U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

National Policy

ORDER 8200.47

Effective Date: 09/06/2015

SUBJ: Flight Inspection of the Transponder Landing System

This order is directive upon all personnel charged with the responsibility for execution of the flight inspection mission, specific to Transponder Landing System (TLS). Compliance with this order, however, is not a substitute for common sense and sound judgment. Nothing in this order will be construed to relieve flight inspection crews or supervisory personnel of the responsibility of exercising initiative in the execution of the mission, or from taking such emergency action as the situation warrants.

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Director
Flight Inspection Services

Distribution: Electronic

Initiated By:AJW-331

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Chapter 1: General Information

1. Purpose of This Order. The purpose of this order is to prescribe standardized procedures for flight inspection of the Transponder Landing System (TLS). It is not intended as authorization for an agency to assume flight inspection authority over any group of services which are not now under its jurisdiction. Similarly, it carries no designation of responsibility within any agency unless such has been so designated in its usual procedural manner, such as general orders, regulations, etc. This order details the flight inspection procedures, requirements, and analysis for the evaluation of the Transponder Landing System (TLS).

2. Audience. The primary audience is Flight Inspection Services, who has the responsibility to complete the flight inspection. The secondary audience is facilities engineering and maintenance including military and international entities.

3. Where Can I Find This Order? The order is available on-line at the FAA Orders and Notices webpage, on both the employee and public websites.

Chapter 2. Transponder Landing System (TLS) Information

1. Introduction. Transponder Landing System (TLS) tracks and provides valid landing and approach guidance to only one individual aircraft returning a specific transponder identification code. TLS guidance signals emulate an Instrument Landing System (ILS) signals that would exist at the current position of the tracked aircraft. Another aircraft not being tracked that tunes the TLS localizer and glide slope channel will receive the guidance intended for the target aircraft, not valid guidance for its position in the airspace.

The TLS determines the location of the aircraft by interrogating the aircraft transponder and then measuring the transponder range, azimuth angle, and elevation angle with two sensors located adjacent to the runway. Localizer and glide slope corrections are then computed as necessary to guide the aircraft to the desired course. This guidance information is transmitted throughout the TLS service volume using Very High Frequency (VHF) localizer and Ultra High Frequency (UHF) glide slope signals modulated with 90 and 150 Hz tones. The TLS guidance signals are dynamic in that they change with time as the tracked aircraft moves.

2. Basic TLS Operation. Operational sequence for providing guidance to landing aircraft is as follows. An aircraft operating under Air Traffic Control (ATC) Instrument Flight Rules (IFR) procedures has an assigned transponder identification code. When the aircraft comes within 60nm and is within line-of-sight, the TLS uses transponder multilateration to display a track symbol corresponding to the aircraft location on the TLS Remote Control Unit (RCU) console. The RCU is normally located at the control tower and is used to input the assigned transponder code for an aircraft intending to make an approach. Once activated by inputting the assigned transponder code, TLS will search the service volume for the code. The TLS transmits an interrogation signal which commands all transponders in the TLS service volume to reply. Simultaneously, as the interrogation signal is broadcast, a “start pulse” signal is sent to the TLS sensors to begin a data collection cycle. For a period following the start pulse, the sensors store the transponder pulse returns from all aircraft located within the service volume along with carrier signal measurements that allow angles to be computed. This interrogation and search cycle is repeated multiple times per second. Interrogator Side Lobe Suppression (SLS) is used to block replies from outside the service volume.

If the TLS identifies two or more aircraft providing replies with an identical selected identification code, no guidance will be generated. Position is computed based on Time-of-Arrival (TOA) of the code relative to the start pulse, giving range to the aircraft and the carrier signal phase measurement, Angle-of-Arrival (AOA), giving azimuth and elevation angles. When the tracking solution meets the confidence criteria for accuracy, the TLS initiates path and course guidance corrections. These are based on the aircraft’s horizontal and vertical offset from the predefined approach path. Interrogations, position measurements, and guidance transmissions continue cyclically multiple times per second. This cycle is continued as long as the aircraft being tracked remains inside the service volume or until the aircraft reaches the runway threshold. The TLS terminates path and course guidance when the aircraft crosses over the runway threshold and then the system waits for a command to search for the next user aircraft.

TLS produces a virtual flight path to a virtual emanation point for the localizer and a virtual emanation point for the glide slope. There are no antennas physically located at the points from which the TLS localizer and glide slope signals appear to emanate. Flight inspection measurements must be based on the locations of the virtual points for the TLS Localizer and Glide Slope.

3. TLS Operation Sequence. The steps below describe the TLS operational sequence:

a. When the assigned aircraft enters the service volume, its transponder receives the interrogation signal.

b. The aircraft transponder replies with its preset identification code.

c. TLS sensors receive this preset identification code.

d. The azimuth sensor array (ASA) and the elevation sensor array (ESA) measure the time difference between the start pulse and aircraft transponder reply to compute the time-of-arrival and the phase angle. This data is sent to the TLS Base Station.

e. The Base Station calculates aircraft location from ASA and ESA data.

f. The calculated aircraft location is used to guide the aircraft on the desired path and course by Glide Slope and Localizer signal modulation.

g. The modulation of the Glide Slope and Localizer carrier signals is used to display path and course guidance on the CDI.

4. TLS Components. The TLS is composed of following principal components (Figure 1):

a. The Azimuth Sensor Array (ASA) which includes infrastructure and antennas

b. The Elevation Sensor Array (ESA) which includes infrastructure and antennas

c. The Alternate Time of Arrival (ATA) which includes infrastructure and an antenna

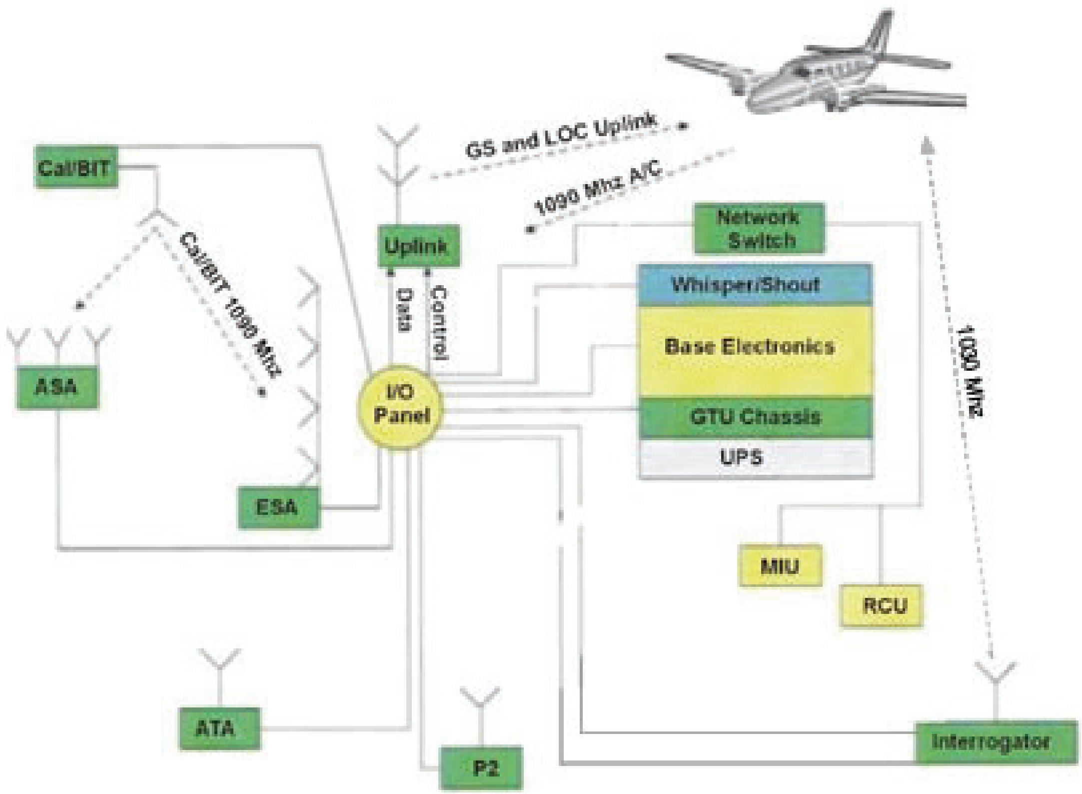
d. The Calibration/Built-in-Test (Cal/BIT) which includes infrastructure and antenna

e. The Base Station containing primary electronics rack and an optional reserve electronics rack.

f. The Ethernet network, including fiber-optic cabling

g. The Remote Control Unit (RCU)

Figure 1. TLS Block Diagram.



Chapter 3. Flight Inspection of Transponder Landing System (TLS).

1. Introduction. This chapter presents flight inspection requirements for TLS approaches. It is intended to provide guidance to flight inspection personnel to collect the airborne data for commissioning and periodic system evaluations. Flight inspection techniques and procedures are the same as for ILS in accordance with FAA Order 8200.1, USSFIM, Chapter 15, Instrument Landing System, except as noted in this order.

2. Preflight Requirements.

a. Facilities Maintenance Personnel. Prepare for flight inspection in accordance with Order 8200.1, USSFIM, and the TLS Maintenance Manual.

b. Flight Personnel. Prepare for flight inspection in accordance with Order 8200.1, USSFIM.

c. Special Equipment Requirements: AFIS-equipped aircraft capable of Transponder Mode 3A/C as a minimum.

d. Facility Data Requirements. Engineering personnel will supply data to FAA Aeronautical Information Services. The locations of the virtual Localizer and Glide Slope antennas are critical.

3. Flight Inspection Checklist. The checklist outlines the minimum evaluations required to satisfactorily perform the type of check indicated. Maintenance personnel may request facility optimization not required by the checklist or referenced in the text. Prior to accomplishing any checks, coordinate with maintenance personnel regarding the requirements and expected results.

a. Commissioning Inspection requirements: Glide Slope width, angle, structure and mean width. Localizer alignment and structure at all published angles.

b. Periodic Inspection requirements: Glide Slope width, angle and structure. Localizer alignment and structure at all published angles.

> Note: If the facility is located within the Continental United States (CONUS) Interrogator Optimization must be accomplished prior to other commissioning checklist items.

c. Localizer.

Type Check	Reference Paragraph	Inspection C	Inspection P	Facility Configuration	Modulation	Width	Symmetry	Clearances	Alignment	Structure
Interrogator Optimization (2)	3.8	X								
Ident, Markers, & Voice	3.12	X	X	Normal						X
Coverage (1)	3.9	X		Reduced Guidance Power						
Modulation Level	3.11	X	X	Normal	X					
Width and Clearance at LSA (1)	3.10	X	X	Normal	X	X	X	X		
High Angle Clearance	3.10	X		Normal	X			X		
Alignment and Structure	3.11	X	X	Normal	X				X	X
Structure Optimization	3.11	X		Normal						X
Polarization (1)	3.11	X	X	Normal						
Remote Control Unit (RCU) Approach (1)	3.7a	X	X							

Footnote:

(1) May be accomplished in Reduced Power Configuration

(2) Applies to facilities located in the Continental United States (CONUS)

d. Glide Slope.

Type Check	Reference Paragraph	Inspection		Facility Configuration	Modulation	Width	Angle	Symmetry	Structure Below Path	Clearances	Structure
		C	P								
Modulation Level	3.11	X	X	Normal	X						
W/ A/ S	3.13	X	X	Normal		X		X	X(2)	X	
Mean Width	3.14	X		Normal		X		X			
Angle and Structure	3.11	X	X	Normal	X		X				X
Structure Optimization	3.11	X		Normal							X
Clearance (1)	3.15	X		Normal						X	
Off-course Clearance (1)	3.15	X		Normal						X	
Coverage (1)	3.16	X		Reduced Guidance Power							
Polarization (1)	3.11	X	X	Normal							
Remote Control Unit (RCU) Approach (1)	3.7a	X	X								

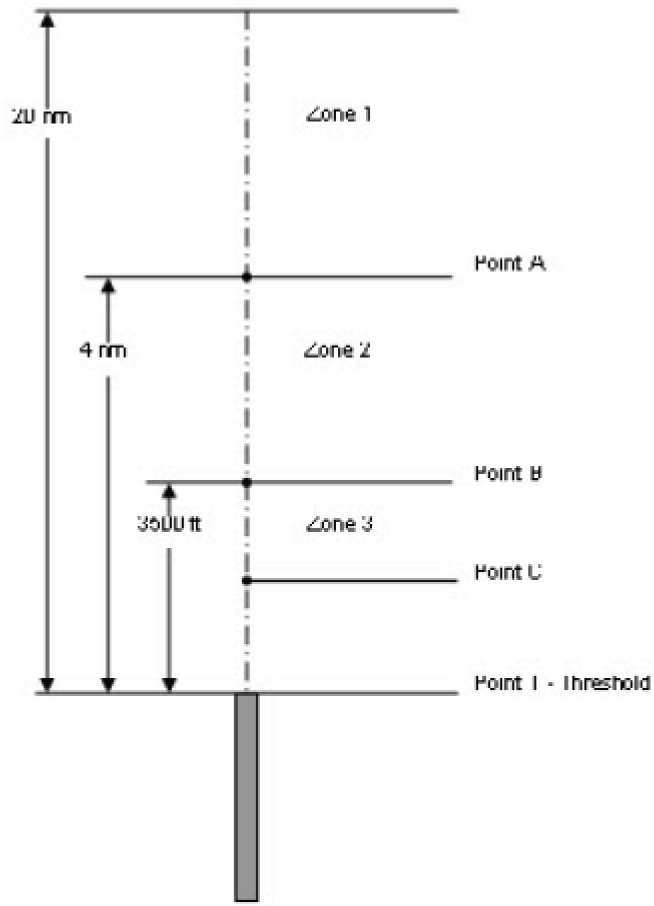
Footnote:
(1) May be accomplished in Reduced Power Configuration
(2) If structure below path tolerances cannot be met, clearance procedures and tolerances will be applied.

4. Periodic Inspection Interval. Periodic flight inspections will be accomplished in accordance with FAA Order 8200.1, USSFIM. The inspection interval must be the same as an ILS.

5. Maintenance Procedures Requiring a Confirming Flight Inspection. The TLS Maintenance Manual 020-00074 "return to service " procedure will indicate to ground maintenance personnel if the TLS will require a special flight inspection.

6. Zones and Points. Flight Inspection of the TLS will be based on the zones and points in Figure 2 Definition of ICAO Points and Zones.

Figure 2. Definition of ICAO Points and Zones



Note: Virtual localizer antenna may be located on the runway.

The following definitions for flight inspection points and zones will apply to analysis of the TLS flight inspection data.

Point A A point on-course located 4 nm from the runway threshold measured along the runway centerline extended.

Point B A point on-course located 3500 feet from the runway threshold measured along the runway centerline extended.

Point C A point through which the downward extended straight portion of the glide path (at the commissioned angle) passes at a height of 100 feet above the horizontal plane containing the runway threshold.

Zone 1 The distance from the localizer/ glide path coverage limit to Point A.

Zone 2 The distance front Point A to Point B on-course.

Zone 3 The distance from Point B to Point C on-course.

7. Flight Inspection Procedures. TLS does not transmit guidance until placed in the "ACQUIRE" mode and a suitable track on the desired aircraft is established. Flight inspection crews may experience a slight delay between requesting "ACQUISITION" and receiving a signal. TLS guidance will be lost if the aircraft maneuvers outside the service volume.

Aircraft entering the service volume may encounter a system delay in acquiring TLS guidance. This may falsely indicate an area of inadequate coverage. If an area of inadequate coverage is suspected, recheck coverage in the suspected area. Position the aircraft in an area of adequate coverage and ensure the TLS system has acquired the aircraft prior to commencing the check. Flight Inspection profiles must not be "EXECUTED" until after signal reception to avoid erroneous results.

a. When maintenance personnel are present, equipment may be placed in abnormal configurations to facilitate maintenance data collection. These configuration changes must be accomplished by maintenance personnel at the base station.

One run must be "ACQUIRED" via the RCU as a test of radio and data-link communications.

b. Periodic checks should be accomplished via the RCU interface with the TLS in normal operating configuration.

c. Document the transponder codes used during the flight inspection in the Remarks section of the fight inspection report.

8. Interrogator Optimization (CONUS Only). Interrogator power and Side Lobe Suppression (SLS) setting is normally accomplished using installation support aircraft. During a Commissioning, flight inspection validates the final settings will support the service volume. Flight inspection may establish interrogator initial power settings. The aircraft's transponder "FLT INSP SELECT" switch should be in the "ON" (Low receiver sensitivity) position and the "LOW POWER SELECT" switch should be in the "ON" (Low Power) position. During this check, reception of TLS guidance is not required. In addition, the guidance signal may be received beyond normal service volumes. Due to TLS acquisition times, only the data obtained after passing centerline is used. If a run is broken-off, restart in the same direction from at least 5° prior to the break-off point. All runs must be accomplished as specified in the table below. The arcs will not be combined. Distances are referenced to virtual localizer antenna.

a. Setting. If the flight inspection aircraft is used to set the interrogator power and SLS level, engineering will determine the altitudes and TLS attenuator settings for the following runs.

RUN	GROUND CONFIGURATION
-5 to +15° arc, 22 nm	P1/P3 "ON" Attenuator "IN" P2 "OFF"
+5 to -15° arc, 22 nm	P1/P3 "ON" Attenuator "IN" P2 "OFF"
-10 to +90° arc, 12 nm	P1/P3 and P2 "ON"
+10 to -90° arc, 12 nm	P1/P3 and P2 "ON"

b. Validation. Fly the following arcs with P1/P3 and P2 "ON."

-5 to +15° arc, 22 nm at 1,500ft above the virtual localizer antenna or 500ft above intervening terrain, whichever is higher.

+5 to -15° arc, 22 nm at1,500ft above the virtual localizer antenna or 500ft above intervening terrain, whichever is higher.

-10 to +45° arc, 12 nm at 1,500ft above the virtual localizer antenna or 500ft above intervening terrain, whichever is higher.

+10 to -45° arc, 12 nm at 1,500ft above the virtual localizer antenna or 500ft above intervening terrain, whichever is higher.

Ground analysis of the data will be accomplished to validate successful interrogation efficiency. If efficiency requirements are not met, engineering will request additional runs.

9. Localizer Standard Service Volume (SSV) or Expanded Service Volume (ESV). This inspection is conducted to determine that the localizer guidance meets applicable tolerances throughout the service volume while operating at a reduced guidance power. Check for interference, signal strength, clearances, proper flag indication, identification, markers/voice and structure as follows:

a. Fly a 10° - 10° arc across the localizer course at 18 nm (25 nm for ICAO Service Volumes) from the virtual localizer antenna at 4,500 feet above antenna elevation.

b. Fly a 10° - 10° arc across the localizer course at 18 nm (25 nm for ICAO Service Volumes) from the virtual localizer antenna at 2,000 feet above threshold elevation or 1,000 feet above intervening terrain, whichever is higher.

c. Proceed on course, inbound from 18 nm (25 nm for ICAO Service Volumes), from the virtual localizer antenna at 2,000 feet above threshold or 1,000 feet above intervening terrain, whichever is higher, until reaching 7° above the horizontal (measured from the apparent localizer) or Point C, whichever occurs last.

d. Fly a 35° - 35° arc across the localizer course at 10 nm (17nm for ICAO Service Volume, 2,000 feet above threshold or 1,000 feet above intervening terrain) from the virtual localizer antenna, at the 1,500 feet above the virtual localizer or 500 feet above intervening terrain, whichever is higher.

(1) Record glide slope signal strength.

(2) To determine optimal guidance antenna orientation, verify maximum glide slope signal strength occurs on localizer centerline.

e. If an ESV is requested, fly the following additional runs: If an ESV altitude is requested within the SSV distance, ensure there is TLS lateral guidance.

Note: If an ESV altitude is requested within the SSV distance, ensure TLS lateral guidance at the requested altitude and distance.

(1) Fly a 10° - 10° arc across the localizer course at the ESV distance and the highest requested ESV altitude.

(2) Fly a 10° - 10° arc across the localizer course at the ESV distance and the lowest requested ESV altitude.

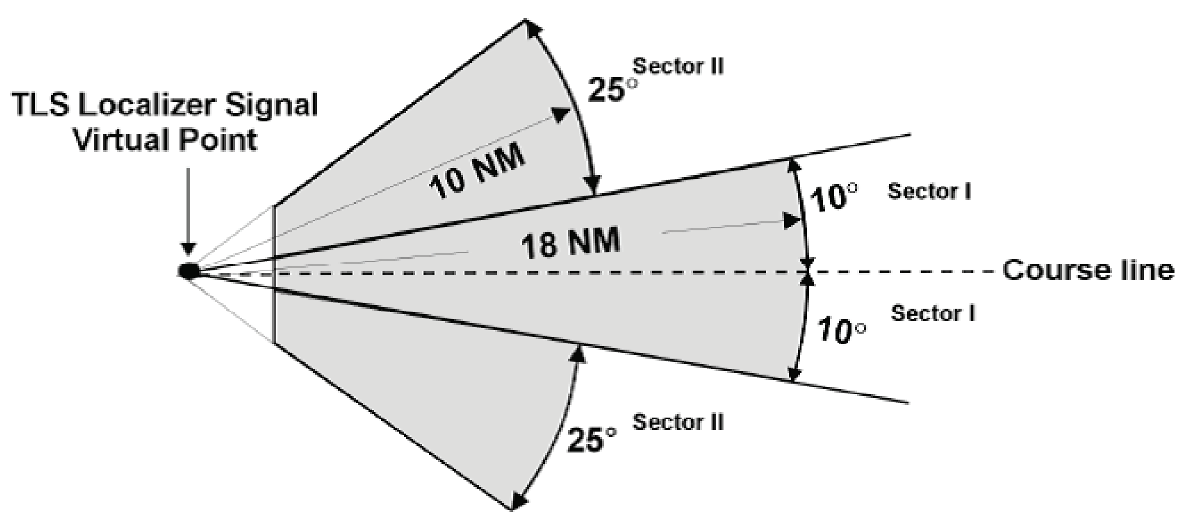
Note: If one procedural altitude is requested, only one ESV arc is required.

(3) Proceed on course, inbound from the ESV distance to 18nm (25 nm for ICAO Service Volumes) from the virtual localizer antenna at the lowest requested ESV altitude.

10. Localizer Width, Symmetry and Clearance Check. This check is to establish and maintain a course sector width and ratio between half-course sectors that will provide the desired displacement sensitivity required at the procedural missed approach point (MAP) or threshold and be within the limitations of the procedural protected area. The TLS localizer virtual point must be used for these measurements and not the actual location of any TLS antenna.

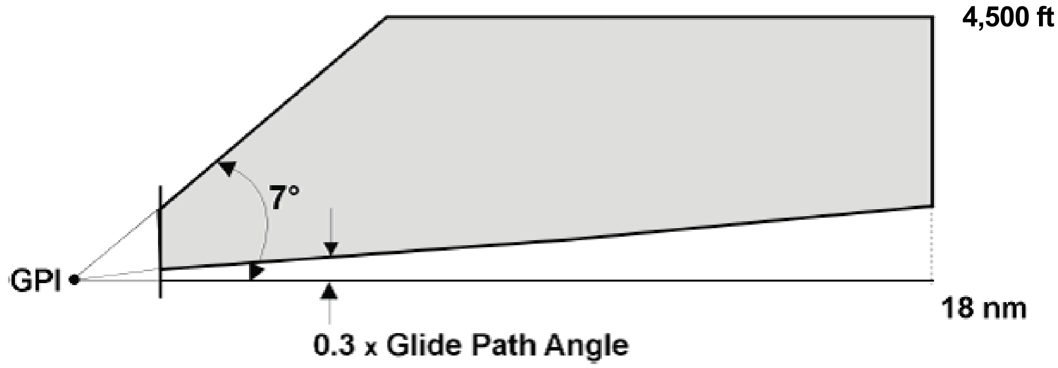
a. Width, Symmetry, and Clearance. Fly a 35° - 35° arc between 6 and 10 nm from the virtual localizer antenna at the lower standard altitude of 1,500 feet above the virtual antenna or 500 feet above intervening terrain, whichever is higher, throughout Sectors I and II. Measure clearances, course sector width, and symmetry.

Figure 3. TLS Localizer Coverage in Azimuth



b. High Angle Clearance. Fly an arc across the localizer course at 10 nm from the virtual localizer antenna at 4,500 feet above site elevation throughout Sectors I and II. Check clearances and modulation. . If clearances are out of tolerance, additional checks will be made at decreasing altitudes to determine the highest altitude at which the facility may be used.

Figure 4. TLS Localizer Coverage in Elevation



c. Width Requirements (Tailoring). Localizer sensitivity will be tailored for a linear sector width of 700 feet at Point T, not to exceed 6°.

Width Exceptions. The tailoring requirement may be waived for facilities supporting Category I, offset or LDA operations if the optimum width cannot be achieved. However, the final width will 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 will not provide for at least 400 feet linear width at runway threshold, the course must be restricted as unusable inside the point where the linear width is 400 feet.

11. Localizer/Glide Slope Approach (Course Alignment, Glide Path Alignment, Glide Path Angle, Structure, and Modulation). These checks measure the quality, alignment, angle and modulation of the on-course and on-path signals. Alignment and structure for the localizer and the alignment, angle and structure checks are usually performed simultaneously; therefore, use the same procedures.

a. Approach. All approaches will be evaluated on the designed procedural azimuth and the commissioned glide path unless otherwise indicated. For the purpose of evaluating structure, optimizing localizer and glide slope alignment and conducting periodic inspections, start the approach at a distance not closer than the published final approach fix or 6 nm from the runway threshold, whichever is greater.

b. Point in Space Use. For TLS localizer signals oriented toward a point in space where adequate visual checkpoints are not available to validate actual course alignment, the alignment may be determined to be either Satisfactory or Unsatisfactory. TLS glide slope signals may be evaluated using rate of descent to compute the vertical angle.

c. Course Alignment, Angle, and Modulation. Determine the course alignment using the area beginning 1 nm from the threshold to the threshold. When a restriction occurs in an area where alignment is normally analyzed, measure the alignment from one mile from the start of the restriction to the start of the restriction. Measure glide path angle in the area from Point "A" to Point "B". Measure both localizer and glide slope modulation in the area between 7 and 3 nm from the threshold.

d. Polarization Effect. The purpose of this check is to determine any effects of vertical polarization on the guidance signals. As a non-phase dependent system, unwanted polarization would only affect localizer or glide slope signal strength. This check may be accomplished concurrently with the course structure check. Fly inbound on-course within unrestricted coverage prior to the FAF and roll the aircraft to a 20° bank left and right. Actuate the event mark at the maximum banked attitudes.

e. Structure and Structure Optimization. The TLS alignment and structure are adjustable through changes to the approach calibration files. The calibration files compensate for both overall misalignment and transponder multi-path effects that account for most structure. The localizer will normally need only alignment adjustment, but the glide slope usually will need some structure reduction. The key to reduction of structure is effective communication of results to ground maintenance personnel.

The most effective method is to record at least two approaches, then land for engineering analysis of the corrected error traces. The approach calibration files will be broken into segments where the structure is relatively linear in trend. These segments may be in irregular distance units (e.g., 4.0 nm to 1.6 nm, 1.6 nm to 0.9 nm, 0.9 nm to 0.5 nm, 0.5 nm to 0.1 nm) to best fit the trends of the structure. Once the calibration segments are determined, file changes are made for each segment. The initial corrections may be to all segments, but subsequent changes are best made to each segment independently.

(1) Communication. During the engineering analysis, determine what segment lengths the Mission Specialist (MS) needs to report. The engineers may need results in small critical segments (e.g. each 0.5 nm), while larger segments may be appropriate in more stable areas. Report Zone 2 results from the first corrected error trace and Zone 3 from the second corrected error trace. Once the segments are determined, the MS should report the results in microamps (μA) above or below the measured angle in each segment to be adjusted. The facility engineers will transcribe the reported deviations onto graph paper to facilitate their adjustments.

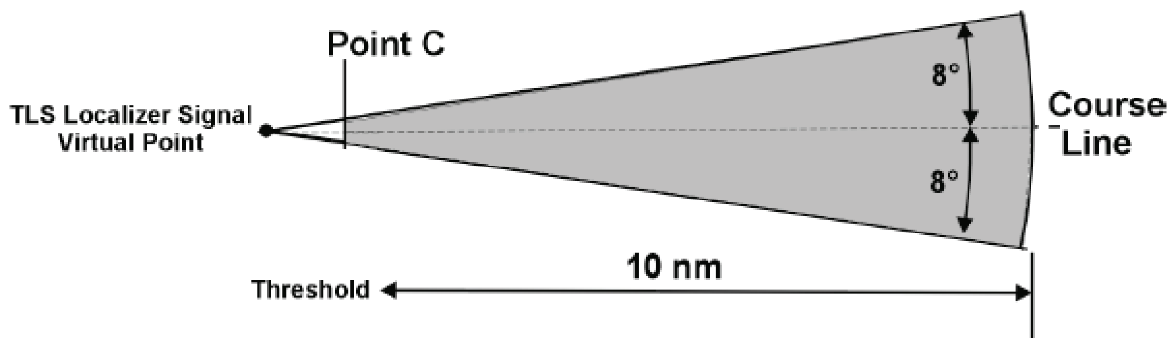
(2) Aircraft Positioning. TLS glide slope has a virtual emanation point on the runway surface. Large angular/microamp differences in relation to small height deviations close to the runway and dual aircraft transponder antennas require a stabilized approach to achieve consistent glide slope structure results.

12. Marker Indications. TLS can produce voice or marker indications received through the ILS localizer receiver audio circuitry. The marker modulation tones are intentionally different from 75 MHz systems to avoid misidentification. The Outer Marker (OM) indication is a series of dashes, 700 Hz, keyed at a 120-characters-per-minute rate. The Middle Marker (MM) indication is alternating dots and dashes, 2000 Hz, keyed at the rate of 180 characters per minute. As these marker indications are not from a 75 MHz system, they will not illuminate the normal marker lights and will not be displayed on the printer/ charts.

Coverage of marker indications is not dependent upon aircraft height. The TLS marker tone transmissions will be received at full strength throughout the marker coverage area in contrast to traditional marker tones which grow to a peak directly over the physical marker antenna then fade as the aircraft continues on its path. To measure the widths, activate the printer/ plotter event marks at the beginning and end of the audible indications. Compare these event marks to AFIS distance marks. During all inspections, measure along-course (minor axis) width on localizer centerline. During a commissioning inspection, measure lateral coverage (major axis) during the off-course clearance check (Paragraph 3.15). Voice indications must be evaluated for clarity and effect on course structure.

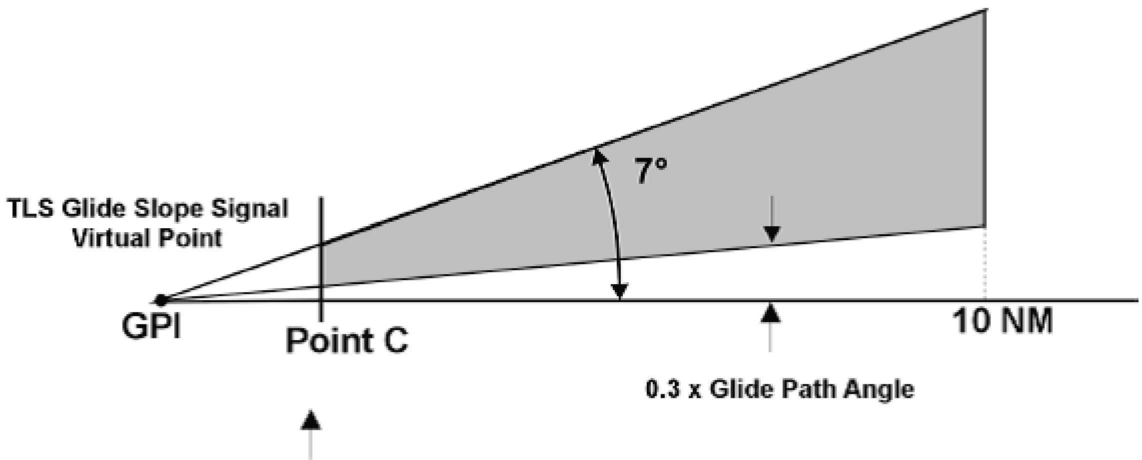
13. Glide Slope Level Run (Width, Angle, Symmetry, Structure Below Path, Clearance Above Path). These parameters may be measured from the results of one level run. Position the aircraft beyond the 190 µA/ 150 Hz glide slope point on the localizer course or procedural designed azimuth. Fly the established level run altitude corrected to true to obtain 190 µA outside the normal path measurement area. The established level run altitude should be 1,500 feet above the antenna or 500 feet above terrain, whichever is higher. The TLS glide slope virtual point must be used for these measurements and not the actual location of the TLS antenna.

Figure 5. TLS Glide Slope Coverage in Azimuth



a. Structure Below Path. This check determines that the 190 µA/ 150 Hz point occurs at an angle above the horizontal that is at least 30 percent of the commissioned angle. The structure below path is determined from the data obtained during the level run angle or width measurements. Altitudes lower than GSI may be required to make this measurement.

Figure 6. TLS Glide Slope Coverage in Elevation



b. Width. Path width is the width in degrees of the half glide path width sector as normally measured between the 75 µA points.

(1) Non-linear transitions may preclude the use of the 75 µA points. If this occurs, determine the path width of the facility between points other than 75 µA (maximum 90 µA, minimum 60 µA). The path width will be determined by proportioning the value obtained at the selected points to 75 µA.

(2) If a point other than 75 µA is used to measure path widths, that point must be used on all subsequent checks and inspections.

(3) When a point other than 75 µA is used, the new point must be documented on the AVNIS datasheet and used in all subsequent inspections.

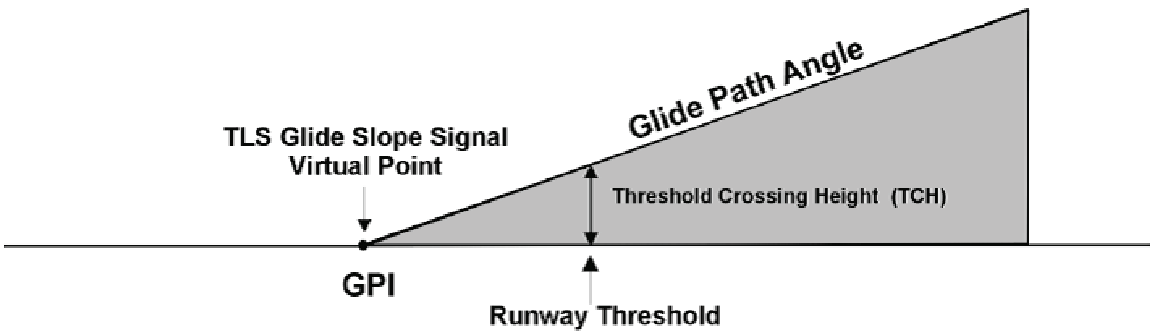
c. Symmetry. Symmetry is the balance of the 150 Hz and 90 Hz width sectors as determined from the data obtained during level run width measurements. The glide path should be as symmetrical as possible; however, there normally is some imbalance. If the level run symmetry is not acceptable, AFIS must be used to determine the mean symmetry (see Glide Slope Mean Width 3.14). Apply the mean symmetry as a correction factor to level runs results. If the symmetry still remains out-of-tolerance, the facility must be removed from service.

(1) If points other than the 75 µA points are used for measuring the path width, they must also be used for the symmetry measurements.

(2) Annotate the symmetry correction factor on the AVINS datasheet.

d. Clearance Above Path. Check that 150 µA fly-down occurs prior to receiving the flag alarm.

Figure 7. Glide Slope Signal Virtual Point



14. Glide Slope Mean Width. This check determines the mean width of a glide path between Points "A" and "B". This check is also to be used to determine the mean symmetry of the glide path.

The path width should be established, as near as possible to 0.7° prior to the check.

Maneuver	Glide Slope	AFIS	Analysis
ILS-3 on course/ on path between Points "A" and "B".	Normal	ILS-3 "ON"	Measure the on path angle
ILS-3 on course/ 75uA above path between Points "A" and "B".	Normal	ILS-3 "ABV"	Measure the 75uA above path angle
ILS-3 on course/ 75uA below path between Points "A" and "B".	Normal	ILS-3 "BLW"	Measure the 75uA below path angle

Determine the mean width from the angle found above and below the glide path and calculate symmetry from the on-path angle. Fly an approach, maintaining 75uA above the glide path between Points "A" and "B". Repeat the same run at 75uA below the glide path and again while on the glide path. It is important that the aircraft not deviate too far beyond 75ua on these profiles, as the TLS will sense the aircraft track as beyond the limits of normal flight and automatically abort the guidance.

Mean width = Above path angle – Below path angle

Mean Symmetry = Above-path angle – On-path/ Mean width

15. Glide Slope Clearance. The TLS has been designed such that glide slope clearances will not exceed approximately 195uA above and below path, regardless of deviation from the correct angle.

a. Clearance Below Path. This check is performed to assure that positive fly-up indications exist between the bottom of the glide path sector and obstructions. Below path runs are more difficult than on standard ILS, due to the limited area of proportionality beyond the minimum tolerance. Flying beyond the lower limit of the service volume will result in cessation of guidance signal. Attempt to maintain approximately half the commissioned angle by reference to the AFIS on these runs. Pilot/ MS coordination and situational awareness are essential during this check. Check that adequate obstacle clearance exists with at least 180uA of fly-up between the FAF or GSI, whichever is further, and:

(1) Centerline Clearances. On localizer course, ILS Point "C" for an unrestricted glide slope; or, the point at which the glide slope is restricted.

(2) Off-Course Clearances. At localizer extremities, ILS Point "B"; for an unrestricted glide slope; or, the point at which the glide slope is restricted.

b. Clearance Above Path. Clearances above the path are checked to ensure that positive fly-down indication is received prior to receiving the flag alarm. Check that 150uA fly-down occurs prior to receiving the flag alarm. Perform this check during the level runs.

16. Glide Slope Standard Service Volume. The glide path transmitter will be placed in reduced power setting for this check. This check will be made on the localizer on-course and 8° on each side of the localizer on-course. For localizer service aligned on or within 3° of runway centerline, the vertex of this 8° angle will be abeam the glide slope origination point; for LDA service beyond 3.0°, it will be the point abeam the actual runway threshold on the LDA procedural course. While maintaining an altitude equal to 0.45 times the commissioned angle at 10 nm, 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 150uA occurs). Fly through the glide path sector and check clearances above the path.

17. Glide Slope Expanded Service Volume. 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 nm checks. If the facility is unsatisfactory, perform the ESV check at a higher altitude that provides 150uA 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. If the system does not meet tolerances at that altitude, the minimum altitude where these parameters are met must be published as the lower limit of the ESV.

18. Standard Instrument Approach Procedures (SIAP). The SIAP must be evaluated to determine the procedure is safe and flyable. If a new instrument approach procedure is unsatisfactory, the flight inspector will coordinate with the procedure designer to determine the necessary changes. When an existing instrument approach procedure is found unsatisfactory due to obstructions, navigation source, charting error, etc., initiate NOTAM action immediately and advise the procedure designer.

Chapter 4. Analysis and Tolerances.

1. Flight Inspection Analysis. Data analysis will be in accordance with FAA Order 8200.1, USSFIM, Chapter 15, Instrument Landing System.

2. Application of Localizer/ Course/ Glide path Structure Tolerances. Application of course structure analysis contained in this paragraph applies to all zones (1, 2 and 3) of glide paths and all zones of localizers (1, 2 and 3). This provision does not apply to glide slope rate of change/ reversal. If course or path tolerances are exceeded, analyze the course/path structure as follows:

a. Where course/path structure is out-of-tolerance in any region of the approach**,** the flight recordings will be analyzed in distance intervals of 7,089 feet (1.17 nm) centered about the region where the out-of-tolerance or aggregate of out-of-tolerance condition(s) occurs. Two 7,089 foot 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 foot 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 course/path structure is acceptable if the aggregate structure is out-of-tolerance for a distance equal to or less than 354 feet within each 7,089 foot segment.

3. Rate of Change/ Reversal in the Slope of the Glide path. The following analysis of the path angle recording must be accomplished during all inspections.

a. Inspect the Glide path. Corrected error trace in Zones 2 and 3 for changes and or reversals in the trend of the slope of the path trace.

b. Determine 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 feet along the approach with an essentially continuous slope.

c. If one or more changes/reversals meet the condition in b. above, draw a straight line through the average slope that covers at least a 1,500 feet segment each side of the point of change. 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 feet segment. Determine the change-in-slope by measuring the divergence of the two lines at a point 1,000 feet from their intersection.

d. NOTAM Action. Facilities which do not meet the tolerance will not be classified as restricted, but will have an autopilot use limitation imposed by NOTAM. Autopilot coupled approaches are not authorized below an altitude (MSL) that is 50 feet higher on the glide path than the altitude at which the out-of-tolerance change in slope occurs. Compute the MSL altitude of such a limitation based on the commissioned angle of the facility. Advise the appropriate procedures specialist. Specific NOTAM instructions are in Order 8200.1, Chapter 5, Facility Status Classification and Notices to Airman (NOTAM).

4. Localizer Course Width Linearity. Momentary non-linearity or scalloping of the localizer crosspointer in Sector 1 prior to reaching 175 µA can be averaged without further evaluation, provided the crosspointer deviation does not present a noticeable effect on flyability or create a possible false course. Questionable reversals of trend or excessive irregular flattening of the course ("steps") require an evaluation of the effect on the procedure. When this condition occurs, re-fly the Sector 1 arc at the service volume limit at LSA at a maximum ground speed of 170 knots. Evaluate for noticeable effects on flyability and possible false course indications. The procedure must be removed if reversals of trend exceed 10 µA or flyable false course indications occur. If the arc at LSA is satisfactory for flyability, document the check on the Facility Data Sheet, e.g., "Deviations in Sector 1 clearance linearity evaluated, and the results found satisfactory IAW FAA Order 8200.XX, Chapter 4, Paragraph 4."

5. Application of Localizer Coverage Requirements. The localizer must meet all applicable tolerances for the checks defined in this order throughout the Standard Service Volume to be assigned a facility classification of "UNRESTRICTED". The localizer may still be usable when coverage does not meet tolerances throughout the standard service volume, depending on the effect of the restriction on procedural use.

The TLS will often be installed in those sites unsuitable for standard ILS. While it will work in more adverse terrain, it can be expected to suffer from terrain factors, including signal screening. Any line-of-sight screening would most likely degrade the interrogator and/ or transponder signal and as a consequence, no guidance signal will be available in the screened area. In evaluating such effects, all coverage criteria must be considered; however, to be procedurally usable with a "RESTRICTED" classification, the following criteria must also be met:

a. Clearance Restrictions. 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.

b. Distance Requirements.

(1) 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.

(2) Restrictions above the prescribed width, clearance and coverage altitudes are acceptable, provided a step-down fix, etc., can be added to the appropriate approach segment which restricts decent to within the altitude/ distance at which acceptable coverage was achieved.

c. Vertical Angle Requirements.

(1) If in-tolerance coverage cannot be maintained up to 7°or Point C as required by Chapter 3, paragraph 3.9, coverage is restricted. The localizer will be classified as "unusable" if in-tolerance coverage cannot be maintained up to 4°or 1°greater than the commissioned glide path angle, whichever is greater.

(2) If vertical angle coverage is limited but the localizer can be used on a restricted basis, a NOTAM must be issued which restricts the localizer as "unusable" above a specified altitude, both at point C and at least one other point, usually the FAF. Note the angle at which unsatisfactory coverage occurred and evaluate its effect on maximum holding altitudes, and missed approach instructions/ protected areas.

6. Tolerances.

a. Localizer.

Parameter	Reference	Inspection C	Inspection P	Tolerance/Limit
Modulation	3.11	X	X	36 – 44%
Width	3.10			Maximum -- 6.0° Precision approach -- 400 feet minimum course width at the threshold
		X		±0.1° of the commissioned width
				Within 17% of the commissioned width.
Symmetry	3.10	X	X	45 - 55%
Alignment	3.11	X		Within 3 µA of the designed procedural azimuth
			X	From the designed procedural azimuth: ±15 µA ±20 µA for offset localizer/LDA
Structure	3.11	X	X	Zone 1 - from the graphical average course: ±30 µA to Point A Zone 2 - from the actual course alignment: ±30 µA at Point A; linear decrease to ±15 µA at Point B. Zone 3 - from the actual course alignment: ±15 µA from Point B to Point C

				Exception: An aggregate out-of-tolerance condition for 354 feet may be acceptable in a 7,089-foot segment. Note: For offset localizer, LDA and reduced guidance power alarm, structure maybe measured from graphical average course.
Polarization	3.11	X	X	Signal Strength -- At least 15 µV
Coverage	3.9	X	X	Signal Strength -- At least 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	3.10	X	X	Sector 1 -- linear increase to 175 µA then maintain 175 µA to 10° Sector 2 -- 150 µA
Identification and Voice	3.12	X	X	Clear, correct; audio level of the voice equal to the identification level. The identification must have no effect on the course. Voice must not cause more than 5 µA of course disturbance.
Markers	3.12			Throughout localizer course sector (150 - 150 µA)
Outer		X	X	1350 feet to 4000 feet (2000 feet optimum) (major and minor axis)
Middle		X	X	675 feet to 1325 feet (1000 feet optimum) (major and minor axis)

b. Glide Slope.

Parameter	Reference	Inspection C	Inspection P	Tolerance/Limit
Modulation Level	3.11	X		78 - 82%
			X	75 - 85%
Width	3.13	X		0.7° ± 0.05°
			X	0.7° ± 0.2°
Angle	3.11	X		± 0.05° of the commissioned angle
			X	+10.0% to -7.5% of the commissioned angle
Symmetry	3.13	X	X	67 - 33%
Structure below Path	3.13	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.
Clearance	3.13	X	X	Below Path: Adequate obstacle clearance at no less than180 µA Above Path: 150 µA of fly-down signal
Structure	3.11	X	X	Zone 1 – 30 µA from graphical average path Zone 2 – 30 µA from actual path angle Zone 3 – 30 µA from graphical average path Exception: An aggregate out-of-tolerance condition for 354 feet may be acceptable in a 7,089-foot segment.
Change/Reversal	4.3	X	X	25 µA per 1,000 feet in a 1,500 feet segment
Polarization	3.11	X	X	Signal Strength - At least 5 µV
Coverage	3.16 3.17	X	X	Signal Level - At least15 µV Flag Alarm - No Flag or indication of invalid signal Fly-up Signal - At least 150 µA Fly-down Signal - At least 150 µA Clearance and Structure - in-tolerance Interference - must not cause an out-of-tolerance condition.

7. Records, Reports, and Notices to Airmen. See FAA Order 8200.1, USSFIM, Chapter 5, Facility Status Classification and Notices to Airman (NOTAM) and Records and Reports and FAA Order 8240.36 for ILS reports.

Chapter 5: Administrative Information

1. Distribution. This order will be sent through electronic distribution methods to all parties affected by the order.

2. Background. TLS tracks and provides landing approach guidance to an individual aircraft returning an assigned transponder identification code. TLS guidance signals emulate Instrument Landing System (ILS) signals that would exist at the current position of the tracked aircraft. TLS performance was evaluated using Federal Aviation Administration and International Civil Aviation Organization Annex 10 requirements for a Category I precision approach system.

3. Authority to Change This Order. The Federal Aviation Administration will coordinate and provide approved changes to this order by means of a page revision method. Revised pages will be transmitted by a Federal Aviation Administration Change or Notice. Recommendations concerning changes or additions to the subject material are welcomed and should be forwarded to the following address:

FAA: Director of Flight Inspection Services, PO Box 20582, Oklahoma City OK 73125

4. Related Publications.

a. FAA Order 8200.1, *United States Standard Flight Inspection Manual (USSFIM)*

b. FAA Order 8240.36, *Instructions for Flight Inspection Reporting*

c. FAA Order 6700.20, *Non-Federal Navigational Aids and Air Traffic Facilities*