate of out-of-tolerance condition(s) occurs. Two 7,089 ft areas must not overlap.

(b) **Where necessary to avoid overlap,** centering the interval about the out-of-tolerance region may be disregarded.

(c) **It is not permissible to extend the 7,089 ft segment beyond the area checked,** i.e., service volume or ESV, whichever is greater, or the point closest to the runway where analyzation stops.

(d) **The course structure is acceptable if** the aggregate structure is out of tolerance for a distance equal to or less than 354 ft within each 7,089 ft segment.

(3) Localizer Alignment

<table>
<tr><th>Maneuver</th><th>Localizer</th><th>AFIS</th><th>Analysis</th></tr>
<tr><td>Maneuver the same as in Paragraph 15.12c(1).</td><td>Course Norm,
*Clearance Norm</td><td>ILS-3</td><td>
<table>
<tr><th>Front Course</th><th>From</th><th>To</th></tr>
<tr><td>CAT I, II, III</td><td>One mile from runway threshold</td><td>Runway threshold</td></tr>
<tr><td>ILS Zone 4</td><td>Runway threshold</td><td>Point D</td></tr>
<tr><td>ILS Zone 5</td><td>Point D</td><td>Point E</td></tr>
<tr><td>Offset Localizers</td><td>One mile from runway threshold</td><td>Runway threshold or abeam runway threshold</td></tr>
<tr><td>LDAs and SDFs</td><td>One mile from Point C</td><td>Point C</td></tr>
<tr><td>Back Course</td><td></td><td></td></tr>
<tr><td>All Types of Facilities</td><td>Two miles from the antenna</td><td>One mile from the antenna</td></tr>
</table>
</td></tr>
</table>

(* Dual Freq Only)

Other Considerations

- FAA, U.S. non-Federal civil facilities, U.S. Army and U.S. Navy/ Marine Corps alignment must meet the "Initial" maintenance tolerance any time alignment is adjusted, or at the end of a Periodic with monitors inspection.
- When a restriction occurs in an area where alignment is normally analyzed, measure average course alignment manually or with AFIS from one mile from the start of the restriction to the start of the restriction
- LDA(s) oriented toward a nondescript point-in-space where adequate visual checkpoints are not available and AFIS runway updates are impractical, the alignment on commissioning type inspections must be determined using Differential GPS AFIS "truth system", pseudo runway development or theodolite. Flight Inspection Policy, Practices, and Training must approve in advance pseudo runway development based on surveyed airport checkpoints (runway ends, taxiways, etc.). Establish an equality of modulation reference for subsequent alignment and monitor comparison. During subsequent periodic inspections, where AFIS updates are impractical, the localizer alignment may be determined to be either Satisfactory (S) or Unsatisfactory (U), in lieu of course alignment values. If the actual alignment is required (i.e., SOIA,), the use of Differential GPS AFIS "truth system", theodolite, or pseudo runway development is required.
- For facilities not aligned along runway centerline, evaluate alignment with theodolite, RTT, or AFIS.

(4) Localizer Only Structure Evaluations

Maneuver	Localizer	AFIS	Analysis
Maintain published altitudes in each segment prior to the final segment. Fly the final segment as follows: upon reaching the FAF inbound, descend at a rate of approximately 400 ft per mile (930 ft per minute at 140 knots; 800 ft per minute at 120 knots) to an altitude of 100 ft below the lowest published MDA and maintain this altitude to point C, which is the MAP.	Course Normal, *Clearance Normal	ILS-3	Analyze structure in Zones 1, 2, and 3.

(* Dual Freq Only)

Other Considerations

- See Appendix 1 for the definition of Point C for localizer only approaches.
- For ILS approaches which support localizer-only minima, the procedure specified in (4) above must be used in addition to the run on normal glidepath during the following inspections: site, commissioning, and specials for antenna system change, user complaint or site modifications, and on a periodic inspection any time there is significant deterioration of localizer structure.

(5) **Roll-Out Procedures** are required for all Category II/ III localizers. Roll-out is also required for all Category I localizers installed with runway lengths of 5,000 ft or greater. Offset localizers, localizers installed without glide slopes SDF(s), LDA(s), and facilities currently with a classification of I/A, B, or C, need not be checked.

(a) Site, Commissioning, Reconfiguration, and Categorization Inspections of centerline oriented facilities.

Maneuver	Localizer	AFIS	Analysis
Cross Point C at 100 ft, runway threshold at approximately 50 ft, and continue on the extended glidepath angle to the touchdown point. Continue the landing roll to the runway end.	Course Normal, *Clearance Normal	ILS-3	Measure course structure from the alignment found in the respective zone (i.e., measure Zone 4 structure from the alignment found in Zone 4 and measure Zone 5 structure from the alignment found in Zone 5)

(* Dual Freq Only)

Other Considerations

- If actual alignment for Zones 4 and 5 cannot be determined by the method above, taxi the aircraft along the runway centerline from abeam the glide slope to Point E. Record the raw cross-pointer information and mark abeam the glide slope, Point D, and Point E. Manually analyze the actual course alignment and structure for each of the required zones.

- There is also a comparison check intended to authorize the 50-ft run as a periodic check of Zones 4 and 5 structure. A comparison of structure results found on Rollout and on the 50-ft ILS-3 run is needed to determine if the expedient method of checking Zones 4 and 5 structure on the 50-ft run is valid for periodic checks. Satisfactory comparability must be defined as 3 µA or less difference between the results in each zone with both Rollout and 50-ft results being in tolerance for that zone. Maximum structure in either zone does not have to occur at the same point on the runs to be comparable. Apply the 95% rule, as specified in Paragraph 15.21i(2), to results outside normal tolerance. Rollout checks and the 50-ft ILS-3 comparison checks are required on both transmitters.

- Zones 4 and 5 structure analysis determined during Rollout procedures is the definitive pass/ fail criteria, taking precedence over the results of the 50-ft ILS-3 maneuver.

- Document the Rollout and ILS-3 50-ft structure comparability results IAW Order 8240.36, Appendix 8 and Order 8240.52, Aeronautical Data Management, Appendix 2. Submit FAA Form 8240-30, AVNIS Data Change Submission, to effect ILS Classification changes, to the National Flight Data Center (NFDC).

- When the Rollout check is found satisfactory on a Category I ILS and the comparability check is unsatisfactory, Flight Inspection Policy must contact the National Flight Procedures Office Procedures Specialist and the regional All-Weather Operations representative to determine if any users are authorized IFR use below Category I minima. Flight Inspection Policy will make the final determination as to the requirement for future Zones 4 and 5 Rollouts on that facility and transmit the appropriate ILS classification to NFDC.

- Localizer Rollout comparability must be completed if the runway length changes or when there are changes in the localizer to threshold distance.

- **Refer to the Rollout flow chart and associated Rollout code legend for Zones 4 and 5 structure comparison process.**

(b) Periodic or Special Inspections which require Structure Analysis

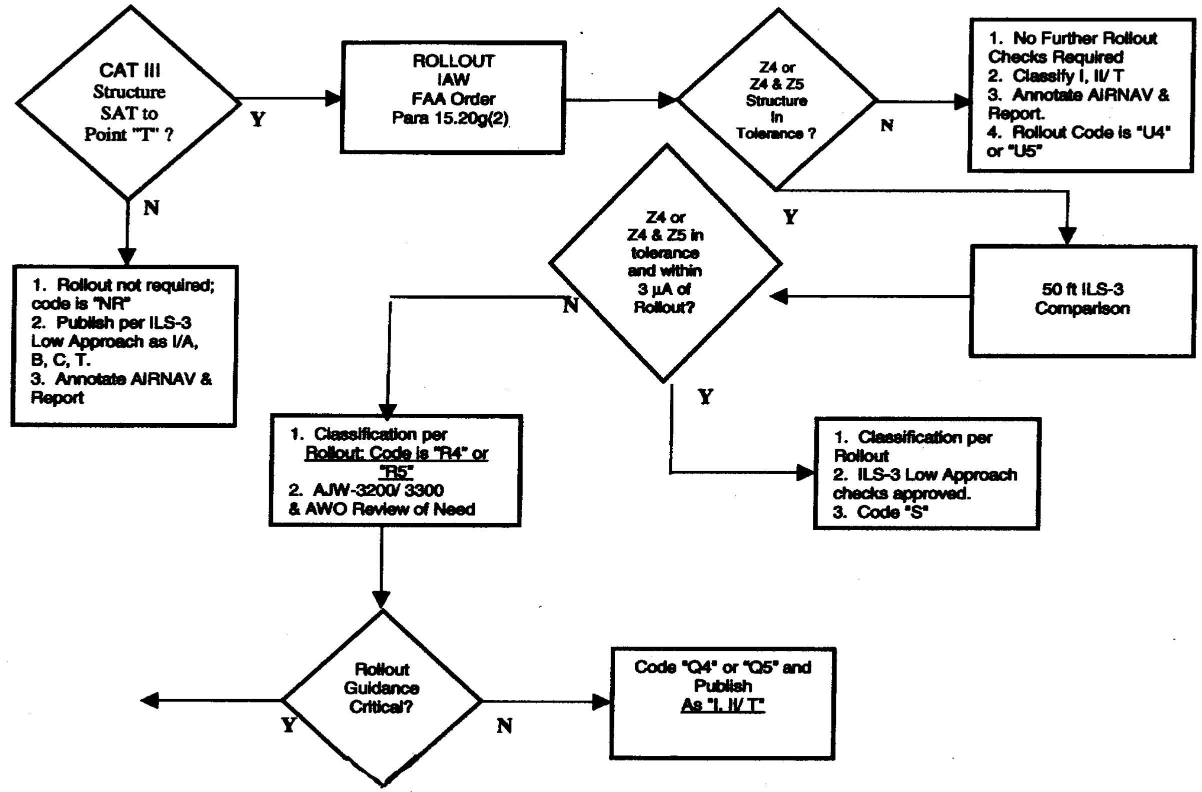
Maneuver	Localizer	AFIS	Analysis
Cross Point C at 100 ft, runway threshold at approximately 50 ft, and conduct a low approach at 50 to 100 ft, on runway centerline to the runway end.	Course Normal, *Clearance Normal	ILS-3	Measure course structure from the alignment found in the respective zone (i.e., measure Zone 4 structure from the alignment found in Zone 4 and measure Zone 5 structure from the alignment found in Zone 5)

(* Dual Freq Only)

Other Considerations

- If the aircraft cannot maintain centerline for the evaluation of Zones 4 and 5 due to wind conditions, the evaluation may be conducted by taxiing the aircraft down the centerline through Zones 4 and 5.
- Facilities previously checked satisfactory for Zone 4 and Zone 5 Rollout/ ILS-3 50-ft run structure comparability: if Zone 4 or Zone 5 structure appears to have deteriorated since the previous inspection, or if out-of-tolerance structure is found, verify the results of this check by flying the Rollout procedure listed in Paragraph 15.21i(5)(a) above. If that structure has deteriorated to below Category III standards for facilities with published classification of I, II, III/ T, D, or E (as applicable), initiate NOTAM action and send FAA Form 8240-20 IAW TI 8200.52, Appendix 2.
- When periodic ILS-3 50-ft runs indicate improved Zone 4 and Zone 5 structure on localizers previously documented as "Rollout required" (due to unsatisfactory Zone 4 and Zone 5 Rollout / ILS-3 50-ft run comparability) **identify the improvement to Flight Inspection Policy**. Flight Inspection Policy must review the facility historical results to determine if the improvement is based on seasonal changes or long-term structure improvements, prior to any publication or NOTAM action.
- As indicated in the chart below, periodic rollout checks are only required on localizers that have failed the comparability check; Zone 4 and Zone 5 Rollout is satisfactory, and a documented requirement exists where users are authorized IFR use below Category I minima. In these cases, use the procedure in Paragraph 15.21i(5)(a).

CATEGORY	CODE	INSPECTION
I/ II/ III	S	Z4 & Z5 inspect via 50-ft run
I/ II	NR, U4, or Q4	Z4 & Z5 no inspection
I/ II	Q5 or U5	Z4 inspect via 50-ft run; no Z5 inspection
I/ II/ III	R4 or R5	Z4 & Z5 inspect via Rollout



1. Use this criteria for CAT I, II, and III localizers
2. 354 ft structure exception applies
3. Do not accomplish a rollout if the localizer is restricted prior to Point "T", is offset, is classified I. II/A, B, or C; or the runway length is less than 5,000'.
4. Complete a rollout comparison of Z4 only if Z4 structure is SAT and Z5 structure is OT.
5. The 3µA comparison value applies only if both the rollout and low approach structure are in tolerance.
6. Rollout comparison checks for all existing facilities must be scheduled via special inspection request.
7. Existing facilities retain present classification, pending rollout analysis.
8. After the rollout comparison, the Flight Inspection Policy, Practices, and Training Team will change the "AC" rollout code to the appropriate code on the data sheet.

Flight Inspection Policy assigns the following codes to AVNIS facility data sheets to indicate Localizer eligibility for a Rollout check:

NR = Check is not required.

AC = Awaiting Rollout Check

Flight inspectors assign the following codes on the flight inspection report and via FAA Form 8240-20 to change AVNIS facility data sheets to indicate the status of Rollout checks:

S = Rollout accomplished; results of both the Rollout and the 50-ft run are within Category III tolerance and compare within 3 μA.

U4 = Rollout accomplished; Zone 4 results do not meet Category II/ III tolerances.

U5 = Rollout accomplished; Zone 5 results do not meet Category III tolerances.

R4 = Rollout required for evaluation of Zone 4 and Zone 5. Rollout was accomplished; ground results meet Category II/ III requirements but do not compare with results of the 50 ft run in Zone 4.

R5 = Rollout required only for evaluation of Zone 5. Rollout was accomplished; ground results meet Category III requirements; comparison with the 50-ft run was Satisfactory in Zone 4 but Unsatisfactory in Zone 5.

Flight Inspection Policy assigns the following codes to the AVNIS facility data sheets post flight inspection after contact with the National Flight Procedures Office Procedures Specialist and regional All-Weather Operations representative:

Q4 = Periodic Rollout not required. Rollout accomplished; results meet Category II/ III requirements, but Zone 4 ground results do not compare with results of the 50-ft run. This code means that future evaluations of Zone 4 and Zone 5 must be through a Rollout Check but that <u>it need not be done on periodic inspections</u>, as these zones are not currently used for IFR. This code is only applied by Flight Inspection Policy and does not apply to Category III. Application to Category II is only appropriate IAW Paragraph 15.21i(2), Note 2.

Q5 = Periodic Rollout not required. Rollout accomplished; results meet Category II/ III requirements, but Zone 5 ground results do not compare with results of the 50-ft run. This code means that future evaluations of Zone 5 must be through a Rollout Check but that <u>it need not be done on periodic inspections</u>, as these zones are not currently used for IFR. This code is applied only by Flight Inspection Policy and is only used to easily display the non-comparable zone.

Other Considerations

- Rollout procedures are required for all Category II/ III localizers. They are also required for all Category I localizers installed at airports with runway lengths of 5,000 ft or greater. Offset localizers, localizers installed without glide slopes, SDF(s), LDA(s), and facilities currently with a classification of I/ A, B, or C, need not be checked. Rollout checks and the 50 ft ILS-3 comparison checks are required on both transmitters.
- If Zone 4 and Zone 5 alignment cannot be determined using the method above in the table, taxi the aircraft along the runway centerline from abeam the glide slope to point E. Record the raw crosspointer and mark abeam the glide slope, Point D, and Point E. Manually calculate the alignment and structure in Zone 4 and Zone 5.
- Compare the results of the 50 ft run and the landing roll. If the results of the 50 ft run do not accurately reflect that achieved during roll-out checks (3μA or less difference between the results in each zone with both Rollout and 50 ft results being in tolerance for that zone), document that structure analysis of Zones 4 and 5 must be roll-out checked on future inspections. Refer to Appendix 2 of Order 8240.52, Aeronautical Data Management, for documentation procedure.
- During Periodic or Special inspections, which require structure analysis, use the procedure in the table above, except conduct a 50 to 100 ft low approach on runway centerline, throughout the required zones. If the aircraft cannot maintain centerline for evaluations of Zones 4 and 5 due to wind conditions, the evaluation may be conducted by taxiing the aircraft down centerline throughout Zones 4 and 5.

(6) Glide Slope Signal on Localizer Back Course. Evaluation of localizer back course must also include an evaluation for active glide slope signals. Glide slope signals that result in flag or CDI activity must be cause for immediate action to alert pilots to disregard all glide path indications on the back course approach (i.e., NOTAM). Ensure the alert will be printed on the localizer back course instrument approach chart.

j. Polarization. Polarization check determines the effects of vertical polarization on the course structure.

Maneuver	Localizer	AFIS	Analysis
Fly inbound on-course within unrestricted coverage prior to the FAF and roll the aircraft to 20° bank left and right.	Course Normal, *Clearance Normal	ILS-3	Analyze course structure

(* Dual Freq Only)

Other Considerations

- Actuate the event mark at the maximum-banked attitude.
- Accomplish the polarization check on both the front course and back course (if procedurally used).
- Polarization may be checked concurrently with the course structure check.
- Check is required on one transmitter only.

k. Monitor References. These checks determine that the localizer meets specified tolerances while in abnormal configurations.

(1) General Information. The inspector must ensure that the facility is set at the monitor reference prior to each check.

(2) Width Monitor Reference

Maneuver	Localizer	AFIS	Analysis
Between 6 - 10 miles from the localizer antenna (10 nm being optimum) at the LSA.	The appropriate configuration IAW the Checklist	ILS-1	Analyze width and clearances

Other Considerations.

- Prior to configuring the facility for monitor references, check the normal configuration.
- At the conclusion of any width monitor inspection, return the facility to normal. Check and report the resulting course sector width and symmetry.

l. **Alignment Monitor Reference.** This check ensures the monitors will detect a shift of the localizer course. The applicable Technical Operations Service Area or appropriate military authority must pre-approve flight inspection of this parameter. This check may be accomplished on the front course without the waveguide transmitter radiating or on the back course, using the procedures described in Paragraph 15.21i.

(1) **General Information**

(a) Alignment monitors may be completed on the ground, in the air, or by the modulation equality method. The preferred method is to complete the alignment monitors on the ground.

(b) Request the course be misaligned to the monitor alarm limits each side (90 Hz/ 150Hz) of the operational course.

(c) Use both the recorder and the visual display to verify course alignment shifts.

(d) Reference monitor limits to the procedural on-course alignment.

(e) It is not necessary to verify ground alignment monitors checks in the air or to verify airborne alignment monitor checks on the ground.

(2) **Ground Alignment Monitors**

Step	Maneuver	Localizer	AFIS	Analysis
1	Determine the airborne alignment	Course Normal, *Clearance Normal	ILS-3	Measure course alignment
2	Position the aircraft near the runway threshold where a stable crosspointer is received. The aircraft may be displaced as much as 75µA from the on-course signal (providing the sensitivity of the course sector width is linear).	Request maintenance shift the course to both of the monitor limit points and then return to normal.	ILS-3	Reference the received course indication to the alignment found airborne from Step 1 of this table.

(* Dual Freq Only)

Other Considerations

- For facilities that are installed offset to the runway, the alignment monitor limits may be established with the aircraft on the ground within 75µA of the on-course signal; but the aircraft must not be positioned closer than 3,000 ft from the antenna array. If these two conditions cannot be met, perform this check in the air.
- If alignment monitors are initially checked on the ground and alignment is then adjusted based on airborne analysis, a monitor recheck is not required, providing the following criteria are met:
    - In-tolerance flag/ modulation and AGC exist.
    - Crosspointer is stable.
    - Crosspointer data is recorded as found during adjustment and at the final setting.
    - The monitor shift on the ground, when applied to the new airborne alignment, is in tolerance.
    - Monitor settings are not changed after the alignment is adjusted.

(3) **Airborne Alignment Monitors** may be checked by two methods. Method 1 uses the corrected error trace, and Method 2 uses the raw crosspointer.

(a) **Method 1**

Maneuver	Localizer	AFIS	Analysis
Start at 7-5 nm from the threshold. Using visual cues, align the aircraft to the runway centerline.	Between 3.5 and 1.5 nm from the threshold, request alignment shifts in both directions and then back to normal. Shifts must be completed and facility returned to normal by 1.5 nm to allow AFIS to measure alignment properly.	ILS-3	The alignment shifts will be determined by analyzing the Zone 2 corrected error trace. The Zone 2 shifts will be from the actual alignment, so the Mission Specialist will have to draw a line indicating the correct procedural azimuth. To find the correct procedural azimuth, take the inverse of the localizer alignment box and draw a line throughout Zone 2 corrected error trace. The alignment shifts will be from the line drawn.

(b) **Method 2**

Maneuver	Localizer	AFIS	Analysis
Start at 7-5 nm from the threshold. Using visual cues align the aircraft to the runway centerline.	Request alignment shifts in both directions and then back to normal.	ILS-3	The alignment shifts will be determined by analyzing the instantaneous course displacements or course shifts as referenced to runway centerline extended.

Other Considerations

- Perform airborne alignment monitor checks while inbound on the designed procedural azimuth (on localizers aligned along runway centerline, the aircraft should be aligned with the centerline extended).
- If feasible, accomplish check on one run during which both limit points and a return to normal are recorded.

(4) Equality of Modulation. If course alignment is satisfactory and a monitor inspection is required, localizers may be evaluated for monitor references using equality of modulation method. This method may be used on all categories of localizer with the concurrence of maintenance personnel.

Warning: Hazardous and Misleading Information
Misleading information is produced by this configuration. Ensure NOTAM is active. Monitor ATC communications for improper clearances to other aircraft.

NOTE: FAA, U.S. non-Federal civil, U.S. Army, and U.S. Navy/ Marine Corps glide slopes must be OFF when the localizer is producing HMI.

Step	Maneuver	Localizer	AFIS	Analysis
1	Determine the airborne alignment	Course Normal, *Clearance Normal	ILS-3	Measure course alignment
2	Position the aircraft on the ground or in the air within the course sector (35°-35° on a single frequency and approximately 7°-7° on a dual frequency facility)	Have maintenance place the course transmitter to modulation balance and *clearance in normal. Have maintenance shift the alignment in both directions. Then restore system to normal.	ILS-3	Record the modulation equality value with zero alignment shift; this will become the reference value. Compute the alignment shifts by taking the difference between the reference value and the alignment shifts. The amount of deflection must then be algebraically added to the localizer alignment.

(* Dual Freq Only)

Other Considerations. Use of this method requires a remark on the flight inspection report.

m. RF Power Monitor Reference. Conduct this check to determine that the localizer meets specified tolerances throughout the service volume while operating in reduced power.

Step	Maneuver	Localizer	AFIS	Analysis
1	Fly a 10°-10° arc across the localizer course at 18 nm (25 nm for ICAO Service Volumes) from the localizer antenna at 4,500 ft above antenna elevation. **See Note 1**	Course Reduced RF Power, *Clearance Reduced RF Power	ILS-1	Check for interference, signal strength, clearances, flag alarm, and identification.
2	Fly a 10°-10° arc across the localizer course at 18 nm (25 nm for ICAO Service Volumes) from the localizer antenna at 2,000 ft above the threshold elevation or 1,000 ft above intervening terrain, whichever is highest. **See Note 2**	Course Reduced RF Power, *Clearance Reduced RF Power	ILS-1	Check for interference, signal strength, clearances, flag alarm, and identification.
3	Proceed on course, inbound from 18 nm (25 nm for ICAO Service Volumes) from the localizer antenna at 2,000 ft above threshold or 1,000 ft above intervening terrain, whichever is higher, until reaching 7° above the horizontal (measured from the localizer antenna) or Point C, whichever occurs last.	Course Reduced RF Power, *Clearance Reduced RF Power	ILS-3	Check for interference, signal strength, flag alarm, structure, and identification
4	Fly a 35°-35° arc across the localizer course at 10nm (17nm for ICAO Service Volumes) from the Localizer antenna at the LSA. **See Note 3**	Course Reduced RF Power, *Clearance Reduced RF Power	ILS-1	Check for interference, signal strength, clearances, flag alarm, and identification.

(* Dual Freq Only)

NOTE 1: If, due to intervening terrain, the LSA is higher than 4,500 ft above antenna elevation, the localizer must be restricted. Attempt to determine a distance where terrain clearance is within the SSV for a localizer restriction distance.

NOTE 2: If 1,000 ft above intervening terrain is higher than 4,500 ft above site antenna elevation, the localizer must be restricted. Determine a distance where terrain clearance is within the SSV for a localizer restriction distance. The facility must have an ESV for use outside the SSV.

NOTE 3: Altitude is intended to be level. If unable to maintain minimum terrain clearance within the SSV, restrict the facility accordingly.

NOTE 4: Step 3 may also be used for localizer Zone 1 structure analysis.

Other Considerations

- This procedure applies to the front course (and back course if it is used for an approach or missed approach).
- If in-tolerance coverage cannot be maintained up to 7°, or Point C, as required by Step 3, the localizer may still be used for CAT I and non-precision operations on a restricted basis. However, the localizer must be classified as "unusable" if in-tolerance coverage cannot be maintained up to 4° or 1° greater than the commissioned glidepath angle, whichever is greater (both measured from the localizer).
- If vertical angle coverage is limited but the localizer can be used on a restricted basis as outlined above, a NOTAM must be issued which restricts the localizer as "unusable" above a specified altitude, both at the threshold and at least one other point, usually the FAF (see NOTAM SECTION). Note the angle at which unsatisfactory coverage occurred and evaluate its effect on the non-precision MDA, Maximum holding altitudes, and missed approach instructions/protected areas.
- Restrictions to localizer coverage at distances less than the standard service volume are permitted, provided the localizer meets all coverage tolerances throughout all procedural approach segments and at the maximum distance at which the procedure turn may be completed.
- Restrictions above the LSA are acceptable, provided a step-down fix, etc., can be added to the appropriate approach segment which restricts descent to within the altitude/ distance at which acceptable coverage at the LSA was achieved.
- See Chapter 22 for additional ESV requirements. If the ESV altitude is within the SSV distance, special consideration will be applied to localizer support.

n. **High Angle Clearance**. This check determines that the transmitted signals provide proper off-course indications at the upper limit of the service volume. This applies to the front course (and back course if procedurally used).

Maneuver	Localizer	AFIS	Analysis
Fly a 10 nm (17 nm for ICAO Service Volumes) arc through Sectors 1 and 2 (and 3, if procedurally required), at 4,500 ft above antenna elevation.	Course Normal, *Clearance Normal	ILS-1	Check clearances and modulation

(* Dual Freq Only)

Other Considerations

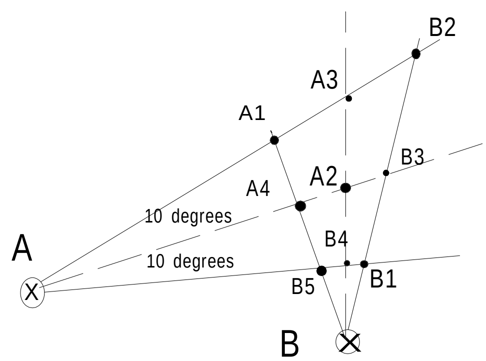
- This check is only required on one transmitter.
- If clearances are out-of-tolerance, conduct additional checks at decreasing altitudes to determine the highest altitude at which the facility may be used.
- Check High Angle Clearances during site evaluation, commissioning, or for a change in location, height, or type of antenna.

o. **Reporting Fixes, SID(s)/ DP(s), STAR(s), and Profile Descents.** The localizer, SDF, or LDA may be used to support fixes, or departure, en route, and arrival procedures. Under these circumstances, navigation is accomplished by using some other facility such as a VOR or an NDB. Check these items during a commissioning inspection, when new procedures are developed or re-described, or on appropriate special inspections (e.g., user complaints). Facility performance of all facilities involved must be checked to ensure that all coverage parameters are within tolerance.

NOTE: If the procedural altitude is below 1,500 ft above the antenna and higher than 500 ft above intervening terrain within the ILS SSV, evaluate the localizer at the procedural altitude. Out-of-tolerance indications will result in denial of the procedure but will not affect the localizer service volume.

(1) **Reporting Fixes.** When fixes are located within the RHO-THETA FISSV and ILS SSV, coverage throughout the fix displacement area can be predicted (fix displacement evaluation is not required). If the fix is not contained within the localizer and/or glide slope SSV, establish an ESV to support the procedure. Refer to Chapter 22 for ESV information. The following are the required coverage checks.

Figure 15-3
Fix Coverage Requirements



(a) Localizer (A) B1 to B2. This requirement is satisfied by service volume validation and need not be repeated.

(b) Rho-Theta (Radial ± 4.5°) or NDB (Bearing ± 5°) facility (B) check A1 to B2. Does not have to be checked if within the VOR/ NDB FISSV.

(c) Rho-Theta or NDB facility (B) A3 to B4

(2) **SID(s)/ DP(s).** Check on-course structure throughout the area of intended use. Check clearance in Sector 1 at the termination point at the minimum authorized altitude.

(3) **STAR(s) and Profile Descents.** Fly these procedures as proposed or as published. Check facility performance when checking STAR(s) and profile descents in accordance with Paragraphs (1) and (2) above.

SECTION 3
GLIDE SLOPE

15.30 FLIGHT INSPECTION PROCEDURES

a. Spectrum Analysis. Reserved.

b. Modulation Level. This check measures the modulation of the radiated signal.

Maneuvering	Glide Slope	AFIS	Analysis
ILS-3	Normal	ILS-3	Measure the average modulation percentage between 7 and 3 miles from the glide slope antenna with a signal strength of 150 µV or greater.

Other considerations. The AFIS will report the average modulation between 5 and 3 miles with the crosspointer within 30µA. The AFIS announced results should be confirmed graphically.

c. Modulation Equality. This check establishes the balance of the carrier signals.

> **Warning**:
> Hazardous and Misleading Information
> Misleading information is produced by this configuration. Ensure NOTAM is active. Monitor ATC communications for improper clearances to other aircraft.

NOTE: FAA, U.S. non-Federal civil, U.S. Army, and U.S. Navy/ Marine Corps localizers must be OFF when glide slopes are transmitting HMI.

Maneuvering	Glide Slope	AFIS	Analysis
ILS-3	Maintenance will configure the facility to radiate carrier signal only. When checking capture effect facilities, the course transmitter radiates carrier only while the clearance transmitter is off or in dummy load.	ILS-3	Measure the modulation equality while inbound on the localizer/glide path course between 7 and 3 miles from the glide slope antenna with a signal strength of 150 µV or greater. Record raw data. While descending, call out the balance to facilities maintenance personnel. Zero µA is optimum. Adjust an imbalance in excess of 5µA towards optimum.

Other considerations. Make this check prior to any phasing checks and use as a reference during phasing.

d. **Phasing.** This check determines the correct carrier and sideband phase relationship distribution to the antennas.

Warning:
Hazardous and Misleading Information
Misleading information is produced by this configuration. Ensure NOTAM is active.
Monitor ATC communications for improper clearances to other aircraft.

NOTE: FAA, U.S. non-Federal civil, U.S. Army, and U.S. Navy/ Marine Corps localizers must be OFF when glide slopes are transmitting HMI.

Prior to any phasing checks, the glide slope modulation level and modulation equality must be properly set and checked.

Prior to airborne phasing, confirm that maintenance has established normal carrier to sideband ratios and that ground phasing is complete. A comparison of airborne and ground phasing data should be made by maintenance personnel in order to determine if optimum phasing has been established.

(1) Null Reference Phasing

Maneuvering	Glide Slope	AFIS	Analysis
Proceed inbound from 10 miles from the glide slope antenna along the localizer procedural ground track, at 1/3 to ½ of the glide path angle. Maintain an angular descent until reaching threshold.	Maintenance personnel will configure the facility to radiate the sidebands in quadrature to the carrier.	ILS-3	Record raw data. Relay the crosspointer indications to maintenance and have them adjust the phaser until the crosspointer is centered about the value found during the modulation equality check.

Other considerations. Do not make facility adjustments inside 4 miles during the angular descent. If the µA value varies from the average between 1/2 mile from the threshold and runway threshold, the antenna offset may be incorrect and should be checked (antenna offset is most accurately established and set by maintenance).

(2) **Sideband reference**

Step	Maneuvering	Glide Slope	AFIS	Analysis
1	Conduct a level run at 1,000 ft above antenna elevation between 10 to 5 miles from the glide slope antenna.	Maintenance will dummy load the upper antenna feed and insert a 90° section in the main sideband line.	ILS-3	Record raw data. Relay the crosspointer indications to maintenance and have them adjust the phaser until the crosspointer is centered about the value found during the modulation equality check.
2	Conduct a level run at 1,000 ft above antenna elevation between 10 to 5 miles from the glide slope antenna.	Maintenance will remove the 90° section. (Upper antenna will remain dummy loaded)	ILS-3	Check for full fly-down signal. This indicates that the lower antenna sensing is correct. If full fly-up signal is indicated, sensing is incorrect and the facility must be adjusted. It is permissible to combine Steps 1 and 2 into one run.
3	Proceed inbound from 10 miles from the glide slope antenna along the localizer procedural ground track, at 1/3 to ½ of the glide path angle. Maintain an angular descent until reaching threshold.	Have maintenance radiate upper and lower antennas with a 90° section in the main sideband phaser.	ILS-3	See Step 1
4	Proceed inbound from below the glidepath	Have maintenance remove the 90° section from the main sideband line	ILS-3	Ensure that a fly-up signal is received when the aircraft is below the glidepath. It is permissible to combine Steps 3 and 4 into one run.

Other Considerations. Do not make facility adjustments inside 4 miles during the angular descent. If the µA value varies from the average between 1/2 mile from the threshold and runway threshold, the antenna offset may be incorrect and should be checked (antenna offset is most accurately established and set by maintenance).

(3) **Capture Effect.** Capture effect glide slopes are normally phased on the ground by maintenance personnel; however, they may request airborne phasing. The airborne phase verification procedure must be accomplished on commissioning inspections and when requested by maintenance. This procedure confirms that correct phasing has been achieved.

(a) **Airborne Phase Verification Procedure.** This procedure helps maintenance to determine if proper phasing exists. Both transmitters may be checked if dual equipment is installed.

Step	Maneuvering	Glide slope	AFIS	Analysis
1	ILS-3	Normal	ILS-3	**Angle**: ± .05 of commissioned for commissioning type inspections **Structure:** in tolerance
2	ILS-2	Normal	ILS-2	**Width**: .70° +/- .03° **SBP:** ≥ 30% of commissioned angle **Symmetry:** in tolerance
3	Below path approach from the GSI to threshold. For glide slopes associated with offset localizers or LDA(s) check to point "C"	Normal	ILS-2 or ILS-3	**CBP**: ≥180 μA of fly-up signal can be maintained
4	ILS-2	Main Sideband Advanced (usually 30° is used)	ILS-2	Expect the width to widen approximately the same amount when the main sideband is in advance or retard configuration. The following numbers are expected results. Tolerances in Paragraph 15.60b apply: **Width** should not exceed 0.1° sharper or 0.2° wider than normal. **Angle** should not change more than .1° **SBP:** ≥ 30% of commissioned angle
5	ILS-2	Main Sideband Retarded (usually 30° is used)	ILS-2	See step 4

Step	Maneuvering	Glide slope	AFIS	Analysis
6	ILS-2	Middle Antenna Advanced 10-20° (usually 19° is used)	ILS-2	Expect the width to widen approximately the same amount when the middle antenna is in advance or retard configuration. The following numbers are expected results. Tolerances in Paragraph 15.60b apply: **Width** should not exceed 0.1° sharper or 0.2° wider than normal **Angle** should not change more than .05°. **SBP:** ≥ 30% of commissioned angle
7	See Step 3	Middle Antenna Advanced	ILS-2 or ILS-3	**CBP**: ≥150 µA of fly-up signal can be maintained
8	ILS-2	Middle Antenna Retarded 10-20° (usually 19° is used)	ILS-2	See Step 6
9	See Step 3	Middle Antenna Retarded	ILS-2 or ILS-3	See Step 7
10	ILS-2	Normal	ILS-2	Width: .70° +/- .05°

Other considerations

- Steps 4 and 5 are required on commissioning checks, and are accomplished at maintenance request on other checks.
- For clearances, fly a recommended angle of 1.0 ° from 4 miles to runway threshold maintaining at least the minimum microamp level. If obstruction clearance is a limiting factor, an acceptable higher fixed angle may be used.
- Steps 6 -9 may be used to complete checklist items if the phasing amount was equal to or greater than the amount required for the monitor check.
- Maintenance should use measured/ fixed line lengths to de-phase the glide slope rather than using variable phasers.
- Steps 4, 5, 6, and 8 the Maintenance Reference "INITIAL" tolerances apply if establishing references.

(b) Airborne Phasing Procedure No. 1

Step	Maneuvering	Glide Slope	AFIS	Analysis
1	Proceed inbound from 10 miles from the glide slope antenna on the localizer procedural ground track, at ½ the angle (up to 2/3 the angle if terrain is an issue). Maintain angular descent until reaching threshold.	Have maintenance setup to phase the upper to middle antenna: **Lower antenna** - dummy loaded **Middle antenna**- Radiate carrier and sidebands **Upper antenna** – radiate sidebands **Main sideband phaser**- in quadrature **Clearance Tx**—de-energized	ILS-3	Record raw data. Relay the crosspointer indications to maintenance and have them adjust the phaser until the crosspointer is centered about the value found during the modulation equality check.
2	Proceed inbound from 10 miles from the glide slope antenna on the localizer procedural ground track, at the glide path angle until reaching threshold.	Have maintenance setup to phase the lower antenna to upper and middle antenna: **Lower antenna** - radiate carrier and sidebands **Middle antenna** – radiate carrier and sidebands **Upper antenna** – radiate sidebands **Main sideband phaser**- in quadrature **Clearance Tx**—de-energized	ILS-3	See Sep 1

Other considerations

- Do not make facility adjustments inside 4 miles during the angular descent. If μA value varies from the average between 1/2 mile from the threshold and runway threshold, the antenna offset may be incorrect and should be checked (antenna offset is most accurately established and set by maintenance).
- After completing airborne phasing, complete phase verification.

(c) Airborne Phasing Procedure No. 2 (most commonly used)

Step	Maneuvering	Glide Slope	AFIS	Analysis
1	Proceed inbound from 10 miles from the glide slope antenna on the localizer procedural ground track, at ½ the angle (up to 2/3 the angle if terrain is an issue). Maintain angular descent until reaching threshold.	Have maintenance setup to phase the lower to middle antenna: **Lower antenna** – radiate carrier only **Middle antenna** – radiate sidebands only **Upper antenna** – dummy loaded **Main sideband phaser**- in quadrature **Clearance Tx**—de-energized	ILS-3	Record raw data. Relay the crosspointer indications to maintenance and have them adjust the phaser until the crosspointer is centered about the value found during the modulation equality check.
2	Proceed inbound from 10 miles from the glide slope antenna on the localizer procedural ground track, at the glide path angle until reaching threshold.	Have maintenance setup to phase the lower antenna to the upper antenna. **Lower antenna** - radiate carrier only **Middle antenna** – dummy loaded **Upper antenna** – radiate sidebands only **Main sideband phaser**- in quadrature **Clearance Tx**—de-energized	ILS-3	See Step 1

Other considerations

- Procedure 2 only applies to those facilities in which it is possible to separate carrier and sideband signals in the Amplitude and Phase Control Unit (APCU).
- Do not make facility adjustments inside 4 miles during the angular descent. If µA value varies from the average between 1/2 mile from the threshold and runway threshold, the antenna offset may be incorrect and should be checked (antenna offset is most accurately established and set by maintenance).
- After completing airborne phasing, complete phase verification.

(d) **Alternate Phasing Procedure.** Unlike airborne phasing, ground maintenance may dephase an antenna and ask flight inspection to provide data from a level run, expecting a symmetrical change in the width or angle. The results are factored into a formula to determine optimum phasing settings. Maintenance may dephase lower-to-upper and/or lower-to-middle antennas. The following procedures can produce more stable results than standard phasing where adjustments are being made with the aircraft on a descent path.

1 **Upper Antenna Procedures**. Maintenance will dephase the upper antenna a known amount (e.g., 57°). Fly a level run (standard ILS-2 profile) and provide the following values: path angle, path width, structure below path, and symmetry. Expect a symmetrical lowering of the path angle for equal amounts of advance and retard. The expected optimum amount of glide angle change is 0.2-0.3°.

2 **Middle Antenna Procedures.** Maintenance will dephase the middle antenna a known amount (e.g., 19°). Fly a level run (standard ILS-2 profile) and provide the following values: path angle, path width, structure below path, and symmetry. Dephasing the middle antenna should result in a symmetrical widening of the path width and a lowering of the structure below path angle of equal value in advance and retard.

e. Null Check. The antenna null check is an engineering support check and is conducted at engineering/ maintenance personnel request. This check measures the vertical angles at which the nulls of the individual glide path antennas occur. It can be conducted on all image array systems. No procedures exist for the non-image arrays.

Warning:
Hazardous and Misleading Information
Misleading information is produced by this configuration. Ensure NOTAM is active.
Monitor ATC communications for improper clearances to other aircraft.

NOTE: FAA, U.S. non-Federal civil, U.S. Army, and U.S. Navy/ Marine Corps localizers must be OFF when glide slopes are transmitting HMI.

Maneuvering	Glide Slope	AFIS	Analysis
ILS-2	Have maintenance radiate carrier only from the antenna to be tested.	ILS-2	Measure angles from the nulls that appear on the recording as dips in the AGC.

Other considerations

- A level run and analysis should be made for each antenna.
- In the case of the first null of the upper antenna of a capture effect glide slope, the AGC dips are broad. Angle measurements can be accomplished by measuring the second and/or third null.
- When no other means to measure the angle is available, the Glide Path Width or Angles formula in Paragraph A2.7 may be used. Constant airspeed is critical since time (paper units) is the computation factor.

Alternate procedure: On a capture effect glide slope, maintenance may want to check antenna nulls by configuring the facility as a null reference.

Step	Maneuvering	Glide Slope	AFIS	Analysis
1	ILS-2	Have maintenance radiate carrier only from the lower antenna	ILS-2	Measure the angle from the nulls that appear on the recording as a dip in the AGC. Angle should be twice the commissioned angle.
2	ILS-3	Have maintenance set up as null reference configuration: Lower antenna – radiate carrier + sidebands Middle antenna – radiate sidebands only	ILS-3	Measure the angle – should be 3°.
3	ILS-3	Have maintenance set up as null reference configuration: Lower antenna – radiate carrier + sidebands Upper antenna – radiate sidebands only	ILS-3	Measure the angle – should be 4°.

f. Antenna Offset. Perform this check to establish the horizontal antenna displacements on the mast. Offset affects the phase relationship of the glidepath signal as the aircraft approaches the runway threshold. Improper offset may cause low clearances, and/or a fly-up/down signal between Point B and the runway threshold. Antenna offsets can be accurately determined and positioned by facilities maintenance personnel without flight inspection assistance.

Prior to checking the antenna offset, check the phasing.

Warning:
Hazardous and Misleading Information
Misleading information is produced by this configuration. Ensure NOTAM is active.
Monitor ATC communications for improper clearances to other aircraft.

NOTE: FAA, U.S. non-Federal civil, U.S. Army, and U.S. Navy/ Marine Corps localizers must be OFF when glide slopes are transmitting HMI.

Maneuvering	Glide Slope	AFIS	Analysis
After optimum results are achieved in the far field (1/2 mile from the runway threshold and beyond), park the aircraft on centerline at the runway threshold.	Maintenance will configure the facility to radiate the sidebands in quadrature to the carrier.	ILS-3	Record raw crosspointer. As the antennas are being adjusted, relay crosspointer indications to the Facilities Maintenance personnel. The optimum setting is the same as the displacement found during the modulation equality check.

Other considerations

- The top antenna should be closest to the runway.
- When the antenna is secured and personnel are not on the mast, take a final reading.
- Check the effects of the antenna offset adjustment in the far and near fields by performing another phasing check. Do not make phasing adjustments.
- If the crosspointer is not stable when the aircraft is parked at the runway threshold, the antenna offset cannot be established on the ground. In this case: have maintenance adjust the antenna offset based on the final phasing run then re-fly the last 3,000 ft to the runway threshold. Compare the crosspointer to the indications found prior to the antenna adjustment.

g. **Spurious Radiation.** Perform this check to determine if any glide slope signal exists in the final approach segment with the facility configured in dummy load.

Maneuvering	Glide Slope	AFIS	Analysis
ILS-3 from at least 4 nm	Have maintenance dummy load the facility	ILS-3	Using a spectrum analyzer or the glide slope receiver traces, compare any signals that are received during the approach with the results found while the facility is transmitting normally.

h. **Angle.** Two methods are used to determine the glidepath angle. They are the level run method and the actual path angle method. Prior to beginning a site or commissioning inspection, obtain the commissioned angle from the facility datasheet.

(1) **ILS-2 Level-Run Method:** Use this method for measuring the glidepath angle during monitor checks (for any ILS category), engineering support checks, etc.

Maneuvering	Glide Slope	AFIS	Analysis
Position the aircraft beyond the 190µA/ 150hz glidepath point on the localizer on-course or procedural designed azimuth. Maintain a constant altitude and airspeed at the established level run altitude corrected to true.	Normal or other configuration	ILS-2	Measure the angle that the crosspointer intersects the 0 µA baseline.

Other considerations

- The level run method may be used for periodic inspections of the glidepath angle for CAT I facilities.
- The algebraic difference between the NORMAL ILS-3 angle and the NORMAL ILS-2 angle becomes a **correction factor.** Apply the correction factor to all subsequent ILS-2 monitor angles.
- Width, symmetry, and structure below path may be combined with the angle check during one level run, except when the actual path angle is required (for specific ILS categories and on various types of inspections). In these cases, determine the angle by the actual path angle method.
- For a periodic inspection, the level run altitude may be adjusted for weather.

(a) **Level Run Theodolite Method.** Position the theodolite or tracking device in accordance with paragraph 15.11f, Theodolite Procedures. Proceed inbound recording 1020 hz reference marks from the theodolite. Measure the angle by referencing the recording at the 190µA/ 150hz, 75µA/ 150 hz on path, 75µA/ 90 hz points with the theodolite 1020 hz marks which are usually spaced at 0.2° intervals.

NOTE: An RTT may be used to track an aircraft throughout the path sector. Apply the path sector width received to the calibration of the RTT.

(b) **Level Run Manual Method:** During the inbound run, mark checkpoints or DME distances with the event mark and identify them on the recording. Checkpoints are normally the outer marker and the glide slope antenna; however, any two checkpoints separated by a known distance may be used. A distance for each point (i.e., 190µA, 75µA, 0µA, and 75µA) is determined by using time/distance ratios. The angle is calculated from these values.

$$\text{Measured Angle} = \frac{\mathbf{A1}}{\mathbf{106 \times D}}$$

Where:

A1 = Tapeline altitude in feet
D = Distance in nautical miles from the glide slope

(2) **ILS-3 Zone 2 Actual Path Angle**. The actual path angle method is used to measure the path angle during site, commissioning, after-accident inspections, special inspections at maintenance request, and to confirm out-of-tolerance angles found during Level Run maneuvers. Use during any inspection to determine the normal angle for Category II and III glide slopes.

Maneuvering	Glide Slope	AFIS	Analysis
ILS-3	Normal or other configuration	ILS-3	Measure ILS Zone 2

(a) **Actual Angle RTT Method.** Determine the actual path angle from the straight-line arithmetic mean of all deviations of the differential trace occurring in ILS Zone 2. The arithmetic mean can be determined either by using a compensating polar planimeter or by averaging 2-second samples of the deviations in Zone 2 (smaller sampling interval may be used, e.g., 1-second samples).

(b) **Actual Angle Standard Theodolite Method**. Sufficient positioning information must be obtained to determine the actual path angle and the presences of bends, reversals, and shorter-term aberrations. Therefore, more than one run may be required.

i. Width. Obtain path width measurements of the half ILS glidepath width sector from ILS-2 level runs.

Maneuvering	Glide Slope	AFIS	Analysis
ILS-2	Normal or other configuration	ILS-2	Measure the difference in the angles where the crosspointer intersects the 150 Hz and 90 Hz 75µa points

Other considerations

- The 75µA points are normally used as the measurement points for the width. Some facilities have step characteristics of the cross pointer transition, which may preclude the use of the 75µA points. Check data sheet remarks for non-standard width measurement area.
- When steps are encountered, the following procedure is recommended to determine which level run measurement points should be used for path width analysis:
  - Perform a mean width check IAW Paragraph n.
  - Fly a normal level run using 60µA measurement points.
  - Fly a normal level run using 90µA measurement points.

On subsequent level runs, use the measurements points that most closely match the path width results measured on the mean width check. If a point other than 75 µA is used to measure path widths, that point must be used on all subsequent checks and inspections. . If the steps continue to affect the level run results, consider another altitude, or evaluate all Normal and monitor reference widths using the mean width method.

- The **AFIS** width measurement point defaults to 75µA; however, any value from 60µA to 90µA can be used as described above.
- When a point other than 75µA is used, the new point must be documented on the AVNIS datasheet and used in all subsequent inspections.
- **ILS-2 manual method:** During the inbound run, mark checkpoints or DME distances with the event mark and identify them on the recording. Checkpoints are normally the outer marker and the glide slope antenna; however, any two checkpoints separated by a known distance may be used. The width is calculated from these values.

$$\frac{\mathbf{A1}}{\mathbf{106 \times D \text{ of } 75\mu A/90hz}} - \frac{\mathbf{A1}}{\mathbf{106 \times D \text{ of } 75\mu A/150hz}}$$

Where:

A1 = Tapeline altitude in feet
D = Distance in nautical miles from the glide slope

j. **Symmetry.** Symmetry is the balance of the 2 sectors, 90Hz/ 150Hz. The glidepath should be as symmetrical as possible; however, there normally is some imbalance. It is determined from the data obtained during level run angle and/or width measurements.

Maneuvering	**Glide Slope**	**AFIS**	**Analysis**
ILS-2	Normal	ILS-2	Measure the angle that the crosspointer intersects the 150 Hz/ 75µa point, the 0µA baseline and the 90 Hz/ 75µA point. Symmetry is calculated as the percent 90 Hz of the total width. Symmetry = $\frac{\text{90 Hz width}}{\text{Total width}}$

Other considerations

- If points other than the 75µA points are used for measuring the path width, they must also be used for the symmetry measurements.
- If the level run symmetry is out of tolerance, determine the mean symmetry (see Paragraph n., Mean Width). Apply the mean symmetry as a correction factor to level runs; annotate on the AVNIS data sheet. If the symmetry remains out of tolerance after performing mean width check, the facility must be removed from service.

k. Structure Below Path. This check determines that the 190µA/ 150Hz point occurs at an angle above the horizontal that is at least 30 percent of the commissioned angle. Measure the structure below path during the level run.

Maneuvering	Glide Slope	AFIS	Analysis
ILS-2	Normal or other configuration	ILS-2	Measure the angle that the crosspointer intersects the 190µA /150 Hz point.

Other considerations

- Altitudes lower than the established level run altitude may be required to make this measurement.
- The structure-below-path point does not have to occur within the service volume of the facility to be a valid check, provided the AGC and flag alarm current indications are within appropriate tolerances.
- If unable to find the 190 µA/ 150 Hz point in any facility configuration conduct a clearance below path check starting at the edge of the service volume. Apply the appropriate tolerance.
- Maintenance may use this information for system optimization.

l. **Clearances.** Glide slope clearances give the pilot an indication if the aircraft is above or below the commissioned glide angle. In flight inspection, the primary concern is a full fly up indication on the pilot instruments.

(1) **Clearance Below the Path.** Perform this check to assure that positive fly-up indications exist between the bottom of the glidepath sector and obstructions.

Maneuvering	Glide Slope	AFIS	Analysis
Below path approach from GSI to threshold on the localizer course. For glide slopes associated with offset localizers or LDA(s), check to Point C. For the 5 and 8° endfire checks, check to Point B.	Normal or other configurations	ILS-2	Check that the required amount of fly-up signal exists

Other considerations. Check clearance below path from the FAF/ GSI to the following points:

- For all glide slopes with runway centerline localizers, check centerline clearances to threshold.
- CAT I not used below 200 ft Decision Altitude (DA) -- ILS point "C" for an unrestricted glide slope, to threshold for Part 139 airports or the point at which the glide slope is restricted. When checking clearances to threshold, document the results as satisfactory or unsatisfactory between Points “C” and “T” on the flight inspection report.
- CAT I special use as Cat II and all CAT II/III –to Runway threshold.
- For glide slopes associated with offset localizers or LDA(s), check to point “C”.
- For the 5° and 8° Endfire checks, check only to Point “B”.

(2) **Clearances Above the Path.** Check clearances above path to ensure that positive full-scale fly-down indication is received prior to intercepting the first false path.

Maneuvering	Glide Slope	AFIS	Analysis
ILS-2	Normal or other configurations	ILS-2	Check that 150µA fly-down occurs prior to the first false path.

m. **Tilt.** This check verifies that the glidepath angle and clearances are within the authorized tolerance at the extremities of the localizer course sector.

Maneuvering	Glide Slope	AFIS	Analysis
ILS-2 left of course at the localizer 150 µA point	Normal	ILS-2	Verify that the angle, modulation, and clearances above path are in tolerance
ILS-2 right of course at the localizer 150 µA point	Normal	ILS-2	Verify that the angle, modulation, and clearances above path are in tolerance
Below path approach from the GSI distance to point "B" left of course at the localizer 150 µA point	Normal	ILS-2	Verify that the clearance below path meets tolerances
Below path approach from the GSI distance to point "B" right of course at the localizer 150 µA point	Normal	ILS-2	Verify that the clearance below path meets tolerances

Other considerations

- Fly the ILS-2 at the established level run altitude.
- Apply the actual angle correction factor to the level run angles.
- Tilt check is only required on 1 transmitter.

n. **Mean Width.** Perform this check on all commissioning inspections and per maintenance request for verification of questionable path width and/or symmetry results. It determines the mean width of a glidepath between ILS Points "A" and "B". This check is also be used to determine the mean symmetry of the glidepath. Theodolite, RTT, or AFIS must be used.

Establish the level run width prior to the mean width check.

Maneuvering	Glide Slope	AFIS	Analysis
ILS-3 on course/ on path	Normal	ILS-3 "ON"	Measure the on path angle
ILS-3 on course/ 75µA above path	Normal	ILS-3 "ABV"	Measure the 75µA above path angle
ILS-3 on course/ 75µA below path	Normal	ILS-3 "BLW"	Measure the 75µA below path angle

Other considerations

- This check should also be used to determine which width measurement points should be used when the facility has step characteristics of the crosspointer transition which preclude the use of the 75µa points (Paragraph 15.30i)
- Mean width = Above path angle – Below path angle
- Mean symmetry = $\frac{\text{Above path angle- On path angle}}{\text{Mean width}}$

o. **Structure and Zone 3 Angle Alignment.** These checks measure structure deviations and Zone 3 angle alignment. The angle alignment (or deviation of the mean angle from Point B to Point T) is affected by siting, phasing, and antenna offset factors that may not affect the measured Zone 2 angle. Angle alignment must be evaluated using the RTT or AFIS.

Maneuvering	Glide Slope	AFIS	Analysis
ILS-3 on the glidepath and localizer course	Normal	ILS-3	Measure the worst (with respect to tolerances) µA deviations: **Zone 1**- from Graphical average **Zone 2** - from Actual angle **Zone 3** - from Graphical average In addition for CAT II or III evaluate angle alignment: **PT B** – Worst average µA deviation of point B-C BFSL angle (with respect to tolerance) from the commissioned angle. **PT C** – Worst average µA deviation of point C-Threshold BFSL angle (with respect to tolerance) from the commissioned angle. **PT T** – µA deviation at point T from the commissioned angle.

Other considerations

(1) **Structure Tolerances (95% Rule).** Application of path structure analysis contained in this paragraph applies to all zones (1, 2, 3) of glidepaths. This provision does not apply to glide slope rate of change/ reversal. For Category II/ III facilities, the applicable region or military command engineering staff must be notified of initial application of this criteria. If path tolerances are exceeded, analyze the path structure as follows:

(a) Where path structure is out-of-tolerance in any region of the approach, the flight recordings will be analyzed in distance intervals of 7,089 ft (1.17 nm) centered about the region where the out-of-tolerance or aggregate of out-of-tolerance condition(s) occurs. Two 7,089 ft areas must not overlap.

(b) Where necessary to avoid overlap, centering the interval about the out-of-tolerance region may be disregarded.

(c) It is not permissible to extend the 7,089 ft segment beyond the area checked, i.e., service volume or ESV, whichever is greater, or the point closest to the runway where analysis stops.

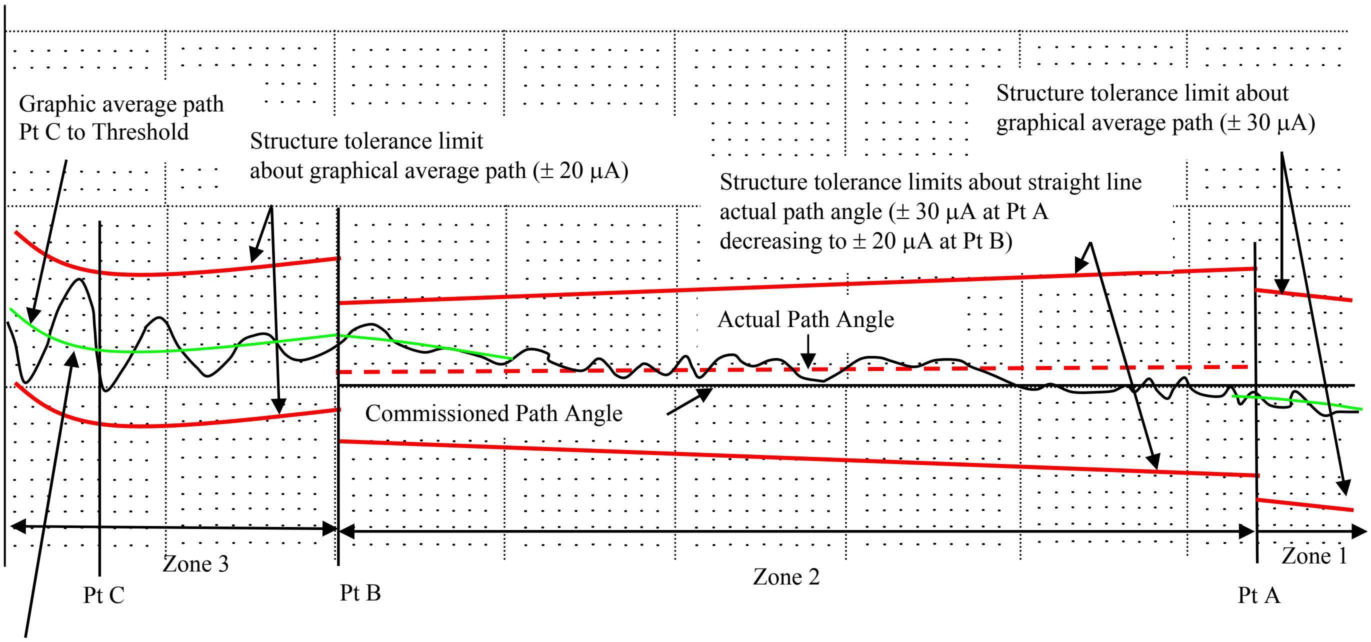
(d) The path structure is acceptable if the aggregate structure is out of tolerance for a distance equal to or less than 354 ft within each 7,089 ft segment.

(2) During site, commissioning, reconfiguration, categorization, antenna, and/or frequency change, evaluate the structure from 10 miles from the glide slope antenna or ESV (whichever is greater) through all zones.

(3) During all other inspections (i.e., periodic, periodic with monitors, etc.) this evaluation can be accomplished from the GSI or FAF (whichever is further).

(4) Position the aircraft within 22.5 μA of the "on-path" throughout 95% of Zone 2 unless the path characteristically exhibits structure of greater magnitude.

APPLICATION OF STRUCTURE TOLERANCE -- CAT. II & III



Projection of the trend of the graphic average path from Point. C

p. Rate of Change/ Reversal in the Slope of the Glidepath. The following analysis of the path angle recording must be accomplished during all inspections where AFIS, RTT, or other tracking devices are being used. It applies to all categories of ILS.

(1) Inspect the glidepath corrected error trace/ differential trace in Zones 2 and 3 for changes and/or reversals in the trend of the slope of the path trace.

(2) If the trace (or trend), on either or both sides of the point where a change in direction occurs, extends for at least 1,500 ft along the approach with an essentially continuous slope (see graphic on next page), this qualifies as a "measurable rate of change reversal", subject to further analysis.

(3) If one or more rate of changes/ reversals meets the condition in (2). above, draw a straight line through the average slope that covers at least a 1,500 ft segment <u>each side of the point of change.</u> It is permissible to extend the straight line of the average slope to inside Point C if required, in order to obtain the 1,500 ft segment. Determine the change-in-slope by measuring the divergence of the two lines at a point 1,000 ft from their intersection.

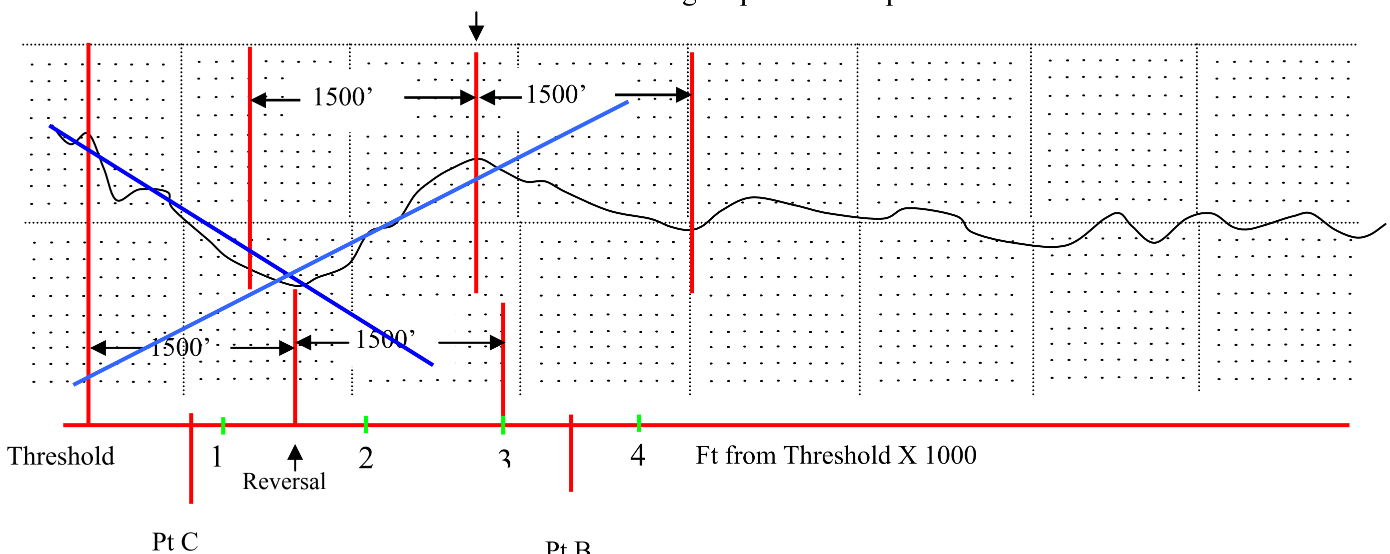
(4) NOTAM Action. The use of facilities which do not meet the change/ reversal tolerance must be limited by a NOTAM (see Chapter 5, Paragraph 5.12) that withholds authorization for autopilot coupled approaches below an altitude (MSL) which is 50 ft higher on the glidepath than the altitude at which the out-of-tolerance condition occurs. Compute the MSL altitude for such a restriction based on the commissioned angle of the facility.

(a) **Category I facilities that do not meet the change/** reversal tolerance <u>must not</u> be classified "restricted" due to the change/ reversal. However, NOTAM action must be taken and the National Flight Procedures Office advised.

(b) **Category II and III** facilities are required to meet the established change/ reversal criteria. If a change/ reversal is found, the facility <u>must</u> be classified “restricted” and the Cat II/ III procedures NOTAMed. Additional NOTAM action per Chapter 5, Paragraph 5.12 also applies. See the graphs below for analysis of rate of change/ reversal and structure.

RATE OF CHANGE/ REVERSAL IN THE SLOPE OF THE GLIDEPATH

Note the analysis line drawn to the left of the reversal located at 2,800 ft must include 1,500 ft of trend, to the 1,300 ft point, even though the slope changes direction again prior to that point.



There are two reversals in slope in the area of consideration: one at 2,800 ft and one at 1,500 ft from the threshold. Each reversal meets the requirement that the slope or trend on at least one side of the break extends for at least 1,500 ft.

q. **Transverse Structure--Endfire Glide Slope.** This is a measurement of the horizontal structure of the glidepath and is directly related to on-path structure, tilt, and clearance.

Maneuvering	Glide Slope	AFIS	Analysis (expected results)
Fly an arc of at least 12° each side of localizer centerline at the *FAF distance and FAF altitude corrected to true altitude. Reference the arc laterally to localizer centerline abeam the glide slope antenna.	Course TX normal/ Clearance TX normal Or Course TX normal/ Clearance TX off (commis-sioning type check)	Record both localizer and glide slope crosspointer: The glide slope should be calibrated to 150µA to ensure proper trace definition. The localizer should be calibrated to enable the technician to identify the 150µA points.	(1) Within the localizer course sector, the change of the glide slope signal should not exceed *64µA of 150 Hz or *48µA of 90 Hz from the crosspointer value found on the localizer on-course. (2) From the edge of the localizer course sector to 8° from the localizer on-course, signals should not exist that are greater than 48 µA in the 90 Hz direction from the glide slope crosspointer value found on the localizer on-course. See Figure 15-4 *This analysis applies to a 3.0° commissioned glide slope angle.

Transverse Structure Microamp Limits

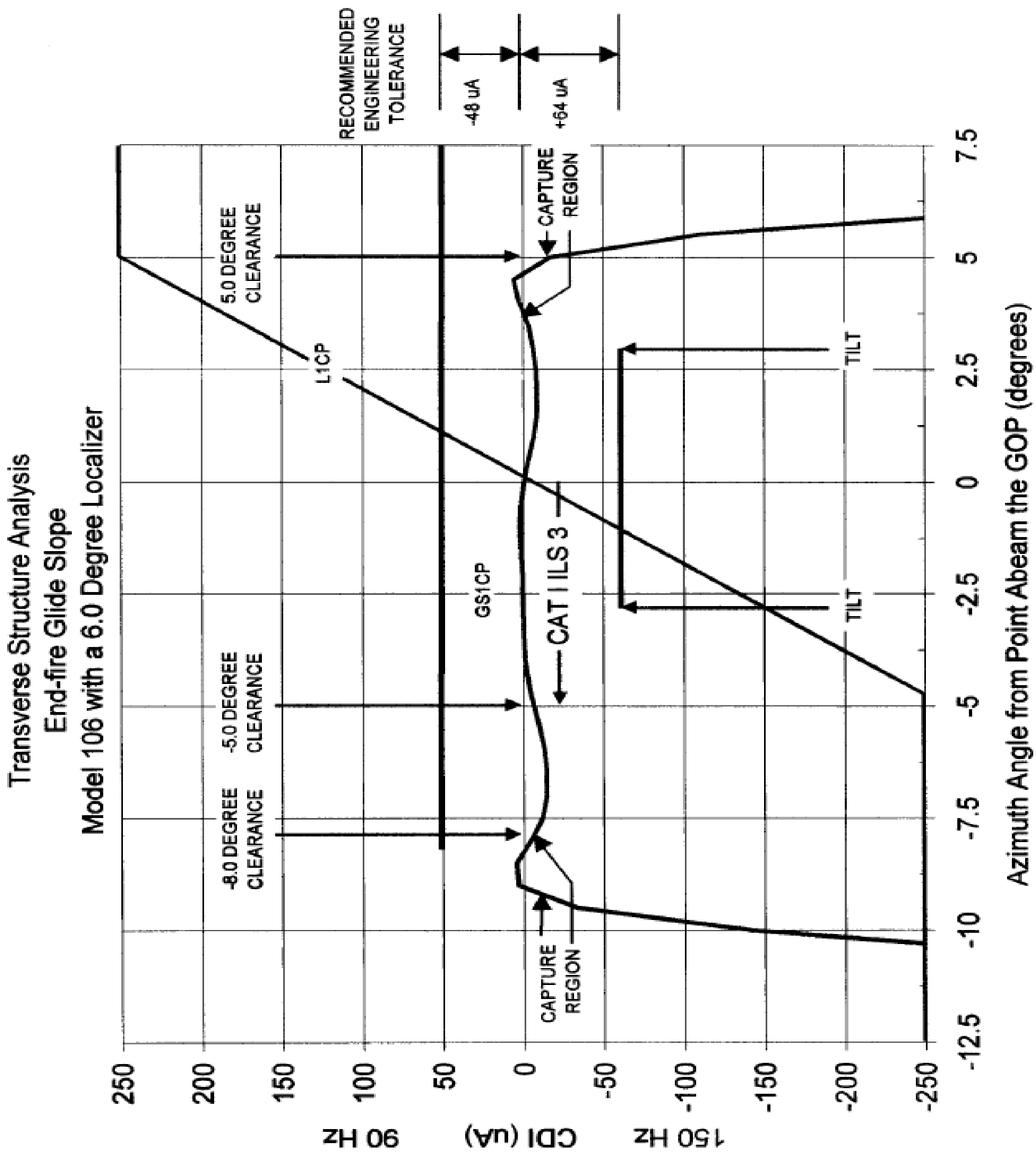
+10%/ -7.5% ANGLE ALARM/TRANSVERSE STRUCTURE MICROAMP VALUE

Commissioned Angle	**Low Angle (°/µ A)**	**High Angle (°/µ A)**
2.5°	2.32°/ 38 µA (90 Hz)	2.75°/ 53 µA (150 Hz)
3.0°	2.78°/ 48 µA (90 Hz)	3.30°/ 64 µA (150 Hz)
3.5°	3.24°/ 55 µA (90 Hz)	3.85°/ 75 µA (150 Hz)

Other considerations

- In the event any part of the transverse structure does not meet the recommended value due to a deflection into the 90 Hz direction, verify that adequate 150 Hz fly-up signal exists in this area while clearing obstructions. These data should be included in the engineering analysis prior to final resolution.
- If the FAF is less than 5.0 miles from the glide slope, change the arc distance to at least 5 miles. (*Since aircraft distance and altitude affects the received glide path, it is critical that these parameters do not vary during the arc.)*
- Results exceeding the expected values will require engineering analysis prior to final resolution.
- Engineering may use the results of these checks to adjust antenna pedestal locations and signal levels.
- If using ILS-1 Profile, make the following changes to AFIS: FI ILS FACILITY DATA page change LC DIS to 0, and on PLOT CONTROL PAGE change SYS-B NCU INPUT to GS1, SYS-A and SYS-B Raw CP baseline to 5.0, and the RAW CP scale to 150µA.
- Multiple runs may be required to optimize the antenna arrays.
- On any inspection after commissioning, where transverse structure is checked, compare the course and clearance normal results with those from the last results on file.
- Notify maintenance of any significant changes. Perform a tilt check on the affected side(s) if the glide slope µA deflection at the localizer 150 µA point exceeds angle tolerances.

Figure 15-4


Transverse Structure Analysis
End-fire Glide Slope
Model 106 with a 6.0 Degree Localizer
RECOMMENDED ENGINEERING TOLERANCE
-48 uA
+64 uA
5.0 DEGREE CLEARANCE
-5.0 DEGREE CLEARANCE
-8.0 DEGREE CLEARANCE
CAPTURE REGION
CAPTURE REGION
L1CP
GS1CP
CAT I ILS 3
TILT
TILT
250
200
150
100
50
0
-50
-100
-150
-200
-250
90 Hz
CDI (uA)
150 Hz
-12.5
-10
-7.5
-5
-2.5
0
2.5
5
7.5
Azimuth Angle from Point Abeam the GOP (degrees)

r. Monitors. The purpose of these checks is to measure glidepath parameters when the facility is set at the monitor reference.

Maneuvering	Glide slope	AFIS	Analysis
ILS-2	Monitor reference (Wide, Narrow, etc)	ILS-2	Measure width, angle, and structure below path in each required monitor reference condition

Other considerations

- Check the facility in normal prior to conducting the monitor check.
- After any monitor inspection, return the facility to normal, check angle, width, symmetry, and structure below the path, and report results to maintenance.

s. RF Power Monitor Reference. Conduct this check to determine that the glide slope meets specified tolerances throughout its service volume while operating at reduced power.

Maneuvering	Glide Slope	AFIS	Analysis
While maintaining a level altitude equal to 0.45 times the commissioned angle and on the localizer course, fly inbound from 10 nm from the facility to the interception of the lower sector of the glide path (i.e. the point nearest the glide path at which 150µA occurs). Fly through the glide path sector and check clearances above the path.	Reduced power (both course and clearance transmitters for capture effect and endfire glide slopes).	ILS-2	Signal strength Fly-up/ Fly-down Flag alarm
While maintaining a level altitude equal to 0.45 times the commissioned angle and 8° right of localizer centerline abeam the glideslope origination point, fly inbound from 10 nm from the facility to the interception of the lower sector of the glide path (i.e. the point nearest the glide path at which 150µA occurs). Fly through the glide path sector and check clearances above the path.	Same as above	ILS-2	Same as above
While maintaining a level altitude equal to 0.45 times the commissioned angle and 8° left of localizer centerline abeam the glideslope origination point, fly inbound from 10 nm from the facility to the interception of the lower sector of the glide path (i.e. the point nearest the glide path at which 150µA occurs). Fly through the glide path sector and check clearances above the path.	Same as above	ILS-2	Same as above

Other considerations.

- In situations where less than 150 µA fly-up signal is received, descend to an altitude which will provide at least 150 µA fly-up while providing adequate obstacle clearance at 10 miles.
- To validate an ESV, see Chapter 22.
- The endfire glide slope antenna array is orientated toward the runway. The normal fly-up/ fly-down signal ends at approximately 5°on the antenna side of the runway; therefore, you will have only 150 Hz clearance signal at 8°on the antenna side of the runway.

t. **Glide Slope Best-Fit Straight Line (BFSL)** is used to determine the CAT II/ III glide slope angle, RDH, ARDH, and GPI. (Reference FAA Order 8240.47)

> **NOTE:** Glide Slope Transmitter Equality of Modulation and Phasing can affect the results. A skew can affect the announced angle. Keep the path width angle within commissioning tolerances.

Step	Maneuvering	Glide Slope	AFIS	Analysis
1	ILS-3	Normal	ILS-3	Review the ILS BFSL – LATEST RUN RESULTS, Pg 3 of 4. If the approach is acceptable, enter the run on the next available column on the ILS BSFL – SUMMARY RESULTS, Pg 4 of 4.
2	ILS-3	Normal	ILS-3	Same as Step 1
3	ILS-3	Normal	ILS-3	Same as Step 2
4				If the Z2BF DHT of the ILS BFSL – SUMMARY RESULTS on Pg 4 average value is ≤ 3 feet of 0 and of each other. Algebraically add the value of “Z2BF DHT” “AVE” to the “GS HGT” “INITIAL” value to obtain the new value of the glide slope height rounded to the nearest foot)
5			Change the AFIS Facility Data Page “GS HGT” to the new value, save and print page.	

Step	Maneuvering	Glide Slope	AFIS	Analysis
6				**Repeat** Steps 1-4 until the Z2BF DHT average value is ≤ 3 feet and each announced AFIS angle is within 0.03°, the glide slope angle and origination point have been optimized..
7				The final computed BFSL and announced angle must be within ± 0.05° of the desired commissioned angle. When the announced AFIS angle is within 0.03° of the computed BFSL angle, the glide slope angle and origination point have been optimized. It is permissible to have a small skew to prevent an RDH less than 50 or greater than 60 feet.
8				Report the following from "ILS BFSL – SUMMARY RESULTS" page 4 of ILS-3 Mode to the Procedures Specialist and enter in the Remarks of the FI Report: **RDH** – The value listed as "TCH/ RDH" in the "INITIAL" column **ARDH** – Z3 T HGT in AVE column + (algebraic) final TCH/RDH value in INITIAL column **GS HGT** – The value listed as "GS HGT" in the "INITIAL" column **GPI** – The value listed as the "GPI RNG" in the "INITIAL" column

Other considerations

- A skew can affect the announced angle. If skewing is present in Zone 2 of the corrected error trace, it indicates optimum AFIS aiming point elevation (glide slope height) has not been achieved.
- CAT II/ III – The RDH must be commissioned at 50 – 60 ft. Flight Standards may provide a waiver up to 63 ft at the request from the applicable service area.
- BFSL must be applied to Category I facilities proposed to support Special Category II/III minima. It can be applied to all other Category I facilities if jointly deemed advantageous by flight inspection and facilities engineering personnel.
- If BFSL is applied to a CAT I facility, the flight check derived RDH replaces procedural TCH.

- TERPS Instrument Procedures limits the CAT I procedural TCH to a maximum of 60 ft.
- If the criteria cannot be met, consult Engineering/ Installation personnel to determine if the facility will meet its "Operational Requirements" before attempting to commission the facility.

u. Special checks

(1) Antenna change (same type). Flight inspection of the glide slope after a same type antenna change or feed-line cable replacement should include as a minimum, the periodic with monitor checks. Ground maintenance and the flight crew will make the final determination of the checks to be performed. Discussion should take place concerning the effect on the radiated signal, the ability to trace current references, and the need establish new references. Consider the following checks:

(a) Clearance below path in the condition with the lowest SBP

(b) Phase Verification (capture effect)

(c) Reduced RF power

(d) Evaluation of structure from the service volume

SECTION 4
75 MHz MARKER BEACON

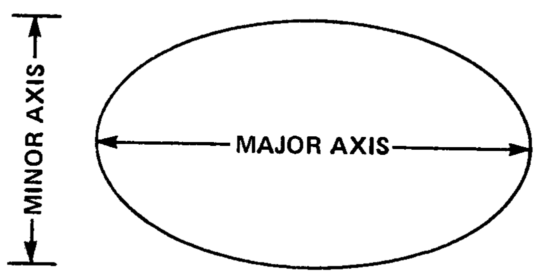
15.40 INTRODUCTION

a. **General.** A marker beacon is a VHF radio transmitter, which radiates an elliptically shaped (fan) vertical radiation pattern on an assigned frequency of 75MHz. Marker beacons provide an aural and visual indication of station passage in association with facilities providing course guidance.

b. **Characteristics.** Marker beacons transmit an elliptical pattern with dimensions of approximately 2,400 ft in width and 4,200 ft in length at 1,000 ft above the antenna.

c. **Classification.** 75MHz marker beacons are separated into two categories: ILS markers and fan markers. Figure 15-4 shows the basic radiation pattern for either type marker looking down on the antenna.

Figure 15-5
RADIATION PATTERN-PLAN VIEW



(1) **ILS Markers.** These markers are located on the approximate instrument runway centerline extended in accordance with installation criteria specified in other documents. They are installed to indicate the position of an aircraft along the instrument approach course.

(a) **Outer Marker.** Normally indicates a position at which an aircraft at the appropriate altitude on the localizer course will intercept the ILS glide path. Modulated at 400Hz, keyed at continuous dashes (— — —) at a rate of two per second, and illuminates a blue lamp.

(b) **Middle Marker.** Indicates a position approximately 3,500 ft from the landing threshold. This is also the position where an aircraft on the glide path will be at an altitude of approximately 200 ft above the touchdown zone elevation. Modulated at 1300Hz, keyed at alternating dots (• — • —) and dashes at a rate of 95 combinations per minute, and illuminates the amber lamp.

(c) **Inner Marker.** Indicates a point at which an aircraft is at a designated decision height (DH) on the glide path between the MM and landing threshold. Modulated at 3000Hz, keyed at continuous dots (••••) at a rate of six per second, and illuminates the white lamp.

(2) **Fan Markers.** These markers are generally associated with nonprecision approach procedures; however, they may be associated with an ILS to serve as a localizer step-down fix or MAP for circling approaches to secondary airports. Fan markers are modulated at 3000Hz and illuminate the white lamp. Fan markers keying code is different for Back Course Fan Markers and other installations

(a) **Back Course Fan Marker.** Is keyed at two dot pairs (• • • •) at a rate of 95 pairs per minute; older equipment is keyed at 75 pairs per minute.

(b) **Other Installations.** Morse code letter R (• — •). Where more than one approach marker is located in the same area, different keying is necessary to avoid confusion. The Morse code letter K (— • —), P (• — — •), X (— • • —), and Z (— — • •) will be used in the priority listed.

15.41 FLIGHT INSPECTION PROCEDURES

a. **Spectrum Analysis.** Reserved

b. **Identification and Modulation Tone.** Evaluate the facility identification for correct tone, keying code, and interference throughout the area of required coverage.

(1) **Maneuvering.** Maneuver the aircraft on the procedural course and on the glide path for an ILS or the published minimum altitude for non-precision approaches.

(2) **AFIS/ Equipment Setup**. The marker beacon sensitivity must be in the low position. Turn marker volume on to a comfortable level on the audio box.

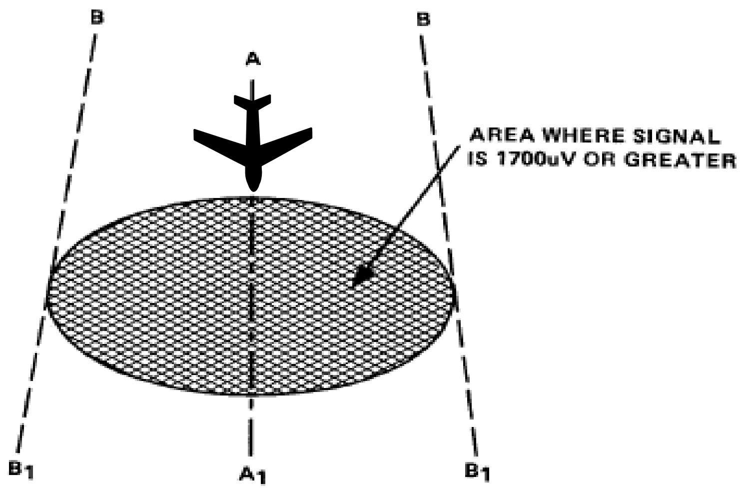
(3) **Analysis.** Evaluate the keying code while flying in the radiation pattern, and check the audio modulation tone is correct by noting that the proper light comes on for the marker being inspected.

(4) **Other Considerations.** Keying rate is checked by facility maintenance.

c. **Width and Coverage.** Width is measured to assure adequate time in the radiated pattern to activate audio and visual cues in the cockpit of the aircraft executing an approach. Coverage is conducted to ensure that the facility provides an elliptical radiation pattern that supports operational requirements without interfering with other facilities or instrument flight procedures.

(1) **Minor Axis** is defined as the shortest diameter of the ellipse. The actual width of the marker is measured on the minor axis, and is measured on the procedural course. This check is normally made during a "Flight Inspection Low Approach". (See note)

Figure 15-6
Marker Beacon Width



NOTE:

A-A_1-Electronic On-Course (LOCALIZER, NDB, VOR, VORTAC)

B-B_1-LOCALIZER/SDF/LDA 75µA 90 or 150Hz or Omni-Directional 5° either side of the Electronic Procedural Bearing / Radial

(a) **Maneuvering.** On precision approach, intercept the glide slope at an altitude to allow the aircraft to be established on path and on course when flying through the marker signal. For non-precision, fly through the marker beacon signal on the electronic course providing approach guidance in the direction of intended use at the minimum altitude of the approaches. (See Figure 15-5) An alternate procedure is to maintain the altitude at which the glide slope intersects the marker location.

(b) **AFIS/ Equipment Setup.** The marker beacon sensitivity must be in the low position. Toggle "Marker" and "GND SPD" to "ON" on the Plot Control. Turn on/up the volume for the marker on the audio control panel.

(c) **Analysis.** Marker width is determined based on duration the signal strength exceeds 1700µV. Outer and fan markers are allowed "holes" in the area of coverage provided that it is less then 300 feet in duration, a hole is defined as a momentary reduction in signal strength below 1700µV within the coverage area. The existence of a hole must be included in the total width of the marker. (See Figure 15-10)

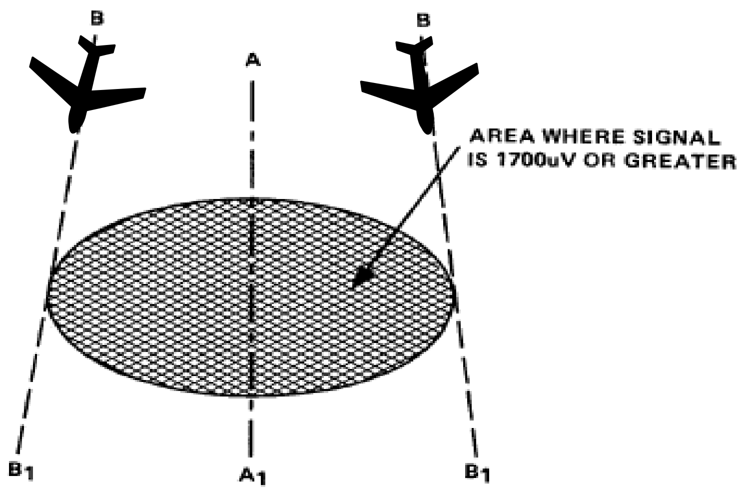
NOTE: Markers may be manually measured using the ground speed method. Determine the average ground speed while over the marker using the AFIS trace. Next determine the seconds between the first positive and final negative crossing of the 1700µV reference level. Then multiply the average speed by the seconds, and divide by 0.592. (See Figure 15-12)

(d) **Other Considerations.**

- If a marker beacon supports both precision and non-precision procedures and the difference between the respective intercept altitudes exceeds 100 feet, conduct the initial minor axis check at both altitudes; thereafter, either altitude may be used.
- Outer marker optimum width is 2,000 ft

(2) **Major Axis** is defined as the longest diameter of the ellipse. Conduct this check to verify that the marker beacon provides adequate coverage by measuring the width of the minor axis at the extremities of a predefined off-course sector. Measure each side when established on glide path. (See Note)

Figure 15-7
Marker Beacon Coverage



NOTE:

A-A_1-Electronic On-Course (LOCALIZER, NDB, VOR, VORTAC)

B-B_1-LOCALIZER/SDF/LDA 75µA 90 or 150Hz or Omni-Directional 5° either side of the Electronic Procedural Bearing / Radial

(a) **Maneuver.** Check the major axis at the same altitude as the minor axis. Unidirectional facilities (e.g. LOC/ LDA/ SDF) must be provided lateral marker coverage 75µA each side of the on-course signal. Omni directional facilities (e.g. VOR, NDB, etc.) must be provided lateral coverage 5° each side of the procedural on-course signal.

(b) **AFIS/ Equipment Setup.** Marker beacon sensitivity must be in the low position. Toggle "Marker" and "GND SPD" to "ON" on the Plot Control. Turn on/ up the volume for the marker on the audio box.

(c) **Analysis.** Major axis coverage is determined by the type of facility it is associated with and will meet tolerances in Section 6.

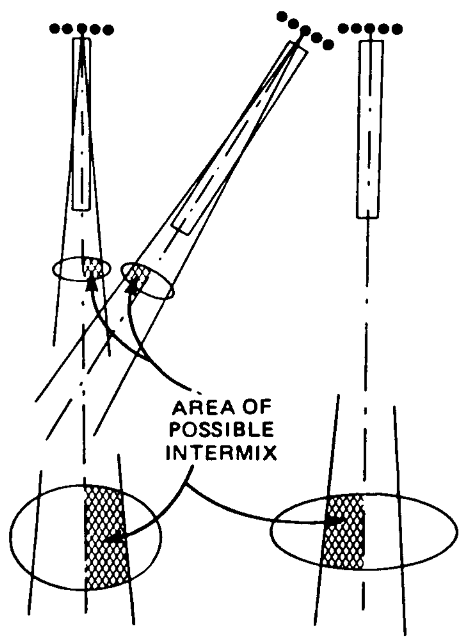
(d) **Other Considerations.**

- There is no requirement to check major axis coverage for inner markers.
- It is not necessary to obtain the limits of actual coverage unless requested as an engineering assist.

d. Proximity Check. This inspection supplements the basic coverage check to assure operational compatibility of a marker beacon sited in close proximity to another marker beacon. The check may be performed prior to the commissioning inspection as a type of site evaluation. It must be performed on each applicable marker beacon prior to authorizing operational use. There are two possible proximity checks to be performed, signal intermix and beacon/ procedure overlap.

(1) Marker Beacon Signal Intermix. This check is conducted to determine if there is unacceptable signal derogation caused by the simultaneous operation of two or more marker beacons in close proximity

Figure 15-8
Marker Beacon/ Procedure Intermix



(a) Maneuver. Check the major axis at the lowest procedural altitude on the side closest to the adjacent marker.

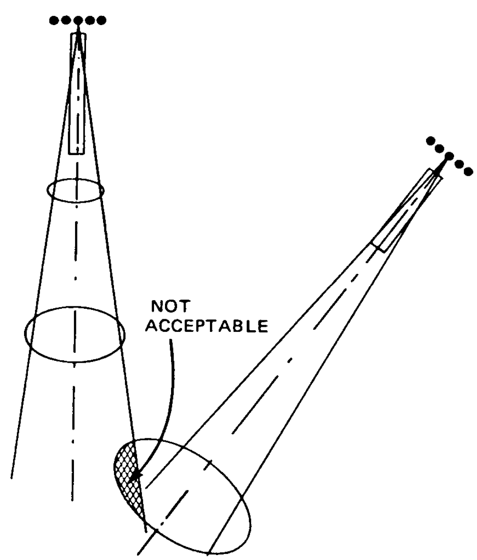
(b) AFIS/ Equipment Setup. Marker beacon sensitivity must be in the low position. Toggle “Marker” and “GND SPD” to “ON” on the Plot Control. Turn on/ up the volume for the marker on the audio box. Perform periodic checklist items with all proposed marker beacons operating.

(c) **Analysis.** Ensure required parameters are in-tolerance and there are no adverse audio interference or vague/ distorted fix indication.

(d) **Other Considerations.** Conduct the proximity check on the side of the adjacent marker.

(2) **Marker Beacon/Procedure Overlap.** Conduct this check to ensure there is no false marker beacon indication present along an instrument approach course, which would authorize a premature descent before the point at which the actual fix position/marker beacon occurs. This situation could exist if the "intruding" marker beacon signal had the same modulation, even though the identifications may differ. Conduct this check only if this suspected condition exists.

Figure 15-9
Marker Beacon Overlap



(a) **Maneuver.** Position the aircraft at either 150µA point for LOC/ LDA and SDF(s), or 5° for omni directional facilities nearest the potentially misleading marker beacon at the minimum procedural altitude.

(b) **AFIS/ Equipment Setup.** The marker beacon sensitivity must be in the low position. Toggle "Marker" to "ON" on the Plot Control. Turn on/ up the volume for the marker on the audio box.

(c) **Analysis.** Suspend the procedure if the signal intrusion into the approach area is at or above 1700μV.

(d) **Other Considerations.** If the signal cannot be reduced, the procedure must be denied or the misleading marker removed from service.

e. **Holding Fixes.** Marker beacon transmitters can be used as a holding fix at altitudes greater than Paragraph b.

(1) **Maneuvering.** Check the major and minor axis at the highest proposed altitude.

(2) **AFIS/ Equipment Setup.** The marker beacon sensitivity must be in the low position. Toggle "Marker" and "GND SPD" to "ON" on the Plot Control. Turn on/ up the volume for the marker on the audio box.

(3) **Analysis.** The marker must meet the same tolerances at the highest proposed altitude as at the lowest proposed altitude.

(4) **Other Considerations.** If performance is unsatisfactory and cannot be corrected by facility adjustment, the operational altitudes must be revised or procedural use denied.

f. **Standby Equipment.** Complete the full commissioning checklist on both transmitters, if equipped.

g. **Standby Power.** If standby power is installed, have the facility power source switched to standby and check equipment on the minor axis.

NOTE: If facility is operating on floating battery, this check is not required.

15.42 TABLES AND SUPPLEMENTAL INFORMATION

Figure 15-10
75 MHz Marker Width Measurement

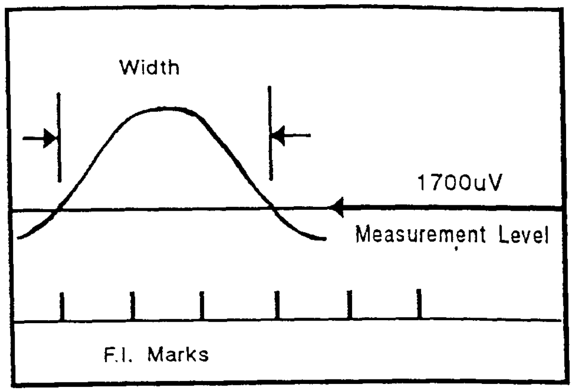


Figure 15-11
75 MHz Marker Width Measurement
(A to B Equals Width, Includes the hole)

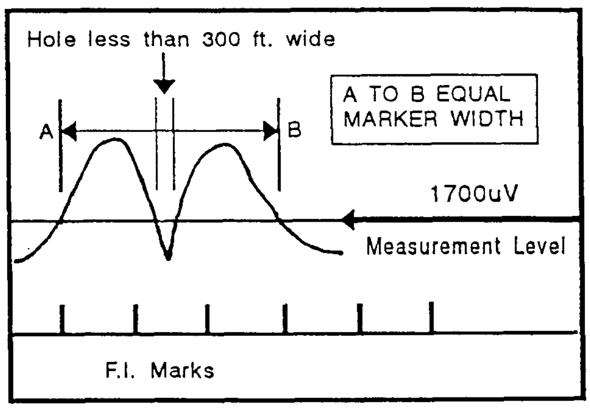


Figure 15-12
Examples of Patterns not meeting Width Criteria
(A&B are not additive)

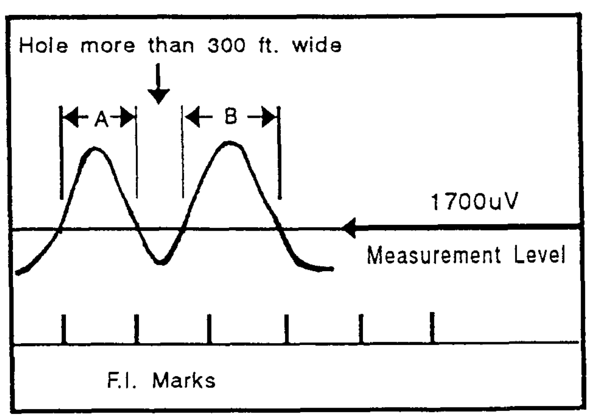


Figure 15-13

75 MHz Marker Beacon Formulas

Marker Width

$$W_{ft} = \frac{(TAS)(T_{av})}{0,592} \quad \text{or}$$

$$W_{ft} = \frac{(G_s)(T)}{0.592} \quad \text{or}$$

$$W_{nm} = \frac{(TAS)(T_{av})}{3600}$$

Where:

- G_S = Ground Speed (knots)
- W_{ft} = Width (ft)
- W_{nm} = Width (nm)
- T = Time (sec)
- TAS = True Airspeed (knots)
- T_{av} = Time Average (sec)

SECTION 5
ANALYSIS

15.50 ILS ANALYSIS. A detailed analysis of the measurements and calculations made during the course of the flight inspection provides an overall picture and permanent record of facility performance.

a. Application of Localizer Coverage Requirements. The procedures described in Section 2 of this chapter define the localizer standard service volume. In order for the localizer to be classified "UNRESTRICTED", coverage tolerances must be met throughout the standard service volume. The localizer may still be used procedurally when coverage does not meet tolerances throughout the standard service volume. Procedural approval depends on the effects of the restriction on the procedure.

b. Application of Glide Slope Coverage Requirements. The RF Power Monitor check described in Paragraph 15.30s defines the lateral and vertical standard service volume of the glide slope. The approved procedure specifies to check for clearances above the path. If there is no defined glidepath or clearance above path, the glide slope must be restricted as unusable beyond a point referenced angularly to runway centerline at which no glidepath or clearance above path is provided. See an example in Chapter 5, Section 1. The glide slope must meet the tilt tolerance and the RF power monitor tolerance.

c. CAT III Adjust and Maintain. Normal localizer width/ alignment and glide slope angle checks on Category III ILS systems are required to be maintained at tighter than monitored values. Results that exceed these values, but do not exceed flight inspection tolerances IAW Paragraph 15.60a and b, should not be considered out-of-tolerance, and no discrepancies should be noted on the Daily Flight Log. When a value exceeds the "adjust and maintain" limits, the flight inspector must issue an ILS Maintenance Alert IAW Paragraph 15.50d and document the circumstances on the flight inspection report.

(1) Inspections Not Involving Maintenance Personnel. When CAT III facilities are found operating beyond these tighter values, repeat the run(s) to confirm the measurement and, if repeatable, advise Maintenance immediately.

(a) If Maintenance is unable to respond and make adjustments, document the circumstances on the flight inspection report. A Maintenance Alert must be issued IAW Paragraph 15.50d. The facility will remain CAT III unless downgraded by Maintenance.

(b) If Maintenance is available, remain on station to check the adjusted parameters and document the circumstances on the flight inspection report. Issue a Maintenance Alert IAW Paragraph 15.50d. Do not leave the facility operating CAT III beyond the "Adjust and Maintain" values; the facility must be downgraded.

(2) Inspections Requiring Maintenance Personnel:

(a) Remain on station until "adjust and maintain" parameters are within limits, unless Maintenance terminates the inspection. If the adjusted parameters are not corrected, document the circumstances on the flight inspection report. Issue a Maintenance Alert IAW Paragraph 15.50d.

(b) Do not leave the facility operating CAT III beyond the "Adjust and Maintain" values; the facility must be downgraded.

(3) Adjust and Maintain Values:

Localizer Alignment	±4 μA
Localizer Width (Commissioned Width)	± 10%
Glide Slope Angle (Commissioned Angle)	± 4%

d. ILS Maintenance Alert. Facilities serving the National Airspace System (NAS) and all U.S. Air Force facilities must be provided an ILS maintenance alert as follows:

(1) Category I/ II. An ILS maintenance alert must be provided by flight inspection following a normal periodic check without monitors or other check when maintenance is not present if a measured flight inspection parameter is 60 percent or more of the flight inspection tolerance. This applies to the following critical monitored parameters:

(a) CAT I/ II Localizer course widths

(b) Localizer alignment

1 CAT I ILS, Localizer only, and SDF(s) aligned along runway centerline ≥ 9 μA

2 CAT II ≥ 6 μA

3 Offset localizers, Offset SDF(s), LDA(s), and Independently Monitored Back Courses ≥ 12 μA

4 Other Back Courses ≥ 39 μA

(c) Glide slope path widths ≤ 0.58° / ≥ to 0.82°

(d) CAT I /II Glide Slope Angles

(2) Category III. An ILS maintenance alert must be provided by flight inspection when a CAT III facility is found operating beyond the "Adjust and Maintain" limits specified in Paragraph 15.50c, regardless if the value(s) were corrected.

(3) The flight inspector must forward the ILS maintenance alert results by FAX or telephone (when FAX is unavailable) to the FICO. The FICO must enter the results on FAA Form 8240-11, Appendix 11, FAA Order 8240.36 (current version) and forward the results by FAX or telephone (when FAX is unavailable) to the Technical Operations Service Area Maintenance Engineer within 24 hours. For U.S. Air Force facilities, notify the appropriate Major Command (MAJCOM) headquarters. When the results are forwarded by telephone, enter the name of the person contacted in the Remarks block on FAA Form 8240-11, which must be forwarded to the Technical Operations Service Area Maintenance Engineer.

(4) When a measured flight inspection parameter exceeds the flight inspection tolerance, if Air Traffic Technical Operations Maintenance is available and on site, request an evaluation of the parameter that has exceeded tolerance and determine whether it can be corrected. If the parameter that exceeded tolerance is corrected, leave the facility in service. Check the other transmitter, if available. If maintenance is not available, remove the facility from service and issue a NOTAM.

e. Glide Slope Snow NOTAM. During periods of heavy snow accumulation, Air Traffic Technical Operations personnel may NOTAM glide slope facilities as "due to snow on the XXX (appropriate identifier), glide slope minima temporarily raised to localizer only." Category II/ III operations are not authorized during the snow NOTAM. The following guidance is to be followed when an ILS is scheduled for a periodic inspection when a snow NOTAM is in effect and the flight inspection window is exceeded. Localizer flight checks must be conducted as normally scheduled. Glide slope flight checks must be accomplished dependent upon the following conditions:

(1) If the NOTAM indicates localizer only for all categories of aircraft, then an approach evaluation must be made to determine angle and structure. All out-of-tolerance conditions must be reported to maintenance. After the snow NOTAM is canceled, flight inspection of the glide slope will be in accordance with Chapter 4, Section 2. On the Flight Inspection Daily Flight Log (DFL), FAA Form 4040-5, code the glide slope periodic inspection as incomplete. In the "Remarks" section of the DFL, indicate "Snow NOTAM".

(2) If the NOTAM indicates glide slope minima raised to localizer only for Category D aircraft, follow the procedure outlined in Paragraph 15.50e(1) above--the only exception being that any out-of-tolerance condition must generate a discrepancy and the appropriate NOTAM. Restoration flight check must be scheduled as an "Unscheduled Special (U)."

(3) If the glide slope supports Category II/ III approach procedures, the glide slope will only be evaluated to Category I tolerances. Restoration of Category II/ III facilities, after the snow NOTAM is removed, will be considered as a periodic overdue inspection in accordance with Chapter 4, Section 2.

(4) Monitor check must not be accomplished while the snow NOTAM is in effect. Flight inspection after the snow NOTAM is canceled must be considered as a periodic overdue in accordance with Chapter 4, Section 2.

(5) If the approach is satisfactory, a Category I periodic check will be complete when a level run to check width and symmetry is accomplished and no out-of-tolerances are found. Entries on the DFL must be normal.

f. Threshold Crossing Height (TCH)/ Reference Datum Height (RDH).

(1) **CAT I**. FAA Order 8260.3, TERPS Instrument Procedures, limits the CAT I procedural TCH to a maximum of 60 ft. Minimum TCH varies per the wheel crossing height of the user aircraft. TCH is normally determined by procedures personnel and is not evaluated by flight inspection. If FAA Order 8240.47, Determination of ILS Glidepath Angle, RDH, and Ground Point of Intercept (GPI), is applied to a CAT I facility, the flight check derived RDH replaces procedural TCH.

NOTE: IAW Order 8240.47, specific requirements must be met prior to application of that order.

(**2**) **CAT II/ III.** FAA Order 8240.47 must be applied.

SECTION 6
TOLERANCES

15.60 TOLERANCES

CODES:

C — Tolerances that are applied to site, commissioning, reconfiguration, and categorization inspection.

P — Tolerances that are applied to any inspection subsequent to the inspections outlined in Code C.

a. Localizers

PARAMETER	REFERENCE PARAGRAPH	INSPECTION		TOLERANCE/ LIMIT
		C	P	
Spectrum Analysis	Reserved			
Modulation Level	15.21d	X	X	36 – 44% as measured IAW Paragraph 15.20d
				30% - 60% throughout the service volume of all localizers installed or reconfigured with new type antennas after 01/01/2000. For existing systems, note in the flight inspection report areas where modulation exceeds 60%.
		X	X	For two-frequency systems, the standard for maximum modulation percentage does not apply at or near azimuth where the course and clearance signal levels are equal in amplitude (i.e., at azimuths where both transmitting systems have a significant contribution to the total modulation percentage).
Waveguide Clearance XMTR				36 – 44% as measured IAW Paragraph 15.20d
Power Ratio	15.21c	X		The course transmitter power level must be at least 10 dB greater than the clearance transmitter.
Phasing	15.21f	As Required		No tolerance.
Width—	15.21g			Maximum—6.0° (SDF-12.0°). CAT II & III tailored to 700 ft. Precision approach—400 ft minimum course width at the threshold.
Front Course		X		± 0.1° of the commissioned width.
			X	Within 17% of the commissioned width.
Transmitter Differential (Front Course)			X	The difference in the normal widths must not be greater than 0.5° or 10% of the commissioned width, whichever is least.
Back Course		X		Between 3.0° and 6.0°
			X	Between 2.49° and 7.02° in normal or monitor alarm condition.
		X	X	SDF(s) — Within 10% of the front course sector width.
Symmetry (Front Course Only)	15.21g	X	X	With the facility in normal: 45-55%.

PARAMETER	REFERENCE PARAGRAPH	INSPECTION C	INSPECTION P	TOLERANCE/LIMIT
Alignment	15.21i			
Front Course and Independently Monitored Back Courses		X		Within ± 3 µA of the designed procedural azimuth.
			X	For ILS(s), localizer-only on centerline and SDF(s) on centerline. From the designed procedural azimuth: CAT I ± 15 µA. CAT II ± 11 µA. CAT III ± 9 µA. Offset Localizers, Offset SDF(s), and LDA(s) ± 20µA Back Course ± 20 µA. At the conclusion of a monitor inspection or when alignment is adjusted, FAA, U.S. non-Federal civil, U.S. Army, and U.S. Navy/ Marine Corps localizers must be ≤ 3µA, LDA(s), offset localizers must be ≤ 8µA, and independently monitored back courses must be ≤ 10µA.
Back Course (Facilities subordinate to front course.)		X	X	Designed procedural azimuth ± 65 µA.
Course Structure	15.21i			
Front Course		X	X	Zone 1—From the graphical average course: CAT I, II, III ± 30 µA to Point A SDF: ± 40 µA to Point A
NOTE: For localizer only approaches (ILS facilities), including RF alarm, and when alignment is determined as S/ U, structure may be measured from graphical average course				Zone 2—From the actual course alignment: CAT I: ± 30 µA at Point A; linear decrease to ± 15µA at Point B. CAT II, III: ± 30 µA at Point A; linear decrease to ± 5µA at Point B, SDF: ± 40 µA at Point A; linear decrease to ± 20µA at Point B. Zone 3—From the actual course alignment: CAT I: ± 15 µA at Point B; ± 15µA at Point C. SDF: ± 20 µA at Point C.
				Zones 3 & 4—From the actual course alignment. CAT II, III: ± 5 µA at Point B; ± 5 µA to Point D. Zone 5—From the actual course alignment. CAT III: ± 5 µA at Point D; linear increase to ± 10 µA at Point E.
Back Course		X	X	Zone 1—From the graphical average course: ± 40 µA to Point A. Zone 2—From actual course alignment: ± 40 µA at Point A; linear decrease to ± 20 µA at Point B. Zone 3—From actual course alignment ± 20 µA at Point B; ± 20 µA at Point C.
Front and Back Course	15.21i	X	X	Exception: An aggregate out-of-tolerance condition for 354 ft may be acceptable in a 7,089-foot segment.

PARAMETER	REFERENCE PARAGRAPH	INSPECTION C	INSPECTION P	TOLERANCE/LIMIT
Monitors	15.21l			
Alignment Front Course				The course alignment monitor must alarm when the actual course alignment signal shifts from the designed procedural azimuth by no greater than:
Facilities aligned along the runway		X	X	CAT I ILS and SDF(s) aligned along runway centerline ± 15 µA CAT II ± 11 µA CAT III ± 9 µA.
Offset Localizers, Offset SDFs, and LDAs		X	X	± 20 µA from the designed procedural azimuth when using actual course alignment references, i.e., AFIS, theodolite, etc.
Localizers, SDF's, and LDA's where alignment is determined to be satisfactory by visual observations		X	X	±20 µA from established equality of modulation reference.
Width Front Course & Independently Monitored Back Courses		X	X	Not more than ± 17% of the commissioned width.
Back Course		X	X	2.49 – 7.02°
RF Power	15.21m	X		Maintained at or above: Signal Strength—5 µV Flag Alarm—No Flag or indication of invalid signal Clearance and Structure—in tolerance.
Coverage		X	X	At or greater than: Signal Strength—5 µV Flag Alarm—No Flag or indication of invalid signal Clearance and Structure — in tolerance Interference—must not cause an out-of-tolerance condition.
Clearances (Front and Back Course)	15.21h			As measured from the procedural designed azimuth:
Facility in Normal configuration		X	X	Sector — Minimum Clearance 1 — Linear increase to 175 µA then maintain 175 µA to 10°. 2 — 150 µA (see note). 3 — 150 µA (see note).
Facility in any alarm configuration		X	X	Clearances are reduced 15 µA from the clearance required in normal.
		X	X	NOTE: Exceptions are authorized in Sectors 2 and 3.
Polarization	15.21j	X	X	Polarization error not greater than: CAT I ± 15 µA CAT II ± 8 µA CAT III ± 5 µA
Identification and Voice	15.21b	X	X	Clear, correct; audio level of the voice equal to the identification level. The identification must have no effect on the course. Voice modulation must not cause more than 5µA of course disturbance.

b. Glide Slopes

PARAMETER	REFERENCE	INSPECTION C	INSPECTION P	TOLERANCE/LIMIT
Spectrum Analysis	Reserved			
Modulation Level	15.30b	X		78 – 82%
			X	75 – 85%
Modulation Equality	15.30c	As Required		Zero µA ± 5µA
Phasing and Airborne	15.30d	As Required		No Tolerance
Engineering & Support Tests	15.30e 15.30f	As Required		No Tolerance
Width	15.30i	X		0.7° ± 0.05° (Site Survey, USAF test van: 0.7° ± 0.1°)
			X	0.7° ± 0.2°
Angle	15.30h	X		Within ± 0.05° of the commissioned angle. (Site Survey, USAF test van: ± 0.1° of the commissioned angle)
			X	Within + 10.0% to -7.5% of the commissioned angle.
Transmitter Differential		X		± 0.10°
			X	± 0.20°
Alignment	15.30o	X	X	CAT I — Not applicable CAT II and III (Also CAT I authorized use below CAT I minima) Zone 3 ± 37.5 µA about the commissioned angle at Point B; expanding linearly to ± 48.75 µA about the commissioned angle at Point C; expanding linearly to ± 75 µA about the commissioned angle at ILS reference datum.
Tilt	15.30m	X		Within + 10.0% to -7.5% of the commissioned angle. Clearance Above Path, Modulation Clearance Below Path - 180µA
Reference Datum Height (RDH)	15.50f	X		CAT I: Maximum 60 ft CAT II and III: 50 to 60 ft. (Also CAT I authorized use below CAT I minima)
Symmetry	15.30j	X	X	The following criteria are applied with the facility in a normal configuration: CAT I 67-33%. Broad sector either above or below path. CAT II 58-42%. Broad sector either above or below path. 67-33% If broad sector below path only (Also CAT I authorized use below CAT I minima) Cat III 58-42%. Broad sector either above or below path.
Structure below Path	15.30k	X	X	190 µA of fly-up signal occurs at an angle which is at least 30% of the commissioned angle.
		X	X	Exception: If this tolerance cannot be met, apply clearance procedures and tolerances.

PARAMETER	REFERENCE PARAGRAPH	INSPECTION		TOLERANCE/LIMIT
		C	P	
Clearance Below the Path	15.30l	X	X	Adequate obstacle clearance at no less than 180 µA of fly-up signal in normal (150 µA in any monitor limit condition).
Above the Path		X	X	150 µA of fly-down signal occurs at some point prior to the first false path.
Structure	15.30o			
With AFIS or Tracking Device.		X	X	
Zone 1 2 3				Category 1 30 µA from graphical average path. 30 µA from actual path angle. 30 µA from graphical average path
Zone 1 2 3				Category II and III (Also CAT I authorized use below CAT I minima) 30 µA from graphical average path. From actual path angle 30 µA at Point A, then a linear decrease to 20 µA at Point B. 20 µA from the graphical average path
Without AFIS or tracking device Zone 1 2 3	15.30o		X	Category 1 30 µA from the graphical average path. 30 µA from the graphical average path. 30 µA from the graphical average path.
	15.30o	X	X	Exception: An aggregate out-of-tolerance condition for 354 ft may be acceptable in a 7,089-foot segment.
Change/ Reversal	15.30p	X	X	25 µA per 1,000 ft in a 1,500-foot segment.
Coverage	15.30s	X	X	At or greater than: Signal Level: 15 µV Flag Alarm: No Flag or indication of invalid signal Fly-up/ Fly-down Signal: 150 µA Clearance and Structure in tolerance. Interference must not cause an out-of-tolerance condition.
Monitor Reference Values	15.30r			
Angle		X	X	Within + 10.0% to -7.5% of the commissioned angle
Width		X	X	0.9° maximum. 0.5° minimum.
RF Power	15.30s	X		Not less than: Signal Level—15 µV Fly-up/ Fly-down Signal: 150 µA Flag Alarm: No Flag or indication of invalid signal

c. 75 MHz Marker Tolerances. Marker beacons must meet these tolerances or be removed from service. The following tolerances are applied with the receiver sensitivity in low.

Parameter	Reference Paragraph	Tolerance/Limit
Spectrum Analysis	15.41a Reserved	Interference must not cause an out-of-tolerance condition.
Identification	15.41b	Distinct, correct, constant throughout the coverage area; and clearly distinguishable from any other markers.
Modulation	15.41b	The modulation must illuminate the following lights: OM - Blue Light (400 Hz) MM - Amber Light (1,300 Hz) IM - White Light (3,000 Hz) FM - White Light (3,000 Hz)
Coverage	15.41c	With a constant signal at or above 1,700 microvolts (μV), the following widths must be provided:
Minor Axis	15.41c(1)	
ILS Outer Marker		Width must not be less than 1,350 ft or more than 4,000 ft
ILS Middle Marker		Width must not be less than 675 ft or more than 1,325 ft
ILS Inner Marker		Width must not be less than 340 ft or more than 660 ft
Fan Markers Used for a missed approach or step-down fix in the final approach segment		Width must not be less than 1,000 ft or more than 3,000 ft
All others		Same as ILS Outer Marker
Major Axis	15.41c(2)	
ILS Outer Marker *		Minimum: 700 ft Maximum: 4,000 ft Those markers installed to serve dual runways must not exceed 4,000 ft within the normal localizer width sector of 150 μA, either side of the procedural centerline.
ILS Middle Marker *		Minimum: 350 ft Maximum: 1,325 ft
ILS Inner Marker *		Not Applicable
All Others *		Any duration not to exceed the respective minor axis tolerance.
Separation		A separation between the 1,700 μV points of succeeding marker patterns which provide a fix on the same approach course; e.g., MM to IM, must be at least 709 ft.

* As measured along the minor axis at the extremities of the pre-defined off-course sector.

15.61 ADJUSTMENTS. See Chapter 4, Section 3. When equipment performance characteristics are abnormal but within tolerances, they should be discussed with maintenance personnel to determine if adjustments will increase the overall performance of the systems. Following any adjustment to correct an out-of-tolerance condition, the appropriate monitor(s) must be checked and proper monitor operation verified.

CHAPTER 16

MICROWAVE LANDING SYSTEM

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SECTION 3

MOBILE MICROWAVE LANDING SYSTEMS (MMLS)

FIGURES

TABLES

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CHAPTER 16. MICROWAVE LANDING SYSTEM (MLS)

SECTION 1

GENERAL

16.10 INTRODUCTION

a. **General.** The MLS uses three main components to develop approach guidance information. The Azimuth or AZ antenna provides lateral guidance. The Elevation or EL antenna provides vertical guidance. The third component is a DME. The MLS is capable of providing approach guidance with pilot selectable azimuth and elevation angles within the limits set by transmitted data words. To mitigate the effects of reflections, the limits of the antenna scan can be reduced laterally and/or vertically. Azimuth, elevation, and DME coverage are normally evaluated concurrently on all checks except some monitor checks.

b. **Classification:** Standard installation of an MLS is called Split-Site. The EL antenna is offset near threshold similar to GS antenna and AZ antenna past the end of runway similar to a localizer.

c. **Characteristics:** Within proportional guidance, CDI deflection is proportional to aircraft deviation from the selected azimuth and selected angle. Outside the proportional guidance area, the azimuth clearance guidance provides full-scale deflection. The typical service volume provides lateral coverage to 40° each side of antenna boresight, but the standard service volume may extend laterally to 60°. The elevation guidance is proportional throughout its coverage.

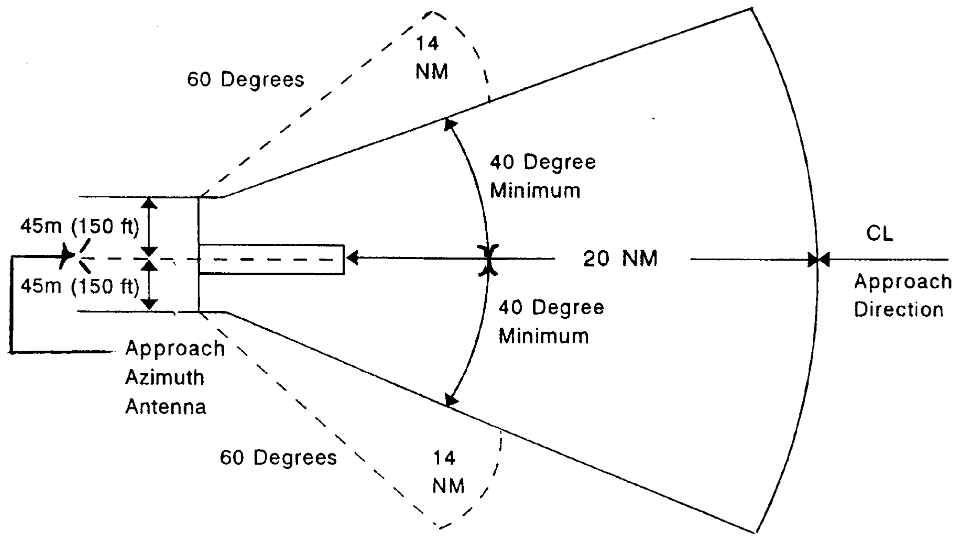
d. **MLS Service Volumes.** The MLS standard and optional service volumes are depicted in Figures 16-1 and 2.

e. **MLS Zones and Points.** MLS Zones are depicted in Figures 16-3, 4, 5, and 6.

Figure 16-1
Approach Azimuth/ Data Coverage

Horizontal Coverage

dashed lines = optional service volume



Vertical Coverage

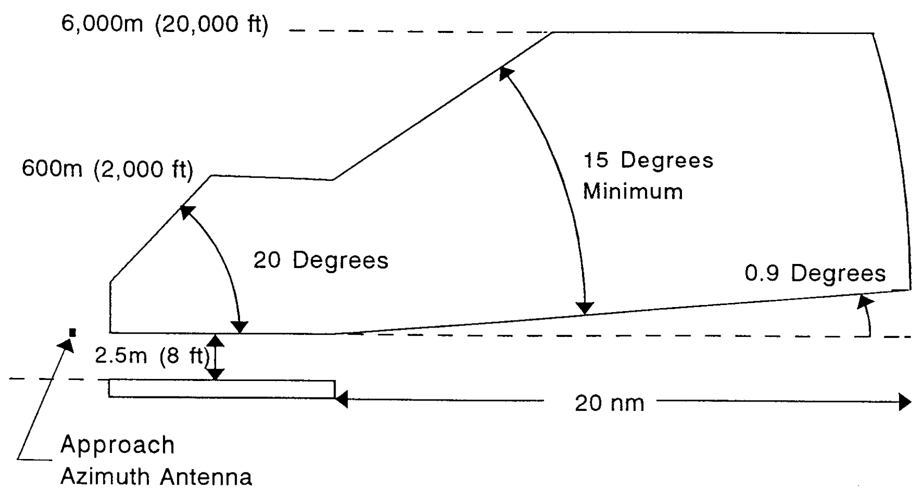
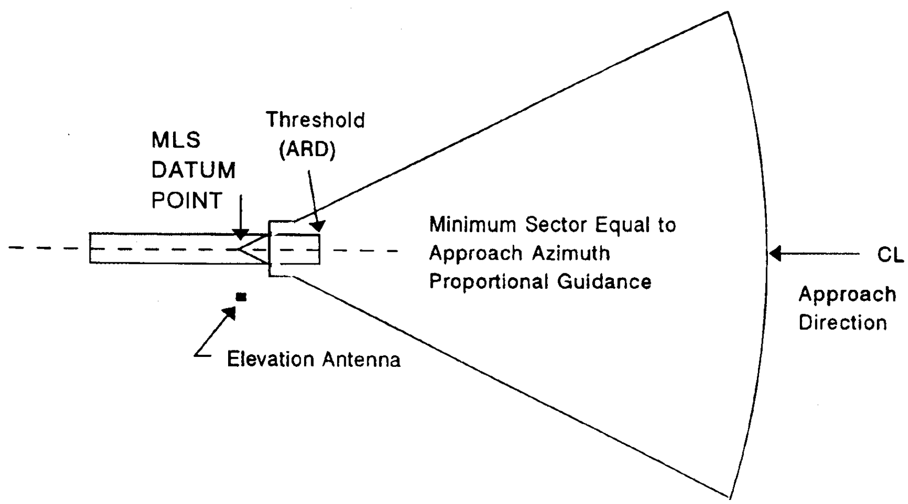
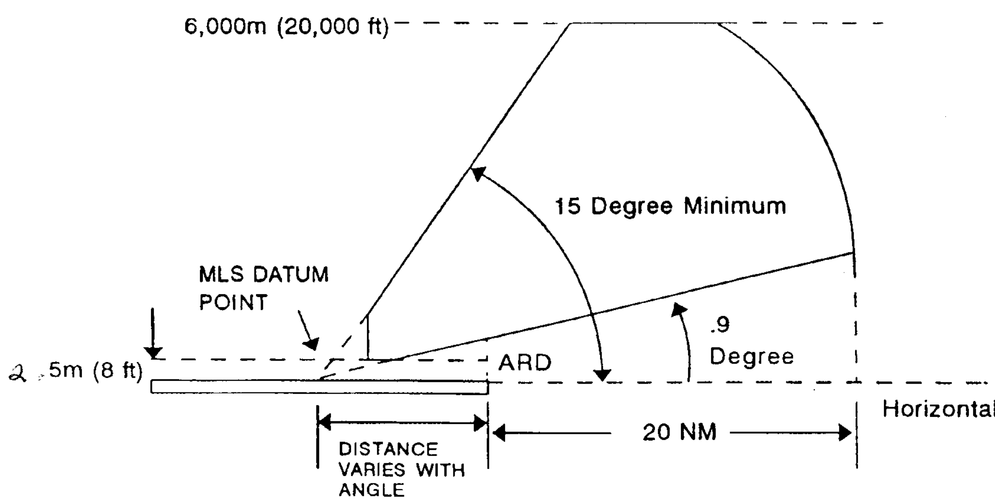


Figure 16-2
Approach Elevation Coverage

Horizontal Coverage



Vertical Coverage



MLS POINTS AND ZONES

Figure 16-3

Standard MLS

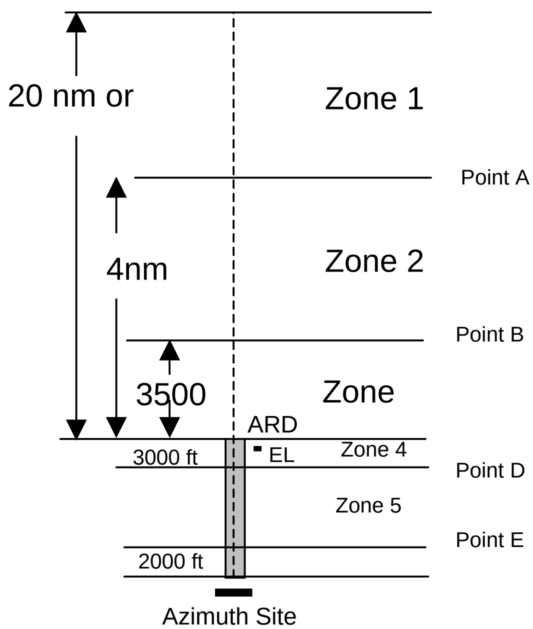
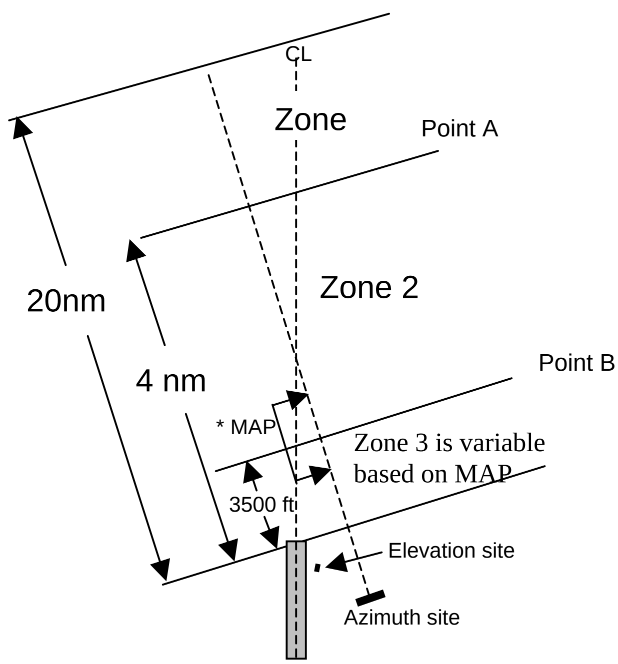


Figure 16-4

Offset MLS



*MAP is variable based on decision altitude

MLS POINTS AND ZONES, CONTINUED

Figure 16-5
Collocated MLS

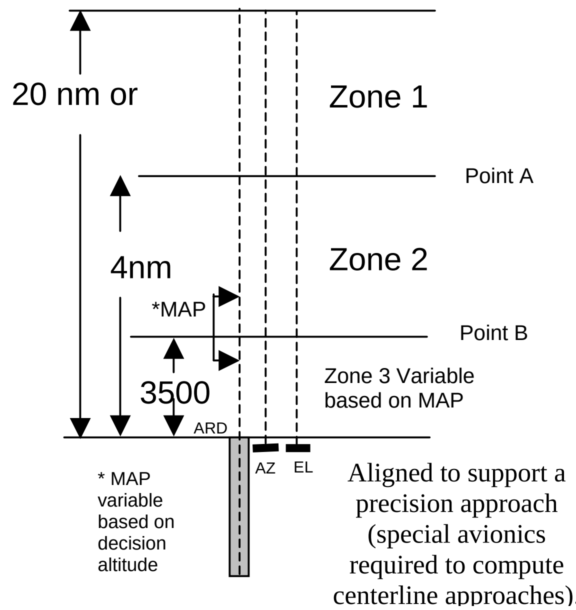
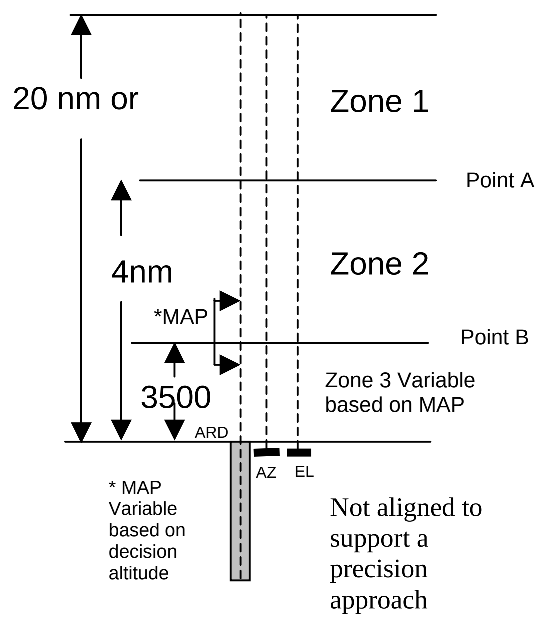


Figure 16-6
Point in Space MLS



16.11 MAINTENANCE ACTIONS AND FLIGHT INSPECTION REQUIREMENTS.

Activities Requiring a Confirming Flight Inspection:

a. Major changes in local obstructions or buildings that may affect the signal strength, coverage, or courses.

b. Facility operating frequency changed.

c. Replacement or repositioning of an azimuth, elevation, or DME antenna.

d. Changes in the nominal electronic boresight alignment.

e. Change in data words that affect azimuth or elevation alignment.

16.12 PREFLIGHT REQUIREMENTS

Flight Inspection Personnel:

a. Review of all facility data and computation of facility error budget.

b. Review of facility horizontal and vertical terrain and obstruction profiles to determine line-of-sight characteristics and areas of possible signal anomalies. These profiles will be provided by installation engineering personnel if obstruction definition is critical to the facility performance.

SECTION 2

MICROWAVE LANDING SYSTEMS (MLS)

16.20 CHECKLIST

MLS

TYPE CHECK	REFERENCE PARAGRAPH	Inspection			ANTENNA CHANGE		Measurements Required					
		C	P	FC*	AZ	EL	CONFIGURATION	STRUCTURE	ALIGNMENT	DATA	COVERAGE	CLEARANCE
Data Word Verification	16.21a	X	X	X	X	X	Norm			X		
Lateral Coverage	16.21b	X			X	X	RF Power	X			X	X
Vertical Coverage	16.21c	X			X	X	RF Power	X			X	
Ref Arc	16.21b	X	X	X	X	X	Norm	X		X	X	X
Approach AZ	16.21d	X, 2	X	X	X		Norm	X	X	X		
Approach EL	16.21d	X, 2	X	X		X	Norm	X	X			
AZ Monitor	16.21e	X	1				Align Ref		X			
EL Monitor	16.21f	X X	1 1				HI Angle LO Angle		X X		 3	
DME	16.21i	X	X				Norm				X	
OCI Orbit	16.21j	1					Norm			X		X
Ident	16.21h	X	X				Norm				X	

NOTES:

1. Engineering or maintenance request
2. Additional approach from service volume limit at minimum RF Power
3. Coverage below path.

* = Frequency Change

16.21 FLIGHT INSPECTION PROCEDURES

a. Data Word Verification. Data words contain facility siting and approach information and are used by the aircraft receiver to process AZ and EL information, identify the station, and determine cross pointer sensitivity. There are two types of data words: Basic and Auxiliary. Basic data words are used for all approaches. Auxiliary data words are used for RNAV and Computed Centerline Approaches. Some facilities may not transmit all auxiliary data words. Some of the MMLS data words are labeled differently than the AFIS received data words. Refer to Table 16-1, Data Word Translator.

NOTE: Facility data entries that are RIGHT = “+” and LEFT = “-“

(**1**) **Maneuvering.** Maneuver the aircraft within the standard service volume.

(2) AFIS/ Equipment Setup. AFIS loaded with the correct facility data is the standard for comparison with transmitted data words. On non-AFIS flight inspection equipment, compare the received data words to the facility data sheet. After completing MLS profiles, the data words are printed on the last page of the NAV/TEST CTRL.

(3) Analysis. On commissioning inspections, data word discrepancies will be resolved with facility maintenance before placing the facility in service. Any intentionally missing data words will be documented on the facility data sheet.

NOTE: Due to calculation rounding and the conversion between feet/ meter, some errors may occur. Basic Data Words 1 and 3, as well as Auxiliary Data Words 1, 2, and 3 have tolerances.

(4) Other Considerations. The technician may need additional time to verify data word accuracy. Data word verification does not have to be checked after each flight inspection profile. AFIS does not capture all the data words every time. The Mission Specialist may need time to watch the data word page, and wait for the missing data words to populate the fields.

Table 16-1
MLS DATA WORD TRANSLATOR

Word	Description	AFIS Term	Least Signification Bit
Basic 1	AZ ant to Threshold Dist AZ proportional neg limit AZ proportional pos limit Clearance signal type	F DIS F PNLM F PPLM C TYPE	100 mtr 2° 2° 0=pulse/1=scan
Basic 2	Minimum glidepath angle	E MPA	0.1°
	Apch EL Status	EL/F/BZ	0=abnormal/1=normal
	Apch AZ Status	EL/F/BZ	0=abnormal/1=normal
	Back AZ Status	EL/F/BZ	0=abnormal/1=normal
	DME Status	DME ST	(1)
Basic 3	AZ Beamwidth	F BMW	0.5°
	EL Beamwidth	E BMW	0.5°
	DME Distance	DDIS	12.5 mtr
Basic 4	AZ Mag Orientation	F ALN	1° (2)(3)
	Back AZ Orientation	B ALN	1°
Basic 5	Back AZ neg prop limit	B PNLM	2°
	Back AZ pos prop limit	B PPLM	2°
	Back AZ Beamwidth	B BMW	0.5°
Basic 6	MLS Identification	FAC ID	

Table 16-1
MLS DATA WORD TRANSLATOR
(continued)

Word	Description	AFIS Term	Least Signification Bit
AUX 1	AZ antenna offset	F OFF	1 mtr (3)(5)
	AZ antenna to Datum Point distance	F DIS	1 mtr (3)
	AZ alignment with Rwy C/L	F ALN	0.01° (3)(5)
	AZ coordinate system	AZ C/P	0=Conical/1=planar
	AZ antenna phase center height	AZ HT	1 mtr
AUX 2	EL antenna offset	E OFF	1 mtr (5)
	Datum point to threshold distance	MLS DIS	1 mtr (3)
	EL antenna phase center height	E HT	0.1 mtr
	Datum point elevation	MLS HT	1 mtr (6)
	Threshold Height	RWY HT	0.1 mtr
AUX 3	DME offset	DME OFF	1 mtr (3)(5)
	DME to datum point distance	DME DIS	1 mtr (3)
	DME antenna height	DME HT	1 mtr
	RWY stop end distance	RWY SND	1 mtr (6)
AUX 4	Back AZ ant offset	B OFF	1 mtr (5)
	Back AZ to datum point distance	B DIS	1 mtr
	Back AZ align with rwy C/L	B ALN	0.01° (5)
	Back AZ coord sys	BZ C/P	0=Conical/1=Planar
	Back AZ ant phase center height	B HT	1 mtr

FOOTNOTES:

(1) DME status codes:
0 0 DME inoperative or not available
0 1 Only initial approach or DME/ N
1 0 Final approach mode std 1 available
1 1 Final approach mode std 2 available

(2) Magnetic orientation is 180° from procedural front course azimuth.

(3) Computed centerline critical values

(4) Distances and heights are with respect to MLS datum point.

(5) Negative number indicates left of C/ L looking from threshold to stop end.

(6) May be zero or actual value.

b. **Lateral Coverage.** Performed to define the lateral coverage and distance limits of the AZ, EL, and DME (Figure 16-7). Evaluate proportional guidance and clearance coverage.

(1) **Service Volume Arc** is a commissioning inspection maneuver to define and certify the operational range and the lateral and vertical limits of the MLS service volume. Perform the inspection with the facility operating at the lowest computed power required to establish adequate signal coverage for the intended service volume.

(a) **Maneuvering.** MLS-1 profile starting 5° outside the service volume limit, at maximum usable distance (usually 20 nm from the threshold), and maintain an altitude equal to the minimum glide path (MGP). The altitude may be obtained by using Table 16-2, or by using OAT formula including earth curvature. Add the altitude of the reference arc to the remarks section of the AVNIS data sheet. Inspect the MLS coverage throughout the facility's service volume. There is no requirement to check the lower, 0.9°, or upper, 20,000 ft, limit of the service volume, unless procedurally or operationally required. Program and couple the autopilot to AFIS for evaluation.

(b) **AFIS/ Equipment Setup.** Program the AFIS for arc direction, front course, and arc distance. Evaluate AZ, EL and DME guidance throughout the service volume. The default (auto selected) MLS Receiver is set according to Orbit Direction: Receiver 1 (AZ1 and EL1) for CCW, Receiver 2 (AZ2 and EL2) for CW.

(c) **Analysis.** Evaluate AZ, EL, and DME guidance throughout the service volume. Minimum printer/ plotter traces are AZ and EL, CMN, Deviation, and Range Error. Evaluate the proportional guidance throughout the service volume. Azimuth and elevation deviations for fluctuations greater than 0.5° that exceed 2° of arc, and all MLS receiver unlocks must be validated by radial flight as outlined in the vertical coverage check. If signal coverage of all MLS components cannot be maintained at the MGP, the MLS must be restricted.

NOTE: There must be no less than 10° proportional guidance either side of procedural on course.

(d) **Other Considerations.** The equipment must be in reduced RF Power. The Optional Service volume Arc should be flown at a distance of 14nm if operationally needed. AFIS printout will show PASS AZ and PASS EL. Disregard AFIS PASS/ FAIL indications in lieu of manual trace analysis. Maximum PFE, PFN and CMN deviations will also be listed.

(2) **Reference Arc.** The reference arc is used to check azimuth and elevation signal coverage throughout the service volume at the lower edge of elevation deflection sensitivity.

(a) **Maneuvering.** The arc should be established between 5 and 10 nm from the ARD at an altitude equal the MGP X 0.75 at the distance flown. Start the arc 5° outside the facility's service volume (See Figure 16-7). The approximate (including earth curvature) arc altitudes above site elevation are computed by using Table 16-2. Pilots may select the angle flown (ex. 3.00°x0.75=2.25°, select 2.25° in the MLS receiver). Maintaining a centered elevation crosspointer at the correct distance will give a more precise altitude and is the preferred method of flying the arcs.

(b) **AFIS/ Equipment Setup**. Program the AFIS for arc direction, front course, and arc distances, see TI 4040.55 for further guidance.

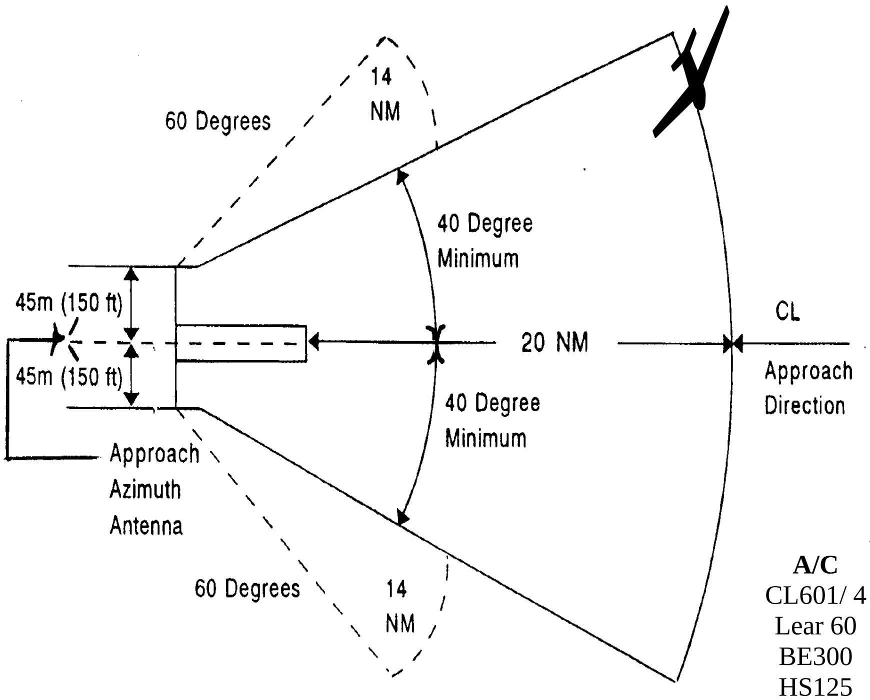
NOTE: The default (auto selected) MLS Receiver is set according to Orbit Direction: Receiver 1 (AZ1 and EL1) for CCW, Receiver 2 (AZ2 and EL2) for CW. When performing the MLS-1 inspection, the aircraft has to be inside the EL proportional section.

(c) **Analysis.** While traversing the service volume, record the azimuth and elevation deviation. Deviations greater than 0.5° that exceed 2° of arc and all MLS receiver unlocks, must be validated by radial flight using the procedures outlined in Vertical Coverage. There must be no less than 10° proportional guidance either side of procedural on course.

NOTE: Results can be found on PG 1 of the NAV/ TEST CTRL DATA page. Evaluate AZ, EL and DME guidance throughout the service volume. Minimum printer/ plotter traces are AZ and EL Deviation and Error traces, Range Error, and FI Marker.

(d) Other Considerations. After commissioning, as a reference for periodic inspections, the mission specialist will forward the distance and altitude of the Reference Arc to the Aeronautical Information Specialist to be documented on the AVNIS facility data sheet.

Figure 16-7
MLS-1 Split Site Configuration
Azimuth Horizontal Coverage



Aircraft Configuration

A/C	Speed KIAS	Flaps	Gear
CL601/ 4	170 – 250	UP	UP
Lear 60	170 – 250	UP	UP
BE300	170 – 200	UP	UP
HS125	170 – 250	UP	UP

dashed lines=optional service volume

c. Vertical Coverage. Performed to evaluate vertical coverage of the Azimuth and Elevation, and to verify out of tolerance deviations and unlocks found on the coverage and reference arcs. It is evaluated on the procedural azimuth and at ± 10° each side. Vertical coverage will consist of at least three runs.

(1) Maneuvering. Accomplish this check with a level run starting from the standard service volume at an altitude equal to MGP x 0.75 as calculated at the FAF distance. While flying inbound, determine the angle at which a consistent satisfactory signal is achieved. If this angle is higher than 0.9°, the facility must be restricted. If the angle found is greater than MGP x 0.75, the facility is unusable.

(2) AFIS/ Equipment Setup. Select MLS-2 IAW TI 4040.55. Record deviation, PFN, and CMN.

(3) Analysis. Observe the azimuth and elevation crosspointers for excessive signal aberrations that may indicate multipath or signal shadowing. Observe the elevation cross pointer for a smooth linear transition terminating between 15° and 20°. AFIS automatically stops when the signal is lost in the vertical plane.

(4) Other Considerations. Equipment must be in RF Power. When fluctuations exceed ± 0.5 within ±10° of the procedural on course, fly the approach offset by 5°on the affected side(s) of the procedural on course and apply PFN and CMN tolerances. If the 5° offset approach is satisfactory, the approach may be placed in service. Validation of deviations noted on arcs must be discussed with maintenance personnel for corrective action. If not correctable, the area in question must be restricted. An increase in the minimum EL lower scan limit may present an erroneous crosspointr indication at elevation angles below the scan limit. The elevation coverage should be restricted below the lower scan limit if the lower scan limit was raised above 0.9°.

NOTE: Increases in the minimum EL lower scan limit made after determination of normal path structure require a recheck of the EL approach guidance inside the FAF.

Figure 16-8
Approach Elevation Coverage
Vertical Coverage

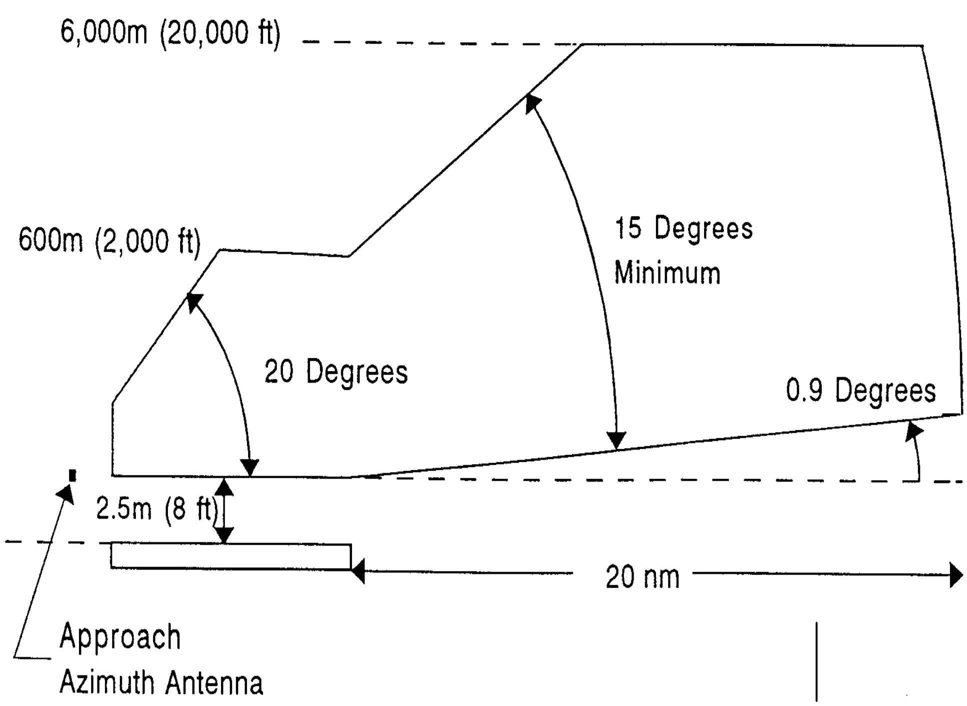
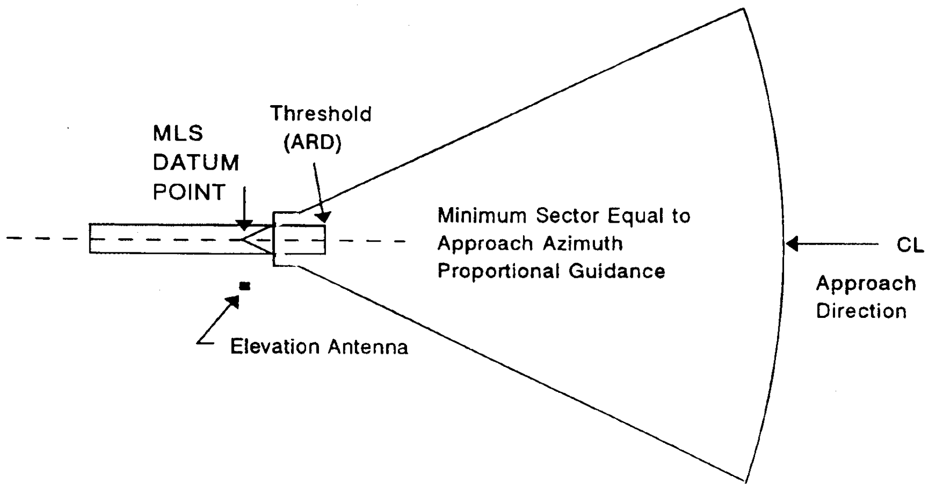


Figure 16-9
Approach Elevation Coverage
Horizontal Coverage



d. **Approach AZ & EL (MLS-3)** The approach should be the first item checked during a commissioning, reconfiguration, or restoration. This will ensure the facilities can support the proposed or published approach, and the facilities may be optimized to the desired procedural alignment. During site, commissioning, reconfiguration, categorization, antenna, and/or frequency change inspection—check all of Zone 1. All other inspections (i.e., periodic, periodic with monitors, etc.), evaluate structure from published FAF, GSI, or 6 nm (whichever is further) through all other required zones. Approved RTT and/or AFIS methods must be used for the approach evaluation. The facility error budget will provide all tolerances to be used during commissioning and periodic flight inspection. Mean course error (MCE) must be established prior to application of PFE tolerances. Exclude data in areas that are restricted due to facility performance.

(1) **Maneuvering.** Inspect the approach while flying the designed procedural azimuth and minimum glide path, unless otherwise indicated. Start the approach at the GSI, FAF, or 6 nm, whichever is greater, from runway threshold. Azimuth facilities sited along runway centerline with decision altitudes of 200 ft or less must be evaluated through Zones 1, 2, and 3 (Zones 4 and 5 if autoland or CAT II/ III operations are authorized) for all inspections requiring alignment and structure measurements; elevation guidance on these facilities must be evaluated to the ARD. All other facilities must be evaluated 100 ft below decision altitude (DA). Commissioning inspections must include an approach on the MGP from the desired service volume limits at normal power and while the facility is at minimum RF power.

(2) AFIS/ Equipment Setup. MLS-3 profile. The Mission Specialist may select either "AUTO", "MAN", OR "PILOT" for runway updating. Approved RTT and/or AFIS methods must be used for the approach evaluation. The facility error budget will provide all tolerances to be used during commissioning and periodic flight inspections. During the commissioning flight inspection, document the facility error budget on the datasheet. MCE must be established prior to application of PFE tolerances.

NOTE: Pilots must engage the following switches when appropriate:

Lear, MLS G/ P when MGP is less than 3.00° or greater than 4.00°

BE300, MLS/ MSGS whenever the MGP is anything but 3.00°

CL601, Select MAN on the Mode Selector, Press SEL button until GS is selected, then turn the Selector Knobs to dial in the desired glide slope angle (limited 2.0 to 19.9°).

HS125, Select MAN with the right selector knob, then use the center selector knobs to highlight GP and then set the glidepath.

(3) Analysis. Use this maneuver to measure azimuth and elevation adjustments and to measure MCE, MGP, AZ, EL PFE, PFN, and CMN. For azimuth facilities sited along runway centerline with a DA at or below 200 ft, the azimuth MCE must be determined in the 1.0 nm segment ending at the ARD. For other facilities use the 1.0 nm segment ending at 100 ft below DA. Report the worst PFE, PFN, or CMN found in Zones 1, 2, or 3. If AFIS reports the same value in two zones, report the announced value that is closest to threshold.

NOTE: When a restriction occurs in an area where MCE is normally analyzed, measure MCE from 1.0 nm from the start of the restriction to the start of the restriction.

(4) Other Considerations

(a) If the MLS supports an Azimuth Only Minima, the final approach segment must be checked during site evaluation, commissioning, and special inspections for azimuth antenna change and anytime there is significant deterioration of azimuth structure. Azimuth Only approaches will be flown at a descent of 400 ft per mile (930 ft per minute at 140 knots; 800 ft per minute at 120 knots) to an altitude of 100 ft below the lowest published MDA and maintain this altitude to the MAP.

(b) If the MLS supports Visual Autoland or CAT II/ III operations, complete a roll-out. Roll-out will be inspected by crossing Point C at 100 ft, runway threshold at approximately 50 ft, and continue on the extended glide path to the touchdown point. Continue the landing roll and determine the actual course alignment for Zones 4 and 5. If the actual alignment for Zones 4 and 5 cannot be determined using this method, taxi the aircraft along the runway centerline from abeam the elevation site to Point E. Record the raw crosspointer information and mark, abeam the EL site Point D, and Point E. Manually calculate the actual course alignment, PFE, PFN, and CMN for each of the required zones.

Figure 16-10
MLS-3 Flight Inspection Low Approach

Aircraft Configuration

A/C	Speed KIAS	Flaps	Gear
CL601/ 4	140 – 180	20	DN
Lear 60	160 – 200	20	DN
BE300	140 – 160	Approach	DN
HS125	Vref+25	15	DN

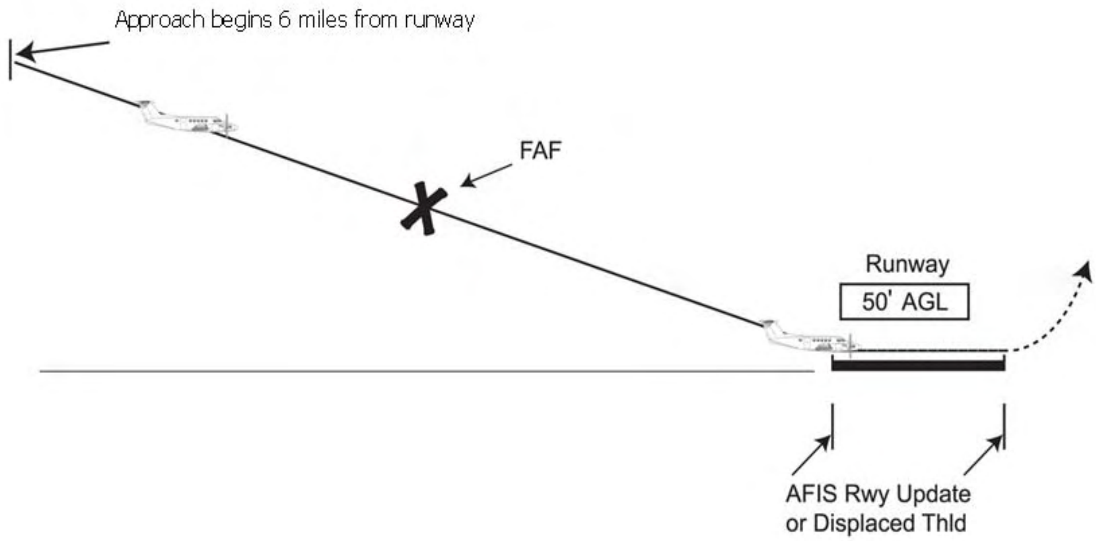
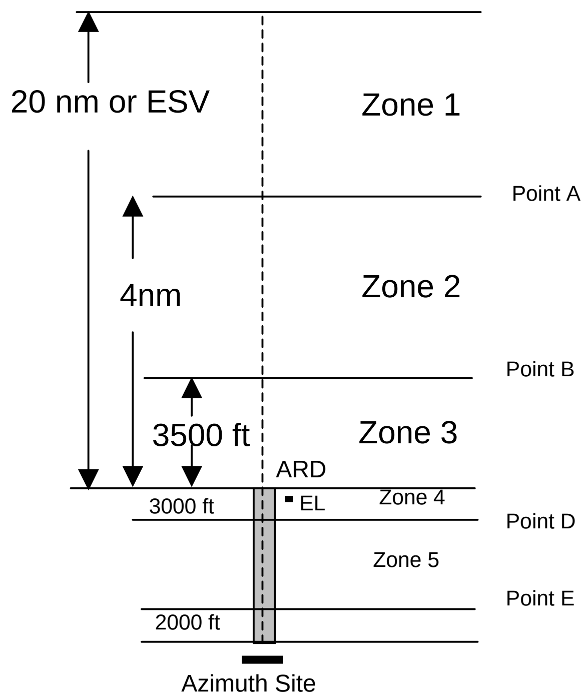


Figure 16-11
AZ/ EL APPROACH



e. **Azimuth Monitor.** Validates the monitor parameters associated with the azimuth antenna and provides Facility Maintenance Personnel reference readings to be used in validation of facility monitoring parameters.

(1) **Maneuvering.** The azimuth monitor evaluation may be checked while the aircraft is parked within the proportional guidance. The aircraft should be at the maximum practical distance from the antenna while maintaining line of site. Checking the monitors airborne is the best practice. The AFIS panel will analyze PFE when checked airborne.

(2) **AFIS/ Equipment Setup.** MLS-3 profile can be used for checking the azimuth monitor either airborne or on the ground.

(3) **Analysis.** Analyze azimuth alignment and apply PFE tolerances. Facility performance is unsatisfactory for IFR use if the alignment shift results in out-of-tolerance PFE at any distance on the approach.

(4) **Other Considerations.** MCE must be within ± 0.02° before attempting to check the monitors. If the monitors are checked on the ground, the airborne PFE is algebraically added to the AZ alignment shift. (AFIS will not compute this value on the ground). Restore to Normal when complete.

f. **Elevation Monitor.** Validates the monitor parameters associated with the elevation antenna. The facility will be configured for "High Angle" and "Low Angle" alarm conditions. For both of these checks, request an angle change of no more than ± 0.10°. High angle should be accomplished prior to the low angle because Below Path Coverage Evaluation checks are required in Low angle alarm.

(1) **Maneuvering.** Inspect the approach while flying the designed procedural azimuth and minimum glidepath. Start the approach at the FAF or 6 nm from runway threshold, whichever is greater. Fix Updating should be performed just like an ILS 3 maneuver. The Mission Specialist may select either "AUTO", "MAN", or "PILOT".

(2) **AFIS/ Equipment Setup.** Select MLS-3 profile on the NAV/Test Control Page. .

(3) **Analysis.** Analyze elevation alignment and apply PFE tolerances. Facility performance is unsatisfactory if the elevation change results in out-of-tolerance PFE at any distance on the approach.

(4) **Other Considerations.** MGP must be established within ± 0.02° of the commissioned angle prior to inspecting the Elevation monitor. If the lower scan angle limit is increased to improve PFE, recheck normal EL path structure. Restore to Normal when complete.

g. **Below Path Coverage Evaluation.** Perform this check during a commissioning inspection. There are three runs for this inspection.

(1) **Maneuvering.** With the MGP selected for evaluation, fly at an angle equal to (MGP degrees X 0.75)-0.25°. Fly one run on procedural centerline and at 2° either side of centerline. Gear should be down.

(2) **AFIS/ Equipment Setup.** May be checked using MLS-3 without runway updates using raw data only. Identify the GSI and the MAP on the recordings using event marks.

(3) **Analysis.** Pilot will ensure a full-scale fly up indication is maintained on the elevation signal, and azimuth guidance and obstacle clearance can be maintained from the GSI to the MAP.

(4) **Other Considerations.** PFE, PFN, and CMN tolerances are not applied for this check. The EL facility will be in low angle alarm for this check.

h. **Identification.** The identification is validated by listening to the Morse code and recording Basic Data Word 6. Morse code must be readable throughout the facilities service volume.

i. **DME.** DME will be evaluated as a DME/ N throughout all areas of coverage. ICAO has specified MLS DME to transmit the three-letter ID. The “M” has been dropped; however, facilities previously commissioned transmitting the four letters DME ID will be left in service.

(1) **Maneuvering.** DME will be checked concurrent with other required checks. No additional maneuvers are needed.

(2) **AFIS/ Equipment Setup.** The AFIS panel will announce the DME range error in whichever profile is selected.

(3) **Analysis.** DME Ident must be readable throughout service volume of facility. Apply applicable tolerances for range error.

j. **Out of Coverage (OCI).** OCI ensures that no false angle decoding occurs outside of facility coverage areas. This is a maintenance request item, if there are procedural requirements beyond the service volume.

(1) **Maneuvering.** Fly an orbit of 6 to 10 miles about the azimuth facility, and at an altitude as close to MGP that allows line of site with the MLS facilities.

(2) **AFIS/ Equipment Setup.** Select MLS-1 profile on the NAV/Test Control Page.

(3) **Analysis.** During the orbit, note the position of any AZ or EL signals lasting longer than 4 seconds or 1.5° of arc, whichever is greater.

(4) **Other Considerations.** If AZ or EL signals last longer than 4 seconds or 1.5°, whichever is greater, return to the area after completing the orbit and manually program the AZ or EL into the receiver. If the signal can be locked onto and flown as a radial, even though OCI is present, the problem must be corrected or the facility will be restricted.

Table 16-2
Reference ARC Altitude

MGP ANGLE	MGP @ 20 nm	MGP x 0.75 @ 5 nm	MGP x 0.75 @ 6 nm	MGP x 0.75 @ 7 nm	MGP x 0.75 @ 8 nm	MGP x 0.75 @ 9 nm	MGP x 0.75 @ 10 nm
2.5	5659	1017	1225	1436	1648	1862	2077
2.6	5871	1056	1273	1491	1711	1933	2157
2.7	6084	1096	1321	1547	1775	2005	2237
2.8	6297	1136	1369	1603	1839	2077	2316
2.9	6509	1176	1416	1659	1903	2148	2396
3	6722	1216	1464	1714	1966	2220	2476
3.1	6935	1256	1512	1770	2030	2292	2555
3.2	7147	1295	1560	1826	2094	2363	2635
3.3	7360	1335	1608	1882	2158	2435	2715
3.4	7573	1375	1655	1937	2250	2507	2794
3.5	7786	1415	1703	1993	2285	2579	2874
4	8851	1614	1942	2272	2604	2937	3273
4.5	9917	1814	2182	2552	2923	3296	3672
5	10985	2013	2421	2831	3243	3656	4071
5.5	12054	2213	2661	3111	3562	4015	4470
6	13126	2413	2901	3391	3882	4375	4870

16.22 ANALYSIS

a. Azimuth PFE, PFN, and CMN will be evaluated over any 40-second interval of radial flight within the coverage area. Measured parameters must be in tolerance for no less than 95% of the interval measured. PFE tolerances will only be applied with use of AFIS or RTT.

b. Elevation PFE, PFN, and CMN will be evaluated over any 10-second interval of radial flight within the coverage area at or above 0.9°. Measured parameters must be in tolerance for no less than 95% of the interval measured. PFE tolerances will only be applied with use of AFIS or RTT when flown radially.

c. Manual analysis of PFN can be determined by measuring the signal deviations from the mean azimuth or elevation angle that have a duration greater than:

(1) 6.3 seconds for azimuth

(2) 2 seconds for elevation

d. Manual analysis of CMN can be determined by measuring the signal deviations from the mean azimuth or elevation angle that have a duration less than:

(1) 10.4 seconds for azimuth

(2) 6.3 seconds for elevation

(3) CMN filter bandpass frequency overlaps a portion of the PFE bandpass frequency. The resultant CMN signal will be superimposed upon the PFE component, resulting in a larger error than is actually present. CMN must be reported after subtraction of the PFE component.

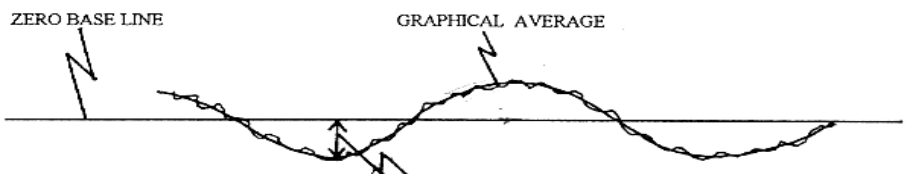
MLS ANALYSIS

1. ANALYSIS

A. CMN- is taken from graphical average line. Then read as 1/2 of that. Report in degrees.

Report this.

B. PFE- Determine maximum PFE by selecting the point of maximum deviation of the graphic average trace from differential zero.

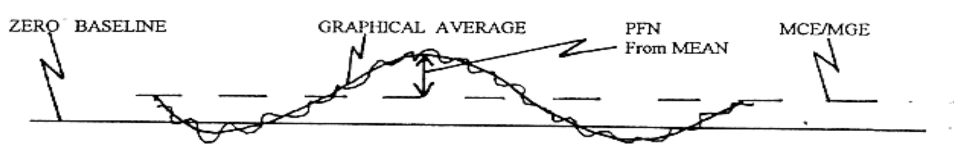


Report PFE in degrees from Zero Base line .0187 per LL

c. PFN- Determine MGE (Mean Glidepath Error (angle)) or MCE (Mean Course Error (azimuth)). Draw this line from 4NM to TH (or MAP if offset).

PFN is recognizable as any smooth deviation of the graphical average line from the previously drawn MGE or MCE line.

PFN is measured from **MCE** or **MGE** to the maximum deviation.



PFN is reported in degrees.

e. Monitor limits are determined by the maximum PFE found in the alarm configurations. If monitors are checked airborne, make separate runs, measuring PFE in each configuration. If the AZ alignment monitor is checked on the ground, algebraically add the amount of alignment change to the PFE value found on the normal approach.

16.23 TOLERANCES

a. Facility Error Budgets. Due to the unique siting requirements of each MLS installation and the resulting difference in tolerances, an MLS error budget must be computed for each facility. The location of the azimuth site determines the Reference Point to be used in the computation of the error budget. The EL error budget reference point must coincide with the AZ.

(1) **ARD** when the azimuth is sited along or within 1.00° of runway centerline. (See Figure 16-3), and a 200 ft or less Decision Altitude is published.

(2) **100 ft below the MAP when the azimuth is:**

(a) Sited along or within 1.00° of runway centerline (See Figure 16-3), and a Decision Altitude above 200 ft is published

(b) Offset. (See Figure16-4)

NOTE: Azimuth antennas installed with a distance to Missed Approach Point/ Decision Altitude greater than 9,115 ft must have a tolerance of 0.11° for PFN and 0.22° for PFE applied at the MAP.

(c) Co-located azimuth with elevation (See Figure 16-5)

(d) Heliports which are considered to be those facilities with less than 2,300 ft between the azimuth and the approach reference datum when sited along runway centerline

(e) Non-precision approach aid terminating at a point in space and not aligned with a precision runway (See Figure 16-6)

b. **Application of Tolerance Degradation Factors.** Tolerances are specified as the calculated or standard value at the reference point, either ARD or MAP. As shown in Table 16-3, these tolerances may be widened (in most cases to an indicated maximum value) by the indicated degradation factors with increasing distance, lateral, or elevation displacement from the reference point. To calculate azimuth tolerance at a given point, use the following steps, in order:

(1) **Determine the tolerance at the reference point,** using the formula in Appendix 2.

(2) **Define the measurement point** in distance, lateral angle, and elevation angle from the reference point

(3) **C/ L Distance Degraded Tolerance**

(a) Multiply the tolerance at the reference point by the distance degradation factor. This gives the maximum boresight tolerance at 20 nm.

(b) Subtract the tolerance at the reference point from the tolerance at 20 nm. This gives the maximum degradation.

(c) Divide the maximum degradation by 20, giving the degradation increment (degrees per nm).

(d) Multiply the degradation increment by the mileage from ARD of the measurement point, then add the original tolerance at the reference point. The result is the tolerance on C/ L (boresight) at the distance of the measurement point.

(4) **Laterally Degraded Tolerance**

(a) Multiply the distance degraded tolerance from Step (3)(d) above by the off-course degradation factor, giving the maximum degradation at 40 (60)° at the specified distance.

(b) Subtract the C/ L value from the value at 40°. The result is the maximum degradation.

(c) Divide the maximum degradation by 40 to get the degradation Increment (degrees per degree).

(d) Multiply the degradation increment by the number of degrees off-course at the measurement point; add this value to the value from Step (3)(d) above. This gives the tolerance at the measurement distance and lateral offset.

(5) Vertically Degraded Tolerance (above 9° only).

(a) Multiply the distance and laterally degraded tolerance from Step (4)(d) above by the vertical degradation factor, giving the maximum tolerance at 15° elevation at the specified distance and lateral offset.

(b) Subtract the distance and laterally degraded value (Step (4)(d)). The result is the maximum degradation.

(c) Divide the maximum degradation by the number of degrees difference from the MGP and 15° to get the degradation increment (degrees per degree).

(d) Multiply the degradation increment by the number of degrees above the MGP at the measurement point; add this value to the value from (4)(d). This gives the tolerance degraded by all three factors.

(6) The tolerance to be applied is the greater of either the value calculated above, or the maximum, as listed in the individual facilities listed below.

EXAMPLE:

Given: AZ to ARD distance – 7,965 ft, MGP – 3.0°

PFE tolerance at ARD from Paragraph 16.22e – 20 ft

Find: AZ PFE tolerance at 14 nm from ARD, @ 10° off-course, @ 12°

Table 16-3
Tolerance Degradation Computation

14b step	Calculation	Result	Definition
(1)	Arctan (20 / 7,965)	0.1438	Tolerance at ARD
(3)(a)	(0.1438 x 1.2)	0.1726	Tolerance @ 20 nm on C/L @ 3.00°
(3)(b)	(0.1726 – 0.1438)	0.0288	Maximum Degradation
(3)(c)	(0.0288 / 20 nm)	0.0014 per nm	Degradation Increment
(3)(d)	(0.0014 x 14 nm) + 0.1438	0.01634	Tolerance @ 14 nm on C/L @ 3.00°
(4)(a)	(0.1634 x 1.5)	0.2451	Tolerance @ 14 nm @ 40°
(4)(b)	(0.2451 – 0.1634)	0.0817	Maximum Degradation
(4)(c)	(0.0817 / 40°)	0.0020 per degree	Degradation Increment
(4)(d)	(0.0020 x 10°) + 0.1634	0.1834	Tolerance @ 14 nm @ 10° @ 3.00°
(5)(a)	(0.1834 x 1.5)	0.2751	Tolerance @ 14 nm @ 10° @ 15°
(5)(b)	(0.2751 – 0.1834)	0.0917	Maximum Degradation
(5)(c)	(0.0917 / 12°)	0.0076	Degradation Increment
(5)(d)	(0.0076 x 9°) + 0.1834	0.2518	Tolerance @ 14nm @ 10° @ 12°

c. **Standby Equipment** must meet the same tolerances as the primary equipment.

d. **Alignment** must be reported as the average flight inspection angle. Facilities found with an alignment that exceeds 60% of the allowable PFE must generate a maintenance alert IAW Paragraph 15.50d.

e. Individual System Tolerances

(1) Standard Facilities

(a) Centerline Azimuth Facilities

Parameter	**Reference Paragraph**	**Inspection C**	**Inspection P**	**Tolerance/Limit at ARD**	**Maximums**	**Degradation Factors**
Alignment (MCE)	16.21d	X X	 X	0.02 0.05 Military non-autoland only PFE tolerances apply		
PFE	16.22	X	X	20 ft not to exceed 0.25°	<9° EL=0.25° >9° EL=0.50°	(1)
PFN	16.22	X	X	11.5 ft not to exceed 0.25°	<9° EL=0.25° >9° EL=0.50°	(1)
CMN (Autoland Authorized)	16.22	X	X	10.5 ft not to exceed 0.10° within 10° from C/ L More than 10° from C/ L = .20	0.10°	(2)
Runway Area (Autoland Authorized)	16.22	X	X	Zones 4 and 5 PFE/ PFN/ CMN tolerances are equal to the linear (footage) values at the ARD.		
CMN (Cat I Minima)	16-22	X	X	0.10° within 10° of rwy C/ L 0.20° beyond 10° from rwy C/ L	0.10° 0.20°	
Alignment Monitor	16-21e	X	X	PFE tolerances apply		

NOTES:

(1) On C/ L at 20 nm = 1.2 x ARD value
At 40° off course = 1.5 x C/ L value at same distance from ARD.
At 60° off course = 2.0 x C/ L value at same distance from ARD.
From +9 to +15° EL = 1.5x value at same distance and direction

(2) Linear increase to 0.10° at 20 nm.

(b) **Offset Azimuth, Azimuth Collocated with Elevation, and Heliport Azimuth Facilities**

Parameter	Reference Paragraph	Inspection C	Inspection P	Tolerance/Limit @ Reference Point	Maximums	Degradation Factors
Alignment (MCE)	16.21d	X		0.02°		
			X	PFE tolerances apply		
PFE	16.22	X	X	28 ft not to exceed 0.50	0.50°	(1)
PFN	16.22	X	X	14 ft not to exceed 0.50	0.50°	(1)
CMN	16.22	X	X	0.20°	0.20°	
Alignment Monitor	16.21e	X	X	PFE tolerances apply		

NOTE:

(1) On procedural C/ L at 20 nm=1.2 x Reference Point value

At 40° off course = 1.5 x procedural C/ L value at same distance from Reference Point
From +9 to +15° EL = 1.5 x value at same distance and direction from Reference Point

(c) **Azimuth and Elevation Facilities Not Aligned as a Precision Approach Aid to a Runway**

Parameter	Reference Paragraph	Inspection C	Inspection P	Tolerance/Limit @ Reference Point	Maximums	Degradation Factors
Alignment (MCE)	16.21d	X	X	(1)		
PFE	16.22			No requirements		
PFN	16.22	X	X	0.50°		None
CMN	16.22	X	X	0.20°		None

NOTE:

(1) Alignment must be considered satisfactory when the flight inspector determines that the azimuth on course and elevation rate of descent allow safe completion of the procedure as published.

(d) Elevation

Parameter	Reference Paragraph	Inspection C	Inspection P	Tolerance/Limit @ 3.0° @ Reference Point	Maximums	Degradation Factors
Alignment (MCE)	16.21d	X	X	0.02° PFE tolerances apply		
PFE	16.22	X	X	0.133		(1) (2) (5)
PFN	16.22	X	X	0.087		(1) (2) (5)
CMN (autoland authorized)	16.22	X	X	0.05	Within 10° of rwy C/ L = 0.10° Beyond 10° of rwy C/ L = 0.20°	(3) (4)
CMN (Cat I minima)	16.22	X	X	0.10	Within 10° of rwy C/ L = 0.10° Beyond 10° of rwy C/ L = 0.20°	
Alignment Monitor	16.21f	X	X		PFE tolerances apply	

NOTES:

(1) On C/ L at 20 nm = 1.2 x ARD value

(2) At 40° off course = 1.2 x C/ L value at same distance from Reference Point
At +15° EL = 2.0 x value at same distance and direction from Reference Point

(3) Linear increase to 0.10° at 20 nm

(4) At 40° off course = 2.0 x C/ L value at same distance from Reference Point

(5) With decreasing elevation angle: The PFE and PFN limits from +3° (or 60% of the MGP, whichever is less) to the coverage extreme, are degraded linearly by a factor of 3 times the value at the Reference Point.

f. **Data Words.** The AFIS is the reference for the correctness of the received data words (data sheet for non-AFIS). Due to calculation rounding and feet/ meter conversion, some apparent errors occur. When the received data words do not match the AFIS expected values, the differences must be resolved with Facilities Maintenance. The following data words, if transmitted, have acceptable tolerances; all other values must match.

(1) Basic Data Words

Word	Description	Tolerance
Basic 1	AZ to threshold distance	± 1 Meter
Basic 3	DME distance	± 1 Meter

(2) Auxiliary Data Words

Word	Description	Tolerance
AUX 1	Az to Offset	± 1 Meter
	Az to MDPT	± 1 Meter
	Az Ant Height	± 1 Meter
AUX 2	El Ant Offset	± 1 Meter
	MDPT Distance	± 1 Meter
	El Ant Height	± 0.1 Meter
	MDPT Height	± 1 Meter
	Threshold Height	± 0.1 Meter
AUX 3	DME Offset	± 1 Meter
	DME to MDPT Distance	± 1 Meter
	DME Ant Height	± 1 Meter
	Rwy Stop End Distance	± 1 Meter

SECTION 3

MOBILE MICROWAVE LANDING SYSTEMS (MMLS)

16.30 INTRODUCTION

a. The MMLS is a tactical landing aid designed for rapid installation. MMLS may be installed in a Split-Site Configuration or in a collocated configuration. The Split-Site Configuration is essentially the same as any other MLS installation. For Split-Site installations, the standard flight inspection procedures of Paragraph 16.20 apply.

b. **In the Collocated Configuration,** the Azimuth (AZ) and DME are sited with the Elevation (EL) and provide a computed centerline approach for a normal runway or assault-landing zone (ALZ). The antenna is typically 150 to 300 ft from centerline with distance from threshold dependent upon desired Minimum Glide Path (MGP). The AZ guidance is boresighted parallel with procedural centerline.

c. **Procedural centerline** is usually runway centerline, but unusual siting conditions may cause an offset situation. The standard flight inspection receiver will see the course as parallel to the procedural centerline and will not be guided to the runway. In the Collocated Configuration, a specialized receiver (e.g., CMLSA or multi-mode Receiver) capable of developing a "Computed Centerline," uses the AZ and DME to compute a procedural centerline based upon the facility data words.

d. The MMLS does not transmit a clearance signal and will be restricted laterally if the proportional guidance limits are reduced from the normal ± 40°. MMLS facilities are designed for 15 nm Service Volume. In addition, the RF power of the MMLS is monitored but not adjustable. The 20 nm checks flown at the normal RF power will simulate the power alarm condition. All DOD MMLS facilities must be restricted beyond 15 nm. Standard Service Volume and the coverage checks may be further reduced to 2 nm greater than the farthest procedural need; the facility must be restricted beyond the checked distance. Most restrictions will be due to reflections or signal screening. These restrictions should be placed at the distance of occurrence.

If an MMLS is confirmed to have inadequate signal strength, it must be restricted beyond a distance equal to 0.75 times the distance of the out-of-tolerance signal.

16.31 CHECKLIST

MOBILE MLS

TYPE CHECK	REFERENCE PARAGRAPH	INSPECTION			ANTENNA CHANGE		CEU CHANGE (1)(2)(3)	DEU CHANGE	MEASUREMENTS REQUIRED				
		C2	P2	FC*	AZ	EL			CONFIGURATION	STRUCTURE	ALIGNMENT	DATA	COVERAGE
Data Word Verification	16.33e	X	X	X	X	X	X		Norm			X	
Lat Covg	16.33a	X			X	X		X (5)	Norm	X			X
Vert Covg	16.33b	X			X	X			Norm	X			X
Ref Arc	16.33a	X	X	X	X	X			Norm	X		X	X
Approach AZ	16.21d	X,	X	X	X		X	(6)	Norm	X	X	X	
Approach EL	16.21d	X	X	X		X	X	(6)	Norm	X	X		
AZ Monitor	16.21e 16.33d	X	(1)				X		Align Ref		X		
EL Monitor	16.21f 16.33d	X X	(1) (1)				X X		Hi Angle Lo Angle		X X		 (4)
DME	16.21i 16.33g	X	X					X	Norm				X
Ident	16.21h 16.33f	X	X				X	X	Norm				X
Computed Centerline Validation	16.33c	X							Norm		X		

NOTES:

(1) Engineering or maintenance request

(2) Commissioning of MMLS facilities with backup CEU(s), perform Periodic and "CEU Change" checklists on backup CEU.

(3) MMLS Redeployment. If the system was removed and reinstalled in its previous configuration and exact location with no changes, perform a "P" and "CEU Change" Checklist.

(4) Coverage below path. Required on commissioning-type inspections.

(5) 20 nm coverage arc required

(6) Azimuth/ Elevation analysis is not required for a DEU change; evaluate the DME with the aircraft configured on the approach.

*FC = Frequency Change

16.32 EXAMPLE BEST PRACTICE COMMISSIONING TYPE CHECKLIST.

The following checklist is meant as a guide only and will not replace the official checklist (Paragraph 16.31). It provides a suggested sequence of steps to aid in the crewmembers' preparation for commissioning type flight inspections. The steps can be modified based on Air Traffic or other various considerations.

Run	Configuration	Type	Start Distance	Remarks
1	Normal	MLS-3	FAF or 6.0 nm from threshold, whichever is further	
2	AZ ALARM	MLS-3	FAF or 6.0 nm from threshold, whichever is further	Left alignment shift
3	AZ ALARM	MLS-3	FAF or 6.0 nm from threshold, whichever is further	Right alignment shift
4	Normal	MLS-3	FAF or 6.0 nm from threshold, whichever is further	Accomplished to ensure MCE is returned to normal
5	EL ALARM	MLS-3	FAF or 6.0 nm from threshold, whichever is further	High angle
6	EL ALARM	MLS-3	FAF or 6.0 nm from threshold, whichever is further	Low angle
7	EL ALARM	MLS-3	FAF or 6.0 nm from threshold, whichever is further	Low angle/2° right/Clearance Below Path
8	EL ALARM	MLS-3	FAF or 6.0 nm from threshold, whichever is further	Low angle/2° left/Clearance Below Path
9	EL ALARM	MLS-3	FAF or 6.0 nm from threshold, whichever is further	Low angle/Centerline/Clearance Below Path
10	Normal	MLS-3	FAF or 6.0 nm from threshold, whichever is further	
11	Normal	MLS-2	20.0 nm from antenna	10° past the published front course azimuth or the minimum proportional guidance limit, whichever is further (non-equipment side)
12	Normal	MLS-2	20.0 nm from antenna	10° past the boresite azimuth (equipment side)
13	Normal	MLS-2	20.0 nm from antenna	Centerline/Vertical Coverage
14	Normal	MLS-1	20.0 nm from threshold	45°-45°/Service Volume Arc (Lateral Coverage) Simulated RF Power Check
15	Normal	MLS-3	20.0 nm from threshold	Simulated RF Power Check
16	Normal	MLS-1	10.0 nm from threshold	45°-45°/Reference Arc
17	Normal	MLS-3	FAF or 6.0 nm from threshold whichever is further	Computed centerline approach (CMLSA)

Other Considerations

- If commissioning an MMLS with a backup CEU, then perform “CEU Change” checklist on backup CEU and “Periodic” checklist on both CEU(s).
- On AFIS Facility Data Page, toggle to the configuration of the MMLS under test (e.g., CO-LOCATED, SPLIT SITE). This is a very important step as it tells the computer when to stop collecting data.
- On AFIS Facility Data Page, change the DIST MAP-TH distance to be 100’ below the decision altitude distance.
- Pseudo runway updating is no longer required if results are satisfactory.

16.33 FLIGHT INSPECTION PROCEDURES. The procedures for inspecting standard MLS installations are modified as necessary to support computed centerline approaches. Use those procedures except as directed below.

a. **Coverage Arcs.** Arcs are flown only to measure the proportional guidance limits. The minimum limit on the equipment side of the runway is 10° beyond the published front course azimuth. On the non-equipment side, the minimum is the greater of either 10° beyond the azimuth from the MAP to the AZ antenna **OR** 5° beyond the azimuth from the threshold to the AZ antenna (See Figure 16-13). EXCEPTION: For ALZ operations where touchdown within 500 ft of threshold is essential, the non-equipment side limit may be decreased, as long as coverage is provided to at least 100 ft below Decision Height. To preclude difficulties with the vertical coverage check, if the proportional guidance limit is set to the same value as the minimum required coverage, attempt to widen the proportional guidance at least an additional 2°.

b. **Vertical Coverage.** Accomplish this check by flying a level run starting at 20 nm from the antenna. The azimuth for the vertical coverage checks on the equipment side of the runway is 10° past the published front course azimuth. On the non-equipment side, fly the further of either 10° from antenna boresight azimuth or the minimum proportional guidance limit. If the proportional guidance limits are set at the minimum required limits and cannot be expanded, it is permissible to fly the vertical coverage 2° inside of the minimum limits of proportional guidance. Document on the flight inspection report if these runs are flown inside of the standard azimuths. (See Figure 16-13.)

c. **Computed Centerline Approaches.** Techniques for checking computed centerline procedures depend on the equipment used for the checks. Some flight inspection equipment is limited to checking only the antenna boresight signal while others can evaluate the computed centerline.

(1) If the flight inspection equipment is capable of determining structure and alignment of the computed centerline and elevation signal while flying the approach course, measure these parameters on the computed centerline IAW the AFIS manual. The procedural evaluation may be accomplished using the AFIS only if the aircraft can be navigated along the computed centerline by reference to the AFIS.

NOTE: If results are unsatisfactory, actual boresite must be flown.

(**2)** **Azimuth.** If using theodolite or if AFIS is not capable of measuring the computed centerline, the azimuth boresight signal must be evaluated. When using theodolite, position the instrument to be in-line with the antenna center and use normal procedures. To inspect the azimuth boresight using AFIS, create a "pseudo runway". The centerline of this "runway" passes throught the AZ antenna. Runway updates are through markers on centerline at each end of the "runway". The television positioning system (TVPS) must be used unless suitable visual cues are present to accurately determine centerline and runway ends. Facility data is changed in the AFIS to use the "pseudo runway" and must be used as the reference for AZ alignment and structure measurements. If using the pseudo runway concept, determine azimuth alignment in 1 nm segment, ending at the MAP. When using AFIS, actual, or "pseudo runway" data may be used for coverage arcs or vertical coverage checks. Coordinates of the "pseudo runway" threshold and updating method used must be documented on the commissioning report and facility data sheet. MCE is determined in a 1nm segment ending at the MAP. Analysis of the azimuth inside the MAP is for coverage only.

NOTE: If measuring to the boresite, the following must be changed on the AFIS Facility Data page:

- AZ Offset: Change to 0.0 ft
- Threshold Coordinates: Change to pseudo threshold values
- DME Offset: Change to 0.0 ft (Changing this value may induce slight inaccuracy in DME for NCU updating position).

- The TH HGT and RE HGT will cause errors in EL results but do NOT need to be changed, as they have no effect on AZ results. Do not attempt to measure the EL angle on a run using Pseudo Runway data unless the pseudo runway ends are on hard surface taxiways level with the actual runway ends and measured path angles are the same as those found using the actual runway runs. If the angles are the same, document on the commissioning report and the facility datasheet. Angles derived from the pseudo runway data may be used, but the structure is not valid for correlation to actual procedural centerline.

(3) **Elevation.** Actual runway data and normal procedures must be used for all elevation angle and structure validation when using theodolite or AFIS with or without computed centerline capability.

(4) **Procedural Evaluation.** On commissioning and for any change in procedural azimuth or changes in data words affecting azimuth determination, the procedure must be validated using a “computed centerline” receiver or AFIS capable of providing equivalent pilot indications. For periodic inspections including SIAP and obstacle checks, a standard receiver (using Pseudo Runway procedures) may be used if:

(a) Azimuth PFE is within the tolerances specified in Paragraph 16.35e.

(b) Basic and Auxiliary Data Words critical to computed centerline determination match those used during final approach course certification of the current SIAP. (See Table 16-4)

d. **Monitors.** Mobile Microwave Landing System (MMLS) AZ and EL monitor limits must be evaluated at the actual alarm points. Optimize the AZ and EL Mean Course Errors to within 0.05° before checking monitor PFE limits. Figure 16-14 depicts the azimuths to be flown for coverage below path evaluations.

e. **MMLS Data Words.** The MMLS Data Words generated by the equipment are calculated from the equipment siting and procedural information input by the installer. The equipment may use an input to generate more than one data word, and some of these words are labeled differently in the MMLS than the received words. The following table translates these words.

Table 16-4
MMLS DATA WORD TRANSLATOR

Word	Description	MMLS Term	AFIS Term	Least Signification Bit
Basic 1	AZ ant to Threshold Dist	DATUM/THR (5)	F DIS	100 mtr
	AZ proportional neg limit	AZ LOW LIM	F PNLM	2°
	AZ proportional pos limit	AZ UPR LIM	F PPLM	2°
	Clearance signal type	(1)	C TYPE	0=pulse/1=scan
Basic 2	Minimum glidepath angle	MIN GP	E MPA	0.1°
	Apch EL Status	FLD MON	EL/F/BZ	0=abnormal/1=normal
	Apch AZ Status	FLD MON	EL/F/BZ	0=abnormal/1=normal
	Back AZ Status	(1)(4)	EL/F/BZ	0=abnormal/1=normal
	DME Status	DEU/NORM/BYP	DME ST	(2)
Basic 3	AZ Beamwidth	(1)	F BMW	0.5°
	EL Beamwidth	(1)	E BMW	0.5°
	DME Distance	AZ/DATUM DIST	DDIS	12.5 mtr
Basic 4	AZ Mag Orientation	AZ MAG ORIENT	F ALN	1° (3)(6)
	Back AZ Orientation	(4)	B ALN	1°
Basic 5	Back AZ neg prop limit	(4)	B PNLM	2°
	Back AZ pos prop limit	(4)	B PPLM	2°
	Back AZ Beamwidth	(4)	B BMW	0.5°
Basic 6	MLS Identification	3-letter entry	FAC ID	
AUX 1	AZ antenna offset	AZ OFFSET DIST	F OFF	1 mtr (8)(6)
	AZ antenna to Datum Point distance	AZ/DATUM DIST	F DIS	1 mtr (6)
	AZ alignment with Rwy C/L	AZ W/CL	F ALN	0.01° (8)(6)
	AZ coordinate system	(1)	AZ C/P	0=Conical/1=planar
	AZ antenna phase center height	AZ ANT HGT	AZ HT	1 mtr
AUX 2	EL antenna offset	EL OFFSET DIST	E OFF	1 mtr (8)
	Datum point to threshold distance	DATUM/THR	MLS DIS	1 mtr (6)
	EL antenna phase center height	EL ANT HGT	E HT	0.1 mtr
	Datum point elevation	DATUM ELEV	MLS HT	1 mtr (9)
	Threshold Height	THRESH HGT	RWY HT	0.1 mtr

Table 16-4
MMLS DATA WORD TRANSLATOR
(continued)

Word	Description	MMLS Term	AFIS Term	Least Signification Bit
AUX 3	DME offset	AZ OFFSET DIST	DME OFF	1 mtr (8)(6)
	DME to datum point distance	AZ/DATUM DIST	DME DIS	1 mtr (6)
	DME antenna height	AZ ANT HGT	DME HT	1 mtr
	RWY stop end distance	STOP END DIS	RWY SND	1 mtr (9)
AUX 4	Back AZ ant offset	(4)	B OFF	1 mtr (8)
	Back AZ to datum point distance	(4)	B DIS	1 mtr
	Back AZ align with rwy C/L	(4)	B ALN	0.01° (8)
	Back AZ coord sys	(4)	BZ C/P	0=Conical/1=Planar
	Back AZ ant phase center height	(4)	B HT	1 mtr

NOTES:

1. Factory set, no field input

2. DME status codes: 0 0 DME inoperative or not available
0 1 Only initial approach or DME/N available (normal MMLS status*)*
1 0 Final approach mode std 1 available
1 1 Final approach mode std 2 available

3. Magnetic orientation is 180° from procedural front course azimuth.

4. Back azimuth not used.

5. Split-site configuration is combined value: AZ/DATUM DIST DATUM/THR

6. Computed centerline critical values

7. Distances and heights are with respect to MLS datum point.

8. Negative number indicates left of C/L looking from threshold to stop end.

9. May be zero or actual value.

f. **ID.** To preclude confusion with DME indications, ensure the MMLS identification is not the same as any other DME source used for any approach or missed approach guidance.

g. **DME**. When the MMLS is placed in an abnormal configuration for monitor checks or adjustments, the DME continues transmitting, but the pulse spacing is changed to 33 microseconds. With the normal "Y" channel DME spacing of 30 microseconds, some receivers may remain locked onto the DME signal. This indication is not hazardous and should be disregarded.

16.34 ANALYSIS

a. Azimuth PFE, PFN, and CMN will be evaluated over any 40-second interval of radial flight within the coverage area. Measured parameters must be in tolerance for no less than 95% of the interval measured. PFE tolerances will only be applied with use of AFIS or RTT.

b. Elevation PFE, PFN, and CMN will be evaluated over any 10-second interval of radial flight within the coverage area at or above 0.9°. Measured parameters must be in tolerance for no less than 95% of the interval measured. PFE tolerances must only be applied with use of AFIS or RTT when flown radially.

c. Manual analysis of PFN can be determined by measuring the signal deviations from the mean azimuth or elevation angle that have a duration greater than:

(1) 6.3 seconds for azimuth

(2) 2 seconds for elevation

d. Manual analysis of CMN can be determined by measuring the signal deviations from the mean azimuth or elevation angle that have a duration less than:

(1) 10.4 seconds for azimuth

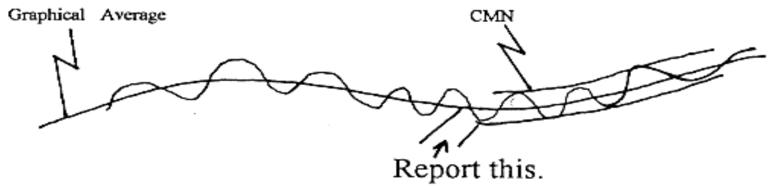
(2) 6.3 seconds for elevation

(3) CMN filter bandpass frequency overlaps a portion of the PFE bandpass frequency. The resultant CMN signal will be superimposed upon the PFE component, resulting in a larger error than is actually present. CMN must be reported after subtraction of the PFE component.

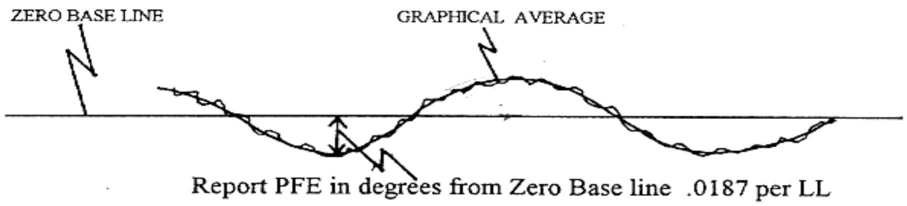
MLS ANALYSIS

1. ANALYSIS

A. CMN- is taken from graphical average line. Then read as 1/2 of that. Report in degrees.



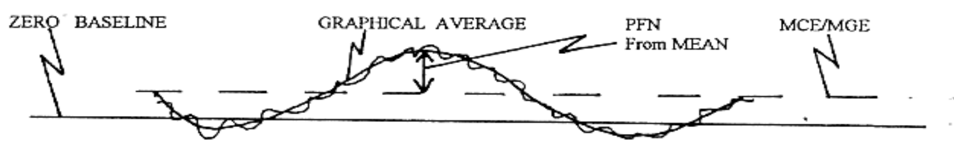
B. PFE- Determine maximum PFE by selecting the point of maximum deviation of the graphic average trace from differential zero.



c. PFN- Determine MGE (Mean Glidepath Error (angle)) or MCE (Mean Course Error (azimuth)). Draw this line from 4NM to TH (or MAP if offset).

PFN is recognizable as any smooth deviation of the graphical average line from the previously drawn MGE or MCE line.

PFN is measured from **MCE** or **MGE** to the maximum deviation.



PFN is reported in degrees.

e. Monitor limits are determined by the maximum PFE found in the alarm configurations. If monitors are checked airborne, make separate runs, measuring PFE in each configuration. If the AZ alignment monitor is checked on the ground, algebraically add the amount of alignment change to the PFE value found on the normal approach.

16.35 TOLERANCES

a. **Facility Error Budgets.** An MMLS error budget must be computed in the same manner as one done for an MLS. Due to the unique siting requirements of each MMLS installation and the resulting difference in tolerances, an MLS error budget must be computed for each facility. The location of the azimuth site determines the reference point to be used in the computation of the error budget. The EL error budget reference point must coincide with the AZ.

(1) **ARD** when the azimuth is sited along or within 1.00° of runway centerline (See Figure 16-3), and a 200 ft or less Decision Altitude is published.

(2) **100 ft below the MAP when the azimuth is:**

(a) Sited along or within 1.00° of runway centerline (See Figure 16-3), and a Decision Altitude above 200 ft is published.

(b) Offset. (See Figure 16-4).

NOTE: Azimuth antennas installed with a distance to Missed Approach Point/ Decision Altitude greater than 9,115 ft must have a tolerance of 0.11° for PFN and 0.22° for PFE applied at the MAP.

(c) Co-located azimuth with elevation. (See Figure 16-5).

(d) Heliports which are considered to be those facilities with less than 2,300 ft between the azimuth and the approach reference datum when sited along runway centerline.

(e) Non-precision approach aid terminating at a point in space and not aligned with a precision runway. (See Figure 16-6.)

b. **Application of Tolerance Degradation Factors.** Tolerances are specified as the calculated or standard value at the reference point, either ARD or MAP. These tolerances may be widened (in most cases to an indicated maximum value) by the indicated degradation factors with increasing distance, lateral, or elevation displacement from the reference point. As shown in Table 16-3, to calculate azimuth tolerance at a given point, use the following steps, in order:

(1) **Determine the tolerance at the reference point,** using the formula in Appendix 2.

(2) **Define the measurement point** in distance, lateral angle, and elevation angle from the reference point.

(3) C/ L Distance Degraded Tolerance

(a) Multiply the tolerance at the reference point by the distance degradation factor. This gives the maximum boresight tolerance at 20 nm.

(b) Subtract the tolerance at the reference point from the tolerance at 20 nm. This gives the maximum degradation.

(c) Divide the maximum degradation by 20, giving the degradation increment (degrees per nm).

(d) Multiply the degradation increment by the mileage from ARD of the measurement point, then add the original tolerance at the reference point. The result is the tolerance on C/ L (boresight) at the distance of the measurement point.

(4) Laterally Degraded Tolerance

(a) Multiply the distance degraded tolerance from Step (3)(d) above by the off-course degradation factor, giving the maximum degradation at 40° or 60°(optional service volume) at the specified distance.

(b) Subtract the C/ L value from the value at 40°. The result is the maximum degradation.

(c) Divide the maximum degradation by 40 to get the degradation increment (degrees per degree).

(d) Multiply the degradation increment by the number of degrees off-course at the measurement point; add this value to the value from Step (3)(d) above. This gives the tolerance at the measurement distance and lateral offset.

(5) Vertically Degraded Tolerance (above 9° only).

(a) Multiply the distance and laterally degraded tolerance from Step (4)(d) above by the vertical degradation factor, giving the maximum tolerance at 15° elevation at the specified distance and lateral offset.

(b) Subtract the distance and laterally degraded value (Step (4)(d)). The result is the maximum degradation.

(c) Divide the maximum degradation by the number of degrees difference from the MGP and 15° to get the degradation increment (degrees per degree).

(d) Multiply the degradation increment by the number of degrees above the MGP at the measurement point; add this value to the value from (4)(d). This gives the tolerance degraded by all three factors.

(6) **The tolerance to be applied is** the greater of either the value calculated above, or the maximum, as listed in the individual facilities listed below.

EXAMPLE:

Given: AZ to ARD distance – 7,965 ft, MGP – 3.0°

PFE tolerance at ARD from Paragraph 16.22e – 20 ft

Find: AZ PFE tolerance at 14 nm from ARD, @ 10° off-course, @ 12°

Table 16-3
Tolerance Degradation Computation

14b step	Calculation	Result	Definition
(1)	Arctan (20 / 7,965)	0.1438	Tolerance at ARD
(3)(a)	(0.1438 x 1.2)	0.1726	Tolerance @ 20 nm on C/L @ 3.00°
(3)(b)	(0.1726 – 0.1438)	0.0288	Maximum Degradation
(3)(c)	(0.0288 / 20 nm)	0.0014 per nm	Degradation Increment
(3)(d)	(0.0014 x 14 nm) + 0.1438	0.01634	Tolerance @ 14 nm on C/L @ 3.00°
(4)(a)	(0.1634 x 1.5)	0.2451	Tolerance @ 14 nm @ 40°
(4)(b)	(0.2451 – 0.1634)	0.0817	Maximum Degradation
(4)(c)	(0.0817 / 40°)	0.0020 per degree	Degradation Increment
(4)(d)	(0.0020 x 10°) + 0.1634	0.1834	Tolerance @ 14 nm @ 10° @ 3.00°
(5)(a)	(0.1834 x 1.5)	0.2751	Tolerance @ 14 nm @ 10° @ 15°
(5)(b)	(0.2751 – 0.1834)	0.0917	Maximum Degradation
(5)(c)	(0.0917 / 12°)	0.0076	Degradation Increment
(5)(d)	(0.0076 x 9°) + 0.1834	0.2518	Tolerance @ 14nm @ 10° @ 12°

c. **Standby Equipment** must meet the same tolerances as the primary equipment.

d. **Alignment** must be reported as the average flight inspection angle. Facilities found with an alignment that exceeds 60% of the allowable PFE must generate a maintenance alert IAW Paragraph 15.50d. Facilities must not be NOTAMed unless the PFE allowance at the reference point is exceeded.

e. **Individual System Tolerances**

(1) MMLS Facilities Authorized for no Lower than Category I Minima Use by Military Aircraft Only

(2) Facilities checked using these tolerances must be restricted. If applicable, the flight inspection reports must be annotated IAW Chapter 24.

(3) Split-Site Centerline Azimuth

Parameter	Reference Paragraph	Inspection C	Inspection P	Tolerance/Limit at ARD	Maximums	Degradation Factors
Alignment (MCE)	16.21d	X	 X	0.05° PFE tolerances apply		
PFE	16.22	X	X	28 ft not to exceed 0.50°	0.50°	(1)
PFN	16.22	X	X	14 ft not to exceed 0.50°	0.50°	(1)
CMN	16.22	X	X	0.20°		
Alignment Monitor	16.21e	X	X	PFE tolerances apply		

NOTE:

(1) On C/ L at 20 nm = 1.2 x MAP value

(4) Azimuth Collocated with Elevation

Parameter	Reference Paragraph	Inspection C	Inspection P	Tolerance/Limit @ Reference Point	Maximums	Degradation Factors
Alignment (MCE)	16.21d	X	 X	0.05° PFE tolerances apply		
PFE	16.22	X	X	35 ft not to exceed 0.50°	0.50°	(1) (2)
PFN	16.22	X	X	66% of allowable PFE	0.50°	(1) (2)
CMN	16.22	X	X	0.20°	0.20°	None
Alignment Monitor	16.21e	X	X	PFE tolerances apply		

NOTES:

(1) On C/ L at 20 nm = 1.2 x Reference Point value

(2) At 40° off course = 1.5 x C/ L value at same distance from Reference Point

(5) **Elevation**

Parameter	Reference Paragraph	Inspection		Tolerance/Limit @ Reference Point	Maximums	Degradation Factors
		C	P			
Alignment (MCE)	16.21d	X		0.05°		
			X	PFE tolerances apply		
PFE	16.22	X	X	0.30°	0.30°	None
PFN	16.22	X	X	0.133°	0.133°	None
CMN	16.22	X	X	0.20°	0.20°	None
Alignment Monitor	16.21f	X	X	PFE tolerances apply		

f. Data Words. The AFIS is the reference for the correctness of the received data words (data sheet for non-AFIS). The transmitted data words from the MMLS facility must be correct. Due to calculation rounding and feet/ meter conversion, some apparent errors occur. When the received data words do not match the AFIS expected values, the differences must be resolved with Facilities Maintenance. The following data words, if transmitted, have acceptable tolerances; all other values must match.

(1) **Basic Data Words**

Word	Description	Tolerance
Basic 1	AZ to threshold distance	± 1 Meter
Basic 3	DME distance	± 1 Meter

(2) **Auxiliary Data Words**

Word	Description	Tolerance
AUX 1	Az to Offset	± 1 Meter
	Az to MDPT	± 1 Meter
	Az Ant Height	± 1 Meter
AUX 2	El Ant Offset	± 1 Meter
	MDPT Distance	± 1 Meter
	El Ant Height	± 0.1 Meter
	MDPT Height	± 1 Meter
	Threshold Height	± 0.1 Meter
AUX 3	DME Offset	± 1 Meter
	DME to MDPT Distance	± 1 Meter
	DME Ant Height	± 1 Meter
	Rwy Stop End Distance	± 1 Meter

Figure 16-12
Pseudo Runway

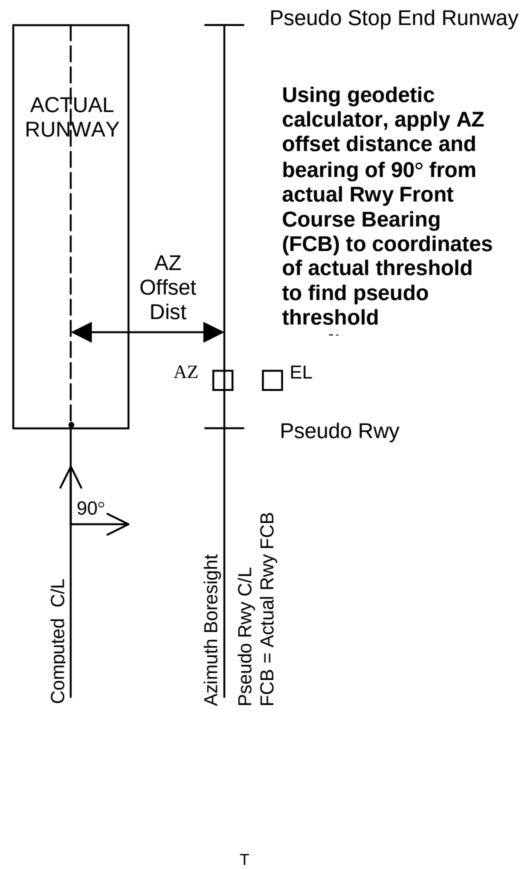


Figure 16-13
MMLS Coverage Validation and Minimum Proportional Guidance

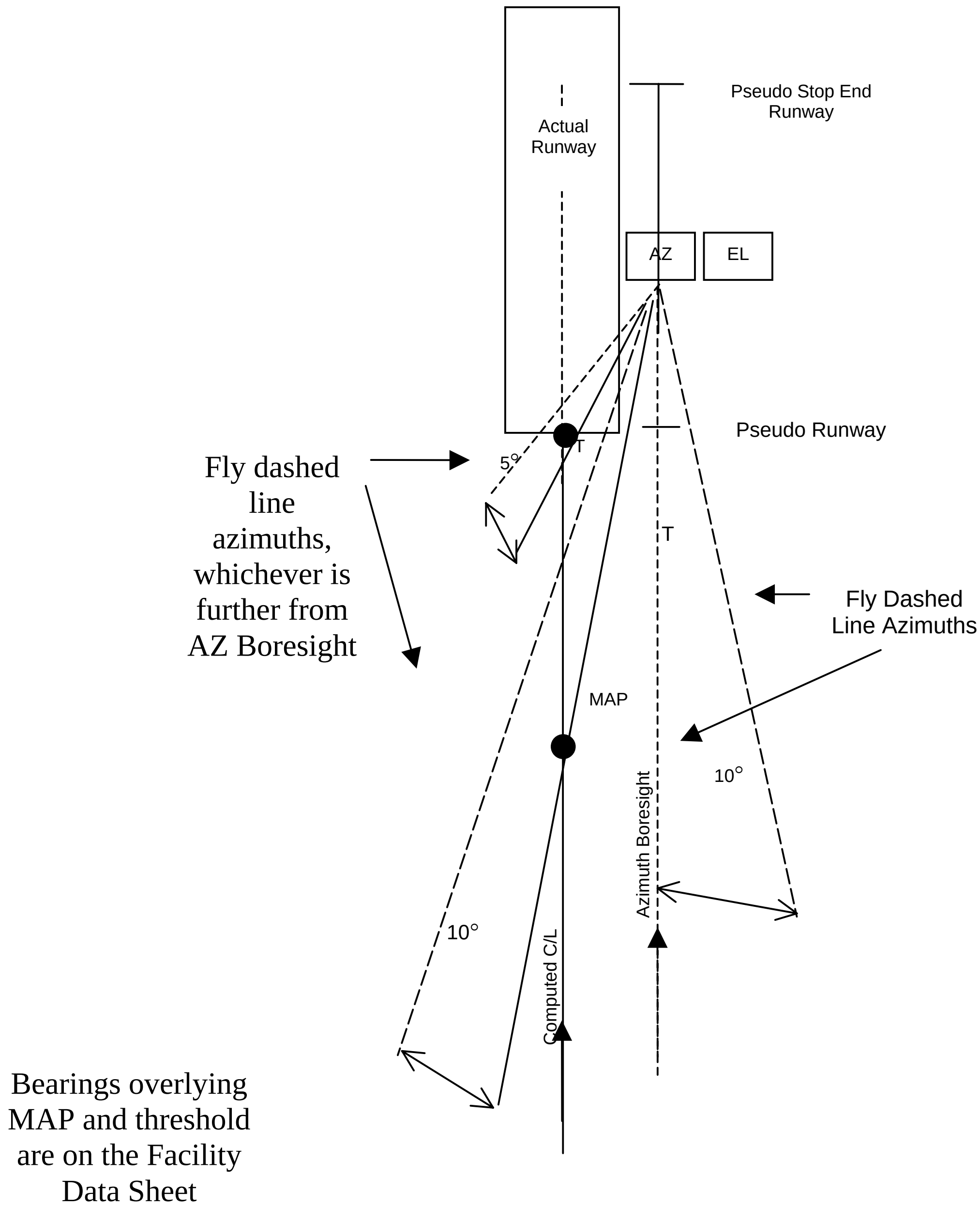
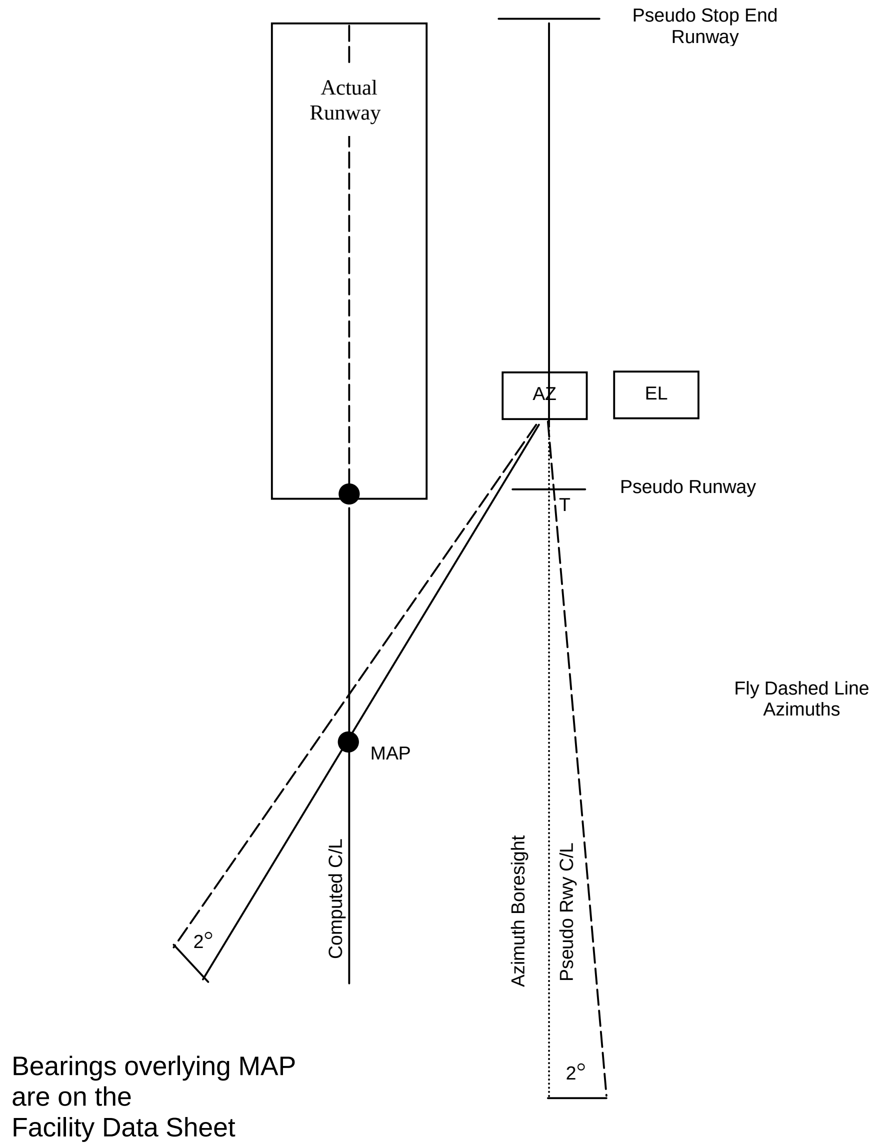


Figure 16-14
Azimuths for Coverage Below Path
(Computed Centerline Facilities)



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CHAPTER 17

LOCAL AREA AUGMENTATION SYSTEM (LAAS)

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CHAPTER 17

LOCAL AREA AUGMENTATION SYSTEM (LAAS)

17.10 INTRODUCTION. LAAS is a safety-critical system consisting of the hardware and software that augments the GPS Standard Positioning Service (SPS) to provide for precision approach and landing capability. The positioning service provided by GPS is insufficient to meet the integrity, continuity, accuracy, and availability demands of precision approach and landing navigation. The LAAS Ground Facility (LGS) augments the GPS SPS in order to meet these requirements. These augmentations are based on differential GPS concepts.

LAAS will supplement the GPS to improve aircraft safety during airport approaches and landings. LAAS will yield the extremely high accuracy, availability, and integrity necessary for Category I, II, and III precision approaches. It is expected that the end-state configuration will pinpoint the aircraft's position to within one meter or less with a significant improvement in service flexibility and user operating costs.

LAAS is comprised of ground equipment and avionics. The ground equipment includes four reference receivers, a LAAS ground facility, and a VHF data broadcast (VDB) transmitter. This ground equipment is complemented by LAAS avionics installed on the aircraft. Signals from GPS satellites are received by the LAAS GPS Reference Receivers at the LAAS-equipped airport. The reference receivers calculate their position using GPS.

The VDB broadcasts the LAAS signal throughout the LAAS coverage area to avionics in LAAS-equipped aircraft. The LAAS reference receivers independently measure GPS satellite pseudo-range and carrier phase and generate differential carrier-smoothed-code corrections that are eventually broadcast to the user via a 31.5 kbps VHF data broadcast (in the 108 – 118 MHz band) that also includes safety and approach geometry information. Aircraft landing at a LAAS-equipped airport will be able to perform precision approach operations to at least Category I weather minima.

17.11 FLIGHT INSPECTION PROCEDURES (Reserved)

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CHAPTERS 18 – 19

RESERVED

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CHAPTER 20

FLIGHT INSPECTION OF VFR AERONAUTICAL CHARTS

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CHAPTER 20

FLIGHT INSPECTION OF VFR AERONAUTICAL CHARTS

20.10 INTRODUCTION. This chapter describes the procedures used to perform flight inspection of FAA Visual Flight Rules (VFR) Aeronautical Charts. These include Sectional Aeronautical Charts and their associated Terminal Area and VFR Flyway Planning Charts, Helicopter Route Charts, and the Grand Canyon VFR Aeronautical Chart. Data gathered is used to update VFR charts and obstruction data for the FAA Minimum Safe Altitude Warning System (MSAW) program.

a. Sectional Aeronautical Chart. Sectional Aeronautical Charts are designed for visual navigation use by slow and medium speed aircraft. The topographic information consists of contour lines, shaded relief, drainage patterns, and an extensive selection of visual checkpoints and landmarks used for flight under VFR. Cultural features include cities and towns, roads, railroads, and other distinct landmarks. The aeronautical information includes visual and radio aids to navigation, airports, controlled airspace, special-use airspace, obstructions, and related data.

b. Terminal Area Chart (TAC). The TAC depicts airspace designated as Class B. While similar to Sectional Charts, the TAC has more detail on a larger scale chart. The TAC is used by pilots operating to and from airfields underlying or near Class B airspace.

c. Charted VFR Flyway Planning Chart. This chart is printed on the reverse side of selected TAC Charts. The coverage is the same as the associated TAC. Flyway planning charts depict flight paths and altitudes recommended for use to bypass high traffic areas. Ground references are provided as a guide for visual orientation.

d. Grand Canyon VFR Aeronautical Chart. This chart covers the Grand Canyon National Park area. It is designed to promote aviation safety, flight free zones, and to facilitate VFR navigation in this popular area. The chart contains aeronautical information for general aviation VFR pilots on one side and commercial VFR air-tour operators on the other side.

e. Helicopter Route Chart. This chart displays aeronautical information useful to helicopter pilots navigating in areas of high concentrations of helicopter activity. Information depicted includes helicopter routes, heliports with associated frequency and lighting capabilities, NAVAID(s), and obstructions. In addition, pictorial symbols, roads, and easily identified geographical features are portrayed.

20.11 PREFLIGHT REQUIREMENTS. Prior to each VFR Aeronautical Chart flight inspection mission, the inspector(s) will meet with the National Aeronautical Charting Office (NACO) VFR Flight Inspection Program (VFIP) coordinator and cartographers to discuss any issues for the inspection.

When VFR Aeronautical Chart flight inspection operations will be conducted in areas affecting air traffic, the inspector must coordinate with Air Traffic Control (ATC).

20.12 DETAILED PROCEDURES. Current chart copies are compared with the corresponding geographic areas. The inspector will evaluate and verify topographic and cultural data (roads, railroads, power lines, antennas, urban areas, etc.) depicted on the charts for accuracy and navigational usefulness.

a. **Flight Line Track.** Flight line tracks will be established to ensure systematic and complete coverage of the entire chart area. Cardinal directions should normally be used unless limited by terrain, localized weather, ATC, or other factors. Flight line spacing may vary to accommodate different levels of visibility and densities of charted features, but should not normally be spaced more than 12 nm.

b. **Altitudes.** The flight line track must be flown at altitudes that will ensure that the pilots can clearly observe the relative position of all objects and their characteristic details. The inspection should normally be performed at altitudes between 2,000 to 5,000 feet above ground level (AGL).

c. **Weather.** VFR Aeronautical Chart flight inspection must be conducted in VFR conditions.

20.13 ANALYSIS AND EVALUATION. Inspectors must record their notes on an annotated VFR chart field sheet. Field sheets are considered source data and must be retained and archived by NACO.

The inspector(s) will recommend corrections and changes and resolve questions and discrepancies raised by NACO cartographers that cannot be resolved by source review in the office.

CHAPTER 21
HELICOPTER

(Reserved)

CHAPTER 22

FLIGHT INSPECTION OF EXPANDED SERVICE VOLUME (ESV) FOR GROUND BASED NAVIGATIONAL AIDS

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CHAPTER 22

FLIGHT INSPECTION OF EXPANDED SERVICE VOLUME (ESV) FOR GROUND BASED NAVIGATIONAL AIDS

22.10 INTRODUCTION. This chapter provides information concerning flight inspection's role with an Expanded Service Volume (ESV) and the ESV process. Service Volume (SV) is defined as that volume of airspace surrounding a NAVAID within which a signal of usable strength exists and where that signal is not operationally limited by co-channel interference.

NOTE: For VOR/ TACAN/ DME and ILS, the following definitions are used:

a. **Standard Service Volume (SSV) -** That volume of airspace defined by the national standard.

b. **Flight Inspection Standard Service Volume (FISSV)** is defined in the appropriate chapter for the specific facility type.

c. **Expanded Service Volume (ESV) -** An ESV is a volume of airspace, outside of a facility's Standard Service Volume (SSV), that is approved for operational use by Spectrum Engineering, and where a facility meets the applicable flight inspection requirements. An ESV is validated by flight inspection when requested by the FAA's Air Traffic Service or procedure specialist and approved by frequency management of Technical Operations applicable Service Area.

d. **Operational Service Volume (OSV) -** The airspace available for operational use. It includes the following:

(1) **The SSV** excluding any portion of the SSV that has been restricted.

(2) **The ESV**

22.11 DETAILED PROCEDURES

a. **Rho-Theta.** Expanded Service Volumes (ESV(s)) are required only when procedural use is predicated on a NAVAID's performance outside of the SSV. Evaluate ESV(s) on one transmitter only. When required, an ESV may be revalidated by orbital flight at the ESV distance and lowest approved altitude. Lateral limits of the area should encompass allowable radial misalignment or applicable fix displacement area. There is no need to inspect the upper limits of an ESV unless interference is reported or suspected.

In most applications, the VOR is the primary facility supporting procedural use (i.e., airways, fixes, intersections). When evaluating facilities supporting procedural uses, record all component signals. If any NAVAID component (i.e., VOR, TAC, or DME) does not meet flight inspection parameter tolerances, document the results as follows.

(1) Within the applicable 25 or 40 nm flight inspection service volume, complete the appropriate flight inspection report form(s) and restrict the NAVAID accordingly.

(2) Beyond the applicable flight inspection service volume but within the SSV, complete the appropriate flight inspection report form(s) and document flight inspection results on the procedures package forms. No facility restriction is required.

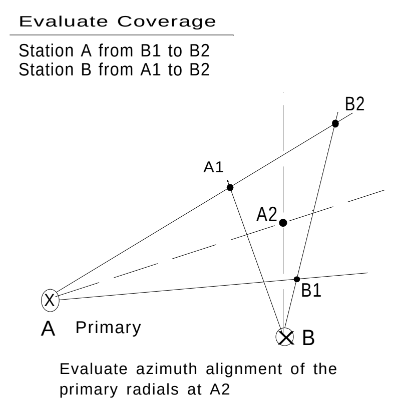
(3) Beyond the applicable SSV, complete the appropriate flight inspection form(s), ESV forms, noting the component(s) that will not support the ESV, and document the results on the procedures package forms. No facility restriction is required.

For flight inspections beyond the applicable 25 or 40 nm distance, complete only the fields of the flight inspection report forms for the NAVAID components identified for procedural use.

(4) En route Radial Fixes located beyond the FISSV

(a) If the fix is located beyond the FISSV of any facility that supports the fix, the appropriate fix displacement coverage evaluation must be accomplished for that facility. When establishing a fix that is located beyond the FISSV, the station(s) are evaluated on the furthest side from the facility of the fix to ensure that usable signals exist. Evaluations must include course sensitivity or modulations, identification, roughness and scalloping, alignment, and signal strength.

Figure 22-1



The radials of the primary facility are evaluated at ± 4 nm or ± 4.5° either side of the primary radial, whichever is greater. The crossing radial is evaluated at ± 3.6°.

NOTE: The primary facility provides primary course guidance to the intersection. If either facility can be the primary, then evaluate both at ± 4 nm or ± 4.5°. If the crossing facility is an NDB, the primary facility is evaluated ± 5° of the NDB on-course bearing. In Figure 22-1, if Station B were an NDB providing the crossing radial, A1 and B2 would each be 5° from the NDB crossing bearing, and Station B would be evaluated from A1 to B2.

(b) Coverage Evaluation. Evaluate the radials of the primary facility at ± 4 nm or ± 4.5°, whichever is greater (3.6° for crossing radials). Note that at 50.8 nm, 4nm equals 4.5° off course. The two methods for evaluating the fix displacement are explained below.

<u>Standard Method</u>

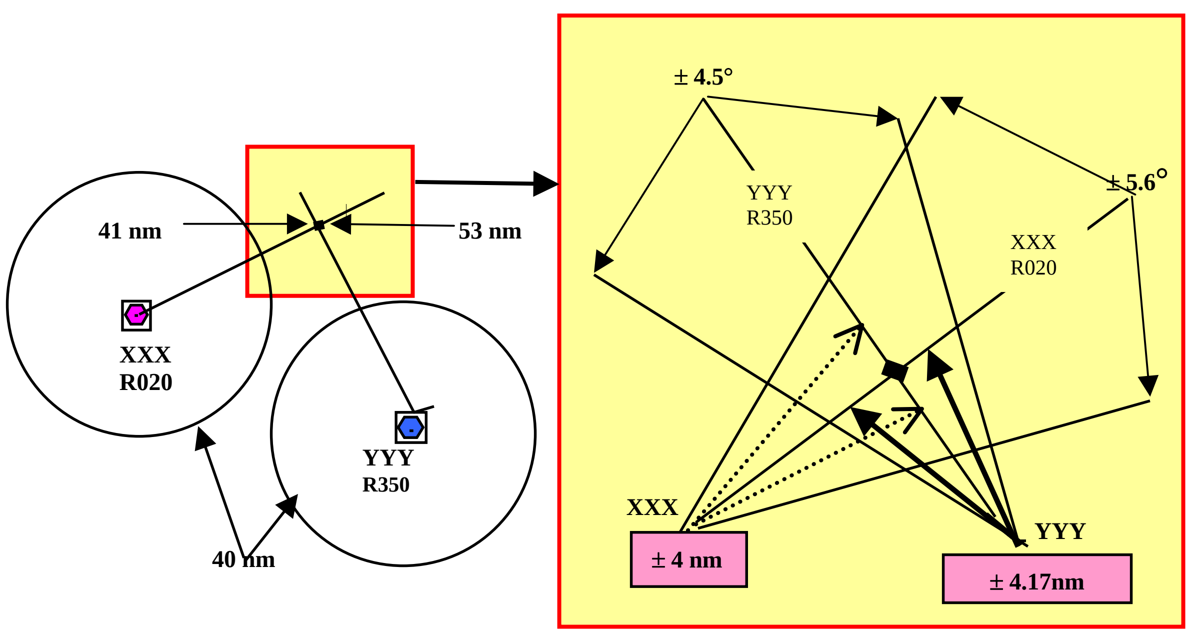
- Beyond 40 nm but within 50.8 nm of the primary facility, calculate the degrees off course that equals 4 nm (See Table 22-1)
- Beyond 50.8 nm the offset radials will be ± 4.5°
- In the example (Figure 22-2), either facility is primary
- To evaluate XXX fix displacement, fly YYY R354.5 from XXX R025.6 to R014.4
- To evaluate YYY fix displacement, fly XXX R014.4 from YYY R345.5 to R354.5

<u>Alternate Method</u>

- Beyond 40 nm but within 50.8 nm, fly an arc about the facility at the fix distance plus 4 nm or 4.5°, whichever is greater (3.6° for crossing radials)
- Beyond 50.8 nm the arc remains 4.5°, but the distance added to the arc will increase as the distance outbound increases.
- In the example (Figure 22-2), either facility is primary
- To evaluate XXX fix displacement, fly from XXX R25.6 to R014.4 at 45.17 nm (41 nm plus 4.17 nm which equates to 4.5° at 53 nm)
- To evaluate YYY fix displacement, fly from YYY R345.5 to R354.5 at 57 nm (53 nm plus 4 nm which is the greater of 4.5° or 4 nm at 41 nm)

(c) **Stand-Alone DME Fixes** are evaluated for coverage ± 4 nm or 4.5^0 (whichever is greater) at 5 nm greater than the fix distance.

Figure 22-2



b. **Instrument Landing System (ILS).** When an operational requirement exists to use either or both the localizer and glide slope to altitudes and/or distances beyond the normal service volume, the facilities must be inspected to the expanded altitudes and/or distances (in accordance with the respective RF alarm reference checks) to determine that facility performance for the required parameters meets tolerances. Place particular emphasis on signal strength, interference, clearances, identification, and structure. If a localizer or glide slope cannot support ESV requirements, the ESV must be denied. The facility must not be classified as restricted solely because it fails to support the ESV. Check ESV(s) during a commissioning inspection, when new procedures are developed or changed so as to require localizer or glide slope use beyond the normal service volume, or on appropriate special inspections (e.g., user complaints).

(1) **Localizer.** The two most common ESV(s) are those to support transitions and those to support localizer interception at greater than normal distances. In either case, the validated minimum altitude in the ESV area may be higher than the lower standard altitude (LSA) within the SSV. These minimum altitudes, as well as the maximum authorized, must be specifically documented on the flight inspection report and the facility data sheet. Validate a localizer ESV using the steps below.

Localizer RF Power Monitor ESV Validation

Step	Maneuvering	Localizer	AFIS	Analysis
1	Fly a 10°-10° arc across the localizer course at the ESV distance and the highest ESV altitude.	Course Reduced RF Power, *Clearance Reduced RF Power	ILS-1	Check for interference, signal strength, clearances, flag alarm, and identification.
2	Fly a 10°-10° arc across the localizer course at the ESV distance and the lowest ESV altitude.	Course Reduced RF Power, *Clearance Reduced RF Power	ILS-1	Check for interference, signal strength, clearances, flag alarm, and identification.
3	Proceed on course, inbound from the ESV distance to 18 nm (25 nm for ICAO Service Volumes) from the localizer antenna at the lowest altitude.	Course Reduced RF Power, *Clearance Reduced RF Power	ILS-3	Check for interference, signal strength, flag alarm, structure, and identification

(* Dual Freq Only)

NOTE 1: If the ESV includes one procedural altitude, only one ESV arc is required, and the ESV will be approved at that one altitude.

NOTE 2: Step 3 may also be used for localizer Zone 1 structure analysis.

(2) **Glide Slope**. To validate an ESV, calculate the altitude at 0.45 times the commissioned angle at the ESV distance. Use that altitude to fly the checks listed below, starting no closer than the ESV distance. The ESV checks replace the standard 10-mile checks. If the facility is unsatisfactory, perform the ESV check at a higher altitude that provides 150 µA fly-up indications and coverage requirements. Approve the ESV at the requested altitude and distance if these requirements can be met at any altitude between 0.45 times the commissioned angle and the requested ESV altitude.

Glide Slope RF Power Monitor ESV Validation

Step	Maneuvering	Glide Slope	AFIS	Analysis
1	At an altitude 0.45 times commissioned angle at the ESV distance and on the localizer course, fly inbound beginning at the ESV distance from the facility through the glidepath sector until reaching clearance above the path.	**Reduced power (both primary and clearance transmitters for capture effect and endfire glide slopes).**	ILS-2	Signal strength Fly-up/ Fly-down Flag alarm
2	At an altitude 0.45 times commissioned angle at the ESV distance and 8° right of localizer course, fly inbound beginning at the ESV distance from the facility through the glidepath sector until clearance above the path is reached.	Same as above	ILS-2	Same as above
3	At an altitude 0.45 times commissioned angle at the ESV distance and 8° left of localizer course, fly inbound beginning at the ESV distance from the facility through the glidepath sector until clearance above the path is reached.	Same as above	ILS-2	Same as above

NOTE 1: Endfire. The endfire glide slope antenna array is oriented toward the runway. The normal fly-up/ fly-down signal ends at approximately 5° on the antenna side of the runway; therefore, you will have only 150 Hz clearance signal at 8° on the antenna side of the runway.

NOTE 2: Glide Slope structure must be analyzed while flying inbound on the glidepath and localizer course from the ESV distance to 10 miles from the glide slope antenna. This evaluation may be used for glide slope Zone 1 structure analysis.

(3) **Reporting Fixes, Transition Areas, SID(s)/ DP(s), STAR(s), and Profile Descents**. Refer to Figure 22-3. The localizers/ SDF, or LDA may be used to support fixes, or departure, en route, and arrival procedures. Transitions may be published through airspace which are beyond the localizer, SDF, or LDA service volume. Under these circumstances, navigation is accomplished using some other facility such as VOR or NDB. If the fix is not contained within the localizer and/or glide slope SSV (see definition in Appendix 1), an ESV must be established to support the procedure.

(a) **Required Coverage** (See Figure 22-3)

1 LOC (A) B1 to B2.

2 VOR (B) A1 to B2 (R ± 4.5°).

3 VOR (B) A3 to B4.

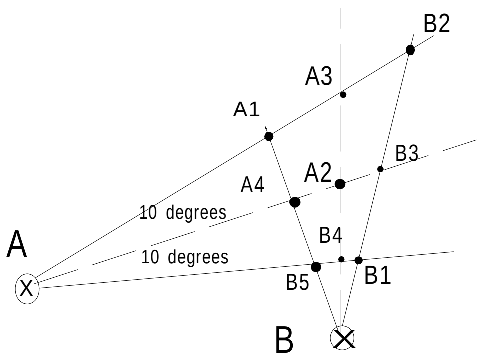
(b) **Transitions.** When a transition (or missed approach routing) is designed to traverse localizer course Sector 3 or air space which is outside the commissioned service volume, and the transition termination point is not identified with a facility other than the localizer course, check clearance and coverage throughout the entire transition air space at the minimum authorized altitudes. This will normally be an approach segment from a facility or fix to intercept a localizer final approach. An ESV must be established for areas outside the ILS SSV. Termination points not requiring clearance validation are: DME Fixes on transition radial, waypoint, Compass Locator, Lead Radials, fixes made up from other than the localizer, and "Radar Required" fixes. Examples of a transition requiring clearances would be a radial to the localizer only or a radial to a marker beacon on the localizer course.

EVALUATE COVERAGE (See Figure 22-3)
LOC (A) B to A2
VOR (B) B to A2

(c) **Standard Instrument Departure (SID(s))/ Departure Procedure (DP(s))**. Check on-course structure throughout the area of intended use. Check clearance in Sector 1 at the termination point at the minimum authorized altitude.

(d) **Standard Terminal Arrival Route (STAR(s)) and Profile Descents.** Fly these procedures as proposed or as published. Check facility performance when checking STAR(s) and profile descents with fixes IAW Paragraphs (a) and (b) above.

Figure 22-3



c. **Microwave Landing System (MLS).** An ESV comprises the area outside of an MLS facility's Standard Service Volume (SSV), that is approved for operational use by Spectrum Engineering, and where a facility meets the applicable flight inspection requirements. An ESV will be validated by flight inspection only when requested by the FAA's Air Traffic Service or procedure specialist and approved by frequency management of the Technical Operations applicable Service Area.

d. **Nondirectional Beacon (NDB)**

(1) Evaluate obstructions or hazards for impact on intended procedures and advise the Procedure Specialist. Evaluate the signal for excessive needle oscillation, weak or garbled ident, and interference. Coverage at distances greater than the orbit radius will be certified for specific routes or transitions. The flight inspector must fly intended routes or transitions at the minimum altitudes and maximum distances as depicted in the flight procedure document. If the facility does not support the procedure, the flight inspector must determine the minimum altitudes and maximum distances that meet all the tolerances, and forward this information to the Procedure Specialist.

(2) Expanded Service Volume (ESV) on commissioned facilities will be established at normal power. At facilities where dual transmitters are installed, evaluate ESV(s) on one transmitter only. ESV(s) must be described by single bearings from the facility with minimum altitudes specified.

(a) **Maneuvering.** Fly the requested ESV at the minimum specified altitude.

(b) **AFIS/ Equipment Setup**

(1) If needed to monitor the distance and bearing from the facility, an NDB can be selected on the AFIS. On the FI FAC page, enter the three-letter IDENT, followed by the appropriate type identifier IAW TI 4040.55. For example, the CMH compass locator would be selected by entering CMHO. After the facility is selected, ensure accuracy of the retrieved data by comparing it to the data sheet, make changes, if necessary. The FI NAV page on the pilot's CDU will then display the distance and bearing from the facility for navigation reference.

(2) If AFIS is not available, program the FMS or GPS by entering the coordinates from the Facility Data Sheet.

(c) **Analysis.** Evaluate the signal for out of tolerance needle oscillations, weak or garbled identification, and interference.

e. **Distance Measuring Equipment (DME).** Chapter 11, Section 3 provides instructions and performance criteria for certifying standard distance measuring equipment (DME). The flight inspection validation of an ESV for DME can be performed separately but is normally checked in conjunction with the more detailed check of the associated ILS, MLS, VOR, or TACAN facility. When conducting a flight inspection for ESV of DME, independent of an associated facility, check the following:

- Accuracy
- Identification
- Coverage

f. **Area Navigation (RNAV)—Procedural Routes Predicated on DME/ DME Position Estimation.** This paragraph addresses expanded service volume (ESV) guidance for inspection of RNAV procedures requiring a DME/ DME infrastructure.

Expanded Service Volume (ESV) requirements: Where the DME infrastructure assessment tool (RNAV-PRO) indicates insufficient DME coverage, using standard service volume, the RNAV-PRO can identify proposed ESV(s) for DME facilities that should ensure an acceptable navigational solution.

When ESV documentation is provided in the procedure package, the expected coverage on the ESV form will be compared to the ESV data collected during the flight inspection. The actual facility ESV coverage is presented on the "DME/ DME Leg Summary Report" printed by AFIS at the end of each route inspected. (AFIS Technician User Manual, TI 4040.55, DME/ DME Mode Operations, explains AFIS operation and display.) The Leg Summary Report is the actual facility coverage and should be reported on the ESV request form if it is different from the expected coverage on the ESV form. The ESV request form with noted differences is returned to the FICO after the procedure inspection is completed.

During the inspection, if a Critical, or ESV designated, DME appears not to be transmitting, verify with Air Traffic or a local Flight Service Station that the facility is in service. If a DME designated Critical is off the air, the inspection must be terminated and resumed after the facility is returned to service. When there are three or less DME(s) and one of the three is out of service, the check should be rescheduled.

22.12 EXPANDED SERVICE VOLUME PROCESS

a. **FMO-Approved Limits.** When a proponent requests an ESV, the FMO ensures the calculated signal level from the desired (D) facility is sufficient and signal levels from any undesired (U) transmissions are low enough to provide a satisfactory D/ U ratio throughout the area of use. Usually, these values are predicted to be satisfactory at the requested altitude, azimuth, and distance limits. Flight inspections are required to verify satisfactory signal strength and quality (structure, modulation, etc.). In the event that the signal does not meet flight inspection tolerances at the requested and FMO-approved limit, the ESV must be limited to the area of satisfactory coverage.

(1) In some cases, the FMO calculations predict satisfactory signal level and/or frequency protection to some point less than requested. This is indicated on FAA Form 6050-4, Expanded Service Volume Request, by a Part II entry of "Restricted" and definition of the FMO-approved limit. This limit may be due to factors used in the FMO modeling process and not detectable through flight inspection. For example, at the requested distance, the D/U ratio is unsatisfactory, but flight check only sees a clean signal, meeting flight inspection tolerances. We could then erroneously approve an ESV where there is insufficient frequency protection. In this example, the flight inspection should not extend beyond the Part II Restricted distance or lowest altitude.

(2) Occasionally, frequency protection is not a problem, but desirable signal strength is calculated to be marginal. The FMO would note in a Part II remark that they approve of an ESV to a given point less than requested, and defer the final approval contingent on a successful flight check at the requested limit. In this case, the flight inspection should be to the requested distance and at the lowest requested altitude.

(3) It must be understood that **flight inspection does not approve any part of an ESV beyond that which is approved by the FMO.**

b. **Clarity of Flight Inspection Results.** Some flight inspection comments in Part III of FAA Form 6050-4 have been misleading. As can be seen in Paragraph 22.12a(1), the final flight inspection approval can only be equal to or more restrictive than the FMO-approved limit. If the FMO approves exactly what was originally requested and the signal strength and quality meet flight inspection tolerances to the requested distance and lowest altitude, the flight inspector should check the APPROVED block in Part III. In the Remarks section, **define the limits of the ESV by facility component, azimuth/bearing, distance, and Minimum Reception Altitude (MRA) and Maximum Authorized Altitude (MAA).** Any other situation requires a Part III entry of RESTRICTED and a **definition of the ESV limits**. Facility components, such as VOR and TACAN, which result in different coverage limits, should be defined individually.

c. **Expanded Service Volume (ESV) Facilities.** When a facility no longer supports an ESV, the facility is not restricted, but a NOTAM must be issued for the instrument flight procedures predicated on that ESV.

22.13 TABLES AND SUPPLEMENTENTAL INFORMATION

Table 22-1

INTERSECTIONS (Coverage) to 50.8 nm			
Primary Radials = 4 nm or 4.5°, whichever is greater			
Distance from Facility in nm	**Degrees Off-Course = 4 nm**	**NDB(s)**	**Crossing Radial (not primary)**
5	38.7	± 5°	± 3.6°
6	33.7	± 5°	± 3.6°
7	29.7	± 5°	± 3.6°
8	26.6	± 5°	± 3.6°
9	24.0	± 5°	± 3.6°
10	21.8	± 5°	± 3.6°
11	20.0	± 5°	± 3.6°
12	18.4	± 5°	± 3.6°
13	17.1	± 5°	± 3.6°
14	15.9	± 5°	± 3.6°
15	14.9	± 5°	± 3.6°
16	14.0	± 5°	± 3.6°
17	13.2	± 5°	± 3.6°
18	12.5	± 5°	± 3.6°
19	11.9	± 5°	± 3.6°
20	11.3	± 5°	± 3.6°
21	10.8	± 5°	± 3.6°
22	10.3	± 5°	± 3.6°
23	9.9	± 5°	± 3.6°
24	9.5	± 5°	± 3.6°
25	9.1	± 5°	± 3.6°
26	8.7	± 5°	± 3.6°
27	8.4	± 5°	± 3.6°
28	8.1	± 5°	± 3.6°
29	7.9	± 5°	± 3.6°
30	7.6	± 5°	± 3.6°
31	7.4	± 5°	± 3.6°
32	7.1	± 5°	± 3.6°
33	6.9	± 5°	± 3.6°
34	6.7	± 5°	± 3.6°
35	6.5	± 5°	± 3.6°
36	6.3	± 5°	± 3.6°
37	6.2	± 5°	± 3.6°
38	6.0	± 5°	± 3.6°
39	5.9	± 5°	± 3.6°
40	5.7	± 5°	± 3.6°
41	5.6	± 5°	± 3.6°
42	5.4	± 5°	± 3.6°
43	5.3	± 5°	± 3.6°
44	5.2	± 5°	± 3.6°
45	5.1	± 5°	± 3.6°

Distance from Facility in nm	Degrees Off-Course = 4 nm	NDB(s)	Crossing Radial (not primary)
46	5.0	± 5°	± 3.6°
47	4.9	± 5°	± 3.6°
48	4.8	± 5°	± 3.6°
49	4.7	± 5°	± 3.6°
50.8	4.5	± 5°	± 3.6°

Table 22-2

INTERSECTIONS (Coverage) Beyond 50.8 nm			
Primary Radials = 4 nm or 4.5°, whichever is greater			
Distance from Facility in nm	nm Distance=4.5°	NDB(s)	Crossing Radial (not primary)
52	4.09	± 5°	± 3.6°
53	4.17	± 5°	± 3.6°
54	4.25	± 5°	± 3.6°
55	4.33	± 5°	± 3.6°
56	4.41	± 5°	± 3.6°
57	4.49	± 5°	± 3.6°
58	4.56	± 5°	± 3.6°
59	4.64	± 5°	± 3.6°
60	4.72	± 5°	± 3.6°
61	4.80	± 5°	± 3.6°
62	4.88	± 5°	± 3.6°
63	4.96	± 5°	± 3.6°
64	5.04	± 5°	± 3.6°
65	5.12	± 5°	± 3.6°
66	5.19	± 5°	± 3.6°
67	5.27	± 5°	± 3.6°
68	5.35	± 5°	± 3.6°
69	5.43	± 5°	± 3.6°
70	5.51	± 5°	± 3.6°
71	5.59	± 5°	± 3.6°
72	5.67	± 5°	± 3.6°
73	5.75	± 5°	± 3.6°
74	5.82	± 5°	± 3.6°
75	5.90	± 5°	± 3.6°
76	5.98	± 5°	± 3.6°
77	6.06	± 5°	± 3.6°
78	6.14	± 5°	± 3.6°
79	6.22	± 5°	± 3.6°
80	6.30	± 5°	± 3.6°

Distance from Facility in nm	nm Distance=4.5°	NDB(s)	Crossing Radial (not primary)
81	6.37	± 5°	± 3.6°
82	6.45	± 5°	± 3.6°
83	6.53	± 5°	± 3.6°
84	6.61	± 5°	± 3.6°
85	6.69	± 5°	± 3.6°
86	6.77	± 5°	± 3.6°
87	6.85	± 5°	± 3.6°
88	6.93	±5°	± 3.6°
89	7.00	±5°	±3.6°
90	7.08	± 5°	± 3.6°
91	7.16	± 5°	± 3.6°
92	7.24	± 5°	± 3.6°
93	7.32	± 5°	± 3.6°
94	7.40	± 5°	± 3.6°
95	7.48	± 5°	± 3.6°
96	7.56	± 5°	± 3.6°
97	7.63	± 5°	± 3.6°
98	7.71	± 5°	± 3.6°
99	7.79	± 5°	± 3.6°
100	7.87	± 5°	± 3.6°
101	7.95	± 5°	± 3.6°
102	8.03	± 5°	± 3.6°
103	8.11	± 5°	± 3.6°
104	8.18	± 5°	± 3.6°
105	8.26	± 5°	± 3.6°
106	8.34	± 5°	± 3.6°
107	8.42	± 5°	± 3.6°
108	8.50	± 5°	± 3.6°
109	8.58	± 5°	± 3.6°
110	8.66	± 5°	± 3.6°
111	8.74	± 5°	± 3.6°
112	8.81	± 5°	± 3.6°
113	8.89	± 5°	± 3.6°
114	8.97	± 5°	± 3.6°
115	9.05	± 5°	± 3.6°
116	9.13	± 5°	± 3.6°
117	9.21	± 5°	± 3.6°
118	9.29	± 5°	± 3.6°
119	9.37	± 5°	± 3.6°
120	9.44	± 5°	± 3.6°
121	9.52	± 5°	± 3.6°
122	9.60	± 5°	± 3.6°
123	9.68	± 5°	± 3.6°
124	9.76	± 5°	± 3.6°
125	9.84	± 5°	± 3.6°

Distance from Facility in nm	nm Distance=4.5°	NDB(s)	Crossing Radial (not primary)
126	9.92	± 5°	± 3.6°
127	10.00	± 5°	± 3.6°
128	10.07	± 5°	± 3.6°
129	10.15	± 5°	± 3.6°
130	10.23	± 5°	± 3.6°
131	10.31	± 5°	± 3.6°
132	10.39	± 5°	± 3.6°
133	10.47	± 5°	± 3.6°
134	10.55	± 5°	± 3.6°
135	10.62	± 5°	± 3.6°
136	10.70	± 5°	± 3.6°
137	10.78	± 5°	± 3.6°
138	10.86	± 5°	± 3.6°
139	10.94	± 5°	± 3.6°
140	11.02	± 5°	± 3.6°
141	11.10	± 5°	± 3.6°
142	11.18	± 5°	± 3.6°
143	11.25	± 5°	± 3.6°
144	11.33	± 5°	± 3.6°
145	11.41	± 5°	± 3.6°
146	11.49	± 5°	± 3.6°
147	11.57	± 5°	± 3.6°
148	11.65	± 5°	± 3.6°
149	11.73	± 5°	± 3.6°
150	11.81	± 5°	± 3.6°
151	11.88	± 5°	± 3.6°
152	11.96	± 5°	± 3.6°
153	12.04	± 5°	± 3.6°
154	12.12	± 5°	± 3.6°
155	12.20	± 5°	± 3.6°
156	12.28	± 5°	± 3.6°
157	12.36	± 5°	± 3.6°
158	12.43	± 5°	± 3.6°
159	12.51	± 5°	± 3.6°
160	12.59	± 5°	± 3.6°
161	12.67	± 5°	± 3.6°
162	12.75	± 5°	± 3.6°
163	12.83	± 5°	± 3.6°
164	12.91	± 5°	± 3.6°
165	12.99	± 5°	± 3.6°

Distance from Facility in nm	nm Distance=4.5°	NDB(s)	Crossing Radial (not primary)
166	13.06	± 5°	± 3.6°
167	13.14	± 5°	± 3.6°
168	13.22	± 5°	± 3.6°
169	13.30	± 5°	± 3.6°
170	13.38	± 5°	± 3.6°
171	13.46	± 5°	± 3.6°
172	13.54	± 5°	± 3.6°
173	13.62	± 5°	± 3.6°
174	13.69	± 5°	± 3.6°
175	13.77	± 5°	± 3.6°
176	13.85	± 5°	± 3.6°
177	13.93	± 5°	± 3.6°
178	14.01	± 5°	± 3.6°
179	14.09	± 5°	± 3.6°
180	14.17	± 5°	± 3.6°
181	14.25	± 5°	± 3.6°
182	14.32	± 5°	± 3.6°
183	14.40	± 5°	± 3.6°
184	14.48	± 5°	± 3.6°
185	14.56	± 5°	± 3.6°
186	14.64	± 5°	± 3.6°
187	14.72	± 5°	± 3.6°
188	14.80	± 5°	± 3.6°
189	14.87	± 5°	± 3.6°
190	14.95	± 5°	± 3.6°
191	15.03	± 5°	± 3.6°
192	15.11	± 5°	± 3.6°
193	15.19	± 5°	± 3.6°
194	15.27	± 5°	± 3.6°
195	15.35	± 5°	± 3.6°
196	15.43	± 5°	± 3.6°
197	15.50	± 5°	± 3.6°
198	15.58	± 5°	± 3.6°
199	15.66	± 5°	± 3.6°
200	15.74	± 5°	± 3.6°

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CHAPTER 23

RADIO FREQUENCY INTERFERENCE DETECTION

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CHAPTER 23

RADIO FREQUENCY INTERFERENCE DETECTION

23.10 INTRODUCTION. The radio frequency spectrum, particularly in the VHF communication and navigation bands, is the subject of increasing interference from many sources. This chapter describes the role of flight inspection and presents techniques of flight inspection in the location of Radio Frequency Interference (RFI) to Communications, Navigation, and Surveillance (CNS) systems, including satellite Global Positioning System (GPS).

a. **Airborne investigation** of RFI is usually the last resort and should not be used until all reasonable ground methods are tried. In general, if an interfering signal can be received on the ground, it can be located through ground investigation. In few instances, usually in remote areas, it may be impractical to use any ground methods. If the source of interference is not near a ground receiver, it may only affect the airborne reception and must be located through use of an aircraft. Although the aircraft has pinpointed some RFI sources, it is generally sufficient to narrow the location down to an area small enough to cover with ground equipment.

b. **Types of Interferers.** Interference to CNS systems may take several forms, from broadband noise to narrow-band signals. Interference may be constant or intermittent, either predictable or random. Most interference is unintentional, although there have been instances of intentional disruption of air traffic services by individuals or groups for various purposes. Knowing the characteristics of the various types of interference is a key factor in locating their source.

(1) **Unintentional interference** to CNS systems is usually the result of defective equipment or intermodulation of two or more frequencies. Most cases requiring airborne investigation are due to spurious emissions from defective electric or electronic devices. Many frequencies generated by malfunctioning equipment are not stable and may drift, impacting several victim frequencies.

(2) **Intentional interference** is usually directed at VHF communications frequencies. Some intentional interference has been disguised as unintentional, but the majority of cases involve voice or music transmitted from a normal VHF transceiver. Some rare cases involve “Phantom Controllers” attempting to misdirect aircraft. As intentional interference to CNS systems is a criminal activity, investigative methods and results should be treated as confidential information to avoid compromising any prosecution of the offenders.

23.11 PREFLIGHT REQUIREMENTS

a. **Facility Maintenance Personnel.** Tasking for a formal airborne RFI investigation must be initiated by National Operations Control Center (NOCC) Spectrum Engineering Services Liaison through Flight Inspection Central Operations (FICO). Searches for routine, unintentional interference usually require only that the regional Frequency Management Office (FMO) has accomplished a "table top" study of aircraft reports and has determined a likely starting place for the mission. For complex or intentional disruption of service, the NOCC/ FICO/ Service Area FMO must ensure ground and air efforts are coordinated. Such coordination should include non-VHF communications and alternate aircraft call signs as necessary for covert operations.

b. **Flight Personnel.** Unless both systems are simultaneously accessible by one person, it may be advantageous to have two technicians, one using the spectrum analyzer, and the other using the Direction Finding (DF) equipment. If the signal is difficult to find, consultation or participation of the local or national spectrum managers should be sought, and these phone contacts kept in the aircraft.

23.12 FLIGHT INSPECTION PROCEDURES. Use the equipment and techniques of Paragraph 23.14 for missions dispatched to search for RFI. Flight inspectors should remain alert to any suspected interference throughout normal flight activities. Any possible interference received must be investigated as thoroughly as possible within the constraints of equipment capabilities and mission limits.

a. **If interference is suspected within the Standard or Expanded Service Volume** of a facility undergoing flight inspection, attempt to get the facility shut down and verify the presence and characteristics of the interfering signal. If time and circumstances permit, try to identify the source. If it is not readily found, report the findings to the Service Area FMO for ground analysis before further airborne attempts.

b. **If interference is to a facility or frequency used for normal flight operations,** use the applicable techniques from Paragraph 23.14 to analyze the problem. Documenting the signal characteristics at multiple locations along the route of flight will significantly aid the Service Area FMO in determining the next step in the process.

23.13 CHECKLIST. There are no specific checklist items for RFI detection and location.

23.14 DETAILED PROCEDURES

a. Airborne Equipment

(1) **DF Equipment.** The DF receiver system produces a strobe indication giving a Line of Bearing (LOB) from the aircraft to the transmission source. Following the strobe will bring the aircraft to the signal source. Usually, the aircraft is too high on the initial pass over the signal source for its identification. A descending 270° turn to pass over the signal from a different direction may aid in its location.

(2) **Spectrum Analyzer.** Many interfering signals are not on the affected frequency but are within the victim receiver's bandwidth. Tuning the DF receiver to the affected frequency with its bandwidth set too narrow will degrade its effectiveness. Use the spectrum analyzer to find the center frequency and effective bandwidth of any signals that appear close enough to the victim frequency to be the likely interferer.

CAUTION

Notify flight crew when in VHF mode VHF #2 inoperative for communications

(3) **Flight inspection receivers** can be tuned slightly above or below the affected facility frequency to find a peak in signal strength through the flight inspection equipment. This may help find the center frequency of the interference source.

(4) **Audio Recording.** Flight inspection aircraft should be equipped with audio recorders capable of recording from the various communications or navigational radios as selected by the crew. Record the interference whenever practical to assist FMO personnel in characterizing the signals.

(5) **Autonomous GPS recording capability** is available in some flight inspection aircraft. It continually monitors the GPS signal for any anomalies and stores up to 24 "events" of unsatisfactory GPS data. The airborne technician should monitor this capability and report any new "Events" to the FICO.

b. **Search patterns** are usually based either on signal strength or a homing receiver. The signal strength methods are less accurate but may be accomplished with more basic equipment.

(1) **Hot/ Cold.** This method requires the aircraft to go closer or further from the interferer while the signal strength or best signal to noise ratio (SNR) is noted. If the aircraft travels in a straight line, the peak of the signal should be when the transmitter is directly off the aircraft wing. Another track flown 90° from the first will provide another peak. Sequentially flying a "box pattern" of decreasing size will locate the interference.

(2) The second method, particularly useful for finding GPS interference, requires antennas both on the top and bottom of the aircraft feeding separate sensors. With the bottom antenna fed to a receiver or spectrum analyzer and the top to a GPS receiver, the aircraft is banked to both sides. As the GPS interference will be from the ground, banking the aircraft away from the interferer exposes the bottom sensor antenna to more of the interfering signal, decreasing the SNR. It also shades the top antenna from the ground interference and increases the SNR on that receiver. No significant change while banking either left or right indicates the interference is in front or behind the aircraft. Changes in direction can eventually narrow the search area.

(3) **Triangulation.** A radiation source can be located by using the DF Receiver to get LOB from two or more locations. Using a geodetic calculator program with an "Intersection" function, the coordinates of the receiver(s) and the lines of bearing (True) are input, and the result is the coordinates of the intersection. It is important to use the correct aircraft heading reference (true or magnetic) to correlate with the DF receiver direction reference. The more samples taken with the receiver locations separated by several miles increase the accuracy of the intersection coordinates.

23.15 ANALYSIS

a. **Intermittent Interference.** Some interference occurs intermittently in either a random or predictable time pattern. Locating these type signals is sometimes very difficult and may take several attempts, with each attempt gathering one or more receiver coordinates and lines of bearing. Each piece of information gathered should be filed together with all data reevaluated as new information is obtained. Assuming the interference source is not physically moving, time has no impact on the data quality. Interfering signals may also move in frequency, i.e., sweep through the victim band. In this case, the bandwidth on the Spectrum Analyzer should be increased. They may also change in modulation, i.e., change in appearance on the spectrum analyzer when the bandwidth is narrow.

b. **Analyze the interfering signal** as much as possible, using the equipment and techniques in Table 23-1, to provide as much information as possible to the Service Area FMO.

Table 23-1

System	Record Audio	Detune Receiver	Spectrum Analyzer	Oscilloscope
VHF/ UHF Comm	X	X	X	
NDB/ ADF	X	X	X	
VOR/ ILS	X	X	X	
TACAN/ DME		X	X	X
MLS		X	X	X
GPS			X	
VHF		X	X	X
DATALINK				

23.16 TOLERANCES. Tolerances applicable to specific facilities are contained in their individual chapters of this order.

23.17 ADJUSTMENTS. Adjustments to systems to mitigate RFI will be as directed by the applicable system engineer.

23.18 RECORDS AND REPORTS. Complete a flight inspection report for the affected facility, using the form designated for that type facility, IAW FAA Order 8240.36. Reports on intentional interference and the original audio or signal trace recordings of such RFI must be maintained as evidentiary material for possible use in legal action. Copies of such recordings may be made available to FAA FMO(s) or other applicable Government agencies for their use. Release of other copies must be in accordance with the Freedom of Information Act (FOIA).

CHAPTER 24

MILITARY CONTINGENCY
AND NATURAL DISASTER
FLIGHT INSPECTION PROCEDURES

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CHAPTER 24

MILITARY CONTINGENCY AND NATURAL DISASTER FLIGHT INSPECTION PROCEDURES

SECTION 1

GENERAL

24.10 INTRODUCTION. The potentially catastrophic consequences of a major natural disaster or the need to respond quickly to a military combat operation necessitates advanced planning and definition of operational requirements. The ability to provide sustained flight inspection support for the numerous and diverse requirements which may exist will be predicated upon the use of abbreviated flight inspection procedures. Flight inspection will greatly depend on both air traffic and facility maintenance support preparations.

a. Purpose. The guidance, procedures, and tolerances contained in this chapter describe the **minimum** facility performance standards when contingency situations require deviation from normal standards. Basic flight inspection requirements and methods of taking measurements apply to the contingency chapter unless specific guidance or tolerances are given. Facilities/ procedures which have been placed in operation using these procedures must be re-inspected to normal standards as soon as circumstances permit.

b. Authority. The authority to implement these provisions may be exercised by either the military or FAA. When military authority determines that an operational situation dictates the application of these procedures and tolerances, the appropriate flight inspection activity and the FAA Aviation System Standards Office (AVN) Manager, Flight Inspection Operations Office must be notified. Application to civil facilities will be determined by appropriate FAA authority, who must notify both Flight Inspection Operations and the appropriate military authority.

24.11 FLIGHT INSPECTION REQUIREMENTS

a. Personnel Requirements. Flight inspection personnel, performing facility/ procedure inspection and certification using the provisions of this chapter, must be authorized and certified to perform flight inspection duties.

b. Aircraft and Equipment

(1) If necessary, equipment which has exceeded calibration due dates may be used for flight inspection under the following sections. Calibrated equipment must be used when the facility is subsequently inspected using standard procedures.

(2) The use of other than a flight inspection-configured aircraft may be necessary. Reliability of such equipment must be established before use by the flight inspector. Examples of test methods available to verify the accuracy of uncalibrated flight inspection systems or aircraft not equipped with a flight inspection system are:

(a) Comparison with a facility verified by maintenance, or another flight inspection aircraft, as operating normally.

(b) Comparison with two or more facilities in operation.

(c) Use of a VOT or similar radiated test signal.

24.12 FLIGHT INSPECTION DOCUMENTATION AND REPORTS

a. All facilities/ procedures inspected using the provisions of this chapter must be assigned a status classification of **restricted.** All flight inspection records must be retained until the facility/ procedure can be inspected using normal procedures and tolerances.

b. In the event that flight inspection equipment is inoperative or not available, flight inspections will continue to meet operational requirements until replacement or repair is practical. Under these circumstances, the flight inspection crew is responsible for documenting all of the applicable data displayed by instrumentation at their duty positions. All such manually-acquired data must be identified in the remarks section of the flight inspection report. The facility/ procedure must be reflown with operational flight inspection equipment when conditions permit.

c. Completion and distribution of flight inspection reports are secondary to the accomplishment of flight inspection. At the conclusion of the inspection, the flight inspector must pass the facility status to the air traffic control watch supervisor. This will suffice as the official report until the written report has been completed and distributed.

d. The flight inspector must ensure that flight inspection reports are completed and submitted for processing. Each parameter specified in this section’s flight inspection procedures checklists must be reported. Flight inspection reports may be handwritten using reproducible ink.

e. Records and reports must reflect that the inspection was accomplished using MILITARY CONTINGENCY FLIGHT INSPECTION PROCEDURES or NATURAL DISASTER FLIGHT INSPECTION PROCEDURES, as appropriate. If only the final and missed approach segments were inspected, annotate the facility is in operation for “approach use only.”

SECTION 2

MILITARY CONTINGENCY PROCEDURES

24.20 INSPECTION TYPES

a. **Only special and commissioning type flight inspections** will be conducted under the procedures contained in this section. A commissioning flight inspection under this section will provide a limited-use facility where only the desired instrument procedures are supported.

b. **After-accident flight inspection** must follow normal procedures to the maximum extent possible.

24.21 FREQUENCY OF INSPECTIONS

a. **Non-precision.** All non-precision facilities will be re-commissioned using this section or the applicable chapter of this manual, as conditions warrant, within the period of 180 to 360 days after the previous contingency inspection. If the facility goes more than 360 days without being re-commissioned, and the controlling military commander wishes to continue to use the facility, it will convert to a "For Military Use Only" facility as described in Paragraph 24.24d, and the appropriate NOTAM(s) must be issued.

b. **Precision.** All precision facilities will be re-commissioned using this section or the applicable chapter of this manual, as conditions warrant, within the period of 90 to 180 days after the initial contingency inspection. If the precision facility was re-commissioned using contingency procedures with the 90 to 180 period, the facility periodicity would transition to 180 days, then 270 days. Due date window for subsequent inspections is ± 60 days. If after the initial inspection the facility goes more than 180 days without being re-commissioned or due date windows for subsequent inspections are not met, and the controlling military commander wishes to continue to use the facility, it will convert to a "For Military Use Only" facility as described in Paragraph 24.24d, and the appropriate NOTAM(s) must be issued.

24.22 PRE-INSPECTION REQUIREMENTS. The combatant commander being supported, or appropriate designee, is required to supply the flight inspection crew with the necessary support to accomplish the mission. This may include, but is not limited to, crew and airplane bed down, current intelligence, threat assessment, theater Special Instructions (SPINs), entry in the Air Tasking Order (ATO), and, if deemed necessary, escort aircraft. The flight inspection crew must provide proper documentation to gain access to any classified information.

a. Prior to arriving on location, the flight inspector mission commander or the controlling military office must contact the airfield operations commander and the navigation aid maintenance supervisor in order to coordinate the following items:

(1) Arrival time

(2) Operational requirements as defined by the airfield operations commander.

(3) Airspace requirements for conducting the flight inspection profile.

(4) Anticipated support such as refueling, ground transportation for a theodolite operator, etc.

b. The airfield operations commander must accomplish the following prior to arrival of the flight inspection aircraft.

(1) Make final determination regarding operational requirements for the facilities and SIAP(s) requiring flight inspection, and be prepared to brief changes on initial contact.

(2) Coordinate airspace requirements and obtain necessary clearances from appropriate airspace control authorities for conducting the inspection.

(3) If required, designate and brief an air traffic controller to work the flight inspection aircraft.

(4) Provide current Facility Data Sheet (FAA Form 8240-22) for each facility to be inspected.

c. The navigation aid maintenance supervisor must:

(1) Ensure adequate radio communications are available and operational.

(2) Assign qualified maintenance personnel to support the flight inspection of the equipment being inspected.

(3) Assist the airfield operations commander in completing FAA Form 8240-22 (Facility Data Sheet) for each facility to be inspected.

(4) Arrange for ground transportation for the theodolite operator if necessary.

24.23 INSTRUMENT PROCEDURES

a. Approach Procedure

(1) **The minimum flight inspection** required to certify SIAP(s) predicted on ground-based facilities is the inspection of the final approach and missed approach segments. Area navigation (RNAV) procedures require the inspection of the intermediate, final, and missed approach segments. A night inspection is not required for an airfield/ runway conducting **military only** operations.

(2) **If an approach must be established,** the flight inspector may be responsible for establishing final and missed approach segments. Both segments of the procedure must be flown and recorded to establish and document flyability, accuracy, reliability, and obstacle clearance. The flight inspector must record the SIAP on the flight inspection report and provide the air traffic control watch supervisor with adequate detail for issuance of the NOTAM.

(3) **In all cases, the flight inspector must** determine, through visual evaluation, that the final and missed approach segments provide adequate terrain and obstacle clearance.

(4) If a circling maneuver is desired, the flight inspector must comply with Paragraph 6.12g. Otherwise, a NOTAM stating that circling is not authorized must be issued.

b. **En Route and Transition Coverage.** If there is a need for facility coverage to provide en route and environment guidance, air traffic control may use aircraft of opportunity to fly the transition procedure. Pilot reports of satisfactory cockpit instrument performance and controller evaluation of radar target strengths are sufficient for air traffic control to determine usability.

c. **Departure Procedure**. The minimum flight inspection required to certify departure procedures is that the departure provides adequate terrain and obstacle clearance and satisfactory navigational guidance in the initial departure segment.

d. **Communications.** Communications inspections will be conducted concurrently with other inspections. User aircraft may be used.

24.24 FACILITY STATUS AND NOTAM(s)

a. Prior to beginning the inspection, the flight inspector must ascertain from the air operations commander the intended operational use of the facility. After completing the inspection, the inspector must determine the facility status and advise the air traffic control watch supervisor prior to departing the area.

b. Upon being advised of the status, the air traffic control watch supervisor must ensure issuance of applicable NOTAM(s). As a minimum, the NOTAM must include who can use the procedure and any limiting conditions. Lengthy NOTAM(s) which describe NAVAID(s) in great detail will not be issued. The flight inspector must subsequently record the NOTAM text in the Remarks section of the applicable flight inspection report.

c. NOTAM Examples. The following are examples of conditions and prescribed NOTAM(s).

(1) Approach procedures checked using military contingency section.

NOTAM: Kandahar AB, Afghanistan, KAF TACAN, restricted to OPERATION ENDURING FREEDOM. HI TACAN RWY 3 approach only.

(2) Circling not checked, final and missed approach segments checked using military contingency section. NOTAM: Baghdad International, Iraq, BAP TACAN, restricted to OPERATION IRAQI FREEDOM. HI TACAN RWY 15L & HI TACAN RWY 33R approach use only. Circling NA.

(3) Approaches and departures checked using military contingency section. NOTAM: Basrah International, Iraq, BAR TACAN, restricted to OPERATION IRAQI FREEDOM. TACAN RWY 14, TACAN RWY 32 approaches & MGOUG ONE DEP only.

(4) PAR checked using military contingency section. NOTAM: Bagram AB, Afghanistan, PAR RWY 03, restricted to OPERATION ENDURING FREEDOM.

d. **The flight inspector has the authority and responsibility** for determining that a NAVAID can safely and adequately support the operations intended under contingency conditions. However, military commanders have final authority and responsibility for operation of military facilities which are not part of the common system, and may elect to use those facilities FOR MILITARY MISSIONS. Additionally, the military may elect to use a military or civil NAVAID, which is part of the common system, even though that NAVAID is considered unusable by the flight inspector. In all such cases, the military commander that controls the NAVAID is responsible for issuing the appropriate NOTAM advising that the NAVAID is in operation "For Military Use Only" and stating which aircraft are authorized to use it.

SECTION 3

NATURAL DISASTER PROCEDURES

24.30 INSPECTION TYPES. Only special type flight inspections will be conducted under the procedures contained in this section.

24.31 FREQUENCY OF INSPECTIONS

a. **Non-precision.** All non-precision facilities will be re-inspected using this section or the applicable chapter of this manual, as conditions warrant, within the period of 180 to 360 days after the previous contingency inspection. If the facility goes more than 360 days without being re-inspected, the FICO must initiate NOTAM action to remove them from service.

b. **Precision.** All precision facilities will be re-inspected using this section or the applicable chapter of this manual, as conditions warrant, within the period of 90 to 180 days after the initial contingency inspection. If the precision facility was re-inspected using contingency procedures with the 90 to 180 period, the facility periodicity would transition to 180 days, then 270 days. Due date window for subsequent inspections is ± 60 days. If after the initial inspection the facility goes more than 180 days without being re-inspected or due date windows for subsequent inspections are not met, the FICO must initiate NOTAM action to remove them from service.

24.32 FACILITY STATUS AND NOTAM(s). Prior to beginning the inspection, the flight inspector must ascertain from air traffic control the intended operational use of the facility. After completing the inspection, the inspector must determine the facility status for emergency use and advise the air traffic control watch supervisor prior to departing the area. NOTAM(s)/ Restrictions must be issued for airspace within the Flight Inspection SSV not checked, i.e., “PWA VOR: Approach Use Only”, or “IRW VORTAC Azimuth and DME unusable 031° cw 009°; 010° cw 030° beyond 15 nm”.

Upon being advised of the status, the air traffic control watch supervisor must ensure issuance of applicable NOTAM(s). Unusable SIAP(s), or portions thereof, must be included in the NOTAM (e.g., ELP VOR and TACAN: VOR SIAP Runway 26L unusable TACAN SIAP Runway 26L unusable). The NOTAM for a civil facility must be issued as a NOTAM D to ensure that information is made available using the most expeditious method. Lengthy NOTAM(s) which describe NAVAID(s) in great detail will not be issued. The flight inspector must subsequently record the NOTAM text in the Remarks section of the applicable flight inspection report.

SECTION 4. FLIGHT INSPECTION PROCEDURES/ TOLERANCES

24.40 ILS GLIDE SLOPE

Checks Required	Tolerances/ Procedures
Modulation	The modulation and carrier energy level is such that the flag is hidden in the area identified as usable.
Angle	± 0.5° of desired or commissioned angle.
Coverage	Minimum 15 µV signal, 2 nm outside OM or FAF, whichever is further.
Clearance (1)	Minimum 150 µA (full scale) fly up and clear all obstructions prior to 1,000 ft from threshold
Width, Symmetry, and Structure Below Path (SBP) (1)	(Level Run) Width 0.7° ± 0.2°; Symmetry 67 – 33%; Structure Below Path: 190 µA point occurs at or above 30% of the commissioned angle. If can’t meet SBP tolerance, clearance procedures and tolerances will be applied.
Course Structure	45 µA from graphical average for all zones if restricted to manual approaches. Standard tolerances apply if used for coupled approaches.
Flyability	Any condition that may induce confusion will render the facility unusable.
PAR Coincidence	0.2°. If PAR/ ILS coincidence cannot be established, a NOTAM must be issued.

(1) When supporting an operation that may require long-term use of the same facility before normal inspection procedures can be used, a clearance-below-path check is not required on subsequent Chapter 24 inspection of the same ILS facility, provided no changes have been made to the system that would normally require a clearance check in Chapter 15. A significant shift in SBP from previous inspections should be investigated further, including flying a clearance below path.

NOTE: These tolerances and procedures are valid for Category I minimums only. If operational requirements dictate the restoration/ commissioning to Categories II or III standards, the flight inspector must use normal procedures (see Chapter 15).

24.41 ILS LOCALIZER

Checks Required	Tolerances/Procedures
Identification	Sufficient information to identify the facility. ID must not render the facility unusable.
Modulation	The modulation and carrier energy level is such that the flag is hidden at all times in the area identified as usable.
Coverage	15 nm minimum coverage area with 5 µV minimum signal, not less than 10° each side of on-course position.
Course Structure	± 45 µA from graphical average for all zones if restricted to manual approaches. Standard tolerances apply if used for coupled approaches.
Alignment	30 µA from designated procedural azimuth.
Clearance	150 µA minimum throughout established coverage area
Obstructions	Evaluate obstruction effect on procedure
Flyability	Any condition that may induce confusion will render the facility unusable.
Polarization	± 30 µA

NOTE: These tolerances and procedures are valid for Category I minimums only. If operational requirements dictate the restoration/ commissioning to Categories II and III standards, the flight inspector must use normal procedures (see Chapter 15).

24.42 MARKERS/ BEACONS

Checks Required	Tolerances/ Procedures
Identification	Correct/ sufficient to illuminate the proper bulb modulation
Coverage	
Major Axis	Not less than ± 1/3 HSI deflection
Minor Axis	
Outer marker	3,000 ft ± 2,000 ft
Middle marker	No limit
Inner marker	No limit
Fan marker	3,000 ft ± 2,000 ft if used for obstacle clearance; otherwise, no limit

NOTES: These tolerances and procedures are valid for Category I minimums only.
If an operational marker or beacon is not available for establishing aircraft position in relation to runway threshold, other methods of position identification (DME fix, radar fix or crossing radial) may be substituted.

24.43 MICROWAVE LANDING SYSTEM

Checks Required	Tolerances/Procedures
Horizontal Coverage	5° each side beyond procedural use at 3 nm beyond procedural use
Vertical Coverage	3 nm beyond furthest procedural use at 0.75 MGP
Alignment/ Angle	0.10° from optimum
Path Following Error	AZ 0.50°/ EL 0.40°
Control Motion Noise	Approach AZ/ MGP 0.30°, if used for manual approaches. Standard tolerance for coupled use. Other areas, 0.8°.
Low Angle EL Clearance	Fly 0.75 MGP, adequate AZ and EL guidance and obstruction clearance FAF to MAP on procedural AZ, observe each side for obstructions within 2° laterally.
Data Words	Multiply acceptable tolerances contained in Paragraphs 16.23f and 16.35f by a factor of 3.0.
DME	No unlocks in final approach segment, accuracy 3.0% of charted distance.
IDENT	Correct as published
PAR/ ILS Angle Coincidence	0.20°. If coincidence cannot be established, a NOTAM must be issued.

24.44 VOR

Checks Required	Tolerances/Procedures
Identification	Sufficient information to identify the facility. ID must not render any parameter unusable.
Sensing and Rotation	Correct
Polarization	± 4.0°
Modulation	AM: 25 to 35% FM Deviation Ratio: 14.8 - 17.2 9960: 20 - 35% with voice 20 - 55% without voice Modulation exceeding the listed tolerances is acceptable, using the following criteria: .05 nm in any 1.0 nm segment from FAF to MAP 0.25 nm in any 5 nm segment from sea level up to 10,000 ft MSL 0.5 nm in any 10 nm segment from 10,001 to 20,000 ft MSL 1.0 nm in any 20 nm segment above 20,000 ft MSL
Approach	Alignment within ± 2.5°. Structure not to exceed ± 6.0°. Inspect from FAF to MAP.
Missed Approach	Meets flyability constraints until clear of obstructions and course is established.
En Route	Alignment within ± 4.0°. Structure not to exceed ± 6.0°.
Monitors	To be set and checked by maintenance. Flight inspection will verify when practical.
Standby Equipment	Will be checked by transmitter change on approach and en route radials.
Coverage	Sufficient to support requirements.
Flyability	Any condition that may induce confusion will render the procedure or facility unusable.
Voice	Voice must not render any parameter unusable.

NOTE 1: Alignment orbit, coverage orbit, transmitter differential, and inspection of radials 5° each side of final approach radial are not required.

NOTE 2: Final approach segments may be inspected inbound or outbound.

24.45 TACAN

Checks Required	Tolerances/ Procedures
Identification	Sufficient information to identify the facility. ID must not render any parameter unusable.
Sensing and Rotation	Correct
Polarization	± 4.0°
Distance Accuracy	3% of charted value or 1.0 nm, whichever is greater
Approach	Alignment within ± 2.5°. Structure not to exceed ± 6.0°. ¼ nm aggregate azimuth, DME unlock, or out-of-tolerance structure permitted. Inspect from FAF to MAP.
Missed Approach	Meets flyability constraints until clear of obstructions and course is established.
En Route	Alignment within ±4.0°. Structure not to exceed ±6.0°. 1.0 nm aggregate azimuth, DME unlock, or out-of-tolerance structure permitted in any 5 nm of radial flight.
Monitors	To be set and checked by maintenance. Flight inspection will verify when practical.
Standby Equipment	Will be checked by transponder change on approach and en route radials
Coverage	Sufficient to support requirements.
Flyability	Any condition that may induce confusion will render that procedure or facility unusable.

NOTE 1: Alignment orbit, coverage orbit, transmitter differential, and null checks are not required.

NOTE 2: Final approach segments may be inspected inbound or outbound.

24.46 SHIPBOARD TACAN

Checks Required	Tolerances/Procedures
Identification	Sufficient information to identify the facility. ID must not render any parameter unusable.
Sensing and Rotation	Correct
Polarization	± 4.0
Distance Accuracy	3% or 1.0 nm, whichever is greater
Approach	Alignment within ±2.5°. Structure not to exceed ±6.0°· ¼ nm aggregate azimuth, DME unlock, or out-of-tolerance structure permitted. Fly the radial from a minimum of 7 nm and 700 ft MSL to pass over the ship at 300 ft MSL.
En Route	Alignment within ± 4.0°. Structure not to exceed ± 6.0°. 1.0 nm aggregate azimuth, DME unlock, or out-of-tolerance structure permitted in any 5 nm of radial flight.
Equipment Stability	Stability will be checked during radial inspection by requesting the ship to turn left 15° and then right 15°. Advise the ship's personnel of any change in azimuth or alignment during the turns.
Standby Equipment	Will be checked by transponder change on approach and en route radials
Flyability	Any condition that may induce confusion will render that procedure or facility unusable

24.47 PAR

Checks Required	Tolerances/Procedures
Course Alignment	Sufficient to guide an aircraft down the runway centerline extended, within ± 50' of runway centerline at threshold. Helicopter-only approaches require delivery to within 50' either side of desired touchdown point.
Glidepath Alignment	± 0.5° of the commissioned angle. If PAR/ ILS coincidence (± 0.2°) cannot be established, a NOTAM must be issued.
Lower Safe Limit	Clear all obstacles to threshold
Coverage	Sufficient to meet operational requirements.
Range Accuracy	5% of true range and sufficient to determine when aircraft is over threshold
Flyability	Any condition that may induce confusion will render the facility unusable.

24.48 ASR/ ATCRBS RADAR

Checks Required	Tolerances/ Procedures
Azimuth Accuracy	En route--within ± 5° Approaches: 1. Straight-in within 500' of the edges of the runway at the MAP. 2. Approach to airport/ circling within a radius of the MAP which is 5% of the aircraft-to-antenna distance or 1,000', whichever is greater.
Range Accuracy	Approach and en route within 5% of fix-to-station distance or 500', whichever is greater.
Coverage	Sufficient to support requirement. Targets of opportunity may be used by air traffic personnel. Standard vertical and horizontal coverage profiles not required.

24.49 HOMING BEACONS

Checks Required	Tolerances/Procedures
Identification	Sufficient information to identify the facility.
Coverage	En route--± 15° needle swing. Approach--± 10° needle swing. Sufficient signal to support required use.
Station Passage	Approximately over the station at all altitudes
Flyability	Any condition that may induce confusion will render the procedure or use unusable.

24.50 DF FACILITIES

Checks Required	Tolerances/ Procedures
Same as standard	See Chapter 8

24.51 VGSI

Checks Required	Tolerances/ Procedures
Glidepath Alignment	Actual angle need not be determined but must be safe and adequate to support requirements as determined by flight inspector. If angle is measured, ± 0.5° of the commissioned angle. Angle must be suitably coincident with PAR/ MLS/ ILS to preclude pilot confusion or must be NOTAMed as non-coincidental.
Lower Safe Limit	Clear all obstacles to threshold.
Coverage	Sufficient to meet operational requirements.
Transitions	All light boxes must transition from red to white in the correct sequence.
Flyability	Any condition that may induce confusion will render the facility unusable.

24.52 RNAV PROCEDURES

Parameter	Tolerance/ Limit
Procedure Design (FMS or AFIS calculated values)	
Route/ DP/ SID/ STAR	
True Course to next WP	± 1°
Distance to next WP	± 0.1 nm
Initial/ Intermediate Approach Segment	
True Course to next WP	± 1°
Distance to next WP	± 0.1 nm
Final Approach Segment	
True Course to next WP	± 1°
Distance to next WP	± 0.1 nm
Missed Approach Segment	
True Course to next WP	± 1°
Distance to next WP	± 0.1 nm
Vertical Path	± 0.1°
FMS/ GPS	
GPS Integrity	RAIM
DME Supported RNAV	
DME Accuracy	≤ 0.20 nm

APPENDIX 1

SUPPLEMENTAL INFORMATION

SECTION 1
GLOSSARY

Definitions and Symbols. The use of italics within a definition denotes another definition contained within this section.

Actual Glidepath Alignment or Actual Glidepath Angle. The straight line arithmetic mean of all deviations around the *on-path* position derived in ILS zone 2.

Actual Course (Alignment). The straight line arithmetic mean of all deviations around the *on-course* position derived from the area in which alignment was taken.

Actual Navigation Performance (ANP). Sometimes called Estimated Position Error (EPE) or "Q" factor, is an onboard computation of the estimated 95% Navigation System Error using knowledge of the real world navigation environment, i.e., number of satellites tracked, number/geometry of ground facilities, and statistical error models of the various navigation sources. ANP is continuously compared to RNP, and the crew is alerted if ANP exceeds RNP.

AFIS Corrected Error Trace. A graphical presentation of deviation about the mean of all points measured in ILS Zone 2 for glidepaths and zones 2 and 3 for localizers.

Automatic Gain Control (AGC). A process of electronically regulating the gain in the amplification stages of a receiver so that the output signal tends to remain constant though the incoming signal may vary in strength.

AGC Current or Voltage. A current or voltage responding to the action of the AGC circuit that may be interpreted in terms of signal intensity.

Airport Surface Detection Equipment, Model X (ASDE-X) is a multi-sensor surveillance system that enables air traffic controllers to obtain enhanced situational awareness of aircraft and vehicle movement on airport runways and taxiways.

Air Traffic Control Radar Beacon System (ATCRBS). The general term of the ultimate in functional capability afforded by several automation systems. Each differs in functional capabilities and equipment. ARTS IA, ARTS II, ARTS III, and ARTS IIIA (see AIM).

Airway/Federal Airway. A control area or portion thereof established in the form of a corridor, the centerline of which is defined by navigational aids (refer to FAR Part 71, AIM).

Alignment. Coincidence of a positional or directional element with its nominal reference.

Alignment, Azimuth. The azimuth or actual magnetic bearing of a course.

Alignment, Elevation. The actual angle above a horizontal plan originating at a specific point of a course used for altitude guidance.

Alignment Error. The angular or linear displacement of a positional or directional element from its normal reference.

Alignment Error, Azimuth. The difference in degrees between the position of a selected course and the correct magnetic azimuth for this course.

> **NOTE:** The error is positive when the course is clockwise from the correct azimuth.

Alignment Error, Elevation. The difference in degrees between the measured angle of the course and the correct angle for the course.

> **NOTE:** The error is positive when the course is above the correct angle.

ALTITUDES:

- **a.** **Absolute Altitude.** The altitude of the aircraft above the surface it is flying (AC 00-6A). It may be read on a radio/radar altimeter.
- **b.** **Calibrated Altitude.** Indicated altitude corrected for static pressure error, installation error, and instrument error.
- **c.** **Indicated Altitude.** The altitude as shown by an altimeter on a pressure or barometric altimeter. It is altitude as shown uncorrected for instrument error and uncompensated for variation from standard atmospheric conditions (AIM).
- **d.** **Pressure Altitude.** Altitude read on the altimeter when the instrument is adjusted to indicate height above the standard datum plane (29.92" Hg.)(AC 61-27 latest revision).
- **e.** **True Altitude.** The calibrated altitude corrected for nonstandard atmospheric conditions. It is the actual height above mean sea level .

Ampere. A unit of electric current such as would be given with an electromotive force of one volt through a wire having a resistance of one OHM. See Symbols. See Crosspointer.

Amplitude (Peak). The maximum instantaneous value of a varying voltage or current measured as either a positive or negative value.

Anomalous Propagation. Weather phenomena resulting in a layer in the atmosphere capable of reflecting or refracting electromagnetic waves either toward or away from the surface of the earth.

Angle Voltage. The alignment points of the azimuth and elevation electronic cursors are expressed in angle voltage or dial divisions.

Antenna. A device used to radiate or receive electromagnetic signals.

Antenna Reflector. That portion of a directional array, frequently indirectly excited, which reduces the field intensity behind the array and increases it in the forward direction.

Approach Azimuth. Equipment which provides lateral guidance to aircraft in the approach and runway regions. This equipment may radiate the Approach Azimuth function or the High Rate Approach Azimuth function along with appropriate basic and auxiliary data.

Approach Elevation. The equipment which provides vertical guidance in the approach region. This equipment radiates the Approach Elevation function.

Approach Reference Datum (ARD). A point at a specified height located vertically above the intersection of the runway centerline and the threshold.

Approach with Vertical Guidance (APV). RNAV procedures with vertical guidance are termed "APV" (approach with Vertical Guidance). APV is a classification of approach capability between Non-Precision and Precision. APV landing minimums are based on the performance criteria and technology related to the Navigation System Error (NSE), Flight Technical Error, and Total System Error (TSE).

Different APV approaches, based on different technologies, are defined in the following table:

Name	Lateral Performance	Vertical Performance
RNAV (DME/ DME) with BARO-VNAV	Based on DME/ DME No NSE defined, TSE: 0.3 nm	Based on Barometer No NSE defined, FTE: Equivalent to Non Precision Approach (75 m/ 246 ft)
RNAV (GNSS) With BARO-VNAV	Based on GNSS NSE: 220 m (95%) TSE: 0.3 nm	Based on Barometer No NSE defined, FTE: Equivalent to Non Precision Approach (75 m/ 246 ft)
RNP with BARO-VNAV	Varied (depends on RNP)	Based on Barometer No NSE defined, FTE: Equivalent to Non Precision Approach (75 m/ 246 ft)
Operation using APV-I performance	Based on GNSS Equivalent to Localizer NSE and FTE	Based on GNSS NSE: 20m (95%) 50 m (limit)
Operation using APV-II performance	Based on GNSS Equivalent to Localizer NSE and FTE	Based on GNSS NSE: 8m (95%) 20m (limit) FTE: Equivalent to FTE on ILS glide slope

Area Navigation (RNAV). A method of navigation that permits aircraft operations on any desired course within the coverage of station referenced navigation signals or within the limits of self-contained system capability (AIM).

Area VOT. A facility designed for use on the ground or in the air. It may be located to provide the test signal to one or more airports.

ARINC Specification 424. ARINC Specification 424 is a standard by which a navigation database is created to interface with an airborne navigation computer (i.e., FMS, GPS receiver, etc.) The navigation database will provide paths and termination points for the navigation computer to follow. ARINC 424 defines 23 leg path and terminators. A limited number of the leg types can be used to define RNAV procedures. The leg types used to define RNP RNAV procedures are further limited in order to provide repeatable aircraft ground tracks.

Attenuation. The reduction in the strength of a signal, expressed in decibels (dB).

Average Course Signal. The course determined by drawing the mean of the maximum course deviations due to roughness and scalloping.

Azimuth. A direction at a reference point expressed as the angle in the horizontal plane between a reference line and the line joining the reference point to another point, usually measured clockwise from the reference line.

Auxiliary Data. Data, transmitted in addition to basic data, that provide facilities maintenance equipment siting information for use in refining airborne position calculations and other supplementary information.

Barometric Vertical Navigation (BARO VNAV). A navigation system which presents computed vertical guidance to the pilot. The computer-resolved Glidepath Angle (GPA) is based on barometric altitude, and is either computed as a geometric angle between two waypoints, or an angle from a single waypoint.

Baseline Extension (Loran-C). The extension of the baseline beyond the master or secondary station. Navigation in this region may be inaccurate due to geometrical considerations resulting in ambiguous position solutions.

Basic Data. Data transmitted by the facilities maintenance equipment that are associated directly with the operation of the landing guidance system.

Bearing. The horizontal direction to or from any point usually measured clockwise from true north or some other reference point (see Non-Directional Beacon)(AIM).

Bends. Slow excursions of the course.

Bits per second (BPS). Refers to digital data transfer rate, usually by modem or direct cable.

Black Hole. An area in the vicinity of an airport, which visually appears void of features normally used by the pilot for situational awareness. This term is normally associated with nighttime operations.

Blind Speed. The rate of departure or closing of a target relative to the radar antenna at which cancellation of the primary target by MTI circuits in the radar equipment causes a reduction or complete loss of signal (AIM).

Blind Zones (Blind Spots). Areas from which radio transmissions and/or radar echoes cannot be received.

Broadband. Nonautomated signal processing.

Capture Effect. A system in which coverage is achieved by the use of two independent radiation field patterns spaced on separate carrier frequencies.

Change/ Reversal in Slope of the Glidepath. A long term (1,500 ft or more) change in the direction of the *on-path* position as determined by the graphic averaging of the short term (roughness, high frequency scalloping) deviations as represented by the differential/corrected error trace.

Checkpoint. A geographical point on the surface of the earth whose location can be determined by reference to a map or chart.

Circular Polarization (CP). An electromagnetic wave for which the electronic and/or the magnetic field vector at a point describes a circle.

NOTE: Circular Polarization reduces or eliminates echoes from precipitation.

Clearance. The preponderance of the modulation signal appropriate to the area on one side of the reference line or point to which the receiver is positioned, over the modulation signal appropriate to the area on the other side of the reference line.

Clearance Guidance Sector. The volume of airspace, inside the coverage sector, within which the azimuth guidance information provided is not proportional to the angular displacement of the aircraft but is a constant fly-left or fly-right indication of the direction relative to the approach course the aircraft should proceed in order to enter the proportional guidance sector.

Close-in Courses. That portion of a course or radial which lies within 10 miles of the station.

Code Train. A series of pulses of similar characteristics and specific spacing. Applicable to the group of pulses transmitted by a transponder each time it replies to an interrogator.

Comma-Separated Values (CSV) file. In computers, a CSV file contains the values in a table as a series of ASCII text lines organized so that each column value is separated by a comma from the next column's value and each row starts a new line. A CSV file is a way to collect the data from any table so that it can be conveyed as input to another table-oriented application.

Common Digitizer Data Reduction Program (CD). A computer data recording of raw narrowband radar data (minimal filtering ability is provided).

Cone of Ambiguity. Airspace over a VOR or TACAN station, conical in shape, in which the To/From ambiguity indicator is changing positions.

Constant False Alarm Rate (CFAR). PAR electronic circuitry which allows search video clutter reduction on the radar display presentation.

Control Electronic Unit (CEU). Mobile MLS computer transmitter and monitoring system.

Control Motion Noise (CMN). Those fluctuations in the guidance which affect aircraft attitude, control surface, column motion, and wheel motion during coupled flight but do not cause aircraft displacement from the desired course or glidepath.

Cooperating Aircraft. Aircraft which cooperate by flying courses required to fulfill specific portions of the flight inspection and which meet the requirements for a small aircraft.

Cosecant-Squared Beam. A radar beam pattern designed to give approximately uniform signal intensity for echoes received from distant and nearby objects. The beam intensity varies as the square of the cosecant of the elevation angle.

Course Coincidence. The measured divergence of the designated radials of two adjacent facilities in the airway structure. (ICAO Document 8071).

Course Displacement. The difference between the actual course alignment and the correct course alignment. (ICAO Document 8071).

Course Error. The difference between the course as determined by the navigational equipment and the actual measured course to the facility. This error is computed as a plus or minus value, using the actual measured course to the facility as a reference.

Course Line Computer. Airborne equipment which accepts bearing and distance information from receivers in an aircraft, processes it, and presents navigational information enabling flight on courses other than directly to or from the ground navigation aid being used. (Used in Area Navigation--RNAV.)

Course Roughness. Rapid irregular excursions of the course usually caused by irregular terrain, obstructions, trees, power lines, etc.

Course Scalloping. Rhythmic excursions of the electromagnetic course or path.

Course Width (Course Sensitivity). The angular deviation required to produce a full-scale course deviation indication of the airborne navigation instrument.

Coverage. The designated volume of airspace within which a signal-in-space of specified characteristics is to be radiated.

Critical DME. For RNAV operations, a DME facility that, when unavailable, results in navigation service which is insufficient for DME/ DME/IRU supported operations along a specific route or procedure. The required performance assumes an aircraft's RNAV system meets the minimum standard (baseline) for DME/ DME RNAV systems or the minimum standard for DME/ DME/IRU systems found in Advisory Circular 90-100x, U.S. Terminal and En route Area Navigation (RNAV) Operations. For example, terminal RNAV DP(s) and STAR(s) may be published with only two DME(s), in which case, both are critical.

Crosspointer (Deflection Indicator Current (ICAO)). An output current proportional to: ILS-- Difference in depth of modulation measured in microamperes. VOR/VORTAC/TAC -- The difference in phase of two transmitted signals measured in degrees of two audio navigation components for a given displacement from a navigation aid.

Cycle Skip. The receiver uses the incorrect cycle of the 100 kHz carrier of the Loran-C signal, for time measurements. Normally the third cycle of a given carrier pulse is used for time measurements. Each cycle skip will result in a 10-microsecond error in time measurement and a corresponding error in navigation.

Cyclic Redundancy Check (CRC). The CRC is an error detection algorithm capable of detecting changes in a block of data. Navigation databases require high integrity of the data. The CRC performs a mathematical calculation of the navigation data and returns a number that uniquely identifies the content and organization of the data. The actual number that is used to identify the data is called a checksum or CRC remainder code. CRC values are stored and transmitted with their corresponding data. By comparing the CRC code of a WAAS RNAV FAS data block to the FAA Fpr, 8260-10 procedural data CRC code, determination can bbe made if FAS data has been corrupted.

Dedicated TRIAD. Three specific Loran-C stations from one CHAIN. Dedicated TRIAD selection is utilized to ensure that receiver positioning is determined only by these stations.

Designed Procedural Azimuth. The azimuth determined by the procedure specialist that defines the desired position of a course or bearing.

DF Course (Steer). The indicated magnetic direction of an aircraft to the DF station and the direction the aircraft must steer to reach the station.

DF Fix. The geographical location of an aircraft obtained by the direction finder.

Difference in Depth of Modulation (DDM). The percentage modulation of the larger signal minus the percentage modulation of the smaller signal.

Dilution of Precision (DOP). (HDOP - horizontal, VDOP - vertical, PDOP - position, i.e., the combination of horizontal and vertical) Dilution of precision is the mathematical representation of the quality of GPS satellite geometries. The number and location of the visible satellites control DOP. A value of 1.0 would be optimum satellite constellation and high quality data (1.5 or less is normal). A value of 8.0 would be poor constellation and data.

Discrepancy. Any facility operating parameter which is not within the given tolerance values (prescribed in the U.S. Standard Flight Inspection Manual) as determined by flight inspection measurements.

Displaced Threshold. A threshold located on the runway at a point other than the designated beginning of the runway (AIM).

Distance Measuring Equipment (DME). Electronic equipment used to measure, in nautical miles, the slant range of the aircraft from the navigation aid. (AIM)

Distance Measuring Equipment/Precision (DME/ P). The range function associated with the MLS. It is a precision distance measuring equipment providing accurate range (20 to 40 ft at a 2-sigma probability).

DME Electronic Unit (DEU). Mobile MLS transmitter and monitoring system.

Doppler VOR (DVOR). VOR using the Doppler frequency shift principle.

Dual-Frequency Glidepath System. An ILS glidepath in which coverage is achieved by the use of two independent radiation field patterns spaced on separate carrier frequencies within the particular glidepath channel, e.g., Capture Effect Glidepath.

Dual-Frequency Localizer System. A localizer system in which coverage is achieved by the use of two independent radiation frequencies within the particular localizer VHF channel.

Ellipsoid (WGS-84). WGS-84 ellipsoid is used by DoD for mapping, charting, surveying, and navigation needs, including its GPS "broadcast" and "precise" orbits. The absolute positions that are obtained directly from GPS are based on the 3D, earth-centered WGS-84 ellipsoid.

Ellipsoid Height. Ellipsoid height is the vertical distance of a point above the WGS-84 ellipsoid.

Envelope to Cycle Discrepancy (ECD). The discrepancy between the desired and actual zero phase crossing at the end of the third cycle of the Loran-C 100 kHz carrier pulse.

Essential Data. Essential data words are Basic Data Words 1, 2, 3, 4, and 6; and Auxiliary Data Words A1, A2, and A3.

Expanded Service Volume (ESV). (See Service Volume.)

Fault Detection & Exclusion (FDE). If six or more space vehicles (SV(s)) are received, the GPS avionics will determine any errors, which SV is providing faulty data, and exclude it. FDE is required for remote/ oceanic operations.

Feed Horn. Radar antenna focal point. Also reference point in antenna elevation measurements.

Fictitious Threshold Point (FTP). The FTP is the equivalent of the landing threshold point (LTP) when the final approach course is offset from runway centerline. It is defined as the intersection of the final course and a line perpendicular to the final course that passes throught the LTP. FTP elevation is the same as the LTP. For the purposes of this document, where LTP is used, FTP may apply as appropriate.

Figure of Merit (FOM). Horizontal and Vertical FOM are the current assessment of the 95% accuracy of the reported position in these dimensions for WAAS.

Final Approach Segment. This is the segment in which alignment and descent for landing are accomplished. The final approach segment considered for obstacle clearance begins at the final approach fix or point and ends at the runway or missed approach point, whichever is encountered last. A visual portion within the final approach segment may be included.

Final Approach Segment (FAS) Data Block. The FAS Data Block contains data for a single operation. It is self-contained and utilizes a cyclic redundancy check (CRC) to preserve integrity. The FAS Data Block contains the parameters that define a single straight-in **precision** approach. Parameters include: airport ID, approach performance designator, course width at threshold, CRC code, flight path alignment point lat/ long, glide path angle, landing threshold point height above ellipsoid, landing threshold lat/ long, length offset, operation type, route indicator, runway letter, runway number, SBAS provider, threshold crossing height, and threshold corssing height units selector.

Fixed Map. A background map on the radar display produced by one of the following methods:

- **a.** Engraved marks on an overlay illuminated by edge lighting
- **b.** Engraved fluorescent marks on an overlay illuminated by means of ultraviolet light.
- **c.** Projected on the display by means of film and a projector mounted above and in front of the scope.
- **d.** Electronically mixed into the display as generated by a "mapper" unit

Flag (Flag Alarm). A warning device in certain airborne navigation equipment and flight instruments indicating: (1) instruments are inoperative or otherwise not operating satisfactorily, or (2) signal strength or quality of the received signal falls below acceptable values. (AIM)

Flag Alarm Current. The d.c. current flowing in the Flag Alarm Circuit, usually measured in microamperes, which indicates certain characteristics of the modulation of the received signal.

Flight Inspection (Flight Check). Inflight investigation and evaluation of air navigation aids and instrument flight procedures to ascertain or verify that they meet established tolerances and provide safe operations for intended use.

> **NOTE::** *Flight checked* describes the procedure to accomplish the function of flight inspection. The two terms are interchangeable.

Flight Inspector. Flight crewmember certified by FAA's Aviation System Standards (AVN) to perform flight inspection.

Flight Inspection Standard Service Volume (FISSV) (see Service Volume).

Flight Path Alignment Point (FPAP). The FPAP is a 3D point defined by World Geodetic System (WGS)-84/ North American Datum (NAD)-83 latitude, longitude, MSL elevation, and WGS-84 Geoid height. The FPAP is used in confunction with the LTP and the geometric center of the WGS-84 ellipsoid to define the vertical plane of a precision RNAV final approach course. The course may be offset up to 3° by establishing the FPAP left or right of centerline along an arc centered on the LTP.

Flight Path Control Point (FPCP). The FPCP is a 3D point defined by the LTP or FTP latitude/ longitude position, MSL elevation, and a threshold crossing height (TCH) value. The FPCP is in the vertical plane of the final approach course and is used to relate the glidepath angle of the final approach track to the landing runway. It is sometimes referred to as the TCH point or reference datum point (RDP).

Fly-By Waypoint. A waypoint that requires the use of turn anticipation to avoid overshoot of the next flight segment.

Fly-Over Waypoint. A waypoint that precludes any turn until the waypoint is overflown.

Geoid. The geoid is a gravitational equi-potential surface. The geoid is referenced to equate to the mean sea surface shaped by density distributions in the earth's crust. The density distributions in the earth's crust cause variations in gravitational pull; therefore, causing an irregular surface.

Geodial Height. Geoidal height is how far the geoid is above or below the **WGS-84 ellipsoid.**

Geometric Dilution of Precision (GDOP). A factor used to express navigational error at a position fix caused by divergence of the hyperbolic lines of position as the aircraft's receiver distance from the baseline increases. The larger the GDOP, the larger the standard deviation of position errors.

Geostationary Earth Orbit Satellite (GEO). A GEO is a communications satellite (positioned about 22,000 miles above the earth along the equator). WAAS GEO(s) transmit a corrected GPS ranging signal on L1.

Geostationary Satellite. Geostationary is a satellite, which appears to remain perfectly stationary in the sky as seen from earth. In order for this to happen, its orbital period must perfectly match the earth's 23 hour 56 minute day. As an added qualifier, it must also be exactly above the equator (inclination of 0). To keep a satellite perfectly geostationary for a long amount of time would require too much fuel (in compensation for the gravity fields of other non-stationary bodies, the sun and moon); therefore, most satellites are geosynchronous, which allows for some deviation.

Glidepath. See: ILS Glidepath.

Glidepath Angle. The angle between the downward extended straight line extension of the ILS glidepath and the horizontal.

Glidepath Structure. Characteristics of a glidepath including bends, scalloping, roughness, and width.

Glide Slope. A facility which provides vertical guidance for aircraft during approach and landing.

Glide Slope Intercept Altitude. The true altitude (MSL) proposed or published in approved let-down procedures at which the aircraft intercepts the glidepath and begins descent

Global Positioning System (GPS) Service Volume. The terrestrial service volume is from the surface of the Earth up to an altitude of 3,000 kilometers.

Graphical Average Path. The average path described by a line drawn through the mean of all crosspointer deviations. This will usually be a curved line which follows long-term trends (1,500 ft or greater) and averages shorter term deviations.

Ground-Based Augmentation System (GBAS). ICAO term (e.g., LAAS, SCAT 1).

Ground Point of Intercept (GPI). A point in the vertical plan on the runway centerline at which it is assumed that the *downward straight line extension* of the glide path intercepts the runway approach surface baseline. (FAA Order 8260.3 latest revision)

Group Repetition Interval (GRI). The time interval (microseconds divided by 10) between one group of 100 kHz carrier pulses and the next, from any transmitter within a Loran-C CHAIN. All stations in a specific CHAIN use the same GRI.

Hertz (Hz). A unit of frequency of electromagnetic waves which is equivalent to one cycle per second. See Symbols in this chapter.

Kilohertz (kHz). A frequency of 1000 cycles per second.

Megahertz (MHz). A frequency of one million cycles per second.

Gigahertz (GHz). A frequency of one billion cycles per second.

HLOM. An H Class of NDB facility installed as a compass locator at the outer marker. The standard service volume extends to 50 nm.

Hole (Null). An area of signal strength below that required to perform the necessary function or furnish the required information, which is completely surrounded by stronger signal areas of sufficient strength to perform required functions.

Horizontal Alert Limit (HAL). The radius of a circle, with its center being at the true aircraft position, which describes the region required to contain the indicated horizontal position with a probability of $1\text{-}10^{-7}$ per flight hour.

Horizontal Integrity Limit (HIL). The radius of a circle in the horizontal plane, with its center being at the indicated position, which describes the region which is assured to contain the true position. It is the horizontal region for which the missed alert and false alert requirements can be met. It is only a function of the satellite and user geometry and the expected error characteristics; it is not affected by actual measurements. Therefore, this value is predictable.

Horizontal/ Vertical Protection Level (HPL/ VPL). WAAS integrity (uncertainty) associated with the 3-dimensional position accuracy that is output by the receiver. The number of satellites, geometry of satellites, tropospheric delay, and airborne receiver accuracy affect these levels. HPL/ VPL are compared to the HAL/ VAL. If HPL/VPL exceeds the associated alert limit, the receiver will flag either part or all of the approach.

ILS--Back-Course Sector. The *course sector* which is the appropriate reciprocal of the front *course sector.*

ILS--Commissioned Angle--Glide Slope. The glidepath angle calculated by a qualified procedure specialist which meets obstruction criteria (FAA Order 8260.3 latest revision). This nominal angle may be increased to meet additional criteria, i.e., engineering, noise abatement, site deficiencies, etc.

ILS--Commissioned Width--Localizer. The nominal width of a localizer. In practice the width is computed by using the criteria prescribed in Chapter 15 of FAA Order 8200.1 (latest revision).

ILS--Course Sector. A sector in a horizontal plane containing the course line and limited by the loci of points nearest to the course line at which 150uA is found.

ILS--Differential Corrected Trace. The trace on the recording which is the algebraic sum of the Radio Telemetering Theodolite (RTT) crosspointer (DDM) and the aircraft receiver crosspointer (DDM) and which is produced by the differential amplifier within the airborne Theodolite Recording System.

ILS--Downward Straight Line Extension. The mean location of the ILS Glidepath in zone 2.

ILS--Facility Reliability. The probability that an ILS ground installation radiates signals within the specified tolerances.

ILS--Front Course Sector. The course sector which is situated on the same side of the localizer as the runway.

ILS--Glidepath. The locus of points in the vertical plane (containing the runway centerline) at which the DDM is zero, which of all such loci is the closest to the horizontal plane.

> **NOTE::** Offset ILS(s) do not contain the runway centerline.

ILS--Glidepath Sector. The sector in the vertical plane containing the ILS glidepath at which 150uA occurs.

> **NOTE::** The ILS glidepath sector is located in the vertical plane containing the localizer *on-course* signal and is divided by the radiated glidepath called upper sector and lower sector, referring respectively to the sectors above and below the path.

ILS--Glidepath Sector Width (Normal Approach Envelope). The width of a sector in the vertical plane containing the glidepath and limited by the loci of points above and below the path at which reading of 150uA is obtained.

ILS—Glidepath Rate of Change. A change in the trend, or direction, of the glidepath.

ILS—Glidepath Reversal. A glidepath rate of change that meets or exceeds 25 µA at the divergence measurement point.

ILS—Half ILS Glidepath Sector. The sector in the vertical plane containing the ILS glidepath and limited by loci of points nearest to the glidepath at which 75 µA occurs.

ILS--Half Course Sector. The sector, in a horizontal plane containing the course line and limited by the loci of points nearest the course line at which 75µA occurs.

ILS--Localizer Back Course Zone 1. The distance from the coverage limit to 4 miles from the localizer antenna.

ILS--Localizer Back Course Zone 2. From 4 miles from the localizer antenna to 1 mile from the localizer antenna.

ILS--Localizer Back Course Zone 3. One mile from the localizer antenna to the missed approach point, which may be as close as 3,000 ft from the localizer antenna.

ILS--Localizer Clearance Sector 1. From 0^{o} to 10^{o} each side of the center of the localizer *on-course.*

ILS--Localizer Clearance Sector 2. From 10^{o} to 35^{o} each side of the center of the localizer *on-course*.

ILS--Localizer Clearance Sector 3. From 35^{o} to 90^{o} each side of the center of the localizer *on-course*.

ILS--Localizer Course Sector Width. The sum of the angular distances either side of the center of the course required to achieve full scale (150µA) crosspointer deflection.

ILS—Lower Standard Altitude (LSA). That altitude which is 1,500 ft above the localizer antenna or 500 ft above intervening terrain, whichever is higher.

ILS--Performance Category I. An ILS which provides acceptable guidance information from the coverage limits of the ILS to the point at which the localizer course line intersects the glidepath at a height of 100 ft or less above the horizontal plane containing the runway threshold.

ILS--Performance Category II. An ILS which provides acceptable guidance information from the coverage limits of the ILS to the point at which the localizer course line intersects the glidepath at a point above the runway threshold.

ILS--Performance Category III. An ILS, which, with the aid of ancillary equipment where necessary, provides guidance information from the coverage limit of the facility to, and along, the surface of the runway.

ILS--Point "A". An imaginary point on the glidepath/localizer *on-course* measured along the runway centerline extended, in the approach direction, 4 nautical miles from the runway threshold.

> **NOTE:** For back Course and installations sited to project a course substantially forward of threshold as in Figure 217-1B(2), this point is 4 nm from the antenna.

ILS--Point "B". An imaginary point on the glidepath/localizer *on-course* measured along the runway centerline extended, in the approach direction, 3,500 ft from the runway *threshold.*

> **NOTE:** For back course as in Figure 217-1B(3), this point is 1 nm from the antenna. For installations sited to project a course substantially forward of threshold as in Figure 217-1B(2), this point is 1 nm from the threshold.

ILS--Point "C". A point through which the *downward extended straight portion* of the glidepath (at the commissioned angle) passes at a height of 100 ft above the horizontal plane containing the *runway threshold*.

> **NOTE::** Localizer only, Back Course, LDA's and SDF only facilities, Point C is the missed approach point and may not necessarily be the runway threshold.

ILS Point "D". A point 12 ft above the runway centerline and 3,000 ft from the runway threshold in the direction of the localizer.

ILS Point "E". A point 12 ft above the runway centerline and 2,000 ft from the stop end of the runway in the direction of the *runway threshold*.

ILS Point "T". A point at specified height located vertically above the intersection of the runway centerline and the *runway threshold* through which the *downward extended straight line* portion of the ILS glidepath passes.

ILS Reference Datum. Same as ILS Point "T".

ILS--Zone 1. The distance from the coverage limit of the localizer/glidepath to Point "A" (four miles from the *runway threshold).*

ILS--Zone 2. The distance from Point "A" to Point "B"

ILS--Zone 3. CAT I - The distance from Point "B" to Point "C" for evaluations of Category I ILS.
CAT II and III - The distance from Point "B" to the *runway threshold* for evaluations of Category II and III facilities.

> **NOTE::** Localizer Only, Back Course, LDA, and SDF facilities will have no Zone 3 if Point "C" occurs prior to Point "B." Structure tolerance remains defined by Points "A" to "B."

ILS--Zone 4. The distance from runway threshold to Point "D".

ILS--Zone 5. The distance from Point "D" to Point "E".

Initial Approach Segment. In the initial approach, the aircraft has departed the en route phase of flight, and is maneuvering to enter an intermediate segment. This is the segment between the initial approach fix/waypoint and the intermediate fix/waypoint or the point where the aircraft is established on the intermediate course or final approach course.

Integrity (WAAS). The integrity of a system is that quality, which relates to the trust, which can be placed in the correctness of the information, supplied by the total system. Integrity risk is the probability of an undetected (latent) failure of the specified accuracy. Integrity includes the ability of the system to provide timely warnings to the user when the system should not be used for the intended operation. The WAAS sensor displays integrity in the form of Horizontal/ Vertical Protection Level.

Intermediate Approach Segment. This is the segment which blends the initial approach segment into the final approach segment. It is the segment in which aircraft configuration, speed, and positioning adjustments are made for entry into the final approach segment. The intermediate segment begins at the intermediate fix (IF) or point, and ends at the final approach fix (FAF).

In-Phase. Applied to the condition that exists when two signals of the same frequency pass through their maximum and minimum values of like polarity at the same time.

Integrity. That quality which relates to the trust which can be placed in the correctness of the information supplied by the facility.

Integrators. Received target enhancement process used in primary radar receivers.

Interrogator. The ground-based surveillance radar transmitter-receiver which normally scans in synchronism with a primary radar, transmitting discrete radio signals which repetitiously request all transponders, on the mode being used, to reply. The replies are displayed on the radar scope. Also applied to the airborne element of the TACAN/DME system. (AIM)

Investigator-in-Charge (IIC). Person responsible for on-site aircraft investigation procedure.

Ionosphere. A band of charged particles 80 – 120 nm above the earth, which represent a non-homogeneous and dispersive medium for radio signals. Signal phase delay depends on the electron content and affects carrier content. Group delay depends on dispersion in the ionosphere and affects signal modulation. Propagation speed (refraction) is changed as it passes through the ionosphere. SBAS and GBAS systems are designed to mitigate much of the error induced into GNSS signal as it passes through the ionosphere.

Joint Acceptance Inspection (JAI). Inspection at culmination of facility installation and preparation. System is technically ready for commissioning after successful JAI.

Joint Use. For this document, refer to radar sites used by both the FAA and military.

L1/ L2/ L5 Satellite Frequency. L1 (1575.42 MHz), L2 (1227.60 MHz), L5 (1176.45 MHz).

Landing Threshold Point (LTP). The LTP is a 3D point at the intersection of the runway centerline and the runway threshold. WGS-84/ NAD-83 latitude, longitude, MSL elevation, and Geoid height define it. It is used in conjunction with the FPAP and the geometric center of the WGS-84 ellipsoid to define the vertical plane of an RNAV final approach course. LTP elevation (LTPE) applies to the LTP and FTP when the final approach course is offset from runway centerline. For the purposes of this document, where LTP is used, FTP may apply as appropriate.

Line-of-Position (LOP). LOP is a hyperbolically curved line defined by successive but constant time difference measurements using the signals from two Loran-C transmitters. Two LOP's from two station pairs define the location of a receiver and establish a position fix.

Local Area Augmentation System (LAAS). LAAS is an augmentation to GPS that focuses its service on the airport area (approximately a 20 – 30 mile radius). It broadcasts its correction message via a very high frequency (VHF) radio data link from a ground-based transmitter. LAAS will yield the extremely high accuracy, availability, and integrity necessary for Category I, II, and III precision approaches, and will provide the ability for more flexible, curved approach paths. LAAS demonstrated accuracy is less than 1 meter in both the horizontal and vertical axis.

Local Area Monitor (LAM). A stationary receiver designed to monitor and record Loran-C signals and time difference (TD) data. TD information obtained by this unit is used for calculating receiver TD calibration values.

Localizer Type Directional Aid (LDA). A facility of comparable utility and accuracy to a LOC, but which is not part of a full ILS and may not be aligned with the runway. (FAA Order 8260.3, latest revision)

Localizer (LOC). The component of an ILS which provides lateral guidance with respect to the runway centerline. (FAA Order 8260.3, latest revision).

Localizer Zones. See ILS-Zones or ILS-Localizer Back Course Zones

Lock-On. The condition during which usable signals are being received by the airborne equipment and presentation of steady azimuth and/or distance information starts.

Loran-C CHAIN. Loran-C stations are grouped into sets of stations called CHAINs. Each CHAIN consists of a master station and two or more secondary stations that repeat transmissions over a specific period of time (see GRI).

Loran Signal Evaluation System (LSES). The LSES is a Loran-C receiver and a time difference data device used to evaluate approach sites. The device determines if usable signals are present and establishes the time difference relationship with the local area monitor.

Loran-C Time Difference (TD). The elapsed time, in microseconds, between the arrival of two signals.

Lower Standard Altitude (LSA). See ILS Lower Standard Altitude (LSA).

Localizer Precision with Vertical guidance (LPV). FAA Order 8260.54 specifies criteria for RNAV WAAS approach procedures. Approaches constructed under these criteria are termed "LPV". The lateral protection area is based on the precision approach trapezoid dimensions and the vertical surfaces are constructed around WAAS vertical performance. The lateral criterion is based on the WAAS Horizontal Alarm Limit (HAL) being ≤40 meters. The vertical criterion is based on the WAAS Vertical Alarm Limit (VAL) being >12 meters and ≤50 meters. RNAV WAAS LPV procedures can be supported to HAT of ≥200'. In comparison, CAT I approach procedures require the same lateral containment, but require ≤11 meters vertical containment. LPV approach performance level is between that defined for APV I and APV II. An RNAV approach procedure with published line minima titled "LPV", will require a WAAS sensor to fly to those minima.

MLOM. An MH Class NDB facility installed as a compass locator at the outer marker. The standard service volume extends to 25 nm.

Mask Angle Elevation. A fixed elevation angle referenced to the user's horizon below which satellites are ignored by the receiver software. Mask angles are used primarily in the analysis of GNSS performance, and are employed in some receiver designs. The mask angle is driven by the receiver antenna characteristics, the strength of the transmitted signal at low elevations, receiver sensitivity, and acceptable low elevation errors.

Maximum Authorized Altitude (MAA). A published altitude representing the maximum usable altitude or flight level for an airspace structure or route segment. It is the highest altitude on a Federal airway, Jet route, area navigation low or high route, or other direct route for which an MEA is designated in FAR Part 95, at which adequate reception of navigation and signals is assured.

Maximum Error. The maximum amplitude of course alignment from zero, either in the clockwise or counterclockwise direction.

Mean Course Error (MCE). The mean value of azimuth or elevation error along the approach course or specified glidepath.

Microampere(s). (Microamps)--One millionth of an ampere (amp). In practice, seen on a pilot's omnibearing selector (OBS), oscillograph recordings, and/or flight inspection meters, as a deviation of the aircraft's position in relation to a localizer on-course (zero DDM) signal or glidepath on-path (zero DDM) signal, e.g., "5 microamperes (µA) right" (localizer); "75µA low" (glidepath). See Crosspointer and Symbols.

Microwave Landing System (MLS). The international standard microwave landing system.

Milliampere (mA). One one-thousandth of an ampere.

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 en route IFR altitude (MEA). (AIM)(See Minimum En Route IFR Altitude).

Minimum Descent Altitude (MDA). The lowest altitude, expressed in feet above mean sea level, to which descent is authorized on final approach or during circle-to-land maneuvering in execution of a standard instrument approach procedure where no electronic glidepath is provided. (AIM)

Minimum En Route IFR Altitude (MEA). The lowest published altitude between radio fixes which assures acceptable navigational signal coverage and meets obstacle clearance requirements between those fixes. The MEA prescribed for a Federal airway or segment thereof, area navigational low or high route, or other direct route applies to the entire width of the airway, segment, or route between the radio fixes defining the airway, segment, or route. (AIM) (FAR Parts 91 and 95).

Minimum Glide Path (MGP). The lowest angle of descent along the zero degree azimuth that is consistent with published approach procedures and obstacle clearance criteria.

Minimum Holding Altitude (MHA). The lowest altitude prescribed for a holding pattern which assures navigational signal coverage, communications, and meets obstacle clearance requirements. (AIM)

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 which assures acceptable navigation signal coverage only within 25 statute miles (22nm) of a VOR. (AIM) (Refer to FAR Parts 91 and 95)

Minimum Radar Range. The shortest distance from the radar at which the aircraft can be clearly identified on each scan of the radar antenna system.

Minimum Reception Altitude (MRA). The lowest altitude at which an intersection can be determined. (AIM) (Refer to FAR Part 95)

Minimum Safe Altitude Warning (MSAW). A software function of the air traffic ARTS II/III computer that is site specific. MSAW monitors Mode-C equipped aircraft for obstacle separation. It is designed to generate both aural and visual alerts at the air traffic controller’s display when an aircraft is at or predicted to be at an unsafe altitude.

MSAW Approach Path Monitor (APM). Automation software used to generate low altitude alert warnings for aircraft within a narrow approach path corridor.

MSAW General Terrain Monitor (GTM). Automation software used to generate low altitude alert warnings for aircraft outside the areas designated for approach monitoring.

MSAW Bin. A 2 nm square area within an MSAW General Terrain Map; 4,096 bins make up an MSAW General Terrain Map.

MSAW Bin Altitude. An altitude that is determined by the highest obstacle within the MSAW bin, plus 500 ft.

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 or J-route segment. It may be utilized for radar vectoring only upon the controllers' determination that an adequate radar return is being received from the aircraft being controlled. Charts depicting minimum vectoring altitudes are normally available only to the controllers and not to pilots. (AIM)

Missed Approach Point (MAP). 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. (AIM: See Missed Approach and Segments of an Instrument Approach Procedure.)

Missed Approach Segment. The missed approach segment is initiated at the decision height in precision approaches and at a specified point in non-precision approaches. The missed approach must be simple, specify an altitude, and whenever practical, a clearance limit (end of the missed approach segment). The missed approach altitude specified in the procedure shall be sufficient to permit holding or en route flight.

MLS Approach Reference Datum. A point at a specified height located vertically above the intersection of the runway centerline and the threshold.

MLS Auxiliary Data. Data, transmitted in addition to basic data, that provide facilities maintenance equipment siting information for use in refining airborne position calculations and other supplementary information.

MLS Basic Data. Data transmitted by the facilities maintenance equipment that are associated directly with the operation of the landing guidance system.

MLS Coverage Sector. A volume or airspace within which service is provided by a particular function and in which the signal power density is equal to or greater than the specified minimum.

MLS Datum Point. The point on the runway centerline closest to the phase center of the approach elevation antenna.

MLS Function. A particular service provided by the MLS; e.g., approach azimuth guidance, approach elevation guidance, or basic data, etc.

MLS Mean Course Error. The mean value of the azimuth error along a specified radial of the azimuth function.

MLS Mean Glidepath Error. The mean value of the elevation error along a specified angle of the elevation function.

MLS Minimum Glidepath. The lowest angle of descent along the zero-degree azimuth that is consistent with published approach procedures and obstacle clearance criteria.

MLS-Point "A". An imaginary point on the minimum glidepath and commissioned azimuth radial, 4 nautical miles from the runway threshold.

MLS-Point "B". An imaginary point on the minimum glidepath and commissioned azimuth radial, 3,500 ft from the runway threshold.

MLS-Point "C". A point through which the downward extended straight portion of the glidepath passes at a height of 100 ft above the horizontal plane containing the runway threshold.

NOTE:: Azimuth only facilities, Point C is the missed approach point.

MLS-Point "D". A point 12 ft above the runway centerline and 3,000 ft from the runway threshold in the direction of the azimuth station.

MLS-Point "E". A point 12 ft above the runway centerline and 2,000 ft from the stop end of the runway in the direction of the runway threshold.

MLS Proportional Guidance Sector. The volume of airspace within which the angular guidance information provided by a function is directly proportional to the angular displacement of the airborne antenna with respect to the zero angle difference.

MLS Reference Point. The point at which flight inspection begins to apply facility budget error tolerances. This will normally be either the ARD or MAP.

Mode. The letter or number assigned to a specific pulse spacing of radio signals transmitted or received by ground interrogator or airborne transponder components of the Air Traffic Control Radar Beacon System (ATCRBS). Mode A (military Mode 3), Mode C (altitude reporting), and Mode S (data link) are used in air traffic control. (See transponder, interrogator, radar.) (AIM)

ICAO-Mode (SSR) Mode. The letter or number assigned to a specific pulse spacing of the interrogation signals transmitted by an interrogator. There are five modes: A, B, C, D, and M--corresponding to five different interrogation pulse spacings.

Moving Target Detection (MTD). Type of moving target detection system (like MTI) based on digital storage map techniques. Used in newer primary radars.

Moving Target Indicator (MTI). Electronic circuitry that permits the radar display presentation of only targets which are in motion. A partial remedy for ground clutter.

MTI Reflector. A fixed device with electrical characteristics of a moving target which allows the demonstration of a fixed geographic reference on a MTI display. (Used to align video maps, azimuth reference, etc.)

Multi-Mode Receiver (MMR). A navigation receiver with multiple capabilities in one unit (i.e., ILS, VOR, WAAS, and LAAS).

Narrowband Radar Display. Computer generated display of radar signals.

National Flight Data Center (NFDC). A facility in Washington, D.C., established by FAA to operate a central aeronautical information service for the collection, validation, and dissemination of aeronautical data in support of the activities of government, industry, and the aviation community. The information is published in the National Flight Data Digest. (AIM: See National Flight Data Digest.)

National Flight Procedures Office (NFPO). The FAA element responsible for the development, maintenance, quality assurance, and technical approval of public-use instrument procedures.

National Transportation Safety Board (NTSB). Office responsible for aircraft accident investigations.

NAVAID. Any facility used in, available for use in, or designated for use in aid of air navigation, including landing areas, lights, any apparatus or equipment for disseminating weather information, for signaling, for radio direction finding, or for radio or other electronic communication, and any other structure or mechanism having a similar purpose for guiding or controlling flight in the air or the landing or takeoff of aircraft. (Re: Federal Aviation Act of 1958, as amended.) (AIM)

Nondirectional Beacon/Radio Beacon (NDB). An L/MF or UHF radio beacon transmitting nondirectional signals whereby the pilot of an aircraft equipped with direction finding equipment can determine his bearing to or from the radio beacon and "home" on or track to or from the station. When the radio beacon is installed in conjunction with the Instrument Landing System marker, it is normally called Compass Locator. (AIM)

Nonprecision Approach Procedure/ Nonprecision Approach. A standard instrument approach procedure in which no electronic glide slope is provided; e.g., VOR, TACAN, NDB, LOC, ASR, LDA, or SDF approaches. (AIM)

Notices to Airmen/Publication. A publication designed primarily as a pilot's operational manual containing current NOTAM information (see Notices to Airmen - NOTAM) considered essential to the safety of flight, as well as supplement data to other aeronautical publications. (AIM)

Notices to Airmen/NOTAM. A notice containing information (not known sufficiently in advance to publicize by other means) concerning the establishment, condition, or change in any component (facility, service, or procedure of, or hazard in the National Airspace System) the timely knowledge of which is essential to personnel concerned with flight operations. (AIM)

a. **NOTAM (D) -** A NOTAM given (in addition to local dissemination) distant dissemination via teletype writer beyond the area of responsibility of the Flight Service Station. These NOTAMS will be stored and repeated hourly until canceled.

b. **NOTAM (L) -** A NOTAM given local dissemination by voice (teletypewriter where applicable), and a wide variety of means such as: TelAutograph, teleprinter, facsimile reproduction, hot line, telecopier, telegraph, and telephone to satisfy local user requirements.

c. **FDC NOTAM** A notice to airmen, regulatory in nature, transmitted by NFDC and given all-circuit dissemination.

d. **ICAO NOTAM.** A notice, 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. (AIM)

Null. That area of an electromagnetic pattern where the signal has been intentionally canceled or unintentionally reduced to an unacceptable level.

Obstacle. An existing object, object of natural growth, or terrain at a fixed geographical location, or which may be expected at a fixed location within a prescribed area, with reference to which vertical clearance is or must be provided during flight operation. (AIM)

Obstacle Clearance. The vertical distance between the lowest authorized flight altitude and a prescribed surface within a specified area. (FAA Order 8260.19, latest revision)

Obstruction. An object which penetrates an imaginary surface described in FAR Part 77. (AIM) (Refer to FAR Part 77).

Omnibearing Selector (OBS). An instrument capable of being set to any desired bearing of an omnirange station and which controls a course deviation indicator.

On-Course. The locus of points in the horizontal plane in which a zero or on-course reading is received.

On-Path. Same as on-course but in the vertical plane. See ILS--Glidepath.

Operational Advantage. An improvement which benefits the users of an instrument procedure. Achievement of lower minimums or authorization for a straight-in approach with no derogation of safety are examples of an operational advantage. Many of the options in TERP's are specified for this purpose. For instance, the flexible final approach course alignment criteria may permit the ALS to be used for reduced visibility credit by selection of the proper optional course. (FAA Order 8260.3, latest revision)

Optimum Error Distribution. Best overall facility alignment error distribution to achieve maximum operational benefits (not necessarily a perfect balance of the errors).

Orbit Flight. Flight around a station at predetermined altitude(s) and constant radius.

Orthometric Height. Elevation above the geoid.

Oscilloscope. An instrument for showing visually, graphic representations of the waveforms encountered in electrical circuits.

Out-of-Coverage Indication (OCI). A signal radiated into areas outside the intended coverage sector where required to specifically prevent invalid removal of an airborne warning indication flag in the presence of misleading guidance information.

Out of Tolerance Condition. See Discrepancy.

Path Following Error (PFE). The guidance perturbations which the aircraft will follow. It is composed of a path following noise and of the mean course error in the case of azimuth functions or the mean glidepath error in the case of elevation functions.

Path Following Noise (PFN). That portion of the guidance signal error which could cause aircraft displacement from the mean course line or mean glidepath as appropriate.

Pilot-Controlled Lighting. Airfield lighting systems activated by VHF transmissions from the aircraft.

Pilot-Defined Procedure. Any data entered into an FMS or GPS navigator by the pilot, including waypoints, airports, runways, SID(s), routes, STAR(s), and approaches. For flight inspection of procedures, data must be entered from official source documentation.

Pilot Navigation Area (PNA). An area used to transition from RADAR vectoring to the area navigation route. The PNA is bounded by two lines, represented by the design maximum intercept courses leading to the departure intermediate fix, enclosed by and arc of specified radius centered on the departure intermediate fix.

Planned View Display (PVD). A display presenting computer generated information such as alphanumerics or video mapping.

Polarization Error. The error arising from the transmission or reception of a radiation having a polarization other than that intended for the system.

Position Estimation Error (PEE). The difference between true position and estimated position.

Primary Area. The area within a segment in which full obstacle clearance is applied. (FAA Order 8260.3, latest revision)

Proportional Guidance Sector. The volume of airspace within which the angular guidance information provided by a function is directly proportional to the angular displacement of the airborne antenna with respect to the zero angle reference.

Pseudo Random Noise (PRN). A signal coded with random-noise-like properties consisting of a repeating sequence of digital ones and zeros. The GPS C/ A code consists of 1,023 bits transmitted at a 1.023 MHz rate and, therefore, repeats every millisecond. Each GPS satellite has a unique PRN code. This code structure provides a low auto-correlation value for all delays or lags, except when they coincide exactly. Each SV has a unique pseudo-random noise code.

"Q" Factor. See Actual Navigation Performance.

Quadradar. Ground radar equipment named for its four presentations.

- **a. Height Finding**
- **b. Airport Surface Detection**
- **c. Surveillance**
- **d. Precision Approach**

/R. RNAV and transponder with altitude encoding capability.

Radar Bright Display Equipment (RBDE). Equipment at the ARTCC which converts radar video to a bright raster scan (TV type) display.

Radar Data Analysis Software (RDAS). A generic term referring to many types of terminal and en route radar data analysis tools. (COMDIG, RARRE, DRAM, etc.)

Radar Plan Position Indicator (RAPPI). Maintenance display used with CD-1 common digitizers.

Radar/Radio Detecting and Ranging. A device which, by measuring the time interval between transmission and reception of radio pulses and correlating the angular orientation of the radiated antenna beam or beams in azimuth and/or elevation, provides information on range, azimuth, and/or elevation of objects in the path of the transmitted pulses.

a. **Primary Radar.** A radar system in which a minute portion of a radio pulse transmitted from a site is reflected by an object and then received back at that site for processing and display at an air traffic control facility.

b. **Secondary Radar/Radar Beacon/ ATCRBS.** A radar system in which the object to be detected is fitted with cooperative equipment in the form of a radio receiver/transmitter (transponder). Radar pulses transmitted from the searching transmitter/receiver (interrogator) side are received in the cooperative equipment and used to trigger a distinctive transmission from the transponder.

This reply transmission, rather than a reflected signal, is then received back at the transmitter/receiver site for processing and display at an air traffic control facility. (See Transponder, Interrogator.) (AIM)

c. **ICAO-Radar.** A radio detection device which provides information on range, azimuth, and/or elevation of objects.

(1) **Primary Radar.** A radar system which uses reflected radio systems.

(2) **Secondary Radar.** A radar system wherein a radio signal transmitted from a radar station initiates the transmission of a radio signal from another station.

Radar Resolution - Azimuth. The angle in degrees by which two targets at the same range must be separated in azimuth in order to be distinguished on a radar scope as individual returns.

Radar Resolution - Range. The distance by which two targets at the same azimuth must be separated in range in order to be distinguished on a radar scope as individual returns.

Radar Route. A flight path or route over which an aircraft is vectored. Navigational guidance and altitude assignments are provided by ATC. (See Flight Path, Route.) (AIM)

Receiver Autonomous Integrity Monitoring (RAIM). A technique whereby a civil GPS receiver/processor determines the integrity of the GPS navigation signals without reference to sensors or non-DoD integrity systems other than the receiver itself. This determination is achieved by a consistency check among redundant pseudorange measurements.

Range of Validity. Area around a local area monitor where published Loran-C receiver TD calibration values are valid.

Radial. A magnetic bearing extending from a VOR/VORTAC/TACAN navigation facility. (AIM)

Range, Azimuth, Radar, Reinforced Evaluator (RARRE). An IBM 9020 radar diagonostic program which is used to evaluate narrowband radar.

Real Time Quality Check (RTQC). Internally generated test target in automated target processing devices (common digitizers, etc.)

Receiver Check Point. A specific point designated and published, over which a pilot may check the accuracy of his aircraft equipment, using signals from a specified station.

Recorder Event Mark. A galvo mark on a recorder related to a position or time, required for correlation of data in performance analysis.

Reference Radial. A radial, essentially free from terrain and side effects, designated as a reference for measuring certain parameters of facility performance.

Reference Voltage (VOR Reference Voltage). A 30 Hz voltage derived in the reference phase channel of the aircraft VOR receiver.

Required Navigation Performance (RNP). A statement of the navigational performance accuracy, integrity, continuity, and availability necessary for operation within a defined airspace.

RHO/THETA Position. Coordinate position described by distance and angle.

Ring-Around. A display produced on the scope by front, side, or back antenna lobes of the secondary radar system. It appears as a ring around the radar location and may occur when an aircraft transponder replies to ground interrogations while in close proximity to the antenna site.

RNAV DME/ DME Infrastructure. DME facilities, meeting accuracy, coverage and geometry requirements for a Flight Management System to compute a navigation solution for the intended operation.

Rotation (Correct Rotation). A condition wherein the transmitted azimuth angle increases in a clockwise direction.

Roughness. Rapid irregular excursions of the electromagnetic course or path.

Runway Approach Surface Baseline. An imaginary plane down the runway at the height of the runway surface at threshold.

Runway Environment. The runway threshold or approved lighting aids or other markings identifiable with the runway. (FAA Order 8260.3)

Runway Point of Intercept. The point where the extended glide slope intercepts the runway centerline on the runway surface.

Runway Reference Point. Where VGSI angle of visual approach path intersects runway profile (see RPI).

Runway Threshold. The beginning of that portion of the runway usable for landing. (AIM) (When used for flight inspection purposes, displaced threshold(s) or threshold mean the same thing.)

Scalloping. See Course Scalloping. (FAA Order 1000.15, latest revision)

Search (DME/TACAN). Rapid movement of the distance or bearing indicators during the period in which either is unlocked. (FAA Order 1000.15, latest revision)

Secondary Area. The area within a segment in which required Obstruction Clearance (ROC) is reduced as distance from the prescribed course is increased (FAA Order 8260.3, latest revision).

Segment. The basic functional division of an instrument approach procedure. The segment is oriented with respect to the course to be flown. Specific values for determining course alignment, obstacle clearance areas, descent gradients, and obstacle clearance requirements are associated with each segment according to its functional purpose. (FAA Order 8240.3, latest revision)

Sensing (Correct Sensing). A condition wherein the ambiguity indicator gives the correct To/From indication.

Sensitivity Time Control (STC). Procedure used to vary receiver sensitivity with range. Gain is reduced as a function of decreasing range, in an attempt to make all radar replies uniform. (Gain would be maximum to maximum range in this event.)

Service Volume/SV. That volume of airspace surrounding a NAVAID within which a signal of usable strength exists and where that signal is not operationally limited by co-channel interference.

NOTE: For VOR/TACAN/DME and ILS, the following definitions are used:

a. **Standard Service Volume (SSV) -** That volume of airspace defined by the national standard.

b. **Flight Inspection Standard Service Volume (FISSV)** is defined as follows: On "T" class facilities, this FISSV is 25 nm and 1,000 ft (2,000 ft in designated mountainous areas) above site elevation or intervening terrain. On "L" and "H" class facilities, the distance extends to 40 nm, and the altitudes are the same as for the "T" class. The FISSV is used to determine the performance status of VOR/TAC/DME facilities.

c. **Expanded Service Volume (ESV) -** That additional volume of airspace outside the standard service volume requested by the FAA's Air Traffic Service or procedure specialist and approved by frequency management of the Airway Facilities Division and flight inspection for operational use.

d. **Operational Service Volume (OSV) -** The airspace available for operational use. It includes the following:

(1) **The SSV** excluding any portion of the SSV which has been restricted.

(2) **The ESV**

Short-Term Excursions. Excursion characteristics of a navigation on-course or on-path signal which includes scalloping, roughness, and other aberrations but excludes bends.

Side Bands. The separated and distinct signals that are radiated whenever a carrier frequency is modulated. In terms of most air navigation facilities, double sidebands are present. This means that frequencies above and below the carrier frequency differing by the amount of the modulating frequencies are present. These sidebands contain intelligence for actuating navigation instruments.

Simplex. Single channel operation usually referred to at those sites using a single channel where dual channel (diplex) operation is available.

Splits. Two or more beacon targets generated from a single target reply. An undesirable condition due to problems in the beacon transmitter, antenna, propagation, aircraft transponder, or processing equipment.

Simplified Directional Facility/SDF. A NAVAID used for nonprecision instrument approaches. The final approach course is similar to that of an ILS localizer.

Slant Range. The line-of-sight distance between two points not at the same elevation.

Space-Based Augmentation System (SBAS) – The ICAO term applied to all wide-area augmentation systems. Corrected GPS data is transmitted to the aircraft by a geostationary satellite(s).

Stagger. A feature used with primary MTI radar systems to vary the PRF at pre-selected intervals. This moves the inherent blind speed to a less troublesome value.

Standard VOT. A facility intended for use on the ground only (See VHF Omnidirectional test range).

Structure. Excursion characteristics of a navigation on-course or on-path signal which includes bends, scalloping, roughness, and other aberrations.

Structure Below Path. An angular measurement of clearance below path.

Subclutter Visibility. A performance characteristic of the system to detect a moving target in the presence of relatively strong ground clutter.

Symbols:

G	10^9 times (a unit); giga
M	10^6 times (a unit); mega
k	10^3 times (a unit); kilo
h	10^2 times (a unit); hecto
dk	10 times (a unit); deca
d	10^{-1} times (a unit); deci
c	10^{-2} times (a unit); centi
m	10^{-3} times (a unit); milli
μ	10^{-6} times (a unit); micro
n	10^{-9} times (a unit); nano
μμ	10^{-12} times (a unit); micromicro
θ	Commissioned angle
Σ	Sum; Sum of; algebraic sum of:
>	Greater than:
<	Less than
≥	Equal to or greater than:
≤	Equal to or less than:
=	equals:
:	ratio; ratio of:
∴	therefore:

Symmetry. (ILS)—ICAO: Displacement sensitivity. A ratio between individual width sectors (90 Hz and 150 Hz) expressed in percent.

Systems Performance Analysis Rating (SPAR). A rating based on performance or expected performance. These ratings are related to flight inspection intervals as follows:

TACAN Distance Indicator (TDI). A unit of airborne equipment used to indicate distance from a selected facility.

Target of Opportunity. An itinerant aircraft operating within the coverage area of the radar and which meets the requirements for a small aircraft as described in FAA Order 8200.1 (latest revision) Section 215.

Target Return. The return signal transmitted by a beacon-equipped aircraft in reply to the ground facility interrogator. Also, indication shown on a radar display resulting from a primary radar return.

Threshold. See Runway Threshold.

Touchdown Zone (TDZ). The first 3,000 ft of runway beginning at the threshold. (See FAA Order 8260.3, latest revision).

Touchdown Zone Elevation. The highest runway centerline elevation in the touchdown zone.

Total System Error (TSE). The position error is represented by the Total System Error (TSE), which is a combination of the Flight Technical Error (FTE) and the Navigation System Error (NSE). The NSE is the error in position due to navigation, such as Global Positioning System (GPS), Distance Measuring Equipment (DME/ DME), or Very High Frequency Omni Directional Range (VOR/ DME). FTE is the difference between the position estimated by the Flight Management System (FMS) and the desired aircraft position.

Tracking. Condition of continuous distance or course information.

Transponder. The airborne radar beacon receiver/transmitter portion of the Air Traffic Radar Beacon System (ATCRBS) which automatically receives radio signals from interrogators on the ground, and selectively replies with a specific reply pulse or pulse group only to those interrogations being received on the mode to which it is set to respond. (See Interrogator.) (AIM)

Trend. The general direction or incline of a segment of the glidepath which persists for a distance of 1,500 ft or more along the approach course.

Un-Lock. Condition at which the airborne interrogator (TACAN) discontinues tracking and starts search.

Usable Distance. The maximum distance at a specified altitude at which the facility provides readable identification and reliable bearing or glidepath information under average atmospheric condition.

Variable Voltage (VOR Variable Voltage). A 30 Hz voltage derived in the variable phase channel of the aircraft VOR receiver.

Vertical Alert Limit (VAL). Half the length of a segment on the vertical axis, with its center being at the true position, which describes the region, which is required to contain the indicated vertical position with a probability of $1\text{-}10^{-7}$ per flight hour.

Vertical Angle. An angle measured upward from a horizontal plane.

VHF Omnidirectional test range (VOT). A radio transmitter facility in the terminal area electronic navigation systems, radiating a VHF radio wave modulated by two signals having the same phase relationship at all azimuths. It enables a user to determine the operational status of a VOR receiver. (See Standard VOT and Area VOT.)

Video Map. An electronic displayed map on the radar display that may depict data such as airports, heliports, runway centerline extensions, hospital emergency landing areas, NAVAIDs and fixes, reporting points, airway/route centerlines, boundaries, handoff points, special use tracks, obstructors, prominent geographic features, map alignment indicators, range accuracy marks, and minimum vectoring altitudes (AIM).

Visual Descent Point (VDP). The visual descent point is a defined point on the final approach procedure from which normal descent from the MDA to the runway touchdown point may be commenced, provided visual reference is established. (AIM)

Visual Glide Slope Indicator (VGSI). Ground devices that use lights to define a vertical approach path during the final approach to a runway.

Visual Glide Slope Indicator (VGSI) slow transition. Result of a poorly focused VGSI box where the transition from red to white, or vice versa, occurs abnormally slow. This is most noticeable during level runs.

VORTAC. A facility composed of azimuthal information from both VOR and TACAN, plus distance information of TACAN.

VOT—Standard. See Standard VOT.

VOT—Area Use. See Area VOT.

VOT Reference Point. A point on or above an airport at which the signal strength of a VOT is established and subsequently checked (applies to both standard and area VOTs).

Waveform. The shape of the wave obtained when instantaneous values of an a.c. quantity are plotted against time in rectangular coordinates.

Waveguide. A hollow pipe usually of rectangular cross section used to transmit or conduct RF energy.

Wavelength. The distance usually expressed in meters traveled by a wave during the timer interval of one complete cycle. Equal to the velocity divided by the frequency.

Wide Area Augmentation System (WAAS). A system comprised of two Wide-Area Master Control Stations (WMS), Geostationary Earth Orbit (GEO) communications satellites, Ground Uplink Stations (GUS), and 25 Wide-area Reference Stations (WRS). The WAAS provides improved accuracy, integrity, and availability over the standard GPS signal. Future addition of WSR(s), GEO(s), and other WAAS enhancements are expected to increase WAAS capability to support full CAT I approach requirements.

Wide Area Multilateration (WAM) System is a surveillance system that uses multiple sensors to detect, identify, display, and track targets.

9960 Hz Voltage. A voltage derived from the VOR 9960 amplitude modulation by the reference channel of the VOR receiver. The 9960 Hz AM is a subcarrier which is frequency modulated by the 30Hz reference. Also referred to the 10 kHz sub-carrier.

SECTION 2. ABBREVIATIONS, ACRONYMS, AND LETTER SYMBOLS

A	: Ampere
a.c.	: alternating current
AC	: advisory circular
ADF	: automatic direction finding
ADP	: automatic data processing
AER	: approach end of runway
AF	: Airway Facilities
AFB	: Air Force Base
AFC	: automatic frequency control
AFIS	: automated flight inspection system
AGC	: automatic gain control
AGL	: above ground level
AIM	: Airmen's Information Manual
air	: airborne
align	: alignment
ALS	: approach lighting system
ALSF	: approach lighting system with sequenced flashing lights
am.	: ammeter
AM	: amplitude modulation
amp	: Ampere
ANF	: air navigation facility
ANP	: actual navigation performance
ant	: antenna
APM	: Approach Path Monitor
APPCON	: approach control
APV	: non-standard approach with vertical guidance
ARAC	: Army radar approach control
ARD	: approach reference datum
ARG	: auxiliary reference group
ARR	: automated flight inspection system reference radial
ARSR	: air route surveillance radar
ARTCC	: air route traffic control center
ARTS	: automated radar terminal system
ASBL	: approach surface baseline
ASDE-X	: Airport Surface Detection Equipment, Model X
ASIS	: Aviation Standards Information System
ASOS	: automated surface aviation observing system
ASR	: airport surveillance radar
AT	: air traffic
ATC	: air traffic control
ATCALS	: Air Traffic Control and Landing System
ATCRBS	: Air Traffic Control Radar Beacon System
ATIS	: Automatic Terminal Information Service

ATKER : along track error
AVN : Office of Aviation System Standards
AWOS : automatic weather observation system
az : azimuth
Az-El : azimuth-elevation

Baz : back azimuth horizontal guidance
BCM : back course marker
bcn : beacon
BFTA : beacon false target analysis
BPS : bits per second
BIT : a digit in a binary coded decimal
BRITE : brite radar indicator tower equipment
BUEC : backup emergency communications
BW : beam width

c : centi (=10^{-2})
C : Celsius
°C : degrees Celsius
C/A code : coarse/acquisition code
cal : calibrate, calibrated
CAS : calibrated airspeed
CAT : category
CCW : counterclockwise
CD : common digitizer
CDI : course deviation indicator
CDU : control display unit
CEU : control electronic unit
CHAIN : a group of Loran C stations
chan : channel
chg : change
CIC : combat information center
CL : centerline
Comm : Commission
CMLSA : Commercial MLS Avionics
CMN : control motion noise
COMDIG : common digitizer data reduction
COMLO : compass locator
CONUS : continental United States
COP : change-over-point
CSV : comma-separated values file
CTOL : conventional takeoff and landing
CP : circular polarization
CW : clockwise

d	: deci (=10^{-1})
DA	: decision altitude
DAME	: distance azimuth measuring equipment
db	decibel
dB/Hz	: Decibel/Hertz
dbm	: decibel referred to 1 milliwatt
DBRITE	: Digital Bright Radar Indicator Tower Equipment
dbw	: decibel referred to 1 watt
d.c.	: direct current
DDM	: difference in depth of modulation
DER	: Departure End of Runway
DEU	: DME electronic unit
DF	: direction finding
DFL	: Daily Flight Log
DGPS	: differential global positioning system
DH	: decision height
disc	: discrepancy
DME	: distance measuring equipment
DME/N	: distance measuring equipment/ non precision (standard DME)
DME/P	: distance measuring equipment/ precision
DOD	: Department of Defense
DOP	: dilution of precision
DOT	: Department of Transportation
DP	: departure procedure
DPSK	: differential phase shift keying
DVOR	: doppler very high frequency omni-directional range
E.	: East
EARTS	: en route automated radar tracking service
ECD	: envelope to cycle discrepancy (difference)
ECOM	: enroute communications
ECM	: electronic counter measures
EFIS	: electronic flight instrument system
e.g.	: exempli gratia (for example)
el	: elevation
EMI	: electromagnetic interference
ESV	: expanded service volume
et al.	: et alibi (and elsewhere; et alii (and others)
etc.	: etcetera (and the rest; and so forth)

F	: Fahrenheit
°F	: degrees Fahrenheit
FAA	: Federal Aviation Administration
FAC	: final approach course
FAF	: final approach fix
FANS	: Future Air Navigation System (ICAO)
FAP	: final approach point
FAR	: Federal Aviation Regulations
FAS	: final approach segment
FAWP	: final approach waypoint
FBWP	: flyby waypoint
FICO	: Flight Inspection Central Operations
FIP	: Flight Inspection and Procedures (staff)
fig.	: figure
FM	: fan marker
FM	: frequency modulation
FMO	: Frequency Management Office
FMS	: flight management system
FOWP	: flyover waypoint
freq	: frequency
FSS	: flight service station
FTC	: fast time constant
G	: giga (=10^9)
galv	: galvanometers
GBAS	: ground-based augmentation system
GCA	: ground controlled approach
GDOP	: geometric dilution of precision
GHz	: gigahertz
GLS	: GPS landing system
govt.	: government
Gnd	: ground
GNSS	: Global Navigation Satellite System
GPI	: ground point of intercept
GRI	: ground repetition interval
GS	: glide slope
GSI	: glide slope intercept altitude (Point)
GTC	: gain time control
GTM:	: General Terrain Monitor

h	: hecto (-10^2); hour
H	: homer
HAA	: height above airport elevation
HAT	: height above touchdown
H-Class	: high altitude
HDOP	: horizontal dilution of precision
HF	: high frequency
HF/DF	: high frequency/direction finding
HFOM	: horizontal figure of merit
HIL	: horizontal integrity limit
HIRLS	: high intensity runway lighting system
HIWAS	: Hazardous Inflight Weather Advisory Service
HLOM	: H Class compass locator at outer marker
Hz	: Hertz
IAC	: initial approach course
IAF	: initial approach fix
IAS	: indicated airspeed
IAWP	: initial approach waypoint
IC	: intermediate course
ICAO	: International Civil Aviation Organization
IIC	: investigator-in-charge
ID	: identification
i.e.	: id est (that is)
IF	: intermediate fix
IFIO	: International Flight Inspection Office
IFR	: Instrument Flight Rules
IFSS	: international flight service stations
ILS	: instrument landing system
IM	: inner marker
INS	: inertial navigation system
IO	: input-output
IRU	: inertial reference unit
ips	: inches per second
ISLS	: improved side lobe suppression
IWP	: intermediate waypoint
JAI	: joint acceptance inspection
JSS	: joint surveillance site
k	: Kilo (=10^3)
kHz	: kilohertz
KIAS	: knots indicated airspeed
kn	: knots
kW	: kilowatt

LAAS	: local area augmentation system
LAM	: local area monitor
lat.	: latitude
L-Class	: low altitude VOR
LDA	: localizer directional aid
LDIN	: lead-in lights
LEPP	: live environment performance program
LF	: low frequency
LMM	: compass locator at middle marker
LOC	: localizer
LOM	: compass locator at outer marker
long.	: longitude
LOP	: line-of-position
Loran	: long range navigation
LOS	: line of site
LP	: linear polarization
LPV	: localizer performance with vertical guidance
LRCO	: limited remote communications outlet
LSA	: lower standard altitude
LSES	: loran signal evaluation system
m	: meter
M	: mega (=10^6)
mA	: milliampere
MAA	: maximum authorized altitude
MAHP	: missed approach holding point
MAHWP	: missed approach holding waypoint
MALS	: medium intensity approach lights—5,000 cp
MALSF	: medium intensity approach lights; sequenced flashing lights
MALSR	: same as MALSF; runway alignment indicator lights
MAP	: missed approach point
MATWP	: missed approach turning waypoint
MAWP	: missed approach waypoint
MB	: marker beacon
MCA	: minimum crossing altitude
MCE	: mean course error
MDA	: minimum descent altitude
MDP	: MLS datum point
MEA	: minimum en route altitude
MEARTS	: micro en route automated radar tracking system
MF	: medium frequency
MGP	: minimum glide path
MHA	: minimum holding altitude
Mhz	: megahertz
MIRL	: medium intensity runway lights

MLOM	: MH Class compass locator at outer marker
MLS	: microwave landing system
MM	: middle marker
MOCA	: minimum obstruction clearance altitude
MRA	: minimum reception altitude
MOPS	: minimum operational performance standards
MRG	: main reference group
MSAW	: minimum safe altitude warning
MSG	: minimum selectable glidepath
MSL	: mean sea level
MTD	: moving target detection
MTI	: moving target indicator
MTR	: mission test report
MSAW	: minimum safe altitude warning
MUA	: maximum usable altitude
mV	: millivolt
MVA	: minimum vectoring altitude
MVAR	: magnetic variation
n	: nano (=10^{-9})
N.	: North
NA	: not applicable or not authorized (when applied to instrument approach procedures)
NACO	: National Aeronautical Charting Office
NAS	: National Airspace System
NASE	: Navigational Aids Signal Evaluator
NAVAID	: air navigation facility
NDB	: nondirectional beacons
NFDC	: National Flight Data Center
NFPO	: National Flight Procedures Office
nm	: nautical mile
NOTAM	: Notice to Airmen
NRKM	: nonradar keyboard multiplexer
NTSB	: National Transportation Safety Board
OBS	: omnibearing selector
OCI	: out of coverage indication
ODALS	: omnidirectional approach lighting system
OM	: outer marker
orb.	: orbit
OVLY	: GPS overlay crosstrack error

PAPI	: precision approach path indicator
P code	: precision code
PAR	: precision approach radar
PD	: power density
PDOP	: precision dilution of position
PE	: permanent echo
PEE	: position estimation error
PFE	: path following error
PFN	: path following noise
PIDP	: programmable indicator data processor
PNA	: pilot navigation area
PPI	: plan position indicator
PPS	: precise positioning service, P-code
PRF	: pulse-repetition frequency
PRN	: pseudo-range number
PT	: procedure turn
PVD	: plan view display
QARS	: quick analysis of radar sites
RADAR or radar	: radio range and detecting
RADES	: Radar Evaluation Squadron (military)
RAG	: range and azimuth gating
RAIL	: runway alignment indicator light
RAIM	: receiver autonomous integrity monitoring
RAPCON	: radar approach control (USAF)
RAPPI	: Radar plan position indicator
RARRE	: range, azimuth radar reinforced evaluator
RATCC	: radar approach control center (USN)
RBDE	: radar bright display equipment
RCAG	: remote, center air/ground communication facility
RCO	: remote communication outlet
RDAS	: radar data analysis software
RDH	: reference datum height
rec	: receiver
ref	: reference
REIL	: runway end identifier light
RF	: radio frequency
RFI	: radio frequency interference
RMI	: radio magnetic indicator
RML	: radar microwave link
RNAV	: area navigation
RNP	: required navigation performance
ROC	: required obstruction clearance

RPI	: runway point of intercept
RPM	: revolutions per minute
RRP	: runway reference point
RSCAN	: radar statistical coverage analysis system
RTQC	: real time quality check
R/T	: receiver-transmitter
RTT	: radio telemetering theodolite
RVR	: runway visual range
RVV	: runway visual value
RWY	: runway
s	: second
S.	: South
SA	: selective availability
SALS	: short approach light system
SAVASI	: simplified abbreviated visual approach slope indicator system
SBAS	: space-based augmentation system
SDF	: simplified directional facility
sec	: second
SECRA	: secondary radar
SER	: stop end of runway
SIAP	: standard instrument approach procedure
SID	: standard instrument departure
SINE	: site integration of NAS equipment
SLS	: side lobe suppression
SNR	: Signal-to-noise ratio
SNR-FS	: Signal-to-noise ratio-field strength
SNR-PH	: Signal-to-noise ratio-phase
SPAR	: system performance analysis rating
SPS	: standard positioning service, C/A code
SSALF	: simplified short approach light system; sequenced flashing lights
SSALR	: same as SSALF; runway alignment indicator lights
SSV	: standard service volume
STAR	: standard terminal arrival route
STC	: sensitivity time control
STOL	: short takeoff and landing

TACAN : tactical air navigation
TAR : test analysis report
TCH : threshold crossing height
T-Class : terminal VOR, TACAN, or VORTAC
TCOM : terminal communications
TD : time difference
TDI : TACAN distance indicator
TDM : time division multiplex
TDR : touchdown reflector
TDZ : touchdown zone
TDZL : touchdown zone lights
TERPS : terminal instrument procedures
TH : threshold
TLS : Transponder Landing System
TOWP : take-off waypoint
T/R : transponder-radar (system)
TRACALS : traffic control and landing systems
TRACON : terminal radar approach control (FAA)
TRIAD : 3 Loran C stations of a specific chain
TRSB : time reference scanning beam
TSE : total system error
T-VASI : T (configuration)—visual approach slope indicator
TVOR : terminal VOR
TWEB : transcribed weather broadcast equipment

u : micro
UDF : ultra high frequency direction finder
UHF : ultra high frequency
USA : United States Army
USN : United States Navy
USAF : United States Air Force
USSFIM : United States Standard Flight Inspection Manual
UTC : universal coordinated time

V : volt
var. : variation
VASI : visual approach slope indicator
VDF : very high frequency direction finder
VDOP : vertical dilution of precision
VDP : visual descent point
VFIP : VFR flight inspection program
VFR : visual flight rules
VGSI : visual glide slope indicator

VHF	: very high frequency
VLF	: very low frequency
VNAV	: vertical navigation
VOR	: very high frequency omnidirectional range
VORDME	: very high frequency omnidirectional range, distance measuring equipment
VOT	: very high frequency omnidirectional range test
VP	: vertical polarization
V/STOL	: vertical/short takeoff and landing
VORTAC	: very high frequency omnidirectional range, tactal air navigation
W	: watt
W.	: West
WAM	: Wide Area Multilateration
WGS-84	: World Geodetic Survey of 1984
WPDE	: waypoint displacement error
WP	: waypoint
Xmtr	: transmitter
XTK	: receiver cross-track information
XTKER	: crosstrack error
Z	: zulu time (Greenwich mean time)

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APPENDIX 2

FORMULAS

TABLE OF CONTENTS

Paragraph *Title* *Pages*

FIGURES

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APPENDIX 2

FORMULAS

A2.1 INTRODUCTION. The following formulas and methods of calculation are presented as a ready reference.

A2.2 GENERAL. The following information is of a general nature, and use of it may be applicable to more than one facility.

a. **Constants Used in this Order.** Following is a list of constants used in this order. Others are unique to a particular formula and can be found in reference material concerning the subject.

Constant	Definition/Derivation
6076.1	feet per nautical mile
3600	seconds per hour
106	tan 1° (6076.1)
0.00943	$\frac{1}{\tan 1^\circ (6076.1)}$
0.0159	$\frac{6076.1}{(3600)(106)}$
0.592	$\frac{3600}{6076.1}$

b. **Rounding.** Measurements and calculations should be carried to one decimal place more than that required for tolerance application. Then apply the following criteria to round off a measurement.

Numbers 1 to 5 - round off to zero
Numbers 6 to 9 - round off to the next higher value.

Example: Glidepath Course Width:

0.755° = 0.75° and
0.756° = 0.76°

Exception: When a value exceeds a tolerance, it should not be rounded off to an in-tolerance condition.

Example: Glidepath Course Width:

= 0.903° is out of tolerance.

c. Time Average

$$T_{av} = \frac{2(T_1 \times T_2)}{(T_1 + T_2)}$$

Where:

T_{av} = Time average
T_1 = Time to cross in one direction
T_2 = Time to cross in opposite direction

d. Conversion of Knots to Feet per Second

$$V = \frac{6076.1 \times V_k}{3600}$$

Where:

V = Velocity (ft per sec)
V_k = Velocity (knots)

e. Slant Angle

$$\angle = \text{arc tan } \frac{A}{D}$$

Where:

A = Altitude above the horizontal (ft)
D = Geodetic distance (ft)
$\angle$ = Slant Angle (degrees)

f. Slant Range to Chart Distance

$$S = \frac{D}{\cos \angle}$$

Where:

D = Geodetic distance (ft)
S = Slant range distance (ft)
$\angle$ = Slant Angle (degrees)

g. Chart Distance to Slant Range

D = S cos ∠

Where:
D = Geodetic distance (ft)
S = Slant range distance (ft)
∠ = Slant angle (degrees)

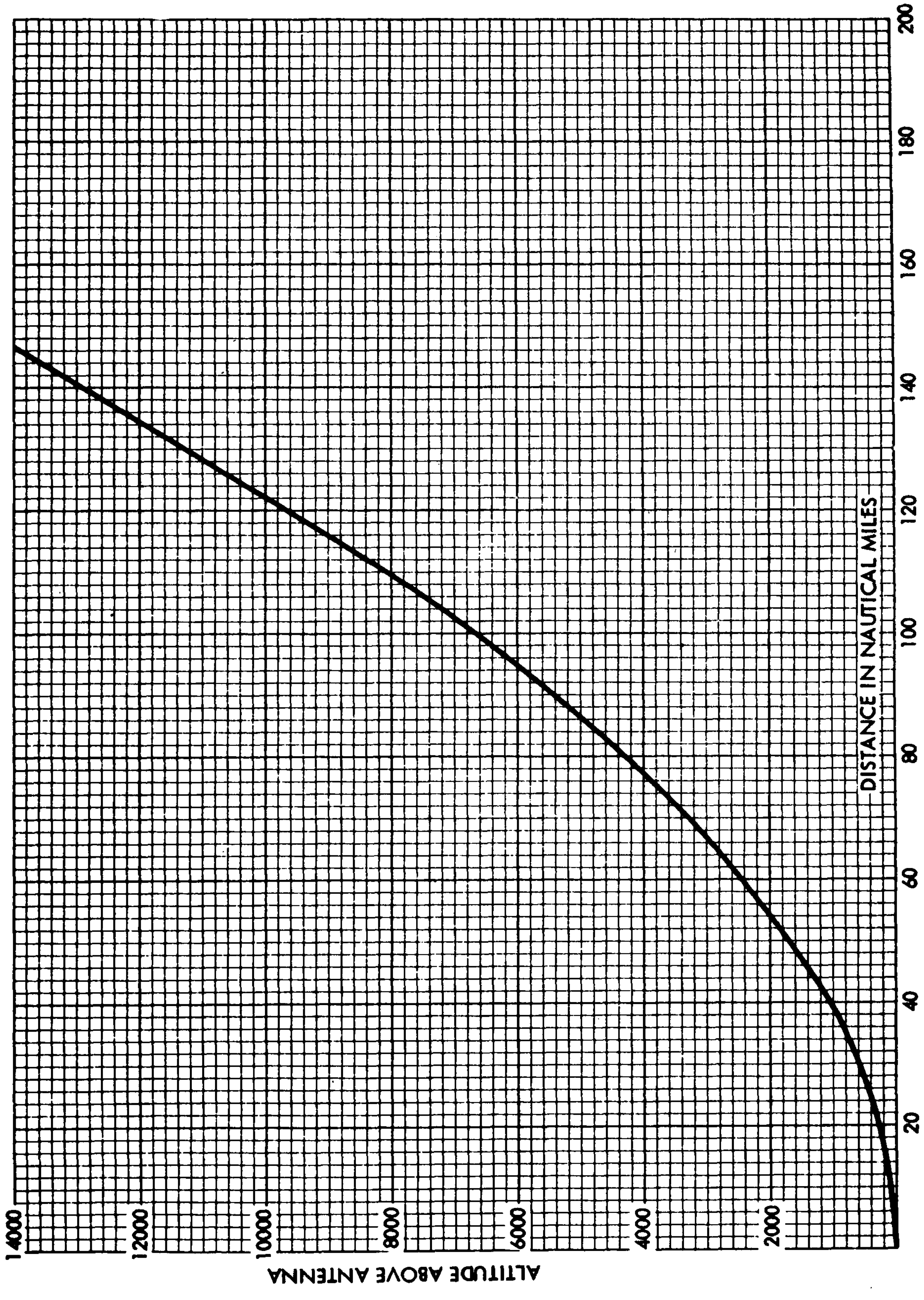
h. Radio Line of Sight

$$D = 1.23\ (\sqrt{H_r} + \sqrt{H_t})$$

Where:
D = Radio Line of Sight Distance (nm)
Hr = Height of receiving antenna (ft)
Ht = Height of transmitting antenna (ft)

Figure A2-1

RADIO LINE OF SIGHT CHART



i. Earth Curvature

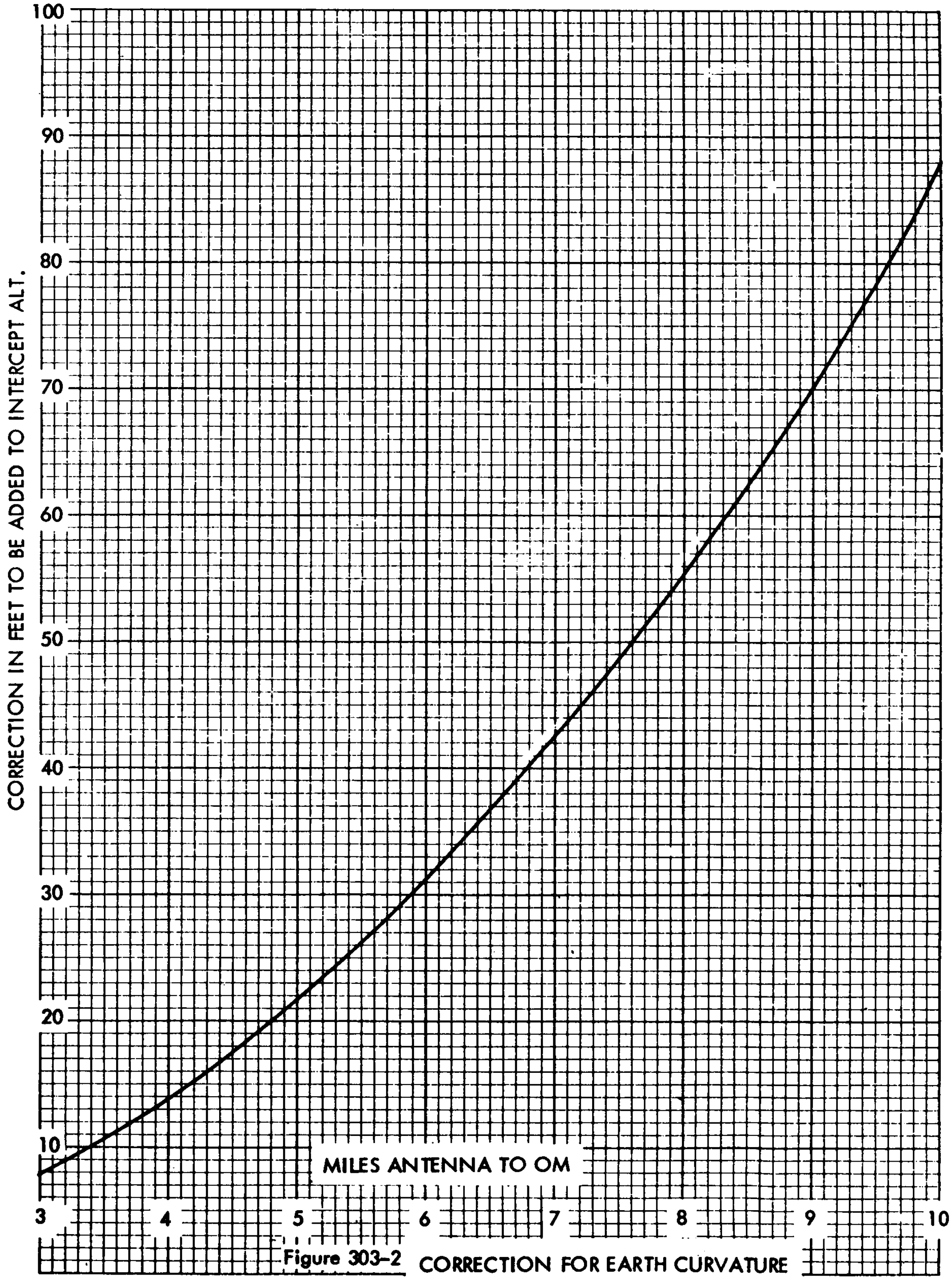
$$Ec = (D)^2(0.883)$$

Where:

Ec = Earth Curvature (ft)
D = Distance from a point (nm)

Figure A2-2

CORRECTION FOR EARTH CURVATURE



j. True Altitude

TA= CA + (CA-FE) * (ISADEV) / (273+OAT)

Where:

TA	= True Altitude above sea level
FE	= Field Elevation of station providing the altimeter setting
CA	= Altitude indicated by altimeter when set to the altimeter setting, corrected for calibration error
ISADEV	= Average deviation from standard temperature from standard in the air column between the station and the aircraft (in degrees C)
OAT	= Outside air temperature (at altitude)

A2.3 TACAN

Modulation Percentage 135 and 15 Hz

$$15\text{ Hz modulation} = \frac{(V_1 + V_2) - (V_3 + V_4)}{(V_1 + V_2) + (V_3 + V_4)}$$

$$135\text{ Hz modulation} = \frac{(V_1 + V_3) - (V_2 - V_4)}{(V_1 + V_2) + (V_3 + V_4)}$$

Where:
V_1 = Max of 135 Hz and 15 Hz
V_2 = Min of 135 Hz at max of 15 Hz
V_3 = Max of 135 Hz and 15 Hz at min 15 Hz
V_4 = Min 135 and 15 Hz at min 15 Hz

A2.4 MARKERS (75 MHz)

Marker Width

$$W_{ft} = \frac{(TAS)(T_{av})}{0{,}592} \text{ or}$$

$$W_{ft} = \frac{(G_s)(T)}{0.592} \text{ or}$$

$$W_{nm} = \frac{(TAS)(T_{av})}{3600}$$

Where:
G_s = Ground Speed (knots)
W_f = Width (ft)
W_{nm} = Width (nm)
T = Time (sec)
TAS = True Airspeed (knots)
T_{av} = Time Average (sec)

A2.5 RADAR

Blind Speed using Non-Staggered or Uniform Pulse

$$V = \frac{291(PRF)}{F}$$

Where:

V = Groundspeed (knots)
PRF = Pulse Repetition Frequency (pulses/sec)
F = Transmitter Frequency (Mhz)

A2.6 LOCALIZER

a. Course Width

$$W = \frac{0.0159(ETAS)(T_{av})}{D}$$

Where:

W = Width (degrees)
ETAS = Effective True Airspeed (knots)
T_{av} = Time Average for course crossing (sec)
D = Distance from the localizer antenna to the point where the aircraft cross the localizer course (nm to the nearest thousandth)

Computed true airspeed (TAS) may be used if correction for crosswind component is applied from Figure 3 in Appendix 3.

b. Determining Localizer Tailored Width

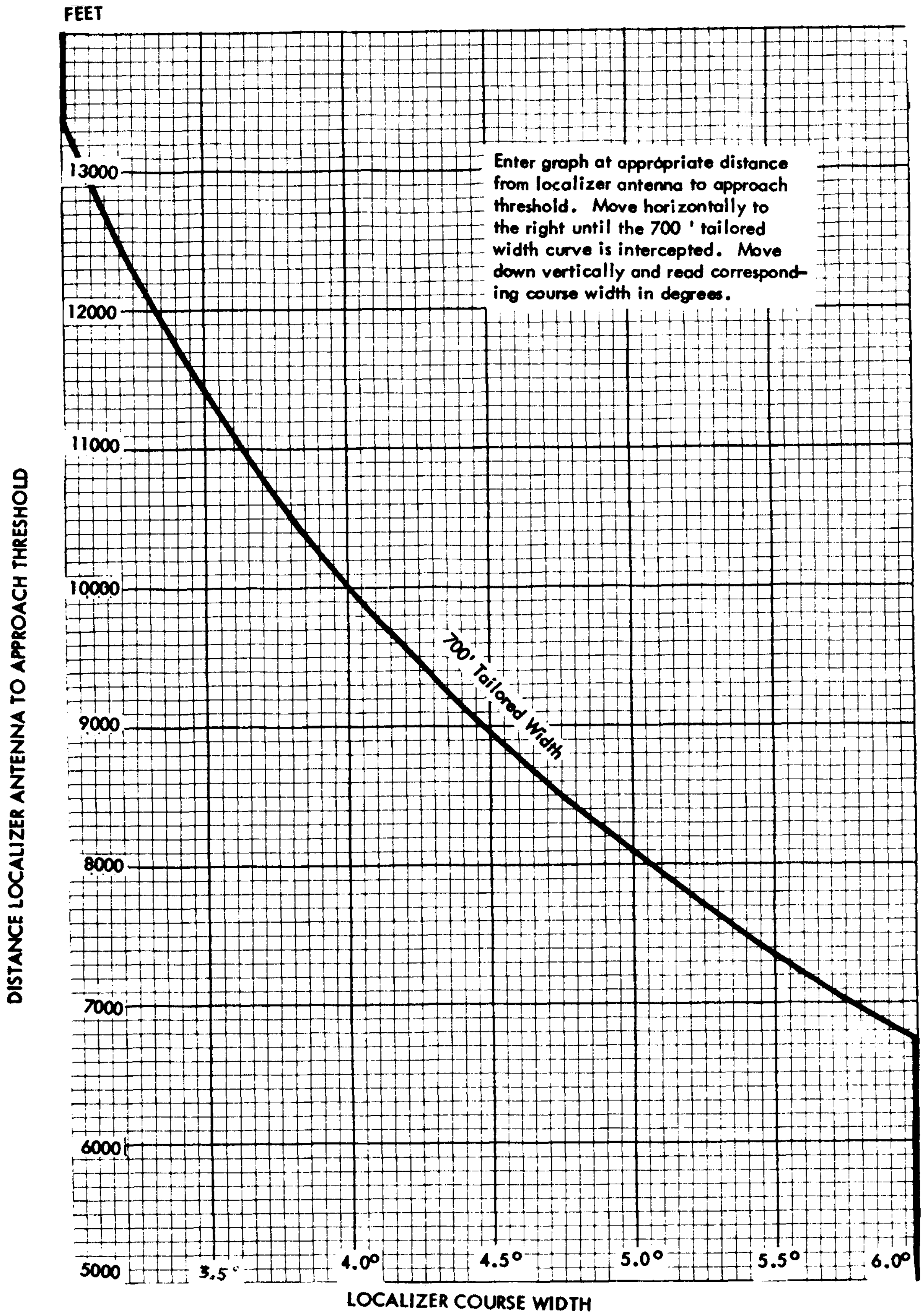
$$W = 2\left(\arctan\left(\frac{350}{D}\right)\right)$$

Where:

W = Tailored Width (degrees)
D = Distance from the localizer antenna to the runway threshold (ft)

Figure A2-3

TAILORED LOCALIZER COURSE WIDTH



c. Dual Frequency Localizer Power Ratio

$$dB = 20\left(\log \frac{E_1}{E_2}\right)$$

Where:

DB = Power ratio (dB)

E_1 = Signal Strength of course transmitter as read from the AGC Meter (μvolts)

E_2 = Signal Strength of clearance transmitter as read from the AGC Meter (μvolts)

A2.7 GLIDE SLOPE

Glidepath Width or Angles

$$\theta = \text{arc tan } \frac{A}{D \pm F}$$

Where:

θ = Angle (degrees)

A = Absolute (Tapeline) altitude (ft) above the glide slope antenna

D = Geodetic distance (ft) from the glide slope antenna to the outer marker (or checkpoint)

$$F = 6076.1\left(\frac{V}{3600}\right)T$$

NOTE: F is a factor. The value and sign (plus or minus) is determined by the location of the computation point on the recording.

- Assign a minus value to F if T occurs between the outer marker (or checkpoint) and the facility
- Assign a plus value to F if T occurs prior to the outer marker (or checkpoint)

V = Ground speed (knots)

T = Time to computation point (e.g., 75μA, 150HZ, 0μA, 75μA 90Hz for path width, and angle)

Glideslope distance – Threshold to Point C calculation:

$$\left[\frac{100+(\text{threshold elevation-GPI elevation})}{\text{tangent of the commissioned angle}}\right] - \text{GS Distance to threshold}$$

A2.8 PRECISION APPROACH

a. Level Run Glidepath Angle (using paper units)

(1) $$\theta = \frac{A(0.00943)}{D}$$

Where:

θ = Glidepath Angle (degrees)
A = Absolute (Tapeline) altitude (ft) above the glide slope antenna
D = Distance from the Runway Point of Intercept (RPI) to the point where the glidepath is crossed (nm to the nearest thousandth)

(2) $$\theta = \frac{A(I_1)}{106(D)(I_2)}$$

Where:

θ = Glidepath Angle (degrees)
A = Absolute (Tapeline) altitude (ft) above the glide slope antenna
I_1 = Inches or units of recording paper from surveyed checkpoint to RPI
I_2 = Inches or units of recording paper from RPI to the point where the glidepath is crossed
D = Distance from the Runway Point of Intercept (RPI) to the point where the glidepath is crossed (nm to the nearest thousandth)

b. Altimetry Method

$$\text{Measured Angle} = \frac{A1}{106 \times D}$$

Where:

A1 = Tapeline altitude in feet
D = Distance in nautical miles from RPI

A2.9 PROCEDURES

Gradient and Climb Rates

$$\frac{Cfd}{60} : \frac{Gr}{1} : \frac{Cr}{Gs}$$

Where:

Cfd = Climb rate (ft/nm)
Gr = Gradient (in percent/100)
Cr = Rate of Climb (ft/min)
Gs = Ground Speed (knots)

This formula is expressed as a ratio which can be solved directly on a pilot's computer (e.g., Jeppeson CR-3)

A2.10 MLS PFE/ PFN/ CMN ANGULAR TOLERANCE

$$\theta = \arctan \frac{Tf}{D}$$

Where:

θ = Angular Tolerance at measure point.
Tf = PFE/PFN/CMN Tolerance in feet
D = Distance in feet from Azimuth antenna to Tolerance reference Point (ARD or MAP)

A2.11 FMS WAYPOINT DME EVALUATION ORBIT/ ARC RADIUS

R = 0.0125D +0.25NM + XTRK

Where:

R = Radius in nm of orbit or arc
D = Distance in nm from the DME station farthest from the waypoint.
XTRK = Waypoint design criteria from Order 8260.40

NOTE: The XTRK value is .6 nm for Initial Approach, Intermediate, Final Approach, Missed Approach, and missed approach holding waypoints, 2.0 nm for feeder waypoints, and 3.0 nm for en route waypoints.

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APPENDIX 3

MICROWAVE SCANNING BEAM LANDING SYSTEM (MSBLS) PROCEDURES

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APPENDIX 3

MICROWAVE SCANNING BEAM LANDING SYSTEM (MSBLS) PROCEDURES

A3.1 INTRODUCTION. The MSBLS is a precision approach and landing system that provides slant range, azimuth, and elevation data to NASA's Shuttle Orbiter during terminal area energy management, approach, and landing phases of the Shuttle at CONUS based End of Mission and Transatlantic Abort Landing sites in Spain, Morocco, and France. Unlike a conventional MLS, the MSBLS does not provide a published procedural azimuth track at a fixed angle of descent. It provides the Shuttle's Guidance, Navigation, and Control (GN&C) computer continuous digital azimuth, elevation, and range signal offsets relative to the MSBLS antenna phase centers. The GN&C computer, in turn, steers the Shuttle on a user programmed approach and landing profile using multiple azimuth tracks and elevation angles.

A3.2 DATABASE. Dual transmitter MSBLS installations, called MSBLS GS (Ground Station) or MSBLS JRSW (Junior Switchable), contain individual antennas (per transmitter) and monitor systems. Due to the tight azimuth / elevation flight inspection tolerances (0.015 degrees) separate AFIS facility databases are developed for each transmitter / antenna pairing.

A3.3 TRUTH SYSTEM. AFIS measures the accuracy of the MSBLS signals using GPS real-time kinematics (RTK) differential technology as truth reference data. RTK differential methods require a GPS reference (base) station, provided by NASA at all MSBLS locations, to send a GPS pseudo range correction to a separate GPS receiver (rover) in the aircraft, which calculates the precise position of the aircraft. The AFIS NCU provides continuous real-time MSBLS error without any TVPS or pilot runway updates. Current status of the DGPS truth system is available in the "SYS-P" field of the AFIS software's MSBLS Graphics Display page. "**Fixed RTK" mode is required for all MSBLS flight inspection, with the following exceptions; momentary status changes to "Float RTK" are permissible on radial and arc flight inspection**. **If Fixed RTK mode cannot be achieved and maintained, the flight inspection shall be terminated.**

A3.4 LIMITATIONS. MSBLS flight inspection is limited to fair weather conditions. Due to the 15 GHZ operating frequency, precipitation may affect the MSBLS signal propagation. Turbulence and radical aircraft movement may also affect the flight inspection results.

a. Report any of these weather-related conditions to the on-site NASA Navaids engineer who will make the ultimate decision to continue or terminate the flight inspection.

b. The aircraft's weather radar adversely affects the MSBLS receiver due to the proximity of the weather radar antenna to the aircraft's MSBLS antennas, and the 4 GHZ frequency of the radar. **The weather radar must be in standby mode during all MSBLS flight inspection profiles, and the MSBLS NAVSET must remain off on all other occasions when the weather radar is active.**

A3.5 PROCEDURES

a. **The MSBLS AFIS flight inspection mode,** as installed on the Challenger 601 aircraft, operates in a graphical environment. This environment, developed specifically for MSBLS flight inspection, integrates Windows based graphics and Ethernet real-time data into console generated displays. The MSBLS Graphics Display page contains:

(1) A top panel that displays navigational data, facility data, MSBLS receiver monitor data, and profile setup parameters.

(2) The NAPLPS display area (white background) which plots the MSBLS signal strengths and azimuth, elevation, and DME errors.

(3) A selection of "macro" buttons on the right side of the page that provides all the utility functions needed to perform the flight inspection. This macro setup eliminates the need for dedicated keyboard "hotkeys;" to start/stop a run, select other pages, or setup MSBLS flight inspection profiles.

b. **On the MSBLS/ DGPS Control Box** manually press the MSBLS and DGPS power switches.

c. **AFIS Self-Test Procedures**. The MSBLS self test function is not functional with the current revision of software. During the AFIS preflight check, the display will show a failed indication. An alternate procedure has been developed to ensure the MSBLS flight inspection system is operational. The first step requires Mission Specialist input. The second is a built-in failsafe that requires no input.

(1) Prior to any flight inspection mission, ensure the AGC or Signal Strength (SS) of the Azimuth, Elevation, and DME MSBLS data parameters is displayed on the Graphics page. This step ensures that the MSBLS flight inspection system is usable (i.e., receiver and data converter are functional; AFIS is decoding and displaying data correctly).

(2) During MSBLS flight inspection operations, the MSBLS receiver’s Functional Status Word (FSW 1) is constantly internally monitored for system status and health. Any receiver fault detected in FSW 1 will be immediately reflected by a cessation of displayed MSBLS data. If data is being displayed on the MSBLS Inspection page, receiver integrity is confirmed and the flight inspection mission can continue.

d. **AFIS set-up for a MSBLS flight inspection** is as follows:

(1) With Windows opened on the Miltope, double-click the "IFWS Ethernet" ICON that opens the NAPLPS program to the System Service Page.

(2) Select the MSBLS mode

(3) Select the System Setup Page. Verify the following lever arm values:

ACDLN49 = - 7.1

ACDHT09 = +11.7

ACDHT49 = +7.0

ACDLN45 = +11.8

ACDHT05 = + 6.9

(4) Select the DME/Fix Update page. Verify the FINAV mode is "DGPS". **DGPS mode provides RTK differential positioning as a truth source to AFIS only. The selection does not affect aircraft navigation accuracy.**

(5) Select the FI Facility Data page and verify the data matches that on the AVNIS product. Note the MSBLS IDENT is broken down to a "P" and "B" for primary and backup systems.

MSBLS DATUM HGT = Elevation Datum Point Height

GPS UNDULATION = DGPS Reference Point DELTA-HGT

All azimuth, elevation, and DME references pertain to primary or backup antenna measurements, ***not*** *the datum point measurements*.

(6) Select the Graphics button to open the MSBLS Graphics Display Page.

(7) Select the Profile button to choose from a list of "canned" radials, arcs, and approaches. Note all the profiles used on commissioning and periodic inspections are "canned". Changes in altitude, distance, or azimuth / elevation tracks may be hand-loaded on the profile page. **All profiles must be executed from the Profile page.**

(8) Begin the run using the Start button. All runs auto-stop based on the parameters entered via the Profile page. This feature works well on arcs and radials, however the approaches will not auto-stop at threshold as required by some approach profiles. The Stop button is then used. MSBLS antenna selection is done via the AFIS software, with the nose antenna used on all approaches and radials, left antenna used on counter-clockwise arcs, and the right antenna used for clockwise arcs.

(9) Select the Print button to screen-print the Graphics Display Page to the inkjet printer.

The RMS 33 is not used for MSBLS flight inspection.

e. Each time a manual stop or auto-stop is processed the measured data is automatically sent to a Flight Inspection Summary page. The "as left" results are then selected by the Mission Specialist from the Summary page and included on a Flight Inspection Report page which represents the final report to NASA.

The reported MSBLS errors are accumulated from all sample points measured during the inspection. Average azimuth, elevation, and DME error is reported on the Final Report Page. The Summary and Flight Inspection Report pages tabulate that data at the bottom of each page, which affords the flight inspector real-time accumulated error.

f. The aircraft's auto-pilot cannot couple to the MSBLS signal. All flight inspection profiles are to be flown via RNAV routes developed from predetermined waypoints stored on FMS media. Close coordination between the Mission Specialist and pilot is essential for precise aircraft placement. The only FIS information available to the pilot is the profile selected, present position, and the results of the run.

g. The MSBLS results may be altered to eliminate extraneous information, i.e., elevation signal unusable but the azimuth was satisfactory, via data markers on the graphics display page. When any data is excluded, the plots and all results on the Graphics Display page remain unchanged, however the Summary page that is used to compute the overall error will be altered accordingly. Various subroutines are available on the MSBLS software, including the capability to overlay several error plots and recreate error plots. Consult T.I. 4040.55 and 56 for more detailed graphics functions.

h. All data shall be logged using the PCMIA card reader. The recorded media is to be retained for archiving purposes. In the MSBLS mode the data automatically logs to the PCMIA reader. Each MSBLS run consumes approximately 5MB of space on the PCMIA media. To ensure data is not lost a blank PCMIA card should be loaded for each runway end.

A3.6 FLIGHT INSPECTION MODES

a. **Arcs.** Manually start the AFIS at 15° of azimuth offset. The AFIS auto-stops the run approximately 13.5° on the other side of system centerline. *Airspeeds of 170 - 250 knots indicated should be used for arc flight.*

b. **Radials.** Manually start the profile. The AFIS auto-stops the run per the stop distance on the Profile page. *Airspeeds of 170 - 200 knots should be used for radial flight.*

c. **Approaches.** Manually start the profile. The AFIS auto-stops the run per the stop distance on the Profile page. Since only 1 approach per transmitter is flown the full length of the runway, the Mission Specialist must manually stop the remaining approaches at the runway threshold. *Use 20° flap settings on the approach and 45° when landing. VREF + 10 knots airspeed for a 20° flap setting should be used.*

A3.7 FMS PROGRAMMING. Graphical depictions and actual site-specific coordinates of waypoints used to program the FMS to fly the MSBLS flight inspection maneuvers, and actual flight inspection checklists will be located on the Airman's Information File (AIF) as soon as possible. Until that time they may be obtained from Flight Inspection Policy. The waypoints are grouped into named routes in the FMS and stored on zip drive media for each MSBLS system.

APPENDIX 4

FREQUENCY SPECTRUM

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Paragraphs *Title* *Pages*

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APPENDIX 4

FREQUENCY SPECTRUM

A4.1 FREQUENCY ALLOCATION

The following is a tabulation of frequencies available for use in the aeronautical, broadcast, and mobile bands. This tabulation may be used as an aid for identifying potential sources of interference. Also included is the VHF/UHF NAVAID Frequency Channeling and Pairing Chart which covers the X and Y channels for TACAN, 50 kHz spacing for VOR and LOC, and 150 kHz GS spacing. The Frequency Management Office can provide additional information regarding users of specific frequencies or bands of frequencies.

FREQUENCY	SERVICE
200-415 kHz	L/ MF radio beacons, ranges, and tower voice (285-325 kHz and 405-415 kHz shared with maritime navigational aids).
1605 kHz-24 mHz	MF/ HF Communications (shared with all services and Government/non-Government users).
90 -110 kHz	Loran-C
75m Hz	VHF Marker Beacons
108-118 mHz	ILS Localizer & VOR
118-136 mHz	VHF Communications
162-174 mHz	Relay/ Control of VORTAC
225-328.6 mHz	UHF Communications
328.6-335.4 mHz	ILS Glide Slope
335.4-400 mHz	UHF Communications
406-420 mHz	Relay/ Control of VORTAC
420-460 mHz	Radio Altimeter
960-1215 mHz	TACAN and DME
1030 mHz and 1090 mHz	ATC Radar Beacon
1215-1400 mHz	Long Range Surveillance Radar
1227.6 mHz	L2 GPS
1435-1535 mHz	Aeronautical Telemetering (Flight Tests)
1535-1542.5 mHz	Maritime Mobile-Satellite
1542.5-1543.5 mHz	Aeronautical Mobile-Satellite (R) and Maritime Mobile-Satellite
1543.5-1558.5 mHz	Aeronautical Mobile-Satellite (R)
1558.5-1636.5 mHz	Aeronautical Radio Navigation
1575.42mHz	L2 Global Positioning System
1636.5-1644 mHz	Maritime Mobile-Satellite
1644-1645 mHz	Aeronautical Mobile-Satellite (R) and Maritime Mobile Satellite
1645-1660 mHz	Aeronautical Mobile Satellite (R)
2700-2900 mHz	Airport Surveillance Radar (shared with meteorological radar).

FREQUENCY	SERVICE
4200-4400 mHz	Radar Altimeter
5000-5250 mHz	Reserved for Aeronautical Radio Navigation and Space Radio Communication
5031 –5090.7 MHz	Microwave Landing System (MLS)
5350-5470 mHz	Airborne Weather Radar
7125-8400 mHz	Microwave Link for Long Range Radar Relay
8800 mHz	Airborne Doppler Radar
9000-9200 mHz	Precision Approach Radar (PAR)
9300-9500 mHz	Airborne Weather Radar
13.25-13.4 gHz	Doppler Navigation Aids
15.4-15.7 gHz	Reserved for Aeronautical Radio Navigation and Space Radio Communications
24.25-24.47 gHz	Airport Surface Detect Radar (ASDE)

Frequency	Broadcast
540-1600 kHz	Standard USA
2300-2495 kHz	Tropical Zone only
2500 kHz	WWV Standard Frequency
3200-3400 kHz	Tropical Zone only
3900-4000 kHz	International (Region 3 only)
3950-4000 kHz	International (Region 1 only)
4750-4995 kHz	Tropical Zone only
5000 kHz	WWV Standard Frequency
5005-5060 kHz	Tropical Zone only
5950-6200 kHz	International
9500-9775 kHz	International
10 mHz	WWV Standard Frequency
11.7-11.975 mHz	International
15 mHz	WWV Standard Frequency
15.1-15.45 mHz	International
17.7-17.9 mHz	International
20 mHz	WWV Standard Frequency
21.45-21.75 mHz	International
25 mHz	WWV Standard Frequency
25.6-26.1 mHz	International
54-72 mHz	Television, VHF
76-88 mHz	Television, VHF
88-108 mHz	FM
174-216 mHz	Television, VHF
470-890 mHz	Television, UHF

A4.2 NOMENCLATURE OF FREQUENCY BANDS

a. International

VLF	Very Low Frequency	0 - 30 kHz
LF	Low Frequency	30 - 300 kHz
MF	Medium Frequency	300 - 3,000 kHz
HF	High Frequency	3,000 - 30,000 kHz
VHF	Very High Frequency	30,000 kHz - 300 mHz
UHF	Ultra High Frequency	300 - 3,000 mHz
SHF	Super High Frequency	3,000 - 30,000 mHz
EHF	Extremely High Frequency	30,000 - 300,000 mHz

The shaded frequencies are, for AFIS use, paired communications frequencies that correspond to the indicated TACAN channel.

b. VHF/ UHF NAVAID FREQUENCY CHANNELING AND PAIRING

DME CHANNEL NUMBER	-------------FREQUENCY-------- LOC	GS	VHF/ VOR	MLS	MLS CHANNEL NUMBER	DME AIRBORNE INTERROGATE FREQ	PULSE CODE NORMAL DME us	P/ DME IA us	FA us	DME GND REPLY DME FREQ	PC us
1X	-	-	134.40	-	-	1025	12	--	--	962	12
1Y	-	-	134.45	-	-	1025	36	--	--	1088	30
2X	-	-	134.50	-	-	1026	12	--	--	963	12
2Y	-	-	134.55	-	-	1026	36	--	--	1089	30
3X	-	-	134.60	-	-	1027	12	--	--	964	12
3Y	-	-	134.65	-	-	1027	36	--	--	1090	30
4X	-	-	134.70	-	-	1028	12	--	--	965	12
4Y	-	-	134.75	-	-	1028	36	--	--	1091	30
5X	-	-	134.80	-	-	1029	12	--	--	966	12
5Y	-	-	134.85	-	-	1029	36	-	-	1092	30
6X	-	-	134.90	-	-	1030	12	-	-	967	12
6Y	-	-	134.95	-	-	1030	36	-	-	1093	30
7X	-	-	135.00	-	-	1031	12	-	-	968	12
7Y	-	-	135.05	-	-	1031	36	-	-	1094	30
8X	-	-	135.10	-	-	1032	12	-	-	969	12
8Y	-	-	135.15	-	-	1032	36	-	-	1095	30
9X	-	-	135.20	-	-	1033	12	-	-	970	12
9Y	-	-	135.25	-	-	1033	36	-	-	1096	30
10X	-	-	135.30	-	-	1034	12	-	-	971	12
10Y	-	-	135.35	-	-	1034	36	-	-	1097	30
11X	-	-	135.40	-	-	1035	12	-	-	972	12
11Y	-	-	135.45	-	-	1035	36	-	-	1098	30
12X	-	-	135.50	-	-	1036	12	-	-	973	12
12Y	-	-	135.55	-	-	1036	36	-	-	1099	30

VHF/ UHF NAVAID FREQUENCY CHANNELING AND PAIRING, CONTINUED

DME CHANNEL NUMBER	FREQUENCY LOC	FREQUENCY GS	FREQUENCY VHF/ VOR	FREQUENCY MLS	MLS CHANNEL NUMBER	DME AIRBORNE INTERROGATE FREQ	PULSE CODE NORMAL DME us	PULSE CODE P/ DME IA us	PULSE CODE P/ DME FA us	DME GND REPLY DME FREQ	DME GND REPLY PC us
13X	-	-	135.60	-	-	1037	12	-	-	974	12
13Y	-	-	135.65	-	-	1037	36	-	-	1100	30
14X	-	-	135.70	-	-	1038	12	-	-	975	12
14Y	-	-	135.75	-	-	1038	36	-	-	1101	30
15X	-	-	135.80	-	-	1039	12	-	-	976	12
15Y	-	-	135.85	-	-	1039	36	-	-	1102	30
16X	-	-	135.90	-	-	1040	12	-	-	977	12
16Y	-	-	135.95	-	-	1040	36	-	-	1103	30
17X	-	-	108.00	-	-	1041	12	-	-	978	12
17Y	-	-	108.05	5043.0	540	1041	36	36	42	1104	30
18X	108.10	334.70		5031.0	500	1042	12	12	18	979	12
18Y	108.15	334.55		5043.6	542	1042	36	36	42	1105	30
19X	-	-	108.20	-	-	1043	12	-	-	980	12
19Y	-	-	108.25	-	-	1043	36	36	42	1106	30
20X	108.30	334.10		5031.6	502	1044	12	12	18	981	12
20Y	108.35	333.95		5044.8	546	1044	36	36	42	1107	30
21X	-	-	108.40	-	-	1045	12	-	-	982	12
21Y	-	-	108.45	5045.4	548	1045	36	36	42	1108	30
22X	108.50	329.90		5032.2	504	1046	12	12	18	983	12
22Y	108.55	329.75		5046.0	550	1046	36	36	42	1109	30
23X	-	-	108.60	-	-	1047	12	-	-	984	12
23Y	-	-	108.65	5046.6	552	1047	36	36	42	1110	30
24X	108.70	330.50		5032.8	506	1048	12	12	18	985	12
24Y	108.75	330.35		5047.2	554	1048	36	36	42	1111	30
25X	-	-	108.80	-	-	1049	12	-	-	986	12
25Y	-	-	108.85	5047.8	556	1049	36	36	42	1112	30
26X	108.90	329.30		5033.4	508	1050	12	12	18	987	12
26Y	108.95	329.15		5048.4	558	1050	36	36	42	1113	30
27X	-	-	109.00	-	-	1051	12	-	-	988	12
27Y	-	-	109.05	5049.0	560	1051	36	36	42	1114	30
28X	109.10	331.40		5034.0	510	1052	12	12	18	989	12
28Y	109.15	331.25		5049.6	562	1052	36	36	42	1115	30
29X	-	-	109.20	-	-	1053	12	-	-	990	12
29Y	-	-	109.25	5050.2	564	1053	36	36	42	1116	30
30X	109.30	332.00		5034.6	512	1054	12	12	18	991	12
30Y	109.35	331.85		5050.8	556	1054	36	36	42	1117	30
31X	-	-	109.40	-	-	1055	12	-	-	992	12
31Y	-	-	109.45	5051.4	568	1055	36	36	42	1118	30
32X	109.50	332.60		5035.2	514	1056	12	12	18	993	12
32Y	109.55	332.45		5052.0	570	1056	36	36	42	1119	30
33X	-	-	109.60	-	-	1057	12	-	-	994	12
33Y	-	-	109.65	5052.6	572	1057	36	36	42	1120	30
34X	109.70	333.20	-	5035.8	516	1058	12	12	18	995	12
34Y	109.75	333.05	-	5035.2	574	1058	36	36	42	1121	30

VHF/ UHF NAVAID FREQUENCY CHANNELING AND PAIRING, CONTINUED

DME CHANNEL NUMBER	LOC	GS	VHF/ VOR	MLS	MLS CHANNEL NUMBER	FREQ	DME AIRBORNE INTERROGATE PULSE CODE NORMAL DME us	P/ DME IA us	P/ DME FA us	DME GND REPLY DME FREQ	DME GND REPLY PC us
35X	-	-	109.80	-	-	1059	12	-	-	996	12
35Y	-	-	109.85	5053.8	576	1059	36	36	42	1122	30
36X	109.90	333.80		5036.4	518	1060	12	12	18	997	12
36Y	109.95	333.65		5054.4	578	1060	36	36	42	1123	30
37X	-	-	110.00	-	-	1061	12	-	-	998	12
37Y	-	-	110.05	5055.0	580	1061	36	36	42	1124	30
38X	110.10	334.40		5037.0	520	1062	12	12	18	999	12
38Y	110.15	334.25									
39X	-	-	110.20	-	-	1063	12	-	-	1000	12
39Y	-	-	110.25	5056.2	584	1063	36	36	42	1126	30
40X	110.30	335.00		5037.6	522	1064	12	12	18	1001	12
40Y	110.35	334.85		5056.8	586	1064	36	36	42	1127	30
41X	-	-	110.40	-	-	1065	12	-	-	1002	12
41Y	-	-	110.45	5057.4	588	1065	36	36	42	1128	30
42X	110.50	329.60		5038.2	524	1066	12	12	18	1003	12
42Y	110.55	329.45		5058.0	590	1066	36	36	42	1129	30
43X	-	-	110.60	-	-	1067	12	-	-	1004	12
43Y	-	-	110.65	5058.6	592	1067	36	36	42	1130	30
44X	110.70	330.20		5038.8	526	1068	12	12	18	1005	12
44Y	110.75	330.05		5059.2	594	1068	36	36	42	1131	30
45X	-	-	110.80	-	-	1069	12	-	-	1006	12
45Y	-	-	110.85	5059.8	596	1069	36	36	42	1132	30
46X	110.90	330.80		5039.4	528	1070	12	12	18	1007	12
46Y	110.95	330.65		5060.4	598	1070	36	36	42	1133	30
47X	-	-	111.00	-	-	1071	12	-	-	1008	12
47Y	-	-	111.05	5061.0	600	1071	36	36	42	1134	30
48X	111.10	331.70		5040.0	530	1072	12	12	18	1009	12
48Y	111.15	331.55		5061.6	602	1072	36	36	42	1135	30
49X	-	-	111.20	-	-	1073	12	-	-	1010	12
49Y	-	-	111.25	6062.2	604	1073	36	36	42	1136	30
50X	111.30	332.30		5040.6	532	1074	12	12	18	1011	12
50Y	111.35	332.15		5062.8	606	1074	36	36	42	1137	30
51X	-	-	111.40	-	-	1075	12	-	-	1012	12
51Y	-	-	111.45	5063.4	608	1075	36	36	42	1136	30
52X	111.50	332.90		5041.2	534	1076	12	12	18	1013	12
52Y	111.55	332.75		5064.0	610	1076	36	36	42	1139	30
53X	-	-	111.60	-	-	1077	12	-	-	1014	12
53Y	-	-	111.65	5064.4	612	1077	36	36	42	1140	30
54X	111.70	333.50		5041.8	536	1078	12	12	18	1015	12
54Y	111.75	333.35		5065.2	614	1078	36	36	42	1141	30
55X	-	-	111.80	-	-	1079	12	-	-	1016	12
55Y	-	-	111.85	5065.8	616	1079	36	36	42	1142	30

VHF/ UHF NAVAID FREQUENCY CHANNELING AND PAIRING, CONTINUED

DME CHANNEL NUMBER	LOC	GS	VHF/ VOR	MLS	MLS CHANNEL NUMBER	FREQ	DME AIRBORNE INTERROGATE PULSE CODE NORMAL DME us	P/ DME IA us	P/ DME FA us	DME GND REPLY DME FREQ	DME GND REPLY PC us
	-------------FREQUENCY--------										
56X	111.90	331.10		5042.4	538	1080	12	12	18	1017	12
56Y	111.95	330.95		5066.4	618	1080	36	36	42	1143	30
57X	-	-	112.00	-	-	1081	12	-	-	1018	12
57Y	-	-	112.05	-	-	1081	36	-	-	1144	30
58X	-	-	112.10	-	-	1082	12	-	-	1019	12
58Y	-	-	112.15	-	-	1082	36	-	-	1145	30
59X	-	-	112.20	-	-	1083	12	-	-	1020	12
59Y	-	-	112.25	-	-	1083	36	-	-	1146	30
60X	-	-	133.30	-	-	1084	12	-	-	1021	12
60Y	-	-	133.35	-	-	1084	36	-	-	1147	30
61X	-	-	133.40	-	-	1085	12	-	-	1022	12
61Y	-	-	133.45	-	-	1085	36	-	-	1148	30
62X	-	-	133.50	-	-	1086	12	-	-	1023	12
62Y	-	-	133.55	-	-	1086	36	-	-	1149	30
63X	-	-	133.60	-	-	1087	12	-	-	1024	12
63Y	-	-	133.65	-	-	1087	36	-	-	1150	30
64X	-	-	133.70	-	-	1088	12	-	-	1151	12
64Y	-	-	133.75	-	-	1088	36	-	-	1025	30
65X	-	-	133.80	-	-	1089	12	-	-	1152	12
65Y	-	-	133.85	-	-	1089	36	-	-	1026	30
66X	-	-	133.90	-	-	1090	12	-	-	1153	12
66Y	-	-	133.95	-	-	1090	36	-	-	1027	30
67X	-	-	134.00	-	-	1091	12	-	-	1154	12
67Y	-	-	134.05	-	-	1091	36	-	-	1028	30
68X	-	-	134.10	-	-	1092	12	-	-	1155	12
68Y	-	-	134.15	-	-	1092	36	-	-	1029	30
69X	-	-	134.20	-	-	1093	12	-	-	1156	12
69Y	-	-	134.25	-	-	1093	36	-	-	1030	30
70X	-	-	112.30	-	-	1094	12	-	-	1157	12
70Y	-	-	112.35	-	-	1094	36	-	-	1031	30
71X	-	-	112.40	-	-	1095	12	-	-	1158	12
71Y	-	-	112.45	-	-	1095	36	-	-	1032	30
72X	-	-	112.50	-	-	1096	12	-	-	1159	12
72Y	-	-	112.55	-	-	1096	36	-	-	1033	30
73X	-	-	112.60	-	-	1097	12	-	-	1160	12
73Y	-	-	112.65	-	-	1097	36	-	-	1034	30
74X	-	-	112.70	-	-	1098	12	-	-	1161	12
74Y	-	-	112.75	-	-	1098	36	-	-	1035	30
75X	-	-	112.80	-	-	1099	12	-	-	1162	12
75Y	-	-	112.85	-	-	1099	36	-	-	1036	30

VHF/ UHF NAVAID FREQUENCY CHANNELING AND PAIRING, CONTINUED

DME CHANNEL NUMBER	FREQUENCY LOC	FREQUENCY GS	FREQUENCY VHF/ VOR	FREQUENCY MLS	MLS CHANNEL NUMBER	DME AIRBORNE INTERROGATE FREQ	PULSE CODE NORMAL DME us	PULSE CODE P/ DME IA us	PULSE CODE P/ DME FA us	DME GND REPLY DME FREQ	DME GND REPLY PC us
76X	-	-	112.90	-	-	1100	12	-	-	1163	12
76Y	-	-	112.95	-	-	1100	36	-	-	1037	30
77X	-	-	113.00	-	-	1101	12	-	-	1164	12
77Y	-	-	113.05	-	-	1101	36	-	-	1038	30
78X	-	-	113.10	-	-	1102	12	-	-	1165	12
78Y	-	-	113.15	-	-	1102	36	-	-	1039	30
79X	-	-	113.20	-	-	1103	12	-	-	1166	12
79Y	-	-	113.25	-	-	1103	36	-	-	1040	30
80X	-	-	113.30	-	-	1104	12	-	-	1167	12
80Y	-	-	113.35	5067.0	620	1104	36	36	42	1041	30
81X	-	-	113.40	-	-	1105	12	-	-	1168	12
81Y	-	-	113.45	5067.6	622	1105	36	36	42	1042	30
82X	-	-	113.50	-	-	1106	12	-	-	1169	12
82Y	-	-	113.55	5068.2	624	1106	36	36	42	1043	30
83X	-	-	113.60	-	-	1107	12	-	-	1170	12
83Y	-	-	113.65	5068.8	626	1107	36	36	42	1044	30
84X	-	-	113.70	-	-	1108	12	-	-	1171	12
84Y	-	-	113.75	5069.4	628	1108	36	36	42	1045	30
85X	-	-	113.80	-	-	1109	12	-	-	1172	12
85Y	-	-	113.85	5070.0	630	1109	36	36	42	1046	30
86X	-	-	113.90	-	-	1110	12	-	-	1173	12
86Y	-	-	113.95	5070.6	632	1110	36	36	42	1047	30
87X	-	-	114.00	-	-	1111	12	-	-	1174	12
87Y	-	-	114.05	5071.2	634	1111	36	36	42	1048	30
88X	-	-	114.10	-	-	1112	12	-	-	1175	12
88Y	-	-	114.15	5071.8	636	1112	36	36	42	1049	30
89X	-	-	114.20	-	-	1113	12	-	-	1176	12
89Y	-	-	114.25	5072.4	638	1113	36	36	42	1050	30
90X	-	-	114.30	-	-	1114	12	-	-	1177	12
90Y	-	-	114.35	5073.0	640	1114	36	36	42	1051	30
91X	-	-	114.40	-	-	1115	12	-	-	1178	12
91Y	-	-	114.45	5073.6	642	1115	36	36	42	1052	30
92X	-	-	114.50	-	-	1116	12	-	-	1179	12
92Y	-	-	114.55	5074.2	644	1116	36	36	42	1053	30
93X	-	-	114.60	-	-	1117	12	-	-	1180	12
93Y	-	-	114.65	5074.8	646	1117	36	36	42	1054	30
94X	-	-	114.70	-	-	1118	12	-	-	1181	12
94Y	-	-	114.75	5075.4	648	1118	36	36	42	1055	30
95X	-	-	114.80	-	-	1119	12	-	-	1182	12
95Y	-	-	114.85	5076.0	650	1119	36	36	42	1056	30

VHF/ UHF NAVAID FREQUENCY CHANNELING AND PAIRING, CONTINUED

DME CHANNEL NUMBER	FREQUENCY LOC	GS	VHF/ VOR	MLS	MLS CHANNEL NUMBER	FREQ	DME AIRBORNE INTERROGATE PULSE CODE NORMAL DME us	P/ DME IA us	P/ DME FA us	DME GND REPLY DME FREQ	PC us
96X	-	-	114.90	-	-	1120	12	-	-	1183	12
96Y	-	-	114.95	5076.6	652	1120	36	36	42	1057	30
97X	-	-	115.00	-	-	1121	12	-	-	1184	12
97Y	-	-	115.05	5077.2	654	1121	36	36	42	1058	30
98X	-	-	115.10	-	-	1122	12	-	-	1185	12
98Y	-	-	115.15	5077.8	656	1122	36	36	42	1059	30
99X	-	-	115.20	-	-	1123	12	-	-	1186	12
99Y	-	-	115.25	5078.4	658	1123	36	36	42	1060	30
100X	-	-	115.30	-	-	1124	12	-	-	1187	12
100Y	-	-	115.35	5079.0	660	1124	36	36	42	1061	30
101X	-	-	115.40	-	-	1125	12	-	-	1188	12
101Y	-	-	115.45	5079.6	662	1125	36	36	42	1062	30
102X	-	-	115.50	-	-	1126	12	-	-	1189	12
102Y	-	-	115.55	5050.2	664	1126	36	36	42	1063	30
103X	-	-	115.60	-	-	1127	12	-	-	1190	12
103Y	-	-	115.65	5080.8	666	1127	36	36	42	1064	30
104X	-	-	115.70	-	-	1128	12	-	-	1191	12
104Y	-	-	115.75	5081.4	668	1128	36	36	42	1065	30
105X	-	-	115.80	-	-	1129	12	-	-	1192	12
105Y	-	-	115.85	5082.0	670	1129	36	36	42	1066	30
106X	-	-	115.90	-	-	1130	12	-	-	1193	12
106Y	-	-	115.95	5082.6	672	1130	36	36	42	1067	30
107X	-	-	116.00	-	-	1131	12	-	-	1194	12
107Y	-	-	116.05	5083.2	674	1131	36	36	42	1068	30
108X	-	-	116.10	-	-	1132	12	-	-	1195	12
108Y	-	-	116.15	5083.8	676	1132	36	36	42	1069	30
109X	-	-	116.20	-	-	1133	12	-	-	1196	12
109Y	-	-	116.25	5084.4	678	1133	36	36	42	1070	30
110X	-	-	116.30	-	-	1134	12	-	-	1197	12
110Y	-	-	116.35	5085.0	680	1134	36	36	42	1071	30
111X	-	-	116.40	-	-	1135	12	-	-	1198	12
111Y	-	-	116.45	5085.6	682	1135	36	36	42	1072	30
112X	-	-	116.50	-	-	1136	12	-	-	1199	12
112Y	-	-	116.55	5086.2	684	1136	36	36	42	1073	30
113X	-	-	116.60	-	-	1137	12	-	-	1200	12
113Y	-	-	116.65	5086.8	686	1137	36	36	42	1074	30
114X	-	-	116.70	-	-	1138	12	-	-	1201	12
114Y	-	-	116.75	5087.4	688	1138	36	36	42	1075	30
115X	-	-	116.80	-	-	1139	12	-	-	1202	12
115Y	-	-	116.85	5088.0	690	1139	36	36	42	1076	30

VHF/ UHF NAVAID FREQUENCY CHANNELING AND PAIRING, CONTINUED

DME CHANNEL NUMBER	-------------FREQUENCY-------- LOC	GS	VHF/ VOR	MLS	MLS CHANNEL NUMBER	DME AIRBORNE INTERROGATE FREQ	PULSE CODE NORMAL DME us	P/ DME IA us	P/ DME FA us	DME GND REPLY DME FREQ	DME GND REPLY PC us
116X	-	-	116.90	-	-	1140	12	-	-	1203	12
116Y	-	-	116.95	5088.6	692	1140	36	36	42	1077	30
117X	-	-	117.00	-	-	1141	12	-	-	1204	12
117Y	-	-	117.05	5089.2	694	1141	36	36	42	1078	30
118X	-	-	117.10	-	-	1142	12	-	-	1205	12
118Y	-	-	117.15	5089.8	696	1142	36	36	42	1079	30
119X	-	-	117.20	-	-	1143	12	-	-	1206	12
119Y	-	-	117.25	5090.4	698	1143	36	36	42	1080	30
120X	-	-	117.30	-	-	1144	12	-	-	1207	12
120Y	-	-	117.35	-	-	1144	36	-	-	1081	30
121X	-	-	117.40	-	-	1145	12	-	-	1208	12
121Y	-	-	117.45	-	-	1145	36	-	-	1082	30
122X	-	-	117.50	-	-	1146	12	-	-	1209	12
122Y	-	-	117.55	-	-	1146	36	-	-	1083	30
123X	-	-	117.60	-	-	1147	12	-	-	1210	12
123Y	-	-	117.65	-	-	1147	36	-	-	1084	30
124X	-	-	117.70	-	-	1148	12	-	-	1211	12
124Y	-	-	117.75	-	-	1148	36	-	-	1085	30
125X	-	-	117.80	-	-	1149	12	-	-	1212	12
125Y	-	-	117.85	-	-	1149	36	-	-	1086	30
126X	-	-	117.90	-	-	1150	12	-	-	1213	12
126Y	-	-	117.95	-	-	1150	36	-	-	1087	30

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APPENDIX 5

MAP INTERPRETATION

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APPENDIX 5

MAP INTERPRETATION

A5.1 INTRODUCTION

a. **Aeronautical charts** normally used for checkpoint orbit checks have substantial effect on the data processing center. Through the cooperation of the United States Coast and Geodetic Survey, certain information concerning aeronautical charts has been collected. Coast and Geodetic Survey personnel have accompanied flight crews on orbit type checks. Outlined here is information considered helpful in improving the accuracy of flight inspection results, with particular reference to chart construction, design, and preparation for flight inspection use, checkpoint selection, etc.

b. **The use of state highway maps or county maps** is not recommended if aeronautical charts are available, as there is considerable variation in the accuracy of the maps among various states and counties.

c. It has been determined, however, that the **Defense Mapping Agency Series 1501, Joint Operations Graphics,** although not aeronautical charts, are satisfactory for flight inspection use. Due to the scale of these maps (1 to 250,000), greater detail is available than that displayed by the sectional charts; consequently more definable checkpoints can be utilized.

d. **The positions of many facility sites have been determined by first-order triangulation or photogrammetric methods with a high degree of accuracy.** Before recommending that coordinates of a facility be changed, the Coast and Geodetic Survey should be contacted for verification of such a change.

A5.2 AERONAUTICAL CHART PREPARATION

a. **In congested areas of the Nation,** checkpoints are plentiful, and it is possible to select only the most desirable. In sparsely settled areas, it may be necessary to use every feature appearing on the chart in order to obtain a maximum of 8 or 10 checkpoints. For these reasons, it is helpful to have an understanding of the manner in which final drawings for aeronautical charts are made.

b. **The preparation of final drawings for charts using three separate colors is made as follows:**

(1) **Black.** Includes railroads, roads (these are sketched in black, but photograph gray on final chart), city and town symbols, boundaries, dots showing the location of spot heights, landmark symbols, etc.

(2) **Blue.** Drainage

(3) **Brown.** Contours

c. **In order to provide satisfactory clearances between various features, it is often necessary to shift some away from their correct geographic positions.** This shift does not usually amount to more than 1/32 of an inch on the printed chart, but it is often required for increased clarity and legibility of the chart. In shifting, two general conditions are to be met:

(1) **All possible detail in the relative position of the features is retained as closely as possible.**

(2) **The geographic position of the combination of features is retained as closely as possible.**

d. **For example, in case of a road paralleling a railroad for a short distance,** the railroad is drawn in its true geographic position, and the road is displaced enough to provide the required clearance. If both were displaced by equal amounts, as first might be suspected, a curve that is nonexistent in fact would have to be introduced into the railroad or the railroad would have to be displaced for some little distance on either side, with consequent displacement of towns and other features along the railroad.

e. **Similarly, if a road parallels the railroad for a short distance, then crosses and again parallels the railroad on the other side,** the railroad should be shown in its correct position and the road displaced as before.

f. **Further, there are conditions where a road may parallel a railroad for a short distance,** and both may be displaced by an amount equal to one-half the required clearance.

g. **In general, it has been found that a railroad should be held in its correct position first, a road second, and stream last.** That is, between a railroad and a highway or stream, the latter are usually shifted; between a road and a stream, the stream is displaced.

h. **If a stream flows between a road and a railroad, or between two railroads,** *the stream retains its true position* and other features are displaced. As a rule, all town and city symbols are affixed in their correct positions. Since railroads and towns are usually held in their correct positions, other features are adjusted to them. Landmarks such as oil derricks, race-tracks, etc., should be used only as a last resort.

i. **Since each color on a printed chart is a separate sheet, the registration of the colors** may be checked at the "neat line" at each corner of the chart. The color which is not correct can be identified by the color tick. If a color is too far from correct registration, several charts should be examined and an effort made to obtain one that is more accurate.

A5.3 PREPARATION OF CHARTS FOR FLIGHT INSPECTION USE. In preparing a chart for a flight inspection, the following procedure is outlined.

a. The *exact* latitude and longitude of the facility should be plotted on the chart as follows:

(1) Plot the longitude on parallels, which are subdivided into 1-minute intervals, north and south of the station, then draw a fine line connecting these two points and extend the line far enough in both directions to fit a large protractor. This will be the true north reference. The latitude should be scaled, using hairspring dividers, from the parallel below the site along the nearest meridian, subdivided into 1-minute -intervals, and then be transferred to the true north reference where it intersects the same parallel. Because of curvature in the parallels, this procedure will be far more accurate than measuring the latitude on each side of the site and then drawing a line between the two points of latitude.

(2) If two or more charts must be joined together, such as Kansas City and Des Moines for the St. Joseph VOR, it is suggested that the following method be used: Select one of the charts which will be used to plot the correct position of the VOR and use it as the overlay chart. For example, the correct position of the STJ VOR is to be plotted on the Kansas City chart. Place a straight edge on the intersection of north lat. 40° 05'00" and 94° 00'00" west long. Draw a *straight line* between these two points. The use of a razor blade for cutting along a straight edge is preferred. This chart will be mounted on the Des Moines chart by correctly aligning the central meridian of 95° 00'00" and placing the two points mentioned above in their correct position. The slight difference in the size of the two charts will fall away from the central meridian and allow the minimum error near the station. If it is necessary to join four charts together, it is suggested that the two north charts be mounted on the two south charts to form the east and west half, then the east and west sections may be mounted along a meridian such as 96° 00'00" ,making sure that the 40° parallel is in correct alignment and that the 96th meridian is in a straight line.

(3) **The magnetic north reference may not be plotted from the facility location** with magnetic variation interpolated from the lines of magnetic variation shown on the chart. The determination of the correct magnetic variation is extremely important. Whenever possible, the magnetic variation should be obtained from the latest information available through the Coast and Geodetic Survey. If the available information is not up to date, the annual rate of change in variation should be applied. It is conceivable that errors as great as 0.5° may occur if proper determination of magnetic variation is not made through use of the latest and most accurate source of this information.

(4) **After the magnitude of magnetic variation has been determined,** it is suggested that this be plotted on the chart using at least a 6-inch circular protractor and marking it from the true north reference, both north and south of the site and connecting the two points with a fine line which passes directly through the site. The 90° to 270° magnetic lines may be marked by resetting the protractor on the magnetic north reference.

A5.4 USE OF THE CHART

a. **In the selection of checkpoints, black should be used first, gray second, and blue (drainage) last.** Only in rare cases will be the facility site be accurately located. Consequently, the facility location should always be plotted as outlined above.

b. **One good checkpoint each 30° provides more repeatable results** (provided constant radius is maintained) than large numbers of checkpoints using all types of map information.

c. **If the same chart is used over an extended period of time,** it may be necessary to realign the magnetic north reference line due to annual change in the variation. This is particularly true in some areas where the annual rate of change is extraordinary.

APPENDIX 6

UHF HOMING BEACONS

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APPENDIX 6

UHF HOMING BEACONS

A6.1 INTRODUCTION

a. **The UHF Homing Beacon (AN/ URN-12)** ground station transmits a continuous carrier in the frequency range of 275 to 287 megacycles, modulated with a 1,020-cycle tone for identification purposes. The power output is approximately 15 watts.

b. **The pilot of an aircraft equipped with the AN/ARA-25 or similar equipment** can determine the relative bearing of, and "home" on, the facilities maintenance equipment. The airborne equipment extracts the information from signals received by the AN/ARC-27 or similar UHF communications receiver. The relative bearing of the signal source is indicated on a course indicator. Best results are obtained under straight and level flight conditions.

A6.2 PREFLIGHT REQUIREMENTS

a. **Facilities maintenance personnel** should prepare for flight inspection in accordance with procedures outlined in Chapter 4.

b. **Air.** The flight inspector will prepare for the flight inspection in accordance with procedures outlined in Chapter 4. In addition to the above preparations, the flight inspector will:

(1) Be sure that an approved type of airborne equipment is installed and has been calibrated and aligned in accordance with current FAA directives.

(2) For commissioning, use a suitable chart, scale 1:500,000 or greater, to plot the exact location of the facility. Plot a series of checkpoints spaced approximately 45° apart at a radius between 20 and 30 nm from the station. Determine the primary air routes that are served by the facility and plot the routes on the chart. Select two courses for a long-distance check. Note: These two courses may be extensions of the primary air routes previously selected, but should be at least 45° apart.

A6.3 FLIGHT INSPECTION PROCEDURES. The primary object of the flight inspection is to determine the coverage and quality of the transmitted signal; therefore, it is necessary that the aircraft be flown through normal usage patterns and procedures to determine the usability of the facility and to ensure that the homing beacon meets the operational requirements for which it was installed.

a. Checklists

Type Check	Reference Paragraph	C	P
Station identification	A6.3b(1)	X	X
Bearing accuracy	A6.3b(2)	X	X
Voice	A6.3b(3)	X	X
Coverage	A6.3b(4)	X	X
Long distance	A6.3b(5)	X	
Low approach	A6.3b(6)	X	X
Station passage	A6.3b(7)	X	X
Standby equipment	A6.3b(8)	X	X
Standby power	4.33c	X	

b. Detailed Procedures

(1) Station Identification. Select the proper frequency and check for correct identification and tone of the signal. Any discrepancies noted should be reported to maintenance personnel for corrective action before continuing the flight inspection. Note any frequency interference from other stations.

(2) Bearing Accuracy. Check bearing accuracy against AFIS, GPS, or map reference at least at one point in the service volume, preferably on a published procedure. Fly at minimum instrument altitudes or at an altitude to ensure adequate signal strength.

(3) Voice. If the facility is equipped with voice feature, this feature should be checked at maximum usable distance. It will be noted that most types of airborne equipment will require the receiver function selector to be placed in the RECEIVE position to receive voice transmissions. Request a long voice transmission and note the voice quality, modulation, and freedom from interference. In the event voice transmissions do not reach the maximum usable range, return inbound until they can be received satisfactorily. Record this distance on the flight inspection report.

(4) Coverage

(a) Proceed outbound along one of the primary air routes at minimum instrument altitude until reaching 45 nm or until any out-of-tolerance condition is observed. This position will be the usable distance. Upon completion of the investigation of the first route, proceed to the remaining routes and repeat the above procedures.

(b) During the check, observe the surrounding terrain and note the location of terrain, or other obstructions that may prevent line-of-sight transmissions to an area beyond the obstructions. Reflections of radio signals, or shadow effect, caused by the intervening terrain, or other obstacles, may result in bearing errors or loss of usable signal.

(c) If areas of weak signal are encountered or if terrain obstructions exist, investigate the areas in question and record the areas checked, location of apparent obstructions, and the minimum altitude and distance at which a usable signal can be received.

(d) For periodic inspections, check coverage from 45 nm at minimum en route altitude until intercepting the approach procedure.

(5) **Long-Distance Check.** Proceed outbound along one of the air routes or courses selected to a distance of 100 nm at an altitude of 10,000 ft. Observe and record the extent of the pilot's direction indicator needle oscillation, AGC, and the station identification. Then proceed to the other air route or selected course at the 100-mile range and fly inbound along this route to the facility site, again noting the identification, AGC, and needle oscillation.

(6) **Standard Instrument Approach Procedure (SIAP).** If this facility is to be used as a low approach aid, a low approach will be made for each of the proposed or approved procedures. Check each approach procedure for flyability. Unusual conditions noted will be further investigated. The flight inspector must follow the procedures for inspection of SIAP(s) contained in Chapter 6. Altitudes flown must be the minimum proposed or published for the segment evaluated, except that the final segment must be flown to 100 ft below the lowest published MDA. The flight inspector must check to ensure compliance with tolerances.

(a) **Commissioning Inspection of SIAP.** The flight inspector shall evaluate all segments of the proposed procedure.

(b) **For a periodic inspection,** evaluate the final approach segment of the SIAP.

(7) **Station Passage.** Fly over the antenna site and note the position where station passage is indicated. The station passage should be indicated by a sharp positive reversal of the pilot's direction indicator needle. No specific tolerances are established for station passage; however, it should be encountered approximately over the facility. Any area where the needle has a tendency to reverse itself before actually passing over the station should be plotted on the chart and reported on the flight inspection report.

(8) **Standby Equipment.** Standby equipment will be spot-checked to ascertain that it meets the same tolerances as the primary equipment.

A6.4 ANALYSIS

a. From the data obtained during the flight inspection, the flight inspector must determine if there are any areas where the facility fails to meet the coverage and/or bearing tolerance. If such areas were noted during the flight inspection, he should analyze all data to determine if such effects are caused by terrain or equipment. Normally this facility cannot be expected to give reliable information at ranges and altitudes which are below line of sight.

b. The airborne ADF equipment (AN/ARA-25) is an attachment applied to the UHF transceiver to enable it to take bearings on a transmitted signal. While in the ADF position, the ADF antenna seeks a null in the process of presenting a bearing. Under these conditions, very little signal from the transmitter is applied to the UHF transceiver, and tone identification cannot be heard at distances greater than 70 nm, line of sight, but may be heard at shorter distances depending upon the ambient electrical noise level of the airborne ADF system. (The antenna drive mechanism develops a 100-cycle signal that is great enough to blanket the tone identification except at close range to the transmitter.) Continuous switching from the RECEIVE to ADF position must be accomplished in order to monitor both the identification and the ADF indications.

c. The bearing indicator normally hunts plus or minus a few degrees of the received bearing when the transmitter is operating satisfactorily. In the absence of a carrier, the bearing indicator usually rotates slowly and continuously over 360^{o} of azimuth, or remains stationary. For this reason, the station must be monitored intermittently in the RECEIVE and ADF position.

A6.5 Tolerances. All UHF Homers will meet these tolerances for an UNRESTRICTED classification. Classification of the facility based on flight inspection results is the responsibility of the flight inspector.

a. Identification. Station Identification will be correct, clear, and intelligible.

b. Bearing Error

(1) Maximum bearing error will not exceed ± 5°

(2) ADF needle oscillation will not exceed ± 5°

c. Voice. If provided, will be clear and readable at distances equal to or greater than two-thirds of the maximum usable distance of the facility.

d. Coverage. Usable distance will not be less than 45 nm at minimum instrument altitude.

e. Station Passage. At all altitudes, the needle reversal must occur approximately over the ground facility. (Any condition of false reversal attributable to the ground facility requires a notice to airmen.)

f. Standby Equipment. Standby equipment will meet the same tolerances as specified for the primary equipment.

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APPENDIX 7

RADIO TELEMETER THEODOLITE (RTT) CALIBRATION

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APPENDIX 7

RADIO TELEMETER THEODOLITE (RTT) CALIBRATION

A7.1 GENERAL. This capability has been added to allow for special operations when complete facility data is not available or circumstances require RTT use. This procedure should be applied when an RTT is to be used in certifying a NAVAID for operational use.

> **NOTE:** The RTT should be ground tested prior to flight. Set up the RTT with the transmitting antenna facing the nose of the aircraft.

Theory of Operation: The RTT is used as a perfect ILS/ MLS reference to compare against the facility under test. Once the theodolite is manually aligned to either the vertical (commissioned elevation angle) or horizontal (designed procedural course) reference, the RTT transmits a comparable electronic course to the flight inspection aircraft. Any difference between the RTT and the facility crosspointer action will be measured as ILS/ MLS error. The RTT is calibrated to a predetermined sensitivity off-course in order to provide accurate deflection representative of the aircraft's offset from the reference course. The telemetering capability of the RTT system allows measurement of facility error without requiring the aircraft to remain constantly on-course or on-path.

Calibration of the RTT is facility specific and is required for each approach. The airborne calibration is embedded in the aircraft's AFIS software. Analysis of the RTT error plotter trace is entirely manual. The validity of the RTT error can be verified on each run. Observe the deviation of the RTT crosspointer from baseline throughout the approach. The RTT error deflection equals the facility under test's crosspointer deviation subtracted from the RTT deviation.

> **NOTE:** AFIS and RTT operations can be conducted simultaneously.

A7.2 FLIGHT INSPECTION PROCEDURES

a. Localizer:

(1) MISC SERVICE - Select ILS 3 Mode

(2) SYS PLOT – Select RTT DEV, RTT ERROR, and RTT VLD on Page 2

(3) Instruct THEO operator to transmit "0".

(4) I/ O Page

(a) BWD to the RTT Control/ Setup page

(b) TGL RTT Mode to "ILS Localizer"

(c) TGL RTT Calibration to "0"

(d) Execute SPD on "Clear Cal Value?"

(5) Start Plotter

(6) RTT Control/ Setup page

(a) Observe the "Raw RTT Input" value	- Uncorrected RTT output
(b) Execute SPD on "Execute Cal?"	- "Raw RTT Input" indicates 0 - "RTCP" = **5.0** in. on the plotter

(7) Instruct THEO operator to go to ½ localizer course width to the operator's **left**

- THEO AZ scale = <360°
- RTT TX = negative degrees

(8) RTT Control/ Setup page

(a) TGL RTT Calibration to "150 µA Left"	- Observe the "Raw RTT Input" indicates negative number - Observe the "RTCP" deflects **left**
(b) Execute SPD on "Execute Cal?"	- "Raw RTT Input" indicates -150µA - "RTCP" trace = **2.0** in. on the plotter

(9) Instruct THEO operator to go to ½ localizer course width to the operator's **right**

- THEO AZ scale = > 360°
- RTT TX = positive degrees

(10) RTT Control/ Setup page

(a) TGL RTT Calibration to, "150 µA Right"	- Observe the "Raw RTT Input" indicates positive number - Observe the "RTCP" trace deflects **right**
(b) Execute SPD on "Execute Cal?"	- "Raw RTT Input" indicates +150µA - "RTCP" trace = **8.0** in. on the plotter

(11) **Print** INSP Page

(12) At this time the RTT system is calibrated and ready for use. Instruct the theo operator to return to “0” to track the aircraft.

(13) Operation

(a) Manually analyze the RTT error trace IAW Chapter 15.

(b) Repeat the calibration procedure inbound for each approach.

*(c) The RTT "**VLD**" (RTFG) trace indicates a valid RTT signal by a deflection to **2.7** inches.*

*(d) The RTT "**INVLD**" (RTFG) trace indicates an invalid RTT signal by a deflection to **5.0** inches.*

(e) A left alignment error will be indicated by a right RTT error deflection from the 3 in. baseline.

b. Glide Slope:

(1) MISC SERVICE - Select ILS-3 Mode

(2) SYS PLOT – Select RTT DEV, RTT ERROR, and RTT VLD on Page 2

(3) Instruct THEO operator to transmit “0”.

(4) I/ O Page.

(a) BWD to the RTT Control/ Setup page

(b) TGL RTT Mode to “ILS Glide Slope”

(c) TGL RTT Calibration to “0”

(d) Execute SPD on “Clear Cal Value?”

(5) Start Plotter

(6) RTT Control/ Setup page

(a) Observe the "Raw RTT Input" value	- Uncorrected RTT output
(b) Execute SPD on "Execute Cal?"	- "Raw RTT Input" indicates 0 - "RTCP" = **5.0** in. on the plotter

(7) Instruct THEO operator to go to 0.35° above the reference angle

- THEO EL scale = 0.35° higher than the reference angle)
- RTT TX = +0.35°

(8) RTT Control / Setup page

(a) TGL RTT Calibration to, "75µA Above"	- Observe the "Raw RTT Input" indicates positive number - Observe the "RTCP" deflects **right**
(b) Execute SPD on "Execute Cal?"	- "Raw RTT Input" indicates + 75 µA - "RTCP" trace = **6.5** in. on the plotter

(9) Instruct THEO operator to go to 0.35° below the reference angle

- THEO EL scale = 0.35° lower than the reference angle
- RTT TX = -0.35°

(10) RTT Control/ Setup page

(a) TGL RTT Calibration to, "75 µA Below"	- Observe the "Raw RTT Input" indicates negative number - Observe the "RTCP" deflects **left**
(b) Execute SPD on "Execute Cal?"	- "Raw RTT Input" indicates –75 µA - "RTCP" trace = **3.5** in. on the plotter

(11) **Print** INSP Page

(12) At this time the RTT system is calibrated and ready for use. Instruct the theo operator to return to "0" to track the aircraft.

(13) Operation

(a) *Manually analyze the RTT error trace IAW Chapter 15.*

(b) *Repeat the calibration procedure inbound for each approach.*

(c) *The RTT "**VLD**" (RTFG) trace indicates a valid RTT signal by a deflection to **2.7** inches.*

(d) *The RTT "**INVLD**" (RTFG) trace indicates a valid RTT signal by a deflection to **5.0** inches.*

(e) ***A high glide slope angle will be indicated by a right RTT error deflection from the 3 in. baseline***

(f) *Each **0.1 in. deflection = 0.023°** (.35°/ 1.5 in.)*

c. MLS Azimuth:

(1) MISC SERVICE - Select MLS-3 Mode

(2) SYS PLOT - Select RTT DEV, RTT ERROR, and RTT VLD on Page 2.

(3) Instruct THEO operator to transmit “0”.

(4) I/ O Page

(a) BWD to the RTT Control/ Setup page

(b) TGL RTT Mode to “MLS Azimuth”

(c) TGL RTT Calibration to “0”

(d) Execute SPD on “Clear Cal Value?”

(5) Start Plotter

(6) RTT Control/ Setup page

(a) Observe the “Raw RTT Input” value	- Uncorrected RTT output
(b) Execute SPD on “Execute Cal?”	- “Raw RTT Input” indicates 0 - “RTCP” = **5.0** in. on the plotter

(7) Instruct THEO operator to go to -1.0° to the operator's **left**

- THEO AZ scale = 359°
- RTT TX = -1.0°

(8) RTT Control/ Setup page

(a) TGL RTT Calibration to, "1° **Left**"	- Observe the "Raw RTT Input" indicates negative number - Observe the "RTCP" deflects **left**
(b) Execute SPD on "Execute Cal?"	- "Raw RTT Input" indicates –1.00° - "RTCP" trace = **4** in. on the plotter

(9) Instruct THEO operator to go to +1.0° to the operator's **right**

- THEO AZ scale = 001°
- RTT TX = +1.0°

(10) RTT Control/ Setup page

(a) TGL RTT Calibration to, "1° **Right**"	- Observe the "Raw RTT Input" indicates a positive number - Observe the "RTCP" deflects **right**
(b) Execute SPD on "Execute Cal?"	- "Raw RTT Input" indicates +1.00° - "RTCP" trace = **6** in. on the plotter

(11) **Print** INSP Page

(12) At this time the RTT system is calibrated and ready for use. Instruct the theo operator to return to "0" to track the aircraft. Manually analyze the RTT error trace IAW Chapter 16.

(13) Operation

(a) *Repeat the calibration procedure inbound for each approach. The RTT "**VLD**" (RTFG) trace indicates a valid RTT signal by a deflection to 2.7 inches.*

(b) *The RTT "**INVLD**" (RTFG) trace indicates an invalid RTT signal by a deflection to **5.0** inches.*

(c) ***A left or positive alignment error will be indicated by a left RTT error deflection from the 3 in. baseline.***

(d) *Each **0.1 in. deflection = 0.02°** (.2°/ 1.0 in.)*

d. MLS Elevation:

(1) MISC SERVICE - Select MLS 3 Mode

(2) SYS PLOT - Select RTT DEV, RTT ERROR, and RTT VLD on Page 2.

(3) Instruct THEO operator to transmit “0”.

(4) I/ O Page

(a) BWD to the RTT Control/ Setup page

(b) TGL RTT Mode to “MLS Elevation”

(c) TGL RTT Calibration to “0”

(d) Execute SPD on “Clear Cal Value?”

(5) Start Plotter

(6) RTT Control/ Setup page

(a) Observe the “Raw RTT Input” value	- Uncorrected RTT output
(b) Execute SPD on “Execute Cal?”	- “Raw RTT Input” indicates 0 - “RTCP” = **5.0** in. on the plotter

(7) Instruct THEO operator to go to 1.0° above the reference angle

- THEO EL scale = Reference angle + 1.0°
- RTT TX = +1.0°

(8) RTT Control / Setup page

(a) TGL RTT Calibration to, “1° Above”	- Observe the “Raw RTT Input” indicates positive number - Observe the “RTCP” deflects **right**
(b) Execute SPD on “Execute Cal?”	- “Raw RTT Input” indicates +1.00° - “RTCP” trace = **6.0** in. on the plotter

(9) Instruct THEO operator to go to 1.0° below the reference angle

- THEO EL scale = Reference angle – 1.0°
- RTT TX = -1.0°

(10) RTT Control/ Setup page

(a) TGL RTT Calibration to, "1° Below"	- Observe the "Raw RTT Input" indicates negative number - Observe the "RTCP" deflects **left**
(b) Execute SPD on "Execute Cal?"	- "Raw RTT Input" indicates -1.00° - "RTCP" trace = **4.0** in. on the plotter

(11) **Print** INSP Page

(12) At this time the RTT system is calibrated and ready for use. Instruct the theo operator to return to "0" to track the aircraft. Manually analyze the RTT error trace IAW Chapter 16.

(13) Operation

(a) *Repeat the calibration procedure inbound for each approach.*

(b) *The RTT "**VLD**" (RTFG) trace indicates a valid RTT signal by a deflection to **2.7** inches.*

(c) *The RTT "**INVLD**" (RTFG) trace indicates an invalid RTT signal by a deflection to **5.0** inches.*

(d) ***A high elevation angle will be indicated by a left RTT error deflection from the 3 in. baseline***

(e) ***Each 0.1 in. deflection = 0.02° (.2°/ 1.0 in.)***

A7.3 SIERRA FLIGHT INSPECTION SYSTEM

a. Localizer:

(1) Select an ILS-3 profile

(2) Select RTT plots and sensitivity

(a) RTT DEVN

(b) RTT FLAG

(c) RTT/ LOC DIFF

(3) "ENTER" to select "RTT Localizer Calibration"

(4) Select "Perform CAL" - "Two-Point Calibration" screen appears with cursor in the "No Signal Point Calib Value" field

(5) Instruct THEO operator to transmit "0" - Verify a value in the No-Signal Point Measured Value" field

(6) "Enter key - Cursor goes to "Full-scale Point Calib Value" field

(7) Instruct THEO operator to go to ½ localizer course width to the operator's **right**

- THEO AZ scale = > 360°
- RTT TX = positive degrees
- Measured value = positive degrees

(8) "Enter" key

(9) Select the "**Print Screen**" function

(10) "Enter" key

(11) Select "Continue"

(12) "Enter" key

(13) Start the ILS-3 profile

(14) Instruct THEO operator to transmit "0" - RTT DEVN (RDVN) = **7.0** in

(15) Instruct THEO operator to go to ½ localizer course width to the operator's **right**

- THEO AZ scale = > 360°
- RTT TX = positive degrees
- RTT DEVN (RDVN) = **11.0** in.

(16) Instruct THEO operator to go to ½ localizer course width to the operator's **left**

- THEO AZ scale = < 360°
- RTT TX = negative degrees
- RTT DEVN (RDVN) = **3.0** in.

(17) At this time the RTT system is calibrated and ready for use. Instruct the theo operator to return to "0" to track the aircraft. Manually analyze the RTT error trace IAW Chapter 15.

(18) Operation

(a) *Repeat the calibration procedure inbound for each approach.*

(b) *The RTT Flag (RTT) trace indicates a **valid** RTT signal by a deflection to **9.9** inches.*

(c) *A deflection to **12.0** inches indicates an **invalid** RTT signal.*

(d) ***A left alignment error will be indicated by a right RTT error deflection from the 6 in. baseline.***

b. Glide Slope:

(1) Select an ILS-3 profile

(2) Select RTT plots and sensitivity

(a) RTT DEVN

(b) RTT FLAG

(c) RTT/ GLS DIFF

(3) "ENTER" to select "RTT Glide Slope Calibration"

(4) Select "Perform CAL" - "Two-Point Calibration" screen appears with cursor in the "No Signal Point Calib Value" field

(5) Instruct THEO operator to transmit "0" - Verify a value in the "No-Signal Point Measured Value" field

(6) "Enter" key - Cursor goes to "Full-scale Point Calib Value" field

(7) Instruct THEO operator to go to 0.35° above the reference angle

- THEO EL scale = 0.35° higher than the reference angle
- RTT TX = +0.35°
- Measured value = positive degrees

(8) "Enter" key

(9) Select the "**Print Screen**" function

(10) "Enter" key

(11) Select "Continue"

(12) "Enter" key

(13) Start the ILS-3 profile

(14) Instruct THEO operator to transmit “0” - RTT DEVN (RDVN) = **7.0** in.

(15) Instruct THEO operator to go to 0.35° above the reference angle

- THEO EL scale = 0.35° higher than the reference angle)
- RTT TX = +0.35°
- RTT DEVN (RDVN) = **9.0** in.

(16) Instruct THEO operator to go to 0.35° below the reference angle

- THEO EL scale = 0.35° below the reference angle
- RTT TX = -0.35°
- RTT DEVN (RDVN) = **5.0** in.

(17) At this time the RTT system is calibrated and ready for use. Instruct the theo operator to return to “0” to track the aircraft. Manually analyze the RTT error trace IAW Chapter 15.

(18) Operation

(a) Repeat the calibration procedure inbound for each approach.

(b) The RTT Flag (RTT) trace indicates a **valid** RTT signal by a deflection to **9.9** inches.

(c) A deflection to **12.0** inches indicates an **invalid** RTT signal.

(d) A high glide slope angle will be indicated by a right RTT error deflection from the 6 in. baseline

(e) Each 0.1 in. deflection = 0.0175° (.35°/ 2.0 in.)

A7.4 MLS. The MLS RTT operation involves the use of the portable MLS flight inspection system as installed as a "stand-alone" non-AFIS system. The following RTT operation assumes the installation of the portable MLS "package" and the initial RMS-33 plotter set-up procedures have been accomplished.

a. MLS Azimuth:

(1) Select MLS-1 profile

(2) RTT CONTROL UNIT;

(a) ON

(b) DISC OFF

(c) CAL OFF

(d) SETUP ON

(e) 75 CAL

(f) AZ

(3) RTT THEO AZ "0"

DVM - RTT	**DVM - DIFF**
- ADJUST RTT ZERO POT	- ADJUST DIFF ZERO POT
- DVM ± .001VOLTS	- DVM ± .001 VOLTS
- RTT **5** in. BASELINE	- RTT **6** in. BASELINE

(4) RTT THEO AZ +1.0°

DVM - RTT	**DVM - DIFF**
- ADJUST RTT GAIN POT	- ADJUST DIFF GAIN POT
- DVM +.075 VOLTS	- DVM -.075 VOLTS
- RTT **2** in. LEFT (RMS)	- DIFF **2** in. RIGHT (RMS)

(5) RTT THEO AZ -1.0°

DVM - RTT	DVM - DIFF
- DVM -.075 VOLTS	- DVM +.075 VOLTS
- RTT **2** in. RIGHT (RMS)	- RTT **2** in. LEFT (RMS)

(6) RTT THEO AZ "0"

(7) RTT SETUP OFF

NOTE: DIFF TRACE DEFLECTS LEFT FOR RIGHT MLS MISALIGNMENT .05°/ LL @ 37.5 RMS SENS

Manually analyze the RTT error trace IAW FAA Order 8200.1, Chapter 16.

b. MLS Elevation:

(1) Select MLS-1 profile

(2) RTT CONTROL UNIT

(a) ON

(b) DISC OFF

(c) CAL OFF

(d) SETUP ON

(e) 75 CAL

(f) EL

(3) RTT THEO ELEVATION "0" DDM

DVM - RTT	DVM - DIFF
- ADJUST RTT ZERO POT	- ADJUST DIFF ZERO POT
- DVM 0 ± .001 VOLTS	- DVM 0 ± .001 VOLTS
- RTT **5** in. BASELINE	- DIFF **6** in. BASELINE

(4) RTT THEO EL +0.30° (FROM REFERENCE ANGLE)

DVM - RTT	DVM - DIFF
- ADJUST RTT GAIN POT	- ADJUST DIFF GAIN POT
- DVM +.060 VOLTS	- DVM -.060 VOLTS
- RTT **1.6** in. LEFT (RMS)	- DIFF **1.6** in. RIGHT (RMS)

(5) RTT THEO EL -0.30° (FROM REFERENCE ANGLE)

DVM - RTT	DVM - DIFF
- DVM -.060 VOLTS	- DVM +.060 VOLTS
- RTT **1.6** in. RIGHT (RMS)	- DIFF **1.6** in. LEFT (RMS)

(6) RTT THEO EL "0" DDM

(7) RTT SETUP OFF

NOTE: DIFF TRACE DEFLECTS RIGHT FOR HIGH MLS ANGLE

.01875 Deg/ LL @ 37.5 RMS SENS. Other sensitivities may be used.

Manually analyze the RTT error trace IAW Chapter 16.

A7.5 QUICK REFERENCE PLOTTER CHART

CONDITION	NXT	SIERRA
LOC RTT “0”	RTT CP = 5.0 in.	RTT CP = 7.0 in.
LOC RTT CAL Left	RTT CP = 2.0 in.	RTT CP = 3.0 in.
LOC RTT CAL Right	RTT CP = 8.0 in.	RTT CP = 11.0 in.
Localizer CL	RTT ERR = 3.0 in.	RTT ERR = 6.0 in.
Localizer Misaligned Right	RTT ERR = Left	RTT ERR = Left
Localizer Misaligned Left	RTT ERR = Right	RTT ERR = Right
G/ S RTT "0"	RTT CP = 5.0 in.	RTT CP = 7.0 in.
G/ S RTT CAL Above	RTT CP = 6.5 in.	RTT CP = 9.0 in.
G/ S RTT CAL Below	RTT CP = 3.5 in.	RTT CP = 5.0 in.
"0" G/ S Angle Error	RTT ERR = 3.0 in.	RTT ERR = 6.0 in.
G/ S Angle High	RTT ERR = Right	RTT ERR = Right
G/ S Angle Low	RTT ERR = Left	RTT ERR = Left
MLS AZ RTT "0"	RTT CP = 5.0 in.	RTT CP = 5.0 in.
MLS AZ RTT CAL Left (-)	RTT CP = 4.0 in.	RTT CP = 7.0 in.
MLS AZ RTT CAL Right (+)	RTT CP = 6.0 in.	RTT CP = 3.0 in.
MLS AZ CL	RTT ERR = 3.0 in.	RTT ERR = 6.0 in.
MLS AZ Misaligned Left (+)	RTT ERR = Left	RTT ERR = Right
MLS AZ Misaligned Right (-)	RTT ERR = Right	RTT ERR = Left
MLS EL RTT "0"	RTT CP = 5.0 in.	RTT CP = 5.0 in.
MLS EL RTT CAL Above	RTT CP = 6.0 in.	RTT CP = 3.4 in.
MLS EL RTT CAL Below	RTT CP = 4.0 in.	RTT CP = 6.6 in.
"0" MLS EL Error	RTT ERR = 3.0 in.	RTT ERR = 6.0 in.
MLS EL Angle High	RTT ERR = Left	RTT ERR = Right
MLS EL Angle Low	RTT ERR = Right	RTT ERR = Left

1. RTT CP traces are identified by their location on the RMS-33 plotter, in inches.

2. RTT ERR plots are identified by their location on the plot in inches, and by the deflection direction from "0" baselines.

3. “CAL" left and right are referenced to the theodolite operator's left and right.

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APPENDIX 8

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APPENDIX 9

AFIS OPERATIONS WITH DIFFERENTIAL GLOBAL POSITIONING SYSTEM (DGPS) TRUTH SYSTEM

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APPENDIX 9

AFIS OPERATIONS WITH DIFFERNTIAL GLOBAL POSITIONING SYSTEM (DGPS) TRUTH SYSTEM

A9.1 INTRODUCTION

a. Automated Flight Inspection Systems (AFIS) equipped with DGPS avionics (to include data radio communication and associated antennas and cabling) data-linked to a ground DGPS station are capable of achieving sub-meter positioning accuracy. A DGPS ground station (base) is utilized to transmit GPS corrections to the airborne DGPS unit (rover) resulting in a fixed real-time kinematic AFIS position solution.

b. DGPS positioning is acceptable for use in all flight inspection modes, providing the ground and airborne units are operated by trained flight inspection personnel.

c. Surveyed coordinates and the ellipsoid height of the base DGPS antenna are required for all flight inspection using DGPS. This data may be obtained from airport authorities or various NGS/ NOAA websites. Aeronautical survey data for airports may be located at: http://www.ngs.noaa.gov/AERO/aero.html.

d. DGPS operations require deployment and recovery of the base-station and are not designed to replace TVPS or pilot-marked runway updates. The primary use of the system is when runway updates are impractical, as occurs when the designed procedural course is not in-line with the runway. For LDA with glide slope situations, offset ILS/ MLS, or point-in-space facilities, the DGPS is an excellent special-purpose AFIS truth system.

A9.2 Z-MAX DGPS BASE OPERATIONS

a. The base station must have an unobstructed view of the sky. Ensure the Z-Max base station has a charged 12VDC battery available, or AC power is present.

b. Erect the DGPS ground station, to include:

(1) Z Max DGPS

(2) DGPS Tripod

(3) UHF Data Radio

(4) Data Antenna

NOTE: In the following Z Max set-up procedure, a DGPS site elevation is required. This elevation is an *Ellipsoid* elevation, or the surveyed MSL value of the survey marker algebraically added to the *Geoid* height (provided in the NGS website).

There are several avenues to obtain the ellipsoid altitude of the surveyed marker:

- If an established airport survey marker is used, the ellipsoid altitude will be provided in the online data sheet for that geographic area.
- If the MSL altitude is provided there is an on-line utility to provide a geoid correction value for a given set of coordinates, called an undulation value. This value when algebraically added to the MSL altitude provides the required ellipsoid height. For coordinates in NAD83/WGS84 molodensky constant, use the following web address,

  http://www.ngs.noaa.gov/cgi-bin/GEOID_STUFF/geoid03_prompt1.prl

c. If this is the first Z-MAX use at a particular location, "**Reinitialize"** which deletes any old data.

NOTE: Errors have been detected that affect DGPS accuracy when the unit is moved from one location to another and it is not reinitialized.

d. Perform the following steps on the Ashtech Z Max DGPS ground station:

(1) Hold the power button down for 5 seconds.

(2) "REINIT" appears on the display. Wait for the display to return to main menu before continuing.

(3) Arrow to "Sessions"

(a) "Enter"

(b) Right error to "Stop Sessions"

(c) "Enter"

(4) Cancel to Top Menu

(5) Arrow to "Survey CONF." "Enter"

(6) Arrow to "Mode"

(a) "Enter"

(b) Arrow to "RTK Base"

(c) "Enter"

(7) Arrow to "Port/Type"

(a) "Enter"

(b) Arrow to "A"

(c) "Enter"

(8) Arrow to "DBEN". "Enter"

NOTE: Ports B and D are not used.

(9) Cancel up 1 menu to "REC INT"

(a) "Enter"

(b) Enter "001.0 sec"

(c) "Enter"

(d) Arrow to "ELEV Mask"

(e) "Enter"

(f) Enter "10 degrees"

(g) Arrow to "RTK Base"

(h) "Enter”

(10) Cancel up to main menu

(11) Arrow to "Survey RTK Base"

(a) "Enter"

(b) Arrow to "ANT HT"

(c) "Enter"

(d) Enter 0.0.

This option allows the user to input the height of the DGPS antenna above the surveyed mark; however, the height cannot be verified by the rover unless it is added to the site elevation.

(e) Arrow to "ANT RAD"

(f) "Enter"

(g) Enter 0.0

(12) Arrow to "Base POS"

(a) "Enter"

(b) Arrow to "LAT"

(c) "Enter"

(d) Enter coordinates

(e) Arrow to "LON"

(f) "Enter"

(g) Enter coordinates

(h) Arrow to "ALT"

(i) "Enter"

(j) Enter Ellipsoid height, including DGPS antenna height, if an antenna height of 0 was entered for "ANT HT"

(13) Cancel up to main menu

(a) Arrow to "SETTINGS"

(b) "Enter"

(c) Arrow to "BAUD RATE"

(d) "Enter"

(e) Arrow to "38.4 kbaud"

(f) "Enter"

(g) Arrow to "SAVE"

(h) "Enter"

(i) "Displays indicates "SAVE?"

(j) "Enter"

(k) Display indicates "Done"

A9.3 AIRBORNE OPERATIONS

a. **Confirm the DGPS ground station is present** and located at an accurately surveyed point. Verify with the DGPS operator the surveyed coordinates and Ellipsoid height the DGPS is transmitting.

b. **On the "DME FIX" Page:**

(1) Verify the "GND STN" coordinates and altitude are those of the DGPS ground station. This information is transmitted from the Base Station to the aircraft.

NOTE: The altitude is shown in feet, and the DGPS transmits the altitude in meters.

1 Meter = 3.2808399 ft.

(2) Perform a sanity check by verifying the aircraft's static position indicated by the DGPS coordinates is valid; close to the Hybrid position.

c. **On the I/O DGPS Page, Verify:**

(1) Ground LAT/LON/HEIGHT are the transmitted DGPS coordinates and height, (this time in meters).

(2) Sufficient satellites are in use by the airborne "Rover DGPS unit

(a) The first 3 lines of the satellite info (SAT SV, AZ, EL, and S/N) indicate the airborne unit is functioning autonomously as a GPS sensor.

(b) The "Used" field displays a "U" if the satellite is used for both the airborne and base DGPS units. It's a good sign the DGPS link is active and is only displayed when the DGPS position solution is in "Float" or Fixed RTK"

(3) The other two sets of coordinates are always the same and indicate current aircraft position.

(4) With the DGPS base station deployed and active, the "RAW/DIFF POSITION should be in either "FLOAT" or "FIXED RTK" with the aircraft on the ground and in line of site with the base station. Make every attempt to obtain "FIXED RTK" or "FLOAT" prior to takeoff.

"AUTONOMOUS" positioning indicates no link between base and rover DGPS.

"INVALID" indicates an inoperative airborne DGPS unit.

d. DGPS positioning is used when the "FINAV" mode is toggled to "DGPS", on the DME FIX page. Each time a different profile is selected on the "MISC SERV" page, the FINAV mode must be re-toggled to DGPS.

e. The bottom right of every INSP CTL page indicates DGPS status and the FINAV mode.

f. Non-Approach modes (Rho-Theta, etc) are affected with DGPS positioning by the facility error traces reacting in real-time to the DGPS accuracy; the DGPS operation is transparent.

g. In approach modes such as ILS, MLS, PAR/PAPI, the inspection results are affected by DGPS after the aircraft reaches the runway, via the post-profile traces.

(1) Runway marks are not used or needed since the facility error is computed real-time, and the end of the runway simply signals AFIS that Zones 4 and 5 are recorded.

(2) **If Zones 4 and 5 are not needed** (offset LDA, ILS) the runway length can be shortened to a minimum of 2,000 ft to expedite run completion. Runway lengths less than 2,000 ft affected Zone 3 in early software testing and are not recommended.

Over-flight of the threshold and runway ends is not required if Zones 4 and 5 are not measured. AFIS will stop the run when the plane containing the runway end (per RWY length in the FDB) is passed. The aircraft can remain on the offset facility designed procedural course.

A9.4 TROUBLESHOOTING

a. If the base DGPS is not transmitting the correct surveyed data, as verified on the DME and I/O pages, reset the NCU toggle switch. This causes AFIS to dump any existing DGPS data and re-look to the DGPS for positioning. If the problem persists, re-initialize the base DGPS.

NOTE: If the correct base DGPS base coordinates cannot be verified on these pages, <u>do not fly.</u>

b. If the DGPS position ever goes to "Autonomous", there is no RTK solution; the base and airborne DGPS are not communicating. The AFIS positioning will be no better than standard GPS. Attempt to gain line of site (expect 25nm DGPS coverage) with the base DGPS.

(1) The base DGPS uplink is transmitted on 329 MHz. Listen to the UHF audio and/or use the spectrum analyzer to verify the base station is transmitting. If the base DGPS is transmitting, it is an indication of a healthy base station. It will not uplink GPS corrections if the base station is faulted.

(2) During DGPS testing, with the aircraft on the ground and in line-of-site of the DGPS ground unit, an "Autonomous" solution was encountered on rare occasions. A "Fixed RTK solution was obtained by removing the DGPS station from the tripod and, while still powered on, the antenna was shielded from satellite coverage by pointing the unit at the ground for just a few seconds.

NOTE: The DGPS can display a "FIXED RTK" position even though the base station is set up at the wrong surveyed checkpoint, or if the coordinates entered into the base station are not those of the geographic location of the base unit. If either of these situations occur and the coordinates transmitted are within 500 yards of the actual geographic location, a faulty FIXED RTK position can be obtained. The AFIS position will be in error and penalize the facility under test.

c. If the DGPS position indicates "FLOAT" it still provides accuracy to within a meter. Do not terminate a check for this condition but attempt to fly close to the airfield containing the base station. Normally the position will then revert back to "FIXED RTK". Execute "Output Messages" then "Send All" on the DGPS I/O page to electronically reset the airborne DGPS.

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APPENDIX 10

GENERAL OPERATION PROCEDURES

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APPENDIX 10

GENERAL OPERATION PROCEDURES

A10.1 INTRODUCTION. This chapter applies to all aircraft in the FAA flight inspection fleet. It provides basic guidance to cover the flight inspection system and procedures that are presently in use.

a. The software provider for the flight inspection system is NXT. Operating instructions for the **NXT flight inspection** system are contained in the NXT Automatic Flight Inspection System Manual (T.I. 4040.55, AFIS Mission Specialist, or T.I. 4040.56, AFIS Pilot). Standard terminology is used to help establish a common work base. The basic procedures for the NXT System are used throughout this manual.

(1) **Initialization.** The pilot will ensure the aircraft is initialized to the coordinates of where it is physically located. Accomplish this either by using the coordinates recorded prior to engine shutdown, or the coordinates received from GPS. Using the airport reference point coordinates should be used only as a last resort.

(2) **LR-60, CL-601.** These systems have a Tone Decoder Interface Unit mounted in the equipment bay across the aisle from the Mission Specialist workstation. The primary function is to provide an along-track mark every 0.1 and 1.0 nm from the global Positioning Inertial Reference Unit (GPIRU) sent to the printer/plotter. The tone decoder interface combines the co-pilot runway update/ event, Mission Specialist event, and the 1020 Hz theodolite tone (from #3 VHF), generating an audio tone over the intercom system and a mark on the printer/plotter.

(3) **MILTOPE.** This system is installed in all legacy aircraft. The track ball on the keyboard or a discreet track ball may be used with this system. A cursor can be moved around the display using a track ball; clicking the proper button allows the scratch pad to become active wherever the cursor is placed. MILTOPE-equipped aircraft have the capability to save new facility data or modified data not found in the AFIS database for later retrieval.

(4) **RTT.** RTT capability is available in the CL-601 aircraft. Procedures for MILTOPE RTT calibration can be found in Appendix 7 of this manual.

(5) **Radio Frequency Interference (RFI).** This equipment is installed in some of the aircraft. System operations are explained in Chapter 23 of this manual.

(6) **Navigational Aids Signal Evaluator (NASE).** This equipment is temporarily installed in aircraft when it is needed to support Airway Facilities

(7) **Microwave Scan Beam Landing System.** The MSBLS is a precision approach and landing system that provides slant range, azimuth, and elevation data to NASA's Shuttle Orbiter during terminal area energy management, approach, and landing phases of the Shuttle at CONUS based End of Mission and Transatlantic Abort Landing sites in Spain, Morocco, and France. Detailed operations procedures and special aircraft requirements are in Chapter 3 of this manual.

(8) **LR60 VOR.** There is a difference in course sensitivity between the cockpit and AFIS VOR receivers in the Lear. Lear crews will rely on AFIS as the standard for VOR structure determination. Any rapid course deviations that appear on the cockpit VOR receiver should be compared with AFIS for magnitude and flyability determination.

(9) **AFIS Receiver Differences.** If large signal strength differences are displayed between AFIS receivers, the mission specialist should normally use the receiver with the higher signal strength. Make the comparison at lower signal strength levels. Differences at high signal levels should not be considered. Similarly, when observing ILS cross pointer differences between receivers, mission specialists must evaluate the difference between receivers while in the measurement area of the ILS, before determining usability of receiver.

In addition, the LR60 crew must provide a copy of the logger file to the Flight Inspection Policy, Practices, and Training Team, along with the Tail Number, Facility ID, Transmitter Configuration, Signal Strength as taken from the recordings, and distance from GS antenna, for distribution to Engineering.

b. Software and Equipment Self-Test

(1) The Mission Specialist must ensure the current and correct RNAV and Automated Flight Inspection System (AFIS) software versions are installed in the aircraft (current software revision is found as PGM on the SERVICE PAGE).

The Mission Specialist must ensure the current calibration data is correct and resident in the AFIS prior to flight. The following pages must be printed and archived with the first recordings on the first day of itinerary.

(a) System Setup

(b) TVPS

(c) VTAC Facility Data (Receiver Calibration)

(d) MISC SERV (AFIS Software Revisions, Crew, Date, etc)

(e) Self Test Results

(f) Printer Test results

NOTE: Any time the AFIS program and database software are reinstalled, the Mission Specialist must manually input the receiver calibration values on the VORTAC Facility Data page. Receiver calibration data is found on the ramp calibration page in the Airborne Calibration Book stored on board the Aircraft. Note that the values on the ramp calibration page are of **OPPOSITE** polarity from what the Mission Specialist inputs on the VORTAC Facility Data Page.

(2) A complete self-test of the flight inspection equipment will be performed prior to each sortie. The results will be printed and filed with the recordings of the first inspection of the sortie. Annotate on the MISC SERV page in the “Self Test Fac” field the ID and facility type for the inspection about to take place (i.e. ABC VTAC). On subsequent inspections, print the MISC SERV page to indicate where the self-test results can be found for that sortie.

c. Database Management

(1) The operator cannot permanently change the AFIS database; however, the facility data for the facility being inspected may be temporarily modified. The Mission Specialist will compare the stored data with a current AVNIS data sheet prior to starting the inspection. Glide slope, PAR, and VGSI latitude and longitude: tolerance of ± .05 seconds is acceptable due to rounding. If other aircraft data does not match the AVNIS data sheet, use the AVNIS data sheet information and notify Resource and Data Management. An AFIS printout of the data used for the inspection will be filed with the recordings.

(2) A supplemental database is available through the Data Logger drive. Modified data or new facility data may be saved and retrieved from the disk when the Supplemental Database is activated on the Flight Inspection Facility Data Page.

d. Data Recording

(1) The following Display pages will be printed and recorded with each facility type inspection. Any time a change is made to these pages, the changed page must be printed.

(a) SERVICE PAGE. This will indicate which inspection mode is selected, the crew names and crew numbers, Aircraft tail number, which facility the Self-Test results are located, and the Data Logger status.

(b) FI FACILITY DATA. This displays what data is used for NCU inputs and calculations.

(c) PLOT CONTROL PAGE/ PAGES. This page(s) shows which traces are used, their baselines, and sensitivity. Normally, the default plotter traces are used.

(d) NAV/TEST CONTROL PAGE(S). This page(s) provides the control and monitoring functions. See T.I. 4040.55 and T.I.4040.56 for a detailed description for each mode of operation. This page is automatically printed when AFIS sensors meet required parameters or when STOP command is executed using EXEC CMD function.

(e) Print any other pages that may be beneficial in analyzing facility performance or aircraft condition.

(2) Printer Plotter Annotation: Full utilization of the Annotate Plot feature is recommended; however, manual annotation may be necessary. There should be adequate information to duplicate the flight inspection report by someone who was not on the itinerary.

(a) Annotate the recordings with the run number sequence, transmitter number, and configuration. Also include any information that will be helpful in analyzing the recorded data.

(b) Identify the purpose of every event mark.

(c) Annotate all manual analysis.

(3) Alert Page. This page provides information of system or inspection out-of-tolerance conditions during an inspection. This page may be printed to help in analyzing facility and system problems.

e. Aircraft Communication

(1) Left-Seat Pilot:

ATC	Primary
Interphone	Primary
FI Air/ Ground	Secondary

(2) Right-Seat Pilot:

ATC	Primary
Interphone	Primary
FI Air/ Ground	Secondary

(3) FI Mission Specialist :

ATC	Secondary
Interphone	Primary
FI Air/ Ground	Primary

f. Aircraft Positioning. Positioning of the aircraft is critical to the data collection process. Close attention must be given to minimize crew induced positioning errors.

(1) Initialization. Although the Navigation Computer Unit (NCU) can refine its positioning, the positioning reference of the Inertial Reference Unit (IRU) will never be better than the accuracy of the location of the aircraft relative to the coordinates used for initialization.

(2) Prior to flight, the IRU will be initialized to known coordinates of where the aircraft is located on the airfield, either stored or manually entered. The hybrid update mode must be used during initialization. If a backup is required, perform the following procedure. Using the CHANGE AIRPORT function, enter the four-letter airport code to find the airport coordinates corresponding to the first runway threshold found in the database. If they are not found, use LAT/ LON function to manually enter the airport reference point coordinates or other known coordinates at the airport. The aircraft should be parked as close as practical to these coordinates during initialization. The difference between the aircraft position and entered coordinates will become apparent as soon as updating begins; a 1nm error is typical, but the error may be greater at larger airports.

(3) NCU Continuous Updating: The NCU must have real-time updating during operations. This is achieved by several methods, automatic and manual. The primary NCU update is automatic through the HYBRID GPS mode. However, three pilot selectable DME modes are available. Differential GPS is also available for specific types of flight inspections.

(a) Hybrid Mode (HYBRID). This is the preferred mode for flight inspection and may be used for en route operations. It uses both Inertial Sensing System (ISS) and GPS information for updates.

(b) Differential Global Positioning System Mode (DGPS) may be used when available and/or required for the type of flight inspection mission assigned. AFIS DGPS is supported by a ground station located on or near the facility under test. DGPS does NOT use any manual runway updates. TVPS or Pilot updates are NOT needed; AFIS will automatically correct the data when the aircraft crosses threshold (no entry required).

(c) FLIGHT INSPECTION Mode (FI-DME). AFIS automatically selects up to 6 DME stations located around the facility under test. DME station error needs to be closely monitored. A DME with a station error of 0.2 nm or greater should not be used for flight inspection. AFIS may not select the most suitable stations for positioning. When this occurs, Manual DME Mode (MN-DME) is appropriate. Optimum geometry between any two DME is 90°. Adequate positioning can usually be achieved if the system is using two or more acceptable DME with 60° to 120° bearing difference. Manual updating is used when there are inadequate DME stations for positioning.

(d) RNAV DME Mode (RN-DME). This mode may be used during en route flight. It may also be used for flight inspection during coverage and airway checks when station alignment was determined using FI-DME or MN-DME. FI-DME Mode is limited to using DME near the facility under test. Position accuracy is lost when using FI-DME over long distances. MN-DME is usable if the positioning DME are updated with stations off the nose of the flight inspection aircraft.

(e) DME Manual Select (MN-DME). This mode may be used to improve DME updating by manually inserting or removing positioning DME(s) with an error of 0.2 nm or greater. When this mode is used for flight inspection, the stations selected should be noted in Remarks of the AVNIS Data Sheet for future use.

(4) Manual Update. When manual updates are used, the NCU and DME must be disabled. Manual updates can only be executed from the pilot CDU. For manual updating, the aircraft must be positioned precisely over the checkpoint at a low enough altitude (usually 500 ft AGL) to ensure accuracy.

(a) To update over the facility being inspected, select FIX, then FI FAC on the pilot CDU. Fly over the facility and press "EXECUTE". If the facility being selected is an ILS, update over the Localizer antenna

(b) To update over a known checkpoint other than the facility, enter the coordinates through the FIX button, then LAT/LON buttons. Press "EXECUTE" when over the checkpoint. Good coordinates for manual updating are runway ends or another NAVAID. At islands or other locations where visual checkpoints are nonexistent, coordinates can be computed on a localizer centerline if a DME source within 23° of the centerline is available.

(5) NCU Reliability Factors. Radio Altimeter Error (RA ERR) displayed on ILS-3 and MLS-3 NAV/TEST CTRL Page 1 of 4 is a bias number applied to the radio altimeter vertical fix values used for computations. The RA ERR is established during the RA Self-Test: Lear 60 or Challenger 601 may be 4 ft or less; BE-300 may be 5 ft or less. If Vertical Accelerometer Bias (VABias) is greater than 2000µgs, flight inspection operations must be terminated until cause can be found and corrected. VABias must be monitored during flight inspection operations because changes during a sortie could indicate NCU problems. The Mission Specialist should pay special attention to data collected.

A10.2 TABLES AND SUPPLEMENTAL INFORMATION

a. **Antenna Positions**. In normal operation, the antenna is defaulted to the optimum antenna for the flight inspection mode entered. Use Table A10-1 to verify that the optimum antenna is selected for flight inspection mode. Antenna selection is controlled on the Plot Control Page.

Table A10-1
Normal Antenna Positions

MODE	**B300**				**LEAR 60**			
	SYS A	SYS B	SYS C	ANT	SYS A	SYS B	SYS C	ANT
VOR								
RADIN	VL1	TAC	OFF	N/A	VL1	TAC	OFF	AFT(2)
RADOUT	VL1	TAC	OFF	N/A	VL1	TAC	OFF	AFT(2)
ORBIT	VL2	TAC	OFF	N/A	VL1	TAC	OFF	AFT(2)
TACAN								
RADIN	VL1	TAC	OFF	BA(3)	VL1	TAC	OFF	BA(1)
RADOUT	VL1	TAC	OFF	BA(3)	VL1	TAC	OFF	BA(1)
ORBIT	VL2	TAC	OFF	BA(3)	VL1	TAC	OFF	TA(1)
DME	N/A	N/A	OFF	N/A	N/A	N/A	OFF	N/A
ILS								
ILS-1	VL1	VL2	OFF	N/A	VL1	VL2	OFF	AFT(2)
ILS-2	VL1	GS1	OFF	N/A	VL1	GS1	OFF	AFT(2)
ILS-3	VL1	GS1	OFF	N/A	VL1	GS1	OFF	FWRD(2)

Table A10-1
Normal Antenna Positions
(continued)

MODE	**CL 601/ 4**			
	SYS A	SYS B	SYS C	ANT
VOR				
RADIN	VL1	TAC	OFF	FWRD(2)
RADOUT	VL1	TAC	OFF	AFT(2)
ORBIT	VL1	TAC	OFF	AFT(2)
TACAN				
RADIN	VL1	TAC	OFF	BF(1)
RADOUT	VL1	TAC	OFF	BA(1)
ORBIT	VL1	TAC	OFF	BA(1)
DME	N/A	N/A	OFF	N/A
ILS				
ILS-1	VL1	VL2	OFF	AFT(2)
ILS-2	VL1	GS1	OFF	AFT(2)
ILS-3	VL1	GS1	OFF	FWRD(2)

1. **TACAN antenna selection is a manual function from the cockpit.**
2. **Forward/ AFT VOR/ LOC antenna selection on the Lear and Challenger Aircraft to be controlled via NCU O/G output discrete.**
3. **TACAN antenna selection is a manual function from the inspector's console.**

b. Aircraft Dimensions. Aircraft dimensions information is displayed on the System Setup Page in AFIS. This information is loaded by maintenance, and it should not be necessary for the Mission Specialist to modify. See Table A10-2.

Table A10-2
Aircraft Dimensions

A/C Dimension	L60	CL601	CL604	BE300
ACDLN47	019.2	014.3	012.3	012.0
ACDLN41	-031.6 note	014.3	011.3	-022.0
ACDLN24	-002.5	026.3	030.3	004.5
ACDLN48	009.2	004.3	010.3	003.0
ACDHT07	002.8	006.5	006.5	004.0
ACDHT08	008.8	11.4	011.4	009.0
ACDHT48	005.5	008.0	008.0	005.0
ACDLN49	001.4	-007.1	-016.0	-007.0
ACDHT09	008.9	11.7	011.7	11.7
ACDHT49	005.6	007.0	007.0	007.0
ACDLN45		11.8		
ACDHT05		006.9		

ACDLN47 Distance from IRU #1 to Glide Slope (GS) antenna (+ for GS antenna forward of IRU)

ACDLN41 Distance from IRU #1 to Localizer (LOC) antenna (- for IRU forward of LOC antenna) (See NOTE)

ACDLN24 Distance from Radio Altimeter antennas to IRU #1 (+ for IRU forward)

ACDLN48 Distance from IRU #1 to forward MLS antenna (+ for MLS forward of IRU)

ACDHT07 Height of Glide Slope antenna above the ground with the aircraft level and weight on wheels

ACDHT08 Height of forward MLS antenna above the ground with the aircraft level and weight on wheels

ACDHT48 Height of forward MLS antenna above the IRU #1 (+ for MLS antenna above IRU)

ACDLN49 Distance from IRU #1 to DGPS antenna and or WAAS antenna (+ for GPS antenna forward of IRU)

ACDHT09 Height of DGPS antenna and/or WAAS antenna above the ground with aircraft level and weight on wheels

ACDHT49 Height of forward DGPS antenna and/or WAAS antenna above IRU #1 (+ for GPS antenna above IRU)

ACDLN45 Distance from IRU #1 to MSBLS antenna (+ for MSBLS antenna forward of IRU). This dimension scratchpad is active and displayed when A/C is CL601 and MSBLS Availability Flag is toggled to "ENABLE"

ACDHT05 Height of MSBLS antenna above the ground with aircraft level and weight on wheels. This dimension scratchpad is active and displayed when A/C is CL601 and MSBLS Availability Flag is toggled to "ENABLE."

NOTE: The Lear 60 ACDLN41 dimension will change to +19.7 to match the antenna selection logic.

c. **Antenna Normalization**. The VOR/ LOC Antenna Normalization Table is used to balance received signals of selected system. This information is loaded by maintenance, and it should not be necessary for the Mission Specialist to modify. See Table A10-3.

Table A10-3
VOR/ LOC Antenna Normalization

	B300	**L60**	**CL601/4**
Bearing	dB	dB	dB
0	+5	+5	+4
30	+7	+7	+4
60	+3	+6	+4
90	+4	+1	+4
120	+3	+1	+4
150	+4	0	+5
180	0	0	+4
210	+1	+2	+4
240	+3	0	+4
270	+6	0	+4
300	+3	+4	+4
330	+2	+6	+4

d. **Antenna Gain Factor.** The Antenna Gain Factor Table is the same for all NXT equipped aircraft. Antenna Gain Factors are entered to compensate for signal loss within the aircraft. A plus value means there is attenuation in the airplane, and all signal strength values will be increased a corresponding amount to represent outside world values. Plots on the printer/ plotter are only updated at the next power-up or at the next mode change. Information is loaded automatically during a program load and does not normally require revision. See Table A10-4.

Table A10-4
Antenna Gain Factors

VOR/ LOC	+00dB
GS	+00 dB
TACAN	+06 dB
MLS-FWD	+00 dB
MLS-AFT	+00dB

Table A10-5
dBm to Microvolt Conversion

dBm	µVolts		dBm	µVolts		dBm	µVolts
-27	10000.0		-54	446.7		-81	20.0
-28	8912.5		-55	398.1		-82	17.8
-29	7943.3		-56	354.8		-83	15.8
-30	7079.5		-57	316.2		-84	14.1
-31	6309.6		-58	281.8		-85	12.6
-32	5623.4		-59	251.2		-86	11.2
-33	5011.9		-60	223.9		-87	10.0
-34	4466.9		-61	199.5		-88	8.9
-35	3981.1		-62	177.8		-89	7.9
-36	2548.1		-63	158.5		-90	7.1
-37	3162.3		-64	141.3		-91	6.3
-38	2818.4		-65	125.9		-92	5.6
-39	2511.9		-66	112.2		-93	5.0
-40	2238.7		-67	100.0		-94	4.5
-41	1995.3		-68	89.1		-95	4.0
-42	1778.3		-69	79.4		-96	3.5
-43	1584.9		-70	70.8		-97	3.2
-44	1412.5		-71	63.1		-98	2.8
-45	1258.9		-72	56.2		-100	2.5
-46	1122.0		-73	50.1		-101	2.2
-47	1000.0		-74	44.7		-102	2.0
-48	891.3		-75	39.8		-103	1.8
-49	794.3		-76	35.5		-104	1.6
-50	707.9		-77	31.6		-105	1.4
-51	631.0		-78	28.2		-106	1.3
-52	562.3		-79	25.1		-107	1.1
-53	501.2		-80	22.4		-108	1.0

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APPENDIX 11

WORKSHEETS AND TOLERANCES

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APPENDIX 11

WORKSHEETS AND TOLERANCES

A11.1 INTRODUCTION. This appendix contains quick reference guides for flight inspection crews, either in the form of a worksheet that can be used to track inspection progress, and/or a simple list of tolerances from this document.

NDB FLIGHT INSPECTION WORKSHEET

	C	P (5)	Antenna Change (3)	Frequency Change
IDENT	X	X	X	X
Voice	X	X	X	X
Coverage Orbit	X		X	X
Routes & Transitions	X	(1)	(4)	(1)
SIAP(s)	X	(2)	(2)	(2)
Station Passage	X	X	X	X
Standby Transmitter	X			
Standby Power	X			

FI IDENT ________
Morse Code Ident __________
Freq ________ Voice? _____
TX (Dual or Single?) _______

(1) Surveillance only incidental to other required checks.

(2) Final approach segment only.

(3) Required for change in antenna type, or mods are made to antenna or ground plane, or change in antenna current designed to change coverage area.

(4) Fly any airways, routes or transitions and reevaluate any associated ESV(s).

(5) During periodic inspections, evaluate coverage on a surveillance basis, including verification of the minimum usable distance.

CLASS	Range	2/3
Compass Locator	15 nm	10 nm
MH Facility	25 nm	16.7 nm
H Facility	50 nm	33.3 nm
HH Facility	75 nm	50 nm

Ident: Morse code or voice ident correct, clear, and identifiable throughout the area of intended use, including ESV(s).

Voice: Clear and recognizable for a minimum of 2/3 NDB class usable distance. Note effective range on commissioning. Anytime less than required distance notify maintenance. Don't restrict the facility for voice coverage. Remove if interferes with coded ident (except live voice).

Coverage Orbit: Fly at reduced power level as determined by maintenance. Altitude 1,500 ft above site, or min altitude that provides 1,000 ft (2,000 ft in designated mountainous areas) above intervening terrain or obstacles, whichever is higher. Permissible to alternate transmitters for dual transmitter facilities.

Airways, Routes and Transitions. Fly at min altitudes and max distances as required by the procedure. Bearing deviation tolerance is ±10°, (holding patterns and approaches are ±5°).

ESV(s): Coverage at greater than the orbital distance for specific fixes, airways, routes, or transitions, may be evaluated on one transmitter. Establish at normal power.

SIAP(s). Fly in direction of use. Descend 100 feet below the MDA and all stepdown fixes after the FAF or PT altitude. During periodic inspections, for SIAP(s) without a FAF, fly the final segment from the PT distance. Bearing deviation tolerance is ±5° , including holding patterns.

Station Passage. Needle reversal should occur when passing directly over or in very close proximity to the facility. Overfly at minimum procedural altitude. Momentary needle hunting while near or over the station must not constitute false station passage.

Standby Transmitter. Repeat all checks on commissioning. On periodic, try to check transmitter that wasn't checked during the last inspection. International agreements may require periodic inspections on both transmitters.

Standby Power. Not required to check if constantly charged batteries.

Special Inspections. (1) Antenna or transmitter change: periodic plus coverage orbit, airways, routes, transitions and ESV(s); (2) Frequency Change: periodic plus coverage orbit, no requirement to check ESV(s).

Tolerance exceptions. Short duration out-of-tolerance needle action is allowed when either: (1) does not exceed 4 seconds on approach; (2) does not exceed 8 seconds for en route and holding patterns (but no false station passage).

PAR FLIGHT INSPECTION WORKSHEET – (version 2006-3, previous versions are obsolete)							
IDENT	**OWNR**	**STATE**	**CTRY**	**INSPECTION DATE(S)**	**LOCATION**	**RWY**	**INSP TYPE**

PIC:	**MS:**	**A/C NO.:**

PAR TYPE:	**FACILITY STATUS:**	**SERIAL NO.:**

CONTRLR PERF SAT ☐ UNSAT ☐	**ILS/MLS/VGSI COINC.** SAT ☐ UNSAT ☐	**STBY EQUIP** SAT ☐ UNSAT ☐	**STBY PWR** SAT ☐ UNSAT ☐	**LIGHTING** SAT ☐ UNSAT ☐
AZIMUTH RADAR:	**COURSE ALIGNMNT** SAT ☐ UNSAT ☐	**DEVIATION ACC** SAT ☐ UNSAT ☐	**RANGE ACCRCY** SAT ☐ UNSAT ☐	**COVERAGE** SAT ☐ UNSAT ☐
ELEVATION RADAR:	**RANGE ACCRCY** SAT ☐ UNSAT ☐	**COVERAGE** SAT ☐ UNSAT ☐		

FREQUENCIES USED:	**SAT:**	**UNSAT:**

MTI/MTD BLIND SPEED (commissioning only): ________KTS VERIFIED: YES ☐ NO ☐
MTI/MTD required for Final Approach? YES ☐ NO ☐
For Computer Generated displays: SCAN (normal radar) Mode Usable for Approach? YES ☐ NO ☐
- if not, record inner limit (minimum distance) for controlling aircraft: _____ NM

GENERIC TYPE PAR(s) (FPN-40, FPN-62/ 63, MPN-14, TPN-18, TPN-44)

RUN	MTI		POLAR-IZATION		TRANSMITTER Note (1)		CURSOR	TX USED	ANGLE	Checks	
	ON	OFF	CP	LP	PRIM	STBY				C	P
Approach #1					X		A			X	X
Approach #2					X		B			X	X
Approach #3						X	A			X	X
Approach #4						X	B			X	X
AZ Only Apch										X	
Alternate Angle							A			X	

GPN-22 and TPN-25 TYPE PAR(s)

RUN	TRACK MODE		FTC		MTI		RCVR CHAN	CUR-SOR	TX USED	ANGLE	Checks	
	NRM	BK UP	ON	OFF	COH	NON-COH			Note (1)		C	P
Approach #1	X		X		X		A	A			X	X
Approach #2		X		X		X	A	A			X	
Approach #3	X		X		X		B	A			X	X
Approach #4	X		X		X		B	B			X	X
Approach #5	X		X		X		A	B			X	
Backup Radar Transmitter (From 20 miles - can combine with Backup Database Checks)												
Approach #1	X		X		X		A	A			X	
Backup Database (EPROM Firmware)												
Approach #1	X		X		X		A	A			X	
Approach #2		X		X		X	A	A			X	
Approach #5	X		X		X		A	B			X	
Azimuth Only Procedure												
	X		X		X		A				X	
Alternate Angle												
Approach #1	X		X		X		A	A			X	
To commission Standby Power (generator), evaluate during any of approaches 1, 3, 4, or 5.												

Note (1): Transmitters used should be swapped between Periodic inspections. Record in "TX Used" block, 1=Primary, 2=Standby.

Commissioning Data (GPN-22/TPN-25): (next page)

Commissioning Data (GPN-22/ TPN-25):

Transmitter Output Power:
Receiver Sensitivity: Normal: Coherent MTI: Non-Coherent MTI:
Firmware: Version No. Part No.
Clutter (Rain) Reject: YES ☐ NO ☐ NA ☐
Digital MTI Baseline Limiting Settings:
Usable Range (20 NM Radar):

TPN-22 TYPE PAR(s) (AZIMUTH 46-DEG SECTOR SETTING IS ON FOR ALL RUNS)

RUN	MTI		CFAR		ALS PAR MODE (1)		USABLE DIST	CUR-SOR	ANGLE	Checks	
	ON	OFF	ON	OFF	AUTO	MAN				C	P
Approach #1		X		X	X			A		X	X
Approach #2		X		X	X			B		X	X
Approach #3	X			X	X			A		X	X
Approach #4	X			X	X			B		X	X
Approach #5		X	X			X		A		X	
Approach #6	X		X			X		A		X	
Alternate Touchdown Point #1 (on same runway heading)											
Approach 1A		X		X	X			A		X	X
Approach 2A		X		X		X		A		X	X
Approach 3A		X		X		X		B		X	X
Azimuth Only Procedure											
AZ Only		X		X	X					X	

NOTES for TPN-22:
1. A periodic check should be considered complete if Auto-Mode is inoperative. The PAR must be considered as “Restricted” and authorized for use in Manual-Mode only.
2. If equipped, standby power should be performed on the last run due to the extensive time required to reload the software and data.

Commissioning Data (TPN-22):

Transmitter Output Power:
Receiver Sensitivity:
Software: Name Build Date **Version No. Part No.**

MPN-25, TPN-31, FPN-67, and GCA-2000 PAR(s)

Use Generic PAR block for the inspection, equating Clear Mode with Linear Polarization (LP) and Rain Mode with Circular Polarization (CP). The Standby Transmitter B-Cursor approach (#4) is not required for these computer generated PAR(s). There is no manual control of Clear/Rain Mode for the TPN-31 and FPN-67 PAR(s). A database change requires flying approaches #1, #2, and alternate angle using the new database. Record the identifying information for each database checked.

APPENDIX 12

FLIGHT INSPECTION DAILY FLIGHT LOG (DFL)

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APPENDIX 12

FLIGHT INSPECTION DAILY FLIGHT LOG (DFL)

A12.1 BACKGROUND. The Pilot-in-Command (PIC), or a designated representative, must complete FAA Form 4040-5 for each aircraft flown by the PIC for each day. The form will be retained in Flight Inspection Central Operations (FICO).

A12.2 GENERAL INSTRUCTIONS. Complete one DFL per PIC/ aircraft per day. However, two DFL(s) are acceptable if there are two duty days that begin in the same Zulu date. Do not complete an additional DFL if a change in crewmembers occurs, as long as the PIC and aircraft do not change. In the event that a continuation sheet is required to complete the Workload Accomplishment or Crew Data sections, use a new DFL. Enter data for Blocks 1 through 3 and only that data required for completion of the DFL. For example, if a continuation sheet is required for the Workload Accomplishment section, it is not necessary to make entries in the other sections. Submit the completed DFL to the FICO at the end of each duty day. If using electronic means to complete the DFL, refer to special instructions in Paragraph A12.7.

A12.3 INSTRUCTIONS FOR COMPLETING FORM. Blocks 1 – 3 and all appropriate flight, workload, and crew data are required. It is only necessary to complete "Page __ of __" when submitting more than one page. See Paragraph A12.6 for additional information on RNAV helicopter procedures and helicopter recurrent training.

When completing Blocks 1 through 8, refer to Figure 1.

Figure 1

☐ Amended		DAILY FLIGHT LOG				Page ____ of ____	
1. N-NUMBER	2. DATE	3. PILOT IN COMMAND / ASIP	4. TOTAL FLIGHT TIME	5. TOTAL TIS	6. DUTY ON	7. DUTY OFF	8. COST CODE

a. **Block 1 – N-Number:** Enter the tail number of the aircraft (Example N69).

NOTE: Some flight inspection duties will involve flying aboard non-AVN aircraft. In this case, enter in Block 1 the registration number of the aircraft used for the inspection, unless a predetermined mission identifier has been assigned (e.g., MILOPS, RNAV, or ARMY). When a mission identifier is provided on the itinerary, enter it in Block 1 and log the registration number in Remarks.

b. **Block 2 - Date:** Enter the date that corresponds to the UTC time for Duty On (Block 6), using the format mm/dd/yy.

c. **Block 3 – Pilot In Command/ ASIP:** Enter the name of the Pilot-in-Command or ASIP. Use the format: Last Name, First Name, Middle Initial.

NOTE: When the Airspace System Inspection Pilot (ASIP) is not the Pilot In Command (PIC) of the aircraft, the ASIP will log his or her flight time as Second In Command (SIC) or Additional Crew Member (ACM), as appropriate. If the PIC is not an AVN crewmember, use FI999 to log the PIC time and enter the ASIP name in Block 3.

d. **Block 4 – Total Flight Time:** This block must equal the sum of all flight times from Block 9. In addition, this value must equal the cumulative flight hours in the Total Flight Hours, Block 21, and the cumulative flight hours in the Pilot Hours, Block 27.

e. **Block 5 – Total TIS (Time in Service):** This block must equal the sum of all TIS times from Block 9 (i.e., the cumulative airborne time). This time is used by Maintenance to monitor airborne airframe hours only. It is not required for non-AVN aircraft.

f. **Block 6 – Duty On:** Enter the start time of duty day in UTC (hh:mm).

g. **Block 7 – Duty Off:** Enter the end time of duty day in UTC (hh:mm).

h. **Block 8 – Cost Code:** Enter the appropriate cost code as provided by FICO. Use 8R50 as the cost code for the following flight activities, including helicopter training:

Ferry	(Type Check F)
Test	(Type Check H)
Other	(Type Check O, unless used in flight inspection)
Proficiency	(Type Check T)

i. **Block 9 - Departure/ Arrival:**

When completing data in Block 9, refer to Figure 2

Figure 2

9. DEPARTURE / ARRIVAL											
DEP ID KOKC	TIME OUT 14:08	ARRIVAL ID KCLL	TIME IN 17:22	FLIGHT TIME 3.2	TIS 2.9	DEP ID KCLL	TIME OUT 18:47	ARRIVAL ID KLIT	TIME IN 21:05	FLIGHT TIME 2.3	TIS 2.1
DEP ID	TIME OUT	ARRIVAL ID	TIME IN	FLIGHT TIME	TIS	DEP ID	TIME OUT	ARRIVAL ID	TIME IN	FLIGHT TIME	TIS

(1) **Dep ID:** Enter the ICAO identifier for airport of departure.

(2) **Time Out:** Enter the time the aircraft starts to taxi, in UTC (hh:mm).

(3) **Arrival ID:** Enter the ICAO identifier for airport of final destination.

(4) **Time In:** Enter the time the aircraft blocks in, in UTC (hh:mm).

(5) **Flight Time:** Enter the difference between TIME OUT and TIME IN, expressed in hours and tenths. Flight time means the time from the moment the aircraft first moves under its own power for the purpose of flight, until the moment it comes to rest at the final destination.

(6) **TIS (Time in Service):** Enter the total airborne time from lift-off to touch-down at the final destination, expressed in hours and tenths. Use the hour meter, if available, to verify time.

Use the following table to determine the correct tenth of an hour:

1 – 2 minutes = .0 hr	21 – 26 minutes = .4 hr	45 – 50 minutes = .8 hr
3 – 8 minutes = .1 hr	27 – 32 minutes = .5 hr	51 – 56 minutes = .9 hr
9 – 14 minutes = .2 hr	33 – 38 minutes = .6 hr	57 – 60 minutes = 1.0 hr
15 – 20 minutes = .3 hr	39 – 44 minutes = .7 hr	

When completing Blocks 10 – 21, refer to Figure 3

Figure 3

WORKLOAD ACCOMPLISHMENT									FLIGHT HOURS			
10. Ident	11. Facility / Proc	12. Type Check	13. Control Number	14. Checks Complete	15. Owner Code	16. Reimburs. Acct. No.	17. Discrepancy XMIT 1	XMIT 2	18. Inspection	19. Adjustment	20. Enroute	21. Total Flight Hours
CJF	ILS/G	P		PM	F				0.8	0.6	0.5	1.9
CJF	ILS/L	P		PMA	F				0.7			0.7
BWG	VTAC/V	S	BG-08-015-3	PO	F				0.9		0.5	1.4

NOTE: DFL entries and pending report requirements: Pending report requirements are initiated by DFL entries. The following rules apply for the assignment of pending report requirements:

A pending report flag is issued for all DFL entries EXCEPT:

1. Type checks F, H, L, N, O, T, or Y.
2. An APM, WAM, or ASDE/X inspection.
3. RNAV periodic, Required Obstruction Clearance (ROC) (Obstacle Evaluation) or Surveillance inspection; however, a report IS required if a discrepancy is found.

j. **Block 10 – Ident:** Location identifiers must be entered as follows:

(1) Enter the location identifier provided on the Flight Inspection Itinerary.

(2) If no location identifier is provided, enter the three-character designator that identifies the facility or the primary NAVAID upon which the procedure is predicated. For Area Navigation (RNAV) procedures, use the GPS control number or identifier provided on the flight inspection itinerary.

k. **Block 11 – Facility/ Procedure:** Enter the appropriate code from Table 1. Separate entries must be made for each primary facility or procedure being inspected and for public and private use procedures supported by the same facility. When a public facility supports a private procedure(s), the time flown on the procedure(s) must be logged separately for accounting purposes. Flight inspection of private approaches should be entered as a special and recorded with the accompanying Reimbursable Account Number. The correct Reimbursable Account Numbers should be taken from the Flight Inspection Itinerary or the data sheet.

All facilities that are checked in conjunction with a procedure flight inspection must be recorded. The first DFL entry must have the ident of the procedure and the special control number assigned by the FICO. Each subsequent entry must have the facility ident and facility type used for that procedure, without the special control number. Log all flight time to the primary procedure entry and insert "0" in inspection time (Block 18) for each subsequent entry. For example:

10.	11.	12.	13.	14.	15.	16.	17. Discrepancy		18.	19.	20.	21.
Ident	Facility/ Proc	Type Check	Control Number	Checks Complete	Owner Code	Reimburs. Acct. No.	XMT 1	XMT 2	Inspection	Adjustment	En Route	Total Flight Hours
BLUFI.1	**PROC/T**	**S**	**AP-07-152-5**		**F**				**1.0**		**1.1**	**2.1**
MLB	**VDME/V**	**S**			**F**				**0**			**0**
PBI	**VTAC/V**	**S**			**F**				**0**			**0**

If one facility is used for more than one procedure check, enter the procedure special control number on the line entry for the associated facility.

Table 1
Facility/ Procedures Code Table

FACILITY/ PROCEDURE TYPE		DFL CODE
Airport Lights (4)	APL	APL/ A – Approach Light Systems APL/ C – Centerline Light System APL/ H – High-Speed Runway Turn-Off Lights APL/ L – Visual Lead-in Light System APL/ P - PAPI APL/ R – REIL APL/ T – Taxi Light System APL/ V – VASI APL/ Y – Other (Explain in "Remarks") APL/ Z – Touchdown Zone Light System
Air Route Surveillance Radar	ARSR Only	ARSR
Air Route Surveillance Radar	SECRA Component	ARSR/ S
Airport Surface Detection Equipment	ASDE	ASDE/ X
Airport Surveillance Radar	ASR Only	ASR (2)
Airport Surveillance Radar	SECRA Component	ASR/ S
Approach Path Monitor	APM	APM
Charted Visual Flight Procedure	CVFP	CVFP
Direction Finding Stations	DF	DF
En Route Communications	ECOM	ECOM/ C – Center ECOM/ F – FSS ECOM/ H – HF Communications ECOM/ I – IFSS ECOM/ M - Military A/G
Fan Markers (Markers not broadcasting their own identification – including "Z" Markers)	FAN	FAN
Homing Beacons (3)	NDBC (Compass Locator)	NDBC/ N – NDB Only NDBC/ D – DME
Homing Beacons (3)	NDBH (H Facility)	NDBH/ N – NDB Only NDBH/ D – DME
Homing Beacons (3)	NDBU (UHF)	NDBU/ N – NDB Only NDBU/ D – DME
Homing Beacons (3)	NDBM (MH Facility)	NDBM/ N – NDB Only NDBM/ D – DME

Table 1
Facility/ Procedures Code Table
(continued)

FACILITY/ PROCEDURE TYPE		DFL CODE
Instrument Landing System (Includes LDA(s) with Glide Slopes)	ILS	ILS/ D – DME (1) ILS/ G – Glide Slope ILS/ L - Localizer
Localizer Only System (Includes LDA(s))	LOC	LOC/ D – DME (1) LOC/ L - Localizer
Locations with DME Only	DME	DME
Marker Beacons	Instrument Landing System	ILS/ LM – LMM ILS/ LO – LOM ILS/ MI – MBI ILS/ MM – MBM ILS/ MO – MBO
Marker Beacons	Localizer Only	LOC/ LM – LMM LOC/ LO – LOM LOC/ MI – MBI LOC/ MM – MBM LOC/ MO – MBO
Marker Beacons	SDF System	SDF/ LM – LMM SDF/ LO – LOM SDF/ MI – MBI SDF/ MM – MBM SDF/ MO - MBO
Microwave Landing System	MLS	MLS/ A – Azimuth MLS/ B – Back AZ MLS/ D – DME MLS/ E – Elevation
Microwave Scanning Beam Landing System	MSBLS	MSBLS/ A – Azimuth MSBLS/ D – DME MSBLS/ E – Elevation
Precision Approach Radar	PAR	PAR (2)
Precision Runway Monitor	PRM	PRM

Table 1
Facility/ Procedures Code Table
(continued)

FACILITY/ PROCEDURE TYPE		DFL CODE
Procedures (7)	PROC	PROC/ A – Approaches PROC/ C – Point in Space – Copter PROC/ D – DME/ DME SID(s)/ STAR(s) PROC/ F – Flight Management System (FMS) PROC/ G – LNAV PROC/ H – Helicopter PROC/ L – LAAS PROC/ N – Area Navigation Routes PROC/ O – Overlay (5) PROC/ P – RNP PROC/ Q – Point in Space – Fixed Wing PROC/ R – Routes & Airways, including Substitute Routes PROC/ S – WAAS, LPV PROC/ T – Terminal (Arrival or Departure) PROC/ V – Vertical Navigation PROC/ W – WAAS, LP PROC/ X – Intersections PROC/ Y – Night Evaluation/ Other (Explain in “Remarks”)
Required Obstruction Clearance	ROC	ROC (Obstacle Evaluation) (6)
Runway Incursion	ARPT	ARPT
SDF System	SDF	SDF/ S – SDF Only SDF/ D – DME
Standard Terminal Automation Replacement System (STARS) Final Monitor Aid (FMA)	FMA	FMA
TACAN	TACAN – TACAN Only	TACAN
Terminal Communications	TCOM	TCOM/ R – RAPCON TCOM/ S – AWOS/ ASOS TCOM/ T – Tower TCOM/ W – Pilot to Forecaster

Table 1
Facility/ Procedures Code Table
(continued)

FACILITY/ PROCEDURE TYPE		DFL CODE
Transponder Landing System	TLS	TLS/ D – DME TLS/ G – Glide Slope TLS/ L – Localizer
VDME	VDME	VDME/ V – VOR Component VDME/ D – DME Component
VHF Omni Test	VOT	VOT
Visual Flight Inspection Program	VFIP	VFIP
VOR	VOR – VOR Only	VOR
VTAC	VTAC	VTAC/ T – TACAN Component VTAC/ V – VOR Component
Wide Area Multilateration	WAM	WAM

NOTES:

1. Do not make separate entries for associated facilities (DME, marker beacons, approach lights, communications, etc.) which are inspected at the same interval as the service they support, except when:

   a. A discrepancy is found during routine inspection.

   b. A specific requirement exists to inspect the associated facility, e.g., restoration following maintenance, user complaint, after accident, etc.

   c. Commissioning or decommissioning the associated facility.

2. When more than one ASR or PAR is in operation at the same location, this equipment will be identified with letters or numbers respectively, following the normal three-letter identifier. Enter the DFL code provided on the data sheet or itinerary for reporting purposes.

3. Report Homing Beacons by facility identifier provided by Flight Inspection Technical Service Sub-Team.

4. APL(s) are identified by the combination of the airport identifier and the runway.

5. A number of approach procedures titled “VOR or GPS” and “NDB or GPS” have had the primary ground facility removed or shut down. A periodic inspection based on the underlying VOR or NDB is no longer valid. After a periodic inspection is completed based on GPS, the procedure may continue to be flown using GPS and a current navigation database.

   The ident will be a GPS ident, and Type will be PROC/ O.

6. Obstruction inspections for Operational Network (OPSNET) airports are documented by airport and runway for straight-in approaches. Each inspection task represents all obstacle requirements for all procedures that serve that runway. All obstruction requirements for that runway must be met before the inspection can be considered completed.

   Identifier: KOKC17R DFL Type: ROC

   Represents all SIAP(s) to this runway. In this case, the SIAP(s) to 17R at KOKC in Oklahoma City, OK; ILS RWY 17R; RNAV RWY 17R; NDB RWY 17R

7. If the signed (Sat, Unsat, or with required changes) Procedure Control Page is not received by the FICO within 24 hours of the inspection, the flight release will not be granted until the PC log is received in the FICO, unless the reason for the delay is documented on the DFL.

l. **Block 12 – Type Check**: Enter letter designator(s). This entry is used in the automation system for tracking the receipt of flight inspection reports.

See Table 2 for a list of valid type check codes and Table 3 for type check suffixes.

Table 2
Type Check Code Table

A	**After Accident** (Requires Report)
C	**Commissioning:** An extensive inspection that certifies a NAVAID or an approach for its initial use. (Requires report)
E	**Site Evaluation:** True site evaluations (Requires report)
F	**Ferry:** Used for positioning aircraft with a ferry permit (No report required).
H	**Test:** Aircraft or aircraft systems/ development of flight inspection policy. (No report required)
L	**Logistics:** The movement of personnel and/or material in support of the Alaskan Region or for aircraft maintenance support when commercial sources are not available. (No report required)
N	**Aircraft Pre-Positioning or Post-Positioning:** If the aircraft is moved to a location in preparation of future flight inspection of a facility or for post positioning back to home base, but NO flight inspection was performed. (No report required).
O	**Other:** Any type check not specifically covered by an assigned code. Give complete explanation in the appropriate Remarks section. (No report required)
P	**Periodic:** (Requires report) *See Notes.
R	**Reconfiguration:** An extensive inspection, including most or all commissioning requirements, of an existing or similar type facility following major maintenance or relocation within the general area. (Requires report)
S	**Scheduled Special:** Maintenance projects, e.g., programmed TACAN antenna change. (Requires report)
T	**Proficiency:** The “T” code must only be used for check rides and mission training. (No report required)
U	**Unscheduled Special:** On-site requests, and/or specials without a special control number, e.g., facility restoration, TACAN antenna change due to malfunction, etc. (Requires report)
V	**Surveillance** (Requires report when a discrepancy is found)
Y	**Navigation Aid Signal Evaluation (NASE):** (No report required)
Z	**Radio Frequency Interference (RFI)** (Requires report)

Table 3
Type Check Suffixes

I	**Incomplete Inspection:** Enter as a suffix to the type checks in Table 2 to indicate incomplete check (e.g., CI = Commissioning Incomplete, EI = Site Evaluation Incomplete). Indicate reason for the incomplete in the Remarks. Not appropriate for "F", "H", "L", "N", or "T". Does NOT close procedure special. Once the inspection is completed, all report requirements may be included in one report.
U	**Procedure Unsatisfactory:** Applies to Special Procedural Inspections Only. Enter as a suffix to the type checks in Table 2 to indicate when an inspection is completed, but unsatisfactory. This may be used when flight procedure inspections are unsatisfactory and need to be returned for rework. Closes procedure special. (Report required)
C	**Procedure Satisfactory with Required Changes:** Applies to Special Procedural Inspections Only. Enter as a suffix to the type checks in Table 2 to indicate when an inspection is completed satisfactory, but with changes required to the procedure prior to publication and an additional flight check is not required. Closes procedure special. (Report required)
G	**Procedure Satisfactory under Gold Standard:** Applies to Special Procedural Inspections only. Enter as a suffix to the type checks in Table 2 to indicate when an inspection is completed under Gold Standard. Closes procedure special. (Report required).

NOTES:

1. If periodic requirements are met, except for SIAP(s), and the crew does not expect to complete the inspection, record a list of "UNCHECKED" SIAP(s) in Block 23. Enter "P" in Block 12 and show the inspection complete. If it is determined the SIAP(s) cannot be checked within its periodic interval, the procedure(s) will be NOTAMed, (Not Authorized), and a Special will be generated to ensure accountability. Include the procedure name and airport served for SIAP(s) not checked.

2. If an APM discrepancy is found, do not mark inspection as incomplete.

m. **Block 13 – Control Number:** Enter the special control number assigned by the FICO.

n. **Block 14 – Checks Complete:** If Type Check is "P", "C", or "R", an entry is required in "Checks Complete," Block 14. In all cases, the "Checks Complete" entry must be in accordance with FAA Order 8200.1 and must match the entry recorded on the associated flight inspection report. Enter the appropriate code from the Checks Complete Table, Table 4, to show the type of check completed. This entry is critical, as it is used to set the update flag used in the automation system to schedule facility due dates.

Table 4
Checks Complete Table

P	**Periodic requirements completed.** **For localizers, this indicates it was flown at the higher comparability altitude.**
PA	**All periodic requirements completed and SIAP "A" check completed. For localizers, this indicates it was flown at the higher comparability altitude.**
PM	**Periodic requirements completed AND monitors updated.** **For localizers, this indicates it was flown at the higher comparability altitude.**
PMA	**Periodic requirements met AND monitors updated AND SIAP requirements completed. For localizers, this indicates it was flown at the higher comparability altitude.**
PL	**For localizers flown *at* the lower standard altitude, periodic requirements completed.**
PAL	**For localizers flown *at* the lower standard altitude, periodic requirements completed AND SIAP "A" check completed.**
PML	**For localizers flown *at* the lower standard altitude, periodic requirements completed AND monitors updated.**
PMAL	**For localizers flown *at* the lower standard altitude, periodic requirements completed AND monitors updated AND SIAP requirements completed.**
D	**Facility having no periodic requirement or facility whose periodic requirements are associated with a primary component: Caution should be used when entering a "D", as this entry will inhibit any further scheduled inspections.**
PR	**Periodic requirements (with radial) completed in lieu of orbit if orbit cannot be flown. Does not apply to reference radial requirement.**
PRA	**Periodic requirements (with radial) completed in lieu or orbit if orbit cannot be flown and SIAP "A" check completed. Does not apply to reference radial requirement.**
PO	**Periodic requirements (with alignment orbit) completed.**
POA	**Periodic requirements (with alignment orbit) completed and SIAP "A" check completed.**

NOTES:

1. For dual transmitter facilities where the second transmitter will be completed at a later date, enter the periodic update as the date of completion of the first transmitter check. Do not update after completing the second transmitter unless the first transmitter was rechecked.

2. When it has been determined that a localizer has not been flown at lower standard altitude (1,500 ft above the antenna or 500 ft above intervening terrain, whichever is highest) within the preceding 1,080 days, a PL or PML will be scheduled on the itinerary. This indicates the inspection must be flown at the lower standard altitude or it will be incomplete. Conversely, the absence of an "L" in the scheduled checks on the itinerary (e.g., P or PM) does not mean the inspection *should* be flown at the higher comparability altitude. This merely indicates the option exists to fly the inspection at or above the lower standard altitude if comparability is satisfactory IAW Order 8200.1, Chapter 15. Anytime it can be accomplished, a localizer inspection should be flown at the lower standard altitude, and this should be indicated on the DFL by using a checks complete code of PL or PML.

3. For facilities at OPSNET airports, do not update an "A" checks complete. All required obstruction clearances for OPSNET airports should be entered as a separate line item on the DFL as explained in Note 6 to Table 1.

o. **Block 15 – Owner Code:** Entry required for "Private" inspections only.

Table 5
Owner Code Table

A	Air Force
B	Public
C	Coast Guard
E	FAA F&E Projects
F	FAA (other than F&E)
H	International Public
I	International (Generic)
J	International Private
K	International Air Force
L	International Army
M	International Navy
N	Navy
O	Other, Specify in "Remarks"
P	Private
R	Army
S	State, County, or City
X	Public Special

p. **Block 16 – Reimbursable Account Number:** Enter the reimbursable account number from the Flight Inspection Itinerary or the data sheet.

Table 6
Reimbursable Code Table

Private Use Approaches	Private use approaches are flight checked on a reimbursable basis in conjunction with other periodic requirements. If the navigational aid supports both public and private procedures, report the flight hours attributed to the private procedure in a separate workload accomplishment column (with the cost accounting number in this block). This data becomes the basis for billing the sponsor of the private procedure in accordance with an established reimbursable agreement. When supported by a NAVAID, the private use approach will be listed on the **SIAPS** portion of the facility data sheet with an 'N' in the 'Published' column. RNAV private use approaches can be identified by the 'Owner' column of the Flight Inspection Itinerary.
RFI	For Regional RFI flights, use VN200R
NASE	For Regional NASE flights, use VN200N
AC0420	For Flight Inspection Airport Safety Program (Runway Incursion)

q. **Block 17 - Discrepancy:** Enter the applicable discrepancy codes on all periodic inspections and special flight inspections if the purpose of the special is not related to the discrepancy found. Enter transmitter discrepancies in the appropriate column, using applicable codes listed in Paragraph A12.4. Do not assign a discrepancy code for commissioning, reconfiguration, or special inspections that are related to the discrepancy found. If facility is found off the air, use Discrepancy Code 2.

NOTE: In reporting a discrepancy, explain the discrepancy in the facility status. Examples:

ILS/ L - The localizer had four discrepancies written as XEO in the XMT 1 field of Block 17 and Y in the XMT 2 field. TX-1-alignment monitor, modulation, coverage (usable distance), and TX-2-clearance monitor.

PAR - The PAR had two discrepancies - alignment and glide slope angle, written as AK.

ILS/ L - The localizer had two discrepancies on TX1, narrow alarm and wide alarm, written as ZZ.

r. **Block 18 – Inspection:** Enter flight time spent inspecting facility.

s. **Block 19 – Adjustment:** Enter all flight time spent on the actual adjustment to a parameter of a facility and, as a result of an adjustment, the recheck of parameters previously inspected. If any facility changes made by a ground technician require flight inspection, the time must be logged as "Adjustment." Flight time that is accrued as a result of ground technician request must be logged as "Adjustment" on ALL types of flight inspection.

t. **Block 20 - En Route:** Enter the flight times en route to accomplish an inspection. When accomplishing multiple inspections, en route time must document the time from the "Original Block Out Time" to the beginning of the inspection of the first facility. The actual en route time charged to a reimbursable agreement will be post-processed for possible time sharing between several different reimbursable agreements. Subsequent en route times will be computed from the end of the previous inspection to the beginning of the next facility inspection. The last facility inspected will include the total en route time for the return leg. En route time can also include FERRY, TEST, PROFICIENCY, LOGISTICS, and Other.

u. **Block 21 – Total Flight Hours:** The Total Flight Hours will equal the sum of Blocks 18 through 20. The total of all entries in Block 21 must equal the value in Block 4.

v. **Block 22 – Fuel**: Enter the quantity and location for fuel purchased.

w. **Block 23 – Remarks/ Facility Status/ Airport Facility Data Changes/ Aircraft Status:**

(1) Remarks:

(a) All passengers must be listed in this section or on an attached passenger manifest, if additional space is needed. Include at least the following:

- Passenger's last name and first initial
- Routing symbol or agency (if passenger is not an FAA employee, identify organization)
- Point of embarkation and final deplaning point
- Status, i.e., purpose of being on aircraft
- Liability release form. This should be faxed to the FICO prior to flight and will be attached to the DFL upon completion of the mission.

(b) Facilities that were inspected after normal duty hours on overtime and the reason for the overtime.

(c) Any fees or expenses (other than fuel) incurred during the course of flight inspection chargeable to a reimbursable agreement. These may include, but are not limited to, the following:

- Holiday Pay
- Ramp Fees
- Parking Fees
- Service Fees
- Taxes
- Custom Fees

(d) When a mission identifier is provided on the itinerary and is entered in Block 1, N-Number, then log the registration number in Remarks.

(2) Facility Status:

(a) Progress and/or problems encountered on each incomplete inspection.

(b) Nature and outcome of special checks (e.g., on-site requests, discrepancies found during surveillance).

(c) Facility Discrepancies or Restrictions. If a facility classification/ status is changed as a result of flight inspection, enter the appropriate remarks to identify the reason for the change. Enter the text of any NOTAM issued as a result of the flight inspection. If a NOTAM was issued, enter the organization contacted.

(d) For RHO-THETA and VOT flight inspections, the flight crew will document those ground checkpoints that were not checked.

(e) RNAV WAAS (LPV) or DME/ DME Inspections. If discrepancy is found, document details.

{***NOTE:*** *When anomalies are observed during any phase of a flight inspection involving GNSS procedures, document the relevant parameters at the time of the anomaly and forward the data to Flight Inspection Policy for analysis.*}

(f) Remark Format for APM MSAW Discrepancies:

APM, Approach Title {*e.g., ILS RWY 17L*}, Ident {*of APM*}, MSAW Transponder Code used, In contact with Tower or Approach Control; Description of Discrepancy; UTC Time, if feedback is requested by FI Pilot

Example (APM Discrepancy):
APM, ILS RWY 06L, KLAX06P, 4226, Approach Control; No alarm start 4.5nm/ 700’ to 2nm/ 300’; 1436Z, feedback requested.

(g) Remark Format for GTM MSAW Discrepancies:

GTM, Ident {*of ASR*}, MSAW Transponder Code used, In contact with Tower or Approach Control; Description and Location {*LAT/ LONG and MSL Altitude*}; UTC Time, if feedback is requested by FI Pilot

Example (GTM Discrepancy):
GTM, AUS, 3366, Approach Control; No alarm at N3012.5/ W09744.2 and 900'MSL; 1830Z, no feedback requested.

(h) Remark Format for RFI:

For RFI checks, enter a narrative description of checks performed and results obtained. Provide physical description and latitude/longitude of suspected interference source. For incomplete or unsuccessful checks, report bearings obtained, and aircraft location, and provide any information that may aid another crew in locating the source.

(3) Airport/ Facility Data Changes: Note all changes in airport or facility data that require action or intervention in the official airports/ NAVAIDS database by Flight Inspection Technical Services Sub-Team.

(4) Aircraft Status: List a brief description of the maintenance and avionics discrepancies, if applicable.

NOTE: All entries in Block 23 must be limited to those necessary for accurate reporting of flight inspection and aircraft operation activities. Any NOTAM(s) issued or rescinded will be noted in this area. This must not be used for personal comments or opinions.

When completing Blocks 24 – 33, refer to Figure 4

Figure 4

CREW DATA													
24. CREW NUMBER	RES	25. POSITION	26. TIME (HRS / 1/10)	27. PILOT (HRS / 1/10)	28. IP (HRS / 1/10)	29. HOOD (HRS / 1/10)	30. IMC (HRS / 1/10)	31. NIGHT (HRS / 1/10)	32. TAKEOFF DAY	32. TAKEOFF NT	33. LANDINGS DAY	33. LANDINGS NT
VN146		PIC	2.8	0.9					1			
VN026		SIC	2.8	1.9			1.1				1	
VN041		MS	2.8									
VN888		ACM	2.8									

x. **Block 24 – Crew Number:** Enter the crew number for each crewmember. All employees of AVN and its contractors, including military, will be considered crewmembers. Place a checkmark in the "RES" column if the crewmember is flying under the Air Force Reserve Program.

y. **Block 25 – Position:** Enter the crew position (e.g., PIC, SIC, Mission Specialist (MS), ACM)

- En route Inspectors. An FAA Inspector conducting an en route inspection must be designated by the crewmember code VN999 and position ACM.
- Non-Pilot Crew Positions. Any other crew member who does not have his/ her own AVN crew number must be designated by the crew number VN888 and position ACM.

z. **Block 26 – Time:** Enter the time flown for each crewmember. Multiple MS, SIC, and ACM positions are authorized to account for additional crewmembers.

aa. **Block 27 – Pilot:** Pilot time must be credited only for that time the pilot is the sole manipulator of the flight controls, regardless of the qualifications for the control position at which they sit. This includes the time spent controlling the aircraft by use of the autopilot. The total of all entries in Block 27 must equal the value in Block 4.

bb. **Block 28 – Instructor Pilot (IP):** IP time must be credited only to pilots designated as Flight Inspection Instructor/ Evaluator Pilots, or 14 CFR Part 135 Instructor/ Check Pilots, for such time as they are acting in that capacity. The total IP time credited to all pilots should not exceed the Total Flight Time.

cc. **Block 29 – Hood:** Enter that flight time the individual is manipulating the flight controls under simulated instrument meteorological conditions (IMC).

dd. **Block 30 – IMC:** Enter that flight time the individual is manipulating the flight controls under actual IMC.

ee. **Block 31 – Night:** Enter that flight time that occurs between the end of evening civil twilight and the beginning of morning civil twilight, as published in The Air Almanac.

ff. **Block 32 – Takeoffs:** Enter number of takeoffs, day or night. Night takeoffs will be logged only when they are accomplished during the period between one hour after sunset and one hour before sunrise, as published in The Air Almanac.

gg. **Block 33 – Landings:** Enter the number of landings, day or night. Night landings will be logged only when they are accomplished during the period between one hour after sunset and one hour before sunrise, as published in The Air Almanac.

A12.4 DISCREPANCY CODES BY FACILITY TYPE

APL

Alignment (A)
Charting Error (CE)
Clearance (C)
Coverage (O)
Facility Off Air (2)
Filters (F)
Glide Slope Angle (K)
Glide Slope Coincidence (J)
Inoperative Lights (B)
Light Intensity (L)
Obstacle Clearance (A1)
Pilot Controlled Lighting (P)
Sequencing (S1)

ARPT

Airport Diagram (D1)
Charting Error (CE)
Construction (C1)
Ground (G1)
Lighting (L1)
Markings (M1)
Other (O1)
Signs (S1)
Heliport Visual Segment (V1)
Obstacle Clearance (A1)

APM

APM Failure (4)

ARSR/ ASR/ SECRA

Alignment (A)
Charting Error (CE)
Coverage (O)
Facility Off Air (2)
Fix Accuracy (G)
GTM Failure (3)
Obstacle Clearance (A1)

CVFP

Charting Error (CE)

DF

Alignment (A)
Coverage (O)
Facility Off Air (2)
Obstacle Clearance (A1)

DME (ILS/D, LOC/D)

Charting Error (CE)
Coverage (O)
Facility Off Air (2)
Frequency Interference (Q)
Identification (I)
Obstacle Clearance (A1)
Range Accuracy (N)
Transmitter Differential (T)
Unlocks (U)

ECOM/ TCOM

Charting Error (CE)
Coverage (O)
Facility Off Air (2)
Frequency Interference (Q)
Voice (V)

ILS/G

Alignment Angle Monitors (X)
Charting Error (CE)
Clearance (C)
Coincidence (J)
Coverage (O)
Facility Off Air (2)
Frequency Interference (Q)
Glide Slope Angle (K)
Modulation (E)
Structure (S)
Symmetry (1)
TX Differential (T)
Width (W)
Width Monitors (Z)

DISCREPANCY CODES BY FACILITY TYPE

(continued)

ILS/ L (LOC/L)

Alignment (A)
Alignment Monitors (X)
Charting Error (CE)
Clearance (C)
Clearance Monitors (Y)
Coverage (O)
Facility Off Air (2)
Frequency Interference (Q)
Identification (I)
Modulation (E)
Obstacle Clearance (A1)
Polarization (P)
Structure (S)
Symmetry (1)
Width (W)
Width Monitors (Z)

MB

Coverage (O)
Facility Off Air (2)
Frequency Interference (Q)
Modulation (E)
Identification (I)
Transmitter Differential (T)
Width (W)

MLS

Alignment (A)
Alignment Monitor (X)
Charting Error (CE)
Clearance (C)
Coverage (O)
Data Words (6)
Facility Off Air (2)
Frequency Interference (Q)
Glide Slope Angle (K)
Identification (I)
Modulation (E)
Monitor (M)
Obstacle Clearance (A1)
OCI (W)
Range Accuracy (N)
Scan Rage (7)
Structure (S)
Transmitter Differential (T)
Unlocks (Frame Flags) (U)

MSBLS

Alignment (A)
Charting Error (CE)
Coverage (O)
Glide Slope Angle (K)
Range Accuracy (N)

NDB

ADF Needle Action (D)
Alignment (A)
Charting Error (CE)
Coverage (O)
Facility Off Air (2)
Frequency Interference (Q)
Identification (I)
NDB Station Passage (H)
Obstacle Clearance (A1)
Range Accuracy (N)
Transmitter Differential (T)
Unlocks (U)
Voice (V)

PAR

Alignment (A)
Charting Error (CE)
Coverage (O)
Facility Off Air (2)
Glide Slope Angle (K)
Glide Slope Coincidence (J)
Obstacle Clearance (A1)
Range Accuracy (N)

DISCREPANCY CODES BY FACILITY TYPE

(continued)

PRM

Alignment (A)
Charting Error (CE)
Coverage (O)
Facility Off Air (2)
Fix Accuracy (G)
Obstacle Clearance (A1)

PROC

Airport/Heliport Lighting (L1)
Angle (K)
Bearing and Distance (E1)
Charting Error (CE)
Climb Gradient (F1)
Communications (D1)
Coverage (O)
Descent Gradient (G1)
Fix Accuracy (J1)
GPWS Alert (C1)
Human Factors (B1)
Obstacle Clearance (A1)
Procedural Leg Types (H1)
RADAR Coverage (O)
Runway/ Heliport Markings (M1)
Helicopter Visual Segment (V1)
Helicopter VFR Segment (V2)

ROC

Obstacle Clearance (A1)

SDF/ S

Alignment (A)
Alignment Monitors (X)
Charting Error (CE)
Clearance (C)
Clearance Monitors (Y)
Coverage (O)
Facility Off Air (2)
Frequency Interference (Q)
Identification (I)
Modulation (E)
Obstacle Clearance (A1)
Polarization (P)
Structure (S)
Symmetry (1)
Width Monitors (Z)

TAC/ VDME/ VOR/ VOT/ VTAC

Alignment (A)
Charting Error (CE)
Coverage (O)
Facility Off Air (2)
Frequency Interference (Q)
Identification (I)
Modulation (E)
Monitor (M)
Obstacle Clearance (A1)
Polarization (P)
Rotation and Sensing (R)
Structure (S)
Transmitter Differential (T)
Unlocks (U)
Voice (V)

A12.5 FAA FORM 4040-5, DAILY FLIGHT LOG

If a DFL must be changed, the originator must complete an amended version. Check the box next to "Amended". Each amended DFL must include the number of the amendment in the Remarks section of the DFL (e.g., Amendment #1) to identify if a DFL is amended more than once.

FAA FORM 4040-5, DAILY FLIGHT LOG

☐ Amended

DAILY FLIGHT LOG

Page ____ of ____

1. N-NUMBER	2. DATE	3. PILOT IN COMMAND / ASIP	4. TOTAL FLIGHT TIME	5. TOTAL TIS	6. DUTY ON	7. DUTY OFF	8. COST CODE

9. DEPARTURE / ARRIVAL

DEP ID	TIME OUT	ARRIVAL ID	TIME IN	FLIGHT TIME	TIS	DEP ID	TIME OUT	ARRIVAL ID	TIME IN	FLIGHT TIME	TIS
DEP ID	TIME OUT	ARRIVAL ID	TIME IN	FLIGHT TIME	TIS	DEP ID	TIME OUT	ARRIVAL ID	TIME IN	FLIGHT TIME	TIS

WORKLOAD ACCOMPLISHMENT									FLIGHT HOURS			
10. Ident	11. Facility / Proc	12. Type Check	13. Control Number	14. Checks Complete	15. Owner Code	16. Reimburs. Acct. No.	17. Discrepancy XMIT 1	17. Discrepancy XMIT 2	18. Inspection	19. Adjustment	20. Enroute	21. Total Flight Hours

22. FUEL

GALLONS	LOCATION	GALLONS	LOCATION	GALLONS	LOCATION	GALLONS	LOCATION

23. REMARKS / FACILITY STATUS / AIRPORT FACILITY DATA CHANGES / AIRCRAFT STATUS

CREW DATA

24. CREW NUMBER	RES	25. POSITION	26. TIME HRS	26. TIME 1/10	27. PILOT HRS	27. PILOT 1/10	28. IP HRS	28. IP 1/10	29. HOOD HRS	29. HOOD 1/10	30. IMC HRS	30. IMC 1/10	31. NIGHT HRS	31. NIGHT 1/10	32. TAKEOFF DAY	32. TAKEOFF NT	33. LANDINGS DAY	33. LANDINGS NT

FAA Form 4040-5 (10/2005) (FORMFLOW) (Supersedes Previous Editions)

A12.6 DFL ENTRIES FOR RNAV HELICOPTER PROCEDURES

a. Global Positioning System (GPS)/ Helicopter:

The purpose of this paragraph is to provide instructions for completing DFL entries when performing flight inspections on helicopter RNAV (GPS) approaches and helicopter recurrent training missions. This appendix will address only those fields or entries which vary from the more traditional flight inspection entries.

Block 1: Aircraft No.	N/A
Block 3: Pilot-in-Command	Name of Responsible FAA ASIP
Block 8: Cost Code	Enter "FGPSA", unless a different cost code is assigned by FICO
Block 23: Remarks	Evaluate the suitability and safety of a fixed wing aircraft to accomplish future periodic inspections. If the final approach segment, terrain, and obstacle environment are suitable for flight inspection by a fixed wing, enter the remark, "fixed wing approved." Otherwise, enter the remark, "Fixed wing not approved". Also include the following Remarks: Helicopter N____________________________ Type Aircraft - ___________________________ Type Navigation Receiver - ________________ SIAP Owner - ____________________________
Block 24: Crew Number	FI999 as PIC (if the ASIP is not the PIC, and the PIC has no crew number) ASIP as SIC or ACM (unless ASIP is PIC) All other FAA crew members will enter their crew number and position. When the ASIP is not the PIC of the proponent aircraft, the ASIP must appear in Block 3. The duty position of the ASIP should be SIC or ACM, as appropriate, entered in Block 25. The actual PIC of the aircraft will be designated as PIC in Block 25 with Crew Number of FI999 in Block 24.
Block 25: Position	VN123 FAA Pilot Crew Number as SIC or ACM. All other FAA crew members will fill in crew number and MS or ACM When the ASIP is not the PIC of the proponent aircraft, the ASIP must appear in Block 3. The duty position of the ASIP should be SIC or ACM, as appropriate, enter in Block 25. The actual PIC of the aircraft will be designated as PIC in Block 25 with Crew Number FI999 in Block 24.

b. The purpose of this paragraph is to provide instruction for completion of DFL entries when performing training during Helicopter usage, whether rental or simulator:

Block 1. Aircraft No.	Aircraft Number: N/A
Block 3. Pilot-in-Command	Name of AVN PIC, ___________Last, First, MI
Block 23. Remarks	Remarks format: a. Helicopter Number N________ b. Type Aircraft_________ c. Type Navigation Receiver_______
Block 24. Crew Number	AVN PIC VN______ SIC FI999 ACM VN____

A12.7 ONLINE DAILY FLIGHT LOG

INTRODUCTION
An online Daily Flight Log interface is available to complete and transmit the DFL via the FAA Intranet or dial-up. This interface is also useful for researching historical DFL data and facility history.

SITE ACCESS
The online DFL is located at http://avnokcdp.amc.faa.gov/disp/. You will be required to log in to the Flight Inspection Dispatch program using your FIRPS/ FOMS user id and password.

SITE INSTRUCTIONS
After logging into the application, you will have the following menu options available:

FIND (DEFAULT)
Find previously submitted DFL(s). This is a read-only view.

OUTSTANDING LIST
Access the PIC, Date, and N# of flights that have already occurred and have a pending DFL requirement (i.e., the DFL has not yet been submitted). You have rights to SAVE data in this form (multiple times). Once the DFL is submitted by the FICO, the DFL will no longer appear on this list. DFL(s) that have been saved by crewmembers will be flagged by a "YES" in the "External DFL" column of the outstanding DFL list.

NOTE: Access to submitted DFL(s) is via the "Find" menu. Submitted DFL(s) are read-only.

FACILITY HISTORY

Access facility history by Ident and Type.

LOGOFF

Log off the application.

DEFINITION OF SAVE AND SUBMIT COMMANDS

SAVE

This command allows you to save a DFL to the form, but it does not populate that database. The data is merely saved to the form. You may make multiple inserts, deletions, and/ or updates. Crewmembers have rights to "SAVE" DFL(s), but NOT to "SUBMIT" DFL(s). If the DFL is sent to the FICO via other means, such as fax, the FICO will save and submit the DFL internally.

SUBMIT

When a DFL is submitted, the database is populated with all the workload accomplishment and crew data. Only the FICO has rights to "SUBMIT" a DFL. The crews are expected to save the information on the form. The FICO will QC the data and submit the DFL. Once the data is submitted, it can only be changed by the FICO, but it can still be viewed via the "FIND" command.

FORM INSTRUCTIONS

After selecting the form you want to populate from the Outstanding DFL List, you will notice the flight information is pre-populated from the dispatch release. If the information needs to be changed, please advise the FICO.

You will notice an orange "+" symbol on the Flight Segment, Location, and Crew fields. When pressed, this button adds a line for data entry. Add as many lines as needed. The added lines will also have a yellow "-" button which will delete the line.

Enter the required data. Some fields will auto-populate.

Save the DFL.

PRINTING

When a DFL is selected, you will notice a "Hardcopy" button at the bottom of the page. Pressing this button will display a printable version of the form. The print command can then be used to print the form.

> **NOTE:** All DFL(s) that are saved by crewmembers will show a "YES" on the external DFL column of the outstanding DFL list.

A12.8. OPERATIONAL NETWORK (OPSNET) AIRPORTS

KABQ	KDEN	KJFK	KMSP	KRDU
KATL	KDFW	KLAS	KMSY	KSAN
KBNA	KDTW	KLAX	KOAK	KSEA
KBOS	KEWR	KLGA	KORD	KSFO
KBWI	KFLL	KMCI	KPBI	KSJC
KCLE	KHOU	KMCO	KPDX	KSLC
KCLT	KIAD	KMDW	KPHL	KSTL
KCVG	KIAH	KMEM	KPHX	KTEB
KDCA	KIND	KMIA	KPIT	KTPA