CHANGE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

6750.49A
CHG 4

12/10/2004
Implementation

Date:06/10/2004

SUBJ: MAINTENANCE OF INSTRUMENT LANDING SYSTEM (ILS) FACILITIES

1. PURPOSE. This change will correct identified errors, omissions, and incorporate other required changes in Order 6750.49A, Maintenance of Instrument Landing System (ILS) Facilities. This directive implements Configuration Control Decision (CCD) No. N24624, Update Maintenance Technical Handbook Order 6750.49A, Change 4.

2. DISTRIBUTION.

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4. IMPLEMENTATION DATE. To provide national uniformity for this change, the regional AXX-470's have request that Oklahoma City NAVAIDS Systems Branch, AOS-240 provide a "final implementation date". This final implementation date is one where that all facilities nationwide, can be expected and will be held accountable for having completed or complied with the change. The change may be implemented anytime after the effective date, but must be completed by the final implementation date. This final implementation date shall be six months after the change date, i.e. as noted on the front page.

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Director for Technical Operations Support

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CHAPTER 1. GENERAL INFORMATION AND REQUIREMENTS

1-1. OBJECTIVE. This handbook provides the necessary guidance to be used, in conjunction with information available in instruction books and other handbooks, for the proper maintenance of all instrument landing system (ILS) facilities (localizer, localizer-type directional aid (LDA), glide slope, and ILS associated markers.

1-2. MAINTENANCE CONCEPT.

a. General. The ILS maintenance concept is that the characteristics and limits of the radiated signal, rather than the monitored signal, shall be measured, documented, flight tested, and protected by monitors.

b. Test Equipment.

(1) General. The latest edition of Order 6200.4, Test Equipment Management Handbook, requires that all test equipment used to maintain National Airspace System (NAS) equipment shall be calibrated. Exceptions are made for older test equipment or those used for maintaining reference readings only, not absolute measurements. As an example, measurements from Bird wattmeter elements are used for reference readings and are not intended to represent actual wattage. RF power is established by flight inspection and maintained by the wattmeter references. Calibration shall not be performed, and no wattmeter components shall be removed from the facilities to which they are dedicated. Newer ILS facilities are being procured that include built-in test equipment (BITE) which has been calibrated at the factory by the manufacturer. The BITE is designed to be of sufficient accuracy and reliability for the ILS specialist to document, maintain, and troubleshoot the ILS equipment in lieu of external test equipment. However, when the BITE is used for this purpose, a certified ILS specialist must verify the proper operation and accuracy of the BITE. Verification of the BITE shall be made upon installation, upon replacement of equipment modules that contain BITE circuitry, and on a periodic basis. When properly maintained and verified by a certified ILS specialist, the BITE is the preferred method to document, troubleshoot, and maintain the ILS equipment.

(2) External Test Equipment. External test equipment shall be used to document, troubleshoot, and maintain the ILS when BITE is not available. This equipment includes the portable ILS receiver (PIR), the FA-9438 modulation meter, power meters, voltmeters, etc., and/or other equivalent test equipment as required. The PIR is the primary ILS test instrument, and therefore shall be maintained, calibrated, and used by a certified ILS specialist. This order provides calibration procedures for the PIR.

(3) Built-In Test Equipment (BITE). ILS BITE, when available, is the preferred method to document, troubleshoot, and maintain the ILS equipment. This is largely due to the fact that the ILS BITE measurements may be accessed at the facility or at a remote location by a maintenance data terminal (MDT). The BITE in conjunction with the MDT eliminates the necessity for the ILS specialist to have available at all times many different pieces of test equipment, and for the specialist to be on-site to ascertain proper operation. Future plans may include an electronic method of recording periodic maintenance checks to floppy disks via the MDT, eliminating the necessity for handwritten forms. However, for the BITE to be utilized for this purpose, the following conditions shall be met:

(a) The BITE shall be verified for proper operation and accuracy with calibrated test equipment and/or calibration standards traceable to the National Institute of Standards and Technology (NIST), by a certified ILS specialist in accordance with the standards and tolerances, and periodicity specified in this order.

(b) In the case of repair or replacement of an equipment module and/or its software, containing BITE sensors, measurement circuits, etc., calibration of that portion of the BITE must be verified for proper operation and accuracy at the time of the repair or replacement.

NOTE: Any RF power measurements using analog wattmeter do not need to be verified with calibrated test equipment since repeatable readings are more important than quantitative readings.

(4) Facilities with a Remote Maintenance Monitor (RMM). Many facilities containing BITE measurement capability and those that only remote the monitor measurements have the capability of transmitting that data via modems over Federal Aviation Administration (FAA) or Telco circuits to a remote location. The remote location may be the local Airport Traffic Control Tower (ATCT), and/or an Air Route Traffic Control Center (ARTCC), and the associated maintenance control center (MCC). This hand-

book will strive to follow the maintenance concept of paragraph 1-2a, above. That is, the ILS radiated signal measurements, not the monitored signal, will be measured, documented, and maintained. For those facilities that contain BITE which is properly maintained, and has its data remoted via modems, remote maintenance monitoring system (RMMS), and RMM, that data may be substituted for an actual site visit for certification purposes. RMM facilities which only remote the monitor readings may not be used for remote certification purposes. To remotely certify facilities equipped with BITE, the following conditions must be met:

(a) In all but the most unusual cases, the remoting of the ILS BITE measurement data and/or monitor data should not fail in a manner that would result in erroneous data being presented to the ILS specialist or operator at a remote facility. The remoting system would be expected to either fail completely or present data that would be instantly recognized as garbled data. However, to ensure that the data being transferred (via RMS/ RMMS systems, remote control panels, modems, etc.) over FAA or Telco circuits/links is valid, the accuracy of the data transferred must be verified by a ILS certified specialist in accordance with the standards and tolerances, and periodicity specified in this order.

(b) In the case of repair or replacement of an equipment module and/or its software, which performs data multiplexing, encoding/decoding of data, or otherwise involved with the transfer of data to a remote location, the accuracy of data transfer must be verified at the time of repair or replacement.

1-3. REMOTE MONITORING SUBSYSTEM (RMS).

a. Background. The purpose of instrument landing system (ILS) RMS is to automate and add remote capabilities to the maintenance operations required for ILS equipment. Remote maintenance monitoring does not replace the ILS executive monitor (the monitor which causes equipment shutdown), the remote status indicator normally used by air traffic personnel, or the notification requirements for shutdown and restoration of the ILS equipment.

b. Policy. ILS equipment with airport remote monitoring systems (ARMS) installed or ILS equipment designed with RMS capability shall be maintained in accordance with the appropriate RMS related paragraphs of this handbook. All prescribed maintenance activities must be accomplished whether RMS capability is installed or not. Remote data collection is an acceptable method of reading and recording facility parameters provided the remote readings accurately correlate with onsite readings.

1-4. ILS FACILITY OPERATION. After a facility has been accepted for operation and placed into service, the system specialist is responsible for ensuring continued operation by performing the maintenance tasks prescribed in this order, equipment instruction books and other applicable agency orders. The system specialist assigned to maintain ILS facilities must review all operational requirements and be familiar with all maintenance aspects of these facili-ties. This includes the technical standards and procedures in this order, equipment instruction books, facility reference data on file, meter readings, recorded data on technical performance records, past or current flight inspection report information, and the condition of test equipment. The system specialist is expected to keep his/her supervisor advised of all abnormal or unusual conditions.

1-5. STAND-ALONE OPERATION OF GLIDE SLOPE FACILITIES. A glide slope facility is normally installed with an associated localizer facility (i.e., no known permanent stand-alone operation of glide slope facilities exist). Whenever a localizer facility must be removed from service, and has an associated glide slope facility, the glide slope facility should continue in operation. Glide slopes installed on opposite ends of the same runway need not be interlocked; they may operate simultaneously provided that they are on different operating radio frequencies (rf) and that no rf interference problem exists between them.

1-6. HAZARDOUSLY MISLEADING INFORMATION (HMI). Order 6000.15, General Maintenance Handbook for Airway Facilities, defines HMI as "erroneous information that is sent by navigational aids to an aircraft instrument that is presented in a manner that could result in a significant reduction in terrain clearance."

a. Background. Certain facility maintenance practices (e.g., quadrature phasing navigation signals, checking modulation balance) may require intentionally radiating HMI, but do not produce abnormal cockpit indications. Traditionally, ILS specialists have relied on removing the Morse code identification signal when working on the localizer, and requesting the issuance of a NOTAM advising users that the localizer or glide slope is out of service, as the assurance that such signals will not be used during maintenance activities. Recently, however, the International Civil Aviation Organization (ICAO) has noted an increasing number of incidents internationally in

which air crews have coupled to and used HMI for guidance, in some cases with near-disastrous consequences. After extensive international discussions, ICAO issued a May, 2001, letter to its member countries requesting that aviation regulatory authorities take extra steps to preclude the inadvertent use of HMI. The general theme of some of these steps is that without an abnormal cockpit indication of HMI, pilots may use the guidance even though a NOTAM removing the facility from service may have been issued.

b. Policy. For the purpose of applying the following requirements, conducting a routine flight inspection with monitors is not considered to produce HMI signals, unless quadrature phasing or modulation balance signals are radiated. For all other circumstances and activities (e.g., routine maintenance activities, tuneup of or radiation by a new ILS localizer or glide slope prior to a commissioning flight inspection), the following precautions against unintended aircrew use of HMI shall be taken:

(1) Latest version of Order 6000.15 requires that occurrences of radiation of HMI shall be minimized in both number and duration when practical. Methods to accomplish this include using more than one specialist to eliminate access time to far-field measurement areas, and using additional or specialized test equipment and procedures as a substitute for radiating HMI. It also requires that risk management techniques be used to mitigate the remaining risk.

(2) Order 6000.15 requires that ILS Specialists personally confirm that a NOTAM has been issued prior to removing any navaid from service if HMI will be radiated. This may be accomplished by a variety of methods, including but not limited to calling the servicing AFSS, coordinating with AF control center or ATC personnel, or monitoring the applicable ATIS.

(3) During periods of radiating HMI on the Localizer, the corresponding glide slope, if installed, shall be administratively removed from service, and the radiation of glide slope signals terminated. (To accomplish the latter requirement, the transmitter may be either turned off or terminated into dummy loads.) This action causes the glide slope flag to appear in the cockpit.

* **(4)** During periods of radiating HMI on the Glide Slope, the corresponding localizer shall be administratively removed from service, and the radiation of localizer signals terminated. (To accomplish the latter requirement, the transmitter may be either turned off or terminated into dummy loads.) This action causes the localizer flag to appear in the cockpit. *

1-7. MAINTENANCE.

a. Localizer. For maintenance purposes, all localizer facilities, whether conventional, offset, or localizer-type directional aid (LDA), are treated identically unless provided for otherwise within this order.

b. Pre-Alarm Settings. In much of the ILS equipment currently in use, there exists the capability to alert an Airway Facilities Control Center (AFCC) prior to an equipment shutdown. This is called the pre-alarm, and is a monitor setting that lies between the normal operating value, and the monitor shutdown value. This feature, when properly utilized, would prevent or shorten the duration of outages by dispatching a technician when a pre-alarm is noted by the responsible AFCC. This feature has been proven to track equipment drifts during snow buildup and other environmental events, and would be an essential part of maintaining continuity of service for our CAT II/III ILS's. This pre-alarm setting should be close enough to the actual shutdown value to prevent nuisance alarms, but far enough from it to allow time for a technician to respond. The exact value for each parameter should take into account -- category of service provided; adjust and maintain philosophy; travel time to the site; and the difference between the nominal value and alarm value.

1-8. CERTIFICATION. Refer to Order 6000.15 for general guidance on the certification of systems, subsystems, and equipment. Refer to appendix 1 of this handbook for the specific certification requirements of the ILS. When the direct measurement of certification parameters method is used, the certification parameters must be measured using the handbook procedures referenced in the standards and tolerances table for that parameter. Follow the guidance of Order 6000.15 for other certification methods.

1-9. DEFINITIONS OF CATEGORIES OF OPERATION.

a. Category I. An instrument approach procedure that provides for approaches to a decision height (DH) of not less than 200 ft (60 m) and visibility of not less than a value of the order of 2600 ft (800 m); or runway visual range (RVR) value of the order of 2400 ft (730 m) or an RVR value of the order of 1800 ft (550 m) with operative touchdown zone and runway centerline lights.

b. Category II. An instrument approach procedure that provides for approaches to less than a DH of 200 ft (60 m) and an RVR value of the order of 2400 ft (730 m) to as low as a DH of 100 ft (30 m) and an RVR value of the order of 1200 ft (360 m).

c. Category IIIa. An instrument approach procedure that has no DH limitation, to and along the surface of the runway with external visual reference during the final phase of the landing with an RVR not less than a value of the order of 700 ft (210 m). (Advisory Circular AC 120-28B provides for Category III operation with an operational decision height of 50 ft (15 m) at some airports with Category II ground equipment.)

NOTE: In the United States, any operations that are conducted with an RVR value of the order between 1200 ft (360 m) and 700 ft (210 m), and with a DH below 100 ft (30 m) height above touchdown (HAT) or no DH are considered to be Category IIIa operations.

d. Category IIIb. An instrument approach procedure that is the same as Category IIIa except that the RVR requirement is reduced to a value of the order of 150 ft (45 m).

e. Category IIIc. An instrument approach procedure that is the same as Category IIIa except that it allows landings with the RVR equal to zero.

1-10. ILS FACILITY HARDWARE REQUIREMENTS BY CATEGORY. The hardware requirements are defined in the latest edition of Order 6750.24, Instrument Landing System (ILS) and Ancillary Electronic Component Configuration and Performance Requirements. The maintenance standards and tolerances are determined by the category of operation, not by the hardware type. Therefore, when Category II hardware is used for Category IIIa approaches, the Category III standards and tolerances apply.

1-11. OPERATION OF THE LOCAL ELECTRONIC MONITOR.

a. Affecting the Radiated Signal. When performing maintenance that could affect the facility RADIATED signal, the monitor is not to be used for determining proper facility operation. It is the responsibility of the specialist to evaluate facility performance by measurement of the radiated signals, using the test equipment and procedures designed and approved for this specific purpose.

b. Bypassing Monitor. Monitor control of the automatic transfer/shutdown (i.e., Executive Action) feature is bypassed only when absolutely necessary. The maintenance log must show when and why monitor control * responsibilities were assumed and relinquished, and the * initials of the air traffic personnel with whom the activity was coordinated.

1-12. OPERATION OF THE REMOTE ILS MONITOR (STATUS CHANGE).

a. Unmonitored System. When the ATCT is unmanned and no provision has been made for remote status observation, refer to the latest edition of Order 7232.5, Reduced or Increased Operating Hours for Airport Traffic Control Towers/Approach Control Facilities, for conditions for such operations.

b. Loss of Remote Monitoring. There are basically two types or functions of remote monitoring. One is the remote maintenance monitor (RMM) function primarily used by airway facilities maintenance personnel. The second is the remote control and status function used by air traffic personnel. In either case, if part of, or all of the remoted functions fail or are taken out of service for maintenance (either to a complete ILS system, an individual localizer, glide slope, or marker beacon facility) continued operation of the particular system/facility is permitted, provided the system/facility automatic monitoring and shutdown feature is fully functional. All interested parties should be notified (particularly air traffic) whenever a loss of remote monitoring to an entire ILS or a particular ILS facility occurs, or is removed for maintenance activities.

NOTE: Care should be exercised when performing maintenance since some remote control and status units may automatically shut off their associated facilities with loss of power.

(3) Several well-studied facts provide the basis for decisions as to whether a special flight inspection is needed for a given concern-causing event.

(a) Environment changes in areas beyond 30 glide slope (GS) or 35 localizer (LOC) azimuthal degrees from the course or path line rarely affect ILS user indications.

(b) Metallic structures and power lines produce the greatest effect on course/path structure when erected parallel to the runway centerline azimuth.

(c) Objects erected beyond 1200 ft (360 m) and less than 0.5° in elevation have little effect on the glide slope guidance information.

(d) Changes in ground contour of 1 ft (30 cm) or more within the defined critical areas of the localizer and image-type glide slopes are of concern, more so if within 500 ft (150 m) of the glide slope antenna or 1000 ft (300 m) of the localizer antenna arrays.

b. Activities Requiring a Special Flight Inspection.

(1) Changes in obstructions, buildings, power lines, electromagnetic environment, etc., that may affect the radiated signal or service provided.

(2) Construction work, runway repairs, etc., being performed in the general area of the localizer or glide slope and there is doubt about the impact upon the as-published service.

(3) A change in the facility's assigned operating frequency.

(4) Repositioning (change in height or offset) of an antenna within a glide slope, localizer, or marker radiating array.

c. Activities Requiring Special Approval to Restore Service.

(1) Following corrective maintenance involving certain critical elements and circuit components, engineering personnel (regional level or higher) must approve the restoration of service. Verbal approvals to restore must be followed by a timely letter or facsimile from the regional AF engineering division formally documenting the authorization. Such documents of authorization and related records of performance must be retained until such time as log entries covering these activities are purged.

(2) The ILS engineer or system specialist may request additional checks of system performance as a precondition for approving the return of a given facility to service. Special technical documentation requirements typically include before-and-after readings of parameters affected by the specific maintenance activity and which support a conclusion that normal equipment operation is restored. Some special procedures and/or records may be requested to support anticipated future troubleshooting activities.

(3) Critical corrective maintenance activities include:

(a) Replacement of any transmit rf components, such as coaxial lines and antenna elements, bridges, power dividers, modulators, and transmitter units that contain these components. (Typical post-repair activities include measurement of signal amplitudes and phase relationships potentially affected during the repair, measurement of monitor input signals, system phasing, etc.)

(b) Repair, replacement, or reinstallation of a localizer antenna element within the array. (Typical post-repair activities include pair null checks, a system phase check, a ground check, measurement of monitor input signals, etc.)

(c) Repair, replacement, or reinstallation of a glide slope antenna. (Typical post-repair activities include measurements of signal amplitudes and phase in individual antenna elements with a proximity probe and/or vector voltmeter, measurements of monitor input signal characteristics, etc.)

d. Other Activities. All other maintenance activities that meet the requirements of this handbook do not require special documentation or a flight inspection evaluation.

e. Retention of Flight Inspection Data. ILS facilities operating parameters reference values are established by flight inspection personnel using airborne measurement and evaluation. These include operating rf power levels and adjustment deviation limits for monitored parameters. When a reference value is established during a given flight inspection, a copy of the associated flight inspection report and data worksheet(s) shall be retained * until the facility is decommissioned. This requirement * applies to all ILS facilities (including markers). At all facilities, established parameter reference values shall be traceable to the appropriate flight inspection report

through facility documentation maintained in the Facility Reference Data File.

1-23. RESTRICTIONS TO REDUCE INTERFERENCE.

a. Obstruction Criteria. Airway facilities personnel are to monitor all construction activities or natural growths for possible violation of obstruction criteria and possible effects to the radiated characteristics of the facility. Full precautionary measures must be taken to avoid possible interference with localizer or glide slope radiation patterns during maintenance activities. If there is any doubt of the accuracy of the radiated signal, the facility shall be shut down until accuracy is verified by Flight Inspection. Similar action is required following reports of localizer or glide slope interference caused by aircraft or vehicles. Criteria for determining obstructions to air navigation can be found in Federal Air Regulation (FAR) Part 77, Objects Affecting Navigable Airspace.

b. RF Interference. Rf interference is the result of undesirable signals that deteriorate the radiated or received characteristics of the ILS facility signals. Rf interference problems that cannot be corrected should be reported through official channels to the regional Frequency Management staff, and their assistance should be requested. It may be necessary to request assistance from Flight Inspection.

1-24. ILS CRITICAL AREAS.

a. Definition. The facility system specialist must be aware that disturbance to the localizer or glide slope signals may occur when other aircraft or surface vehicles operate near the localizer or glide slope antennas. These areas, which are to be protected from vehicular or aircraft traffic, are called the ILS critical areas. Airway facilities ILS specialists should consider conformance to critical area marking standards when certifying a facility. The critical areas and additional data concerning hold lines, signs, etc., are defined in the latest edition of Order 6750.16, Siting Criteria for Instrument Landing Systems, and the latest editions of Advisory Circular 150/5340-1, Marking of Paved Areas of Airports, and Advisory Circular 150/5340-18, Standards for Airport Sign Systems.

b. Protection of Areas. Air Traffic procedures require that the tower personnel control airport surface traffic so localizer and glide slope critical areas are protected whenever reported weather is poorer than prescribed minima. When the weather conditions are better than the prescribed minima, or when no tower is in operation, ILS critical area protection is not provided other than by self-policing of airport areas. For this reason, proper marking of the ILS critical areas is essential.

c. Actions Required.

(1) Airway facilities personnel are responsible for advising airport management authorities of critical area criteria, and for requesting that they provide and maintain the necessary signs, holding lines, and other markings delineating the restricted areas.

(2) Airway facilities personnel are responsible for unlighted critical area warning signs, to prevent unauthorized vehicular traffic in the localizer and glide slope critical areas. At a minimum, signs shall be installed where each road enters/leaves the critical area. The signs should be approximately 1 ft by 2 ft (30 by 60 cm) in size, and preferably constructed of nonmetallic material. Suggested wording is ILS CRITICAL AREA KEEP OUT. See figure 1-2 for typical placement.

(3) Vegetation in the critical areas shall be kept below 12 inches (30 cm). Except for cutting and removal of vegetation, all farming activities are forbidden in the ILS critical areas.

SECTION 3. 75 MHZ ILS MARKER (Continued)

path at which the decision height (DH) is located for Category I operations – 200 ft (61 m) above the touchdown zone elevation. The inner marker (IM) is installed only for Category II and III ILS approaches and is located approximately 1000 ft (300 m) from the runway approach threshold, coinciding with the nominal Category II DH of 100 ft (30.5 m).

2-91. 75 MHZ ILS MARKER GROUND-BASED SYSTEM.

a. Description. 75 MHz ILS markers transmit an upward-directed cone of information at 75.000 MHz. (An exception to this exists for closely spaced parallel runways, where adjacent marker signals might cause incorrect aircraft indications. In this case, the marker frequencies may be offset from 75.000 MHz by 4 kHz.) Each marker is amplitude modulated by an audio tone which is keyed in Morse code. Both the audio tone frequency and the keying are distinctive according to the marker's location. Outer markers are keyed with a continuous sequence of dashes at a tone frequency of 400 Hz. Middle markers are keyed with alternating dashes and dots at a tone frequency of 1300 Hz. Inner markers are keyed with a continuous sequence of dots at a tone frequency of 3000 Hz.

b. Antenna Patterns. Antenna systems for 75 MHz ILS markers are very simple, compared to localizer or glide slope systems. The prevalent antenna systems are a dual Yagi arrangement directed upward with 120° spacing between the Yagis for outer markers, and two vertically stacked dipoles for middle and inner markers. Each antenna system provides a pattern which approximates an ellipse when cut by a horizontal plane. The minor or narrow axis of the ellipse is parallel to runway centerline. The output power of a marker transmitter is adjusted so that the aircraft receiver detects the * marker information for specific distance along the approach while descending on the glide path. Figure 2-36 plots the relative signal strength along the minor axis for various altitudes above the antenna system.

c. Monitoring. In the past, marker beacon antenna systems included a monitor probe for the purpose of providing sampling of the radiated signal to the beacon's internal monitoring circuitry. Newer systems are provided with integral monitoring, eliminating problems associated with the external monitor probe due to environmental conditions. Many older systems have been modified to integral monitoring, while others still retain the external monitor probe. Typical monitored parameters include output power, modulation percentage, keying and in newer systems, antenna voltage standing-wave ratio (swr).

2-92. 75 MHZ ILS MARKER AIRBORNE SYSTEM.

Aircraft receivers for 75 MHz ILS markers are superheterodyne or tuned radio frequency (TRF) types, with linear envelope detectors to recover the received audio signals. Refer to paragraph 2-3 for a more detailed discussion of envelope detectors. Audio filters at 400, 1300, and 3000 Hz direct the keyed tones to rectifier circuits, which activate relays or logic circuits and three differently colored lights on the aircraft instrument panel.

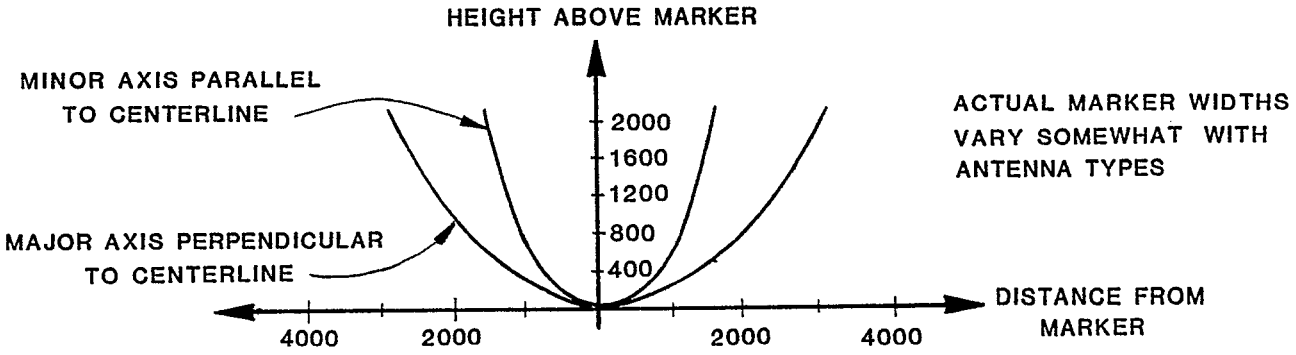
2-93. 75 MHZ ILS MARKER ADJUSTMENTS AND FLIGHT INSPECTIONS.

a. Adjustments. Other than audio and carrier frequencies, the only transmitting equipment adjustments for 75 MHz ILS markers are the output power level and tone modulation percentage. Since the airborne receiving system is not gain leveled, changing either the output power or the modulation percentage will affect the width of the detected marker indication along runway centerline.

b. Measurements. The flight inspection aircraft measures the distance along the runway centerline during which 1700 microvolts of signal is received. Flight Inspection also confirms that the major axis of the pattern has * sufficient width.

SECTION 3. 75 MHz ILS MARKER (Continued)

FIGURE 2-36. SIGNAL STRENGTH ABOVE MARKER ANTENNA



2-94. thru 2-99. RESERVED.

SECTION 4. BUILT-IN TEST EQUIPMENT (BITE)

2-100. thru 2-109. RESERVED.

SECTION 5. REMOTE MAINTENANCE MONITORING (RMM)

2-110. thru 2-119. RESERVED.

SECTION 1. LOCALIZERS (Continued)

SUBSECTION 1. NORMAL TRANSMITTER PARAMETERS (Continued)

Parameter	Reference Paragraph	Standard	Tolerance/Limit Initial	Tolerance/Limit Operating
→ **3-14. ANTENNA SYSTEM PHASING.**	5-16	Optimum	±5° of standard	±10° of standard
3-15 ANTENNA SYSTEMS.				
a. Insulation Resistance.	5-132	Infinity	>50 megohms	>20 megohms
b. DC Resistance.	5-133	Baseline measurement	≤ Standard +5 Ω	Same as initial
c. Voltage Standing-Wave Ratio (VSWR).	5-121, 5-124	1.0:1	≤1.25:1	≤1.40:1
3-16. thru 3-19. RESERVED.				

SUBSECTION 2. EXECUTIVE MONITOR PARAMETERS

Parameter	Reference Paragraph	Standard	Tolerance/Limit Initial	Tolerance/Limit Operating
→ **3-20. MONITOR ALARM POINTS.**				
a. Course Shift Alarm.	5-13 6-34			
(1) Clockwise and Counterclockwise		Shift from derived normal centerline DDM reference:		
* **(a)** Category I		≤0.012 DDM	Same as standard	≤0.013 DDM
(b) Category II		≤0.008 DDM	Same as standard	≤0.009 DDM
(c) Category III		≤0.006 DDM	Same as standard	≤0.007 DDM
(d) Offset Localizer, LDA, and independently monitored back course		≤0.012 DDM	Same as standard	≤0.013 DDM *
(2) Clearance (If centerline monitored)		≤0.015 DDM	≤0.018 DDM	≤0.020 DDM
b. Course Width Alarm.	5-13			
(1) Wide		As established by flight inspection	Alarms when sideband power ≥ standard	Same as initial
(2) Narrow		As established by flight inspection	Alarms when sideband power ≤ standard	Same as initial
c. Clearance Width Alarm (Wide) (Two-Frequency Only).	5-13	As established by flight inspection	Alarms when sideband power ≥ standard	Same as initial

SECTION 1. LOCALIZERS (Continued)

SUBSECTION 2. EXECUTIVE MONITOR PARAMETERS

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*	
			Initial	*Operating*
d. RF Power Alarm.[1]	5-13			
(1) Single-frequency		60 percent of normal	As established by flight inspection but ≥50 percent of normal	Same as initial
(2) Two-frequency		85 percent of normal	As established by flight inspection but ≥80 percent of normal	Same as initial
e. Modulation Level Alarm.	5-13			
(1) Course and Clearance Monitors[2]				
(a) Low		SDM = 36 percent	SDM ≥34 percent	Same as initial
(b) High		SDM = 44 percent	SDM ≤46 percent	Same as initial
(2) Identification Tone (if equipped)		Alarms with loss of tone and continuous tone	Same as standard	Same as standard
f. Far-Field Monitor Alarm.	5-13			
(1) Course Shift (cw and ccw)				
(a) Category II		≤0.011 DDM	Same as standard	Same as standard
(b) Category III		≤0.009 DDM	Same as standard	Same as standard
(2) RF Level		Alarms with loss of RF	Same as standard	Same as standard
g. Remote Monitor Receiver Alarm.	5-11	Appropriate indication for facility shutdown	Same as standard	Same as standard

[1] The standard value may be increased by flight inspection requirements. In these instances, the initial and operating tolerances shall equal or exceed the standard.

[2] Sum of depth of modulations (SDM) is the sum of the 90 and 150 Hz modulation components.

SECTION 1. LOCALIZERS (Continued)

SUBSECTION 3. REFERENCE PARAMETERS (Continued)

Parameter	Reference Paragraph	Standard	Tolerance/Limit Initial	Tolerance/Limit Operating
3-31. GROUND CHECK.				
→ **a. Normal.**	5-12			
(1) Course Width				
(a) Category I, LDA, and offset		DDM established during reference ground check	Same as standard	Initial ±0.015 DDM
(b) Category II and III		DDM established during reference ground check	Same as standard	Initial ±0.010 DDM
(2) Off Course Clearance		DDM established during reference ground check	Same as standard	≥90 percent of standard
(3) Course Position				
(a) Category I, LDA, and offset		0 DDM	DDM established during reference ground check	Initial ±0.008 DDM
(b) Category II		0 DDM	DDM established during reference ground check	Initial ±0.006 DDM
(c) Category III		0 DDM	DDM established during reference ground check	Initial ±0.004 DDM
* **b. Composite Sideband Null Position.**	5-22, 5-23	Centerline	≤10 inches from centerline per 1000 ft from array or ≤25 centimeters from centerline per 300 meters from array	≤20 inches from centerline per 1000 ft from array or ≤50 centimeters from centerline per 300 meters from array *
c. Centerline Capture Ratio.	5-176	≥10 dB	Same as standard	Same as standard
3-32. RESERVED.				

SECTION 1. LOCALIZERS (Continued)

*

SUBSECTION 4. STANDBY MONITOR PARAMETERS

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*	
			Initial	*Operating*
3-33. MONITOR ALARM POINTS (dual equip.). [1]				
a. Alignment Shift Alarm (0.000), cw and ccw	5-9	0.006 DDM	Same as standard	Same as standard
b. Course and Clearance Width Alarm (0.155)	5-9			
(1) Wide		0.148 DDM	Same as standard	Same as standard
(2) Narrow		0.162 DDM	Same as standard	Same as standard
c. RF Power Alarm (100.0%).	5-9	95.0%	Same as standard	Same as standard
d. Modulation Level Alarm. Sum of Depth of Modulation (40.0%).	5-9			
(1) Low		37%	Same as standard	Same as standard
(2) High		43%	Same as standard	Same as standard
e. Monitor Time Shutdown Delay.	5-9	≤15 seconds	Same as standard	Same as standard
3-34. RESERVED.				

[1] Values in parentheses are the nominal monitor values used for a normal transmitter. Direct reading on the monitor, assuming use of the indicated nominal value, sets initial alarm limits. *

SECTION 2. GLIDE SLOPES

3-35. GENERAL. This section prescribes the standards and tolerances for all glide slope facilities, as defined and described in Order 6000.15, General Maintenance Handbook for Airway Facilities.

3-36. thru 3-39. RESERVED.

SUBSECTION 1. NORMAL TRANSMITTER PARAMETERS

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*	
			Initial	*Operating*
→ **3-40. RF POWER LEVELS.**				
a. Null Reference..... (Carrier Power)	5-40	As established by flight inspection	98 to 102 percent of standard	90 to 110 percent of standard
b. Sideband Reference.				
(1) Carrier power.....	5-40	As established by flight inspection	98 to 102 percent of standard	90 to 110 percent of standard
(2) Sideband power ratio ..... (lower to upper antenna)	5-125	1:1	0.95:1 to 1.05:1	Same as initial
c. Capture Effect.				
(1) Transmitter Carrier Power Output..... **(Course and Clearance)**	5-40	As established by flight inspection	98 to 102 percent of standard	90 to 110 percent of standard
(2) Antenna Power Ratios	5-126			
* **(a)** Clearance power in upper..... antenna to course power in middle antenna		0.15:1 (-8.2 dB)	As established by flight inspection, but not to exceed 0.25:1 (-6.0 dB)	Initial +20% / -10% (+0.8dB / -0.5dB) *
(b) Sideband power				
1 Lower to upper antenna		1:1 (0.0 dB)	0.95:1 to 1.05:1 (±0.2 dB)	Same as initial
2 Middle to upper antenna..... (or lower antenna)		4:1 (6.0 dB)	As established by flight inspection, but between 3:1 (4.8 dB) to 5:1 (7.0 dB)	Initial ±5 percent (±0.2 dB)
(c) Carrier power, lower to middle..... antenna		Equal to established middle to upper sideband ratio	Standard ±5 percent (±0.2 dB)	Initial ±5 percent (±0.2 dB)

SECTION 2. GLIDE SLOPES (Continued)

SUBSECTION 1. NORMAL TRANSMITTER PARAMETERS (Continued)

Parameter	Reference Paragraph	Standard	Tolerance/Limit Initial	Tolerance/Limit Operating
d. End-Fire Glide Slope.				
(1) Transmitter Carrier Power Output ..... **(Course and Clearance)**	5-40	As established by flight inspection	98 to 102 percent of standard	90 to 110 percent of standard
* **(2) Antenna Power Ratios**				
(a) Course array ..... (rear to front antenna)		1.46:1 (1.6 dB)	Less than 1.6:1 (2.0 dB)	Same as initial
(b) Clearance array ..... (front to rear antenna)		1:1 (0.0 dB)	Less than 1.2:1 (0.8 dB)	Same as initial
→ **3-41. MODULATION LEVELS.**				
a. Course Transmitter.				
(1) 90 Hz.....	5-47	40 percent	39 to 41 percent	38 to 42 percent
(2) 150 Hz.....	5-47	40 percent	39 to 41 percent	38 to 42 percent
(3) Modulation equality[1].....	5-40	0 DDM	≤0.002 DDM	≤0.004 DDM *
b. Clearance Transmitter. ..... **(CEGS and EFGS Only)**	5-47	80 percent	76 to 84 percent	Same as initial
3-42. AUDIO PHASING..... Course to clearance tones, phase relationship (CEGS and EFGS only)	5-58	In phase	Within 185 µs (10° of 150 Hz cycle)	Same as initial

* [1] The standard for EFGS is 0 DDM with the SBO dummy loaded or the reference DDM in the carrier feedline after the dummy load is removed. Refer to paragraph 5-40. *

SECTION 2. GLIDE SLOPES (Continued)

SUBSECTION 1. NORMAL TRANSMITTER PARAMETERS (Continued)

Parameter	Reference Paragraph	Standard	Tolerance/Limit Initial	Tolerance/Limit Operating
→ **3-43. FREQUENCY.**	5-57			
a. Carrier, Single-Frequency.		Authorized (add offset if applicable)	Standard ±0.002 percent	Same as initial
b. Carrier, Two-Frequency. [1]				
(1) Course transmitter		Authorized +4 kHz	Standard ±0.002 percent	Same as initial
(2) Clearance transmitter		Authorized –4 kHz	Standard ±0.002 percent	Same as initial
(3) Carrier frequency separation		8 kHz	Standard ±5.0 percent	Standard ±10.0 percent
c. Modulation Tones.				
(1) 90 Hz		90 Hz	89.1 to 90.9 Hz	Same as initial
(2) 150 Hz		150 Hz	148.5 to 151.5 Hz	Same as initial
* → **3-44. ANTENNA SYSTEM PHASING.**				
a. NRGS (CSB to SBO).	5-48	Optimum	±1° of standard	±5° of standard
b. SBRGS.	5-50			
(1) CSB to SBO in lower antenna		Optimum	±1° of standard	±5° of standard
(2) Upper to lower antenna		Optimum	±1° of standard	±5° of standard
c. CEGS.	5-52			
(1) CSB/SBO Phasing				
(a) Middle antenna		Optimum	±1° of standard	±5° of standard
(b) Lower antenna		Optimum	±1° of standard	±5° of standard
(2) Antenna Phasing [2]				
(a) Antenna #1		Optimum	±1° of standard	±5° of standard
(b) Antenna #2		Optimum	±1° of standard	±5° of standard

[1] These three tolerances must be met concurrently.

[2] Two antennas phased with respect to the third 'reference' antenna (common to both pairs). *

SECTION 2. GLIDE SLOPES (Continued)

SUBSECTION 1. NORMAL TRANSMITTER PARAMETERS (Continued)

Parameter	Reference Paragraph	Standard	Tolerance/Limit Initial	Tolerance/Limit Operating
* **d. EFGS.**				
(1) Clearance array (Dual only) …….	5-55	Minimum detected clearance on monitor M2	±1° of standard	±5° of standard
(2) CSB to SBO phasing, course array …….	5-54	90°	±1° of standard	±3° of standard *
3-45. ANTENNA SYSTEMS.				
a. Insulation Resistance. ……	5-132	Infinity	>50 megohms	>20 megohms
b. DC Resistance. ……	5-133	Baseline measurement	≤ Standard +5 Ω	Same as initial
c. VSWR. ……	5-121, 5-124	1.0:1	≤1.25:1	≤1.40:1
d. VSWR (EFGS Only). Feedlines ..... **clearance and monitor antennas (antennas connected).**	5-121, 5-123	1.0:1	≤1.90:1	≤2.0:1
e. EFGS CLEARANCE MONITOR ..... **ANTENNA.**	5-122	Equal signal from both clearance transmitting antennas	Front antenna signal equals rear antenna signal ±10 percent	Same as initial
3-46. thru 3-49. RESERVED.				

SECTION 2. GLIDE SLOPES (Continued)

SUBSECTION 2. EXECUTIVE MONITOR PARAMETERS

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*	
			Initial	*Operating*
→ **3-50. MONITOR ALARM POINTS.**				
a. Path or Phase Channel Alarm.				
(1) Single and Parallel Integral Path Monitor				
(a) NRGS, CEGS	5-43, 5-45	Alarms when modulation balance DDM is shifted 0.025 DDM	≤0.030 DDM	Same as initial
(b) SBRGS	3-60, 5-44			
1 High angle		Alarms when path is shifted +0.3° from established angle	Alarms when upper antenna power is increased to value established for high angle alarm by flight inspection	Upper antenna power ≤ initial value
2 Low angle		Alarms when path is shifted –0.2° from established angle	Alarms when upper antenna power is decreased to value established for low angle alarm by flight inspection	Upper antenna power ≥ initial value
3 Path (phasing)		Alarms when upper antenna is advanced and retarded 19° from normal	As established by flight inspection but not to exceed ±30°	Same as initial

SECTION 2. GLIDE SLOPES (Continued)

SUBSECTION 2. EXECUTIVE MONITOR PARAMETERS (Continued)

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*	
			Initial	*Operating*
(2) Both Field and Integral Path Monitors, EFGS	3-60, 5-46			
(a) Snap Down				
1 High angle		Alarms when path is shifted +0.3° from established angle	Alarms when path shift ≤ standard	Same as initial
2 Low angle		Alarms when path is shifted –0.2° from established angle	Alarms when path shift ≤ standard	Same as initial
(b) Integral				
1 High angle		Alarms when path is shifted +0.3° from established angle	Alarms when path shift ≤ standard	Same as initial
2 Low angle		Alarms when path is shifted –0.2° from established angle	Alarms when path shift ≤ standard	Same as initial
b. Width or Amplitude Channel Alarm.	5-43, 5-44, 5-45, 5-46			
(1) Wide		As established by flight inspection	Alarms when sideband power ≥ standard	Same as initial
(2) Narrow		As established by flight inspection	Alarms when sideband power ≤ standard	Same as initial

SECTION 2. GLIDE SLOPES (Continued)

SUBSECTION 2. EXECUTIVE MONITOR PARAMETERS (Continued)

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*	
			Initial	*Operating*
c. RF Power Alarm[1]	5-43, 5-44, 5-45, 5-46			
(1) One-frequency		60 percent of normal	As established by flight inspection but ≥50 percent of normal	Same as initial
* **(2)** Two-frequency (CEGS)		85 percent of normal	As established by flight inspection but ≥80 percent of normal	Same as initial
(3) Two-frequency (EFGS)				
(a) Course Transmitter		68 percent of normal	As established by flight inspection but ≥63 percent of normal	Same as initial
(b) Clearance Transmitter		60 percent of normal	As established by flight inspection but ≥50 percent of normal	Same as initial *
d. Modulation Level Alarm.	5-43, 5-44, 5-45, 5-46			
(1) Course monitor				
(a) Low		SDM = 76 percent	SDM ≥72 percent	Same as initial
(b) High		SDM = 84 percent	SDM ≤86 percent	Same as initial

[1] The standard value may be increased by flight inspection requirements. In these instances the initial and operating tolerances shall equal or exceed the standard. Where there are both near-field and integral RF monitors, these tolerances apply to integral monitors.

SECTION 2. GLIDE SLOPES (Continued)

SUBSECTION 2. EXECUTIVE MONITOR PARAMETERS (Continued)

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*	
			Initial	*Operating*
* **(2) Clearance monitor**		76 percent	As established by flight inspection but ≥68 percent	Same as initial *
e. Antenna Signal Attenuation Alarm ..... **(CEGS Only).**	3-60, 5-45			
(1) Upper antenna.....		5.0 dB	As established by flight inspection but not to exceed 5.0 dB	Same as initial
(2) Middle antenna		1.5 dB	As established by flight inspection but not to exceed 2.0 dB	Same as initial
f. Middle Antenna Dephasing Alarm ..... **(CEGS Only).**	3-60, 5-45	15° advanced and retarded from normal	As established by flight inspection but not to exceed 20°	Same as initial
g. Main SBO Dephasing Alarm.				
* **(1)** NRGS	5-43	30° advanced and retarded from normal	As established by flight inspection but not to exceed 30°	≤ initial value
(2) EFGS	5-46	15° advanced and retarded from normal	As established by flight inspection but not to exceed 15°	Same as initial *
h. Remote Monitor Receiver Alarm.	5-41	Appropriate indication for facility shutdown	Same as standard	Same as standard

SECTION 2. GLIDE SLOPES (Continued)

SUBSECTION 2. EXECUTIVE MONITOR PARAMETERS (Continued)

Parameter	Reference Paragraph	Standard	Tolerance/Limit Initial	Tolerance/Limit Operating
→ **3-51. MONITOR TIME DELAYS.**				
a. Category I. [1, 2]				
(1) Shutdown delay	5-59	5 seconds	≤6 seconds	Same as initial
(2) Auto-restart delay (single equipment)	5-60	≥20 seconds	Same as standard	Same as standard
(3) Auto-reset delay (single equipment)	5-60	≥4.5 minutes	Same as standard	Same as standard
* **(4)** Restoration delay	5-59	≥20 seconds	Same as standard	Same as standard
b. Category II, III. [2, 3]				
(1) Shutdown delay	5-59	≤2 seconds	Same as standard	Same as standard
(2) Cold standby equipment auto-restart delay after main equipment shutdown	5-60	≥20 seconds	Same as standard	Same as standard
(3) Restoration delay	5-59	≥20 seconds	Same as standard	Same as standard
→ **3-52. MONITOR SYSTEM PHASING.**				
a. NRGS.	5-49	Optimum	±5° of standard	Same as initial
b. SBRGS.	5-51	Optimum	±5° of standard	Same as initial
c. CEGS.	5-53	Optimum	±5° of standard	Same as initial
d. EFGS Path.	5-56	Optimum	±5° of standard	Same as initial *
3-53. Thru 3-59. RESERVED.				

[1] For the end-fire glide slope, the time delay is measured from the time the glide slope station monitor senses an out-of-tolerance condition from its monitored parameter or senses an alarm condition from the snap-down monitor.

[2] The parameters specified in this paragraph are maximum times allowed for the category. For specific adjustment procedures, refer to the applicable instruction book.

[3] At GRN-29 facilities, this is the time for the main equipment to shut down without a transfer after a monitor alarm. The standby equipment should not energize before the period specified in paragraph 3-51.

SECTION 2. GLIDE SLOPES (Continued)

SUBSECTION 3. REFERENCE PARAMETERS

Parameter	Reference Paragraph	Standard	Tolerance/Limit Initial	Tolerance/Limit Operating
3-60. AIRBORNE MEASUREMENTS. [1, 2]	6-5			
a. Flight Inspection Path Angle.				
(1) Normal				
(a) Cat I, II		Commissioned angle (CA)	CA ±0.05°	CA +10.0, –7.5 percent
(b) Cat III		Commissioned angle (CA)	CA ±0.05°	CA ±4 percent
(2) High-angle alarm[3]		CA +0.05°	CA +0.25°	CA +10.0 percent
(3) Low-angle alarm[3]		CA –0.05°	CA –0.15°	CA –7.5 percent
(4) All other alarm conditions (except RF)		CA ±0.10°	CA –0.15° to CA +0.25°	CA –7.5 percent to CA +10.0 percent
b. Flight Inspection Path Width.				
(1) Normal		0.70°	0.65° to 0.75°	0.50° to 0.90°
(2) Wide alarm		0.80°	0.75° to 0.87°	≤0.90°
(3) Narrow alarm		0.60°	0.53° to 0.65°	≥0.50°
(4) All other alarm conditions (except RF)		0.80°	0.53° to 0.87°	≤0.90°
c. Flight Inspection Structure Below Path (Angle for 190 μA).				
(1) Normal		≥70 percent of CA	≥50 percent of CA	≥30 percent of CA
(2) All other alarm conditions (except RF)		≥60 percent of CA	≥40 percent of CA	≥30 percent of CA

[1] The operating tolerances in paragraph 3-60(a) through 3-60(d) are the flight inspection tolerances/limits as published in OA P 8200.1, U.S. Flight Inspection Manual. The initial tolerance for any of these parameters (i.e., angle, width, SBP, and symmetry) shall be met before a valid reference value for that parameter can be established or re-established.

[2] Airborne measurements on standby equipment shall be in accordance with the latest edition of Order 8200.1.

[3] These tolerances apply to path angle changes caused by parameters other than modulation balance. It is inappropriate to flight inspect modulation balance changes for any type of GS. Tolerances are only applicable to SBRGS & EFGS.

SECTION 2. GLIDE SLOPES (Continued)

SUBSECTION 3. REFERENCE PARAMETERS (Continued)

Parameter	Reference Paragraph	Standard	Tolerance/Limit Initial	Tolerance/Limit Operating
* **d. Path Symmetry (in normal).**				
(1) Cat I		50 percent	60 to 40 percent	67 to 33 percent
(2) Cat II, III		50 percent	55 to 45 percent	58 to 42 percent *
e. System Dephasing (Advance and Retard). [1,2,3]	5-192			
(1) Main sidebands (NRGS, CE, and SBR)		≤30°	18°to 30°	Same as initial
(2) Middle antenna (CEGS)		≤20°	10° to 20°	Same as initial
(3) Upper antenna (SBRGS)		≤30°	18° to 30°	Same as initial
f. Attenuation (CEGS). [1,2]				
(1) Middle antenna		1.5 dB	≤2 dB	Same as initial
(2) Upper antenna		5 dB	≤5 dB	Same as initial
3-61. GROUND CHECKS (EFGS).	5-42			
a. Snap-Down Points 1, 2, and 3.		As established during reference ground check	±0.025 DDM of standard	±0.040 DDM of standard
b. Normal.				
(1) Points 1, 2, and 3		As established during reference ground check	±0.025 DDM	±0.040 DDM of standard
(2) Points 4 and 5		>0.500 DDM	>0.300 DDM	Same as initial
3-62. RESERVED.				

[1] The standard values for system dephasing and attenuation are greater than initial values because a properly optimized system will withstand larger changes in these parameters.

[2] During a reference flight inspection, each dephasing or attenuation amount must remain within its initial tolerance, and the system must remain simultaneously within the initial tolerance of paragraphs 3-60a(4), b(4), and c(2) before a valid reference can be established. During non-reference flight inspections, while dephasing or attenuating the same amount as selected during the reference inspection, the system must remain simultaneously within the operating tolerance of paragraphs 3-60a(4), b(4), and c(2).

[3] System dephasing tolerances do not apply to end-fire glide slopes.

SECTION 2. GLIDE SLOPES (Continued)

*

SUBSECTION 4. STANDBY MONITOR PARAMETERS

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*	
			Initial	*Operating*
3-63. MONITOR ALARM POINTS(dual equip.). [1]				
a. Path Alarm (0.000), 90 and 150 Hz	5-9	0.006 DDM	Same as standard	Same as standard
b. Width Alarm (0.175)	5-9			
(1) Wide		0.168 DDM	Same as standard	Same as standard
(2) Narrow		0.182 DDM	Same as standard	Same as standard
c. RF Power Alarm(s) (100.0%).	5-9	95.0%	Same as standard	Same as standard
d. Modulation Alarm. (80.0% CLR and SDM) Sum of Depth of Modulation.	5-9			
(1) Low		77%	Same as standard	Same as standard
(2) High		83%	Same as standard	Same as standard
e. Monitor Time Shutdown Delay.	5-9	≤15 seconds	Same as standard	Same as standard
3-64. RESERVED.				

[1] Values in parentheses are the nominal monitor values used for a normal transmitter. Direct reading on the monitor, assuming use of the indicated nominal value, sets initial alarm limits. *

SECTION 3. 75 MHZ ILS MARKERS

3-65. GENERAL. This section prescribes the standards and tolerances for all 75 MHz ILS marker facilities as defined and described in Order 6000.15, General Maintenance Handbook for Airway Facilities.

3-66. thru 3-69. RESERVED.

SUBSECTION 1. NORMAL TRANSMITTER PARAMETERS

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*	
			Initial	*Operating*
→ **3-70. RF CARRIER POWER LEVEL.**	5-70	As established by flight inspection	98 to 102 percent of standard	90 to 110 percent of standard
→ **3-71. MODULATION LEVEL.**	5-71	95 percent	93 to 97 percent	91 to 99 percent
→ **3-72. FREQUENCY.**	5-75			
a. Carrier.				
(1) Conventional		75.000 MHz	±2250 Hz of standard	±3750 Hz of standard
(2) Offset frequency operation		75.004 MHz and 74.996 MHz	±1500 Hz of standard	Same as initial
b. Modulation Tones.				
(1) Outer marker		400 Hz	399 to 401 Hz	396 to 404 Hz
(2) Middle marker		1300 Hz	1297 to 1303 Hz	1287 to 1313 Hz
(3) Inner marker		3000 Hz	2992 to 3008 Hz	2970 to 3030 Hz
3-73. ANTENNA SYSTEMS.				
→ **a. Reflected power level (VSWR).**	5-121, 5-124	1.0:1	≤1.67:1	≤1.75:1
b. Insulation resistance.	5-132	Infinity	≥50 megohms	≥20 megohms
c. DC Resistance.	5-133	Baseline measurement	≤ Standard +5 Ω	Same as initial
→ **3-74. ANTENNA SYSTEM (COLLINEAR ARRAY).**				
a. Antenna Current Balance Ratio.	5-211	1.0:1	≤1.05:1	≤1.1:1
b. Electrical Length of Phasing Sections (Collinear Dual Dipoles).	5-210	Y section equal to X section plus 180°	±2° of standard	±4° of standard
3-75. thru 3-79. RESERVED.				

SECTION 3. 75-MHZ ILS MARKERS (Continued)

SUBSECTION 2. EXECUTIVE MONITOR PARAMETERS

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*	
			Initial	*Operating*
→ **3-80. MONITOR ALARM POINTS.**	5-72			
a. Carrier Power.[1]		60 percent of normal	≥50 percent of normal	Same as initial
b. Modulation.				
(1) Non-Measured System				
(a) Loss of tone		Alarms	Same as standard	Same as standard
(b) Continuous tone		Alarms	Same as standard	Same as standard
(2) Measured System				
(a) Low modulation		85 percent	≥80 percent	Same as initial
(b) High modulation		99 percent	≤99 percent	Same as initial
c. VSWR (for systems with VSWR monitoring).		2.5:1	≤3.0:1	Same as initial
→ **3-81. AUTOMATIC TRANSFER AND/OR SHUTDOWN.**	5-73	15 seconds	≤30 seconds	≤30 seconds
3-82. thru 3-84. RESERVED.				

[1] This is not a parameter that needs to be checked by flight inspection.

SECTION 4. BUILT-IN TEST EQUIPMENT (BITE)

3-85. GENERAL. This section prescribes the standards and tolerances for built-in test equipment (BITE) as defined and described in Order 6000.15, General Maintenance Handbook for Airway Facilities.

3-86. thru 3-89. RESERVED.

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*	
			Initial	*Operating*
3-90. VERIFICATION OF BUILT-IN TEST EQUIPMENT (BITE). [1]				
* **a. Power Measurement Error.**	5-81, 5-85, 5-86	0.0 percent	≤5.0 percent (2.5% voltage)	Same as initial
b. VSWR Measurement Error.	5-81, 5-87	2.0:1	1.8 to 2.2:1	Same as initial *
c. Modulation Percent Measurement Error.	5-82			
(1) Localizer Course and Clearance, Glide Slope Course		0.0 percent	± 1.5 percent	Same as initial
(2) Glide Slope Clearance, Marker Beacons		0.0 percent	± 3.0 percent	Same as initial
d. Difference in Depth of Modulation (DDM) Measurement Error.	5-83	0.000 DDM	± 0.002 DDM	Same as initial
e. Frequency Separation Measurement Error.	5-84	0.0 Hz	±50.0 Hz	Same as initial
3-91. thru 3-94. RESERVED.				

[1] Refer to the designated maintenance procedures for equations and examples on how to determine if the parameter is in tolerance.

SECTION 5. REMOTE MAINTENANCE MONITOR (RMM)

3-95. GENERAL. This section prescribes the standards and tolerances for all remote maintenance monitor (RMM) (both analog and digital RMM) for ILS facilities as defined and described in Order 6000.15, General Maintenance Handbook for Airway Facilities.

3-96. thru 3-99. RESERVED.

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*	
			Initial	*Operating*
3-100. ANALOG SYSTEMS. (e.g., ARMS, RMS)	5-90			
a. DDM Indications.		Indication on data terminal same as local indication	±0.002 DDM	±0.002 DDM
b. Other Indications Required For Certification.		Indication on data terminal same as local indication	±3 percent of local reading	±5 percent of local reading
c. Other Indications Not Required For Certification.		Indication on data terminal same as local indication	Standard ±8 percent	Standard ±10 percent
3-101. DIGITAL SYSTEMS. (e.g., Mark 20).....	5-91			
a. Digital Indications.		Indication on data terminal same as local indication	±1 least significant digit (LSD)	Same as initial
b. Parameters Locally Measured By Meters Or External Test Equipment.				
(1) DDM indications		Indication on data terminal same as local indication	±0.002 DDM	Same as initial
(2) Other indications		Indication on data terminal	±3 percent of local reading	±5 percent of local reading
3-102. thru 3-104. RESERVED.				

CHAPTER 4. PERIODIC MAINTENANCE

4-1. GENERAL.

a. Description. This chapter establishes the maintenance activities that are required for ILS facilities on a periodic basis and provides the schedules for their accomplishment. The chapter is divided into two sections. The first section identifies the performance checks (i.e., tests, measurements, and observations) of normal operating controls and functions which are necessary to determine whether operation is within established tolerances/limits. The second section identifies other maintenance tasks which are necessary to prevent deterioration and/or ensure reliable operation. Refer to Order 6000.15, General Maintenance Handbook for Airway Facilities, for additional guidance.

b. Application. These schedules apply to all ILS facilities. When a conflict exists between this handbook and other handbooks or equipment instruction books, this handbook takes precedence.

c. Reference Paragraphs. The reference paragraphs in the maintenance procedure columns are listed to show only the basic paragraphs wherein the specific procedures are found. Only the subparagraph(s) directly applicable to the item(s) being checked apply.

4-2 thru 4-9. RESERVED.

SECTION 1. PERFORMANCE CHECKS

SUBSECTION 1. LOCALIZERS

Performance Checks	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
* **4-10. MONTHLY.** Complete a line entry of normal equipment parameters for each set of equipment installed.	--	5-10
4-11. QUARTERLY.		
a. Perform normal (both equipments if dual) ground check.....	3-31	5-12
b. Check monitor alarm points.	3-20	5-13
c. Check monitor shutdown function of each set of equipment ..... installed.	--	5-11 *
4-12. SEMIANNUALLY.		
a. Check modulations.....	3-11	5-14, 5-15
b. Check antenna system phasing.....	3-14	5-16

SUBSECTION 1. LOCALIZERS - (Continued)

Performance Checks	Reference Paragraph: Standards and Tolerances	Reference Paragraph: Maintenance Procedures
4-13. ANNUALLY.		
a. Measure frequencies.	3-13	5-18
b. Check audio phasing.	3-12	5-19
c. Check time delays.	3-21	5-20
d. Check auto-reset/restart.	3-21	5-21
* **e.** Check sideband null.	3-31	5-22, 5-23
f. Check standby monitor.	3-33	5-9 *
4-14. AS REQUIRED.		
a. Immediately preceding monitor flight inspection: [1]		
(1) Check modulations.	3-11	5-14, 5-15
(2) Check air-to-ground (a-g) transceiver operation.	Order 6600.21, Maintenance of Communication Transceivers	5-221
(3) Perform normal ground check.	3-31	5-12
* **(4)** Dual Equipment Matching.	--	5-8 *
b. Immediately following monitor flight inspection (that established new reference values), perform reference ground check. Update monitor references (if needed).[2]	3-31	5-175
c. Check monitor system phasing.	3-22	5-17
4-15. thru 4-19. RESERVED.		

[1] Reference 6-31 & 6-32 for additional information.

[2] Reference 6-37 for additional information.

SUBSECTION 2. GLIDE SLOPES

Performance Checks	Reference Paragraph: Standards and Tolerances	Reference Paragraph: Maintenance Procedures
* **4-20. MONTHLY.** Complete a line entry of normal equipment parameters for each set of equipment installed.	--	5-40
4-21. QUARTERLY.		
a. Perform ground check (end-fire only; both equipments if dual).	3-61	5-42
b. Check monitor alarm points.	3-50	5-43 thru 5-46
c. Check monitor shutdown function of each set of equipment installed.	--	5-41
4-22. SEMIANNUALLY.		
a. Check modulations.	3-41	5-47
b. Check antenna system phasing.	3-44	5-190, 5-54, 5-55 *
4-23. ANNUALLY.		
a. Measure frequencies.	3-43	5-57
b. Check audio phasing.	3-42	5-58
c. Check time delays.	3-51	5-59
d. Check auto-reset/restart.	3-51	5-60
* **e.** Check standby monitor(s).	3-63	5-9 *

* **SUBSECTION 2. GLIDE SLOPES – (Continued)**

Performance Checks	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
4-24. AS REQUIRED.		
a. Immediately preceding monitor flight inspection: [1]		
(1) Check modulations	3-41	5-47
(2) Check a-g transceiver operation	Order 6600.21, Maintenance of Communication Transceivers	5-221
(3) Perform ground check (end-fire only)	3-61	5-42
(4) Dual Equipment Matching	--	5-8
b. Immediately following monitor flight inspection (that established new reference values): [2]		
(1) Perform reference ground check (end-fire only)	3-61	5-42
(2) Update monitor references (if needed)	--	5-62
c. Check monitor system phasing.	3-52	5-49, 5-51, 5-53, 5-56
4-25. thru 4-29. RESERVED.		

[1] Reference 6-31 & 6-32 for additional information.

[2] Reference 6-37 for additional information.

SUBSECTION 3. 75-MHZ ILS MARKERS

Performance Checks	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
4-30. SEMIANNUALLY.		
a. Check RF power	3-70	5-70
b. Check modulation.	3-71	5-71
c. Check monitor alarm points.	3-80	5-72
d. Check automatic transfer/shutdown.	3-81	5-73
e. Check alternate equipment (dual systems).	--	5-74
4-31. ANNUALLY. Measure frequencies.	3-72	5-75
4-32. thru 4-39. RESERVED.		

SUBSECTION 4. BUILT-IN TEST EQUIPMENT (BITE)

Performance Checks	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
4-40. ANNUALLY.[1]		
* **a.** Power output check.	3-90a	5-86
b. VSWR measurement.	3-90b	5-87
c. Modulation percentage.	3-90c	5-82
d. Difference in depth of modulation.	3-90d	5-83
e. Frequency separation.	3-90e	5-84
4-41. AS REQUIRED.		
a. Initial installation.	3-90	5-80 thru 5-84
b. Replacement of module containing BITE circuitry.	3-90	5-80 thru 5-84
c. Power output and VSWR verification.	3-90a	5-81, 5-85 *
4-42. thru 4-49. RESERVED.		

[1] A line entry shall be made on a Form 6000-8 recording the five BITE portable maintenance data terminal (PMDT) readings vs. the external standard test equipment measurements and the final adjusted measurement(s) if made. A separate Form 6000-8 shall be utilized for each set of equipment (i.e., No:1 and No:2 GS equipment).

SUBSECTION 5. REMOTE MAINTENANCE MONITOR (RMM)

Performance Checks	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
4-50. SEMIANNUALLY. Verify remote maintenance monitor data (analog system).	3-100	5-90
4-51. ANNUALLY. Verify remote maintenance monitor data (digital system).	3-101	5-91
4-52. thru 4-59. RESERVED.		

SECTION 2. OTHER MAINTENANCE TASKS

SUBSECTION 1. ILS FACILITIES

Maintenance Tasks	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
4-60. MONTHLY. Perform equipment time update for facilities with remote set capability.	--	5-112
4-61. QUARTERLY.		
a. Check all warning and critical area signs.	--	5-110
b. Check vegetation control.	--	5-110
c. Environmental Encroachment.	--	5-114
4-62. SEMIANNUALLY.		
a. Check equipment air filters.	--	5-110
b. Perform PIR audio calibration.	--	5-111
c. Perform equipment time update.	--	5-112
4-63. ANNUALLY.		
a. Clean/inspect all equipment.	--	5-110
b. Check/perform PIR rf/audio calibration (PIR's capable of field RF calibration).	--	5-111
c. Perform backup power (battery) check.	--	5-113
4-64. AS REQUIRED.[1] Check test equipment calibration due dates as noted on calibration labels and forward for calibration as needed.		
4-65. thru 4-69. RESERVED.		

[1] Certain PIR models, manufactured by NAVAIDS, THALES ATM, and ASII, have or are being modified for extended calibration cycles (i.e. four years).

SUBSECTION 2. ILS ANTENNAS

Maintenance Tasks	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
4-70. ANNUALLY.		
a. Measure VSWR at transmitter.	3-15, 3-45, 3-73	5-121
b. Check EFGS clearance monitor antenna location.	3-45	5-122
c. Check EFGS air system integrity.	--	5-123
d. Check Glide Slope antenna RF power distribution.	3-40	5-125, 5-126
4-71. AS REQUIRED. Measure VSWR at antenna feed lines.	3-15, 3-45, 3-73	5-124
4-72. thru 4-79. RESERVED.		

SUBSECTION 3. ILS TRANSMISSION LINES

Maintenance Tasks	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
4-80. ANNUALLY. Inspect RF cables.	--	5-131
4-81. AS REQUIRED.		
a. Measure RF cable insulation resistance.	3-15, 3-45, 3-73	5-132
b. Measure RF cable dc resistance (Except V-Ring).	3-15, 3-45, 3-73	5-133
4-82. thru 4-89. RESERVED.		

CHAPTER 5. MAINTENANCE PROCEDURES

5-1. GENERAL. This chapter establishes the procedures for accomplishing the various essential maintenance activities which are required for ILS facilities, on either a periodic or incidental basis. The chapter is divided into three sections. The first section is divided into five subsections: localizer, glide slope, 75 MHz markers, built-in test equipment (bite), and remote maintenance monitor (RMM), and describes the procedures to be used in making the performance checks listed in chapter 4, section 1. The second section is divided into three subsections: ILS facilities, ILS antennas, and ILS transmission lines, and describes the procedures for performing the tasks listed in chapter 4, section 2. The third section is divided into five subsections describing special tasks relating to all subsystems in general and specifically to localizers, glide slopes, and 75 MHz markers; usually nonscheduled and not listed in chapter 4. Refer to Order 6000.15, General Maintenance Handbook for Airway Facilities, for additional general guidance.

5-2. thru 5-4. RESERVED.

SECTION 1. PERFORMANCE CHECK PROCEDURES

5-5. GENERAL.

a. Contents of Subsections. Each subsection establishes the procedures for accomplishing the various essential maintenance activities that are common to each subsystem (localizer, glide slope, etc.) of the instrument landing system. In some procedures, the actual measurement of the parameter requires the adjustment of the parameter being measured. In these cases, the measurement and adjustment procedures are combined into one procedure. The results of these tests, measurements and observations shall be compared to the prescribed tolerances and limits of Chapter 3. Refer to Order 6000.15, General Maintenance Handbook for Airway Facilities, for additional general guidance.

* **WARNING:** The following procedure(s) may produce Hazardously Misleading Information (HMI). Before proceeding, refer to paragraph 1-6 and follow the specific HMI guidance provided. Failure to follow this guidance can result in Controlled Flight Into Terrain (CFIT). The duration and frequency of radiating HMI must be kept to a minimum by any means necessary, as required by Order 6000.15, paragraphs 307, 425, and 432. *

b. Use of Unspecified Procedures. The maintenance procedures in this handbook were developed for known equipment types and use test equipment available at the time this handbook was prepared. These procedures are not the only possible methods of performing maintenance checks on FAA facilities. As new operating and test equipment is introduced, better methods of performing some maintenance checks will become apparent. With the advent of RMM, it is possible to complete certain maintenance and certification activities via data terminals. Use of RMM capabilities is preferred over manual collection when these capabilities satisfy data collection and analysis. Lack of mention in this handbook does not preclude the use of newer methods of performing maintenance checks with more sophisticated test equipment. An example of this situation is the use of the vector voltmeter to perform measurements on rf components. Although it is not specifically specified in this handbook it is permissible to utilize the vector voltmeter for many rf measurements presently being done with thruline rf wattmeter, such as vswr checks, power distribution checks, and attenuation checks. Such use of sophisticated test equipment is not only permissible, but encouraged. However, it is the responsibility of the certifying system specialist to ensure that any alternate procedure or method used in performing any maintenance activity fully and completely satisfies the requirements contained in this and associated FAA orders.

* **c. Measurements.** Data should be recorded with the minimum number of significant digits required to properly maintain the facility. For parameters not listed in the table 5-1 below, data shall be recorded with at least the same resolution of significant digits as found in the most restrictive column of the Chapter 3 standards, initial, or operating tolerances. Parameters designated, as "Established by Flight Inspection" should be recorded with the minimum number of digits required so that these values can be reasonably repeated.

TABLE 5-1. PARAMETER RESOLUTION (DIGITAL)

Parameter	Resolution
Loc/GS/Marker Course Carrier Power	0.1 W
Localizer Clearance Carrier Power	0.1 W
CEGS Clearance Carrier Power	0.01 W
End Fire GS Clearance Carrier Power	0.1 W
Loc/GS Sideband Power	1 mW
SBR GS Upper Antenna Power	1 mW
Modulations (SDM)	0.1 %
Modulation Equality (DDM)	0.001 DDM
Phasing	1°
Attenuation	0.1 dB
Thru-line voltage references	0.001 V

*

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

* **(1) Recording of Analog Data.** Analog data for ILS facilities is typically limited to the measurement and recording of analog powers. Use of analog power meters requires the proper selection of elements to assure adequate resolution and proper care and usage to assure adequate repeatability.

(a) Wattmeter components. When using a BIRD wattmeter for power measurements, the same set of RF bodies, wattmeter, and elements must be utilized due to the variability of these wattmeter components. The elements shall be clearly marked for its assigned measurement. To assure adequate resolution, detector elements should be selected with the smallest full-scale rating that will cover the range of values to be measured.

(b) Supplemental voltmeter readings. Supplementing the wattmeter references on the reference line of technical performance records (TPR) with digital voltmeter (DVM) readings provides an easier to read reference to aid in the adjustment of powers to the wattmeter references. Line entries must be documented in watts as read off the power meter.

(2) Recording of Digital Data. Digital test equipment often displays measurements to a resolution that is much finer than reasonable for the maintenance of ILS. The documentation of the following digitally displayed parameters will be rounded off to the nearest unit in accordance with the following table. References that are documented to a finer resolution will be treated in accordance with the above table and shall be converted accordingly on subsequent Technical Performance Record forms.

(3) Verification of References (Digital and Analog). For the purpose of defining "equal", such as verification of flight inspection references (Refer to Order 6750.49A, paragraph 6-32), often the resolution of the measurement (particularly for digital measurements) is unnecessarily tight to properly maintain ILS facilities. Verification is achieved if the documented measurements are within the following limits of the established reference:

Loc/GS/Marker Course Carrier Power	+/- 0.1	Watt
Localizer Clearance Carrier Power	+/- 0.1	Watt
CEGS Clearance Carrier Power	+/- 0.01	Watt
End Fire GS Clearance Carrier Power	+/- 0.1	Watt
Localizer Sideband Power	+/- 2	%
Glide Slope Sideband Power	+/- 1	mW
SBR GS Upper Antenna Power	Exact	
Modulation	0.5	%
Loc Course Modulation Equality	Exact	*
* Loc Clearance Modulation Equality	+/-0.001	DDM
Glide Slope Modulation Equality	+/-0.001	DDM
Phasing	Exact	
Attenuation	Exact	
Thru-line voltage references	+/-1	%

d. Using a 1400-ohm precision resistor when using a DVM for reference readings. When using a DVM, the use of a 1400-ohm precision resistor is recommended. This is done by connecting a DVM, set to measure dc voltage, to the detector element output in place of the normal meter. Improved consistency in DVM readings will result if the DVM input is shunted with a 1400Ω ±1 percent resistor. This resistor represents the same load to the detector elements as the normal analog meter. If the reference readings are made with the load resistor in place, any further use must be made in this configuration. *

5-6. ENTRIES ON TECHNICAL PERFORMANCE RECORD FORMS.

a. General Guidance Document. Order 6000.15 contains policy, guidance, and detailed instructions for field use of technical performance record forms as applicable to ILS facilities. Entries shall be made in accordance with the instructions published in Order 6000.15.

b. Use of General Purpose Forms and Computer Generated Data Reports. FAA Form 6000-8 is to be used for recording parameters of new equipment for which existing forms or computer generated reports are not available or applicable. Recent ILS procurements have provided for equipment that is computer controlled and have available various forms of computer generated data reports. To reduce the amount of maintenance time spent in transposing data from computer generated reports to FAA forms, some of the computer generated data reports may be used in lieu of the corresponding FAA form for the official maintenance record. Computer generated data reports may be completed remotely, thereby saving a site visit. Individual maintenance procedures contained in this chapter will indicate when a computer generated data report may be used in lieu of a FAA form, the particular report required, and the procedure to generate the report.

c. Sample Forms. Examples of technical performance record forms are in appendix 2 of this order. Entries on these forms shall be made when and as specified in chapters 4 and 5 of this order. Each numerical entry must include enough significant figures to show whether the parameter meets applicable tolerances.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

d. Specialized Guidance on the Preparation of ILS Technical Performance Record Forms.

(1) An ILS technical performance record form shall be replaced with a new form only under the following circumstances:

(a) When the previously used form has been filled.

(b) When new standard or operating tolerance values are prescribed in changes to this handbook.

(c) When new reference values or tolerances are established for the facility, whether due to flight inspection discrepancies or for other reasons.

(d) If the current form has become damaged or has otherwise deteriorated to the point that replacement is necessary.

NOTE: The forms do not need to be replaced at the beginning of each calendar year.

* **(2)** For the purposes of completing forms referenced by this handbook, the following definitions shall apply:

(a) Standard shall be the standard value specified in chapter 3 of this handbook.

(b) Operating tolerances for standard values shall be the values specified as operating tolerance/limit in chapter 3 of this handbook. *

(c) Reference shall be a value derived from flight inspection data. Further guidance for determining reference values is found in this chapter.

(d) Operating tolerances for reference values shall be derived from flight inspection data and tolerances specified in chapter 3 of this handbook. This chapter contains further guidance for determining tolerance for reference values.

* **e. Required Forms.** The FAA forms listed in table 5-2 are the minimum requirements for the recording of equipment data, computer generated data reports which document the same parameters may be used in lieu of the required forms, where applicable. *

*

TABLE 5-2. ILS MAINTENANCE FORMS

FAA FORM NUMBERS	*TITLE*	*APPLICATION*
6750-3	Localizer Flight Inspection Data Work Sheet	All localizers
6750-4	Glide Slope Flight Inspection Data Work Sheet	All glide slopes
6750-22	Localizer and Glide Slope Delays/ Feedlines/ Sideband Null	All localizers/glide slopes
6750-23	Localizer Normal Ground Check	All localizers
6750-24	Localizer Monitor Reference Data	All localizers
6750-26	All Glide Slope Normal Radiated Parameters	All glide slopes
6750-27	NRGS Monitor Reference Data	All null-reference glide slopes

*

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

* **TABLE 5-2. ILS MAINTENANCE FORMS (Continued)**

FAA FORM NUMBERS	*TITLE*	*APPLICATION*
6750-28	SRGS Monitor Reference Data	All sideband-reference glide slopes
6750-29	CEGS Monitor Reference Data	All capture-effect glide slopes
6750-30	EFGS Ground Check	All end-fire glide slopes
6750-31	EFGS Monitor Reference Data	All end-fire glide slopes
6750-32	Modulation/Frequencies	All localizers/glide slopes
6750-33	ILS Built-In Test Equipment (BITE)	Mark 20/20A localizers/glide slopes/markers
6770-4	ILS 75 MHz Marker	All 75 MHz markers

*

5-7. GROUND CHECKS.

a. General. The information presented in this paragraph applies to all localizer facilities.

(1) Ground checks of localizer radiated signals, using a portable ILS receiver (PIR), provide a useful method of evaluating overall system performance. They are required on a periodic basis to ensure that the radiated signal has not changed due to changes of the localizer antenna array, the environment around the array, or the localizer equipment. Reference ground check data establishes the reference data base that is used by the systems specialist to ensure that the localizer radiated signal is maintained within flight inspection tolerances. With a few exceptions, this will also allow the specialist to restore a facility without a confirming flight inspection.

(2) Three types of ground checks may be used in the maintenance of ILS localizers. They are normal, monitors, and reference ground checks.

(a) A normal ground check is the taking of data at the established check points with the transmitting equipment operating normally. The parameters measured are course position, course width and clearance.

(b) A monitors ground check includes all the data taken by a normal ground check plus course position and width data with the facility in the alarm conditions. The monitors ground check may be used to ensure that the monitor alarms at or before the radiated signal reaches the alarm limits established during flight inspection.

(c) The reference ground check includes all normal ground check data. Reference ground check data provides a means of correlating current conditions to those at the time of the last reference ground check (when initial airborne tolerances were met).

b. When Ground Checks Are Required. Ground checks are required under any of the following conditions:

(1) Reference Ground Checks. This check shall be completed within 8 hours of flight inspection and shall be completed before returning the facility to service.

(a) Upon completion of flight inspection for purposes of commissioning a new facility.

(b) Upon completion of any monitors flight inspection that requires a change to the facility reference values. This will result whenever a flight inspection discrepancy occurs, or when new radiated signal or monitor parameters are necessary. These parameters include carrier power, sideband power, modulation balance, etc. Only changes required during flight inspection need be updated on the reference ground check. However, changes that the specialist makes to establish new, tighter reference operating limits, if past flight check indicated this action to be prudent, do not require a new reference ground check.

(2) Monitor Ground Checks. (Optional)

(a) May be used in troubleshooting efforts.

(b) Refer to paragraph 5-13 for a procedure to determine if the localizer monitor alarm points are within

the reference values established during the reference flight inspection.

(3) Normal Ground Checks.

(a) Periodically, as required by chapter 4.

(b) After an aircraft accident.

(c) Before a scheduled monitor flight inspection. This may be accomplished up to 5 days before the monitors flight inspection.

(d) After a monitors flight inspection, if a normal ground check was not performed prior to the inspection.

(e) When, in the judgment of the specialist, it is required to confirm facility operation.

* **5-8. Dual Equipment Matching.**

a. General. The following paragraphs provide direction for verifying uniformity between dual transmitters (main and standby).

b. Background. For dual equipment systems, flight inspection typically checks the standby equipment only in its normal configuration. Monitors are verified on the main equipment and these references are matched to the standby equipment. In cases where maintenance cannot determine if transmitters are sufficiently matched, references of both transmitters will have to be validated by flight inspection.

c. Transmitter Matching. Transmitters are matched to the extent possible by measurement and/or calibration of radiated parameters (i.e. powers, phasing, modulation equality) at a point common to both transmitters. The common point is typically at a RF thru-line body permanently installed between the output of the changeover relay and the input of any common distribution network. Monitor action, ground checks, and flight inspection results of normal conditions are also "common point" means of supporting a judgment that transmitters are matched.

(1) Flight Inspection Requirements. For dual equipment systems, flight inspection will typically check monitors on only one transmitter under the assumption that the matching of transmitter powers, phasing, and modulation is a maintenance action verifiable without the airborne measurements. In cases where maintenance * cannot judge that transmitters are sufficiently matched, references of both transmitters will have to be validated by flight inspection.

(2) Maintenance Requirement. Maintenance personnel must use their judgment to determine whether transmitters are properly matched to support a facility certification without a full validation flight inspection of both transmitters.

(a) The primary basis for this judgment is the following:

1 References for the various powers are equal on both transmitters in accordance with paragraph 5-5.c.

2 Reference transmitter phasing is equal on both transmitters in accordance with paragraph 5-5.c.

3 Reference transmitter modulations (SDM and DDM) are equal on both transmitters in accordance with paragraph 5-5.c. Localizer DDM matching must consider measurement of both transmitters at a common point (CSB RF thru-line), in order to take into account variations due to calibration uncertainties.

(b) Additionally, the following are also indicators to assure transmitter matching:

1 Monitor readings indicate matched transmitters.

2 Localizer ground check measurements indicate matched transmitters.

3 Periodic-with-Monitors flight inspection of both transmitters under normal conditions support equality considering flight inspection repeatability.

5-9. Standby Monitor.

a. Object. This procedure provides a method to check the operation of the standby monitor at dual equipment facilities.

b. Discussion. The standby monitor signal is formed typically by a simple combining network located in the controlled environment of the equipment rack. Very little drift is expected, since the network is not subjected to the same environmental rigors as the antenna system. With the intention of maintaining the standby transmitter in a near optimum condition, and to minimize the requirement *

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

* for maintenance verification, monitoring limits on the standby transmitter are much tighter than those typical of the operating transmitter. Standby monitor limits are set as specific values unlike the executive (main transmitter) monitor, for which the transmitter is adjusted to reference radiated parameters and the monitor limits are set to assure alarm action. Match the abnormal settings (alarm points) to the main transmitter. Flight inspection is only required to check the standby equipment in the normal configurations.

c. Test Equipment Required.

(1) PMDT as necessary

(2) Device suitable to measure time

d. Conditions. Coordination with the remote status monitor point is required for alarm verification. Since this test involves only the standby transmitter, an outage is not required. *

* **e. Detailed Procedure.**

(1) By direct observation of the standby monitor(s), assure alarm settings are within the operating tolerances of chapter 3.

(2) Initiate a continuous alarm condition on the standby transmitter, and measure the time between initiation of the alarm condition and the standby transmitter shutdown.

(3) Assure this measurement meets the operating tolerance of chapter 3. Correct as necessary.

(4) Confirm proper status indication is received at the monitor point.

(5) Return equipment to normal. *

SUBSECTION 1. LOCALIZERS

5-10. LINE ENTRY OF NORMAL READINGS.

a. Object. This procedure provides a method to complete a line entry of the normal parameters on FAA Form 6750-24, with the equipment in normal configuration.

b. Discussion. A line entry of the localizer normal parameters is required before a normal ground check and periodically as required in chapter 4. This check is made without adjustment to the equipment and can be performed from a remote maintenance monitor (RMM). Computer generated data reports may be used in lieu of FAA form.

c. Test Equipment Required.

(1) A portable ILS receiver (PIR).

(2) A digital voltmeter (dvm) (optional).

(3) The facility rf wattmeter and/or built-in test equipment (BITE).

NOTE: Chapter 1, Paragraph 1-2b, Test Equipment, discusses external test equipment and BITE, and their proper use in the NAS. Particular attention must be paid to the proper use and maintenance of test equipment to ensure accurate evaluations of equipment operation. For instance, when using a BIRD wattmeter for power measurements, the same set of rf bodies, wattmeter, and elements must be utilized due to the variability of the wattmeter components. For BITE, proper calibration and verification of measurements are required.

d. Conditions. The facility is operating normally. For facilities that are equipped with standby equipment, switch standby equipment on-line to take readings.

e. Detailed Procedure. At the local site or RMM location, perform the following steps.

(1) Measure and record the normal carrier power on FAA Form 6750-24. Confirm that the power is within the established tolerance value. If not within tolerance, corrective action is required.

(2) Measure and record the normal sideband power on FAA Form 6750-24.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

(3) Measure and record the monitor width DDM, the monitor course DDM, and the modulation equality (carrier feedline DDM) on FAA Form 6750-24.

NOTE: Carrier feedline DDM measurements may differ from audio measurements. This is likely due to the sideband energy coming back down the CSB feedline.

(4) Check the quality of the identification and voice for clarity and correct information. If acceptable, record a check mark under the appropriate column. This check may be omitted when completing the line entry from the RMM.

(5) At two-frequency localizers, complete the steps above for the clearance transmitter.

(6) To obtain a computer generated data report of normal readings for the Mark 20 ILS; log onto the facility to be recorded, check that the transmitter to be recorded is "On Antenna"; from the "Commands" menu depress the key sequence <D E O> for transmitter one; or <D E T> for transmitter two. Hot keys, Alt F5 or Alt F6, may also be used. The report may be printed by depressing the "Print Screen" key and then selecting "P" for print. If desired the report may also be saved to disk by depressing the "D" key.

(7) At all dual equipment facilities complete a normal line entry for each set of equipment.

5-11. LOCAL AND REMOTE MONITOR SHUTDOWN OPERATION.

a. Object. This procedure provides a method to determine that a shutdown is properly sensed at the local and/or remote control points.

b. Discussion. Certain alarms in the ILS equipment shall result in an equipment transfer and/or shutdown. Also, if remotely monitored, an indication that the facility is shut down shall be received at the remote monitor location. This check confirms that the shutdown occurs and that the remote control point is properly notified. This check can also be initiated and monitored from a remote maintenance monitor (RMM) location.

c. Conditions. A facility shutdown is required for this check.

d. Detailed Procedure.

(1) Simulate a continuous alarm, or from the RMM perform a station integrity check.

(2) Allow a shutdown to occur.

(3) Determine that the proper remote and local alarm indications occurred.

(4) If remote restore capability is installed, restore the facility from the remote control point or allow the auto-restart circuit to restore the facility.

(5) Make an entry in the facility log that this check was completed.

5-12. NORMAL GROUND CHECK.

a. Object. This procedure provides a method to determine that the localizer course alignment, width, and clearance are within tolerance.

b. Discussion. Navigational information provided by the localizer is a complex function of the localizer system. It is affected by the airport geometry, antenna system phase and current distribution, and other equipment parameters. The normal ground check provides a system check that is representative of the user's view.

c. Test Equipment Required.

(1) A portable ILS receiver (PIR).

(2) An appropriate antenna.

d. Conditions. The facility is operating normally, and approval has been obtained from air traffic personnel to operate on the ILS runway when required.

e. Detailed Procedure.

(1) Complete a line entry on FAA Form 6750-24 in accordance with paragraph 5-10.

(2) At the edge of course, centerline, and low clearance ground check points on each side of the array, measure the DDM value and record data on FAA Form 6750-23.

(3) Compare the data recorded with the limits established by the reference ground check.

(4) At two-frequency localizers with a commissioned backcourse, complete the steps above, using separate forms for the backcourse. Clearance ground check

points are not required when ground checking the back-course.

5-13. LOCALIZER MONITOR.

a. Object. This procedure provides a method to determine if the localizer monitor alarm points are within the reference values established during the reference flight inspection.

b. Discussion.

(1) The localizer monitor is used to ensure the integrity of the localizer system by permitting the localizer to operate only if certain system parameters are within the limits established during the reference flight inspection. This performance check is accomplished by adjusting the transmitting equipment to cause an executive monitor alarm and then verifying that the radiated parameters are within established reference values. If a radiated parameter is found outside the established reference values, it must be determined if the condition is due to monitor drift. If so, the monitor alarm points must be tightened to ensure that for day-to-day monitor drift, the monitor will alarm whenever the radiated signal parameters are at or beyond the established reference values.

(2) The reference data must be measured carefully. Power measurements must always be accomplished with the same meter and elements. The elements shall be clearly marked. In addition to the rf wattmeter readings, it is recommended that a digital voltmeter (dvm) be used to obtain reference readings for carrier and sideband power in normal, wide, and narrow alarms. These reference readings can be made with greater repeatability using the dvm than by using the analog wattmeter. This is done by connecting a digital voltmeter, set to measure dc voltage, to the detector element output in place of the normal meter. Improved consistency in dvm readings will result if the dvm input is shunted with a 1400 Ω ±1 percent resistor. This resistor presents the same load to the detector elements as the normal analog meter. If the reference readings are made with the load resistor in place, all future measurements must be made in this configuration. When using BITE, proper calibration and verification of measurements are required.

(3) The monitor DDM values are the monitor input values measured with the PIR or monitor digital readout values. No tolerance exists for the DDM values. They are used to detect trends such as system or monitor drift.

(4) This performance check requires a line entry on FAA Form 6750-24. The reference data line contains the reference data used to perform a monitor performance check. The reference data line and reference ground check can be updated only in accordance with paragraph 5-175.

c. Test Equipment Required.

(1) A portable ILS receiver (PIR) and/or BITE.

(2) The facility rf wattmeter or BITE.

(3) An optional digital voltmeter (dvm).

(4) The FA-9438 modulation meter, BITE, or equivalent.

NOTE: Chapter 1, Paragraph 1-2b, Test Equipment, discusses external test equipment and BITE, and their proper use in the NAS. Particular attention must be paid to the proper use and maintenance of test equipment to ensure accurate evaluations of equipment operation. For instance, when using a BIRD wattmeter for power measurements, the same set of rf bodies, wattmeter, and elements must be utilized due to the variability of the wattmeter components.

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedure.

(1) Preliminary actions.

(a) Refer to FAA Form 6750-24 for the applicable reference values.

(b) Verify that the SDM and DDM are set to reference values. Check carrier power and if required, adjust to the reference value as established on FAA Form 6750-24. Adjustments should be made as accurately as possible, as they will affect the subsequent path width alarm points. The facility and monitor combining network (if applicable) must be properly phased.

(c) Bypass the monitor to prevent shutdown.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

(2) Width alarms.

(a) Verify that the rf carrier power level is at the power established during the reference flight inspection. Reduce the sideband power until the monitor width channel is in wide alarm. Record the sideband power on FAA Form 6750-24.

(b) Confirm that the sideband power is greater than, or equal to, the operating tolerance. If it is not within tolerance, corrective action is required.

(c) Measure and record the width monitor DDM on FAA Form 6750-24. Note that no tolerance exists on this entry. It is used to detect trends.

(d) Increase the sideband power until the monitor width channel is in narrow alarm. Record the sideband power on FAA Form 6750-24.

(e) Confirm that the sideband power is less than or equal to, the operating tolerance. If not within tolerance, corrective action is required.

(f) Measure and record the width monitor DDM on FAA Form 6750-24. Note that no tolerance is established on this entry. It is used only to detect trends.

(g) Return the sideband power to normal.

(3) Course position alarms.

(a) Connect the PIR to measure DDM in the carrier feedline or reference the BITE radiated signal DDM measurement.

(b) Using the modulation balance control or MDT, shift the course clockwise (150 > 90 Hz) until the monitor course position channel is in alarm. Measure and record the carrier feedline DDM value on FAA Form 6750-24. Confirm that the carrier feedline DDM is not more than established reference value. If not within tolerance, corrective action is required.

(c) Measure and record the course monitor DDM on FAA Form 6750-24. Note that no tolerance is established for this entry. It is used only to detect trends.

(d) Repeat the procedure in steps (b) and (c) with the modulation balance control adjusted to shift the course counterclockwise (90 > 150 Hz).

(e) Restore the modulation balance control or the MDT settings to normal.

(4) Modulation level alarms.

(a) Reduce the composite carrier modulation (90 + 150 Hz) until the monitor is in low modulation percent alarm. Measure the carrier modulation, using the modulation meter or MDT. Confirm that the modulation percentages are not below the operating tolerance stated in chapter 3.

(b) On equipment that monitors high modulation percent, repeat step (a) for high modulation percent alarm. Confirm that the modulation percentages are not above the operating tolerance in chapter 3. On some equipment, verification of modulation alarms by adjusting the transmitting equipment is not possible. In this case, verify the modulation alarm(s) by using the monitor test dial or reducing the monitor input as appropriate. The tolerance for this type of equipment is stated as a percent of full scale monitor indication.

(c) Record the results of the modulation alarm point checks. The readings are to be recorded on FAA Form 6750-32. The entries can be made in either the remarks column or can be added using the additional empty column.

(d) Restore the carrier modulation to normal.

(5) Rf level alarms.

(a) Reduce the carrier power until the monitor is in rf low-level alarm. Measure and record the carrier power. Determine if the carrier power is within the operating tolerance in chapter 3.

(b) For those systems that monitor high power (e.g., the Mark 20) increase the carrier power until the monitor is in rf high-level alarm. Measure and record the carrier power. Determine if the carrier power is within the operating tolerance in chapter 3. Note that no tolerance is established for high RF level alarm.

(c) Restore the carrier rf power to normal.

(6) Dual frequency systems. For dual frequency localizers, repeat the above applicable procedures for the clearance equipment.

(7) Identification alarms.

(a) If the facility is equipped with identification tone monitoring, continue with the following steps. Otherwise, omit this check.

(b) Using the 1020 Hz identification keying switch or a MDT, set the identification tone to CONSTANT. Confirm that an identification alarm occurs.

(c) Set the 1020 Hz identification to OFF using the keying switch or the MDT. Confirm that an identification alarm occurs.

(d) Restore the 1020 Hz identification tone to normal.

(8) Far-field monitor alarms. This procedure must be performed during periods of low activity to avoid reflections that can cause inaccurate results. This procedure requires a person at the localizer and at the far-field monitor.

(a) Connect the PIR or an MDT, and setup to read modulation equality of the radiated signal. Note the DDM reading for reference.

(b) Adjust the modulation balance in one direction until all far-field monitors are in alarm.

(c) Calculate the difference in DDM between the reference DDM and the DDM in alarm. Determine if the difference is within the operating tolerance of paragraph 3-20f.

(d) Repeat steps (b) and (c) adjusting the modulation balance in the opposite direction.

(e) Adjust the modulation balance to the reference reading obtained in step (a).

(f) Momentarily disconnect the antenna from each far-field monitor receiver. Confirm that the far-field monitor alarms.

(g) Return the equipment to normal.

5-14. 90 AND 150 HZ MODULATION PERCENTAGES.

a. Object. This procedure provides a method to determine the amplitude modulation percentages of the 90 and 150 Hz navigational tones.

b. Discussion.

(1) The FA-9438 modulation meter (or equivalent) is the primary standard for the measurement of modulation percentage. Other equivalent pieces of test equipment could include a portable ILS receiver (PIR) capable of measuring modulation directly or built-in test equipment (BITE). These may be substituted for the FA-9438 when properly calibrated and/or verified for accuracy. The oscilloscope method is a backup method that uses the detected composite carrier envelope for determining the approximate percentage. The oscilloscope reference values should be noted when flight inspection or FA-9348 modulation meter have been used to measure modulation.

(2) If flight inspection reports the modulation out of tolerance, reconfirm your measurement. If the measurement is within the FA-9438 or BITE that has been verified with the FA-9438, before adjusting the transmitter modulation percentage to meet flight inspection tolerances, advise flight inspection personnel of your situation. If possible, ask them to verify their system calibration and check for radio-frequency interference (rfi). Factors that may cause a difference in modulation percentage readings are:

(a) Excessive carrier component distortion.

(b) FA-9438 calibration correction factor or front panel calibration

(c) BITE malfunction. With standby equipment, a quick check might be made by transferring to the standby to check for the same indication.

(d) Transmitter output spectrum and frequency and the 90 and 150 Hz frequencies.

(e) Stray rf pickup by the cable connecting the FA-9438 to the rf wattmeter body coupler may cause erroneous or inconsistent readings. Double-shielded

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

coaxial cable, such as RG-223/U will minimize stray rf pickup by the cable.

c. Test Equipment Required.

(1) The FA-9438 modulation meter (or equivalent) and associated rf wattmeter body coupler.

(2) BITE/MDT.

(3) Oscilloscope, if the alternate procedure is used.

d. Conditions. The facility is operating normally.

e. Procedures. Refer to Instruction Book TI 6750.141, Installation, Operation, and Maintenance Instructions for Meter, ILS Modulation, Type FA-9438, section 3, for complete front panel calibration and operational instructions. The following steps are a digest of those instructions. Steps (1) through (5) are the front panel calibration steps. The alternate procedure (paragraph g) uses the oscilloscope to determine the approximate modulation percentage.

(1) Turn the FA-9438 ac power switch ON and allow a 10-minute warmup.

(2) Place the function selector switch to RF ZERO, and adjust the RF ZERO control for 00.0 on the PERCENT MODULATION indication.

(3) Place the function selector switch to DISPLAY ZERO, and adjust the DISPLAY ZERO control for 00.0 on the PERCENT MODULATION indicator.

(4) Place the function selector switch to CAL 150 Hz, and adjust the CAL 150 Hz control for 42.5 on the PERCENT MODULATION indicator.

(5) Place the function selector switch to CAL 90 Hz, and adjust the CAL 90 Hz control for 42.5 on the PERCENT MODULATION INDICATOR.

NOTE: It may be necessary to repeat steps (2) through (5) occasionally as the FA-9438 warms up.

(6) Insert the FA-9438 wattmeter coupler into the carrier feedline wattmeter body and rotate the coupler for maximum pickup.

(7) Use a double-shielded coaxial cable and connect the coupler to the RF INPUT jack of the modulation meter.

(8) Place the function selector switch to LOCALIZER or GLIDE SLOPE, as appropriate, and read the 90 Hz and 150 Hz modulation percentages on the PERCENT MODULATION indicator.

(9) Record the percentages on FAA Form 6750-32, and determine if they are in tolerance.

(10) At two-frequency facilities, complete the steps above for the clearance transmitter on a different FAA Form 6750-32.

(11) Restore the equipment to normal.

f. BITE/MDT Procedure. Refer to the facility technical instruction book, section 3, for operation of the BITE/MDT.

(1) Proceed to the transmitter data screen of the selected transmitter and record the percentages on FAA Form 6750-32 and determine if they are in tolerance.

(2) At two-frequency facilities, complete the steps above for the clearance transmitter on a separate FAA Form 6750-32.

(3) For facilities with standby equipment, bring the standby equipment up and complete steps (1) and (2) and record on separate FAA Form(s) 6750.32.

g. Alternate Procedure. This procedure is not as accurate as the above procedure and shall be used only as a standby procedure.

(1) Set the oscilloscope vertical amplifiers for dc operation and verify that the dc balance is correct. The baseline will not move when the vertical gain is varied.

(2) Connect the detected signal jack on the carrier feedline rf body to the vertical input of the oscilloscope.

(3) Insert the wattmeter element into the rf body as if to read forward power.

(4) Adjust the sweep and sync (or trigger) controls for a stable display of the composite waveform.

(5) Disconnect the signal to the oscilloscope and position the sweep along the bottom horizontal graticule.

(6) Reconnect the signal to the oscilloscope and adjust the vertical gain until the peak of the large audio lobe is displayed tangent to the top horizontal graticule (E_{max}).

(7) Repeat steps (5) and (6) as necessary.

(8) Determine the number of E_{min} and E_{max} divisions and compute the 90 Hz plus 150 Hz composite modulation percentage:

$$\%\,\text{mod} = \frac{E_{max} - E_{min}}{E_{max} + E_{min}} \; x \; .54$$

(9) Record the percentages on FAA Form 6750-32 and determine if they are within tolerance.

(10) Restore the equipment to normal operation.

5-15. IDENTIFICATION TONE MODULATION PERCENTAGE.

a. Object. This procedure provides various methods to determine the modulation percentage of the localizer identification tone.

b. Discussion.

(1) Built-in test equipment (BITE) measurement of the identification tone modulation is the preferred method when available and its calibration has been verified.

(2) Other methods rely on the fact that the amplitude of the 1020 Hz audio signal detected from the carrier feedline is proportional to the percent of carrier modulation. The detected audio contains 90 and 150 Hz components with amplitudes proportional to the 90 and 150 Hz modulation percentages. By comparing the relative amplitudes of the 1020 Hz with the 90 and 150 Hz components, the relative identification modulation percentage can be determined.

c. Test Equipment Required.

(1) BITE/MDT.

(2) Audio wave analyzer with wattmeter element and suitable audio cable for connection to an rf body.

(3) A digital voltmeter (dvm).

d. Conditions. Use of the BITE/MDT requires only the hook up of the MDT. If the audio analyzer is used, permission shall be obtained from air traffic personnel to briefly interrupt the identification keying. When using the digital voltmeter method, a facility shutdown is required.

e. BITE/MDT Detailed Procedure. Refer to the facility technical instruction book, section 3, for operation of the BITE/MDT.

(1) Proceed to the transmitter data screen of the selected transmitter and record the percentages on FAA Form 6750-32 and determine if they are in tolerance.

(2) At two-frequency facilities, complete the step above for the clearance transmitter on a separate FAA Form 6750-32.

(3) For facilities with standby equipment, bring the standby equipment up and complete steps (1) and (2) and record on a separate FAA Form(s) 6750.32.

f. Procedure Using a Wave Analyzer with a Relative Scale.

(1) Connect the output connector on the rf body in the carrier feedline to the wave analyzer input.

(2) Insert the wattmeter element into the rf body as if to read forward power.

(3) Adjust the wave analyzer to read relative levels. Set the wave analyzer so that the 90 or 150 Hz level equals 100 percent.

(4) With the identification keying switched to continuous tone operation, measure and record the indicated value for the 1020 Hz component.

(5) Return the keying to normal.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

(6) Multiply the relative 1020 Hz value from step (4) by the modulation percentage for the 90 or 150 Hz component (nominal 20 percent) used in step (3). Determine if the results are within tolerance, and record the actual modulation percentage on FAA Form 6750-32. If the results are out of tolerance, circle the entry and take corrective action.

g. Procedure Using Wave Analyzer Without a Relative Scale.

(1) Connect the output connector on the rf body in the carrier feedline to the wave analyzer input.

(2) Insert the wattmeter element into the rf body as if to read forward power.

(3) With the analyzer, measure and record on FAA Form 6750.32, for reference, the indicated absolute values of the 90 or 150 Hz component.

(4) With the identification keying switched to continuous tone operation, measure and record the indicated absolute value for the 1020 Hz component.

(5) Return the keying to normal.

(6) Divide the 1020 Hz value from step (4) by either value from step (3) and multiply the result by the modulation percentage for the 90 and 150 Hz components (nominal 20 percent). Determine if the results are within tolerance and record the actual modulation percentage on the FAA Form 6750-32. If the results are out of tolerance, circle the entry and take corrective action.

h. Digital Voltmeter Procedure.

(1) Switch the ident tone and one of the navigation tones (90 or 150 Hz) OFF.

(2) If the modulation percentage of the navigation tones is not known, measure the modulation percentage of the remaining navigation tone, using the FA-9438 modulation meter or equivalent.

(3) Connect a dvm, set to read ac millivolts, to the transmitter CSB test jack or to the CSB rf body with an appropriate detector element installed. Record the dvm reading.

(4) Switch the navigation tone off and the ident tone to continuous. Record the dvm reading. *

(5) Calculate the ident tone modulation percentage with the following formula:

Ident mod% =

$$\frac{Nav\ Tone\ Mod\%\ x\ Ident\ Tone\ DVM\ Reading}{Nav\ Tone\ DVM\ Reading}$$

(6) Switch both navigation tones on and the ident tone to normal.

(7) Determine if the results are within tolerance, and record the actual modulation percentage on FAA Form 6750-32. If the results are out of tolerance, circle the entry and take corrective action.

* 5-16. SYSTEM PHASING, IN-LINE AND FAR-FIELD. *

a. Object. These procedures provide methods to adjust for optimum phase relationships between the carrier and sideband-only radiated signals.

b. Discussion.

(1) RF Misphasing. The effectiveness of the sideband only (SBO) radiated energy in producing off-course guidance (clearance) is compromised by rf misphasing. A few degrees of sideband-to-carrier misphasing from optimum is not significant. As misphasing increases toward 90°, however, the effectiveness of the sideband energy decreases at a cosine rate to zero. Rf misphasing indications are increased course width and decreased clearances with normal sideband-to-carrier power ratios.

(2) Phasing Methods. There are two methods of phasing a localizer, far-field quadrature and in-line.

* (a) In-line.

1 The in-line procedure is easier to accomplish, offers more repeatable readings and does not generate Hazardous Misleading Information (HMI) to the aircraft. The in-line phasing method can be used with the following antenna arrays: V-ring, type 55, *

* traveling wave, waveguide, and log periodic. These arrays exhibit a normal quadrature sideband-to-carrier relationship in the feedline to the antenna.

2 Antenna arrays such as the V-ring, type 55, traveling wave, waveguide, and log periodic have a normal quadrature phase relationship between the carrier and sideband-only currents in the antennas and antenna feedlines. These currents can be sampled by means of a permanently installed rf wattmeter body and detector element, or an in-line phasing detector. Waveguide systems can be in-line phased by using the probe permanently installed in the waveguide.

(b) Far-field quadrature.

1 The far-field quadrature method is not as repeatable as In-line method plus it generate Hazardous Misleading Information (HMI) to the aircraft. (Refer to paragraphs 5-173 and 5-174.) It negates the need for airborne phasing.

2 The far-field quadrature phasing procedure is used to check the composite carrier-to-sideband phase relationship in the far-field. It is applicable at all localizers and will reflect phase changes corresponding to changes in the antenna or transmission line system. The reliability and accuracy of this procedure depends on the establishment of a proper far-field check point (refer to paragraphs 5-173 and 5-174) and the proper length of the 90° phasing section (refer to paragraph 5-151). Once established, far-field quadrature phasing can be used as standard to verify proper phasing of a localizer antenna system.

c. Test Equipment Required.

(1) Far-field phasing.

(a) A portable ILS receiver (PIR).

(b) The facility 90° phasing section.

(2) In-line phasing. A PIR.

d. Conditions. A facility shutdown is required for both far-field and in-line checks.

* **e. In-Line Phasing, Detailed Procedure.**

WARNING: The following procedure will produce Hazardously Misleading Information (HMI). Before proceeding, refer to paragraph 1-6 and follow the specific HMI guidance provided. Failure to follow this guidance can result in Controlled Flight Into Terrain (CFIT). The duration and frequency of radiating HMI must be kept to a minimum by any means necessary, as required by Order 6000.15, paragraphs 307, 425, and 432.

(1) Connect the PIR to the course CSB RF Body and disable the clearance system.

(2) Note the reference DDM reading on the PIR.

(3) Connect the PIR to the signal sampler. If a V-ring hang-on probe is used, it should be attached to one of the two outermost antennas. The same antenna should be used for all subsequent checks.

(4) Note the initial phaser setting.

(5) Adjust the sideband phaser for reference DDM. The difference between the phaser settings should be less than the tolerance listed in paragraph 3-14.

(6) At two-frequency localizers, restore the clearance system to normal and disable the course system. Connect the PIR to the clearance CSB RF Body. and repeat steps (2) through (5) above.

(7) For dual transmitter systems repeat steps (2) through (6) above.

(8) Restore the facility to service.

f. Far-Field Quadrature Phasing, Detailed Procedure.

WARNING: The following procedure will produce Hazardously Misleading Information (HMI). Before proceeding, refer to paragraph 1-6 and follow the specific HMI guidance provided. Failure to follow this guidance can result in Controlled Flight Into Terrain (CFIT). The duration and frequency of radiating HMI must be kept to a minimum by any means necessary, as required by Order 6000.15, paragraphs 307, 425, and 432. *

*

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

* **(1)** Dummy-load the sideband output. At two-frequency localizers, disable the clearance system.

(2) Position the PIR at the established far-field phasing point, and note the reference DDM reading. The far-field phasing point shall be established per paragraph 5-173.

(3) Remove the dummy load and insert the 90° phasing section in the sideband feedline.

(4) Adjust the sideband phaser until the reference DDM is obtained at the phasing point. The difference between far-field and in-line phasing should be less than the tolerance listed in paragraph 3-14.

(5) Remove the 90° phasing section and reconnect the sideband feedline.

(6) At two-frequency localizers, restore the clearance system to normal and disable the course system. Dummy-load the clearance system sideband output, and repeat steps (2) through (5) above.

(7) For dual transmitter systems repeat steps (2) through (6) above.

(8) Restore the facility to service. *

5-17. MONITOR PHASING AND AMPLITUDE.

a. Object. This procedure provides a method to determine the monitor carrier to sideband-only phase and amplitude relationship and to correct, if necessary.

b. Discussion. To ensure that the monitor will properly sense system dephasing and sideband amplitude changes, the monitor phasing and amplitude adjustment should be near optimum. This procedure measures the monitoring system sideband phase and amplitude, not the radiated signal sideband and amplitude. Before this measurement, the localizer system phasing and course width must be adjusted to optimum.

c. Test Equipment Required.

(1) A portable ILS receiver (PIR).

(2) BITE/MDT.

(3) The facility 90° phasing section.

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedure.

(1) Ensure that the localizer course width and phasing are adjusted to optimum in accordance with paragraphs 5-171 and 5-16. *

(2) Connect the PIR to the course CSB RF-Body and take a reference DDM reading. The reference reading should be near 0.000 DDM.

(3) Insert the 90° section in series with the SBO input to the monitor combining unit. With the PIR at the width monitor output from the monitor combining network note the DDM reading.

(4) For systems other than the Mark 20, note the position of the integral monitor phaser and then adjust the phaser to the reference value obtained in step 5-17(2). For the Mark 20 localizer, a length of cable was installed instead of an adjustable phaser.

(5) For systems other than the Mark 20, the difference between the original phaser position and the new position is the error that existed before this procedure was accomplished. This error should be within the operating tolerance listed in chapter 3. For the Mark 20 localizer, note the difference between the reference DDM in step 5-17(2) and the value obtain in step 5-17(3). Compare this to the operating tolerance listed in chapter 3. If out of operating tolerance, cable A2W49, SBO IN to SBO OUT, on the monitor recombiner unit must be changed or recut. In this case, the phasing must be brought to within initial tolerance.

NOTE: To convert 'degrees to DDM' remember that an elbow in LOC frequency is about 6 degrees which is about 0.018 DDM (1 deg. = 0.003 DDM).

(6) Remove the 90° section from the sideband monitor in-line.

(7) If required, adjust the width level attenuator in the monitor recombining network to the established DDM level. A typical value is 0.155 DDM. *

(8) Restore the facility to service.

5-18. AUDIO AND RF FREQUENCIES.

a. Object. This procedure provides a method to measure the ILS facility audio and carrier frequencies.

b. Discussion. The operating frequencies of an ILS facility must remain within specified limits of the authorized values. The rf body installed in the carrier or an antenna feedline is a convenient point to obtain a sample for the rf measurement. The navigational audio frequencies are essential for establishing the course and width, while the identification tone is a necessary indication of facility availability and identification. Navigation audio signals may be sampled via an rf wattmeter body with a suitable element installed, or an equipment test point(s) depending on the facility type.

c. Test Equipment Required.

(1) A frequency counter with 0.0001 percent (1 part per million (ppm)) or better accuracy.

(2) An rf wattmeter body coupler.

(3) An optional wave analyzer.

d. Conditions. For sampled measurements, i.e., those taken without disturbing the radiated signal, the facility may remain in operation. For measurements taken where a frequency must be removed or switched to continuous, the facility must be removed from service.

e. Detailed Procedure. For the following test connections consult the applicable TI for an appropriate test point or jack, or use an rf wattmeter body and element. For the Mark 20 Localizer/Glide Slope, a convenient point is located on the AC/DC Switch Module Assembly 1A2/1A4.

(1) Measure the modulation frequencies (90, 150, 1020 Hz, etc.) using an equipment test point, jack, or detected output from an rf wattmeter body. If no jack is provided on the equipment which accesses the 90 and 150 Hz tones individually, they may be measured by using a wave analyzer to separate the 90 and 150 Hz tones. The input of the wave analyzer is connected to the audio output of the carrier rf body with an appropriate size element inserted.

(a) Connect the frequency counter to the output of the wave analyzer. Adjust the wave analyzer first to 90 and then to 150 Hz and read the navigational tone frequencies on the counter.

(b) The 1020 Hz or any other identification tone frequency may be measured directly at the oscillator or by using the wave analyzer with the keyer set for constant tone.

(2) Measure the rf frequency of the transmitter(s) by connecting the counter to an rf wattmeter body coupler. The transmitter must be operating for at least 15 minutes before measuring rf frequency. The audio modulation may have to be removed to obtain a constant counter readout.

(3) Record the results obtained in steps (1) and (2) on the appropriate form. If any frequency or the frequency separation at two-frequency facilities is out of tolerance, corrective action shall be taken.

* **(4)** If the rf frequency is adjustable, the transmitter should be adjusted as close to the authorized frequency as possible, and shall be adjusted to within the initial tolerances specified in chapter 3. Following RF frequency adjustment, * the final measurement should be performed at least 5 minutes after the last adjustment is made. This is to allow the oscillator sufficient time to settle to its final operating frequency.

5-19. AUDIO PHASING.

a. Object. This procedure provides a method to determine that the audio phase relationship between the 90 Hz and 150 Hz modulation tones of the course and clearance transmitters are in phase.

b. Discussion. The audio phase relationship between the course and clearance signals must be in phase to ensure that these signals always add to and not subtract from each other. This is true for both localizers and glide slopes. When an aircraft is in transition between a predominance of signal from the course, and clearance transmitter, these signals may be approximately equal. When this occurs, a false course or path could be produced if the audio phasing is out of phase. Navigation audio signals may be sampled via an RF wattmeter only with a suitable element installed, or an equipment test point(s) depending on the facility type.

c. Test Equipment Required.

(1) An oscilloscope with an accurately calibrated time base.

(2) An RF wattmeter body with suitable wattmeter element.

d. Conditions. For sampled measurements, i.e., those taken without disturbing the radiated signal, the facility may remain in operation. For measurements taken where a frequency is removed or switched to continuous the facility must be removed from service.

e. Detailed Procedure.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

NOTE: For the following test connections consult the applicable TI for an appropriate test point or jack, or use an wattmeter body and element. For the Mark 20 Localizer/Glide Slope, a convenient point is located on the AC/DC Switch Module Assemble 1A2/1A4.

(1) Connect the oscilloscope Y INPUT to observe the course (or path) transmitter 150 Hz output.

(2) Connect the oscilloscope TRIGGERING INPUT to the course (or path) transmitter 150 Hz output, or an external scope sync output..

(3) Adjust the triggering so that the waveform crosses the zero axis at the center of the oscilloscope display.

(4) Connect the oscilloscope Y INPUT to observe the clearance transmitter 150 Hz output. DO NOT ADJUST ANY CONTROLS.

(5) Confirm that the positive and negative peaks are in the same position on the oscilloscope as the course transmitter.

(6) Measure the time (in microseconds) between the center of the oscilloscope and the scope trace.

(7) Confirm that the time measured is within the operating tolerance of chapter 3.

(8) Restore the equipment to normal operation.

5-20. TIME DELAYS.

a. Object. This procedure provides a method to determine the times of the shutdown and far-field monitor (FFM) time delays.

b. Discussion. The time that a facility is permitted to radiate outside monitor alarm limits must be short. This is to protect aircraft in the final stages of approach from prolonged exposure to possible signal error. The different time delays are defined below.

(1) Shutdown delay. This delay is the total time a facility is allowed to radiate with a continuous monitor alarm. For dual equipment, this delay includes the transfers from main to standby to shutdown except at GRN-29 facilities. At GRN-29 facilities, this is the time for the main equipment to shut down without a transfer after a monitor alarm.

(2) Far-field monitor delay. This time delay applies to localizers that have a far-field monitor(s) and is the total time between the initiation of a continuous far-field monitor alarm and a localizer shutdown or to CAT I downgrade. This time delay is relatively long, as the far-field monitor experiences numerous momentary alarms due to multipath from taxiing and overflying aircraft.

(3) Restoration Delay. This delay is the 20 second time period after a shutdown in which no further attempts to restore the system are allowed. This includes the interlocking function, and can be tested by switching runways and measuring the time for the selected ILS to go on-line. This delay can also be tested at the specific site by causing a shutdown, then immediately resetting the equipment. The time it takes for the equipment to return to normal is the restoration delay.

c. Test Equipment Required. A device suitable for measuring elapsed time. For Mark 20; the PMDT.

NOTE: Mark 20 facilities: The transfer and shutdown timing test have been included in the localizer/glide slope test menu..

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedure.

(1) Shutdown delay (non-Mark 20 system).

(a) Initiate a continuous monitor alarm and measure the time between initiation of the alarm condition(s) and localizer shutdown.

(b) Compare this measurement with the standard and tolerance contained in paragraph 3-21, and correct, if necessary. Record shutdown delay on the appropriate form.

(c) Return facility to service.

(2) Shutdown delay (Mark 20 system).

(a) Connect the Mark 20 PMDT serial communications cable to the equipment serial communications port. Set the PMDT power switch to ON and log onto the equipment.

(b) From the commands menu proceed to the "Tests" menu and perform the "Shutdown time test" (i.e., from the "Commands" menu; execute the following sequence of keys <T H>. The total shutdown time (including transfer for dual equipment) will be displayed via a pop-up shutdown/transfer test screen; labeled "Shutdown time:"

(c) Compare this measurement with the standard and tolerance contained in paragraph 3-21 and correct, if necessary. Record the shutdown or downgrade delay on the appropriate form.

(d) Log off the equipment, set the PMDT power switch to OFF and disconnect the PMDT serial communications cable from the equipment. Return the facility to service.

(3) Far-field monitor delay. Initiate a continuous alarm at the far-field monitor(s). This may be accomplished by removing one of the navigation tones at the localizer, or by causing an alarm at the far-field monitor itself.

NOTE: Mark 20 facilities: Due to the difficulty of performing this check at Mark 20 facilities, the far-field monitor delay measurement will not be performed at this time. Procedures for this check are being evaluated for inclusion into this handbook at a later date.

(a) Measure the time between initiation of the alarm condition(s) and localizer shutdown. If the system contains more than one timer for far-field monitor shutdown delay, the tolerance applies only to the total delay and not to any individual timers.

(b) Measure the time between the initial start of the far-field monitor status unit (FA-10039) countdown and the aural alarm.

(c) Confirm that the times measured are within the operating tolerances of chapter 3.

(d) Restore the facility to service operations.

5-21. AUTOMATIC RESTART AND RESET (SINGLE AND COLD STANDBY EQUIPMENT).

a. Object. This procedure provides a method of determining if the automatic restart and reset circuits function properly and are within the established limits.

b. Discussion. The function of the auto-restart is to attempt to return a single-equipment or a cold standby, dual-equipment facility to service shortly after it has shut down due to an alarm condition. If the auto-restart is successful and the equipment remains in service for a predetermined length of time, the auto-reset function will clear the auto-restart circuit and restore it to normal operation. When an alarm occurs, a short delay takes place before the facility shuts down. This delay is called the shutdown delay. The equipment will remain off the air until a longer delay, called the auto-restart delay, occurs. After the auto-restart delay, the equipment will attempt to return itself to service. If the alarm still persists, a number of other restart attempts with varying auto-restart delay times may occur depending on the equipment type. If the equipment restarts and remains in service for a predetermined period of time, an auto-reset circuit resets the auto-restart function to its normal status. If all auto-restart attempts are exhausted and the equipment does not stay in service, the restart/reset circuits must be manually reset at the facility.

c. Test Equipment Required. A device suitable for measuring elapsed time.

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedure.

(1) Initiate a monitor alarm and allow the equipment to shut down.

(2) Measure the time elapsed between shutdown and the time when the automatic restart attempts to return the facility to service. Record the time on the appropriate form. Determine if the auto-restart time is within the established limits.

(3) Repeat steps (1) and (2) for each available auto-restart. Determine if the auto-restart time(s) is within the established limits, and record the shortest time on the appropriate form.

(4) After the final auto-restart attempt, ascertain that if the alarm is still present the equipment shuts down and a manual reset is required to restart it.

(5) Initiate a monitor alarm and allow the equipment to shut down. Remove the alarm condition and allow the auto-restart to return the equipment to service. If the equipment has auto-reset capabilities, ascertain that the

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 1. LOCALIZERS (Continued)

auto-reset circuits are reset after an elapsed time of 4.5 minutes or greater, measured from the time the alarm was initiated. For specific times refer to the equipment instruction book.

(6) Restore the facility to service.

5-22. SIDEBAND NULL – RF METHOD.

a. Object. This procedure provides a method to determine the position of the sideband null relative to course centerline.

b. Discussion. The location of the sideband null and its coincidence with the course centerline affords optimum structure of the localizer course. A null in the sideband radiation pattern occurs when sideband energy from one-half of the localizer array is received concurrently with an equal amount of opposite phased energy from the other half. If an amplitude inequality occurs between the two halves, the resulting energy difference converts the former null into a sideband intensity minimum. Altering the 180° sideband phase relationship between the two halves shifts the null (or minimum) toward the side with the greater delay (lagging phase). Reflections also modify the null depth and position. Rotating the array moves the null position degree for degree.

c. Test Equipment Required.

(1) A portable ILS receiver (PIR).

(2) An audio meter.

(3) A directional antenna, such as a Yagi designed for localizer frequencies, is highly recommended.

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedure.

(1) Feed a maximum of 5 watts carrier, modulated by a continuous 1020 Hz tone, into the sideband input to the antenna array.

(2) Position the PIR on the course centerline. The distance to the array should be as far as possible while still maintaining a sharp null indication. A directional antenna should be used with the PIR if available.

(3) Locate the RF null as indicated by minimum audio or RF level from the PIR.

(4) Measure the null displacement from the course (centerline).

(5) Using English units: Divide the measured displacement in inches by the distance to the array in 1000's of feet. For example: the sideband null is measured 1500 feet from the array and found at 17 inches from course centerline.

$$\frac{17 \text{ inches}}{1.5} = 11.33 \text{ inches per } 1000 \text{ feet}$$

OR;

Using metric units: Divide the measured displacement in centimeters by the distance to the array in 300's of meters. For example: the sideband null is measured 450 meters from the array and found at 45 centimeters from course centerline.

$$\frac{45 \text{ cm}}{1.5} = 30 \text{ centimeters per } 300 \text{ meters}$$

(6) Record the results of step (5) on FAA Form 6750-22. If the results are not within tolerance, take appropriate action.

(7) To determine if site effects are compromising the measurement, repeat steps (1) through (5) at alternate distances.

(8) Restore the facility to service.

5-23. SIDEBAND NULL - DDM METHOD.

a. Object. This procedure provides a method to determine the position of the sideband null relative to course centerline.

b. Discussion. The location of the sideband null and its coincidence with the course centerline affords optimum structure of the localizer course. A null in the sideband radiation pattern occurs when sideband energy from one-half of the localizer array is received concurrently with an equal and oppositely phased amount of energy from the other half. If the amplitudes are not exactly equal, an RF minimum occurs where the null would have been. If the sides are not exactly opposite in phase, the null (or

minimum) would shift toward the side with the lagging (delayed) phase. Reflections also modify the depth and position of the null. Rotating the array moves the null position degree for degree.

NOTE: The need to re-cut individual pair nulls is quite rare, and all other possibilities should be investigated first.

c. Test Equipment Required.

(1) A portable ILS receiver (PIR).

(2) Enough male and female, N-type, 2 watt dummy loads to terminate all cables and ports of the distribution unit. Ensure all loads are 50Ω, +/- 2Ω.

(3) A directional antenna, such as a Yagi designed for localizer frequencies, is highly recommended.

d. Conditions. A facility shutdown is required for this procedure.

e. Detailed Procedure.

* **WARNING:** The following procedure will produce Hazardously Misleading Information (HMI). Before proceeding, refer to paragraph 1-6 and follow the specific HMI guidance provided. Failure to follow this guidance can result in Controlled Flight Into Terrain (CFIT). The duration and frequency of radiating HMI must be kept to a minimum by any means necessary, as required by Order 6000.15, paragraphs 307, 425, and 432. *

(1) Verify 0 DDM in the carrier (CSB) thru-line using a PIR and RF sniffer. For dual frequency systems, turn off or dummy load the Clearance CSB and SBO signals.

(2) Dummy load all cables and ports on the distribution unit except for the Course CSB and SBO, and the antenna pair to be checked, e.g. 1L and 1R.

(3) Position the PIR on the course centerline. The distance to the array should be approximately 1500', though it may be necessary to move closer for certain airport environments. Move towards the array, and away from the array, approximately 50' from the initial point, and verify that the PIR indication does not change. Verify that the reading on the PIR shows a greater amount of 90 Hz while moving to the left of course centerline, and more 150 Hz while moving to the right.

(4) Move left or right as necessary to achieve 0 DDM on the PIR.

(5) Measure the distance, in inches, to course centerline. Measure how far from the array the PIR is located, in feet, and divide this number by 100.

(6) The initial tolerance for null displacement is 1" per 100' from the array. Therefore, if the null is 17" right of centerline, and this was measured 1500' from the array, the null would be out of initial tolerance.

(7) In the above example, an N-type, square elbow would be placed in series with the 1L antenna tie-line. The null location would then be re-checked.

(8) Using a ratio and proportion equation, the initial null displacement is divided by the difference of the before and after null locations. This dividend is multiplied by 1.34 if using RG-214 for tie-lines, or 1.62 if using ¼" Heliax. This calculated amount would then be cut from the 1R antenna tie-line in this example.

Example: Initial null displacement = 17"
N-type elbow moved null 68" (51" other side of centerline).
17/68 = 0.25
0.25 X 1.62 (1/4" Heliax) = 0.405 cut from 1R tie-line.

(9) After cutting the tie-line the calculated amount, remove N-type elbow and check null displacement again. If within initial tolerance, dummy load this pair and move on to the next pair.

(10) Repeat steps 4 through 9 for all remaining pairs. For an 8-element array, pair 4 has reverse sensing. For most dual frequency systems, pair 7 may have to be checked with pair 6 radiating due to RF distribution of the array.

(11) After all individual nulls have been checked and recorded, re-connect all tie-lines to their respective ports on the distribution unit and check the composite null location to ensure it meets initial tolerance.

(12) Record this composite null location in the FRDF along with all of the individual pair nulls.

(13) Restore facility to service.

5-24. thru 5-39. RESERVED.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES

5-40. LINE ENTRY OF NORMAL READINGS.

a. Object. This procedure provides a method to complete a line entry of the normal parameters on FAA Form 6750-26, with the equipment in normal configuration.

b. Discussion. A line entry of the glide slope normal parameters is required after equipment transfer, before a normal end-fire glide slope ground check, and periodically as required in chapter 4. This check is made without adjustment to the equipment and can be performed from a remote maintenance monitor (RMM). Computer generated data reports may be used in lieu of FAA forms.

c. Test Equipment Required.

(1) A portable ILS receiver (PIR).

(2) A dvm (optional).

(3) The facility rf wattmeter and/or built-in test equipment (BITE).

NOTE: Chapter 1, Paragraph 1-2b, Test Equipment, discusses external test equipment and BITE, and their proper use in the NAS. Particular attention must be paid to the proper use and maintenance of test equipment to ensure accurate evaluations of equipment operation. For instance, when using a BIRD wattmeter for power measurements, the same set of rf bodies, wattmeter, and elements must be utilized due to the variability of the wattmeter components. For BITE, proper calibration and verification of measurements are required.

d. Conditions. The facility is operating normally. For facilities that are equipped with standby equipment, switch standby equipment on-line to take readings.

e. Detailed Procedure. At the local site or RMM location, perform the following steps.

(1) Measure and record the normal carrier power and clearance power (if applicable) on FAA Form 6750-26. Confirm that the power(s) are within the established reference value. If not within tolerance, corrective action is required.

(2) Measure and record the normal sideband power and carrier feedline DDM (modulation equality) on FAA
* Form 6750-26. Glide slope modulation equality should always be 0 DDM. Refer to paragraph 5-62b(4) and 5-62c(2)(a)3 for EFGS. *

(3) Measure and record the monitor width DDM, the monitor course DDM, if applicable on FAA Form 6750-26. Note that no tolerance is established for these entries. They are used only to detect trends and for troubleshooting.

* **(4)** To obtain a computer generated data report of * normal readings for the Mark 20 ILS; log onto the facility to be recorded, check that the transmitter to be recorded is "On Antenna"; from the "Commands" menu depress the key sequence <D E O> for transmitter one; or <D E T> for transmitter two. Hot keys Alt F5 or Alt F6 may also be used. The report may be printed by depressing the "Print Screen" key and then selecting "P" for print. If desired the report may also be saved to disk by depressing the "D" key.

* **(5)** At all dual equipment facilities complete a normal line entry for each set of equipment. *

5-41. LOCAL AND REMOTE MONITOR SHUTDOWN OPERATION.

a. Object. This procedure provides a method to determine that a shutdown is properly sensed at the local and/or remote control points.

b. Discussion. Certain alarms in the ILS equipment shall result in an equipment transfer and/or shutdown. Also, if remotely monitored, an indication that the facility is shut down shall be received at the remote monitor location. This check confirms that the shutdown occurs and that the remote control point is properly notified. This check can also be initiated and monitored from a remote maintenance monitor (RMM) location.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)
SUBSECTION 2. GLIDE SLOPES (Continued)

c. Conditions. A facility shutdown is required for this check.

d. Detailed Procedure.

(1) Simulate a continuous alarm, or from the RMM perform a station integrity check.

(2) Allow a shutdown to occur.

(3) Determine that the proper remote and local alarm indications occurred.

(4) If remote restore capability is installed, restore the facility from the remote control point or allow the auto-restart circuit to restore the facility.

(5) Make an entry in the facility log that this check was completed.

5-42. END-FIRE GROUND CHECK.

a. Object. This procedure provides a method to check the path angle of the transverse structure.

b. Discussion. The rf phase relationship between the front and rear course antenna determines the glide slope path angle. By inserting a known phase delay in the front antenna feedline, the path angle can be lowered to ground level. This is accomplished with a switch on the end-fire interface unit. The DDM at ground level is checked at various locations in the glide slope transverse structure with the path normal and snapped down. The location of the ground check points is defined in paragraph 5-197.

c. Test Equipment Required. A portable ILS receiver (PIR).

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedure.

* **WARNING:** The following procedure will produce Hazardously Misleading Information (HMI). Before proceeding, refer to paragraph 1-6 and follow the specific HMI guidance provided. Failure to follow this guidance can result in Controlled Flight Into Terrain (CFIT). The duration and frequency of radiating HMI must be kept to a minimum by any means necessary, as required by Order 6000.15, paragraphs 307, 425, and 432. *

(1) With the facility normal, complete a line entry on FAA Form 6750-26.

(2) With the facility normal (at each ground check point), measure the DDM with the PIR and record the value on FAA Form 6750-30.

(3) Place the mode switch on the end-fire interface unit to the DOWN position.

(4) At ground check points 1, 2, and 3, measure the DDM with the PIR, and record the value on FAA Form 6750-30.

(5) Confirm that the values measured in steps (2) and (4) are within the established reference values. If not within tolerance, corrective action is required.

(6) Return the mode switch to the OPERATE position.

(7) Restore the facility to service.

5-43. NULL-REFERENCE MONITOR.

a. Object. This procedure provides a method to determine whether the glide slope monitor alarm points are within the reference values established during a flight inspection that established reference values.

b. Discussion.

(1) The glide slope monitor is used to ensure the integrity of the glide slope system by permitting the glide slope to operate only if certain system parameters are within the limits established during the reference flight inspection. This performance check is accomplished by adjusting the transmitting equipment to cause a monitor alarm and then verifying that the radiated parameters are within established reference values. If a radiated parameter is found outside the established reference values, it must be determined if the condition is due to monitor drift. If so, the monitor alarm points must be tightened to ensure that for day-to-day monitor drift, the monitor will alarm whenever the radiated signal parameters are at or beyond the established reference values.

(2) The reference data must be measured very carefully. Power measurements must always be accomplished with the same meter and elements. The elements shall be clearly marked. In addition to the rf wattmeter readings, it is recommended that a digital voltmeter (dvm) be used to obtain reference readings for carrier and sideband power in

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES

normal, wide, and narrow alarm. These reference readings can be made with greater repeatability by using the dvm than by using the analog wattmeter. This is done by connecting a dvm, set to measure dc voltage, to the detector element output in place of the normal meter.

(3) The monitor DDM values are the monitor input values measured with the PIR or monitor digital readout values. No tolerance exists for the DDM values. They are used to detect trends such as system or monitor drift.

(4) This performance check requires a line entry on FAA Form 6750-27. The reference data line contains the reference data used to perform a monitor performance check. The reference data line can be updated only in accordance with paragraph 5-62.

c. Test Equipment Required.

(1) A portable ILS receiver (PIR).

(2) An rf wattmeter.

(3) A dvm (optional).

(4) The FA-9438 modulation meter or equivalent.

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedure.

(1) Preliminary actions.

(a) Refer to FAA Form 6750-27 for the reference values specified during the monitor performance check.

(b) Verify that modulation is 40 percent for each tone. If required, adjust carrier power to the reference value as established on FAA Form 6750-26. The carrier power must be correct because the width (and width alarm) is a function of the carrier/sideband ratio. The facility and monitor combining network (if applicable) must be properly phased.

(c) Connect the PIR to the carrier rf body, and ensure that modulation equality (0 DDM) exists.

(2) Width alarms.

(a) Reduce the sideband power until the monitor width channel is in wide alarm. Record the sideband power on FAA Form 6750-27.

(b) Confirm that the sideband power is not less than the established reference value. If not within tolerance, corrective action is required.

(c) Measure and record the width monitor DDM on FAA Form 6750-27. Note that no tolerance is established on this entry. It is used only to detect trends.

(d) Raise the sideband power until the monitor width channel is in narrow alarm. Record the sideband power on FAA Form 6750-27.

(e) Confirm that the sideband power is not more than the established reference value. If not within tolerance, take corrective action.

(f) Measure and record the width monitor DDM on FAA Form 6750-27. Note that no tolerance is established on this entry. The entry is used only to detect trends.

(g) Return the sideband power to normal.

(3) Path angle alarms (integral). For monitors with parallel path channels, perform steps (a) thru (d) for both channels.

(a) Connect the PIR to measure DDM in the carrier feedline.

(b) Adjust the modulation balance control until the integral monitor path channel is in high path angle alarm (150 > 90 Hz). Measure and record the modulation equality and monitor DDM values on FAA Form 6750-27. Determine if the rf body DDM is within the operating tolerances in chapter 3. If the carrier DDM is out of tolerance, corrective action is required. Compare the monitor input DDM to previous readings. Note that no tolerance is established for this entry. The entry is used only to detect trends.

(c) Repeat step (b) for the modulation balance control adjusted for 90 > 150 Hz.

(d) Adjust the modulation balance control for 0 DDM.

(4) SBO dephasing alarms.

(a) Note the position of the main sideband (SBO) phaser.

(b) Advance the main (SBO) phaser until the monitor width channel alarms. A preferred alternate method

is to add a predetermined line length (type N or BNC elbows, or equivalent) to the carrier feedline. Determine if the phaser change is within established reference values. Record the change in degrees on FAA Form 6750-27.

(c) Repeat the procedure in step (b) with the SBO phaser retarded.

(d) Return the main (SBO) phaser to the normal position noted in step (a).

(5) Modulation level alarms.

(a) Reduce the composite carrier modulation (90 + 150 Hz) until the monitor is in low modulation percent alarm. Measure the carrier modulation, using the modulation meter. Confirm that the modulation percentages are not below the operating tolerance in chapter 3.

(b) Record the results of the modulation alarm point checks. The readings are to be recorded on FAA Form 6750-32. The entries can be made in either the remarks column or can be added using the additional empty column.

(c) Restore the carrier modulation to normal.

(6) Rf level alarms.

(a) Reduce the carrier power until the monitor is in rf low-level alarm. Measure and record the carrier power. Determine if the carrier power is within the operating tolerance in chapter 3. Note that no tolerance is established for high rf level alarm.

(b) Restore the carrier rf power to normal.

5-44. SIDEBAND-REFERENCE MONITOR.

a. Object. This procedure provides a method to determine whether the glide slope monitor alarm points are within the reference values established during the reference flight inspection.

b. Discussion.

(1) The glide slope monitor is used to ensure the integrity of the glide slope system by permitting the glide slope to operate only if certain system parameters are within the limits established during the reference flight inspection. This performance check is accomplished by adjusting the transmitting equipment to cause a monitor alarm and then verifying that the radiated parameters are within established reference values. If a radiated parameter is found outside the established reference values, it must be determined if the condition is due to monitor drift. If so, the monitor alarm points must be tightened to ensure that for day-to-day monitor drift, the monitor will alarm whenever the radiated signal parameters are at or beyond the established reference values.

(2) The reference data must be measured very carefully. Power measurements must always be accomplished with the same meter and elements. The elements shall be clearly marked. In addition to the rf wattmeter readings, it is recommended that a digital voltmeter (dvm) be used to obtain reference readings for carrier and sideband power in normal, wide, and narrow alarm. These reference readings can be made with greater repeatability by using the dvm than by using the analog wattmeter. This is done by connecting a dvm, set to measure dc voltage, to the detector element output in place of the normal meter.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES (Continued)

(3) The monitor DDM values are the monitor input values measured with the PIR or monitor digital readout values. No tolerance exists for the DDM values. They are used to detect trends such as system or monitor drift.

(4) This performance check requires a line entry on FAA Form 6750-28. The reference data line contains the reference data used to perform a monitor performance check. The nominal data line can only be updated in accordance with paragraph 5-62.

c. Test Equipment Required.

(1) A portable ILS receiver (PIR).

(2) An rf wattmeter.

(3) A dvm (optional).

(4) The FA-9438 modulation meter or equivalent. *

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedure.

(1) Preliminary actions.

(a) Refer to FAA Forms 6750-28 for the reference values specified during the monitor performance check.

(b) Verify that modulation is 40 percent for each tone. If required, adjust carrier power to the reference value as established on FAA Form 6750-26. The carrier power must be correct because the width (and width alarm) is a function of the carrier/sideband ratio. The facility and monitor combining network (if applicable) must be properly phased.

(c) Connect the PIR to the carrier rf body and ensure that modulation equality (0 DDM) exists.

(2) Width alarms.

(a) Reduce the sideband power until the monitor width channel is in wide alarm. Record the sideband power on FAA Form 6750-28.

(b) Confirm that the sideband-to-carrier power ratio is not less than the established reference value. If not within tolerance, corrective action is required.

(c) Measure and record the width monitor DDM on FAA Form 6750-28. Note that no tolerance is established on this entry. It is used only to detect trends.

(d) Raise the sideband power until the monitor width channel is in narrow alarm. Record the sideband power on FAA Form 6750-28.

(e) Confirm that the sideband power is not more than the established reference value. If not within tolerance, corrective action is required.

(f) Measure and record the width monitor DDM on FAA Form 6750-28. Note that no tolerance is established on this entry. It is used only to detect trends.

(g) Return the sideband power to normal.

(3) Path angle alarms. *

NOTE: This procedure cannot be performed in equipment (i.e. ASII) that does not have an SBO power divider in the APCU. *

(a) Adjust the power divider on the amplitude and phase control unit (APCU) until the integral monitor path channel alarms (upper antenna power increases).

(b) Measure and record the upper antenna power in the angle high integral column on FAA Form 6750-28. Confirm that upper antenna power is not more than the established reference value. If not within tolerance, corrective action is required.

(c) Measure and record the integral path monitor DDM in the angle high integral column on FAA Form 6750-28. Note that no tolerance is established on this entry. It is used only to detect trends.

(d) Repeat the steps of this check with the APCU power divider adjusted for low angle alarm (upper antenna power decreases).

(e) Return the APCU power divider to normal. Refer to paragraph 5-125 for a procedure on adjusting the sideband power between upper and lower antennas.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES (Continued)

(4) SBO dephasing alarms. (Optional)

(a) Note the position of the main sideband (SBO) phaser.

(b) Advance the main SBO phaser until the monitor width channel alarms. A preferred alternate method is to add a predetermined line length (type N or BNC elbows, or equivalent) to the carrier feedline.

(c) Repeat the above step with the SBO phaser retarded.

(d) Return the main (SBO) phaser to the normal position noted in step (a).

(5) Upper antenna dephasing alarms.

(a) Advance the APCU upper antenna phaser until a monitor alarm occurs. A preferred alternate method is to add a predetermined line length (type N or BNC elbows, or equivalent) to the lower antenna feedline.

(b) Record the change in degrees in the upper antenna dephasing column on FAA Form 6750-28. Confirm that the value is within established reference value. If not within tolerance, corrective action is required.

(c) Repeat the steps of this check with the upper antenna phaser retarded. A preferred alternate method is to add a predetermined line length (type N or BNC elbows, or equivalent) to the upper antenna feedline.

(d) Restore the upper antenna phaser to normal.

(6) Modulation level alarms.

(a) Reduce the composite carrier modulation (90 + 150 Hz) until the monitor is in low modulation percent alarm. Measure the carrier modulation using the modulation meter. Confirm that the modulation percentages are not below the operating tolerance in chapter 3.

(b) Record the results of the modulation alarm point checks. The readings are to be recorded on FAA Form 6750-32. The entries can be made in either the remarks column or can be added using the additional empty column.

(c) Restore the carrier modulation to normal.

(7) Rf level alarms.

(a) Reduce the carrier power until the monitor is in rf low level alarm. Measure and record the carrier power. Determine that the carrier power is within the operating tolerance in chapter 3. Note that no tolerance is established for high rf level alarm.

(b) Restore the carrier rf power to normal.

(8) Restore the facility to service.

5-45. CAPTURE-EFFECT MONITOR.

a. Object. This procedure provides a method to determine whether the glide slope monitor alarm points are within the reference values established during the reference flight inspection.

b. Discussion.

(1) The glide slope monitor is used to ensure the integrity of the glide slope system by permitting the glide slope to operate only if certain system parameters are within the limits established during the reference flight inspection. This performance check is accomplished by adjusting the transmitting equipment to cause a monitor alarm and then verifying that the radiated parameters are within established reference values. If a radiated parameter is found outside the established reference values, it must be determined if the condition is due to monitor drift. If so, the monitor alarm points must be tightened to ensure that for day-to-day monitor drift, the monitor will alarm whenever the radiated signal parameters are at or beyond the established reference values.

(2) The reference data must be measured carefully. Rf power measurements using the Bird Wattmeter must always be accomplished with the same meter and elements. The elements shall be clearly marked. In addition to the rf wattmeter readings, it is recommended that a digital voltmeter (dvm) be used to obtain reference readings for carrier and sideband power in normal, wide, and narrow alarm. These reference readings can be made with greater repeatability by using the dvm than by using the analog wattmeter. This is done by connecting a dvm, set to measure dc voltage, to the detector element output in place of the normal meter.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES (Continued)

(3) Measurements taken with built in test equipment (BITE) (i.e., power, DDM, modulation, etc.) must be verified for accuracy with external test equipment as outlined in this handbook. This is to ensure that repeatable results are obtained and maintained in the case of internal equipment failure and/or replacement of modules that effect BITE measurements.

(4) For equipment with pre and hard alarms, in all cases where a procedure instructs an adjustment to a monitor alarm, reference is to the hard alarm.

(5) For equipment that uses a maintenance data terminal (MDT), when adjusting the phase of a signal, the number of degrees adjusted may need to be determined from a reference index number. This may be accomplished via a table or conversion chart, usually found in the equipment TI. For this reason, the alternate methods described in the procedures (i.e., the addition and removal of line lengths, elbows, etc.) is recommended.

(6) The monitor DDM values are the monitor input values as measured with a PIR or the digital readout values of the monitor or as measured with BITE/MDT. No tolerance is established for the DDM values. They are used to detect trends such as system or monitor drift.

(7) This performance check requires a line entry on FAA Form 6750-29. The reference data line contains the reference data used to perform a monitor performance check. The reference data line can only be updated in accordance with paragraph 5-62.

c. Test Equipment Required.

(1) A portable ILS receiver (PIR).

(2) BITE/MDT

(3) Rf wattmeter.

(4) A dvm (optional).

(5) The FA-9438 modulation meter or equivalent.

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedure.

(1) Preliminary actions.

(a) Refer to FAA Form 6750-29 for the reference values specified during the monitor performance check.

(b) Verify that modulation is 40 percent for each tone. If required, adjust carrier power to the reference value as established on FAA Form 6750-26. The carrier power must be correct because the width (and width alarm) is a function of the carrier/sideband ratio. The facility and monitor combining network (if applicable) must be properly phased.

(c) Set up the PIR, BITE/MDT, or equivalent to measure DDM in the carrier feedline and ensure that modulation equality (0 DDM) exists.

(d) Bypass the equipment monitor(s).

(2) Width alarms.

(a) Reduce the sideband power until the monitor width channel is in wide alarm. Record the sideband power on FAA Form 6750-29.

(b) Confirm that the sideband power is not less than the established reference value. If not within tolerance, corrective action is required.

(c) Measure and record the width monitor DDM on FAA Form 6750-29. Note that no tolerance is established on this entry. It is used only to detect trends.

(d) Raise the sideband power until the monitor width channel is in narrow alarm. Record the sideband power on FAA Form 6750-29.

(e) Confirm that the sideband power is not more than the established reference value. If not within tolerance, corrective action is required.

(f) Measure and record the width monitor DDM on FAA Form 6750-29. Note that no tolerance is established on this entry. It is used only to detect trends.

(g) Return the sideband power to normal.

(3) Path angle alarms (integral). For monitors with parallel path channels, perform steps (a) through (d) for both channels.

(a) Set up the PIR, BITE/MDT, or equivalent to measure DDM in the carrier feedline.

(b) Adjust the modulation balance until the integral monitor path channel is in high path angle alarm (150 > 90 Hz). Measure and record the carrier feedline and monitor DDM values on FAA Form 6750-29. Determine if the DDM is within the operating tolerances in chapter 3. If the carrier feedline DDM is out of tolerance, corrective action is required. Compare the monitor input DDM to previous readings. Note that no tolerance is established for this entry. It is used only to detect trends.

(c) Follow the procedure in step (b) for the modulation balance adjusted for 90 > 150 Hz.

(d) Readjust the modulation balance for 0 DDM.

(4) SBO dephasing alarms. (Optional)

(a) Note the position of the main sideband (SBO) phaser or the MDT SBO phase setting.

(b) Advance the main (SBO) phase or insert and adjust the test kit phaser until the monitor width channel alarms. A preferred alternate method is to add a predetermined line length (type N or BNC elbows, or equivalent) to the carrier feedline. *

(c) Repeat the procedure in step (b) with the SBO phase retarded.

(d) Return the main (SBO) phase to the normal position noted in step (a) or remove the added line lengths.

(5) Middle antenna dephasing alarms.

(a) Advance the APCU middle antenna phase (or insert and adjust the test kit phaser in the middle antenna feedline) until the width monitor alarms. If the test kit phaser is used, it should be the same as used for the reference flight check that established the FAA Form 6750-29 values. Also, the test phaser should have been previously checked with a vector voltmeter to ensure accuracy. A preferred alternate method is to add the same predetermined line length (type N or BNC elbows, or equivalent) to both the lower and upper antenna outputs of the APCU.

(b) Record the change in degrees in the middle antenna dephasing column on FAA Form 6750-29. Confirm that the value is within established reference value. If not within tolerance, corrective action is required.

(c) Repeat the procedure in the above steps with the middle antenna phase retarded (the same line length added to the middle antenna output).

(d) Restore the middle antenna phase to normal, or remove the test phaser or lines.

(6) Attenuate upper antenna alarm.

(a) Insert the capture-effect test kit attenuator into the upper antenna feedline. This attenuator should have been previously checked with a vector voltmeter to ensure that the total insertion phase delay equals 360° ±5°. Also, the accuracy of the dial calibration of the attenuator should be verified. Refer to paragraph 5-155 for this procedure.

(b) Adjust the test attenuator until the path monitor alarms. *

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES (Continued)

(6) Insert the FA-9438 wattmeter coupler into the carrier feedline wattmeter body and rotate the coupler for maximum pickup.

NOTE: For the Mark 20 Glide Slope, the lower antenna rf wattmeter body will have to be used. Turn off the SBO and clearance signals.

(7) Use a double-shielded coaxial cable and connect the coupler to the RF INPUT jack of the modulation meter.

(8) Place the function selector switch to LOCALIZER or GLIDE SLOPE, as appropriate, and read the 90 Hz and 150 Hz modulation percentages on the PERCENT MODULATION indicator.

(9) Record the percentages on FAA Form 6750-32, and determine if they are in tolerance.

(10) At two-frequency facilities, complete the steps above for the clearance transmitter on a separate FAA Form 6750-32.

(11) Restore the equipment to normal.

f. BITE/MDT Procedure. Refer to the facility technical instruction book, section 3, for operation of the BITE/MDT.

(1) Proceed to the transmitter data screen of the selected transmitter and record the percentages on FAA Form 6750-32 and determine if they are in tolerance.

NOTE: A maintenance data screen is available for the Mark 20 ILS. This screen contains all measurements normally taken for a normal line entry.

(2) At two-frequency facilities, complete step f (1) above for the clearance transmitter on a different FAA Form 6750-32.

(3) For facilities with standby equipment, bring the standby equipment up and complete steps (1) and (2), and record on a separate FAA Form(s) 6750.32.

g. Alternate Procedure. This procedure is not as accurate as the procedures in e and f and shall be used only as a standby procedure.

(1) Set the oscilloscope vertical amplifiers for dc operation and verify that the dc balance is correct. The baseline will not move when the vertical gain is varied.

(2) Connect the detected signal jack on the carrier feedline rf body to the vertical input of the oscilloscope.

(3) Insert the wattmeter element into the rf body as if to read forward power.

(4) Adjust the sweep and sync (or trigger) controls for a stable display of the composite waveform.

(5) Disconnect the signal to the oscilloscope and position the sweep along the bottom horizontal graticule.

(6) Reconnect the signal to the oscilloscope and adjust the vertical gain until the peak of the large audio lobe is displayed tangent to the top horizontal graticule (E_{max}).

(7) Repeat steps (5) and (6) as necessary.

(8) Determine the number of E_{min} and E_{max} divisions and compute the 90 Hz plus 150 Hz composite modulation percentage:

$$\%\,\text{mod} = \frac{E_{max} \quad E_{min}}{E_{max} + E_{min}} \times .54$$

(9) Record the percentages on FAA Form 6750-32 and determine if they are within tolerance.

(10) Restore the equipment to normal operation.

5-48. NULL-REFERENCE SYSTEM PHASING.

a. Object. This procedure provides a method to adjust the length of the transmission lines to produce an in-phase condition between carrier and sideband rf energy in the far field.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES (Continued)

b. Discussion. Rf misphasing between the carrier and sideband signals results in a broad path width and reduced below path clearances. A misphased null-reference glide slope requires more sideband power to obtain a normal 0.7° path width. Increased sideband power will cause increased path roughness. Significant changes in ground phasing requires investigation and corrective action.

c. Test Equipment Required.

(1) A portable ILS receiver (PIR).

(2) A glide slope antenna.

(3) A quadrature (90°) line section.

(4) Two-way communications.

* **(5)** RF Directional Coupler.

(6) Vector Volt Meter.

d. Conditions. A facility shutdown is required for this check. A ground-phasing reference point must have been previously established in accordance with paragraph 5-191.

e. Detailed Procedure.

(1) Method #1.

WARNING: The following procedure will produce Hazardously Misleading Information (HMI). Before proceeding, refer to paragraph 1-6 and follow the specific HMI guidance provided. Failure to follow this guidance can result in Controlled Flight Into Terrain (CFIT). The duration and frequency of radiating HMI must be kept to a minimum by any means necessary, as required by Order 6000.15, paragraphs 307, 425, and 432.

(a) Confirm that the modulation equality is 0 DDM. Correct if necessary.

(b) Position the PIR at the ground-phasing point established in accordance with paragraph 5-191.

(c) Install the facility quadrature line section in the sideband line.

(d) Note the sideband phaser setting. *

* **(e)** Adjust the rf phasing controls for a DDM reading on the PIR equal to the reference DDM reading obtained when ground phasing was established. Note that this may be a non-zero DDM value.

(f) Remove the quadrature line section and restore the equipment to normal. At the ground-phasing point, verify a predominance of 150 Hz.

(g) The difference between the phaser's initial setting and the new setting is the phase error that existed before this procedure was accomplished. Significant changes in phasing should be investigated.

(h) Refer to paragraph 5-49 and check the integral width monitoring network phasing if the facility phaser required adjustment.

(i) Restore the facility to service.

(2) Method #2.

(a) Radiate RF only by turning off the modulation (90/150) and dummy load the SBO signal.

(b) Insert directional coupler in series with lower antenna transmit line.

(c) Connect the 'A' channel of the VVM to the coupler incident port and the 'B' channel to the lower antenna monitor return line.

(d) Set the lower antenna reading as the 'Reference' (0 dB, 0 degrees).

(e) Remove directional coupler from the lower antenna transmit line.

(f) Insert directional coupler in series with upper antenna transmit line.

(g) Connect the 'A' channel of the VVM to the coupler incident port and the 'B' channel to the upper antenna monitor return line.

(h) Radiate RF only in the upper antenna. *

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES (Continued)

* **(i)** Note phase and amplitude readings.

(j) Compare these readings against previous readings. Any amplitude change of more than 0.5 dB, or phase changes of more than 5 degrees should be investigated and phase verified with method #1.

NOTE: For initial readings document all findings in the FRDF.

(k) Restore the facility to service.

5-49. NULL-REFERENCE GLIDE SLOPE INTEGRAL MONITOR.

a. Object. This procedure provides a method to determine whether the phase of the rf signals from the carrier and sideband antenna pickup loops are within prescribed tolerances at the monitor corner of the combining bridge and to correct the phase if necessary.

b. Discussion. The rf signals from the integral width monitoring pickups must be in phase at the width monitor output of the combining bridge to provide symmetrical monitor alarm points when the facility is dephased in opposite directions. Phasing at the combining bridge output should not change except for network deterioration. A change in glide slope phasing will require checking of the phase of the width monitor network.

c. Test Equipment Required. A portable ILS receiver (PIR), dummy loads, and a quadrature (90°) line section.

d. Conditions. The facility is properly phased. A shutdown is required for this check.

e. Detailed Procedure.

* **(1)** Connect PIR to the course CSB RF-Body and take a reference DDM reading.

(2) Confirm that the modulation balance is 0.00 DDM. Correct to 0 DDM if necessary.

(3) Insert the 90° section in series with the SBO input to the monitor combining unit. With the PIR at the width monitor output from the monitor combining network note the DDM reading.

* **(4)** Note the position of the integral monitor phaser. Adjust the phaser for a 0.00 DDM reading on the PIR.

(5) The difference between the original phaser position and the new position is the error that existed before this procedure was accomplished. This error should be within the operating tolerance listed in chapter 3.

* **(6)** Remove the 90° section from the SBO input to the monitor combining unit.

(7) If the DDM is substantially different, adjust the integral monitor attenuator to increase or decrease the DDM reading. Repeat steps (3) through (6) to correct any phase changes caused by changing the attenuator setting.

(8) Using the main sideband phaser, dephase the main sidebands in one direction to alarm. Fixed line lengths may be used in lieu of adjusting the main sideband phaser as described in paragraph 6-35e. Note the change from the normal phaser setting. Dephase the main sidebands in the other direction, again noting the change from the normal setting. If the monitor does not alarm with symmetrical (equal) dephasing of the main sideband phase the monitor combining unit phase that was adjusted in step (4) will require refining to provide symmetrical dephasing to alarm. If this situation occurs, the station 90° line section should be checked.

(9) Restore the facility to service.

5-50. SIDEBAND REFERENCE SYSTEM PHASING.

a. Object. This procedure provides a method to ground-phase the system such that the correct carrier, CSB, and sideband-only (SBO) phase relationships are distributed to the antennas, and to properly phase the antennas to each other.

b. Discussion. RF phasing of the sideband reference glide slope affects both path width and path angle. Advancing or retarding the SBO signals of a properly phased sideband reference system with the main sideband phaser will symmetrically broaden the path width. *

*

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES (Continued)

Likewise, advancing or retarding the upper antenna phaser will symmetrically broaden the path width and lower the glide angle. Significant changes in ground phasing require investigation and corrective action.

c. Test Equipment Required.

(1) A portable ILS receiver (PIR).

(2) A glide slope antenna.

(3) Dummy loads.

(4) A quadrature (90°) line section.

(5) Two-way communications.

* **(6)** RF Directional Coupler.

(7) Vector Volt Meter.

d. Conditions. A facility shutdown is required for this check. A ground-phasing reference point must have been previously established in accordance with paragraph 5-191. The SBO power distribution must be correct in accordance with paragraph 5-125.

e. Detailed Procedure.

(1) Method #1.

WARNING: The following procedure will produce Hazardously Misleading Information (HMI). Before proceeding, refer to paragraph 1-6 and follow the specific HMI guidance provided. Failure to follow this guidance can result in Controlled Flight Into Terrain (CFIT). The duration and frequency of radiating HMI must be kept to a minimum by any means necessary, as required by Order 6000.15, paragraphs 307, 425, and 432.

(a) Lower antenna (CSB + SBO) phasing.

1 Disconnect and dummy load the sideband input of the amplitude and phase control unit (APCU). Also dummy-load the sideband output of the transmitter.

2 Connect the PIR to the lower antenna wattmeter detector output. Confirm that modulation equality is 0 DDM. Correct to 0 DDM if necessary.

* 3 Add the facility quadrature line section to the sideband input line removed in step (a) and reconnect it to the APCU.

4 Adjust the main SBO phaser for 0 DDM in the lower antenna feedline.

5 Remove the 90° section, and verify that there is a predominance of 90 Hz in the lower antenna feedline.

(b) Upper to lower antenna phasing.

1 Insert the facility quadrature line section in the APCU sideband input line.

2 Note the upper antenna phaser setting.

3 Position the PIR at the ground-phasing point established in accordance with paragraph 5-191.

4 Adjust the upper antenna phaser for the reference DDM reading obtained when the ground-phasing point was established. Note that this may be a non-zero DDM value.

5 The difference between the old and new phaser setting is the phase error that existed before this procedure was accomplished.

6 Restore the facility to service. At the ground-phasing point, verify a predominance of 150 Hz.

7 Refer to paragraph 5-51 and check the integral monitoring network phasing if the upper antenna phaser required adjustment.

(2) Method #2.

(a) Radiate RF only by turning off the modulation (90/150) and dummy load the SBO signal.

(b) Insert directional coupler in series with lower antenna transmit line.

(c) Connect the 'A' channel of the VVM to the coupler incident port and the 'B' channel to the lower antenna monitor return line. *

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES (Continued)

* **(d)** Set the lower antenna reading as the 'Reference' (0 dB, 0 degrees).

(e) Remove directional coupler from the lower antenna transmit line.

(f) Insert directional coupler in series with upper antenna transmit line.

(g) Connect the 'A' channel of the VVM to the coupler incident port and the 'B' channel to the upper antenna monitor return line.

(h) Radiate RF only in the upper antenna.

(i) Note phase and amplitude readings.

(j) Compare these readings against previous readings. Any amplitude change of more than 0.5 dB, or phase changes of more than 5 degrees should be investigated and phase verified with method #1.

NOTE: For initial readings document all findings in the FRDF.

(k) Restore the facility to service. *

5-51. SIDEBAND REFERENCE MONITOR COMBINING NETWORK.

a. Object. This procedure provides a method to determine whether the sideband-reference glide slope monitor combining network is properly adjusted.

b. Discussion. The rf signals are sampled from upper and lower antenna monitor pickups. Rf phase and amplitude adjustments provide an rf phase (path) output and an rf amplitude (width) output either directly to the monitor or through an rf detector to the monitor. Readjustment of system rf phasing or APCU power to optimum requires readjustment to the monitor combining network. The monitor combining network should not be adjusted until the sideband-reference glide slope rf phasing and APCU powers are determined at optimum.

c. Test Equipment Required. A portable ILS receiver (PIR).

d. Conditions. Interruption to facility monitoring is required for this procedure.

e. Detailed Procedure.

(1) Place the monitor bypass switch in BYPASS.

(2) Confirm that the modulation balance is 0 DDM. Correct to 0 DDM if necessary.

(3) Disconnect the cable from the hybrid path output, and connect the PIR to the hybrid path output.

(4) If the PIR is not indicating 0 DDM, note the phaser setting and adjust the phaser for 0 DDM indication on the PIR. Verify that the rf phase difference of the phaser setting is within established tolerance.

(5) If the glide slope system rf phasing and powers have been optimized, leave the monitor combining network phaser adjusted for 0 DDM. If the system has not been optimized, return the phaser to the setting noted in step (4).

(6) Disconnect the PIR cable from the hybrid path output and reconnect the cable removed in step (3).

(7) Disconnect the cable from the hybrid width output, and connect the PIR to the hybrid width output. The PIR should indicate a predominate 150 Hz signal of approximately 0.240 DDM. Changes in this value from monitor reference readings require investigation of system rf power ratios and rf phasing.

(8) Remove the PIR cable from the hybrid width output, and reconnect the cable disconnected in step (7).

(9) If adjustments were made to the monitor combining network, readjust the monitor as required before unbypassing the monitor and returning the system to service.

5-52. CAPTURE-EFFECT SYSTEM PHASING.

a. Object. This procedure provides a method to ground phase the system such that the correct carrier and

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES (Continued)

sideband-only phase relationships are distributed between the three antennas, and to correctly phase the antennas to each other.

b. Discussion. System phasing affects path angle, path width, path symmetry, and below path clearances. A ground phasing point must be established in the far field in accordance with paragraph 5-191. The desired phase relationships are:

(1) The carrier sidebands (CSB) in the lower antenna are 180° out of phase with CSB in the middle antenna.

(2) The sidebands only (SBO) in the lower antenna are 180° out of phase with the SBO in the middle antenna.

(3) The SBO in the upper antenna are 180° out of phase with the SBO in the middle antenna.

(4) The 90 Hz SBO signal in the middle antenna is in phase with the 90 Hz CSB signal in the middle antenna, and 90 Hz predominates.

(5) The 90 Hz SBO signal in the lower antenna is in phase with the 90 Hz CSB signal in the lower antenna, and 90 Hz predominates.

(6) The clearance signal in the upper antenna is in phase with the clearance signal in the lower antenna.

NOTE: If significant changes to the system are being made, such as replacing antennas or antenna cables, it is recommended that the rf method of phasing given in the latest edition of Order 6750.54, Installation Instructions for Instrument Landing System (ILS) Facilities, paragraphs 319 and 322, be used initially so that gross errors may be avoided.

c. Test Equipment Required.

(1) A portable ILS receiver (PIR).

(2) A glide slope antenna.

(3) Dummy loads.

(4) A quadrature (90°) line section.

(5) Two-way communications.

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedure.

* **(1) Method #1.**

WARNING: The following procedures will produce Hazardously Misleading Information (HMI). Before proceeding, refer to paragraph 1-6 and follow the specific HMI guidance provided. Failure to follow this guidance can result in Controlled Flight Into Terrain (CFIT). The duration and frequency of radiating HMI must be kept to a minimum by any means necessary, as required by Order 6000.15, paragraphs 307, 425, and 432.

*

(a) Middle antenna CSB/SBO phasing.

1 Turn off (or disconnect and dummy load) the clearance transmitter and the clearance input port of the APCU.

2 Disconnect and dummy load the APCU sideband input cable and the APCU sideband input port.

3 Connect the PIR to the middle antenna thruline body, and confirm that the modulation equality is 0 DDM. Correct if necessary.

4 Connect the facility quadrature line section to the main sideband line, and reconnect it to the APCU. With the PIR connected to the middle antenna thruline body, adjust the main sideband phaser for 0 DDM.

(b) Lower antenna CSB/SBO phasing.

NOTE: Perform steps 1 and 2 only if the APCU has a lower antenna CSB/SBO phaser.

1 Connect the PIR to the lower antenna thruline body.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES (Continued)

2 Adjust the lower antenna APCU CSB/SBO phaser until the PIR reads 0 DDM.

3 Remove the quadrature line section, reconnect the sideband line, and check for proper sensing (90 Hz predominate) in the lower and middle antenna thruline bodies.

(c) Upper/middle antenna phasing.

NOTE: The middle antenna phaser (if installed) should not be adjusted. Even though the lower antenna is the theoretical phase reference of a capture-effect glide slope, the middle antenna is treated as a reference in phasing procedures because of the middle antenna dephasing check performed on some flight inspections.

1 Replace all wattmeter elements.

2 Disconnect and dummy load the APCU lower antenna output and the lower antenna feedline.

3 Reinsert the quadrature line section in the APCU sideband input line.

4 Take the PIR to the established far-field phasing point. Observe the DDM scale, and adjust the upper antenna phaser for the reference DDM value obtained when phasing references were established. This value should be recorded on the appropriate Facility Reference Data File (FRDF) Records.

5 The difference between the phaser's original setting and the new phaser setting is the error that existed before this procedure was performed. Significant changes in ground phasing should be investigated.

(d) Lower/upper antenna phasing.

1 Remove the dummy load from the APCU lower antenna output and reconnect the lower antenna.

2 Disconnect and dummy load the middle antenna feedline and the APCU middle antenna output.

3 At the established far-field phasing point, observe the DDM scale, and adjust the lower antenna phaser for the reference DDM value that was obtained when phasing references were established. This value should be recorded on the appropriate Facility Reference Data File (FRDF) Records.

4 The difference between the phaser's original setting and the new phaser setting is the error that existed before this procedure was performed. Significant changes should be investigated.

5 Restore clearance energy.

6 Restore the facility to service.

7 Refer to paragraph 5-53, and check the integral width monitoring network phasing if the facility phasing was changed.

(e) Changing the DDM reference.

1 The reference values of DDM given in steps (c)4 and (d)3 are values that have been carefully established. They are values that were measured after completing a glide slope flight inspection that determined proper far-field phasing. These reference values should seldom change after they are established.

2 If it is necessary to establish new references for a facility, they shall not be changed until a flight inspection, that includes all the periodic with-monitors checks, has been completed. When the middle antenna phase is advanced and retarded, the facility must meet initial tolerances. The reference values can then be measured and recorded on facility reference data file (FRDF) records and included in the facility records after the flight inspection has been completed.

(2) Method #2.

WARNING: The following procedures will produce Hazardously Misleading Information (HMI). Before proceeding, refer to paragraph 1-6 and follow the specific HMI guidance provided. Failure to follow this guidance can result in Controlled Flight Into Terrain (CFIT). The duration and frequency of radiating HMI must be kept to a minimum by any means necessary, as required by Order 6000.15, paragraphs 307, 425, and 432.

(a) Middle antenna CSB/SBO phasing.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES (Continued)

1 Turn off (or disconnect and dummy load) the clearance transmitter and the clearance input port of the APCU.

2 Disconnect and dummy load the APCU sideband input cable and the APCU sideband input port.

3 Connect the PIR to the middle antenna thruline body, and confirm that the modulation equality is 0 DDM. Correct if necessary.

4 Connect the facility quadrature line section to the main sideband line, and reconnect it to the APCU. With the PIR connected to the middle antenna thruline body, adjust the main sideband phaser for 0 DDM.

(b) Lower antenna CSB/SBO phasing.

NOTE: Perform steps 1 and 2 only if the APCU has a lower antenna CSB/SBO phaser.

1 Connect the PIR to the lower antenna thruline body.

2 Adjust the lower antenna APCU CSB/SBO phaser until the PIR reads 0 DDM.

3 Remove the quadrature line section, reconnect the sideband line, and check for proper sensing (90 Hz predominate) in the lower and middle antenna thruline bodies.

(c) Lower/middle antenna phasing.

NOTE: The middle antenna phaser (if installed) should not be adjusted. Even though the lower antenna is the theoretical phase reference of a capture-effect glide slope, the middle antenna is treated as a reference in phasing procedures because of the middle antenna dephasing check performed on some flight inspections.

1 Configure the APCU so that CSB is transmitted out the lower antenna only.

2 Configure the APCU so that SBO is transmitted to the middle and upper antennas only.

3 Disconnect and dummy load the upper antenna feedline and the APCU upper antenna output.

4 Reinsert the quadrature line section in the APCU sideband input line.

5 At the established far-field phasing point, adjust the lower antenna phaser for the reference DDM value obtained when phasing references were established. This value should be recorded on the appropriate Facility Reference Data File (FRDF). The difference between the phaser's original setting and the new phaser setting, is the error that existed before this procedure was performed. Significant changes in ground phasing should be investigated.

6 Remove the quadrature line section, reconnect the sideband line, and check for proper sensing in far-field (150 Hz predominate).

(d) Lower/upper antenna phasing.

1 Disconnect and dummy load the middle antenna feedline and the APCU middle antenna output.

2 Remove the dummy load from the APCU upper antenna output and reconnect the upper antenna.

3 Reinsert the quadrature line section in the APCU sideband input line.

4 At the established far-field phasing point, adjust the upper antenna phaser for the reference DDM value obtained when phasing references were established. This value should be recorded on the appropriate Facility Reference Data File (FRDF). The difference between the phaser's original setting and the new phaser setting, is the error that existed before this procedure was performed. Significant changes in ground phasing should be investigated.

5 Remove the quadrature line section, reconnect the sideband line, and check for proper sensing in far-field (90 Hz predominate).

6 Remove the dummy load from the APCU middle antenna output and reconnect the middle antenna.

7 Restore clearance energy and check for proper sensing in far-field (150 Hz predominate).

8 Restore the facility to service.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES (Continued)

9 Refer to paragraph 5-53, and check the integral width monitoring network phasing if the facility phasing was changed.

(e) Changing the DDM reference.

1 The reference values of DDM given in steps (c)4 and (d)3 are values that have been carefully established. They are values that were measured after completing a glide slope flight inspection that determined proper far-field phasing. These reference values should seldom change after they are established.

2 If it is necessary to establish new references for a facility, they shall not be changed until a flight inspection, that includes all the periodic with-monitors checks, has been completed. When the middle antenna * phase is advanced and retarded, the facility must meet initial tolerances. The reference values can then be measured and recorded on facility reference data file (FRDF) records and included in the facility records after the flight inspection has been completed.

(3) Method #3. If signal strength is inadequate for this procedure, use method #2.

WARNING: The following procedures will produce Hazardously Misleading Information (HMI). Before proceeding, refer to paragraph 1-6 and follow the specific HMI guidance provided. Failure to follow this guidance can result in Controlled Flight Into Terrain (CFIT). The duration and frequency of radiating HMI must be kept to a minimum by any means necessary, as required by Order 6000.15, paragraphs 307, 425, and 432.

(a) Middle antenna CSB/SBO phasing.

1 Turn OFF (or disconnect and dummy load) the clearance transmitter and the clearance input port of the APCU.

2 Disconnect and dummy load the APCU upper antenna output, the APCU sideband input cable, and the APCU sideband input port.

3 Connect the PIR to the middle antenna thruline body, and confirm that the modulation equality is 0 DDM. Correct if necessary.

4 Connect the facility quadrature line section to the main sideband line, and reconnect it to the APCU. With the PIR connected to the middle antenna thruline body, adjust the main sideband phaser for 0 DDM.

(b) Lower antenna CSB/SBO phasing.

NOTE: Disregard steps 1 and 2 if a carrier-sideband phaser is not installed.

1 Connect the PIR to the lower antenna thruline body.

2 Adjust the lower antenna APCU carrier-sideband phaser for the reference DDM value obtained in step (a)3.

3 Remove the quadrature line section, reconnect the sideband line, and check for proper sensing (90 Hz predominate) in the lower and middle antenna thruline bodies.

(c) Lower/middle antenna phasing.

1 Reinsert the quadrature line section in the APCU sideband input line.

2 Note the upper and lower antenna phaser settings.

3 At the established far-field phasing point, adjust the lower antenna phaser for the reference DDM value obtained when phasing references were established. This value should be recorded on the appropriate Facility * Reference Data File (FRDF). The difference between the * phaser's original setting and the new phaser setting, is the error that existed before this procedure was performed. Significant changes in ground phasing should be investigated.

NOTE: The middle antenna phaser (if installed) should not be adjusted, as it is the reference for the upper and lower antenna phaser settings.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES (Continued)

(d) Upper/lower antenna phasing.

1 Remove the dummy load from the APCU upper antenna output and reconnect the upper antenna.

2 Disconnect and dummy load the middle antenna feedline and APCU middle antenna output.

3 At the established far-field phasing point, adjust the upper antenna phaser for the reference DDM reading when phasing references were established. This value should be recorded on the appropriate Facility Reference Data File (FRDF) Record. The difference between the phaser's original setting and the new phaser setting is the error that existed before this procedure was performed. Significant changes in ground phasing should be investigated.

4 Remove the quadrature line section from the APCU input sideband line, and reconnect the middle antenna feedline.

5 Restore clearance energy.

6 Restore the facility to service.

7 Refer to paragraph 5-53, and check the integral width monitoring network phasing if the facility phasing was changed.

(e) Changing the DDM reference.

1 The reference values of DDM given in steps (c)3 and (d)3 are values that have been carefully established. They are values that were measured after completing a glide slope flight inspection that determined proper far-field phasing. These reference values should seldom change after they are established.

2 If it is necessary to establish new references for a facility, they shall not be changed until a flight inspection, that includes all the periodic with-monitors checks, has been completed. When the middle antenna phase is advanced and retarded, the facility must meet initial tolerances. The reference values can then be measured and recorded on facility reference data file (FRDF) records and included in the facility records after the flight inspection has been completed.

(4) Method #4.

(a) Radiate RF only by turning OFF the modulation (90/150) and dummy load the SBO signal.

(b) Insert directional coupler in series with lower antenna transmit line.

(c) Connect the 'A' channel of the VVM to the coupler incident port and the 'B' channel to the lower antenna monitor return line.

(d) Set the lower antenna reading as the 'Reference' (0 dB, 0 degrees).

(e) Remove directional coupler from the lower antenna transmit line.

(f) Insert directional coupler in series with middle antenna transmit line.

(g) Connect the 'A' channel of the VVM to the coupler incident port and the 'B' channel to the middle antenna monitor return line.

(h) Radiate RF only in the middle antenna.

(i) Note phase and amplitude readings.

(j) Compare these readings against previous readings. Any amplitude change of more than 0.5 dB, or phase changes of more than 5 degrees should be investigated and phase verified with method #1.

NOTE: For initial readings document all findings in the FRDF.

(k) Repeat steps 5-52e(4)(f) to (j) for the upper antenna.

(l) Restore the facility to service.

5-53. CAPTURE-EFFECT INTEGRAL MONITOR.

a. Object. This procedure provides a method to determine whether the phase of the rf signals from the carrier and sideband antenna pickup loops are within prescribed tolerances at the monitor corner of the combining bridge.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES (Continued)

b. Discussion. The rf signals from the integral width monitoring pickups must be in phase at the width monitor output of the combining bridge to provide symmetrical monitor alarm points when the facility is dephased in opposite directions. They must also be properly phased and of the correct amplitude for proper operation of the integral path monitor. Phasing at the combining bridge output should not change except for network deterioration. A change in glide slope phasing will require checking of the phase of the width monitor network.

c. Test Equipment Required.

(1) A portable ILS receiver (PIR).

(2) Dummy loads.

(3) A quadrature (90°) line section.

* **(4)** Identical type N elbows (which are 17 to 19 electrical degrees in length at glide slope frequencies).

d. Conditions. The facility is properly phased. A shutdown is required for this check.

e. Detailed Procedure. Refer to the manufacturer's instruction book for specific procedures. The general procedures are detailed below.

(1) Method #1.

WARNING: The following procedure will produce Hazardously Misleading Information (HMI). Before proceeding, refer to paragraph 1-6 and follow the specific HMI guidance provided. Failure to follow this guidance can result in Controlled Flight Into Terrain (CFIT). The duration and frequency of radiating HMI must be kept to a minimum by any means necessary, as required by Order 6000.15, paragraphs 307, 425, and 432.

(a) Disconnect and dummy load the main sideband output of the transmitter and the SBO input to the APCU.

(b) Connect the PIR to the width monitor detector or to the width monitor rf output of the recombining bridge. *

* **(c)** Confirm that the modulation balance is 0 DDM. Correct to 0 DDM if necessary.

(d) Reconnect the sideband input to the APCU through facility quadrature line section.

(e) Note the position of the monitor combining unit middle antenna phaser. Adjust the phaser for a 0 DDM reading on the PIR.

(f) The difference between the original phaser position and the new position is the phase error that existed before this procedure was accomplished. Ascertain that the phase error is within operating tolerance, and return the phaser to the position noted in step (e).

(g) Remove the quadrature line section from the sideband line.

(h) If the DDM is substantially different, adjust the attenuator in the lower antenna monitor line to increase or decrease the DDM reading. Repeat steps (d) through (g) to correct any phase changes caused by changing the attenuator setting.

(i) Restore the facility to service.

(j) Check the clearance cancellation in accordance with paragraph 5-61.

NOTE: Steps 5-53e(1)(k) through (s) apply only to facilities that have a pickup probe in the upper antenna.

(k) With the sideband output terminated into a dummy load, radiate only the modulated carrier.

(l) Connect the PIR to the output of the path monitor detector or to the path monitor rf output of the combining bridge.

(m) Obtain a reference (0.00 DDM) reading on the PIR.

(o) Reconnect the sideband output through a quadrature line section.

(p) Note the monitor combining unit upper antenna phaser position, and then adjust it for the reference value noted in step (m). *

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES (Continued)

* **(q)** Ascertain that the phase error is within operating tolerance for the capture-effect integral monitor width phasing.

(r) Return the monitor combining unit upper antenna to the position noted in step (p). Remove the quadrature line section and restore the equipment to normal.

(s) Restore the facility to service.

(2) Method #2.

(a) Ensure the transmitters are in normal configuration, at the established normal reference powers and at reference facility phasing.

(b) Confirm that the monitor width is normal.

(c) Separately dephase the middle antenna by using the fixed line section (~19 degrees) used during commissioning flight inspection.

(d) Place the fixed line section in the middle antenna monitor-line to retard the middle antenna. Record the path width.

(e) Remove the fixed line section from the middle antenna monitor-line. Place the fixed line section in the lower antenna and the upper antenna monitor-line simultaneously to advance the middle antenna. Record the path width.

(f) Compare the values with the values recorded in step (d). The path width should symmetrically widen in the monitor width display. Optimization typically results by adjustment of the monitor combining unit middle antenna phaser.

(g) Remove the elbows from the upper and lower antenna monitor-lines.

(h) If the path width reading in normal is substantially different, adjust the path width power divider to increase or decrease the DDM reading.

* **(i)** Repeat steps 5-53e(2)(d) to (h) until symmetry is achieved and to correct any phase changes caused by changing the path width power divider.

(j) Connect the PIR to the path monitor rf output of the combining bridge.

(k) Adjust upper antenna phaser for maximum 150 Hz or minimum 90Hz.

(l) Adjust clearance power divider for a reading of 0.000 DDM.

(m) Restore the facility to normal.

*

5-54. END-FIRE COURSE ARRAY SBO PHASING.

a. Object. This procedure provides a method to ground-phase the system to obtain the correct carrier to sideband-only phase relationship.

b. Discussion. Carrier, CSB, and sidebands, SBO, are fed in quadrature to both antennas of the course array. CSB to SBO phasing can be effectively performed on the ground by observing the DDM in the front course antenna feedline. Airborne phasing checks of CSB to SBO phase shall not be conducted on end-fire systems. The phasing of the course array should always be maintained in quadrature (0 DDM), as any value other than quadrature will derogate facility performance.

c. Test Equipment Required. A portable ILS receiver (PIR).

d. Conditions. The facility is operating normally.

e. Procedure.

(1) Note the position of the main SBO phaser.

(2) Verify transmitter modulation balance. Refer to paragraphs 5-62b(4) and 5-62c(2)(a)3.

(3) Disconnect quadrature detector from signal sampler in the front antenna, and connect PIR to the sampler output.

(4) Adjust main SBO phaser on the transmitter for 0.00 DDM.

*

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES (Continued)

(5) Confirm that the phaser change is within the operating tolerance in chapter 3.

(6) Return the main SBO phaser to the normal position noted in step (1).

(7) Restore the facility to service.

5-55. END-FIRE CLEARANCE ARRAY PHASING.

a. Object. This procedure provides a method to obtain the proper radiated rf phase between the two clearance array antennas.

b. Discussion. The end-fire array provides precision guidance in a relatively narrow sector either side of the runway centerline. The clearance array provides the user full scale fly-up outside this sector. To provide this, the two clearance antennas are fed equal power and are phased to provide minimum energy near runway centerline and two broad maxima at approximately ±20° from runway centerline.

c. Test Equipment Required. An oscilloscope.

d. Conditions. Facility operating normal.

e. Procedure.

(1) Connect an oscilloscope to monitor the detected output of the snap-down monitor detector (midfield monitor) and note waveform of M2 during a scan. The waveform will be an audio (90/150 Hz) waveform with a higher frequency waveform superimposed on it. This higher frequency waveform is the beat frequency (approximately 8 kHz) between the course transmitter and the clearance transmitter.

(2) Note the position of the front clearance antenna phaser.

(3) While observing the oscilloscope, adjust the front clearance antenna phaser for minimum detected 8 kHz.

(4) Determine the amount of change, in degrees, from the normal phaser position noted in step (2). Compare this value with your facility reference data, as established by flight inspection, and note any difference. This difference (i.e., between the current measurement and the facility reference value) should be within the operating tolerance in chapter 3. If not within tolerance, corrective action is required.

(5) If an adjustment is made in step (4) the location of the clearance monitor antenna should be confirmed in accordance with paragraph 5-122.

(6) Return the clearance front clearance array phaser to the position noted in step (2).

(7) Restore the facility to service.

5-56. END-FIRE COURSE ARRAY MONITOR PHASING.

a. Object. This procedure provides a method to obtain the correct phase relationships between the front and rear course array integral monitor signals.

b. Discussion. A part of the energy fed to each antenna of the course array is not radiated and is available for monitoring the relative phase shifts of the signals passing through the antennas. Since the relative phase shift is directly related to the path angle, the unused energy provides an accurate means to monitor the glide slope angle. This monitor will not detect angle changes due to physical spacing, horizontal location, or physical obstructions in the array. The snap-down monitor will monitor these environmental affects.

c. Test Equipment Required.

(1) A portable ILS receiver (PIR).

(2) Two dummy loads.

d. Conditions. The facility operating normally.

e. Procedure.

(1) Verify transmitter modulation balance. Refer to paragraphs 5-62b(4) and 5-62c(2)(a)3.

(2) Verify that the CSB to SBO phasing is in accordance with paragraph 5-54.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES (Continued)

(3) Verify that the rf power levels from the front and rear monitor feedlines are within the power ratio as listed in the standards and tolerances in chapter 3. This is accomplished by dummy loading one of the monitor feedlines and its associated monitor bridge input and noting the integral monitor rf level. Repeat this step for the other monitor feedline.

(4) Reconnect both feedlines to the course integral monitor bridge.

(5) Disconnect the course detector from the output of the monitor bridge and connect the PIR to the bridge.

(6) Note the position of the course monitor rear feedline phaser.

(7) Adjust the phaser in the rear course monitor feedline until the PIR reads the reference DDM and that the path rf level shows a maximum. Confirm that the change is within the operating tolerance in chapter 3.

(8) Return the course monitor rear feedline phaser to the position noted in step (6).

(9) Return the facility to service.

5-57. AUDIO AND RF FREQUENCIES.

a. Object. This procedure provides a method to measure the ILS facility audio and carrier frequencies.

b. Discussion. The operating frequencies of an ILS facility must remain within specified limits of the authorized values. The rf body installed in the carrier or an antenna feedline is a convenient point to obtain a sample for the rf measurement. The navigational audio frequencies are essential for establishing the course and width, while the identification tone is a necessary indication of facility availability and identification. Navigation audio signals may be sampled via an rf wattmeter body with a suitable element installed, or an equipment test point(s) depending on the facility type.

c. Test Equipment Required.

(1) A frequency counter with 0.0001 percent (1 part per million (ppm)) or better accuracy.

(2) An rf wattmeter body coupler.

(3) An optional wave analyzer.

d. Conditions. For sampled measurements, i.e., those taken without disturbing the radiated signal, the facility may remain in operation. For measurements taken where a frequency must be removed or switched to continuous, the facility must be removed from service.

e. Detailed Procedure. For the following test connections consult the applicable TI for an appropriate test point or jack, or use an rf wattmeter body and element. For the Mark 20 Localizer/Glide Slope, a convenient point is located on the AC/DC Switch Module Assemble 1A2/1A4.

(1) Measure the modulation frequencies (90, 150, 1020 Hz, etc.) using an equipment test point, jack, or detected output from an rf wattmeter body. If no jack is provided on the equipment which accesses the 90 and 150 Hz tones individually, they may be measured by using a wave analyzer to separate the 90 and 150 Hz tones. The input of the wave analyzer is connected to the audio output of the carrier rf body with an appropriate size element inserted.

(a) Connect the frequency counter to the output of the wave analyzer. Adjust the wave analyzer first to 90 Hz and then to 150 Hz and read the navigational tone frequencies on the counter.

(b) The 1020 Hz or any other identification tone frequency may be measured directly at the oscillator or by using the wave analyzer with the keyer set for constant tone.

(2) Measure the rf frequency of the transmitter(s) by connecting the counter to an rf wattmeter body coupler. If the only available rf wattmeter body happens to be in a glide slope antenna feedline, other signals may need to be turned off (i.e. an clearance transmitter) to obtain the measurement. The transmitter must be operating for at least 15 minutes before measuring rf frequency. The audio modulation may have to be removed to obtain a constant counter readout.

(3) Record the results obtained in steps (1) and (2) on the appropriate form. If any frequency or the frequency

separation at two-frequency facilities is out of tolerance, corrective action shall be taken.

(4) If the rf frequency is adjustable, the transmitter should be adjusted as close to the authorized frequency as possible, and shall be adjusted to within the initial tolerances specified in chapter 3. Following rf frequency adjustment, the final measurement should be performed at least 5 minutes after the last adjustment is made. This is to allow the oscillator sufficient time to settle to its final operating frequency.

5-58. AUDIO PHASING.

a. Object. This procedure provides a method to determine that the audio phase relationship between the 150 Hz modulation tones of the path and clearance transmitters (for glide slope) or the 90 Hz and 150 Hz modulation tones of the course and clearance transmitters (for localizer) are in phase.

b. Discussion. The audio phase relationship between the course and clearance signals must be in phase to ensure that these signals always add to and not subtract from each other. This is true for both localizers and glide slopes. When an aircraft is in transition between a predominance of signal from the course, and clearance transmitter, these signals may be approximately equal. When this occurs, a false course or path could be produced if the audio phasing is out of phase. Navigation audio signals may be sampled via an rf wattmeter body with a suitable element installed, or an equipment test point(s) depending on the facility type.

c. Test Equipment Required.

(1) An oscilloscope with an accurately calibrated time base.

(2) An rf wattmeter body with suitable wattmeter element.

d. Conditions. For sampled measurements, i.e., those taken without disturbing the radiated signal, the facility may remain in operation. For measurements taken where a frequency is removed or switched to continuous the facility must be removed from service.

e. Detailed Procedure.

NOTE: For the following test connections consult the applicable TI for an appropriate test point or jack, or use an rf wattmeter body and element. For the Mark 20 Localizer/Glide Slope, a convenient point is located on the AC-DC Switch Module Assemble 1A2/1A4.

(1) Connect the oscilloscope Y INPUT to observe the course (or path) transmitter 150 Hz output.

(2) Connect the oscilloscope TRIGGERING INPUT to the course (or path) transmitter 150 Hz output or an external scope sync output.

(3) Adjust the triggering such that the waveform crosses the zero axis at the center of the oscilloscope display.

(4) Connect the oscilloscope Y INPUT to observe the clearance transmitter 150 Hz output. DO NOT ADJUST ANY CONTROLS.

(5) Confirm that the positive and negative peaks are in the same position on the oscilloscope as the course transmitter.

(6) Measure the time (in microseconds) between the center of the oscilloscope and the scope trace.

(7) Confirm that the time measured is within the operating tolerance of chapter 3.

(8) Restore the equipment to normal operation.

5-59. TIME DELAYS.

a. Object. This procedure provides a method to determine the time of the shutdown and monitor time delay.

b. Discussion. The time that a facility is permitted to radiate outside monitor alarm limits must be short. This is to protect aircraft in the final stages of approach from prolonged exposure to possible signal error. The different time delays are defined below.

(1) Shutdown delay. This delay is the total time a facility is allowed to radiate with a continuous monitor alarm. For dual equipment, this delay includes the transfers from main to standby to shutdown except at

GRN-29 facilities. At GRN-29 facilities, this is the time for the main equipment to shut down without a transfer after a monitor alarm.

(2) Restoration Delay. This delay is the 20 second time period after a shutdown in which no further attempts to restore the system are allowed. This includes the interlocking function, and can be tested by switching runways and measuring the time for the selected ILS to go on-line. This delay can also be tested at the specific site by causing a shutdown, then immediately resetting the equipment. The time it takes for the equipment to return to normal is the restoration delay.

c. Test Equipment Required. A device suitable for measuring elapsed time. For Mark 20; the portable maintenance data terminal (PMDT).

NOTE: Mark 20 facilities: The transfer and shutdown timing test have been included in the Localizer/Glide Slope Test menu.

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedure.

(1) Shutdown delay (non-Mark 20 system).

(a) Initiate a continuous monitor alarm and measure the time required for the facility to shutdown. Record the shut down delay on the appropriate form.

(b) Compare this measurement with the standard and tolerance contained in paragraph 3-51 and correct, if necessary. Record shutdown delay on the appropriate form.

(c) Return facility to service.

(2) Shutdown delay (Mark 20 system).

(a) Connect the Mark 20 PMDT serial communications cable to the equipment serial communications port. Set the PMDT power switch to ON and log onto the equipment.

(b) From the commands menu proceed to the "Tests" menu and perform the "Shutdown time test" (i.e., from the "Commands" menu; execute the following sequence of keys <T H>. The total shutdown time (including transfer for dual equipment) will be displayed via a pop-up shutdown/transfer test screen; labeled "Shutdown time".

(c) Compare this measurement with the standard and tolerance contained in paragraph 3-51 and correct, if necessary. Record the shutdown delay on the appropriate form.

(d) Log off the equipment, set the PMDT power switch to OFF and disconnect the PMDT serial communications cable from the equipment. Return the facility to service.

5-60. AUTOMATIC RESTART AND RESET (SINGLE AND COLD STANDBY EQUIPMENT).

a. Object. This procedure provides a method of determining if the automatic restart and reset circuits function properly and are within the established limits.

b. Discussion. The function of the auto-restart is to attempt to return a single-equipment or a cold standby, dual-equipment facility to service shortly after it has shut down due to an alarm condition. If the auto-restart is successful and the equipment remains in service for a predetermined length of time, the auto-reset function will clear the auto-restart circuit and restore it to normal operation. When an alarm occurs, a short delay takes place before the facility shuts down. This delay is called the shutdown delay. The equipment will remain off the air until a longer delay, called the auto-restart delay, occurs. After the auto-restart delay, the equipment will attempt to return itself to service. If the alarm still persists, a number of other restart attempts with varying auto-restart delay times may occur depending on the equipment type. If the equipment restarts and remains in service for a predetermined period of time, an auto-reset circuit resets the auto-restart function to its normal status. If all auto-restart attempts are exhausted and the equipment does not stay in service, the restart/reset circuits must be manually reset at the facility.

c. Test Equipment Required. A device suitable for measuring elapsed time.

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedure.

(1) Initiate a monitor alarm and allow the equipment to shut down.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES (Continued)

(2) Measure the time elapsed between shutdown and the time when the automatic restart attempts to return the facility to service. Record the time on the appropriate form. Determine if the auto-restart time is within the established limits.

(3) Repeat steps (1) and (2) for each available auto-restart. Determine if the auto-restart time(s) is within the established limits, and record the shortest time on the appropriate form.

(4) After the final auto-restart attempt, ascertain that if the alarm is still present the equipment shuts down and a manual reset is required to restart it.

(5) Initiate a monitor alarm and allow the equipment to shut down. Remove the alarm condition and allow the auto-restart to return the equipment to service. If the equipment has auto-reset capabilities, ascertain that the auto-reset circuits are reset after an elapsed time of 4.5 minutes or greater, measured from the time the alarm was initiated. For specific times refer to the equipment instruction book.

(6) Restore the facility to service.

5-61. CAPTURE-EFFECT MONITOR CLEARANCE CANCELLATION (GRN-29 EQUIPMENT).

a. Object. This procedure provides a method to prevent the clearance signal in the lower antenna from entering the monitor width channel via the integral monitor network.

b. Discussion. Clearance 150 Hz, if allowed to enter the monitor width channel, could add to, or subtract from, the course system 150 Hz, thereby producing incorrect path width DDM indications. To prevent this, a clearance signal of equal amplitude and 180° out of phase to that of the lower antenna is taken from the APCU or upper antenna pickup probe and used to cancel the clearance from the lower antenna before it enters the monitor width channel.

c. Test Equipment Required. An oscilloscope.

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedure.

(1) Turn the clearance transmitter on and radiate all signals normal.

(2) Connect an oscilloscope to the monitor width (clearance) channel test jack, and observe the predominant 150 Hz signal.

(3) Adjust the clearance cancellation phase and amplitude for minimum 8 kHz. Lock the controls in position.

(4) With the monitor properly adjusted and both course and clearance transmitters energized, observe the 150 Hz indication on the monitor width meter as the clearance transmitter is turned on and off. If clearance cancellation adjustments were correctly made, there should be either no change in the 150 Hz level or only a slight flicker of the meter.

(5) Restore the facility feedlines to normal.

(6) Adjust the monitor to alarm at or before the wide alarm sideband-to-carrier power ratio established by flight inspection. Restore the sideband power to normal.

(7) Restore the facility to service.

5-62. REFERENCE DATA, FAA FORMS 6750-26 TO -29 AND -31.

a. Object. This procedure establishes the reference values and operating limits that all subsequent glide slope performance checks must meet.

b. Discussion.

(1) Facility reference data is prepared at facility commissioning or any subsequent flight inspection that requires the establishment of new radiated reference parameters for normal or alarm points. New reference values would typically be required if a flight inspection measurement was out of tolerance or a recommissioning was required, such as antenna change, angle change, etc. Whenever the initial or subsequent reference values are established, the initial airborne tolerances of paragraph 3-60 shall be met. The operating tolerances are based on the reference values for both the normal and the alarm conditions. The tolerances are applied to the radiating portion of the system, NOT the monitor. The monitor is adjusted to ensure that the system transfers or shuts down before the radiating system exceeds the reference value. The systems specialist should

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES (Continued)

establish tighter monitor operating limits if past flight inspections or monitor drift indicates this to be prudent. For example, if flight inspections subsequent to the establishment of reference values indicate that the facility is close to being out of tolerance, new, tighter, radiated reference values may be established and the monitor alarm points moved accordingly. This will ensure that later flight inspections will be in tolerance.

(2) Monitor input DDM is recorded for trend analysis and troubleshooting purposes only. There are no tolerances placed on monitor input DDM values.

(3) The reference data must be measured very carefully. Power measurements must always be accomplished with the same meter and elements. The elements shall be clearly marked. In addition to the rf wattmeter readings, it is recommended that a digital voltmeter (dvm) be used to obtain reference readings for carrier and sideband power in normal, and in wide and narrow alarm. These reference readings can be made with greater repeatability using the dvm than by using the analog wattmeter. This is done by connecting a dvm set to measure dc voltage, to the detector element output in place of the normal meter. Improved consistency in dvm readings will result if the dvm input is shunted with a 1400 Ω ±1 percent resistor. This resistor presents the same load to the detector elements as the normal analog meter. If the reference readings are made with the load resistor in place, all future measurements must be made in this configuration.

(4) At end-fire glide slopes the sideband-only (SBO) and carrier-plus sideband (CSB) combining hybrid present an impedance unbalance to the two inputs which results in an erroneous modulation balance indication at the carrier feedline rf body. Therefore, the SBO must be terminated in a dummy load before adjusting the modulation balance to 0 DDM. After the modulation balance is adjusted for 0 DDM, the SBO dummy load should be removed and a reference DDM measured at the carrier rf body and recorded on FAA Form 6750-26. The FA-9438 wattmeter coupler is the preferred coupler for measuring the carrier feedline DDM in the carrier rf body.

c. Detailed Procedure.

(1) Reference values. The reference values from both normal and alarm conditions entered on FAA Forms 6750-26 through -29 and -31 are derived from the FAA Form 6750-4, Glide Slope Flight Inspection Data Work Sheet. This form is completed during the reference flight inspection. Parameters not subject to flight inspection are derived from the standards and tolerances in chapter 3.

(2) Operating tolerance values.

(a) FAA Form 6750-26, All Glide Slopes Normal Radiated Parameters.

1 Carrier power: For both the lower and upper tolerances enter your facilities reference values (i.e., for a single frequency facility with a normal reference value of 3.0 watt; lower standard would be 60% or 1.8 watts; upper standard would be 120% or 3.6 watts).

2 Clearance power: Same as for carrier power.

3 Carrier feedline DDM: Enter the modulation equality operating tolerances on the lower and upper tolerance lines; e.g., ≤0.004 DDM of reference value.

WARNING: At EFGS, the SBO must be dummy loaded at the SBO rf body Z12 before adjusting for 0 DDM in the carrier rf body Z13. The carrier feedline DDM with the dummy removed becomes the reference value. Dummy loading the SBO will produce Hazardously Misleading Information (HMI). Before proceeding, refer to paragraph 1-6 and follow the specific HMI guidance provided. Failure to follow this guidance can result in Controlled Flight Into Terrain (CFIT). The duration and frequency of radiating HMI must be kept to a minimum by any means necessary, as required by Order 6000.15, paragraphs 307, 425, and 432

(b) FAA Form 6750-27, Null-Reference Glide Slope Monitor Reference Data.

1 Wide sideband power: Enter ≥ the reference value for wide alarm.

2 Narrow sideband power: Enter ≤ the reference value for narrow alarm.

3 Angle high and low, integral carrier feedline DDM: Enter ≤ the operating tolerance DDM.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 2. GLIDE SLOPES (Continued)

4 Dephasing main SBO: Enter ≤ the reference dephasing values for advance and retard to wide alarm.

(c) FAA Form 6750-28, Sideband Reference Glide Slope Monitor Reference Data.

1 Wide sideband power: Enter ≥ the reference value for wide alarm.

2 Narrow sideband power: Enter ≤ the reference value for narrow alarm.

3 Angle high, integral and field upper antenna power: Enter ≤ the reference upper antenna power for high angle alarm.

4 Angle low, integral and field upper antenna power: Enter ≥ the reference upper antenna power for low angle alarm.

5 Dephasing main SBO: Enter the reference dephasing values for advance and retard to wide alarm.

6 Dephasing upper antenna: Enter ≤ the reference dephasing values for advance and retard to path alarm.

(d) FAA Form 6750-29, Capture-Effect Glide Slope Monitor Reference Data.

1 Wide sideband power: Enter ≥ the reference value for wide alarm.

2 Narrow sideband power: Enter ≤ the reference value for narrow alarm.

3 Angle high and low, integral carrier feedline DDM: Enter ≤ the operating tolerance DDM.

4 Dephasing middle antenna: Enter ≤ the reference dephasing values for advance and retard to width alarm.

5 Attenuation upper antenna: Enter ≤ the reference upper antenna attenuation to alarm.

6 Attenuation middle antenna: Enter ≤ the reference middle antenna attenuation to wide alarm, whichever occurs first.

7 Dephasing upper antenna: Enter ≤ the reference dephasing values for advance and retard to path alarm.

(e) FAA Form 6750-31, End-Fire Glide Slope Monitor Reference Data.

1 Sideband power-wide: Enter ≥ the reference value for wide alarm.

2 Sideband power-narrow: Enter ≤ the reference value for narrow alarm.

3 Angle high or low, integral: Enter ≤ the reference value for rear antenna degrees.

4 Angle high or low, field: Enter ≤ the reference value of main array advance and retard degrees for angle alarm.

5 Angle high or low, snap down: Enter ≤ the reference value of main array advance and retard degrees for snap down (width) alarm.

6 Dephasing clearance: Enter ≤ the reference values clearance array advance and retard to clearance alarm.

5-63. thru 5-69. RESERVED.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 3. 75 MHZ ILS MARKERS (Continued)

(3) Measure the modulation frequency (400, 1300, or 3000 Hz.) using an equipment test point, jack, detected output from an rf wattmeter body, or with modulation type test equipment which will measure the audio modulation frequency. (Note: The Mark 20 MDT marker beacon screen display of modulation frequency is not a measured frequency but a selected frequency only.)

(4) Measure the rf frequency of the transmitter(s) by connecting an rf counter to an inline rf sampler, or a sniffer inserted in an rf wattmeter body, or depending on test equipment connect the rf output signal directly to the test equipment (with suitable rf attenuator). The transmitter must be operating for at least 15 minutes before measuring rf frequency. The audio keying may have to be removed to obtain a constant counter readout.

(5) Record the results obtained in steps (3) and (4) on the appropriate form. If any of the facility frequencies are out of tolerance, corrective action shall be taken.

(6) If the rf frequency is adjustable, the transmitter should be adjusted as close to the authorized frequency as possible, and shall be adjusted to within the initial tolerances specified in chapter 3. Following rf frequency adjustment, the final measurement should be performed at least 5 minutes after the last adjustment is made. This is to allow the oscillator sufficient time to settle to its final operating frequency.

(7) Set the marker beacon for normal operation and restore to service.

5-76. thru 5-79. RESERVED.

SUBSECTION 4. BUILT-IN TEST EQUIPMENT (BITE)

5-80. GENERAL. *

a. This section establishes the procedures for accomplishing the various essential maintenance activities that are required to verify that the Mark 20 BITE is properly calibrated and performing within specified tolerances.

b. The Mark 20 ILS BITE is designed to be of sufficient accuracy and reliability for the ILS technician to document, maintain, and troubleshoot the Mark 20 ILS equipment. The Mark 20 BITE is intended to be used in lieu of external test equipment and is the preferred method for maintaining the Mark 20 equipment. This is largely due to the fact that the ILS BITE measurements may be accessed at the facility or at a remote location by a maintenance data terminal (MDT). The BITE in conjunction with the MDT eliminates the necessity for the ILS technician to have available at all times many different pieces of test equipment, and for the technician to be on-site to ascertain proper operation. Verification of the BITE measurement calibration ensures that consistent and reliable measurements are being reported by the BITE to the ILS specialist. This procedure should be performed during installation, after repair or replacement of an equipment module containing BITE sensors, measurement circuits and/or software, etc., and on a periodic basis as specified in this handbook.

c. FAA form 6750-33 will be used to record the BITE reference data. The reference data must be measured very carefully. Power measurements must always be accomplished with the same meter and elements. The elements shall be clearly marked. In addition to the rf wattmeter readings, it is recommended that digital voltmeter (dvm) readings be taken.

d. It is recommended that these checks be accomplished during a scheduled outage of the facility. However, since the Mark 20 Glide Slope and Localizer facilities are provided as a dual equipment setup, one set of equipment could remain "on the air" while working on the other. Therefore, removing the facility from service is optional, and up to the responsible ILS technician.

e. All test equipment to be used for the following verification checks at a particular facility should be set up at one time, power applied, and switched ON. This is to let the equipment stabilize to the facility ambient temperature. Various test equipment may be used for these procedures; therefore, have available the individual test equipment technical instructions book to answer questions of operation, input signal levels, and etc. Properly calibrated and maintained test equipment shall be utilized for these procedures. *

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 4. BUILT-IN TEST EQUIPMENT (BITE) (Continued)

5-81. BITE POWER OUTPUT AND VSWR VERIFICATION PROCEDURE.

a. Object. This procedure provides a method to verify the calibration of the Mark 20 BITE and PMDT power settings and measurements.

b. Discussion. The rf power output and ratios directly affect the performance of the ILS facilities. Verifying and maintaining the BITE calibration to known standards will * greatly enhance the specialist's ability to accurately * maintain reference settings, to check for changes in power amplifiers (PA's), to make repair and replacement of PA's and reset to known power values.

c. Test Equipment Required.

(1) HP 437B or E4418A RF Power Meter with HP 8482B Power Sensor, or equivalent.

(2) Optional: Rf test cable for HP power sensor (e.g., a four- to five-foot length of RG-223 or RG-400 with type N (F) to TNC (M) connectors).

* **NOTE:** It is recommended that an rf test cable be used between the PA rf output connector and the power sensor to reduce stress on the connector. If an rf test cable is used, measure its loss in dB with a vector voltmeter at the facility frequency. Enter this loss in the offset function of the power meter. Reference Chapter 2 of the Power Meter User's Guide for setting the offsets. The offset allows for the power meter to compensate for the rf test cable loss, and provides for a direct reading of the measured power.

(3) Two 50 Ω, 10 watt, dummy loads, type N, attached to type N tee connector with TNC (M) adapter.

d. Conditions. Coordinate a scheduled outage for the facility being verified with air traffic control (recommended; but optional if dual equipment is available).

e. HP 437B Power Meter Set-Up. Reference the Operating Manual or the Getting Started Guide for the HP 437B Power Meter for complete front panel operation and calibration instructions. Following is a short summary of the steps required to prepare the meter for measurement of output power.

(1) Place the meter in close proximity to the equipment to be verified. Connect the HP 8482B power sensor via its sensor cable to the meter, and connect to ac power. Depress the LINE switch to ON and allow a 10 minute warm up before proceeding.

(2) The HP 437B performs an internal self test when first turned on, and if satisfactory, comes up with the same control settings it had before line power was last removed. If this is not desired, to start at a known point depress the PRESET/LOCAL key and then press ENTER.

(3) Disconnect the HP 8482B power sensor from its companion attenuator. Connect the power sensor to the 1.00 mW, 50 MHz, POWER REF output connector on the front panel of the HP 437B. If the power sensor has a thick protective plastic washer on it, the flat indention on the inside of the washer must be aligned with the flat bottom portion of the connector for connection.

(4) Depress the SHIFT key; then press the SENSOR key. Select the sensor data table that contains the data for your particular HP 8482B power sensor. Press ENTER. If you have not already done so, load your sensor's data table, at this time. The data table is found on the power sensor itself. Follow the steps outlined in the operation manual under section 3, detailed operating instructions for sensor data. It is suggested that you use data table 2, since it should already contain factory data which closely matches your sensor and will require minimal changes (e.g., enter N when asked if you want to clear the data table and modify the existing data to match your power sensors data).

(5) Calibrate the HP 437B by first depressing the shift ZERO key. Wait for it to zero and then depress the CAL key. Check that the displayed ref. cal factor is the value for your power sensor. Next, press the ENTER key. In a few seconds calibration of the meter is concluded.

(6) Disconnect the power sensor from the power ref. connector and attach back to its companion attenuator. Set * meter for proper frequency for amplifier under test procedures. From the initial time of turn on, allow at least 30 minutes to elapse before proceeding with the BITE power verification.

CAUTION: Do not use this sensor without its companion 30 dB attenuator to make power measurements. The sensor and attenuator are a calibrated matched pair and damage can result to the sensor without the attenuator attached.

* **(7)** Configuration of all other settings such as units of measurement, resolution, digital vs. analog display, and etc., are all covered in chapter 2 of the user's manual. Most settings are selected via the instruments menus, with menu maps covered in chapter 3 of the user's manual. *

f. HP E4418A Power Meter Set-Up. Reference the Operating Manual for the HP E4418A Power Meter for complete front panel operation and calibration instructions. Following is a short summary of the steps required to prepare the meter for measurement of output power.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 4. BUILT-IN TEST EQUIPMENT (BITE) (Continued)

(1) Place the meter in close proximity to the equipment to be verified. Connect the HP 8482B power sensor via its sensor cable to the meter, and connect to ac power. Depress the POWER switch to ON and allow a 30 minute warm up before proceeding.

(2) The HP E4418A performs an internal self test when first turned on, and if satisfactory, comes up with the same control settings it had before line power was last removed. If this is not desired, to start at a known point depress the PRESET/LOCAL key and then press Confirm.

(3) Disconnect the HP 8482B power sensor from its companion attenuator. Connect the power sensor to the 1.00 mW, 50 MHz, POWER REF output connector on the front panel of the HP E4418A. If the power sensor has a thick protective plastic washer on it, the flat indention on the inside of the washer must be aligned with the flat bottom portion of the connector for connection.

(4) Depress the following sequence of keys: System Inputs, Tables, Sensor Cal Tables, scroll down to the HP 8482B table, and depress Table On. If you have not already done so, load your sensor's data table at this time by depressing the Edit Table key. The data table is found on the power sensor itself. Follow the steps outlined in the Power Meter User's Guide, Chapter 2, Editing Sensor Calibration Tables. It is suggested that you use data table 2, since it should already contain factory data which closely matches your sensor and will require minimal changes.

(5) Calibrate the HP E4418A by first depressing the Zero/Cal key. Check that the displayed ref. cal factor is the value for your power sensor. Wait for it to zero and then depress the CAL key. In a few seconds calibration of the meter is concluded.

(6) Disconnect the power sensor from the power ref. connector and attach back to its companion attenuator. Press the Frequency/Cal Fac key and confirm the setting of the frequency to be measured, modify with the arrow keys, if necessary. From the initial time of turn on, allow at least 30 minutes to elapse before proceeding with the BITE power verification.

* **CAUTION:** Do not use this sensor without its companion 30 dB attenuator to make power measurements. The sensor and attenuator are a calibrated matched pair and damage can result to the sensor without the attenuator attached. *

(7) Configuration of all other settings such as units of measurement, resolution, digital vs. analog display, and etc., are all covered in chapter 2 of the user's manual. Most settings are selected via the instruments menus, with menu maps covered in chapter 3 of the user's manual. The HP E4418A has more capabilities than the HP 437b and can be somewhat confusing. As such, familiarization with the meter is recommended before use, perhaps with known power levels and practice readings.

* *

g. Detailed Procedure for the Mark 20 ILS Glide Slope or Localizer Facilities.

(1) Connect the PMDT serial communications cable to the equipment serial communications port. Set the PMDT power switch to ON and log onto the equipment.

(2) From the Commands menu execute the following sequence of keys <T C P>. Select one of the equipment power amplifier's (PA) for verification.

(3) Follow the instructions per the PMDT software routine, paying particular attention to all warning and message screens. Use the following formula to determine if the two power measurements are within the operating tolerances of Chapter 3, Standards and Tolerances. If out of tolerance, make the necessary adjustments per instructions in the software procedure. Be sure to double check all equipment set ups, measurements, and calculations before replacement of any equipment circuit cards or modules.

$$\frac{(\text{Test Eq. Power Indication} - \text{BITE Power Indication}) \times 100}{\text{Test Eq. Power Indication}}$$

Localizer Power Example:

$$\frac{(17.07 \text{ watts} - 16.93 \text{ watts}) \times 100}{17.07 \text{ watts}} = 0.82\%$$

0.82% is in tolerance.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 4. BUILT-IN TEST EQUIPMENT (BITE) (Continued)

(4) Connect two 50 Ω, 10 watt dummy loads, attached to a tee (for a total impedance of 25 Ω) to the PA output. Verify that the VSWR measurement is within the operating tolerances of Chapter 3, Standards and Tolerances. If out of tolerance, make the necessary adjustments per instructions in the software procedure. Be sure to double check all equipment set ups, measurements, and calculations before replacement of any equipment circuit cards or modules.

*

Perform procedure 5-85, 'Bite Power Output And VSWR Verification Procedure.'

*

(5) Complete steps (2) through (4) for each PA rf power output and vswr measurement to be verified.

(6) Log off the equipment, set the PMDT power switch to OFF and disconnect the PMDT serial communications cable from the equipment.

NOTE: Comparisons between power measurements with the power meter and the Mark 20 BITE equipment will differ with modulation on or off. SBO modulation cannot be turned off except during the calibration procedure when a calibration voltage is automatically programmed to the SBO. Power measurements may also differ with the BIRD wattmeter, both because of modulation being on or off and differences in instrument accuracy. If desired, the BIRD wattmeter (with elements kept in the same locations) may be used for checking and maintaining day to day measurements (i.e., checking for repeatable performance).

h. Detailed Procedure for Mark 20 ILS Marker Beacon Facility.

(1) Connect the Mark 20 PMDT serial communications cable to the equipment serial communications port. Set the PMDT power switch to ON and log onto the equipment.

(2) Bypass the monitor and set the marker beacon identification tone to OFF by executing the following sequence of keys from the Commands menu; <C T I O>.

(3) Turn OFF the transmitter and disconnect the rf output cable at the PA rf output connector, A2J3. Attach the power sensor to this point.

(4) Turn ON the transmitter and note the rf output power as measured with the power meter. (If using an rf test cable and its loss in dB has not been entered into the power meter offset function, a correction must be made to the displayed power measurement to obtain the true rf output power.)

(5) On the Mark 20 PMDT, select the transmitter data screen for the PA being verified (from the Commands menu select; <D T>) and note the forward power reading as measured by the Mark 20 BITE.

(6) Use the following formula to determine if the two power measurements are within the operating tolerances of Chapter 3, Standards and Tolerances. If out of tolerance, troubleshoot and replace the faulty module(s). Be sure to double check all equipment set ups, measurements, and calculations before replacement of any equipment circuit cards or modules.

$$\frac{(\text{Test Eq. Power Indication} - \text{BITE Power Indication}) \times 100}{\text{Test Eq. Power Indication}}$$

Marker Beacon Power Example:

$$\frac{(1.03 \text{ watts} - 0.97 \text{ watts}) \times 100}{1.03 \text{ watts}} = 5.83\%$$

5.83% is out of tolerance.

(7) Connect two 50 Ω, 10 watt dummy loads, attached to a tee (for a total impedance of 25 Ω) to the output of the marker beacon PA.

(8) On the Mark 20 MDT, note the vswr reading as measured by the Mark 20 BITE (from the Commands menu select <D M>).

(9) Compare the Mark 20 vswr measurement with the standard and tolerance for vswr listed in Chapter 3, Standards and Tolerances. If out of tolerance, troubleshoot and replace the faulty module(s). Be sure to double check all equipment set ups, measurements, and calculations before replacement of any equipment circuit cards or modules.

(10) Reconnect the rf output cable, reset identification tone to Keyed, and return the monitor to normal.

(11) Log off the equipment, set the PMDT power switch to OFF and disconnect the PMDT serial communications cable from the equipment.

NOTE: If desired, the BIRD wattmeter (with elements kept in the same locations) may be used for checking and maintaining day to day measurements (i.e., checking for repeatable performance).

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 4. BUILT-IN TEST EQUIPMENT (BITE) (Continued)

5-82 BITE MODULATION PERCENTAGE VERIFICATION.

a. Object. This procedure provides a method to verify the calibration of the Mark 20 BITE modulation percentage measurements.

b. Discussion.

(1) The modulation percentage directly affects the performance of the ILS facilities. Verifying and maintaining the BITE calibration to known standards will greatly enhance the specialist's ability to accurately maintain reference settings, to check for changes in circuits affecting modulation, to make repairs and replace modules, and to reset to known modulation values.

(2) Several different methods of measuring modulation is possible depending on the test equipment used. Basically, a sample of the transmitter rf is taken and the modulation percentage is either read directly or calculated and then compared to the BITE/PMDT measurement. The Glide Slope and Localizer procedure describes the use of a modulation meter. The Marker Beacon procedure describes the use of an rf sampler. Refer to your particular test equipment technical instruction manual for different methods of setup for measuring modulation percentage.

c. Test Equipment Required. The Mark 20 PMDT and one or more of the following items is required depending on the facility and test equipment used.

(1) An FA-9438 Modulation Meter with rf wattmeter body coupler (sniffer), or HP 8920 rf communications radio test set, or equivalent.

(2) A Wilcox model FA-10592 or NavAids model 89-GR Portable ILS Receiver.

(3) A vhf oscilloscope capable of displaying the particular equipment modulation envelope, or an audio oscilloscope with a modulation monitor.

(4) An optional rf wattmeter body and coupler (sniffer), or an in-line rf sampler, and a 50 Ω dummy load of sufficient wattage rating for the transmitter equipment under test.

(5) Rf test cables as required. Suggest using double shielded cables of RG-223 or RG-400.

d. Conditions. For sampled measurements (i.e., those taken without disturbing the radiated signal) the facility may remain in operation. For measurements taken where a frequency must be removed or switched to continuous, the facility must be removed from service.

e. FA-9438 Modulation Meter Set-Up.

(1) Prepare the FA-9438 modulation meter for modulation measurement. Refer to instruction book TI 6750.141, Installation, Operation, and Maintenance Instruction Book for Meter, ILS Modulation, Type FA-9438, section 3, for complete front panel calibration and operational instructions. The following is a digest of those instructions. Steps (a) through (e) are the front panel calibration steps.

(a) Turn the FA-9438 ac power switch on and allow a 10-minute warmup before proceeding.

(b) Place the function selector switch to RF ZERO, and adjust the RF ZERO control for 00.0 on the PERCENT MODULATION indication.

(c) Place the function selector switch to DISPLAY ZERO, and adjust the DISPLAY ZERO control for 00.0 on the PERCENT MODULATION indicator.

(d) Place the function selector switch to CAL 150 Hz, and adjust the CAL 150 Hz control for 42.5 on the PERCENT MODULATION indicator.

(e) Place the function selector switch to CAL 90 Hz, and adjust the CAL 90 Hz control for 42.5 on the PERCENT MODULATION indicator.

NOTE: It may be necessary to repeat steps (a) through (e) occasionally as the FA-9438 warms up. Allow a total warm up period of at least 30 minutes before proceeding with the BITE modulation percentage verification.

f. Detailed Procedure for the Mark 20 ILS Glide Slope or Localizer Facilities.

(1) Insert the wattmeter rf coupler into the carrier feedline wattmeter body and rotate the coupler for maximum pickup.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 4. BUILT-IN TEST EQUIPMENT (BITE) (Continued)

NOTE: For the Mark 20 Glide Slope, the lower antenna rf wattmeter body will have to be used. Turn off the two signals not being measured. *

(2) Use a double-shielded coaxial cable and connect the coupler to the RF INPUT jack of the modulation meter.

(3) Place the function selector switch to LOCALIZER or GLIDE SLOPE, as appropriate, and read the 90 Hz and 150 Hz modulation percentages on the PERCENT MODULATION indicator.

(4) On the Mark 20 MDT, select the transmitter data screen for the transmitter modulation being verified, and note the 90 Hz and 150 Hz modulation percentages as measured by the Mark 20 BITE.

* **(5)** Use the following formula to determine if the two modulation measurements are within the operating tolerances of Chapter 3, Standards and Tolerances. If out of tolerance, troubleshoot and replace the faulty module. Be sure to double check all equipment set ups, measurements, and calculations before replacement of any equipment circuit cards or modules.

Test Eq. Mod % Indication – BITE Mod % Indication

Localizer Modulation % Example:

21.7% - 19.8% = 1.9% difference

1.9% is out of tolerance.

(6) Complete steps (1) through (5) for each PA being verified. *

(7) Restore the equipment to normal.

g. Detailed Procedure for Mark 20 ILS Marker Beacon Facility.

(1) Connect the Mark 20 PMDT serial communications cable to the equipment serial communications port. Set the PMDT power switch to ON and log onto the equipment.

(2) Bypass the monitor and switch OFF the transmitter with the front control panel toggle switches.

* **(3)** Using an rf cable attach a thruline wattmeter body or an in-line rf sampler terminated into a 50 Ω dummy load to the rf power amplifier output jack, A2J3.

(4) Switch the transmitter ON with the control panel toggle switch.

(5) Connect the particular piece of test equipment that you are using to a coupler probe (sniffer) and insert the probe into the thruline body or attach to the in-line sampler.

(6) If using a modulation monitor and audio oscilloscope, connect the intermediate frequency (if) output to the vertical input of the oscilloscope. For a direct reading modulation meter, refer to the instrument instructions and set for measuring modulation.

(7) On the PMDT set the modulation to continuous; i.e., from the Commands menu execute the following sequence of keys <C T I C>.

(8) Adjust the test equipment to display the modulation envelope. For a direct reading modulation meter or radio test set, note the modulation percentage.

(9) For the scope method, use the following formula to calculate the modulation percentage.

$$\%\,\text{mod} = \frac{E_{\max} - E_{\min}}{E_{\max} + E_{\min}} x\,100$$

(10) On the PMDT; from the Commands menu execute the following sequence of keys <D T>) and read the BITE modulation percentage given after 'Ident Signal'.

* **(11)** Use the following formula to determine if the two modulation measurements are within the operating tolerances of Chapter 3, Standards and Tolerances. If not, be sure to double check all equipment set ups, measurements, and calculations before replacement of any equipment circuit cards or modules.

Test Eq. Mod % Indication – BITE Mod % Indication

Marker Beacon Modulation % Example:

95.5% - 93.2% = 2.3% difference

2.3% is in tolerance. *

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 4. BUILT-IN TEST EQUIPMENT (BITE) (Continued)

(12) Restore the facility to normal configuration and check that the PMDT shows normal operation. Log off the equipment, disconnect the PMDT serial communication cable, switch off the PMDT, and return marker to service.

5-83. BITE DIFFERENCE IN DEPTH OF MODULATION (DDM) VERIFICATION.

a. Object. This procedure provides a method to verify the calibration of the Mark 20 BITE difference in depth of modulation (DDM) measurements.

b. Discussion.

(1) The DDM directly affects the performance of the ILS facilities. Verifying and maintaining the BITE calibration to known standards will greatly enhance the specialist's ability to accurately maintain reference settings, to check for changes in circuits affecting DDM, to make repairs and replace modules and reset to known DDM values.

(2) DDM test generators can generate quite accurate DDM signals; whereas a PIR may have a tolerance specification 10 times greater than the generator. If a PIR is on the edge of its specification, and the BITE correct or slightly off in the opposite direction, the BITE may appear to be out of the operating tolerance desired (but in fact it is reading better than the PIR). If this occurs, use a precision DDM test generator to recheck your PIR and determine if its measurement is off, how much, and in what direction. Then use that value to correct your difference calculation between the PIR and BITE measurement before comparison to the Chapter 3, Standard and Tolerance values.

c. Test Equipment Required. One of the following items is required.

(1) An Wilcox model FA-10592 or NavAids model 89-GR Portable ILS Receiver.

(2) An equivalent piece of test equipment that measures DDM with an accuracy of +/- .002 DDM or better (ambient temperature).

d. Detailed Procedure.

(1) Prepare the FA-10592 portable ILS receiver (PIR) for DDM measurement. Refer to instruction book TI 6750.185, Mark 20 Category II/III Instrument Landing System, Portable Instrument Landing System Receiver Group (supplied with the Mark 20 Category II/III ILS), Type FA-10592, section 3, for complete operational instructions. Following is a summary of the steps required to prepare the meter for measurement of rf DDM.

(a) Toggle ON/OFF switch on PIR ON.

(b) Press the MODE key on the PIR, and select the LOC or GS mode for the facility being checked.

(c) Press the MODE key on the PIR, and select the CH function. Press the SET key, and enter desired frequency using numeric keys on PIR.

(d) Press the FCTN key on the PIR, and select the DDM function. From the initial time of turn on, allow at least 30 minutes to elapse before proceeding with the BITE DDM verification.

(2) Insert the wattmeter body rf coupler (sniffer) into the carrier feedline wattmeter body and rotate the coupler for maximum pickup.

NOTE: For the Mark 20 Glide Slope, the lower antenna rf wattmeter body will have to be used. Turn off the SBO and clearance signals.

(3) Use a double-shielded coaxial cable and connect the coupler to the RF GS IN or the RF LOC IN connector of the PIR. Record the DDM on FAA Form 6000-8.

(4) On the Mark 20 MDT, select the transmitter data screen for the transmitter DDM being verified, and note the carrier feedline DDM as measured by the Mark 20 BITE. Record the DDM on FAA Form 6000-8 below the previous FA-10592 measurement.

(5) Use the following formula to determine if the two DDM measurements (i.e., from the FA-10592 and the BITE) are within the operating tolerances of Chapter 3, Standards and Tolerances. If out of tolerance, troubleshoot and replace the faulty module. Be sure to double check all equipment set ups, measurements, and calculations before replacement of any equipment circuit cards or modules.

Test Eq. DDM Indication – BITE DDM Indication

Localizer DDM Example:

0.001 (90 Hz) – 0.001 (150 Hz) = 0.002 DDM

0.002 DDM is in tolerance.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 4. BUILT-IN TEST EQUIPMENT (BITE) (Continued)

5-84. BITE FREQUENCY SEPARATION VERIFICATION.

a. Object. This procedure provides a method to verify the calibration of the Mark 20 BITE frequency separation measurement.

b. Discussion. The frequency separation directly affects the performance of the ILS facilities. Verifying and maintaining the BITE calibration to known standards will greatly enhance the specialist's ability to accurately maintain reference settings, to check for changes in circuits affecting frequency and frequency separation, to make repairs and replace modules and reset to known frequency values.

c. Test Equipment Required.

(1) A frequency counter with 0.0001 percent (1 ppm) or better accuracy.

(2) An rf wattmeter body coupler.

d. Conditions. Coordinate a scheduled outage for the facility being verified with air traffic control personnel (recommended; but optional if dual equipment is available).

e. Detailed Procedure.

(1) Prepare the frequency counter for rf frequency measurement. Allow for a warm up period of at least 30 minutes.

(2) Connect the PMDT serial communications cable to the equipment serial communications port. Set the PMDT power switch to ON and log onto the equipment.

(3) Bypass the equipment monitors via the front control panel toggle switches or the PMDT.

(4) Turn off all modulation to the course and clearance transmitters of the Mark 20 transmitting equipment set being verified (i.e., execute the following sequence of keys from the Commands menu <C T O/T M> select O or T for transmitter set one or two and set modulation type to RF Only).

(5) Measure the rf frequency of the transmitter(s) by connecting the counter to an rf wattmeter body coupler (sniffer) in the antenna line rf bodies. Measure both the carrier and clearance rf carrier frequencies. Depending on where the rf signals are measured, one or the other transmitters may need to be turned off during the measurement to prevent interference. The transmitter must be operating for at least 15 minutes before measuring the rf frequency.

(6) Calculate the difference between the course and clearance transmitter rf frequencies.

(7) On the PMDT, execute the following sequence of keys from the Commands menu <D M E/S C> (select E or S for the transmitting set being checked). Note the 'Crs/Clrnce Freq Diff' as reported by the Mark 20 BITE.

(8) Use the following formula to determine if the two frequency difference measurements (i.e., from the frequency counter and the Mark 20 BITE) are within the operating tolerances of Chapter 3, Standard and Tolerances. If out of tolerance, troubleshoot and replace the faulty module(s). Be sure to double check all equipment set ups, measurements, and calculations before replacement of any equipment circuit cards or modules.

Test Eq. Freq. Difference Indication – BITE Freq. Difference Indication

Glide Slope Frequency Difference Example:

(332.404238 (CSE) MHz – 332.396523 (CLR) MHz) – 7708 Hz =

7715 Hz – 7708 Hz = 7 Hz

7 Hz is in tolerance.

(9) Return the equipment to normal configuration.

(10) Return facility to service operation.

* **5-85. BITE POWER OUTPUT AND VSWR VERIFICATION PROCEDURE.**

a. Object. See Figure 5-1a.

(1) For ILS systems (Localizers, Glide Slopes, and Marker Beacons) this procedure provides a method to verify proper alignment between (1) the THRU-LINE POWER references (at a common place), (2) the COMMANDED POWER VALUE that is set using software commands, and (3) the PMDT DISPLAYED POWER. This procedure will *

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 4. BUILT-IN TEST EQUIPMENT (BITE) (Continued)

* match the PMDT DISPLAYED POWER indication with the software COMMANDED POWER VALUES.

(2) For localizers and glide slopes only, this procedure will set the PMDT DISPLAYED VSWR for the proper indication.

(3) For dual equipment localizers and glide slopes only, this procedure will match the transmitter no. 2 PMDT DISPLAYED POWER indications, as well as the transmitter no. 2 software COMMANDED POWER VALUES, with those for transmitter no. 1.

b. Discussion. The RF power output and ratios directly affect the performance of ILS facilities. Verifying and maintaining the BITE to known references will greatly enhance the specialist's ability to maintain reference settings, make repair to (or replace) power amplifiers (PA's), and reset to known power values.

c. Test Equipment Required.

(1) Thru-line RF body with dedicated associated elements.

(2) Digital Voltmeter.

(3) Wattmeters (optional).

(4) One 25 Ω (2:1 VSWR) load consisting of two 10 watt, type N, 50 Ω dummy loads connected to one type N tee connector with a TNC (male) adapter.

d. Conditions. Coordinate a scheduled outage for the facility with the appropriate Airways Facilities (AF) Control Center.

e. BITE Power Output Alignment Procedure.

(1) Use software commands to set the transmitter for normal operation. Record COMMANDED POWER VALUES.

(2) Measure and record the THRU-LINE POWER (in voltage) at the thru-line RF body that is installed at a common point.

NOTE: This power measurement can also be recorded in Watts. Due to the increased accuracy of the * voltmeter, however, voltage measurements are recommended.

(3) Compare the power readings recorded in step (2) above to the established THRU-LINE POWER reference. If outside initial tolerances, adjust the PA OUTPUT CONTROL to obtain the THRU-LINE POWER reference.

(4) Adjust the BITE POWER MEASUREMENT CONTROL to make the PMDT DISPLAYED POWER match the software COMMANDED POWER VALUES set in step (1) above. For localizers and glide slopes proceed to the next step.

NOTE: In some systems, the PMDT DISPLAYED SBO POWER is in Watts and the COMMANDED SBO POWER VALUE is displayed as a percentage of normal power. There may be no direct correlation between the PMDT DISPLAYED SBO POWER (in Watts) and the software COMMANDED SBO POWER VALUE (in percent). Therefore, for these types of systems, it is not necessary to match the PMDT DISPLAYED SBO POWER with the software COMMANDED SBO POWER VALUE.

(5) For single equipment localizers and glide slopes, proceed to step (9) below. For dual equipment, transfer to the no. 2 equipment and continue to step (6).

(6) Use software commands to set the power outputs of transmitter no. 2 to the same software COMMANDED POWER VALUES as transmitter no. 1. Record the COMMANDED POWER VALUES.

(7) Measure and adjust, if necessary, the transmitter no. 2 PA OUTPUT CONTROL to obtain the THRU-LINE POWER reference as in step (3) above. This matches the power output of transmitter no. 2 with the power output of transmitter no. 1.

(8) Adjust the BITE POWER MEASUREMENT CONTROL to make the PMDT DISPLAYED POWER for transmitter no. 2 match the software COMMANDED POWER VALUE set in step (6) above.

NOTE (SBO Alignment): For systems that display the COMMANDED SBO POWER VALUE as a percentage *

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 4. BUILT-IN TEST EQUIPMENT (BITE) (Continued)

* of normal power (instead of Watts), adjust the BITE POWER MEASUREMENT CONTROL to make the PMDT DISPLAYED SBO POWER for transmitter no. 2 match the PMDT DISPLAYED SBO POWER for transmitter no. 1.

(9) Repeat steps (1) through (8) above for each PA output.

f. Alignment of Replacement Amplifiers. Perform the following steps after replacing a defective power amplifier (PA).

(1) Use software commands to set the transmitter for normal operation.

(2) Adjust the PA OUTPUT CONTROLS to obtain the THRU-LINE POWER references that were established at the thru-line RF body.

(3) Adjust the BITE POWER MEASUREMENT CONTROLS to make the PMDT DISPLAYED POWERS match the software COMMANDED POWER VALUES set in step (2) above.

g. BITE VSWR Verification Procedure (Localizers and glide slopes only). To prevent the radiation of Hazardously Misleading Information (HMI), perform the following procedure on standby equipment (for dual-equipment facilities) or with the PA outputs dummy-loaded (for single-equipment facilities). *

* **(1)** Bypass monitors standby monitors.

(2) Turn OFF the transmitter for which the VSWR indications are to be verified.

(3) Connect a 25-ohm load directly to the transmitter output (CSB or SBO) port.

(4) Turn ON the transmitter.

(5) Measure and record the PMDT DISPLAYED VSWR value. Compare this reading to the appropriate tolerance.

(6) Adjust, troubleshoot, or replace modules as necessary to meet the tolerance.

(7) Turn OFF the transmitter and disconnect test equipment.

(8) Repeat steps (2) through (7) above for each PA output.

(9) Return facility to normal operation.

*

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 4. BUILT-IN TEST EQUIPMENT (BITE) (Continued)

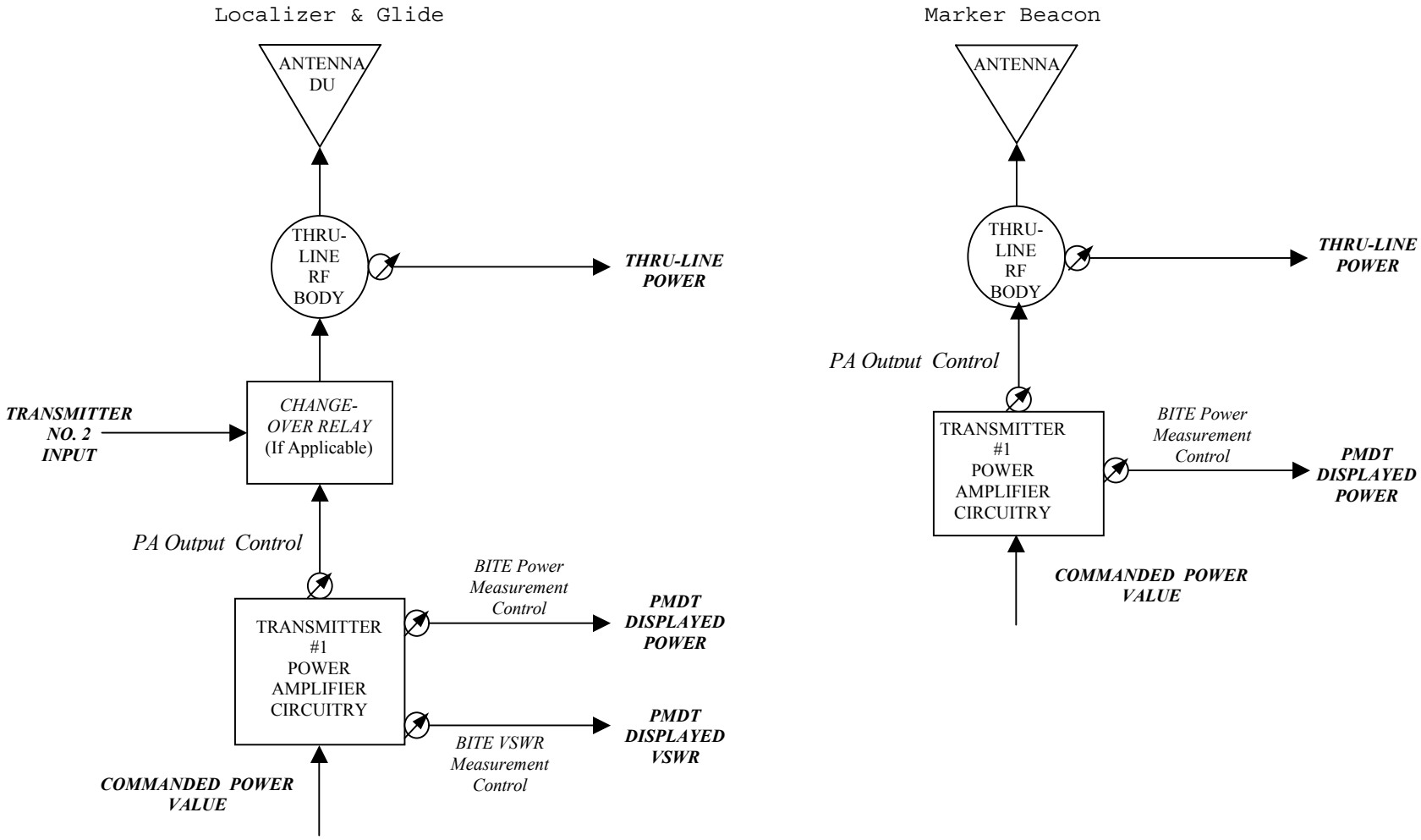


FIGURE 5-1a. BLOCK DIAGRAM FOR TYPICAL COMPUTER-BASED ILS

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 4. BUILT-IN TEST EQUIPMENT (BITE) (Continued)

* **5-86. BITE POWER OUTPUT CHECK PROCEDURE**.

a. Object. See figure 5-1a. This procedure provides a method to verify proper alignment between the THRU-LINE POWER references, the COMMANDED POWER VALUE that is set using software commands, and the PMDT DISPLAYED POWER indications.

b. Discussion. The RF power output and ratios directly affect the performance of ILS facilities. Verifying the BITE to known references will greatly enhance the specialist's ability to maintain reference settings, make repair to (or replace) power amplifiers (PA's), and reset to known power values.

c. Test Equipment Required.

(1) Thru-line RF body with dedicated associated elements.

(2) Digital Voltmeter.

(3) Wattmeters (optional).

d. Conditions. Coordinate this activity with air traffic personnel.

e. BITE Power Output Alignment Procedure.

(1) Measure and note the THRU-LINE POWER (in voltage) at the thru-line RF body. On glide slope systems, if a thru-line body is not permanently installed, dummy load all APCU outputs before inserting a temporary thru-line RF body. The temporary RF body should be installed at a common point after the changeover relays and prior to any distribution unit.

NOTE: This power measurement can also be recorded in Watts. Due to the increased accuracy of the voltmeter, however, voltage measurements are recommended.

(2) Note the COMMANDED POWER VALUE.

(3) Compare the power readings noted in step (1) above to the established THRU-LINE POWER reference. Use software commands to adjust the COMMANDED POWER VALUE to match the THRU-LINE POWER reference. Record this thru-line power value and the * corresponding commanded power value on BITE reference data form 6750-33.

(4) Compare the PMDT DISPLAYED POWER to the PMDT DISPLAYED POWER recorded when calibration was established. If this value is not within 5% perform procedures 5-81 or 5-85.

(5) Return COMMANDED POWER VALUE to the value noted in step (2) above.

(6) Repeat for all transmitter outputs.

5-87. BITE VSWR VERIFICATION PROCEDURE.

a. Object. See figure 5-1a. This procedure will set the PMDT DISPLAYED VSWR for the proper indication.

b. Discussion. The VSWR directly affects the performance of the ILS facility. Verifying and maintaining the BITE to known standards will greatly enhance the specialist's ability to maintain reference settings and make repair to (or replace) power amplifiers (PA's).

c. Test Equipment Required.

(1) One 25 Ω (2:1 VSWR) load consisting of two 10 watt, type N, 50 Ω dummy loads connected to one type N tee connector with a TNC (male) adapter.

d. Conditions. Coordinate a scheduled outage for the facility with the appropriate Airways Facilities (AF) Control Center.

e. BITE VSWR Verification Procedure. To prevent the radiation of Hazardously Misleading Information (HMI), perform the following procedure on standby equipment (for dual-equipment facilities) or with the PA outputs dummy-loaded (for single-equipment facilities).

(1) Bypass monitors.

(2) Turn OFF the transmitter for which the VSWR indications are to be verified.

(3) Connect a 25-ohm load directly to the transmitter output (CSB or SBO) port.

* **(4) Turn** ON the transmitter. *

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 5. REMOTE MAINTENANCE MONITOR (BITE) (Continued)

* **(5)** Measure and record the PMDT DISPLAYED VSWR value. Compare this reading to the appropriate tolerance.

(6) Adjust, troubleshoot, or replace modules as necessary to meet the tolerance.

(7) Turn OFF the transmitter and disconnect test equipment. *

* **(8)** Repeat steps (2) through (7) above for each PA output.

(9) Return facility to normal operation.

5-88. thru 5-89. RESERVED. *

SUBSECTION 5. REMOTE MAINTENANCE MONITOR (RMM)

5-90. REMOTE MAINTENANCE MONITOR DATA VERIFICATION (ANALOG SYSTEMS).

a. Object. This procedure provides a method to determine if data terminal indications correlate to local analog indications. This procedure is designed to provide an operational check rather than a rigorous calibration check of the remote maintenance monitor (RMM) system.

b. Discussion. The data from the RMM display terminal can be recorded on the technical performance record forms for monthly performance checks in lieu of local indications. Quarterly performance checks shall be conducted at the local facility.

c. Test Equipment Required.

(1) A portable ILS receiver.

(2) A portable data terminal.

d. Conditions. The facility under test is operating normally. If a data terminal is not on site, communications between the remote monitor location and the ILS site are required.

e. Detailed Procedure.

(1) Compare the local analog monitor and data terminal indications for the following parameters, and determine if data terminal indications are within the operating tolerances of chapter 3.

(a) Course DDM.

(b) Width DDM.

(c) Course level (if applicable).

(d) Width level (if applicable).

(2) Compare the local and data terminal indications for the following parameters, and determine if data terminal indications are within the operating tolerances of chapter 3.

(a) Carrier power (multimeter indication).

(b) Sideband power (multimeter indication).

(c) Carrier modulation balance (PIR).

(d) Carrier forward power.

(e) Sideband forward power.

5-91. REMOTE MAINTENANCE MONITOR DATA VERIFICATION (DIGITAL SYSTEMS).

a. Object. This procedure provides a method to determine if data terminal indications correlate to local digital indications. This procedure is designed to provide an operational check rather than a rigorous calibration check of the RMM system.

b. Discussion. The data from the RMM display terminal can be recorded on the technical performance record forms for monthly performance checks in lieu of local indications. Quarterly performance checks shall be conducted at the local facility.

c. Test Equipment Required.

(1) A portable ILS receiver.

(2) A portable data terminal.

SECTION 1. PERFORMANCE CHECK PROCEDURES (Continued)

SUBSECTION 5. REMOTE MAINTENANCE MONITOR (RMM) (Continued)

d. Conditions. The facility under test is operating normally. If a data terminal is not on site, communications between the remote monitor location and the ILS site are required.

e. Detailed Procedure.

(1) Compare the local digital monitor and data terminal indications for the following parameters, and determine if data terminal indications are within the operating tolerances of chapter 3.

(a) Test DDM (if applicable).

(b) Course DDM.

(c) Width DDM.

(d) Rf level.

(e) Percent modulation.

(f) Ident modulation.

(2) Compare the local and data terminal indications for the following parameters, and determine if data terminal indications are within the operating tolerances of chapter 3.

(a) Carrier power (multimeter indication).

(b) Sideband power (multimeter indication).

(c) Carrier modulation balance (PIR).

(d) Carrier forward power.

(e) Sideband forward power.

(f) Battery voltage.

5-92. thru 5-99. RESERVED.

SECTION 2. OTHER MAINTENANCE TASK PROCEDURES

5-100. thru 5-109. RESERVED.

SUBSECTION 1. ILS FACILITIES

5-110. EQUIPMENT CLEANING AND INSPECTION.

a. Object. This paragraph provides general guidance for and a checklist of various housekeeping activities.

b. Procedure. The following items should be inspected, cleaned, repaired, and/or reported as required.

(1) Antenna system, including monitor antennas and towers. Clean all insulators. Inspect and repair all connectors. Determine that antenna heaters, heater thermostats, and misalignment and cable fault detectors are operating correctly. Visually check physical alignment of localizer array. Inspect the glide slope antenna towers for loose or broken supporting hardware such as nuts, bolts, rivets, and welds. Inspect the antenna mounting hardware for loose or broken nuts, bolts, welds, etc. Inspect the antenna covers and monitor probes for visual damage or deterioration. Clean any rusted areas, and apply rust inhibiting paint as required.

(2) Buildings. Inspect buildings for deterioration, both inside and out. Check condition of building paint and for signs of leaking.

(3) Grounds. Check vegetation control, cable marker signs, fences, and gates.

(4) Air filters. Inspect and replace as required all building and equipment air filters. On EFGS systems check and replace as necessary compressor air filter.

(5) Motors. Inspect all motors to determine that they are not overheating. Lubricate as required

(6) Critical areas. Check critical area signs, and install or replace as required. Check vegetation in the critical area and have it cut as required.

(7) Battery systems. Inspect for proper ventilation. Clean any battery corrosion.

(8) Safety signs. Inspect the site and install signs as required.

5-111. CALIBRATION OF THE PORTABLE ILS RECEIVER.

a. Object. This procedure provides a method to determine that the portable ILS receiver (PIR) is properly calibrated. This procedure applies to FA-8766, FA-9392, FA-9740, and FA-9945 model PIR's.

b. Discussion.

(1) The PIR is the primary instrument used for facility certification. Accurate PIR calibration is essential to the proper operation of an ILS facility. Improper calibration of the PIR may result in an out-of-tolerance flight inspection, ground check, and/or improper monitor alarm limit settings.

(2) The PIR must be calibrated before a monitor flight inspection and periodically, as scheduled in chapter 4. If the PIR is found to be out of calibration, a thorough investigation should be made to determine that the PIR has changed, not the calibration procedure or methods. Also, the ILS facility should be carefully analyzed to ensure that equipment adjustments made were not due to improper PIR calibration.

(3) The PIR is calibrated utilizing a modulation of 20 percent for each localizer tone and 40 percent for each glide slope tone. (The PIR will read the correct DDM only when modulation is adjusted to 20 percent each tone for localizer and 40 percent each tone for glide slope.) The sum of the two modulation tones (90 and 150 Hz) is indicated on the level meter of the PIR.

When the sum of the two tones is not 40 percent for localizer or 80 percent for glide slope, the adjustment of the level meter to redline does not ensure proper calibration of the PIR and will result in incorrect DDM readings. The same holds true at a facility. Localizer and glide slope modulation levels must be maintained at their reference value to ensure accurate repeatable DDM readings.

(4) If an ILS test set is used to generate the known DDM inputs to the PIR during the calibration process, the unit must be checked for accuracy before it is used. Refer to the manufacturer's instruction book for the setup procedure for the ILS test set.

SECTION 2. OTHER MAINTENANCE TASKS PROCEDURES (Continued)

SUBSECTION 1. ILS FACILITIES (Continued)

c. Test Equipment Required.

(1) A digital ac voltmeter.

(2) An rf signal generator, HP8640B or equivalent.

(3) An ILS test set (FA-5166 or a means of obtaining a known DDM).

(4) An ILS modulation meter, FA-9438 or equivalent.

d. Conditions. The PIR is operating normally and is fully charged. If an ILS test set is used, its calibration must be checked.

e. Detailed Procedure for FA-8766 and FA-9392.

NOTE: For calibration of only the audio circuits, complete steps (1) through (12).

(1) Make sure that the battery reads above 60 and the PIR has not been on charge for the past 30 minutes. Do not charge the battery during this procedure.

(2) To check the calibration of the PIR, start with step (9) noting the difference between the optimum reading and the as-found value. Do not make any internal adjustments to the PIR. For a complete PIR DDM calibration, start with step (3) and complete all adjustments.

(3) Mechanically zero the DDM and level meters with the PIR off. Check that the DDM meter reads zero when the PIR is either face up or face out. Replace the meter if required.

(4) With no input signal and the DDM switch on 0.05, adjust R69, DDM balance, for zero DDM.

(5) Connect 0.100 V root mean square (rms), 150 Hz, to the input jack, set the rear panel switch to AUDIO, and adjust the monitor gain control so that the collector of Q18 reads 0.185 ±0.002 V rms. With the rear panel switch set to CAL, adjust R56, calibrate level, until the level meter reads redline.

(6) Check that the level meter remains on redline when the PIR is used face up or face out. Replace the meter if required.

(7) Adjust 1R4 on the back of the PIR until the DDM reading is 0.165 (on the 150 Hz side).

(8) Change the audio frequency to 90 Hz, and adjust 1R3 on the back of the PIR until the DDM reading on the meter is 0.165 (on the 90 Hz side).

(9) Place the rear switch in the AUDIO position, place the LOC/GS switch in LOC, and introduce a known 0.155 DDM ratio into the 90/150 Hz input to the PIR. A voltage ratio of 2.27 to 1.0 corresponds to 0.155 DDM. Use the formula:

$$R = \frac{2m + DDM}{2m - DDM}$$

to determine other voltage ratio DDM relationships. Adjust the front panel monitor gain control until the DDM readings correspond with the input. Adjust R58 until the level meter reads redline.

(10) Change the LOC/CS switch to GS, and introduce a known 0.175 DDM ratio by using the voltage ratio of 1.56 to 1.0. Adjust the monitor gain control until the DDM meter reads 0.175 DDM. Adjust R41 until the level meter reads redline.

(11) Introduce equal 90 and 150 Hz signals (0 DDM) into the PIR. With the LOC/GS switch in the LOC position, adjust the front panel monitor gain control for redline on the level meter. Note the DDM reading. Change the LOC/GS switch to GS, readjust the monitor gain control for redline, and note the DDM reading. Both readings noted should be zero DDM. If not, adjust 1R3 and 1R4 equally so that the average DDM reading is zero. Typical changes are 0.002 DDM.

(12) Repeat steps (9) thru (11) until no adjustments are required.

(13) Connect an rf signal generator whose output is 1000 μV to the localizer input, modulated with equal 90

SECTION 2. OTHER MAINTENANCE TASKS PROCEDURES (Continued)

SUBSECTION 1. ILS FACILITIES (Continued)

and 150 Hz, 20 percent each tone. Adjust R8 for 4.45 V dc on the positive lead of C1. The amplifier gain should vary the level meter between approximately 20 and 80 Hz.

(14) Verify that redline can be obtained for all rf inputs between 25 µV and 200 mV.

(15) Change the modulation on the rf signal generator to approximately 28 percent -90 Hz and 12 percent –150 Hz. Verify that the PIR reads a constant DDM for all rf inputs between 25 µV and 200 mV.

(16) Repeat step (13) using the glide slope frequency and 40 percent each tone. Redline shall be obtained between 25 µV and 200 mV.

(17) Change the modulation on the rf signal generator to approximately 50 percent -90 Hz and 30 percent –150 Hz. Verify that the PIR reads a constant DDM for all rf inputs between 25 µV and 200 mV.

f. Detailed Procedure for FA-9740.

NOTE: For calibration of only the audio circuits, complete steps (1) through (11).

(1) With selector switch in the OFF position, mechanically zero front panel meters 1M1 (DDM) and 1M2 (level) with their adjustment screws.

(2) Ensure that the battery in the PIR is fully charged. A fully charged battery will read above the redline and approximately 60 on the level meter.

(3) Set the selector switch to 0.05 DDM with no input signal, and verify that the DDM meter is zero.

(4) Set the selector switch to 0.25 DDM and the level switch 1S2 (rear panel) to the 150 Hz CAL position. Set the band switch to localizer input. Connect a 150 Hz tone 100 mV rms to the 90/150 Hz input jack (front panel). Adjust MON GAIN control for redline on the level meter. Adjust the 150 Hz level control 1R4 (rear panel) for a DDM meter reading of 0.165.

(5) Ensure that the level meter stays on redline when the PIR is used face up or face out. If not, the PIR must be used in the same position in which it was calibrated.

(6) Connect a 90 Hz tone, 100 mV rms to the 90/150 Hz input jack. Set the level switch 1S2 to the 90 Hz CAL position. Adjust MON GAIN control for redline on the level meter. Adjust the 90 Hz level control 1R3 (back panel) for a DDM meter reading of 0.165.

(7) Recheck the 150 Hz CAL setting in step (4), and the 90 Hz CAL setting in step (6).

(8) Set the level switch to the 90/150 Hz position. Introduce a known 0.155 DDM signal into the 90/150 Hz input jack with the band switch in the localizer position. Adjust the MON GAIN control until the level meter is at redline. The DDM reading will not be adjustable and must be 0.155 ±.010 DDM. If this reading cannot be obtained, the precision resistors must be replaced or the PIR should be exchanged and repaired.

(9) Change the band switch to the glide slope position and introduce a known 0.175 DDM ratio into the 90/150 Hz input. Adjust the MON GAIN control until the level meter is at redline. The DDM reading must be 0.175 ±.010 DDM.

(10) Introduce a 0.000 DDM signal into the PIR. Select localizer on the band switch. Adjust the MON GAIN for redline on the level meter. With the selector switch on the 0.05 DDM setting, note the DDM. Place the band switch in the GS position and adjust MON GAIN for redline on the level meter. Both readings noted should be 0.000 ±.002 DDM. If needed, adjust 1R3 and 1R4 on the back of the PIR to average the DDM reading around 0.000 DDM. The reading must be 0.000 ±.005 DDM (operating tolerance).

(11) Repeat steps (8) thru (10) until no further adjustments are required.

(12) Connect an rf signal generator to the localizer input BNC connector. Modulate the signal generator with equal 90 and 150 Hz tones (0.000 DDM), at 20 percent each tone. Verify that the level meter redline can be obtained for all rf input levels between 25 microvolts to 500 millivolts.

(13) Position the selector switch to 0.05 DDM. Verify that the DDM reading is 0.000 ±.005 DDM for all inputs between 25 microvolts to 500 millivolts. Ensure that the level meter is at redline before each reading.

SECTION 2. OTHER MAINTENANCE TASKS PROCEDURES (Continued)

SUBSECTION 1. ILS FACILITIES (Continued)

(14) Position the selector switch to 0.25 DDM. Change the modulation into the rf signal generator to 0.155 DDM (localizer). Verify that the PIR reads 0.155 ±.010 DDM for all rf input levels between 25 microvolts to 500 millivolts.

(15) Repeat step (12) using glide slope frequency and 40 percent modulation per tone. The level meter redline should be obtained for all input levels between 25 microvolts to 500 millivolts.

(16) Change the modulation to 0.175 DDM. Verify that the PIR reads 0.175 ±.010 DDM for all rf input levels between 25 microvolts to 500 millivolts.

g. Detailed Procedure for FA-9945.

NOTE: For calibration of only the audio circuits, complete steps (1) through (11).

(1) Mechanically zero the DDM and level meters with the PIR off.

(2) Ensure that the battery in the PIR is fully charged. The reading should be above the redline on the level meter. A fully charged battery will read 60 or above on the meter.

(3) Set the selector switch to 0.05 DDM with no signal input, and verify that the DDM meter is zero.

(4) Set the selector switch to 0.25 DDM and the level switch (rear panel) to the 150 Hz CAL position. Select the localizer input on the band switch. Connect a 150 Hz tone, 100 mV rms to the 90/150 Hz input jack (front panel). Adjust the MON GAIN control for redline indication on the level meter. Adjust the 150 Hz level control 1R4 for DDM reading of 0.165.

(5) Ensure that the level meter stays on redline when the PIR is used face up or face out. If not, the PIR must be used in the same position in which it was calibrated.

(6) Set the level switch to the 90 Hz CAL position. Connect a 90 Hz tone, 100 mV rms to the input jack. Adjust MON GAIN control for redline indication on the level meter. Adjust the 90 Hz level control 1R3 for DDM meter indication of 0.165.

(7) Recheck the calibration by alternately applying 90 Hz and 150 Hz input signals and adjusting for DDM reading of 0.165.

(8) Set the level switch to the 90/150 Hz position. Introduce a known 0.155 DDM into the 90/150 Hz input jack with the band switch in the localizer position. Adjust the MON GAIN control for 0.155 DDM. Adjust audio DDM level control R28 on audio frequency (af) board 1A3 until level meter is at redline.

(9) Change the band switch to the glide slope position, and introduce a known 0.175 DDM ratio into the 90/150 Hz input. Adjust the MON GAIN control until the DDM meter reads 0.175 DDM. Adjust glide slope DDM level control R29 on af board 1A3 for a level meter indication of redline.

(10) Introduce a 0.000 DDM signal into the PIR. Select localizer on the band switch.

(a) Adjust the MON GAIN control for redline. With the selector switch on the 0.05 DDM setting, note the DDM.

(b) Place the band switch in the GS position, and adjust MON GAIN for redline. Note the DDM reading.

(c) Both readings noted should be zero DDM. If not, adjust 1R3 and 1R4 on the back of the PIR equally so that the DDM reading is 0.000 ±.005 DDM.

(11) Repeat steps (8) thru (10) until no further adjustments are required.

(12) Connect an rf signal generator to the localizer input BNC. Modulate the signal generator with equal 90 and 150 Hz tones (0.000 DDM), at 20 percent each tone. Extend af board 1A3. Measure the voltage at pin R of the extender. The voltage should vary from 10.6 volts at 25 µV to 2.2 volts at 500 mV.

(13) Position the selector switch to 0.05 DDM. Verify that the DDM reading is 0.000 +.005 DDM for all rf inputs between 25 microvolts to 500 millivolts. Adjust the AMP GAIN control for redline on the level meter before each reading.

SECTION 2. OTHER MAINTENANCE TASKS PROCEDURES (Continued)

SUBSECTION 1. ILS FACILITIES (Continued)

(14) Position the selector switch to 0.25 DDM. Change the modulation into the rf signal generator to 0.155 DDM (localizer). Verify that the PIR reads a constant 0.155 DDM for all rf input levels between 25 microvolts to 500 millivolts.

(15) Repeat step (12) using the glide slope frequency and 40 percent modulation per tone. Level meter redline should be obtained for all input levels between 25 microvolts to 500 millivolts.

(16) Change the modulation to 0.175 DDM. Verify that the PIR reads 0.175 DDM for all rf inputs levels between 25 microvolts to 500 millivolts.

5-112. EQUIPMENT TIME UPDATE.

a. Object. This procedure provides a method for the setting and synchronization of the microprocessor based Mark 20 ILS facilities equipment time.

b. Discussion. Newer microprocessor based ILS facilities have incorporated within them an internal equipment clock. The internal clock provides for an accurate accounting of when equipment data reports were generated, when executive and standby alarms occurred, when integrity alarms may have occurred, and time of data and screen setup file logging. The following procedure describes the setting and synchronization for the Mark 20 ILS. Other microprocessor based systems with internal clocks, such as commercial or nonfederal Mark 10 or ASII ILS's, are being taken over by the FAA. Each site specialist should ascertain the particular procedure for setting and maintaining the accuracy of his facilities equipment internal clock/time (if applicable) and complete at this procedures maintenance interval.

c. Test Equipment Required.

(1) The Mark 20 PMDT.

(2) An accurate time source.

d. Conditions. The ILS operating normally. Prior notification of air traffic control personnel is not required.

e. Procedure.

(1) Set up the Mark 20 PMDT at a location that has an accurate time source (such as can be found at an ATCT).

(2) Set the PMDT power switch to ON, and go to the DOS command prompt.

(3) Type in the command 'date' and press Enter. If the current date is displayed, press Enter; if not, follow the prompted order of month, day, and year; and set the current date; then press ENTER.

(4) Type in the command 'time' and press Enter. Set the current time in accordance with your time source; the press Enter. Set the PMDT power switch to OFF.

(5) Move the PMDT to the Mark 20 link control unit (LCU) location of the ILS to be checked. Connect the PMDT serial communications cable to the LCU.

(6) Set the PMDT power switch to ON, and log onto the LCU.

(7) Set the LCU time to that of the PMDT by performing the following; from the LCU commands menu execute the following sequence of keys <C C T>.

(8) Synchronize all Mark 20 facilities time to that of the LCU by performing the following; from the LCU Commands menu execute the following sequence of keys <C R K>.

NOTE: If the LCU is not connected to each of your facilities, the time update may be performed directly at the facility using the PMDT.

(9) Log off the LCU, set the PMDT power switch to OFF, and disconnect the PMDT serial communications cable from the LCU. This completes the time set and synchronization procedure.

SECTION 2. OTHER MAINTENANCE TASKS PROCEDURES (Continued)

SUBSECTION 1. ILS FACILITIES (Continued)

5-113. BACKUP BATTERY POWER CHECK.

a. Object. This procedure provides a method for a basic check of facility backup battery dc power. The purpose is to identify major problems with the backup power system.

b. Discussion.

(1) To provide continuity of service in areas of poor commercial power or during times of heavy storms and subsequent power outages, backup power has been provided at almost all ILS facilities. Larger airports may have the facilities connected to a critical ac power bus (i.e., engine generators); however, almost all have some form of backup battery dc power. Battery aging, charger problems, float voltage adjustments, blown fuses, and etc. can result in a severally limited battery capacity, or no backup power at all. In general, battery backup power capability at Localizer and Glide Slope facilities have been sized to provide power for four hours or more. Marker Beacon battery backup power can sometimes be capable of powering the facility for several days.

(2) Most systems should meet the following minimum one hour check. However, if your equipment shuts down or alarms occur, check that your system is designed to meet at least a one hour backup time. If so, note battery voltage readings, check fuses, check that battery cables and connections are in good condition, check battery charger equalize and float voltages, and if all appear good; the batteries may require replacement. Refer to Order 6980.25, Maintenance of Batteries for Standby Power.

c. Test Equipment Required.

(1) A wrist watch or clock.

(2) For a Mark 20 or similar ILS, the PMDT.

(3) Optional; a dvm (Fluke or equivalent).

d. Conditions. The ILS facility operating normally and notification given to Air Traffic of the intended check. This procedure takes one hour to complete, and a possibility exist that an equipment shutdown or transfer to standby equipment could occur. Since the system specialist is most familiar with the facilities, it is left up to his or her judgment as to whether-or-not the facility is taken out of service for maintenance and a Notice to Airmen (NOTAM) is issued.

e. Procedure.

(1) At the equipment monitor, or with the ILS PMDT, note that equipment monitored parameters are normal.

(2) This step is optional; connect a dvm, or setup the ILS PMDT to display the backup battery dc voltage.

(3) Locate the ac power circuit breaker for the equipment to be checked.

(4) Using a wrist watch or clock, note the current time and switch the equipment ac circuit breaker to the OFF position.

(5) For a period of one hour; observe that all equipment monitored parameters remain within normal limits and that no alarms occur (except for a possible maintenance alert of loss of commercial power).

(6) Switch the equipment ac power circuit breaker to the ON position.

(7) At dual equipment facilities with a separate ac power circuit breaker; repeat the above procedure for the second set of equipment.

5-114. ENVIRONMENTAL OBSERVATION.

a. Object. Detect environmental changes that may cause signal degradation.

b. Discussion. As the airborne performance of an ILS is affected by environmental factors it is important to observe the area surrounding facilities for changes. Some of these changes may not affect ground check readings. Significant changes in signal screening and reflective characteristics may occur, primarily through building construction, between flight inspections. Additionally, some periodic flight inspection methods may not detect all low altitude localizer clearance problems caused by screening.

c. Test Equipment required. None required. Optional aids include airport maps, magnetic compass, binoculars, camera, etc.

d. Conditions. Equipment operating normally.

e. Procedure. While standing near the antenna, visually scan the area in front and to the sides of the approach path noting any temporary or permanent changes to vertical screening or sources of signal multipath. Type, height, distance, and angle from the runway should be noted for new construction. Environmental changes suspected to cause changes in the received signal should be discussed with engineering and/or flight inspection personnel to determine if a special flight inspection is needed.

5-115. thru 5-119. RESERVED.

SECTION 2. OTHER MAINTENANCE TASKS (Continued)

SUBSECTION 2. ILS ANTENNAS

5-120. GENERAL. This section establishes the procedures for accomplishing the various essential maintenance activities that are required to verify that the ILS antennas are performing within specified tolerances.

5-121. ANTENNA SYSTEM VSWR AT OUTPUT OF TRANSMITTER.

a. Object. This procedure provides a method to measure the vswr of the antenna distribution circuit.

b. Discussion. Because of coaxial line loss, the vswr is not constant along a transmission line, but is greatest at the load (antenna) end. However, any change in the vswr of the antenna distribution circuit or the antenna itself will be reflected to the transmitting end. This routine check of antenna system vswr will be accomplished from the transmitting end (i.e., at the output of the transmitting equipment). Changes in the reference vswr at a particular ILS facility will require the specialist to make a more extensive check of the antenna system to identify the source of the problem.

b. Test Equipment Required. One of the following items is required.

(1) A directional rf wattmeter with appropriate elements.

(2) Mark 20 BITE and PMDT.

d. Conditions. The facility is operating normally.

e. Detailed Procedure for Non Mark 20 System.

(1) With the transmitter operating normally, measure the forward and reflected power at the thruline body, using the directional wattmeter.

(2) Compute the vswr from the values of the forward and reflected power by the use of the following formula, the vswr chart provided with the wattmeter, or the vswr chart provided in appendix 4. Record values on FAA form 6750-22.

$$Vswr = \frac{\sqrt{Power_{(forward)}} + \sqrt{Power_{(reflected)}}}{\sqrt{Power_{(forward)}} - \sqrt{Power_{(reflected)}}}$$

(3) Compare the measured vswr to the applicable tolerance and to previous measurements.

(4) Repeat the above steps for each coaxial transmission line.

f. Detailed Procedure for Mark 20 System.

(1) Connect the PMDT serial communications cable to the equipment serial communications port. Set the PMDT power switch to ON and log onto the equipment.

(2) For the Localizer or Glide Slope facility execute the following sequence of keys from the Commands menu < D T O/T C/O> (O for transmitter one and T for transmitter two; and C for the clearance transmitter and O for the on-course).

(3) Record the CSB and SBO transmitter vswr on FAA form 6750-22.

(4) Log off the equipment, set the PMDT power switch to OFF, and disconnect the PMDT serial communications cable from the equipment.

5-122. END-FIRE CLEARANCE MONITOR ANTENNA LOCATION.

a. Object. This procedure provides a method to locate the clearance monitor antenna for proper monitoring of clearance array maladjustments or faults.

b. Discussion. The clearance rf channel of the monitor is used to field monitor the radiation pattern of the two clearance antennas. The monitor antenna is positioned to detect power reduction from each of the two antennas as well as change in relative phases between the two antennas. The monitor is placed in a position where the rf energy from each antenna is in-phase (a maximum) and equal. At this location the clearance rf monitor should respond symmetrically to dephasing of the clearance antennas.

c. Test Equipment Required. None

d. Conditions. The clearance array must be properly phased in accordance with paragraph 5-55. A facility shutdown is required for this check.

SECTION 2. OTHER MAINTENANCE TASKS (Continued)

SUBSECTION 2. ILS ANTENNAS (Continued)

e. Procedure.

* **WARNING:** The following procedure will produce Hazardously Misleading Information (HMI). Before proceeding, refer to paragraph 1-6 and follow the specific HMI guidance provided. Failure to follow this guidance can result in Controlled Flight Into Terrain (CFIT). The duration and frequency of radiating HMI must be kept to a minimum by any means necessary, as required by Order 6000.15, paragraphs 307, 425, and 432.

(1) Disconnect the front clearance antenna, and terminate the coaxial cables in dummy loads.

(2) Observe the rf level on the clearance monitor. It should be approximately 50 percent.

(3) Reconnect the front clearance antenna, and disconnect the rear clearance antenna. Terminate the open coaxial connectors with dummy loads.

(4) Observe the rf level on the clearance monitor. It should be equal to the level measured from the rear antenna, as observed in step (2), plus or minus 10 percent. If not, the clearance monitor should be reaimed toward the antenna with the lower observed rf level.

(5) Repeat steps (1) thru (4) until the levels are within 10 percent of each other.

(6) Verify the proper operation of the clearance monitor rf level if an adjustment was made in step (4).

(7) Restore the facility to service.

5-123. END-FIRE AIR SYSTEM INTEGRITY.

a. Object. This procedure provides a method to determine that air leaks do not exist in the pressurized coaxial transmission lines.

b. Discussion. Because phase stability is very important in the end-fire glide slope, the coaxial transmission lines are pressurized with dry air. An air pump drier and manifold system are used to pressurize the coaxial lines. This prevents the intrusion of moisture, which is the primary reason for phase instability of air transmission lines.

c. Conditions. The facility is operating normally.

d. Test Equipment Required. None.

e. Detailed Procedure.

(1) Check the manifold in the interface unit to ensure that all of the needle valves are fully open.

(2) Note the current manifold gauge pressure.

(3) Turn OFF the pump.

(4) Over a 3-hour period, occasionally check for an air pressure drop. Pressure may vary several pounds force per square inch (psi) with changes in outside temperature or sunshine.

(5) If the pressure drops more than 20 percent, locate and repair the leak.

(6) Check desiccant and replace as required.

(7) Restore the facility to service.

5-124. ANTENNA SYSTEM VSWR AT ANTENNA FEEDLINES.

a. Object. This procedure provides a method to measure the vswr of the antenna and its rf feedline. The purpose of this check is to better identify aging or damaged rf cables and/or antennas for immediate or future replacement.

NOTE: This routine should be performed in conjunction with the rf cable insulation and dc resistance measurements of Subsection 3, ILS Transmission Lines. *

b. Discussion. Because of coaxial line loss, the vswr is not constant along a transmission line, but is greatest at the load (antenna) end. However, any change in the vswr at the antenna will be reflected to the transmitting end. This routine check of the antenna vswr will be accomplished on each transmitting antenna with its corresponding feedline (i.e., out of the distribution network to the antenna). An

out-of-tolerance condition or changes in the previous vswr measurements for a particular antenna and its feedline will require the specialist to make a more extensive vswr check of the antenna and/or feedline to identify the source of the problem.

c. Test Equipment Required. One of the following items is required.

(1) Directional wattmeter with appropriate elements.

(2) Vector Voltmeter with directional coupler.

d. Conditions. Coordinate a scheduled outage for the facility being verified with air traffic control personnel and remove from service.

e. Detailed Procedure.

(1) Configure the transmitter for an output of rf carrier only, and determine a method by which the signal may be transmitted to the point at which the antenna feedline will be disconnected.

(2) Depending on the type of test equipment to be used, adjust the transmitter rf output level to obtain stable readings of forward and reverse power (i.e., for a wattmeter, 1 watt may be selected; for a vector voltmeter (vvm) a lower output level that results in an approximate 0 dBm at the vvm may be used).

CAUTION: Do not exceed maximum input levels of the vvm test equipment. Expensive damage to the input circuits can occur. If unsure of levels; start with decreased rf power output in conjunction with a 30 dB rf attenuator attached inline to the directional coupler, gradually increase rf power or decrease attenuation until a satisfactory level is reached.

(3) One at a time, disconnect each antenna rf feedline at its distribution unit, dummy load that port, and apply the rf carrier signal to the feedline via an rf directional wattmeter. A vvm with its companion directional coupler may also be used, but the rf signal level may need to be reduced to operate normally. In either case, measure the forward and reflected power either in watts or dBm units.

(4) Compute the vswr from the values of the forward and reflected power by the use of the following formula, the vswr chart provided with the wattmeter, or the vswr chart provided in appendix 4. Record values on FAA form 6000-8. *

$$Vswr = \frac{\sqrt{Power_{(forward)}} + \sqrt{Power_{(reflected)}}}{\sqrt{Power_{(forward)}} - \sqrt{Power_{(reflected)}}}$$

(5) Compare the measured vswr to the applicable tolerance and to previous measurements.

(6) Repeat the above steps for each antenna and its transmission feedline/tie line.

5-125. SIDEBAND-REFERENCE ANTENNA SBO AMPLITUDE EQUALITY.

a. Object. This procedure provides a method to verify, and adjust if necessary, the distribution of sideband power between the upper and lower antennas.

b. Discussion. The ratio of sideband power to the upper and lower antennas affects both the path angle and width. The following procedure should be performed before phasing the facility.

c. Test Equipment Required.

(1) A thruline wattmeter and appropriate detector elements.

(2) Two dummy loads.

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedures.

(1) Disconnect the carrier input to the APCU and terminate the carrier input connector into a dummy load.

(2) Disconnect the sideband input to the APCU and terminate the sideband line from the transmitter into a dummy load.

SECTION 2. OTHER MAINTENANCE TASKS (Continued)

SUBSECTION 2. ILS ANTENNAS (Continued)

(3) Disconnect the upper and lower antenna feedlines from the APCU and connect a dummy load to the APCU outputs.

(4) Connect the carrier output of the transmitter to the sideband input of the APCU.

(5) Using the same wattmeter detector element and meter, measure the rf power at the upper and lower antenna rf bodies. The power ratio should be within the limits prescribed in chapter 3. If necessary, adjust the power divider to equalize the powers.

(6) Restore the facility to service.

5-126. CAPTURE-EFFECT ANTENNA AMPLITUDE.

a. Object. This procedure provides a method to verify and adjust (if necessary) the carrier, sideband, and clearance power distribution to the three antennas.

b. Discussion. The rf power distribution to the antennas affects the glide angle, path width, symmetry, and below-path clearance (fly-up). Proper operation of the capture-effect glide slope can be achieved only by the use of extreme care and accuracy in amplitude and phase control unit (APCU) adjustments. It is assumed that the course transmitter modulator has been carefully adjusted for modulation equality and lobe balance and that the clearance transmitter has been adjusted for proper audio phasing and modulation percentage before proceeding with the following adjustments. The relative rf power ratios are to be established by the use of a wattmeter or a vector voltmeter. If a wattmeter is used, the same wattmeter detector element and meter movement should be inserted into the appropriate APCU thruline bodies. Due to nonuniformity between elements, the wattmeter elements used should be clearly marked to ensure that they are not unintentionally interchanged with other units. All wattmeter bodies shall be plugged with detector elements or plugs during this procedure as well as during normal facility operation. Failure to leave the wattmeter bodies in a standard configuration will affect system adjustments and stability.

NOTE: If a vector voltmeter is used for this procedure, extreme care must be taken to ensure that excessive power is not fed to the input ports. The use of in-line attenuators, directional couplers, and power samplers is strongly recommended.

c. Test Equipment Required. A wattmeter with appropriate detector elements and dummy loads. A vector voltmeter (vvm) and a directional coupler may be used in place of the wattmeter. A PIR that measures rf level may also be used.

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedure.

(1) Establishment of relative carrier power levels.

* (a) Deenergize the clearance transmitter.

(b) Dummy load the three antenna APCU outputs.

(c) Remove the sideband input from the APCU and dummy load the cable and APCU sideband input. Remove the antenna cables and dummy load the APCU antenna outputs.

(d) Measure and record the power in the middle antenna thruline body. (With a vvm and directional coupler, measure the middle antenna output. Replace the dummy load when finished.)

(e) Move the wattmeter to the lower antenna thruline body (vvm to antenna output), and measure the power.

(f) If necessary, adjust the carrier power divider for the correct lower-to-middle carrier power ratio.

(g) Repeat steps (d) and (e) as necessary until the proper ratio is obtained. *

(2) Establishment of relative sideband power ratios.

(a) Deenergize the course transmitter. Remove the dummy load from the APCU sideband input. Change the carrier cable from APCU carrier input to the APCU sideband input. Dummy load the APCU carrier input. Turn on the course transmitter.

(b) Measure and record the lower antenna power. Move the wattmeter element to the upper antenna thruline (vvm to upper antenna output).

(c) If necessary, adjust sideband power divider no. 2 for equal power in the lower and upper antennas. This also sets the correct upper-to-lower clearance power ratio.

SECTION 2. OTHER MAINTENANCE TASKS (Continued)

SUBSECTION 2. ILS ANTENNAS (Continued)

(d) Repeat steps (b) and (c) as necessary. Lock sideband power divider no. 2.

(e) Move the wattmeter element or vvm to the middle antenna. If necessary, adjust sideband power divider no. 1 for the correct middle-to-lower power ratio.

(f) Lock down sideband power divider no. 1.

(3) Establishment of course and clearance transmitter lower ratios. The vvm should not be used during this procedure. The wattmeter and normal system detector elements are to be used.

(a) Deenergize the course transmitter. Remove the dummy load from the APCU carrier input. Change the carrier cable from the APCU sideband input to the APCU carrier input. Dummy load the APCU sideband input. Turn on the course and clearance transmitters.

(b) Adjust the course transmitter for normal carrier power input to the APCU.

*

(c) Measure and record the middle antenna carrier power.

(d) Measure and record the upper antenna clearance power. *

(e) If necessary, adjust the power output of the clearance transmitter for the clearance power in the upper antenna specified as the initial tolerance in chapter 3. (The clearance power ratio of the upper to lower antennas was determined in step (2)(c).)

(4) Establishment of sideband-to-carrier ratio for course signals.

(a) Remove all dummy loads, and connect all APCU input and antenna cables for normal operation.

(b) Adjust the sideband power control on the course transmitter for the carrier-to-sideband power ratio at the APCU input established by flight inspection.

(5) Corrective action.

(a) If any adjustments above were major in nature (other than fine adjustments to center a power ratio), the system must be ground-phased and the monitor alarms verified using the most recent reference data.

(b) Restore the facility to service.

5-127. thru 5-129. RESERVED.

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SECTION 3. SPECIAL MAINTENANCE PROCEDURES
SUBSECTION 1. ALL SUBSYSTEMS (Continued)

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedure.

(1) With the rf turned off, break the line at the point of interest, and insert the rf body with the special line section.

(2) Insert an element of proper size and frequency into the rf body, and take the power reading.

(3) Restore the facility to service.

5-154. RF BRIDGE ISOLATION.

a. Object. This procedure provides a method to check the isolation capability of an rf bridge.

b. Discussion. Rf bridges are commonly used throughout localizer and glide slope systems. They are used to divide rf energies, combine rf energies, and provide isolation. The proper performance of an rf bridge depends upon bridge leg lengths, bridge leg impedances, proper terminations, and frequency. Rf bridges are constructed using many different techniques. A common characteristic is their excellent reliability. Thus they are often overlooked when pursuing system malfunctions. Numerous test methods exist for verifying the operation of an rf bridge. This procedure will deal only with an rf signal generator and a vector voltmeter. Alternate methods are satisfactory if they yield similar results to the procedures listed below.

c. Test Equipment Required.

(1) An rf source at the operating frequency.

(2) A vector voltmeter (vvm).

(3) A bidirectional coaxial coupler, Narda 3020A or equivalent.

(4) Two 50 Ω loads.

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedures.

(1) Turn off the transmitter. Then isolate the bridge to be checked by removing all four normal connections.

(2) Connect the bridge to the test setup as shown in figure 5-1b. *

CAUTION: The input to the vvm MUST BE limited to ≤10 mW. If the facility transmitter is used, it must be attenuated properly to protect the input circuits of the vvm.

(3) Establish a power reference on channel A of the vvm. The power indicated on channel A is not the power level to the bridge (port A) due to the coupling factor of the Narda directional coupler (typically –20 to –25 dB). Using the graph provided on the Narda directional coupler, determine this coupling factor. The power feeding the bridge (port A) is added (coupling factor in dB) from the reading on channel A. Note this level. (The insertion loss of the Narda directional coupler can be ignored for this test.)

(4) At the bridge (port C), measure and note the power level on channel B of the vvm. Subtract the channel B reading from the noted channel A reading. This difference is the isolation capability of the bridge from port A to port C. Typical isolation for a good bridge is –30 dB.

(5) Reconfigure the test setup to measure the isolation from port B to port D. Merely rotate all connections. Repeat the procedure in steps (3) and (4) for this new configuration.

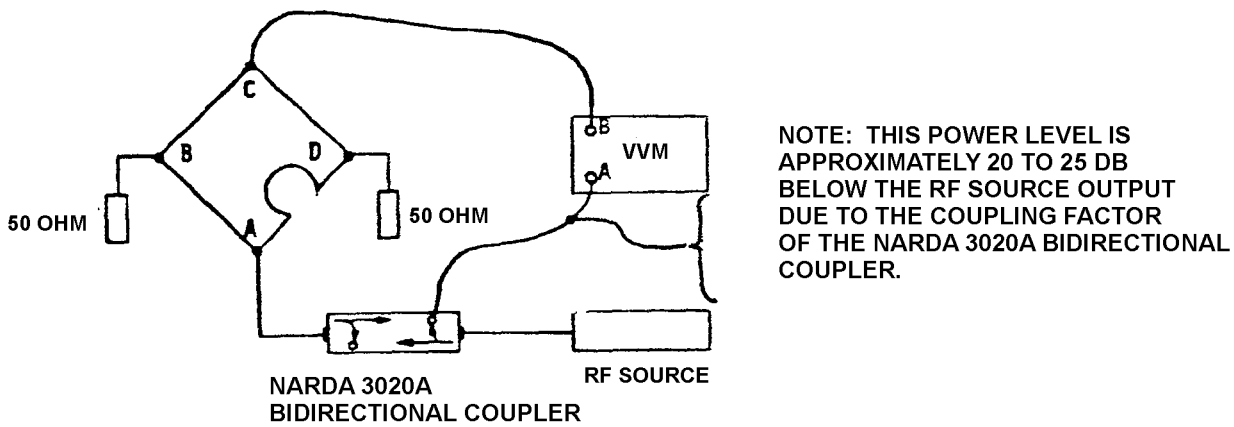
(6) Repeat the process of step (5) until all four ports of the bridge have been compared to their corresponding isolated ports.

(7) Restore the facility to service.

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 1. ALL SUBSYSTEMS (Continued)

* FIGURE 5-1b. RF BRIDGE ISOLATION TEST *



5-155. VECTOR VOLTMETER MEASUREMENT OF PHASE AND ATTENUATION IN RF COMPONENTS.

a. Object. This procedure provides a method to determine the phase and attenuation in rf components.

b. Discussion.

(1) Physical inspection of rf components (i.e., coaxial lines, connectors, bridges, attenuators) may not always detect flaws or damage that affects the phase and amplitude of the signal through the component. Continuity checks with an ohmmeter will only measure/ indicate dc resistance, opens and shorts, but not phase angle.

(2) This procedure describes a method by which rf components can be checked at their operating frequency. The data taken may be used as a reference should a problem occur in the system.

c. Test Equipment Required.

(1) A vector voltmeter (vvm).

(2) A bidirectional coupler, Narda 3020A or equivalent.

(3) An rf signal source.

(4) A 50 Ω dummy load.

d. Conditions. A facility shutdown may be required for this check (depending upon the function of the component in question and whether or not the facility transmitter will be used as the signal source).

e. Detailed Procedure.

CAUTION: The input to the vvm MUST BE limited to ≤10 mW. If the facility transmitter is used as the rf signal source, it must be attenuated properly to protect the input circuits of the vvm.

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)
SUBSECTION 1. ALL SUBSYSTEMS (Continued)

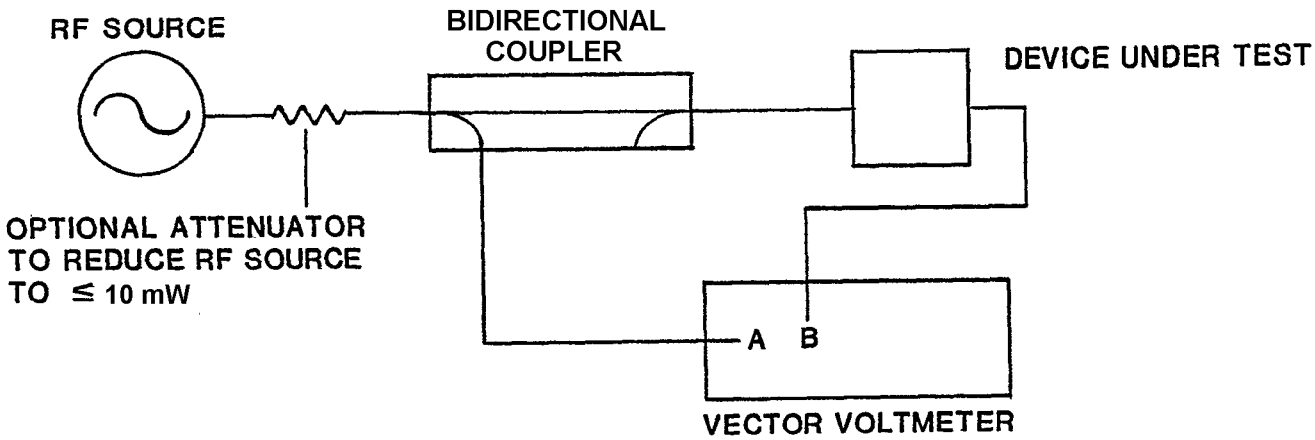
(1) Connect the vvm, bidirectional coupler and low power signal source (an rf signal generator set to the facility operating frequency or the facility transmitter, properly attenuated) as shown in figure 5-2.

(2) Connect the output port of the bidirectional coupler to the B channel of the vvm.

(3) Apply rf power. Note the power level and the phase angle on channel B of the vvm. Subtract the channel B readings from the channel A readings. These values are the reference values.

(4) Turn off the rf signal source, and insert the rf component to be tested between the bidirectional coupler and the B channel of the vvm.

FIGURE 5-2. PHASE AND ATTENUATION MEASUREMENT WITH VECTOR VOLTMETER



(5) Reapply rf power and note the channel B readings of the amplitude and phase meters on the vvm. Subtract the channel B readings from the channel A readings. The difference between this calculation and the reference values as found in step (3) is the attenuation and phase delay through the component.

(6) Compare the component attenuation and phase delay value found in step (5) with previous readings or theoretical optimum values. If it varies more than 2 dB or 5°, corrective action is required.

(7) Restore the facility to service.

5-156. ADDING FIXED ATTENUATORS TO OPTIMIZE TRANSMITTER POWER RANGE.

a. Object. This procedure provides (and authorizes) a method to optimize transmitter performance by adding an * attenuator to the transmitter output. Perform this procedure only if the transmitter is operating outside the manufacturer's suggested power range or the transmitter/monitor is unstable. *

b. Discussion.

(1) The normal transmitter power range must be given in the manufacturer's instruction book. This may be given as a minimum power with no maximum.

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 1. ALL SUBSYSTEMS (Continued)

(2) The operating power of an ILS transmitter (including 75 MHz markers) will vary with location and conditions. The transmitter power may decrease up to 3 dB for alarm checks. If the system operating power is not within the manufacturer's suggested transmitter power range, power reduction may cause instability.

(3) Transmitter power can be measured either by adding a thruline body with the wattmeter and appropriate elements or using the system equivalent if available.

(4) Optimally, the attenuator to be added should have the same type of connectors as the system. Adapters should be avoided if possible. The power rating of the attenuator should be at least twice the power that will be dissipated in the attenuator at the operating power.

c. Test Equipment Required. Thruline body with wattmeter and appropriate elements for the power and frequency range being measured is required if the system does not have an equivalent.

d. Conditions. A facility shutdown is required for this procedure.

e. Detailed Procedure.

(1) If the system does not have a built-in wattmeter, temporarily install a thruline body and connect to a wattmeter; install the appropriate element for the power and frequency range being measured.

(2) Determine from the manufacturer's instruction book the minimum power of the transmitter. Increase this power by the amount of the power reduction alarm. For example, if the power reduction alarm is 3 dB, the minimum power would be doubled. The resulting power will be designated (P_A).

(3) Note the normal station power and designate this as (P_B). If P_B is greater than P_A, then no attenuation is required. If P_B is less than P_A, then attenuation is required. Compute the attenuation with the formula below. Round this value to the next available value of attenuation.

$$\text{Attenuation (dB)} = 10 \log \frac{P_B}{P_A}$$

For example, the minimum recommended power for the Mark 1d, 1e, and 1f markers is 250 mW. If a middle marker is operating at 400 mW, the 3 dB reduction will bring the power to 200 mW, which is below the recommended power. Additional attenuation would be required in this case. Minimum acceptable power, determined from the manufacturer's instruction book is 250 mW. This value increased by the 3 dB reduction power alarm value for markers would mean that the minimum acceptable transmitter power would be 500 mW (P_A). In the example, the normal station power is 400 mW (P_B). An attenuator should be selected so that at 500 mW transmitter output the attenuated output is less than or equal to 400 mW. The calculated attenuation is –0.97 dB and will be rounded to 1 dB of attenuation. The attenuator will be dropping approximately 100 mW, so the wattage rating of the attenuator should be at least 200 mW.

(4) Install the selected attenuator in the transmitter output feed lines.

(5) Confirm that the transmitter operates within its power stability range of the transmitter while supplying the required station power operating range.

(6) Remove the thruline body and wattmeter if installed. Return system to normal service.

5-157. thru 5-169. RESERVED.

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 2. LOCALIZERS (Continued)

* **TABLE 5-3a. GROUND CHECK POINT REQUIREMENTS**

Facility Type	*Runway Centerline and Course Width*[1]	*Clearance Points*[2, 3]
All one-frequency localizers, and two-frequency localizers without a commissioned backcourse.	Approach end runway threshold or closer as required, but no closer than 20 times the width of the array.	Check on front side at the low clearance azimuth each side of the course.
Two-frequency localizer with a commissioned backcourse. Front Course:	Approach end runway threshold or closer as required, but no closer than 20 times the width of the array.	Check on front side at the low clearance azimuth each side of the course.
Backcourse:	(1) Check on backside at a distance ≥10 times the width of the clearance array if available real estate permits. OR- (2) Check with course transmitter off, on the front side at approach end, runway threshold or closer as required, but no closer than 20 times the width of the array.	Not required. Not required.
LDA or offset, one- and two-frequency localizers	Check on front side at a distance ≥20 times the width of the array or closer as required, but no closer than 20 times the width of the array.	Check on front side at the low clearance azimuth each side of the course.

[1] The preferred location for the course position and width ground check points is at the runway approach threshold. However, it may be impossible to obtain repeatable data at the runway threshold due to insufficient signal strength or reflections. If this occurs, move in toward or away from the localizer antenna array as outlined in the detailed procedure. If it is necessary to locate the ground check point closer than 20 times the width of the array, written regional approval is required.

* [2] Consult Table 5-3b for the low clearance angle and minimum ground check distance for each array type. (Additional ground check points are recommended at ±10°, ±20°, ±30°, and ±35°). Existing permanent ground check points that are within 3 degrees of the Table's low clearance azimuth may be used without relocation. In rare cases (e.g., an array mounted very near a shore line facing the water), the clearance ground check points must be located on the back side of the array. If a clearance ground check point is outside the airport boundary at any distance equal to or greater than the specified minimum distance, the ground check distance for that point may be reduced to half the minimum distance specified in Table 5-2a; if this location is still outside the airport boundary, the ground check at this location may be omitted. *

[3] Abnormal case DDM: Some localizer antenna arrays exhibit abnormal case DDM in the clearance sectors. Abnormal case DDM will exist when the separate sideband components are greater than the carrier sidebands. When this condition occurs, space modulation is greater than transmitter modulation. This destroys the normal CSB/SBO relationship of the clearance ground check, as the DDM value measured with the PIR initially increases as the sideband power is decreased. This is caused by the method of DDM measurement within the PIR. Clearance ground check measurements are not required at azimuths where abnormal case DDM exists. See paragraph 5-175 for a procedure to determine if abnormal case DDM exists.

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 2. LOCALIZERS (Continued)

* **TABLE 5-3b. CLEARANCE GROUND CHECK POINT DATA** *

Array [1]	*Aperture,*[2] *Clearance, Feet*	*Azimuth,* [3] *Low Clearance, Degrees*	*G.C. Distance,* [4] *Minimum, feet*	*Lateral Offset,* [5] *Minimum, feet*
8 element narrow spacing	45.5	20	910	310
14 element narrow spacing	86	13	1720	390
8 element wide spacing	51	18	1020	315
14 element wide spacing	99.2	11	1980	378
14/6 2-freq	32	28	640	300
Redlich 2-freq	68[2]	31	1360[2]	700
14/10 2-freq	67	35	1340	770
20/10 2-freq	67	35	1340	770
(future 1)				
(future 2)				

1. As new arrays are added to the FAA inventory, the aperture and minimum clearance angles are determined as defined in Notes 2 and 3 of this table.

2. The aperture is the nominal width of the clearance array, measured between its outer elements, which may not be the outermost elements for the course array. For arrays whose clearance aperture is very large (e.g., Redlich), but for which the outer elements are fed very low clearance power with respect to the element with the highest clearance power (i.e., < -20 dB), only those elements with clearance power greater than –20 dB are included in the (effective) clearance aperture, for the purpose of defining a minimum G.C. distance.

3. The low clearance azimuth angles are determined by mathematical modeling, using analog receiver processing.

4 The minimum distance shown is twenty times the (effective) width of the clearance array. See Note 2.

5. The minimum lateral offset is the distance from runway centerline for a low clearance ground check point (column 3) located at the minimum distance (column 4) from the array, and is calculated as [(min dist) x sin (low clearance azimuth)].

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 2. LOCALIZERS (Continued)

(7) Calculate the distance from the runway centerline to the edge of the localizer course for this distance from the localizer array using the following formula:

$$\text{Distance to Edge of Course} = \text{Distance to Localizer} \times \text{Tan}\left(\frac{\text{Commissioned Course Width}}{2}\right)$$

(8) [Mandatory] From the runway centerline, measure and establish permanent course width ground check points at the distance calculated in step (7). Tape measure accuracy is sufficient.

(9) Using a map or drawing of the airport, pick out clearance ground check points at ±10°, ±20°, ±30°, ±35°, if used, and at the low clearance point **[Mandatory]** on each side of the array. Protractor accuracy is sufficient for this task. It is not necessary for the clearance ground check points to be in a straight line, or on an arc, or at the same distance as the centerline and course width ground check points. Consult Table 5-2a for the low clearance azimuth and the corresponding minimum ground check distance from the array.

(10) Install permanent (use posts, paint, etc.) clearance ground check markers at the locations established in step (9). As these markers are used to provide only relative readings, absolute accuracy in their placement is not required.

(11) [Mandatory] A map showing the ground check locations shall be displayed at the localizer facility.

5-173. LOCATING A GROUND PHASING POINT.

a. Object. This procedure provides a method to locate a suitable far-field ground-phasing point that provides optimum carrier to sideband-only phase relationship.

b. Discussion. Optimum performance of the localizer radiated signal depends upon the proper phase relationship of the carrier to sideband-only (SBO) signals. A method of verifying this phase relationship is to use the portable ILS receiver (PIR) at a point established in the far-field. The phase relationship can be determined by measuring the effects of the sideband-only signal on the carrier while in quadrature. The point at which the measurement is taken must be representative of the entire system phase relationship. This point must also be free from reflections that contribute to the inaccuracy of the measurement.

c. Test Equipment Required.

(1) A portable ILS receiver (PIR) with antenna.

(2) The facility 90° phasing section.

d. Conditions. A facility shutdown is required for this procedure.

e. Detailed Procedure.

* **WARNING:** The following procedure will produce Hazardously Misleading Information (HMI). Before proceeding, refer to paragraph 1-6 and follow the specific HMI guidance provided. Failure to follow this guidance can result in Controlled Flight Into Terrain (CFIT). The duration and frequency of radiating HMI must be kept to a minimum by any means necessary, as required by Order 6000.15, paragraphs 307, 425, and 432. *

(1) Consult the appropriate technical instruction book for the particular antenna system that is to be phased. A plot of the sideband-only radiation pattern for the array should be given. From the plot, determine where the peak of the sideband lobes occur in azimuth, relative to centerline. The relative azimuth of this sideband lobe peak is a good point to begin for locating the ground-phasing point.

(2) Position the PIR at the azimuth point of step (1) or the previously established ground check point. (See paragraph 5-172.) Ensure that this point provides line-of-sight to the localizer array.

(3) At the equipment shelter, terminate the sideband-only signal and its cable. With carrier only radiating, note the DDM reading at the far-field ground-phasing point.

(4) Insert the facility 90° phasing section in the sideband-only cable and reconnect it to its normal output port.

(5) Note the new (quadrature) DDM at the far-field ground phasing point. If the facility has been previously phased using the in-line method (per paragraph 5-16f), the reading at the far-field ground-phasing point should be near the reference DDM taken in step (3). If necessary, note the main sideband phaser setting and adjust the phaser to obtain reference DDM at the far-field ground phasing point.

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 2. LOCALIZERS (Continued)

(6) A test to ensure that this point is free from reflections is to observe the PIR while moving it approximately 50 feet in all directions from this point. The DDM should remain within ±0.05 DDM of reference. Large changes in DDM indicate that the readings at this point are a result of reflections. If reflections are present, a new point, perhaps on the opposite side of centerline, should be tried. The final far-field ground phasing point selected should pass this test for reflections.

(7) A quadrature ground check, see paragraph 5-174 should be taken to ensure that the established far-field ground phasing point provides optimum results. Attention should be given to the usual low clearance points for the particular array to be phased. If flight inspection reports marginal clearances, often these clearances can be improved by far-field phasing at the reported low-clearance azimuth.

(8) Restore the facility to service.

(9) The location of the established far-field ground-phasing point shall be clearly identified. The date, method used, and the far-field phasing values shall be identified on the appropriate facility drawings.

5-174. QUADRATURE GROUND CHECK.

a. Object. This procedure provides a method to determine that the method used to phase a localizer antenna array produces optimum phasing in the far-field.

b. Discussion.

(1) A quadrature ground check provides a means to determine the amount of antenna array misphasing at each ground check point. A plot of this misphasing for all ground check points gives a visual indication of how well the antenna system is phased.

(2) A perfect localizer antenna array, that is perfectly phased, and which does not have structures to cause reflections, would produce zero DDM everywhere in the far-field when the sidebands are in quadrature. Any imperfection in the array, such as mutual coupling or misphasing, causes non-zero DDM readings in the far field. The amount of antenna system phase error can be calculated by:

$$\text{System phase error, in degrees} = \arctan\left(\frac{\text{quadrature DDM}}{\text{normal DDM}}\right)$$

(3) The optimum phasing of the localizer array occurs when the algebraic sum of the phase errors for each evenly spaced ground check points equals zero. When the sum of the phase errors does not equal zero, the total average phase error can be calculated by dividing the sum of the phase errors by the number of phase error data points. This procedure is valid only where phasing is checked every 5°. Optimum localizer antenna array phase can then be obtained by adjusting the carrier-to-sideband phase by the average phase error.

(4) Optimum localizer phasing does not necessarily mean that all clearances will be improved. For example, the quadrature plot of figure 5-3 shows that if the system is adjusted for optimum phase, the clearances would improve at 20° and beyond, but would get worse inside 15°. At 15° on the 150 Hz side, the clearances would be considerably lower.

c. Test Equipment Required.

(1) A portable ILS receiver (PIR).

(2) Dummy loads.

(3) The facility 90° phasing section.

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedure.

* **WARNING:** The following procedure will produce Hazardously Misleading Information (HMI). Before proceeding, refer to paragraph 1-6 and follow the specific HMI guidance provided. Failure to follow this guidance can result in Controlled Flight Into Terrain (CFIT). The duration and frequency of radiating HMI must be kept to a minimum by any means necessary, as required by Order 6000.15, paragraphs 307, 425, and 432. *

(1) Insert the 90° phasing section in the sideband feedline.

(2) Measure the DDM at each ground check point except centerline. The ground check points must be in the far field to obtain satisfactory results. For instance, a quadrature ground check at the 200-foot arc will produce unsatisfactory results due to proximity error.

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 2. LOCALIZERS (Continued)

(3) Calculate the phase error for each ground check point using the following formula:

$$\Phi \text{ (phase error)} = \arctan\left(\frac{\text{quadrature DDM}}{\text{normal DDM}}\right)$$

If the quadrature DDM is not the same predominating audio frequency, the phase angle is defined to be negative.

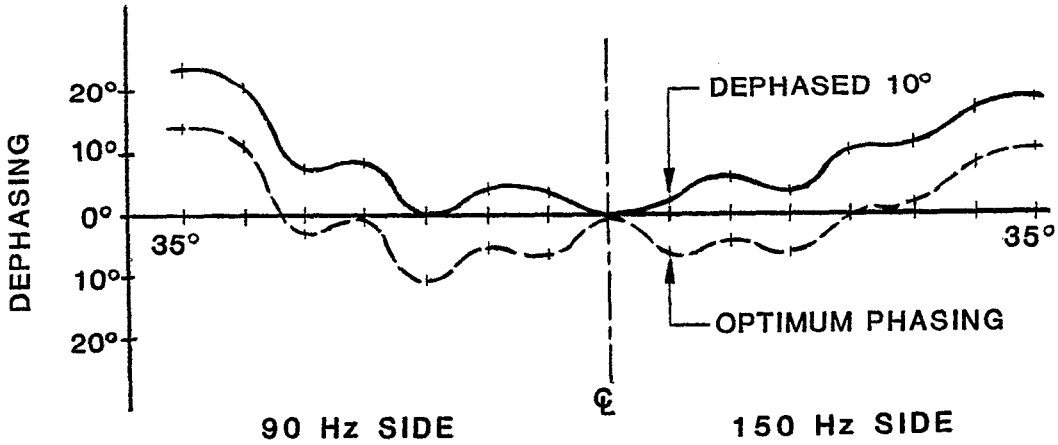
$$\text{i.e., } \Phi = \arctan\left(\frac{.05\ (90)}{.155\ (150)}\right) = -17.9^{\circ}$$

(4) Plot the amplitude of the phase error against localizer azimuth as shown in figure 5-3.

(5) With some qualifications, the best quadrature plot is one that averages zero degrees on each side of the array. Analyze the plot, and if necessary, rephase the antenna system and repeat steps (1) through (4). For small phase changes, less than 15° to 20°, a new normal ground check is not required for the purpose of calculating phase error.

(6) Restore the facility to service.

FIGURE 5-3. QUADRATURE GROUND CHECK



TYPICAL LOCALIZER QUADRATURE GROUND CHECK PLOT
OPTIMUM PHASING
VS
DEPHASED 10°

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 2. LOCALIZERS (Continued)

5-175. REFERENCE GROUND CHECK, FAA FORMS 6750-23 AND -24.

a. Object. The reference ground check establishes the limits to which all subsequent normal ground checks are to be compared. This reference data is to be recorded on FAA Forms 6750-23 and -24.

b. Discussion.

(1) A reference ground check is prepared after facility commissioning and after any subsequent monitor flight inspection that requires the establishment of new parameters. A reference ground check shall be completed before returning the facility to service.

(2) The system specialist should establish new, tighter reference operating limits if past flight inspections indicate this to be prudent. For instance, if previous flight inspections have found the wide alarm course width to be near the flight inspection tolerance limit, the sideband power at wide alarm may be increased. This will ensure that subsequent flight inspections will be in tolerance. Changes which loosen the reference ground check limits require a confirming flight inspection.

(3) The reference data must be measured very carefully. Power measurements must always be accomplished with the same meter and elements. The elements shall be clearly marked. In addition to the rf wattmeter readings, it is recommended that a digital voltmeter (dvm) be used to obtain reference readings for carrier and sideband power. These reference readings can be made with greater repeatability using the dvm than by using the analog wattmeter. This is done by connecting a digital voltmeter, set to measure dc voltage, to * the detector element output in place of the normal meter.

*

c. Test Equipment Required.

(1) A portable ILS receiver (PIR).

(2) An appropriate antenna.

(3) A dvm (optional).

(4) The facility rf wattmeter.

d. Conditions. Ensure that the facility commissioning flight inspection or monitor flight inspection that required the establishment of new parameters met the initial tolerances of paragraph 3-30. A facility shutdown is required. The facility should be operating normally, and approval obtained from Air Traffic to operate on the ILS runway when required.

* **e. Detailed Procedure.**

(1) Using the values established during flight inspection, enter on the reference line of FAA Form 6750-24 the values for normal carrier and sideband power, carrier feedline DDM (as derived for centerline in accordance with 6-34d), monitor course and width DDM.

(2) If applicable, insert the operating tolerance for each entry completed on FAA Form 6750-24. Refer to steps (6)(a)1 through 3 of this procedure for further guidance.

(3) Confirm that the carrier feedline modulation balance is normal, as derived for centerline in accordance with 6-34d. *

(4) Normal.

(a) Verify that the carrier and sideband powers are at the levels established during flight inspection.

(b) At the edge of course, centerline, and low clearance ground check points, carefully measure the DDM values, and record data on FAA Form 6750-23 on the reference line.

(c) Insert the operating tolerance for each entry completed above on FAA Form 6750-23. Refer to steps (6)b)1 and 2 for further guidance.

(5) Abnormal case DDM test (only performed during reference ground check).

(a) Decrease the course transmitter sideband power to the wide alarm power established by flight inspection.

(b) At two-frequency localizers, adjust the clearance transmitter sideband and carrier power to the established wide-alarm power value.

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 2. LOCALIZERS (Continued)

(c) At each established clearance ground check point, carefully measure the DDM value.

(d) Determine if the DDM value measured has decreased from that measured in step (4)(b). If the value increased or did not change, it indicates that abnormal case DDM exists at this particular azimuth (ground check point). (Refer to paragraph 5-172 for more information on abnormal case DDM.)

(e) On FAA Form 6750-23, enter abnormal case DDM on the CENTERLINE LOWER WIDTH and CLEARANCE DDM LIMITS line for any azimuth where abnormal case DDM exists.

(f) Restore the facility to service.

(g) At facilities with dual equipment (main and standby), repeat steps (1) through (5)(f).

(6) Guidelines for determining tolerances on FAA Forms 6750-23 and -24.

(a) FAA Form 6750-24, Localizer Monitor Reference Data.

1 WIDE ALARM SIDEBAND POWER TOLERANCE: Enter the reference value.

2 NARROW ALARM SIDEBAND POWER TOLERANCE: Enter the reference value.

* 3 COURSE SHIFT CARRIER FEEDLINE DDM: Enter operating tolerance. *

NOTE: Standard, reference, and tolerance values are to be carried over when new forms are established.

(b) FAA Form, 6750-23, Localizer Normal Ground Check.

1 CENTERLINE and UPPER WIDTH DDM LIMITS IN NORMAL line.

a Add the course width operating tolerance from chapter 3 to the REFERENCE, EDGE value and enter the result in each EDGE column.

b Add the course position operating tolerance from chapter 3 to the REFERENCE, CENTERLINE-value and enter the result in the CENTERLINE column.

2 CENTERLINE LOWER WIDTH, and CLEARANCE DDM LIMITS line:

a Subtract the course width operating tolerance located in chapter 3 from the REFERENCE, EDGE values, and enter the results in each EDGE column.

b Subtract the course position operating tolerance located in chapter 3 from the REFERENCE, CENTERLINE value, and enter the result in the CENTERLINE column.

c Multiply each REFERENCE clearance check point value by the off-course clearance operating tolerance located in chapter 3, and enter the result in each clearance check point column except where abnormal case DDM exists. See step (5)(e).

(c) Two-frequency localizer with commissioned backcourse. To ground-check the backcourse, repeat the procedure in steps (1) through (6)(b)3c for the backcourse, using separate forms. Clearance check points are not required.

5-176. CENTERLINE CAPTURE RATIO.

a. Object. This procedure provides a method to determine that the transmitted signal level ratio between the course and clearance transmitters is within established limits.

b. Discussion. Two-frequency localizer systems have a course and clearance transmitter separated by approximately 9 kHz. On the runway centerline, an approaching aircraft should be receiving primarily the course signal, while the clearance signal level should be significantly less than the course signal level. The ratio of these two signal levels, expressed in dB, is called the centerline capture ratio. As the ratio between the two signals increases, the aircraft receiver will respond primarily to the stronger of the two, and will be said to have been captured by the stronger signal. At a normally operating two-frequency localizer, the course signal should be at least 10 dB stronger on the runway

centerline, and the clearance signal should be at least 10 dB stronger in the clearance sector (for approximately 10° to 35° of azimuth from runway centerline). Centerline capture ratio depends upon the antenna system(s) and the power ratio of the transmitters and is established at commissioning by flight inspection.

c. Test Equipment Required. A portable ILS receiver (PIR), or a spectrum analyzer capable of separating the course and clearance transmitters and a suitable antenna.

d. Conditions. A facility shutdown is required for this check unless a spectrum analyzer is used.

e. Detailed Procedure Using PIR.

(1) Dummy load the clearance transmitter output and turn the transmitter on to radiate course signal only.

(2) Position the PIR on runway centerline such that the rf level reading on the PIR is near midscale. Note the reading.

(3) Turn off the transmitter and remove the dummy load from the clearance transmitter. Connect the clearance transmitter output for normal operation.

(4) Dummy load the course transmitter output, and turn the transmitter on to radiate clearance signal only.

(5) Read the PIR and note the rf level reading.

(6) Using the chart supplied with the PIR, convert the reading taken in steps (2) and (5) to microvolts.

(7) Using the formula dB = 20 log (V1/V2), convert the two microvolt levels to a ratio in dB.

(8) Compare the results obtained in step (7) with the standards and tolerances of chapter 3.

(9) If the centerline capture ratio is out of tolerance and the facility is otherwise satisfactory and has passed flight inspection at the present power levels, the facility may continue to operate until the next scheduled flight inspection. At that time, flight inspection personnel should be requested to measure the capture ratio before commencing the flight inspection. If flight inspection personnel find the centerline capture ratio out of tolerance, the clearance transmitter power should be reduced to correct the ratio.

(10) Restore the facility to service.

f. Detailed Procedure Using Spectrum Analyzer.

(1) Set up the spectrum analyzer on the runway centerline at a distance not less than 20 times the width of the antenna array from the localizer antenna.

(2) Adjust the spectrum analyzer to view the course and clearance transmitters, using the logarithmic vertical display.

(3) Determine the difference in dB between the course and clearance transmitter signal strength.

(4) Compare the results obtained in step (3) with the standards and tolerances of chapter 3.

(5) If the centerline capture ratio is out of tolerance and the facility is otherwise satisfactory and has passed flight inspection at the present power levels, the facility may continue to operate until the next scheduled flight inspection. At that time, flight inspection personnel should be requested to measure the capture ratio before commencing the flight inspection. If flight inspection personnel finds the centerline capture ratio out of tolerance, the clearance transmitter power should be reduced to correct the ratio.

(6) Restore facility to service.

5-177. thru 5-189. RESERVED.

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 3. GLIDE SLOPES

* **5-190. VECTOR VOLTMETER MEASUREMENT OF GLIDE SLOPE ANTENNA PHASE AND AMPLITUDE.**

a. Object. This procedure provides a method to determine the amplitude and phase of the glide slope carrier and sideband signals.

b. Discussion.

(1) Determining the condition of a glide slope antenna can be difficult. VSWR measurements alone are inconclusive. Often a defective antenna may have intolerance VSWR, especially if VSWR measurements are made at the transmitter end of the transmission line.

(2) This procedure describes the use of a probe designed to measure the amplitude and phase outputs of each antenna element. The data taken is not required but is valuable as a reference should a problem occur in the antenna system. Probe details are shown in figures 5-4 .

(3) A sample format for NR, SBR, and CEGS is shown in figure 5-6. The data entered on the form shows amplitude and phase of each antenna element. Do not expect textbook values. The reference reading must be made on a healthy glide slope system, which was confirmed by flight inspection personnel. This data is for further reference only and should not change the established procedures for phasing or setting antenna powers.

c. Test Equipment Required.

(1) A vector voltmeter (vvm).

(2) Dummy loads.

(3) A glide slope H-field probe (NSN:6625-01-366-6311). *

* **d. Conditions.** A facility shutdown is required for this check.

e. Detailed Procedure. The following procedure is written for the capture-effect glide slope. It is adaptable to any glide slope configuration and should be documented by using the appropriate section of the probe measurement data sheet, figure 5-6.

(1) Turn OFF the clearance transmitter, turn OFF modulation (90/150) and dummy load the sidebands.

(2) Connect the VVM reference input (channel A) to the monitor port of the middle antenna. (Refer to figure 5-7 for setup procedures.)

(3) Attach the probe (which is connected to the B channel of the vvm) to the center element of the middle antenna. Set the phase to a reference zero with the phase shifter, if used, or the phase adjust. Note the amplitude.

(4) Move the probe to the lower antenna, center element, and note the phase and amplitude.

(5) At the APCU, insert the CSB signal into the SBO input.

(6) Measure the phase and amplitude of all elements on each antenna.

(7) Dummy load CSB and SBO and turn ON the clearance transmitter. Move the reference input from the middle antenna monitor port to the lower antenna monitor port. Place the probe on the lower antenna center element, and set the phase to a reference zero.

(8) Move the probe to the upper antenna center element, and note the phase and amplitude.

(9) Restore the facility to service. *

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 3. GLIDE SLOPES (Continued)

* FIGURE 5-4. ISOMETRIC PROJECTION OF PROBE *

Configuration for Making Probe Measurements

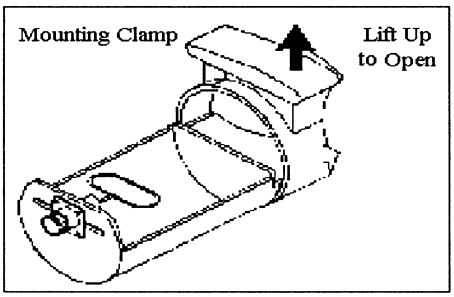


Figure 2 Glideslope H-Probe

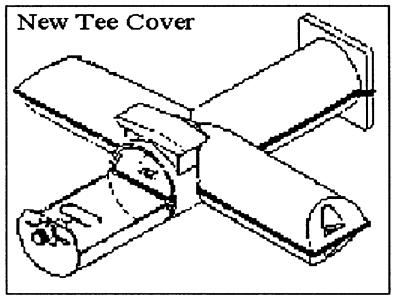


Figure 3 Probe Mounted on Tee Cover

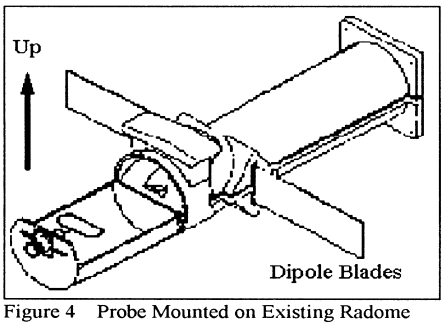


Figure 4 Probe Mounted on Existing Radome

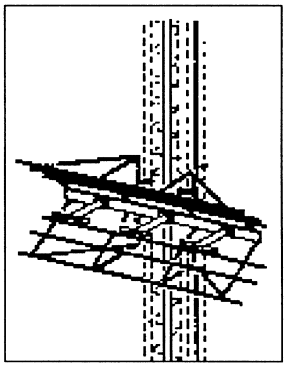
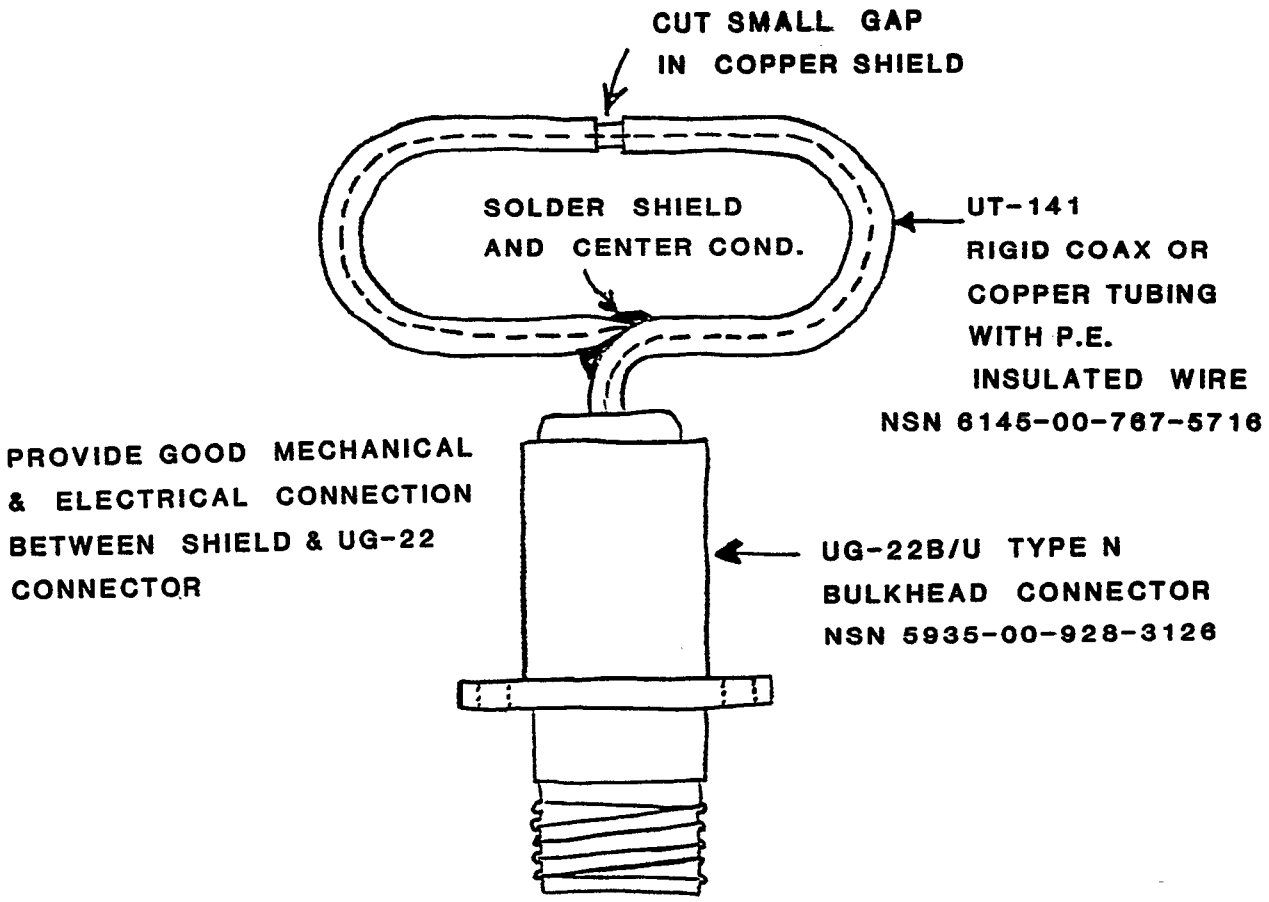


Figure 5 Antenna on Tower

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 3. GLIDE SLOPES (Continued)

* FIGURE 5-5. GLIDE SLOPE H-FIELD PROBE *



SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 3. GLIDE SLOPES (Continued)

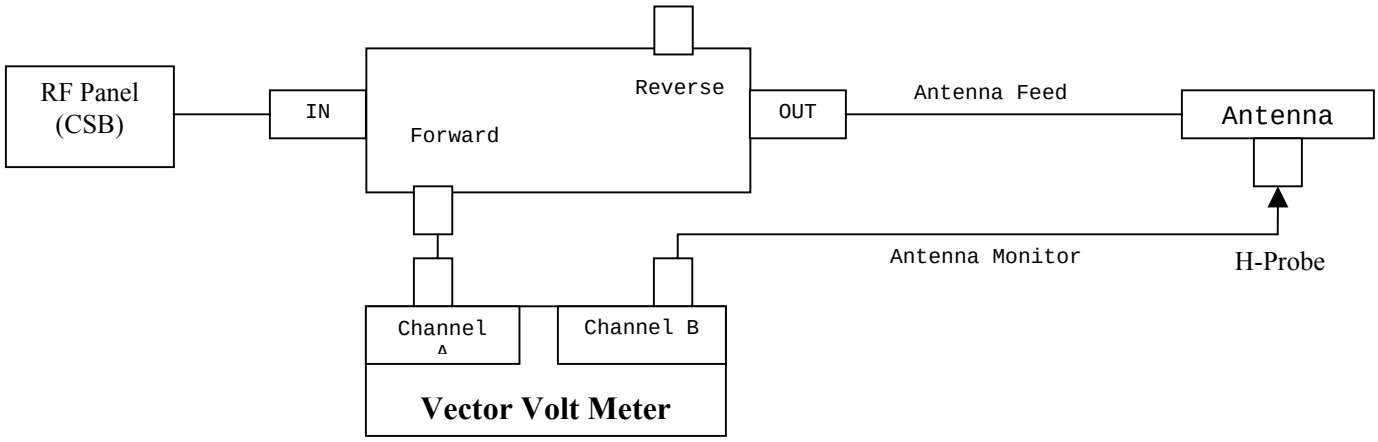
* **FIGURE 5-6. SAMPLE PROBE MEASUREMENT DATA SHEET**

	AMPLITUDE	PHASE
NULL REFERENCE		
CSB to Lower		
Lower antenna (center element)	_____	_____
Lower antenna (runway element)	_____	_____
Lower antenna (outside element)	_____	_____
CSB to Upper		
Upper antenna (center element)	_____	_____
Upper antenna (runway element)	_____	_____
Upper antenna (outside element)	_____	_____
SIDEBAND REFERENCE		
CSB to SBO (SBO Dummied)		
Lower antenna (center element)	_____	_____
Lower antenna (runway element)	_____	_____
Lower antenna (outside element)	_____	_____
Upper antenna (center element)	_____	_____
Upper antenna (runway element)	_____	_____
Upper antenna (outside element)	_____	_____
CAPTURE EFFECT		
CSB Only (SBO Dummied and Clearance OFF)		
Middle antenna (center element)	_____	_____
Lower antenna (center element)	_____	_____
CSB into SBO (SBO Dummied and Clearance OFF)		
Middle antenna (center element)	_____	_____
Middle antenna (runway element)	_____	_____
Middle antenna (outside element)	_____	_____
Upper antenna (center element)	_____	_____
Upper antenna (runway element)	_____	_____
Upper antenna (outside element)	_____	_____
Lower antenna (center element)	_____	_____
Lower antenna (runway element)	_____	_____
Lower antenna (outside element)	_____	_____
Clearance Only (CSB and SBO Dummied)		
Upper antenna (center element)	_____	_____
Lower antenna (center element)	_____	_____ *

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 3. GLIDE SLOPES (Continued)

FIGURE 5-7. CONFIGURATION FOR MAKING PROBE MEASUREMENTS



SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 3. GLIDE SLOPES (Continued)

5-191. ESTABLISHING A GROUND-PHASING REFERENCE POINT.

a. Object. This procedure provides a method to locate and permanently establish a ground-phasing point, which will be used to properly phase the signals radiated by the glide slope antennas.

b. Discussion. The initial phasing of all glide slope facilities is determined with the assistance of flight inspection. Once the facility is properly phased, a ground- phasing point is established that allows subsequent facility phasing to be accomplished without flight inspection.

c. Test Equipment Required.

(1) A portable ILS receiver (PIR).

(2) A glide slope antenna. (The localizer antenna with screw-on elements (which mounts on the PIR) should not be used.)

(3) Dummy loads.

(4) A quadrature (90°) line section.

d. Conditions. A facility shutdown is required for this check, and the facility must be properly phased and must meet the requirements of paragraph 5-192. At sideband reference and capture-effect facilities, APCU internal phase and amplitude adjustments must be correct.

e. Detailed Procedure.

*

WARNING: The following procedure will produce Hazardously Misleading Information (HMI). Before proceeding, refer to paragraph 1-6 and follow the specific HMI guidance provided. Failure to follow this guidance can result in Controlled Flight Into Terrain (CFIT). The duration and frequency of radiating HMI must be kept to a minimum by any means necessary, as required by Order 6000.15, paragraphs 307, 425, and 432.

*

(1) Selecting a ground-phasing point.

(a) The ground-phasing point should be between the runway threshold and the middle marker on the extended runway centerline or, if necessary, on the glide slope side of the runway, as close to the runway centerline as possible.

(b) There should be no significant horizontal reflectors, such as overhead power lines or fences, nor any significant terrain perturbations such as ditches, banks, hills, or mounds of dirt between the ground phasing point and the facility.

(c) All GS antennas should be line-of-sight from the phasing point.

(2) Evaluation of the proposed ground-phasing point.

(a) Ensure that the system modulation balance is 0 DDM, and the quadrature line section is 90° ±2°. Using the 90° line section, place the facility in quadrature. At CEGS facilities, disconnect and dummy load (or turn off) the clearance transmitter; disconnect and dummy load the upper antenna and APCU upper antenna output, and configure the APCU for CSB in the lower antenna only.

(b) At the proposed ground-phasing point, using a directional antenna held at head height (facing the facility), read and note the reference DDM. Ideally, this value should be near 0 DDM for a reflection-free site.

(c) Slowly pan the antenna from side to side approximately ±30° from the facility antennas. Changes in DDM should not exceed 0.05. If significant reflections are present at the proposed phasing point, pointing the directive antenna at the reflection source will increase its contribution to the total received signal. If the DDM changes more than, 0.05 DDM, attempt to locate a better location.

(d) Move the PIR and directional antennas to points approximately 100 ft (30 m) in front of and behind the proposed phasing point while remaining on the runway centerline (or extended centerline). At each position, aim the antenna at the facility and note the DDM at each point. Ideally, the DDM readings should be the same as at the proposed site. The difference between the proposed phasing point and each 100-ft (30 m) displaced point should not exceed 0.025 DDM for a high-quality phasing point.

(3) Establishment of reference ground-phasing values.

(a) With the facility still in the condition described in step (2)(a), measure and record the DDM value

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 3. GLIDE SLOPES (Continued)

at the phasing point.

(b) At CEGS facilities only, perform the following additional steps.

1 Reconnect the upper antenna feedline to the APCU.

2 Disconnect and dummy load the middle antenna feedline and APCU middle antenna output.

3 Measure and record the DDM value at the phasing point.

(c) Restore the facility to service.

(d) On a map or drawing, mark the position of the phasing point. The date, method used, and the far-field phasing values shall be identified on the appropriate facility drawings. Record the reference DDM reading(s) for future reference. This data will be required whenever the system is phased.

* **5-192. Airborne Verification of Facility Phasing**

a. Object. This procedure provides a method to verify the validity of ground phasing of the glide slope facility or to properly phase the facility so that a ground phasing reference point can be established.

b. Discussion.

(1) Facility reference ground phasing, in conjunction with reference normal powers (to include reference power ratios) and antenna heights, is the basis for the validity of all airborne measurements. Airborne verification of facility ground phasing is accomplished at commissioning and subsequently when any of the facility normal references are altered. Facility phasing impacts the validity of all glide slope references. When facility phasing is altered, all facility angle and width references must be reassessed based on the new normal phasing.

(2) Airborne verification of facility ground phasing is accomplished by airborne dephasing checks. Dephasing should be accomplished with fixed coaxial adapters (e.g., elbows) to eliminate calibration or reading errors associated with some mechanical phasers.

(3) The goal is to pass airborne verification using the maximum allowable number of degrees in the tolerances of paragraph 3-60.e., and to achieve symmetrical changes to glide slope parameters for each direction of dephasing. * Although symmetrical airborne dephasing results are highly desirable, the operating tolerances of paragraph 3-60.a.(4), 3-60.b.(4), and 3-60.c.(2) must be met as a first priority. When new phasing references are required, the initial tolerances of the above paragraphs must be met.

c. Test Equipment Required.

(1) Identical type N elbows (which are 17 to 19 electrical degrees in length at glide slope frequencies).

(2) In-line adapters for 28-30 degrees adjustments (i.e. N-type barrel/bullet combination).

(3) The flight inspection aircraft.

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedure for Null-Reference Facilities. For null reference facilities, airborne verification of facility phase is repeated as part of the periodic validation of monitor references. For optimization the verification should be attempted at maximum allowable limits per tolerances of paragraph 3-60.e.

(1) Ensure the transmitter is in normal configuration, at the established normal reference powers and at reference facility phasing.

(2) Confirm by flight inspection that the normal width meets initial airborne tolerances. Correct as necessary.

(3) Place the established reference dephasing section (30° maximum) in the upper antenna feedline to retard the SBO signal. Record the path width, path angle, and the structure below path angle (W/A/S) reported by flight inspection from a level run (ILS-2) on FAA Form 6750-4. Remove the dephasing section.

(4) Place the established reference dephasing section in the lower antenna feedline to advance the SBO signal. Record the W/A/S and compare the value with the corresponding values recorded in step (2). The path width should symmetrically widen, the path angle should not change, and the structure below path angle should symmetrically drop (within flight inspection measurement accuracy).

(5) Remove the phasing section and return the *

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 3. GLIDE SLOPES (Continued)

* facility to normal.

f. Detailed Procedure for Sideband Reference Facilities. For sideband reference facilities**,** airborne verification of facility phase is repeated as part of the periodic validation of monitor references. For optimization the verification should be attempted at maximum allowable limits per tolerances of paragraph 3-60e.

(1) Ensure the transmitter is in normal configuration, at the established normal reference powers and at reference facility phasing.

(2) Confirm by flight inspection that the normal width meets initial airborne tolerances. Correct as necessary.

(3) Place the established reference dephasing section (30° maximum) in the upper antenna feedline to retard the upper antenna. Record the path width, path angle, and the structure below path angle (W/A/S) reported by flight inspection from a level run (ILS-2) on FAA Form 6750-4. Remove the dephasing section.

(4) Place the established reference dephasing section in the lower antenna feedline to advance the upper antenna. Record the W/A/S and compare the value with the corresponding values recorded in step (2). The path width should symmetrically widen, and the path angle and the structure below path angle should symmetrically drop (within flight inspection measurement accuracy).

(5) Remove the phasing section and return the facility to normal.

g. Detailed Procedure for Capture-Effect Facilities. For capture effect facilities, airborne verification of middle antenna phase is repeated as part of the periodic validation of monitor references. Full verification, to include the main sideband phase verification portion, must be accomplished in conjunction with any adjustment to the normal references of antenna phasing or powers. For optimization the verification should be attempted at maximum allowable limits per tolerances of paragraph 3-60e.

(1) Ensure the transmitters are in normal configuration, at the established normal reference powers and at reference facility phasing. *

* **(2)** Confirm by flight inspection that the normal width meets initial airborne tolerances. Correct as necessary.

(3) Separately dephase the middle antenna and main sidebands (SBO), by using a fixed line sections, to the maximum limits as allowed by paragraph 3-60.e. Although SBO phase must be set to optimum in accordance with paragraph 3-44.c.(1), SBO dephasing checks are part of the Flight Inspection phase verification requirement (refer to Order 8200.1) and are particularly useful in the optimization of upper antenna phasing.

(a) Place one elbow (~19 degrees) in the middle antenna feedline to retard the middle antenna. Record the path width, path angle, and the structure below path angle (W/A/S) reported by flight inspection from a level run (ILS-2) on FAA Form 6750-4.

(b) Remove the elbow from the middle antenna feedline. Place one elbow in the lower antenna feedline and one elbow in the upper antenna feedline simultaneously to advance the middle antenna. Record the W/A/S. Compare the values with the values recorded in step (a). The path width should symmetrically widen, the path angle should not change, and the structure below path angle should symmetrically drop (within flight inspection measurement accuracy). Optimization typically results by adjustment of the middle antenna phaser normal setting.

(c) Remove the elbows from the upper and lower antenna feedlines. Place a 30 degree phase section in the course transmitter (SBO) output feedline. Record the W/A/S reported by flight inspection from a level run (ILS-2) on FAA Form 6750-4.

(d) Remove the 30 degree phase section from the SBO output. Place the 30 degree phase section in the course transmitter Carrier-plus-Sideband (CSB) output feedline. Record the W/A/S. Compare the values with the values recorded in step (c). The path width should symmetrically widen, the path angle should not change, and the structure below path angle should symmetrically drop (within flight inspection measurement accuracy).

(e) Path angle changes in opposite directions during main SBO dephasing are indicative of an upper antenna phasing error. For instance, if the angle increases in the SBO retard condition, and decreases in the SBO advance condition, the upper antenna is advanced from optimum. Conversely, angle movements in the *

* opposite directions indicate the upper antenna is retarded from optimum. A path angle difference of 0.20 degrees between the main SBO advance and retard conditions indicates approximately 20 degrees of upper antenna misphasing.

(f) Optionally, upper antenna phasing can be optimized by symmetrically advancing and retarding the upper antenna by approximately 54 degrees (3 elbows) and looking for symmetrical lowering of the glide slope angle. Adjust the facility upper antenna phaser to correct any non-symmetry (within flight inspection repeatability). Any adjustment by this method must be confirmed by repeating the phase verification per steps (a) through (d) above.

(g) Width and structure below path angle changes should have similar effects as noted for middle antenna dephasing in steps (a) and (b) above, however typically to a greater degree. Optimization of non-symmetry is typically accomplished by adjustment of normal middle antenna phasing.

(h) Remove all line sections and return the facility to normal.

(4) Since most capture-effect sites have difficult terrain conditions, optimum phasing verification results often may be difficult to achieve. Consideration should be given to the following if warranted:

(a) Middle antenna dephasing is a monitored parameter, and since it is more sensitive to conditions that cause monitor drift than other CEGS parameters, it is particularly important to use the maximum allowed tolerance when establishing dephase reference limits. Since main SBO dephasing is not monitored, the only requirement is that normal glide slope phasing is established and maintained so that airborne verification requirements are met for the minimum established main SBO dephasing tolerances of paragraph 3-60e(1).

(b) Large drops in structure below path angles during a dephased condition can often be mitigated by an increase in the facility clearance power, not to exceed the tolerances of paragraph 3-40c(2)(a).

(c) Reducing the middle antenna dephasing amounts may be an option as a last resort to achieving in-tolerance phase verification (minimum dephasing amounts are also specified as tolerances in paragraph 3-60e).

*

5-193. GLIDE SLOPE PATH WIDTH ADJUSTMENT.

a. Object. This procedure provides a method to adjust the glide slope path width.

b. Discussion. Glide slope path width is adjusted by changing the sideband-only (SBO) power output of the facility. Path width varies inversely as the square root of sideband power, with carrier power held constant. Temporary sideband power changes are necessary to establish certain reference readings or to check alarm points. Permanent changes from established references are seldom needed or justified. Do not use SBO power level adjustments to compensate for equipment faults or system changes. This adjustment procedure is intended to expedite corrections that may be required during flight inspection. Prior to adjusting path width, ascertain that the system is properly phased, and that APCU power ratios are correct.

c. Test Equipment Required. A wattmeter and detector elements.

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedure.

(1) Measure and record the existing carrier and sideband power outputs for reference.

(2) Divide the existing path width by the desired path width, square the result, and multiply by the existing sideband power.

$$\text{SB Power}_{(New)} = \text{SB Power}_{(Exist)} \left(\frac{\text{PW (Exist)}}{\text{PW (Desired)}} \right)^2$$

(3) Adjust the sideband power to the result of step (2) to produce the path width desired.

(4) Verify the new path width.

(5) Restore the facility to service.

5-194. AN/GRN-27(V) CAPTURE-EFFECT SYSTEM PHASING.

a. Object. This procedure provides a method to

ground phase the AN/GRN-27(V) capture-effect system so that the correct carrier and sideband-only phase relationships are distributed between the three antennas, and to correctly phase the antennas to each other.

b. Discussion. Capture-effect system phasing affects path angle, path width, path symmetry, and below path clearances. The AN/GRN-27(V) capture-effect configuration does not contain rf phasers in the antenna feedlines. Therefore, this procedure converts the capture-effect facility to a null-reference facility, without changing the phase of the lower carrier and middle sideband signals from their normal relationship in the capture-effect configuration. The main sideband phaser is used to make all phase measurements. This procedure uses quadrature DDM indications entirely, rather than rf nulls.

c. Test Equipment Required.

(1) A portable ILS receiver (PIR).

(2) A glide slope antenna.

(3) Two dummy loads.

(4) A quadrature (90°) line section.

(5) Two-way communications.

d. Conditions. A facility shutdown is required for this procedure.

* e. **Detailed Procedure.**

WARNING: The following procedure will produce Hazardously Misleading Information (HMI). Before proceeding, refer to paragraph 1-6 and follow the specific HMI guidance provided. Failure to follow this guidance can result in Controlled Flight Into Terrain (CFIT). The duration and frequency of radiating HMI must be kept to a minimum by any means necessary, as required by Order 6000.15, paragraphs 307, 425, and 432. *

This procedure assumes that cabinet phasing at the outputs of the distribution circuit, or APCU, have been previously set and will not be changed.

(1) SBO to C + SB phasing.

(a) Set CONTROL SELECT switch to MONITORS LOCALLY BYPASSED, and set MAIN UNIT SELECT switch to O.

(b) On COURSE I monitor channel, disconnect the monitor input cable from the MON IN connector A2J43.

(c) Disconnect the monitor input cable from SENSITIVITY I monitor channel, and connect it to the input of COURSE I monitor channel.

(d) Connect test cable W23 between the test jack A3J6 on COURSE I monitor channel and the TEST CABLE jack on the front of the equipment cabinet.

(e) Set TEST SELECT 2 switch to 5.

(f) Add a 90° (quarter-wavelength) cable to the SBO output cable from modulator I (1A19).

(g) Set MAIN UNIT SELECT switch to TRANSMITTER 1. TEST METER 2 shall indicate the same value recorded as the reference. If necessary, adjust phase shifter 1A30A2 to correct phase.

(h) Set MAIN UNIT SELECT switch to 0.

(i) Repeat steps (f) and (g) for modulator 2 and transmitter 2, except adjust phase shifter 1A30A3 if necessary.

(j) Set MAIN UNIT SELECT switch to O.

(k) Disconnect test cable W23 and the 90° cable.

(l) Reconnect all system cables for normal operation.

(m) Set MAIN UNIT SELECT switch to the main transmitter and set CONTROL SELECT switch to REMOTE.

(2) Ground phasing the AN/GRN-27. This procedure uses quadrature DDM indications which require configuring the system as a null-reference glide slope radiating SBO from one antenna and carrier only from another. To convert the AN/GRN-27 from capture-effect to null-reference using the lower and middle antennas, perform the following steps.

(a) Disconnect one end of wire 10, and load both

the cable and the jack (W10P66 and J66).

(b) Disconnect one end of wire 7, and load both the cable and the jack (W7P43 and J43).

(c) Disconnect the upper antenna at the cabinet output, and load the cable and the output jack.

(d) Turn off the clearance transmitter.

(e) Place a quarter-wavelength cable in the sideband input to the distribution circuit at J47.

(f) Turn on the course transmitter, and adjust for approximately 300 mW on the lower antenna. Adjust the modulator SBO power control for approximately 3.0 mW on the middle antenna. Adjust the sideband phaser on the changeover/test panel for quadrature DDM at the far-field phasing point.

NOTE: To ensure that the 90° is the correct length, turn off the course transmitter, remove the quadrature section from the sideband, and place it in the carrier input to the distribution circuit (J22). Readjust the sideband phaser for quadrature at the phasing point. If the reading is not the same as before, the quadrature section is not 90° at the glide slope frequency being used. The DDM change is twice the error of the cable length from 90° and, if in excess of 2°, should be corrected. On the AN/GRN-27 glide slope sideband phasers, one centimeter on the scale is approximately 7.5°, or equivalent to one-half inch in RG-214 or RG-223 rf coax.

(g) With a correct quadrature section installed, and the facility radiating null-reference, lower and middle antennas, adjust the main sideband phaser for 0 DDM at the far-field phasing point. Record the phaser setting.

(h) Interchange the upper and middle antenna feedlines and radiate null-reference, lower and upper antennas. Adjust the main sideband phaser for 0 DDM at the phasing point. Record the phaser setting.

NOTE: Steps (g) and (h) determine the relative lengths of the middle and upper feedlines in respect to the lower. To determine the length of the lower feedline in respect to the middle and upper, the reference must be shifted from the lower to either the middle or upper feedlines.

(i) Disconnect the lower antenna feedline from the carrier output and load it. Connect the middle antenna feedline to the carrier output. The system will now radiate null-reference, middle to upper antenna. Adjust the main sideband phaser for 0 DDM at the phasing point. Record the phaser setting.

(j) Interchange the upper and lower antenna feedlines and radiate null-reference, middle to lower antenna. Adjust the main sideband phaser for 0 DDM at the phasing point. Record the phaser setting.

(k) Determine the phasing corrections required as shown in the following example:

Normal Phaser Setting: 3.0 cm or 22.5°
Lower/Middle (step g): 5.3 cm or 39.75°
Lower/Upper (step h): 1.6 cm or 12°
Middle/Upper (step i): 1.9 cm or 14.25°
Middle/Lower (step j): 0.7 cm or 5.25°

From this information it can be seen that the middle antenna feedline is the shortest. The upper antenna feedline is approximately 28° (39.75°–12°) longer than the middle antenna feedline. The lower antenna feedline is approximately 9° (14.25°–5.25°) longer than the upper antenna feedline, therefore the lower antenna feedline is 37° (28°+9°) longer than the upper antenna feedline. Since 7.5° on the coax cable is approximately one-half inch, the lower feedline should be trimmed approximately 2.5 inches (6.41 cm). The upper antenna feedline should be trimmed approximately 1.87 inches (4.79 cm).

(l) Repeat steps (g) through (k). If the feedline lengths are correct, quadrature DDM should be obtainable at the phasing point when any two antennas are fed with either antenna of the pair which is radiating carrier, and with no additional adjustments of the phaser.

(m) After the phasing is complete, check the sensing by radiating carrier from the lower antenna and SBO from either the middle or upper antenna. Remove the quadrature section, and verify that 150 Hz is predominate at the phasing point.

(n) Restore the system to the capture-effect configuration. Restore the phaser to its original setting (0 DDM on the middle feedline, with the capture-effect in quadrature).

5-195. END-FIRE ANTENNA CURRENT DISTRIBUTION MEASUREMENT.

a. Object. This procedure provides a method to measure the relative rf energy radiated from each gap of all

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 3. GLIDE SLOPES (Continued)

antennas.

b. Discussion. The integrity of the composite radiated signal from the array depends on the proper phase and amplitude of energy radiated from each gap. A discontinuity caused by a bad gap will be seen at other gaps as oscillations in amplitude. No standards or tolerances exists for these amplitudes. Original readings taken when the antenna was in a known good condition should be retained for future reference.

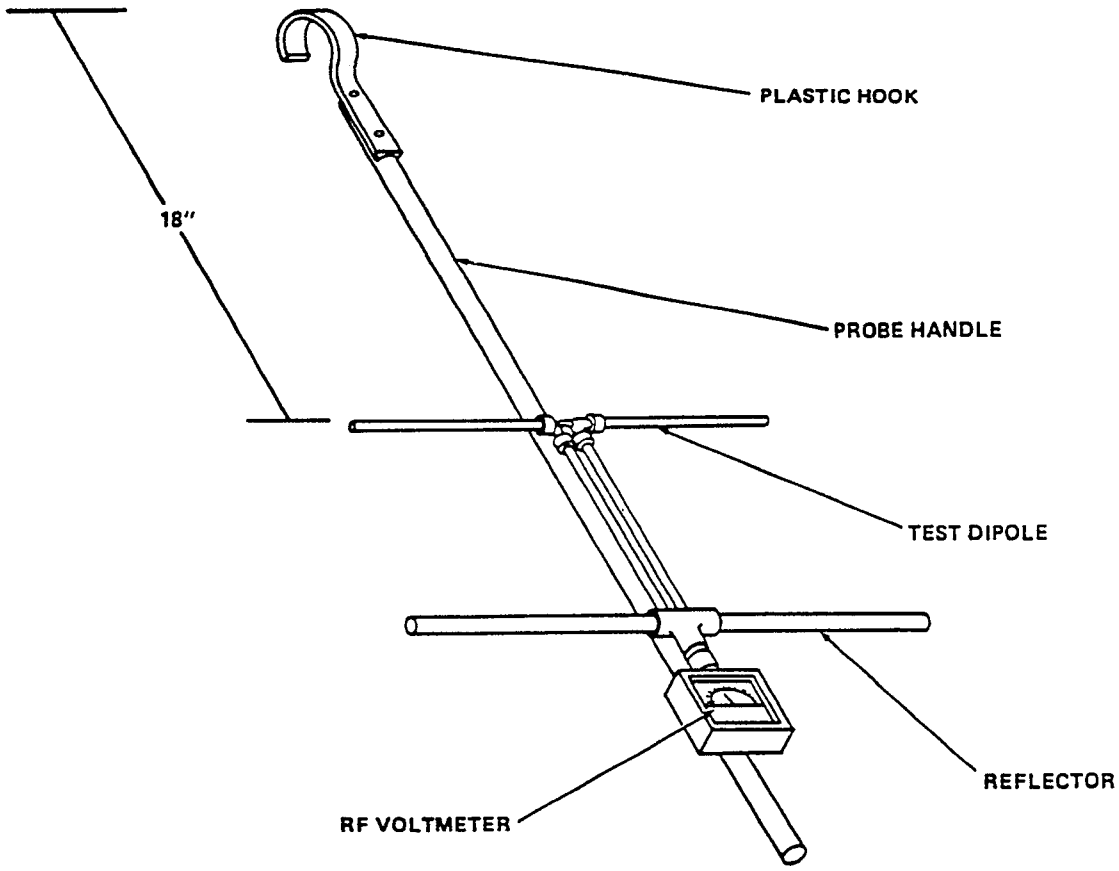
c. Test Equipment Required. A passive probe detector, antenna, and monitoring bracket. Refer to figure
* 5-8. *

d. Conditions. A facility shutdown is required for this check.

e. Procedure.

(1) Place the plastic hook of the test probe over the first slot of the third antenna section nearest the feed end of the rear course antenna. The test probe must be held in a horizontal position in front of the slot being measured, and the recorder should stand 10 ft (3 m) farther away from the antenna.

FIGURE 5-8. END-FIRE PASSIVE PROBE DETECTOR



SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 3. GLIDE SLOPES (Continued)

(2) Adjust the course transmitter power until the probe reading is 90 percent of full scale.

(3) Proceed to the first slot at the feed end of the rear course antenna. Measure and record the reading for future reference.

(4) Measure and record the readings of all 96 (model 105) slots on the rear main course antenna in sequence.

(5) Repeat the procedure in steps (1) thru (4) for the front course antenna.

(6) Reduce clearance transmitter rf power.

(7) Place the plastic hook of the test probe over the third slot of the feed end of the rear clearance antenna.

(8) Adjust the clearance transmitter power until the probe reading is 90 percent of full scale.

(9) Proceed to the first slot at the feed end of the rear clearance antenna, and measure and record the reading.

(10) Measure and record the readings of all slots on the rear main clearance antenna in sequence.

(11) Repeat steps (7) thru (9) for the front clearance antenna.

(12) Restore the main and clearance power to normal.

(13) Restore the facility to service.

5-196. END-FIRE PATH ANGLE ADJUSTMENTS.

a. Object. The relative rf phase between the front and rear antennas has a direct effect on the glide angle. This procedure describes the method used to adjust the path angle. This procedure must only be done with a confirming flight inspection.

b. Discussion. A 12° change in relative phase between the front and rear antennas will change the glide angle approximately 0.2°. Retarding the phase of the front antenna lowers the glide angle. The relative phase of the antennas can be changed in three ways:

(1) Trimming the course antenna feedlines.

(2) Sliding the antennas horizontally through their supports.

(3) Physically moving the supports to increase or decrease the spacing between the antennas.

NOTE: The first method is the only practical method. The other methods could affect the glide angle differently at different azimuths (change the transverse shape). This is undesirable except during pedestal optimization.

c. Test Equipment Required. None.

d. Conditions. A facility shutdown is required for this check.

e. Procedure.

(1) Trimming feedlines.

(a) Verify transmitter modulation balance (0 DDM) equality and glide angle as determined by flight inspection.

(b) From the formula below, determine the amount of feedline trimming required in electrical degrees.

$$\frac{12^\circ \text{ (electrical)}}{0.2^\circ \text{ (vertical)}} = \frac{X}{E}$$

where X = the number of electrical degrees the feedline is to be trimmed.

and E = glide angle error (glide angle as determined by flight inspection minus desired glide angle).

(c) Convert electrical degrees to inches using the formula 1 inch (2.54 cm) = 14.3° for RG-402 cable.

(d) Trim the proper feedline. (Trimming front antenna feedline raises glide angle.)

(e) Verify the glide angle with flight inspection.

(f) Verify the phasing of the integral course monitor.

(g) Conduct reference ground checks.

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 3. GLIDE SLOPES (Continued)

(h) Restore the facility to service.

5-197. LOCATION OF END-FIRE GROUND CHECK POINTS.

a. Object. This procedure defines the location of the five ground check points used with the end-fire glide slope system.

b. Discussion. The end-fire glide slope angle can be ground-checked by lowering the path to ground level and then measuring the DDM at several locations in the transverse structure. This procedure establishes five ground check points, three directly in line between the field monitors and the phase center and on a line perpendicular to runway centerline, and one point on each side of the course array main beam.

c. Test Equipment Required.

(1) A tape measure.

(2) A means of permanently marking the ground check points.

d. Detailed Procedure.

(1) Using figure 5-9, locate the ground check points 1, 2, and 3. These points are an extension of lines from the phase center through the midfield monitors M1, M2, and M3.

(2) With the clearance transmitter off and the path up, locate 0 DDM points on the edges of the main beam where DDM is in rapid transition from high 150 to high 90 Hz. These are points 4 and 5 on figure 5-9.

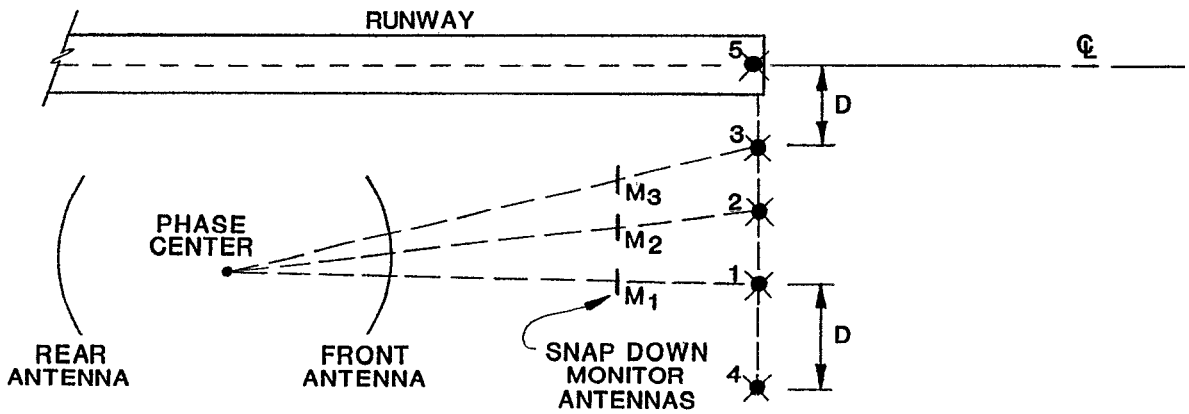
(3) Establish permanent ground check markers, using either spray paint or concrete markers.

(4) Restore the facility to service.

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 3. GLIDE SLOPES (Continued)

FIGURE 5-9. LOCATING GROUND CHECK MARKERS (END-FIRE GS)



5-198. END-FIRE SNAP-DOWN MONITOR ADJUST MENT.

a. Object. This procedure adjusts the end-fire glide slope snap-down monitor assembly.

b. Discussion. The snap-down provides a field monitor of the end-fire glide slope path angle. It accomplishes this by lowering the path to ground level for 100 microseconds, approximately 60 times per second. Pin diode switches are used to add phase delay and attenuation to the front course antenna. The phase delay lowers the path to ground level, and the attenuation compensates for the difference in the distance from the field monitor antennas to the front and rear course antennas. The received signal from the front course antenna is then approximately the same amplitude as the rear course antenna signal. During the snap-down period, the clearance signal is turned off to prevent its interaction with the course signal.

c. Test Equipment Required.

(1) A digital voltmeter (dvm).

(2) An oscilloscope.

d. Condition. A facility shutdown is required for this check.

e. Detailed Procedure.

*

> **WARNING:** The following procedure will produce Hazardously Misleading Information (HMI). Before proceeding, refer to paragraph 1-6 and follow the specific HMI guidance provided. Failure to follow this guidance can result in Controlled Flight Into Terrain (CFIT). The duration and frequency of radiating HMI must be kept to a minimum by any means necessary, as required by Order 6000.15, paragraphs 307, 425, and 432. *

(1) Using the dvm, measure the following sync card voltages referenced to chassis ground (TP0).

(a) Check between TP3 and ground (TP0) for +15 V dc.

(b) Check between TP4 and ground (TP0) for –15Vdc.

(c) Measure between TP2 and chassis ground (TP0) for +5.00 volts. Adjust using REF R8 if necessary.

(d) Connect dvm between TP1 and chassis ground (TP0).

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 3. GLIDE SLOPES (Continued)

(e) Adjust GAIN R1 for +4.3 V dc.

(2) Connect an oscilloscope to the waveform jack on the door.

(3) Set the METER SELECTOR switch to R (rear main antenna), and observe the 90 and 150 Hz modulation pattern shown in figure 5-10(a). This pattern is not the same as CSB due to the addition of quadrature sidebands.

(4) Set the METER SELECTOR to F (front main antenna), and observe a similar 90/150 Hz modulation pattern as shown in figure 5-10(b) but with the superimposed snap-down pulses.

(5) Adjust DELAY, R34, to center the snap-down pulses as shown in figure 5-10(b).

(6) Set the mode switch to PATH UP, and observe that the snap-down pulses are absent from the waveform.

(7) Remove the test equipment, and ensure that all switches are returned to normal.

NOTE: Steps (8) thru (14) may only be accomplished after the radiated signals (path angle) have been optimized by flight inspection personnel or ground checked.

(8) Place the mode switch in PATH DOWN. Install a dummy load on SBO so that only CSB is being radiated.

(9) On the M1 CHAN board, adjust GAIN, RI, for maximum clockwise (as evidenced by clicking when the screw is turned). Connect the dvm between TP1 and chassis ground TP0. Adjust ATTN, R52, for a reading of approximately 6 volts. Adjust GAIN, R1, reducing the reading to 1.55 volts.

(10) Adjust M1 LOW LIMIT, R36, until M1 LEVEL ALARM just lights.

(11) Readjust M1 GAIN, R1 for 2.2 V dc on dvm.

(12) Center the path panel meter for M1, using CENT, R4, on the circuit board.

(13) Repeat the procedure in steps (8) thru (12) for M2 and M3.

NOTE: The front panel limit meters, M1 PATH, M2 PATH, and M3 PATH should now all read 100 µA. Moving the mode switch from PATH DOWN to OPERATE should not appreciably change their readings.

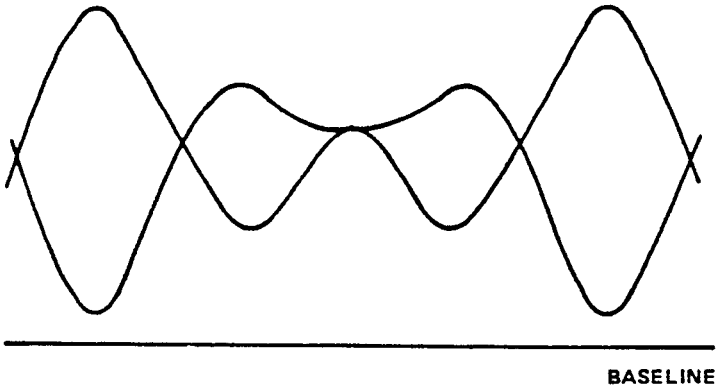
(14) Remove dummy load, reconnecting SBO, and restore the facility to service.

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

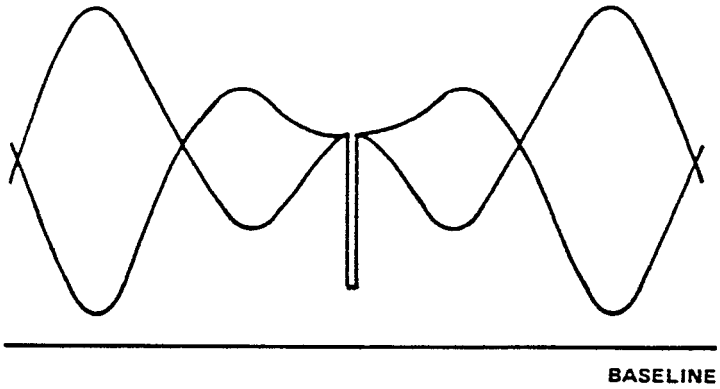
SUBSECTION 3. GLIDE SLOPES (Continued)

FIGURE 5-10. FRONT AND REAR MAIN ANTENNA MODULATION PATTERN

a. Rear Main Antenna Modulation Pattern



b. Front Main Antenna Modulation Pattern
(Showing Time of Snap-Down Pulse)



SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 3. GLIDE SLOPES (Continued)

5-199. SNOW REMOVAL PROCEDURE.

a. Object. This procedure provides guidance to the maintenance specialist for various snow accumulation conditions.

b. Discussion.

(1) Signal samples used to analyze and control operation are obtained and processed to provide all indication of what the airborne user is receiving. Monitoring signals in lieu of actual far-field signals are obtained from integral samples. The integral monitor sample and far-field indication are essentially unaffected by small amounts of snow accumulation. When snow accumulation reaches a particular depth described in table 5-4, the action described for that snow depth shall be taken. Snow depth monitors located at selected glide slope facilities will alert the specialist when field accumulations approach prescribed limits.

TABLE 5-4. SNOW REMOVAL VERSUS SNOW DEPTH

ACTION TAKEN	*SNOW DEPTH*		
	SBR < 6 in (15 cm) NR, CEGS < 18 in (45 cm)	SBR 6 to 8 in (15 to 20 cm) NR, CEGS 18 to 24 in (45 to 60 cm)	SBR > 8 in (20 cm) NR, CEGS > 24 in (60 cm)
SNOW REMOVAL (See figure 1-1)	Removal not required. Restore full service and category.	ILS Category I Remove snow 50 feet (15 m) wide at mast widening to 200 feet (60 m) wide at 1000 feet (300 m) toward middle marker. ILS Categories II and II As above plus widen the area to include a line from the mast to the far edge of runway threshold.	
NO SNOW REMOVAL	Restore full service and category.	All Categories Restore to Category I service. Category D aircraft minima raised to localizer only. Typical NOTAM text: "Due to snow on the IXXX (appropriate identifier) glide slope, minima temporarily raised to localizer only for Category D aircraft." If applicable, "Category II NA[1]," or "Category II/III NA".	All Categories Approach restricted to localizer only minima. Typical NOTAM text: "Due to snow on the IXXX (appropriate identifier) glide slope, minima temporarily raised to localizer only."

[1] NA (not authorized)

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 3. GLIDE SLOPES (Continued)

(2) One of the best monitoring concepts is the requirement to have specialists visually scrutinize the area of critical ground, and take action to remove any existing problem. Items which cause problems are easily spotted visually. There is no substitute for the specialist's skills in observation and analysis of the critical area for snow/ice depths, drifts, piling, obstruction to signals, etc., and exercising prudent judgments regarding requisite action.

(3) Image-type glide slope facilities with full integral monitoring are essentially insensitive to snow/ice buildup. Those facilities located in areas that have significant snow/ice accumulations require special attention as * described in table 5-4.

c. Test Equipment Required. None.

d. Conditions. Refer to table 5-4 for snow conditions.

e. Detailed Procedure.

(1) Follow the guidance listed in table 5-4 for snow depths. Take appropriate action using a visual inspection, * a snow depth monitor alarm, a near-field monitor alarm, or any appropriate combination of these.

(a) Visual Inspection. Refer to figure 1-1. Visually inspect the glide slope critical area. Determine the snow depth by visually averaging peaks and valleys. (Use a physical probing if necessary.) Large drifts or snow mounds must be leveled, compacted, or removed.

(b) Snow Depth Monitor Alarm. If a monitor alarms because of snow or ice conditions, remove snow or ice from the snow depth monitor. Remove, level, or compact snowbanks or drifts in the monitor area to conform to the average snow depth observed. Determine the snow * depth and take action in accordance with table 5-4. *

(2) The depth of snow banks along runways and taxiways in the glide slope snow clearance area (figure 1-1) must not exceed 2 ft (0.6 m). This height limitation applies only to the operation of the glide slope. At some airports, aircraft operation requirements (for example: wing-tip/ engine clearance) may dictate lower heights.

5-200. thru 5-209. RESERVED.

SUBSECTION 4. 75 MHZ ILS MARKERS

5-210. PHASING AND MATCHING TRANSMISSION LINE EQUIVALENCE OF COLLINEAR ARRAYS.

a. Object. This procedure provides a method to check the electrical length of the separate lines of the phasing and matching networks at the antenna.

b. Discussion.

(1) The line lengths in the phasing and matching sections of the collinear antenna are cut to an electrical length that will result in proper phasing and amplitude of the antenna element currents. The Y section of line is cut to equal the X section plus 180°. This has a direct relationship to the radiation pattern of the antenna. Unbalanced antenna element currents cause nonsymmetry in the radiation pattern and can result in flight inspection discrepancies. Causes of antenna element current unbalance include incorrect line lengths in the phasing and matching lines.

(2) This paragraph describes a method by which rf lines can be checked at their operating frequency.

c. Test Equipment Required. A vector voltmeter (vvm), a bidirectional coupler (Narda 3020A or equivalent), an rf signal source, and a 50 Ω dummy load.

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedure.

CAUTION: The input to the vvm must be limited to <10 mW. If the facility transmitter is used as the rf signal source, it must be attenuated properly to protect the input circuits of the vvm.

(1) Connect the vvm, bidirectional coupler, and low power signal source (an rf signal generator set to the facility frequency or the facility transmitter, properly attenuated).

(2) Connect the output port of the bidirectional coupler to the B channel of the vvm, using one of the cables to be tested.

(3) Apply rf power. Note the power level, and adjust the vvm for a 0° reference phase indication.

(4) Replace the cable connected in step (2) with the other cable to be tested.

(5) Adjust the vvm to read the relative phase of the B channel. The amplitude should be nearly the same as read in step (3). Since the B channel phase was referenced to the first cable, the phase should now be 180°. Determine whether the cable relative phase delay is within the operating tolerance of chapter 3.

(6) Repeat the procedure in steps (2) through (5) for each set of cables to be tested.

(7) Restore the facility to service.

5-211. COLLINEAR ANTENNA ELEMENT CURRENTS.

a. Object. This procedure provides a method to measure the collinear antenna element current balance ratio.

b. Discussion.

(1) For the collinear array to be balanced, two requirements must be met. The radiated rf energy from the two elements must be in phase, and the amount of radiated rf energy from the two elements must be equal.

(2) The relative phase of the rf energy radiated from each antenna element is a function of the difference in electrical length of the transmission lines feeding each element. The total electrical length of a transmission line is only dependent upon the propagation constant of the line and the line length. Any parallel loads or stubs connected to the line associated with a particular antenna element do not affect the phase of the rf energy radiated from that element. The amount of rf energy radiated from each antenna element depends upon the total energy delivered from the transmitter and the degree of impedance mismatch between the antenna elements and the transmission line feed system.

(3) Do not trim or replace the coax lines that make up a phasing and matching section for the purpose of balancing antenna element currents. While the antenna element current balance ratio must meet specified tolerances, it must be achieved in conjunction with line lengths that are electrically correct. Refer to paragraph 5-210 for checking line lengths of the phasing and matching line section.

(4) The electrical lengths of the lines must be correct to provide proper phasing of the radiated rf energy. If the maximum current point on a particular antenna element changes, this is usually an indication that the antenna elements, the counterpoise, or the antenna element supports are not symmetrical.

(5) Antenna element currents shall be measured at the maximum current points, or as near to the maximum current point as practical. The CA-1024 antenna current meter coupling adjustment should be set at 5, or as required to provide a reading in the upper one-third of the meter.

c. Test Equipment Required. Antenna current meter CA-1024 (or equivalent).

d. Conditions. A facility shutdown is required for this check.

e. Detailed Procedure.

(1) Bypass the monitor.

(2) Set the modulation to continuous tone.

(3) Position the antenna current meter at the point where the maximum current reading is obtained and record the results for both halves of the antenna. The position of maximum current will usually occur approximately one-quarter wavelength (35 inches or 89 centimeters) from the open end of the antenna element. Divide the larger current by the smaller, and record the antenna current balance ratio on the appropriate form. Since no column is provided for this parameter, the specialist may designate a blank column for this data.

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 4. 75 MHZ ILS MARKERS (Continued)

NOTE: Should the current maximum occur on the antenna element at the point of insulator attachment, a reading should be taken on each side of the insulator and the point marked where the higher reading is obtained. The point should be measured from the open end of the element and the same point marked on the other antenna element.

(4) Determine if the antenna current balance ratio is within the operating tolerance. Take corrective action and repeat step (3) if not within tolerance.

(5) Restore the facility to service.

5-212. thru 5-219. RESERVED.

SUBSECTION 5. SPECIAL EQUIPMENT

5-220. USE OF THE GENERAL RADIO GR-1586A WAVE ANALYZER.

a. Object. This procedure provides a method of measuring harmonic distortion using the GR-1586A wave analyzer.

b. Discussion. Measurement of ILS modulation distortions requires the measurement of the voltage at each harmonic frequency. The GR-1586A wave analyzer has an input level control that will allow direct measurement of the harmonic distortion at each desired frequency without calculation. The following procedure is applicable to all wave analyzer models with an input level control.

c. Detailed Procedure.

(1) Connect the wave analyzer input to the thruline rf body detector output. The output of the detector element must be 100 millivolts or greater, or more than approximately 75 percent of full scale on the meter. The wattmeter detector element must be sized in accordance with the wave analyzer maintenance handbook.

(2) Adjust the frequency to 90 or 150 Hz for carrier distortion levels. The frequency should be adjusted to 60 or 240 Hz for a check of the sideband distortion levels.

(3) With the input level control, select from the two frequencies the one which has the higher input level.

(4) Adjust the analyzer calibration (cal) control, with the range switch dots centered up, for a meter reading in the cal range.

(5) With the input level control, set the meter reading to 100 millivolts, using the frequency which had the higher input level.

NOTE: The wave analyzer is now calibrated, and the input control must not be readjusted after step (5).

(6) Change the frequency to the harmonic frequency to be measured. Adjust the analyzer calibration control for a meter reading in the cal range.

(7) Measure the voltage level in millivolts. Each millivolt is equal to 1 percent of distortion: e.g., 30 millivolts = 30 percent distortion.

(8) Repeat this procedure for each harmonic frequency that is to be measured.

5-221. AIR-TO-GROUND TRANSCEIVER.

a. Object. This procedure provides a method to ensure proper operation of the air/ground transceiver.

b. Discussion.

(1) Faulty communications is a principal contributor to expensive delays during flight inspection. Therefore, the air-to-ground communications transceiver should be checked out before any monitor flight inspection. To ensure reliable communications over the range required, a good outside antenna is required. A minimum would be to mount the antenna above the corner of the equipment shelter. At image glide slope facilities, the antenna may be mounted on top of the glide slope antenna mast.

SECTION 3. SPECIAL MAINTENANCE PROCEDURES (Continued)

SUBSECTION 3. GLIDE SLOPES (Continued)

(2) The following procedure is intended to supplement rather than supersede the requirements of the latest edition of Order 6600.21, Maintenance of Communication Transceivers.

c. Test Equipment Required. A directional wattmeter set.

d. Detailed Procedure.

(1) Using either the rf wattmeter, connected between the transceiver and the antenna, or the internal power output indicator on the transceiver (if installed), determine that the transceiver output power is normal.

(2) If possible, establish radio communication to ensure that the audio quality is satisfactory.

5-222. thru 5-299. RESERVED.

the established reference values previously verified during the monitors flight inspection. If flight inspection personnel find a facility nearly out of tolerance, at the system specialist judgment, new tighter reference values may be established. When either of these occurs, a thorough investigation shall be made to determine why the reference values required changing.

6-6. FLIGHT INSPECTION SCHEDULES AND SPECIAL FLIGHT INSPECTIONS. Flight inspection is performed on a periodic basis, the period of inspection based on system-wide discrepancy rates. The facility monitor is checked during every other periodic inspection. Order 8200.1, section 105, list the intervals between inspections and explains the criteria for interval changes. Personnel should be aware of the inspection interval for their assigned facilities for planning purposes. When possible, facility changes requiring a flight check should be coordinated in conjunction with a scheduled periodic flight inspection.

6-7. BASIC DEFINITIONS. (Refer to figures 6-1 thru 6-3.)

a. Localizer Clearance Sector 1. From 0° to 10° each side of the localizer course.

b. Localizer Clearance Sector 2. From 10° to 35° each side of the localizer course.

c. Localizer Clearance Sector 3. From 35° to 90° each side of the localizer course.

d. Localizer Course Sector Width. The sum of the angular distances either side of the center of the course required to achieve full scale (150 microamperes) crosspointer deflection.

e. Point A. An imaginary point on the localizer/glide slope on course located 4 nmi (7.4 km) from the runway threshold as measured along the extended runway centerline.

f. Point B. An imaginary point on the localizer/glide slope on course located 3500 ft (1065 m) from the runway threshold as measured along the extended runway centerline.

g. Point C. A point through which the downward extended straight portion of the glide slope (at commissioned angle) passes at a height of 100 ft (30.5 m) above the horizontal plane containing the runway threshold. For facilities without a glide slope, point C is the missed approach point (MAP).

h. Point D. A point 12 ft (3.66 m) above the runway centerline and 3000 ft (915 m) from the threshold toward the localizer.

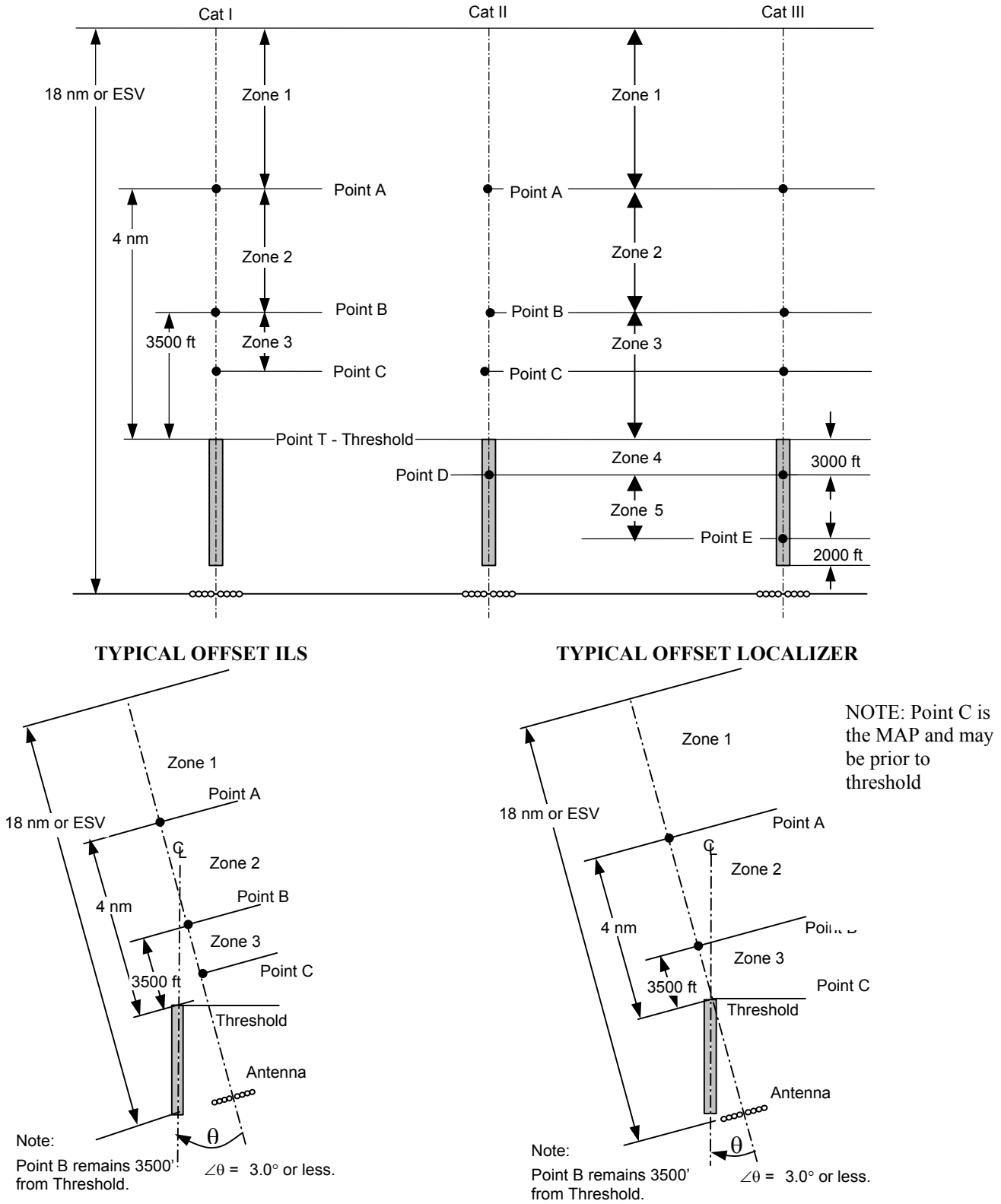
i. Point E. A point 12 ft (3.66 m) above the runway centerline and 2000 ft (610 m) from the stop end of the runway.

j. Zone 1. The distance from the coverage limit of the localizer/glide slope to point A on localizer course.

k. Zone 2. The distance from point A to point B on localizer course.

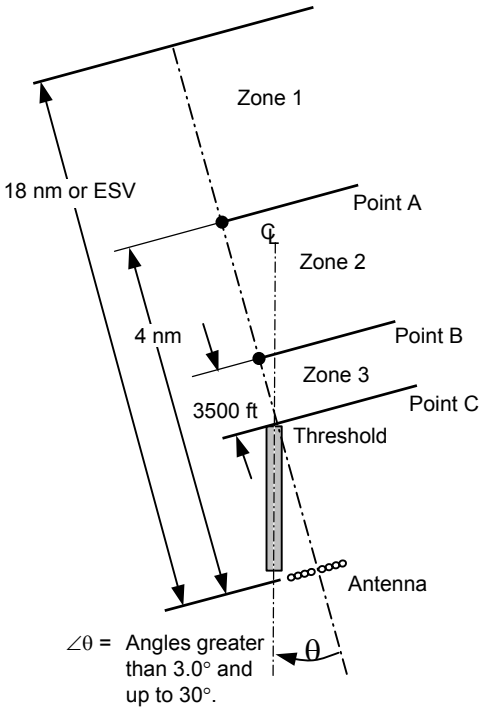
SECTION 1. AIRBORNE INFORMATION (Continued)

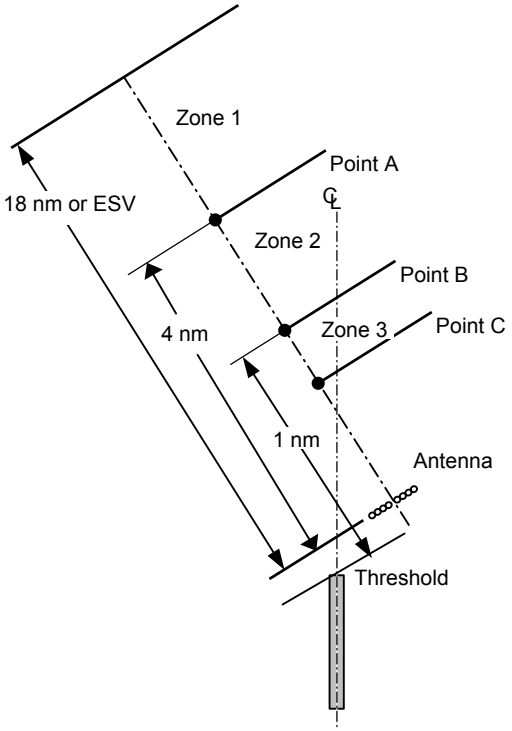
FIGURE 6-2. ILS POINTS AND ZONES



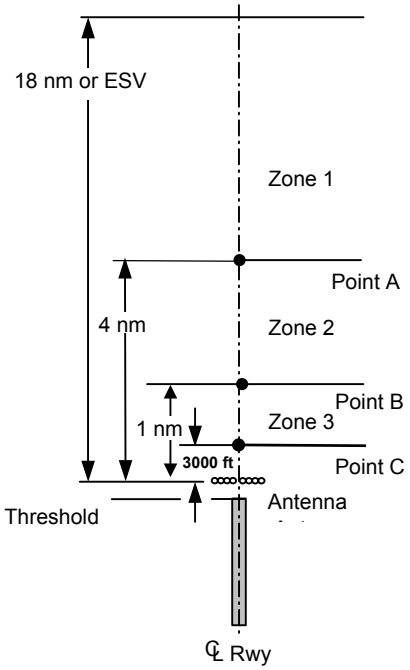
SECTION 1. AIRBORNE INFORMATION (Continued)

FIGURE 6-3. POINTS AND ZONES OF LDA'S



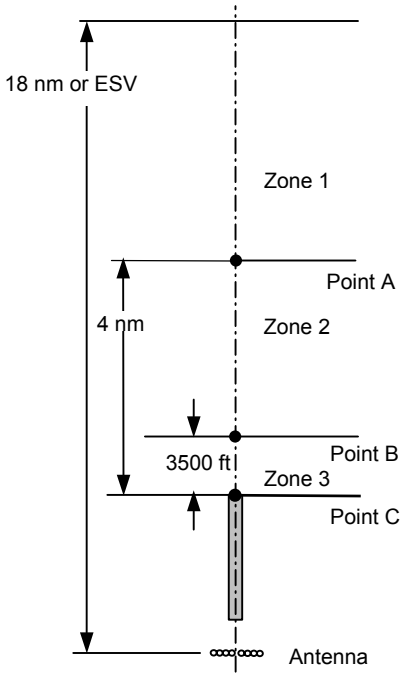


BACK COURSE LOCALIZER/SDF



LOCALIZER/SDF APPROACH

* NOTE: Point C is the MAP and may be prior to threshold *



SECTION 1. AIRBORNE INFORMATION (Continued)

l. Zone 3. Category I: The distance from point B to point C on localizer course. Category II and III: The distance from point B to the runway threshold.

m. Zone 4. The distance from runway threshold to point D on localizer course.

n. Zone 5. The distance from point D to point E on localizer course.

o. Localizer Back Course Zone 1. The distance from the coverage limit to 4 nmi (7.4 km) from the localizer antenna on localizer course.

p. Localizer Back Course Zone 2. Four (4) nmi (7.4 km) from the localizer antenna to one (1) nautical mile from the localizer antenna on localizer course.

q. Localizer Back Course Zone 3. One (1) nmi from the localizer antenna to the Missed Approach Point which is no closer than 3500 ft from the localizer antenna on localizer course

r. Service Volume.

(1) Localizer. The Standard Service Volume (SSV) coverage in sector 1 is 18 nmi from the localizer antenna and within 10° each side of runway centerline extended up to an altitude of 4500 ft above the antenna. The coverage of sector 2 is 10 nautical miles from the localizer antenna and from 10° to 35° each side of runway centerline extended. If there is a procedural requirement and the facility supports it, coverage may be required beyond 35° each side of centerline. If a back course is provided and used, the coverage is the same as for the front course.

(2) Glide Slope. The Standard Service Volume coverage is 10 nautical miles from the antenna and within 8° each side of the localizer on course at the final approach altitude.

(3) Extended Service Volume (ESV). When Air Traffic requires service beyond the normal limits, an ESV specifying the coverage area required is requested. The ESV must be within 10° of runway centerline extended and be approved by Frequency Management. All usable distance checks are performed with the facility in rf alarm.

6-8. AUTOMATED FLIGHT INSPECTION SYSTEM (AFIS).

a. General. The AFIS provides the capability to track the position of the flight inspection aircraft and provide computer analysis of most flight inspection data. The results are displayed to the Airborne Electronic Technician (AET) on a plasma display. Radio telemetry theodolite (RTT) positioning capability still exists on a few flight inspection aircraft and is available on special request. Graphic recordings are made during AFIS operation to retain the capability of detailed analysis and provide hard copy historical data. All FAA aircraft have the same type antennas, receivers and AFIS programming.

b. Position Tracking. The position tracking of AFIS is an area navigation (RNAV) system consisting of a LaserRef inertial reference unit (IRU), the navigation computer unit (NCU), and GPS and DME sensors for position updating. A control display unit (CDU) provides the man/machine interface with the system. When the system is powered-up, it is provided the latitude and longitude of the current aircraft position. Movement of the aircraft is then detected by the lru in the form of velocities (N-S and E-W). Instead of mechanical gyro sensors, the system utilizes rings of polarized laser light to sense position changes. The NCU uses the on board database to constantly select DME stations in the vicinity of the aircraft and global positioning system (GPS) satellite signals for update information to correct any position errors within the system. Precise position updating over the runway ends using a Television Positioning System (TVPS) or visual updates is used to correct any velocity errors in the inertial system.

c. Areas of Poor DME Coverage. In areas of poor DME coverage or in the event of aircraft DME failure, position updates can be inserted manually utilizing known navaid antenna locations. GPS signals are also available for position updates with near 100 percent world-wide coverage available.

d. Receivers. The flight inspection system has two vhf omnidirectional radio range (VOR)/ILS receivers which are independent of those the flight crew uses for navigation. These receivers are dedicated to the measurement system and the NCU for computations. The AET can

SECTION 1. AIRBORNE INFORMATION (Continued)

select either, or both, receivers as input to the AFIS. All test equipment used to calibrate these receivers is calibrated to a source traceable to the National Institute of Standards and Technology (NIST).

e. Recorder. The flight inspection system includes a thermal dot-matrix printer operated as a 32-channel chart recorder with alphanumeric annotation provided by the NCU. The printer is automatically setup and scaled according to the mode of inspection initiated. The AET can also manually select channels and scaling. When an out-of-tolerance parameter is shown to exist during a flight inspection and difficulty is encountered in correcting the parameter, consider requesting the recording for further analysis.

6-9. AFIS ILS MODES. AFIS has three programmed modes for automatic data gathering and computation of ILS localizer and glide slope signals. The NCU uses the facility data available from the on board database and the programmed flight pattern to execute the specific check to be performed. A brief description of the AFIS ILS modes follows.

a. ILS-1 Mode (Localizer ARC).

(1) This mode evaluates the following conditions of the localizer:

(a) Localizer sector clearances.

(b) Signal strengths throughout the areas inspected.

(c) Width and symmetry.

(2) This mode is a partial orbit that can be flown either clockwise or counterclockwise at a set distance from the facility. Repeated measurements, required for monitor checks, may be conducted in an oval flight pattern. The crosspointer deviation is monitored in the front and back courses and values are recorded. The lowest clearance values and the bearing at which it occurred in each sector is displayed on the CDU.

b. ILS-2 Mode (Glide Slope Level Run).

(1) This mode evaluates the following conditions of the glide slope:

(a) Glide slope width.

(b) Symmetry.

(c) Below path structure (190 microamperes).

(d) Clearances.

* (e) Angle *

(2) The ILS-2 mode is flown at a constant altitude (normally the procedural intercept altitude) inbound along the runway bearing. The radiated signal is evaluated to calculate structure below path, width, symmetry, and clearances. During the run, the glide slope automatic gain control (agc) and modulation levels are monitored. Glide slope angle and width monitor checks may be performed with this mode. If the symmetry is out-of-tolerance during this run, it will be remeasured in the ILS-3 mode using above and below path runs.

c. ILS-3 Mode (ILS Approach).

(1) This mode evaluates the following conditions of the localizer, glide slope, and marker beacons:

(a) Glide slope and localizer alignment.

(1) Localizer alignment:

a Front course alignment is the average course between one (1) nautical mile and the runway threshold.

b Back course alignment is the average course from two (2) to one (1) nautical miles from the localizer antenna.

(2) Glide slope angle alignment: Glide slope angle alignment is the average angle from point A to point B.

* (b) Modulation levels measured between 5 and 3 NM from threshold.

(c) Structure.

(d) Widths and signal levels of marker beacons. *

(2) The ILS-3 mode can evaluate either the front or back course conditions. The mode will evaluate structure for the glide slope in zones 1, 2, and 3, and for the localizer in zones 1, 2, 3, 4, and 5. The mode will display the worst structure in each zone in microamps/nautical miles. Position fixes are manually executed at the runway threshold and runway end along with centerline off-set.

SECTION 1. AIRBORNE INFORMATION (Continued)

With these updates, the NCU computes the correction to be applied to all data samples and computes alignment and structure for the localizer and glide slope.

* **(3)** Offset localizers and some LDAs are checked in ILS-3 mode in the normal manner, except that the aircraft is flown manually down the runway for fix updates. Limitations of the system require that at the approach end of the runway, the aircraft be within 150 microamperes of the on course signal

(4) The ILS-3 mode may be programmed to measure the width and symmetry of the glide slope path throughout zone 2. This commissioning check, called "Mean Width", may be used to provide the final measurement when out-of-tolerance symmetry is found with the ILS-2 mode. Three runs are required, above path, below path, and on path. The aircraft is normally flown 75 microamperes above/ below path.

6-10. AIR-TO-GROUND COMMUNICATIONS AND MONITOR FLIGHT INSPECTION CHECKLISTS.

a. Transceivers. Flight inspection aircraft have one uhf and three vhf transceivers installed. The specialist and pilots must communicate via interphone. There are times, especially in high density traffic areas, when all communication systems are in use. This may prevent immediate response to the ground specialist. Because this can happen at any time, the crews appreciate a response to all calls as fast as possible with direct answers, particularly to inform the crew when the facility is ready for the next run.

b. Checklists. To expedite communications and more effectively use flight time, tables 6-1 through 6-7 provide checklists for monitors flight inspections of the different types of facilities. These checklists are a suggested sequence for best use of flight time and meet the requirements of the Order 8200.1. Using these checklists aids anticipation of and preparation for the next adjustment. While a flight inspection run is in progress, readings should be taken and any calculations for the next run may be made. Ensure the airborne technician provides all required data for each run. If you need additional data, do not hesitate to ask for it.

TABLE 6-1. SINGLE-FREQUENCY LOCALIZER PERIODIC WITH MONITORS

CHECK	*TRANSMITTER CONFIGURATION*
1. Course Width .	Normal
2. Course[1] (35° to 35°; Width, Clr).	Wide Alarm[2]
3. Course[1] (Ident, Mod Level, Width, Sym, Clr).	Normal
4. Approach[1] (Alignment, Structure, Mod Percent).	Normal

[1] Back course checks - if back course used.
[2] As established (reference point).

SECTION 1. AIRBORNE INFORMATION (Continued)

TABLE 6-2. DUAL-FREQUENCY LOCALIZER WITHOUT BACK COURSE PERIODIC WITH MONITORS

CHECK	*TRANSMITTER CONFIGURATION*	
	COURSE XMTR	*CLEARANCE XMTR*
1. Course Width .	Normal	Normal
2. Course (35° to 35°, Width, Clr).	Wide Alarm[1]	Wide Alarm[1]
3. Course (Ident, Mod Level, Width, Sym, Clr).	Normal	Normal
4. Approach (Alignment, Structure, Mod Percent).	Normal	Normal

[1] As established (reference point).

TABLE 6-3. DUAL-FREQUENCY LOCALIZER WITH BACK COURSE PERIODIC WITH MONITORS

CHECK	*TRANSMITTER CONFIGURATION*	
	COURSE XMTR	*CLEARANCE XMTR*
1. Front Course Width .	Normal	Normal
* 2. Front Course Width (35° to 35°). [1]	Wide Alarm [2]	Wide Alarm [2] *
3. Front Course Width. [1]	Normal	Normal
4. Approach (Alignment, Structure, Mod Percent).	Normal	Normal
* 5. Back Course Width (35° to 35°). [1,2]	Wide Alarm [2]	Wide Alarm [2] *
6. Back Course Width. [1]	Normal	Normal
7. Back Course Approach (Alignment, Structure, Mod Percent).	Normal	Normal

[1] Can be done as 1 run (full orbit).
* [2] As established (reference point). *

SECTION 1. AIRBORNE INFORMATION (Continued)

TABLE 6-4. NULL-REFERENCE GLIDE SLOPE PERIODIC WITH MONITORS

CHECK[1]	*TRANSMITTER CONFIGURATION*
1. Path Width and Angle .	Normal
* 2. Path Width and Angle.	Wide Alarm [3]
3. Path Width and Angle.	Advance Phasing to Alarm [3] (Report no. of degrees) [2]
4. Path Width and Angle.	Retard Phasing to Alarm [3] (Report no. of degrees) [2] *
5. Path Width and Angle.	Normal
6. Approach (Angle, Structure, Mod Percent).	Normal

[1] Structure Below Path Angle (190 microamperes) must be checked on all level runs.
[2] Fixed line sections should be used for dephasing checks.
* [3] As established (reference point). *

TABLE 6-5. SIDEBAND-REFERENCE GLIDE SLOPE PERIODIC WITH MONITORS

CHECK[1]	*TRANSMITTER CONFIGURATION*
1. Path Width and Angle .	Normal
* 2. Path Width and Angle.	Wide Alarm [4]
3. Path Width and Angle.	Upper Antenna Advanced to Alarm (Report no. of degrees) [2.4]
4. Path Width and Angle.	Upper Antenna Retarded to Alarm (Report no. of degrees) [2.4]
5. Path Width and Angle. [3]	Low Angle Alarm [4]
6. Path Width and Angle. [3] (Maintenance Request).	High Angle Alarm [4] *
7. Path Width and Angle.	Normal
8. Approach (Angle, Structure, Mod Percent).	Normal

[1] Structure Below Path Angle (190 microamperes) must be checked on all level runs.
[2] Fixed line sections should be used for dephasing checks.
[3] Only 1 transmitter if common power divider AND parallel monitors.
* [4] As established (reference point). *

SECTION 1. AIRBORNE INFORMATION (Continued)

TABLE 6-6. CAPTURE-EFFECT GLIDE SLOPE PERIODIC WITH MONITORS

CHECK[1]	*TRANSMITTER CONFIGURATION*	
	COURSE XMTR	*CLEARANCE XMTR*
1. Path Width and Angle .	Normal	Normal
* 2. Path Width and Angle.	Wide Alarm [3]	Mod Percent Alarm [3]
3. Path Width and Angle.	Middle Antenna Advanced (Report no. degrees) [2,3]	Normal
4. Path Width and Angle.	Middle Antenna Retarded (Report no. degrees) [2,3]	Normal
5. Path Width and Angle.	Upper Antenna Attenuated to Path Alarm (Report dB) [3]	Normal *
6. Path Width and Angle	Normal	Normal
7. Approach (Angle, Structure, Mod Percent)	Normal	Normal

[1] Structure Below Path Angle (190 microamperes) must be checked on all level runs.
[2] Fixed line sections should be used for dephasing checks.
* [3] As established (reference point). *

TABLE 6-7. END-FIRE GLIDE SLOPE PERIODIC WITH MONITORS

CHECK[1]	*TRANSMITTER CONFIGURATION*	
	COURSE XMTR	*CLEARANCE XMTR*
1. Transverse Structure Arc at FAF[2], 10° to 10°.	Normal	Normal
2. Path Width and Angle .	Normal	Normal
* 3. Path Width and Angle.	Wide Alarm [4]	Normal
4. High Angle and Path Width (Maintenance Request).	Main Array Dephased (Report no. degrees)[3,4]	Normal
5. Low Angle and Path Width.	Main Array Dephased (Report no. degrees) [3, 4]	Normal *
6. Path Width and Angle.	Normal	Normal
7. Approach (Angle, Structure, Mod Percent).	Normal	Normal

[1] Structure Below Path Angle (190 microamperes) must be checked on all level runs.
[2] Final approach fix.
[3] Fixed line sections should be used for dephasing checks.
* [4] As established (reference point). *

SECTION 1. AIRBORNE INFORMATION (Continued)

6-11. FLIGHT INSPECTION REPORTS.

a. Discussion. Following flight inspection, a report is completed in accordance with the latest edition of Order 8240.36, Instructions for Flight Inspection Reporting. When the monitors are inspected, two forms are required: FAA Form 8240-8, Flight Inspection Report — Instrument Landing System, and FAA Form 8240-9, Flight Inspection Report — Instrument Landing System Supplement Sheet. * For a Localizer commissioning check or reconfiguration to a different type of antenna, FAA Form 8240-10, Flight Inspection Report- Clearance Plot is used. For commissioning or baseline checks of EndFire Glide Slopes, FAA Form 8240-19, Flight Inspection Report-Endfire Glideslope Transverse Structure Plot is used. * These forms are discussed here in general. For more detail, refer to Order 8240.36. FAA Form 8240-8 contains the majority of the localizer data, all normal glide slope data, and ancillary equipment information. FAA Form 8240-9 contains all glide slope monitor and airborne phasing data. Both forms contain facility name, identification, and date of inspection. Reported data by flight inspection is usually derived from the AFIS computer announcements and manual analysis of the facility recordings.

b. FAA Form 8240-8, Flight Inspection Report — Instrument Landing Systems. Refer to figure 6-4. The column labeled OT to the left in front course, back course, and glide slope data columns in fields 8 and 9 will not have any marks unless an out-of-tolerance condition was found during the inspection. When a parameter was found out of tolerance and corrected, a C is placed in the OT column on the line corresponding with the INITIAL column value. If the out-of-tolerance condition was not corrected during the inspection, an X is placed in the OT column on the line corresponding with the FINAL column value. All uncorrected out-of-tolerances are explained in the REMARKS section. The FINAL column is for the "as left" values after all adjustments have been made. Both fields have a line for system category, i.e., 1, 2, or 3. The assigned category does not change even if the facility fails to meet category 2 or 3 tolerances. * Some Category 1 facilities are used below normal Category 1 minima for "Special" approach procedures not published for general use; these facilities may be reported as Category 2 to change the category designation, the system and approach * plates must be changed.

(1) Fields 1 through 7. Self-explanatory: Identify the system by airport, identification, date, owner, type of inspection, and which component(s) of the system were inspected.

(2) Field 8, Localizer: Contains localizer front and back course data.

* (a) Comd Width: The established optimum course width for the facility. This is normally the "Tailored" width but may be other than "Tailored" for CAT I systems. See paragraph 6-34a.

(b) Category: Lowest minima performance category of the facility (I, II, or III).

NOTE: A, B, or C are not used for report.

(c) TX1/TX2 OT column: Under the appropriate transmitter number, an "X" is entered for any out-of-tolerance condition found and not corrected during the inspection. A "C" is entered whenever the condition is corrected.

(d) TX1/TX2 Initial column: Under the appropriate transmitter number the "as found" operating condition is entered if this condition was changed or altered during the inspection.

(e) TX1/TX2 Final column: Under the appropriate transmitter number the operation condition at the completion of the inspection is entered. Also used to report results of after accident checks.

(f) Course Width: The measured width in normal.

(g) Modulation: The measured modulation of approach run (ILS Mode-3).

(h) Clearance 150: Lowest value on 150 Hz side. Reported as microamperes/degrees. Measured with width in normal. Usually only reported on commissioning and periodic inspection WITHOUT monitors.

(i) Clearance 90: Lowest value on 90 Hz side. Reported as microamperes/degrees. Measured with width in normal. Usually only reported on commissioning and periodic inspection WITHOUT monitors.

(j) Course Structure-Z1 through -Z5: The roughness, scalloping, or bends in the respective zones as measured during the approach run. The values are shown as microamperes/nautical miles from the runway threshold. These values are the worst or closest to tolerance values for each zone. Zone 1 results are measured as deviation from the graphical average. Values of zones 2 and 3 represent deviation of the course from the measured average alignment. *

SECTION 1. AIRBORNE INFORMATION (Continued)

* **FIGURE 6-4. SAMPLE FAA FORM 8240-8, FLIGHT INSPECTION REPORT** *

FLIGHT INSPECTION REPORT–INSTRUMENT LANDING SYSTEM REVIEW INITIALS

1. LOCATION: 2. IDENT:

3. RUNWAY NO: 4. DATE(S) OF INSPECTION: 5. OWNER:

6. TYPE OF INSPECTION: SITE EVALUATION / COMMISSIONING / PERIODIC / SURVEILLANCE / SPECIAL / INCOMPLETE

7. FACILITY INSPECTED: LOCALIZER / LDA / SDF / TLS / GLIDE SLOPE / LIGHTING SYSTEM / 75 mHz MARKERS / COMPASS LOCATORS / DME / OTHER

8. AZIMUTH

FRONT COURSE						COMD WIDTH:	BACK COURSE					
TX 1			TX 2				TX 1			TX 2		
O T	INITIAL	FINAL	O T	INITIAL	FINAL	CATEGORY:	O T	INITIAL	FINAL	O T	INITIAL	FINAL
						COURSE WIDTH						
						SYMMETRY						
						MODULATION						
						CLEARANCE 150						
						CLEARANCE 90						
						COURSE STRUCTURE-Z 1						
						COURSE STRUCTURE-Z 2						
						COURSE STRUCTURE-Z 3						
						COURSE STRUCTURE-Z 4						
						COURSE STRUCTURE-Z 5						
						VERTICAL POLARIZATION						
						ALIGNMENT						
						IDENTIFICATION						
						VOICE						
						USABLE DISTANCE						
						MONITOR						
						COURSE WIDTH (Narrow)						
						COURSE WIDTH (Wide)						
						CLEARANCE 150						
						CLEARANCE 90						
						ALIGNMENT 150						
						ALIGNMENT 90						

9. GLIDE SLOPE							10. GENERAL	SAT	UNSAT
TX 1			TX 2			COMD ANGLE:	75 mHz MARKERS		
O T	INITIAL	FINAL	O T	INITIAL	FINAL	CATEGORY:	COMPASS LOCATORS		
						ANGLE	D M E		
						MODULATION	LIGHTING SYSTEMS		
						WIDTH	SIAP(S) VERIFIED		
						STRUCTURE BELOW PATH	11. FACILITY STATUS	F / C	G / S	B / C
						SYMMETRY	UNRESTRICTED			
						PATH STRUCTURE-Z 1	RESTRICTED			
						PATH STRUCTURE-Z 2	UNUSABLE			
						PATH STRUCTURE-Z 3	ILS CLASSIFICATION SYSTEM			
						CLEARANCE BELOW PATH	NOTAM's:			
						USABLE DISTANCE				

12. REMARKS:

REGION:	FLIGHT INSPECTOR 'S SIGNATURE:	TECHNICIAN 'S SIGNATURE:	AIRCRAFT NO :
FIO:			

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SECTION 1. AIRBORNE INFORMATION (Continued)

(k) Vertical Polarization: The amount of course displacement in microamperes caused by vertical polarization, and the distance the check was conducted at (e.g., 2 microamperes/8.0 nautical miles; 2/8.0).

(l) Symmetry: The percentage of symmetry of the 90 Hz side.

(m) Alignment: The value is the average number of microamperes (µA) left or right of the localizer course from runway centerline (or procedural course in the case of offset localizers or LDA's) measured through the alignment area. A report of a 5-µA left would indicate that the course centerline was found to the left of runway centerline, and that an approximate increase of 0.005 DDM/90 Hz would be necessary to move the front course centerline over to the runway centerline. Reverse sensing occurs on the back course; therefore, a report of a 5 µA left would require an increase of 0.005/150 Hz to correctly align the back course.

(n) Voice: If localizer has voice capabilities, shown as an S (satisfactory) or U (unsatisfactory). Voice should not cause any other parameter to exceed tolerance.

(o) Identification: As with voice, an S or U. Identification is checked for correctness and clarity, not level. Identification is checked throughout the coverage area of the localizer.

(p) Usable Distance: Normally checked on commissioning only. It may be checked when coverage is suspect or an extended service volume (ESV) is requested by Air Traffic. When inspected, facility is at the reduced power level reference and distance is in nautical miles.

(q) Course Width (Narrow): Measured width at narrow reference setting .

(r) Course Width (Wide): Measured width at wide reference .

(s) Clearance 150: Lowest value on 150 Hz side at wide reference for single-frequency localizers or course wide/clearance wide alarms for two-frequency localizer. Reported as microamperes/degrees.

(t) Clearance 90: Lowest value on 90 Hz side at wide reference for single-frequency localizers or course wide/clearance wide reference for two-frequency localizer. Reported as microamperes/degrees.

(u) Alignment 150: Alignment monitor value reported in microamperes. The 150 Hz entry is the course displaced to the right of centerline as viewed at the threshold facing the localizer. To achieve this requires an increase in the 90 Hz modulation of the modulation balance in the localizer signal. This check is normally not done on FAA facilities.

(v) Alignment 90: Alignment monitor value reported in microamperes. The 90 Hz entry is the course displaced to the left of centerline as viewed at the threshold facing the localizer. This check is normally not done on FAA facilities.

NOTE: When there is a procedural use for the back course, the measured values are entered in the appropriate columns. For localizers with independently monitored and adjustable back course alignments , alignment monitor values shall be shown. Usually monitor inspection reports will not have values for clearances in normal, as the clearances are checked in worst case reference conditions.

(3) Field 9, Glide Slope:

(a) Commissioned Angle: The assigned angle prior to commissioning. This angle is the design value used by the procedures specialist prior to establishing the facility.

(b) Category: Lowest minima performance category of the facility (I, II, or III). Note: A, B, or C are not used for report.

(c) TX1/TX2 OT Column: Under the appropriate transmitter number, an “X” is entered for any out-of-tolerance condition found and not corrected during the inspection. A “C” is entered whenever the condition is corrected.

(d) TX1/TX2 Initial Column: Under the appropriate transmitter number “as found” operating condition is entered if this condition was changed or altered during the inspection.

SECTION 1. AIRBORNE INFORMATION (Continued)

(e) TX1/TX2 Final Column: Under the appro- completion of the inspection is entered. Also used to report results of after accident checks.

(f) Angle: The actual measured angle is entered.

(g) Modulation: The measured modulation on approach run (ILS-3 Mode-3).

(h) Width: The measured width in normal.

(i) Clearance Below Path: Normally this is only checked and reported at commissioning. However, it may be checked at other times when clearance appears to be a problem (structure below path angle is low or can't be found). When reported, it will be a S or U. Clearance below path with the facility in normal must be 180 micro- * amperes of 150 Hz from the final approach fix (FAF) to point C (category I) or threshold (category II/III) with the aircraft clearing all obstacles.

(j) Structure Below Path: The highest measured angle at which 190 microamperes of 150 Hz occurs with the facility at normal width. This must be no lower than 30 percent of the commissioned angle and is an indication of below-path clearances.

(k) Path Structure -Z1, -Z2, and -Z3: Similar to localizer course structure above. Zone 1 values are measured based on the graphical path average. Zone 2 is the deviation from the measured average angle, and zone 3 is also a graphical average. Zones 1, 2 and 3 values are computer announced. Values are reported as micro- amperes/nautical miles.

(l) Usable Distance: Same as that of localizer.

(m) Symmetry: The percentage of symmetry of the 90 Hz side.

priate transmitter number the condition at the

(4) Field 10, General: Provides documentation of visual aids and facilities that are checked concurrently with the ILS. Any unsatisfactory (UNSAT) condition will be listed in the remarks section. Unless there is a DME at the localizer, the identification and facility type will be entered following DME, e.g., XYZ, VTAC, ZYX, VDME. This is done where a DME other than an ILS DME is part of the procedure.

(5) Field 11, Facility Status: Indicates if an ILS facility meets all requirements or if it has a restriction. When removed from service by flight inspection, the UN- USABLE line will be marked. Any change must have a Notice to Airmen (NOTAM) issued by the Flight Inspec- tion Office (FIO). The NOTAM field is only for NOTAM's issued due to this inspection. The ILS * Classification System entry indicates the furthest point that the localizer structure meets category III tolerances. This data is used to support autolandings. Reference 6750.24.

(6) Field 12, Remarks: Must contain objective in- formation. May include any comments and additional data needed to document and explain results.

(7) Region: The three-letter code of the region in which the facility is located.

(8) FIO: The three-letter code of the FIO conduct- ing the inspection.

(9) Flight Inspector's Signature: Certifies the operational status of the facility and that the facility sup- ports the approved instrument flight procedure(s) inspected.

(10) Technician's Signature: Certifies that the * data reported conforms to national standards and specifications, and is complete and accurate.

(11) Aircraft No.: Contains the flight inspection aircraft "N" number.

SECTION 1. AIRBORNE INFORMATION (Continued)

c. FAA Form 8240-9, Flight Inspection Report - Instrument Landing System Supplement Sheet. Refer to figure 6-5.

(1) Fields 1 through 3: Self-explanatory.

(2) Field 4, Glide Slope: Lines 4a through 4j provided to cover monitor checks for all types of glide slope systems. Only those that apply to the facility being reported will be filled in. All lines contain angle, width, and structure below path (190-microampere angle).

(a) Glide Slope Type: Null-reference (NR); Sideband-Reference (SBR); Capture-Effect (CE); End-Fire-Standard (ED), or End-Fire-Short (EH).. *

(b) Dephase; Advance and Retard: The system dephased to the established reference alarm value. The number of degrees advanced and retarded must be reported for each transmitter. The dephasing check reported depends on the facility type:

Null-reference	Main Sideband Phaser
Sideband-reference	Upper Antenna Phaser
Capture-effect	Middle Antenna Phaser
End-fire	Main Array Phaser

(c) Path Angle Lowered to Limit: Glide slope angle set to the established reference low-angle alarm value with appropriate adjustment (e.g., power divider, phaser). Normally done on commissioning only.

(d) Path Angle Raised to Limit: Glide slope angle set to the established reference high-angle alarm value with appropriate adjustment (e.g., power divider, phaser, modulation balance).

(e) Path Width Narrowed to Limit: Measured with sideband power set for the established reference narrow alarm. Normally done on commissioning only.

(f) Path Width Widened to Limit: Measured with sideband power set for the established reference alarm value.

(g) Clearance Tx Modulation Decreased to Limit: For capture-effect systems only: the facility set for the established reference wide and clearance transmitter modulation alarm values simultaneously. The values are entered on this line, and line 4f is left blank.

(h) Attenuate Middle Antenna to Limit (Alarm): For capture effect systems only, measured with the middle antenna attenuated to WIDE established reference alarm value.

(i) Attenuate Upper Antenna to Limit: For capture-effect systems only, measured with the upper antenna attenuated to PATH established reference alarm value.

(j) Transverse Structure: Completed only for end-fire glide slopes. Reported values are crosspointer deflection at the localizer extremities referenced to the value found on localizer centerline. Radius is from the localizer antenna and altitude is in hundreds of feet above Mean Sea Level (MSL). *

(k) Modulation Balance TX1/TX2: When modulation balance is checked, entered as microamperes/ predominate tone.

(l) Phasing TX1/TX2: If airborne phasing is checked, entered the same as (k).

(m) Front Course Area Where Phasing Was Conducted: If airborne phasing is checked, the left block indicates the distance in nautical miles from the antenna where repeatable phasing existed (i.e., 10/7). The altitude flown, above mean sea level, is in the right block.

(n) Clearance Below Path TX1/TX2: When below path runs are made, an "S" is entered if all below path clearances are satisfactory. If unsatisfactory, an asterisk is placed in this field and explained in field 5. Normally this would only be done during commissioning checks.

(3) Field 5, Remarks: Used to clarify any items on the form.

d. FAA Form 8240-10, Flight Inspection Report-Azimuth Clearance Plot. Refer to Figure 6-6. This form is used to plot the localizer clearances as measured in the various identified configurations. Direct correlation of plotted values with ground checks may not be possible due to differing environmental factors at the two measurement *

SECTION 1. AIRBORNE INFORMATION (Continued)

* locations. These plots are useful to predict the airborne results caused by changes found through ground checks. Each form has three identical areas used for different equipment configurations or measurement altitude.

e. FAA Form 8240-19, Flight Inspection Report – Endfire Glide Slope Transverse Structure Plot. Refer to Figure 6-7. This form is used to display the End Fire Glide Slope (EFGS) transverse structure. It is used to document baseline conditions on commissioning type * checks and after any major antenna realignment. It is used by the airborne technician toe compare with results of periodic transverse structure runs that are not plotted. It us useful to the ILS technician to compare with periodic ground check results to assess the possible effects on airborne results. Each form has two identical areas used for different equipment configurations.

6-12. thru 6-29. RESERVED. *

SECTION 1. AIRBORNE INFORMATION (Continued)

FIGURE 6-5. SAMPLE FAA FORM 8240-9, FLIGHT INSPECTION SUPPLEMENTAL SHEET

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REVIEW INITIALS

FLIGHT INSPECTION REPORT–INSTRUMENT LANDING SYSTEM SUPPLEMENTAL SHEET

1. LOCATION:	2. IDENT:
3. DATE(S) OF INSPECTION:	

4. GLIDE SLOPE			PATH ANGLE		PATH WIDTH		STRUCTURE BELOW PATH	
4a. GLIDE SLOPE TYPE:			TX1	TX2	TX1	TX2	TX1	TX2
4b. DEPHASE	ADVANCE	TX1 TX2						
	RETARD	TX1 TX2						
4c. PATH ANGLE LOWERED TO LIMIT								
4d. PATH ANGLE RAISED TO LIMIT								
4e PATH WIDTH NARROWED TO LIMIT								
4f. PATH WIDTH WIDENED TO LIMIT								
4g. CLEARANCE TX MODULATION DECREASED TO LIMIT - (PRIMARY TX WIDE LIMIT)								
4h. ATTENUATE MIDDLE ANT TO LIMIT		TX1 TX2						
4i. ATTENUATE UPPER ANT TO LIMIT		TX1 TX2						

4j. TRANSVERSE STRUCTURE		TX1	LEFT OF CL uA Hz	RIGHT OF CL uA Hz
RADIUS	ALT	TX2	LEFT OF CL uA Hz	RIGHT OF CL uA Hz

4k. MODULATION BALANCE	TX1	TX2
4l. PHASING	TX1	TX2
4m. FRONT COURSE AREA WHERE PHASING WAS CONDUCTED	NM	MSL
4n. CLEARANCE BELOW PATH	TX1	TX2

5. REMARKS

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SECTION 1. AIRBORNE INFORMATION (Continued)

FIGURE 6-6. FAA Form 8240-10, Flight Inspection Report, Clearance Plot

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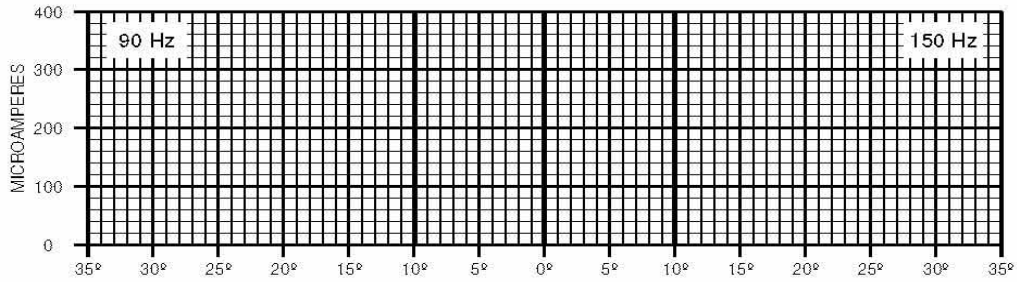
FLIGHT INSPECTION REPORT-- AZIMUTH CLEARANCE PLOT

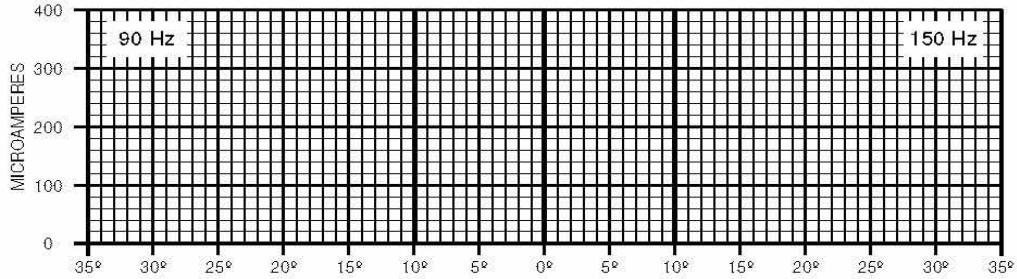
1. LOCATION:						2. IDENT:
3. DATE(S) OF INSPECTION:				4. ANT TYPE:		5. SITE ELEV:
6. TX:	7. CFG:	8. ALT:	9. RADIUS:	10. WIDTH FC:	11. WIDTH BC:	CODE: FC ——— BC - - - - - - -

12.



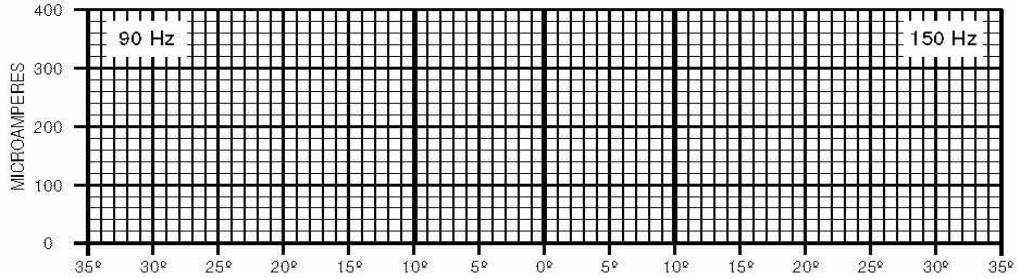
6. TX:	7. CFG:	8. ALT:	9. RADIUS:	10. WIDTH FC:	11. WIDTH BC:	CODE: FC ——— BC - - - - - - -

12.



6. TX:	7. CFG:	8. ALT:	9. RADIUS:	10. WIDTH FC:	11. WIDTH BC:	CODE: FC ——— BC - - - - - - -

12.



13. REMARKS:

REGION:	FLIGHT INSPECTOR'S SIGNATURE:	TECHNICIAN'S SIGNATURE:	AIRCRAFT NO:
FIO:	N/A		

FAA FORM 8240 - 10 (3/2000) (FORMFLOW) (Formerly FAA Form 8240-18-1) Date Completed:

SECTION 1. AIRBORNE INFORMATION (Continued)

FIGURE 6-6. FAA Form 8240-19, Flight Inspection Report, Transverse Structure Plot

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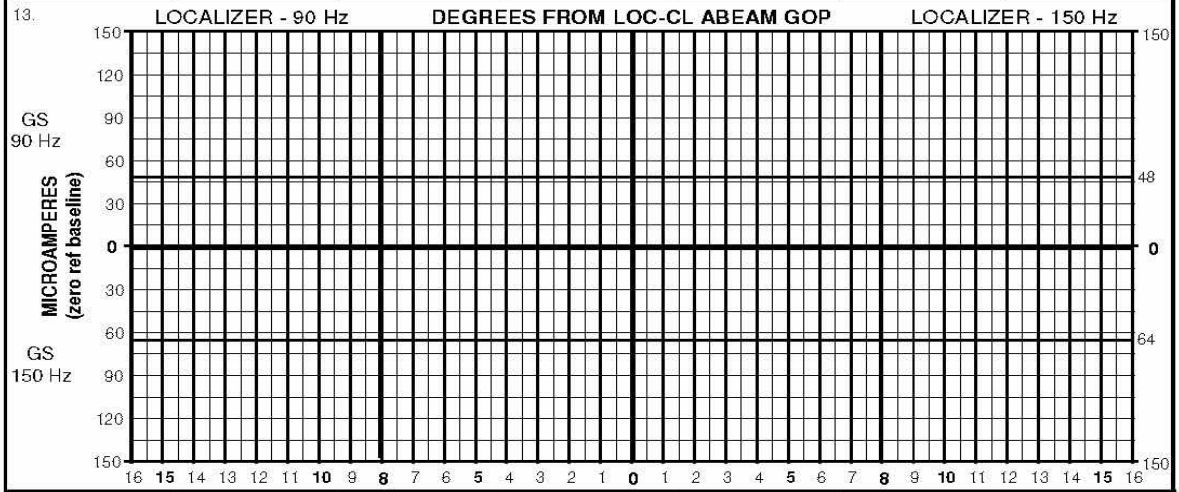
FLIGHT INSPECTION REPORT-- TRANSVERSE-STRUCTURE PLOT

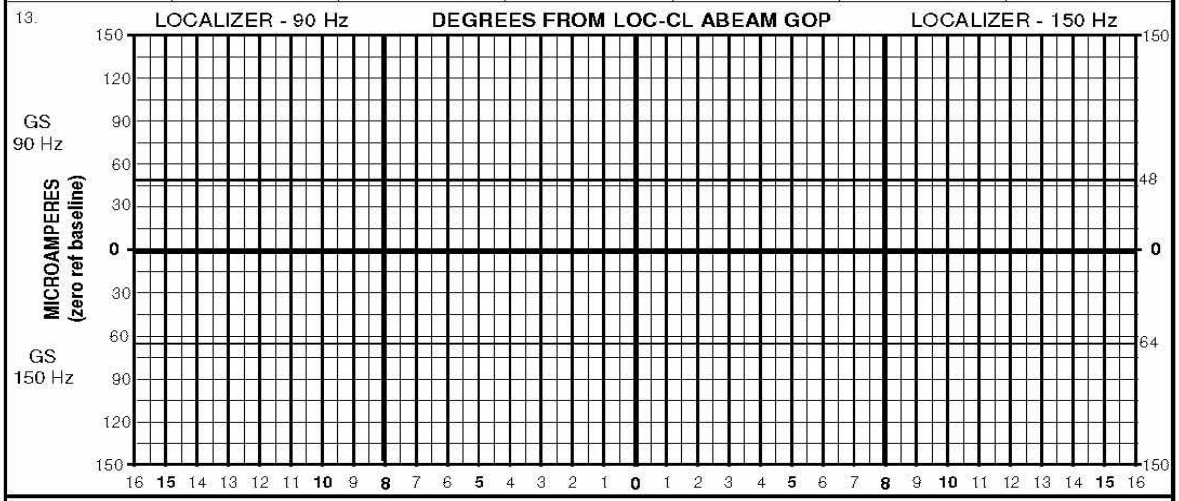
1. LOCATION:						2. IDENT:
3. DATE(S) OF INSPECTION:			4. ANT TYPE:			5. SITE ELEV:
6. TX:	7. CFG:	8. ALT:	9. RADIUS:	10. FLT DIRECT:	11. GS WIDTH:	12. GS ANGLE:

13.



6. TX:	7. CFG:	8. ALT:	9. RADIUS:	10. FLT DIRECT:	11. GS WIDTH:	12. GS ANGLE:

13.



14. REMARKS: (Draw vertical lines at Localizer 150µA-points.)

REGION:	FLIGHT INSPECTOR'S SIGNATURE:	TECHNICIAN'S SIGNATURE:	AIRCRAFT NO:
FIO:	N/A		

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SECTION 1. AIRBORNE INFORMATION (Continued)

6-30. FLIGHT INSPECTION CONSIDERATIONS.

a. General. Flight inspections are conducted on an ILS facility for a variety of purposes. Maintenance personnel involved with a flight inspection should be familiar with the required adjustments of the facility and the airborne procedures used (see section 6-33) to minimize the time and expense required.

b. Flight Inspection of RMM Equipped ILS Facilities. Specialists are not required to be on site to perform a monitor flight inspection of an ILS facility equipped with RMM, providing the following conditions are met.

(1) The specialist conducting the flight inspection has direct communications with the aircraft.

(2) The specialist has the capability to remotely make all routine adjustments required by flight inspection. For glide slope facilities this includes the capability of advancing and retarding the phase of the glide slope antenna signals, as well as attenuating capture effect glide slope antenna signals.

(3) A copy of the current monitor reference data for the ILS is on hand for the specialist conducting the flight inspection.

(4) The specialist conducting the flight inspection ensures that the activities required in this chapter are accomplished.

c. Types of Flight Inspections.

(1) Periodic. Periodic flight inspections are conducted on a surveillance basis to document the performance of the facility as the user experiences it. These inspections typically alternate with monitor flight inspections. The flight inspection aircraft documents the as-found condition with the equipment in normal/operating condition (not purposely adjusted to alarm limits). Since no facility adjustments, ground checks, or record keeping is required, maintenance personnel do not need to be at the facility being flight-checked.

(2) Monitor. Monitor flight inspections are conducted to initially (or occasionally) set and routinely confirm that the facility remains within airborne tolerances, when the transmitting equipment is adjusted to the limits of the radiated signal, which will initiate monitor action. Since it is undesirable to require a flight inspection should either the radiating or monitoring half of the system fail, it is necessary that the limits of the radiated, rather than monitored, signal be documented. This means that the monitor does not need to be optimized, adjusted, or centered during the flight inspection due to changes resulting from the flight inspection. It may be adjusted for these conditions after the flight inspection, as long as the ground parameters corresponding to the flown limits are well documented and used to set the monitor.

(3) Special. Special flight inspections are conducted on an as-needed basis to permit changing or reestablishing reference values. Periodic or monitor types of flight inspections have prescheduled activities. The special flight inspection permits airway facilities personnel to take flight check time to verify equipment performance following equipment component changes and monitor adjustments. A recommended time to request a special flight inspection is when flight inspection is in the area or before a scheduled flight inspection.

(4) After-Accident. The purpose of after-accident flight inspection is to document the as-found condition of the signal in space, without any facility adjustments. Should any airborne parameters be found out of tolerance, monitor alarm limits will be flown. (At the discretion of the flight inspector, as-found parameters that are nearly out of tolerance may be flown at their monitor limits as well.) FOR AFTER-ACCIDENT MONITOR ALARM LIMIT CHECKS, the radiated signal is adjusted until the monitor (unadjusted) actually alarms.

d. Preparation. Before a monitor flight inspection, maintenance personnel should prepare for the effort in accordance with the requirements outlined in this order. In particular, FAA Forms 6750-3 and 6750-4, localizer and glide slope flight inspection data worksheets, should be on hand. A calculator is necessary for efficient adjustments of sideband power. The airborne tolerances section of chapter 3 of this order and any previously established flight inspection reference limits as documented on FAA forms should also be readily available.

SECTION 2. FACILITY INFORMATION (Continued)

6-31. ACTIVITIES PRECEDING FLIGHT INSPECTION.

a. Frequency of Flight Inspections. Since the frequency of routine flight inspections is tailored to the stability and dependability of the instrument landing system (ILS), the specialist should ensure that the facility is representative of the day-to-day ILS operation before each flight inspection. The interval between inspections is scheduled to be as long as possible without compromising system safety. During the first year a facility is operational, the flight inspections are more frequent to establish facility baseline data.

b. Reminder of Next Inspection. Post the date of the next scheduled monitor flight inspection in a prominent location at the facility. This will serve as a reminder to complete the following items in a timely manner.

c. Preflight Inspection Activities. Perform the preflight inspection activities in chapter 4.

d. Facility Shutdown. Arrange a facility shutdown for a monitor flight inspection.

e. Test Equipment. Have the proper test equipment such as PIR, modulation meter, wattmeter, and optional digital multimeter (dmm), available.

f. Coordination of Communications Frequency. Coordination with flight inspection personnel is essential to determine which communication frequency will be used during the flight inspection. The transceiver shall be tested for proper operation prior to a flight inspection.

g. Worksheets. Use the appropriate flight inspection data worksheet, FAA Form 6750-3 for localizer and FAA Form 6750-4 for glide slope. (Refer to figures 6-6 and 6-7.)

h. Checklists. Use the checklists tables 6-1 through 6-7. These checklists are a suggested order of occurrence for best use of flight inspection hours and meet the minimum requirements of the flight inspection manual.

i. Calculation of Power Ratios. Have the sideband power formula and a scientific calculator available, as new power ratios may have to be calculated during flight inspection.

6-32. EQUIPMENT ADJUSTMENTS BEFORE FLIGHT INSPECTION. The following checks will verify the quality of radiated parameters before flight inspection. The values must equal the established normal reference values.

a. Modulation Levels.

b. Tuning of All Transmitting Equipment.

c. Path Width/Course Width.

d. Path Angle/Course Alignment.

e. Equality Between Equipments (Dual Equipment).

f. Power Levels.

g. System Phasing. Paragraphs 5-16, 5-48, 5-50, 5-52, 5-54, or 5-55.

h. Ground Check. For localizer, paragraph 5-12 and end-fire glide slope, paragraph 5-42.

NOTE: The facility parameters listed above should be adjusted to the reference values previously established for the facility. Review the reference values and have them available during flight inspection. Do not adjust the monitor alarm points to the reference flight inspection values. (The monitor is not flight inspected.)

SECTION 2. FACILITY INFORMATION (Continued)

FIGURE 6-6. FAA FORM 6750-3, LOCALIZER FLIGHT INSPECTION DATA WORKSHEET

LOC - Flight Inspection Data Work Sheet

Identification	Location	Airport	Runway	Start Date - UTC Time
				Stop Date - UTC Time
Technician Conducting FC	Technician(s) Assisting with FC		FC Aircraft Number	Flight Check Crew Names

Run Number	Facility Data														Flight Inspection Data						Remarks
	Transmitter Number	Course Transmitter				Clearance Transmitter				Monitor			Zero Alignment Mod Equality (DDM / Hz)	Derived Course Alignment	Course Width (degrees) **	Course Alignment (u-amp) (L or R) **	Low Clearance 90 Hz (u-amp / azimuth) **	Low Clearance 150 Hz (u-amp / azimuth) **	Modulation (SDM %)**	Symmetry (%) of 90 Hz side **	Notes: * Dual Power and digital voltmeter readings are acceptable. ** Reference Order 6750.49A Par 3-30 and Order 8200.1A Par 217.5a for airborne tolerances. Commissioned Width _____
										CSE		CLR									
		Carrier Power * (Watts)	Sideband Power * (mW)	Modulation Equality (DDM / Hz)	Modulation (SDM %)	Carrier Power * (Watts)	Sideband Power * (mW)	Modulation Equality (DDM / Hz)	Modulation (SDM %)	Course (DDM / Hz)	Width (DDM) 150 Hz	Width #1 / 2 (DDM) 150 Hz									

FAA Form 6750-3 (10-03)

FIGURE 6-7. FAA FORM 6750-4, GLIDE SLOPE FLIGHT INSPECTION DATA WORKSHEET

GS - Flight Inspection Reference Work Sheet

Identification	Location	Airport	Runway	Start Date - UTC Time
				Stop Date - UTC Time
Technician Conducting FC	Technician(s) Assisting with FC	FC Aircraft Number		Flight Check Crew Names

Run Number	Facility Data															Flight Inspection Data					Remarks
	Transmitter Number	Course Transmitter				Clearance		Antenna Powers **			Monitor Readings			Phase Shift to Alarm (deg)							
		Carrier Power (Watts) **	Sideband Power (mW) **	Carrier Feedline (DDM / Hz)	Carrier Modulation (SDM %)	Clearance Power (mW) **	Clearance Modulation (%)	U* Upper (mW)	M * Middle (mW)	L* Lower (Watts)	Path (DDM / Hz)	Width (DDM) 150 Hz	Clearance		Path Width (deg) ***	Path Angle (deg)***	Structure Below Path Angle (deg) ***	Symmetry (%) ***	Modulation (SDM %) ***	Notes: * If applicable ** Dual Power and digital voltmeter readings are acceptable. *** Reference Order 6750.49A Par 3-60 and Order 8200.1A Par 217.5b for airborne tolerances.

FAA Form 6750-4 (1-03)

SECTION 2. FACILITY INFORMATION (Continued)

6-33. ACTIVITIES DURING FLIGHT INSPECTION.

a. Instructions for Preparation of the Flight Inspection Data Worksheets.

(1) Put the facility in the proper configuration for the first run. (See the checklists, tables 6-1 through 6-7.) Advise flight inspection of the equipment configuration and of readiness for the first run. Identify the runs in order of occurrences (1, 2, etc.). The run numbers should agree with the run numbers kept by the flight inspection specialist on his/her worksheet. This enables ground-air correlation later should any difficulties arise. (Refer to figures 6-6 and 6-7.)

(2) The data columns identified as FACILITY DATA are those readings taken inside the shelter during the flight inspection.

(3) The data columns identified as FLIGHT CHECK DATA are those readings taken by the airborne specialist and reported by radio.

(4) In the REMARKS column, enter the facility configuration for that run, such as normal, wide alarm upper attenuated 2.5 dB, middle advanced 15, etc.

b. Conducting the Flight Inspection.

(1) The purpose of a monitor flight inspection is to verify the limits of the radiated signal. In the shelter, this is done with the transmitter measurements, NOT the monitor. Monitors are not adjusted during flight inspection. Do not depend on the monitor to adjust the radiated parameters. The facility is adjusted to the established reference values for the configuration being checked. After flight inspection personnel depart, the monitor shall be adjusted for proper action when the radiated signal exceeds the established reference values previously verified during flight inspection. (Note that after a facility outage or monitor failure, the facility must be certified based on radiated parameters only, such as phasing, modulation balance, power ratios, etc. Thus it is not necessary to recenter or adjust the monitor between flight check runs, this wastes valuable flight time.)

(2) When making corrective adjustments to radiated parameters, use every resource available to predict and produce the precise change requested or needed. Giving the knob a "tweak" in the "right direction" without regard to the amount of adjustment often requires unnecessary re-adjustment and repeated runs, and may result in the facility having out-of-tolerance indications in the air and/or on the ground. Do not guess when making sideband power adjustments to set course or path width. Use the following formulas.

New sideband power =

$$\text{Old sideband power X } \frac{\text{Old course width}^2}{\text{New course width}^2}$$

New width monitor DDM reading =

$$\text{Old width monitor DDM reading X } \frac{\text{Old course width}}{\text{New course width}}$$

Make the calculations, then the adjustment. Notify flight inspection when ready. If the measurement agrees with your prediction, it will build confidence. If it does not, it reveals inaccuracies in the airborne measurement, ground measurement, or the calculations.

(3) Anticipate and be ready to make the next adjustment long before it is requested. Use the appropriate checklist (tables referenced in paragraph 6-9) and coordinate with the flight inspection personnel.

(4) Promptly make adjustments, observing only radiated parameters, NOT the monitor. NO ADJUSTMENT SHOULD TAKE LONGER THAN 60 SECONDS. Notify flight inspection personnel when the adjustment is completed and obtain their acknowledgement. (At times, the aircraft crew is busy and may be listening to higher-priority traffic.)

(5) Do not delay flight inspection by taking readings after the run. This time should be for setting up for the next run. Measure and record the data on the data worksheet DURING the run. The run takes approximately 7 minutes.

(6) Every effort should be made to ground phase all facilities. Ground personnel should not normally ask Flight Inspection to set phasing. Refer to paragraphs 5-16, 5-48, 5-50, 5-52, 5-54, and 5-55.

(8) **(7)** Flight Inspection will not normally set facility modulation. Facility modulation should be set on the ground by the facility specialist using appropriate test equipment.

* **(8)** When the flight inspection results do not agree with the expected results, discuss the problem with flight inspection. If the specific problem cannot be resolved, continue to work with flight inspection to complete the remaining work. Do not, under any circumstances, attempt to prove that the flight results are wrong by being in any configuration other than that known to the aircrew. Doing this causes undue confusion and may delay finding the cause of the disagreement. After the flight inspection is completed, the problem should be analyzed by the facility specialist and his/her supervisor, to determine if additional flight inspection is required or if sector or regional engineering personnel should be contacted.

(9) Ensure that all required data is obtained and the data is satisfactory before flight inspection personnel depart. This requires prompt analysis of the flight inspection data. On several occasions, flight inspection personnel have been required to return to a facility because insufficient data was taken during the inspection.

(10) During flight inspection make efficient use of available flight time for cost efficiency. *

c. Modulation Adjustments During Flight Inspection.

(1) If flight inspection reports the modulation high or low, maintenance personnel should:

(a) Check the equipment modulation with the modulation meter. Correct the modulation, as necessary. If the modulation is within tolerance, advise flight inspection. Proceed with step (b), if necessary

(b) Check the carrier and sideband modulation components. If the modulation components are high, correct them. If the modulation components are within tolerance, advise flight inspection.

NOTE: High modulation distortion components, especially in the frequency range of 60 to 180 Hz, could pass through bandpass filters in the aircraft receiver, causing the indicated 90 and 150 Hz modulation to appear high.

(2) If flight inspection still requires a modulation adjustment after being advised that the ground readings are within tolerance, make the adjustment and:

(a) If possible, verify the calibration of the modulation meter. Check the modulation using the wattmeter element and oscilloscope.

(b) Ask flight inspection to check the calibration of the avionics equipment at the first opportunity. Their receivers are calibrated with the same modulation meter Airway Facilities uses.

(c) Follow up with flight inspection to resolve the difference in modulation readings.

NOTE: Changes to equipment adjustments should be made in accordance with chapter 5 of this order or the equipment instruction books.

6-34. LOCALIZER ACTIVITIES.

a. Flight Inspection Course Width. Localizer facilities have a desired tailored course width of 700 feet (213 m) at runway threshold provided the width is not greater than 6º. All Cat II/III localizer "commissioned course width" must be tailored. With region approval, Cat I localizers may deviate from the tailored value if necessary to improve service, usually course structure or clearances. Deviation from the tailored value should be the minimum needed to achieve the desired results. This value is established as the "commissioned course width" for the facility.

b. Flight Inspection Measurement. Course width as measured by flight inspection personnel for normal, wide alarm, and narrow alarm is referenced to the commissioned course width. These three flight inspection values shall be entered on FAA Form 6750-3, Localizer Flight Inspection Data Worksheet, and compared with the tolerances of paragraph 3-30a. During a reference flight inspection, additional flight inspection runs shall be requested until initial tolerances are obtained. In certain cases, the use of a signal-in-space evaluation type package may be desirable to save on flight inspection cost. Initial tolerances are required since the reference flight inspection establishes

SECTION 2. FACILITY INFORMATION (Continued)

the operating limits, which all subsequent normal ground measurements must meet.

c. Flight Inspection Low Clearance. Flight inspection measurement of the facility's low clearance points determines if the facility provides adequate off-course indications. The low clearance of the facility will be reported to the facility specialist in microamps at a particular azimuth. This value shall be entered on FAA Form 6750-3, Localizer Flight Inspection Data Worksheet. (Note: 150 microamps equals 0.155 DDM.)

d. Flight Inspection Course Alignment (Monitors). It is desirable to radiate localizer course alignment as close to optimum as possible, with symmetrical course shift limits. To accomplish this, flight inspection personnel announce the as-found average alignment, and ground personnel must derive the optimum reference values for day-to-day maintenance use. For derivation purposes, 0.001 DDM equals one microamp.

(1) During a reference flight inspection, adjust the airborne alignment to meet the initial tolerances of paragraph 3-30c(1), and record this initial alignment and the corresponding carrier modulation balance on FAA Form 6750-3.

(2) After completion of the flight inspection, compute the carrier feedline modulation balance value necessary to achieve a zero alignment as would be seen by the flight inspection aircraft. This feedline DDM value shall be used as the normal front course alignment reference, and is recorded on FAA form 6750-3.

(3) Compute the necessary modulation balance values corresponding to symmetrical course shift alarms around the normal alignment reference in accordance with the initial limits of 3-20.a.(1). These values shall be used as the course shift alignment references.

(4) Document the above derivations by additional line entries on FAA Form 6750-3, including appropriate remarks to indicate these entries are the derived centerline and course shift references.

(5) During subsequent monitors flight inspections, the derived centerline normal reference shall be flown. Considering flight inspection measurement repeatability and facility history, it is not necessary to adjust the derived normal facility alignment or course shift references for announcements of 3 microamps or less. Ideally, the established and maintained alignment reference will result in flight inspection announcements that average centerline, with frequent values of ±1 microamps, occasional values of ±2 microamps, and rare values of ±3 microamps to be expected.

(6) Consideration should be given to establishing a new derived reference centerline if facility history indicates an alignment trend that averages other than centerline. A new centerline reference (and corresponding course shifts) must be derived if the normal alignment announcement exceeds ±3 microamps.

Example one: Flight inspection gives an announced alignment of 2 microamps left. This indicates that the course centerline was found to the left of runway centerline, and that an approximate increase of .002 ddm/90 Hz would be necessary to move the course centerline over to the runway centerline. At the centerline ground check point or the carrier feedline note the "DDM" reading on the PIR. Increase the modulation balance until a shift of .002/90 Hz is indicated from the reading previously noted on the PIR. This sets the proper alignment. Now shift course centerline to the initial alignment alarm tolerances prescribed for the Category of ILS, using the PIR DDM indications at the centerline ground check point or the carrier feedline. Document these values and set the monitor accordingly to protect these limits.

Example two: Flight inspection gives an announced alignment of 2 microamps right. This indicates that the course centerline was found to the right of runway centerline, and that an approximate increase of .002 ddm/150 Hz would be necessary to move the course centerline over to the runway centerline. At the centerline ground check point or the carrier feedline note the "DDM" reading on the PIR. Increase the modulation balance until a shift of .002/150 Hz is indicated from the reading previously noted on the PIR. This sets the proper alignment. Now shift course centerline symmetrically around this reference, to the initial alignment alarm tolerances prescribed for the Category of ILS, using the PIR DDM indications at the centerline ground check point or the carrier feedline. Document these values and set the monitor accordingly to protect these limits.

6-35. GLIDE SLOPE ACTIVITIES.

a. Flight Inspection Path Angle. Glide slope facilities have a path angle designated by the procedures specialist developing the approach procedure. The chosen path angle is nominally 3.0º. This designated angle is defined as "commissioned path angle" and will vary from glide slope to glide slope. Path angle as measured by flight inspection for normal, low angle alarm, and high angle alarm is compared to commissioned path angle. These three values, as measured by flight inspection, shall be logged on FAA Form 6750-4, Glide Slope Flight Inspection Data Worksheet. The corrected angle will be measured during the approach run. Angle alarms are normally checked only on sideband reference and end fire systems. *

b. Flight Inspection Path Width. Flight inspection measurement of the facility's path width determines if the facility provides proper aircraft crosspointer sensitivity indications. The path width of the facility will be reported to the facility specialist as width in degrees. The path width is determined between the fly up and fly down 75 microampere points as measured with the aircraft on the extended runway centerline. This value shall be logged on FAA Form 6750-4.

c. Flight Inspection Structure Below Path. The highest vertical angle at which 190 microamps of fly up signal last occurs will be determined by flight inspection during the same runs as the path width measurement. The structure below path angle tolerances ensure that the aircraft will have adequate fly up indications to clear any below path obstructions within the approach corridor. At commissioning, flight inspection also flies at low angles to verify obstruction clearance. Following commissioning, the structure below path angle value is used to verify that facility performance has not deteriorated. The initial values in Chapter 3, Standards and Tolerances, ensure that the low angle fly up signals are better than required for safe operation. The structure below path angles shall be recorded on FAA Form 6750-4.

d. Flight Inspection Path Symmetry. Glide slope path symmetry is a quantitative comparison of the amount of total path width (75 to 75 microamps) that occurs above and below the measured path angle. A perfect facility has 50 percent symmetry. This will occur when the 75 microamp points occur exactly the same number of degrees (0.35) above and below the on path signal. In image systems, this verifies that the antenna heights, power ratios, and phasing are properly adjusted for the site. The symmetry value shall be recorded on FAA Form 6750-4. The value is reported in percent for the 90 Hz (above path) lobe.

e. Flight Inspection System Dephasing and Attenuation.

(1) Variances in normal system phasing and amplitudes can cause substantial changes in normal path characteristics; therefore, these abnormal conditions are verified by flight inspection. Flight inspection values for angle, width, symmetry (no flight inspection tolerance for abnormal conditions), and structure below path shall be recorded on FAA Form 6750-4 for each required configuration. The configuration and values shall be annotated in the remarks column (i.e., Middle Advanced 15). *

(2) To ensure repeatability between successive flight inspections, dephasing checks should be performed using fixed line lengths rather than the internal variable phasers. This technique will give the same results over time even when different facility technicians perform the flight inspection and will provide symmetrical changes in the facility for both advanced and retard conditions. See subparagraph f, below, for typical phase lengths of common coaxial fittings. All image glide slopes should be able to dephase 30º for SBO dephase. Sideband reference facilities should be able to dephase the upper antenna 30º. Capture-effect facilities should be able to dephase the middle antenna 20º.

f. Phase Lengths of Coaxial Fittings at Glide Slope Frequencies.

(1) Type N double male and type N double female 30º.

(2) Type N elbow 19º.

(3) Type BNC/TNC elbow 15º.

(4) Type N double male, type N double female, type N elbow 49º.

SECTION 2. FACILITY INFORMATION (Continued)

6-36. MARKER ADJUSTMENTS DURING FLIGHT INSPECTION.

a. General. ILS marker facilities must meet the two requirements for the following when checked by flight inspection personnel: minor axis width and major axis width. The most frequent requests for changes in facility characteristics by flight inspection involve radiation pattern width. The pattern width is a function of power output and modulation percent; that is, the more power output or the higher the modulation, the wider the pattern.

b. Minor Axis Width. This check is made on glide slope path and localizer on course (approach run), and verifies that the minor axis width is within prescribed tolerances.

c. Major Axis Width. This check is made on glide slope path and at localizer half-width points (75 micro- * amperes) to ensure that the marker pattern is minimally sufficient to momentarily activate the cockpit marker indicators (2 mA level on the recording).

d. Width Adjustments.

(1) If flight inspection personnel advises that either axis is narrow, the marker power must be increased until the required widths are achieved.

(2) If the axes are too wide, the power must be reduced. Whenever power changes are made, verify that the modulation percentage is also correct.

e. Unpredictable Results. When airborne indications are appreciably different than those predicted by ground data, the flight inspection should be stopped until the reason for the disparity can be determined. Some of the possible cause of abnormal airborne indications are:

(1) Transmitter output frequency outside the specified tolerance. This creates a requirement for excessive output power to produce a normal radiation pattern indication in the airborne receiver.

(2) Incorrect modulation frequency, which results in a reduced output from the airborne receiver's bandpass filters.

(3) Excessive antenna system leakage resistance, resulting in reduced radiation and/or a distorted pattern.

(4) Low modulation, which results in a reduced output from the airborne receiver.

NOTE: If changes that invalidate previously established reference values are made, new reference values must be established on FAA Form 6770-4.

6-37. ACTIVITIES FOLLOWING FLIGHT INSPECTION.

a. General.

(1) The activities required following a flight inspection depend upon which activities were performed before and during the flight inspection. If the flight inspection involved no corrective adjustments that invalidated the established reference values, updating the reference values or ground checks is not required.

(2) If equipment parameters were changed beyond the established reference values, new reference values for the affected parameters shall be established. If applicable, a ground check shall be made.

b. Monitor Alarm Adjustments Following Flight Inspection.

(1) Monitor alarm points are checked by changing the radiated parameters to the same value used during flight inspection (usually established reference values). The appropriate monitor control is adjusted to cause a continuous alarm at or before the values used during flight inspection.

(2) The equipment shall not be returned to service before measuring and recording all parameters on the appropriate FAA form. These readings should be made as soon as possible and before weather or other changes invalidate the readings, especially when ground checks are required.

(3) The Flight Inspection Data Worksheet used during the flight inspection shall be retained until the facility is decommissioned. When the flight inspection report arrives (usually 5 to 6 weeks after the flight inspection), staple it to the Flight Inspection Data

Worksheet. These documents are the source of data for the FAA Forms 6750-22 to -32.

(4) Make the proper Facility Maintenance Log entries including the facility certification statement. Advise air traffic and other concerned parties that the facility is returned to service and that the NOTAM may be canceled.

6-38. TRACEABLE FLIGHT INSPECTION REFERENCE DATA CHECKLISTS.

In order to more easily identify which traceable flight inspection references are required, the following tables (Table 6-8 through Table 6-13) outline both the facility and airborne measurements that are to be recorded on the flight inspection data worksheets. The failure to record either the facility or airborne measurement results in improperly established flight inspection references. Ensure the airborne technician provides all required data for each run. If you need additional data, do not hesitate to ask for it.

6-39. thru 6-99. RESERVED.

SECTION 2. FACILITY INFORMATION (Continued)

TABLE 6-8. SINGLE-FREQUENCY LOCALIZER

REFERENCE	FACILITY MEASUREMENT	AIRBORNE MEASUREMENT	TOLERANCE	COMMENTS
Normal Width (front and back)	CSB Power SBO Power	Normal Course Width Low Clearances[1]	3-30a(1) 3-30b(1)	If applicable, back course can be measured during the front course run. (1 full orbit)
Wide (front and back)	SBO Power[2]	Wide Course Width Low Clearances	3-30a(2) 3-30b(2)	If applicable, back course can be measured during the front course run. (1 full orbit)
Narrow[1] (front only)	SBO Power[2]	Narrow Course Width Low Clearances[3]	3-30a(2) 3-30b(2)	Although not measured routinely, specialists are required to maintain the narrow width reference.
Normal Course (front and back)	Modulation Equality Derived Modulation Equality	Normal Course Alignment (Derived Course Alignment)	3-30c(1), (2) & (3)	Derivations for modulation equality and course alignment shall be recorded on the flight inspection worksheet.
Course Shift (Clockwise)	Derived Modulation Equality	(Derived CW Course Shift)	3-30c(4) & (5)	Course shifts are no longer airborne measurements but are derived from the airborne alignment value.
Course Shift (Counterclockwise)	Derived Modulation Equality	(Derived CCW Course Shift)	3-30c(4) & (5)	Course shifts are no longer airborne measurements but are derived from the airborne alignment value.
Rf Power Reduction[1] (front and back) (Main or Stby only)	CSB Power	Useable Distance	Satisfactory	Reduce the CSB power to 50% of normal power. The RF power maybe set greater than 50% by flight inspection in order to establish usable distance.
Ground Check	Course Width Off Course Clearance Course Position		3-31a(1) 3-31a(2) 3-31a(3)	Established immediately following a monitors flight inspection that established new Normal CSB/SBO powers or carrier feedline DDM reference values.

[1] Although not routinely checked during periodic monitor flight inspections, ILS specialists are required to maintain traceability of the reference.
[2] Assuming CSB Power and System Phasing have remained constant.
[3] This check was not required prior to 6/01/01. DO NOT request a special flight inspection for absence of Low Clearances only. (Request the next "Regular" periodic-with-monitors flight inspection be changed to a "Special" and establish new references at that time).

SECTION 2. FACILITY INFORMATION (Continued)

TABLE 6-9. DUAL-FREQUENCY LOCALIZER

REFERENCE	FACILITY MEASUREMENT	AIRBORNE MEASUREMENT	TOLERANCE	COMMENTS
Normal Width (front and back)	Course XMTR CSB Power Course XMTR SBO Power Clearance XMTR CSB Power Clearance XMTR SBO Power	Normal Course Width Low Clearances[1]	3-30a(1) 3-30b(1)	If appliable, back course can be measured during the front course run. (1 full orbit)
Course Wide/ Clearance Wide (front and back)	Course XMTR SBO Power[2] Clearance XMTR SBO Power[2]	Wide Course Width Low Clearances	3-30a(2) 3-30b(2)	If appliable, back course can be measured during the front course run. (1 full orbit)
Course Narrow/ Clearance Wide[1] (front and back)	Course XMTR SBO Power[2] Clearance XMTR SBO Power[2]	Narrow Course Width Low Clearances[3]	3-30a(2) 3-30b(2)	Although not measured routinely, specialists are still required to maintain the narrow width reference.
Normal Course (front and back)	Modulation Equality Derived Modulation Equality	Normal Front Course Alignment (Derived Course Alignment)	3-30c(1) 3-30c(2) 3-30c(3)	Derivations for modulation equality and course alignment shall be recorded on the flight inspection worksheet.
* Course Shift (Clockwise)	Derived Modulation Equality	(Derived CW Course Shift)	3-20a(1)	Course shifts are no longer airborne measurements but are derived from the airborne alignment value.
Course Shift (Counterclockwise)	Derived Modulation Equality	(Derived CCW Course Shift)	3-20a(1)	Course shifts are no longer airborne measurements but are derived from the airborne alignment value. *
Rf Power Reduction[1] (front and back) (Main or Stby only)	Course XMTR CSB Power Clearance XMTR CSB Power	Useable Distance	Satisfactory	Reduce the CSB and CLR power to 80% of normal power. The RF power maybe set greater than 80% by flight inspection in order to establish useable distance.
Ground Check	Course Width Off Course Clearance Course Position		3-31a(1) 3-31a(2) 3-31a(3)	Established immediately following a monitors flight inspection that established new Normal CSB/SBO powers or carrier feedline DDM reference values.

[1] Although not routinely checked during periodic monitor flight inspections, ILS specialists are required to maintain traceability of the reference.
[2] Assuming CSB Power and System Phasing have remained constant.
[3] This check was not required prior to 6/01/01. DO NOT request a special flight inspection for absence of Low Clearances only. (Request the next "Regular" periodic-with-monitors flight inspection be changed to a "Special" and establish new references at that time.)

SECTION 2. FACILITY INFORMATION (Continued)

TABLE 6-10. NULL-REFERENCE GLIDE SLOPE

REFERENCE	FACILITY MEASUREMENT	AIRBORNE MEASUREMENT	TOLERANCE	COMMENTS
Normal Path Angle	Established by antenna heights and Modulation equality.	Normal Path Angle	3-60a(1)	Normal Path Angle is the average angle measured during the low approach run. (ILS-3)
Normal Path Width	CSB Power SBO Power	Normal Path Width Structure Below Path Path Symmetry	3-60b(1) 3-60c(1) 3-60d	
Wide	SBO Power[2]	Corrected Path Angle Wide Path Width Structure Below Path	3-60a(4) 3-60b(2) 3-60c(2)	
Narrow[1]	SBO Power[2]	Corrected Path Angle Narrow Path Width Structure Below Path	3-60a(4) 3-60b(3) 3-60c(2)	Not measured routinely, but specialists are required to maintain the narrow width reference.
SBO Advance Dephase (Main or Stby only)	SBO advanced (18 to 30 deg.)	Corrected Path Angle Path Width Structure Below Path	3-60a(4) 3-60b(4) 3-60c(2)	When (re)establishing references, the path angle and the structure below path must remain within the INITIAL tolerances of paragraph 3-60a(4), b(4), and c(2). (Page 84, Note 2).
SBO Retard Dephase (Main or Stby only)	SBO retarded (18 to 30 deg.)	Corrected Path Angle Path Width Structure Below Path	3-60a(4) 3-60b(4) 3-60c(2)	When (re)establishing references, the path angle and the structure below path must remain within the INITIAL tolerances of paragraph 3-60a(4), b(4), and c(2). (Page 84, Note 2).
Rf Power Reduction[1] (Main or Stby only)	CSB Power	Useable Distance and full fly-up Clearances exist on localizer centerline and 8 degrees each side of localizer centerline.	Satisfactory	Reduce the CSB power to 50% of normal power. The RF power may be set greater than 50% by flight inspection in order to establish usable distance.

[1] Although not routinely checked during periodic monitor flight inspections, ILS specialists are required to maintain traceability of the reference.
[2] Assuming CSB Power and System Phasing have remained constant.

SECTION 2. FACILITY INFORMATION (Continued)

TABLE 6-11. SIDEBAND-REFERENCE GLIDE SLOPE

REFERENCE	FACILITY MEASUREMENT	AIRBORNE MEASUREMENT	TOLERANCE	COMMENTS
Normal Path Angle	Established by antenna heights, modulation equality, and SBO balance between antennas.	Normal Path Angle	3-60a(1)	Normal Path Angle is the average angle measured during the low approach run. (ILS-3)
Normal Path Width	CSB Power SBO Power	Normal Path Width Structure Below Path Path Symmetry	3-60b(1) 3-60c(1) 3-60d	
Wide	SBO Power[2]	Corrected Path Angle Wide Path Width Structure Below Path	3-60a(4) 3-60b(2) 3-60c(2)	
Narrow[1]	SBO Power[2]	Corrected Path Angle Narrow Path Width Structure Below Path	3-60a(4) 3-60b(3) 3-60c(2)	Not measured routinely, but specialists are required to maintain the narrow width reference.
U-A Advance Dephase (Main or Stby only)	U-A advanced (18 to 30 deg.)	Corrected Path Angle Path Width Structure Below Path	3-60a(4) 3-60b(4) 3-60c(2)	When (re)establishing references, the path angle and the structure below path must remain within the INITIAL tolerances of paragraph 3-60a(4), b(4), and c(2). (Page 84, Note 2).
U-A Retard Dephase (Main or Stby only)	U-A retarded (18 to 30 deg.)	Corrected Path Angle Path Width Structure Below Path	3-60a(4) 3-60b(4) 3-60c(2)	When (re)establishing references, the path angle and the structure below path must remain within the INITIAL tolerances of paragraph 3-60a(4), b(4), and c(2). (Page 84, Note 2).
High Angle	Upper antenna SBO (increased) Lower antenna SBO (decreased)	Corrected High Path Angle Path Width Structure Below Path	3-60a(2) 3-60b(4) 3-60c(2)	Not measured routinely, but specialists are required to maintain the high angle reference.
Low Angle	Upper antenna SBO (decreased) Lower antenna SBO (increased)	Corrected Low Path Angle Path Width Structure Below Path	3-60a(3) 3-60b(4) 3-60c(2)	
Rf Power Reduction[1] (Main or Stby only)	CSB Power	Useable Distance and full fly-up Clearances exist on localizer centerline and 8 degrees each side of localizer centerline.	Satisfactory	Reduce the CSB power to 50% of normal power. The RF power may be set greater than 50% by flight inspection in order to establish usable distance.

[1] Although not routinely checked during periodic monitor flight inspections, ILS specialists are required to maintain traceability of the reference.
[2] Assuming CSB Power and System Phasing have remained constant.

TABLE 6-12. CAPTURE-EFFECT GLIDE SLOPE

SECTION 2. FACILITY INFORMATION (Continued)

REFERENCE	FACILITY MEASUREMENT	AIRBORNE MEASUREMENT	TOLERANCE	COMMENTS
Normal Path Angle	Established by antenna heights, modulation equality, UA to LA power balance, and UA phasing.	Normal Path Angle	3-60a(1)	Normal Path Angle is the average angle measured during the low approach run. (ILS-3)
Normal Path Width	CSE XMTR CSB Power CSE XMTR SBO Power CLR XMTR Power	Normal Path Width Structure Below Path Path Symmetry	3-60b(1) 3-60c(1) 3-60d	
Course Wide/ Low Clearance Mod %	CSE XMTR SBO Power[2] CLR XMTR Modulation	Corrected Path Angle Wide Path Width Structure Below Path	3-60a(4) 3-60b(2) 3-60c(2)	Reduce clearance modulation to approximately 60%, but at least something less than the INITIAL tolerance of paragraph 50d(2)(a).
Narrow[1]	CSE XMTR SBO Power[2]	Corrected Path Angle Narrow Path Width Structure Below Path	3-60a(4) 3-60b(3) 3-60c(2)	Not measured routinely, but specialists are required to maintain the narrow width reference.
M-A Advance Dephase (Main or Stby only)	M-A advanced (10 to 20 deg.)	Corrected Path Angle Path Width Structure Below Path	3-60a(4) 3-60b(4) 3-60c(2)	When (re)establishing references for middle antenna dephasing and attenuation conditions, the path angle and structure below path measurements must remain within the INITIAL tolerances of paragraphs 3-60a(4), b(4) and c(2).
M-A Retard Dephase (Main or Stby only)	M-A retarded (10 to 20 deg.)	Corrected Path Angle Path Width Structure Below Path	3-60a(4) 3-60b(4) 3-60c(2)	
M-A Attenuation[1]	M-A attenuated (</=2.0 dB.)	Corrected High Path Angle Path Width Structure Below Path	3-60a(2) 3-60b(4) 3-60c(2)	Not measured routinely, but specialists are required to maintain the middle antenna attenuate reference.
U-A Attenuation	U-A attenuated (</=5.0 dB.)	Corrected Low Path Angle Path Width Structure Below Path	3-60a(3) 3-60b(4) 3-60c(2)	When (re)establishing references for upper antenna attenuation conditions, the path width and structure below path measurements must remain within the initial tolerances of paragraphs 3-60a(4), b(4) and c(2).
Rf Power Reduction[1] (Main or Stby only)	CSE XMTR CSB Power CLR XMTR Power	Useable Distance and full fly-up Clearances exist on localizer centerline and 8 degrees each side of localizer centerline.	Satisfactory	Reduce the CSB and CLR power to 80% of normal power. The RF power may be set greater than 80% by flight inspection in order to establish useable distance.

[1] Although not routinely checked during periodic monitor flight inspections, ILS specialists are required to maintain traceability of the reference.
[2] Assuming CSB Power and System Phasing have remained constant.

SECTION 2. FACILITY INFORMATION (Continued)

TABLE 6-13. END-FIRE GLIDE SLOPE

REFERENCE	FACILITY MEASUREMENT	AIRBORNE MEASUREMENT	TOLERANCE	COMMENTS
Normal Path Angle	Established by antenna positions, Modulation equality and (Z4 Phaser setting)	Normal Path Angle	3-60a(1)	Normal Path Angle is the average angle measured during the low approach run. (ILS-3)
Normal Path Width	CSE XMTR CSB Power CSE XMTR SBO Power CLR XMTR Power	Normal Path Width Structure Below Path Path Symmetry	3-60b(1) 3-60c(1) 3-60d	
Wide	CSE XMTR SBO Power[2]	Corrected Path Angle Wide Path Width Structure Below Path	3-60a(4) 3-60b(2) 3-60c(2)	
Narrow[1]	CSE XMTR SBO Power[2]	Corrected Path Angle Narrow Path Width Structure Below Path	3-60a(4) 3-60b(3) 3-60c(2)	Not measured routinely, but specialists are required to maintain the narrow width reference.
High Angle[1]	Main Array Dephased	Corrected High Path Angle Path Width Structure Below Path	3-60a(2) 3-60b(4) 3-60c(2)	
Low Angle[1]	Main Array Dephased	Corrected Low Path Angle Path Width Structure Below Path	3-60a(3) 3-60b(4) 3-60c(2)	
SBO Advance Dephase (Main or Stby only)	SBO advanced (15 deg.)	Corrected Path Angle Path Width Structure Below Path	3-60a(4) 3-60b(4) 3-60c(2)	When (re)establishing references, the path angle and the structure below path must remain within the INITIAL tolerances of paragraph 3-60a(4), b(4), and c(2). (Page 84, Note 2).
SBO Retard Dephase (Main or Stby only)	SBO retarded (15 deg.)	Corrected Path Angle Path Width Structure Below Path	3-60a(4) 3-60b(4) 3-60c(2)	When (re)establishing references, the path angle and the structure below path must remain within the INITIAL tolerances of paragraph 3-60a(4), b(4), and c(2). (Page 84, Note 2).
Rf Power Reduction[1] (Main or Stby only)	CSE XMTR CSB Power CLR XMTR Power	Useable Distance and full fly-up Clearances exist on localizer centerline and 8 degrees each side of localizer centerline.	Satisfactory	Reduce the course transmitter CSB power to 63% of normal power and the clearance transmitter power to 50% of normal power. The RF power may be set greater than the initial values by flight inspection in order to establish useable distance.
Snap-Down Points 1,2,3 Normal Points 1,2 & 3 Normal Points 4 & 5	Ground Check		3-61a 3-61b(1) 3-61b(2)	

[1] Although not routinely checked during periodic monitor flight inspections, ILS specialists are required to maintain traceability of the reference.
[2] Assuming CSB Power and System Phasing have remained constant.

FIGURE 31. EXAMPLE OF FAA FORM 6750-35 FOR MARK 20/20A LOCALIZER

SECTION 8. MARK 20 BUILT-IN TEST EQUIPMENT

Technical Performance Record — **ILS Built-In Test Equipment (BITE) Reference Data**

Identification	Location	From	Supervisors Signature
SSF	Oklahoma City	12/10/03	
Equipment Number	**Course or Clearance**	**Localizer, Glide Slope, or Marker**	**Equipment Type**
1	Course	Localizer	Mark 20 DEDF

Date 03	Zulu Time	Power Reference: CSB/MARKER: Commanded Power Value (watts)	Power reference measurement*	PMDT Displayed Power (watts)	PMDT Displayed VSWR	SBO: Commanded Power Value (%)	Power reference measurement*	PMDT Displayed Power (milliwatts)	PMDT Displayed VSWR	Mod. Percentage (SDM): CSB\MARKER: Ext Test Equip (% SDM)	BITE SDM (Tx % SDM)	Mod % Error (Ext-BITE % SDM)	Diff-In-Depth Mod.(DDM): CSB: Ext Test Equip (DDM)	BITE Modulation Balance (Tx DDM)	DDM Error (Ext-BITE DDM)	Clearance Frequency Separation (if applicable): Freq. Diff. Ext Test Equip (Course-Clearance Hz)	BITE Crs/Clrnce Freq Diff (Hz)	Freq. Sep. Error (Ext-BITE Hz)	Remarks *Reference may be power (Watts) or digital voltmeter (Volts)	Initials
12/10	1700	15.0	12.5	15.0	2.1	43	160	152	2.1	40.0	41	-1.0	0.000	0.000	0.000	8000	8000	2	Standard or Reference	A.C
12/10	1700	--------	--------	15.7	2.2	--------	--------	174	2.2	--------	--------	+1.5	--------	--------	+0.002	--------	--------	+50	Upper Operating Tolerance	A.C.
12/10	1700	--------	--------	14.3	1.8	--------	--------	129	1.8	--------	--------	-1.5	--------	--------	-0.002	--------	--------	-50	Lower Operation Tolerance	A.C.
12/18	1700	15.0	12.5	14.9	2.1	43	160	153	2.1	40.5	41	-0.5	0.000	0.000	0.000	8000	8002	2	ANNUAL	A.C

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FIGURE 32. EXAMPLE OF FAA FORM 6750-33 FOR MARK 20/20A GLIDE SLOPE

Technical Performance Record — **ILS Built-In Test Equipment (BITE) Reference Data**

Identification	Location	From	Supervisors Signature
SSF	Oklahoma City	12/10/03	
Equipment Number	**Course or Clearance**	**Localizer, Glide Slope, or Marker**	**Equipment Type**
1	Course	Glide Slope	Mark 20A DEDF

Date	Zulu Time	Power Reference: CSB/MARKER: Commanded Power Value (watts)	Power Reference: CSB/MARKER: Power reference measurement *	Power Reference: CSB/MARKER: PMDT Displayed Power (watts)	Power Reference: CSB/MARKER: PMDT Displayed VSWR	Power Reference: SBO: Commanded Power Value (%)	Power Reference: SBO: Power reference measurement *	Power Reference: SBO: PMDT Displayed Power (milliwatts)	Power Reference: SBO: PMDT Displayed VSWR	Mod. Percentage (SDM): CSB\MARKER: Ext Test Equip (% SDM)	Mod. Percentage (SDM): CSB\MARKER: BITE SDM (Tx % SDM)	Mod. Percentage (SDM): CSB\MARKER: Mod % Error (Ext-BITE % SDM)	Diff-In-Depth Mod.(DDM): CSB: Ext Test Equip (DDM)	Diff-In-Depth Mod.(DDM): CSB: BITE Modulation Balance (Tx DDM)	Diff-In-Depth Mod.(DDM): CSB: DDM Error (Ext-BITE DDM)	Clearance Frequency Separation (if applicable): Freq. Diff. Ext Test Equip (Course-Clearance Hz)	Clearance Frequency Separation (if applicable): BITE Crs/Clrnce Freq Diff (Hz)	Clearance Frequency Separation (if applicable): Freq. Sep. Error (Ext-BITE Hz)	Remarks *Reference may be power (Watts) or digital voltmeter (Volts)	Initials
03																				
12/10	1730	3.0	2.7	3.0	2.1	40	60	48	2.1	80.7	79.9	0.8	0.000	0.000	0.000	8000	8000	0	Standard or Reference	A.C.
12/10	1730	--------	--------	3.1	2.2	--------	--------	50	2.2	--------	--------	+3.0	--------	--------	+0.002	--------	--------	+50	Upper Operating Tolerance	A.C.
12/10	1730	--------	--------	2.9	1.8	--------	--------	46	1.8	--------	--------	-3.0	--------	--------	-0.002	--------	--------	-50	Lower Operation Tolerance	A.C.
12/18	1900	3.0	2.7	3.0	2.1	40	60	48	2.1	80.6	80.0	0.6	0.000	0.000	0.000	8000	8002	1	Annual	A.C.

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FIGURE 33. EXAMPLE OF FAA FORM 6750-33 FOR MARK 20 MARKER

Technical Performance Record — ILS Built-In Test Equipment (BITE) Reference Data

Identification	Location	From	Supervisors Signature
SSF	Oklahoma City	12/10/03	
Equipment Number	**Course or Clearance**	**Localizer, Glide Slope, or Marker**	**Equipment Type**
—	—	Marker	Outer Marker

Date 03	Zulu Time	Power Reference: CSB/MARKER: Commanded Power Value (watts)	Power Reference: CSB/MARKER: Power reference measurement *	Power Reference: CSB/MARKER: PMDT Displayed Power (watts)	Power Reference: CSB/MARKER: PMDT Displayed VSWR	Power Reference: SBO: Commanded Power Value (%)	Power Reference: SBO: Power reference measurement *	Power Reference: SBO: PMDT Displayed Power (milliwatts)	Power Reference: SBO: PMDT Displayed VSWR	Mod. Percentage (SDM) CSB\MARKER: Ext Test Equip (% SDM)	Mod. Percentage (SDM) CSB\MARKER: BITE SDM (Tx % SDM)	Mod. Percentage (SDM) CSB\MARKER: Mod % Error (Ext-BITE % SDM)	Diff-In-Depth Mod.(DDM) CSB: Ext Test Equip (DDM)	Diff-In-Depth Mod.(DDM) CSB: BITE Modulation Balance (Tx DDM)	Diff-In-Depth Mod.(DDM) CSB: DDM Error (Ext-BITE DDM)	Clearance Frequency Separation (if applicable): Freq. Diff. Ext Test Equip (Course-Clearance Hz)	Clearance Frequency Separation (if applicable): BITE Crs/Clrnce Freq Diff (Hz)	Clearance Frequency Separation (if applicable): Freq. Sep. Error (Ext-BITE Hz)	Remarks *Reference may be power (Watts) or digital voltmeter (Volts)	Initials
12/10	1900	2.0	1.9	2.0	2.0					96.5	98.0	-2.5							Standard or Reference	A.C.
12/10	1900	--------	--------	2.1	2.2	--------	--------			--------	--------	+3.0	--------	--------		--------	--------		Upper Operating Tolerance	A.C.
12/10	1900	--------	--------	1.9	1.8	--------	--------			--------	--------	-3.0	--------	--------		--------	--------		Lower Operation Tolerance	A.C.
12/18	2100	2.0	1.9	2.0	2.0					96.6	98.0	-2.4							Annual	A.C.

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