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U.S. Department of Transportation
Federal Aviation Administration

PERFORMANCE SPECIFICATION

INSTRUMENT LANDING SYSTEM (ILS)

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TABLE OF CONTENTS

1. SCOPE 1
2. APPLICABLE DOCUMENTS AND REFERENCES 1
   2.1 FAA Documents 1
      2.1.1 FAA Orders 1
      2.1.2 FAA Standards 1
      2.1.3 FAA Specifications 2
      2.1.4 FAA Advisory Circulars (ACs) 2
      2.1.5 FAA Interface Control Documents (ICDs) 2
      2.1.6 FAA Miscellaneous Documents 2
   2.2 Other Government Documents 2
      2.2.1 IPC Documents 2
      2.2.2 Military Standards and Handbooks 2
      2.2.3 Government Miscellaneous Documents 2
   2.3 Non-Government Documents 3
      2.3.1 National Electrical Manufacturers Association (NEMA) 3
      2.3.2 National Fire Protection Agency (NFPA) 3
      2.3.3 Underwriters Laboratories (UL) 3
      2.3.4 Institute of Electrical and Electronics Engineers (IEEE) 3
      2.3.5 Non-Government Miscellaneous Documents 3
3. REQUIREMENTS 5
   3.1 Equipment Comprising an Instrument Landing System (ILS) 5
   3.2 General System Requirements 5
      3.2.1 General Electrical Requirements 5
      3.2.2 Mechanical 9
      3.2.3 Characteristics 12
      3.2.4 Equipment Design and Construction 14
      3.2.5 Electromagnetic Compatibility (EMC)/Electromagnetic Interference (EMI) 21
      3.2.6 Nameplates and Markings 22
      3.2.7 Interchangeability 24
      3.2.8 Personnel Safety and Health 24
      3.2.9 Human Engineering 30
      3.2.10 System Performance 30
      3.2.11 Controls and Indicators 31
      3.2.12 Transmitter Internal RF Power Measurement 36
      3.2.13 Standby Power 36
      3.2.14 Battery Disconnect Switch and Fuse/Circuit Breaker 37
      3.2.15 Maintainability of Electronic Equipment 37
      3.2.16 Reliability of Electronic Equipment 37
      3.2.17 Continuity of Service 38
      3.2.18 Integrity of Signal 38
      3.2.19 Failsafe 38
      3.2.20 Antenna Support Structure Design 39
      3.2.21 Dual Equipment 39
      3.2.22 Security Requirements 39
   3.3 VHF Localizer System Requirements 40
      3.3.1 Localizer Subsystem 40
      3.3.2 VHF Localizer Station Performance 40
      3.3.3 Localizer Transmitter 41
      3.3.4 Localizer Antenna Array 46

DRAFT

3.3.5 Localizer Monitor 52
3.3.6 Localizer Far-Field Monitor (FFM) Subsystem 59
3.4 UHF Glide Slope System Requirements 62
3.4.1 Glide Slope Subsystem 62
3.4.2 UHF Glide Slope Subsystem Performance 62
3.4.3 Glide Slope Transmitter 63
3.4.4 Amplitude and Phase Control and Distribution 67
3.4.5 Image-type Glide Slope Antenna Array 69
3.4.6 Glide Slope Monitor 74
3.5 VHF Marker Beacon Station 78
3.5.1 Coverage 79
3.5.2 Marker Beacon Transmitter 79
3.5.3 Marker Beacon Transmitting Antenna 81
3.5.4 AC Power Control 82
3.5.5 Marker Beacon Cabinet 82
3.5.6 Performance of Periodic Checks and Certification 82
3.6 Remote Control Subsystem (RCS) 83
3.6.1 Remote Status and Control Unit (RSCU) 83
3.6.2 Remote Status and Interlock Control (RSIC) 86
3.7 ILS/DME Monitor Receiver Subsystem 91
3.7.1 ILS/DME Monitor Receiver General Requirements 91
3.7.2 Receiver(s) and Processing Equipment 91
3.7.3 ILS/DME Monitor Receiver Subsystem Functions 91
3.7.4 ILS/DME Monitor Receiver Performance 92
3.7.5 Remote Status Panel (RSP) 92
3.7.6 Antennas 93
3.8 Remote Maintenance Monitoring (RMM) 93
3.8.1 Remote Monitoring Subsystem (RMS) 93
3.8.2 Alarm and Alert Messages 94
3.8.3 Non-Volatility 95
3.8.4 RMS Data Sampling Rate 95
3.8.5 Real Time Clock/Calendar 95
3.8.6 ILS Equipment Fault Diagnostics 95
3.8.7 Status Monitoring of Co-located Electronic Equipment 96
3.8.8 Auxiliary Input Pass-through 96
3.8.9 Spare Input/Output Capacity 96
3.8.10 Environmental Monitoring 97
3.8.11 RMS Security 98
3.8.12 RMS Data Filtering 99
3.8.13 RMS Failure Protection 99
3.8.14 Interface with RMM Subsystems 99
3.9 Data Security 100
3.9.1 Access Control 100
3.9.2 Audit Logging 100
4. VERIFICATION 101
4.1 Methods of Verification 101
4.1.1 Inspection (I) 101
4.1.2 Analysis (A) 101
4.1.3 Demonstration (D) 101
4.1.4 Test (T) 101
4.2 Test Allocation 101

DRAFT

4.2.1 Developmental Test (DT) 101
4.2.2 Operational Test (OT) 101
4.3 General Procedures 102
4.3.1 Test Tools 102
4.3.2 Electrical Grounding 102
4.3.3 Flight Tests 102
4.4 Specific Procedures 102
4.4.1 Environmental Conditions 102
4.4.2 Electromagnetic Compatibility (EMC)/Electromagnetic Interference (EMI) 105
4.4.3 Power Quality Requirements 108
4.5 Verification Requirements Traceability Matrix (VRTM) 111
5. PACKAGING 156
5.1 Packaging requirements shall be as specified in the contract. 156
6. NOTES 157
6.1 Definitions 157
6.2 Acronyms, Abbreviations, and Initializations 157
6.3 ICAO Annex 10 Compliance Matrix 160
APPENDIX A. ILS CHANNELS 161

LIST OF FIGURES

Figure 3-1. Inrush Current Ratio Limits 8
Figure 3-2. Nameplates 23
Figure 3-3. Personnel Safety Sign Layout 28
Figure 3-4. Example CRS and CLR Patterns with Amplitude Relationships Identified 50
Figure 3-5. Glide Slope Antenna Horizontal Radiation Pattern 71
Figure 4-1. Inrush Current Limit Measurements 110
Figure 4-2. Inrush Current Ratio Limits 110

LIST OF TABLES

Table 3-1. Localizer Requirements 31
Table 3-2. Glide Slope Requirements 31
Table 3-3. Parameter Resolution 36
Table 3-4. Horizontal RF Radiation Pattern Characteristics 48
Table 3-5. Capture Effect RF Distribution 67
Table 3-6. Sideband Reference RF Distribution 68
Table 3-7. Marker Beacon Coverage 79
Table 3-8. Category for Various Conditions (CAT II/III-Capable Systems) 84
Table 3-9. Status Indicators of ILS and Co-located Equipment 88
Table 4-1 Applicable Requirements From MIL-STD-461G 105
Table 4-2 Limits of Individual Harmonics 108

DRAFT

1. SCOPE

The performance requirements specified herein are, for the most part, those requirements contained in Federal Aviation Administration (FAA) Specification FAA- E-2852/b Change 2 and derived from International Civil Aviation Authority (ICAO) Annex 10, Volume 1, Radio Navigation Aids, International Standards and Recommended Practices. The notable areas of exception are summarized below:

a. **Remote Maintenance Monitoring (RMM) Requirements.** These requirements exceed the minimum requirements contained in Annex 10 and are based on FAA maintenance requirements.

b. **Localizer Antenna Array Performance.** These requirements exceed the minimum requirements contained in Annex 10 and are based on FAA experience in obtaining a quality guidance signal in a high multi-path environment.

c. **Remote Control Subsystem (RCS).** These requirements are tailored to meet interlock requirements of other already fielded equipment in the National Airspace System (NAS).

The Instrument Landing System (ILS) is an instrument approach landing aid that provides guidance to properly equipped aircraft that are making approaches to and landing on airport runways where the ILS is installed. The testing, evaluation, and delivery of all subsystems and equipment that are required for a completed Category (CAT) I/II/III ILS include a Localizer subsystem, a Glide Slope subsystem, up to three Marker Beacon subsystems, Remote Control subsystem, Localizer Far-Field Monitor (FFM) subsystem, and a Remote Maintenance Monitor (RMM) subsystem.

2. APPLICABLE DOCUMENTS AND REFERENCES

2.1 FAA Documents

2.1.1 FAA Orders

A. FAA Order 6050.32B, Change 3, Spectrum Management Regulations and Procedures Manual, November 17, 2005.
B. FAA Order 6750.49B, Maintenance of Instrument Landing Systems (ILS) Facilities, September 19, 2016.
C. FAA Order 8200.1D, Change 2, United States Standard Flight Inspection Manual (USSFIM), September 20, 2024.

2.1.2 FAA Standards

A. FAA-STD-003, Paint Systems for Structures, June 11, 1965.
B. FAA-STD-019G, Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment, January 16, 2024.
C. FAA-STD-032, Design Standards for National Airspace System Facilities, August 1, 1996.
D. FAA-STD-049, Change 1, Fiber Optic Telecommunication Systems and Equipment, February 18, 1994.
E. FAA-STD-067, Standard Practice, Preparation of Specifications, December 4, 2009.
F. HF-STD-001B, Human Factors Design Standard, December 30, 2016.

DRAFT

2.1.3 FAA Specifications

A. FAA-E-910A, Structural Steel, May 19, 1982.
A. FAA-E-2970, United States Department of Transportation, Federal Aviation Administration, Performance Specification, Category II/III Instrument Landing System (ILS), January 25, 1993.
B. FAA-E-3039A, Protocol Specification, Common Message Handling Protocol (CMHP), September 2018

2.1.4 FAA Advisory Circulars (ACs)

A. FAA AC 70/7460-1M, Obstruction Marking and Lighting, November 16, 2020.
B. FAA AC 5545-2, Specification for L-810 Obstruction Lights.

2.1.5 FAA Interface Control Documents (ICDs)

FAA ICD NAS-IC-51015108-01, Version 0.92, Remote Monitoring and Logging System (RMLS) To Remote Monitoring Subsystem (RMS) Using Common Message Handling Protocol (CMHP), March 2014.

2.1.6 FAA Miscellaneous Documents

A. FAA-C-1217H, Change 1, Electrical Work, Premises Wiring, January 5, 2021.
B. FAA-E-3039A, Common Message Handling Protocol (CMHP), September 2018.
C. FAA-G-2100J, Electronic Equipment General Requirements, April 19, 2022.

2.2 Other Government Documents

2.2.1 IPC Documents

A. IPC-A-600M, Applicability of Printed Circuit Boards, May 1, 2025.
B. IPC-A-610J, Acceptability of Electronic Assemblies, March 2024.
C. IPC-C-830C, Qualification and Performance of Electrical Insulating Compound for Printed Wiring Assemblies, January 1, 2019.
D. IPC-CM-770E, Guidelines for Printed Board Component Mounting, January 1, 2004.
E. IPC-J-STD-001J, Requirements for Soldered Electrical and Electronic Assemblies, March 1, 2024.
F. IPC-SM-780, Component Packaging and Interconnecting with Emphasis on Surface Mounting, March 1, 1988.

2.2.2 Military Standards and Handbooks

A. MIL-STD-461H, Interface Standard, Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment, April 17, 2026.
B. MIL-STD-810H, Change 1, Test Method Standard, Environmental Engineering Considerations and Laboratory Tests, May 18, 2022.
C. MIL-STD-889D, Galvanic Compatibility of Electrically Conductive Materials, July 21, 2021.

2.2.3 Government Miscellaneous Documents

DRAFT

A. FEMA P2082, NEHRP Recommended Seismic Provisions for New Buildings and Other Structures, September 1, 2020.
B. W-C-596-100B, Federal Specification Sheet, Connector, Plug, Electrical, Special Purpose, Grounding, Locking, 2 Pole, 3 Wire, 15 Amperes, 125 Volts, 50/60 Hertz, September 24, 2001.
C. W-C-596H, Federal Specification Sheet, Connector, Electrical, Power, General, May 25, 2014.

2.3 Non-Government Documents

2.3.1 National Electrical Manufacturers Association (NEMA)

A. NEMA C18.1M - Part 1, Portable Primary Cells and Batteries with Aqueous Electrolyte - General and Specifications, September 9, 2025.
B. NEMA C18.1M, Part 2, Portable Primary Cells and Batteries with Aqueous Electrolyte - Safety Standard, June 14, 2024.
C. NEMA C18.2M, Part 1, Portable Rechargeable Cells and Batteries - General and Specifications, June 17, 2025.
D. NEMA C18.2M, Part 2, Portable Nickel Rechargeable Cells and Batteries - Safety Standard, February 18, 2026.
E. NEMA C18.3M, Part 1, Portable Lithium Primary Cells and Batteries - General and Specifications, May 28, 2024.
F. NEMA C18.3M, Part 2, Portable Lithium Primary Cells and Batteries – Safety Standard, August 4, 2024.
G. NEMA WD 6, Wiring Devices – Dimensional Specifications, January 2021.
H. NEMA Z535.1-2022, American National Standard for Safety Colors, August 9, 2022.
I. NEMA Z535.2-2023, American National Standard for Environmental and Facility Safety Signs, December 14, 2023.

2.3.2 National Fire Protection Agency (NFPA)

A. NFPA 70, National Electrical Code (NEC), 2026.
B. NFPA 70E, Standard for Electrical Safety in the Workplace, 2026.
C. NFPA 780, Standard for the Installation of Lightning Protection Systems, 2026.

2.3.3 Underwriters Laboratories (UL)

A. UL 49, 14th Edition, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures, March 7, 2025.
B. UL 62, 20th Edition, Standard for Flexible Cords and Cables, January 31, 2023.
C. UL 900, 8th Edition, Standard for Air Filter Units, August 1, 2022.

2.3.4 Institute of Electrical and Electronics Engineers (IEEE)

A. IEEE C95.1-2019, Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz, October 4, 2019.
B. IEEE Standard C95.2-2018, Standard for Radio-Frequency Energy and Current-flow Symbols, October 5, 2018.

2.3.5 Non-Government Miscellaneous Documents

DRAFT

A. ASHRAE Standard 52.2-2025, Method for Testing General Ventilation Air-cleaning Devices for Removal Efficiency by Particle Size, 2025.
B. ASME Y14.44-2008, Reference Designations for Electrical and Electronic Parts and Equipment, July 22, 2008.
C. ASSP A10.48-2023, Criteria for Safety Practices with the Construction, Demolition, Modification and Maintenance of Communication Structures, October 3, 2023.
D. EIA/ECA 310-E, Cabinets, Racks, Panels, and Associated Equipment, December 1, 2005.
E. Health Physics Society (HPS) N2.1, Radiation Symbol, May 19, 2011
F. IEC 61000-3-2, Electromagnetic Compatibility (EMC), Limits for Harmonic Current Emissions (equipment input current ≤16 A per phase), Table 3, January 26, 2018.
G. International Standard, Recommended Practices and Procedures for Radio Navigation Aids, Aeronautical Telecommunications, Annex 10 to the Convention on International Civil Aviation, Eight Edition of Volume 1, July 2023.
H. SAE AMS-STD-595B, Colors Used in Government Procurement, June 3, 2026.
I. Telecommunications Industry Association (TIA)-222-A, Maintenance and Condition Assessment of Telecommunication Towers, October 2, 2023.

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3. REQUIREMENTS

3.1 Equipment Comprising an Instrument Landing System (ILS)

This specification describes the following equipment:

a. Very High Frequency (VHF) Localizer Subsystem in section 3.3

b. Localizer Far-Field Monitor (FFM) Subsystem in section 3.3.6

c. Ultra High Frequency (UHF) Glide Slope Subsystem in section 3.4

d. VHF Marker Beacon Station in section 3.5

e. Remote Control Subsystem (RCS) in section 3.6

f. ILS/Distance Measuring Equipment (DME) Monitor Receiver Subsystem in section 3.7

g. ILS Remote Maintenance Monitoring (RMM) in section 3.8

h. Data Security in section 3.9

3.2 General System Requirements

The general requirements of sections 3.2.1 through 3.2.22 herein are applicable to all ILS subsystems unless otherwise indicated.

3.2.1 General Electrical Requirements

3.2.1.1 Electrical Power

a. The equipment shall interface to building wiring in accordance with National Fire Protection Agency (NFPA) 70, NFPA 70E, FAA-STD-032, and FAA-C-1217, in that order of precedence.

b. Electrical enclosures, cabling, and wiring shall be approved by an Occupational Safety and Health Act (OSHA) nationally recognized testing laboratory.

3.2.1.1.1 Physical Requirements and Construction

a. Accessibility for maintenance and operations shall allow access to electrical components in accordance with NFPA 70E Standard for Electrical Safety in the Workplace, including connections, wiring, etc., when the equipment is fielded.

b. Permanent installations of critical equipment should be hard wired whenever possible.

c. Equipment hardwired to line power shall meet the following requirements:

1. The main disconnecting means shall break all incoming lines immediately before the line filter, terminal block or connector, fuses, or other parts.

2. The main disconnecting means shall consist of disconnect switches or circuit breakers.

DRAFT

3. Where radio frequency interference (RFI) and electromagnetic interference (EMI) shielding integrity would be compromised, the disconnect shall be located at the power panelboard or other location, as defined in NFPA 70.
4. Controls and indicators for electrical line voltage of an equipment rack shall be located in accordance with NFPA 70.

d. Equipment and systems connected by cord and plug to line power shall meet the following requirements:

1. Provide plugs and receptacles connecting permanently mounted equipment to the alternating current (AC) supply line with twist-lock types in accordance with the requirements of W-C-596 and install in accordance with the requirements of NFPA 70. If installed inside the equipment, use plugs and receptacles that are FAA-approved, or industry-recognized, latching type.
2. Use power cords for connecting equipment to the AC supply in accordance with the requirements of UL62, and install in accordance with NFPA 70:
    i. For 120V circuits, use a three-conductor cord (hot, neutral and ground).
    ii. For 208V or 240V systems circuits, use a three-, four- , or five-conductor cord, dedicated ground pin mandatory.
3. Detachable power cords shall not be twist-lock type and be UL-listed for its intended purpose.
4. The supply end shall have a plug in accordance with the requirements of W-C-596/100.
5. For all critical power circuits, receptacles shall be twist lock type except where the receptacles are not subject to be kicked or bumped (e.g., receptacles mounted inside an equipment rack).
6. When the equipment has a female connector, it shall have additional security to prevent inadvertent mechanical disconnection. (Note: This type of connector shall have locking/latching or retaining capability. Examples include DESC 87204 (Cannon connector); International Electrotechnical Commission (IEC) 60320-C13 or IEC 60320-C19 with locking or latching provisions suitable for IT equipment; or as otherwise approved by FAA.)

e. The ILS localizer, glide slope, and marker beacon equipment racks shall each include one 20 A, 125 VAC, National Electrical Manufacturers Association (NEMA) WD 5 grounding duplex receptacle, installed and wired in accordance with the requirements of NFPA-70.

f. The receptacle shall be located on the front of the cabinet at the bottom.

g. The equipment design shall include the provisions required to provide power to the outlet from a source independent of the equipment system power source.

DRAFT

3.2.1.2 Power Quality Requirements

3.2.1.2.1 Harmonics

a. Equipment or systems shall meet IEC 61000-3-2, "Limits for Harmonic Current Emissions (equipment input current ≤16 A per phase)," Table 3 (Limits for Class D Equipment), Maximum permissible harmonic current (A) for individual equipment item or subsystem.

b. Systems not certified to IEC harmonic requirements above shall be tested in accordance with section 4.4.3.1.

Note: If all subcomponents meet the requirements, then the entire piece of equipment also meets the requirement.

Note: If the equipment has an IEC stamp/certification for 230 V and 400 V (50 Hz) systems, any 120/240 V (60 Hz) applications shall be considered compliant, with no additional testing required.

3.2.1.2.2 Power Factor Displacement

The power factor (PF) for the ILS equipment shall be within 0.7 (lag) – 0.7 (lead).

3.2.1.2.3 Inrush Current

a. Equipment-caused current transients, including inrush currents, shall not cause nuisance tripping of the electrical system circuit breakers.

b. The inrush current shall be measured for equipment loads greater than 5 A in accordance with the test procedure in section 4.4.3.3.

c. The ratio of peak inrush current to steady state RMS current shall be equal to or less than the ratio defined by Figure 3-1.

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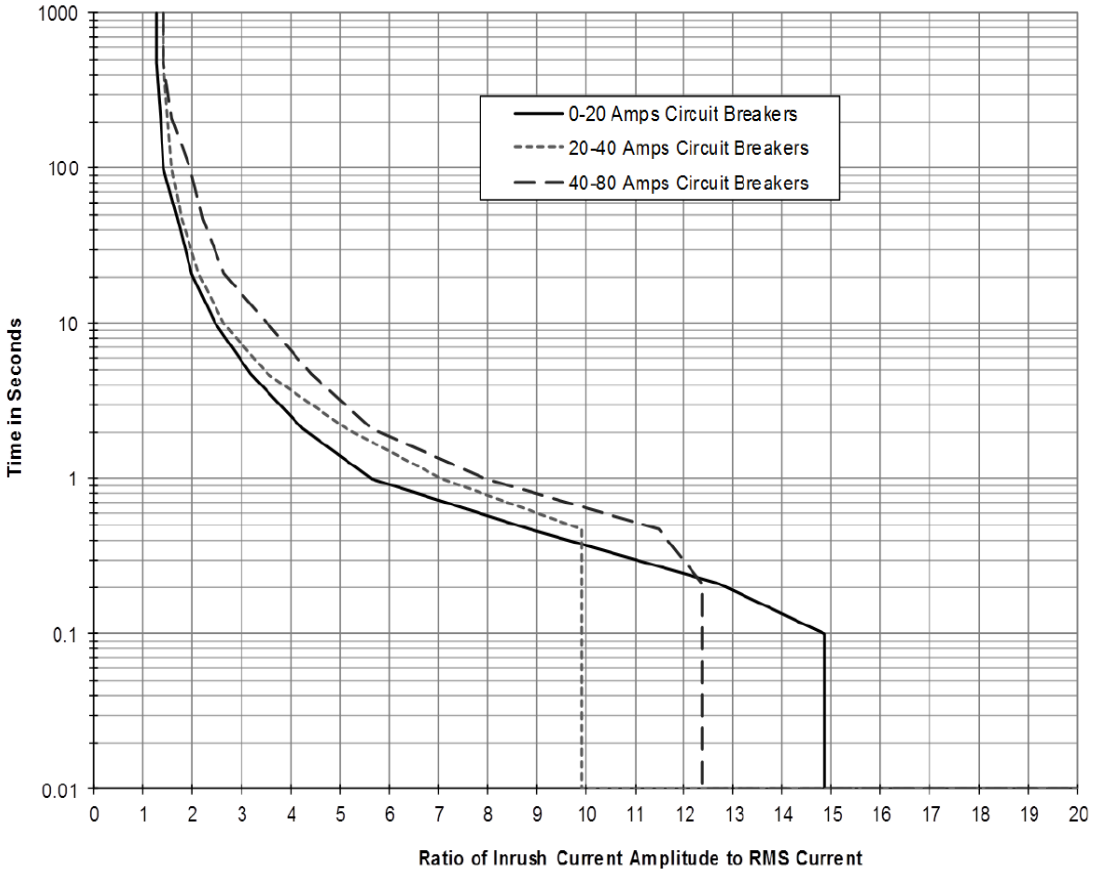

Figure 3-1. Inrush Current Ratio Limits

3.2.1.3 Protection of Equipment from AC/DC Power Anomalies

Protection of equipment from alternating current (AC)/direct current (DC) power anomalies shall comply with the following:

a. Provide current overload protection for the equipment by fuses, circuit breakers, or other protective devices for primary circuits;

b. The interrupting current of overcurrent protection devices shall not be less than 10 kiloampere (kA) interruption capacity (AIC) rating;

c. Provide protection against a total loss of power;

d. Provide protection against the loss of one or more phases of power; and,

e. Provide protection against a sustained undervoltage condition.

3.2.1.4 Input Power Conditions

The system shall operate within tolerance when the AC input power varies according to the following:

a. The input voltage from 102–132 VAC;

b. Frequency is set to any value from 57–63 Hz (steady state);

c. Steady state frequency by ±0.5 Hz;

d. Steady state frequency variation rate up to 1.5 Hz/s;

e. Momentary deviation of frequency from 53–65 Hz, lasting 0.5 s to 3 s;

f. Momentary changes in frequency at a 5 Hz/sec rate, lasting 0.5 s to 3 s;

g. Total harmonic distortion (THD) shall be 10% or less; and,

h. Individual harmonic distortion shall be 3% or less.

3.2.1.5 Lightning and Surge Protection, Grounding, Bonding, and Shielding (LPGBS)

a. LPGBS for ILS electronic equipment shall be in accordance with most recent editions of FAA-STD-019 and NFPA 780.

b. Surge protection devices (SPD) requirements for NAS electronic equipment shall be in accordance with FAA-STD-019, Section 5.6.4 Equipment Power Entrance – Transient Protection, and its subsections.

3.2.1.6 Transformer Isolation of Non-Switching DC Power Supplies

a. All power supplies energized from the AC line power source shall be isolated from the AC input to reduce shock hazard and other circuit issues.

b. The DC resistance from each input line terminal (with fuses in place and AC line control contacts closed) to the signal or chassis ground shall be greater than 1 MΩ.

3.2.1.7 Protection of Outputs of Radio Frequency Equipment, Audio Equipment and Other Electronic Circuits

a. All equipment output circuits shall be designed to include circuit protection and to prevent damage to equipment upon occurrences of opens or shorts on the output terminals.

b. When operated at any voltage standing wave ratio (VSWR), including open and short conditions, the transmitter output circuitry shall not be damaged or exceed dissipation limits.

c. The transmitter shall shut itself down upon detection of a high VSWR.

3.2.2 Mechanical

3.2.2.1 Removable Parts and Mating Connectors

a. Electronic equipment shall be furnished with a complete set of installed fuses.

b. Removable circuit cards shall be shipped in individual packages with information to identify their location in the system.

DRAFT

c. Removable circuit cards shall include hardware to prevent inadvertent removal by shock and vibration.

d. Mating connectors of equipment-mounted coaxial or cable connectors shall be provided.

e. Mating connectors shall be provided when two or more pieces of equipment require interconnection.

f. Circuit card guides shall support and retain the card in the guides during all phases of removal and insertion.

3.2.2.1.1 Equipment Racks

3.2.2.1.1.1 Pullout Drawers

a. Any equipment pullout drawers shall be of a full- suspension roller type with latching stops.

b. Slides shall be of sufficient rigidity to prevent bowing and/or having rollers jump their track when the drawer is fully extended and components are being replaced/maintained.

c. Drawers shall be equipped with handles to permit withdrawing the drawer into the open position and latches on active panel fasteners to secure the drawer in the closed position.

d. The rack cabinet shall not tip over during normal operation and all maintenance activities.

3.2.2.1.1.2 Rack Panels

a. Where rack panels are used, they shall be in accordance with EIA/ECA 310-E.

b. Panel slot/hole pattern shall be the universal hole spacing pattern for 1U, 2U, and 3U panels and the wide hole spacing for panels 4U and higher.

c. Nominal thickness for aluminum panels shall be 3/16”, or greater.

d. Nominal thickness for steel panels shall be at 1/8”, or greater.

3.2.2.1.2 Shelf Life

Materials and the processes shall ensure the equipment will meet performance requirements after a period of two years in a non-operational state after Government acceptance.

3.2.2.1.3 Moisture

Equipment in its operational environment shall not collect moisture.

3.2.2.2 Accessibility

3.2.2.2.1 General

a. All non-hinged shields or plates that are normally opened or removed in servicing equipment, shall be secured with captive fasteners.

b. Captive fasteners shall be spaced on centers not exceeding 10” and shall be located around the entire periphery of the shields or plates.

DRAFT

3.2.2.2.2 Line Replaceable Units (LRUs)

a. The system shall utilize Line Replaceable Units (LRUs).

b. LRU Mounting devices shall provide the capability of the LRU to be repeatedly installed and removed in the field without degrading performance.

c. LRU plug-in modules and assemblies shall be designed to prevent insertion into the incorrect location or orientation.

3.2.2.2.3 Enclosures

a. No enclosure, or part thereof, shall support or sustain combustion in excess of the requirements of NEMA 250.

b. Enclosures for equipment or systems, up to 1,000 V, installed outside a building (outdoors) shall be either NEMA Type 4 or Type 4X as directed by the system specification.

c. Enclosures for equipment or systems, up to 1,000 V, installed inside a building where no dripping or splashing liquids or dust are normally expected shall be NEMA Type 1.

d. Exterior enclosures shall be lockable.

e. Accessibility to chassis, assemblies, or parts contained within cabinets, consoles or other enclosures shall be provided from outside the basic equipment.

f. Mounting such items on withdrawal slides, swinging doors, through cable extenders and cable retractors, and provisions for circuit card extenders shall allow part or module operation in the open position.

g. Locks shall be provided to lock the chassis in the servicing position.

h. When withdrawal slides are used they shall be of guided sectional construction.

i. Complete removal and access for servicing of electronic equipment contained within cabinets, consoles or other enclosures shall be provided from either the front or rear of the equipment.

j. Guide pins (or locating pins), or the equivalent, shall be provided for mechanical alignment during mounting.

3.2.2.3 Thermal Design

a. When air filters are required with forced air cooling, the air filters shall be in accordance with UL900 and ASHRAE 52.2.

b. The difference between the exhaust air temperature (measured inside the cabinet or console in front of the exhaust air vent) and input air temperature (measured outside the cabinet or console directly in front of the input air vent) shall be less than 15°C with the equipment operating under normal service conditions.

c. Air exhaust shall be directed away from operating personnel.

d. Cooling methods such as liquid, evaporative coolants, and vapor cycle refrigerants shall not be used.

DRAFT

e. Failure of a cooling device shall cause a maintenance alert.

f. Failure of a forced cooling device shall cause no damage to the equipment.

g. Any forced air-cooling device shall be an LRU.

3.2.2.3.1 Ventilating Fan Motors

a. All ventilating fan motors (commonly called pancake type) shall be ball bearing.

b. Fans shall be capable of being continuously energized while its rotation is blocked without damage to the equipment.

c. Fans shall be of any frame construction type.

3.2.3 Characteristics

3.2.3.1 Environmental Conditions

Unless otherwise stated, all requirements of this specification shall be met over the full range of service conditions appropriate for the equipment described. The following ILS operating and non-operating environmental condition requirements were derived from MIL-STD-810.

3.2.3.1.1 Non-Operating Conditions

3.2.3.1.1.1 Non-Operating Temperature Range

Each system and sub-system packaged for storage, shipping, or transporting (non-operating) shall withstand a temperature range of -46°C to +71°C.

3.2.3.1.1.2 Non-Operating Altitude

Each system and sub-system packaged for storage, shipping, or transporting (non-operating) shall withstand atmospheric pressure of 575 to 1025 mbar (equivalent to approximately 15,000 feet above sea level in a standard atmosphere down to approximately 300 feet below sea level).

3.2.3.1.1.3 Vibration

Each system and sub-system shall not be damaged when subjected to the vibrations listed in Table 514.8C-I, Method 514.8 Annex C of MIL-STD-810, and the exposure duration provided in Annex C, Section 2.1.4.

3.2.3.1.1.4 Shock

Each system and sub-system shall not be damaged when subjected to the mechanically induced shock as specified in Method 516.8, Procedure II of MIL-STD-810.

3.2.3.1.2 Operating Conditions

3.2.3.1.2.1 Seismic Zone Design

a. The equipment rack shall be bolted to the shelter floor to ensure positive attachment.

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b. All equipment and enclosures shall be designed and installed so that the enclosure and the mounted LRU and/or components will remain upright and in place, and all access panels, doors, and drawers shall remain secured to the enclosure.

3.2.3.1.2.2 Outdoor Temperature

All outdoor equipment shall operate in the temperature range of -46°C to +50°C.

3.2.3.1.2.3 Indoor Temperature

All indoor equipment shall operate in the temperature range of -10°C to +50°C.

3.2.3.1.2.4 Rain

All outdoor equipment shall operate while exposed to wind-blown rain, at a rate of 1.7 mm/minute (4 in/hr), and up to 18 m/s (40 mph) blowing wind.

3.2.3.1.2.5 Operating Altitude

All indoor and outdoor equipment shall operate over the atmospheric pressure range of 700 to 1025 mbar (equivalent to approximately 10,000 feet above sea level in a standard atmosphere down to approximately 300 feet below sea level).

3.2.3.1.2.6 Wind Velocity

All outdoor equipment shall operate in wind conditions up to 100 mph velocity.

3.2.3.1.2.7 Ice Loading

The ILS antennas shall withstand up to 0.5” accumulation of clear ice on all outdoor components.

3.2.3.1.2.8 Humidity

a. Equipment shall operate within a relative humidity range from 5% to 100% when the temperature is 40°C or less.

b. Above 40°C, the equipment shall operate with a relative humidity based upon a dew point of 40°C.

3.2.3.2 Physical Characteristics

3.2.3.2.1 Electronic Equipment Assembly Requirements

a. Equipment assemblies, subassemblies, printed circuit board assemblies, terminal board assemblies, electronic modules, shall be Class 2 or Class 3 as defined in IPC-J-STD-001.

b. Printed circuit boards exposed to uncontrolled environmental conditions shall have a conformal coating in accordance with IPC CC-830.

3.2.3.2.2 Component Mounting

Component mounting shall be in accordance with IPC-CM-770 or IPC-CM-780, as applicable, except the term “not recommended” shall be interpreted as “reject.”

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3.2.3.2.3 Printed Circuit Boards

Printed circuit boards shall be in accordance with IPC-A-600M.

3.2.3.2.4 Assembly

Assembly shall be in accordance with IPC-A-610 and IPC-J-STD-001J.

3.2.3.2.5 Wire Wrap

Wire wrap shall not be used.

3.2.3.3 Maintainability

a. During routine servicing and maintenance, unsoldering of wires, wire harnesses, parts, or assemblies shall not be required.

b. When it is necessary to displace a part in order check or remove another part, the former part shall be wired and mounted so that it can be moved without being disconnected.

c. Removal of any panel or any sub-chassis for maintenance purposes shall be accomplished without unsoldering or soldering of connections.

d. Replacement of air filters shall be accomplished without the shutdown of fans.

e. The equipment shall automatically return to normal operation when input power is restored after a power interruption.

f. Test points and controls for adjustment shall not be located in compartments with voltage points of 300 V or more.

g. All test points and controls for adjustments shall be located to preclude accidental shock to personnel engaged in normal operating or maintenance activities.

h. Protection shall be provided in the test point circuitry to prevent equipment damage caused by the external grounding of test points.

i. Failure of built-in-test (BIT) devices shall not degrade equipment operation or cause equipment shutdown unless equipment is specifically designed to shut down in case of BIT device failure.

j. Test points on plug-in circuit cards shall be immediately accessible inside the electronic component cabinet.

3.2.4 Equipment Design and Construction

3.2.4.1 Materials, Processes, and Parts

3.2.4.1.1 Materials

3.2.4.1.1.1 Dissimilar Metals

a. Selection of metals for use in electronic equipment shall be made in accordance with the requirements of MIL-STD-889.

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b. Where electronic design requirements preclude the isolation from one another of incompatible metal combinations as identified in MIL-STD-889, the incompatible materials shall be isolated from exterior environments.

3.2.4.1.1.2 Metals, Corrosion Resistance

a. Metals shall be corrosion resistant or shall be coated or metallurgically processed to resist corrosion.

b. Materials and processes for metallic parts shall conform to applicable requirements in MIL-STD-889.

c. Non-corrosion resistant steel alloys, except where specifically required for electronic purposes shall not be used.

3.2.4.1.1.3 Corrosion-resisting Ferrous Alloys

a. Austenitic corrosion-resisting steel shall be used for all structural parts that will be subjected to severe corrosive conditions, such as exposure to sea water and combustion gases.

b. Corrosion-resisting steels shall be given a passivation treatment.

3.2.4.1.1.4 Flammable Materials

Materials used in the end item configuration shall be noncombustible or fire retardant in the most hazardous conditions of the equipment environment.

3.2.4.1.2 Equipment Manufacturing Processes

3.2.4.1.2.1 Strain Relief

Each part lead terminating at a connection point shall have allowance for strain relief to minimize tensile or shear stress.

3.2.4.1.2.2 Painted Finish

a. Metal surfaces not otherwise protected as described herein shall be painted.

b. The painted surfaces shall withstand the environmental operating conditions defined in this specification without flaking, cracking, blistering or allowing any corrosion of the underlying surface.

c. Painted finishes shall be of a smooth texture, lusterless, brown color matching number 30372 of SAE AMS-STD-595.

d. Leaded paint shall not be used.

3.2.4.1.2.3 Cadmium Plating

Cadmium plating shall not be used.

3.2.4.1.3 Electrical Parts

3.2.4.1.3.1 Batteries

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a. Batteries shall be in accordance with NEMA C18.1M Part 1 and Part 2; NEMA C18.2M Part 1 and Part 2; NEMA C18.3M Part 1 and Part 2; and applicable recognized industry standards.

b. Equipment containing batteries shall be able to operate and be maintained in accordance with their formally documented maintenance procedures for a minimum of 2 years before requiring replacement.

c. Batteries shall not leak or generate toxic, corrosive, or combustible fumes.

d. Except for equipment requiring permanent battery installation, battery-powered equipment shall be labeled externally as follows: "WARNING: REMOVE BATTERIES BEFORE SHIPMENT OR INACTIVE STORAGE OF 30 DAYS OR MORE."

e. Battery compartments shall be provided in accordance with the following:

    1. Contain devices to firmly secure the batteries.

    2. Provide access for battery installation, maintenance, testing, and removal without disassembly of equipment.

    3. Prevent the build-up of heat, gases, liquids, or chemicals released during battery operation, charging, deterioration, or rupture.

    4. Prevent build-up of heat, gases, liquids, or chemicals from entering the electronic compartment.

    5. Prevent accidental battery discharge during battery installation, maintenance, testing, and removal.

f. Batteries used with or assembled to microelectronics to supply power to microelectronics shall not require a dedicated battery compartment.

g. Connections, polarity, minimum acceptable voltage for equipment operation, nominal voltage, and type(s) of batteries required shall be marked as applicable in a prominent place on or adjacent to the battery compartment.

3.2.4.1.3.2 Circuit Breakers

a. Circuit breakers shall be in accordance with the requirements of Underwriters Laboratories (UL) 489, unless they are used in a UL approved equipment item or load.

b. Each pole of all circuit breakers shall provide complete overcurrent protection by having inverse time and instantaneous tripping characteristics.

c. Circuit breakers shall be operated by a toggle type handle and have a quick-make, quick-break, over-center switching mechanism, operating all poles, that is mechanically trip free from the handle so that the contacts cannot be closed against short circuit currents.

d. Circuit breakers shall be capable of manual operation to the open (off) and closed (on) conditions.

e. Circuit breakers shall not be used as switches unless they are specifically approved and listed for switching duty.

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f. Circuit breakers operating handles shall indicate, by visual or tactile means, the open (off), closed (on), and tripped states of the breaker.

g. Equipment or system circuit breakers shall be coordinated with the circuit breaker providing power to the equipment or system circuit breakers such that any overcurrent condition in the equipment or system will trip one or more equipment or system circuit breakers without tripping their power feed circuit breaker protecting the facility bus.

h. Equipment and system circuit breakers shall provide complete continuous overcurrent protection for the load served and be unaffected by load harmonics and inrush current.

i. Circuit breakers shall be full size units or multiples thereof, unless they are used in an UL approved equipment item or load.

j. Circuit breakers shall be permanently identified as to their continuous ampere rating.

k. Standard trip curve circuit breakers shall be used to the limits possible, unless they are used in an UL approved equipment item or load.

l. Circuit breakers shall not perform the function of thermal overload relays.

3.2.4.1.3.3 Connectors with Thermocouple Contacts

a. All connectors used in conjunction with thermocouples shall have their contact materials identified by one of the following methods:

    1. Nameplate securely attached to each connector half or mounted on the panel mounted receptacles.

    2. By means of insulation sleeving or other markers designed for attachment around wire bundles.

b. Markers shall be attached adjacent to the plug.

c. Contact materials shall be identified using the standard abbreviations for the elements used.

3.2.4.1.3.4 Power Connectors

a. All electrical power connectors shall be UL listed for their application and use.

b. All power connectors shall be in accordance with NEMA WD 6 standards.

c. Polarized connectors shall be used to ensure safety of equipment and personnel.

d. All unmated connectors shall be protected with metal or plastic caps or otherwise suitably protected during maintenance, storage, and shipment.

e. Unmated connectors with exposed contacts that may contain electrically hot circuits shall be covered with moisture-proof and vapor-proof caps.

f. Protective caps shall remain permanently linked to the equipment when not in active use.

3.2.4.1.3.5 Fuses

a. Fusing shall be coordinated so that fuses in branch circuits will open before the fuses in the main circuit.

b. Fuses shall not perform the function of thermal overload relay devices.

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c. Fuse ratings shall be compatible with both starting and operating currents.

d. Connections to extractor post type fuse holders shall be such that the load is connected to the fuse terminal that terminates in the removable cap assembly.

e. Fuses shall have a minimum interrupting capacity of 10,000 A when used in any AC line whose voltage exceeds 100 V.

3.2.4.1.3.6 Switches

Switches shall maintain their indicated state, i.e., open or closed, when subjected to any accidental force on the switch or the switch mounting equivalent to a 10g acceleration of either switch or mounting.

3.2.4.1.3.7 Wiring

3.2.4.1.3.7.1 Wiring – Electrical Clearance and Leakage Current

Clearance between solder connections or bare conductors (such as terminal strips, stand-offs, or similar connections), shall not allow accidental contact occurring between adjacent connections when subject to service conditions specified in this specification.

3.2.4.1.3.7.2 Wiring – Marking

a. All signal, control, and power wiring shall be uniquely identified to and within the enclosure along the wire and at each termination by permanent markings or labels that are protected from fading or abrasion.

b. Marking/labeling of the wiring shall occur at structural penetrations and at every 20 feet of wiring.

3.2.4.1.3.7.3 Wiring – Protection

a. The wiring shall be secured and protected against chafing due to vibration or movement (such as slide out racks or drawers).

b. Wiring to pullout drawers shall employ cable retractors to protect the equipment.

3.2.4.1.3.7.4 Cable Ducts

Where cable ducts are employed, provisions shall be made for the removal of any wire that may become faulty.

3.2.4.1.3.7.5 Wiring – Bend Radius

a. The bend radius of wire and cable shall not be less than five times the cable diameter to avoid establishing a permanent set in the cable.

b. All enclosures and cable ducts shall be large enough to accommodate freely routing cables and wires while still maintaining clear access for all routine maintenance tasks.

3.2.4.1.3.7.6 Wiring – Sleeving

a. Flexible plastic sleeving shall be used on cables subject to flexing, such as panel door cables.

b. The sleeving shall be secured under cable clamps at each end.

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c. The cable shall be formed, secured, and protected so that no abrasion to the cable occurs when flexing in its normal motion.

3.2.4.1.3.7.7 Wiring – Panel Door Cables

Wiring to parts on a hinged door shall be arranged to flex without becoming damaged when the door is opened and closed.

3.2.4.1.3.7.8 Wiring – Through Hole Protection

a. Whenever wires are run through openings in metal partitions, shields, and the like, which are less than 0.125" in thickness, the holes shall be equipped with suitable mechanical protection (grommet) or insulation.

b. Openings in panels 0.125" or more in thickness shall have either grommets or the edges of the openings rounded to a minimum radius of 0.0625".

c. Grommets for wires operating at RF potentials exceeding 500 Vrms shall be of ceramic or plastic material of suitable dielectric strength, except for coaxial cables that have outside protection, where rubber or neoprene is acceptable.

3.2.4.1.3.7.9 Wiring – Arrangement

a. Signal, data, control, and other low power conductors shall not be placed adjacent to line power conductors.

b. Materials used for lacing, binding, sleeving, and strapping shall be compatible with the conductor or cable insulation or jacket.

c. Wiring shall be arranged to permit bundling or permanent mounting in cable ducts.

3.2.4.1.3.7.10 Wiring – Slack

Discretely terminated wires and cables shall be as short as practicable and still allow for maintenance and operation without damage or crimping of the wires.

3.2.4.1.3.7.11 Wiring – Entrance Cabling

Wiring from cable entrances to terminal boards, plugs, jacks, and similar devices shall be harnessed and clamped or supported in a cable duct.

3.2.4.1.3.7.12 Wire

a. Stranded wire shall be preferred; however, solid wire may be used in the equipment, provided such wire is insulated and held in place so that it does not fail or show excessive motion likely to result in failure when the equipment is subjected to vibration and shock encountered under the specified service conditions.

b. Wire shall be continuous from point of origin, on a discrete device or terminal, to the point of destination, on a discrete device or terminal.

c. Wire and cable shall be supported and secured to prevent stress on the conductors and terminals and change in position of the wire or cable during and after subjection of the equipment to specified service conditions, or after service or repair of the equipment in a normal manner.

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d. Twine or tape shall not be used for securing wire and cable.

e. Insulation sleeving of conductors shall be UL listed for the application.

3.2.4.1.3.7.13 Fungus Protection

Materials that support fungus growth shall not be used for wiring or wiring insulation.

3.2.4.1.3.7.14 Aluminum Conductors

Aluminum conductors shall not be used for interconnections between LRUs.

3.2.4.1.3.7.15 Termination of Signal and Control Wiring

All external signal and control wiring entering the equipment shall be terminated with a connector.

3.2.4.1.3.7.16 Fiber Optics

Use of fiber optics shall be in accordance with FAA-STD-049.

3.2.4.1.4 Mechanical Parts

3.2.4.1.4.1 Controls and Switches

3.2.4.1.4.1.1 Direction of Movement

a. Controls shall be connected in the circuit so the controlled characteristics (e.g., sensitivity, volume, or voltage) increase with clockwise rotation of the control as seen from the operating position.

b. Movement of a control forward, clockwise, right, or up, shall turn the equipment on, or cause the quantity to increase, the equipment to move forward, clockwise, to the right, or up.

3.2.4.1.4.1.2 Operating Controls

Controls necessary for the operation of the equipment shall be located on the front panel of the unit.

3.2.4.1.4.1.3 Adjustment Controls

a. Adjustment controls that are required for periodic alignment or calibration shall be mounted behind covered openings (such as access doors), and on the faces of the equipment most accessible when installed.

b. When not adjustable by hand, controls shall be designed to accept a common screwdriver blade tip.

c. Controls which are infrequently adjusted need not be accessible from the operating panel, but shall be readily accessible for servicing without the use of an extender card when the equipment is opened for maintenance purposes.

d. The adjustment range shall not be large enough to cause equipment damage.

3.2.4.1.4.1.4 Operation

a. Play and backlash in controls shall be held to a minimum commensurate with intended operational functions maintaining electrical contact and accurate settings.

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b. Controls shall operate freely and smoothly without binding, scraping, or cutting.

c. Normal settings of all continuously variable controls shall not fall in the first tenth or last tenth of angular rotation.

3.2.4.1.4.1.5 Stops

a. Mechanical stops shall be provided for all adjustable controls, except controls designed for unlimited rotation.

b. Stops shall be provided on the driving end of the shaft where flexible control shafts are employed, or where stops that are integral to the adjustable control or the mechanism could be damaged by excessive torque.

3.2.4.1.4.1.6 Locking Devices

a. Control locking devices shall retain the controls in any given setting within the range of control.

b. The locking and unlocking action shall not affect the setting of the control.

c. Where vernier controls are used, the locking devices shall operate on both main and vernier controls, if necessary, to prevent damage.

3.2.4.1.4.1.7 Non-turn Devices

All non-turning controls and bodies or cases of turning controls shall be equipped with a positive device to prevent their turning in the panel or in the assembly on which they are mounted.

3.2.4.1.4.1.8 Fastener Hardware

a. Fasteners shall be able to be removed and installed without damage to hardware.

b. Fasteners shall remain secure when exposed to equipment operational and environmental stresses.

c. Except for those items designed to be affixed with one fastener, parts shall be secured so failure of a single fastener will not free the part completely.

d. Friction between mating surfaces shall not be employed as the sole means of preventing fixed parts from rotating or shifting.

e. Fasteners shall be selected to minimize the number of standard tools used during maintenance.

3.2.4.1.4.2 Glass and Glass Fibers

a. All glass used in the equipment shall be of the shatterproof type.

b. Glass fibrous materials shall not be used as the outer covering on cables, wire, or other items where they may cause skin irritation to operating or maintenance personnel.

3.2.5 Electromagnetic Compatibility (EMC)/Electromagnetic Interference (EMI)

a. The system shall be successfully tested in accordance with the requirements in 4.4.2.

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b. The equipment manufacturer or supplier shall ensure the system meets the requirements of Federal Communication Commission (FCC) Rules and Regulations, Code of Federal Regulations (CFR) Title 47, Chapter 1: Subchapter A, Part 2 and Part 15; and, Subchapter D, Part 87.

c. All components of the Remote Maintenance Monitoring (RMM) subsystem and any other computing devices shall meet the requirements for Class A computing devices in accordance with FCC Rules and Regulations, CFR Title 47, Chapter 1, Subchapter A, Part 2, subpart J, (Frequency Allocations and Radio Treaty Matters; General Rules and Regulations).

3.2.6 Nameplates and Markings

3.2.6.1 Nameplates

a. Each subsystem shall have one or more nameplates determined by the equipment configuration.

b. Each nameplate shall be in accordance with Figure 3-2.

c. Nameplates shall be attached by a self-adhesive backing or removable 4-40 stainless steel pan-head screws.

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h.

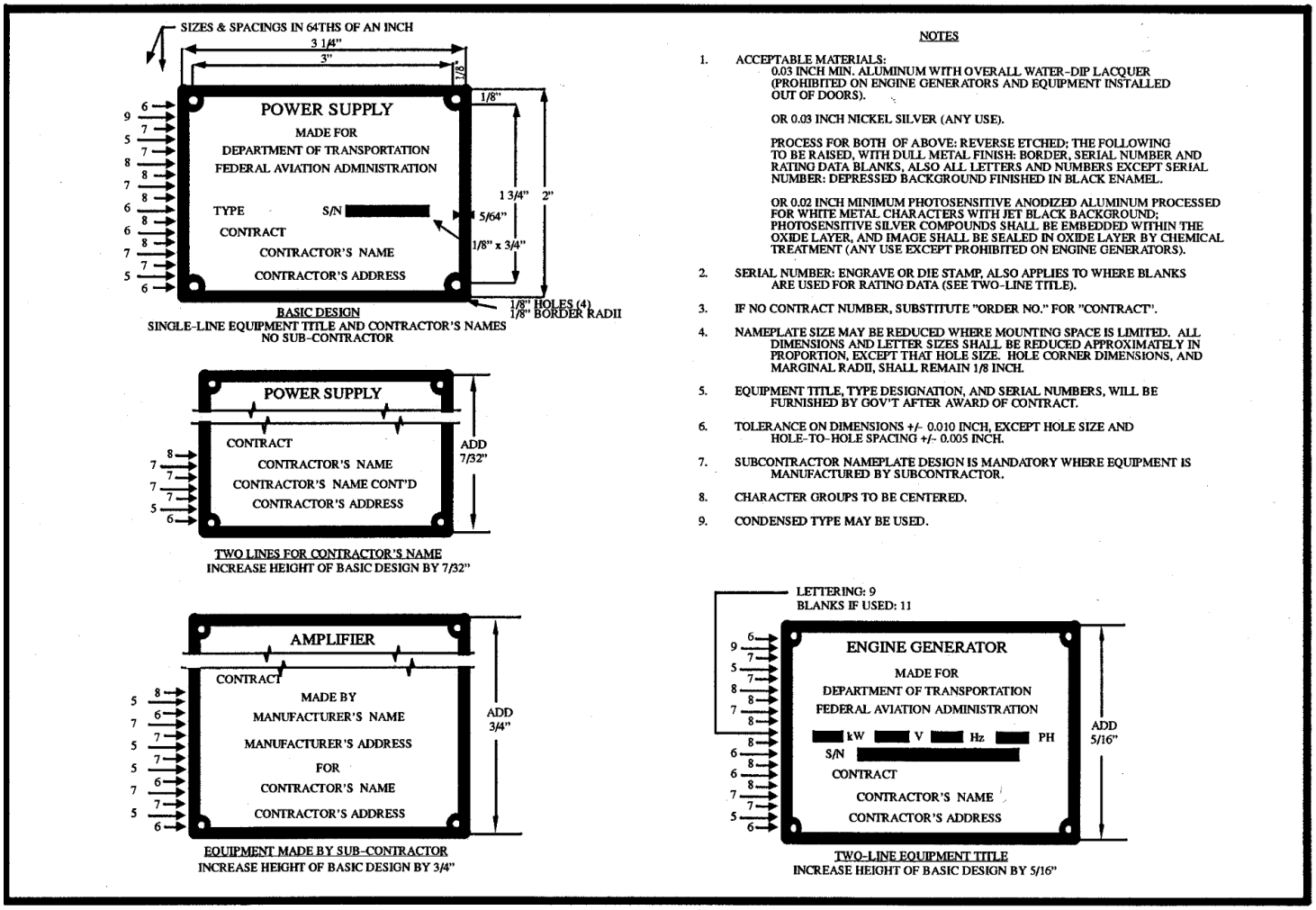

Figure 3-2. Nameplates

3.2.6.1.1 Equipment Titles

Unless specifically set forth in this specification, the FAA shall approve titles and type designations.

3.2.6.2 Marking

a. A marking shall be permanent and legible during normal operation and maintenance usage.

b. A marking shall be as specified in ASME Y14.44.

3.2.6.2.1 Visibility of Parts Labels

All LRU parts that have labels or markings identifying data or ratings, shall be mounted so that the data is visible to maintenance personnel without the necessity for disassembly of parts or of adjacent functional or structural parts.

3.2.6.2.1.1 Fuse Positions

All fuse positions shall be marked with the rated current capacity of the fuse to be employed therein and approved by the FAA.

3.2.6.2.1.2 Terminal Strips, Blocks, and Wafer Switches

All terminal strips, blocks and wafer switches shall be identified.

3.2.6.2.1.3 Controls and Indicating Devices

a. Markings shall be provided on the front of each exterior and interior panel and panel door, and also on control- mounting surfaces of each chassis, sub-panel, etc., to clearly designate the functions and operations of all controls, fuses, and indicating devices mounted thereon, protruding, or available through access holes therein.

b. All markings shall be located on the panel or chassis in correct relationship to the respective designated items.

3.2.7 Interchangeability

a. Like LRUs shall be interchangeable in form, fit, and function without mechanical adjustment.

b. LRU plug-in modules and assemblies shall be designed to prevent insertion into the incorrect location or orientation.

3.2.8 Personnel Safety and Health

a. To ensure personnel safety, the equipment shall be equipped to be anchored and remain in place during a seismic occurrence as stated in the National Earthquake Hazards Reduction Program (NEHRP) FEMA Publication 2082, Recommended Seismic Provisions for New Buildings and Other Structures.

b. Equipment design shall provide for personnel safety in accordance with IEEE C95.1-2019, Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz.

c. Personnel shall be protected from harm of moving parts when replacing filters.

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d. Personnel shall be protected from injury by sharp edges of equipment or cabinets during maintenance.

3.2.8.1 Electrical Safety

a. A means shall be provided to protect personnel from accidental contact with voltages in excess of 30 Vrms or DC with currents greater than 21 mA AC and 80 mA DC during normal operations and maintenance of the equipment.

b. After power to the equipment is turned off, the equipment shall discharge all capacitors to 30 V or less within 2 s.

c. The power input side of the switch and the incoming power line connections shall be given physical protection against accidental contact.

3.2.8.1.1 Ground Potential

a. The design and construction of the equipment shall ensure that all external parts, surfaces, and shields, exclusive of antenna and transmission line terminals, are at ground potential at all times during normal operation.

b. Any external or interconnecting cable, excluding RF cables, where ground is part of the circuit, shall carry a ground wire in the cable terminated at both ends in the same manner as the other conductors.

c. In no case, except with coaxial cables, shall the shield be depended upon for a current-carrying ground connection.

d. Antenna and transmission line terminals shall be at ground potential, except for RF energy on their external surfaces.

e. A point on the electrically conductive chassis or equipment frame shall serve as the common tie point for the static or power ground.

3.2.8.1.2 Hinged or Slide Mounted Panels and Doors

Doors and panels with hinges or slides shall be grounded by use of a flexible ground strap in accordance with FAA-STD-019.

3.2.8.1.3 Shielding

a. Except where a conflict with grounding requirements would be created, shielding on wire or cable shall be grounded to the chassis or frame.

b. The shielding shall be at a sufficient distance from exposed conductors to prevent shorting or arcing between the conductor and the shielding under normal operating conditions and worst-case environmental conditions.

3.2.8.1.4 Guarding of Radio Frequency (RF) Voltages

Transmitter output terminals, antennas and other devices that carry sufficient RF voltage that may burn or injure personnel shall be protected from accidental contact.

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3.2.8.1.5 Electrical Interlocks

a. Interlocks shall be used when voltages between 70–500 V are exposed when the access door, cover, or plate is opened. No interlocks are required when all potentials in excess of 70 V are completely protected with guards or barriers under all operational conditions or any level of maintenance.

b. Bypassable interlock switches shall be momentary action (spring-return) switches marked "INTERLOCK BYPASS" and are provided to allow interlocked access doors and covers to be opened with a manual latch for "on" position to be operated in the exposed interlock switch, without removing power from the equipment.

c. The bypass switches shall be located so that one person can operate the switch, open the door or cover, and set the manual latch.

d. Non-bypassable interlocks shall be used for access doors, covers, and panels when the voltage accessible or exposed exceeds 500 V, and the current available exceeds 100 mA AC or 160 mA DC.

3.2.8.1.6 High Voltage Protection

a. Assemblies operating at potentials in excess of 500V shall be completely enclosed from the remainder of the assembly and interlocked in accordance with the requirements herein. Note: Test probe holes may be provided in the barriers or guards where maintenance testing is required.

b. When the operation or maintenance of equipment is employing potentials in the excess of 300V peak, the equipment shall be provided with test points so these voltages can be measured at a relatively low potential level, but in no case shall the potential exceed 300 V peak relative to ground.

c. Test points with voltages above 30 V shall have the conducting material recessed at a distance no less than the diameter of the probe hole and a minimum of 0.06”.

d. If a voltage divider is used, the voltage divider resistance between the test point and ground shall consist of at least two equally valued resistors in parallel.

3.2.8.1.7 High Current Protection

All power buses supplying 25A or over shall be protected against accidental short circuiting by tools, jewelry, or removable conductive assemblies.

3.2.8.1.8 Electrical Connectors

a. The design of the connector shall be such that the operator is not exposed to electrical shock or burns when normal disconnection methods are used.

b. Exposed pin contacts shall not be energized after being disconnected from the socket contacts.

3.2.8.2 Mechanical Hazards

a. Suitable protection shall be provided to prevent contact with moving mechanical parts such as gears, fans, and belts when the equipment is operating.

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b. Cabinets, doors, and similar parts shall not have sharp projections.

c. Equipment power switches shall be designed and located to prevent accidental contact by personnel from changing the equipment state.

3.2.8.2.1 Mechanical Interconnection

The design shall provide positive means to prevent the inadvertent reversing or mismatching of fittings, couplings, instrument leads, and electrical connections.

3.2.8.3 Markings, Signs, Tags, and Symbols

3.2.8.3.1 Markings

a. Guards, barriers, and access doors, covers or plates shall be marked to indicate the hazard that may be reached upon removal of such devices.

b. A hazard marking shall be located on the equipment such that it is not removed when the barrier or access door is removed.

c. Warnings of hazards internal to a unit shall be marked adjacent to hazards if they are significantly different from those of surrounding items.

d. Physical hazards shall be marked with color codes in accordance with NEMA Z535.1 where applicable to electronic equipment.

3.2.8.3.2 Accident Prevention Signs and Labels

a. Accident prevention signs and labels shall be provided whenever equipment has characteristics or operating conditions which present a hazard to operators, and maintenance or other personnel.

b. Signs and labels shall have the same life expectancy, or greater, as the equipment on which they are affixed.

3.2.8.3.2.1 Sign Design

Signs shall consist of three panels as shown on Figure 3-3 below.

a. The ratio of width to height of the upper panel (a:b) shall fall within the range of 2:1 to 5:1 inclusive.

b. The lower panel shall be equal to the upper panel width (both equal to a).

c. The lower panel height shall be equal to or greater than the upper panel height, but less than twice the width of the sign (b<=c<2a).

d. The optional symbol panel shall be square with its edge equal to the sum of the upper and lower panel (b+c) and placed to the right.

e. The upper panel shall contain the signal or key word.

f. The lower panel shall contain additional direction or explanation.

g. The wording of this panel shall be brief, provide positive direction, and be limited to a single hazard.

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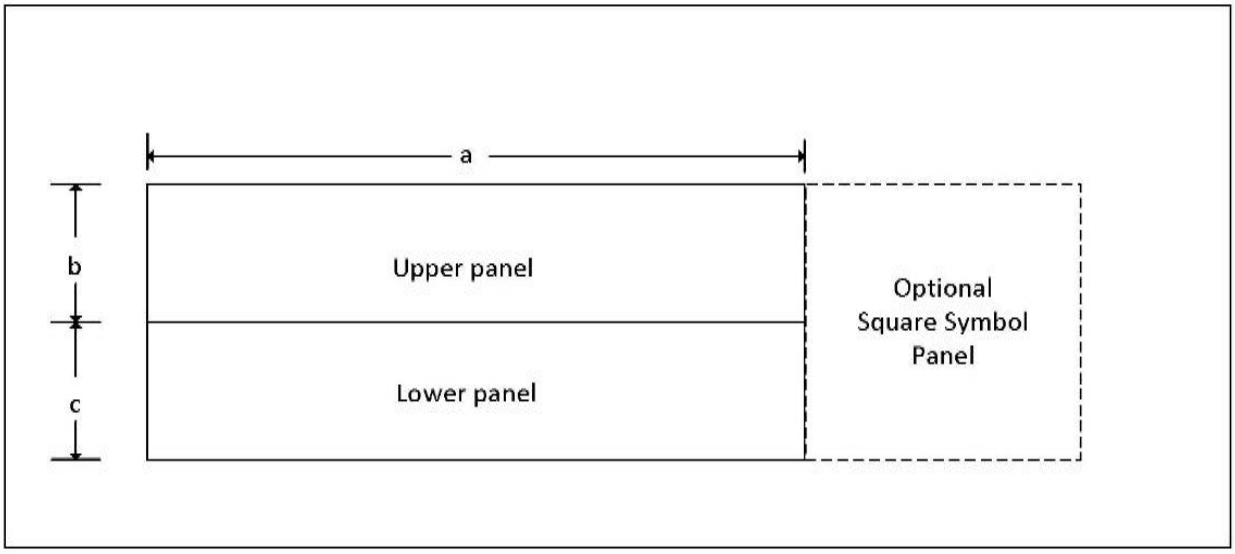

Figure 3-3. Personnel Safety Sign Layout

3.2.8.3.2.2 Sign Classifications and Detailed Design

3.2.8.3.2.2.1 Class I (Danger)

a. These signs indicate immediate and grave danger, peril, or hazard capable of producing irreversible damage or injury, and prohibitions against harmful activities.

b. These signs shall have the word "DANGER" in white within a red oval outline with a white on black rectangle in the upper panel.

c. The lower panel, for additional wording, shall be in black or red on a white background.

3.2.8.3.2.2.2 Class II (Caution)

a. These signs are used to call attention to potentially dangerous hazards capable of or resulting in severe but not irreversible injury or damage.

b. These signs shall have the signal word "CAUTION" in yellow on a black rectangle in the upper panel.

c. The lower panel, for additional wording, shall be in black on a yellow background.

3.2.8.3.2.2.3 Class III (General Safety)

a. These signs include notice of general practice and rules relating to health, first aid, housekeeping, and general safety other than the two cases above.

b. These signs shall have the appropriate keyword in white on a green rectangle in the upper panel.

c. The lower panel, for additional wording, shall be in black or green on a white background.

3.2.8.3.2.2.4 Class IV (Fire and Emergency)

a. These signs shall be used only to label or point the way to fire extinguishing equipment, shutoffs, emergency switches, and emergency procedures.

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b. These signs shall have the keyword in white on a red rectangle in the upper panel.

c. The lower panel, for additional wording, shall be in red on a white background.

3.2.8.3.2.3 Sign Placement

a. Signs shall be placed to alert and inform personnel to avoid the hazard or to take appropriate action.

b. Signs shall be readable from a distance commensurate with a. above, create no additional distractions, or be hazards themselves.

3.2.8.3.3 Symbols

The following symbols shall be used as applicable:

a. Ionizing radiation hazard - Health Physics Society N2.1.

b. Microwave and radio frequency radiation - NEMA Z535.2 and IEEE C95.2.

3.2.8.3.4 Display Warnings

c. Video display warnings shall be provided on equipment with associated video displays to warn operators of impending danger, to alert operators to critical system changes or equipment status, or to remind operators of a critical action which must be taken.

d. Display alert/warnings shall be designed to incorporate clearly discriminative features that distinguish the warning (color, blink, size, etc.) from other display information.

3.2.8.4 Dusts, Mists, Fumes, and Gases

a. The materials installed in the equipment and under service conditions specified in the specific equipment specification shall not liberate gases which when combined with the atmosphere form an acid or corrosive alkali, nor shall they generate toxic or corrosive dusts, mists, or fumes which would be detrimental to the performance of the equipment or health of the equipment operators.

b. In addition to equipment operators, gases or fumes shall not be detrimental to plants, fish, or wildlife if vented to the outside.

c. The materials also shall not liberate gases, which will produce a flammable or explosive atmosphere.

3.2.8.5 Restricted Materials

Mercury and asbestos shall not be used.

3.2.8.6 Seismic Safety

All equipment and enclosures shall be designed and installed so that the enclosure and the mounted line replaceable unit (LRU) and/or components will remain upright and in place, and all access panels, doors, and drawers remain secured to the enclosure.

DRAFT

3.2.9 Human Engineering

3.2.9.1 Noise Hazards

a. The noise generated from the Remote Status and Interlock Control (RSIC) shall not exceed 55 dBA under normal operating conditions.

b. The noise generated from the Remote Status and Control Unit (RSCU) shall not exceed 65 dBA under normal operating conditions.

c. No component of the ILS shall exceed 85 dBA.

d. Noise caution signs shall be clearly visible and legible to all personnel exposed to the hazard.

3.2.9.2 Visual Display Information

a. All information generated by the equipment shall be capable of display to an operator.

b. Information shall be limited to which is necessary to perform specific actions or to make decisions.

c. Numeric digital displays shall not be used as the only display of information when perception of pattern or variation is important to correct comprehension of the information.

d. Numeric digital displays shall not be used when rapid or slow digital display rates inhibit proper understanding.

3.2.9.2.1 Display Positive Feedback

The absence of an indication on status displays shall not be used to indicate critical occurrences (i.e., indicates that the valve has actually closed and not that the button has been pushed or voltage applied).

3.2.9.2.2 Flash

a. The flash rate shall be between three (3) and five (5) flashes per second with approximately equal on and off times.

b. Flashing indicators that could flash at the same time shall be synchronized so that they flash together.

3.2.10 System Performance

a. The ILS subsystems to be provided under this specification shall demonstrate compliance with the airborne measurements specified in Table 3-1 and Table 3-2 below when installed in accordance with FAA standard siting practices.

b. Dual frequency systems shall meet requirements for CAT III operation.

c. Single frequency systems shall meet the requirements for CAT I operation.

d. A single frequency glide slope shall be capable of meeting the requirements for CAT II/III operation when installed in accordance with FAA standard siting practices for CAT II/III service.

DRAFT

Table 3-1. Localizer Requirements

ILS Zone	Tolerance/Limit µA		Reference	
	CAT I	CAT II/III	Average	Course Alignment
1	±30	±30	x	
2	±30 to ±15	±30 to ±5		x
3	±15	±5		x
4	N/A	±5		x
5	N/A	±5 to ±10		x

Table 3-2. Glide Slope Requirements

ILS Zone	Tolerance/Limit µA		Reference	
	CAT I	CAT II/III	Average	Course Alignment
1	±30	±30	x	
2	±30	±30 to ±20		x
3	±30	±20	x	

3.2.11 Controls and Indicators

3.2.11.1 Front Panel

3.2.11.1.1 Controls

At a minimum, the following control functions shall be available from the front panel of the transmitter:

a. On/Off/Reset of each transmitter.

b. Independent On/Off controls for course and clearance transmitters.

c. Enable/Disable Remote control.

d. Disable aural alarms and alarm history when remote control is disabled.

e. Lamp/aural alarm test.

f. Alarm silence.

g. Selection of Main/Standby transmitter, if applicable.

h. Enable bypass of the monitor control, in which:

   1. Automatic monitor shutdown action in response to primary alarms is inhibited; and,
   2. Transmission of the identification signal is stopped.

i. Disable bypass of the monitor control, in which:

   1. Automatic monitor shutdown action in response to primary alarms is enabled; and,

DRAFT

2. Transmission of the identification signal is restarted.

j. Control(s) to turn ON or OFF each of the modulation tones individually.

k. A single control to switch ON or OFF both modulation tones simultaneously for both the carrier plus sideband (CSB) and sideband only (SBO) signals.

3.2.11.1.2 Status and Indicators

a. At a minimum, the following status and indicators shall be available on the equipment front panel:

1. Power status
2. Power source (Main/AC or standby/batteries)
3. Main transmitter status
4. Standby transmitter status
5. Monitor bypass status (executive/standby/field)
6. Local/remote control status
7. Monitor normal/alarm status
8. Maintenance alerts

b. The following colors shall be used for indicators:

1. Green – normal operation
2. Amber – alert condition
3. Red – alarm condition

c. An aural alarm shall be provided to indicate an alarm condition.

3.2.11.1.3 Display and Adjustment of Parameters

a. All status and control functions to install, configure, operate, and maintain the ILS subsystems, and update system software, shall be available from a government-furnished Microsoft Windows-based laptop running portable maintenance data terminal (PMDT) software provided by the vendor.

b. For the purpose of making adjustments, the parameter to be adjusted shall be selectable by cursor or menu.

c. If the display system requires operator input in order to make adjustments, tooltips that display the range of allowed inputs shall be provided.

d. The smallest increment for adjustment of a parameter shall be no coarser than the reading resolution of that parameter as illustrated in Table 3-3 below.

e. Any alpha-numeric parameter setting shall be settable by direct entries via the keypad.

3.2.11.2 Use of a Portable Maintenance Data Terminal (PMDT)

A PMDT connected to the subsystem terminal interface will be used for displaying all control

DRAFT

settings on a neatly formatted screen or screens with the parameter name and its current value clearly displayed.

3.2.11.2.1 PMDT Requirements on Human Factors

3.2.11.2.1.1 Screen Design

a. Information shall be presented to a user in a directly usable form without requiring the user to decode or interpret data.

b. When a user is performing an operation on a selected object in a display, that object shall be highlighted.

c. When an application provides different operational modes, the current mode shall be continuously indicated to a user.

d. Every screen shall have a title or header at the top that is separate and distinguishable from the body of the screen and describes briefly the contents or purpose of the screen.

e. Screens throughout a system or application shall have a consistent structure that is evident to users.

f. Elements of screens such as headers, fields, and labels shall have consistent appearance and relative location throughout a system or application.

3.2.11.2.1.2 Task Entry and Display

a. The Tab key shall move the cursor to the first position of the next cell to the right of its current position, or, if the current position is in the last cell in a row, to the first position of the first cell in the next row.

b. When a field has a set or range of acceptable values and a user enters an unacceptable value, the system shall provide an error message when the user tries to leave the field and not move the cursor from the field.

c. When a user fails to make an entry in a required field, the system shall provide an error message when the user tries to leave the field and not move the cursor from the field.

3.2.11.2.1.3 Graphical Information

When users are required to make comparative evaluations against reference values, the reference values shall be displayed.

3.2.11.2.1.4 Coding

a. Coding shall be consistent throughout an application and related applications.

b. Color-coding shall conform to the following reserved meanings consistent with conventional associations for particular colors:

    1. Red to indicate conditions such as no-go, error, failure, or malfunction.

    2. Flashing red to indicate emergency conditions requiring immediate user action to avert personnel injury or equipment damage.

    3. Yellow to indicate marginal conditions, alert users to situations where caution or rechecking is necessary or notify users of an unexpected delay.

DRAFT

4. Green to indicate that a monitored process or unit of equipment is within tolerance, that a condition is satisfactory, or that it is all right to proceed with an operation or transaction.
5. White to indicate alternative functions or system conditions that do not have operability or safety implications.
6. Blue only as an advisory color.

3.2.11.2.1.5 Interaction

a. When the same menu or option appears in different displays within an application, it shall be consistent in wording and organization.

b. A user shall be able to select an option on a pop-up menu by moving the pointer onto the desired option and clicking the appropriate button.

3.2.11.2.1.6 User-Initiated Interrupts

A system or application shall permit a user to interrupt or terminate the current transaction.

3.2.11.2.1.7 File Management

An easy means shall be provided for saving and retrieving data.

3.2.11.2.1.8 Controls

a. When the system prompts a user for a parameter that has a default value assigned, the default value shall be displayed.

b. Push button labels shall be consistent throughout an application and related applications.

c. A user shall be able to activate a push button by moving the pointer onto the button and pressing the appropriate pointer button.

d. Radio buttons shall be used if it is required that one and only one of a set of mutually exclusive options be selected.

e. An individual radio button shall always be part of a mutually exclusive group of two or more radio buttons.

f. A radio button that is active shall cause all of the other radio buttons in its group to be inactive.

g. Labels shall be provided for each set of radio buttons.

h. Users shall be able to toggle selected and unselected states on a check box using either a pointing device or the keyboard.

i. Labels shall be provided for each set of check boxes.

3.2.11.2.1.9 Windows

a. Scroll-bars shall be provided whenever the size of a textual or graphic entity exceeds the space available to display it.

b. The appropriate directional arrow shall be subdued or grayed out if no information is currently available through scrolling in a particular direction.

DRAFT

c. A scroll-bar shall contain a vertical or horizontal line or area along which the scroll box can move, the length of which represents the entire entity.

3.2.11.2.1.10 System Operations

a. When a system log-on procedure includes both an identification component (for example, a user's name) and an authentication component (for example, a user's password), the system shall provide a self-explanatory prompt for each component with each prompt on a separate line.

b. When a log-on procedure includes the entry of a user's name and a password, the system shall show the user's name but shall not display the password on the screen.

c. When a user makes an error during the log-on procedure, the system shall display an error message in the system message area or in a standard pop-up error window that provides guidance on how to correct the error but not information that could assist someone trying to break into the system.

d. Once a user is logged on into a system, the user shall be able to log off a system at any time by selecting the log-off option from a system level menu.

e. The system shall prompt the user to confirm a log-off request.

f. After completing a system log off, the system shall display the initial system log-on screen.

g. When the processing is time consuming or not otherwise obvious, the system shall notify the user when the processing is complete.

h. When the computer is waiting for input from a user, it shall indicate clearly where on the screen the input is expected and, to the extent possible, what information is expected.

i. When the system takes more than 2 seconds to respond, it shall provide periodic feedback to the user indicating that normal operation is occurring.

j. When a control entry (including log off) will result in a change in stored data, procedures, or system operation (particularly if it is not easily reversible), the system or application shall explicitly notify the user of the potential loss of data and require a confirmation before implementing the action.

k. The Enter key shall not be used for confirmation of destructive actions.

l. Error messages shall be brief, specific, and task-oriented.

3.2.11.3 Parameter Resolution

a. The displayed resolution of a maintenance parameter shall be consistent with that parameter’s tolerances as illustrated in the Table 3-3, unless greater resolution is required for a maintenance procedure.

b. Sufficient resolution of data entry and display shall be provided such that the digitization error of an entered value is less than the rounding error of the least significant digit displayed or entered. For example, if a parameter is displayed with a resolution of hundredths of a unit, when a value of 123.45 is entered by the operator, the stored value is between 123.445 and 123.455, and the displayed value is 123.45.

DRAFT

Table 3-3. Parameter Resolution

Parameter	Resolution	Example
Power ≥ 10 W	Tenths	14.7 W
Power < 10 W and > 1W	Hundredths	2.63 W
Power < 1W and ≥ 100 mW	Units	215 mW
Power < 100 mW	Tenths	18.5 mW
Voltage ≥ 100 V	Units	124 V
Voltage < 100 V	Tenths	12.2 V
Modulation%	Tenths	20.1%
Modulation Balance (DDM)	Thousandths	0.003 DDM
Audio Frequency	Units	1015 Hz
Radio Frequency (dual frequency separation)	Tenths	7.8 kHz
Attenuation	Tenths	0.1 dB
Phasing	Units	5°

3.2.11.4 Adjustment and Storage of Entered Parameter Data

a. Adjustments shall be persistent.

b. Electronic adjustments shall be stored in non-volatile media for at least 90 days minimum retention with settings recalled and restored automatically upon restoration of system power.

3.2.11.5 Storage of Entered Data

a. Electronically entered control settings shall become effective either immediately upon entry or at the conclusion of an adjustment/maintenance operation by pressing a STORE or ENTER key or button as appropriate for the parameter or control setting.

b. If adjustable parameters have been changed, prior to returning the equipment to normal operation, the operator shall be prompted to save the new settings.

c. In the event that the operator chooses not to save the changes, the last-saved settings should be restored.

3.2.12 Transmitter Internal RF Power Measurement

a. A method and procedure shall be provided to calibrate the built-in power sensors described in 3.3.3.15 and 3.4.3.13, to an external RF power meter over the normal operating power range.

b. The accuracy of the built-in power sensors shall be within ±2% over the range from normal operating power to 4 dB below.

3.2.13 Standby Power

The localizer, glide slope, marker beacon, FFM, and RSCU, shall be equipped with standby battery power to provide uninterrupted operation if primary power is lost.

DRAFT

a. The battery or batteries shall, when fully charged, be capable of powering the localizer, glide slope, and RSCU for at least 4 hours and the marker beacon and FFM for at least 72 hours.

b. Localizer, glide slope, and RSCU batteries shall recharge to full capacity in 6 hours or less after operating the ILS equipment for one-half the manufacturer's stated battery operating time (50% usage capacity).

c. Marker beacon and FFM batteries shall fully recharge from 50% usage capacity to full capacity in 24 hours or less.

d. RSCU batteries shall provide the same operating time and require the same recharge time as localizer and glide slope batteries.

e. Batteries shall be sealed electrolyte type.

3.2.14 Battery Disconnect Switch and Fuse/Circuit Breaker

a. All field equipment (localizer, glide slope, marker beacon, RSCU, and FFM) shall be furnished with a manually operated battery disconnect switch to remove battery voltage from the transmitting equipment.

b. This switch shall employ a hardware interlock (i.e., the switch is returned to its normal ON position when maintenance access is secured) or alternately, a front panel mounted amber Maintenance Alert indicator shall illuminate when the battery is disconnected from the equipment.

c. A fuse or circuit breaker shall be provided to prevent excessive current flow to or from the battery.

d. An automatic shutdown shall be provided to prevent damage to the equipment or batteries when the battery voltage falls below a preset threshold.

3.2.15 Maintainability of Electronic Equipment

3.2.15.1 Corrective Maintenance Requirements

The Mean Time to Repair (MTTR) of each subsystem (localizer, glide slope, marker beacon, FFM, remote control subsystem, and other ancillary subsystems) shall be less than 30 minutes.

Note: Time to repair includes diagnostic time; disassembly and removal of the failed LRU; replacement and installation of the new LRU including any adjustments; loading of data necessary to initialize the system after LRU replacement; and verification required to return the ILS to normal operation. Time to repair does not include travel time, or coordination time of the outage.

3.2.15.2 Preventive Maintenance Requirements

a. 95% of all routine maintenance procedures required for the ILS shall be accomplished in less than 15 minutes.

b. No single group of periodic maintenance procedures shall require more than 2 hours to complete or be required more frequently than every 3 months.

3.2.16 Reliability of Electronic Equipment

DRAFT

3.2.16.1 Localizer MTBF

The localizer subsystem shall have a specified mean time between failures (MTBF) of not less than 4,000 hours as a serial reliability model.

3.2.16.2 Glide Slope MTBF

The glide slope subsystem shall have a specified MTBF of not less than 4,000 hours as a serial reliability model.

3.2.16.3 Marker Beacon MTBF

The individual marker beacon subsystems shall each have a specified MTBF of not less than 10,000 hours as a serial reliability model.

3.2.16.4 Localizer Far-Field Monitor (FFM) MTBF

The FFM subsystem shall have a specified MTBF of not less than 10,000 hours as a serial reliability model.

3.2.16.5 Remote Control Subsystem MTBF

The remote-control equipment group (RSCU and RSIC) shall have a specified MTBF of not less than 20,000 hours as a serial reliability model.

3.2.17 Continuity of Service

a. The continuity of service (expressed as a probability of not losing the radiated guidance signals) of a single equipment localizer shall be $1 - 4 \times 10^{-6}$ for any period of 15 seconds.

b. The continuity of a single equipment glide slope shall be $1 - 4 \times 10^{-6}$ for any period of 15 seconds.

c. The continuity of service of a dual equipment localizer shall be $1 - 2 \times 10^{-6}$ for any period of 30 seconds.

d. The continuity of service of a dual equipment glide slope shall be $1 - 2 \times 10^{-6}$ for any period of 15 seconds.

3.2.18 Integrity of Signal

a. Integrity of the signal (expressed as a probability of not radiating false guidance signals) of a single equipment localizer shall be equal to or greater than $1 - 10^{-7}$ in any one landing.

b. Integrity of the signal of a single equipment glide slope shall be equal to or greater than $1 - 10^{-7}$ in any one landing.

c. Integrity of the signal of a dual equipment localizer shall be equal to or greater than $1 - 0.5 \times 10^{-9}$ in any one landing.

d. Integrity of the signal of a dual equipment glide slope shall be equal to or greater than $1 - 0.5 \times 10^{-9}$ in any one landing.

3.2.19 Failsafe

DRAFT

The monitor shall be failsafe such that failure of any part of the monitor subsystem, including any associated control action (transmitter shutdown), either results directly in an alarm condition, or does not alter any alarm limit to allow an out-of-tolerance condition to occur without detection.

3.2.20 Antenna Support Structure Design

a. The design, manufacture and workmanship, factory finish, plans and markings, foundation designs, and protective grounding for steel towers and supports shall be in accordance with Standard TIA-222, FAA Specification FAA-910 and FAA Standard 019.

b. All steel members, including hardware, shall be hot dip galvanized after fabrication.

c. Foundations shall be designed for soil pressure of 3,000 lbs per square foot.

d. Towers and antenna support structures shall be designed to accommodate mounting of double LED type L-810 obstruction lights.

e. All towers and antenna supports shall be painted in accordance with FAA Advisory Circular 70/7460-1.

f. Painting and finish of all towers and supports shall be in accordance with FAA-STD-003.

3.2.21 Dual Equipment

For a dual equipment system, the same requirements shall be met by both the main and standby transmitters and monitors.

3.2.22 Security Requirements

3.2.22.1 Data Security

The CAT I/II/III ILS System shall contain features in its design and operation that prevent unauthorized and disruptive access to the system by implementing the following requirements as a minimum:

a. Authorized user access verification;

b. User password control;

c. Restriction of access to system/Operating System (OS) files/data;

d. Denying access to direct OS functions/commands;

e. Logging of unauthorized system access attempts;

f. Lockout of the log-in process for 15 minutes following three consecutive unsuccessful log-in attempts;

g. Limiting access to specific functions based on job category;

h. While in the normal operating mode, prevent loading of data from removable media or network connections; and,

i. Disable any unused interface ports during normal operation.

DRAFT

3.3 VHF Localizer System Requirements

The localizer chassis, cabinet, and card cage shall be mechanically designed and prewired (power, control, data, backplane) to accept additional modules allowing any configuration to be field-convertible to any other configuration including conversion to dual frequency and dual transmitter/monitor configurations.

3.3.1 Localizer Subsystem

The localizer subsystems shall consist of the following equipment:

a. For CAT II/III installations: Dual (main and standby) course and clearance transmitters with associated modulation and control equipment, with the clearance transmitter being identical in design and construction to the course transmitter with the exception of the carrier frequency.

b. For CAT I installations: Single or dual equipment, single or dual frequency transmitter with associated modulation and control equipment.

c. Localizer antenna array with associated feed and integral monitor cabling, stripline or microstrip signal distribution units, integral monitor pickup devices and stripline or microstrip combining units, obstruction lights, and antenna element support structures. One of the three localizer antenna types described in section 3.3.4 will be specified when ordering.

d. Dual localizer monitor for CAT II/III ILS equipment and single monitor for CAT I ILS equipment.

e. FFM subsystem for CAT II/III equipment.

3.3.2 VHF Localizer Station Performance

a. The VHF localizer subsystem shall provide guidance in the horizontal plane to aircraft in approaches to, and landings at airfields.

b. The radiation from the localizer antenna group shall produce a composite field pattern that is amplitude modulated by a 90 Hz and a 150 Hz tone and 1020 Hz identification tone.

c. The radiation field pattern shall produce a course sector with one tone predominating on one side of the course centerline and the other tone predominating on the opposite side.

d. When facing the localizer antenna from the approach end of the runway, the 150 Hz tone shall predominate on the right-hand side of centerline and the 90 Hz tone shall predominate on the left-hand side.

3.3.2.1 Coverage

a. With the transmitter power output reduced to half power the localizer coverage sector shall provide a signal strength of 5 μV at a flag current of 240 microamperes (μA) and in-tolerance clearance at service volume distances of 25 nmi within ±10° of the course line and 10 nmi within ±35° of the course line.

b . Coverage beyond ±35° of the course line is not required.

DRAFT

c. When installed in an ideal environment the localizer signal shall be receivable at the distance specified at and above the height 1,500 feet above the elevation of the localizer antenna array.

d. Such signals shall be receivable to the distance specified, up to a surface extending outward from the localizer antenna array and inclined 7° above the horizontal.

3.3.2.2 Course Alignment Accuracy

Based on a nominal sector width of 700 feet at threshold, the mean course line shall be capable of being adjusted and maintained to within limits equivalent to 10 feet from the runaway centerline at the ILS reference datum.

3.3.2.3 Displacement Sensitivity

a. The nominal displacement sensitivity within the half course sector at the ILS reference datum shall be 0.00044 DDM/foot, based on a nominal sector width of 700 feet at the ILS reference datum.

b. The increase of DDM shall be substantially linear with respect to angular displacement from the front course line up to an angle on either side of the front course line where the DDM is 0.180.

c. From that angle to ±10° from the course line, the DDM shall not be less than 0.180.

d. From ±10° to ±35° from the course line, the DDM shall not be less than 0.155.

e. Where coverage is required outside of the ±35° sector, the DDM in the area of coverage, except in the back course sector, shall not be less than 0.155.

f. When the course width is adjusted to ±14% for CAT I/II, and ±10% for CAT III, the DDM shall be maintained within the limits indicated above.

3.3.2.4 Course Sector Width

a. The localizer course sector width shall be adjustable in accordance with 3.3.3.12 over the range of 2.0° to 7.0° to allow tailoring to a 700-foot runway threshold course sector width (up to 6°).

b. For dual frequency localizer configurations, the course sector width of the clearance array shall be adjustable to a nominal width that provides smooth transition from the course signal to the clearance signal and that provides maximum clearance signal outside of the normal localizer course sector.

3.3.2.5 Automatic Changeover Unit (Dual Transmitter/Monitor Systems Only)

a. The transmitter shall be equipped with an automatic changeover unit, which is controlled by the monitor.

b. When a fault is detected, the automatic changeover unit shall transfer the antenna signals to the standby transmitter.

3.3.3 Localizer Transmitter

A localizer transmitter includes the following major functional components: RF generator,

DRAFT

modulator, identification keyer, and remote monitoring sensors.

3.3.3.1 Radio Frequency

a. The transmitter frequency shall be selectable to any localizer channel listed in FAA Order 6050.32 Appendix 3, Section 1, Figures 1 a-f.

b. The accuracy of the carrier frequency shall be within ±2 kHz.

c. For a dual frequency localizer, the frequencies of the two RF carriers shall be paired together, requiring only a single setting to select the localizer nominal operating frequency.

d. The two transmitters shall be offset symmetrically about the assigned (channel) frequency, with a frequency difference of 8.0 kHz ±0.5 kHz.

3.3.3.2 Modulation

The nominal depth of modulation of the radio frequency carrier of each of the 90 Hz and 150 Hz tones shall be 20 ±1%.

3.3.3.3 Identification

a. The localizer shall modulate the RF carrier with a keyed 1020 Hz ±50 Hz tone for the purpose of aurally identifying the localizer station at the airborne ILS receiver.

b. The transmission of the identification signal shall not interfere with the localizer guidance.

c. The identification signal shall employ International Morse Code and shall normally consist of four letters, the letter "I" followed by the three-letter code assigned to the localizer station.

d. The identification signal shall be transmitted at a speed corresponding to approximately seven words per minute, and be repeated at approximately equal intervals, not less than six times per minute.

e. A control to remove the identification signal or transmit a continuous tone for test and adjustment purposes shall be provided.

f. An internal speaker for local audible monitoring of the identification signal shall be provided.

g. The identification signal shall cease when the monitors are put into bypass mode.

h. While the monitors are bypassed, a control shall be available to enable the identification signal for maintenance purposes.

3.3.3.4 Transmitter Output Power and Adjustment

a. The course and clearance transmitters shall be capable of providing the range of at least 1 W - 20 W of average carrier output power.

b. The output power of the course and clearance CSB signals shall be adjustable with adjustment resolution of 0.1 W or less.

c. When transmitter power is reduced by -4 dB from the normal operating power:

    1. Modulation balance shall change by no more than 0.002 DDM;

DRAFT

2. Path width shall change by no more than 2%;
3. For course and clearance transmitter the total modulation percentage shall change by no more than 1% in absolute value; and
4. Localizer Identification modulation shall change by no more than 0.8% in absolute value.

3.3.3.5 Transmitter Stability

Variations in the following parameters over the service conditions and with a sideband amplitude between 20 mW and 500 mW shall be equal to or less than the limits below:

a.	Carrier power at carrier output	±5.0%
b.	Sideband ratio	±0.5 dB
c.	Carrier modulation (each tone)	±1.0%
d.	Carrier modulation balance	±0.002 DDM
e.	Sideband balance	±0.3 dB
f.	RF phase between carrier and sideband output	±10°
g.	Navigational tone frequencies	±1.0%
h.	Transmitter carrier frequency	±2 kHz

3.3.3.6 Power-on Stabilization Time

Stability requirements of section 3.3.3.5 shall be met from 0.5 seconds after power-on or transfer between transmitters of a dual transmitter system.

3.3.3.6.1 Hot Standby Transmitter

The localizer subsystem shall be designed so that the standby transmitter can be continuously operated into a dummy load and continuously monitored.

3.3.3.7 Audio Phase of Modulation Tones

a. The relative phase of the 90 Hz and 150 Hz modulation tones of the course transmitter shall be such that the demodulated 90 Hz and 150 Hz waveforms pass through zero in the same direction within 50 μs of each other at the common zero crossing.

b. The phase of the 150 Hz modulation tone of the clearance transmitter, relative to the 150 Hz modulation tone of the course transmitter shall be phase-locked so that the demodulated waveforms pass through zero in the same direction within 50 microseconds (μs) at every zero crossing.

c. An adjustable time offset of the clearance audio tones (90 Hz and 150 Hz), with respect to the course audio tones by up to 16.67 μs in increments not greater than 65.2 μs, shall be provided to minimize the effects of course structure deviations caused by multipath reflections of the clearance signal.

DRAFT

3.3.3.8 Carrier Modulation

a. A control shall be provided to adjust total modulation of the carrier output signals in steps of 0.1% or smaller over a minimum range of 34.0 to 46.0%.

b. RF phase between carrier and sideband outputs shall remain stable within 5° when modulation is adjusted over the range in a. above.

c. The modulation balance shall remain constant within ±0.004 DDM throughout the full specified range of the total modulation percentage adjustment.

3.3.3.9 Distortion of Demodulated Navigation Tones

a. Total harmonic distortion of the modulation shall be less than 5% measured over the bandwidth of 30 Hz to 4 kHz.

b. Any multiple of 30 Hz within the bandwidth of 30 Hz to 4 kHz, with the exception of the 90 and 150 Hz modulation tones, shall have an amplitude less than 4% (-28 dB) of the maximum amplitude of the 90 or 150 Hz tones, whichever is larger.

3.3.3.10 Modulation Balance Adjustment

a. A control shall be provided for precisely adjusting the total modulation balance (ratio between 90 Hz and 150 Hz amplitudes).

b. The control shall be adjustable over the range of ±0.050 DDM or greater with the resolution of at least 0.001 DDM.

c. The total modulation percentage shall remain stable within 0.1% when the modulation balance is adjusted over a range of ±0.025 DDM.

3.3.3.11 Identification Keyer

a. The transmitter shall include an electronic keyer that modulates the carrier with a 1020 Hz tone to a nominal depth of 8 ±1% without interruption of the carrier.

b. The keyer shall provide character timing as follows:

1.	Dot length	0.125 s
2.	Dash length	0.375 s
3.	Space between a series of dots and dashes within a character	0.125 s
4.	Space between characters	0.375 s

c. The keying rates shall remain within ±15% of the specified values under the service conditions.

d. Keying pulses shall contain no discontinuities.

e. Transient peaks due to keying shall be less than or equal to 2% of the peak amplitude of the normal audio frequency waveform at the modulator output.

DRAFT

f. A control shall be provided to enable selection of either keyed, continuous modulation, or to remove all identification modulation from the carrier.

3.3.3.12 Sideband Amplitude Adjustment

a. A sideband amplitude control shall be provided to enable adjustment of the localizer course sector width over the range specified in section 3.3.2.4.

b. Adjustment of sideband amplitude over this range shall change the carrier to sideband phase relationship by no more than ±5°.

3.3.3.13 RF Phase Adjustment

a. A phasing control shall be provided for shifting the RF phase of the signal appearing at the sideband only (SBO) output over a range of ±180° in 1° increments from the carrier plus sideband (CSB) signal.

b. Adjustment of this control over its full range shall cause the sideband amplitude to change less than or equal to ±0.25 dB.

3.3.3.14 Carrier Signal at Sideband Output

For the course and clearance transmitters, with the modulator adjusted for optimum conditions (40% sum of depth of modulation (SDM)), for any combination of sideband amplitude control or sideband phaser control settings, the carrier (CSB) power appearing at the sideband (SBO) output shall be at least 30 dB lower than the carrier power appearing at the carrier (CSB) output.

3.3.3.15 Power and Modulation Measurements

a. Built-in sensor measurements at the output of the transmitter for single equipment, and at the output of the transfer assembly for dual equipment shall be displayed on the PMDT.

b. The parameters shall include:

1. Course and clearance carrier powers;
2. Sideband powers;
3. Course and clearance carrier modulation percentage; and,
4. Modulation balance.

c. Means shall be provided to measure the following using external test equipment without interruption to service:

1. The outputs of the transmitters; and,
2. The outputs of the transfer assembly for dual equipment.

3.3.3.16 DME Keying Output

a. The localizer shall provide an output for identification keying of an associated DME (not part of this specification).

b. When DME keying is selected, every fourth cycle of the localizer identification code modulation shall be suppressed and the station identification Morse code is sent to the

DRAFT

DME keying output terminals.

c. The DME keying output shall employ an isolated, solid-state relay.

d. The solid-state relay shall:

1. Have a contact resistance lower than 250 Ω;
2. Be capable of sinking a current of 20 μA; and,
3. Withstand an open circuit voltage of 50 VDC.

e. If DME keying is selected two modes of operation shall be provided:

1. DME keying output remains active unless the localizer transmitter is off.
2. DME keying output is only active when the localizer is in a normal condition.

f. In addition to the Morse code keying, the DME keying output shall be selectable to provide a single start signal to initiate operation of the DME's internal identification keyer.

3.3.3.17 Display of Performance Parameters

a. The following parameters shall be readable from a PMDT connected to the system, the RMM interface, and optionally from the equipment front panel:

1. Course carrier power output (CSB);
2. Course sideband power output (SBO);
3. Course 90/150 Hz modulation balance (DDM);
4. Course total 90/150 Hz modulation percentage (SDM);
5. 90 Hz and 150 Hz modulation (%);
6. Identification modulation (%);
7. Modulation frequencies (Hz); and,
8. Course carrier frequency (Hz).

b. Dual frequency systems shall include the following additional parameters:

1. Clearance carrier power output (CSB);
2. Clearance sideband power output (SBO);
3. Clearance 90/150 Hz modulation balance (DDM);
4. Clearance total 90/150 Hz modulation percentage (SDM);
5. Far Field Monitor modulation balance (DDM); and,
6. Carrier frequency separation (Hz).

c. For dual transmitter systems, all parameters shall be capable of being displayed for both the main and standby transmitters.

3.3.4 Localizer Antenna Array

The localizer antenna shall consist of one of the following configurations:

DRAFT

a. Narrow aperture, single frequency array for CAT I ILS.

b. Medium aperture, single frequency array for CAT I ILS.

c. Medium aperture, dual frequency array for CAT I/II/III ILS.

d. Wide aperture, dual frequency array for CAT I/II/III ILS.

3.3.4.1 Localizer Antenna Hardware

The localizer antenna subsystem shall include the following components:

a. Broadband (108-112 MHz) prefabricated, welded radiating elements with radomes;

b. Two self-supporting frangible pedestals for mounting of each antenna;

c. Weather-resistant and animal-resistant cable trough or wireway;

d. Closure plates or hole plugs for support masts, cable trough, or wireway to prevent exposure of coaxial cables;

e. Weatherproof housing containing distribution and monitoring components;

f. Support masts, cable trough or wireway constructed in a way that will not allow coaxial cables to be exposed;

g. AC power cable for the obstruction lights, terminating within the distribution/monitor enclosure on a dedicated circuit separate from the convenience outlet and work light; and,

h. All distribution and monitoring stripline or microstrip assemblies, phase shifters, attenuators, detectors, terminal points, power supplies, and any other components necessary to distribute and adjust the RF signals and provide all required information to the Localizer monitor.

3.3.4.2 Frequency Range

The complete localizer antenna system consisting of the stripline or microstrip distribution network(s), antenna array, and stripline or microstrip monitor combining network(s) shall be designed for operation throughout the band of 108 to 112 MHz without retuning.

3.3.4.3 Polarization

a. The localizer radiation shall be horizontally polarized.

b. The vertically polarized component of the radiation shall result in no errors in course alignment greater than 0.005 depth of modulation (DDM) when the aircraft is flying along the course line in a roll attitude of 20° from the horizontal.

3.3.4.4 Intercoupling

The isolation between those adjacent antenna elements in the array with the closest spacing, as measured between the input connector of the driven element and the monitor output of the undriven element, shall be 26 dB or greater.

DRAFT

3.3.4.5 RF Distribution Unit

a. The voltage standing wave ratio (VSWR) at each of the CSB and SBO input ports shall be less than or equal to 1.20:1, referenced to 50 Ω, over the full operating frequency range and service conditions of temperature and humidity.

b. There shall be at least 30 dB of isolation between the CSB and SBO input ports on the RF distribution unit with all outputs terminated.

3.3.4.5.1 Convenience Outlet and Work Light

a. The RF distribution/monitor enclosure shall be equipped with an inside and an outside duplex AC convenience outlet with a ground fault interrupter.

b. The outside outlet shall be protected by a weather resistant spring-loaded cover when not in use.

c. The RF distribution/monitor enclosure shall be equipped with an interior work light.

d. The work light shall be equipped with an on/off switch.

e. The work light shall be protected with a metal, tempered glass, or high impact plastic guard (i.e., not a bare bulb).

3.3.4.6 Horizontal RF Radiation Pattern Characteristics

a. The antenna array shall consist of identical elements with appropriate spacing and excitation to produce the calculated horizontal radiation patterns described in Table 3-4.

b. The maximum course (CRS) CSB amplitude shall occur within 0.1° off the centerline.

c. The maximum CRS SBO amplitude shall occur between 2° and 6° off the centerline.

d. The on-course SBO null shall occur within 0.1° of centerline.

Note: The values in Table 3-4 describe the upper bounds for the actual CRS CSB and CRS SBO patterns. 0 dB is defined as the maximum amplitude of the CRS CSB or CRS SBO, respectively.

Table 3-4. Horizontal RF Radiation Pattern Characteristics

CRS CSB Pattern		CRS SBO Pattern	
Azimuth Angle (±degrees)	**Signal Level (dB)**	**Azimuth Angle (±degrees)**	**Signal Level (dB)**
Narrow Aperture Single Frequency			
0	0	0	-30
10	-3	2	0
20	-12	8	0
50	-23	20	-12.5
		60	-23
Medium Aperture Single Frequency			
0	0	0	-60
2.5	-0.5	0.5	0
10	-10	6	0

DRAFT

CRS CSB Pattern		CRS SBO Pattern	
Azimuth Angle (±degrees)	**Signal Level (dB)**	**Azimuth Angle (±degrees)**	**Signal Level (dB)**
40	-20	11	-7
50	-40	36	-12
90	-40	60	-24
		80	-40
		90	-40
Medium Aperture Dual Frequency			
0	0	0	-60
2.5	0	0.5	-10
5	-3	2.5	0
8	-10	5	0
15	-35	8	-7
35	-37	12.5	-25
90	-37	35	-35
		90	-35
Wide Aperture Dual Frequency			
0	0	0	-60
5	-5	0.5	0
15	-45	5	0
35	-45	7.5	-22
90	-45	35	-30
		90	-40

e. Pattern shapes shall be calculated based on ideal performance of the proposed stripline or microstrip distribution network for the antenna array described, with excitation levels set to produce a 3° course width.

f. For dual-frequency arrays, with the CRS CSB and clearance (CLR) CSB power ratios set at 3 dB, and with the clearance array meeting the DDM requirements of section 3.3.4.6, the relationship between the calculated CRS CSB and CLR CSB patterns shall comply with the following:

1. For medium aperture arrays, the difference between the CRS CSB and CLR CSB amplitudes shall be 20 dB or greater on the localizer course centerline.
2. For wide aperture arrays, the difference between the CRS CSB and CLR CSB amplitudes shall be 23 dB or greater on the localizer course centerline.
3. The difference between the maximum CRS CSB and maximum CLR CSB amplitudes shall be 13 dB or greater.
4. The difference between calculated CRS CSB and CLR CSB pattern amplitudes at all angles beyond the first CRS CSB minimum out to 35° off centerline shall be 15 dB or greater.
5. The difference between the maximum CRS CSB and CLR CSB pattern amplitudes at all angles beyond 40° off centerline shall be 15 dB or greater.

DRAFT

See Figure 3-4 for an illustration of how to apply the above requirements to an example pattern.

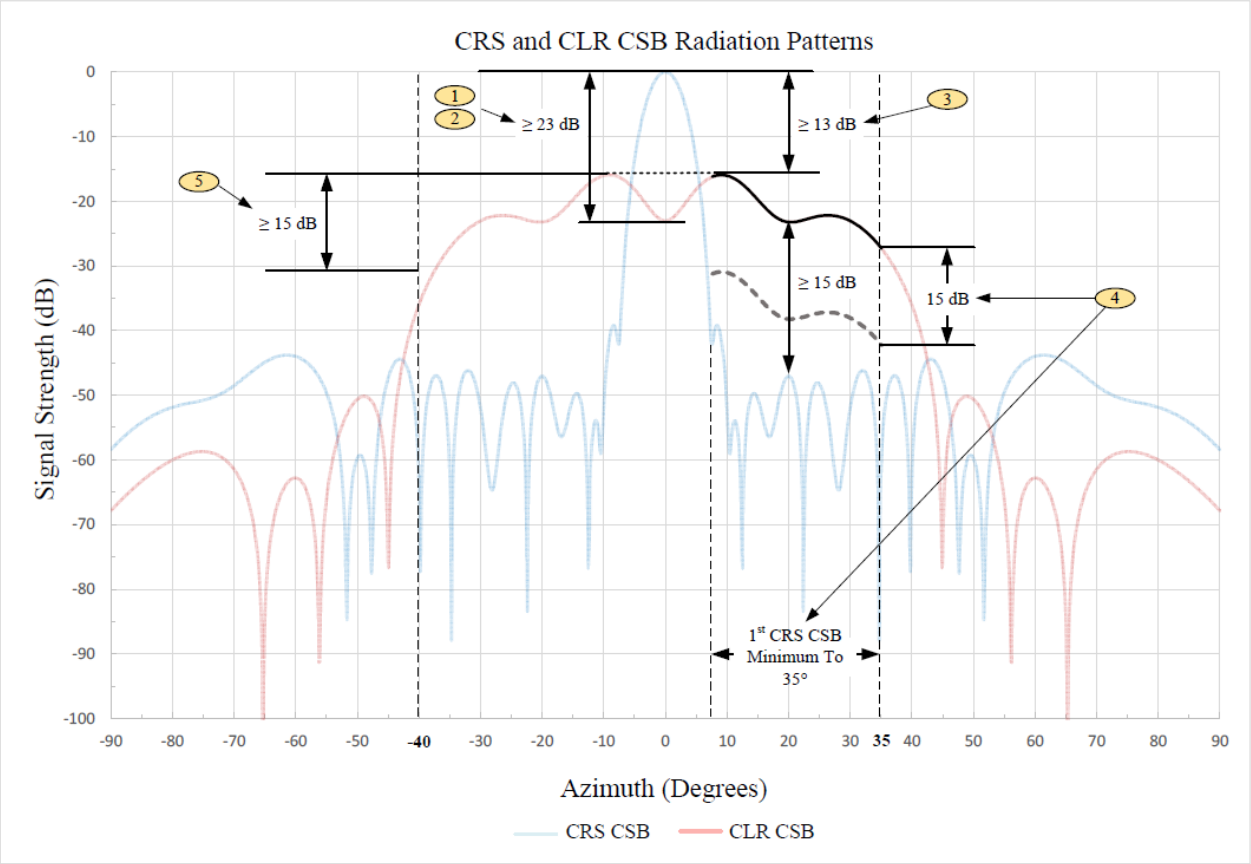

Figure 3-4. Example CRS and CLR Patterns with Amplitude Relationships Identified

3.3.4.7 Clearance Sector DDM Performance

a. For single and dual frequency systems, with the course adjusted for 3° course width and the localizer operating normally, SBO sideband amplitude shall not exceed CSB sideband amplitude to at least ±35° from centerline to assure that abnormal case DDM does not result.

b. For dual frequency systems, with the course and clearance transmitters radiating and adjusted to power ratios for a 3° course width, the clearance CSB-to-SBO relative pattern shapes shall be such that at least 250 µA of clearances exist from 10° to 35° on each side of the localizer course centerline.

c. For single frequency systems, with the course adjusted for a 3° course width, the CSB-to-SBO relative pattern shapes shall be such that at least 210 µA of clearance exist beyond the first CSB minimum.

d. All other pattern requirements and notes shall be met concurrently.

3.3.4.8 Course Width Adjustment

Course width adjustment shall be accomplished only by changing the relative power level of the SBO signal with respect to the CSB signal; no additional equipment or substitution of equipment is permitted.

3.3.4.9 Vertical Radiation

The vertical radiation pattern shall be such that coverage requirements are met with the antenna mounted at any height from ground level to a platform of up to 25 feet above ground level.

3.3.4.10 Antenna Monitor Probes

a. Each antenna shall include an integral monitor probe to sample a portion of the energy radiated by the individual antenna elements.

b. The monitor combining network shall be broadband over the full operating frequency range.

c. The monitor combining network shall require no retuning for changes in localizer operating frequency.

d. The signal level at the antenna monitor output shall have a coupling factor of -9.5 dB to -11.5 dB from 108 MHz to 112 MHz.

3.3.4.10.1 Monitored Azimuths

a. The monitor combiner shall derive separate course and width signals in the localizer antenna array.

b. For a dual-frequency localizer, two additional monitor combiner output signals shall be generated for the radiated clearance signal.

c. The "Course" monitor shall correspond to 0° (i.e., 0.000 DDM).

d. The "Width" monitor shall correspond to the edge of course (i.e., 0.155 DDM).

e. For medium and wide aperture dual frequency systems, the two additional clearance monitor outputs shall correspond to design azimuths selected to best monitor the array's sensitivity to out-of-tolerance clearance signals.

3.3.4.10.2 In-Line Phasing Detector

a. For test and monitoring purposes, provision shall be made for the 90/150 Hz composite audio signal from the integral monitor in-line phasing detector(s) to be available inside the localizer shelter. (Note: Wiring between the antenna subsystem and the shelter will be provided by the FAA.)

b. The antenna port chosen shall provide CSB/SBO in quadrature.

c. The amplitude of the CSB and SBO signal levels on the chosen antenna port shall be ≥40% relative to the maximum amplitude of the CSB and SBO signal levels at any of the other antenna ports to provide adequate sensitivity. (Note: To satisfy this requirement a separate in-line phase detector may be required for course and clearance signals.)

DRAFT

3.3.4.10.3 Monitor Probe Stability

Reserved.

3.3.4.11 Mechanical Design and Frangibility

The antenna array, cable raceway, and monitor/distribution unit housing shall be designed:

a. To break, distort, or yield when subjected to the sudden collision forces of a 6,614-pound (lb) (3,000 kg) aircraft moving on the ground at 31 mph (50 kilometers per hour (km/h) or 27 knots (kt)) or airborne and traveling at 87 mph (140 km/h or 75 kt);

b. To not impose a force on the aircraft in excess of 10,116 lbs (45.0 kilonewton (kN)).

    1. The maximum energy imparted to the aircraft as a result of the collision shall be 40,566 ft lbs (55.0 kilojoule (kJ)) over a 100 µs contact period between the aircraft and the structure.

    2. The structure shall mechanically fail by fracturing or buckling.

c. To provide for a frangibility point no greater than 3.0” (76 mm) above the surrounding grade.

3.3.4.11.1 Array Height

The overall height of the array when mounted on the standard support shall be less than or equal to 6.5 feet.

3.3.4.11.2 Wind and Ice Loading

The antenna subsystem components shall remain mechanically stable under conditions of a wind velocity of 100 mph with a 0.5” radial coating of clear ice.

3.3.4.11.3 Reflectors or Screens

The antenna shall not use external reflectors or screens.

3.3.4.11.4 Environmentally Resistant Design and Construction

a. Radomes, connectors, cable entrances, cable troughs, and the distribution/monitor housing shall be constructed to be resistant to the greatest extent practical to moisture, condensation, insects, and small animals such as mice, geckos, and snakes.

b. Gaskets and screens shall be employed wherever possible to meet a. above.

c. Upward-facing openings shall be avoided.

3.3.4.11.5 Array Mounting

a. The complete localizer antenna array shall be designed for installation on a concrete foundation in the ground or on an elevated platform support.

b. Each individual antenna shall be mounted on two self-supporting frangible pedestals.

3.3.5 Localizer Monitor

DRAFT

a. The localizer subsystem shall be provided with an integral monitor capable of detecting the faults specified in section 3.3.5.3.

b. The integral monitor shall process the monitor signals from the monitor pickup probes in the antenna array, internal transmitter, or cable fault detector.

c. The derived monitoring signals obtained from the antenna pickup probes shall accurately represent the signals that would be obtained from dipoles at the monitor azimuths in the unobstructed far field.

d. When any of the fault conditions specified in section 3.3.5.3 are detected, shutdown or transfer shall be initiated as detailed in section 3.3.5.4.

e. The total time between the occurrence of a fault and either stable radiation and monitoring of the standby transmitter, including the time required to detect an out-of-tolerance signal and transfer to the standby transmitter or shutdown, shall:

   1. Be no greater than 2 seconds for CAT III operation;
   2. No greater than 5 seconds for CAT II operation; or,
   3. No greater than 10 seconds for CAT I operation.

f. The monitor(s) shall have adjustable alarm thresholds for each of the parameters being monitored, as detailed in section 3.3.5.3.

3.3.5.1 Single Equipment Monitoring

a. A single equipment localizer subsystem shall be equipped with a single monitor.

b. The monitor shall initiate a system shutdown upon detection of a fault condition as identified in section 3.3.5.3 below.

3.3.5.2 Dual Equipment Monitoring

a. A dual equipment localizer subsystem shall be equipped with dual parallel monitors for the radiating course and, if dual frequency, clearance signals such that each of the monitor parameters specified in section 3.3.5.3 is examined by two identical monitor channels.

b. An out-of-tolerance condition detected by both monitors simultaneously shall initiate an equipment transfer or shutdown.

c. If an out-of-tolerance condition is detected by one monitor but not the other, the system shall remain operational and a “Monitor fault” alert shall be generated.

d. In the event that one monitor is removed from service, leaving the second monitor active, the remaining monitor shall initiate a transfer or shutdown upon detection of an out-of-tolerance signal.

3.3.5.2.1 Hot Standby Monitoring

a. The standby transmitter shall be monitored for each of the specified monitor parameters while operating into a dummy load.

DRAFT

b. The accuracy and stability of standby monitoring shall be such that when the standby transmitter is switched to the antenna, its signal, as monitored through the main (on-air) monitor path, will be shown to be within operating tolerance.

3.3.5.3 Monitored Parameters

3.3.5.3.1 Course Position

a. The course position shall be accurate to within ±0.003 DDM over the service conditions.

b. The resolution shall be at least 0.001 DDM.

c. The nominal value shall be 0.000 DDM adjustable to ±0.035 DDM.

d. The range of adjustment of the alarm limits shall be the nominal value ±0.035 DDM.

3.3.5.3.2 Course Width

a. The course width position shall be accurate to within ±0.004 DDM over the service conditions.

b. The resolution shall be at least 0.001 DDM.

c. The nominal value shall be 0.155 DDM.

d. The range of adjustment of the alarm limits shall be 0.125 DDM to 0.275 DDM.

3.3.5.3.3 Course RF Level

a. Given a constant transmitter output power, the course RF level shall remain stable to within ±5% over the service conditions.

b. The resolution shall be at least 1%.

c. The nominal value shall be 100%

d. The range of adjustment of the alarm limits shall be 0% to 200%.

3.3.5.3.4 Clearance 1 and 2 RF Levels

a. Given constant transmitter output power, the clearance RF levels shall remain stable to within ±5% over the service conditions.

b. The resolutions shall be at least 1%.

c. The nominal values shall be 100%.

d. The range of adjustments of the alarm limits shall be 0% to 200%.

3.3.5.3.5 Course SDM

a. The course SDM shall be accurate to within ±1.0% (absolute) over the service conditions.

b. The resolution shall be at least 0.1%.

c. The nominal value shall be 40.0%.

d. The range of adjustment of the alarm limits shall be 0% to 100%.

DRAFT

3.3.5.3.6 Clearance SDM

a. The clearance SDM shall be accurate to within ±1.0% (absolute) over the service conditions.

b. The resolution shall be at least 0.1%.

c. The nominal value shall be 40.0%.

d. The range of adjustment of the alarm limits shall be 0% to 100%.

3.3.5.3.7 Clearance Width 1 and 2

a. The clearance width positions shall be accurate to within ±0.004 DDM over the service conditions.

b. The resolution shall be at least 0.001 DDM.

c. The nominal values shall be adjustable between 0.180 to 0.400 DDM.

d. The range of adjustment of the alarm limits shall be 0.130 to 0.400 DDM.

3.3.5.3.8 Course Width RF Level

a. Given constant transmitter output power, the course width RF level shall remain stable to within ±5% over the service conditions.

b. The resolution shall be at least 1%.

c. The nominal value shall be 100%

d. The range of adjustment of the alarm limits shall be 0% to 200%.

3.3.5.3.9 Course Width SDM

a. The course width SDM shall be accurate to within ±1.0% (absolute) over the service conditions.

b. The resolution shall be at least 0.1%.

c. The nominal value shall be 40.0%.

d. The range of adjustment of the alarm limits shall be 0% to 100%.

3.3.5.3.10 Clearance Width 1 and 2 SDM

a. The clearance width 1 and 2 SDM shall be accurate to within ±1.0% (absolute) over the service conditions.

b. The resolution shall be at least 0.1%.

c. The nominal value shall be 40.0%.

d. The range of adjustment of the alarm limits shall be 0% to 100%.

3.3.5.3.11 Course/Clearance RF Level Ratio

a. Given constant course and clearance transmitter output powers, the course/clearance RF level ratio shall remain stable to within ±5% over the service conditions.

DRAFT

b. The resolution shall be at least 1%.

c. The nominal value shall be 100%.

d. The range of adjustment of the alarm limits shall be 0% to 20%.

3.3.5.3.12 Course/Clearance Frequency Difference

a. The course/clearance frequency difference shall be accurate within ±100 Hz over the service conditions.

b. The resolution shall be at least 10 Hz

c. The nominal value shall be 8 kHz.

d. The range of adjustment of the alarm limits shall be 7.5 kHz to 8.5 kHz.

3.3.5.3.13 Course and Clearance Ident Modulation

a. The ident modulations shall be accurate to within ±1.0% (absolute) over the service conditions.

b. The resolutions shall be at least 0.1%.

c. The nominal values shall be 8.0%

d. The range of adjustment of the alarm limits shall be 2.5 to 12.0%

3.3.5.3.14 Course and Clearance Ident Fault

a. The monitor shall detect a continuous identification tone lasting for more than 17 seconds over the service conditions..

b. The monitor shall detect when an identification tone has not been transmitted for more than 17 seconds.

3.3.5.3.15 Cable Fault

a. The monitor shall detect an open or shorted connector or cable between the RF distribution unit and an antenna.

b. The monitor shall detect an open or shorted connector or cable between an antenna monitor output and the RF monitor combiner unit.

c. The monitor shall identify the cable path that caused the fault.

3.3.5.4 Monitor Action

a. The following monitor parameters shall produce executive monitor actions if a fault persists for longer than a preset period of time as specified in section 3.3.5.4.4:

   1. Course position;
   2. Course width; and,
   3. Reduction of radiated RF power.

DRAFT

b. All other monitor parameters listed in section 3.3.5.3 shall be configurable for either executive monitor action or to produce a maintenance alert.

3.3.5.4.1 Single Equipment Response to Monitor Alarm

The following actions shall take place when a fault for an executive monitor parameter existed for longer than a preset period of time:

a. Cease radiation of the signal.

b. Initiate a local visual alarm.

c. Transmit the alarm indication to the remote control point.

d. Attempt to restart the system 50 seconds after detection of the fault.

   1. If the fault is still present after restarting, shut down again and attempt a second restart 5 minutes after the fault was first detected.

   2. If a successful restart is obtained, the automatic restart circuitry shall be rearmed after a period of 4.5 minutes.

   3. If a second fault occurs within this 4.5-minute period, the timer for the "5-minute restart" is still in effect and a restart shall be attempted 5 minutes after the initial fault detection.

   4. If a successful restart is not obtained, fault diagnostics shall run per section 3.8.6.

e. Inhibit radiation of the signal for 20 seconds after shutdown.

f. Inhibit automatic restart whenever the system is in local control.

g. The system shall be configurable to disable all automatic restart actions.

3.3.5.4.2 Dual Equipment Response to Monitor Alarm

The following actions shall take place when a fault for an executive monitor parameter existed for longer than a preset period of time.

a. Cease radiation of the out-of-tolerance transmitter.

b. Transfer the signal to the hot standby transmitter.

c. If the fault persists for the balance of the preset period of time as described in section 3.3.5.4.4. following a transfer, cease radiation of both transmitters and inhibit restoration for at least 20 seconds.

d. Initiate a local visual alarm.

e. Transmit the alarm indications to the remote control point.

f. For dual equipment used for CAT I service, if the fault persists after transfer to the hot standby transmitter, the automatic restart sequence as described in section 3.3.5.4.1. shall commence.

   1. If either the 50-second or 5-minute restart attempt is successful, the (previously) main transmitter shall reset, resume operation into the dummy load, and be

DRAFT

available for transfer when the next fault is detected by the executive (on-air) monitor.

2. If the equipment has additional restart features, they shall be capable of being disabled.
3. After the last available restart, if the fault persists, the transmitter shall cease radiating, run fault diagnostics per section 3.8.6, and require a manual reset to restart.

3.3.5.4.3 Fault Detected by a Single Monitor (Dual Monitor Systems)

If only one monitor senses a fault and that fault persists beyond the preset period of time, the system shall:

a. Initiate a local visual alarm.

b. Transmit an indication of the single monitor alarm status to the remote control point.

3.3.5.4.4 Monitor Action Delay

The monitor shall have a hold-off period adjustable from 0.3 to 10 seconds during which time shutdown or transfer control is inhibited.

3.3.5.4.5 Shutdown Timing Test

A shutdown timing test shall be available from the PMDT and optionally from the front panel controls in which the timing from alarm condition to transmitter shutdown and transfer to standby transmitter is automatically measured and displayed.

3.3.5.5 Localizer Monitor Stabilization Time

With the monitor already powered, the monitor shall stabilize and measure the value of the applied signal with an accuracy of ±25% of the alarm threshold for that monitored parameter within 0.5 seconds after application of the signal.

3.3.5.6 Localizer Monitor Interference Immunity

a. The localizer monitor shall provide adequate immunity to interference from two-signal, third-order intermodulation products caused by VHF Frequency Modulation (FM) broadcast signals having levels in accordance with the following:

   1. $2N_1 + N_2 + 72 \leq 0$ for VHF FM sound broadcasting signals in the range 107.7 – 108.0 MHz; and,
   2. $2N_1 + N_2 + 3\ (24 - 20 \log (\Delta f/0.4) \leq 0$ for VHF FM sound broadcasting signals below 107.7 MHz.

   Where:

   N_1 and N_2 are the levels (dBm) of the two VHF FM sound broadcasting signals at the localizer monitor input that produce, within the receiver, a two-signal, third-order intermodulation product on the desired localizer frequency; and,

DRAFT

$\Delta f = (108.1 - f_1)$, where f_1 is the frequency of the signal that has the level N_1, the VHF FM sound broadcasting signal closer to 108.1 MHz.

b. The levels for N_1 and N_2 above (a.) shall not exceed the desensitization criteria set forth below (c.).

c. The ILS monitor system shall not be desensitized in the presence of VHF FM broadcast signals having levels in accordance with the following:

	Frequency (MHz)	Maximum level of unwanted signal at receiver input (dBm)
1.	88 – 102	+15
2.	104	+10
3.	106	+5
4.	107.9	-10

d. The ILS monitor system shall not be desensitized in the presence of VHF Data Broadcast (VDB) adjacent channel signals (±25 kHz removed from the assigned ILS frequency) having a level of +15 dBm.

Note: The relationship is linear between adjacent points designated by the frequencies in c. above.

3.3.6 Localizer Far-Field Monitor (FFM) Subsystem

3.3.6.1 FFM General Requirements

The localizer FFM subsystem shall be a dual system and include:

a. Two independent receivers;

b. Two antennas which provide reception of the localizer signal by the supplied FFM receivers;

c. A 6-foot high frangible support for each antenna with the frangible breakpoint no higher than 3” above the base;

d. FFM equipment cabinet;

e. Backup battery system; and,

f. All interconnecting cables (power, control, data, etc.) necessary for installation of the FFM when co-located with a marker beacon.

3.3.6.2 Monitor Limit Adjustments

The out-of-tolerance limits shall be adjustable from -0.015 to 0.015 DDM in 0.001 DDM steps.

3.3.6.3 Fault Condition

The FFM system shall detect a shift of the course position outside of the alarm limits.

DRAFT

3.3.6.4 Alert Status Filtering

An alert shall be issued only under the following conditions:

a. The same out-of-tolerance condition is detected by both monitors; and,

b. The out-of-tolerance condition persists for a preset period of time, adjustable over the range of 0.5 s to 10 s.

Note: The intent of these requirements is to avoid nuisance alarms caused by transient objects i.e., aircraft, vehicles, etc. See reference ICAO Annex 10 Attachment C, section 2.8.5.

3.3.6.5 FFM Control and Status Display

The FFM system shall provide for the following control and status display functions:

a. An FFM bypass switch to suppress FFM alerts. Activation of the bypass switch energizes the FFM monitor alarm bypass light. This is a local switch. In addition, this function can be controlled remotely from the localizer or the remote control subsystem in the air traffic control tower.

b. The FFM transmits DDM and RF signal strength measurements to the localizer for status display on the localizer front panel and numeric display on the localizer front panel or portable terminal.

3.3.6.6 Time Delay and Reset

a. A delay-before-alert timer shall be incorporated in the FFM.

b. This timer shall start when an out-of-tolerance condition is detected by both monitors.

c. The timer shall be automatically reset if, within the preset delay time (nominally 10 seconds), both monitors detect that the signal has returned to within the preset tolerance limits.

d. This time delay shall be adjustable from 5 to 90 seconds.

3.3.6.7 FFM Receiver Performance

The FFM subsystem receivers shall meet the following requirements over the environmental service conditions:

a. Frequency range: 108 MHz to 112 MHz.

b. Localizer channel selection by a frequency synthesizer.

c. Desensitization: Application of a 4 V signal 4 MHz removed from the localizer carrier frequency does not cause more than a 2 dB reduction in the detected level of a 5 μV, 30% modulated signal at the localizer carrier frequency.

d. Sensitivity: No more than 5 μV for 10 dB (Signal+Noise)/Noise, 20% modulation, 90 Hz.

e. Intermediate Frequency (IF) image rejection: 90 dB minimum.

f. Synthesized Frequency stability: ±0.002%.

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g. Cross modulation: With an input signal of 5 µV, application of an interfering signal of 5 µV, modulated at 50% and separated from the desired signal by 50 kHz, causes less than 10% distortion of the demodulated audio signal.

h. Selectivity:

1. 15 kHz minimum at -6 dB
2. 35 kHz maximum at -60 dB
3. 60 kHz maximum at -90 dB

i. Input impedance: 50 Ω ±10 Ω.

j. Audio frequency response linearity: For a 20% modulation signal, the difference between 90 Hz and 150 Hz shall be less than 0.1 dB.

k. Audio output level:

1. For a 20 µV input signal 20% modulated at 90 Hz, the audio output level shall be settable from 0 to at least 125% of the minimum level required by the localizer FFM input.
2. For any RF signal level between the automatic gain control (AGC) threshold and 10 µV, the detected audio output shall vary no more than 3 dB.

l. Detector linearity:

1. The detected audio output shall be linear over the range of 15 to 40% modulation.
2. The DC output derived from the detected audio shall be constant within 1 dB or the range of 15 to 40% modulation.

m. Audio distortion shall be less than 5% at 90 Hz and 150 Hz for a 30% modulated RF input signal with an amplitude between 50 µV to 10 µV.

n. Transient filtering: Only changes in DDM detected by the FFM receiver which deviate from the nominal value for longer than one second shall be output to the FFM monitor.

3.3.6.8 FFM Equipment Enclosures

a. The FFM electronics cabinet and battery shelf shall be of aluminum or steel construction.

b. The FFM electronics shall be capable of being either wall mounted or mountable in a 19” rack.

3.3.6.9 FFM Battery Shelf

a. A support/shelf for the batteries shall be provided.

b. The battery shelf shall provide protection against damage caused by electrolyte leakage.

c. The battery or batteries shall be protected from a short circuit across the terminals.

DRAFT

3.4 UHF Glide Slope System Requirements

The standard image configurations are null reference, sideband reference, and capture effect. Single equipment and dual equipment versions are available for each configuration.

3.4.1 Glide Slope Subsystem

The glide slope subsystems shall consist of the following equipment:

a. Transmitter(s) with associated modulation, monitor, and control equipment.

b. Complete glide slope antenna group consisting of two identical transmitting antennas with monitor probes, associated coaxial cabling, and all antenna mounting hardware and dual obstruction lights.

c. Power dividing networks and monitor combining networks required for RF signal distribution and integral monitoring.

d. For dual equipment only: two transmitters/modulators, two monitors, and an antenna changeover unit to switch the antenna from the main to the standby transmitter.

3.4.2 UHF Glide Slope Subsystem Performance

The Glide Slope subsystem provides guidance in the vertical plane to aircraft in approaches to, and landings at airfields.

a. The radiation from the glide slope subsystem shall produce a composite field pattern that is amplitude modulated by 90 Hz and 150 Hz tones.

b. The radiation pattern shall be developed to provide a straight-line descent path in the vertical plane containing the runway centerline, with the 150 Hz tone predominating below path and the 90 Hz tone predominating above path, to at least an angle equal to 175% of the glide angle.

c. The glide slope shall be adjustable to produce glide path angles between 2° and 4°.

d. The glide path shall be capable of being maintained within 4% of the commissioned glide path angle for CAT III systems.

e. The glide path shall be capable of being maintained within 7.5% of the commissioned glide path angle for CAT I/II systems.

3.4.2.1 Coverage

a. The glide slope subsystem shall provide signals sufficient to allow satisfactory operation of a certified typical aircraft installation in sectors of:

   1. 8° in azimuth on each side of the center line of the ILS glide path.
   2. To a distance of at least 10 nmi.
   3. Up to 1.75 times the glide path angle (θ) and down to 0.30 θ above the horizontal.

b. Within the coverage area, and with the course and/or clearance transmitter power output reduced to the RF monitor alarm level the glide slope subsystem shall provide:

   1. Signal level greater than 15 μV,

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2. Flag current greater than 240 µA,
3. Fly-up signal of 150 µA.

3.4.2.2 Automatic Changeover Unit (Dual Transmitter Systems Only)

a. The dual equipment glide slope shall be equipped with an automatic changeover unit.

b. When a fault (out-of-tolerance radiated signal) is detected, the automatic changeover unit shall transfer the connection to the antenna from the main to the standby transmitter.

3.4.3 Glide Slope Transmitter

3.4.3.1 Radio Frequency

a. The glide slope transmitter frequency shall be selectable to any glide slope channel listed in FAA Order 6050.32 Appendix 3, Section 1, Figures 1 a-f. (ILS channel frequencies are also provided in the APPENDIX A. ILS CHANNELS for reference.)

b. The accuracy of the carrier frequency shall be within ±6.0 kHz from the set frequency over the service conditions.

c. For a dual frequency glide slope, the frequencies of the two RF carriers shall be paired together, requiring only a single setting to select the glide slope nominal operating frequency.

d. The two transmitters shall be offset symmetrically about the assigned (channel) frequency, with a frequency difference of 8.0 kHz ±0.5 kHz.

3.4.3.2 Modulation

a. The nominal depth of modulation of the course signal for each of the 90 Hz and 150 Hz tones shall be 40 ±2%.

b. The nominal depth of modulation of the clearance signal for the 150 Hz tone shall be 80 ±2%.

3.4.3.3 Transmitter Output Power and Adjustments

a. The glide slope transmitter(s) shall have sufficient power to meet the coverage requirements as defined in section 3.4.2.1 when properly installed at a site meeting the ILS siting criteria.

1. The course transmitter shall be capable of providing the range of at least 1 W - 5 W of average carrier output power.
2. The clearance transmitter shall be capable of providing the range of at least 0.1 W - 1 W of average carrier output power.
3. The output power of the course CSB signal shall be adjustable with adjustment resolution of 0.1 W or less.
4. The output power of the clearance CSB signal shall be adjustable with adjustment resolution of 0.01 W or less.

b. When transmitter power is reduced by -4 dB from the normal operating power:

DRAFT

1. Modulation balance shall change by no more than 0.002 DDM;
2. Path width shall change by no more than 2%;
3. For course transmitter the total modulation percentage shall change by no more than 0.5% in absolute value; and
4. For clearance transmitter the total modulation percentage shall change by no more than 2% in absolute value for any setting of modulation between 50 and 90%.

3.4.3.4 Transmitter Stability

Variations in the following parameters over the service conditions shall remain within the limits tabulated below throughout all settings of the sideband amplitude control:

a.	Carrier power at carrier output	±5.0%
b.	Sideband ratio	±0.5 dB
c.	Carrier modulation (each tone)	±1.0%
d.	Carrier modulation balance	±0.002 DDM
e.	Sideband balance	±0.5 dB
f.	RF phase between carrier and sideband output	±10°
g.	Navigational tone frequencies	±1.0%
h.	Transmitter carrier frequency	±6 kHz

3.4.3.5 Power-on Stabilization Time

Stability requirements of section 3.4.3.4 shall be met from 0.5 seconds after power-on or transfer between transmitters of a dual transmitter system.

3.4.3.5.1 Hot Standby Transmitter

The glide slope subsystem shall be designed so that the standby transmitter can be continuously operated into a dummy load and continuously monitored.

3.4.3.6 Audio Phase of Modulation Tones

Audio phase relationship between the 90 Hz and 150 Hz modulation tones is as follows:

a. The relative phase of the 90 Hz and 150 Hz modulation tones of the course transmitter shall be such that the demodulated 90 Hz and 150 Hz waveforms pass through zero in the same direction within 50 μs of each other at the common zero crossing.

b. The phase of the 150 Hz modulation tone of the clearance transmitter, relative to the 150 Hz modulation tone of the course transmitter shall be phase-locked so that the demodulated waveforms pass through zero in the same direction within 50 μs at every zero crossing.

DRAFT

3.4.3.7 Carrier Modulation

a. A control shall be provided to adjust total modulation of the carrier output 90/150 Hz signals in steps of 0.1% or smaller over a minimum range of 72.0 to 88.0% for the course transmitter or 50.0 to 90.0% for the clearance transmitter.

b. A control shall be provided to adjust the total modulation of the clearance output 150 Hz signal in steps of 0.1% or smaller over a minimum range of 50.0 to 90.0%.

c. RF phase between carrier and sideband outputs shall remain stable within 5° when modulation is adjusted over the range in a. above.

d. The total modulation balance shall remain constant within ±0.004 DDM throughout the full operating range of the total modulation percentage adjustment.

3.4.3.8 Distortion of Demodulated Navigation Tones

a. Total harmonic distortion of the detected modulation shall be less than 5% measured over the bandwidth of 30 Hz to 4 kHz.

b. Any multiple of 30 Hz within the bandwidth of 30 Hz to 4 kHz, with the exception of the 90 and 150 Hz modulation tones, shall have an amplitude less than 4% (-28 dB) of the maximum amplitude of the 90 Hz or 150 Hz tones, whichever is larger.

3.4.3.9 Course Transmitter Modulation Balance Adjustment

a. A control shall be provided for adjusting the total modulation balance (ratio between 90 Hz and 150 Hz amplitudes), and for simulating changes in the glide path angle.

b. The control shall be adjustable over the range of ±0.030 DDM or greater with a resolution of at least 0.001 DDM.

c. The total modulation percentage shall remain stable within 0.1% when the modulation balance is adjusted over a range of ±0.025 DDM.

3.4.3.10 Sideband Amplitude Adjustment

a. A sideband amplitude control shall be provided to enable adjustment of the glide path full sector width over the range of 0.8° to 2.0°.

b. Adjustment of sideband amplitude over this range shall change the carrier to sideband phase relationship by no more than ±5°.

3.4.3.11 RF Phase Adjustment

a. A phasing control shall be provided for shifting the RF phase of the signal appearing at the sideband (SBO) output over the range of at least ±180° in 1° increments from the carrier (CSB) signal.

b. Adjustment of this control shall cause the sideband amplitude to change less than or equal to ±0.25 dB.

3.4.3.12 Carrier Signal at Sideband Output

With the modulator adjusted for optimum conditions (80% SDM), for any combination of settings

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of the sideband amplitude and sideband phaser control, and over the range of service conditions, the carrier (CSB) power appearing at the sideband (SBO) output shall be 30 dB or more below the carrier power appearing at the carrier (CSB) output.

3.4.3.13 Power and Modulation Measurements

a. Built-in sensor measurements at the output of the transmitter for single equipment, and at the output of the transfer assembly for dual equipment shall be displayed on the PMDT.

b. The parameters shall include:

   1. Course and clearance carrier powers;
   2. Sideband powers;
   3. Course and clearance carrier modulation percentage; and,
   4. Modulation balance.

c. Means shall be provided to measure the following using external test equipment without interruption to service:

   1. The output to each antenna:
   2. The outputs of the transmitters; and,
   3. The outputs of the transfer assembly for dual equipment.

3.4.3.14 Display of Performance Parameters

a. The following parameters shall be readable from a PMDT connected to the system, the RMM interface, and optionally from the equipment front panel:

   1. Course carrier power output (CSB);
   2. Course sideband power output (SBO);
   3. Course 90/150 Hz modulation balance (DDM);
   4. Course total 90/150 Hz modulation percentage (SDM);
   5. Course alignment (DDM);
   6. Course width (DDM);
   7. 90 Hz and 150 Hz modulation (%);
   8. Modulation frequencies (Hz);
   9. Course carrier frequency (Hz);
   10. Course RF level (%);
   11. Clearance carrier power output (CLR)*;
   12. Clearance total 150 Hz modulation percentage (SDM)*;
   13. Carrier frequency separation (Hz)*;
   14. Clearance RF level (%)*; and,

DRAFT

15. Course to clearance RF level ratio (%)*.

b. For dual transmitter systems, all parameters shall be capable of being displayed for both the main and standby transmitters.

*Dual-frequency systems only.

3.4.4 Amplitude and Phase Control and Distribution

The capture effect and sideband reference glide slope configurations shall include amplitude and phase control designed to combine the separate carrier, sideband and (for dual-frequency only) clearance signals from the transmitters and deliver them to the antennas in the proper amplitude and phase relationship.

3.4.4.1 Capture Effect RF Distribution

a. The nominal amplitude and phase relationships of the capture effect signals shall be as shown in Table 3-5.

b. The amplitude and phase relationships shown in Table 3-5 shall be met at any operating frequency.

c. Amplitude values shall be within ±0.2 dB

d. Phase relationships shall be within ±6°.

Table 3-5. Capture Effect RF Distribution

Antenna	CSB Output	SBO Output	Clearance Output
Upper	None	-6 dB, 0°	0 dB, 0°
Middle	-6 dB, 180°	0 dB, 180°	None
Lower	0 dB, 0°	-6 dB, 0°	0 dB, 0°
Note: Relative amplitudes and phases apply only to other values in the same column.			

3.4.4.1.1 Capture Effect Phasers

a. Mechanical phasers (i.e., trombone) shall be provided to adjust the phase at each antenna output in at least 1° increments.

b. Each phaser shall have a range of adjustment of at least ±30 electrical degrees.

c. Adjustment of the phasers over their full range shall not cause the output to vary by more than ±0.1 dB.

d. The common lower antenna far-field phasing (CSB only in lower antenna, SBO only in middle antenna and upper antenna) shall be accomplished without the addition of external parts or cables that are not a part of normal operations.

3.4.4.1.1.1 Adjustable Power Divider(s)

Any adjustable power divider used shall not cause a change in the phase relationship of the outputs by more than ±2° over the full range of operation.

DRAFT

3.4.4.1.2 Capture Effect Carrier Output Port Isolation

The output to the upper antenna shall be isolated from the carrier signal input by at least 40 dB.

3.4.4.1.3 Capture Effect CSB Distribution Stability

After adjustment under normal operating conditions:

a. The power ratio between the outputs to the lower and middle antenna shall vary no more than ±0.5 dB.

b. The phase between the outputs to the lower and middle antenna shall vary no more than ±5°.

3.4.4.1.4 Capture Effect Sideband Port Isolation

The carrier input shall be isolated from the sideband input by 40 dB or greater.

3.4.4.1.5 Capture Effect Sideband Stability

After adjustment under normal operating conditions:

a. The power ratio between any two of the upper, middle, and lower antenna outputs shall vary no more than ±0.5 dB.

b. The phase of the sideband signal between any two of the upper, middle, and lower antenna outputs shall vary by no more than ±5°.

c. The phase of the sideband signal with respect to the carrier signal to the middle and lower antenna outputs shall vary by no more than ±5°.

3.4.4.1.6 Capture Effect Clearance Isolation

With phasers and power dividers set to their center positions, the power at the carrier input, sideband input, and middle antenna output ports shall be 33 dB or more below the power applied to the clearance input.

3.4.4.2 Sideband Reference RF Distribution

a. The nominal amplitude and phase relationships of the sideband reference signals shall be as shown in Table 3-6.

b. The amplitude and phase relationships shown in Table 3-6 shall be met at any operating frequency.

Table 3-6. Sideband Reference RF Distribution

Antenna	CSB Output	SBO Output
Upper	None	0 dB, 180°
Lower	0 dB, 0°	0 dB, 0°

Note: Relative amplitudes and phases apply only to other values in the same column.

DRAFT

3.4.4.2.1 Sideband Reference Stability

Amplitude and phase stability of the sideband reference RF distribution unit shall be identical to that of the capture effect distribution unit described in the above paragraphs.

3.4.4.2.2 Sideband Reference CSB Isolation

With all phasers and power dividers set to midrange, the carrier power at the upper antenna port shall be -40 dB or more relative to the carrier power at the lower antenna port.

3.4.4.3 Variable Attenuator Set

a. A constant phase variable attenuator shall be provided with each glide slope subsystem for test and flight inspection procedures.

b. The attenuator set shall be designed to install in the antenna feedline.

c. Cables for connecting the attenuator shall be provided such that the electrical length of the attenuator plus cables is an integral number of wavelengths long at the glide slope mid-band frequency to preclude significant inter-antenna phase changes when the attenuator is inserted.

d. Attenuation shall be adjustable in 0.2 dB steps or smaller from 0.2 dB to at least 2 dB.

e. The phase shall change by no more than ±10° over the range of attenuation.

3.4.5 Image-type Glide Slope Antenna Array

a. The dual-frequency glide slope antenna array shall consist of three antennas.

b. The single frequency glide slope antenna arrays shall consist of two antennas.

c. All antennas shall be identical and interchangeable.

3.4.5.1 Antenna RF Connections

a. The RF input and integral monitor pickup output connectors shall be:

1. Female N-type;
2. Nickel-plated;
3. Four-hole flange mounting;
4. Soldered, gold-plated center conductor pin;
5. Located on the back of the antenna;
6. Outward facing;
7. Within the middle-third width of the antenna; and
8. Spaced at least 4” apart.

b. The antenna shall include a tethered, removable weather cover to protect the RF connections during normal operation.

DRAFT

3.4.5.2 Polarization

a. The radiated signal of the antenna shall be horizontally polarized.

b. The vertical component shall be at least 25 dB below the horizontal component as measured in front of the antenna and within ±25° in azimuth of a vertical plane perpendicular to the antenna and passing through the center of the antenna.

3.4.5.3 Gain

The antenna shall have at least 10dB of gain over that of a lossless isotropic radiator when measured in free space at 0° azimuth.

3.4.5.4 Front-to-Back Ratio

The front-to-back ratio of radiated signal shall be greater than 16 dB.

3.4.5.5 VSWR

The input VSWR of the antenna shall be less than or equal to 1.25 to 1 referenced to 50 Ω.

3.4.5.6 Horizontal Pattern Requirements

a. The front hemisphere of the horizontal pattern of the antenna when plotted as illustrated in section 3.4.5.8 (Figure 3-5) shall be confined within the upper and lower limits specified thereon.

b. The signal level shall be greater than -22 dB between 20° and 40° azimuth.

c. The 0° reference on Figure 3-5 shall be the electrical axis of the array (the peak of the beam) determined as midway between the 3 dB points of the measured pattern.

d. The electrical axis, so determined, shall deviate from the mechanical axis by no more than ±2°.

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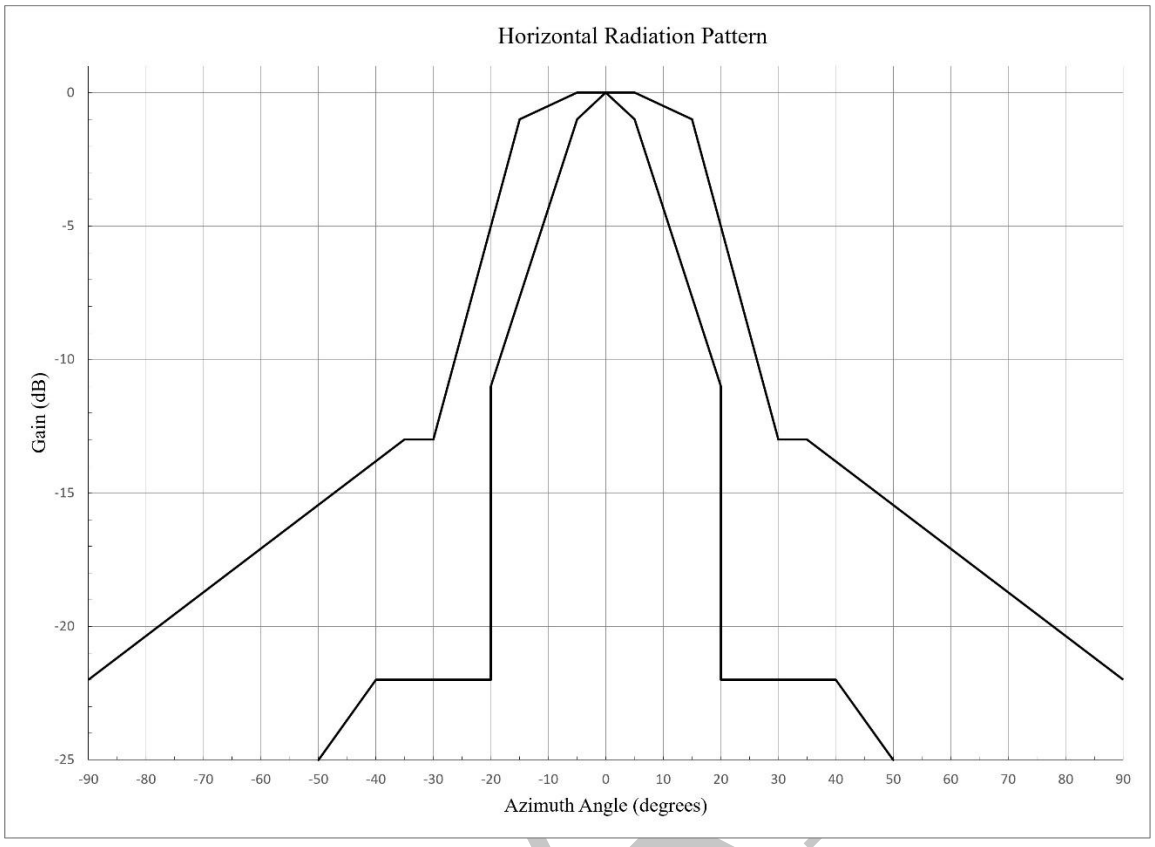

Figure 3-5. Glide Slope Antenna Horizontal Radiation Pattern

3.4.5.7 Vertical Pattern Requirements

a. The vertical pattern of the antenna shall be symmetrical around 0° elevation to the 3 dB point.

b. The vertical pattern amplitude shall decrease smoothly above and below 0° elevation.

3.4.5.8 Antenna Elements and Phasing Distribution Network Assembly

a. The antenna elements and phasing distribution network shall be a weatherproof LRU mounted on the RF corner reflector.

b. This LRU shall be separable from the corner reflector and mast mounting assembly.

c. This LRU shall be replaceable without replacement or movement of the corner reflector or mast mounting assembly.

d. This LRU shall be replaceable without soldering or unsoldering of connections.

3.4.5.9 Integral Monitoring

3.4.5.9.1 Antenna Monitor Probes

a. Each antenna shall include an integral monitor probe to sample a portion of the energy radiated by the individual antenna elements.

b. External antennas shall not be utilized for monitoring the glide slope signal.

c. Where the antenna assembly is composed of multiple radiating elements, the output of each dipole probe shall be combined into a single output for each antenna.

d. The signal level at the antenna output shall have a coupling factor of 8.5 dB to 10 dB at 332 MHz referenced to the input level.

e. The value of the coupling factor shall not change by more than ±1.5 dB over the frequency band.

3.4.5.9.2 Antenna Monitor Probes Stability

The monitor probes shall maintain the following parameter stability under the full range of service conditions (section 3.2.3.1.2):

a. Phase ±5°

b. Coupling Factor +0.3 dB to -0.1 dB (excluding ice)

c. Coupling Factor +0.8 dB to -0.1 dB (with icing effects)

3.4.5.10 Antenna Radomes

a. Full radomes shall be incorporated to protect the antenna elements.

b. The radomes shall be fabricated from a material such that the performance of the radome does not degrade when exposed to the environmental service conditions stated in section 3.2.3.1.

3.4.5.11 Antenna Heaters

a. Heating elements firmly attached to the antenna radiating elements shall be provided.

b. Heater operation shall not affect the radiation pattern of the antenna.

c. Heater operation shall not affect the monitoring characteristics of the antennas such that each antenna tracks within 0.15 dB of coupling loss and 1.5° of coupling phase shift during heater operation.

d. The heaters shall be isolated electrically from the RF circuitry and shall be protected from damage by the pecking of birds.

3.4.5.11.1 Antenna Heater Control

a. Antenna heaters shall be controlled from a snow switch assembly to be mounted outside of the glide slope shelter.

b. The snow switch shall energize the heaters at a temperature adjustable over the range of at least 0 to 5°C during precipitation.

c. The snow switch shall de-energize the heaters when outside of the set temperature range or when there is no precipitation.

DRAFT

3.4.5.12 Glide Slope Antenna Tower

a. A self-supporting glide slope tower shall be comprised of sections that allow adjusting the height of the tower in increments for each of the configurations with no more than 5 feet of tower extending beyond the upper antenna.

b. Glide slope towers shall be painted in an obstruction-marking pattern of alternating aviation orange, color 12197 and insignia white, color 17875 in accordance with SAE AMS-STD-595.

3.4.5.12.1 Antenna Mounting

a. Glide slope antennas shall be capable of being mounted on the face of tower.

b. A means shall be provided to mount the antenna at any vertical location on the tower.

c. Means shall be provided to vertically adjust the position of the antennas continuously by at least 24” above and 24” below the center position of the mounting.

d. Means shall also be provided to laterally offset the antennas continuously by at least 24” to either side of the centered position on the tower.

3.4.5.12.2 Wind and Ice Loading

a. The tower, including the stand-off ladder and work platforms, shall withstand wind velocity up to 100 mph with tower encased in 0.5” of radial ice without taking a permanent set.

b. The top of a 50-foot tower shall deflect no more than 2.5” for wind load conditions of 45 mph with the tower encased in 0.5” radial ice and for wind of 56 mph with no ice.

3.4.5.12.3 Climbing Equipment and Work Platforms

a. Towers shall be designed for safe climbing and on-tower work in accordance with applicable OSHA 29 CFR 1910.23 and ANSI/ASSP A10.48-2023 Standards.

b. A ladder shall be mounted to the outside of the tower on stand-offs sufficiently distant from the tower so that there is at least 7” of clearance between the tower rung and tower cross-brace.

c. Anchorage points for tie-off shall be installed at various locations where work and/or maintenance activities are to be performed.

d. Anchorage points used for attachment of personal fall-arrest equipment shall be independent of any anchorage being used to support or suspend platforms and support at least 5,000 lbs per employee attached, as per OSHA 29 CFR 1910.140(c)(13)(i) and (ii)/1926.502(d)(15).

e. Work platforms shall be located inside the tower structure nominally four feet below each antenna mounting, constructed from steel grating surrounded by a 3.5” toe-board.

f. The work platforms shall be attached by bolts and can be adjusted in height to accommodate the actual mounting location of the glide slope antennas.

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3.4.6 Glide Slope Monitor

a. The glide slope subsystem shall be provided with an integral monitor capable of detecting the faults specified in section 3.4.6.4.

b. The integral monitor shall process the monitor signals from the monitor pickup probes in the antenna array.

c. The derived monitoring signals obtained from the antenna pickup probes shall accurately represent the signals that would be obtained from an unobstructed far-field measurement.

d. Once calibrated, the monitor shall not require readjustment for changes in environmental conditions.

e. When any of the fault conditions specified in section 3.4.6.4 are detected, a shutdown or transfer as detailed in section 3.4.6.4 shall be accomplished.

f. The total time between the occurrence of a fault and either stable radiation and monitoring of the standby transmitter or shutdown, including the time required to detect an out-of-tolerance signal and transfer to the standby transmitter or shut down, shall:

   1. Be no greater than 2 seconds for CAT III operation;
   2. No greater than 2 seconds for CAT II operation; or,
   3. No greater than 6 seconds for CAT I operation.

g. The monitor(s) shall have adjustable alarm threshold controls for each of the parameters being monitored as specified in section 3.4.6.3.

3.4.6.1 Single Equipment Monitoring

a. A single equipment glide slope subsystem shall be equipped with a single monitor.

b. The monitor shall initiate a system shutdown upon detection of a fault condition as identified in section 3.4.6.4.1 below.

3.4.6.2 Dual Equipment Monitoring

a. A dual equipment glide slope subsystem shall be equipped with dual parallel monitors for the radiating glide path and, if dual frequency, clearance signals such that each of the monitored parameters specified in section 3.4.6.3 is examined by two identical monitor channels.

b. An out-of-tolerance condition detected by both monitors simultaneously shall initiate an equipment transfer or shutdown.

c. If an out-of-tolerance condition is detected by one monitor but not the other, rather than causing a shutdown or transfer, a “Monitor fault” alert shall be generated.

d. In the event that one monitor is removed from service (bypassed), the remaining monitor shall initiate a transfer or shutdown upon detection of an out-of-tolerance signal.

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3.4.6.2.1 Hot Standby Monitoring

a. The standby transmitter shall be monitored for each of the specified monitor parameters while operating into a dummy load.

b. The accuracy and stability of standby monitoring shall be such that when the standby transmitter is switched to the antenna, its signal, as monitored through the main (on-air) monitor path, will be shown to be within operating tolerance.

3.4.6.3 Monitored Parameters

3.4.6.3.1 Course Position

a. The course position shall be accurate to within ±0.002 DDM over the service conditions.

b. The resolution shall be at least 0.001 DDM.

c. The nominal value shall be 0.000 DDM.

d. The range of adjustment of the alarm limits shall be the nominal value ±0.035 DDM.

3.4.6.3.2 Course Width

a. The course width shall be accurate to within ±0.005 DDM over the service conditions.

b. The resolution shall be at least 0.001 DDM.

c. The nominal value shall be 0.175 DDM.

d. The range of adjustment of the alarm limits shall be 0.125 DDM to 0.275 DDM.

3.4.6.3.3 Clearance RF Level

a. Given a constant transmitter output power, the clearance RF level shall remain stable to within ±5% over the service conditions.

b. The resolution shall be at least 0.1%.

c. The nominal value shall be 100%.

d. The range of adjustment of the alarm limits shall be 0 to 200%.

e. The clearance RF level shall be measured using the signal from the antenna monitor pickup probes.

3.4.6.3.4 Course RF Level

a. Given a constant transmitter output power, the course RF level shall remain stable to within ±5% over the service conditions.

b. The resolution shall be at least 0.1%.

c. The nominal value shall be 100%.

d. The range of adjustment of the alarm limits shall be 0% to 200%.

e. The course RF level shall be measured using the signal from the antenna monitor pickup probes.

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3.4.6.3.5 Course SDM

a. The course SDM shall be accurate to within ±1.0% (absolute) over the service conditions.

b. The resolution shall be at least 0.1%.

c. The nominal value shall be 80.0%.

d. The range of adjustment of the alarm limits shall be 0 to 100%.

3.4.6.3.6 Clearance SDM

a. The clearance SDM shall be accurate to within ±1.0% (absolute) over the service conditions.

b. The resolution shall be at least 0.1%.

c. The nominal value shall be 80.0%.

d. The range of adjustment of the alarm limits shall be 0 to 100%.

3.4.6.3.7 Course/Clearance RF Level Ratio

a. Given constant course and clearance transmitter output powers, the course/clearance RF level ratio shall remain stable to within ±1 dB over the service conditions.

b. The resolution shall be at least 0.1 dB.

c. The nominal value shall be 0 dB.

d. The range of adjustment of the alarm limits shall be 0.5 to 1 dB.

3.4.6.3.8 Course/Clearance Frequency Difference

a. The course/clearance frequency difference shall be accurate within ±100 Hz

b. The resolution shall be at least 10 Hz

c. The nominal value shall be 8 kHz.

d. The range of adjustment of the alarm limits shall be 7.5 kHz to 8.5 kHz.

3.4.6.4 Monitor Action

a. The following monitor parameters shall produce executive monitor actions if a fault persists for longer than a preset period of time as specified in section 3.4.6.4.5:

   1. Glide path position (section 3.4.6.3.1)
   2. Glide path width (section 3.4.6.3.2)
   3. Reduction of radiated RF power (section 3.4.6.3.3)
   4. Reduction in below-path clearance of a dual-frequency system (section 3.4.6.3.3).

b. All other monitor parameters listed in section 3.4.6.3 shall be configurable for either executive monitor action or to produce a maintenance alert.

DRAFT

3.4.6.4.1 Single Equipment Response to Monitor Alarm

The following actions shall take place when a fault for an executive monitor parameter existed for longer than the preset period of time:

a. Cease radiation of the signal.

b. Initiate a local visual alarm.

c. Transmit the alarm indication to the remote control point.

d. Attempt to restart the system 50 seconds after detection of the fault.

e. If the fault is still present after restarting, shut down again and attempt a second restart 5 minutes after the fault was first detected.

f. If a successful restart is obtained, the automatic restart circuitry shall be rearmed after a period of 4.5 minutes.

g. If a second fault occurs within this 4.5-minute period, the timer for the "5-minute restart" is still in effect and a restart shall be attempted 5 minutes after the initial fault detection.

h. If the equipment has additional restart features, they shall be capable of being disabled.

i. Automatic restart shall be inhibited whenever the system is in local control or a PMDT user is logged in.

j. The system shall be configurable to disable all automatic restart actions.

3.4.6.4.2 Category II/III Dual Transmitter Equipment Response to Monitor Alarm

The following actions shall take place when a fault for an executive monitor parameter existed for longer than the preset period of time.

a. Cease radiation of the main out-of-tolerance transmitter.

b. Transfer the signal to the hot standby transmitter.

c. If the fault persists, cease radiation and require a manual restart.

3.4.6.4.3 Category I Dual Transmitter Equipment Response to Monitor Alarm

The following actions shall take place when a fault for an executive monitor parameter existed for longer than the preset period of time:

a. Cease radiation of the main out-of-tolerance transmitter;

b. Transfer the signal to the hot standby transmitter;

c. If the standby transmitter is out-of-tolerance, attempt to restart the main transmitter 50 seconds after detection of the fault;

d. If the fault is still present after restarting, transfer the signal to the hot standby transmitter;

e. If the standby transmitter is out-of-tolerance, shut down again, transfer, and attempt a second restart to the main transmitter 5 minutes after the fault was first detected;

DRAFT

f. If a successful restart is obtained, the automatic restart circuitry shall be re-armed after a period of 4.5 minutes;

g. If a second fault occurs within this 4.5-minute period with the timer for the "5-minute restart" still in effect, attempt a restart 5 minutes after the initial fault detection;

h. If the fault persists after the 5-minute restart cease radiation of both transmitters and inhibit restoration for at least 20 seconds;

i. If the equipment has additional restart features, they shall be capable of being disabled;

j. After the last available restart, if the fault persists, the transmitter shall cease radiating and require a manual reset to restart;

k. Automatic restart shall be inhibited whenever the system is in local control or a PMDT user is logged in; and,

l. The system shall be configurable to disable all automatic restart actions.

3.4.6.4.4 Fault Detected by a Single Monitor (Dual Monitor Systems)

If only one monitor senses a fault and that fault persists beyond the preset monitor action delay period, the system shall:

a. Initiate a local visual alarm.

b. Transmit an indication of the single monitor alarm status to the remote control point.

3.4.6.4.5 Monitor Action Delay

The monitor shall have a hold-off period adjustable from 0.3 to 10 seconds, during which time shutdown or transfer control is inhibited.

3.4.6.4.6 Shutdown Timing Test

A shutdown timing test shall be available from the PMDT and optionally from the front panel controls in which the timing from alarm condition to transmitter shutdown and transfer to standby transmitter is automatically measured and displayed.

3.4.6.5 Glide Slope Monitor Stabilization Time

With the monitor already powered, the monitor shall stabilize and measure the value of the applied signal with an accuracy of ±25% of the alarm threshold for that monitored parameter within 0.5 seconds after application of the signal.

3.5 VHF Marker Beacon Station

A complete single equipment VHF marker beacon station shall consist of the following:

a. One transmitter with associated monitor and modulation equipment.

b. A complete antenna group, divider networks, associated coaxial cabling, and all antenna mounting towers and hardware.

c. One standby battery power group.

DRAFT

d. For the inner marker beacon, self-supporting, frangible support, with a breakpoint no higher than 3" above the ground.

3.5.1 Coverage

a. The required coverage pattern of each marker beacon shall be elliptically shaped as defined in Table 3-7, with the minor axis oriented along the course centerline.

b. The marker beacon transmitter power shall be capable of being adjusted to provide at least 1,700 μV/m within the bounds of the minimum and maximum dimensions of the axes.

c. The vertical coverage of the marker beacon shall be such that the received signal rises to at least 3000 μV/m near the center of the ellipse.

d. Horizontally polarized radiation.

Table 3-7. Marker Beacon Coverage

Marker Beacon	**Measured distance along course centerline ("Minor axis")**		**Measured distance along 75 μA lines ("Major axis")**	
	Minimum (ft)	Maximum (ft)	Minimum (ft)	Maximum (ft)
Inner	340	660	Not measured	Not measured
Outer	1350	4000	700	4000

3.5.2 Marker Beacon Transmitter

3.5.2.1 Transmitter Maintenance Display Parameters

a. The following parameters shall be readable from a PMDT connected to the system:

1. Antenna VSWR
2. Modulation percentage (resolution 1%)
3. RF Level (resolution 0.1%)
4. Ident Keying Status
5. Ident Status (On/Off)
6. Ident Frequency (resolution 1 Hz)
7. Calibration Status
8. Forward Power (resolution 0.01 W)
9. Reverse Power (resolution 0.01 W)
10. Audio Generator Status
11. Inside Temperature (degree, C)
12. Outside Temperature (degree, C)
13. Smoke Detector Status
14. Intrusion Detector Status

DRAFT

15. Transmitter Status (On/Off)

b. In response to a poll (data request message) received from the remote monitoring and logging system (RMLS), the transmitter shall transmit the current value of each parameter in the group or groups of parameters indicated by the content of the request message.

3.5.2.2 Frequency

a. The marker beacon carrier frequency shall be 75 MHz ±0.002%.

b. Capability shall be provided to offset the 75 MHz center frequency by ±4 kHz.

3.5.2.3 Carrier Output Power

a. The marker beacon transmitter shall be capable of providing at least 2.5 W of output power.

b. The power output shall be adjustable from maximum power down to 0.05 W with adjustment resolution of no coarser than 0.05 W.

3.5.2.4 Carrier Power Output Stability

After initial adjustment of the carrier power, the carrier power shall vary no more than ±0.5 dB over the full range of service conditions.

3.5.2.5 Modulation Frequency

The transmitter shall be capable of modulating the signal to any level from 70 to 97% by any of the following selectable frequencies:

a. 400 Hz ±1Hz (Outer Marker)

b. 3000 Hz ±8Hz (Inner Marker)

3.5.2.6 Modulation Harmonic Distortion

The total harmonic distortion of the demodulated output shall be equal to or less than 8% at rated power output and 95% modulation.

3.5.2.7 Modulation Stability

a. After initial adjustment to 95% modulation at rated power output, the modulation percentage shall vary by no more than ±5% (absolute) over the full range of service conditions.

b. Each modulation frequency shall be within ±1.5% of the nominal frequency under stable environmental conditions.

c. Each modulation frequency shall be within ±2.5% of the nominal frequency over the full range of service conditions.

3.5.2.8 Identification Keyer

a. The transmitter shall key the audio frequency modulation without interruption of the carrier, as follows:

DRAFT

1. Key the outer marker audio modulation frequency (400 Hz) to provide a continuous series of dashes.
2. Key the inner marker audio modulation frequency (3000 Hz) to provide a continuous series of dots.

b. A control shall be provided to select among the following modulation choices:

1. Keyed in the pattern as described in (a.) above;
2. Continuous (unkeyed) modulation at the selected audio frequency; or
3. Unmodulated carrier.

3.5.2.9 Character Timing

Character and dot/dash timing for the marker beacon keying shall be the same as that of the localizer as specified in section 3.3.3.11.

3.5.2.10 Keyer Stability

a. The keying rates shall remain within ±15% of the design center values under the service conditions.

b. Transient peaks due to keying shall be less than or equal to 2% of the peak amplitude of the normal audio frequency waveform at the modulator output.

3.5.3 Marker Beacon Transmitting Antenna

a. The transmitting antenna shall provide the signal coverage as required in section 3.5.1.

b. The height of the inner marker beacon antenna shall not exceed 7 feet above ground level.

3.5.3.1 Marker Beacon Monitor

a. A monitor unit shall provide an alarm indication if the transmitter power output drops by a preset amount or if the identification keying is not correct.

b. The monitor shall incorporate a time delay, adjustable between 5 and 15 seconds, to preclude automatic shutdown for short-term out-of-tolerance conditions.

c. The monitor shall include an integral RF pickup.

d. The monitor shall not require an external monitor antenna.

3.5.3.2 Alarm Threshold Controls

a. A control for adjusting the alarm threshold for power reduction shall be provided.

b. The RF carrier power monitor threshold shall be adjustable to indicate an alarm over the range of -1.5 dB to -4 dB of the operating power.

c. The keying monitor shall alarm if the modulation tone is not present or if the modulation is continuous.

d. Capability to validate the power alarm threshold and incorrect keying detection without the use of external test equipment shall be provided.

DRAFT

3.5.3.3 Monitor Shutdown Action

a. When an alarm condition occurs during normal marker operation, the monitor shall be configurable to automatically shut down the transmitter.

b. The system shall attempt a restart at 50 ±5 seconds after the initiation of a shutdown.

c. If the first restart is unsuccessful, a second restart shall be attempted at 15 minutes ±30 seconds after the initial shutdown.

d. If a successful restart is obtained, the automatic restart circuitry shall be rearmed after a period of 15 minutes.

e. If a second fault occurs within this 15-minute period, the timer for the "15-minute restart" is still in effect and a restart shall be attempted 15 minutes after the initial shutdown.

f. If the marker beacon fails two restart attempts, no further automatic restart action shall be made.

g. A reset operation shall be required to restart the marker transmitter following an automatic shutdown without a successful automatic restart.

3.5.3.4 Remote Alarm Output

When the marker monitor is in alarm, the alarm indicator at the Remote Status and Control Unit (RSCU) shall be activated.

3.5.3.5 Monitor Bypass

a. The marker beacon station shall be furnished with a monitor bypass switch to allow for temporary disabling of the automatic restart/shutdown function for maintenance purposes.

b. An indicator light shall illuminate on the equipment front panel when the automatic shutdown feature is bypassed.

c. Enabling bypass of the monitor control shall inhibit automatic monitor shutdown action in response to primary alarms and,

d. Disabling bypass of the monitor control shall enable automatic monitor shutdown action in response to primary alarms.

3.5.4 AC Power Control

A switch and indicator light shall be provided for the control of primary AC power to the marker beacon station.

3.5.5 Marker Beacon Cabinet

The transmitter, monitor, and battery charger power supply shall be housed in a cabinet that complies with section 3.2.2 and subsections.

3.5.6 Performance of Periodic Checks and Certification

The RF Carrier Power Level and Modulation Level shall be readable from both the RMM interface and from a PMDT connected to the system.

DRAFT

3.6 Remote Control Subsystem (RCS)

The RCS consists of two or more units: The RSCU, which is normally installed in the equipment room of an air traffic control tower, and one or more Remote Status and Interlock Control (RSIC) panels. At least one RSIC will be installed in the air traffic operational area of the control tower.

a. The RSCU shall be configurable to accommodate the full range of configurations from a single equipment localizer-only partial ILS to a full CAT III ILS with three marker beacons and FFM.

b. The RSIC shall be capable of being daisy-chained together for status display and control at other locations.

c. Interlocked control (ON/OFF) of two ILSs shall be controlled by the RSCU.

d. Activating the Runway Select switch on the RSIC shall cause the currently operating localizer and glide slope to cease radiation and its interlocked ILS equipment to begin radiating.

3.6.1 Remote Status and Control Unit (RSCU)

The RSCU provides control and status of the ILS subsystems and status of co-located electronic equipment. The RSCU shall provide the following functional capabilities:

a. An ON/OFF and RESET switch for the localizer, glide slope, and marker beacon subsystems and BYPASS of the localizer FFM.

b. Visual indication of the status, including monitor bypassed, of the localizer, glide slope, FFM, and the marker beacon subsystems.

c. For dual equipment, visually indicate which transmitter is radiating, and the status of the other transmitter.

d. An aural alarm to indicate a change in the operational and/or environmental status of each subsystem and any monitored co-located equipment.

e. Provide data to update the status display on the RSIC upon receiving a status change from any of the runway subsystems including the status of co-located equipment (such as DME) connected to the auxiliary status monitor input on a field subsystem.

f. Send ON/OFF commands to the localizer and the glide slope when a change to an interlocked runway is initiated from the RSIC.

g. Control of auxiliary equipment such as reset command to a co-located DME or non-directional beacon (NDB).

3.6.1.1 Equipment Status Display

a. The status of each subsystem connected to the RSCU shall be displayed on its front panel.

b. Green shall be used to indicate NORMAL or ON status.

c. ALARM or OFF status shall be indicated by red.

d. Amber shall be used to indicate abnormal status such as a maintenance alert.

e. An aural alarm shall sound concurrent with any status change of a monitored subsystem.

DRAFT

f. The RSCU shall determine the category of service available based on the availability of the ILS subsystems including the localizer and glide slope subsystems, standby transmitters, and the FFM signal-in-space measurement.

g. Loss of communication between the RSCU and any of the runway equipment or between the RSCU and RSIC shall result in an indication of communication failure.

3.6.1.1.1 Category Determination

a. The RSCU shall be capable of being configured to provide the proper indications for a runway approach that is either localizer-only, CAT I, CAT II, or CAT III.

b. The RSCU shall interpret localizer and glide slope subsystem operating status to determine the category of operation that the ILS can support based on the transmission of an in-tolerance signal and, for CAT II or III operation, a ready standby transmitter and a satisfactory FFM indication.

c. The category of operation information shall be sent to RSIC panel for display.

d. The RSIC shall have indicators for CAT III, CAT II, CAT I, and localizer Only.

3.6.1.1.2 Category Conditions

The following conditions shall be indicated by the state of the category indicators as shown in Table 3-8 below:

Table 3-8. Category for Various Conditions (CAT I/II/III-Capable Systems)

Condition	CAT III	CAT II	CAT I	Loc Only
Localizer and Glide Slope operating normally, main transmitter signal radiating, no monitor alarms or alerts, monitor not bypassed, no communications faults.	On	On	On	Off
Localizer operating normally, Glide Slope switched to standby transmitter, all other conditions normal.	Off	On	On	Off
Localizer operating on standby transmitter, Glide Slope operating on either main or standby transmitter, all other conditions normal.	Off	On	On	Off
Monitor mismatch (one monitor showing alarm, the other showing normal) at either Localizer or Glide Slope.	On	On	On	Off
FFM course misalignment alert for longer than the preset period for Cat III operation (nominal 15 seconds).	Off	On	On	Off
FFM course misalignment alert for longer than the preset period for Cat II operation (nominal 90 seconds).	Off	Off	On	Off
Single equipment Localizer and Glide Slope operating normally.	Off	Off	On	Off
Glide Slope off, Localizer operating on main or standby transmitter with other conditions normal.	Off	Off	Off	On
Localizer operating normally, Glide Slope switched to standby transmitter, all other conditions normal.	On	On	On	Off

DRAFT

3.6.1.2 Co-located Auxiliary Equipment Status

a. The RSCU shall be equipped with an indicator to display the normal/alarm or ON/OFF status of co-located auxiliary equipment such as a DME which has its monitor status output interfaced to the ILS auxiliary monitor input as specified in section 3.8.7.

b. When the auxiliary equipment is operating normally, its status received from the ILS subsystem shall cause an ON indicator to illuminate on that subsystem's status panel.

c. When the auxiliary equipment is off or in alarm status, an OFF indicator shall be illuminated on the RSCU panel.

d. This status shall be passed to the RSIC for remote indication of the status of the co-located equipment.

3.6.1.3 RSCU Response Time

a. The RSCU shall respond to status changes received from the runway equipment within one second of the status change.

b. When the FFM bypass command is issued from the RSCU, the FFM BYPASSED indicator on the RSCU and RSIC shall illuminate within one second, and the Category indicator shall change to CAT I.

3.6.1.4 Interlock Response Time

All interlocked subsystems of an interlocked ILS controlled by the RSCU shall switch off within 4 seconds after the Runway Select switch of the RSIC is operated.

3.6.1.5 Alarms

a. The RSCU shall be equipped with visual and aural alarms.

b. The volume of the aural alarm shall be adjustable from a recessed front panel control in a range from 55 dB(A) to 90 dB(A).

3.6.1.5.1 Power Loss Alarm

An aural and visual alarm shall indicate that AC power to the RSCU or RSIC has been lost, and the unit is operating on standby (battery) power.

3.6.1.5.2 Environmental Alerts

An aural or visual alert shall indicate when a subsystem has any of the following conditions:

a. Operating on batteries;

b. The temperature sensors exceed the threshold limits;

c. The obstruction lights sensor exceeds the threshold limits;

d. The intrusion detector has been activated; and,

e. The smoke detector has been activated.

DRAFT

3.6.1.5.3 Alarm and Indicator Test

A switch on the RSCU shall be provided which sounds the aural alarm and illuminates all of the indicators.

3.6.1.6 Runway Identification

a. A location shall be provided on the RSCU for a label identifying the runway served by the ILS controlled by that RSCU.

b. The location shall be sized to accommodate three 3/8" to 3/4" high alphanumeric characters, at minimum 0-9, L, R, C, and blank.

c. The identification for the runway currently controlled by the RSCU shall be transmitted to the RSIC.

3.6.1.7 Mounting and Power Requirements

a. The RSCU shall be mountable in an EIA/ECA-310 standard 19" relay rack.

b. Panel height shall be less than or equal to 9".

c. Panel depth, not including the AC power cord, shall be less than or equal to 15".

d. The allowed space shall include the manufacturer's recommended standby battery and mounting bracket or shelf.

e. Power requirements shall be less than or equal to 250 W from a 120 VAC single phase source.

3.6.2 Remote Status and Interlock Control (RSIC)

a. The RSIC shall display status information received from the RSCU of the selected runway.

b. The RSIC shall provide interlocked control of two ILSs (typically) installed on opposite ends of the same runway such that the two localizers can never be radiating at the same time.

c. Operation of related glide slope and marker beacon equipment shall be configurable to follow the radiation status of the localizer.

d. The switching of two interlocked ILSs shall be a toggle action with one ON and the other OFF at all times unless disabled at the field site for maintenance.

e. The RSIC shall include a Runway Select switch on the panel to control the currently radiating ILS.

f. If multiple RSICs are connected to an RSCU:

   1. Only one RSIC shall be capable of controlling the ILSs.
   2. Designation of the controlling RSIC shall be configurable from the RSCU.
   3. Other RSICs connected to the RSCU shall have indicator/alarm functions only, with the Runway Select function being inhibited.

g. The RSIC shall be compatible with legacy systems to the extent that the second (interlocked) ILS can be a standard Mark 20 or ILS 420.

DRAFT

h. Upon operation, the RSIC Runway Select switch shall turn the currently operating ILS equipment OFF and, after a 20-second delay during which neither of the two interlocked ILSs is radiating, switches the interlocked ILS equipment ON.

3.6.2.1 RSIC Controls and Indicators

3.6.2.1.1 ILS Runway Selection (Interlock)

a. Operating the interlocked runway select control shall send the appropriate command to the RSCU to cause the selected/de-selected ILS subsystems to be activated/de-activated, respectively.

b. The runway number for the ILS which the RSIC is currently controlling and displaying status shall be displayed on the RSIC front panel as three electronically generated characters.

c. The remote (RSIC) runway identification display shall change dynamically when interlocked runways are switched at the RSIC or RSCU.

d. Characters shall be at least 0.75” in height.

3.6.2.1.2 Category Status Display

a. The category of operation as determined by the RSCU shall be displayed as a category indicator.

b. Each category indicator LED shall be labeled with the category and shall be green.

c. The Localizer Only indicator LED shall be amber.

3.6.2.1.3 Display of Operating Status of ILS and Co-located Equipment

a. Status indicators listed in Table 3-9 shall be provided.

b. Communication fault between RSCU and ILS subsystems shall be displayed (Amber).

c. Communication fault between the RSCU and RSIC shall be displayed (Amber).

d. Indicator(s) for subsystems or co-located equipment not installed (e.g., an Inner Marker for a CAT I ILS), including the OFF indicator, shall not be illuminated other than when a Lamp Test is being performed.

e. Localizer and glide slope standby equipment status indicators are applicable to dual equipment only and shall be OFF when the RSIC is used with single equipment.

f. When any executive monitor is bypassed, all Category Display indicators shall be OFF.

g. A positive indication of the bypassed state shall be provided by blinking of the red status indicator for the equipment with the bypassed monitor.

DRAFT

Table 3-9. Status Indicators of ILS and Co-located Equipment

Equipment Indicator	Status	Color
Localizer Main Transmitter	ON	Green
	OFF	Red
Localizer Standby Transmitter	ON	Amber
	OFF	Red
Glide Slope Main Transmitter	ON	Green
	OFF	Red
Glide Slope Standby Transmitter	ON	Amber
	OFF	Red
Inner Marker	ON	Green
	OFF	Red
Middle Marker	ON	Green
	OFF	Red
Outer Marker	ON	Green
	OFF	Red
Aux 1	ON	Green
	OFF	Red
Aux 2	ON	Green
	OFF	Red
Far-Field Monitor	Normal	Green
	Bypassed	Amber
	Alarm	Red
	OFF	Red

3.6.2.1.4 Aural Alarm

a. An aural alarm shall be provided to indicate any status change including an FFM alarm.

b. The aural alarm shall also sound each time the Runway Select interlock switch is operated.

c. The loudness of the aural alarm shall be adjustable from 55 dB(A) to 90 dB(A) from a recessed control panel.

d. A front panel switch shall be provided to silence only the current aural alarm.

3.6.2.1.5 Lamp Dimmer Control

a. A front panel control shall be provided to adjust the luminance of the indicators and selected runway display to suit ambient lighting conditions

b. At maximum luminance ($\geq$1750 cd/m^2), the indicators and selected runway display shall be visible with an ambient illumination of 6,000 foot-candles (bright sunlight in air traffic control tower (ATCT) cab).

c. At minimum luminance (35 cd/m^2) the indicators and selected runway display shall be visible within an ambient illumination of 1 foot-candle (darkened ATCT cab).

DRAFT

d. Indicators and the selected runway display shall not be capable of being adjusted to a level which cannot be differentiated from the off conditions.

3.6.2.1.6 Lamp/Alarm Test Switch

A switch on the RSIC shall be provided which sounds the aural alarm and illuminates all of the indicators including those not used for the installed system.

3.6.2.1.7 FFM Bypass Switch

a. A switch shall be provided to bypass/remove bypass the FFM.

b. When the FFM is manually bypassed from the RSIC, the category of operation shall be downgraded to CAT I.

3.6.2.1.8 Category Display Status Change Delay

a. An adjustable delay shall be provided for the purpose of inhibiting an immediate change in the display of category on the RSIC when the FFM indicates an out-of-tolerance condition.

b. The delay shall have the range of 0 s to 120 s in 1 s increments.

c. FFM status shall be cleared automatically if the FFM returns to normal status within the preset hold-off period

d. If the fault has not cleared within the delay time, the category change shall be displayed.

e. Any category change resulting from an alarm of the main or standby monitor shall be displayed without delay.

3.6.2.1.9 RSCU Power Loss Indication

Primary power loss at the RSCU shall be indicated by an alarm and indicator on the RSIC.

3.6.2.2 RSIC Subassembly

a. The RSIC panel shall be flush-mounted not exceeding 10.5” in width, 7” in height, and 3” in depth, excluding cables and connectors.

b. All cables connections shall be made from the rear.

c. Mounting holes shall be provided to allow the panel to be installed securely in a horizontal or vertical wood or metal console.

d. Displayed text shall be readable from 10 feet under normal ATCT illumination.

e. The panel surface shall be divided into the following distinctive functional areas:

1. Runway number display and ILS runway select control.
2. ILS category display.
3. Subsystem status display.
4. Co-located equipment status display.
5. Far-Field Monitor status and bypass switch.

DRAFT

6. Alarm test, silence controls, and lamp dimmer.

3.6.2.2.1 RSIC Interfaces

a. The RSIC shall be capable of interfacing with two RSCUs for the purpose of controlling ILS equipment on opposite ends of an interlocked runway.

    1. If the runway interlocking logic is located at a "primary" RSCU, which is then connected to a "secondary" RSCU for interlocking, a single RSCU interface connector shall be provided.

b. Input and output connectors shall be provided for the purpose of connecting additional RSIC displays for the same runway.

c. Mating connectors for each RSIC shall be provided.

3.6.2.3 RSCU-RSIC Interconnection

The communications protocol between the RSCU and RSIC shall be native (within the ILS subsystem) Transmission Control Protocol (TCP)/Internet Protocol (IP) (IPv6).

3.6.2.4 RSCU-ILS Subsystem Interconnection

The communications protocol between the RSCU and ILS subsystems shall be native TCP/IP (IPv6).

3.6.2.4.1 Radio Links

a. Communication between the ILS subsystems and RSCU shall be possible via an NTIA approved radio link system rather than via hard wiring.

b. All functions shall be available when operating via radio link.

c. All response time requirements shall be met when operating via radio link.

d. If the radio link system requires a unique interface (for example, to power the radio or control half-duplex operation), that interface shall be incorporated in the RSCU and the RSCU interface on the ILS subsystems.

3.6.2.5 Remote Control Subsystem Fail-safe and Failure Modes

a. A failure of the RSIC, RSCU, or communication between the RSCU and subsystems shall not cause a change in operational state of the ILS subsystems.

b. A failure in communications between the RSCU and an ILS subsystem shall disable interlock control from the RSIC.

DRAFT

3.7 ILS/DME Monitor Receiver Subsystem

3.7.1 ILS/DME Monitor Receiver General Requirements

a. The ILS/DME Monitor Receiver Subsystem shall be designed to be installed indoors at a location designated to be the point of status monitoring.

b. The ILS/DME Monitor Receiver Subsystem shall consist of the following:

1. Receiver(s) and processing equipment and display panel;
2. Remote status panel (RSP); and,
3. Antenna(s).

3.7.2 Receiver(s) and Processing Equipment

a. The receiver(s) and processing equipment shall be mountable in an ECI/ECA-310 standard 19” equipment rack.

b. The receiver(s) and processing equipment shall operate from 120 V, 60-Hz commercial power.

c. The receiver and processing equipment shall provide ON/OFF status to its remote display panel described in section 3.7.5.

3.7.3 ILS/DME Monitor Receiver Subsystem Functions

a. The ILS/DME Monitor Receiver shall monitor the localizer and glide slope RF signal levels, and localizer and DME ident from a selected ILS/DME

b. The ILS/DME Monitor Receiver shall provide independent alarm outputs to the RSP.

1. A dry circuit contact shall be provided for each of the alarm conditions.
2. For each dry circuit contact a both normally open and normally closed contacts shall be provided.
3. The dry circuit contacts shall be provided on the back of the monitor receiver subsystem.

c. The Monitor Receiver subsystem shall detect RF signal level from the localizer, if enabled, and glide slope, if enabled.

1. The status panel shall cause an aural and visual alarm when the level falls below a preset threshold.
2. The RF level alarm shall be adjustable from 0.5 dB to 10.0 dB below the normal received signal level.
3. The receiver shall have an adjustable alarm delay timer from 0 to 160 seconds.

d. Localizer Ident Monitoring shall detect the presence of ident keying from the localizer, if enabled.

1. The status panel shall cause an aural and visual alarm when the localizer ident keying ceases.

DRAFT

2. The receiver shall have an adjustable alarm delay timer from 0 seconds to 120 seconds.

e. DME Ident Monitoring shall detect the presence of ident keying from the DME, if enabled.

1. The status panel shall cause an aural and visual alarm when the DME ident keying ceases.

2. The receiver shall have an adjustable alarm delay timer from 0 to 120 seconds.

3.7.4 ILS/DME Monitor Receiver Performance

The ILS/DME Monitor Receivers shall be designed to meet the following requirements over the environmental service conditions:

a. Frequency range:

1. 108 to 112 MHz for localizers
2. 328 to 336 MHz for glide slopes
3. 962 to 1213 MHz for DMEs

b. Sensitivity: 5 µV for 10 dB (Signal + Noise)/Noise.

c. IF image rejection: 90 dB minimum.

d. Frequency stability: ±0.002%.

e. ILS/DME channel selection by a frequency synthesizer.

f. Desensitization: Application of a 4-volt signal removed from the ILS carrier frequency by 4 MHz will not cause more than a 2 dB reduction in the detected amplitude of a 5 µV on-frequency 30% modulated signal.

g. Cross modulation: With an input signal of 5 µV, an interfering signal at a level of 5 µV, separated from the desired signal by 50 kHz and modulated at 50% will cause no more than 10% distortion of the detected modulation of the desired signal.

h. Selectivity:

1. 15 kHz minimum at -6 dB
2. 35 kHz maximum at -60 dB
3. 60 kHz maximum at -90 dB

3.7.5 Remote Status Panel (RSP)

a. The RSP shall be designed to be mounted in an ATCT.

b. Physical dimensions shall be less than or equal to 8” (height) by 8” (width) by 6” (depth).

c. The RSP shall provide visual indication of the navigational aids (NAVAIDs) status as well as an aural annunciator to indicate an alarm.

d. The volume of the aural alarm shall be adjustable from a recessed front panel control.

e. The maximum intensity for the aural alarm shall be at least 90 dB(A).

DRAFT

f. Reduction of volume to fully OFF shall not be possible with this control.

g. A front panel switch shall be provided to silence only the current aural alarm.

3.7.6 Antennas

a. Antennas shall provide adequate gain for reception of the localizer, glide slope, and DME signals when mounted 10 feet above the ground plane.

b. The antennas shall be mountable on a standard 1¼" rigid steel conduit.

c. The antennas shall weigh 10 lbs or less.

3.8 Remote Maintenance Monitoring (RMM)

RMM consists of the various sensors, microprocessor(s), and software necessary to remotely monitor, control, record, and certify proper operation of the ILS system to be furnished under this specification.

3.8.1 Remote Monitoring Subsystem (RMS)

a. The RMS shall be independent from the ILS monitor and shutdown control functions and circuits.

b. RMS faults shall not affect the capability of the ILS monitor and control functions to detect and respond to conditions that can cause hazardously misleading information (HMI).

c. Data monitored by the RMS shall be locally accessible at the PMDT.

d. The RMS shall be integrated into the localizer, glide slope, marker beacon, and FFM rack/cabinet.

3.8.1.1 RMS Functions

The ILS RMS shall provide the following functions:

a. Monitoring of the performance parameters required to determine the operational status of the ILS;

b. Processing of the outputs of the monitoring devices as necessary to provide digital data in the appropriate engineering units for RMM;

c. Processing of the outputs of the monitoring devices to determine alert and pre-alert status by comparing the monitored outputs to user-defined limits;

d. Provision for an PMDT adjustable limit that causes an alert when the monitored parameter reaches the limit;

e. Provision for an PMDT adjustable limit that causes a pre-alert when the monitored parameter reaches the limit, typically 75% of the alert value;

f. Date/time stamping and local storage of the current status of;

1. Alarm and alert data values;

2. Alarm and alert limits;

3. Trend data (3.8.1.3); and,

DRAFT

4. Fault history (3.8.1.4).

g. Capability to provide 100% additional memory storage capacity over that required to meet the requirements specified herein in the initial design;

h. Capability to process RMM/RMS reset commands;

i. Capability to process RMM restart commands to restore ILS operation in the case of interrupted service; and,

j. Environmental monitoring as required in 3.8.10.

3.8.1.2 RMLS Connectivity

a. The RMS shall utilize Simple Asynchronous Interfacing (SAI) protocol messages contained within Common Message Handling Protocol (CMHP) (Protocol Specification FAA-E-3039A) frames to communicate with RMLS using IP protocol (FAA Interface Control Document (ICD) NAS-IC-51015108-01).

b. In response to a poll (data request message) received from the RMLS, transmit the current value of each parameter in the group or groups of parameters indicated by the content of the request message.

3.8.1.3 Trend Data Collection

a. The RMS shall record and store, in non-volatile memory, system status, alarms, pre-alarms, maintenance alerts, all monitored parameter values, all results of fault diagnostics, results of certification tests, and any other system information or data that is required for corrective or preventative maintenance.

b. The rate of data recording of these parameters shall be adjustable from once every 1 second to once every 1,000 s.

c. Each individual record, which consists of one sample from all parameters recorded, shall be time and date stamped to the nearest second.

d. The system memory shall be sufficient to store at least six months' worth of data, on a rolling basis (oldest data is replaced with new data, i.e., first in, first out), when set to sample and record at the fastest rate.

e. The data shall be available via the PMDT in American Standard Code for Information Interchange (ASCII), formatted as a comma-separated values (.csv) file.

3.8.1.4 Fault History

Fault history shall be capable of storing at least 50 events, stored in a first-in-first-out sequence, to be available for retrieval consisting of:

a. The last pre-fault parameter values.

b. The post-fault (prior to shutdown) parameter values.

3.8.2 Alarm and Alert Messages

DRAFT

3.8.2.1 Alarms

a. An alarm message shall be generated and transmitted to the RMLS when a failure occurs within the ILS system that causes a loss of service to the user (shutdown).

b. When the system is commanded off, in local control, or when the system is off as a normal state, alarm messages shall be inhibited.

3.8.2.2 Maintenance Alerts

a. An alert message shall be generated and transmitted to the RLMS when the current value of a measured parameter exceeds the established alert limits.

b. An alert message shall be generated and transmitted to the RMLS when a failure occurs within the ILS system which does not cause a loss of service to the user.

3.8.3 Non-Volatility

a. All control settings, operational parameters and limits, initialization data, data files and fault history shall be locally stored in the RMS.

b. Local storage shall be supported with sufficient battery capacity or other techniques to ensure the non-volatility of stored data for a period of not less than 90 days.

c. Means shall be provided to transfer stored data to another medium for permanent storage purposes.

3.8.4 RMS Data Sampling Rate

The RMS equipment shall sample each parameter at least once every second.

3.8.5 Real Time Clock/Calendar

a. The ILS subsystem shall incorporate a real time clock/calendar with date, hours, minutes, and seconds.

b. The local system time shall be readable as a data point from the RMLS and the PMDT software.

c. The local system time shall be adjustable locally from the PMDT.

d. The clock function shall be accurate to within 15 seconds a month.

e. The local system time shall be supported by a battery independent of the subsystem backup power.

f. The system shall include a clock battery with built-in charging that is capable of maintaining the local system time for at least 180 days.

3.8.6 ILS Equipment Fault Diagnostics

a. Fault diagnostics shall provide diagnostics and system verification to facilitate fault isolation to the LRU level, including the remote maintenance monitoring subsystem(s).

DRAFT

b. The diagnostic routine shall be able to localize 85% of all failures to a single faulty LRU, and 95% of all failure occurrences to no more than two candidate LRUs, one of which contains the fault.

c. Fault diagnostics shall run either continually or on command from the PMDT, and after a failed auto-restart sequence.

d. If fault diagnostics run upon command, then provisions shall be made to permit the operator to stop the test cycle at any time during the test sequence.

e. All LRUs identified as failed by fault diagnostics shall be reported and listed in order of descending likelihood.

f. Fault diagnostics that run continually shall not cause an out-of-tolerance condition of the radiated signals.

g. Fault diagnostic data shall be stored in memory and accessible via the PMDT or by RMLS request.

3.8.7 Status Monitoring of Co-located Electronic Equipment

An input for a contact closure or transistor-transistor logic (TTL) level of either sense shall be provided to allow local display and transmission to the RSCU (section 3.6.1.2) of the operational status (NORMAL or ALARM) of co-located equipment such as a DME installed in a localizer shelter or an NDB co-located with a marker beacon.

3.8.8 Auxiliary Input Pass-through

In order to accommodate auxiliary equipment such as a DME serving multiple runways with interlocked ILS equipment, the auxiliary inputs shall be configurable so that the status of the connected equipment is passed to the RSCU when the ILS is interlocked off-the-air but is still powered on and under RSCU control.

3.8.9 Spare Input/Output Capacity

a. The RMS shall provide at least three spare analog inputs, two spare digital inputs and two spare digital outputs.

b. All spare analog inputs shall provide user-configurable alert and pre-alert limits.

c. Data, alerts, and pre-alerts from the spare inputs shall be transmitted to the RMLS upon demand.

d. Specific requirements for the spare inputs and outputs shall be as follows:

1. Analog inputs:

i. Input range: Bipolar, -5.000 to +5.000 VDC with respect to input ground.

ii. Accuracy: ±5% of reading or ±0.01 V whichever is numerically smaller.

iii. Input impedance: 20 kΩ or greater.

iv. A/D converter resolution: 1 part in 1000.

2. Digital inputs:

DRAFT

i. TTL, low = 0.0 to +0.8 V, high = +2.0 to +5.5 V.

ii. Sense: Programmable such that either high or low represents alarm, with the opposite sense representing normal.

3. Digital outputs:

i. TTL with the same voltage limits as the digital inputs.

ii. Current sink capacity: 24 µA minimum.

3.8.10 Environmental Monitoring

a. The following sensors shall be furnished with each subsystem as identified below:

1. Intrusion detector (localizer, glide slope, and each marker beacon subsystem)
2. Smoke detector (localizer, glide slope, and each marker beacon subsystem)
3. Obstruction lights (localizer and glide slope subsystems)
4. AC Power (localizer, glide slope, and each marker beacon subsystem)
5. Temperature (localizer, glide slope, and each marker beacon subsystem)
6. Antenna Heater Current (glide slope)

b. Each sensor shall be provided with all necessary connectors, terminal boards, enclosures, mounting hardware, and installation instructions.

c. Measurements from each environmental sensor shall be processed by the RMS for output locally via the PMDT and transmission to the RMLS.

3.8.10.1 Intrusion Detector

a. The intrusion detector shall detect the opening of the door of the ILS shelter.

b. The RMS building security timer shall start when the detector senses that the door has been open for 0.25 seconds.

c. If a portable terminal is not connected to the terminal interface within 5 minutes, the RMS shall indicate that the building security parameter is in alert.

d. The RMS shall send an alert message to the RMLS when the building security parameter is in alert.

e. If the PMDT is connected within 5 minutes, the building security parameter shall return to normal.

f. If after being connected, and the PMDT is then disconnected, the RMS shall inhibit sensing a building security alert for a period of 5 minutes prior to resuming normal monitoring of the building security parameter.

g. Capability shall be provided to arm and disarm (bypass) the intrusion detector locally via the PMDT and through the RMLS.

3.8.10.2 Smoke Detector

a. The ionization-type smoke detector shall be powered from the ILS subsystem.

DRAFT

b. The smoke detector shall meet the requirements of Underwriters Laboratories (UL), Inc. Standard 268 and bearing the UL label showing compliance.

c. The RMS shall send an alert message to the RMLS when the smoke detector is activated.

3.8.10.3 Obstruction Light Current Sensors

a. The obstruction light current sensor shall be capable of detecting an outage of one or more lamps.

b. The RMS shall send an alert message to the RMLS when one or more lamps fail.

3.8.10.4 AC Power Sensor

a. The AC power sensor shall measure the AC power (voltage and current) applied to the ILS subsystems.

b. The RMS shall transmit an AC power alert message to the RMLS when the ILS subsystem switches to the backup power source.

3.8.10.5 Temperature Sensors

a. The localizer shelter shall be equipped with both an inside and outside temperature sensor.

b. All other subsystem shelters shall be equipped with an inside temperature sensor only.

c. The sensors measure temperature from -46°C to +70°C with an accuracy within ±4°C.

d. The RMS shall be programmable with upper and lower temperature alert limits.

e. Exceeding the temperature alarm limits shall cause a temperature alert message to be transmitted to the RMLS.

3.8.10.6 Antenna Heater Current Sensors

The antenna heater current sensors shall be capable of detecting the level of current provided to each individual antenna heater unit.

3.8.11 RMS Security

Log-on security shall be implemented to ensure that only authorized personnel can enter RMS commands.

3.8.11.1 Security Implementation

The RMS security design shall:

a. Include a standard initial log-on procedure for factory-delivered systems that provides security-level access for the purpose of assigning passwords and security access levels;

b. Include a method to restore the factory log-on identifications (IDs) and passwords;

c. Utilize assigned user IDs and passwords containing up to 16 alphanumeric characters with a minimum of 24 total ID/password combinations stored in the RMS non-volatile memory;

d. Echo the user ID to the PMDT as non-alphanumeric characters when logging in;

DRAFT

e. Respond to entry of an invalid ID or password by displaying an error message to the PMDT, terminating the log-in procedure (i.e., not prompt the user to try again), and returning to its idle (wait) state;

f. Provide a message identifying the logged-in user to the RMLS for all validated access entries and send a log-off message when the user logs off;

g. Inhibit the transmission of all alarm or alert messages to the RMLS after the initial log-in identification, during the time a second or third security-level user is logged in; and,

h. Automatically log off the user if the terminal has been idle for more than 15 minutes or if there is no terminal activity within 15 minutes following the completion of a user-initiated test.

3.8.11.2 Security Level Definitions

Security levels for the RMS are defined as follows:

a. Level 1: Entry of a valid User ID and password shall allow READ ONLY access/display of subsystem status, configuration, and monitored system parameters. The user has no control over the ILS subsystem.

b. Level 2: Entry of a valid user ID and password shall enable read and write access/display of all subsystem functions and changeable parameters.

c. Level 3: Entry of a valid user ID and password shall enable level 2 capabilities and also provide the ability to assign user IDs and passwords.

3.8.12 RMS Data Filtering

a. All measurements available from the front panel or PMDT shall be available remotely.

b. Each parameter shall be selectable to send an alert message, an alarm message, or no message.

3.8.13 RMS Failure Protection

The ILS system design shall be such that failures in the RMS function cannot cause a loss or degradation of navigation service to the user.

3.8.14 Interface with RMM Subsystems

a. The interface from RMS to RMLS shall be compliant with:

   1. NAS-IC-51015108-01;
   2. FAA-E-3039; and,
   3. IPv6 protocol.

b. The digital data provided at the RMLS interface shall be in the appropriate engineering units for the parameters monitored in the formats defined in NAS-IC-51015108-01, to include but not limited to:

   1. Executive parameters;
   2. System status;

DRAFT

3. Environmental;
4. Communication;
5. Fault diagnostic results;
6. Certification parameters/results; and,
7. Trend analysis data.

3.9 Data Security

3.9.1 Access Control

The ILS system shall contain features in its design and operation that prevent unauthorized and disruptive access to the system by implementing the following requirements as a minimum:

a. Authorized user access verification;
b. User password control;
c. Restriction of access to system/operating system (OS) files/data;
d. Denying access to direct OS functions/commands;
e. Limited access to specific functions based on job category;
f. While in the normal operating mode, prevent the loading of data from removable media or network connections; and,
g. Disable any unused ports during normal operation.

3.9.2 Audit Logging

a. The ILS system shall generate audit logs for both operating system-level and application-level events for local, non-local, and remote sessions on all devices capable of generating event logs.
b. The following minimum events shall be captured, recorded, and reported through the IP interface:
    1. Resource degradation alerts (e.g., 100% utilization, disk space full, volume full);
    2. Login and logout, successful and unsuccessful;
    3. Unauthorized system access attempt;
    4. Account creation/modification and permissions or configuration changes;
    5. Administrator level activities;
    6. Startup/shutdown of system/services/processes;
    7. Access to privileged functions (e.g., setting auditable event and intrusion detection devices) including maintenance;
    8. Results from malicious code protection;
    9. Access control list denials; and,
    10. Intrusion Detection System (IDS) signature-based attacks.

DRAFT

4. VERIFICATION

4.1 Methods of Verification

4.1.1 Inspection (I)

Inspection is a verification method that is accomplished by a visual examination of the item, reviewing descriptive documentation, and comparing the appropriate characteristics with predetermined standards to determine conformance to requirements without laboratory equipment or procedures.

4.1.2 Analysis (A)

Analysis is a verification method that consists of comparing hardware or software design with known scientific and technical principles, technical data, models, or procedures and practices to verify that the proposed design will meet the specified functional/performance requirements.

4.1.3 Demonstration (D)

Demonstration is a verification method that is accomplished by operation, adjustment, or reconfiguration of items performing their designed functions under specific scenarios. The items may be instrumented and quantitative limits of performance monitored, but only observational data rather than actual performance data is required to be recorded for verification. Demonstration is often used to verify compliance with servicing, reliability, maintainability, transportability, and human factors engineering requirements.

4.1.4 Test (T)

Test is a verification method that is accomplished, with or without instrumentation, through systematic exercising of the application item under appropriate conditions with the collection, analysis, and evaluation of quantitative data.

4.2 Test Allocation

4.2.1 Developmental Test (DT)

The primary objective of DT is to demonstrate that all specified technical and performance requirements for a system or service have been met. DT is typically conducted within a controlled test environment and may include the use of third-party test facilities or laboratories. DT is conducted prior to FAA acceptance of the first article units

4.2.2 Operational Test (OT)

OT encompasses the test and evaluation of a system's or service's operational requirements. The primary objective of OT is to examine performance and determine operational readiness (effectiveness and suitability) of a new or modified system for use in the NAS and that the NAS infrastructure is ready to accept the system. The FAA conducts OT on a fully installed system at the FAA William J. Hughes Technical Center for Advanced Aerospace (WJHTC) and other designated operational sites.

DRAFT

4.3 General Procedures

4.3.1 Test Tools

4.3.1.1 Electronic Test Equipment

All electronic test equipment used to verify the requirements of Section 3 shall be calibrated to National Institute of Standards and Technology (NIST) traceable standards, where appropriate.

4.3.1.2 Test Simulators

Simulators used to verify the requirements of Section 3 shall be validated prior to use. Validation demonstrates that the simulator accurately represents the test conditions and scenarios necessary to verify the Section 3 requirements.

4.3.1.3 Antenna Test Range

Any antenna test range used to verify the requirements of Section 3 shall be designed and developed in accordance with the Institute of Electrical and Electronics Engineers Standard 149-2021 Recommended Practice for Antenna Measurements. This includes both anechoic chambers and outdoor test facilities.

4.3.2 Electrical Grounding

Grounding shall be considered satisfactory if the electrical connection between the item of interest and the system tie point exhibits a resistance of 0.1 Ω or less and has sufficient capacity to ensure the reliable and immediate tripping of equipment overcurrent protection devices.

4.3.3 Flight Tests

All verification activities requiring flight test shall be conducted in accordance with FAA Order 8200.1 United States Standard Flight Inspection Manual (USSFIM). All flight test measurements shall be made by a certified FAA flight inspection aircraft.

4.4 Specific Procedures

4.4.1 Environmental Conditions

4.4.1.1 Non-Operating Conditions

Testing of the non-operational environmental conditions shall be conducted on the ILS equipment and LRUs as packaged for storage and/or transport. Each LRU shall be inspected and functionality checked before and after the completion of each test. The ILS shall not be damaged and be fully operable after completion of each test.

4.4.1.1.1 Non-Operating High Temperature

Requirement Reference Section 3.2.3.1.1.1

The ILS equipment shall be tested in accordance with MIL-STD-810H. Procedure I of Method 501.7 shall be used with the high temperature cycles listed in Table 501.7-III for Induced Conditions. At least seven temperature cycles shall be completed. The dwell time at the maximum

DRAFT

temperature of 71°C shall be at least 1 hour for each cycle.

4.4.1.1.2 Non-Operating Low Temperature

Requirement Reference Section 3.2.3.1.1.1

The ILS equipment shall be tested in accordance with MIL-STD-810H. Procedure I of Method 502.7 shall be used with the low temperature cycles listed for Cold (C2) in Table 502.7-I for Induced Environment (-37°C to -46°C). At least seven temperature cycles shall be completed. The dwell time at the minimum temperature of -46°C shall be at least 1 hour for each cycle.

4.4.1.1.3 Non-Operating Altitude

Requirement Reference Section 3.2.3.1.1.2

Test or analysis shall be conducted to verify the conformance of the ILS equipment to the altitude requirements. If analysis is used, then the effects of the low atmospheric pressure on each component shall be evaluated and presented for compliance. If test is used, then the ILS equipment shall be tested in accordance with MIL-STD-810H. Procedure I of Method 500.6 shall be used with a minimum test pressure of 575 mbar (57.5 kPa or 8.3 psia, equating to an altitude of approximately 15,000 feet above sea level) and a maximum test pressure of 1025 mbar (102.5 kPa or 14.9 psia, equating to an altitude of approximately 300 feet below sea level). The ILS equipment shall be exposed to the minimum and maximum pressures for a duration of at least 1 hour each.

4.4.1.1.4 Vibration

Requirement Reference Section 3.2.3.1.1.3

The ILS equipment shall be tested in accordance with MIL-STD-810H. Procedure I of Method 514.8 shall be used with the exposure levels and vibrational spectra given in section 2.1.3 and Table 514.8C-I of Method 514.8 Annex C of MIL-STD-810H and the exposure duration of two hours (as provided in Annex C, section 2.1.4 for 2000 miles of road travel).

4.4.1.1.5 Shock

Requirement Reference Section 3.2.3.1.1.4

The ILS equipment shall be tested in accordance with MIL-STD-810H. Procedure II of Method 516.8 shall be used with the classical shock pulse described in section 2.3.2.3 and the transportation shock sequence listed in Table 516.8-VII. This test may be conducted in conjunction with the vibration test.

4.4.1.2 Operating Conditions

Testing of the operational environmental conditions shall be conducted on the ILE equipment installed in an operational configuration (upright and level). The ILS equipment shall be connected to the appropriate antennas or antenna simulator to observe system functionality.

Indoor LRUs are those that are not exposed to the elements and installed in a temperature and humidity-controlled environment. Outdoor LRUs are those that may be installed in an environment without temperature and humidity control and includes LRUs that may be protected from direct exposure to the elements.

DRAFT

4.4.1.2.1 Operating High Temperature

Requirement Reference Sections 3.2.3.1.2.2 and 3.2.3.1.2.3

The ILS equipment shall be tested in accordance with MIL-STD-810H. Procedure II of Method 501.7 shall be used with the high temperature cycles listed in Table 501.7-III for Induced Conditions. However, a maximum temperature of 50°C shall be used instead of 49°C. At least 7 temperature cycles shall be completed. The dwell time at the maximum temperature of 50°C shall be at least 1 hour for each cycle. For indoor and outdoor LRUs, the dwell time at the maximum temperature of 50°C shall be at least 1 hour for each cycle.

4.4.1.2.2 Operating Low Temperature

Requirement Reference Sections 3.2.3.1.2.2 and 3.2.3.1.2.3

The ILS equipment shall be tested in accordance with MIL-STD-810H. Procedure II of Method 502.7 shall be used. For outdoor LRUs, the low temperature cycles listed for Cold (C2) in Table 502.7-I for Induced Environment (-46°C) shall be used. For indoor LRUs, the minimum temperature shall be -10°C. At least seven temperature cycles shall be completed. The dwell time at the minimum temperature shall be at least 1 hour for each cycle.

4.4.1.2.3 Rain

Requirement Reference Sections 3.2.3.1.2.4 and 3.4.5.8.a

Outdoor LRUs that are exposed to rain when installed in the intended operational configuration shall be tested in accordance with MIL-STD-810H. Depending on the test facility capability, either Procedure I or Procedure II of Method 506.6 shall be used. The outdoor LRUs shall be exposed to a minimum rain rate of 1.7 mm/minute (4 in/hr) with variable winds of up to 18 m/s (40 mph) for a duration of at least 1 hour. The wind direction shall be rotated 90° every 15 minutes. The wind speed of 18 m/s shall be achieved for at least 225 seconds for each direction.

4.4.1.2.4 Operating Altitude

Requirement Reference Section 3.2.3.1.2.5

Test, analysis, or combination thereof shall be conducted to verify conformance to the altitude requirements. If analysis is used, then the effects of the low atmospheric pressure on each component shall be evaluated and presented for compliance. This analysis shall include heating/cooling and arcing/coronal discharge effects due to changes in atmospheric pressure. If test is used, then the ILS equipment shall be tested in accordance with MIL-STD-810H. Procedure II of Method 500.6 shall be used with a minimum test pressure of 700 mbar (70.0 kPa or 10.2 psia, equating to an altitude of approximately 10,000 ft above sea level) and a maximum test pressure of 1025 mbar (102.5 kPa or 14.9 psia, equating to an altitude of approximately 300 ft below sea level). The ILS equipment shall be exposed to the minimum and maximum pressures for a duration of at least 1 hour each.

4.4.1.2.5 Wind and Ice Loading

Requirement Reference Sections 3.2.3.1.2.6, 3.2.3.1.2.7, 3.3.4.11.2, and 3.4.5.12.2.

Test, analysis, or combination thereof shall be conducted to verify the conformance to the wind and ice loading requirements. Analysis shall demonstrate the mechanical survivability of the

DRAFT

antennas and radomes when subjected to 100 MPH winds and covered with 0.5" of clear ice. If a dynamic test is conducted, the wind shall be applied in at least two separate directions. These two directions shall be orthogonal. The wind shall be applied for a duration of at least 1 minute in each direction. If a static test is conducted, then analysis shall be provided to substantiate the load levels and points of application.

4.4.1.2.6 Humidity

Requirement Reference Section 3.2.3.1.2.8

The ILS equipment shall be tested in accordance with MIL-STD-810H. For indoor LRUs, Procedure Ia of Method 507.6 shall be used with Induced Cycle B1 as shown on Figure 507.6-1 and Table 507.6-III. At least three humidity cycles shall be completed. For outdoor LRUs, Procedure Ib of Method 507.6 shall be used with Natural Cycle B3 – Hot Humid as shown in Figure 507.6-6 and Table 507.6-VIII. At least 7 humidity cycles shall be completed. This test may be conducted contemporaneously with temperature testing.

4.4.2 Electromagnetic Compatibility (EMC)/Electromagnetic Interference (EMI)

Requirement Reference Section 3.2.5

The ILS equipment shall be tested in accordance with the applicable requirements and associated procedures of MIL-STD-461G, Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment listed in the table below. For the purpose of requirements applicability, testing shall be consistent with Navy Ground equipment. The testing shall be conducted using a specialized test facility designed to make such measurements.

Table 4-1. Applicable Requirements From MIL-STD-461G

Test ID	MIL-STD-461G Paragraph	Title	Applicability	Performance Requirement
CE102	5.5	Conducted Emissions, Radio Frequency Potential, Power Leads	10 kHz to 10 MHz for all power leads.	Conducted emissions shall not exceed those on Figure CE102-1 of MIL-STD-461G.
CE106	5.6	Conducted Emissions, Antenna Port	100 kHz to 18 GHz	1. Receivers: 34 dBµV 2. Transmitters and amplifiers (standby): 34 dBµV 3. Transmitters and amplifiers (transmit): a. The second and third harmonics shall be suppressed to a level of -20 dBm or 80 dB below the fundamental (-80 dBc), whichever requires less suppression.

DRAFT

Test ID	MIL-STD-461G Paragraph	Title	Applicability	Performance Requirement
				b. Harmonics and spurious emissions in the bands of 1164 MHz – 1240 MHz and 1559 MHz – 1610 MHz shall be suppressed to a level of 96.3 dB below the fundamental (-96.3 dBc). c. Harmonics, except for those noted in a. and b. above, and all other spurious emissions shall be at least 80 dB down from the level at the fundamental (-80 dBc).
CS101	5.7	Conducted Susceptibility, Power Leads	30 Hz to 150 kHz for equipment and subsystem AC and DC power leads.	No out-of-tolerance (OOT) performance or malfunction when subjected to voltages on Figure CS101-1 or powers on Figure CS101-2 of MIL-STD-461G.
CS103	5.8	Conducted Susceptibility, Antenna Port, Intermodulation	10 MHz to 3 GHz This is applicable to the monitor inputs.	66 dB above the level required to obtain the standard reference output for the receiver.
CS104	5.9	Conducted Susceptibility, Antenna Port, Reject of Undesired Signals	30 Hz to 20 GHz Excluding the on-channel frequency band. This is applicable to the monitor inputs.	No OOT performance or malfunction when subjected to the specified maximum input levels.
CS114	5.12	Conducted Susceptibility, Bulk Cable Injection	10 kHz to 200 MHz for all interconnecting cables, including power cables.	No OOT performance or malfunction when subjected to injection probe levels shown on Figure CS114-1 of MIL-STD-461G utilizing the Navy-Ground limits.
CS115	5.13	Conducted Susceptibility, Bulk Cable Injection, Impulse Excitation	All interconnecting cables, including power cables.	No OOT performance or malfunction when subjected to a pre-calibrated signal having the rise and fall times, pulse width, and amplitude as specified on Figure CS115-1 of MIL-STD-461G, at a 30 Hz rate for one minute.

DRAFT

Test ID	MIL-STD-461G Paragraph	Title	Applicability	Performance Requirement
CS116	5.14	Conducted Susceptibility, Damped Sinusoidal Transients, Cables and Power Leads	10 kHz to 100 MHz for all interconnecting cables, including power cables and individual high side power leads.	No OOT performance or malfunction when subjected to a signal having the waveform shown on Figure CS116-1 and having a maximum current as specified on Figure CS116-2 of MIL-STD-461G. The limit is applicable across the entire specified frequency range. Compliance shall be demonstrated at the following frequencies: 0.01, 0.1, 1, 10, 30, and 100 MHz.
CS117	5.15	Conducted Susceptibility, Lightning Induced Transients, Cables and Power Leads	All interconnecting equipment cables including complete power cables, and individual high side power leads.	No OOT performance or malfunction when subjected to the levels and lightning transients specified in Table VII of MIL-STD-461G and supplemented by the waveform and timing definitions shown on Figures CS117-1 through CS117-8 of MIL-STD-461G.
CS118	5.16	Personnel Borne Electrostatic Discharge	All electrical, electronic, and electromechanical subsystems and equipment that have a man-machine interface.	No OOT performance or malfunction when subjected to the values shown in Table VIII of MIL-STD-461G while discharging from a 150 picofarad (pF) capacitor through a 330 Ω resistor with a circuit inductance not to exceed 5 microhenry (μH). Contact discharge at 8 kilovolt (kV) is required for conductive surfaces.
RE102	5.18	Radiated Emissions, Electric Field	2 MHz to 18 GHz for equipment and subsystem enclosures, and all interconnecting cables.	Electric field emissions shall not be radiated in excess of those shown for “Navy-Fixed” on Figure RE102-4 of MIL-STD-461G, not to exceed 86 dBμV/m.
RS103	5.21	Radiated Susceptibility, Electric Field	30 MHz to 18 GHz for equipment and subsystem enclosures and all interconnecting cables.	No OOT performance or malfunction when subjected to the radiated electric fields listed for Ground-Navy applications in Table XI of MIL-STD-461G.

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4.4.3 Power Quality Requirements

The following definitions, test requirements, and test methods are adapted from FAA-G-2100.

All power quality tests and measurements shall be conducted at the equipment level. In lieu of the cord connected requirement, equipment may be submitted for compliance as an integrated system. Perform testing at the rack or branch circuit breaker.

Compliance to the requirements shall be provided by certification, demonstration, or independent test lab.

4.4.3.1 Harmonics

Requirement Reference Section 3.2.1.2.1

The individual current harmonic distortion (IN) produced by each individual equipment item or subsystem (consisting of several items combined in a single power circuit) shall be measured at the input side of the power distribution where the rack or equipment is attached.

Table 4-2 describes the limits for various size systems. If the load exceeds 40,000 W, THD shall be under 10%. The individual current harmonic distortion produced by each individual equipment item or subsystem shall be less than the limits shown in Table 4-2.

Table 4-2. Limits of Individual Harmonics

Harmonic Order	Maximum Limits (mA) 50 < W ≤ 600 (1 phase)	Maximum Limits (mA) 600 < W < 40,000 (1 or 3 phases)[3]
2	1.00 x W	400+ (0.05 x W)
3	3.60 x W	1440+ (1.20 x W)
4	1.00 x W	400+ (0.05 x W)
5	2.00 x W	800+ (0.66 x W)
6	0.50 x W	200+ (0.02 x W)
7	1.50 x W	600+ (0.5 x W)
8	0.50 x W	200+ (0.02 x W)
9	1.00 x W	400+ (0.33 x W)
10	0.10 x W	100+ (0.01 x W)
11	0.60 x W	240+ (0.20 x W)
12	0.10 x W	100+ (0.01 x W)
13	0.51 x W	203+ (0.17 x W)
14	0.10 x W	50+ (0.01 x W)
15	0.44 x W	176+ (0.15 x W)
16	0.10 x W	50+ (0.01 x W)
17	0.39 x W	155+ (0.13 x W)
18	0.10 x W	50+ (0.01 x W)
19	0.35 x W	139+ (0.12 x W)
20	0.10 x W	50+ (0.01 x W)

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Notes:
1. W equals power in watts.
2. Power is active power in watts for both single phase and polyphase circuit.
3. Maximum THD for W > 40,000 shall be less than 10%.

4.4.3.2 Power Factor

Requirement Reference Section 3.2.1.2.2

All rack power measurements shall be taken at the distribution panel circuit breaker feeding the rack being tested. All standalone equipment power measurements shall be taken at the distribution panel circuit breaker feeding the equipment being tested. For system level, testing shall be performed at the circuit breaker controlling all power for each main power bus system under test.

Power factor (PF) shall be defined as the absolute value of the product of the displacement component of power factor and the distortion component of power factor.

$PF = |PF_{disp} \times PF_{dist}|$

The displacement component of the power factor, PF_{disp}, is equal to the cosine of the angle (θ) between voltage and current, which can be calculated by dividing the power dissipation in W by the apparent power in volt-amperes (VA).

$PF_{disp} = COS(\theta) = W/VA$

The distortion component of the power factor, PF_{dist}, is equal to the reciprocal of the square root of one plus the square of the total harmonic distortion of the equipment (THD) as defined in IEEE STD 519.

$$PF_{dist} = \frac{1}{\sqrt{1 + (THD)^2}}$$

The power factor displacement shall be measured with an appropriate power-factor meter. Test at steady- state RMS operation. The power factor displacement shall be within 0.7 (lag) – 0.7 (lead) measured at the rack, and or standalone equipment, power input location.

4.4.3.3 Inrush Current

Requirement Reference Section 3.2.1.2.3

The following steps shall be followed to conduct inrush current testing:

1. Perform the Inrush current measurement by energizing the load or device within 10° of the positive (80° to 90°), and the negative (260° to 270°) peaks of the sine wave of applied voltage as shown in Figure 4-1.
2. The test voltage source shall be rated at least five times the rating current of equipment under test (full load, steady state current or name plate rating). Total voltage distortion of the source shall not exceed three percent (3%).
3. Connect the cord connected equipment to the test voltage source with the same size, type, and length of cord to be furnished with the load or device under test. Connect all other devices or loads to the test voltage source with 4-foot long conductors sized for their RMS

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current in accordance with NFPA 70. All cords and conductors shall be directly connected to the test voltage source.

4. The ratio of peak inrush current to steady state RMS current shall be equal to or less than theratio defined by Figure 4-2.

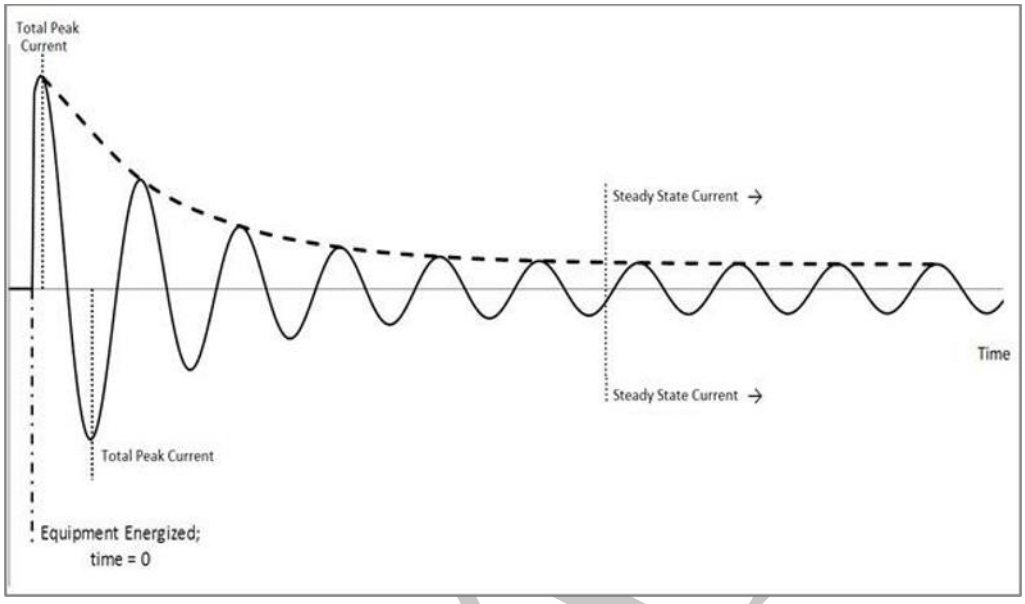

Figure 4-1. Inrush Current Limit Measurements

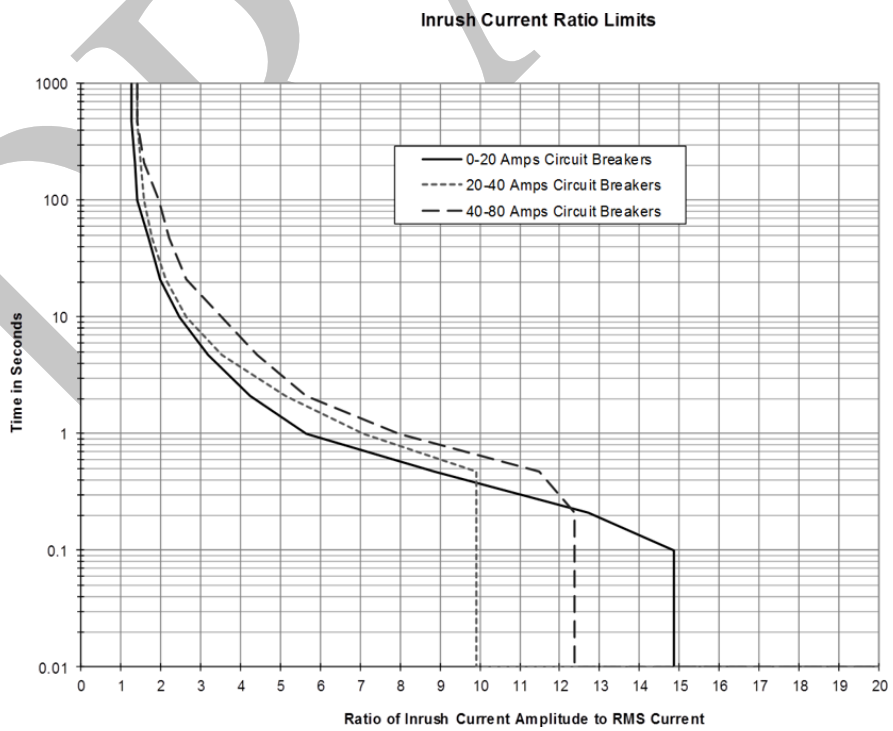

Figure 4-2. Inrush Current Ratio Limits

4.5 Verification Requirements Traceability Matrix (VRTM)

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
1.	3.1	Equipment Comprising an Instrument Landing System (ILS)	-	-		Heading
2.	3.1.a		-	-		Not requirement
3.	3.1.b		-	-		Not requirement
4.	3.1.c		-	-		Not requirement
5.	3.1.d		-	-		Not requirement
6.	3.1.e		-	-		Not requirement
7.	3.1.f		-	-		Not requirement
8.	3.1.g		-	-		Not requirement
9.	3.1.h		-	-		Not requirement
10.	3.2	General System Requirements	-	-		Heading
11.	3.2.1	General Electrical Requirements	-	-		Heading
12.	3.2.1.1	Electrical Power	-	-		Heading
13.	3.2.1.1.a		I			
14.	3.2.1.1.b		I			
15.	3.2.1.1.1	Physical Requirements and Construction	-	-		Heading
16.	3.2.1.1.1.a		I			
17.	3.2.1.1.1.b		I			
18.	3.2.1.1.1.c		-	-		Lead-in shall
19.	3.2.1.1.1.c.1		I			
20.	3.2.1.1.1.c.2		I			
21.	3.2.1.1.1.c.3		I			
22.	3.2.1.1.1.c.4		I			
23.	3.2.1.1.1.d		-	-		Lead-in shall
24.	3.2.1.1.1.d.1		I			
25.	3.2.1.1.1.d.2		-	-		Lead-in
26.	3.2.1.1.1.d.2.i		I			
27.	3.2.1.1.1.d.2.ii		I			
28.	3.2.1.1.1.d.3		I			
29.	3.2.1.1.1.d.4		I			
30.	3.2.1.1.1.d.5		I			
31.	3.2.1.1.1.d.6		I			
32.	3.2.1.1.1.e		I			
33.	3.2.1.1.1.f		I			
34.	3.2.1.1.1.g		I			
35.	3.2.1.2	Power Quality Requirements	-	-		Heading

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
36.	3.2.1.2.1	Harmonics	-	-		Heading
37.	3.2.1.2.1.a		I			
38.	3.2.1.2.1.b		T		4.4.3.1	
39.	3.2.1.2.2	Power Factor Displacement	T		4.4.3.2	
40.	3.2.1.2.3	Inrush Current	-	-		Heading
41.	3.2.1.2.3.a		D			
42.	3.2.1.2.3.b		T		4.4.3.3	
43.	3.2.1.2.3.c		T		4.4.3.3	
44.	3.2.1.3	Protection of Equipment from AC/DC Power Anomalies	-	-		Heading
45.	3.2.1.3.a		I			
46.	3.2.1.3.b		I			
47.	3.2.1.3.c		D			
48.	3.2.1.3.d		D			
49.	3.2.1.3.e		D			
50.	3.2.1.4	Input Power Conditions	-	-		Lead-in
51.	3.2.1.4.a		T			
52.	3.2.1.4.b		T			
53.	3.2.1.4.c		T			
54.	3.2.1.4.d		T			
55.	3.2.1.4.e		T			
56.	3.2.1.4.f		T			
57.	3.2.1.4.g		T			
58.	3.2.1.4.h		T			
59.	3.2.1.5	Lightning and Surge Protection, Grounding, Bonding, and Shielding (LPGBS)	-	-		Heading
60.	3.2.1.5.a		I			
61.	3.2.1.5.b		I			
62.	3.2.1.6	Transformer Isolation of Non-Switching DC Power Supplies	-	-		Heading
63.	3.2.1.6.a		I			
64.	3.2.1.6.b		T			
65.	3.2.1.7	Protection of Outputs of Radio Frequency Equipment, Audio Equipment and Other Electronic Circuits	-	-		Heading
66.	3.2.1.7.a		I			
67.	3.2.1.7.b		D			
68.	3.2.1.7.c		D			
69.	3.2.2	Mechanical	-	-		Heading
70.	3.2.2.1	Removable Parts and Mating Connectors	-	-		Heading
71.	3.2.2.1.a		I			
72.	3.2.2.1.b		I			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
73.	3.2.2.1.c		I			
74.	3.2.2.1.d		I			
75.	3.2.2.1.e		I			
76.	3.2.2.1.f		D			
77.	3.2.2.1.1	Equipment Racks	-	-		Heading
78.	3.2.2.1.1.1	Pullout Drawers	-	-		Heading
79.	3.2.2.1.1.1.a		I			
80.	3.2.2.1.1.1.b		D			
81.	3.2.2.1.1.1.c		I			
82.	3.2.2.1.1.1.d		D			
83.	3.2.2.1.1.2	Rack Panels	-	-		Heading
84.	3.2.2.1.1.2.a		I			
85.	3.2.2.1.1.2.b		I			
86.	3.2.2.1.1.2.c		I			
87.	3.2.2.1.1.2.d		I			
88.	3.2.2.1.2	Shelf Life	I			
89.	3.2.2.1.3	Moisture	I/D			
90.	3.2.2.2	Accessibility	-	-		Heading
91.	3.2.2.2.1	General	-	-		Heading
92.	3.2.2.2.1.a		I			
93.	3.2.2.2.1.b		I			
94.	3.2.2.2.2	Line Replaceable Units (LRUs)	-	-		Heading
95.	3.2.2.2.2.a		I			
96.	3.2.2.2.2.b		D			
97.	3.2.2.2.2.c		I			
98.	3.2.2.2.3	Enclosures	-	-		Heading
99.	3.2.2.2.3.a		I			
100.	3.2.2.2.3.b		I			
101.	3.2.2.2.3.c		I			
102.	3.2.2.2.3.d		I			
103.	3.2.2.2.3.e		I			
104.	3.2.2.2.3.f		D			
105.	3.2.2.2.3.g		I			
106.	3.2.2.2.3.h		I			
107.	3.2.2.2.3.i		I			
108.	3.2.2.2.3.j		I			
109.	3.2.2.3	Thermal Design	-	-		Heading
110.	3.2.2.3.a		I			
111.	3.2.2.3.b		T			
112.	3.2.2.3.c		I			
113.	3.2.2.3.d		I			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
114.	3.2.2.3.e		D			
115.	3.2.2.3.f.		D			
116.	3.2.2.3.g		I			
117.	3.2.2.3.1	Ventilating Fan Motors	-	-		Heading
118.	3.2.2.3.1.a		I			
119.	3.2.2.3.1.b		D			
120.	3.2.2.3.1.c		I			
121.	3.2.3	Characteristics	-	-		Heading
122.	3.2.3.1	Environmental Conditions	-	-		Heading/roll-up shall
123.	3.2.3.1.1	Non-Operating Conditions	-	-		Heading
124.	3.2.3.1.1.1	Non-Operating Temperature Range	T		4.4.1.1.1 4.4.1.1.2	Type test
125.	3.2.3.1.1.2	Non-Operating Altitude	T/A		4.4.1.1.3	Type test
126.	3.2.3.1.1.3	Vibration	T		4.4.1.1.4	Type test
127.	3.2.3.1.1.4	Shock	T		4.4.1.1.5	Type test
128.	3.2.3.1.2	Operating Conditions	-	-		Heading
129.	3.2.3.1.2.1	Seismic Zone Design	-	-		Heading
130.	3.2.3.1.2.1.a		I			
131.	3.2.3.1.2.1.b		I			
132.	3.2.3.1.2.2	Outdoor Temperature	T		4.4.1.2.1 4.4.1.2.2	Type test
133.	3.2.3.1.2.3	Indoor Temperature	T		4.4.1.2.1 4.4.1.2.2	Type test
134.	3.2.3.1.2.4	Rain	T		4.4.1.2.3	
135.	3.2.3.1.2.5	Operating Altitude	A/T		4.4.1.2.4	
136.	3.2.3.1.2.6	Wind Velocity	A/T		4.4.1.2.5	
137.	3.2.3.1.2.7	Ice Loading	A/T		4.4.1.2.5	
138.	3.2.3.1.2.8	Humidity	-	-	4.4.1.2.6	Heading
139.	3.2.3.1.2.8.a		T			Type Test
140.	3.2.3.1.2.8.b		T			Type Test
141.	3.2.3.2	Physical Characteristics	-	-		Heading
142.	3.2.3.2.1	Electronic Equipment Assembly Requirements	-	-		Heading
143.	3.2.3.2.1.a		I			
144.	3.2.3.2.1.b		I			
145.	3.2.3.2.2	Component Mounting	I			
146.	3.2.3.2.3	Printed Circuit Boards	I			
147.	3.2.3.2.4	Assembly	I			
148.	3.2.3.2.5	Wire Wrap	I			
149.	3.2.3.3	Maintainability	-	-		Heading
150.	3.2.3.3.a		D			
151.	3.2.3.3.b		D			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
152.	3.2.3.3.c		D			
153.	3.2.3.3.d		D			
154.	3.2.3.3.e		D			
155.	3.2.3.3.f		I			
156.	3.2.3.3.g		D			
157.	3.2.3.3.h		I			
158.	3.2.3.3.i		D			
159.	3.2.3.3.j		I			
160.	3.2.4	Equipment Design and Construction	-	-		Heading
161.	3.2.4.1	Materials, Processes, and Parts	-	-		Heading
162.	3.2.4.1.1	Materials	-	-		Heading
163.	3.2.4.1.1.1	Dissimilar Metals	-	-		Heading
164.	3.2.4.1.1.1.a		I			
165.	3.2.4.1.1.1.b		I			
166.	3.2.4.1.1.2	Metals, Corrosion Resistance	-	-		Heading
167.	3.2.4.1.1.2.a		I			
168.	3.2.4.1.1.2.b		I			
169.	3.2.4.1.1.2.c		I			
170.	3.2.4.1.1.3	Corrosion-resisting Ferrous Alloys	-			Heading
171.	3.2.4.1.1.3.a		I			
172.	3.2.4.1.1.3.b		I			
173.	3.2.4.1.1.4	Flammable Materials	I			
174.	3.2.4.1.2	Equipment Manufacturing Processes	-	-		Heading
175.	3.2.4.1.2.1	Strain Relief	I			
176.	3.2.4.1.2.2	Painted Finish	-	-		Heading
177.	3.2.4.1.2.2.a		I			
178.	3.2.4.1.2.2.b		I			
179.	3.2.4.1.2.2.c		I			
180.	3.2.4.1.2.2.d		I			
181.	3.2.4.1.2.3	Cadmium Plating	I			
182.	3.2.4.1.3	Electrical Parts	-	-		Heading
183.	3.2.4.1.3.1	Batteries	-	-		Heading
184.	3.2.4.1.3.1.a		I			
185.	3.2.4.1.3.1.b		I/A			
186.	3.2.4.1.3.1.c		I			
187.	3.2.4.1.3.1.d		I			
188.	3.2.4.1.3.1.e		-	-		Lead-in shall
189.	3.2.4.1.3.1.e.1		I			
190.	3.2.4.1.3.1.e.2		I			
191.	3.2.4.1.3.1.e.3		I			
192.	3.2.4.1.3.1.e.4		I			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
193.	3.2.4.1.3.1.e.5		I			
194.	3.2.4.1.3.1.f		I			
195.	3.2.4.1.3.1.g		I			
196.	3.2.4.1.3.2	Circuit Breakers	-	-		Heading
197.	3.2.4.1.3.2.a		I			
198.	3.2.4.1.3.2.b		I			
199.	3.2.4.1.3.2.c		I			
200.	3.2.4.1.3.2.d		D			
201.	3.2.4.1.3.2.e		I			
202.	3.2.4.1.3.2.f		I			
203.	3.2.4.1.3.2.g		I			
204.	3.2.4.1.3.2.h		I/A			
205.	3.2.4.1.3.2.i		I			
206.	3.2.4.1.3.2.j		I			
207.	3.2.4.1.3.2.k		I			
208.	3.2.4.1.3.2.l		I			
209.	3.2.4.1.3.3	Connectors with Thermocouple Contacts	-	-		Heading
210.	3.2.4.1.3.3.a		-	-		Lead-in shall
211.	3.2.4.1.3.3.a.1		I			
212.	3.2.4.1.3.3.a.2		I			
213.	3.2.4.1.3.3.b		I			
214.	3.2.4.1.3.3.c		I			
215.	3.2.4.1.3.4	Power Connectors	-	-		Heading
216.	3.2.4.1.3.4.a		I			
217.	3.2.4.1.3.4.b		I			
218.	3.2.4.1.3.4.c		I			
219.	3.2.4.1.3.4.d		I			
220.	3.2.4.1.3.4.e		I			
221.	3.2.4.1.3.4.f		I			
222.	3.2.4.1.3.5	Fuses	-	-		Heading
223.	3.2.4.1.3.5.a		I			
224.	3.2.4.1.3.5.b		I			
225.	3.2.4.1.3.5.c		I/A			
226.	3.2.4.1.3.5.d		I			
227.	3.2.4.1.3.5.e		I			
228.	3.2.4.1.3.6	Switches	T			
229.	3.2.4.1.3.7	Wiring	-	-		Heading
230.	3.2.4.1.3.7.1	Wiring – Electrical Clearance and Leakage Current	I			
231.	3.2.4.1.3.7.2	Wiring – Marking	-	-		Heading
232.	3.2.4.1.3.7.2.a		I			
233.	3.2.4.1.3.7.2.b		I			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
234.	3.2.4.1.3.7.3	Wiring – Protection	-	-		Heading
235.	3.2.4.1.3.7.3.a		I			
236.	3.2.4.1.3.7.3.b		I			
237.	3.2.4.1.3.7.4	Cable Ducts	I			
238.	3.2.4.1.3.7.5	Wiring – Bend Radius	-	-		Heading
239.	3.2.4.1.3.7.5.a		I			
240.	3.2.4.1.3.7.5.b		I			
241.	3.2.4.1.3.7.6	Wiring – Sleeving	-	-		Heading
242.	3.2.4.1.3.7.6.a		I			
243.	3.2.4.1.3.7.6.b		I			
244.	3.2.4.1.3.7.6.c		I			
245.	3.2.4.1.3.7.7	Wiring – Panel Door Cables	I			
246.	3.2.4.1.3.7.8	Wiring – Through Hole Protection	-	-		Heading
247.	3.2.4.1.3.7.8.a		I			
248.	3.2.4.1.3.7.8.b		I			
249.	3.2.4.1.3.7.8.c		I			
250.	3.2.4.1.3.7.9	Wiring – Arrangement	-	-		Heading
251.	3.2.4.1.3.7.9.a		I			
252.	3.2.4.1.3.7.9.b		I			
253.	3.2.4.1.3.7.9.c		I			
254.	3.2.4.1.3.7.10	Wiring – Slack	I			
255.	3.2.4.1.3.7.11	Wiring – Entrance Cabling	I			
256.	3.2.4.1.3.7.12	Wire	-	-		Heading
257.	3.2.4.1.3.7.12.a		I			
258.	3.2.4.1.3.7.12.b		I			
259.	3.2.4.1.3.7.12.c		I			
260.	3.2.4.1.3.7.12.d		I			
261.	3.2.4.1.3.7.12.e		I			
262.	3.2.4.1.3.7.13	Fungus Protection	I			
263.	3.2.4.1.3.7.14	Aluminum Conductors	I			
264.	3.2.4.1.3.7.15	Termination of Signal and Control Wiring	I			
265.	3.2.4.1.3.7.16	Fiber Optics	I			
266.	3.2.4.1.4	Mechanical Parts	-	-		Heading
267.	3.2.4.1.4.1	Controls and Switches	-	-		Heading
268.	3.2.4.1.4.1.1	Direction of Movement	-	-		Heading
269.	3.2.4.1.4.1.1.a		D			
270.	3.2.4.1.4.1.1.b		D			
271.	3.2.4.1.4.1.2	Operating Controls	I			
272.	3.2.4.1.4.1.3	Adjustment Controls	-	-		Heading
273.	3.2.4.1.4.1.3.a		I			
274.	3.2.4.1.4.1.3.b		I			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
275.	3.2.4.1.4.1.3.c		I			
276.	3.2.4.1.4.1.3.d		D			
277.	3.2.4.1.4.1.4	Operation	-	-		Heading
278.	3.2.4.1.4.1.4.a		I			
279.	3.2.4.1.4.1.4.b		I			
280.	3.2.4.1.4.1.4.c		I			
281.	3.2.4.1.4.1.5	Stops	-	-		Heading
282.	3.2.4.1.4.1.5.a		I			
283.	3.2.4.1.4.1.5.b		I			
284.	3.2.4.1.4.1.6	Locking Devices	-	-		Heading
285.	3.2.4.1.4.1.6.a		I			
286.	3.2.4.1.4.1.6.b		I			
287.	3.2.4.1.4.1.6.c		I			
288.	3.2.4.1.4.1.7	Non-turn Devices	I			
289.	3.2.4.1.4.1.8	Fastener Hardware	-	-		Heading
290.	3.2.4.1.4.1.8.a		I			
291.	3.2.4.1.4.1.8.b		I			
292.	3.2.4.1.4.1.8.c		I			
293.	3.2.4.1.4.1.8.d		I			
294.	3.2.4.1.4.1.8.e		I			
295.	3.2.4.1.4.2	Glass and Glass Fibers	-	-		Heading
296.	3.2.4.1.4.2.a		I			
297.	3.2.4.1.4.2.b		I			
298.	3.2.5	Electromagnetic Compatibility (EMC)/Electromagnetic Interference (EMI)	-	-		Heading
299.	3.2.5.a		T		4.4.2	
300.	3.2.5.b		T			
301.	3.2.5.c		T			
302.	3.2.6	Nameplates and Markings	-	-		Heading
303.	3.2.6.1	Nameplates	-	-		Heading
304.	3.2.6.1.a		I			
305.	3.2.6.1.b		I			
306.	3.2.6.1.c		I			
307.	3.2.6.1.1	Equipment Titles	I			
308.	3.2.6.2	Marking	-	-		Heading
309.	3.2.6.2.a		I			
310.	3.2.6.2.b		I			
311.	3.2.6.2.1	Visibility of Parts Labels	I			
312.	3.2.6.2.1.1	Fuse Positions	I			
313.	3.2.6.2.1.2	Terminal Strips, Blocks, and Wafer Switches	I			
314.	3.2.6.2.1.3	Controls and Indicating Devices	-	-		Heading

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
315.	3.2.6.2.1.3.a		I			
316.	3.2.6.2.1.3.b		I			
317.	3.2.7	Interchangeability	-	-		Heading
318.	3.2.7.a		I			
319.	3.2.7.b		I			
320.	3.2.8	Personnel Safety and Health	-	-		Heading
321.	3.2.8.a		I/A			
322.	3.2.8.b		A			
323.	3.2.8.c		D			
324.	3.2.8.d		D			
325.	3.2.8.1	Electrical Safety	-	-		Heading
326.	3.2.8.1.a		I			
327.	3.2.8.1.b		T			
328.	3.2.8.1.c		I			
329.	3.2.8.1.1	Ground Potential	-	-		Heading
330.	3.2.8.1.1.a		I			
331.	3.2.8.1.1.b		I			
332.	3.2.8.1.1.c		I			
333.	3.2.8.1.1.d		I			
334.	3.2.8.1.1.e		I			
335.	3.2.8.1.2	Hinged or Slide Mounted Panels and Doors	I			
336.	3.2.8.1.3	Shielding	-	-		Heading
337.	3.2.8.1.3.a		I			
338.	3.2.8.1.3.b		I			
339.	3.2.8.1.4	Guarding of Radio Frequency (RF) Voltages	I			
340.	3.2.8.1.5	Electrical Interlocks	-	-		Heading
341.	3.2.8.1.5.a		I			
342.	3.2.8.1.5.b		I			
343.	3.2.8.1.5.c		I			
344.	3.2.8.1.5.d		I			
345.	3.2.8.1.6	High Voltage Protection	-	-		Heading
346.	3.2.8.1.6.a		I			
347.	3.2.8.1.6.b		I			
348.	3.2.8.1.6.c		I			
349.	3.2.8.1.6.d		I			
350.	3.2.8.1.7	High Current Protection	I			
351.	3.2.8.1.8	Electrical Connectors	-	-		Heading
352.	3.2.8.1.8.a		I			
353.	3.2.8.1.8.b		I			
354.	3.2.8.2	Mechanical Hazards	-	-		Heading
355.	3.2.8.2.a		I			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
356.	3.2.8.2.b		I			
357.	3.2.8.2.c		I			
358.	3.2.8.2.1	Mechanical Interconnection	I			
359.	3.2.8.3	Markings, Signs, Tags, and Symbols	-	-		Heading
360.	3.2.8.3.1	Markings	-	-		Heading
361.	3.2.8.3.1.a		I			
362.	3.2.8.3.1.b		I			
363.	3.2.8.3.1.c		I			
364.	3.2.8.3.1.d		I			
365.	3.2.8.3.2	Accident Prevention Signs and Labels	-	-		Heading
366.	3.2.8.3.2.a		I			
367.	3.2.8.3.2.b		I			
368.	3.2.8.3.2.1	Sign Design	-	-		Heading/lead- in shall
369.	3.2.8.3.2.1.a		I			
370.	3.2.8.3.2.1.b		I			
371.	3.2.8.3.2.1.c		I			
372.	3.2.8.3.2.1.d		I			
373.	3.2.8.3.2.1.e		I			
374.	3.2.8.3.2.1.f		I			
375.	3.2.8.3.2.1.g		I			
376.	3.2.8.3.2.2	Sign Classifications and Detailed Design	-	-		Heading
377.	3.2.8.3.2.2.1	Class I (Danger)	-	-		Heading
378.	3.2.8.3.2.2.1.a		I			
379.	3.2.8.3.2.2.1.b		I			
380.	3.2.8.3.2.2.1.c		I			
381.	3.2.8.3.2.2.2	Class II (Caution)	-	-		Heading
382.	3.2.8.3.2.2.2.a		I			
383.	3.2.8.3.2.2.2.b		I			
384.	3.2.8.3.2.2.2.c		I			
385.	3.2.8.3.2.2.3	Class III (General Safety)	-	-		Heading
386.	3.2.8.3.2.2.3.a		I			
387.	3.2.8.3.2.2.3.b		I			
388.	3.2.8.3.2.2.3.c		I			
389.	3.2.8.3.2.2.4	Class IV (Fire and Emergency)	-	-		Heading
390.	3.2.8.3.2.2.4.a		I			
391.	3.2.8.3.2.2.4.b		I			
392.	3.2.8.3.2.2.4.c		I			
393.	3.2.8.3.2.3	Sign Placement	-	-		Heading
394.	3.2.8.3.2.3.a		I			
395.	3.2.8.3.2.3.b		I			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
396.	3.2.8.3.3	Symbols	-	-		Heading/lead-in shall
397.	3.2.8.3.3.a		I			
398.	3.2.8.3.3.b		I			
399.	3.2.8.3.4	Display Warnings	-	-		Heading
400.	3.2.8.3.4.a		I			
401.	3.2.8.3.4.b		I			
402.	3.2.8.4	Dusts, Mists, Fumes, and Gases	-	-		Heading
403.	3.2.8.4.a		I			
404.	3.2.8.4.b		I			
405.	3.2.8.4.c		I			
406.	3.2.8.5	Restricted Materials	I			
407.	3.2.8.6	Seismic Safety	I			
408.	3.2.9	Human Engineering	-	-		Heading
409.	3.2.9.1	Noise Hazards	-	-		Heading
410.	3.2.9.1.a		T			
411.	3.2.9.1.b		T			
412.	3.2.9.1.c		T			
413.	3.2.9.1.d		I			
414.	3.2.9.2	Visual Display Information	-	-		Heading
415.	3.2.9.2.a		I			
416.	3.2.9.2.b		I			
417.	3.2.9.2.c		I			
418.	3.2.9.2.d		I			
419.	3.2.9.2.1	Display Positive Feedback	I			
420.	3.2.9.2.2	Flash	-	-		Heading
421.	3.2.9.2.2.a		I			
422.	3.2.9.2.2.b		I			
423.	3.2.10	System Performance	-	-		Heading
424.	3.2.10.a			T		Flight Test
425.	3.2.10.b			T		Flight Test
426.	3.2.10.c			T		Flight Test
427.	3.2.10.d			T		Flight Test
428.	3.2.11	Controls and Indicators	-	-		Heading
429.	3.2.11.1	Front Panel	-	-		Heading
430.	3.2.11.1.1	Controls	-	-		Heading/lead-in shall
431.	3.2.11.1.1.a		I			
432.	3.2.11.1.1.b		I			
433.	3.2.11.1.1.c		I			
434.	3.2.11.1.1.d		I			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
435.	3.2.11.1.1.e		I			
436.	3.2.11.1.1.f		I			
437.	3.2.11.1.1.g		I			
438.	3.2.11.1.1.h		I			Lead-in shall
439.	3.2.11.1.1.h.1		D			
440.	3.2.11.1.1.h.2		D			
441.	3.2.11.1.1.i		I			Lead-in shall
442.	3.2.11.1.1.i.1		D			
443.	3.2.11.1.1.i.2		D			
444.	3.2.11.1.1.j		I			
445.	3.2.11.1.1.k		I			
446.	3.2.11.1.2	Status and Indicators	-	-		Heading
447.	3.2.11.1.2.a		I			Lead-in shall
448.	3.2.11.1.2.a.1		I			
449.	3.2.11.1.2.a.2		I			
450.	3.2.11.1.2.a.3		I			
451.	3.2.11.1.2.a.4		I			
452.	3.2.11.1.2.a.5		I			
453.	3.2.11.1.2.a.6		I			
454.	3.2.11.1.2.a.7		I			
455.	3.2.11.1.2.a.8		I			
456.	3.2.11.1.2.b		-			Lead-in shall
457.	3.2.11.1.2.b.1		I			
458.	3.2.11.1.2.b.2		I			
459.	3.2.11.1.2.b.3		I			
460.	3.2.11.1.2.c		I			
461.	3.2.11.1.3	Display and Adjustment of Parameters	-	-		Heading
462.	3.2.11.1.3.a		I			
463.	3.2.11.1.3.b		I			
464.	3.2.11.1.3.c		I			
465.	3.2.11.1.3.d		I			
466.	3.2.11.1.3.e		I			
467.	3.2.11.2	Use of a Portable Maintenance Data Terminal (PMDT)	I			
468.	3.2.11.2.1	PMDT Requirements on Human Factors	-	-		Heading
469.	3.2.11.2.1.1	Screen Design	-	-		Heading
470.	3.2.11.2.1.1.a		I			
471.	3.2.11.2.1.1.b		I			
472.	3.2.11.2.1.1.c		I			
473.	3.2.11.2.1.1.d		I			
474.	3.2.11.2.1.1.e		I			
475.	3.2.11.2.1.1.f		I			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
476.	3.2.11.2.1.2	Task Entry and Display	-	-		Heading
477.	3.2.11.2.1.2.a		I			
478.	3.2.11.2.1.2.b		I			
479.	3.2.11.2.1.2.c		I			
480.	3.2.11.2.1.3	Graphical Information	I			
481.	3.2.11.2.1.4	Coding	-	-		Heading
482.	3.2.11.2.1.4.a		I			
483.	3.2.11.2.1.4.b		-	-		Lead-in shall
484.	3.2.11.2.1.4.b.1		I			
485.	3.2.11.2.1.4.b.2		I			
486.	3.2.11.2.1.4.b.3		I			
487.	3.2.11.2.1.4.b.4		I			
488.	3.2.11.2.1.4.b.5		I			
489.	3.2.11.2.1.4.b.6		I			
490.	3.2.11.2.1.5	Interaction	-	-		Heading
491.	3.2.11.2.1.5.a		I			
492.	3.2.11.2.1.5.b		I			
493.	3.2.11.2.1.6	User-Initiated Interrupts	I			
494.	3.2.11.2.1.7	File Management	I			
495.	3.2.11.2.1.8	Controls	-	-		Heading
496.	3.2.11.2.1.8.a		I			
497.	3.2.11.2.1.8.b		I			
498.	3.2.11.2.1.8.c		I			
499.	3.2.11.2.1.8.d		I			
500.	3.2.11.2.1.8.e		I			
501.	3.2.11.2.1.8.f		I			
502.	3.2.11.2.1.8.g		I			
503.	3.2.11.2.1.8.h		I			
504.	3.2.11.2.1.8.i		I			
505.	3.2.11.2.1.9	Windows	-	-		Heading
506.	3.2.11.2.1.9.a		I			
507.	3.2.11.2.1.9.b		I			
508.	3.2.11.2.1.9.c		I			
509.	3.2.11.2.1.10	System Operations	-	-		Heading
510.	3.2.11.2.1.10.a		I			
511.	3.2.11.2.1.10.b		I			
512.	3.2.11.2.1.10.c		I			
513.	3.2.11.2.1.10.d		I			
514.	3.2.11.2.1.10.e		I			
515.	3.2.11.2.1.10.f		I			
516.	3.2.11.2.1.10.g		I			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
517.	3.2.11.2.1.10.h		I			
518.	3.2.11.2.1.10.i		I			
519.	3.2.11.2.1.10.j		I			
520.	3.2.11.2.1.10.k		I			
521.	3.2.11.2.1.10.l		I			
522.	3.2.11.3	Parameter Resolution	-	-		Heading
523.	3.2.11.3.a		I			
524.	3.2.11.3.b		I			
525.	3.2.11.4	Adjustment and Storage of Entered Parameter Data	-	-		Heading
526.	3.2.11.4.a		I			
527.	3.2.11.4.b		I			
528.	3.2.11.5	Storage of Entered Data	-	-		Heading
529.	3.2.11.5.a		D			
530.	3.2.11.5.b		D			
531.	3.2.11.5.c		D			
532.	3.2.12	Transmitter Internal RF Power Measurement	-	-		Heading
533.	3.2.12.a		I			
534.	3.2.12.b		T			
535.	3.2.13	Standby Power	D			Heading/lead-in shall
536.	3.2.13.a		D			
537.	3.2.13.b		D			
538.	3.2.13.c		D			
539.	3.2.13.d		D			
540.	3.2.13.e		I			
541.	3.2.14	Battery Disconnect Switch and Fuse/Circuit Breaker	-	-		Heading
542.	3.2.14.a		I			
543.	3.2.14.b		I			
544.	3.2.14.c		I			
545.	3.2.14.d		D			
546.	3.2.15	Maintainability of Electronic Equipment	-	-		Heading
547.	3.2.15.1	Corrective Maintenance Requirements	D			Maintainability Demo
548.	3.2.15.2	Preventive Maintenance Requirements	-	-		Heading
549.	3.2.15.2.a		D			Maintainability Demo
550.	3.2.15.2.b		D			Maintainability Demo
551.	3.2.16	Reliability of Electronic Equipment	-	-		Heading
552.	3.2.16.1	Localizer MTBF	A			Reliability Demo
553.	3.2.16.2	Glide Slope MTBF	A			Reliability Demo

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
554.	3.2.16.3	Marker Beacon MTBF	A			Reliability Demo
555.	3.2.16.4	Localizer Far-Field Monitor (FFM) MTBF	A			Reliability Demo
556.	3.2.16.5	Remote Control Subsystem MTBF	A			Reliability Demo
557.	3.2.17	Continuity of Service	-	-		Heading
558.	3.2.17.a		A/D			COS Demo
559.	3.2.17.b		A/D			COS Demo
560.	3.2.17.c		A/D			COS Demo
561.	3.2.17.d		A/D			COS Demo
562.	3.2.18	Integrity of Signal	-	-		Heading
563.	3.2.18.a		A			
564.	3.2.18.b		A			
565.	3.2.18.c		A			
566.	3.2.18.d		A			
567.	3.2.19	Failsafe	D			Failsafe Demo
568.	3.2.20	Antenna Support Structure Design	-	-		Heading
569.	3.2.20.a		I			
570.	3.2.20.b		I			
571.	3.2.20.c		I			
572.	3.2.20.d		I			
573.	3.2.20.e		I			
574.	3.2.20.f		I			
575.	3.2.21	Dual Equipment	I/A/D/T			Roll-up
576.	3.2.22	Security Requirements	-	-		Heading
577.	3.2.22.1	Data Security	D			Heading/lead-in shall
578.	3.2.22.1.a		D			
579.	3.2.22.1.b		D			
580.	3.2.22.1.c		D			
581.	3.2.22.1.d		D			
582.	3.2.22.1.e		D			
583.	3.2.22.1.f		D			
584.	3.2.22.1.g		D			
585.	3.2.22.1.h		D			
586.	3.2.22.1.i		D			
587.	3.3	Localizer Equipment Requirements	I			
588.	3.3.1	VHF Localizer Subsystem	-	-		Heading/lead-in shall
589.	3.3.1.a		I			
590.	3.3.1.b		I			
591.	3.3.1.c		I			
592.	3.3.1.d		I			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
593.	3.3.1.e		I			
594.	3.3.2	VHF Localizer Station Performance	-	-		Heading
595.	3.3.2.a			D		
596.	3.3.2.b			D		
597.	3.3.2.c			D		
598.	3.3.2.d			D		
599.	3.3.2.1	Coverage	-	-		Heading
600.	3.3.2.1.a		A	D		Flight Test
601.	3.3.2.1.b		A	D		Flight Test
602.	3.3.2.1.c		A	D		Flight Test
603.	3.3.2.1.d		A	D		Flight Test
604.	3.3.2.3	Course Alignment Accuracy	A	D		
605.	3.3.2.4	Displacement Sensitivity	-	-		Heading
606.	3.3.2.4.a			T		Flight Test
607.	3.3.2.4.b			T		Flight Test
608.	3.3.2.4.c			T		Flight Test
609.	3.3.2.4.d			T		Flight Test
610.	3.3.2.4.e			T		Flight Test
611.	3.3.2.4.f			T		Flight Test
612.	3.3.2.5	Course Sector Width	-	-		Heading
613.	3.3.2.5.a		A	D		
614.	3.3.2.5.b		A	D		
615.	3.3.2.6	Automatic Changeover Unit (Dual Transmitter/Monitor Systems Only)	-	-		Heading
616.	3.3.2.6.a		I			
617.	3.3.2.6.b		D			
618.	3.3.3	Localizer Transmitter	-	-		Heading and non-shall lead-in
619.	3.3.3.1	Radio Frequency	-	-		Heading
620.	3.3.3.1.a		I			
621.	3.3.3.1.b		D			
622.	3.3.3.1.c		D			
623.	3.3.3.1.d		D			
624.	3.3.3.2	Modulation	D			
625.	3.3.3.3	Identification	-	-		Heading
626.	3.3.3.3.a		D			
627.	3.3.3.3.b		T	D		Flight Test
628.	3.3.3.3.c		I			
629.	3.3.3.3.d		D			
630.	3.3.3.3.e		I			
631.	3.3.3.3.f		D			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
632.	3.3.3.3.g		D			
633.	3.3.3.3.h		I			
634.	3.3.3.4	Transmitter Output Power and Adjustment	-	-		Heading
635.	3.3.3.4.a			T		Flight Test
636.	3.3.3.4.b		D			
637.	3.3.3.4.c		D			
638.	3.3.3.4.d		-	-		Lead-In
639.	3.3.3.4.d.1		D			
640.	3.3.3.4.d.2		D			
641.	3.3.3.4.d.3		D			
642.	3.3.3.4.d.4		D			
643.	3.3.3.5	Transmitter Stability	-	-		Heading/lead-in shall
644.	3.3.3.5.a		T			Type Test
645.	3.3.3.5.b		T			Type Test
646.	3.3.3.5.c		T			Type Test
647.	3.3.3.5.d		T			Type Test
648.	3.3.3.5.e		T			Type Test
649.	3.3.3.5.f		T			Type Test
650.	3.3.3.5.g		T			Type Test
651.	3.3.3.5.h		T			Type Test
652.	3.3.3.6	Power-on Stabilization Time	T			
653.	3.3.3.6.1	Hot Standby Transmitter	I			
654.	3.3.3.7	Audio Phase of Modulation Tones	-	-		Heading
655.	3.3.3.7.a		D			
656.	3.3.3.7.b		D			
657.	3.3.3.7.c		D			
658.	3.3.3.8	Carrier Modulation	-	-		Heading
659.	3.3.3.8.a		D			
660.	3.3.3.8.b		T			
661.	3.3.3.8.c		T			
662.	3.3.3.9	Distortion of Demodulated Navigation Tones	-	-		Heading
663.	3.3.3.9.a		D			
664.	3.3.3.9.b		D			
665.	3.3.3.10	Modulation Balance Adjustment	-	-		Heading
666.	3.3.3.10.a		I			
667.	3.3.3.10.b		D			
668.	3.3.3.10.c		D			
669.	3.3.3.11	Identification Keyer	-	-		Heading
670.	3.3.3.11.a		D			
671.	3.3.3.11.b		-	-		Lead-in shall

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
672.	3.3.3.11.b.1		D			
673.	3.3.3.11.b.2		D			
674.	3.3.3.11.b.3		D			
675.	3.3.3.11.b.4		D			
676.	3.3.3.11.c		T			Type Test
677.	3.3.3.11.d		D			
678.	3.3.3.11.e		D			
679.	3.3.3.11.f		I			
680.	3.3.3.12	Sideband Amplitude Adjustment	-	-		Heading
681.	3.3.3.12.a		A			
682.	3.3.3.12.b		T			
683.	3.3.3.13	RF Phase Adjustment	-	-		Heading
684.	3.3.3.13.a		I			
685.	3.3.3.13.b		D			
686.	3.3.3.14	Carrier Signal at Sideband Output	D			
687.	3.3.3.15	Power and Modulation Measurements	-	-		Heading
688.	3.3.3.15.a		I			
689.	3.3.3.15.b		-	-		Lead-in shall
690.	3.3.3.15.b.1		I			
691.	3.3.3.15.b.2		I			
692.	3.3.3.15.b.3		I			
693.	3.3.3.15.b.4		I			
694.	3.3.3.15.c		-	-		Lead-in shall
695.	3.3.3.15.c.1		D			
696.	3.3.3.15.c.2		D			
697.	3.3.3.16	DME Keying Output	-	-		Heading
698.	3.3.3.16.a		I			
699.	3.3.3.16.b		D			
700.	3.3.3.16.c		I			
701.	3.3.3.16.d		-	-		Lead-in shall
702.	3.3.3.16.d.1		D			
703.	3.3.3.16.d.2		D			
704.	3.3.3.16.d.3		D			
705.	3.3.3.16.e		-	-		Lead-in shall
706.	3.3.3.16.e.1		D			
707.	3.3.3.16.e.2		D			
708.	3.3.3.16.f		I			
709.	3.3.3.17	Display of Performance Parameters	-	-		Heading
710.	3.3.3.17.a		-	-		Lead-in shall
711.	3.3.3.17.a.1		I			
712.	3.3.3.17.a.2		I			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
713.	3.3.3.17.a.3		I			
714.	3.3.3.17.a.4		I			
715.	3.3.3.17.a.5		I			
716.	3.3.3.17.a.6		I			
717.	3.3.3.17.a.7		I			
718.	3.3.3.17.a.8		I			
719.	3.3.3.17.b		-	-		Lead-in
720.	3.3.3.17.b.1		I			
721.	3.3.3.17.b.2		I			
722.	3.3.3.17.b.3		I			
723.	3.3.3.17.b.4		I			
724.	3.3.3.17.b.5		I			
725.	3.3.3.17.b.6		I			
726.	3.3.3.17.c		I			
727.	3.3.4	Localizer Antenna Array	-	-		Heading/lead-in
728.	3.3.4.a		I			Definitions
729.	3.3.4.b		I			
730.	3.3.4.c		I			
731.	3.3.4.d		I			
732.	3.3.4.1	Localizer Antenna Hardware	-	-		Heading/lead-in shall
733.	3.3.4.1.a		I			
734.	3.3.4.1.b		I			
735.	3.3.4.1.c		I			
736.	3.3.4.1.d		I			
737.	3.3.4.1.e		I			
738.	3.3.4.1.f		I			
739.	3.3.4.1.g		I			
740.	3.3.4.1.h		I			
741.	3.3.4.2	Frequency Range	D			
742.	3.3.4.3	Polarization	-	-		Heading
743.	3.3.4.3.a		I			
744.	3.3.4.3.b			T		Flight Test
745.	3.3.4.4	Intercoupling	D			
746.	3.3.4.5	RF Distribution Unit	-	-		Heading
747.	3.3.4.5.a		D			
748.	3.3.4.5.b		D			
749.	3.3.4.5.1	Convenience Outlet and Work Light	-	-		Heading
750.	3.3.4.5.1.a		I			
751.	3.3.4.5.1.b		I			
752.	3.3.4.5.1.c		I			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
753.	3.3.4.5.1.d		I			
754.	3.3.4.5.1.e		I			
755.	3.3.4.6	Horizontal RF Radiation Pattern Characteristics	-	-		Heading
756.	3.3.4.6.a		A			
757.	3.3.4.6.b		A			
758.	3.3.4.6.c		A			
759.	3.3.4.6.d		A			
760.	3.3.4.6.e		A			
761.	3.3.4.6.f		A			
762.	3.3.4.6.f.1		A			
763.	3.3.4.6.f.2		A			
764.	3.3.4.6.f.3		A			
765.	3.3.4.6.f.4		A			
766.	3.3.4.6.f.5		A			
767.	3.3.4.7	Clearance Sector DDM Performance	-	-		Heading
768.	3.3.4.7.a		A			
769.	3.3.4.7.b		A			
770.	3.3.4.7.c		A			
771.	3.3.4.7.d		A			
772.	3.3.4.8	Course Width Adjustment	D			
773.	3.3.4.9	Vertical Radiation	A			
774.	3.3.4.10	Antenna Monitor Probes	-	-		Heading
775.	3.3.4.10.a		D			
776.	3.3.4.10.b		D			
777.	3.3.4.10.c		D			
778.	3.3.4.10.d		D			
779.	3.3.4.10.1	Monitored Azimuths	-	-		Heading
780.	3.3.4.10.1.a		D			
781.	3.3.4.10.1.b		D			
782.	3.3.4.10.1.c		D			
783.	3.3.4.10.1.d		D			
784.	3.3.4.10.1.e		D			
785.	3.3.4.10.2	In-Line Phasing Detector	-	-		Heading
786.	3.3.4.10.2.a		D			
787.	3.3.4.10.2.b		D			
788.	3.3.4.10.2.c		D			
789.	3.3.4.10.3	Monitor Probe Stability	-	-		Heading/lead-in shall
790.	3.3.4.10.3.a		T			Type Test
791.	3.3.4.10.3.b		T			Type Test
792.	3.3.4.10.3.c		T			Type Test

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
793.	3.3.4.11	Mechanical Design and Frangibility	-	-		Heading/lead-in shall
794.	3.3.4.11.a		A			
795.	3.3.4.11.b		A			
796.	3.3.4.11.b.1		A			
797.	3.3.4.11.b.2		A			
798.	3.3.4.11.c		I			
799.	3.3.4.11.1	Array Height	I			
800.	3.3.4.11.2	Wind and Ice Loading	A/D		4.4.1.2.5	
801.	3.3.4.11.3	Reflectors or Screens	I			
802.	3.3.4.11.4	Environmentally Resistant Design and Construction	-	-		Heading
803.	3.3.4.11.4.a		I			
804.	3.3.4.11.4.b		I			
805.	3.3.4.11.4.c		I			
806.	3.3.4.11.5	Array Mounting	-	-		Heading
807.	3.3.4.11.5.a		I			
808.	3.3.4.11.5.b		I			
809.	3.3.5	Localizer Monitor	-	-		Heading
810.	3.3.5.a		D			
811.	3.3.5.b		D			
812.	3.3.5.c		D			
813.	3.3.5.d		D			
814.	3.3.5.e		T			
815.	3.3.5.e.1		T			
816.	3.3.5.e.2		T			
817.	3.3.5.e.3		T			
818.	3.3.5.f		D			
819.	3.3.5.1	Single Equipment Monitoring	-	-		Heading
820.	3.3.5.1.a		I			
821.	3.3.5.1.b		T			
822.	3.3.5.2	Dual Equipment Monitoring	-	-		Heading
823.	3.3.5.2.a		I			
824.	3.3.5.2.b		T			
825.	3.3.5.2.c		T			
826.	3.3.5.2.d		T			
827.	3.3.5.2.1	Hot Standby Monitoring	-	-		Heading
828.	3.3.5.2.1.a		D			
829.	3.3.5.2.1.b		D			
830.	3.3.5.3	Monitored Parameters	-	-		Heading
831.	3.3.5.3.1	Course Position	-	-		Heading
832.	3.3.5.3.1.a		T			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
833.	3.3.5.3.1.b		I			
834.	3.3.5.3.1.c		D			
835.	3.3.5.3.1.d		D			
836.	3.3.5.3.2	Course Width	-	-		Heading
837.	3.3.5.3.2.a		T			
838.	3.3.5.3.2.b		I			
839.	3.3.5.3.2.c		D			
840.	3.3.5.3.2.d		D			
841.	3.3.5.3.3	Course RF Level	-	-		Heading
842.	3.3.5.3.3.a		T			
843.	3.3.5.3.3.b		I			
844.	3.3.5.3.3.c		D			
845.	3.3.5.3.3.d		D			
846.	3.3.5.3.4	Clearance 1 and 2 RF Levels	-	-		Heading
847.	3.3.5.3.4.a		T			
848.	3.3.5.3.4.b		I			
849.	3.3.5.3.4.c		D			
850.	3.3.5.3.4.d		D			
851.	3.3.5.3.5	Course SDM	-	-		Heading
852.	3.3.5.3.5.a		T			
853.	3.3.5.3.5.b		I			
854.	3.3.5.3.5.c		D			
855.	3.3.5.3.5.d		D			
856.	3.3.5.3.6	Clearance SDM	-	-		Heading
857.	3.3.5.3.6.a		T			
858.	3.3.5.3.6.b		I			
859.	3.3.5.3.6.c		D			
860.	3.3.5.3.6.d		D			
861.	3.3.5.3.7	Clearance Width 1 and 2	-	-		Heading
862.	3.3.5.3.7.a		T			
863.	3.3.5.3.7.b		I			
864.	3.3.5.3.7.c		D			
865.	3.3.5.3.7.d		D			
866.	3.3.5.3.8	Course Width RF Level	-	-		Heading
867.	3.3.5.3.8.a		T			
868.	3.3.5.3.8.b		I			
869.	3.3.5.3.8.c		D			
870.	3.3.5.3.8.d		D			
871.	3.3.5.3.9	Course Width SDM	-	-		Heading
872.	3.3.5.3.9.a		T			
873.	3.3.5.3.9.b		I			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
874.	3.3.5.3.9.c		D			
875.	3.3.5.3.9.d		D			
876.	3.3.5.3.10	Clearance Width 1 and 2 SDM	-	-		Heading
877.	3.3.5.3.10.a		T			
878.	3.3.5.3.10.b		I			
879.	3.3.5.3.10.c		D			
880.	3.3.5.3.10.d		D			
881.	3.3.5.3.11	Course/Clearance RF Level Ratio	-	-		Heading
882.	3.3.5.3.11.a		T			
883.	3.3.5.3.11.b		I			
884.	3.3.5.3.11.c		D			
885.	3.3.5.3.11.d		D			
886.	3.3.5.3.12	Course/Clearance Frequency Difference	-	-		Heading
887.	3.3.5.3.12.a		T			
888.	3.3.5.3.12.b		I			
889.	3.3.5.3.12.c		D			
890.	3.3.5.3.12.d		D			
891.	3.3.5.3.13	Course and Clearance Ident Modulation	-	-		Heading
892.	3.3.5.3.13.a		T			
893.	3.3.5.3.13.b		I			
894.	3.3.5.3.13.c		D			
895.	3.3.5.3.13.d		D			
896.	3.3.5.3.14	Course and Clearance Ident Fault	-	-		Heading
897.	3.3.5.3.14.a		T			
898.	3.3.5.3.14.b		T			
899.	3.3.5.3.15	Cable Fault	-	-		Heading
900.	3.3.5.3.15.a		T			
901.	3.3.5.3.15.b		T			
902.	3.3.5.3.15.c		T			
903.	3.3.5.4	Monitor Action	-	-		Heading
904.	3.3.5.4.a		-	-		Lead-in shall
905.	3.3.5.4.a.1		T			
906.	3.3.5.4.a.2		T			
907.	3.3.5.4.a.3		T			
908.	3.3.5.4.b		D			
909.	3.3.5.4.1	Single Equipment Response to Monitor Alarm	-	-		Heading/lead-in shall
910.	3.3.5.4.1.a		T			
911.	3.3.5.4.1.b		T			
912.	3.3.5.4.1.c		T			
913.	3.3.5.4.1.d		T			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
914.	3.3.5.4.1.d.1		T			
915.	3.3.5.4.1.d.2		T			
916.	3.3.5.4.1.d.3		T			
917.	3.3.5.4.1.d.4		T			
918.	3.3.5.4.1.e		T			
919.	3.3.5.4.1.f		D			
920.	3.3.5.4.1.g		D			
921.	3.3.5.4.2	Dual Equipment Response to Monitor Alarm	-	-		Heading/lead-in shall
922.	3.3.5.4.2.a		T			
923.	3.3.5.4.2.b		T			
924.	3.3.5.4.2.c		T			
925.	3.3.5.4.2.d		T			
926.	3.3.5.4.2.e		T			
927.	3.3.5.4.2.f		T			
928.	3.3.5.4.2.f.1		T			
929.	3.3.5.4.2.f.2		T			
930.	3.3.5.4.2.f.3		T			
931.	3.3.5.4.3	Fault Detected by a Single Monitor (Dual Monitor Systems)	-	-		Heading/lead-in shall
932.	3.3.5.4.3.a		T			
933.	3.3.5.4.3.b		T			
934.	3.3.5.4.4	Monitor Action Delay	D			
935.	3.3.5.4.5	Shutdown Timing Test	I			
936.	3.3.5.5	Localizer Monitor Stabilization Time	D			
937.	3.3.5.6	Localizer Monitor Interference Immunity	-	-		Heading
938.	3.3.5.6.a		-	-		Lead-in Shall
939.	3.3.5.6.a.1		T			
940.	3.3.5.6.a.2		T			
941.	3.3.5.6.b		T			
942.	3.3.5.6.c		-	-		Lead-in Shall
943.	3.3.5.6.c.1		T			
944.	3.3.5.6.c.2		T			
945.	3.3.5.6.c.3		T			
946.	3.3.5.6.c.4		T			
947.	3.3.5.6.d		T			
948.	3.3.6	Localizer Far-Field Monitor (FFM) Subsystem	-	-		Heading/non-shall
949.	3.3.6.1	FFM General Requirements	-	-		Heading/lead-in shall
950.	3.3.6.1.a		I			
951.	3.3.6.1.b		I			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
952.	3.3.6.1.c		I			
953.	3.3.6.1.d		I			
954.	3.3.6.1.e		I			
955.	3.3.6.1.f		I			
956.	3.3.6.2	Monitor Limit Adjustments	D			
957.	3.3.6.3	Fault Condition	T			
958.	3.3.6.4	Alert Status Filtering	-	-		Heading/lead-in shall
959.	3.3.6.4.a		T			
960.	3.3.6.4.b		T			
961.	3.3.6.5	FFM Control and Status Display	-	-		Heading/lead-in shall
962.	3.3.6.5.a					
963.	3.3.6.5.b					
964.	3.3.6.6	Time Delay and Reset	-	-		Heading
965.	3.3.6.6.a		I			
966.	3.3.6.6.b		T			
967.	3.3.6.6.c		T			
968.	3.3.6.6.d		D			
969.	3.3.6.7	FFM Receiver Performance	-	-		Heading/lead-in shall
970.	3.3.6.7.a		T			
971.	3.3.6.7.b		I			
972.	3.3.6.7.c		T			
973.	3.3.6.7.d		T			
974.	3.3.6.7.e		T			
975.	3.3.6.7.f		T			
976.	3.3.6.7.g		T			
977.	3.3.6.7.h		-	-		Lead-in
978.	3.3.6.7.h.1		T			
979.	3.3.6.7.h.2		T			
980.	3.3.6.7.h.3		T			
981.	3.3.6.7.i		T			
982.	3.3.6.7.j		T			
983.	3.3.6.7.k		-	-		Lead-in
984.	3.3.6.7.k.1		T			
985.	3.3.6.7.k.2		T			
986.	3.3.6.7.l		-	-		Lead-in
987.	3.3.6.7.l.1		T			
988.	3.3.6.7.l.2		T			
989.	3.3.6.7.m		T			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
990.	3.3.6.7.n		T			
991.	3.3.6.8	FFM Equipment Enclosures	-	-		Heading
992.	3.3.6.8.a		I			
993.	3.3.6.8.b		I			
994.	3.3.6.9	FFM Battery Shelf	-	-		Heading
995.	3.3.6.9.a		I			
996.	3.3.6.9.b		I			
997.	3.3.6.9.c		I			
998.	3.4	UHF Glide Slope System Configurations (General)	-	-		Heading/non-shall
999.	3.4.1	Glide Slope Configurations	-	-		Heading/lead-in shall
1000.	3.4.1.a		I			
1001.	3.4.1.b		I			
1002.	3.4.1.c		I			
1003.	3.4.1.d		I			
1004.	3.4.2	UHF Glide Slope Subsystem Performance	-	-		Heading/non-shall
1005.	3.4.2.a			D		
1006.	3.4.2.b			D		
1007.	3.4.2.c			D		
1008.	3.4.2.d			D		
1009.	3.4.2.e			D		
1010.	3.4.2.1	Coverage	-	-		Heading
1011.	3.4.2.1.a		A	D		Flight Test
1012.	3.4.2.1.a.1		A	D		Flight Test
1013.	3.4.2.1.a.2		A	D		Flight Test
1014.	3.4.2.1.a.3		A	D		Flight Test
1015.	3.4.2.1.b		A	D		Flight Test
1016.	3.4.2.1.b.1		A	D		Flight Test
1017.	3.4.2.1.b.2		A	D		Flight Test
1018.	3.4.2.1.b.3		A	D		Flight Test
1019.	3.4.2.2	Automatic Changeover Unit (Dual Transmitter Systems Only)	-	-		Heading
1020.	3.4.2.2.a		I			
1021.	3.4.2.2.b		D			
1022.	3.4.3	Glide Slope Transmitter	-	-		Heading
1023.	3.4.3.1	Radio Frequency	-	-		Heading
1024.	3.4.3.1.a		D			
1025.	3.4.3.1.b		T			
1026.	3.4.3.1.c		D			
1027.	3.4.3.1.d		D			
1028.	3.4.3.2	Modulation	-	-		Heading

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
1029.	3.4.3.2.a		D			
1030.	3.4.3.2.b		D			
1031.	3.4.3.3	Transmitter Output Power and Adjustments	-	-		Heading
1032.	3.4.3.3.a		A	D		Flight Test
1033.	3.4.3.3.a.1		D			
1034.	3.4.3.3.a.2		D			
1035.	3.4.3.3.a.3		D			
1036.	3.4.3.3.a.4		D			
1037.	3.4.3.3.b		-	-		Lead-in
1038.	3.4.3.3.b.1		T			
1039.	3.4.3.3.b.2		T			
1040.	3.4.3.3.b.3		T			
1041.	3.4.3.3.b.4		T			
1042.	3.4.3.4	Transmitter Stability	-	-		Heading/lead-in shall
1043.	3.4.3.4.a		T			Type Test
1044.	3.4.3.4.b		T			Type Test
1045.	3.4.3.4.c		T			Type Test
1046.	3.4.3.4.d		T			Type Test
1047.	3.4.3.4.e		T			Type Test
1048.	3.4.3.4.f		T			Type Test
1049.	3.4.3.4.g		T			Type Test
1050.	3.4.3.4.h		T			Type Test
1051.	3.4.3.5	Power-on Stabilization Time	T			
1052.	3.4.3.5.1	Hot Standby Transmitter	I			
1053.	3.4.3.6	Audio Phase of Modulation Tones	-	-		Heading/non-shall
1054.	3.4.3.6.a		D			
1055.	3.4.3.6.b		D			
1056.	3.4.3.7	Carrier Modulation	-	-		Heading
1057.	3.4.3.7.a		D			
1058.	3.4.3.7.b		D			
1059.	3.4.3.7.c		T			
1060.	3.4.3.7.d		T			
1061.	3.4.3.8	Distortion of Demodulated Navigation Tones	-	-		Heading
1062.	3.4.3.8.a		T			
1063.	3.4.3.8.b		T			
1064.	3.4.3.9	Course Transmitter Modulation Balance Adjustment	-	-		Heading
1065.	3.4.3.9.a		D			
1066.	3.4.3.9.b		D			
1067.	3.4.3.9.c		T			
1068.	3.4.3.10	Sideband Amplitude Adjustment	-	-		Heading

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
1069.	3.4.3.10.a		A			
1070.	3.4.3.10.b		T			
1071.	3.4.3.11	RF Phase Adjustment	-	-		Heading
1072.	3.4.3.11.a		D			
1073.	3.4.3.11.b		T			
1074.	3.4.3.12	Carrier Signal at Sideband Output	T			
1075.	3.4.3.13	Power and Modulation Measurements	-	-		Heading
1076.	3.4.3.13.a		I			
1077.	3.4.3.13.b		-	-		Lead-in shall
1078.	3.4.3.13.b.1		I			
1079.	3.4.3.13.b.2		I			
1080.	3.4.3.13.b.3		I			
1081.	3.4.3.13.b.4		I			
1082.	3.4.3.13.c		-	-		Lead-in shall
1083.	3.4.3.13.c.1		D			
1084.	3.4.3.13.c.2		D			
1085.	3.4.3.14	Display of Performance Parameters	-	-		Heading
1086.	3.4.3.14.a		-	-		Lead-in shall
1087.	3.4.3.14.a.1		I			
1088.	3.4.3.14.a.2		I			
1089.	3.4.3.14.a.3		I			
1090.	3.4.3.14.a.4		I			
1091.	3.4.3.14.a.5		I			
1092.	3.4.3.14.a.6		I			
1093.	3.4.3.14.a.7		I			
1094.	3.4.3.14.a.8		I			
1095.	3.4.3.14.a.9		I			
1096.	3.4.3.14.a.10		I			
1097.	3.4.3.14. a.11		I			
1098.	3.4.3.14. a.12		I			
1099.	3.4.3.14. a.13		I			
1100.	3.4.3.14. a.14		I			
1101.	3.4.3.14. a.15		I			
1102.	3.4.3.14.b		I			
1103.	3.4.4	Amplitude and Phase Control and Distribution	I			
1104.	3.4.4.1	Capture Effect RF Distribution	-	-		Heading
1105.	3.4.4.1.a		T			
1106.	3.4.4.1.b		T			
1107.	3.4.4.1.c		T			
1108.	3.4.4.1.d		T			
1109.	3.4.4.1.1	Capture Effect Phasers	-	-		Heading

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
1110.	3.4.4.1.1.a		I			
1111.	3.4.4.1.1.b		D			
1112.	3.4.4.1.1.c		T			
1113.	3.4.4.1.1.d		D			
1114.	3.4.4.1.1.1	Adjustable Power Divider(s)	T			
1115.	3.4.4.1.2	Capture Effect Carrier Output Port Isolation	T			
1116.	3.4.4.1.3	Capture Effect CSB Distribution Stability	-	-		Heading/non-shall
1117.	3.4.4.1.3.a		T			
1118.	3.4.4.1.3.b		T			
1119.	3.4.4.1.4	Capture Effect Sideband Port Isolation	T			
1120.	3.4.4.1.5	Capture Effect Sideband Stability	-	-		Heading/non-shall
1121.	3.4.4.1.5.a		T			
1122.	3.4.4.1.5.b		T			
1123.	3.4.4.1.5.c		T			
1124.	3.4.4.1.6	Capture Effect Clearance Isolation	T			
1125.	3.4.4.2	Sideband Reference RF Distribution	-	-		Heading
1126.	3.4.4.2.a		T			
1127.	3.4.4.2.b		T			
1128.	3.4.4.2.1	Sideband Reference Stability	T			
1129.	3.4.4.2.2	Sideband Reference CSB Isolation	T			
1130.	3.4.4.3	Variable Attenuator Set	-	-		Heading
1131.	3.4.4.3.a		I			
1132.	3.4.4.3.b		I			
1133.	3.4.4.3.c		T			
1134.	3.4.4.3.d		D			
1135.	3.4.4.3.e		T			
1136.	3.4.5	Image-type Glide Slope Antenna Array	-	-		Heading
1137.	3.4.5.a		I			
1138.	3.4.5.b		I			
1139.	3.4.5.c		I			
1140.	3.4.5.1	Antenna RF Connections	-	-		Heading
1141.	3.4.5.1.a		I			
1142.	3.4.5.1.a.1		I			
1143.	3.4.5.1.a.2		I			
1144.	3.4.5.1.a.3		I			
1145.	3.4.5.1.a.4		I			
1146.	3.4.5.1.a.5		I			
1147.	3.4.5.1.a.6		I			
1148.	3.4.5.1.a.7		I			
1149.	3.4.5.1.a.8		I			
1150.	3.4.5.1.b		I			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
1151.	3.4.5.2	Polarization	-	-		Heading
1152.	3.4.5.2.a		A/T			
1153.	3.4.5.2.b		T			
1154.	3.4.5.3	Gain	T			
1155.	3.4.5.4	Front-to-Back Ratio	T			
1156.	3.4.5.5	VSWR	T			
1157.	3.4.5.6	Horizontal Pattern Requirements	-	-		Heading
1158.	3.4.5.6.a		T			
1159.	3.4.5.6.b		T			
1160.	3.4.5.6.c		T			
1161.	3.4.5.6.d		T			
1162.	3.4.5.7	Vertical Pattern Requirements	-	-		Heading
1163.	3.4.5.7.a		T			
1164.	3.4.5.7.b		T			
1165.	3.4.5.8	Antenna Elements and Phasing Distribution Network Assembly	-	-		Heading
1166.	3.4.5.8.a		T		4.4.1.2.3	
1167.	3.4.5.8.b		I			
1168.	3.4.5.8.c		D			
1169.	3.4.5.8.d		D			
1170.	3.4.5.9	Integral Monitoring	-	-		Heading
1171.	3.4.5.9.1	Antenna Monitor Probes	-	-		Heading
1172.	3.4.5.9.1.a		I			
1173.	3.4.5.9.1.b		I			
1174.	3.4.5.9.1.c		I			
1175.	3.4.5.9.1.d		T			
1176.	3.4.5.9.1.e		T			
1177.	3.4.5.9.2	Antenna Monitor Probes Stability	T			Heading/lead-in shall
1178.	3.4.5.9.2.a		T			Type Test
1179.	3.4.5.9.2.b		T			Type Test
1180.	3.4.5.9.2.c		T			Type Test
1181.	3.4.5.10	Antenna Radomes	-	-		Heading
1182.	3.4.5.10.a		I			
1183.	3.4.5.10.b		I			
1184.	3.4.5.11	Antenna Heaters	-	-		Heading
1185.	3.4.5.11.a		I			
1186.	3.4.5.11.b		D			
1187.	3.4.5.11.c		T			
1188.	3.4.5.11.d		I			
1189.	3.4.5.11.1	Antenna Heater Control	-	-		Heading

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
1190.	3.4.5.11.1.a		I			
1191.	3.4.5.11.1.b		D			
1192.	3.4.5.11.1.c		D			
1193.	3.4.5.12	Glide Slope Antenna Tower	-	-		Heading
1194.	3.4.5.12.a		I			
1195.	3.4.5.12.b		I			
1196.	3.4.5.12.1	Antenna Mounting	-	-		Heading
1197.	3.4.5.12.1.a		D			
1198.	3.4.5.12.1.b		D			
1199.	3.4.5.12.1.c		D			
1200.	3.4.5.12.1.d		D			
1201.	3.4.5.12.2	Wind and Ice Loading	-	-	4.4.1.2.5	Heading
1202.	3.4.5.12.2.a		A/T			
1203.	3.4.5.12.2.b		A/T			
1204.	3.4.5.12.3	Climbing Equipment and Work Platforms	-	-		Heading
1205.	3.4.5.12.3.a		I			
1206.	3.4.5.12.3.b		I			
1207.	3.4.5.12.3.c		I			
1208.	3.4.5.12.3.d		I			
1209.	3.4.5.12.3.e		I			
1210.	3.4.5.12.3.f		I			
1211.	3.4.6	Glide Slope Monitor	-	-		Heading
1212.	3.4.6.a		D			
1213.	3.4.6.b		D			
1214.	3.4.6.c		D			
1215.	3.4.6.d		D			
1216.	3.4.6.e		D			
1217.	3.4.6.f		-	-		Lead-in shall
1218.	3.4.6.f.1		T			
1219.	3.4.6.f.2		T			
1220.	3.4.6.f.3		T			
1221.	3.4.6.g		I			
1222.	3.4.6.1	Single Equipment Monitoring	-	-		Heading
1223.	3.4.6.1.a		I			
1224.	3.4.6.1.b		D			
1225.	3.4.6.2	Dual Equipment Monitoring	-	-		Heading
1226.	3.4.6.2.a		I			
1227.	3.4.6.2.b		T			
1228.	3.4.6.2.c		T			
1229.	3.4.6.2.d		T			
1230.	3.4.6.2.1	Hot Standby Monitoring	-	-		Heading

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
1231.	3.4.6.2.1.a		D			
1232.	3.4.6.2.1b		T			
1233.	3.4.6.3	Monitored Parameters	-	-		Heading
1234.	3.4.6.3.1	Course Position	-	-		Heading
1235.	3.4.6.3.1.a		T			
1236.	3.4.6.3.1.b		I			
1237.	3.4.6.3.1.c		I			
1238.	3.4.6.3.1.d		D			
1239.	3.4.6.3.2	Course Width	-	-		Heading
1240.	3.4.6.3.2.a		T			
1241.	3.4.6.3.2.b		I			
1242.	3.4.6.3.2.c		I			
1243.	3.4.6.3.2.d		D			
1244.	3.4.6.3.3	Clearance RF Level	-	-		Heading
1245.	3.4.6.3.3.a		T			
1246.	3.4.6.3.3.b		I			
1247.	3.4.6.3.3.c		I			
1248.	3.4.6.3.3.d		D			
1249.	3.4.6.3.3.e		I			
1250.	3.4.6.3.4	Course RF Level	-	-		Heading
1251.	3.4.6.3.4.a		T			
1252.	3.4.6.3.4.b		I			
1253.	3.4.6.3.4.c		I			
1254.	3.4.6.3.4.d		D			
1255.	3.4.6.3.4.e		I			
1256.	3.4.6.3.5	Course SDM	-	-		Heading
1257.	3.4.6.3.5.a		T			
1258.	3.4.6.3.5.b		I			
1259.	3.4.6.3.5.c		I			
1260.	3.4.6.3.5.d		D			
1261.	3.4.6.3.6	Clearance SDM	-	-		Heading
1262.	3.4.6.3.6.a		T			
1263.	3.4.6.3.6.b		I			
1264.	3.4.6.3.6.c		I			
1265.	3.4.6.3.6.d		D			
1266.	3.4.6.3.7	Course/Clearance RF Level Ratio	-	-		Heading
1267.	3.4.6.3.7.a		T			
1268.	3.4.6.3.7.b		I			
1269.	3.4.6.3.7.c		I			
1270.	3.4.6.3.7.d		D			
1271.	3.4.6.3.8	Course/Clearance Frequency Difference	-	-		Heading

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
1272.	3.4.6.3.8.a		T			
1273.	3.4.6.3.8.b		I			
1274.	3.4.6.3.8.c		I			
1275.	3.4.6.3.8.d		D			
1276.	3.4.6.4	Monitor Action	-	-		Heading
1277.	3.4.6.4.a		-	-		Lead-in shall
1278.	3.4.6.4.a.1		T			
1279.	3.4.6.4.a.2		T			
1280.	3.4.6.4.a.3		T			
1281.	3.4.6.4.a.4		T			
1282.	3.4.6.4.b		D			
1283.	3.4.6.4.1	Single Equipment Response to Monitor Alarm	-	-		Heading/non-shall
1284.	3.4.6.4.1.a		T			
1285.	3.4.6.4.1.b		T			
1286.	3.4.6.4.1.c		T			
1287.	3.4.6.4.1.d		T			
1288.	3.4.6.4.1.e		T			
1289.	3.4.6.4.1.f		T			
1290.	3.4.6.4.1.g		T			
1291.	3.4.6.4.1.h		T			
1292.	3.4.6.4.1.i		T			
1293.	3.4.6.4.1.j		T			
1294.	3.4.6.4.2	Category II/III Dual Transmitter Equipment Response to Monitor Alarm	-	-		Heading/lead-in shall
1295.	3.4.6.4.2.a		T			
1296.	3.4.6.4.2.b		T			
1297.	3.4.6.4.2.c		T			
1298.	3.4.6.4.3	Category I Dual Transmitter Equipment Response to Monitor Alarm	-	-		Heading/lead-in shall
1299.	3.4.6.4.3.a		T			
1300.	3.4.6.4.3.b		T			
1301.	3.4.6.4.3.c		T			
1302.	3.4.6.4.3.d		T			
1303.	3.4.6.4.3.e		T			
1304.	3.4.6.4.3.f		T			
1305.	3.4.6.4.3.g		T			
1306.	3.4.6.4.3.h		T			
1307.	3.4.6.4.3.i		T			
1308.	3.4.6.4.3.j		T			
1309.	3.4.6.4.3.k		T			
1310.	3.4.6.4.3.l		I			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
1311.	3.4.6.4.4	Fault Detected by a Single Monitor (Dual Monitor Systems)	-	-		Heading/lead-in shall
1312.	3.4.6.4.4.a		T			
1313.	3.4.6.4.4.b		T			
1314.	3.4.6.4.5	Monitor Action Delay	D			
1315.	3.4.6.4.6	Shutdown Timing Test	D			
1316.	3.4.6.5	Glide Slope Monitor Stabilization Time	D			
1317.	3.5	VHF Marker Beacon Station	-	-		Heading/lead-in shall
1318.	3.5.a		I			
1319.	3.5.b		I			
1320.	3.5.c		I			
1321.	3.5.d		I			
1322.	3.5.1	Coverage	-	-		Heading
1323.	3.5.1.a		A	D		Flight Test
1324.	3.5.1.b		A	D		Flight Test
1325.	3.5.1.c		A	D		Flight Test
1326.	3.5.1.d		A	D		Flight Test
1327.	3.5.2	Marker Beacon Transmitter	-	-		Heading
1328.	3.5.2.1	Transmitter Maintenance Display Parameters	-	-		Heading
1329.	3.5.2.1.a		I			
1330.	3.5.2.1.a.1		I			
1331.	3.5.2.1.a.2		I			
1332.	3.5.2.1.a.3		I			
1333.	3.5.2.1.a.4		I			
1334.	3.5.2.1.a.5		I			
1335.	3.5.2.1.a.6		I			
1336.	3.5.2.1.a.7		I			
1337.	3.5.2.1.a.8		I			
1338.	3.5.2.1.a.9		I			
1339.	3.5.2.1.a.10		I			
1340.	3.5.2.1.a.11		I			
1341.	3.5.2.1.a.12		I			
1342.	3.5.2.1.a.13		I			
1343.	3.5.2.1.a.14		I			
1344.	3.5.2.1.a.15		I			
1345.	3.5.2.1.b		D			
1346.	3.5.2.2	Frequency	-	-		Heading
1347.	3.5.2.2.a		T			Type test
1348.	3.5.2.2.b		D			
1349.	3.5.2.3	Carrier Output Power	-	-		Heading

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
1350.	3.5.2.3.a		D			
1351.	3.5.2.3.b		D			
1352.	3.5.2.4	Carrier Power Output Stability	T			Type Test
1353.	3.5.2.5	Modulation Frequency	-	-		Heading/lead-in shall
1354.	3.5.2.5.a		T			
1355.	3.5.2.5.b		T			
1356.	3.5.2.6	Modulation Harmonic Distortion	T			
1357.	3.5.2.7	Modulation Stability	-	-		Heading
1358.	3.5.2.7.a		T			Type Test
1359.	3.5.2.7.b		T			Type Test
1360.	3.5.2.7.c		T			Type Test
1361.	3.5.2.8	Identification Keyer	-	-		Heading/lead-in shall
1362.	3.5.2.8.a		D			
1363.	3.5.2.8.a.1		D			
1364.	3.5.2.8.a.2		D			
1365.	3.5.2.8.b		-			Lead -in Shall
1366.	3.5.2.8.b.1		I			
1367.	3.5.2.8.b.2		I			
1368.	3.5.2.8.b.3		I			
1369.	3.5.2.9	Character Timing	T			
1370.	3.5.2.10	Keyer Stability	-	-		Heading
1371.	3.5.2.10.a		T			Type Test
1372.	3.5.2.10.b		T			Type Test
1373.	3.5.3	Marker Beacon Transmitting Antenna	-	-		Heading
1374.	3.5.3.a		D			
1375.	3.5.3.b		I			
1376.	3.5.3.1	Marker Beacon Monitor	-	-		Heading
1377.	3.5.3.1.a		T			
1378.	3.5.3.1.b		T			
1379.	3.5.3.1.c		I			
1380.	3.5.3.1.d		I			
1381.	3.5.3.2	Alarm Threshold Controls	-	-		Heading
1382.	3.5.3.2.a		I			
1383.	3.5.3.2.b		D			
1384.	3.5.3.2.c		T			
1385.	3.5.3.2.d		D			
1386.	3.5.3.3	Monitor Shutdown Action	-	-		Heading
1387.	3.5.3.3.a		T			
1388.	3.5.3.3.b		T			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
1389.	3.5.3.3.c		T			
1390.	3.5.3.3.d		T			
1391.	3.5.3.3.e		T			
1392.	3.5.3.3.f		T			
1393.	3.5.3.3.g		T			
1394.	3.5.3.4	Remote Alarm Output	T			
1395.	3.5.3.5	Monitor Bypass	-	-		Heading
1396.	3.5.3.5.a		I			
1397.	3.5.3.5.b		D			
1398.	3.5.3.5.c		T			
1399.	3.5.3.5.d		T			
1400.	3.5.4	AC Power Control	I			
1401.	3.5.5	Marker Beacon Cabinet	I			
1402.	3.5.6	Performance of Periodic Checks and Certification	I			
1403.	3.6	Remote Control Subsystem (RCS) (General)	-	-		Heading/non-shall
1404.	3.6.a		D			
1405.	3.6.b		D			
1406.	3.6.c		D			
1407.	3.6.d		D			
1408.	3.6.1	Remote Status and Control Unit (RSCU)	-	-		Heading non-shall
1409.	3.6.1.a		I			
1410.	3.6.1.b		I			
1411.	3.6.1.c		I			
1412.	3.6.1.d		D			
1413.	3.6.1.e		D			
1414.	3.6.1.f		D			
1415.	3.6.1.g		D			
1416.	3.6.1.1	Equipment Status Display (General)	-	-		Heading
1417.	3.6.1.1.a		I			
1418.	3.6.1.1.b		I			
1419.	3.6.1.1.c		I			
1420.	3.6.1.1.d		I			
1421.	3.6.1.1.e		D			
1422.	3.6.1.1.f		D			
1423.	3.6.1.1.g		T			
1424.	3.6.1.1.1	Category Determination	-	-		Heading
1425.	3.6.1.1.1.a		D			
1426.	3.6.1.1.1.b		D			
1427.	3.6.1.1.1.c		D			
1428.	3.6.1.1.1.d		I			
1429.	3.6.1.1.2	Category Conditions (Referencing Table 3-8)	T			Heading/lead-in

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
						shall
1430.	3.6.1.2	Co-located Auxiliary Equipment Status	-	-		Heading
1431.	3.6.1.2.a		I			
1432.	3.6.1.2.b		I			
1433.	3.6.1.2.c		I			
1434.	3.6.1.2.d		I			
1435.	3.6.1.3	RSCU Response Time	-	-		Heading
1436.	3.6.1.3.a		T			
1437.	3.6.1.3.b		T			
1438.	3.6.1.4	Interlock Response Time	T			
1439.	3.6.1.5.a	Alarms	I			
1440.	3.6.1.5.b		D			
1441.	3.6.1.5.1	Power Loss Alarm	T			
1442.	3.6.1.5.2	Environmental Alerts	-	-		Heading/lead-in shall
1443.	3.6.1.5.2.a		T			
1444.	3.6.1.5.2.b		T			
1445.	3.6.1.5.2.c		T			
1446.	3.6.1.5.2.d		T			
1447.	3.6.1.5.2.e		T			
1448.	3.6.1.5.3	Alarm and Indicator Test	I			
1449.	3.6.1.6	Runway Identification	-	-		Heading
1450.	3.6.1.6.a		I			
1451.	3.6.1.6.b		I			
1452.	3.6.1.6.c		D			
1453.	3.6.1.7	Mounting and Power Requirements	-	-		Heading
1454.	3.6.1.7.a		I			
1455.	3.6.1.7.b		I			
1456.	3.6.1.7.c		I			
1457.	3.6.1.7.d		I			
1458.	3.6.1.7.e		I			
1459.	3.6.2	Remote Status and Interlock Control (RSIC)	-	-		Heading
1460.	3.6.2.a		D			
1461.	3.6.2.b		D			
1462.	3.6.2.c		D			
1463.	3.6.2.d		D			
1464.	3.6.2.e		I			
1465.	3.6.2.f		-	-		Lead-in
1466.	3.6.2,f.1		D			
1467.	3.6.2.f.2		D			
1468.	3.6.2.f.3		D			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
1469.	3.6.2.g		D			
1470.	3.6.2.h		D			
1471.	3.6.2.1	RSIC Controls and Indicators	-	-		Heading
1472.	3.6.2.1.1	ILS Runway Selection (Interlock)	-	-		Heading
1473.	3.6.2.1.1.a		D			
1474.	3.6.2.1.1.b		D			
1475.	3.6.2.1.1.c		D			
1476.	3.6.2.1.1.d		I			
1477.	3.6.2.1.2	Category Status Display	-	-		Heading
1478.	3.6.2.1.2.a		I			
1479.	3.6.2.1.2.b		I			
1480.	3.6.2.1.2.c		I			
1481.	3.6.2.1.3	Display of Operating Status of ILS and Co-located Equipment	-	-		Heading
1482.	3.6.2.1.3.a		I			
1483.	3.6.2.1.3.b		D			
1484.	3.6.2.1.3.c		D			
1485.	3.6.2.1.3.d		D			
1486.	3.6.2.1.3.e		D			
1487.	3.6.2.1.3.f		D			
1488.	3.6.2.1.3.g		D			
1489.	3.6.2.1.4	Aural Alarm	-	-		Heading
1490.	3.6.2.1.4.a		D			
1491.	3.6.2.1.4.b		D			
1492.	3.6.2.1.4.c		D			
1493.	3.6.2.1.4.d		D			
1494.	3.6.2.1.5	Lamp Dimmer Control	-	-		Heading
1495.	3.6.2.1.5.a		I			
1496.	3.6.2.1.5.b		D			
1497.	3.6.2.1.5.c		D			
1498.	3.6.2.1.5.d		D			
1499.	3.6.2.1.6	Lamp/Alarm Test Switch	I			
1500.	3.6.2.1.7	FFM Bypass Switch	-	-		Heading
1501.	3.6.2.1.7.a		I			
1502.	3.6.2.1.7.b		D			
1503.	3.6.2.1.8	Category Display Status Change Delay	-	-		Heading
1504.	3.6.2.1.8.a		I			
1505.	3.6.2.1.8.b		I			
1506.	3.6.2.1.8.c		T			
1507.	3.6.2.1.8.d		T			
1508.	3.6.2.1.8.e		T			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
1509.	3.6.2.1.9	RSCU Power Loss Indication	T			
1510.	3.6.2.2	RSIC Subassembly	-	-		Heading
1511.	3.6.2.2.a		I			
1512.	3.6.2.2.b		I			
1513.	3.6.2.2.c		I			
1514.	3.6.2.2.d		I			
1515.	3.6.2.2.e		-	-		Lead-in
1516.	3.6.2.2.e.1		I			
1517.	3.6.2.2.e.2		I			
1518.	3.6.2.2.e.3		I			
1519.	3.6.2.2.e.4		I			
1520.	3.6.2.2.e.5		I			
1521.	3.6.2.2.e.6		I			
1522.	3.6.2.2.1	RSIC Interfaces	-	-		Heading
1523.	3.6.2.2.1.a		I			
1524.	3.6.2.2.1.b		I			
1525.	3.6.2.2.1.c		I			
1526.	3.6.2.2.1.d		I			
1527.	3.6.2.3	RSCU-RSIC Interconnection	I			
1528.	3.6.2.4	RSCU-ILS Subsystem Interconnection	I			
1529.	3.6.2.4.1	Radio Links	-	-		Heading
1530.	3.6.2.4.1.a		I			
1531.	3.6.2.4.1.b		D			
1532.	3.6.2.4.1.c		T			
1533.	3.6.2.4.1.d		I			
1534.	3.6.2.5	Remote Control Subsystem Fail-safe and Failure Modes	-	-		Heading
1535.	3.6.2.5.a		T			
1536.	3.6.2.5.b		T			
1537.	3.7	ILS/DME Monitor Receiver Subsystem	-	-		Heading
1538.	3.7.1	ILS/DME Monitor Receiver General Requirements	-	-		Heading/lead-in shall
1539.	3.7.1.a		I			
1540.	3.7.1.b		I			
1541.	3.7.1.b.1		I			
1542.	3.7.1.b.2		I			
1543.	3.7.1.b.3		I			
1544.	3.7.2	Receiver(s) and Processing Equipment	-	-		Heading
1545.	3.7.2.a		D			
1546.	3.7.2.b		I			
1547.	3.7.2.c		I			
1548.	3.7.3	ILS/DME Monitor Receiver Subsystem Functions	-	-		Heading

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
1549.	3.7.3.a		D			
1550.	3.7.3.b		I			
1551.	3.7.3.b.1		I			
1552.	3.7.3.b.2		I			
1553.	3.7.3.b.3		I			
1554.	3.7.3.c		I			
1555.	3.7.3.c.1		T			
1556.	3.7.3.c.2		D			
1557.	3.7.3.c.3		D			
1558.	3.7.3.d		D			
1559.	3.7.3.d.1		T			
1560.	3.7.3.d.2		D			
1561.	3.7.3.e		D			
1562.	3.7.3.e.1		T			
1563.	3.7.3.e.2		D			
1564.	3.7.4	ILS/DME Monitor Receiver Performance	-	-		Heading/lead-in shall
1565.	3.7.4.a		T			Type test
1566.	3.7.4.a.1		T			Type test
1567.	3.7.4.a.2		T			Type test
1568.	3.7.4.a.3		T			Type test
1569.	3.7.4.b		T			Type test
1570.	3.7.4.c		T			Type test
1571.	3.7.4.d		T			Type test
1572.	3.7.4.e		T			Type test
1573.	3.7.4.f		T			Type test
1574.	3.7.4.g		T			Type test
1575.	3.7.4.h		T			Type test
1576.	3.7.4.h.1		T			Type test
1577.	3.7.4.h.2		T			Type test
1578.	3.7.4.h.3		T			Type test
1579.	3.7.5	Remote Status Panel (RSP)	-	-		Heading
1580.	3.7.5.a		I			
1581.	3.7.5.b		I			
1582.	3.7.5.c		T			
1583.	3.7.5.d		D			
1584.	3.7.5.e		T			
1585.	3.7.5.f		D			
1586.	3.7.5.g		I			
1587.	3.7.6	Antennas	-	-		Heading
1588.	3.7.6.a		A	D		

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
1589.	3.7.6.b		D			
1590.	3.7.6.c		I			
1591.	3.8	Remote Maintenance Monitoring (RMM)	-	-		Heading/non-shall
1592.	3.8.1	Remote Monitoring Subsystem (RMS)	-	-		Heading
1593.	3.8.1.a		I			
1594.	3.8.1.b		D			Failsafe Demo?
1595.	3.8.1.c		I			
1596.	3.8.1.d		I			
1597.	3.8.1.1	RMS Functions	-	-		Heading/lead-in shall
1598.	3.8.1.1.a		I			
1599.	3.8.1.1.b		I			
1600.	3.8.1.1.c		D			
1601.	3.8.1.1.d.		D			
1602.	3.8.1.1.e		D			
1603.	3.8.1.1.f		I			
1604.	3.8.1.1.f.1		I			
1605.	3.8.1.1.f.2		I			
1606.	3.8.1.1.f.3		I			
1607.	3.8.1.1.f.4		I			
1608.	3.8.1.1.g		I			
1609.	3.8.1.1.h		D			
1610.	3.8.1.1.i		D			
1611.	3.8.1.1.j		I			
1612.	3.8.1.2	RMLS Connectivity	-	-		Heading
1613.	3.8.1.2.a		I			
1614.	3.8.1.2.b		D			
1615.	3.8.1.3	Trend Data Collection	-	-		Heading
1616.	3.8.1.3.a		I			
1617.	3.8.1.3.b		D			
1618.	3.8.1.3.c		I			
1619.	3.8.1.3.d		A			
1620.	3.8.1.3.e		I			
1621.	3.8.1.4	Fault History	-	-		Heading/lead-in shall
1622.	3.8.1.4.a		D			
1623.	3.8.1.4.b		D			
1624.	3.8.2	Alarm and Alert Messages	-	-		Heading
1625.	3.8.2.1	Alarms	-	-		Heading
1626.	3.8.2.1.a		T			
1627.	3.8.2.1.b		T			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
1628.	3.8.2.2	Maintenance Alerts	-	-		Heading
1629.	3.8.2.2.a		T			
1630.	3.8.2.2.b		T			
1631.	3.8.3	Non-Volatility	-	-		Heading
1632.	3.8.3.a		I			
1633.	3.8.3.b		A			
1634.	3.8.3.c		I			
1635.	3.8.4	RMS Data Sampling Rate	I			
1636.	3.8.5	Real Time Clock/Calendar	-	-		Heading
1637.	3.8.5.a		I			
1638.	3.8.5.b		I			
1639.	3.8.5.c		D			
1640.	3.8.5.d		T			
1641.	3.8.5.e		I			
1642.	3.8.5.f		T			
1643.	3.8.6	ILS Equipment Fault Diagnostics	-	-		Heading
1644.	3.8.6.a		D	D		
1645.	3.8.6.b		T			
1646.	3.8.6.c		T			
1647.	3.8.6.d		D			
1648.	3.8.6.e		T			
1649.	3.8.6.f		D			
1650.	3.8.6.g		I			
1651.	3.8.7	Status Monitoring of Co-located Electronic Equipment	I			
1652.	3.8.8	Auxiliary Input Pass-through	D			
1653.	3.8.9	Spare Input/Output Capacity	-	-		Heading
1654.	3.8.9.a		I			
1655.	3.8.9.b		D			
1656.	3.8.9.c		D			
1657.	3.8.9.d		-	-		Lead-in shall
1658.	3.8.9.d.1		-	-		Heading
1659.	3.8.9.d.1.i		T			
1660.	3.8.9.d.1.ii		T			
1661.	3.8.9.d.1.iii		T			
1662.	3.8.9.d.1.iv		T			
1663.	3.8.9.d.2		-	-		Heading
1664.	3.8.9.d.2.i		T			
1665.	3.8.9.d.2.ii		T			
1666.	3.8.9.d.3		-	-		Heading
1667.	3.8.9.d.3.i		T			
1668.	3.8.9.d.3.ii		T			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
1669.	3.8.10	Environmental Monitoring	-	-		Heading
1670.	3.8.10.a		-	-		Lead-in Shall
1671.	3.8.10.a.1		I			
1672.	3.8.10.a.2		I			
1673.	3.8.10.a.3		I			
1674.	3.8.10.a.4		I			
1675.	3.8.10.a.5		I			
1676.	3.8.10.a.6		I			
1677.	3.8.10.b		I			
1678.	3.8.10.c		I			
1679.	3.8.10.1	Intrusion Detector	-	-		Heading
1680.	3.8.10.1.a		T			
1681.	3.8.10.1.b		T			
1682.	3.8.10.1.c		T			
1683.	3.8.10.1.d		T			
1684.	3.8.10.1.e		T			
1685.	3.8.10.1.f		T			
1686.	3.8.10.1.g		D			
1687.	3.8.10.2	Smoke Detector	-	-		Heading
1688.	3.8.10.2.a		I			
1689.	3.8.10.2.b		I			
1690.	3.8.10.2.c		D			
1691.	3.8.10.3	Obstruction Light Current Sensors	-	-		Heading
1692.	3.8.10.3.a		D			
1693.	3.8.10.3.b		D			
1694.	3.8.10.4	AC Power Sensor	-	-		Heading
1695.	3.8.10.4.a		D			
1696.	3.8.10.4.b		D			
1697.	3.8.10.5	Temperature Sensors	-	-		Heading
1698.	3.8.10.5.a		I			
1699.	3.8.10.5.b		I			
1700.	3.8.10.5.c		I			
1701.	3.8.10.5.d		D			
1702.	3.8.10.5.e		T			
1703.	3.8.10.6	Antenna Heater Current Sensors	I			
1704.	3.8.11	RMS Security	I			
1705.	3.8.11.1	Security Implementation	-	-		Heading/lead-in shall
1706.	3.8.11.1.a		D			
1707.	3.8.11.1.b		D			
1708.	3.8.11.1.c		D			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
1709.	3.8.11.1.d		D			
1710.	3.8.11.1.e		D			
1711.	3.8.11.1.f		D			
1712.	3.8.11.1.g		D			
1713.	3.8.11.2	Security Level Definitions	-	-		Heading/lead-in shall
1714.	3.8.11.2.a		D			
1715.	3.8.11.2.b		D			
1716.	3.8.11.2.a		D			
1717.	3.8.12	RMS Data Filtering	-	-		Heading
1718.	3.8.12.a		I			
1719.	3.8.12.b		D			
1720.	3.8.13	RMS Failure Protection	A/D			Failsafe Demo
1721.	3.8.14	Interface with RMM Subsystems	-	-		Heading
1722.	3.8.14.a		-	-		Lead-in shall
1723.	3.8.14.a.1		I			
1724.	3.8.14.a.2		I			
1725.	3.8.14.a.3		I			
1726.	3.8.14.b		-	-		Lead-in
1727.	3.8.14.b.1		I			
1728.	3.8.14.b.2		I			
1729.	3.8.14.b.3		I			
1730.	3.8.14.b.4		I			
1731.	3.8.14.b.5		I			
1732.	3.8.14.b.6		I			
1733.	3.8.14.b.7		I			
1734.	3.9	Data Security	-	-		Heading
1735.	3.9.1	Access Control	-	-		Heading/lead-in shall
1736.	3.9.1.a		I			
1737.	3.9.1.b		I			
1738.	3.9.1.c		I			
1739.	3.9.1.d		T			
1740.	3.9.1.e		T			
1741.	3.9.1.f		T			
1742.	3.9.1.g		T			
1743.	3.9.2	Audit Logging	-	-		Heading
1744.	3.9.2.a		D			
1745.	3.9.2.b		-	-		Lead-in shall
1746.	3.9.2.b.1		T			
1747.	3.9.2.b.2		D			

DRAFT

ID	Section 3 Heading Number	Section 3 Heading	Test Method		Section 4 Verification	Comments
			DT	OT		
1748.	3.9.2.b.3		T			
1749.	3.9.2.b.4		T			
1750.	3.9.2.b.5		T			
1751.	3.9.2.b.6		D			
1752.	3.9.2.b.7		D			
1753.	3.9.2.b.8		T			
1754.	3.9.2.b.9		T			
1755.	3.9.2.b.10		T			

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5. PACKAGING

5.1 Packaging requirements shall be as specified in the contract.

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6. NOTES

6.1 Definitions

Term	Definition
Normal Operation	An ILS is in 'Normal Operation' when the localizer is providing horizontal guidance aligned with the runway centerline, and if present, the glide slope is providing vertical guidance to the assigned glide path angle; while the internal and external monitor systems are receiving performance data within the tolerances for the ILS category of the approach.
Portable Maintenance Data Terminal (PMDT)	A handheld or portable computing device running software designed for on-site control, access, data collection, maintenance, and repair.
Local Control	A state in which the system can only be controlled via the front panel or via the PMDT within the shelter.
Remote Control	A state in which the system can be controlled from designated locations, such as the ATCT or equipment room.
Selectable (excluding physical modifications)	Capable of being chosen from a set of available options in which the value, state, or configuration of the system will change accordingly.
Line Replaceable Unit (LRU)	Modular component of an airplane, ship or spacecraft (or any other manufactured device) that is designed to be replaced quickly at an operating location (1st line). The different lines (distances) are essential for logistics planning and operation.
Quadrature	The condition in which the CSB and SBO signals are 90º out of phase, which results in a 0.000 DDM value throughout the service volume.
Elliptically Shaped	The elliptical shape, with its corresponding major and minor axes, is defined as the locus of points at which the received signal is 1,700 µV as measured using a calibrated ILS marker receiver installed in a standard FAA flight inspection aircraft.
Normal ATCT Illumination	1 to 6,000 footcandles.

6.2 Acronyms, Abbreviations, and Initializations

A	Ampere
A	Analysis
AC	Advisory Circular
AC	Alternating Current
AGC	Automatic Gain Control
AIC	Ampere Interrupting Capacity
ASCII	American Standard Code for Information Interchange
ATCT	Air Traffic Control Tower

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C	Celsius
CAT	Category
CLR	Clearance
CMHP	Common Message Handling Protocol
CSB	Carrier plus Sideband
CSV	Comma-separated Values
CRS	Course
D	Demonstration
dB	Decibel
DC	Direct Current
DDM	Depth of Modulation
DME	Distance Measuring Equipment
DT	Developmental Test
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
FAA	Federal Aviation Administration
FCC	Federal Communication Commission
FFM	Far-field Monitor
FM	Frequency Modulation
HMI	Hazardously Misleading Information
Hz	Hertz
I	Inspection
ICAO	International Civil Aviation Authority
ICD	Interface Control Document
IDS	Intrusion Detection System
IEC	International Electrotechnical Commission
IP	Internet Protocol
ILS	Instrument Landing System
kΩ	Kiloohms
kHz	Kilohertz
kt	Knot
kJ	Kilojoule
kN	Kilonewton
kV	Kilovolt
LRU	Line Replaceable Unit
m	Meter
PMDT	Maintenance Data Terminal
MHz	Megahertz

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mA	Milliampere
µA	Microampere
µs	Microsecond
µV	Microvolt
mm	Millimeter
mph	Miles Per Hour
MTBF	Mean Time Between Failures
MTBO	Mean Time Between Outage
NAS	National Airspace System
NAVAID	Navigational Aid
NDB	Non-directional Beacon
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Agency
NIST	National Institute of Standards and Technology
nmi	Nautical Mile
NTIA	National Telecommunications and Information Administration
Ω	Ohm
OOT	Out of Tolerance
OS	Operating System
OSHA	Occupational Safety and Health Administration
OT	Operational Test
pF	Picofarad
PF	Power Factor
PMDT	Portable Maintenance Data Terminal
RCS	Remote Control Subsystem
RF	Radio Frequency
RFI	Radio Frequency Interference
RMM	Remote Maintenance Monitoring
RMLS	Remote Monitoring and Logging System
RMS	Remote Monitoring Subsystem
rms	Root Mean Square
RSCU	Remote Status and Control Unit
RSIC	Remote Status and Interlock Control
RSP	Remote Status Panel
SAI	Simple Asynchronous Interfacing
SBO	Sideband Only
SDM	Sum of Depth of Modulation
SPD	Surge Protection Device
T	Test
TCP	Transmission Control Protocol

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THD	Total Harmonic Distortion
TTL	Transistor-Transistor Logic
UL	Underwriters Laboratories
UHF	Ultra High Frequency
V	Volt
VA	Volt-ampere
VAC	Volts, Alternating Current
VDB	VHF Data Broadcast
VHF	Very High Frequency
VRTM	Verification Requirements Traceability Matrix
VSWR	Voltage Standing Wave Ratio
W	Watt
WJHTC	William J. Hughes Technical Center

6.3 ICAO Annex 10 Compliance Matrix

To be completed.

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APPENDIX A. ILS CHANNELS

	Frequency MHz	
Channel	**Localizer**	**Glide Slope**
18X	108.10	334.70
18Y	108.15	334.55
20X	108.3	334.1
20Y	108.3	334.1
22X	108.5	329.9
22Y	108.55	329.75
24X	108.70	330.50
24Y	108.75	330.35
26X	108.90	329.30
26Y	108.95	329.15
28X	109.10	331.40
28Y	109.15	331.25
30X	109.30	332.00
30Y	109.35	331.85
32X	109.50	332.60
32Y	109.55	332.45
34X	109.70	333.20
34Y	109.75	333.05
36X	109.90	333.80
36Y	109.95	333.65
38X	110.10	334.40
38Y	110.15	334.25
40X	110.3	335
40Y	110.35	334.85
42X	110.50	329.60
42Y	110.55	329.45
44X	110.70	330.20
44Y	110.75	330.05
46X	110.90	330.80
46Y	110.95	330.65
48X	111.10	331.70
48Y	111.15	331.55
50X	111.30	332.30
50Y	111.35	332.15
52X	111.50	332.90

	Frequency MHz	
Channel	**Localizer**	**Glide Slope**
52Y	111.55	332.75
54X	111.70	333.50
54Y	111.75	333.35
56X	111.90	331.10
56Y	111.95	330.95

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