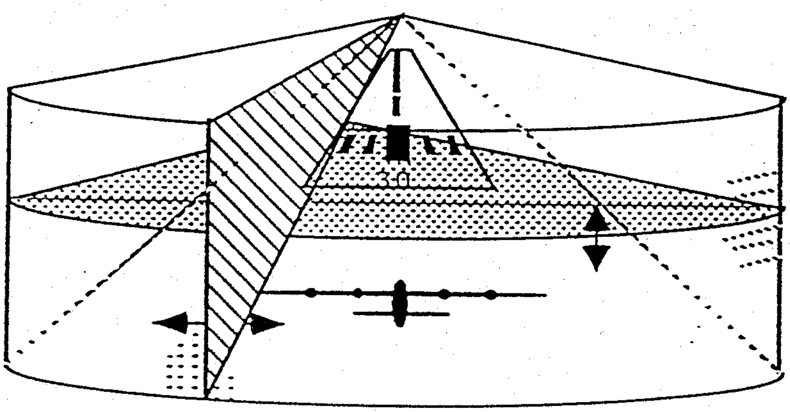
Specification No. 404L-50464-S-108A
1 September 1993

SYSTEM SPECIFICATION
for the
MOBILE MICROWAVE LANDING SYSTEM
REVISION A

CONTRACT NO. F19628-88-C-0062

MOBILE MLS



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1 SCOPE

1.1 Identification. This System Specification establishes the requirements for the Mobile Microwave Landing System (MMLS).

1.2 Purpose. The MMLS is a precision approach guidance system that will provide a landing capability for operations in adverse weather. This capability will support initial deployment of ground forces, forward area resupply, medical evacuation, special operations missions, and other missions not suited for the larger fixed microwave landing systems (MLS). MMLS will also be used to restore landing services to bases that have lost their fixed base capability. The MMLS will be interoperable with civil and military MLS avionics complying with International Civil Aviation Organization (ICAO) standards and recommended practices (SARPS). The MMLS design will allow the equipment to be deployed to meet a number of different siting and mission scenarios.

1.3 Introduction. This document establishes the performance, design, development, and test requirements for the MMLS.

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2 APPLICABLE DOCUMENTS

2.1 Government Documents. The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

SPECIFICATIONS:

Military

MIL-B-82117D 25 July 1983	Battery, Storage: Silver-Zinc, Rechargeable; General Specification for
MIL-C-38999H 27 February 1981 Supplement 1 21 September 1981 Amendment 2 30 September 1986	General Specification for Connector, Electrical
MIL-C-4150J 29 November 1989	Cases, Transit and Storage, Waterproof and Water-Vapor Proof
MIL-C-45150J 17 September 1986	Chassis, Trailer 2-Wheel Cart Type 1/4 to 3 1/2 Ton.
MIL-C-46168D 21 May 1987 Amendment 1 5 August 1987	Coating, Aliphatic Polyurethane, Chemical Agent Resistant
MIL-C-55302E 9 April 1986	Connector, Printed Circuit Subassembly and Accessories
MIL-C-13294C 22 November 1966 Amendment 3 18 December 1975	Cables, Telephone, Electrical (Infantry Field Wire, Twisted Pair, Wire WD-1/TT and WD-1A/TT)
MIL-C-83723D 27 December 1977 Supplement 1 27 December 1977	Connector, Electrical
MIL-C-83733C 28 July 1986 Supplement 1 28 July 1986	Connector, Electrical

MIL-E-4158E 2 January 1973 Amendment 3 31 December 1985	Electronic Equipment, Ground, General Requirements for
MIL-E-5400T 16 November 1979 Amendment 2 9 May 1986	Electronic Equipment, Aerospace, General Specification for
MIL-F-14072C 16 August 1984 Amendment 1 1 June 1986	Finishes for Ground Electronic Equipment
MIL-I-81550C 14 July 1983	Insulating Compound, Electrical, Embedding, Reversion Resistant Silicone
MIL-M-87033 23 November 1977	Mitten Set, Extreme Cold Weather
MIL-P-9024G 6 June 1972	Packaging, Handling, and Transportability for System/Equipment Acquisition
MIL-P-85582A 8 February 1988	Primer Coatings: Epoxy, Waterborne
MIL-S-8516E 30 July 1971 Amendment 2 29 September 1972	Sealing Compound, Polysulfide Rubber, Electric Connectors and Electric Systems, Chemically Cured
MIL-S-23586E 10 July 1987	Sealing Compound, Electrical, Silicone Rubber, Accelerator Required
MIL-T-10579H 17 February 1988	Trailers, Cargo: 2 Wheel, 1/4 Ton to 1-1/2 Ton
S.N. 5684571001 9 September 1974	System Segment Specification for TACAN Navigation Set AN/ARN-118(v)
S.N. 404L-50464-S-109 5 August 1987	System Specification for the Commercial Microwave Landing Systems Avionics

Other Government Agency

DOD-P-15328D Amendment 1 11 April 1983	Primer (Wash), Pretreatment (Formula No.117 for Metals) (Metric)
FAA-E-2721/11 19 June 1986	Microwave Landing System Ground Equipment, General Requirements

Federal

FED-STD-595A 2 January 1968 Notice 9 29 May 1985	Color (Requirements for Individual Color Chips)

Military

MIL-STD-129J 25 September 1984 Notice 1 5 November 1986	Marking for Shipment and Storage
MIL-STD-130F 21 May 1982 Notice 2 1 May 1986	Identification Marking of U.S. Military Property
MIL-STD-21OC 9 January 1987	Climatic Extremes for Military Equipment
MIL-STD-454K 14 February 1986	Standard General Requirements for Electronic Equipment
MIL-STD-490A 4 June 1985	Specification Practices
MIL-STD-633E 22 February 1980	Mobile Electric Power Engine Generator Standard Family Characteristics
MIL-STD-810D 19 July 1983 Notice 1 31 July 1986	Environmental Test Methods and Engineering Guidelines
MIL-STD-883C 25 August 1983 Notice 4 29 November 1985 Notice 6 17 August 1987	Test Methods and Procedures for Microelectronics
MIL-STD-1472C 2 May 1981 Notice 2 10 May 1984 Notice 3 17 March 1987	Human Engineering Design Criteria for Military Systems, Equipment and Facilities

MIL-STD-1629A 24 November 1980 Notice 2 28 November 1984	Procedures for Performing a Failure Mode Effects and Criticality Analysis
MIL-STD-1815A 22 January 1983	ADA Programming Language
MIL-STD-2073A-1A 16 July 1984	DOD Material Procedures for Development and Application of Packaging Requirements

Other Government Agency

DOD-STD-2167 4 June 1985	Defense System Software Development

OTHER PUBLICATIONS:

Manuals

AFM 55-8 Revised May 1963	U.S. Flight Inspection Manual Procedures
Change 44 24 April 1986	
AFM 55-9 July 1976 Changes 1 through 6	U.S. Standard for Terminal Instrument Procedures
AFM 88-14 17 September 1979	Visual Air Navigation Facilities
DOD 5000.39 17 November 1983	Acquisition and Management of Integrated Logistics Support for Systems and Equipment
DM 7.2 May 1982	U.S. Navy Facilities Design Manual
TM 5-803-4 15 July 1983	Planning of Army Aviation Facilities

Regulations

AFR 66-1 21 April 1983	Maintenance Management Policy
AFR 66-14 15 November 1978	Equipment Maintenance Policies, Objectives and Responsibilities

AFR 86-5 1 September 1983	Planning Criteria and Waivers for Airfield Support Facilities
AFR 86-14 12 May 1981	Airfield and Heliport Planning Criteria

Handbooks

GFB Issue 01 Revision E 7 March 1986	Government Furnished Baseline Electrical/Electronic Parts
GFB Issue 01 March 1986	Government Furnished Baseline Mechanical Parts
MIL-HDBK-300L 1 October 1983	Technical Information File of Ground Support Equipment
ESD-TR-85-148 March 1985	Derated Application of Parts for ESD Systems Development

Pamphlets

DA 700-21-1 March 83 Change 1	Department of the Army Pamphlet Test, Measurement, and Diagnostic Equipment Preferred Item List

Reports

ARCSL-CR-81053 November 1981	Chemical and Biological Protective Equipment Guidelines for Modular Collective Protection Equipment Use Systems

Orders

FAA Order 8240.50 2 January 1990	Flight Inspection of Microwave Landing Systems (MLS)

2.2 Non-Government Documents. The following documents of the exact issue shown form a part of this specification to the extent specified herein.

In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

STANDARDS:

RTCA DO-177 17 July 1981 Airborne Receiving Equipment	Minimum Operational Performance Standard for Microwave Landing System (MLS)

RTCA DO-189 20 September 1985 Operating within the Radio Frequency Range of 960-1215 Megahertz	Minimum Operational Performance Standards for Airborne Distance Measuring Equipment
RTCA DO-198 18 March 1988	Minimum Operational Performance Standard for Airborne MLS Area Navigation Equipment
ICAO SARPS Annex 10 April 1985 Amendment 67 22 October 1987	International Civil Aviation Organization International Standards, Recommended Practices and Procedures or Air Navigation Services, Annex 10: Aeronautical Telecommunications
ICAO Doc. 8071 Volume II 1972	Manual on Testing of Radio Navigation Aids, Volume II, ILS

3 REQUIREMENTS

3.1 System Definition. The MMLS will consist of ground-based precision approach equipment that generates microwave guidance signals that enable MLS-equipped aircraft to continuously display aircraft position relative to a selected course and glidepath. MMLS shall provide an all weather range of 15 nautical miles, usable guidance signals for approaches on glidepaths ranging from 2.5° to 12.5° in elevation, and courses of ±40° in azimuth. Azimuth and elevation angle information will be provided by a time reference scanning beam (TRSB) technique, and distance information will be provided by precision distance measuring equipment (DME/P). Both angle and distance signals will be transmitted in accordance with ICAO SARPS to ensure interoperability with international standard civil MLS. MMLS shall include approach azimuth equipment, approach elevation equipment, a DME/P transponder, internal power sources, signal monitoring equipment, control and display equipment, and detachable obstruction lights. The equipment may be set up in different configurations including the collocated and split-site configurations shown in figure 1.

3.1.1 Missions. The MMLS will provide a precision approach capability for a variety of tactical missions. A description of major missions by military organization follows.

3.1.1.1 U.S. Air Force. The MMLS will be used at bases that have lost precision approach capabilities. In other cases, the MMLS, accompanied by an installation and maintenance team with a readiness spares package (RSP), will be transported to the affected base to provide interim mission support (IMS). Maintenance personnel at the deployment base supply will requisition spares as necessary to back-fill the RSP as it is depleted. Once installed, MMLS will operate for periods of up to one year. The system will also be used for Combat Communications Group (CCG) operations. CCGs may deploy MMLS to replace Combat Control Teams (CCT) and to support other quick-reaction precision approach and landing needs.

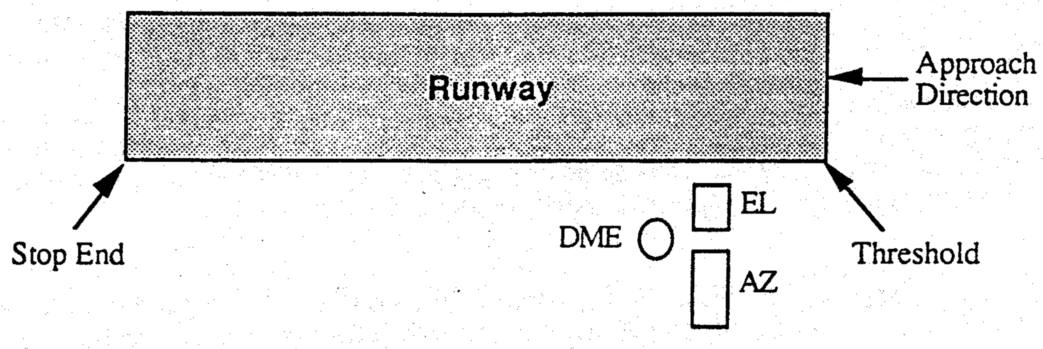
3.1.1.2 U.S. Army. The MMLS will be used to service landing areas and airfields at corps and echelons above corps with a precision landing capability. Three-to-five person teams will set up and operate the equipment.

3.1.2 Threat. MMLS may operate in environments which may be targeted by the enemy for physical and electronic disruption and in which chemical agents may be used. However, there is no requirement to design the MMLS for survivability.

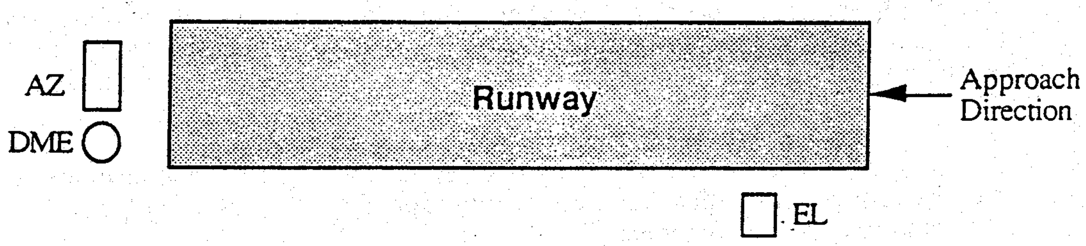
3.1.3 Modes and States. MMLS approach azimuth equipment, approach elevation equipment and DME/P equipment shall have the following modes: OFF, STANDBY, MAINTENANCE, SERVICE-DEMAND, and ON. MMLS shall exist in two states, deployed and stored. When in a deployed state, all modes shall be possible.

3.1.3.1 MMLS Modes.

3.1.3.1.1 OFF Mode. When OFF, primary power shall be removed and the system shall be inoperative.



a. Collocated Configuration



b. Split-Site Configuration

Figure 1. MMLS Configurations

3.1.3.1.2 STANDBY Mode. When STANDBY is selected, primary power shall be applied for the purpose of equipment setup and stabilization but the equipment shall not radiate. All leveling and calibration circuits, data entry and display, and built-in test (BIT) functions shall be enabled. After a maximum of five minutes in STANDBY, MMLS shall be stabilized and capable of operating at specified performance levels when switched to the SERVICE-DEMAND or ON modes.

3.1.3.1.3 MAINTENANCE Mode. When MAINTENANCE is selected, MMLS shall continue to radiate but the monitor shall be inhibited from shutting down the equipment. When initially selected, the parity of all preamble codes shall be changed from even to odd, the Morse code identification shall be suppressed, and Basic Data Word 6 shall be inhibited from radiation. By explicit action, it shall be possible to continue to radiate with valid parity and/or to transmit identification in Morse code and Basic Data Word 6. When in MAINTENANCE mode, BIT shall be enabled to detect and isolate faults and perform diagnostic testing. All leveling and alignment circuits shall be enabled and end-to-end integrity checks shall be possible.

3.1.3.1.4 SERVICE-DEMAND Mode. When SERVICE-DEMAND is selected, MMLS shall operate in a radio-silent demand mode. In this mode there shall be no MMLS transmissions until a correctly coded DME interrogation is received, after which full transmission shall continue as long as DME interrogations are received and MMLS transmissions are within monitor limits. The delay between receipt of a DME interrogation and activation of the angle guidance radiation shall not exceed five seconds. The delay between cessation of DME interrogations and deactivation of the angle guidance radiation shall be selectable as 10 seconds, 30 seconds, or 2 minutes.

3.1.3.1.5 ON Mode. When ON is selected, MMLS shall radiate as specified herein as long as the system remains within monitor limits.

3.1.3.2 MMLS States.

3.1.3.2.1 Deployed State. MMLS shall be considered in the deployed state when all equipment is set up and capable of generating microwave guidance signals.

3.1.3.2.2 Stored State. In a stored state, MMLS shall be disassembled and packaged for transport.

3.1.4 System Functions. MMLS shall perform angle guidance and data transmission, ranging, monitoring, and control and display functions. MMLS shall provide high-rate approach azimuth guidance.

3.1.4.1 Angle Guidance and Data Transmission Functions.

3.1.4.1.1 Channeling. The angle and data functions shall operate on any one of the 200 channels specified in 3.11.4.1.1, including referenced tables, of ICAO SARPS Annex 10. Any channel shall be selectable without alignment, replacement, or rewiring of components.

3.1.4.1.1.1 Frequency Tolerance. MMLS operating frequency tolerance shall be as specified in 3.11.4.1.3 of ICAO SARPS Annex 10.

3.1.4.1.1.2 Radio Frequency Signal Spectrum. The MMLS frequency signal spectrum shall be as specified in 3.11.4.1.4 of ICAO SARPS Annex 10.

3.1.4.1.2 Polarization. The radio frequency transmissions from MMLS shall be vertically polarized.

3.1.4.1.3 Signal Organization. Both angle information and data shall be transmitted by time-division-multiplex (TDM) on a single radio frequency channel.

3.1.4.1.3.1 Function Rates. Function rates for high-rate approach azimuth guidance, approach elevation guidance, and basic data functions shall be as specified in 3.11.4.3.3, including referenced tables, of ICAO SARPS Annex 10. Auxiliary data functions shall be transmitted at a rate of at least 1 Hz within the timing constraints of the ICAO Annex 10 sequence.

3.1.4.1.3.2 Function Timing. Timing standards for preamble, high-rate approach azimuth, approach elevation, basic data, and auxiliary data functions shall be as specified in 3.11.4.3.4, including referenced tables, of ICAO SARPS Annex 10.

3.1.4.1.3.3 Function Sequence. Function sequences shall be as specified in 3.11.4.3.5 of ICAO SARPS Annex 10.

3.1.4.1.3.4 Synchronization. Angle and data transmissions shall be time synchronized to prevent overlap on the selected operational channel. It shall be possible to synchronize transmissions between approach azimuth and approach elevation equipment separated by up to 15,000 ft. MMLS shall maintain specified performance for a period of at least 2 minutes after loss of synchronization. The elevation function shall cease transmission 2 minutes after loss of synchronization.

3.1.4.1.4 Preamble. A preamble signal shall be transmitted as specified in 3.11.4.4.1, including referenced tables, of ICAO SARPS Annex 10.

3.1.4.1.4.1 Carrier Acquisition. Carrier acquisition shall be as specified in 3.11.4.4.2, including referenced tables, of ICAO SARPS Annex 10.

3.1.4.1.4.2 Modulation. Preamble information shall be modulated and encoded as specified in 3.11.4.4.3.1, including referenced paragraphs, of ICAO SARPS Annex 10.

3.1.4.1.4.3 Receiver Reference Time Code. A receiver reference time code shall be transmitted as specified in 3.11.4.4.3.2 of ICAO SARPS Annex 10.

3.1.4.1.4.4 Function Identification. The codes for function identification shall be as specified in 3.11.4.4.3.3, including referenced tables, of ICAO SARPS Annex 10.

3.1.4.1.5 Angle Guidance Encoding. Angle guidance information shall be encoded as specified in 3.11.4.5 of ICAO SARPS Annex 10.

3.1.4.1.5.1 Angle Guidance Parameters. Angle guidance parameters for high-rate approach azimuth and approach elevation functions shall be as specified in 3.11.4.5.1, including referenced tables, of ICAO SARPS Annex 10.

3.1.4.1.5.2 Angle Guidance Parameter Tolerances. The tolerances on the scanning beam velocity and the time separation between TO and FRO pulses corresponding to 0° shall be sufficient to satisfy the accuracy requirements specified in 3.1.4.1.9.

3.1.4.1.5.3 Scan Transmission Symmetry. The TO and FRO scan transmissions for the high-rate approach azimuth and approach elevation functions shall be as specified in 3.11.4.5.3, including referenced tables, of ICAO SARPS Annex 10.

3.1.4.1.6 Azimuth Guidance Functions.

3.1.4.1.6.1 Scanning Convention. The conventions for transmission of azimuth angle guidance shall be as specified in 3.11.4.6.1, and the accompanying note, of ICAO SARPS Annex 10.

3.1.4.1.6.2 Sector Signals. The sector signal format for azimuth shall be as specified in 3.11.4.6.2 of ICAO SARPS Annex 10.

3.1.4.1.6.2.1 Morse Code Equipment Identification. The approach azimuth equipment shall transmit Morse code identifications as specified in 3.11.4.6.2.1 of ICAO SARPS Annex 10.

3.1.4.1.6.2.2 Airborne Antenna Selection Signal. The approach azimuth equipment shall transmit an airborne antenna select signal as specified in paragraph 3.11.4.6.2.2 of ICAO SARPS Annex 10.

3.1.4.1.7 Elevation Guidance Functions.

3.1.4.1.7.1 Scanning Conventions. The elevation guidance scanning beam shall be as specified in 3.11.4.7.1 of ICAO SARPS Annex 10.

3.1.4.1.7.2 Sector Signals. The sector signal format for elevation shall be as specified in 3.11.4.7.2, including referenced paragraphs and tables, of ICAO SARPS Annex 10.

3.1.4.1.8 Data Functions. The MMLS signal format shall provide for the transmission of basic and auxiliary data as specified in 3.1.4.1.4.2.

3.1.4.1.8.1 Basic Data. The MMLS basic data content shall be as specified in Appendix C of RTCA DO-198.

3.1.4.1.8.2 Auxiliary Data. The MMLS auxiliary data shall be as specified in Appendix C of RTCA DO-198. MMLS shall provide storage in the auxiliary data word data base for 192 words.

3.1.4.1.9 System Accuracy. MMLS shall be capable of providing Category I and Category II operational performance under the respective setup and siting conditions specified herein. System accuracy requirements shall be met with the inclusion of errors from all sources, including those from the ground equipment, propagation effects, and airborne equipment. Avionics that meet the requirements of S.N. 404L-50564-S-109 and S.N. 5684571001 should be assumed.

3.1.4.1.9.1 Azimuth Accuracy.

3.1.4.1.9.1.1 Mean Course Error. The mean course error shall not exceed the following values under the specified conditions on a 95 percent probability basis:

a. Category I. ±40 ft at the approach reference datum and ±185 ft at ILS Point "A" with the equipment set up as specified in 3.2.10.1.1 and 3.2.10.1.2.1 and sited as specified in 3.2.10.2.1 and 3.2.10.2.2.1.

b. Category II. ±17 ft at the approach reference datum with the equipment set up as specified in 3.2.10.1.2.2 and sited as specified in 3.2.10.2.2.2.

3.1.4.1.9.1.2 Azimuth Path Following Noise (PFN). The azimuth PFN shall not be greater than the following values under the specified conditions on a 95 percent probability basis:

a. Category I. ±42 ft at the 200 ft decision height along a 3° glidepath with the equipment set up as specified in 3.2.10.1.1 and 3.2.10.1.2.1 and sited as specified in 3.2.10.2.1 and 3.2.10.2.2.1.

b. Category II. ±11.4 ft at the 100 ft decision height along a 3° glidepath with the equipment set up as specified in 3.2.10.1.2.2 and sited as specified in 3.2.10.2.2.2.

3.1.4.1.9.1.3 Azimuth Degradation Allowance. The approach azimuth angular PFN should be allowed to degrade linearly to the limits of coverage as follows:

a. With Distance. The PFN shall not exceed 1.75 times the value specified.

b. With Azimuth angle. The PFN at ±40° azimuth angle shall not exceed one-half times the value of the extended runway centerline at the same distance from the approach reference datum.

c. With Elevation Angle. The PFN shall not degrade up to an elevation angle of 9°. The PFN limit at an elevation angle of 15° shall not exceed two times the value permitted below 9° at the same distance from the approach reference datum and the same azimuth angle.

3.1.4.1.9.1.4 Azimuth Control Motion Noise (CMN). The azimuth CMN shall not be greater than ±10.5 ft or 0.1°, whichever is less, when measured at the approach reference datum under the specified conditions on a 95 percent basis.

3.1.4.1.9.1.5 Azimuth CMN Degradation Allowance. The approach azimuth angular CMN shall be allowed to degrade as specified in paragraph 3.11.4.9.4.3 of ICAO SARPS Annex 10.

3.1.4.1.9.2 Elevation Accuracy.

3.1.4.1.9.2.1 Mean Glidepath Error. The mean glidepath error shall not exceed the following values under the specified conditions on a 95 percent probability basis:

a. Category I. ±0.168° at the approach reference datum with the equipment set up as specified in 3.2.10.1.1 and 3.2.10.1.2.1 and sited as specified in 3.2.10.2.1 and 3.2.10.2.2.1.

b. Category II. ±0.12° at the approach reference datum with the equipment set up as specified in 3.2.10.1.2.2 and sited as specified in 3.2.10.2.2.2.

3.1.4.1.9.2.2 Elevation PFN. The elevation PFN shall not be greater than the following values under the specified conditions on a 95 percent probability basis:

a. Category I. ±0.144° at the 200 ft decision height along a 3° glidepath with the equipment set up as specified in 3.2.10.1.1 and 3.2.10.1.2.1 and sited as specified in 3.2.10.2.1 and 3.2.10.2.2.1.

b. Category II. ±0.053° at the 100 ft decision height along a 3° glidepath with the equipment set up as specified in 3.2.10.1.2.2 and sited as specified in 3.2.10.2.2.2.

3.1.4.1.9.2.3 Elevation Degradation Allowance. The approach elevation angular PFN shall be allowed to degrade linearly to the limits of coverage as follows:

a. With Distance. The PFN shall not exceed 0.175°.

b. With Elevation Angle. For elevation angles from 3° to 15°, the PFN limit shall be allowed to increase linearly to two times the value specified in 3.1.4.1.9.2.2. For elevation angles below 2.5° to the lower limit of coverage, the PFN limit shall be allowed to increase linearly to six times the value specified in 3.1.4.1.9.2.2. No degradation is allowed from 2.5 to 3.0° elevation angle.

c. With Azimuth Angle. The PFN at ±40° azimuth about the elevation antenna phase center shall not exceed the value on the extended runway center line at the same distance from the approach reference datum.

3.1.4.1.9.2.4 Elevation CMN. The elevation CMN shall not be greater than ±1 ft at the approach reference datum for equipment sited to provide a minimum glidepath of nominally 3° or lower.

3.1.4.1.9.2.5 Elevation CMN Degradation Allowance. The approach elevation angular CMN shall be allowed to degrade linearly to the limits of coverage as follows:

a. With Distance and Angle. The limits shall be specified in 3.11.4.9.6.1 (a) and (b) of ICAO SARPS Annex 10.

b. For elevation angles from 3° to 15°, the CMN limit shall be allowed to increase linearly to 2 times the value specified in 3.1.4.1.9.2.4. For elevation angles below 2.5° to the lower limit of coverage, the CMN limit shall be allowed to increase linearly to 6 times the value specified in 3.1.4.1.9.2.4. No degradation is allowed from 2.5° to 3.0° elevation angle. CMN shall not exceed 0.4° at any elevation angle.

3.1.4.1.10 Power Density. The power density for data functions shall be as specified in 3.11.4.10.1 of ICAO SARPS Annex 10, including the referenced table. The power density for angle guidance functions shall be as specified in figure G-12 and 3.11.4.10.2.a of ICAO SARPS Annex 10.

3.1.4.1.11 Residual Radiation. The residual radiation from MMLS transmissions shall be as specified in 3.11.5.1.1 of ICAO SARPS Annex 10.

3.1.4.1.12 Coverage. The MMLS shall provide azimuth, elevation, preamble, and data information at the specified power densities in the following sectors (see figures 2 and 3):

a. Azimuth coverage is to extend 40° to either side of the antenna boresight.

b. Elevation coverage is required between the following two conical surfaces. Each defining cone has its vertex at the elevation antenna phase center and axis lying along the vertical. The cone defining the lower surface of coverage is inclined at 0.9° relative to the horizontal. The cone defining the upper surface limit is inclined at an angle of 15°. Coverage is only required to 20,000 ft above threshold.

c. Coverage in range is required to 17 nautical miles (nmi) from the azimuth antenna.

d. For Category I service, coverage is only required above a horizontal cutoff 150 feet above threshold and beyond a vertical plane oriented perpendicular to the runway centerline located to contain the point on a 3° glideslope 150 ft above threshold.

e. For Category II service, coverage is only required above a horizontal cutoff 50 ft above threshold and beyond a vertical plane oriented perpendicular to the runway centerline located to contain the point on a 3° glideslope 50 ft above threshold.

3.1.4.1.12.1 Azimuth Scan Adjustment. The azimuth scan coverage shall be adjustable from 10° to the maximum scan angle in two degree increments on both sides, independently, of the antenna boresight. Adjustments in scan coverage shall automatically update the basic data words.

3.1.4.1.12.2 Elevation Scan Adjustment. The minimum elevation scan coverage limit shall be adjustable from minus 0.4° to at least plus 6.0° in 0.1° increments. Adjustments above 0.75θ (where θ is the minimum glidepath angle identified in the basic data word and the range of minimum glidepaths is from 2.5° to 12.5°) shall be precluded.

3.1.4.1.13. Azimuth Scanning Beam Characteristics. Azimuth equipment antennas shall produce a beam as specified in 3.11.5.2.1 of ICAO SARPS Annex 10.

3.1.4.1.13.1 Beamwidth. The antenna beamwidth shall be as specified in 3.11.5.2.1.2, including the accompanying note, of ICAO SARPS Annex 10.

3.1.4.1.13.2 Scanning Beam Shape. The minus 10 dB points on the beam envelope shall be displaced from the beam center by at least 0.76 beamwidth, but not more than 0.96 beamwidth.

3.1.4.1.13.3 Dynamic Sidelobes. The dynamic sidelobes shall not exceed the values necessary to satisfy the accuracy specifications in 3.1.4.1.9.1. Furthermore, the dynamic sidelobes or any spurious signal generated by the azimuth equipment shall be at least 10 dB below the main lobe level. This requirement shall apply throughout the proportional guidance sector.

3.1.4.1.14 Elevation Scanning Beam Characteristics. elevation equipment antennas shall produce a beam as specified in 3.11.5.3.1 of ICAO SARPS Annex 10.

3.1.4.1.14.1 Beamwidth. The antenna beamwidth shall be as specified in 3.11.5.3.1.2 of ICAO SARPS Annex 10.

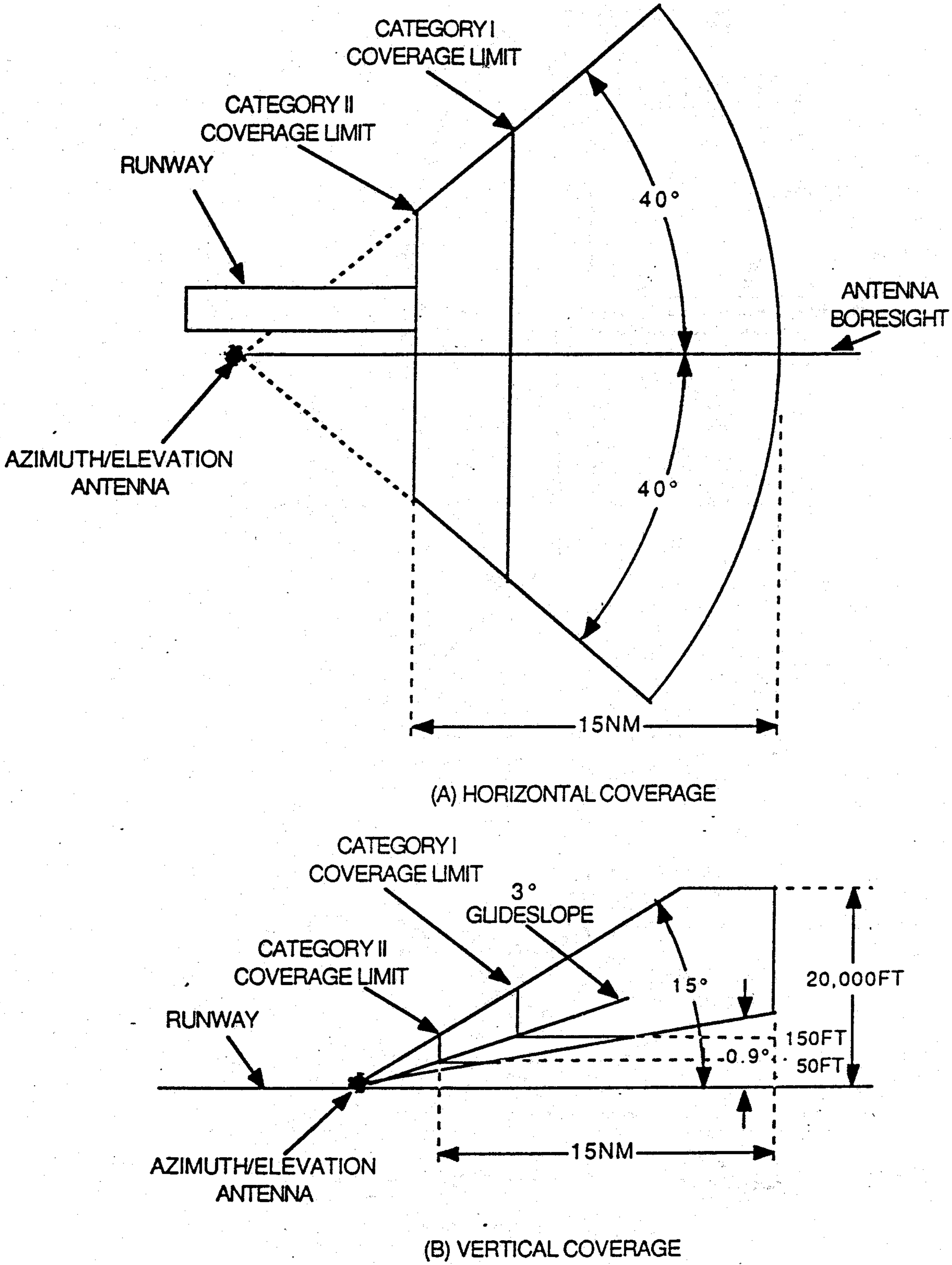


Figure 2. Elevation Equipment and Collocated Equipment Azimuth Coverage

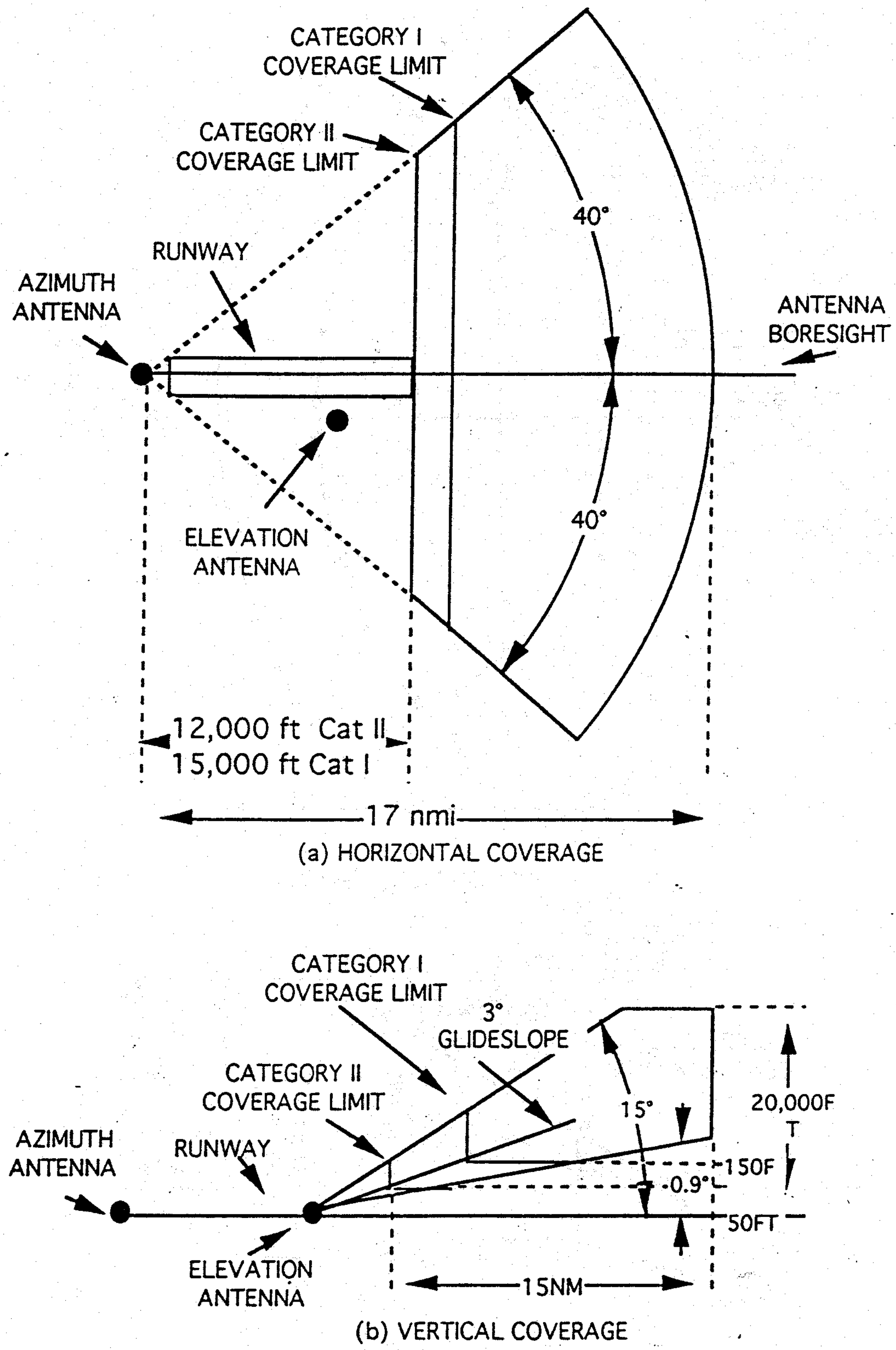


Figure 3. Split Site Azimuth Equipment Coverage

3.1.4.1.14.2 Scanning Beam Shape. The minus 10 dB points on the beam envelope shall be displaced from the beam center by at least 0.76 beamwidth, but not more than 0.96 beamwidth.

3.1.4.1.14.3 Dynamic Sidelobes. The dynamic sidelobes shall not exceed the values necessary to satisfy the accuracy specifications in 3.1.4.1.9.2. Furthermore, the dynamic sidelobes or any spurious signal generated by the elevation equipment shall be at least 10 dB below the main lobe level. This requirement shall apply throughout the proportional guidance sector.

3.1.4.2 Ranging Functions.

3.1.4.2.1 DME/P System Characteristics.

3.1.4.2.1.1 DME/P Coverage. The DME/P shall provide a cylindrical region of coverage extending l7 nmi from the DME/P antenna. This basic coverage volume shall be further limited as follows:

a. Coverage is only required between horizontal planes 50 ft and 20,000 ft above the runway threshold.

b. Coverage is only required between the following two conical surfaces. Each defining cone has its vertex at the DME/P antenna with its axis lying along the vertical. The cone defining the lower surface of coverage is inclined at 0.9° relative to the horizontal. The cone defining the upper surface limit is inclined at an angle of 15°.

c. Coverage at the reference datum shall be provided under all conditions.

3.1.4.2.1.2 Channeling. The DME/P shall operate on any of the 200 channels paired to an MLS channel as specified in table A of ICAO SARPS Annex 10. Any channel shall be selectable without alignment, replacement, or rewiring of components.

3.1.4.2.1.3 Capacity. The processing capacity of the transponder shall be sufficient for handling 100 interrogators, 50 of which may be operating in the final approach (FA) mode.

3.1.4.2.1.4 DME/P Transponder Identification. The DME/P shall transmit an identification signal as specified for transponders associated with MLS facilities in 3.5.3.6 including subparagraphs of ICAO SARPS Annex 10.

3.1.4.2.1.5 DME/P Modes. The DME/P shall have two operating modes, initial approach (IA) and FA. Mode transition shall be as specified in 3.5.3.7 of ICAO SARPS Annex 10.

3.1.4.2.2 DME/P Transmitter.

3.1.4.2.2.1 Frequency of Operation. The transponder shall transmit on the reply frequency of the operating channel assigned in 3.1.4.2.1.2.

3.1.4.2.2.2 Frequency Stability. Transmitter frequency stability shall be as specified in 3.5.4.1.2 of ICAO SARPS Annex 10.

3.1.4.2.2.3 Pulse Shape and Spectrum. The pulse shape and spectrum shall be as specified for DME/P accuracy standard 1 radiated pulses in 3.5.4.1.3 of ICAO SARPS Annex 10.

3.1.4.2.2.4 Pulse Spacing. Pulse spacing for DME/P shall be as specified in table A and 3.5.4.1.4, including subparagraphs, of ICAO SARPS Annex 10.

3.1.4.2.2.5 Power Density. The peak power output shall be as specified for DME/P in 3.5.4.1.5, including subparagraphs, of ICAO SARPS Annex 10 excluding the power density requirement at 8 ft above the runway surface.

3.1.4.2.2.6 Spurious Radiation. Spurious radiation requirements shall be as specified for DME/P in 3.5.4.1.6, including subparagraphs, of ICAO SARPS Annex 10.

3.1.4.2.2.7 Squitter. Squitter pulse pairs shall be automatically generated and controlled to maintain a minimum DME/P output transmission rate that is not less than 700 pulse pairs per second. In no case shall this minimum output transmission rate exceed 1,200 pulse pairs per second. No squitter shall be added when the output transmission rate is greater than the minimum rate. DME/P receiver internal noise shall not be used as the source for squitter pulses. Distribution of squitter pulse pairs shall be nonuniform, with no pulse pairs spaced less than 200 microseconds (μs) apart or within the range of 730 to 750 μs. Squitter pulses shall not be generated while equipment is in STANDBY or in the STANDBY portion of the SERVICE-DEMAND mode.

3.1.4.2.2.8 Priority of Transmission. Transmission of DME/P output signals shall have the following order of precedence:

a. Distance reply pulse pairs in the FA mode

b. Identification pulse pairs

c. Distance reply pulse pairs in the IA mode

d. Squitter pulse pairs

Transmission priority, employing priority intervals, shall be established on the basis of the first pulse of a pulse pair. Two priority intervals, neither of which shall exceed 12 μs, shall exist before and after the virtual origin of the first pulse. If this virtual origin falls within another pulse's priority intervals, the order of priority, as listed above, shall govern which pulse pair is to be transmitted. Should the virtual origin fall outside of the priority intervals, then priority becomes void and transmission shall be effected for the virtual origin occurring first, provided its transmission is consistent with other specification constraints. The identification pulse pairs shall be inhibited, except during the Morse code key-down periods. During these key-down periods, no pulse pairs of lesser precedence shall be transmitted. The IA mode distance reply pulse pairs shall not be inhibited during the time intervals between the Morse code key-down periods, unless they would coincide with an FA mode priority interval. Squitter pulse pairs shall be inhibited when the spacing between the squitter pulse pair and a reply pulse pair is such that the first pulse of the reply would be distorted.

3.1.4.2.3 DME/P Receiver.

3.1.4.2.3.1 Frequency of Operation. The receiver center frequency shall be the interrogation frequency of the DME operating channel assigned in 3.1.4.2.1.2.

3.1.4.2.3.2 Frequency Stability. Receiver frequency stability shall be as specified in 3.5.4.2.2 of ICAO SARPS Annex 10.

3.1.4.2.3.3 Sensitivity. Receiver sensitivity shall be as specified in 3.5.4.2.3, including subparagraphs, of ICAO SARPS Annex 10.

3.1.4.2.3.4 Sensitivity Reduction. Sensitivity reduction shall be as specified for DME/P in 3.5.4.2.4, including subparagraphs, of ICAO SARPS Annex 10.

3.1.4.2.3.5 Bandwidth. Receiver bandwidth shall be as specified for DME/P in both the IA and FA modes in 3.5.4.2.6, including subparagraphs, of ICAO SARPS Annex 10.

3.1.4.2.3.6 Recovery Time. Receiver recovery time shall be as specified in 3.5.4.2.7 of ICAO SARPS Annex 10.

3.1.4.2.3.7 Spurious Radiation. Spurious radiation requirements shall be as specified in 3.5.4.2.8 of ICAO SARPS Annex 10.

3.1.4.2.3.8 Echo Suppression. An echo suppression feature shall be provided for the IA operating mode that in no way affects the operation of the FA mode. The echo suppression feature shall be enabled for a selectable time interval when a valid IA mode interrogation pulse pair is received that has pulse amplitudes in excess of a preset level. During the echo suppression time interval, only IA mode pulse pairs with pulse amplitudes greater than the enabling pulse pair shall be recognized as valid IA mode interrogations. The preset enabling level shall be selectable from 10 dB above IA mode threshold sensitivity to greater than the maximum interrogation signal levels specified. The signal level required for IA mode pulse pairs to be recognized as valid during the echo suppression interval shall be selectable in the range from 0 to 6 dB above the enabling level. The echo suppression time interval shall be selectable over the range of 30 to 150 μsec. The signal level and echo suppression time interval values shall have a default capability, initially set at the factory to 3 dB and 50 μsec, respectively. Adjustment of the signal level and echo suppression time intervals shall be provided by a protected control.

3.1.4.2.3.9 CW Interference. Presence of a CW interference on the assigned channel frequency, or elsewhere within the receiver passband that has a peak power of -100 dBm at the antenna, shall not cause the reply efficiency of FA mode or IA mode interrogations from a single interrogator at their respective threshold sensitivity level to change by more than 10 percent from the reply efficiency value obtained without the CW interference. The signal level of the interrogations shall be:

a. FA Mode - Minimum sensitivity value

b. IA Mode - FA value plus 4 dB

3.1.4.2.4 Decoding. Decoding requirements shall be as specified for DME/P in 3.5.4.3, including subparagraphs, of ICAO SARPS Annex 10.

3.1.4.2.5 Time Delay. Time delay requirements shall be as specified for DME/P associated with MLS in both the IA and FA modes in 3.5.4.4, including subparagraphs, of ICAO SARPS Annex 10.

3.1.4.2.6 Accuracy. The DME/P transponder accuracy shall be as specified for DME/P accuracy standard 1 in both the IA and FA modes in 3.5.4.5, including subparagraphs, of ICAO SARPS Annex 10.

3.1.4.2.7 Efficiency. The DME/P transponder reply efficiency shall be as specified for DME/N and DME/P in both the IA and FA modes in 3.5.4.6, including subparagraphs, of ICAO SARPS Annex 10 under the loading specified in 3.1.4.2.1.3.

3.1.4.3 Monitor Functions. The MMLS shall provide a signal monitor function to ensure the integrity of the transmitted angle guidance, data, and the DME/P signals. The monitor shall include internal, integral, and field sensors. The design shall emphasize the use of internal and integral sensors rather than field sensors. Signals from the sensors shall be processed to provide a real time continuous assessment of system performance. A transmitted signal that is out of tolerance or failure of any part of the monitor function shall directly result in an alarm condition. For such parts as electronical or electromagnetic switching devices, where it is not practical to provide fail-safe operation under both failure modes (open circuit or short circuit), fail-safe protection shall be provided for the failure mode that is more likely to occur.

3.1.4.3.1 Integrity Requirement. The integrity of each azimuth, elevation, and DME/P equipment shall meet or exceed the level 2 integrity value specified in table C-2 of ICAO SARPS Annex 10. To ensure integrity, the transmitter and monitor shall be independent.

3.1.4.3.1.1 End-to-End Integrity Check Capability. Each azimuth equipment, elevation equipment, and DME/P equipment shall be capable of performing end-to-end integrity checks. The proper operation of each active monitor channel, any monitor voting logic, and the control circuits shall be verified by this check. It shall be possible to initiate these checks via the local control while in the MAINTENANCE mode. Failure of these checks shall cause a monitor alarm to occur.

3.1.4.3.2 Angle and Data Monitoring.

3.1.4.3.2.1 Angle and Data Monitor Parameters. MMLS shall be capable of monitoring at a minimum, the parameters specified below. The time periods specified shall include the monitor measurement period, monitor reaction times and delays in control functions.

a. A shift in the mean course of ±35 ft over a time interval of 10 seconds for Category I operations and of ±25 ft over a time interval of 5 seconds for Category II operations;

b. A shift in the mean glidepath of ±.225° over a time interval of 6 seconds for Category I operations and of ±.225° over a time interval of 2 seconds for Category II operations;

c. Reductions in the radiated power to less than that necessary to satisfy the requirements specified in 3.1.4.1.10 for a period of more than 6 seconds for Category I operations and 2 seconds for Category II operations;

d. Errors in preamble or data transmissions which persist for more than of 6 seconds for Category I operations and 2 seconds for Category II operations;

e. The timing standards specified in 3.1.4.1.3.2 are exceeded for a period of more than 6 seconds for Category I operations and 2 seconds for Category II operations; and

f. Errors in the TDM synchronization specified in 3.1.4.1.3.4 for more than 6 seconds for Category I operations and 2 seconds for Category II operations.

3.1.4.3.2.2 Angle and Data Monitor Characteristics. The monitor shall satisfy the following requirements:

a. The limits of each monitored parameter shall be adjustable over a range from +100 percent to -50 percent of the specified values, in increments of 10 percent. Adjusted parameter values shall take precedence over any preset or calculated values. This adjustment capability shall be provided by a protected control at the local control unit.

b. Monitors shall be capable of supporting the response times given in 3.1.4.3.2.1 when switched to the ON mode or angle guidance radiation is activated in the SERVICE-DEMAND mode.

c. Shifts in the mean angle error shall be measured by both a field sensor and an integral sensor. However, it shall be possible to inhibit the output from the field sensor as specified in 3.1.4.3.2.3.c.

d. An error in the data transmissions shall be indicated and localized to one of the following messages:

   1. Function preamble
   2. Morse code identification
   3. Basic data word
   4. Auxiliary data word

e. Where two or more sensors are used to monitor a single parameter, a majority of sensors shall agree that the parameter is in tolerance in order to permit radiation to continue.

f. In the MAINTENANCE mode the monitor shall be inhibited from interrupting radiation except while performing end-to-end integrity checks.

g. In MAINTENANCE mode, controls shall be provided to shift mean angles to the extent required to cause an alarm. The mean angle values shall be restored to their previously established values by manual entry or automatically upon leaving the MAINTENANCE mode.

3.1.4.3.2.3 Responses to Angle and Data Monitor Alarms. Angle and data monitor alarms shall cause radiation to cease in accordance with 6.1, excluding references to back azimuth and flare elevation functions of Attachment G to Part I of ICAO SARPS Annex 10 and shall automatically initiate the following actions:

a. Provide an automatic restart after 20 seconds. A means shall be provided at the local control to permit the selection of the monitor limits to be used in the restart attempt. It shall be possible to attempt restart without a change in monitor limits. When the equipment is operating under Category II monitor limits, it shall be possible to attempt the restart with the monitor limits automatically changed to those for Category I.

b. Provide visual alarm indications to the local and remote displays and aural alarms at the remote display. A control shall be provided to reset the aural alarm.

c. The ground equipment shall be capable of operation with the field sensor disabled for Category I service only. When the field sensor is disabled, an indication shall be provided on the local and remote displays.

3.1.4.3.3 DME/P Monitoring. The DME/P monitor shall cause the transponder radiation to cease and provide a warning at a control point if any of the following conditions persists for longer than the period specified:

a. there is a change in transponder PFE that exceeds the limits specified in either 3.5.4.5.3.1 or 3.5.4.5.4 of ICAO SARPS Annex 10 for more than 2 seconds. If the FA mode limit is exceeded, but the IA mode limit is maintained, the IA mode may remain operative;

b. there is a reduction in the effective radiated power to less than that necessary to satisfy the requirements specified in 3.1.4.2.2 of ICAO SARPS Annex 10 for a period of more than 1 second;

c. there is a reduction of 5 dB or more in the transponder sensitivity necessary to satisfy the requirements specified in 3.5.4.2.3 of ICAO SARPS Annex 10 for a period of more than 5 seconds (provided that this is not due to the action of the receiver automatic sensitivity reduction circuits);

d. the spacing between the first and second pulse of the transponder reply pulse pair differs from the value specified in the table in 3.5.4.4.1 of ICAO SARPS Annex 10 by 1.0 microsecond or more for a period of more than 1 second.

3.1.4.3.3.1 Monitor Logic and Adjustability. It shall not be possible for the monitor to turn on the MMLS equipment while in the SERVICE-DEMAND mode. In addition, the monitor shall be as specified in subparagraphs 3.5.4.7.3.2, 3.5.4.7.3.3, and 3.5.4.7.3.4 of ICAO SARPS Annex 10 except as modified in 3.1.4.3.3 and shall satisfy the following requirements:

a. Where two or more sensors are used to monitor a single parameter, a majority of the sensors must agree that the parameter is in tolerance in order to permit radiation to continue.

b. The limits of each monitored parameter shall be adjustable over a range between ±50 percent of the nominal value, in 10 percent increments. This adjustment capability shall be provided by a protected control at the local control unit.

3.1.4.3.3.2 Responses to DME/P Monitor Alarms. DME/P monitor alarms shall cause an MMLS response as specified in 6.1, including subparagraphs of Attachment G to Part I of ICAO SARPS Annex 10 and shall automatically initiate visual indications to the local and remote displays and aural alarms at the remote display. A front panel control shall be provided to reset the monitor alarms.

3.1.4.4 Control and Display Functions. The MMLS shall include local and remote control and display functions to permit setup, unattended operation, monitoring, and maintenance. Control of the MMLS shall be restricted to authorized personnel.

3.1.4.4.1 Local Control. Local controls shall provide for channel selection, data entry, alignment, selection of landing performance categories, field sensor bypass, and selection of equipment operating modes. For the split-site configuration, a local control and display unit shall be provided with the approach azimuth equipment and another with the approach elevation equipment. The azimuth local control unit shall provide the controls for

DME/P, including indications of DME/P forward and reflected power levels. When set up in the collocated configuration, a single local control unit shall be capable of controlling the azimuth, DME/P, and elevation equipment.

3.1.4.4.1.1 Channel Selection. Control shall be provided to select one of the 200 MLS paired angle and DME/P channels from the local control. An interlock shall be provided to ensure that azimuth, elevation, and DME/P equipment are operating on the same channel.

3.1.4.4.1.2 Equipment Alignment and Antenna Scan Limit Adjustment. Local controls shall permit the ground equipment to be aligned for operation within the accuracy requirements. Alignment controls shall be operational only in the MAINTENANCE and STANDBY modes. Proportional guidance adjustments shall be possible only in the MAINTENANCE and STANDBY modes. Antenna scan limits shall be adjustable as specified in 3.1.4.1.12.1 and 3.1.4.1.12.2.

3.1.4.4.1.2.1 Azimuth Alignment Control. Controls shall be provided to align the electronic boresight to the 0° course line. The control of the bias correction shall be adjustable ±0.5°, in 0.01° increments. The bias correction adjustment shall be stored in non-volatile memory.

3.1.4.4.1.2.2 Elevation Aignment Control. Control shall be provided to align the scanning beam to the desired glidepath. The control of the bias correction shall be adjustable ±0.2°, in 0.01° increments. The bias correction adjustment shall be stored in non-volatile memory.

3.1.4.4.1.3 Modes. Controls shall be provided to permit selection of the equipment mode: OFF, STANDBY, SERVICE-DEMAND, ON, and MAINTENANCE.

3.1.4.4.1.4 Data Entry. A local control capability shall permit entry and update of monitor limits and basic and auxiliary data. Menus or other single-keystroke data entry techniques shall be used to minimize complexity. MMLS shall prevent invalid data entry. Invalid data shall be detected and shall cause the system to respond with error messages and prompts for providing correct input. The basic and auxiliary data shall be preset to the values listed in table I and stored in nonvolatile memory. Input of data in the field shall override the preset data and shall be retained when power is turned off.

3.1.4.4.1.5 PRESET Control. A PRESET control at the local control shall be provided to return data entries to the factory-preset values. This control shall be protected from inadvertent activation.

3.1.4.4.1.6 Landing Performance Selection. A control shall be provided to select Category I or Category II monitor limits and restart monitor limits.

3.1.4.4.2 Local Display. Displays shall be provided at the local control unit to facilitate equipment alignment and data entry. A capability to review the monitor limits and the contents of each data word shall be provided. Displays designed in accordance with MIL-STD-1472 shall be legible in bright sunlight and darkness and shall include a brightness control . The brightness control shall be adjustable from full brightness to full darkness. The local display shall identify, as a minimum, the following:

a. Mode. The equipment is in the ON, OFF, STANDBY, MAINTENANCE, or SERVICE-DEMAND mode.

Table I. Preset Data Information

Data Item	Value
Azimuth to MLS datum point distance	0 ft
MLS datum point to threshold distance	900 ft
Azimuth coverage limit (negative) degrees	-40
Azimuth coverage limit (positive) degrees	+40
Clearance signal type	Scanning beam
Azimuth status	Transmit 1
Elevation status Transmit 1	
DME status	Transmit 01
Minimum glide path	3°
Azimuth beamwidth	3.0°
Elevation beamwidth	2.0°
DME distance (to MLS datum point)	0 ft
DME offset	150 ft
Azimuth antenna offset	150 ft
MLS ground equipment identification	
Character 2	M
Character 3	L
Character 4	S

e. Field Sensor. The field sensor is turned on or disabled.

f. Monitor Alarms. Visual alarms indicate out of tolerance conditions.

g. DME/P Interrogations. DME/P interrogations are being received.

3.1.4.4.3 Remote Control. A capability shall be provided to select equipment modes other than MAINTENANCE or OFF from a remote position. Remote control interface shall be provided at both the azimuth and elevation equipment. Remote controls shall be capable of supporting positions 8000 ft from the equipment over field wire or by other means subject to Government approval. The remote control unit shall be capable of controlling at least two MMLSs. Only one MMLS connected to the remote control unit shall be able to radiate at any given time. When MAINTENANCE mode is selected at a local control unit, the remote control shall be disabled. The MMLS equipment shall be capable of operation without the remote control connected.

3.1.4.4.4 Remote Display. A remote display shall be provided with the remote control unit. The displays shall be in accordance with MIL-STD-1472. All displays shall be legible in bright sunlight and darkness and shall include a brightness control. The brightness control shall be adjustable from full brightness to full darkness. A capability to review the contents of each data word shall be provided. The remote display shall indicate the following as a minimum:

a. Modes. The equipment is in the ON, STANDBY, SERVICE-DEMAND, or MAINTENANCE mode.

b. Performance Limits. The system is operating within either Category I or Category II monitor limits.

c. Power. External power or the internal battery is being used. Low battery power is indicated.

d. Monitor Alarms. Aural and visual alarms indicate out of tolerance conditions and the failed station. It shall be possible to control the volume of the aural alarms.

e. DME/P Interrogations. DME/P interrogations are being received in the SERVICE-DEMAND mode and the angle guidance equipment is radiating.

3.1.5 System Functional Relationships. MMLS system functional relationships are shown in figure 4. Power is provided by either an external source or the MMLS batteries. Angle guidance and data are generated so that MLS avionics can determine position relative to a selected glide path. Simultaneously, the DME/P transponder receives interrogations from DME equipped aircraft and generates reply pulses for range processing. Monitors determine whether the angle guidance, data, or DME performance are within specified tolerance limits. The control and display functions support entry of data, alignment of equipment and the monitoring of equipment status.

3.1.6 Configuration Allocation.

3.1.6.1 Azimuth Antenna Assembly Hardware Configuration Item (HWCI). The azimuth antenna assembly 6531-350002 shall include the azimuth antenna, a field monitor and ancillary equipment needed to perform azimuth angle guidance functions conforming to the TRSB format as specified in 3.11.4.5 and 3.11.4.6 of ICAO SARPS Annex 10 and requirements specified herein. The azimuth Antenna Assembly HWCI together with its associated transport containers shall satisfy the functional and performance requirements identified in table II.

3.1.6.2 Elevation Antenna Assembly HWCI. The elevation antenna assembly 6531-350003 shall include the elevation antenna, a field monitor and ancillary equipment needed to perform elevation guidance functions conforming to the TRSB format as specified in 3.11.4.5 and 3.11.4.7 of ICAO SARPS Annex 10 and requirements specified herein. The elevation Antenna Assembly HWCI together with its associated transport containers shall satisfy the functional and performance requirements identified in table II.

3.1.6.3 Control and Display Assembly HWCI. The control and display assembly 6531-350004 shall include two control electronics units, a remote control and display unit and battery housings and batteries. The control and display assembly shall perform: sequencing, control, and formatting for the angle guidance and data transmission functions; monitoring functions; control and display functions, and mode selection functions. The control and display assembly HWCI together with its associated transport containers shall satisfy the functional and performance requirements identified in table II.

3.1.6.4 DME Assembly. The DME Assembly 6531-350005 shall include a DME/P electronics unit and the DME/P antenna needed to provide slant range distance in accordance with 3.5.4 of ICAO SARPS Annex 10 and requirements specified herein. The DME assembly HWCI together with its associated transport containers shall satisfy the functional and performance requirements identified in table II.

3.1.6.5 MMLS Control Software Computer Software Configuration Item (CSCI). The MMLS Control Software CSCI 6531-944001 shall provide hardware initialization, error logging, BIT, interface, control panel, transmitter data, squitter rate control, automatic delay stabilization, DME maximum transmission rate and monitor functions. The MMLS control software CSCI shall satisfy the functional and performance requirements identified in table II.

3.1.7 Interface Requirements.

3.1.7.1 External Interfaces.

3.1.7.1.1 External Systems Description. The MMLS shall interface with aircraft equipped with MLS avionics and DME, and with external power sources.

3.1.7.1.1.1 MLS Avionics. MLS avionics receive ground-generated sector and scanning beam signals associated with the azimuth and elevation functions, determine the identity of the angle function, and then decode the scanning beam angle information. The receiver subjects the received signals to acquisition criteria before they are accepted and continuous validation following acceptance to provide reliable, interference-free angle information. Angle information is derived by measuring the time difference between the successive passes of the highly directive, narrow, fan-shaped beams. The avionics also receive basic and auxiliary data that are needed to support all weather operations. Deviation information, warning indications, and channel selection are provided to the flight crew.

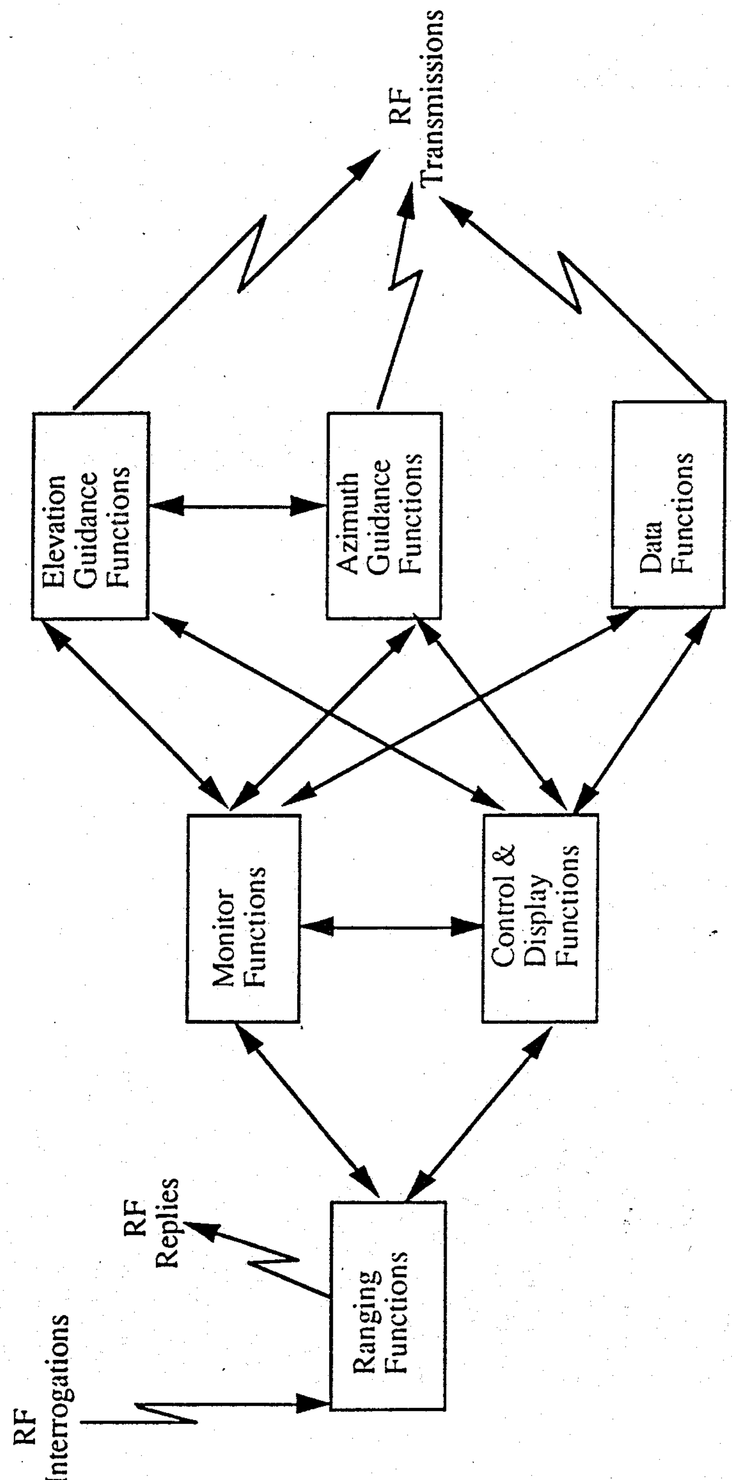


Figure 4. MMLS Functional Relationships

Table II. Configuration Item Requirements Cross Reference Matrix

Section 3 Paragraph	Requirements	System N/A	AZ ANT CI	EL ANT CI	CEU/RCDU CI	DME/P CI	MCS CSCI
3.1.3	Modes and states				X		
3.1.3.1.1	OFF mode				X		
3.1.3.1.2	STANDBY mode				X		X
3.1.3.1.3	MAINTENANCE mode				X		X
3.1.3.1.4	SERVICE-DEMAND mode				X		X
3.1.3.1.5	ON mode				X		X
3.1.3.2.1	Deployed state	X					
3.1.3.2.2	Stored state	X					
3.1.4	System functions				X		X
3.1.4.1.1	Channeling		X	X	X		X
3.1.4.1.1.1	Frequency tolerance				X		
3.1.4.1.1.2	RF signal spectrum				X		
3.1.4.1.2	Polarization		X	X			
3.1.4.1.3	Signal organization				X		X
3.1.4.1.3.1	Function rates				X		X
3.1.4.1.3.2	Function timing				X		
3.1.4.1.3.3	Function sequence				X		X
3.1.4.1.3.4	Synchronization				X		X
3.1.4.1.4	Preamble				X		X
3.1.4.1.4.1	Carrier acquisition				X		X
3.1.4.1.4.2	Modulation				X		
3.1.4.1.4.3	Receiver reference time code				X		X
3.1.4.1.4.4	Function identification				X		X
3.1.4.1.5	Angle guidance encoding				X		X
3.1.4.1.5.1	Angle guidance parameters				X		
3.1.4.1.5.2	Angle guidance parameter tolerances				X		
3.1.4.1.5.3	Scan transmission symmetry				X		
3.1.4.1.6.1	Scanning convention				X		
3.1.4.1.6.2	Sector signals				X		X
3.1.4.1.6.2.1	Morse Code equipment identification				X		X

Table II (Continued)

Section 3 Paragraph	Requirements	System N/A	AZ ANT CI	EL ANT CI	CEU/RCDU CI	DME/P CI	MCS CSCI
3.1.4.1.6.2.2	Airborne antenna selection signal				X		X
3.1.4.1.7.1	Scanning conventions				X		
3.1.4.1.7.2	Sector signals				X		X
3.1.4.1.8	Data functions				X		X
3.1.4.1.8.1	Basic data				X		
3.1.4.1.8.2	Auxiliary data				X		
3.1.4.1.9	System accuracy	X					
3.1.4.1.9.1.1	Mean course error	X					
3.1.4.1.9.1.2	AZ PFN	X					
3.1.4.1.9.1.3	AZ degradation allow	X					
3.1.4.1.9.2.1	Mean glidepath error	X					
3.1.4.1.9.2.2	EL PFN	X					
3.1.4.1.9.2.3	EL degradation allow	X					
3.1.4.1.10	Power density		X	X	X		
3.1.4.1.11	Residual radiation				X		
3.1.4.1.12	Coverage		X	X			X
3.1.4.1.12.1	AZ scan adjustment				X		X
3.1.4.1.12.2	EL scan adjustment				X		X
3.1.4.1.13	AZ scanning beam characteristics		X				
3.1.4.1.13.1	Beamwidth		X				
3.1.4.1.13.2	Scanning beam shape		X				
3.1.4.1.13.3	Dynamic sidelobes		X				
3.1.4.1.14	EL scanning beam characteristics			X			
3.1.4.1.14.1	Beamwidth			X			
3.1.4.1.14.2	Scanning beam shape			X			
3.1.4.1.14.3	Dynamic sidelobes			X			
3.1.4.2.1.1	DME/P Coverage		X				
3.1.4.2.1.2	Channeling				X	X	X
3.1.4.2.1.3	Capacity					X	X

Table II (Continued)

Section 3 Paragraph	Requirements	System N/A	AZ ANT CI	EL ANT CI	CEU/RCDU CI	DME/P CI	MCS CSCI
3.1.4.2.1.4	DME/P transponder identification					X	X
	Reply pulses					X	
	Identification code characteristics					X	
	Identification implementation					X	
3.1.4.2.2.1	Frequency of operation					X	
3.1.4.2.2.2	Frequency stability					X	
3.1.4.2.2.3	Pulse shape and spectrum					X	
3.1.4.2.2.4	Pulse spacing					X	X
3.1.4.2.2.5	Power density					X	X
	Minimum transmission rate					X	
3.1.4.2.2.6	Spurious radiation					X	X
	Out-of-band spurious radiation					X	
3.1.4.2.2.7	Squitter					X	X
3.1.4.2.2.8	Priority of transmission					X	X
3.1.4.2.3.1	Frequency of operation					X	
3.1.4.2.3.2	Frequency stability					X	
3.1.4.2.3.3	Sensitivity					X	
	Minimum interrogation power density					X	
	Reply efficiencies					X	
	Dynamic range					X	
	Pulse pair spacing variations					X	
3.1.4.2.3.4	Sensitivity reduction					X	
3.1.4.2.3.5	Bandwidth					X	
	Minimum bandwidth					X	
	Out-of-band signals					X	
3.1.4.2.3.6	Recovery time					X	
3.1.4.2.3.7	Spurious radiations					X	
3.1.4.2.3.8	Echo suppression					X	X
3.1.4.2.3.9	CW interference					X	

Table II (Continued)

Section 3 Paragraph	Requirements	System N/A	AZ ANT CI	EL ANT CI	CEU/RCDU CI	DME/P CI	MCS CSCI
3.1.4.2.4	Decoding					X	X
	Transponder triggering					X	
	Decoder rejection					X	
3.1.4.2.5	Time delay					X	X
3.1.4.2.6	Accuracy					X	
3.1.4.2.7	Efficiency					X	
	Reply efficiency					X	
	Receiver dead time					X	
3.1.4.3	Monitor function	X					X
3.1.4.3.1	Integrity requirement		X	X	X	X	X
3.1.4.3.1.1	End-to-end integrity check capability				X		X
3.1.4.3.2.1	Angle and data monitor parameters				X		X
3.1.4.3.2.2	Angle and data monitor characteristics				X		X
3.1.4.3.2.3	Responses to angle and data monitor alarms				X		X
3.1.4.3.3	DME/P monitoring					X	X
3.1.4.3.3.1	Responses to DME/P monitor alarms				X	X	X
3.1.4.4	Control and display functions				X		X
3.1.4.4.1	Local control				X		X
3.1.4.4.1.1	Channel selection				X		X
3.1.4.4.1.2	Equipment alignment and antenna scan limit adjustment				X		X
3.1.4.4.1.3	Modes				X		X
3.1.4.4.1.4	Data entry				X		X
3.1.4.4.1.5	PRESET control				X		X
3.1.4.4.1.6	Landing performance selection				X		X
3.1.4.4.2	Local display				X		X
3.1.4.4.3	Remote control				X		X

Table II (Continued)

Section 3 Paragraph	Requirements	System N/A	AZ ANT CI	EL ANT CI	CEU/RCDU CI	DME/P CI	MCS CSCI
3.1.4.4.4	Remote display				X		
3.1.7.1.1.3	Power				X		
3.1.7.1.3	Hardware-to-hardware external interfaces				X		
3.1.7.1.4.1	MLS avionics interface	X					
3.1.7.1.4.2	DME interface	X					
3.2.1.1	Weight		X	X	X	X	
3.2.1.2	Dimensions		X	X	X	X	
3.2.1.3	Transportability		X	X	X	X	
3.2.1.3.1.1	Air transport: fixed wing		X	X	X	X	
3.2.1.3.1.2	Air transport: rotary wing		X	X	X	X	
3.2.1.3.2.1	Truck transport		X	X	X	X	
3.2.1.3.2.2	Trailer transport		X	X	X	X	
3.2.1.3.2.3	Rail transport		X	X	X	X	
3.2.1.3.3	Ship transport		X	X	X	X	
3.2.1.3.4	Man transport		X	X	X	X	
3.2.1.3.5	Modular packaging		X	X	X	X	
3.2.1.4	Durability		X	X	X	X	
3.2.1.5	Stability		X	X	X	X	
3.2.2	Environmental conditions		X	X	X	X	
3.2.2.1.1	Temperature		X	X	X	X	
3.2.2.1.2	Relative humidity		X	X	X	X	
3.2.2.1.3	Altitude		X	X	X	X	
3.2.2.1.4	Sand and dust		X	X	X	X	
3.2.2.1.5	Salt fog		X	X	X	X	
3.2.2.1.6	Fungus		X	X	X	X	
3.2.2.1.7	Rain		X	X	X	X	
3.2.2.1.8	Sunshine		X	X	X	X	
3.2.2.1.9	Wind		X	X	X	X	
3.2.2.1.10	Ice and hail		X	X	X	X	
	Deicing		X	X	X	X	
	Hail		X	X	X	X	

Table II (Continued)

Section 3 Paragraph	Requirements	System N/A	AZ ANT CI	EL ANT CI	CEU/RCDU CI	DME/P CI	MCS CSCI
3.2.2.1.11	Snow		X	X	X	X	
3.2.2.1.12	Lightning		X	X	X	X	
3.2.2.2.1	Shock and vibrations		X	X	X	X	
3.2.2.2.2	Storage		X	X	X	X	
	Stackability		X	X	X	X	
-	Accessibility (batteries)				X		
3.2.4.1	Design and construction		X	X	X	X	
3.2.4.2	Obstruction lights		X	X			
3.2.4.3	Internal power				X		
	Charging				X		
	Standby battery switchover				X		
	Battery type				X		
	Low temperature operation				X		
3.2.4.4	Fastener hardware		X	X	X	X	
3.2.4.5	Cables and connectors		X	X	X	X	
3.2.4.6	Encapsulation and embedment material		X	X	X	X	
3.2.4.7	Finish		X	X	X	X	
3.2.4.8	Chemical decontamination		X	X	X	X	
3.2.4.9.1	Derated application of parts		X	X	X	X	
3.2.4.9.2	Parts selection and screening		X	X	X	X	
3.2.4.10	Environmental stress screening		X	X	X	X	
3.2.5	Electromagnetic radiation		X	X	X	X	
3.2.6	Workmanship		X	X	X	X	
3.2.7	Interchangeability		X	X	X	X	
3.2.8	Safety		X	X	X	X	
3.2.8.1	Safety criteria		X	X	X	X	
	Applied		X	X	X	X	
	Hazards		X	X	X	X	
3.2.8.2	Grounding, bonding, and shielding		X	X	X	X	
3.2.8.3	Electrical overload protection		X	X	X	X	

Table II (Continued)

Section 3 Paragraph	Requirements	System N/A	AZ ANT CI	EL ANT CI	CEU/RCDU CI	DME/P CI	MCS CSCI
3.2.8.4	Corona and electrical breakdown prevention		X	X	X	X	
3.2.9	Human performance/human engineering		X	X	X	X	
3.2.10.1	Set up and teardown	X					
3.2.10.1.1	Collocated group	X					
3.2.10.1.2.1	Split-site setup (Cat I)	X					
3.2.10.1.2.2	Split-site setup (Cat II)	X					
3.2.10.2.1	Collocated siting	X					
3.2.10.2.2.1	Split-site siting (Cat I)	X					
3.2.10.2.2.2	Split-site siting (Cat II)	X					
3.2.10.2.2.2.1	Category II design	X					
3.2.10.2.3	Non-degradation conditions	X					
3.2.12	Nameplates and product marking		X	X	X	X	
3.2.12.1	Nameplates		X	X	X	X	
3.2.12.2	Cable identification		X	X	X	X	
3.2.12.3	Crystal identification		X	X	X	X	
3.3.1.1	Computer hardware requirements				X	X	
3.3.1.1.1	Memory				X	X	X
3.3.1.1.2	Processing speed				X	X	X
3.3.1.1.3	Port requirements				X	X	X
3.3.1.2	Programming requirements					X	X
3.3.1.2.1	Programming languages					X	X
3.3.1.2.2	Compilers and assemblers					X	X
3.3.1.2.3	Operating system					X	X
3.3.1.2.3.1	Operating system augmentations					X	X
3.3.1.3	Design and coding constraints					X	X
3.3.1.3.1	Design requirements					X	X
3.3.1.3.2	Coding requirements					X	X
3.4.1.1	MTBCF		X	X	X	X	X
3.4.1.2	MTBCMA		X	X	X	X	X
3.4.1.3	Independence of failures		X	X	X	X	

Table II (Continued)

Section 3 Paragraph	Requirements	System N/A	AZ ANT CI	EL ANT CI	CEU/RCDU CI	DME/P CI	MCS CSCI
3.4.1.4	Reliability modeling and allocations		X	X	X	X	
3.4.1.5	Reliability predictions		X	X	X	X	
3.4.2.1.1.1	FFD		X	X	X	X	
3.4.2.1.1.2	MTBFA		X	X	X	X	
3.4.2.1.2.1	FFI: Organizational-level		X	X	X	X	
3.4.2.1.2.2	MTTR: Organizational-level	X					
3.4.2.1.4.1	FFI: Depot-level		X	X	X	X	
3.4.2.1.5	Preventive Maintenance		X	X	X	X	
	60 minute requirement		X	X	X	X	
	90 day requirement		X	X	X	X	
	10 minute restoral requirement		X	X	X	X	
3.4.4	Portability		X	X	X	X	
3.5.1.1.1	Common support equipment		X	X	X	X	
3.5.1.2.1	Organizational-level Maintenance		X	X	X	X	
3.5.1.2.2	Depot-level Maintenance		X	X	X	X	
3.5.3	Supply		X	X	X	X	

3.1.7.1.1.2 DME. DME is an air-derived system in which the airborne equipment interrogates a ground transponder (MMLS) with paired pulses at a specific spacing. The ground transponder receives the interrogation and, after a predetermined time delay, transmits a reply on a different carrier frequency. The airborne equipment receives this reply and measures the time difference between its original interrogation and the ground reply. Based upon this time difference, the airborne equipment computes and displays the range of the ground transponder.

3.1.7.1.1.3 Power. The MMLS shall be capable of operating from external AC and DC power sources including batteries and generators.

3.1.7.1.2 External Interface Identification. The external interfaces of MMLS are shown in figure 5.

3.1.7.1.3 Hardware-to-Hardware External Interfaces. External AC power sources shall be 47 to 63 Hz, and either 115 ±20 percent volts or 230 ±20 percent volts, single-phase power as specified in MIL-E-4158 and MIL-STD-633. External DC power sources shall be 24 ±4 volt batteries and 28-volt DC generators including mobile electric power (MEP) 024, 025, 026 or equivalent.

Only a single external power source shall be necessary in the MMLS collocated configuration. In the split-site configuration, the azimuth and elevation equipment locations shall be capable of interfacing with separate external power sources. The remote control and display unit shall also be capable of operating from external power.

Three types of power cables shall be provided to connect the MMLS equipment to any of the three types of external power sources (230 VAC, 115 VAC, and 24-28 VDC). Each cable shall be terminated at one end with the appropriate MMLS compatible connector and the other end shall be undermined. The 230 VAC and the 24-28 VDC cables shall be at least 10 ft long and the 115 VAC shall be at least 50 ft long. One of each cable type shall be provided for each of the azimuth equipment, elevation equipment, and remote control and display unit.

3.1.7.1.4 Software-to-Software External Interfaces.

3.1.7.1.4.1 MLS Avionics Interface. The interface with the avionics equipment is via RF transmission of angle guidance and data. The MMLS shall be interoperable with MLS receivers as defined by RTCA DO-177 and S.N. 404L 50464-S-109.

3.1.7.1.4.2 DME Interface. The interface with the DME aboard the aircraft is via RF transmission. The MMLS shall be interoperable with DME interrogators as defined by RTCA DO-189.

3.1.7.2 Internal Interfaces. Internal interface requirements shall be determined by the contractor in accordance with Appendix I of MIL-STD-490 subject to Government approval.

3.1.8 Government-Furnished Property List. This paragraph is not applicable to this specification.

3.2 System Characteristics.

3.2.1 Physical Requirements.

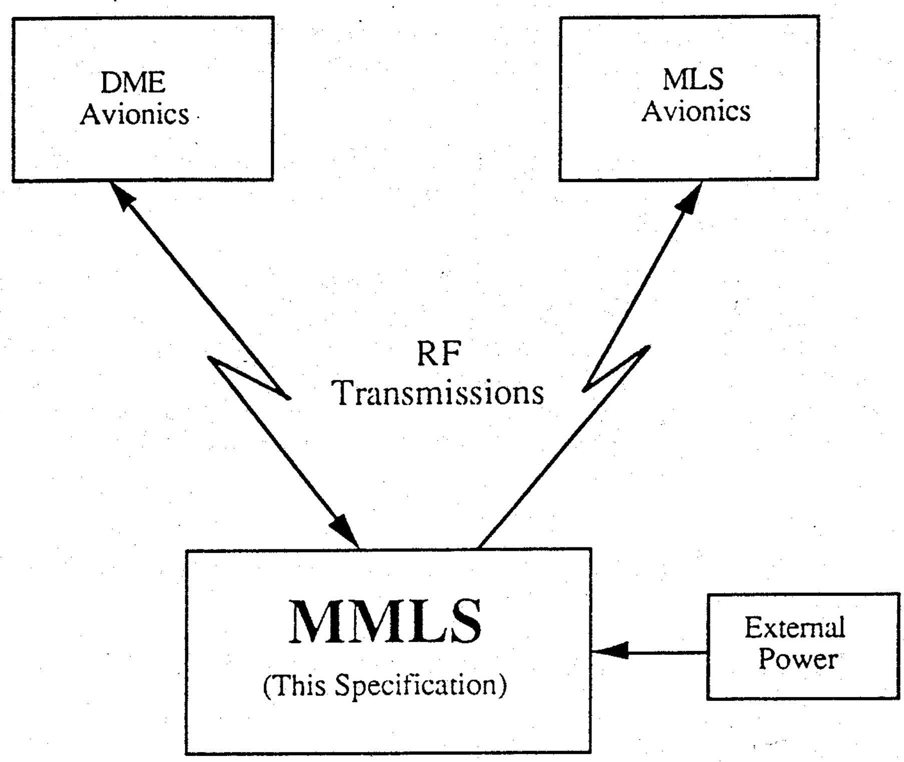


Figure 5. MMLS External Interface Diagram

3.2.1.1 Weight. The MMLS when packaged for transport shall weigh less than 1500 lbs for the split-site configuration, and less than 1200 lbs in the collocated configuration. All equipment required to install, align, calibrate, and verify system operation shall be considered a part of the system and included in the weight. The weight of the remote control unit, and 1/4 mile of WD-l/TT field wire and CE-ll spool and handle assembly for control unit remoting shall be included for the split-site configuration. The weight of the uninterruptible power system (UPS) batteries, their transit cases, and the synchronization line between the azimuth and elevation equipment shall not be included.

3.2.1.1.1 Equipment Weight. The MMLS when removed from its transit cases shall weigh less than 850 lbs in the split-site configuration, and less than 650 lbs in the collocated configuration.

3.2.1.2 Dimensions. The dimensions of the MMLS shall be such that it shall be possible to transport MMLS equipment by all of the methods in 3.2.1.3. Transit cases shall be provided for each transport module.

3.2.1.3 Transportability. The MMLS shall be capable of being broken down into a maximum of 14 stackable transport modules to facilitate transport by a variety of modes and vehicles. The transit cases shall meet the requirements of MIL-C-4150 as tailored in Appendix II. The design shall permit rapid on/off loading without the need for items not normally employed with transport vehicles or provided with MMLS. The design of the MMLS transport modules shall provide means for securing the transport modules to the vehicle.

3.2.1.3.1 Air Transport.

3.2.1.3.1.1 Aircraft: Fixed Wing. The MMLS shall be transportable in C-17, C-130, C-141, and C-5 aircraft.

3.2.1.3.1.2 Aircraft: Rotary Wing. The MMLS shall be transportable in a single helicopter sling load.

3.2.1.3.2 Ground Transport.

3.2.1.3.2.1 Truck Transport. The MMLS shall be transportable in a single 1-1/4-ton four-wheel drive commercial utility cargo vehicle (CUCV), M880 land vehicle, or high mobility multipurpose wheeled vehicle (HMMWV).

3.2.1.3.2.2 Trailer Transport. The MMLS shall be transportable in both one M-116A2, 3/4 ton trailer as specified in MIL-C-45150J and one 1/2 to 1-1/2 ton trailer as specified in MIL-T-10579.

3.2.1.3.2.3 Rail Transport. The MMLS shall be transportable by rail either as palletized or trailer-mounted cargo.

3.2.1.3.3 Ship Transport. The MMLS shall be transportable as containerized cargo for sea transport.

3.2.1.3.4 Man Transport. The design of MMLS transport modules and transit cases shall provide for ease of carrying in accordance with MIL-STD-1472. Each of the 14 stackable transport modules shall weigh less than 130 lbs with the exception of a maximum of 5 which shall either 1) weigh less than 195 lbs or 2) break into two submodules (man transportable modules), each weighing less than 195 lbs. Transport modules weighing 130 lbs or less shall be transportable by two people. Transport modules weighing more than 130 lbs, but less than 195 lbs, shall be transportable by three people. The maximum number of man-transport modules shall be 16.

3.2.1.3.5 Modular Packaging. The modular design shall allow the system to be deployed in either a split-site or collocated configuration without reconfiguring transport modules.

3.2.1.4 Durability. The MMLS shall be designed to withstand at least 500 setups and teardowns over its lifetime without degradation in performance except for that allowed by the reliability requirements of 3.4.1.

3.2.1.5 Stability. The MMLS equipment shall remain within performance limits without realignment for at least ten days when set up under the specified siting and operational environmental conditions.

3.2.2 Environmental Conditions. The MMLS shall be capable of withstanding any individual or combination of environmental conditions specified herein without mechanical or electrical damage or operational degradation. Unless otherwise specified, these requirements apply to MMLS in all of its modes and states.

3.2.2.1 Natural Environment.

3.2.2.1.1 Temperature.

3.2.2.1.1.1 Storage, Transport, and Nonoperating. From -57° C to +68° C.

3.2.2.1.1.2 Operating. From -51° C to +49° C with 360 BTU/hr/ft solar radiation.

3.2.2.1.2 Relative Humidity.

3.2.2.1.2.1 Minimum. 20 percent from the minimum operating temperature to 16° C. Above 16° C, the relative humidity shall be based on a dew point of -7° C.

3.2.2.1.2.2 Maximum. 100 percent including condensation from the minimum operating temperature to 27° C. Above 27° C, the relative humidity shall be based on a dew point of 27° C.

3.2.2.1.3 Altitude.

3.2.2.1.3.1 Nonoperating. 0 to 40,000 ft with a maximum altitude change of up to 2,000 ft per minute.

3.2.2.1.3.2 Operating Altitude Range. 0 to 10,000 ft.

3.2.2.1.4 Sand and Dust. The equipment shall operate without degradation or failure when exposed to sand and dust as specified in MIL-STD-210 for operation in close proximity to aircraft.

3.2.2.1.5 Salt Fog. The equipment shall operate without degradation or failure when exposed to a salt fog atmosphere with a salt concentration of at least 5 percent.

3.2.2.1.6 Fungus. The equipment shall withstand exposure to the species of fungi specified in MIL-STD-810 for a minimum period of 28 days.

3.2.2.1.7 Rain. For waterproofing, the MMLS shall withstand, without leakage, exposure to rain rates of 4 in/hr for 2 hr with wind levels specified herein. MMLS performance requirements shall be met in rain rates of 2 in/hr over a 5-nmi cell and 1 in/hr over the remainder of the coverage area.

3.2.2.1.8 Sunshine. The external surfaces and materials of the equipment shall withstand prolonged exposure to sunshine as defined in MIL-STD-810, method 505.2, Procedure II. Surface colors shall not fade, paints and coatings shall not crack, nor shall such items as gaskets or any other materials show signs of deterioration.

3.2.2.1.9 Wind. In the ON mode, the MMLS shall remain within monitor limits in steady winds up to 50 kt and in gusts or jet blasts of up to 75 kt from any direction. The MMLS shall remain in position and sustain no damage in winds up to 100 kt from any direction.

3.2.2.1.10 Ice and Hail. The MMLS shall not sustain mechanical damage when exposed to 1/2-inch glaze ice on the external surfaces. Angle guidance antenna radomes shall be provided with a deicing capability other than physical scraping. An indicator of deicing capability operation shall be provided. Additionally, all other radomes shall prevent the formation of ice that will degrade the operational performance while operating on external power. The MMLS shall be capable of withstanding hailstones up to 0.5 inch diameter.

3.2.2.1.11 Snow. The MMLS shall withstand the snow load specified in MIL-STD-210 for temporary equipment.

3.2.2.1.12 Lightning. Transient protection for lightning shall protect against pulses having the characteristics defined in MIL-E-4158. Self supporting lightning rods, providing a cone of protection sufficient to encompass the MMLS equipment, shall be provided.

3.2.2.2 Induced Environment.

3.2.2.2.1 Shock and Vibrations. The MMLS shall withstand the vibrations and shocks encountered while being transported by any of the specified methods and shall be capable of passing the shock and vibration tests specified in 4.2.4.11. In addition, the MMLS shall be protected from shocks induced by being dropped during handling, setup, and teardown.

3.2.2.2.2 Storage. The MMLS shall not incur damage when stored for a period of up to 2 years. The individual MMLS transport modules shall be stackable for storage and transport. Batteries shall be easily accessible so that they may be removed for separate storage or for testing, replacement, and recharging.

3.2.3 Nuclear Control Requirements. This paragraph is not applicable to this specification.

3.2.4 Materials, Processes, and Parts.

3.2.4.1 Design and Construction. General design and construction of MMLS shall be in accordance with MIL-E-4158 and MIL-STD-454.

3.2.4.2 Obstruction Lights. MMLS shall be provided with detachable obstruction lights. Structure and wiring for obstruction lights shall be as specified in AFM 88-14.

3.2.4.3 Internal Power. MMLS shall be provided with an uninterruptible power system (UPS) with batteries capable of operating the MMLS, including the remote control unit, for the worst case of 2 hours in the ON mode or 8 hours at a duty cycle of 20 percent in the SERVICE-DEMAND mode. Batteries shall be chargeable in any MMLS operating mode. Protective circuitry shall be provided to prevent battery damage from excessive charge or deep discharge. If external power is interrupted, batteries shall automatically assume the load of the external power source with no loss of functions other than deicing and use of obstruction lights. Batteries shall conform to MIL-B-82117D or Requirement 27 of MIL-STD-454. Only one type of battery shall be provided with the MMLS except for the battery required for the remote control unit. When on external power for a minimum of two hours at the minimum operating temperature, the batteries shall be maintained at a temperature that would permit a minimum of two hours operation after external power is interrupted.

3.2.4.4 Fastener Hardware. Equipment to be assembled or disassembled in the field shall be secured with corrosion-resistant captive hardware, and fabricated in accordance with Requirement 12 of MIL-STD-454 to suit the specified environmental conditions.

3.2.4.5 Cables and Connectors. Connectors shall be in accordance with Requirement 10 of MIL-STD-454, except that only MIL-C-38999 and MIL-C-83723 covering circular connectors, MIL-C-55302 covering printed circuit board connectors, and MIL-C-83733 covering rectangular rack and panel connectors are permitted. Electrical connectors requiring potting compound material shall not be used. Connectors shall be keyed and marked to prevent incorrect assembly. Cables and wire shall be in accordance with MIL-C-13294 and Requirements 20, 65, 66, and 71 of MIL-STD-454. The azimuth and elevation digital cables shall be interchangeable. The RF cables shall be interchangeable.

3.2.4.6 Encapsulation and Embedment Material. Materials used for encapsulation and embedment shall be selected for the operational environment conditions in accordance with Requirement 47 of MIL-STD-454. Only those materials that meet or exceed the requirements of MIL-S-8516, MIL-S-23586, and MIL-I-81550 shall be used.

3.2.4.7 Finish. Exterior surfaces, including exterior surfaces of transit cases, shall comply with the requirements of MIL-C-46168, and shall be green 383 as specified in MIL-C-46168 and match chip number 34094 as specified in FED-STD-595. All other surfaces shall comply with MIL-F-14072. All exterior surfaces shall be primed in accordance with DOD-P-15328D and/or MIL-P-85582 as appropriate. If the color of a surface is contained in the surface material, the finish shall approximate the finish of the MMLS painted surfaces.

3.2.4.8 Chemical Decontamination. The MMLS external surfaces shall be designed and constructed to facilitate chemical decontamination. The MMLS external surfaces shall also be resistant to damage from decontamination agents specified in ARCSL-CR-81053, excluding DS2 and STB. The design shall provide no areas where gaseous and/or liquid agents and decontaminating solutions can collect.

3.2.4.9 Parts.

3.2.4.9.1 Derated Application of Parts. All parts shall comply with a Government-approved contractor derating standard or with ESD-TR-85-148, derating level III. The contractor shall supply and validate all derating standards utilized by the manufacturers of any commercial off-the-shelf equipment/parts used in the design, defining each derating level subject to the approval of the Government.

3.2.4.9.2 Parts Selection and Screening. Parts used in newly designed or modified items shall be selected from the Government Furnished Baseline (GFB) Electrical/Electronic Parts, and the Government Furnished Baseline Mechanical Parts. Parts not covered by these GFBs will be selected by the contractor and approved by the Government using DI-MISC-80071/T. Defective parts identified in the Government/Industry Data Exchange Program (GIDEP) Failure Experience Data Interchange (FEDI) shall not be used. Approved nonstandard parts shall be adequately screened to ensure quality and reliability. Microcircuits shall be screened by the manufacturer in accordance with MIL-STD-883 Class B Method 5004 or Method 5008. The contractor shall have the option to rescreen selected parts to further ensure high quality and reliability. Figure 6 summarizes the parts control procedures.

3.2.4.10 Environmental Stress Screening (ESS). MMLS shall be ESS in accordance with a Government-approved contractor ESS standard or the method prescribed in figure 7. Further, the requirements shall be incorporated in 3.3.2, entitled "Standards of Manufacture," in the configuration item product fabrication specifications to ensure that effective ESS is performed on production equipment. For commercial off-the-shelf equipment, the conditions under which ESS was performed by the manufacturer, with supporting data or field data of acceptable performance, shall be submitted to the Government for approval.

3.2.5 Electromagnetic Radiation. The MMLS equipment shall be designed to operate within the electromagnetic interference (EMI) and susceptibility limits specified for airport environments in tables 1-1 and
1-lA of FAA-E-2721/11.

3.2.6 Workmanship. Workmanship shall conform to MIL-STD-454, Requirement 9.

3.2.7 Interchangeability. Interchangeability of like assemblies, subassemblies, modules, and parts shall conform to MIL-STD-454, Requirement 7.

3.2.8 Safety. The system shall be designed and constructed as specified in MIL-STD-454 and MIL-STD-1472 to prevent injury to personnel or equipment during installation, operation, and maintenance. For personnel safety, the contractor shall conform to Requirement 1 of MIL-STD-454.

3.2.8.1 Safety Criteria. Safety criteria shall be applied during equipment hardware design, selection, and construction to eliminate hazards that could cause injury. Hazards, such as sharp corners, projections, or moving parts that could cause injury directly or indirectly by catching on to clothing shall be eliminated, minimized by design effort, or covered with protective shields or guards.

3.2.8.2 Grounding, Bonding, and Shielding. All grounding, bonding, and shielding shall conform to MIL-STD-454 Requirements 1 and 74. A grounding rod and associated ground cable to provide a suitable ground for each antenna site from potential high voltage surges appearing on the synchronization wire shall be provided.

3.2.8.3 Electrical Overload Protection. Electrical overload protection shall conform to Requirements 8 and 37 of MIL-STD-454 for circuit breakers.

3.2.8.4 Corona and Electrical Breakdown Prevention. Corona and electrical breakdown prevention shall conform to Requirement 45 of MIL-STD-454 and as specified herein.

3.2.8.5 Switch Covers. All exposed switches shall be protected from physical damage with switch guards.

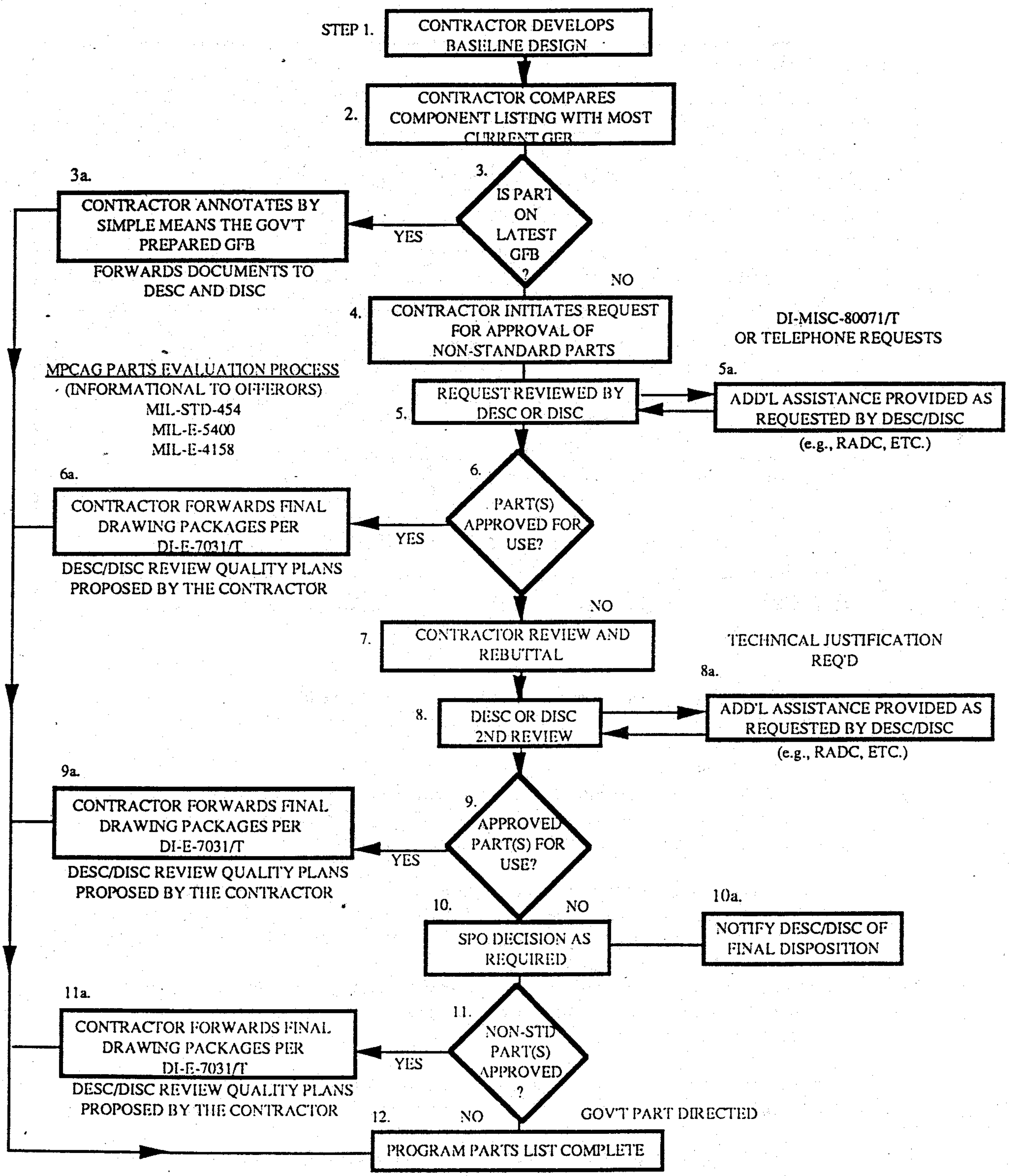


Figure 6. Parts Control Procedure

Temperature Cycling (See Note 6)	PC Board	Equipment, Box, or Drawer	System or Prime Item
Temperature Dwell Range	-54 To +85°C	-54 To +71°C	-54 To +71°C
Temperature Rate of Change (See Note 4)	30 Deg. C Min. (Chamber Air Temp)	10 Deg. C Min. (Chamber Air Temp)	10 Deg. C Min. (Chamber Air Temp)
Temperature Dwell Duration	See Note 1	See Note 1	See Note 1
Temperature Cycles	25	10	5
Failure Free Requirements	Last Two Cycles	Last Two Cycles	Last Two Cycles
Equipment Operation	See Note 2	See Note 2	See Note 2
Equipment Monitoring	See Note 3	See Note 3	See Note 3
Vibration (See Note 5)			
Type	Random	Random	Not Applicable
Power Spectral Density	0.045^2 G/Hz (Average) (20-1000 Hz)	0.045^2 G/Hz (Average) (20-1000 Hz)	
Axes Stimulated Serially or in Combination	2 or 3 Axes	2 or 3 Axes	
Duration Of Vibration	Ten Minutes/Axis	Ten Minutes/Axis	
Equipment Operation	See Note 2	See Note 2	
Equipment Monitoring	See Note 3	See Note 3	

Notes

(1) The next temperature ramp can commence as soon as the temperature has stabilized (i.e., when he temperature of the part of the test item considered to have the longest thermal lag is changing no more than 2°C per hour).

(2) Screened assemblies shall be operating during the temperature rise and vibration and off during the temperature drop. Operating equipment shall be at maximum power loading. Power shall be turned on and off a minimum of three times at the temperature extremes of each cycle.

(3) Instantaneous go-no go performance monitoring during the stress is essential to identify intermittent failures. If such monitoring can not be performed for one level of assembly, ESS will be performed on the next higher level of assembly, but using the ESS specifications of the lower assembly level.

(4) Use of temperature chambers that will provide the temperature rate of change is desired. However, rapid transfers of the equipment between one chamber at maximum temperature and another chamber at minimum temperature is acceptable.

(5) Simultaneous vibration and temperature stress screening is desired but not required. When temperature and vibration are applied separately, it is recommended that vibration occur first.

(6) At least five of the required temperature cycles will be performed after the random vibration portion of this last screen. The last two temperature cycles will be failure free.

Figure 7. ESS Requirements

3.2.9 Human Performance/Human Engineering. Human performance/ engineering shall be in accordance with MIL-STD-1472 and MIL-STD-454, Requirements 36 and 62. All requirements for setup, alignment, operation, and on-site maintenance of equipment exposed to the external environment shall be met while operators and maintenance personnel wear restrictive clothing, including extreme cold weather mittens as specified in MIL-M-87033 and chemical-resistant clothing as specified in ARCSL-CR-81053.

3.2.10 Deployment Requirements. MMLS will operate anywhere in the world in all weather conditions, including tropical, desert, or arctic environments.

3.2.10.1 Setup and Teardown. MMLS setup time shall begin after the equipment has been placed at its erection site. The setup time shall include unpacking the equipment, erecting antennas, interconnecting the equipment, connecting to external power, turning it on, anchoring, installing monitor equipment, connecting the remote control, and performing the alignment necessary to prepare the equipment for flight inspection. Hand tools to support anchoring shall be provided with the system and shall be chosen by the contractor subject to Government approval. Time necessary to "run cable" between split-site configuration equipment sites shall not be considered part of setup time. Teardown time shall include time to turn off the equipment and prepare the equipment for transportation to another location. Specific setup times and siting requirements for different configurations and categories of performance shall be as specified below.

3.2.10.1.1 Collocated Configuration. MMLS in a collocated configuration shall be capable of Category I performance following a setup procedure by no more than three persons that takes less than 75 minutes. Teardown time shall not exceed 75 minutes by no more than three persons. Realignment of equipment shall take less than 10 minutes.

3.2.10.1.2 Split-Site Configuration.

3.2.1O.1.2.1 Category I. MMLS in a split-site configuration shall be capable of Category I performance following a setup procedure by no more than three persons that takes less than 75 minutes to erect the approach azimuth and DME/P equipment at its location and less than 75 minutes to erect the approach elevation equipment at its location. Realignment of equipment at each location shall take no longer than 10 minutes.

3.2.10.1.2.2 Category II. MMLS shall be set up within Category II monitor parameter limits following a setup procedure that takes no longer than 2.5 hours. Category II performance shall be provided following calibration of the MMLS during a flight inspection procedure.

3.2.10.2 Siting. The MMLS shall be provided with auger type ground anchors, anchor plates, and associated stakes.

3.2.10.2.1 Collocated Configuration Siting. MMLS in a collocated configuration shall provide Category I performance with the MMLS equipment placed on surfaces specified in table I of DM 7.2, on bedrock and/or on concrete surfaces. The equipment shall be sited within the constraints shown in figure 8.

3.2.10.2.2 Split-Site Configuration Siting.

3.2.10.2.2.1 Category I Siting. MMLS in a split-site configuration shall provide Category I performance with the MMLS equipment placed on surfaces specified in table I of DM 7.2, on bedrock and/or on concrete surfaces. azimuth equipment shall be sited up to 15,000 ft from runway threshold along the runway centerline and the elevation equipment shall be sited within 450 ft of runway centerline.

3.2.10.2.2.2 Category II Siting. MMLS in a split-site configuration shall provide Category II operational performance when the equipment is installed and anchored to a surface capable of bearing a minimum of 80 tons per square foot. The azimuth equipment shall be sited up to 12,000 ft from runway threshold along the runway centerline and the elevation equipment shall be sited within 450 ft of runway centerline.

3.2.10.2.3 Nondegradation Conditions. MMLS shall not degrade beyond specified performance limits under any of the following siting conditions.

a. Placement of any MMLS element within 10 ft of any other MMLS element or obstruction, natural and/or fabricated, that lies 1 ft below the horizontal plane that is tangent to the lowest physical component of the radiating elements of the unit in question.

b. Placement of MMLS equipment and field sensors adjacent to a body of water with transmitting element(s) located 10 ft or higher above the surface of the water.

c. Placement of sandbags or equivalent protection stacked to the full equipment height, 10° or more outside the sector of transmission.

d. Placement in the vicinity of natural formations of hills, with and without foliage, and with and without snow cover, under and on one or both sides of the approach path, such hills not constituting obstructions within the definitions of TM 5-803-4 and AFM 55-9.

e. Placement in the vicinity of fabricated structures and equipment that do not constitute an obstruction within the definitions of AFR 86-14, AFR 86-5, TM 5-803-4, and AFM 55-9.

f. Placement of MMLS equipment on terrain inclinations of up to 10° in any direction. The antenna phase centers shall be higher than the height of the runway centerline.

g. Placement of MMLS ground equipment in up to 2 ft of snow.

3.2.10.3 Organizational Deployment Requirements.

3.2.10.3.1 CCG. The CCGs will deploy MMLS to support quick-reaction precision approach needs.

3.2.10.3.2 QWROTES. MMLS will be deployed as QWROTES to assure that sufficient MLS equipment is available at selected overseas bases to restore precision approach and guidance service that has been incapacitated. Those QWROTES assets will also be used to establish a precision approach capability for alternate landing surfaces.

3.2.10.3.3 U.S. Army. MMLS will be assigned to the Air Traffic Control Company (Forward) and Air Traffic Control Company (Communications Zone) to provide precision approach service into combat support areas.

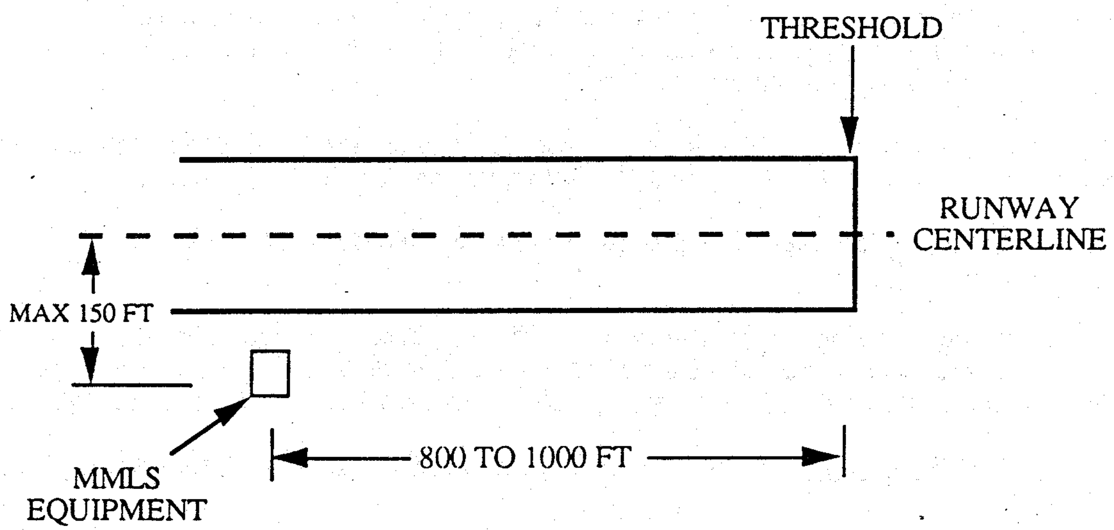


Figure 8. Siting Limits for MMLS Equipment in Collocated Configuration

3.2.11 System Effectiveness Models. System effectiveness models shall be developed to predict the operational performance of MMLS under varying conditions. The models shall be of sufficient detail to project system accuracy when MMLS is used:

a. To service aircraft equipped with varying grades of MLS avionics and at varying approach speeds and glide angles;

b. Under varying siting conditions including runway lengths, setup times, and multipath conditions;

c. Under varying environmental conditions including temperature, wind and rain. The modeling methodology shall be presented at the preliminary design review. The Government will specify up to 30 specific scenarios for examination and results shall be presented at the critical design review (CDR).

3.2.12 Nameplates and Product Marking. Identification and marking shall be in accordance with requirements specified in MIL-E-4158 with the following additions and exceptions:

3.2.12.1 Nameplates. Nameplates shall be in accordance with MIL-STD-130. Foil nameplates shall not be used.

3.2.12.2 Cable Identification. In addition to the cable identification required by MIL-E-4158, all cables with connectors shall bear a unique identification number that signifies the two chassis they interconnect. The identifier shall be permanently affixed to the cable, near each connector.

3.2.12.3 Crystal Identification. Crystals shall conform to MIL-STD-454, Requirement 38.

3.3 Processing Resources.

3.3.1 MMLS Processing Resources. MMLS processing resource requirements shall be completed by the contractor in accordance with Appendix I of MIL-STD-490 and subject to Government approval. All MMLS system functions shall be addressed both individually and collectively in determining the requirements. Processing resources shall satisfy the following general requirements.

3.3.1.1 Computer-Hardware Requirements.

3.3.1.1.1 Memory. Under worst case loading, each processor shall utilize no more than 80 percent of the total available memory at the time of delivery. Each processor shall have a growth capacity of at least 50 percent of the total available memory at the time of delivery.

3.3.1.1.2 Processing Speed. Under worst case loading, each processor, at the time of delivery, shall complete all its required processing utilizing no more than 50 percent of the total available processing time.

3.3.1.1.3 Port Requirements. At the time of delivery, each I/0 port shall be used at less than 50 percent of its capacity under worst-case loading. The system design shall allow for the addition of external devices without hardware redesign.

3.3.1.2 Programming Requirements. All MMLS software shall comply with the requirements of DOD-STD-2167 as tailored by the MMLS Statement of Work (SOW). Firmware shall be subject to the same requirements as software.

3.3.1.2.1 Programming Languages. All newly developed software shall be written in Ada as defined by MIL-STD-1815. A waiver from the contracting agency shall be required for the use of either an HOL other than Ada or an assembly language.

3.3.1.2.2 Compilers and Assemblers. All compilers and assemblers shall be off-the-shelf, vendor supported.

3.3.1.2.3 Operating System. All operating system software shall be off-the-shelf, vendor-supported.

3.3.1.2.3.1 Operating System Augmentations. Operating system augmentations shall be allowed provided they are treated as newly developed software and do not compromise the capability of the operating system vendor to provide maintenance or updates.

3.3.1.3 Design and Coding Constraints. Newly developed support software shall be allowed except for compilers, assemblers, debuggers, linking loaders, and editors which shall be off-the-shelf vendor-supported.

3.3.1.3.1 Design Requirements. Newly developed MMLS software shall be designed using a top-down methodology as specified in DOD-STD-2167.

3.3.1.3.2 Coding Requirements. Newly developed MMLS software shall be coded in accordance with DOD-STD-2167, Appendix C or with a government-approved Software Development Plan.

3.4 Quality Factors.

3.4.1 Reliability.

3.4.1.1 Mean Time Between Critical Failures (MTBCF). The specified MTBCF, considering both hardware and software, shall be greater than 5,000 hrs. The contractor shall predict and design the system to 7,200 hrs. Critical performance requirements are those that, due to failure or degradation, contribute to an out of tolerance condition defined in 3.1.4.3.2.1 and 3.1.4.3.3. Each active LRU with the exception of phase shifters, batteries, and field monitors shall have an elapsed time counter.

3.4.1.2 Mean Time Between Corrective Maintenance Actions (MTBCMA). The specified MTBCMA, with the exception of replacing batteries, shall be greater than 1,400 hrs. The contractor shall predict and design the system to twice the specified value.

3.4.1.3 Independence of Failures. Failure, damage, or removal of one unit or assembly shall not cause failure or damage in any other unit or assembly, and shall not cause a critical failure if there is a properly functioning unit or assembly that is redundant to the failed unit or assembly.

3.4.1.4 Reliability Modeling and Allocations. The contractor shall develop mathematical models, block diagrams, and allocate the specified system reliability values to lower item levels. Allocated values shall be used as baseline requirements in lower level specifications, including contractor and subcontractor procurement specifications and any GFE. All models and allocations shall consider the contribution of hardware and software to reliability. Allocations are subject to Government review and concurrence.

3.4.1.5 Reliability Predictions. The contractor shall predict the reliabilities to meet the maintenance needs (MTBCMA) as specified in 3.4.1.2 and mission needs (MTBCF) as specified in 3.4.1.1 of the system. Predictions will include any GFE and modified/ unmodified off-the-shelf items. All predictions shall include the contribution of both software and hardware. (DI-R-7095/T)

3.4.2 Modifiability.

3.4.2.1 Maintainability.

3.4.2.1.1 Equipment Checkout.

3.4.2.1.1.1 Fraction of Failures Detected (FFD). The FFD shall be at least 98 percent using BIT.

3.4.2.1.1.2 Mean Time Between False Alarms (MTBFA). The mean time between BIT false alarms shall exceed 50,000 hrs.

3.4.2.1.2 Corrective Maintenance-Organizational Level.

3.4.2.1.2.1 Fraction of Failures Isolated (FFI). The FFI to a single LRU shall be at least 90 percent using BIT.

3.4.2.1.2.2 Mean Time to Repair (MTTR). The MTTR, including time to isolate, remove, replace, align, and checkout hardware and reboot software, shall be less than 0.5 hr. At least 95 percent of all hardware repairs shall be completed within 1.5 hrs.

3.4.2.1.3 Corrective Maintenance-Intermediate Level. This paragraph is not applicable to this specification.

3.4.2.1.4 Corrective Maintenance-Depot Level.

3.4.2.1.4.1 FFI. The FFI to a discardable component within one hour shall be greater than 50 percent using BIT, external peculiar test equipment, external common test equipment, and/or external automatic test equipment.

3.4.2.1.5 Preventive Maintenance (PM). PM tasks shall take less than 60 minutes and shall be required no more often than once every 90 days. At any time during PM, the prime mission equipment (PME) shall be capable of being restored to full mission capability (FMC) status within 10 minutes. PM of redundant items shall not interrupt operational performance.

3.4.2.2 Flexibility and Expansion. This paragraph is not applicable to this specification.

3.4.3 Availability. This paragraph is not applicable to this specification.

3.4.4 Portability. Portability requirements shall be as specified in paragraphs 3.2.1.3 and 3.2.1.3.4.

3.5 Logistics. Interface requirements of logistics disciplines of DOD 5000.39 shall be integrated into the design and engineering constraints cited in this specification.

3.5.1 Support Concept.

3.5.1.1 Support Equipment. System BIT capability shall be designed to minimize support equipment requirements at all levels of maintenance.

3.5.1.1.1 Common Support Equipment. Common support equipment shall be restricted to standard test equipment listed in both MIL-HDBK-300 and DA 700-21-1.

3.5.1.1.2 Peculiar Support Equipment. Peculiar support equipment shall include all other test equipment necessary for depot-level maintenance.

3.5.1.2 Maintenance. Two levels of maintenance, organizational and depot, will be established in accordance with the provisions of AFR 66-1 and AFR 66-14.

3.5.1.2.1 Organizational-Level Maintenance. Organizational-level maintenance will consist of maintenance at the deployed site. At the deployed site, deployed personnel or maintenance personnel will have the capability to verify proper system operation and isolate faults to an LRU. System restoral capability at the deployed site will be limited to replacement of LRUs.

3.5.1.2.2 Depot-Level Maintenance. Depot-level maintenance will consist of repair, reclamation, condemnation, or overhaul of assemblies and subassemblies, manufacture of parts, depot-level modification, test, and other maintenance not possible at the organizational maintenance level. In addition, major structural overhaul and refurbishment will be accomplished at the depot facility. Depot maintenance may utilize approved common support equipment and approved peculiar support equipment.

3.5.2 Support Facilities. The maintenance facilities shall be capable of detecting, isolating, and correcting failures in hardware, firm–ware, and software. A software support facility will be determined by HQ AFLC. Specific requirements will be addressed in the Computer Resources Life Cycle Management Plan.

3.5.2.1 Hardware Support. The BIT function will be used at the organizational level to isolate problems down to the LRU level. BIT function and support equipment shall be provided at the depot to diagnose LRU faults, identify and verify shop-replaceable unit (SRU) faults, and identify and verify SRU component faults.

3.5.2.2 CSCI. The capability shall be provided to revise, test, and maintain MMLS software. Software support facility requirements are to be determined by HQ AFLC.

3.5.3 Supply. The system design shall make maximum use of standard, approved electrical, electronic, and technical parts and items. Spares shall be consistent with the maintenance design and cost-effectiveness of the MMLS.

3.5.4 Personnel.

3.5.4.1 Support Personnel.

3.5.4.1.1 Organizational-Level Maintenance Personnel. Organizational level maintenance shall be capable of being accomplished by Air Force (AF) skill Level 5 (AFSC 30452), U.S. Army military occupational specialty code (MOSC) 93D maintenance specialists, or equivalently trained personnel.

3.5.4.1.2 Depot-Level Maintenance Personnel. Depot-level maintenance shall be capable of being accomplished by AF skill levels 5 and 7 (AFSC 30452/72) or U.S. Army MOSC 28D maintenance specialists.

3.5.5 Training. Training requirements are to be determined.

3.6 Precedence. The following is the order of precedence of this specification and related specifications:

a. Quality factors defined in 3.4 through 3.4.4.

b. System functions defined in 3.1.4 through 3.1.4.4.4.

c. Physical requirements specified in 3.2.1 through 3.2.1.5 and system siting requirements in 3.2.10.1.

d. All other requirements in this specification.

e. Standards and specifications referenced in this specification.

4 QUALIFICATION REQUIREMENTS

4.1 General. This section specifies the requirements for formal verification of the design, construction, and performance of MMLS.

4.1.1 Philosophy of Testing. The basic objective of the MMLS test program described herein is to verify that all requirements of section 3 have been met. Requirement verification shall include contractor conducted development test and evaluation (DT&E) and Government conducted operational test and evaluation (OT&E). DT&E shall demonstrate that the system engineering design and development are complete, that design risks have been minimized, and that the system will perform as specified. Flight tests shall be performed during DT&E to verify system performance under various setup, deployment, and environmental conditions. Specific procedures for verification shall be defined by the contractor in test plans and procedures as approved by the Government. Verification of multiple requirements within a single test procedure shall be allowed, but the adequacy and completeness of the test procedure shall be approved by the Government.

4.1.2 Location of Testing. DT&E shall be conducted by the contractor at the contractor's facilities, any other suitable facility or at a Government-approved field site. DT&E flight tests shall be conducted at four sites to be designated by the Government.

4.1.3 Responsibility for Tests. The contractor is responsible for all inspections, analyses, demonstrations, and tests as specified herein. The Government reserves the right to perform all flight inspections and any of the verifications.

4.1.4 Qualification Methods. All requirements of section 3 shall be verified by one or more of the following methods: inspection (I); analysis (A); demonstration (D); and test (T). The qualification method(s) to be used for each of the MMLS performance requirements are specified in 4.4. The following definitions of I, A, D, and T shall apply.

a. Inspection. Verification shall be performed by visually examining the item, reviewing descriptive documentation, and comparing the appropriate characteristics with a referenced standard to determine conformance to requirements.

b. Analysis. Verification shall be performed by evaluation or simulation using mathematical representations, charts, graphs, circuit diagrams, and data reduction.

c. Demonstration. Verification shall be performed by operation, movement or adjustment of the item under a specific condition to perform the desired function without recording quantitative data except for check sheets.

d. Test. The verification shall be performed through systematic exercising of the applicable item under all appropriate conditions with instrumentation and collection, analysis, and evaluation of quantitative data.

4.1.5 Test Levels. The requirements of section 3 shall be verified on one or more of the following qualification levels as defined below: configuration item (CI), subsystem, system, and system deployment. The qualification level(s) to be used for each of the qualification methods are specified in 4.4.

a. CI Level. CI level verifications are performed on configuration items identified by the contractor. This level is identified by a (1) in the Qualification Cross Reference Table.

b. Subsystem Level. Subsystem level verifications are independently performed on the azimuth, elevation, or DME/P equipment. This level is identified by a (2) in the Qualification Cross Reference Table.

c. System Level. System level verifications are performed to verify proper operation of all CIs interacting as the entire MMLS. These verifications are exclusive of flight tests. This level is identified by a (3) in the Qualification Cross Reference Table.

d. System Deployment Level. System deployment level verifications are performed when it is necessary to verify the required system operation in a deployed state by flight tests. This level is identified by a (4) in the Qualification Cross Reference Table.

4.2 Formal Tests. The following verification requirements shall be performed during DT&E and production acceptance testing.

4.2.1 Design and Development Verification.

4.2.1.1 Software Qualification. The contractor shall establish by analysis, subject to Government approval, the worst case condition under which sufficient spare processing capacities shall be verified. At a minimum, the equipment shall be tested in the ON mode under conditions when the DME/P is processing the maximum interrogation rate specified in 3.1.4.2.1.3.

4.2.1.2 Environmental Stress Screening (ESS). The contractor shall verify ESS in accordance with 3.2.4.10. The contractor shall identify any failure that occurs during ESS that suggests design deficiencies and ensure that all failures are processed in accordance with the failure recording, analysis, and corrective action system (FRACAS). (DI-RELI-80253)

4.2.1.3 Parts Derating. Parts derating shall be verified by "analysis."

4.2.1.4 Parts Selection. Prior to DT&E verifications, the system shall be inspected to verify that the parts used are in the approved parts list.

4.2.2 Formal Equipment Performance Tests.

4.2.2.1 Radiated Signal Characteristics Verification.

4.2.2.1.1 Angle and Data. Channeling and frequency tolerance shall be demonstrated on all 200 frequencies specified in 3.1.4.1.1. Tests to verify the angle guidance encoding, function timing, accuracy, and scanning beam shape requirements shall be performed at a minimum of six different frequencies, as selected by the Government, spaced over the range of the frequency band. These measurements shall be performed on an antenna range and in deployment scenarios as specified in 4.2.5. All other verifications shall be performed at one frequency selected by the Government.

4.2.2.1.2 DME/P. Channeling and frequency stability shall be demonstrated on all 200 frequencies specified in 3.1.4.2.1.2. Tests to verify the pulse shape, pulse spacing, time delay, and accuracy requirements shall be performed at a minimum of 6 different frequencies, as selected by the Government, spaced over the range of the frequency band. These measurements shall be performed on an antenna range and in deployment scenarios as specified in 4.2.5. All other verifications shall be performed at one frequency selected by the Government.

4.2.2.2 Performance Stability. The capability of the system to stay within operational performance limits for the specified time without realignment shall be verified by an instrumented test. The equipment shall be set up and aligned, and the performance verified, in both the split-site and collocated configurations. The equipment shall be subjected to a range of operational service conditions that emulate severe deployed conditions, including operational extremes of temperature, high and low humidity, rain, and winds. The total accumulated test time shall be at least 240 hrs. This test may be conducted simultaneously with other antenna range, deployment, environmental, or reliability tests. In addition, at least one stability evaluation shall be performed in a deployed environment, as specified in 4.2.5. The MMLS shall remain assembled and operational for at least 72 hrs. Flight inspections shall be conducted, in accordance with 4.2.5, after initial setup and after the 72-hr minimum operational period. Continuous performance monitoring and recording, at no less than two fixed points within the angle guidance coverage, shall be conducted during the operational period.

4.2.2.3 Deployment Verification. The MMLS shall be setup in split-site and collocated configurations at locations to be determined by the Government. The MMLS shall be operated as a total system for a minimum of two hours after each setup. Setup and teardown shall be performed in the operating environmental conditions specified herein wearing restrictive clothing. Thirty setup and teardown operations of one MMLS unit shall be performed by the contractor as part of qualification testing. The durability requirement shall be verified by analysis of any degradation or wear of mechanical or electronic parts during these setup/teardown tests. The setup and teardown shall be performed by completely packing the equipment on the packing containers, rolling up all wires, placing the equipment in the transportable configuration and transporting the equipment between each setup and teardown. These tests may be conducted simultaneously with other stability or reliability tests. At least the first 2 and last 3 of the 30 setup/teardown operations shall be conducted in conjunction with the Category I performance capability evaluations specified in 4.2.5.

4.2.2.4 Electromagnetic Compatibility (EMC). Electromagnetic interference EMI and susceptibility shall be tested by the methods and criteria of tables 1-1 and 1-1A of FAA-E-2721/11.

4.2.2.5 Internal and External Power. Tolerance of voltage transients shall be verified by applying the specified transient conditions of MIL-E-4158 to the MMLS equipment. Automatic switch-over to battery power shall be tested by removing external power to ensure no loss of MMLS operation.

4.2.3 Reliability Verification. The reliability of the system shall be verified in accordance with 10.2 as follows:

a. The contractor shall develop reliability test plans and procedures (DI-RELI-80251).

b. The system shall be operated as prescribed in figure 9. A contractor standard test environment, approved by the Government, may be used as an alternate.

c. The MTBCMA test shall continue until an accept or reject decision is reached, in accordance with figure 10. If the RVT has progressed beyond the "1000 hour accept" line as shown in figure 10, the government will take delivery of systems for IOT&E if all other DT&E testing has been successfully completed.

d. The MTBCF shall be verified in accordance with table III.

e. False alarms shall be verified as specified in 10.2.4.

f. The contractor shall analyze and summarize the test data and provide test report(s).

4.2.3.1 Failure Modes Effects and Criticality Analysis (FMECA). The contractor shall carry out a failure modes and effects prediction analysis and a criticality analysis in accordance with tasks 101 and 102, respectively, of MIL-STD-1629, and in accordance with the approved FMECA program plan. The criticality analysis shall be carried out using the quantitative approach. The purpose of this analysis is to ensure that the integrity requirements are designed into, and actually achieved by, the equipment. Each failure effect shall be shown to result in one or more of the following categories:

a. A monitor or control failure that would permit potentially hazardous MLS guidance or data signals to be radiated.

b. A transmitter failure that would cause potentially hazardous angle guidance or data signals to be radiated in the absence of correct monitor control system operation.

c. A failure that will cause an interruption of the MMLS guidance signals.

d. A failure that will have no effect on integrity.

4.2.3.2 Maintainability Demonstration (MD). Verification that items have met the maintainability requirements in 3.4.2.1 shall be accomplished by a MD for each specified level of maintenance. The contractor shall develop a MD plan (DI-T-3102A/T) and analyze the demonstration data and report on the results for each maintenance level demonstrated (DI-R-7113/T). The demonstration shall be in accordance with 10.3. Each demonstration shall use technical manuals (draft or final form), support test equipment, and trained Government personnel meeting the requirements of 3.5.4 and that are approved by the Government for the demonstration.

4.2.3.2.1 Organizational-Level Demonstration. Selected failures shall be induced into the equipment to verify that FFD, FFI, and MTTR meet the requirements of 3.4.2.1.1.1, 3.4.2.1.2.1, and 3.4.2.1.2.2, respectively. Inserted failures shall not cause damage and shall include opens, shorts, and adjustments that appear as total failures or degraded failures.

4.2.3.2.2 Intermediate-Level Demonstrations. This paragraph is not applicable to this specification.

4.2.3.2.3 Depot-Level Demonstration. Compliance with 3.4.2.1.4.1 shall be verified by demonstrating that the maintenance procedures and test equipment identified for use at the depot level are capable of isolating failures to a discardable item. Inserted failures will be selected from the failures inserted for organizational-level demonstrations and from other nondestructively inserted opens, shorts, and adjustments that appear as total, degraded, or intermittent failures. The depot-level demonstration shall be conducted when the Government depot is established.

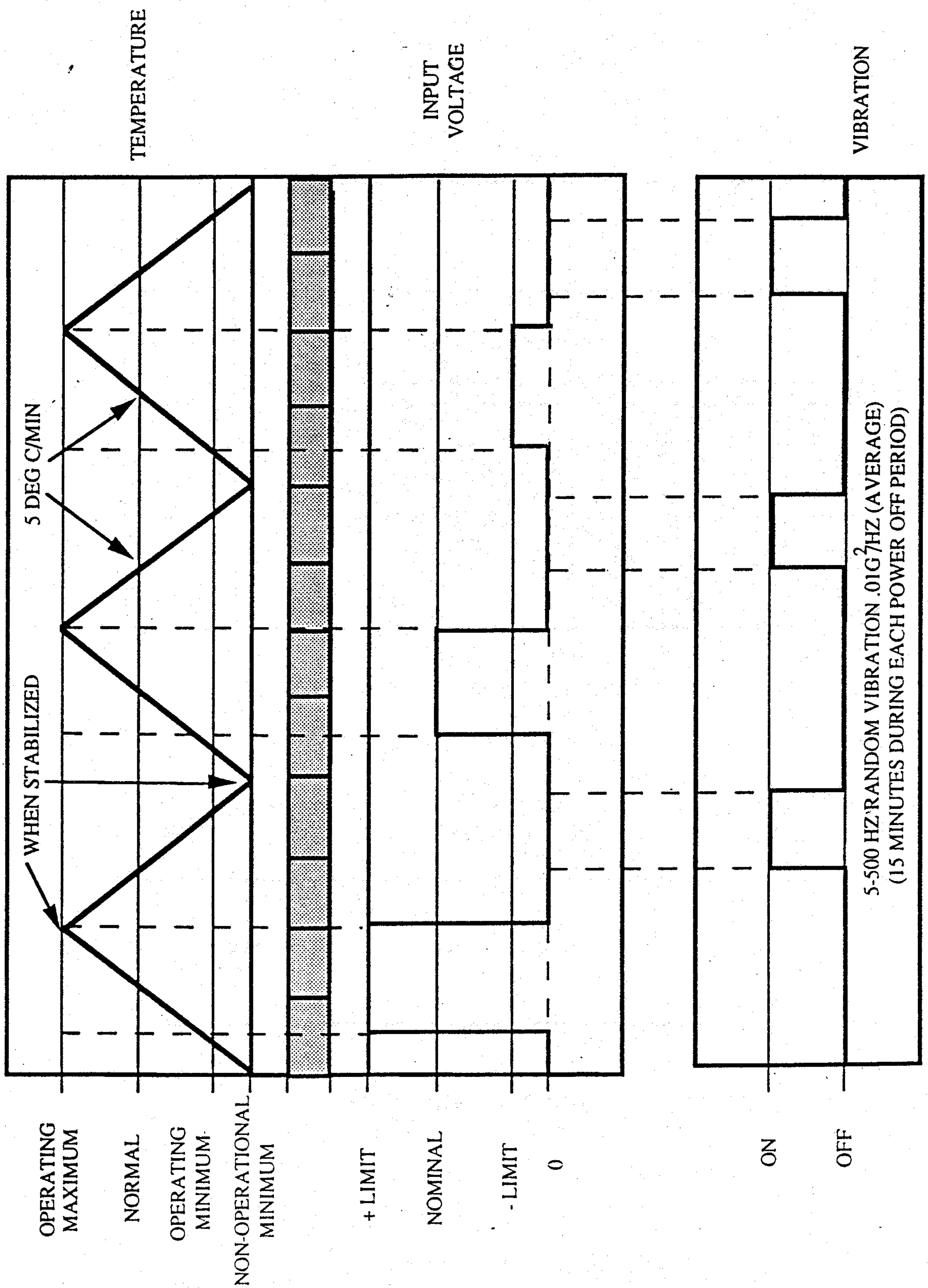
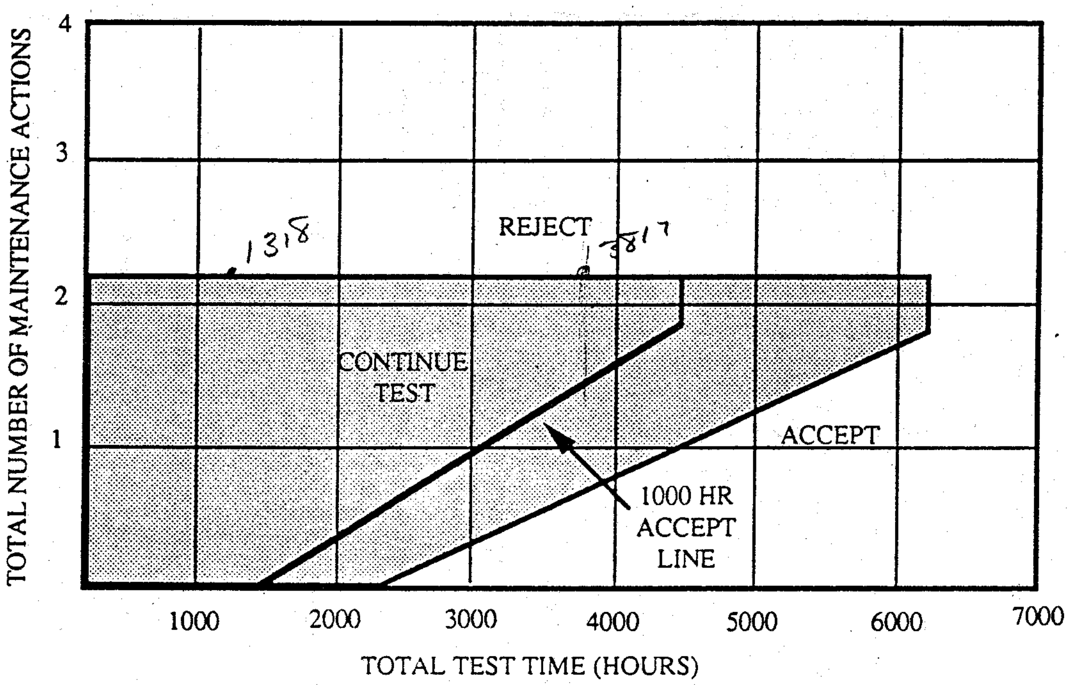


Figure 9. Ground Fixed Test Environment



TOTAL TEST TIME (HOURS)

NUMBER OF MAINTENANCE ACTIONS	REJECT (EQUAL OR LESS)	ACCEPT (EQUAL OR MORE)
0	N/A	2408
1	N/A	4340
2	N/A	6300
3	6300	N/A

Figure 10. MTBCF Accept/Reject Criteria

Table III. MTBCF Accept/Reject Criteria

1. If the MTBCF specification exceeds the MTBCMA actual test time, the verification is acceptable if two criteria are met:

   a. The MTBCMA is accepted in accordance with figure 10.

   b. The reliability prediction of both MTBCMA and MTBCF is accepted.

2. If the MTBCF specification is less than the MTBCMA test time, verification of the MTBCF shall be determined by the point estimate calculated by dividing the total MTBCF test time by the total count of critical failures. The verification is if the point estimate equals or exceeds the specified MTBCF.

4.2.3.3 Preventive Maintenance. Compliance with 3.4.2.1.5 shall be verified by demonstrating that the required PM can be accomplished within the specified time.

4.2.4 Environmental Tests. The following environmental tests shall be performed at one MLS/DME-paired frequency channel selected by the Government.

4.2.4.1 Temperature. The MMLS shall be tested in accordance with MIL-STD-810, Method 501.2, Procedure I and II, and Method 502.2, Procedures I and II. During the Procedure II, measurements of mean course error, mean glidepath error, and time delay of DME, as a minimum, shall be continuously recorded to determine compliance with the specified performance. In addition, the external temperature for each equipment (critical item configuration item or equivalent) shall be measured when the system temperature has stabilized during the maximum operating temperature tests. The measured temperatures shall be within specification for that equipment. Temperature sensors shall be placed at the hottest locations determined during parts derating tests for developed equipment, or by best engineering judgment for off-the-shelf equipment. As applicable to each equipment, the temperatures shall be verified for convection (air) and conduction (heat sink), and the plenum fluid for interior forced convection.

4.2.4.2 Relative Humidity. The MMLS shall be tested in accordance with MIL-STD-810, Method 507.2, Procedure III. During operation, measurements of mean course error, mean glidepath error, and time delay of DME, as a minimum, shall be continuously recorded to determine compliance with the specified performance.

4.2.4.3 Altitude. The MMLS shall be tested in accordance with MIL-STD-810, Method 500.2, Procedures I and II for the operating and non-operating requirements listed in 3.2.2.1.3. During Procedure II, measurements of MCE, mean glide path error, and time delay of DME, as a minimum, shall be continuously recorded to determine compliance with the specified performance.

4.2.4.4 Sand and Dust. The MMLS shall be tested in accordance with MIL-STD-810, Method 510.2, Procedures I and II with a sand concentration of 2.2 g/m^3 and wind velocities of 40 knots for a period of 120 minutes per side of test article. During operation, measurements of MCE, mean glidepath error, and time delay of DME, as a minimum, shall be continuously recorded to determine compliance with the specified performance.

4.2.4.5 Salt Fog. MMLS shall be tested in accordance with MIL-STD-810, Method 509.2, Procedure I with a minimum of 48-hours exposure and a 48-hour drying period.

4.2.4.6 Fungus. The MMLS shall be tested in accordance with MIL-STD-810, Method 508.3. Selected samples, chosen by the Government, shall be tested for a minimum period of 28 days.

4.2.4.7 Rain. The MMLS shall be tested in accordance with MIL-STD-810, Method 506.2, Procedure I with a rainfall rate of 4 in/hr and a wind speed of 50 knots and Procedure III with a water pressure of 40 psig. In addition, a demonstration showing the ease of clean-up of the MMLS shall be performed, including analysis to extrapolate to the use of decontamination agents.

4.2.4.8 Sunshine. The MMLS shall be tested in accordance with MIL-STD-810, Method 505.2, Procedure II.

4.2.4.9 Wind. The MMLS, including field sensor shall be subjected to a wind tunnel test in which the MMLS is exposed to the wind loads specified in 3.2.2.1.9. The MMLS shall be instrumented for continuous real-time monitoring of equipment dynamics, and video recordings of the tests shall be provided. As a minimum, stress and deflection of the equipment shall be recorded for analysis after the test.

4.2.4.10 Ice and Hail. The MMLS radome deicing capability shall be tested after coating the MMLS with 1/2-in of ice. The mean course and mean glidepath error shall be verified after completion of the deicing procedure. Prevention of ice formation on the antenna and field sensor radomes shall also be verified. The mean course and mean glidepath errors shall be measured during an icing procedure.

4.2.4.11 Shock and Vibration. The MMLS shall be tested for shock in accordance with MIL-STD-810, Method 516.3, Procedures IV, VI, and VIII, and for vibration in accordance with Method 514.3, for category 1 and category 3 equipment, with operation verified upon completion of each procedure.

4.2.5 Performance Capability Evaluation. Flight inspection/tests to verify system accuracy, power density, residual radiation, and coverage shall be conducted at four sites incorporating the test configurations defined in 4.2.5.1. At a minimum, the following conditions shall apply:

a. MLS receivers used will meet the requirements of S.N. 404L-50464-S-109.

b. The DME airborne interrogator used shall be the AN/ARN-118 or equivalent.

c. Flight test of the MMLS function shall be conducted as specified by FAA Order 8240.50 except coverage and accuracy requirements shall comply with MMLS performance specified herein. Additional flight check maneuvers to evaluate approaches at four additional glidepaths and one additional approach speed will be used. For collocated configurations up to four computed offset azimuth approaches shall be designated by the Government.

d. The performance of aircraft tracking equipment shall comply with standards established in sections 103.4 and 304 of AFM 55-8 and in paragraph 6.1 and associated subparagraphs for Category II measurement accuracies of ICAO Doc. 8071, Volume II.

e. Accuracy measurements and data reduction methodology for angle guidance functions shall be in accordance with paragraph 2.5.2, including figures and subparagraphs of Attachment G to Part I of ICAO SARPS Annex 10 and FAA Order 8240.50. For those portions of the flight tests not requiring the unique features of the MMLS receiver specified in S.N. 404L-50464-S-109, a standard FAA certified MLS receiver may be used.

f. Flight test of the DME transponder shall be conducted in accordance with section 203 of AFM 55-8, as modified by the performance requirements specified herein. Accuracy measurements for DME/P functions shall be made in accordance with paragraph 7.3.6, including figures and subparagraphs, of Attachment C to Part I of ICAO SARPS Annex 10.

4.2.5.1 Test Configurations. The test configurations chosen shall be representative of expected bare base, main operating base, and restored landing area scenarios as defined below. Flight tests shall include variations in approach elevation angles and azimuth angles representative of expected tactical precision approach flight paths.

4.2.5.1.1 Category I, Collocated System Deployment. The MMLS shall be set up in a collocated configuration, aligned, and readied for flight test for Category I operations as specified in 3.2.10.1.1 and 3.2.10.2.1

4.2.5.1.2 Category I, Split-Site System Deployment. The MMLS shall be set up in a split-site configuration and readied for flight test for Category I operations as specified in 3.2.10.1.2.1 and 3.2.10.2.2.1.

4.2.5.1.3 Category II, Split-Site System Deployment. The MMLS shall be set up in a split-site configuration and readied for flight test for Category II operations as specified in 3.2.10.1.2.2 and 3.2.10.2.2.2.

4.2.6 Production Acceptance Tests. A series of inspections, demonstrations and tests shall be conducted on each MMLS to assure that each operates and performs in accordance with the requirements of this specification. Acceptance test procedures shall include, as a minimum those verification tests marked with (1) in table IV. In addition, the first production system shall undergo the initial increment of the PRAT. (Tests marked (2)) The next initial (maximum of 3) production systems shall be subjected to the production qualification tests specified in 4.2.6.4. (Tests marked (3)).

4.2.6.1 Range Tests. The acceptance tests shall verify, as a minimum the following parameters by measurements with a MLS receiver, as specified in 4.2.5a, on a measurement range:

a. Verification of system MCE and mean glidepath error at a minimum of 3 points in space.

b. Verification of monitor functions.

c. Verification of the effective radiated power (ERP) of the angle guidance signal.

d. Verification of the angular guidance coverage.

4.2.6.2 Production Reliability Acceptance Test (PRAT). The reliability of the production system shall be verified in accordance with 10.2. The test shall be conducted on a sample from each production lot in accordance with the following:

Production Quantity	Number Involved in PRAT
1	1
1 - 5	lst
6 - 20	2
21 - 50	3
51 - 100	4
101 or greater	5

It is intended that the contractor shall perform a single PRAT for each production lot and may use multiple systems to reduce the test time as allowed by the table above.

4.2.6.3 Flight Inspections. Flight inspections shall be conducted on a sample system from each production lot to assure that the designed performance has not been degraded as a result of changes in tooling, processes, work flow, design, parts quality, or other contractor manufacturing method. The performance evaluation shall be conducted in accordance with 4.2.5, for the deployment scenario specified in 4.2.5.1.1. Production flight inspections shall be conducted at a location approved by the Government.

4.2.6.4 Production Qualification Test. In addition to the acceptance tests specified in 4.2.6.1 and 4.2.6.3, the initial production articles shall be subjected to the operating temperature, relative humidity, blowing rain, wind, basic transportation vibration, and EMC tests specified in paragraphs 4.2.4.1, 4.2.4.2, 4.2.4.7, 4.2.4.9, 4.2.4.11, and 4.2.2.4 respectively.

4.3 Formal Test Constraints. Formal test constraints shall be as specified herein.

4.4 Qualification Cross Reference. Table IV specifies the qualification method(s) and test level(s) to be used for each of the MMLS requirements. Any formal tests specified in 4.2 required to verify selected requirements are also identified in table IV. The qualification method shown in the table shall apply to all requirements of the referenced paragraphs unless specified otherwise.

Table IV. Qualification Cross Reference

Section 3 Paragraph	Qualification Requirement	Section 4 Method	Section 4 Level	Formal Test
3.1.3	Modes and states	D	2(1)	
3.1.3.1.1	OFF mode	D	2	
3.1.3.1.2	STANDBY mode	D	2(1)	
3.1.3.1.3	MAINTENANCE mode	D	2(1)	
3.1.3.1.4	SERVICE-DEMAND mode	D	2(1)	
3.1.3.1.5	ON mode	D	2(1)	
3.1.3.2.1	Deployed state	I	3	
3.1.3.2.2	Stored state	I	3	
3.1.4	System functions	D	3	
3.1.4.1.1	Channeling	D	2(1)	4.2.2.1.1
3.1.4.1.1.1	Frequency tolerance	D	2(1)	4.2.2.1.1
3.1.4.1.1.2	RF signal spectrum	T	2(1)	
3.1.4.1.2	Polarization	D	2	
3.1.4.1.3	Signal organization	D	2	
3.1.4.1.3.1	Function rates	T	2	
3.1.4.1.3.2	Function timing	T	2(1)	4.2.2.1.1
3.1.4.1.3.3	Function sequence	T	2	
3.1.4.1.3.4	Synchronization	T	2(1)	
3.1.4.1.4	Preamble	T	2(1)	
3.1.4.1.4.1	Carrier acquisition	T	2	
3.1.4.1.4.2	Modulation	T	2	
3.1.4.1.4.3	Receiver reference time code	T	2	
3.1.4.1.4.4	Function identification	T	2	

Table IV (continued)

Section 3 Paragraph	Qualification Requirement	Section 4 Method	Section 4 Level	Formal Test
3.1.4.1.5	Angle guidance encoding	T	2(1)	4.2.2.1.1
3.1.4.1.5.1	Angle guidance parameters	T	2	
3.1.4.1.5.2	Angle guidance parameter tolerance	T	2	
3.1.4.1.5.3	Scan transmission symmetry	T	2	
3.1.4.1.6.1	Scanning convention	D	2	
3.1.4.1.6.2	Sector signals	T	2(1)	
3.1.4.1.6.2.1	Morse Code equipment identification	T	2	
3.1.4.1.6.2.2	Airborne antenna selection signal	D	2	
3.1.7.1.7.1	Scanning conventions	D	2	
3.1.4.1.7.2	Sector signals	T	2(1)	
3.1.4.1.8	Data functions	T	2(1)	
3.1.4.1.8.1	Basic data	T	2(1)	
3.1.4.1.8.2	Auxiliary data	T	2(1)	
3.1.4.1.9	System accuracy	T	4	4.2.5
3.1.4.1.9.1.1	MCE	T	2,(1)	4.2.5, 4.2.6.1, 4.2.6.3
3.1.4.1.9.1.2	Azimuth PFN	T	2,4(1)	4.2.5, 4.2.6.3
3.1.4.1.9.1.3	Azimuth degradation allowance	T	2,4	4.2.5, 4.2.6.3
3.1.4.1.9.1.4	Azimuth CMN	T	4(1)	4.2.5, 4.2.6.3
3.1.4.1.9.1.5	Azimuth CMN degradation	T	4	4.2.5, 4.2.6.3

Table IV (continued)

Section 3 Paragraph	Qualification Requirement	Section 4 Method	Level	Formal Test
3.1.4.1.9.2.1	Mean glidepath error	T	2,4(1)	4.2.5, 4.2.6.1, 4.2.6.3
3.1.4.1.9.2.2	Elevation PFN	T	2,4(1)	4.2.5, 4.2.6.3
3.1.4.1.9.2.3	Elevation degradation allowance	T	2,4	4.2.5, 4.2.6.3
3.1.4.1.9.2.4	Elevation CMN	T	4(1)	4.2.5, 4.2.6.3
3.1.4.1.9.2.5	Elevation CMN degradation allowance	T	4	4.2.5, 4.2.6.3
3.1.4.1.10	Power density	T	2,4(1)	4.2.5, 4.2.6.1, 4.2.6.3
3.1.4.1.11	Residual radiation	D	4(1)	4.2.5,
3.1.4.1.12	Coverage	T	4(1)	4.2.5, 4.2.6.1, 4.2.6.3
3.1.4.1.12.1	Azimuth scan adjustment	T	4	4.2.5 4.2.6.3
3.1.4.1.12.2	Elevation scan adjustment	D	2	
3.1.4.1.13	Azimuth scanning beam characteristics	D	2	4.2.2.1.1
3.1.4.1.13.1	Beamwidth	T	2(1)	
3.1.4.1.13.2	Scanning beam shape	T	2	
3.1.4.1.13.3	Dynamic sidelobes	T	2	
3.1.4.1.14	Elevation scanning beam characteristics	D	2	4.2.2.1.1
3.1.4.1.14.1	Beamwidth	T	2(1)	
3.1.4.1.14.2	Scanning beam shape	T	2	

Table IV (continued)

Section 3 Paragraph	Qualification Requirement	Section 4 Method	Level	Formal Test
3.1.4.1.14.3	Dynamic sidelobes	T	2	
3.1.4.2.1.1	DME/P Coverage	T	4(1)	4.2.5, 4.2.6.1, 4.2.6.3
3.1.4.2.1.2	Channeling	D	2(1)	4.2.2.1.2
3.1.4.2.1.3	Capacity	T	2	
3.1.4.2.1.4	DME/P transponder identification	T	2	
	Reply pulses	T	2	
	Identification code characteristics	T	2	
	Identification implementation	T	2	
3.1.4.2.1.5	DME/P modes	T	4	4.2.2.1.2
3.1.4.2.2.1	Frequency of operation	D	2(1)	
3.1.4.2.2.2	Frequency stability	T	2(1)	4.2.2.1.2
3.1.4.2.2.3	Pulse shape and spectrum	T	2(1)	4.2.2.1.2
3.1.4.2.2.4	Pulse spacing	T	2(1)	4.2.2.1.2
3.1.4.2.2.5	Power density	T	2,4(1)	4.2.2.1.2
	Minimum transmission rate	T	2	4.2.5, 4.2.6.1, 4.2.6.3
3.1.4.2.2.6	Spurious radiation	T	2(1)	
	Out-of-band spurious radiation	T	2	
3.1.4.2.2.7	Squitter	T	2(1)	
3.1.4.2.2.8	Priority of transmission	T	2	
3.1.4.2.3.1	Frequency of operation	D	2(1)	
3.1.4.2.3.2	Frequency stability	T	2(1)	4.2.2.1.2
3.1.4.2.3.3	Sensitivity			
	Minimum interrogation power density	T	2(1)	

Table IV (continued)

Section 3 Paragraph	Qualification Requirement	Section 4 Method	Level	Formal Test
3.1.4.2.3.3 (cont.)	Reply efficiencies	T	2(1)	
	Dynamic range	T	2(1)	
	Pulse pair spacing variations	T	2(1)	
3.1.4.2.3.4	Sensitivity reduction	T	2(1)	
3.1.4.2.3.5	Bandwidth	T	2	
	Minimum bandwidth	T	2	
	Out-of-band signals	T	2	
3.1.4.2.3.6	Recovery time	T	2(1)	
3.1.4.2.3.7	Spurious radiations	T	2(1)	
3.1.4.2.3.8	Echo suppression	T	2	4.2.2.1.2
3.1.4.2.3.9	CW interference	T	2	4.2.2.1.2
3.1.4.2.4	Decoding			
	Transponder triggering	T	2(1)	
	Decoder rejection	T	2(1)	
3.1.4.2.5	Time delay	T	2(1)	4.2.2.1.2
3.1.4.2.6	Accuracy	T	2,4(1)	4.2.2.1.2 4.2.6.1
3.1.4.2.7	Efficiency			
	Reply efficiency	T	2	
	Receiver dead time	T	2	
3.1.4.3	Monitor functions	T	3	
3.1.4.3.1	Integrity requirement	A	3	4.2.3.1
3.1.4.3.1.1	End-to-end integrity check capability	D	3(1)	
3.1.4.3.2.1	Angle and data monitor parameters	D	3(1)	4.2.6.1
3.1.4.3.2.2.a	Monitor parameter adjustability	D	3	
3.1.4.3.2.2.b	Monitor stabilization	D	3	

Table IV (continued)

Section 3 Paragraph	Qualification Requirement	Section 4 Method	Section 4 Level	Formal Test
3.1.4.3.2.2.c	Mean angle error	D	3	
3.1.4.3.2.2.d	Data transmissions	D	3	
3.1.4.3.2.2.e	Multiple sensors	D	3	
3.1.4.3.2.2.f	MAINTENANCE	D	3	
3.1.4.3.2.2.g	Mean angle shift	D	3	
3.1.4.3.2.3	Responses to angle and data monitor alarms	D	3(1)	4.2.6.1
3.1.4.3.2.3.a	Automatic restart	D	3	
3.1.4.3.2.3.b	Alarm indications	D	3(1)	4.2.6.1
3.1.4.3.2.3.c	Field sensor disabled	D	3	
3.1.4.3.3	DME/P monitoring	T	3(1)	4.2.6.1
3.1.4.3.3.a	Multiple sensors	D	3	
3.1.4.3.3.b	Monitor parameter adjustability	D	3	
3.1.4.3.3.1	Responses to DME/P monitor alarms	D	3(1)	
3.1.4.4	Control and display functions	D	3	
3.1.4.4.1	Local control	D	2(1)	
3.1.4.4.1.1	Channel selection	D	3(1)	
3.1.4.4.1.2	Equipment alignment and antenna scan limit adjustment	D	2	
3.1.4.4.1.2.1	Azimuth alignment control	D	2	
3.1.4.4.1.2.2	Elevation alignment control	D	2	
3.1.4.4.1.3	Modes	D	2(1)	
3.1.4.4.1.4	Data entry	T	2(1)	
3.1.4.4.1.5	PRESET control	D	2	
3.1.4.4.1.6	Landing performance selection	D	3	

Table IV (continued)

Section 3 Paragraph	Qualification Requirement	Section 4 Method	Level	Formal Test
3.1.4.4.3	Remote control	D	3(1)	
3.1.4.4.4	Remote display	D	3(1)	
3.1.7.1.1.3	Power	D	3	4.2.2.5
3.1.7.1.3	Hardware-to-hardware external interfaces	T	3	4.2.2.5
3.1.7.1.4.1	MLS avionics interface	T	4	4.2.5
3.1.7.1.4.2	DME interface	T	4	4.2.5
3.2.1.1	Weight	D	3	
3.2.1.2	Dimensions	D	3	
3.2.1.3	Transportability	D	3	
3.2.1.3.1.1	Air transport: fixed wing	A	3	
3.2.1.3.1.2	Air transport: rotary wing	A	3	
3.2.1.3.2.1	Truck transport	A	3	
3.2.1.3.2.2	Trailer transport	A	3	
3.2.1.3.2.3	Rail transport	A	3	
3.2.1.3.3	Ship transport	A	3	
3.2.1.3.4	Man transport	D	3	
3.2.1.4	Durability	T	3	4.2.2.3
3.2.1.5	Stability	T	3,4	4.2.2.2
3.2.2	Environmental conditions	D	3	
3.2.2.1.1	Temperature	T	2(3)	4.2.4.1
3.2.2.1.2	Relative humidity	T	2(3)	4.2.4.2
3.2.2.1.3	Altitude	T	2	4.2.4.3
3.2.2.1.4	Sand and dust	T	2	4.2.4.4

Table IV (continued)

Section 3 Paragraph	Qualification Requirement	Section 4 Method	Section 4 Level	Formal Test
3.2.2.1.5	Salt fog	T	2	4.2.4.5
3.2.2.1.6	Fungus	T	2	4.2.4.6
3.2.2.1.7	Rain	T,D	2(3)	4.2.4.7
3.2.2.1.8	Sunshine	T	2	4.2.4.8
3.2.2.1.9	Wind	T	2(3)	4.2.4.9
3.2.2.1.10	Ice and hail			
	Deicing	T	2	4.2.4.10
	Hail	A	2	
3.2.2.1.11	Snow	A	2	
3.2.2.1.12	Lightning	A	2	
3.2.2.2.1	Shock and vibrations	T	2(3)	4.2.4.11
3.2.2.2.2	Storage	A	3	
	Stackability	D	3	
	Accessibility (batteries)	D	3	
3.2.4.1	Design and construction	I	1(1)	
3.2.4.2	Obstruction lights	D	2	
3.2.4.3	Internal power	D	2(1)	
	Charging	D	2(1)	
	Standby battery switchover	D	3(1)	4.2.2.5
	Battery type	I	1	
	Low temperature operation	D	3	
3.2.4.4	Fastener hardware	I	1(1)	
3.2.4.5	Cables and connectors	I	1(1)	
3.2.4.6	Encapsulation and embedment material	I	1(1)	
3.2.4.7	Finish	I	1(1)	
3.2.4.8	Chemical decontamination	A	2	

Table IV (continued)

Section 3 Paragraph	Qualification Requirement	Section 4 Method	Section 4 Level	Formal Test
3.2.4.9.1	Derated application of parts	A	1	4.2.1.3
3.2.4.9.2	Parts selection and screening	I	1	4.2.1.4
3.2.4.10	ESS	T	1	4.2.1.2
3.2.5	Electromagnetic radiation	T	3	4.2.2.4
3.2.6	Workmanship	I	1(1)	
3.2.7	Interchangeability	I	1	
3.2.8	Safety	A	1	
3.2.8.1	Safety criteria			
	Applied	A	1	
	Hazards	I	1(1)	
3.2.8.2	Grounding, bonding, and shielding	I	1(1)	
3.2.8.3	Electrical overload protection	D	1	
3.2.8.4	Corona and electrical breakdown prevention	D	1	
3.2.9	Human performance/human engineering	D	3	
3.2.10.1	Setup and teardown	T	3,4	4.2.2.3 and 4.2.5
3.2.10.1.1	Collocated setup	T	3,4	4.2.5.1.1
3.2.10.1.2.1	Split-site setup (Category I)	T	3,4	4.2.5.1.2
3.2.10.1.2.2	Split-site setup (Category II)	T	3,4	4.2.5.1.3
3.2.10.2.1	Collocated siting	T	3,4	4.2.5.1.1
3.2.10.2.2.1	Split-site siting (Category I)	T	3,4	4.2.5.1.2
3.2.10.2.2.2	Split-site siting (Category II)	T	3,4	4.2.5.1.3
3.2.10.2.2.2.1	Category II design	T	3	

Table IV (continued)

Section 3 Paragraph	Qualification Requirement	Section 4 Method	Level	Formal Test
3.2.10.2.3	Nondegradation conditions	A	3	
3.2.12	Nameplates and product marking	I	1(1)	
3.2.12.1	Nameplates	I	1(1)	
3.2.12.2	Cable identification	I	1(1)	
3.2.12.3	Crystal Identification	I	1(1)	
3.3.1.1	Computer hardware requirements	I	1	
3.3.1.1.1	Memory	D	2	4.2.1.1
3.3.1.1.2	Processing speed	T	2	4.2.1.1
3.3.1.1.3	Port requirements	D	2	4.2.1.1
3.3.1.2	Programming requirements	I	1	
3.3.1.2.1	Programming languages	I	1	
3.3.1.2.2	Compilers and assemblers	I	1	
3.3.1.2.3	Operating system	I	1	
3.3.1.2.3.1	Operating system augmentations	A	1	
3.3.1.3	Design and coding constraints	I	1	
3.3.1.3.1	Design requirements	I	1	
3.3.1.3.2	Coding requirements	I	1	
3.4.1.1	MTBCF	T	3(2)	4.2.3, 4.2.6.2
3.4.1.2	MTBCMA	T	3(2)	4.2.3, 4.2.6.2
3.4.1.3	Independence of failures	D	3	

Table IV (continued)

Section 3 Paragraph	Qualification Requirement	Section 4 Method	Level	Formal Test
3.4.1.4	Reliability modeling and allocations	A	3	
3.4.1.5	Reliability predictions	A	3	
3.4.2.1.1.1	FFD	D	3	4.2.3.2.1
3.4.2.1.1.2	MTBFA	A	3	4.2.3
3.4.2.1.2.1	FFI: organizational-level	D	3	4.2.3.2.1
3.4.2.1.2.2	MTTR: organizational-level	D	3	4.2.3.2.1
3.4.2.1.4.1	FFI: depot-level	D	3	4.2.3.2.3
3.4.2.1.5	Preventive maintenance			4.2.3.3
	60 minute requirement	D	3	
	90 day requirement	A	3	
	10 minute restoral requirement	D	3	
3.4.4	Portability	D	3	4.2.2.3
3.5.1.1.1	Common Support equipment	I	3	
3.5.1.2.1	Organizational-level maintenance	D	3	4.2.3.2.1
3.5.1.2.2	Depot-level maintenance	D	3	4.2.3.2.3
3.5.3	Supply	A	3	

5 PREPARATION FOR DELIVERY

Preservation, packaging, and packing of the MMLS shall ensure that no damage shall be incurred during handling and shipment from the source of supply to the Government-designated destination. Level A preservation and packaging and Level A packing shall be provided in accordance with MIL-STD-2073. Design criteria of MIL-STD-2073 and MIL-P-9024 shall be applicable. Markings shall be in accordance with MIL-STD-129.

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6 NOTES

6.1 Definitions. The definition's below shall apply to this specification.

6.1.1 Alarm. The term "alarm," used in conjunction with monitoring, shall denote a situation in which an out-of-tolerance condition as sensed by the monitor function, has existed for a minimum period of time necessary to provide an acceptable estimate of parameter value.

6.1.2 Approach Azimuth. The function that provides lateral guidance to aircraft in the approach region.

6.1.3 Approach Elevation. The function that provides vertical guidance in the approach region.

6.1.4 Auxiliary Data. Data transmitted by the ground equipment, in addition to basic data, that provides:

a. Supplementary ground equipment siting information for use in refining airborne position calculations

b. Meteorological information

c. Runway status

d. Other supplementary information

6.1.5 Basic Data. Data transmitted by the ground equipment associated directly with the operation of the landing guidance system, and advisory data on the MMLS ground equipment performance level.

6.1.6 Beam Center. The midpoint between the -3 dB points on the leading and trailing edges of the scanning beam main lobe.

6.1.7 Beamwidth. The width of the scanning beam main lobe measured at the -3 dB points and defined in angular units on the antenna boresight, in the horizontal plane for the azimuth function, and in the vertical plane for the elevation function.

6.1.8 Category I. A level of service that allows a precision approach down to a decision height of 200 ft and with runway visual range of at least 2600 ft.

6.1.9 Category II. A level of service that allows a precision approach down to a decision height of 100 ft and with runway visual range of at least 1200 ft.

6.1.10 Communications Channel. A functional path along which a signal may be sent in one direction.

6.1.11 Commercial Off-the-Shelf Item. A product in regular production currently or previously sold in substantial quantities to the general public.

6.1.12 Coverage Sector. A volume of airspace within which service is provided by a particular function and in which the signal power density is equal to or greater than the specified minimum.

6.1.13 DME/P. The range function associated with the MMLS. DME/P is compatible with standard navigation DME while providing improved accuracy and additional channel capabilities.

6.1.14 Dynamic Sidelobe Level. The level that is exceeded three percent of the time by the scanning antenna far field radiation pattern exclusive of the main beam as measured at the function scan rate using a 26 kHz beam envelope filter. The three percent level is determined by the ratio of the sidelobe duration which exceeds the specified level to the total scan duration.

6.1.15 End-to-End Integrity Check. A check in which an out-of-tolerance signal for each monitored parameter is intentionally radiated to verify the monitor's ability to detect the fault and effect an appropriate control action.

6.1.16 False Alarm. The indication of an MMLS fault condition which cannot be confirmed upon retest using the BIT fault detection/isolation capability of the MMLS. Alarms associated with the occurrence of momentary power interruptions, transients or out of limits conditions, whether operating from external or battery power sources, are not to be considered false alarms.

6.1.17 False Course. An undesired course which the MLS receiver acquires and tracks due to reflections of the scanning beam, scanning beam antenna sidelobe, scanning beam antenna grating lobes, or incorrect clearance.

6.1.18 Fault. Any failure of the MMLS equipment to perform within acceptable performance limits when the system has been properly installed and checked out. This includes performance degradation beyond specification limits, monitor alarm occurrences, and hard failures when the system is operating from external power sources or in the battery powered mode. A momentary fault indication associated with the occurrence of electrical power source transients, interruptions, or other out of specification electrical power conditions shall not be classified as a fault occurrence.

6.1.19 Field Sensor. A sensor located external to the equipment being monitored that is capable of detecting equipment failures and out-of-tolerance conditions.

6.1.20 Final Approach Mode. The DME/P mode of operation that is characterized by wide bandwidth processing of signals and time delays (both interrogated range measurement and transponder reply delay) that are based on measurements at the virtual origin of the pulse.

6.1.21 Fraction of Failures Detected (FFD). A measure of the effectiveness of detecting system failures during operating checkout: the number of failures which are detected by BIT during operating checkout divided by the total number of failures.

6.1.22 Fraction of Failures Isolated (FFI). A measure of the capability to functionally isolate failures: the number of failures, each of which can be functionally isolated within a specified time to a specified LRU or group of LRUs, divided by the total number of failures.

6.1.23 Growth Capacity. The capacity of a processing system unavailable at the time of delivery that may be added without modification or redesign of existing hardware or software.

6.1.24 Gust. A peak wind disturbance in excess of the steady state wind lasting up to 20 seconds.

6.1.25 Instrument Landing System (ILS) Point "A". A point along a 3° glidepath measured along the extended runway center line in the approach direction a distance of 4 nmi from the threshold.

6.1.26 Initial Approach Mode. The DME/P mode of operation that is similar to a conventional DME (DME/N) operation where narrow band processing is used, and time delays (both interrogated range measurement and transponder reply delay) are based on measurements at the 50 percent of maximum voltage amplitude level on the pulse leading edge.

6.1.27 Integral Sensor. An integral sensor is one that is located within the antenna aperture that samples the radiated signals for monitoring purposes.

6.1.28 Integrity. The probability that the ground equipment will not radiate hazardous MLS guidance or data signals during a specified time interval. Hazardous guidance or data includes any out-of-tolerance conditions that would not be clearly recognizable to a pilot.

6.1.29 Interrogation Signal. A pulse pair radiated by a DME interrogator.

6.1.30 I/O Port. A device, or a place of access to a device, which is a component of a processing system and which provides the interface between that processing system and one or more communications channels.

6.1.31 Line Replaceable Unit (LRU). An item which is to be functionally and physically isolated and replaced during organizational maintenance. The item is capable of being removed and replaced without substantial disassembly of equipment. Substantial disassembly is defined as any remove and replace action which causes the maintenance technician to exceed the specified MTTR.

6.1.32 Man Transportable. Items which have integral provisions for man transport for limited distances (100-500 meters). Upper weight limit is 65 pounds per individual.

6.1.33 Mean Course Error (MCE). The mean value of the azimuth error along a specified radial of an azimuth function.

6.1.34 Mean Glide Path Error. The mean value of the elevation error along the specified glidepath.

6.1.35 Mean Time Between Corrective Maintenance Actions (MTBCMA). A measure of system reliability related to demand for corrective maintenance manpower: the total number of system life units divided by the total number of failures which are repaired by corrective unscheduled maintenance.

6.1.36 Mean Time Between Critical Failure (MTBCF). A measure of mission reliability: the total amount of mission time divided by the total number of critical failures during the mission. A critical failure is a failure or a combination of failures, that prevents an item from performing a specified mission.

6.1.37 Mean Time Between False Alarms. The number of MMLS system operating hours divided by the total number of false alarms.

6.1.38 Mean Time to Repair (MTTR). A measure of maintenance time on equipment only: the sum of repair time divided by the total number of failures. Repair time includes isolation, removal, replacement, alignment, and checkout.

6.1.39 <u>MLS Approach Reference Datum</u>. A point over the runway centerline 50 ft above the approach threshold.

6.1.40 <u>MLS Datum Point</u>. The point on the runway centerline closest to the phase center of the approach elevation antenna.

6.1.41 <u>Multipath</u>. The effect of a reflected signal on the quality of the primary signal at the receiver.

6.1.42 <u>Path Following Noise (PFN)</u>. That portion of the guidance signal error that could cause aircraft displacement from the mean course line or mean glide path, as appropriate.

6.1.43 <u>Proportional Guidance Sector</u>. The volume of airspace within which the angular guidance information provided by a function is directly proportional to the angular displacement of the airborne antenna with respect to the zero angle reference.

6.1.44 <u>Reply Efficiency</u>. The ratio of replies transmitted by the transponder to the total of on-channel interrogations received from a single interrogator.

6.1.45 <u>Runway Threshold</u>. The beginning of that portion of the runway usable for landing.

6.1.46 <u>Shop Replaceable Unit (SRU)</u>. A replaceable subassembly, module, or component of the MMLS equipment as designated in the MMLS Maintenance Technical Orders for replacement at the depot level of maintenance.

6.1.47 <u>Squitter</u>. Pulses generated within the DME to maintain a controlled transponder output transmission rate.

6.1.48 <u>Time Division Multiplex (TDM)</u>. A method of sequentially transmitting a number of functions on a single frequency channel by means of time separation.

6.1.49 <u>Threshold Sensitivity</u>. The minimum RF power level of a signal required at a receiver input which satisfies specified accuracy requirements.

6.1.50 <u>TO and FRO Scan</u>. The first and second scans, respectively, of the scanning beam from one coverage limit to the other. The direction of the FRO scan is opposite to the direction of the TO scan.

6.1.51 <u>Virtual Origin</u>. That point in time, associated with the leading edge of the pulse, where the linear extension of a straight line through the points of 5 percent and 30 percent of the maximum voltage amplitude of the pulse intersects the zero voltage axis as specified in figure 3-2 of ICAO SARPS Annex 10.

10 APPENDIX I

10.1 Scope. The contents of this appendix define reliability verification test and maintainability demonstration requirements.

10.2 Reliability Verification Test (RVT)

10.2.1 Test Prerequisites. The contractor shall assure that the following specific tasks/actions are accomplished prior to start of RVT.

a. The test item(s) (i.e., system/equipment) shall be clearly described and a configuration audit performed to the unit level. All known deficiencies shall be corrected and the corrective action verified prior to start of test so that the test items(s) represents an acceptable baseline configuration.

b. Copies of the Government-approved Reliability Test Plan and Procedures shall be available for use.

c. All test items immediately prior to the start of the RVT shall be subjected to, and shall have successfully passed, detailed tests conducted to verify that the items fully meet their performance specification requirements.

d. Arrangements shall be made for test monitoring by cognizant Government personnel, and test logs are to be cosigned by Government and contractor representatives.

e. Test equipment calibration logs shall indicate that the test equipment is properly calibrated.

f. The test shall be conducted in a controlled area that can be secured to prevent unauthorized access to the test facilities, test equipment, test records, and the test item(s) once the RVT has officially started. Access to the testing area shall be limited to personnel assigned to the test unless Government escorted. A written list of all such personnel shall be maintained by the contractor and made available to the Government upon request.

10.2.2 Conditions of Test.

a. The test item(s) shall be mounted and connected as shown in the reliability test procedures.

b. The system shall be operated in the environments specified in figure 9. During operating segments of the test, test items shall be exercised in as near operational use as possible. This includes the use of various operating modes and the handling of the various required data or information. In order of preference, the data or information handled by the test item will be actual recorded operational data/information, simulated operational data/information, or BIT patterns.

c. All test equipment shall bear current calibration stickers/tags during their use in the RVT.

d. Test time for the RVT shall accrue from the beginning of RVT to the accept or reject point, including operating and nonoperating time, but excluding down time for preventive or corrective maintenance.

e. Test records for each test item shall be maintained. As a minimum, the test records shall include:

1. Systems/equipment serial numbers

2. Elapsed reliability test time and environmental condition for each failure

3. Test log data sheets

4. Failure reports

5. Failure data from which MTBCMA can be verified. Verification of the MTBCF shall be by analysis and in accordance with table III

6. Failure data from which the requirements for False Alarms can be verified

f. All PM shall be kept to an absolute minimum and shall be defined in the RVT plan, and shall be as required in the system/equipment specification. All PM shall be performed prior to RVT and performed thereafter per the required periodicity. No additional PM shall be performed while the test item(s) is in an operational mode or during system/equipment repair. Readjustment of operational controls is not considered PM. Anticipation of failure shall in no case be justification to change either the prescribed intervals or expand the list of authorized replacements.

10.2.3 Failure Detection, Correction, and Analysis.

a. Detection of Failure: A failure shall be recorded as having happened at the time it is detected by one or more of the following methods that are listed in order of desired use. The detection method used shall assure a confidence of failure detection of greater than 99 percent.

1. Continuously monitor for failure while operating using:

(a) Normal system outputs

(b) BIT

(c) Special test equipment

2. Periodically, at least once every 8 hours, test for failures:

(a) Without stopping RVT

(b) Stop RVT, test for failures, restart RVT (least desirable and no maintenance shall be allowed while the RVT is stopped)

b. Corrective Action: To continue the RVT, failures shall only be repaired in accordance with the design and by the methods described in the Technical Orders. If any engineering or manufacturing design changes are needed to correct design deficiencies, the RVT shall start at the beginning after the design changes have been made and all previous verifications requalified.

c. Failure Analysis: As part of the failure analysis the cause of each failure shall be investigated adequately to determine relevancy of the failure. Methods such as test, application study, dissection, X-ray analysis, microscopic analysis, spectrographic analysis, etc., will be employed for this purpose. These investigations will be performed by specialists experienced in state-of-the-art failure analysis and procedures as well as acquainted with the material, processes, and techniques used in the fabrication or manufacture of the failed part. The failure analyst will have at his disposal a complete documented history of the failed part including prior inspections, environmental exposure, electrical testing, and operational experience in his efforts to trace the cause of failure and recommend corrective action. Over stressing of associated and adjacent components and identical problems will be considered.

A copy of each report shall be kept as part of the RVT records. The contractor and the Government shall indicate on each report their respective positions on the relevance as an RVT failure.

10.2.4 Determination of Compliance.

a. Failure Definitions:

1. Relevant Failure: A failure which can be attributed, after failure analysis, to any of the following:

(a) Not meeting system performance requirements including failures in a redundant switching control.

(b) Hardware or software design defects

(c) Manufacturing process, material, or workmanship defects

(d) Physical or functional deterioration (such as wearout, fatigue, or tolerance degradation)

(e) Failures of parts of known limited life (such as batteries) occurring prior to the end of the stipulated period are relevant

(f) Intermittent failures

(g) Failures due to incorrect instruction in the technical manuals used during the RVT

(h) Failures that cannot be duplicated or for which no cause could be determined

(i) Failures which are not proved to be nonrelevant shall be considered as relevant

2. Nonrelevant Failures: A failure that after failure analysis is proven to the satisfaction of the Government to be caused by the following:

(a) Damage resulting from improper installation

(b) Failure of test instrumentation or monitoring equipment that is external to the test vehicles under test

(c) Interrupted operation caused by external power failures

(d) Overstress, beyond the design requirements of the system or defined in the Government or prime item specification, applied to test vehicles under test due to a facility fault

(e) Damage resulting from accident or mishandling by personnel performing the RVT

(f) Failures due to procedural errors by technician or operator

(g) Dependent failure (i.e., a failure of a part(s) as a direct result of a failure of another part within the system). It must be established by the contractor to the satisfaction of the Government that the failure(s) was dependent upon another part failing and was not an unrelated incident occurring at the same time

(h) Failure of certain parts (limited life parts) occurring after their known useful life has expired will not be counted as relevant if identified and approved by the Government prior to start of RVT

b. Accept/Reject Decision:

1. Verification that the MTBCMA requirement(s) has been met shall be determined in accordance with figure 10.

2. Verification that the MTBCF requirement(s) has been met shall be determined in accordance with table III.

3. Verification that the false alarm requirement has been met shall be determined as follows. To determine the mean time between false alarms divide the total RVT test time by the number of BIT failure indications for which no failure was repaired.

c. Notification: If the final classification of all failures has been made and it is determined that a reject decision has been reached, the contractor shall be formally informed by the Government. Prior to a subsequent RVT, all test preparation requirements must be met with emphasis on correction of deficiencies related to the failures during the initial RVT.

10.2.5 Post-Test Requirements. After completion of the RVT all test item(s) shall be subjected to and shall successfully pass the detailed test conducted to verify that the item(s) fully met its performance specification requirements.

10.3 Maintainability Demonstration (MD).

10.3.1 Predemonstration Activities. The contractor shall assure that the following specific tasks/actions are accomplished prior to the start of the MD.

a. The demonstration item(s) (i.e., system/equipment) shall be clearly described and a configuration audit performed to the configuration item.

b. All demonstration item(s), PME, and peculiar test equipment, shall be thoroughly checked for proper operation in the MD setup. Each demonstration item shall have been subjected to and passed the Government formal qualification DT&E.

c. All applicable documents identified in the MD plan shall be available. Special emphasis should be given to obtaining validated technical orders.

d. Arrangements shall be made for demonstration monitoring by cognizant Government engineering personnel. Demonstration data sheets shall be cosigned by Government and contractor representatives at completion of each maintenance action/task.

e. Each demonstration shall be held in a controlled area that can be secured to prevent unauthorized access to the facilities demonstration equipment, demonstration record(s), and the demonstration item(s). Access to the demonstration area shall be limited to personnel assigned to the demonstration unless Government escorted. A written list of all such personnel shall be maintained by the contractor and made available to the Government upon request.

10.3.2 Conditions of Demonstration. The following paragraphs describe the conditions under which the MD will be conducted:

a. Each MD shall be performed at the facility where the PME and the test equipment can be most effectively gathered. Organizational MD will usually be at the contractor facility. Depot MD will usually be at the applicable Air Logistics Center. The demonstration area shall contain only the item(s) to be demonstrated, the specified test equipment, the Government-approved Technical Orders, and the Government-approved spares required by the demonstration team to complete the selected maintenance tasks.

b. The MD shall be accomplished by maintenance technicians from the organization that will perform the operational maintenance. These technicians shall be trained and certified by the contractor and equivalent to the specified skill level.

c. The items to be demonstrated shall be in an operating configuration.

10.3.3 Demonstration Team. The demonstration team will consist of both contractor (CR) and Government (G) representatives, as shown below:

a. Demonstration director and system engineer (G)

b. Contractor system engineer (CR)

c. Failure insertion technicians (CR)

d. Maintenance technicians (G)

e. Procuring activity witness (G) (this may be 10.3.3.a above or a plant representative)

f. Contractor witness (CR) (this may be 10.3.3.b above, or a contractor inspector, or quality control person)

10.3.4 Specific Demonstration Requirements. The following paragraphs describe the requirements of the formal maintainability demonstration:

a. Objective. The objective of the formal maintainability demonstration is to verify the achievement of contract requirements.

b. Selection of Failures. In the maintainability demonstration plan:

1. For the organizational level, the contractor shall list a minimum of 100 continuous and total failures (not intermittent or degraded). Each failure must be inserted and removed without damage to the item being demonstrated. The distribution of the failures among the major items will be based on the current failure rate prediction; apportioning more failures to the items with the higher failure rates, but ensuring that some failures are identified for each LRU. The contractor shall also list each adjustment, both internal and external to the equipment, that will cause the equipment to be out of specification.

2. For the depot level, the contractor shall list those SRUs that will use unique depot test equipment or unique procedures on common depot test equipment. The contractor shall list a minimum of five failures per SRU that can be used to demonstrate the capability of the depot test equipment to isolate a failure to the discardable item. The Government will randomly select one or more failures per SRU to be demonstrated.

c. Performance of Tasks.

1. Induction of Failures and Verification of Detection.

(a) For each maintenance level, the failure insertion technician will insert, in random order, each of the selected continuous total failures and nonfailures into the equipment by reworking or replacing parts or assemblies as necessary. BIT indication of each inserted failure will be checked and recorded.

(b) For the organizational level only, the failure insertion technician will vary each adjustment in each direction until the BIT indicates a failure, and will then determine whether the item is within specified performance (i.e., false alarm) or out of specifications (i.e., proper failure detection). Adjustments which are found to be out of specification will be submitted to the maintenance technician for failure isolation.

(c) For the organizational level only, the failure installation technician will induce the selected software errors and will note whether the BIT indicates the failure.

2. Corrective Maintenance.

(a) The maintenance technician will be called in after each hardware failure or nonfailure is inserted, will verify each failure or nonfailure as prescribed by the technical orders, will isolate each failure, and will repair the selected failure.

(b) The contractor's system engineer will observe and record on the Maintainability Demonstration Log, figure 11, the detailed time and task observations. Upon completion of the task, the data will be summarized into elapsed times and recorded on the Maintainability Demonstration Summary Data Sheet, figure 12.

(c) After completion of the prescribed maintenance for each inserted failure, the maintenance technician will leave the demonstration area. The failure installation technician will correct the failure if a repair has not been made and insert the next failure.

(d) Isolation of a failure will be unsuccessful when the time specified for the MTTR has elapsed or when the failure is erroneously identified. Repair of a failure will be terminated when three times the MTTR has elapsed. No time limits are established for the depot level demonstrations, but the failure isolation must be completed in a reasonable time.

(e) All replacement subassemblies (spares) will be immediately available to the maintenance technician at the organization level. No repairs will be made for the depot level demonstrations.

(f) In the event the maintenance technician fails to find the failure or an incorrect diagnosis is made by the technician, the failure insertion technician will remove the inserted failure, check the system or item for proper operation, and insert the next failure.

(g) In the event an unintended failure occurs, or one is induced by the maintenance technician while isolating a failure, the data taken for that failure will be invalidated. The repair will be made by the failure insertion technician and the system or item checked for proper operation.

(h) Data recorded in (f) and (g) above will be analyzed to identify potential improvements in the procedures, technical orders, built in test, computer program, or equipment design. Recommendation for corrective action will be included in the Maintainability Demonstration Report.

3. Restoral Time by Switching to Redundant Items.

(a) Wherein the system has redundant items, all failures induced by the failure insertion technician shall be induced in the primary operating item.

(b) As prescribed, system critical performance will be restored automatically or manually by the maintenance technician.

MAINTAINABILITY DEMONSTRATION LOG

TASK NO.___________ TECHNICIANS:___________ ITEM_________________
DATE:_______________ WITNESSES:_______________ PAGE_______ OF_______
____
____

EVENT NO.	TIME MIN/SEC	EVENT	COMMENTS

Witnessed By: U.S. Government Representative: ____________________
Contractor Representative: ____________________
Date: ____________________

Figure 11. Maintainability Demonstration Log

ITEM______ ELAPSED TIMES READ IAW MIL-STD-415

MAINTAINABILITY DEMONSTRATION SUMMARY DATA SHEET

Shift No.______________
Date______________
Page________ of________

(1)	ELAPSED TIME MIN:SEC							(9)	(10)	(11)	(12)	(13)
	(2)	(3)	(4)	(5)	(6)	(7)	(8)					
Task Number	Detection	Isolation	Dis-assembly	Inter-change	Re-assembly	Alignment	Check-Out	Total Corrective Maintainance Downtime (in Minutes)	Remarks	Repaired By	Monitored By	Date

Witnessed: U.S. Government Representative ________________ (Signature) ________ (Date)

CONTRACTOR Representative ________________ (Signature) ________ (Date)

Figure 12. Maintainability Demonstration Summary Data Sheet

(c) The contractor system engineer will record the detailed times for each inserted failure on the Maintainability Demonstration Log, figure 11. Upon completion of the task, the data for automatically restored failures will be summarized into elapsed time and recorded on a Redundancy Summary Sheet, indicating the task number, restoral times, and remarks.

d. Determination of Acceptance or Rejection.

1. Fraction of Failures Detected. Determine the total of the inserted continuous total failures (e.g., 200), the inserted nonfailure (e.g., 10), and the number of adjustment induced failures (e.g., twice the number of adjustments each to be done both ways). Divide this into the number of these failures/nonfailures which were detected properly. The resultant must exceed the specification requirement in 3.4.2.1.1.1.

2. Fraction of Failures Isolated. Divide the number of failures which were isolated within one MTTR by the total number of failures, i.e., continuous total failures plus adjustment degraded failures. The resultant must exceed the specification requirements in 3.4.2.1.2.1.

3. Mean Time to Repair. For the inserted failures for which repair was required, sum the repair times and divide by the number of failures. The resultant must be less than the specification requirement for MTTR in 3.4.2.1.2.2.

10.3.5 Redemonstration Phase. If, upon analysis of the demonstration data, it is determined that the item(s) does not meet the specified requirements, further analysis of the demonstration data shall be made to determine where improvements are needed in the procedures, technical orders, built-in-test, computer program, or equipment design. A plan for corrective action and redemonstration shall be submitted to the procuring activity within 15 calendar days.

APPENDIX II

20. MMLS Tailoring of MIL-C-4150J, Waterproof Transit Cases

20.1 The following specifications form a part of the acquisition requirements of MIL-C-4150J paragraph 6.6

1.1 Scope

No loads exceeding 250 lbs net.

1.2 Classification

Type 1 (waterproof)
Style 1 (transit case)
Classes A (maximum gross weight (mgw) $\leq$ 150 lbs) and B (mgw > 150 lbs)
variety HC (hinged closure)

3.1 First Article

First Article inspection required for all cases developed under this contract.

3.2.4 Fire Retarding Material

Fire retardant materials not required.

3.4.2.1 Security Seal

Security seal not required.

3.4.6 Lifting Rings, Class B Cases

Lifting rings not required. Handles are required to replace lifting rings.

3.4.8-9 Vacuum and Pressure Relief Value

Manual vacuum and pressure relief valve acceptable.

3.4.10 Relative Humidity Indicator

Relative humidity indicator not required.

3.4.14 Desiccant

Exempt requirement

3.5.2 Leakage

Exempt requirement

3.6 Color

Exterior surfaces shall be green.

3.7 Finish

External surfaces shall be resistant to damage from decontamination agents specified in ARCSL-CR-81503, excluding DS2 and STB.

3.9 Marking

Identification and marking shall be in accordance with the SOW.

3.11.1 Drawings

Preliminary level III outline drawings shall be maintained by the contractor and made available for design reviews and audits.

3.11.2 First Article Inspection Plan

First article inspection plan not required, except all developed cases need to be tested.

3.11.3 First Article Inspection Report

First article inspection report not required except for all developed cases.

4.0 Quality Assurance Provision

For all cases except the developed cases, the contractor shall certify compliance with all requirements of section 3 (as tailored) by showing similarity to previously fabricated and certified cases than by conducting a first article inspection. Certification shall be documented in contractor format.

5.2 Packaging

Not applicable

5.3 Marking

Not applicable

GLOSSARY

A	analysis
AC	alternating current
AF	Air Force
AFCC	Air Force Communications Command
AFLC	Air Force Logistics Command
AFM	Air Force manual
AFP	Air Force pamphlet
AFR	Air Force regulation
AFSC	Air Force Systems Command
ANSI	American National Standards Institute
ATC	air traffic control
AZ	azimuth
BIT	built-in test
BTU	British thermal unit
C	Celsius
CCG	combat communications group
CCT	combat control team
CDRL	contract data requirements list
CI	configuration item
CR	contractor representative
CUCV	commercial utility cargo vehicle
CW	continuous wave
D	demonstration
DA	Department of the Army
dB	decibel

dBW/m^2	decibels referenced to one watt per square meter
DC	direct current
DME	distance measuring equipment
DME/N	normal distance measuring equipment
DOD	Department of Defense
DPSK	differential phase shift keying
DT&E	development, test, and evaluation
EL	elevation
EMI	electromagnetic interference
ESC	Electronic Systems Center (AFSC)
ESS	environmental stress screening
FA	final approach
FAA	Federal Aviation Administration
FEDI	failure experience data interchange
FFD	fraction of failures detected
FFI	fraction of failures isolated
FMC	full mission capability
FMECA	failure mode effects and criticality analysis
FRACAS	failure recording, analysis, and corrective action system
ft	feet
g/m^3	gram per cubed meter
GFB	Government-furnished baseline
GFE	Government-furnished equipment
GIDEP	Government/industry data exchange program
HMMWV	high mobility multipurpose wheeled vehicle
HOL	higher order language

hr	hour
HQ	headquarters
Hz	hertz
I	inspection
IA	initial approach
ICAO	International Civil Aviation Organization
ILS	instrument landing system
IMS	interim mission support
in	inch
I/0	input/output
kt	knot
lb	pound
LRU	line replaceable unit
MAC	Military Airlift Command
MD	maintainability demonstration
MEDEVAC	medical evacuation
MEP	mobile electric power
MLS	microwave landing system
MMLS	Mobile Microwave Landing System
MOSC	military occupational specialty code
MTBCF	mean time between critical failures
MTBCMA	mean time between corrective maintenance actions
MTBFA	mean time between false alarms
MTTR	mean time to repair
nmi	nautical mile
OCI	out-of-coverage indication

OT&E	operational test and evaluation
PFN	path-following noise
PM	preventive maintenance
PME	prime mission equipment
PRF	pulse repetition frequency
psig	pounds per square inch gauge
QWROTES	quick wartime restoral of TRACALS equipment and services
RF	radio frequency
RTCA	Radio Technical Commission for Aeronautics
RVT	reliability verification test
SARPS	standards and recommended practices
sec	second
SOW	statement of work
SRU	shop replaceable units
T	test
TACAN	tactical air navigation
TDM	time-division-multiplex
TM	technical manual
TRACALS	traffic control and landing systems
TRSB	time reference scanning beam
UPS	uninterruptable power system
U.S.	United States
USAF	United States Air Force
UNAISC	U.S. Army Information Systems Command
μs	microsecond
WRSK	war readiness spares kit