ORDER

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

8200.40B

12/15/04

SUBJ: Flight Inspection of the Transponder Landing System (TLS)

1. PURPOSE. This order details the flight inspection procedures, requirements, and analysis for the evaluation of the Transponder Landing System (TLS).

2. DISTRIBUTION. This order is distributed to the NAVAIDS Platform Division of the National Airspace System Implementation Program, to the National Operations and NAS Policy Divisions of NAS Operations, to the National Airway Systems Engineering Division of Operational Support, to the Program Director of Spectrum Policy and Management, to the Director and IPT Lead for Aircraft, Avionics, & Navigation Systems of the Office of Communications, Navigation, and Surveillance Systems, to the Program Director of the Air Traffic Operations Program, and to the Flight Standards Flight Technologies and Procedures Division, Washington headquarters; to the Navigation Branch of the CNS Engineering and Test Division of the William J. Hughes Technical Center; to Regional Airway Facilities and Air Traffic Divisions; to the branch level in the Flight Inspection Operations Division in Aviation System Standards, to all Flight Inspection Field Offices; and to the FAA Academy, Mike Monroney Aeronautical Center.

3. CANCELLATION. This order cancels FAA Order 8200.40A, Flight Inspection of the Transponder Landing System (TLS), dated January 15, 2001.

4. BACKGROUND. The 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, but was approved March 10, 2004, as a “non-standard approach with vertical guidance (APV) system”. TLS facilities and procedures are special use, administered under the Code of Federal Regulations (CFR) 14, Part 171, Non-Federal Navigation Facilities.

5. RELATED MATERIAL.

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".

Distribution: A-W(NI-90/OP-100/300/OS-240/SR-1/
ND-1/700/TO-1/FS-400/420/CT-360/VN-200-3);
A-X(AF/AT); A-FFS-4; AMA-210

Initiated By: AVN-230

6. FLIGHT INSPECTION PROCEDURES, ANALYSIS, AND TOLERANCES. Appendix 1 contains background material concerning the TLS system. Appendix 2 contains the flight inspection procedure, requirements, and analysis for TLS approaches. Appendix 3 contains definitions for flight inspection zones and points and service volumes applicable to TLS approaches.

7. INFORMATION UPDATE. Any deficiencies found, clarifications needed, or suggested improvements regarding the contents of this order should be noted on FAA Form 1320-19, Directive Feedback Information. If an interpretation is needed, call the originating office for guidance. FAA Form 1320-19 should be used as a follow-up to the verbal conversation.

/s/

Thomas C. Accardi
Director of Aviation System Standards

APPENDIX 1. BACKGROUND MATERIAL FOR THE TRANSPONDER LANDING SYSTEM (TLS)

1. Introduction

The Transponder Landing System (TLS) tracks and provides valid landing approach guidance to only one individual aircraft returning a specific transponder identification code. TLS guidance signals emulate Instrument Landing System (ILS) signals that would exist at the current position of the tracked aircraft. Another aircraft not being tracked that tunes into 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

The operational sequence for establishing track and providing guidance to a landing aircraft is as follows. An aircraft operating under Air Traffic Control (ATC) Instrument Flight Rules (IFR) procedures intending to make an approach is assigned a transponder identification code. The TLS system is commanded by the Remote Control Unit (RCU) operator at the published control station to search the tracking area for this transponder identification code. The TLS transmits an interrogation signal which, when received by any transponder in the TLS service volume, stimulates a reply. At the same time the interrogation signal is broadcast, a “start pulse” signal is sent to the two 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 in the tracking area, along with carrier signal measurements that allow angles to be computed. The TLS then searches the pulse returns for the assigned identification code. This interrogation and search cycle is repeated several times each second. Interrogator Side Lobe Suppression (SLS) is used to block replies from outside the service volume.

When the user aircraft enters tracking volume and its identification code begins to show up in the data from the sensors, the TLS identifies that aircraft as the one to be tracked and starts computing its position. If the TLS identifies two or more aircraft providing replies with the selected identification code, no guidance is generated. Position is computed based on the Time-of-Arrival (TOA) of the code relative to the start pulse, giving range to the aircraft, and the carrier signal phase measurements, Angle-of-Arrival (AOA), from which are derived azimuth and elevation angles. Once confidence criteria on the accuracy of the tracking solution are satisfied, the TLS begins to transmit guidance corrections based on the aircraft’s horizontal and vertical offset from the predefined approach path. Interrogations, position measurements, and guidance transmissions then continue cyclically several times per second. The cycle is continued as long as the aircraft being tracked remains inside the service volume and reaches the Missed Approach Point. The TLS then terminates guidance and returns to a Diagnostic Mode to perform Built-in-Test (BIT). The system will return to Standby Mode if BIT was passed to await a command to search for the next user aircraft.

Dual aircraft transponder antennas induce glide slope structure when automatically switched between top and bottom by the airborne transponder. The amount of structure increases as the aircraft nears the ground station. The published approach Decision Height (DH) is determined by "classes" of aircraft, based on the diameter of their fuselage. The DH is raised for all aircraft to the calculated height that the largest aircraft authorized to use the facility will receive satisfactory guidance.

3. TLS Operation Sequence

Step 1. When the assigned aircraft enters the tracking volume, its transponder receives the interrogation signal.

Step 2. The aircraft transponder replies with its assigned squawk code.

Step 3. The aircraft transponder reply is received by the TLS sensors.

Step 4. The Localizer Angle-of-Arrival (LAOA) and the Glide Slope Angle-of-Arrival (GAOA) sensors measure the time difference between the start pulse and aircraft transponder response to compute the time-of-arrival and the phase angle of the reply signal. The sensors send this data to the TLS Base Station.

Step 5. The Base Station computers receive the LAOA and GAOA data and calculate the location and track of the aircraft.

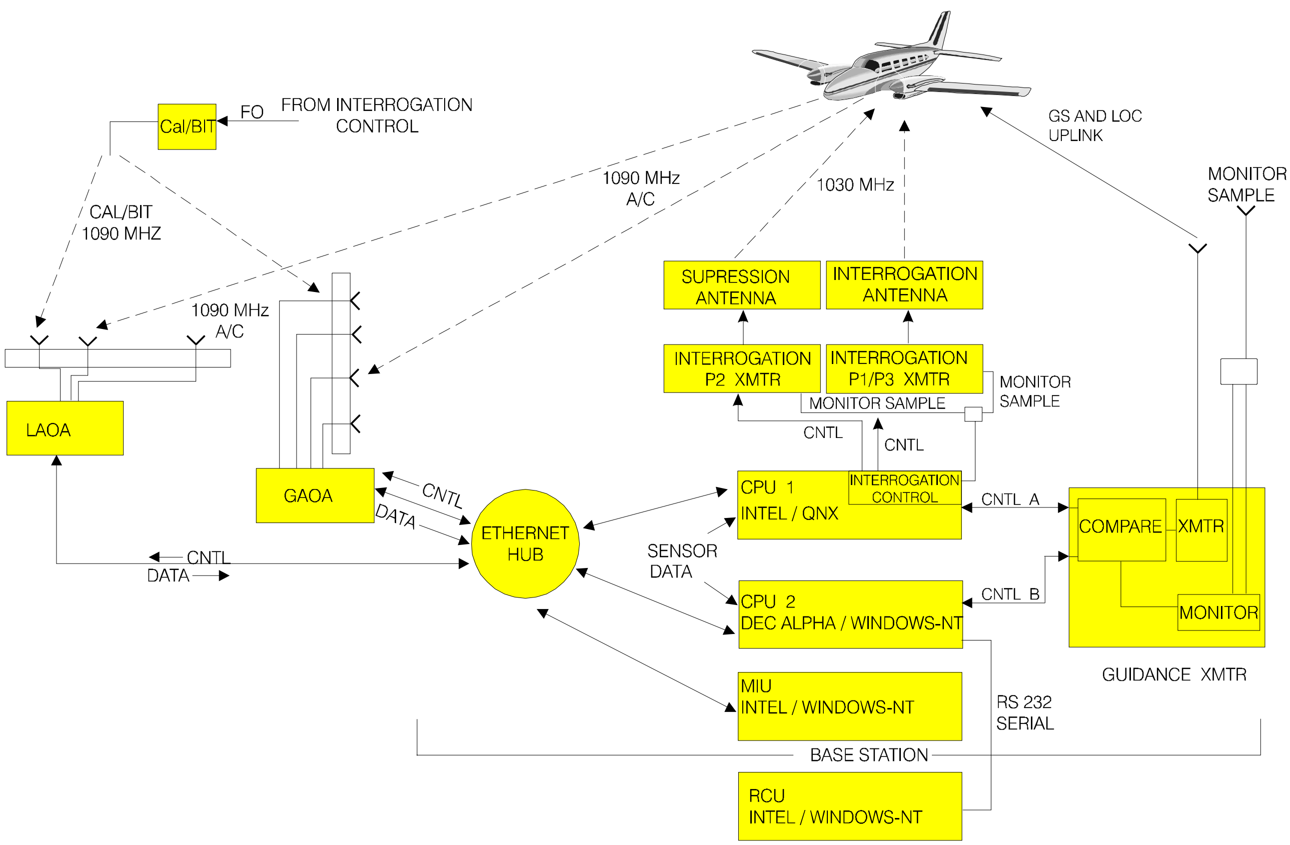
Step 6. Localizer and glide slope Difference in Depth of Modulation (DDM) values are calculated for guiding the aircraft to the desired course.

Step 7. These modulations are applied to the guidance signals transmitted to the aircraft and drive the CDI display.

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

- The Localizer AOA (LAOA) and its associated antenna array
- The Glide Slope AOA (GAOA) and its associated antenna array
- The Base Station containing two Central Processing Units (BCPU), the Maintenance Interface Unit (MIU), the Interrogation Transmitter and associated antenna, and the Guidance Transmitter and associated antennas
- The Ethernet network, including fiber-optic cabling
- The Remote Control Unit (RCU)

Figure 1
TLS Block Diagram



APPENDIX 2. FLIGHT INSPECTION EVALUATION OF TLS

1. Introduction. This appendix presents flight inspection requirements for TLS approaches. It is intended to provide guidance to the manufacturer, user/ sponsor, and flight inspection personnel concerning the airborne data required for commissioning and periodic system evaluations. Flight inspection techniques and procedures are accomplished the same as for ILS, except as noted in this order.

2. Preflight Requirements.

a. Facilities Maintenance Personnel. Prepare for flight inspection in accordance with Order 8200.1, USSFIM (General Flight Inspection Procedures), and pertinent sections of the TLS Maintenance Manual.

b. Flight Personnel. Prepare for flight inspection in accordance with Order 8200.1, USSFIM (General Flight Inspection Procedures).

c. Special Equipment Requirements: AFIS-equipped aircraft capable of Transponder Mode 3A/C as a minimum. Radio Telemetering Theodolite (RTT) may be used if AFIS is unavailable. Engineering personnel shall compute the theodolite location, due to the complexity of the position determination.

d. Facility Data Requirements. Engineering personnel shall supply data, in accordance with FAA Order 8240.36, Instructions for Flight Inspection Reporting, for each runway served. Particularly important are the locations of the apparent Localizer and Glide Slope antennas.

3. Flight Inspection Procedures.

3.1 Checklist. The checklist outlines the minimum evaluations required to satisfactorily perform the type of check indicated. Maintenance may request checks for facility optimization not required by the checklist or referenced in the text. Coordinate the requirement and results expected with maintenance prior to accomplishing the check.

For Commissioning, check glide slope width, angle, structure, mean width and localizer alignment and structure at all higher published angles. For Periodic, check glide slope width, angle, structure, and localizer alignment and structure at all published angles.

NOTE: Interrogator Optimization must be accomplished prior to other commissioning checklist items.

a. Localizer

Type Check	Ref. Para.	Inspection		Facility Config.	MOD	WIDTH	SYM	CLR	ALIGN	STRUC
		C	P							
Interrogator Optimization	3.2.1	X								
Ident, Markers, & Voice	3.2.2 3.2.5	X	X	Normal						X
Coverage	3.2.2	X		Reduced Guid-ance Power	X			X		X
Modulation Level	3.2.4	X	X	Normal	X					
Width	3.2.3	X	X	Normal (1)		X	X	X		
Clearance at Lowest LCA	3.2.3	X	X	Normal (1)		X	X	X		
High Angle Clearance	3.2.3	X		Normal (1)				X		
Alignment	3.2.4	X	X	Normal	X				X	
Structure	3.2.4	X	X	Normal	X					X
Polarization	3.2.4	X	X	Normal (1)						X
SIAP	3.2.10	X	X	Normal						

Note: (1) May be accomplished in Reduced Power Configuration

b. Glide Slope

Type Check	Ref. Para.	Inspection		Facility Config.	MOD	WIDTH	ANGLE	SYM	STRUC BELOW & CLEAR ABOVE PATH	CLR	STRUC
		C	P								
Modulation Level	3.2.4	X	X	Normal	X						
Level Run	3.2.6	X	X	Normal	X	X	X	X	X		
Mean Width	3.2.7	X		Normal	X	X		X			
Angle	3.2.4	X	X	Normal			X				
Structure	3.2.4	X	X	Normal	X						X
Clearance	3.2.8	X		Normal (1)	X					X	
Off-course Clearance	3.2.8	X		Normal (1)	X					X	
Coverage	3.2.9	X		Reduced Guidance Power	X				X	X	

Note: (1) May be accomplished in Reduced Power Configuration

3.1.1 Periodic Inspection Interval. Periodic flight inspections shall be accomplished in accordance with FAA Order 8200.1, USSFIM (Frequency of Periodic Flight Inspections). The interval shall be the same as an ILS. The first inspection following commissioning will occur in 90 days, the second 180 days from the first, and, finally, at 270 day intervals.

3.1.2 Maintenance Procedures Requiring a Confirming Flight Evaluation. A special flight inspection shall be required after replacement of any of the following TLS components:

a. Calibration/Built-In-Test (Cal/ BIT) generator or antenna

b. Angle-of-Arrival (AOA) sensor, antenna cable, or antenna

c. Interrogation transmitter

d. Any software changes that affect aircraft signals as defined in the Technical Instruction Manual, Section 7.

3.1.3 Zones and Points. Flight inspection of the TLS shall be based on the zones and points described by the diagram and definitions in Appendix 3.

3.2 FLIGHT INSPECTION PROCEDURES. As the TLS does not transmit guidance until placed in the “ACQUIRE” mode and a suitable track on the desired aircraft is established, the flight inspection crew must anticipate a delay between requesting “ACQUISITION” and receiving a signal. This delay will be a minimum of 10 seconds and may be as long as 30 seconds. Additional lead time should be planned for each run. At the end of data gathering on each run, the technician should notify the TLS station to abort the run; this stops the ground system from recording needless data to computer file. At the end of some runs, depending on whether or not the aircraft is inside the service volume, the aircraft may receive a loss of guidance signal, followed by a 5-second test signal. This is a function of the Built-in-Test (BIT) and should not be considered as a malfunction. If entering an area of adequate signal coverage from an area without line-of-sight coverage, the system delay in “acquiring” the transponder and transmitting guidance signals may falsely indicate inadequate coverage. This would most likely occur on course crossing arcs. If this situation occurs, recheck coverage in the suspect area by a run originating in an area of good signal and ensure that the system has acquired the aircraft prior to commencing the run. Flight inspection runs should not be ‘EXECUTED” until after signal reception to avoid erroneous structure results.

a. During Commissioning or other checks when maintenance personnel are present, the equipment may be placed in abnormal configurations to facilitate maintenance data recording during some checks. These configuration changes must be accomplished at the base station. Most checks will be done with the equipment controlled from within the base station; however, at least 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 its normal operating configuration.

c. The aircraft’s transponder settings shall be in LOW POWER/ LOW SENSITIVITY (ON/ ON) for all checks except the Interrogator Optimization checks IAW Paragraph 3.2.1; document the transponder codes used during the flight inspection on the flight inspection report in the Remarks section.

3.2.1. Interrogator Optimization. The setting of interrogator power and Side Lobe Suppression (SLS) is normally accomplished using installation support aircraft. On Commissioning, flight inspection validates that the final settings are adequate to support the service volume. Flight Inspection may be asked to establish initial settings of interrogator power. The aircraft transponder “FLT INSP SELECT” switch should be “ON” (Low receiver sensitivity) and the “LOW POWER SELECT” switch should be “OFF” (Normal Power). Flight Inspection may or may not receive guidance signal, and signal may be received beyond normal service volume limits. 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 below. The arcs shall not be combined. Distances are referenced to apparent localizer antenna.

a. Setting. If the flight inspection aircraft is used to set the interrogator power and SLS level, expect to fly the following runs at the altitudes and TLS attenuator settings specified by engineering. Multiple runs may be required to optimize the settings.

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 LCA
+5 to -15° arc, 22 nm at LCA
-10 to +45° arc, 12 nm at LCA
+10 to -45° arc, 12 nm at LCA

Ground analysis of the data will be accomplished to validate successful interrogation efficiency. If efficiency requirements are not met, engineering may require a second set of these flights.

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

3.2.2.1 Approved Procedure.

a. Fly an arc across the localizer course at 18 miles* from the antenna at 4,500 feet above site elevation through Sector 1.

b. Repeat the first step, except fly across the localizer at the Lowest Coverage Altitude (LCA).

c. Proceed on course, inbound from 18 miles*, maintaining the LCA to 10 miles**.

d. Fly an arc across the localizer course at 10 nm** from the antenna, at the LCA , throughout Sectors 1 and 2. For mobile facilities, also record glide slope signal strength during this check. Compare maximum guidance signal strength indications with localizer centerline to determine optimal guidance antenna orientation.

e. Maintain the LCA and proceed inbound on-course until reaching 7° above the horizontal (measured from the apparent localizer) or Point C, whichever occurs last.

f. If an ESV is requested, fly the following <u>in addition to Runs (a) through (e)</u>: If an ESV altitude is requested within the SSV distance, special consideration will be applied to localizer support.

(1) Fly an arc across the localizer at the ESV distance and the highest requested ESV altitude, throughout Sector 1.

(2) Repeat Step (f)(1), except fly at the lowest requested ESV altitude.
NOTE: If one procedural altitude is requested, only one ESV arc is required.

(3) Proceed inbound at the lowest ESV altitude to 18 miles*.

* 25 miles from the antenna for ICAO Service Volumes.
** 17 miles from the antenna for ICAO Service Volumes.

3.2.3 Localizer Width and Clearance Check. The purpose of this check is to establish and maintain a course sector width and ratio between half-course sectors that will provide the desired displacement sensitivity as referenced to the threshold.

a. Width, Symmetry, and Clearance. Fly an arc at a distance of 4 to 10 nm (10 nm preferred) across the localizer course at the LCA throughout Sectors 1 and 2. Check clearances, course sector width, and symmetry. Clearances produced by the TLS are of a SAT/ UNSAT type, the amount of which is controlled in the transmitter. Coverage factors (shading) may block the entire signal, but the amount in unshaded areas should not vary appreciably. During Commissioning checks, the results obtained in reduced power IAW Paragraph 3.2.2.1.d may be used to fulfill this requirement.

b. High Angle Arc (Commissioning). Fly an arc across the localizer course at 10 miles from the antenna at 4,500 feet above site elevation throughout Sectors 1 and 2. Check clearances, course sector width, and symmetry. 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.

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

d. Width Exceptions. The tailoring requirement may be waived for facilities supporting Category I or LDA operations if the optimum width cannot be achieved. However, the final width shall be established as close as possible to the optimum. The course shall be restricted as unusable inside the point where the linear width is less than 400 feet.

3.2.4 Localizer/ Glide Slope Approach (Course Alignment, Glide Angle, Structure, and Modulation). These checks measure the quality and alignment of the on-course signal. The alignment and structure checks are usually performed simultaneously; therefore, use the same procedures to check alignment and structure.

a. Approach. All approaches will be evaluated on the designed procedural azimuth and the commissioned glidepath 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 point or 6 miles from the runway threshold, whichever is greater.

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

c. Determine the course alignment using the area beginning 1 mile from the threshold, to the threshold. When a restriction occurs in an area where alignment is normally analyzed, measure the alignment by manual or AFIS analyzation of the average course signal from 1 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 anywhere in the guidance volume and roll the aircraft to 20° bank left and right. Actuate the event mark at the maximum banked attitudes.

e. 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 the facility installers.

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 the distance definition needed to communicate results from the Airborne Electronics Technician (AET) to the ground personnel. The engineers may need results in some small critical segments, each 0.5 nm increment, while larger increments may be appropriate in more stable segments. Report Zone 2 results from the first corrected error trace and Zone 3 from the second corrected error trace. Once the segments and reporting increments are determined, the AET should report the results in microamps 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. Unlike a conventional glide slope where the signal flares due to its conical shape, the TLS glide slope has an apparent emanation point on the runway surface. Large angular/ microamp differences in relation to small height deviations close in to the runway and dual aircraft transponder antennas require a stabilized approach to achieve consistent glide slope structure results. A NO-FLAP approach configuration has proven successful in the BE-300 for this purpose.

3.2.5. Marker Indications. The TLS can produce voice or marker indications received through the ILS 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/ plotter. Coverage of marker indications is not dependent upon aircraft height. 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. On all inspections, measure along-course (minor axis) width on localizer centerline. On commissioning, measure lateral coverage (major axis) during the off-course clearance check (Para 3.2.8a(2)). Voice indications shall be evaluated for clarity and effect on course structure.

3.2.6 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. The altitude for the level run shall be the Glide Slope Intercept (GSI) corrected to true altitude to obtain 190 μA outside the normal path measurement area.

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.

b. Width. Path width is the width in degrees of the glidepath width sector as normally measured from 75 μA, 0 μA, and 75 μA.

(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 shall 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 shall be used on all subsequent checks and inspections.

c. Symmetry. Symmetry is the balance of the 150 Hz and 90 Hz width sectors as is determined from the data obtained during level run width measurements. If points other than the 75 μA points are used from measuring the path width, they shall also be used for the symmetry measurements. The glidepath envelope should be as symmetrical as possible. When a facility exceeds the specified tolerance and cannot be adjusted, AFIS shall be used to determine the mean symmetry (see FAA Order 8200.1, USSFIM (Instrument Landing System, Mean Width)). If the mean symmetry remains out-of-tolerance, the facility shall be removed from service.

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

3.2.7 Mean Width. This check is used to determine the mean width of a glidepath between Points “A” and “B”. This check may also be used to determine the mean symmetry of the glidepath.

The path width should be established, as nearly as possible, to 0.7°prior to the check. Fly an approach, maintaining 75 μA above the glidepath between Points “A” and “B”. Repeat the same run at 75 μA below the glidepath, and again while on the glidepath. Determine the mean width from the angle found above and below the glidepath and calculate symmetry from the on-path angle. It is important that the aircraft not deviate too far beyond 75 μA on these runs, as the TLS will sense the aircraft track as beyond the limits of normal flight and automatically abort the guidance.

3.2.8 Clearance. The TLS has been designed such that glide slope clearances will not exceed approximately 195 μA, regardless of deviation from the correct angle.

a. Clearance Below the Path. This check is performed to assure that positive fly-up indications exist between the bottom of the glidepath 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 tracking volume will result in a system shutdown. Attempt to maintain approximately half the commissioned angle by reference to the AFIS on these runs. Pilot/ AET coordination and situational awareness are essential during this check. Check that adequate obstacle clearance exists with at least 180 μA 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 the Path: Clearances above the path are checked to ensure that positive fly-down indication is received prior to receiving the flag alarm. Check that 150 μA fly-down occurs prior to receiving the flag alarm. Perform this check during the level runs.

3.2.9 Glide Slope SSV. The glidepath transmitter shall be placed in reduced power setting for this check. This check shall 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 shall be abeam the glide slope origination point; for LDA service beyond 3.0°, it shall be the point abeam the actual runway threshold on the LDA procedural course. While maintaining the LCA, fly inbound from the Standard or Expanded Service Volume limit through to full scale fly-down indication, checking structure below path, normal indications through the glide path sector, and clearance above path.

3.2.9.1 Glide Slope ESV. An ESV defined only by distance shall meet all coverage tolerances at an altitude corresponding to 0.75° at the required distance. 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.

3.2.10 Standard Instrument Approach Procedure (SIAP). The approach procedure shall be evaluated IAW Order 8200.1, USSFIM (Flight Inspection of Instrument Flight Procedures).

4. Flight Inspection Analysis. Data analysis shall be in accordance with FAA Order 8200.1, USSFIM (Instrument Landing System).

4.1 Application of Localizer/ Course/Glidepath Structure Tolerances. Application of course structure analysis contained in this paragraph applies to all zones (1, 2, 3) of glidepaths and all zones of localizers (1, 2 & 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 shall 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 analyzation 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.

4.1.1 Rate of Change/Reversal in the Slope of the Glidepath. The following analysis of the path angle recording shall be accomplished during all inspections where AFIS, RTT, or other tracking devices are being used.

a. 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.

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 ft along the approach with an essentially continuous slope.

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

d. NOTAM Action. Facilities which do not meet the tolerance shall not be classified as restricted, but shall have an autopilot use limitation imposed by NOTAM. Autopilot coupled approaches are not authorized below an altitude (MSL) that is 50 ft higher on the glidepath 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 (Facility Status Classification and Notices to Airman (NOTAM)).

4.1.2 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 LCA at a maximum ground speed of 170 knots. Evaluate for noticeable effects on flyability and possible false course indications. The procedure shall be removed if reversals of trend exceed 10 μA or flyable false course indications occur. If the arc at LCA 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 8200.40, Appendix 2, Paragraph 4.1.2."

4.2 Application of Localizer Coverage Requirements. The localizer shall 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. Clearances Restrictions. If a localizer is restricted in Sector 2, it shall not be used for a procedure turn on the restricted side, unless the inbound procedure turn course guidance is provided by some other facility, such as a VOR, NDB, etc.

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 LCA 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 LCA was achieved.

c. Vertical Angle Requirements.

(1) If in-tolerance coverage cannot be maintained up to 7° or Point C as required by paragraph 3.2.2.1e, coverage is restricted. The TLS is not approved as a CAT I system. It is approved as a non-standard approach with vertical guidance (APV) and cannot be used as localizer only “non-precision” operation. Tthe localizer shall 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.

(2) If vertical angle coverage is limited but the localizer can be used on a restricted basis, a NOTAM shall 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. 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.

5. Tolerances.

a. Localizer

Parameter	Reference	Inspection C	Inspection P	Tolerance/Limit
Modulation Level	3.2.4	X	X	36 – 44%
Width	3.2.3			Maximum -- 6.0° Precision approach -- 400 feet minimum course width at the threshold
		X		± 0.1° of the commissioned width
			X	Within 17% of the commissioned width.
Symmetry	3.2.3	X	X	45 - 55%
Alignment	3.2.4	X		Within 3 µA of the designed procedural azimuth
			X	From the designed procedural azimuth: ± 15 µA ± 20 µA for offset localizer/LDA
Structure	3.2.4	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 and LDA installations, measure structure from graphical average course.
Polarization	3.2.4	X	X	Signal Strength -- ≥ 5 µV
Coverage	3.2.2	X	X	Signal Strength -- ≥ 5 µV Flag Alarm – No Flag or indication of invalid signal Clearance and Structure -- in tolerance Interference -- shall not cause an out-of-tolerance condition.
Clearances	3.2.3	X	X	Sector 1 -- linear increase to 175 µA then maintain 175 µA to 10° Sector 2 -- 150 µA
Identification and Voice	3.2.2	X	X	Clear, correct; audio level of the voice equal to the identification level. The identification shall have no effect on the course. Voice shall not cause more than 5 µA of course disturbance.
Markers	3.2.5			Throughout localizer course sector **(150 - 150 µA)**
Outer		X	X	1350 ft to 4000 ft (2000 ft optimum) (major and minor axis)
Middle		X	X	675 ft to 1325 ft (1000 ft optimum) (major and minor axis)

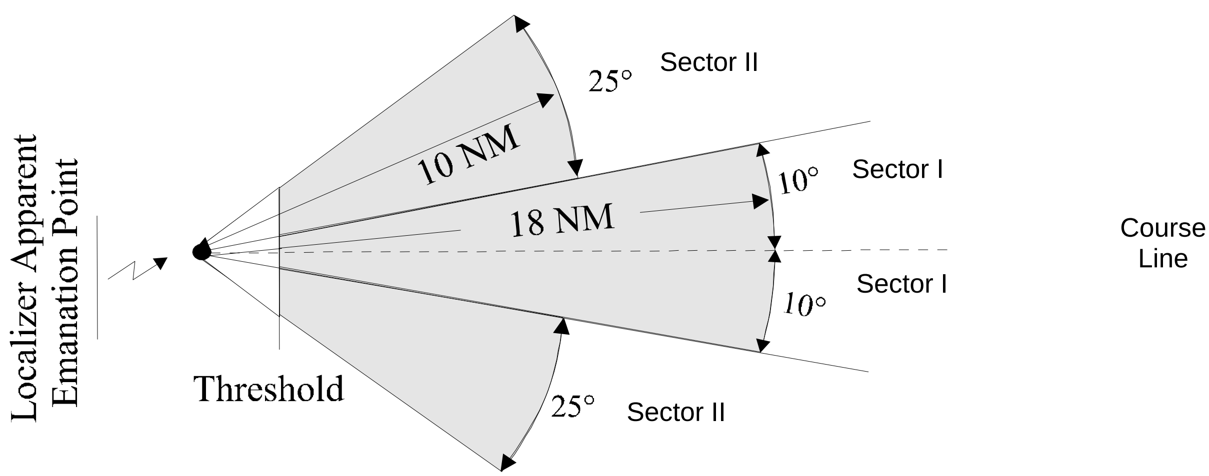
b. Glide Slope

Parameter	Reference	Inspection C	Inspection P	Tolerance/Limit
Modulation Level	3.2.4	X		78 - 82%
			X	75 - 85%
Width	3.2.6	X		0.7° ± 0.05°
			X	0.7° ± 0.2°
Angle	3.2.4	X		± 0.05° of the commissioned angle
			X	+10.0% to -7.5% of the commissioned angle
Symmetry	3.2.6	X	X	67 - 33%
Structure below Path	3.2.6	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	3.2.8	X	X	Below Path: Adequate obstacle clearance at no less than180 μA Above Path: 150 μA of fly-down signal
Structure	3.2.4	X	X	Zone 1 -- 30μA from graphical average path Zone 2 -- 30μA from actual path angle Zone 3 -- 30μA 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	4.11	X	X	25 μA per 1,000 ft in a 1,500 ft segment
Polarization	3.2.4	X	X	Signal Strength -- ≥ 5 μV
Coverage	3.2.9	X	X	Signal Level -- ≥ 15 μV Flag Alarm – No Flag or indication of invalid signal Fly-up Signal -- ≥ 150 μA Fly-down Signal -- ≥ 150 μA Clearance and Structure -- in-tolerance Interference -- shall not cause an out-of-tolerance condition.

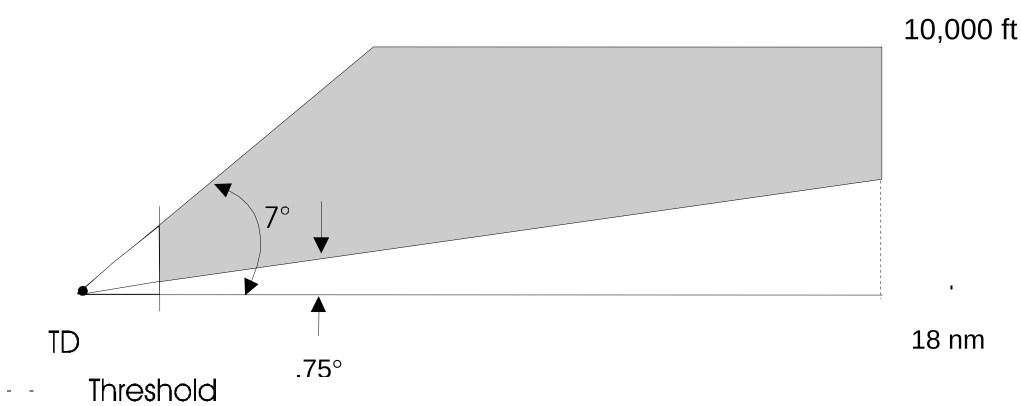
6. Records, Reports, and Notices to Airman. See FAA Order 8200.1, USSFIM (Facility Status Classification and Notices to Airman (NOTAM) and Records and Reports) and FAA Order 8240.36 for ILS reports.

APPENDIX 3. TLS ZONES, POINTS AND COVERAGE

Figure 1
TLS LOCALIZER GUIDANCE COVERAGE



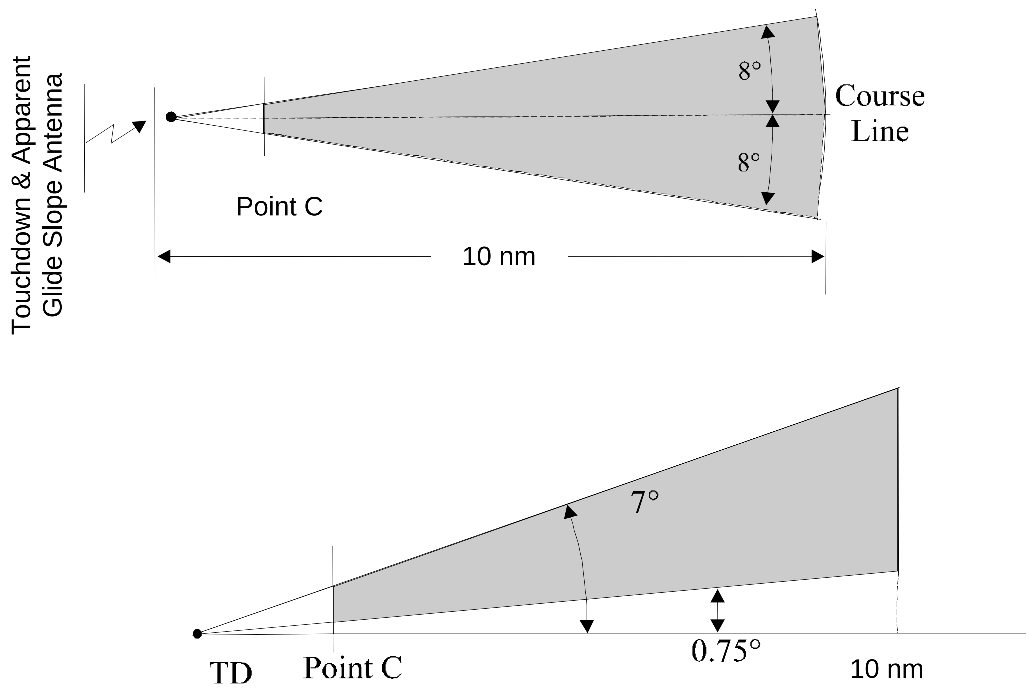
Localizer Coverage in Azimuth



Localizer Coverage in Elevation

Figure 2

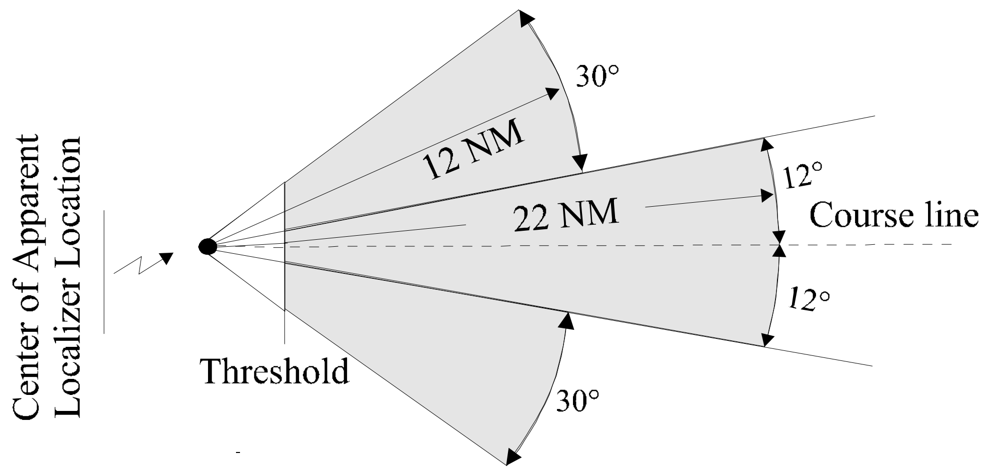
TLS GLIDE SLOPE COVERAGE



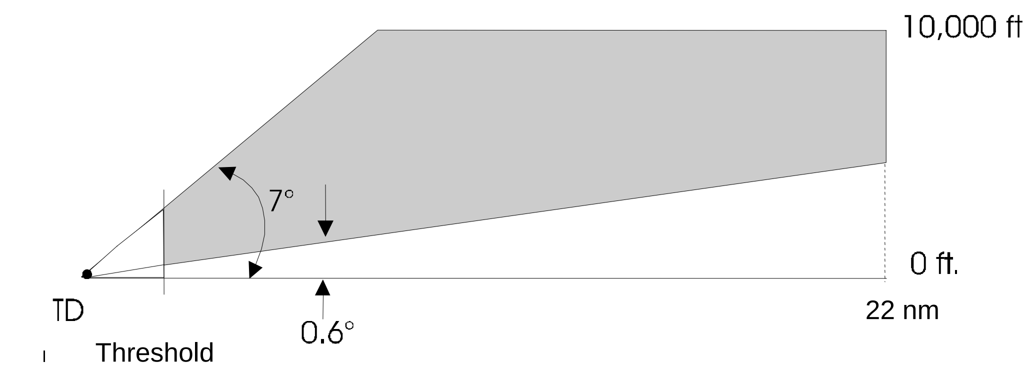
Apparent Glide Slope Antenna

Glide Slope Coverage in Elevation

Figure 3
TLS TRACKING VOLUME

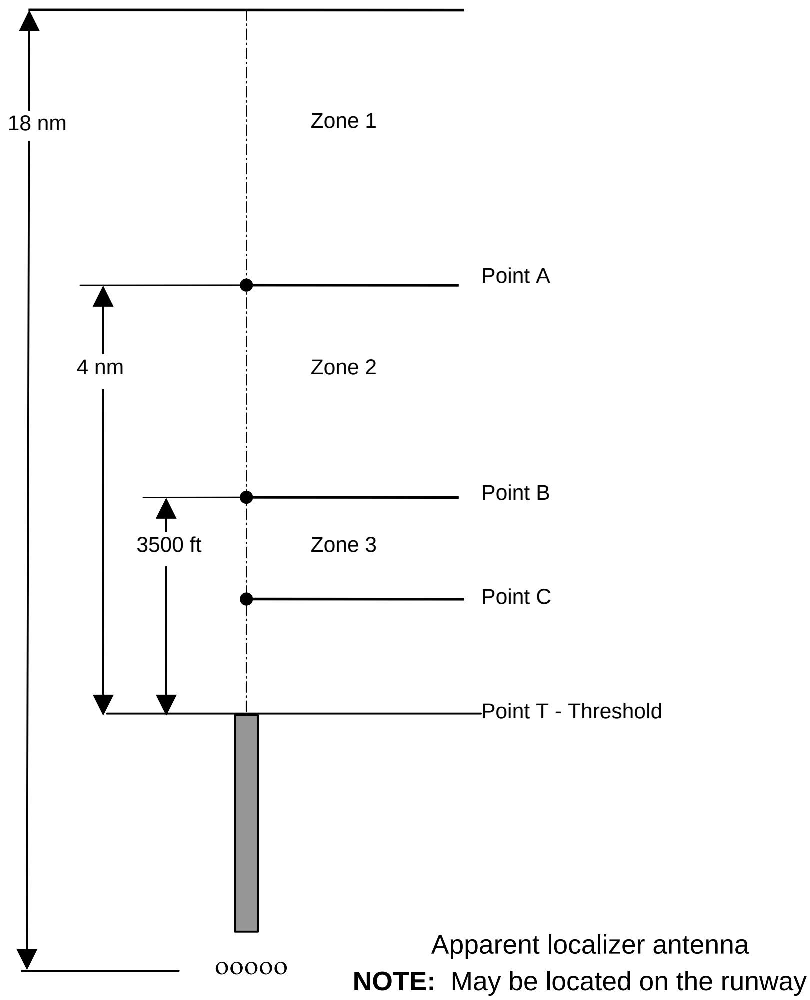


Interrogation & Tracking Coverage in Azimuth



Interrogation & Tracking Coverage in Elevation

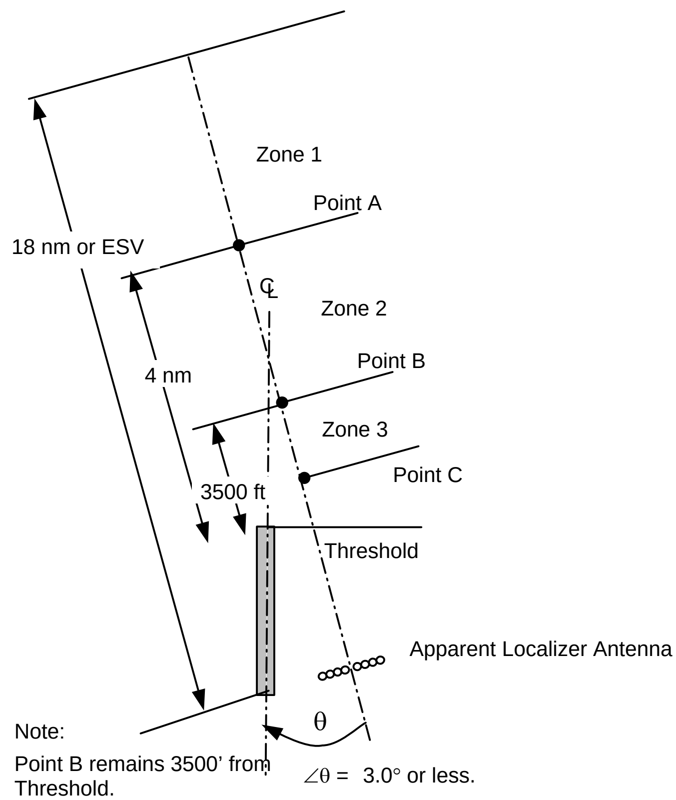
Figure 4
DEFINITION OF TLS POINTS AND ZONES



The following definitions for flight inspection points and zones shall apply to analysis of 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 ft from the runway threshold measured al the runway centerline extended.
Point C	A point through which the glidepath (as commissioned) passes at a height of 100 ft above the horizontal plane containing the runway threshold. For operations without a glidepath, Point C is the MAP.
Zone 1	The distance from the localizer/glidepath coverage limit to Point A.
Zone 2	The distance from Point A to Point B on-course.
Zone 3	The distance from Point B to Point C on-course.

Figure 5
TYPICAL OFFSET TLS



TLS LDA CONFIGURATIONS

Figure 6

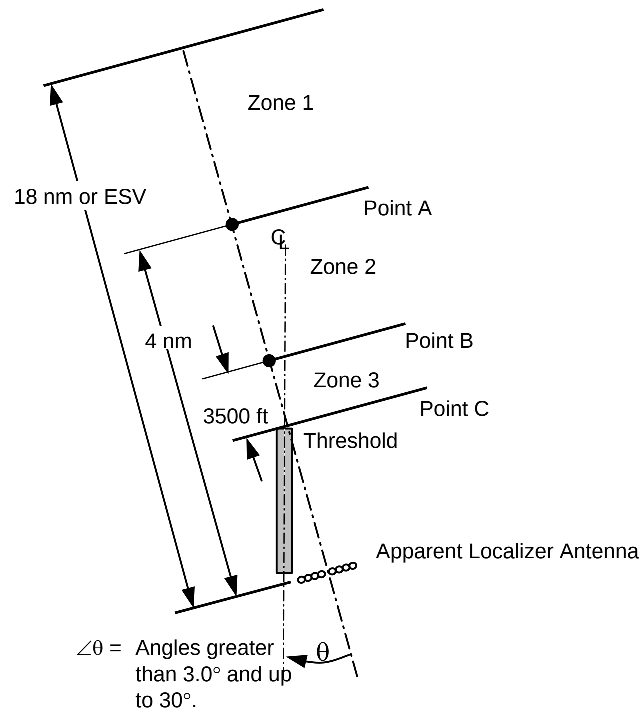


Figure 7