# SUBCHAPTER J—NAVIGATIONAL FACILITIES

## PART 170—ESTABLISHMENT AND DISCONTINUANCE CRITERIA FOR AIR TRAFFIC CONTROL SERVICES AND NAVIGATIONAL FACILITIES

### Subpart A—General



### Subpart B—Airport Traffic Control Towers



### Subpart C—LORAN-C



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SOURCE: 56 FR 341, Jan. 3, 1991, unless otherwise noted.

## Subpart A—General

### § 170.1 Scope.

This subpart sets forth establishment and discontinuance criteria for navigation aids operated and maintained by the United States.

### § 170.3 Definitions.

For purposes of this subpart—

*Air navigation facility* (NAVAID) means any facility used, available for use, or designated for use in the aid of air navigation. Included are landing areas; lights; signaling, radio direction-finding, or radio or other electronic communication; and any other structure or mechanism having a similar purpose of guiding or controlling flight or the landing or takeoff of aircraft.

*Air traffic clearance* means an authorization by air traffic control for an aircraft to proceed under specified traffic conditions within controlled airspace for the purpose of preventing collision between known aircraft.

*Air traffic control* (ATC) means a service that promotes the safe, orderly, and expeditious flow of air traffic, including airport, approach, departure, and en route air traffic control.

*Air traffic controller* means a person authorized to provide air traffic service, specifically en route and terminal control personnel.

*Aircraft operations* means the airborne movement of aircraft in controlled or noncontrolled airport terminal areas, and counts at en route fixes or other points where counts can be made. There are two types of operations: local and itinerant.

(1) *Local operations* mean operations performed by aircraft which:

(i) Operate in the local traffic pattern or within sight of the airport;

(ii) Are known to be departing for, or arriving from flight in local practice areas located within a 20-mile radius of the airport; or

(iii) Execute simulated instrument approaches or low passes at the airport.

(2) *Itinerant operations* mean all aircraft operations other than local operations.

*Airport traffic control tower* means a terminal facility, which through the use of air/ground communications, visual signaling, and other devices, provides ATC services to airborne aircraft operating in the vicinity of an airport and to aircraft operating on the airport area.

*Alternate airport* means an airport, specified on a flight plan, to which a flight may proceed when a landing at the point of first intended landing becomes inadvisable.

*Approach* means the flight path established by the FAA to be used by aircraft landing on a runway.

*Approach control facility* means a terminal air traffic control facility providing approach control service.

*Arrival* means any aircraft arriving at an airport.

*Benefit-cost ratio* means the quotient of the discounted life cycle benefits of an air traffic control service or navigation aid facility (i.e., ATCT) divided by the discounted life cycle costs.

*Ceiling* means the vertical distance between the ground or water and the

lowest layer of clouds or obscuring phenomena that is reported as ''broken,'' ''overcast,'' or ''obstruction.''

*Control Tower*—See Airport Traffic Control Tower.

*Criteria* means the standards used by the FAA for the determination of establishment or discontinuance of a service or facility at an airport.

*Departure* means any aircraft taking off from an airport.

*Discontinuance* means the withdrawal of a service and/or facility from an airport.

*Establishment* means the provision of a service or facility at a candidate airport.

*Instrument approach* means a series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a landing, or to a point from which a landing may be made visually. It is prescribed and approved for a specific airport by competent authority.

*Instrument flight rules* (IFR) means rules governing the procedures for conducting flight under instrument meteorological conditions (IMC) instrument flight.

*Instrument landing system* (ILS) means an instrument landing system whereby the pilot guides his approach to a runway solely by reference to instruments in the cockpit. In some instances, the signals received from the ground can be fed into the automatic pilot for automatically controlled approaches.

*Instrument meteorological conditions* (IMC) means weather conditions below the minimums prescribed for flight under Visual Flight Rules (VFR).

*Instrument operation* means an aircraft operation in accordance with an IFT flight plan or an operation where IFR separation between aircraft is provided by a terminal control facility or air route traffic control center (ARTCC).

*Life cycle benefits* means the value of services provided to aviation users over the life span of a facility or service.

*Life cycle costs* means the value of research and development costs, investment costs, operation costs, maintenance costs, and termination costs over the life span of a facility or service.

*LORAN-C* means an electronic navigational system by which hyperbolic lines of position are determined by measuring differences in time of reception of synchronized pulse signals from two fixed transmitters.

*Maintenance costs* means the costs incurred in servicing and maintaining a facility after establishment.

*Mean sea level* (MSL) means the base commonly used in measuring altitudes.

*Microwave landing system* (MLS) means a landing system which enables equipped aircraft to make curved and closely spaced approaches to properly instrumented airports.

*Noncommercial traffic* means all aircraft operations that are conducted free of compensation.

*Nonprecision approach procedure* means an FAA standard for approaching an IFR runway where no electronic glide slope is available.

*Nonscheduled commercial service* means the carriage by aircraft in air commerce of persons or property for compensation or hire that are not operated in regularly scheduled service such as charter flights.

*Present value* (PV) means the value of a stream of future benefits or costs that are discounted to the present.

*PVB* or *BPV* means the discounted value of life cycle benefits.

*PVC* or *CPV* means the discounted value of life cycle benefits.

*PVCM* or *CMPV* means the discounted value of operations and maintenance costs less termination costs over a facility's remaining life cycle.

*Runway* means a defined rectangular area on a land airport prepared for the landing and takeoff of aircraft along its length.

*Runway visual range* means an instrumentally derived value based on standard calibrations that represent the horizontal distance a pilot will see down the runway from the approach end.

*Scheduled commercial service* means the carriage by aircraft in air commerce under parts 121 and 135 of persons or property for compensation or hire based on published flight schedules.

*Separation* means the spacing of aircraft in flight and while landing and taking off to achieve their safe and orderly movement.

*Takeoff clearance* means authorization by an airport traffic control tower for an aircraft to take off.

*Tower cab* means an ATC facility located at an airport. Controllers at these facilities direct ground traffic, takeoffs, and landings.

*Traffic advisories* means advisories issued to alert pilots to other known or observed air traffic which may be in such proximity to the position or intended route of flight of their aircraft to warrant attention.

*Traffic pattern* means the flow of aircraft operating on and in the vicinity of an airport during specified wind conditions as established by appropriate authority.

*VFR traffic* means aircraft operated solely in accordance with Visual Flight Rules.

*Visual flight rules* (VFR) means rules that govern the procedures for conducting flight under visual conditions. The term ''VFR'' is also used in the United States to indicate weather conditions that are equal to or greater than minimum VFR requirements. In addition, ''VFR'' is used by pilots and controllers to indicate the type of flight plan.

*Visual meteorological conditions* (VMC) means meteorological conditions expressed in terms of visibility, distance from clouds, and ceiling equal to or better than specified minima.

[56 FR 341, Jan. 3, 1991, as amended by Amdt. 170–3, 66 FR 21067, Apr. 27, 2001]

## Subpart B—Airport Traffic Control Towers

### § 170.11 Scope.

This subpart sets forth establishment and discontinuance criteria for Airport Traffic Control Towers.

### § 170.13 Airport Traffic Control Tower (ATCT) establishment criteria.

(a) The following criteria along with general facility establishment standards must be met before an airport can qualify for an ATCT:

(1) The airport, whether publicly or privately owned, must be open to and available for use by the public as defined in the Airport and Airway Improvement Act of 1982;

(2) The airport must be recognized by and contained within the National Plan of Integrated Airport Systems;

(3) The airport owners/authorities must have entered into appropriate assurances and covenants to guarantee that the airport will continue in operation for a long enough period to permit the amortization of the ATCT investment;

(4) The FAA must be furnished appropriate land without cost for construction of the ATCT; and

(5) The airport must meet the benefit-cost ratio criteria specified herein utilizing three consecutive FAA annual counts and projections of future traffic during the expected life of the tower facility. (An FAA annual count is a fiscal year or a calendar year activity summary. Where actual traffic counts are unavailable or not recorded, adequately documented FAA estimates of the scheduled and nonscheduled activity may be used.)

(b) An airport meets the establishment criteria when it satisfies paragraphs (a)(1) through (a)(5) of this section and its benefit-cost ratio equals or exceeds one. As defined in §170.3 of this part, the benefit-cost ratio is the ratio of the present value of the ATCT life cycle benefits (BPV) to the present value of ATCT life cycle costs (CPV).

$$BPV/CPV \geq 1.0$$

(c) The satisfaction of all the criteria listed in this section does not guarantee that the airport will receive an ATCT.

### § 170.15 ATCT discontinuance criteria.

An ATCT will be subject to discontinuance when the continued operation and maintenance costs less termination costs (CMPV) of the ATCT exceed the present value of its remaining life-cycle benefits (BPV):

$$BPV/CMPV < 1.0$$

## Subpart C—LORAN-C

SOURCE: Amdt. 170–1, 58 FR 42817, Aug. 11, 1993, unless otherwise noted.

### § 170.21 Scope.

This subpart sets forth establishment and discontinuance criteria for LORAN-C.

### § 170.23 LORAN-C establishment criteria.

(a) The criteria in paragraphs (a)(1) through (a)(6) of this section, along with general facility and navigational aid establishment requirements, must be met before a runway can be eligible for LORAN-C approach.

(1) A runway must have landing surfaces judged adequate by the FAA to accommodate aircraft expected to use the approach and meet all FAA-required airport design criteria for nonprecision runways.

(2) A runway must be found acceptable for instrument flight rules operations as a result of an airport airspace analysis conducted in accordance with the current FAA regulations and provisions.

(3) The LORAN-C signal must be of sufficient quality and accuracy to pass an FAA flight inspection.

(4) It must be possible to remove, mark, or light all approach obstacles in accordance with FAA marking and lighting provisions.

(5) Appropriate weather information must be available.

(6) Air-to-ground communications must be available at the initial approach fix minimum altitude and at the missed approach altitude.

(b) A runway meets the establishment criteria for a LORAN-C approach when it satisfies paragraphs (a)(1) through (a)(6) of this section and the estimated value of benefits associated with the LORAN-C approach equals or exceeds the estimated costs (benefit-cost ratio equals or exceeds one). As defined in §170.3 of this part, the benefit-cost ratio is the ratio of the present value of the LORAN-C life-cycle benefits (PVB) to the present value of LORAN-C life-cycle costs (PVC):

$$PVB/PVC \geq 1.0$$

(c) The criteria do not cover all situations that may arise and are not used as a sole determinant in denying or granting the establishment of non-precision LORAN-C approach for which there is a demonstrated operational or air traffic control requirement.

### § 170.25 LORAN-C discontinuance criteria.

A LORAN-C nonprecision approach may be subject to discontinuance when the present value of the continued maintenance costs (PVCM) of the LORAN-C approach exceed the present value of its remaining life-cycle benefits (PVB):

$$PVB/PVCM < 1.0$$

## PART 171—NON-FEDERAL NAVIGATION FACILITIES

### Subpart A—VOR Facilities



### Subpart B—Nondirectional Radio Beacon Facilities



### Subpart C—Instrument Landing System (ILS) Facilities



### Subpart D—True Lights



### Subpart E—General

AUTHORITY: 49 U.S.C. 106(g), 40103–40107, 40109, 40113, 44502, 44701–44702, 44708–44709, 44711, 44719–44721, 45303, 46308.

SOURCE: Docket No. 5034, 29 FR 11337, Aug. 6, 1964, unless otherwise noted.

## Subpart A—VOR Facilities

### § 171.1 Scope.

This subpart sets forth minimum requirements for the approval and operation on non-Federal VOR facilities that are to be involved in the approval of instrument flight rules and air traffic control procedures related to those facilities.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended by Amdt. 171–2, 31 FR 5408, Apr. 6, 1966; Amdt. 171–7, 35 FR 12711, Aug. 11, 1970]

### § 171.3 Requests for IFR procedure.

(a) Each person who requests an IFR procedure based on a VOR facility that he owns must submit the following information with that request:

(1) A description of the facility and evidence that the equipment meets the performance requirements of § 171.7 and is installed in accordance with § 171.9.

(2) A proposed procedure for operating the facility.

(3) A proposed maintenance organization and maintenance manual that meets the requirements of § 171.11.

(4) A statement of intention to meet the requirements of this subpart.

(5) A showing that the facility has an acceptable level of operational reliability and an acceptable standard of performance. Previous equivalent operational experience with a facility with identical design and operational characteristics will be considered in showing compliance with this paragraph.

(b) After the FAA inspects and evaluates the facility, it advises the owner of the results and of any required changes in the facility or the maintenance manual or maintenance organization. The owner must then correct the deficiencies, if any, and operate the facility for an in-service evaluation by the FAA.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended by Amdt. 171–7, 35 FR 12711, Aug. 11, 1970]

### § 171.5 Minimum requirements for approval.

(a) The following are the minimum requirements that must be met before the FAA will approve an IFR procedure for a non-Federal VOR:

(1) The facility's performance, as determined by air and ground inspection, must meet the requirements of § 171.7.

(2) The installation of the equipment must meet the requirements of § 171.9.

(3) The owner must agree to operate and maintain the facility in accordance with § 171.11.

(4) The owner must agree to furnish periodic reports, as set forth in § 171.13, and must agree to allow the FAA to inspect the facility and its operation whenever necessary.

(5) The owner must assure the FAA that he will not withdraw the facility from service without the permission of the FAA.

(6) The owner must bear all costs of meeting the requirements of this section and of any flight or ground inspections made before the facility is commissioned, except that the Federal Aviation Administration may bear certain of these costs subject to budgetary limitations and policy established by the Administrator.

(b) If the applicant for approval meets the requirements of paragraph (a) of this section, the FAA commissions the facility as a prerequisite to its approval for use in an IFR procedure. The approval is withdrawn at any time the facility does not continue to meet those requirements.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended by Amdt. 171–6, 35 FR 10288, June 24, 1970]

### § 171.7 Performance requirements.

(a) The VOR must perform in accordance with the ''International Standards and Recommended Practices, Aeronautical Telecommunications,'' Part I, paragraph 3.3 (Annex 10 to the Convention on International Civil Aviation), except that part of paragraph 3.3.2.1 specifying a radio frequency tolerance of 0.005 percent, and that part of paragraph 3.3.7 requiring removal of only the bearing information. In place thereof, the frequency tolerance of the radio frequency carrier must not exceed plus or minus 0.002 percent, and all radiation must be removed during the specified deviations from established conditions and during periods of monitor failure.

(b) Ground inspection consists of an examination of the design features of the equipment to determine that there will not be conditions that will allow unsafe operations because of component failure or deterioration.

(c) The monitor is checked periodically, during the in-service test evaluation period, for calibration and stability The tests are made with a standard ''Reference and variable phase signal generator'' and associated test equipment, including an oscilloscope and portable field detector. In general, the ground check is conducted in accord- ance with section 8.4 of FAA Handbook AF P 6790.9 ''Maintenance Instruction for VHF Omniranges'', adapted for the facility concerned.

(d) Flight tests to determine the facility's adequacy for operational requirements and compliance with applicable ''Standards and Recommended Practices'' are conducted in accordance with the ''U.S. Standard Flight Inspection Manual'', particularly section 201.

(e) After January 1, 1975, the owner of the VOR shall modify the facility to perform in accordance with paragraph 3.3.5.7 of Annex 10 to the Convention on International Civil Aviation within 180 days after receipt of notice from the Administrator that 50 kHz channel spacing is to be implemented in the area and that a requirement exists for suppression of 9960 Hz subcarrier harmonics.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended by Amdt. 171–7, 35 FR 12711, Aug. 11, 1970; Amdt. 171–9, 38 FR 28557, Oct. 15, 1973]

### § 171.9 Installation requirements.

(a) The facility must be installed according to accepted good engineering practices, applicable electric and safety codes, and the installation must meet at least the Federal Communication Commission's licensing requirements.

(b) The facility must have a reliable source of suitable primary power, either from a power distribution system or locally generated, with a supplemental standby system, if needed.

(c) Dual transmitting equipment with automatic changeover is preferred and may be required to support certain IFR procedures.

(d) There must be a means for determining, from the ground, the performance of the equipment, including the antenna, initially and periodically.

(e) A facility intended for use as an instrument approach aid for an airport must have or be supplemented by (depending on circumstances) the following ground-air or landline communications services:

(1) At facilities outside of and not immediately adjacent to controlled airspace, there must be ground-air communications from the airport served by the facility. Separate communications channels are acceptable.

(2) At facilities within or immediately adjacent to controlled airspace, there must be the ground-air communications required by paragraph (e)(1) of this section and reliable communications (at least a landline telephone) from the airport to the nearest FAA air traffic control or communication facility.

Paragraphs (e) (1) and (2) of this section are not mandatory at airports where an adjacent FAA facility can communicate with aircraft on the ground at the airport and during the entire proposed instrument approach procedure. In addition, at low traffic density airports within or immediately adjacent to controlled airspace and where extensive delays are not a factor, the requirements of paragraphs (e) (1) and (2) of this section may be reduced to reliable communications (at least a landline telephone) from the airport to the nearest FAA air traffic control or communication facility, if an adjacent FAA facility can communicate with aircraft during the proposed instrument approach procedure, at least down to the minimum en route altitude for the controlled airspace area.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended by Amdt. 171–7, 35 FR 12711, Aug. 11, 1970; Amdt. 171–16, 56 FR 65664, Dec. 17, 1991]

### § 171.11 Maintenance and operations requirements.

(a) The owner of the facility must establish an adequate maintenance system and provide qualified maintenance personnel to maintain the facility at the level attained at the time it was commissioned. Each person who maintains a facility must meet at least the Federal Communications Commission's licensing requirements and show that he has the special knowledge and skills needed to maintain the facility including proficiency in maintenance procedures and the use of specialized test equipment.

(b) The owner must prepare, and obtain FAA approval of, an operations and maintenance manual that sets forth mandatory procedures for operations, preventive maintenance, and emergency maintenance, including instructions on each of the following:

(1) Physical security of the facility.

(2) Maintenance and operations by authorized persons only.

(3) FCC licensing requirements for operating and maintenance personnel.

(4) Posting of licenses and signs.

(5) Relations between the facility and FAA air traffic control facilities, with a description of the boundaries of controlled airspace over or near the facility, instructions for relaying air traffic control instructions and information (if applicable), and instructions for the operation of an air traffic advisory service if the VOR is located outside of controlled airspace.

(6) Notice to the Administrator of any suspension of service.

(7) Detailed and specific maintenance procedures and servicing guides stating the frequency of servicing.

(8) Air-ground communications, if provided, expressly written or incorporating appropriate sections of FAA manuals by reference.

(9) Keeping of station logs and other technical reports, and the submission of reports required by § 171.13.

(10) Monitoring of the facility.

(11) Inspections by United States personnel.

(12) Names, addresses, and telephone numbers of persons to be notified in an emergency.

(13) Shutdowns for routine maintenance and issue of ''Notices to Airmen'' for routine or emergency shutdowns (private use facilities may omit the ''Notices to Airmen'').

(14) An explanation of the kinds of activity (such as construction or grading) in the vicinity of the facility that may require shutdown or recertification of the facility by FAA flight check.

(15) Procedures for conducting a ground check of course accuracy.

(16) Commissioning of the facility.

(17) An acceptable procedure for amending or revising the manual.

(18) The following information concerning the facility:

(i) Location by latitude and longitude to the nearest second, and its position with respect to airport layouts.

(ii) The type, make, and model of the basic radio equipment that will provide the service.

(iii) The station power emission and frequency.

(iv) The hours of operation.

(v) Station identification call letters and method of station identification, whether by Morse code or recorded voice announcement, and the time spacing of the identification.

(vi) A description of the critical parts that may not be changed, adjusted, or repaired without an FAA flight check to confirm published operations.

(c) The owner shall make a ground check of course accuracy each month in accordance with procedures approved by the FAA at the time of commissioning, and shall report the results of the checks as provided in § 171.13.

(d) If the owner desires to modify the facility, he must submit the proposal to the FAA and may not allow any modifications to be made without specific approval.

(e) The owner's maintenance personnel must participate in initial inspections made by the FAA. In the case of subsequent inspections, the owner or his representative shall participate.

(f) Whenever it is required by the FAA, the owner shall incorporate improvements in VOR maintenance brought about by progress in the state of the art. In addition, he shall provide a stock of spare parts, including vacuum tubes, of such a quantity to make possible the prompt replacement of components that fail or deteriorate in service.

(g) The owner shall provide all approved test instruments needed for maintenance of the facility.

(h) The owner shall close the facility upon receiving two successive pilot reports of its malfunctioning.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended by Amdt. 171–2, 31 FR 5408, Apr. 6, 1966]

### § 171.13 Reports.

The owner of each facility to which this subpart applies shall make the following reports on forms furnished by the FAA, at the times indicated, to the FAA Regional office for the area in which the facility is located:

(a) *Record of meter readings and adjustments* (*Form FAA–198*). To be filled out by the owner with the equipment adjustments and meter readings as of the time of commissioning, with one copy to be kept in the permanent records of the facility and two copies to the appropriate Regional office of the FAA. The owner shall revise the form after any major repair, modernization, or returning, to reflect an accurate record of facility operation and adjustment.

(b) *Facility maintenance log* (*FAA Form 6003–1*). This form is a permanent record of all equipment malfunctioning met in maintaining the facility, including information on the kind of work and adjustments made, equipment failures, causes (if determined), and corrective action taken. The owner shall keep the original of each report at the facility and send a copy to the appropriate Regional office of the FAA at the end of the month in which it is prepared.

(c) *Radio equipment operation record* (*Form FAA–418*). To contain a complete record of meter readings, recorded on each scheduled visit to the facility.

The owner shall keep the original of each month's record at the facility and send a copy of it to the appropriate Regional office of the FAA.

(d) [Reserved]

(e) *VOR ground check error data* (*Forms FAA–2396 and 2397*). To contain results of the monthly course accuracy ground check in accordance with FAA Handbook AF P 6790.9 ''Maintenance Instructions for VHF Omniranges''. The owner shall keep the originals in the facility and send a copy of each form to the appropriate Regional office of the FAA on a monthly basis.

(49 U.S.C. 1348)

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended by Amdt. 171–5, 34 FR 15245, Sept. 30, 1969; Amdt. 171–10, 40 FR 36110, Aug. 19, 1975]

## Subpart B—Nondirectional Radio Beacon Facilities

### § 171.21 Scope.

(a) This subpart sets forth minimum requirements for the approval and operation of non-Federal, nondirectional radio beacon facilities that are to be involved in the approval of instrument flight rules and air traffic control procedures related to those facilities.

(b) A nondirectional radio beacon (''H'' facilities domestically—NDB facilities internationally) radiates a continuous carrier of approximately equal intensity at all azimuths. The carrier is modulated at 1020 cycles per second for station identification purposes.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended by Amdt. 171–2, 31 FR 5408, Apr. 6, 1966; Amdt. 171–7, 35 FR 12711, Aug. 11, 1970]

### § 171.23 Requests for IFR procedure.

(a) Each person who requests an IFR procedure based on a nondirectional radio beacon facility that he owns must submit the following information with that request:

(1) A description of the facility and evidence that the equipment meets the performance requirements of § 171.27 and is installed in accordance with § 171.29.

(2) A proposed procedure for operating the facility.

(3) A proposed maintenance arrangement and a maintenance manual that meets the requirements of § 171.31.

(4) A statement of intention to meet the requirements of this subpart.

(5) A showing that the facility has an acceptable level of operational reliability and an acceptable standard of performance. Previous equivalent operational experience with a facility with identical design and operational characteristics will be considered in showing compliance with this subparagraph.

(b) After the FAA inspects and evaluates the facility, it advises the owner of the results and of any required changes in the facility or the maintenance manual or maintenance organization. The owner must then correct the deficiencies, if any, and operate the facility for an in-service evaluation by the FAA.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended by Amdt. 171–7, 35 FR 12711, Aug. 11, 1970]

### § 171.25 Minimum requirements for approval.

(a) The following are the minimum requirements that must be met before the FAA will approve an IFR procedure for a non-Federal, nondirectional radio beacon facility under this subpart:

(1) The facility's performances, as determined by air and ground inspection, must meet the requirements of § 171.27.

(2) The installation of the equipment must meet the requirements of § 171.29.

(3) The owner must agree to operate and maintain the facility in accordance with § 171.31.

(4) The owner must agree to furnish periodic reports, as set forth in § 171.33, and agree to allow the FAA to inspect the facility and its operation whenever necessary.

(5) The owner must assure the FAA that he will not withdraw the facility from service without the permission of the FAA.

(6) The owner must bear all costs of meeting the requirements of this section and of any flight or ground inspections made before the facility is commissioned, except that the Federal Aviation Administration may bear certain of these costs subject to budgetary limitations and policy established by the Administrator.

(b) If the applicant for approval meets the requirements of paragraph (a) of this section, the FAA commissions the facility as a prerequisite to its approval for use in an IFR procedure. The approval is withdrawn at any time the facility does not continue to meet those requirements. In addition, the facility may be de-commissioned whenever the frequency channel is needed for higher priority common system service.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended by Amdt. 171–6, 35 FR 10288, June 24, 1970]

### § 171.27 Performance requirements.

(a) The facility must meet the performance requirements set forth in the ''International Standards and Recommended Practices, Aeronautical Telecommunications, Part I, paragraph 3.4'' (Annex 10 to the Convention on International Civil Aviation), except that identification by on-off keying of a second carrier frequency, separated from the main carrier by 1020 Hz plus or minus 50 Hz, is also acceptable.

(b) The facility must perform in accordance with recognized and accepted good electronic engineering practices for the desired service.

(c) Ground inspection consists of an examination of the design features of the equipment to determine (based on recognized and accepted good engineering practices) that there will not be conditions that will allow unsafe operations because of component failure or deterioration.

(d) Flight tests to determine the facility's adequacy for operational requirements and compliance with applicable ''Standards and Recommended Practices'' are conducted in accordance with the ''U.S. Standard Flight Inspection Manual'', particularly section 207. The original test is made by the FAA and later tests shall be made under arrangements, satisfactory to the FAA, that are made by the owner.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended by Amdt. 171–7, 35 FR 12711, Aug. 11, 1970]

### § 171.29 Installation requirements.

(a) The facility must be installed according to accepted good engineering practices, applicable electric and safety codes, and FCC licensing requirements.

(b) The facility must have a reliable source of suitable primary power.

(c) Dual transmitting equipment may be required to support some IFR procedures.

(d) A facility intended for use as an instrument approach aid for an airport must have or be supplemented by (depending on the circumstances) the following ground-air or landline communications services:

(1) At facilities outside of and not immediately adjacent to controlled airspace, there must be ground-air communications from the airport served by the facility. Voice on the aid controlled from the airport is acceptable.

(2) At facilities within or immediately adjacent to controlled airspace, there must be the ground-air communications required by paragraph (d)(1) of this section and reliable communications (at least a landline telephone) from the airport to the nearest FAA air traffic control or communication facility.

Paragraphs (d) (1) and (2) of this section are not mandatory at airports where an adjacent FAA facility can communicate with aircraft on the ground at the airport and during the entire proposed instrument approach procedure. In addition, at low traffic density airports within or immediately adjacent to controlled airspace, and where extensive delays are not a factor, the requirements of paragraphs (d) (1) and (2) of this section may be reduced to reliable communications (at least a landline telephone) from the airport to the nearest FAA air traffic control or communications facility, if an adjacent FAA facility can communicate with aircraft during the proposed instrument approach procedure, at least down to the minimum en route altitude for the controlled airspace area.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended by Amdt. 171–16, 56 FR 65664, Dec. 17, 1991]

### § 171.31 Maintenance and operations requirements.

(a) The owner of the facility must establish an adequate maintenance system and provide qualified maintenance

personnel to maintain the facility at the level attained at the time it was commissioned. Each person who maintains a facility must meet at least the Federal Communications Commission's licensing requirements and show that he has the special knowledge and skills needed to maintain the facility including proficiency in maintenance procedures and the use of specialized test equipment.

(b) The owner must prepare, and obtain approval of, an operations and maintenance manual that sets forth mandatory procedures for operations, preventive maintenance, and emergency maintenance, including instructions on each of the following:

(1) Physical security of the facility.

(2) Maintenance and operations by authorized persons only.

(3) FCC licensing requirements for operating and maintenance personnel.

(4) Posting of licenses and signs.

(5) Relations between the facility and FAA air traffic control facilities, with a description of the boundaries of controlled airspace over or near the facility, instructions for relaying air traffic control instructions and information (if applicable), and instructions for the operation of an air traffic advisory service if the facility is located outside of controlled airspace.

(6) Notice to the Administrator of any suspension of service.

(7) Detailed arrangements for maintenance flight inspection and servicing stating the frequency of servicing.

(8) Air-ground communications, if provided, expressly written or incorporating appropriate sections of FAA manuals by reference.

(9) Keeping of station logs and other technical reports, and the submission of reports required by § 171.33.

(10) Monitoring of the facility, at least once each half hour, to assure continuous operation.

(11) Inspections by United States personnel.

(12) Names, addresses, and telephone numbers of persons to be notified in an emergency.

(13) Shutdowns for routine maintenance and issue of ''Notices to Airmen'' for routine or emergency shutdowns (private use facilities may omit the ''Notices to Airmen'').

(14) Commissioning of the facility.

(15) An acceptable procedure for amending or revising the manual.

(16) The following information concerning the facility:

(i) Location by latitude and longitude to the nearest second, and its position with respect to airport layouts.

(ii) The type, make, and model of the basic radio equipment that will provide the service.

(iii) The station power emission and frequency.

(iv) The hours of operation.

(v) Station identification call letters and method of station identification, whether by Morse code or recorded voice announcement, and the time spacing of the identification.

(c) If the owner desires to modify the facility, he must submit the proposal to the FAA and meet applicable requirements of the FCC.

(d) The owner's maintenance personnel must participate in initial inspections made by the FAA. In the case of subsequent inspections, the owner or his representative shall participate.

(e) The owner shall provide a stock of spare parts, including vacuum tubes, of such a quantity to make possible the prompt replacement of components that fail or deteriorate in service.

(f) The owner shall close the facility upon receiving two successive pilot reports of its malfunctioning.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended by Amdt. 171–2, 31 FR 5408, Apr. 6, 1966]

### § 171.33 Reports.

The owner of each facility to which this subpart applies shall make the following reports, at the times indicated, to the FAA Regional office for the area in which the facility is located:

(a) *Record of meter readings and adjustments* (*Form FAA–198*). To be filled out by the owner or his maintenance representative with the equipment adjustments and meter readings as of the time of commissioning, with one copy to be kept in the permanent records of the facility and two copies to the appropriate Regional Office of the FAA. The owner shall revise the form after

any major repair, modernization, or returning, to reflect an accurate record of facility operation and adjustment.

(b) *Facility maintenance log* (*FAA Form 6030–1*). This form is a permanent record of all equipment malfunctioning met in maintaining the facility, including information on the kind of work and adjustments made, equipment failures, causes (if determined), and corrective action taken. The owner shall keep the original of each report at the facility and send a copy to the appropriate Regional Office of the FAA at the end of the month in which it is prepared.

(c) *Radio equipment operation record* (*Form FAA–418*). To contain a complete record of meter readings, recorded on each scheduled visit to the facility. The owner shall keep the original of each month's record at the facility and send a copy of it to the appropriate Regional Office of the FAA.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended by Amdt. 171–10, 40 FR 36110, Aug. 19, 1975]

## Subpart C—Instrument Landing System (ILS) Facilities

### § 171.41 Scope.

This subpart sets forth minimum requirements for the approval and operation of non-Federal Instrument Landing System (ILS) Facilities that are to be involved in the approval of instrument flight rules and air traffic control procedures related to those facilities.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended by Amdt. 171–2, 31 FR 5408, Apr. 6, 1966; Amdt. 171–7, 35 FR 12711, Aug. 11, 1970]

### § 171.43 Requests for IFR procedure.

(a) Each person who requests an IFR procedure based on an ILS facility that he owns must submit the following information with that request:

(1) A description of the facility and evidence that the equipment meets the performance requirements of § 171.47 and is installed in accordance with § 171.49.

(2) A proposed procedure for operating the facility.

(3) A proposed maintenance organization and a maintenance manual that meets the requirements of § 171.51.

(4) A statement of intent to meet the requirements of this subpart.

(5) A showing that the facility has an acceptable level of operational reliability and an acceptable standard of performance. Previous equivalent operational experience with a facility with identical design and operational characteristics will be considered in showing compliance with this subparagraph.

(b) After the FAA inspects and evaluates the facility, it advises the owner of the results and of any required changes in the facility or the maintenance manual or maintenance organization. The owner must then correct the deficiencies, if any, and operate the facility for an in-service evaluation by the FAA.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended by Amdt. 171–7, 35 FR 12711, Aug. 11, 1970]

### § 171.45 Minimum requirements for approval.

(a) The following are the minimum requirements that must be met before the FAA will approve an IFR procedure for a non-Federal Instrument Landing System:

(1) The facility's performance, as determined by air and ground inspection, must meet the requirements of § 171.47.

(2) The installation of the equipment must meet the requirements of § 171.49.

(3) The owner must agree to operate and maintain the facility in accordance with § 171.51.

(4) The owner must agree to furnish periodic reports, as set forth in § 171.53 and agree to allow the FAA to inspect the facility and its operation whenever necessary.

(5) The owner must assure the FAA that he will not withdraw the facility from service without the permission of the FAA.

(6) The owner must bear all costs of meeting the requirements of this section and of any flight or ground inspections made before the facility is commissioned, except that the Federal Aviation Administration may bear certain of these costs subject to budgetary limitations and policy established by the Administrator.

(b) If the applicant for approval meets the requirements of paragraph

(a) of this section, the FAA commissions the facility as a prerequisite to its approval for use in an IFR procedure. The approval is withdrawn at any time the facility does not continue to meet those requirements. In addition, the facility may be de-commissioned whenever the frequency channel is needed for higher priority common system service.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended by Amdt. 171–6, 35 FR 10288, June 24, 1970]

### § 171.47 Performance requirements.

(a) The Instrument Landing System must perform in accordance with the ''International Standards and Recommended Practices, Aeronautical Telecommunications, Part I, Paragraph 3.1'' (Annex 10 to the Convention on International Civil Aviation) except as follows:

(1) The first part of paragraph 3.1.3, relating to suppression of radiation wholly or in part in any or all directions outside the 20-degree sector centered on the course line to reduce localizer does not apply.

(2) Radiation patterns must conform to limits specified in 3.1.3.3 and 3.1.3.4, but this does not mean that suppression of radiation to the rear of the antenna array to satisfy difficult siting positions (as per 3.1.3.1.4) is not allowed. For example, if a reflector screen for the antenna array is required to overcome a siting problem, the area to the rear of the localizer may be made unusable and should be so advertised.

(3) A third marker beacon (inner marker) is not required.

(4) The frequency tolerance of the radio frequency carrier must not exceed plus or minus 0.002 percent.

(b) Ground inspection consists of an examination of the design features of the equipment to determine that there will not be conditions that will allow unsafe operations because of component failure or deterioration.

(c) The monitor is checked periodically, during the in-service test evaluation period, for calibration and stability. These tests, and ground checks of glide slope and localizer radiation characteristics, are conducted in accordance with FAA Handbooks AF P 6750.1 and AF P 6750.2 ''Maintenance Instructions for ILS Localizer Equipment'' and ''Maintenance Instructions for ILS Glide Slope Equipment''.

(d) Flight tests to determine the facility's adequacy for operational requirements and compliance with applicable ''Standards and Recommended Practices'' are conducted in accordance with the ''U.S. Standard Flight Inspection Manual'', particularly section 217.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1974, as amended by Amdt. 171–9, 38 FR 28557, Oct. 15, 1973]

### § 171.49 Installation requirements.

(a) The facility must be of a permanent nature, located, constructed, and installed according to ICAO Standards (Annex 10), accepted good engineering practices, applicable electric and safety codes, and FCC licensing requirements.

(b) The facility must have a reliable source of suitable primary power, either from a power distribution system or locally generated. A determination by the Administrator as to whether a facility will be required to have standby power for the localizer, glide slope and monitor accessories to supplement the primary power, will be made for each airport based upon operational minimums and density of air traffic.

(c) A determination by the Administrator as to whether a facility will be required to have dual transmitting equipment with automatic changeover for localizer and glide slope components, will be made for each airport based upon operational minimums and density of air traffic.

(d) There must be a means for determining, from the ground, the performance of the equipment (including antennae), initially and periodically.

(e) The facility must have, or be supplemented by (depending on the circumstances) the following ground-air or landline communications services:

(1) At facilities outside of and not immediately adjacent to controlled airspace, there must be ground-air communications from the airport served by the facility. The utilization of voice on the ILS frequency should be determined by the facility operator on an individual basis.

(2) At facilities within or immediately adjacent to controlled airspace, there must be the ground-air communications required by paragraph (e)(1) of this section and reliable communications (at least a landline telephone) from the airport to the nearest FAA air traffic control or communications facility.

Paragraphs (e)(1) and (e)(2) of this section are not mandatory at airports where an adjacent FAA facility can communicate with aircraft on the ground at the airport and during the entire proposed instrument approach procedure. In addition, at low traffic density airports within or immediately adjacent to controlled airspace, and where extensive delays are not a factor, the requirements of paragraphs (e)(1) and (e)(2) of this section may be reduced to reliable communications (at least a landline telephone) from the airport to the nearest FAA air traffic control or communications facility, if an adjacent FAA facility can communicate with aircraft during the proposed instrument approach procedure down to the airport surface or at least to the minimum approach altitude.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended by Amdt. 171–6, 35 FR 10288, June 24, 1970; Amdt. 171–16, 56 FR 65664, Dec. 17, 1991]

### § 171.51 Maintenance and operations requirements.

(a) The owner of the facility must establish an adequate maintenance system and provide qualified maintenance personnel to maintain the facility at the level attained at the time it was commissioned. Each person who maintains a facility must meet at least the Federal Communications Commission's licensing requirements and show that he has the special knowledge and skills needed to maintain the facility including proficiency in maintenance procedures and the use of specialized test equipment.

(b) The owner must prepare, and obtain approval of, an operations and maintenance manual that sets forth mandatory procedures for operations, preventive maintenance, and emergency maintenance, including instructions on each of the following:

(1) Physical security of the facility.

(2) Maintenance and operations by authorized persons only.

(3) FCC licensing requirements for operating and maintenance personnel.

(4) Posting of licenses and signs.

(5) Relation between the facility and FAA air traffic control facilities, with a description of the boundaries of controlled airspace over or near the facility, instructions for relaying air traffic control instructions and information (if applicable), and instructions for the operations of an air traffic advisory service if the facility is located outside of controlled airspace.

(6) Notice to the Administrator of any suspension of service.

(7) Detailed and specific maintenance procedures and servicing guides stating the frequency of servicing.

(8) Air-ground communications, if provided, expressly written or incorporating appropriate sections of FAA manuals by reference.

(9) Keeping of station logs and other technical reports, and the submission of reports required by § 171.53.

(10) Monitoring of the facility.

(11) Inspections by United States personnel.

(12) Names, addresses, and telephone numbers of persons to be notified in an emergency.

(13) Shutdowns for routine maintenance and issue of ''Notices to Airmen'' for routine or emergency shutdowns (private use facilities may omit the ''Notices to Airmen'').

(14) Commissioning of the facility.

(15) An acceptable procedure for amending or revising the manual.

(16) An explanation of the kinds of activities (such as construction or grading) in the vicinity of the facility that may require shutdown or recertification of the facility by FAA flight check.

(17) Procedures for conducting a ground check or localizer course alignment width, and clearance, and glide slope elevation angle and width.

(18) The following information concerning the facility:

(i) Facility component locations with respect to airport layout, instrument runway, and similar areas.

(ii) The type, make, and model of the basic radio equipment that will provide the service.

(iii) The station power emission and frequencies of the localizer, glide slope, markers, and associated compass locators, if any.

(iv) The hours of operation.

(v) Station identification call letters and method of station identification and the time spacing of the identification.

(vi) A description of the critical parts that may not be changed, adjusted, or repaired without an FAA flight check to confirm published operations.

(c) The owner shall make a ground check of the facility each month in accordance with procedures approved by the FAA at the time of commissioning, and shall report the results of the checks as provided in §171.53.

(d) If the owner desires to modify the facility, he must submit the proposal to the FAA and may not allow any modifications to be made without specific approval.

(e) ''The owner's maintenance personnel must participate in initial inspections made by the FAA. In the case of subsequent inspections, the owner or his representative shall participate.''

(f) Whenever it is required by the FAA, the owner shall incorporate improvements in ILS maintenance brought about by progress in the state of the art. In addition, he shall provide a stock of spare parts, including vacuum tubes, of such a quantity to make possible the prompt replacement of components that fail or deteriorate in service.

(g) The owner shall provide FAA approved test instruments needed for maintenance of the facility.

(h) The owner shall close the facility upon receiving two successive pilot reports of its malfunctioning.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended by Amdt. 171–2, 31 FR 5408, Apr. 6, 1966]

### §171.53 Reports.

The owner of each facility to which this subpart applies shall make the following reports, at the times indicated, to the FAA Regional Office for the area in which the facility is located:

(a) *Record of meter readings and adjustments* (*Form FAA–198*). To be filled out by the owner or his maintenance representative with the equipment adjustments and meter readings as of the time of commissioning, with one copy to be kept in the permanent records of the facility and two copies to the appropriate Regional Office of the FAA. The owner shall revise the form after any major repair, modernization, or retuning, to reflect an accurate record of facility operation and adjustment.

(b) *Facility maintenance log* (*FormFAA 6030–1*). This form is a permanent record of all equipment malfunctioning met in maintaining the facility, including information on the kind of work and adjustments made, equipment failures, causes (if determined), and corrective action taken. The owner shall keep the original of each report at the facility and send a copy to the appropriate Regional Office of the FAA at the end of each month in which it is prepared.

(c) *Radio equipment operation record* (*Form FAA–418*). To contain a complete record of meter readings, recorded on each scheduled visit to the facility. The owner shall keep the original of each month's record at the facility and send a copy of it to the appropriate Regional Office of the FAA.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended by Amdt. 171–5, 34 FR 15245, Sept. 30, 1969; Amdt. 171–10, 40 FR 36110, Aug. 19, 1975]

## Subpart D—True Lights

### §171.61 Air navigation certificate: Revocation and termination.

(a) Except as provided in paragraph (b) of this section, each air navigation certificate of ''Lawful Authority to Operate a True Light'' is hereby revoked, and each application therefor is hereby terminated.

(b) Paragraph (a) of this section does not apply to—

(1) A certificate issued to a Federal-Aid Airport Program sponsor who was required to apply for that certificate under regulations then in effect, and who has not surrendered that certificate under §151.86(e) of this chapter; or

(2) An application made by a Federal-Aid Airport Program sponsor who was required to make that application under regulations then in effect, and

who has not terminated that application under §151.86(e) of this chapter.

(49 U.S.C. 1101–1120; sec. 307, 72 Stat. 749, 49 U.S.C. 1348)

[Amdt. 171–4, 33 FR 12545, Sept. 5, 1968]

## Subpart E—General

### § 171.71 Materials incorporated by reference.

Copies of standards, recommended practices and documents incorporated by reference in this part are available for the use of interested persons at any FAA Regional Office and FAA Headquarters. An historical file of these materials is maintained at Headquarters, Federal Aviation Administration, 800 Independence Avenue SW., Washington, DC 20590.

[Amdt. 171–8, 36 FR 5584, Mar. 25, 1971]

### § 171.73 Alternative forms of reports.

On a case-by-case basis, a Regional Administrator may accept any report in a format other than the FAA form required by this part if he is satisfied that the report contains all the information required on the FAA form and can be processed by FAA as conveniently as the FAA form.

(49 U.S.C. 1348)

[Amdt. 171–5, 34 FR 15245, Sept. 30, 1969, as amended by Amdt. 171–15, 54 FR 39296, Sept. 25, 1989]

### § 171.75 Submission of requests.

(a) Requests for approval of facilities not having design and operational characteristics identical to those of facilities currently approved under this part, including requests for deviations from this part for such facilities, must be submitted to the Director, Advanced Systems Design Service.

(b) The following requests must be submitted to the Regional Administrator of the region in which the facility is located:

(1) Requests for approval of facilities that have design and operational characteristics identical to those of facilities currently approved under this part, including requests for deviations from this part for such facilities.

(2) Requests for deviations from this part for facilities currently approved under this part.

(3) Requests for modification of facilities currently approved under this part.

[Amdt. 171–7, 35 FR 12711, Aug. 11, 1970, as amended by Amdt. 171–15, 54 FR 39296, Sept. 25, 1989]

## Subpart F—Simplified Directional Facility (SDF)

SOURCE: Docket No. 10116, 35 FR 12711, Aug. 11, 1970, unless otherwise noted.

### § 171.101 Scope.

This subpart sets forth minimum requirements for the approval and operation of non-Federal Simplified Directional Facilities (SDF) that are to be involved in the approval of instrument flight rules and air traffic control procedures related to those facilities.

### § 171.103 Requests for IFR procedure.

(a) Each person who requests an IFR procedure based on an SDF that he owns must submit the following information with that request:

(1) A description of the facility and evidence that the equipment meets the performance requirements of §171.109 and the standards and tolerances of §171.111, and is installed in accordance with §171.113.

(2) A proposed procedure for operating the facility.

(3) A proposed maintenance organization and a maintenance manual that meets the requirements of §171.115.

(4) A statement of intent to meet the requirements of this subpart.

(5) A showing that the facility has an acceptable level of operational reliability as prescribed in §171.111(k), and an acceptable standard of performance. Previous equivalent operational experience with a facility with identical design and operational characteristics will be considered in showing compliance with this paragraph.

(b) After the Federal Aviation Administration inspects and evaluates the facility, it advises the owner of the results and of any required changes in the facility or the maintenance manual or maintenance organization. The

owner must then correct the deficiencies, if any, and operate the facility for an in-service evaluation by the Federal Aviation Administration.

### § 171.105 Minimum requirements for approval.

(a) The following are the minimum requirements that must be met before the Federal Aviation Administration will approve an IFR procedure for a non-Federal Simplified Directional Facility:

(1) A suitable frequency channel must be available.

(2) The facility's performance, as determined by air and ground inspection, must meet the requirements of §§ 171.109 and 171.111.

(3) The installation of the equipment must meet the requirements of § 171.113.

(4) The owner must agree to operate and maintain the facility in accordance with § 171.115.

(5) The owner must agree to furnish periodic reports as set forth in § 171.117, and agree to allow the FAA to inspect the facility and its operation whenever necessary.

(6) The owner must assure the FAA that he will not withdraw the facility from service without the permission of the FAA.

(7) The owner must bear all costs of meeting the requirements of this section and of any flight or ground inspections made before the facility is commissioned, except that the FAA may bear certain of these costs subject to budgetary limitations and policy established by the Administrator.

(b) If the applicant for approval meets the requirements of paragraph (a) of this section, the FAA commissions the facility as a prerequisite to its approval for use in an IFR procedure. The approval is withdrawn at any time the facility does not continue to meet those requirements. In addition, the facility is licensed by the Federal Communications Commission. The Federal Aviation Administration recommends cancellation or nonrenewal of the Federal Communications Commission license whenever the frequency channel is needed for higher priority common system service.

### § 171.107 Definition.

As used in this subpart:

*SDF* (simplified directional facility) means a directional aid facility providing only lateral guidance (front or back course) for approach from a final approach fix.

*DDM* (difference in depth of modulation) means the percentage modulation depth of the larger signal minus the percentage modulation depth of the smaller signal, divided by 100.

*Angular displacement sensitivity* means the ratio of measured DDM to the corresponding angular displacement from the appropriate reference line.

*Back course sector* means the course sector on the opposite end of the runway from the front course sector.

*Course line* means the locus of points along the final approach course at which the DDM is zero.

*Course sector* means a sector in a horizontal plane containing the course line and limited by the loci of points nearest to the course line at which the DDM is 0.155.

*Displacement sensitivity* means the ratio of measured DDM to the corresponding lateral displacement from the appropriate reference line.

*Front course sector* means the course sector centered on the course line in the direction from the runway in which a normal final approach is made.

*Half course sector* means the sector in a horizontal plane containing the course line and limited by the loci of points nearest to the course line, at which the DDM is 0.0775.

*Point A* means a point on the front course in the approach direction a distance of 4 nautical miles from the threshold.

*Point A1* means a point on the front course in the approach direction a distance of 1 statute mile from the threshold.

*Point A2* means a point on the front course at the threshold.

*Reference datum* means a point at a specified height located vertically above the intersection of the course and the threshold.

*Missed approach point* means the point on the final approach course, not farther from the final approach fix

than Point ''A2'', at which the approach must be abandoned, if the approach and subsequent landing cannot be safely completed by visual reference, whether or not the aircraft has descended to the minimum descent altitude.

### § 171.109 Performance requirements.

(a) The Simplified Directional Facility must perform in accordance with the following standards and practices:

(1) The radiation from the SDF antenna system must produce a composite field pattern which is amplitude modulated by a 90 Hz and a 150 Hz tone. The radiation field pattern must produce a course sector with the 90 Hz tone predominating on one side of the course and with the 150 Hz tone predominating on the opposite side.

(2) When an observer faces the SDF from the approach end of runway, the depth of modulation of the radio frequency carrier due to the 150 Hz tone must predominate on his right hand and that due to the 90 Hz tone must predominate on his left hand.

(3) All horizontal angles employed in specifying the SDF field patterns must originate from the center of the antenna system which provides the signals used in the front course sector.

(4) The SDF must operate on odd tenths or odd tenths plus a twentieth MHz within the frequency band 108.1 MHz to 111.95 MHz. The frequency tolerance of the radio frequency carrier must not exceed plus or minus 0.002 percent.

(5) The radiated emission from the SDF must be horizontally polarized. The vertically polarized component of the radiation on the course line must not exceed that which corresponds to an error one-twentieth of the course sector width when an aircraft is positioned on the course line and is in a roll attitude of 20° from the horizontal.

(6) The SDF must provide signals sufficient to allow satisfactory operation of a typical aircraft installation within the sector which extends from the center of the SDF antenna system to distances of 18 nautical miles within a plus or minus 10° sector and 10 nautical miles within the remainder of the coverage when alternative navigational facilities provide satisfactory coverage within the intermediate approach area. SDF signals must be receivable at the distances specified at and above a height of 1,000 feet above the elevation of the threshold, or the lowest altitude authorized for transition, whichever is higher. Such signals must be receivable, to the distances specified, up to a surface extending outward from the SDF antenna and inclined at 7° above the horizontal.

(7) The modulation tones must be phase-locked so that within the half course sector, the demodulated 90 Hz and 150 Hz wave forms pass through zero in the same direction within 20° of phase relative to the 150 Hz component, every half cycle of the combined 90 Hz and 150 Hz wave form. However, the phase need not be measured within the half course sector.

(8) The angle of convergence of the final approach course and the extended runway centerline must not exceed 30°. The final approach course must be aligned to intersect the extended runway centerline between points A1 and the runway threshold. When an operational advantage can be achieved, a final approach course that does not intersect the runway or that intersects it at a distance greater than point A1 from the threshold, may be established, if that course lies within 500 feet laterally of the extended runway centerline at a point 3,000 feet outward from the runway threshold. The mean course line must be maintained within ±10 percent of the course sector width.

(9) The nominal displacement sensitivity within the half course sector must be 50 microamperes/degree. The nominal course sector width must be 6°. When an operational advantage can be achieved, a nominal displacement sensitivity of 25 microamperes/degree may be established, with a nominal course sector width of 12° with proportional displacement sensitivity. The lateral displacement sensitivity must be adjusted and maintained within the limits of plus or minus 17 percent of the nominal value.

(10) The off-course (clearance) signal must increase at a substantially linear rate with respect to the angular displacement from the course line up to an angle on either side of the course

line where 175 microamperes of deflection is obtained. From that angle to ±10°, the off-course deflection must not be less than 175 microamperes. From ±10° to ±35° the off-course deflection must not be less than 150 microamperes. With the course adjusted to cause any of several monitor alarm conditions, the aforementioned values of 175 microamperes in the sector 10° each side of course and 150 microamperes in the sector ±10° to ±35° may be reduced to 160 microamperes and 135 microamperes, respectively. These conditions must be met at a distance of 18 nautical miles from the SDF antenna within the sector 10° each side of course line and 10 nautical miles from the SDF antenna within the sector ±10° to ±35° each side of course line.

(11) The SDF may provide a ground-to-air radiotelephone communication channel to be operated simultaneously with the navigation and identification signals, if that operation does not interfere with the basic function. If a channel is provided, it must conform with the following standards:

(i) The channel must be on the same radio frequency carrier or carriers as used for the SDF function, and the radiation must be horizontally polarized. Where two carriers are modulated with speech, the relative phases of the modulations on the two carriers must avoid the occurrence of nulls within the coverage of the SDF.

(ii) On centerline, the peak modulation depth of the carrier or carriers due to the radiotelephone communications must not exceed 50 percent but must be adjusted so that the ratio of peak modulation depth due to the radiotelephone communications to that due to the identification signal is approximately 9:1.

(iii) The audio frequency characteristics of the radiotelephone channel must be flat to within 3 db relative to the level at 1,000 Hz over the range from 300 Hz to 3,000 Hz.

(12)(i) The SDF must provide for the simultaneous transmission of an identification signal, specific to the runway and approach direction, on the same radio frequency carrier or carriers as used for the SDF function. The transmission of the identification signal must not interfere in any way with the basic SDF function.

(ii) The identification signal must be produced by Class A2 modulation of the radio frequency carrier or carriers using a modulation tone of 1020 Hz within ±50 Hz. The depth of modulation must be between the limits of 5 and 15 percent except that, where a radiotelephone communication channel is provided, the depth of modulation must be adjusted so that the ratio of peak modulation depth due to radiotelephone communications to that due to the identification signal modulation is approximately 9:1. The emissions carrying the identification signal must be horizontally polarized.

(iii) The identification signal must employ the International Morse Code and consist of three letters.

(iv) The identification signal must be transmitted at a speed corresponding to approximately seven words per minute, and must be repeated at approximately equal intervals, not less than six times per minute. When SDF transmission is not available for operational use, including periods of removal of navigational components or during maintenance or test transmissions, the identification signal must be suppressed.

(b) It must be shown during ground inspection of the design features of the equipment that there will not be conditions that will allow unsafe operations because of component failure or deterioration.

(c) The monitor must be checked periodically during the in-service test evaluation period for calibration and stability. These tests, and ground checks of SDF radiation characteristics must be conducted in accordance with the maintenance manual required by §171.115(c) and must meet the standards and tolerances contained in §171.111(j).

(d) The monitor system must provide a warning to the designated control point(s) when any of the conditions of §171.111(j) occur, within the time periods specified in that paragraph.

(e) Flight inspection to determine the adequacy of the facility's operational performance and compliance

with applicable performance requirements must be conducted in accordance with the ''U.S. Standard Flight Inspection Manual.'' Tolerances contained in the U.S. Standard Flight Inspection Manual, section 217, must be complied with except as stated in paragraph (f) of this section.

(f) Flight inspection tolerances specified in section 217 of the ''U.S. Standard Flight Inspection Manual'' must be complied with except as follows:

(1) *Course sector width.* The nominal course sector width must be 6°. When an operational advantage can be achieved, a nominal course sector width of 12° may be established. Course sector width must be adjusted and maintained within the limits of ±17 percent of the nominal value.

(2) *Course alignment.* The mean course line must be adjusted and maintained within the limits of ±10 percent of the nominal course sector width.

(3) *Course structure.* Course deviations due to roughness, scalloping, or bends must be within the following limitations:

(i) *Front course.* (*a*) Course structure from 18 miles from runway threshold to Point A must not exceed ±40 microamperes;

(*b*) Point A to Point A–1—linear decrease from not more than ±40 microamperes at Point A to not more than ±20 microamperes at Point A–1;

(*c*) Point A–1 to Missed Approach Point—not more than ±20 microamperes;

(*d*) Monitor tolerances: width ±17 percent of nominal; alignment—±10 percent of nominal course sector width.

(ii) *Back course.* (*a*) Course structure 18 miles from runway threshold to 4 miles from runway threshold must not exceed ±40 microamperes. Four miles to 1 mile from R/W must not exceed ±40 microamperes decreasing to not more than ±20 microamperes, at a linear rate.

(*b*) Monitor tolerances: width—±17 percent of nominal; alignment—±10 percent of nominal course sector width.

[Doc. No. 10116, 35 FR 12711, Aug. 11, 1970, as amended by Amdt. 171–9, 38 FR 28557, Oct. 15, 1973]

### § 171.111 Ground standards and tolerances.

Compliance with this section must be shown as a condition to approval and must be maintained during operation of the SDF.

(a) *Frequency.* (1) The SDF must operate on odd tenths or odd tenths plus a twentieth MHz within the frequency band 108.1 MHz to 111.95 MHz. The frequency tolerance of the radio frequency carrier must not exceed plus or minus 0.002 percent.

(2) The modulating tones must be 90 Hz and 150 Hz within ±2.5 percent.

(3) The identification signal must be 1020 Hz within ±50 Hz.

(4) The total harmonic content of the 90 Hz tone must not exceed 10 percent.

(5) The total harmonic content of the 150 Hz tone must not exceed 10 percent.

(b) *Power output.* The normal carrier power output must be of a value which will provide coverage requirements of §171.109(a)(6) when reduced by 3 dB to the monitor RF power reduction alarm point specified in §171.111(j)(3).

(c) *VSWR.* (1) The VSWR of carrier and sideband feedlines must be a nominal value of 1/1 and must not exceed 1.2/1.

(2) The sponsor will also provide additional manufacturer's ground standards and tolerances for all VSWR parameters peculiar to the equipment which can effect performance of the facility in meeting the requirements specified in §§171.109 and 171.111.

(d) *Insulation resistance.* The insulation resistance of all coaxial feedlines must be greater than 20 megohms.

(e) *Depth of modulation.* (1) The depth of modulation of the radio frequency carrier due to each of the 90 Hz and 150 Hz tones must be 20 percent ±2 percent along the course line.

(2) The depth of modulation of the radio frequency carrier due to the 1020 Hz identification signal must be within 5 percent to 15 percent.

(f) *Course sector width.* The standard course sector width must be 6° or 12°. The course sector must be maintained with ±17 percent of the standard.

(g) *Course alignment.* Course alignment must be as specified in §171.109(a)(8).

(h) *Back course alignment and width.* If a back course is provided, standards

and tolerances for back course sector width and alignment must be the same as course sector width and course alignment specified in paragraphs (f) and (g) of this section.

(i) *Clearance.* Clearance must be as specified in § 171.109(a)(10).

(j) *Monitor standards and tolerances.* (1) The monitor system must provide a warning to the designated control point(s) when any of the conditions described in this paragraph occur, within the time periods specified in paragraph (j)(6) of this section.

(2) Course shift alarm: The monitor must alarm and cause radiation to cease, or identification and navigation signals must be removed, if the course alignment deviates from standard alignment by 10 percent or more of the standard course sector width.

(3) RF power reduction alarm: The monitor must alarm and cause radiation to cease, or identification and navigation signals must be removed, if the output power is reduced by 3 db or more from normal.

(4) Modulation level alarm: The monitor must alarm and cause radiation to cease, or identification and navigation signals must be removed, if the 90 Hz and 150 Hz modulation levels decrease by 17 percent or more.

(5) Course sector width alarm: The monitor must alarm and cause radiation to cease, or identification and navigation signals must be removed, for a change in course sector width to a value differing by ±17 percent or more from the standard.

(6) Monitor delay before shutdown: Radiation must cease, or identification and navigation signals must be removed, within 10 seconds after a fault is detected by the monitor, and no attempt must be made to resume radiation for a period of at least 20 seconds. If an automatic recycle device is used, not more than three successive recycles may be permitted before a complete SDF shutdown occurs.

(k) *Mean time between failures.* The mean time between failures must not be less than 800 hours. This measure is applied only to equipment failures (monitor or transmitting equipment, including out of tolerance conditions) which result in facility shutdown. It does not relate to the responsiveness of the maintenance organization.

(l) *Course alignment stability.* Drift of the course alignment must not exceed one-half the monitor limit in a 1-week period.

[Doc. No. 10116, 35 FR 12711, Aug. 11, 1970, as amended by Amdt. 171–9, 38 FR 28558, Oct. 15, 1973]

### § 171.113 Installation requirements.

(a) The facility must be installed according to accepted good engineering practices, applicable electric and safety codes, and FCC requirements.

(b) The SDF facility must have the following basic components:

(1) VHF SDF equipment and associated monitor system;

(2) Remote control, and indicator equipment (remote monitor) when required by the FAA;

(3) A final approach fix; and

(4) Compass locator (COMLO) or marker if suitable fixes and initial approach routes are not available from existing facilities.

(c) The facility must have a reliable source of suitable primary power, either from a power distribution system or locally generated. Also, adequate power capacity must be provided for operation of test and working equipment at the SDF. A determination by the Federal Aviation Administration as to whether a facility will be required to have standby power for the SDF and monitor accessories to supplement the primary power will be made for each airport based upon operational minimums and density of air traffic.

(d) A determination by the Federal Aviation Administration as to whether a facility will be required to have dual transmitting equipment with automatic changeover for the SDF will be made for each airport based upon operational minimums and density of air traffic.

(e) There must be a means for determining, from the ground, the performance of the equipment (including antennae), initially and periodically.

(f) The facility must have the following ground-air or landline communication services:

(1) At facilities outside of and not immediately adjacent to controlled airspace, there must be ground-air communications from the airport served by the facility. The utilization of voice on the SDF should be determined by the facility operator on an individual basis.

(2) At facilities within or immediately adjacent to controlled airspace, there must be ground/air communications required by paragraph (b)(1) of this section and reliable communications (at least a landline telephone) from the airport to the nearest Federal Aviation Administration air traffic control or communications facility.

Compliance with paragraphs (f) (1) and (2) of this section need not be shown at airports where an adjacent Federal Aviation Administration facility can communicate with aircraft on the ground at the airport and during the entire proposed instrument approach procedure. In addition, at low traffic density airports within or immediately adjacent to controlled airspace, and where extensive delays are not a factor, the requirements of paragraphs (f) (1) and (2) of this section may be reduced to reliable communications (at least a landline telephone) from the airport to the nearest Federal Aviation Administration air traffic control or communications facility, if an adjacent Federal Aviation Administration facility can communicate with aircraft during the proposed instrument approach procedure down to the airport surface or at least down to the minimum approach altitude.

(g) At those locations where two separate SDF facilities serve opposite ends of a single runway, an interlock must insure that only the facility serving the approach direction in use can radiate, except where no operationally harmful interference results.

(h) At those locations where, in order to alleviate frequency congestion, the SDF facilities serving opposite ends of one runway employ identical frequencies, an interlock must insure that the facility not in operational use cannot radiate.

(i) Provisions for maintenance and operations by authorized persons only.

(j) Where an operational advantage exists, the installation may omit a back course.

[Doc. No. 10116, 35 FR 12711, Aug. 11, 1970, as amended by Amdt. 171–16, 56 FR 65664, Dec. 17, 1991]

### § 171.115 Maintenance and operations requirements.

(a) The owner of the facility shall establish an adequate maintenance system and provide qualified maintenance personnel to maintain the facility at the level attained at the time it was commissioned. Each person who maintains a facility shall meet at a minimum the Federal Communications Commission's licensing requirements and show that he has the special knowledge and skills needed to maintain the facility, including proficiency in maintenance procedures and the use of specialized test equipment.

(b) The SDF must be designed and maintained so that the probability of operation within the performance requirements specified is high enough to insure an adequate level of safety. In the event out-of-tolerance conditions develop, the facility shall be removed from operation, and the designated control point notified.

(c) The owner must prepare, and obtain approval of, and each person operating or maintaining the facility shall comply with, an operations and maintenance manual that sets forth procedures for operations, preventive maintenance, and emergency maintenance, including instructions on each of the following:

(1) Physical security of the facility. This includes provisions for designating critical areas relative to the facility and preventing or controlling movements within the facility that may adversely affect SDF operations.

(2) Maintenance and operations by authorized persons only.

(3) Federal Communications Commission requirements for operating personnel and maintenance personnel.

(4) Posting of licenses and signs.

(5) Relation between the facility and Federal Aviation Administration air traffic control facilities, with a description of the boundaries of controlled airspace over or near the facility, instructions for relaying air traffic

control instructions and information (if applicable), and instructions for the operation of an air traffic advisory service if the facility is located outside of controlled airspace.

(6) Notice to the Administrator of any suspension of service.

(7) Detailed and specific maintenance procedures and servicing guides stating the frequency of servicing.

(8) Air-ground communications, if provided, expressly written or incorporating appropriate sections of Federal Aviation Administration manuals by reference.

(9) Keeping of station logs and other technical reports, and the submission of reports required by § 171.117.

(10) Monitoring of the facility.

(11) Names, addresses, and telephone numbers of persons to be notified in an emergency.

(12) Inspection by U.S. personnel.

(13) Shutdowns for routine maintenance and issue of ''Notices to Airmen'' for routine or emergency shutdowns, except that private use facilities may omit ''Notices to Airmen.''

(14) Commissioning of the facility.

(15) An acceptable procedure for amending or revising the manual.

(16) An explanation of the kinds of activities (such as construction or grading) in the vicinity of the facility that may require shutdown or certification of the facility by Federal Aviation Administration flight check.

(17) Procedure for conducting a ground check of SDF course alignment, width and clearance.

(18) The following information concerning the facility:

(i) Facility component locations with respect to airport layout, instrument runway, and similar areas;

(ii) The type, make, and model of the basic radio equipment that will provide the service;

(iii) The station power emission and frequencies of the SDF, markers and associated COMLOs, if any;

(iv) The hours of operation;

(v) Station identification call letters and method of station identification and the time spacing of the identification;

(vi) A description of the critical parts that may not be changed, adjusted, or repaired without a Federal Aviation Administration flight check to confirm published operations.

(d) The owner shall make a ground check of the facility each month in accordance with procedures approved by the Federal Aviation Administration at the time of commissioning, and shall report the results of the checks as provided in § 171.117.

(e) If the owner desires to modify the facility, he shall submit the proposal to the Federal Aviation Administration and may not allow any modifications to be made without specific approval.

(f) The owner's maintenance personnel shall participate in initial inspections made by the Federal Aviation Administration. In the case of subsequent inspections, the owner or his representatives shall participate.

(g) Whenever it is required by the Federal Aviation Administration, the owner shall incorporate improvements in SDF maintenance. In addition, he shall provide a stock of spare parts, of such a quantity, to make possible the prompt replacement of components that fail or deteriorate in service.

(h) The owner shall provide Federal Aviation Administration approved test instruments needed for maintenance of the facility.

(i) The owner shall close the facility by ceasing radiation and shall issue a ''Notice to Airmen'' that the facility is out of service (except that private use facilities may omit ''Notices to Airmen''), upon receiving two successive pilot reports of its malfunctioning.

### § 171.117 Reports.

The owner of each facility to which this subpart applies shall make the following reports, at the time indicated, to the Federal Aviation Administration Regional Office for the area in which the facility is located:

(a) Record of meter readings and adjustments (Form FAA–198). To be filled out by the owner or his maintenance representative with the equipment adjustments and meter readings as of the time of commissioning, with one copy to be kept in the permanent records of the facility and two copies to the appropriate Regional Office of the Federal Aviation Administration. The owner shall revise the form after any

major repair, modification, or retuning, to reflect an accurate record of facility operation and adjustment.

(b) Facility maintenance log (FAA Form 6030–1) This form is a permanent record of all equipment malfunctioning met in maintaining the facility, including information on the kind of work and adjustments made, equipment failures, causes (if determined), and corrective action taken. The owner shall keep the original of each report at the facility and send a copy to the appropriate Regional Office of the Federal Aviation Administration at the end of each month in which it is prepared.

(c) Radio equipment operation record (Form FAA–418), containing a complete record of meter readings, recorded on each scheduled visit to the facility. The owner shall keep the original of each month's record at the facility and send a copy of it to the appropriate Regional Office of the Federal Aviation Administration.

[Doc. No. 10116, 35 FR 12711, Aug. 11, 1970, as amended by Amdt. 171–10, 40 FR 36110, Aug. 19, 1975]

## Subpart G—Distance Measuring Equipment (DME)

SOURCE: Docket No. 10116, 35 FR 12715, Aug. 11, 1970, unless otherwise noted.

### § 171.151 Scope.

This subpart sets forth minimum requirements for the approval and operation of non-Federal DME facilities that are to be involved in the approval of instrument flight rules and air traffic control procedures related to those facilities.

### § 171.153 Requests for IFR procedure.

(a) Each person who requests an IFR procedure based on a DME facility that he owns must submit the following information with that request:

(1) A description of the facility and evidence that the equipment meets the performance requirements of § 171.157 and is installed in accordance with § 171.159.

(2) A proposed procedure for operating the facility.

(3) A proposed maintenance organization and maintenance manual that meets the requirement of § 171.161.

(4) A statement of intention to meet the requirements of this subpart.

(5) A showing that the facility has an acceptable level of operational reliability and an acceptable standard of performance. Previous equivalent operational experience with a facility with identical design and operational characteristics will be considered in showing compliance with this paragraph.

(b) After the Federal Aviation Administration inspects and evaluates the facility, it advises the owner of the results and of any required changes in the facility or the maintenance manual or maintenance organization. The owner must then correct the deficiencies, if any, and operate the facility for an in-service evaluation by the Federal Aviation Administration.

### § 171.155 Minimum requirements for approval.

(a) The following are the minimum requirements that must be met before the Federal Aviation Administration will approve an IFR procedure for a non-Federal DME:

(1) A suitable frequency channel must be available.

(2) The facility's performance, as determined by air and ground inspection, must meet the requirements of § 171.157.

(3) The installation of the equipment must meet the requirements of § 171.159.

(4) The owner must agree to operate and maintain the facility in accordance with § 171.161.

(5) The owner must agree to furnish periodic reports, as set forth in § 171.163, and must agree to allow the Federal Aviation Administration to inspect the facility and its operation whenever necessary.

(6) The owner must assure the Federal Aviation Administration that he will not withdraw the facility from service without the permission of the Federal Aviation Administration.

(7) The owner must bear all costs of meeting the requirements of this section and of any flight or ground inspections made before the facility is commissioned, except that the Federal

Aviation Administration may bear certain of these costs subject to budgetary limitations and policy established by the Administrator.

(b) If the applicant for approval meets the requirements of paragraph (a) of this section, the Federal Aviation Administration commissions the facility as a prerequisite to its approval for use in an IFR procedure. The approval is withdrawn at any time the facility does not continue to meet those requirements.

### § 171.157 Performance requirements.

(a) The DME must meet the performance requirements set forth in the ''International Standards and Recommended Practices. Aeronautical Telecommunications, Part I, Paragraph 3.5'' (Annex 10 to the Convention of International Civil Aviation).

(b) It must be shown during ground inspection of the design features of the equipment that there will not be conditions that will allow unsafe operations because of component failure or deterioration.

(c) The monitor must be checked periodically, during the in-service test evaluation period, for calibration and stability. These tests and ground tests of the functional and performance characteristics of the DME transponder must be conducted in accordance with the maintenance manual required by §171.161(b).

(d) Flight inspection to determine the adequacy of the facility's operational performance and compliance with applicable ''Standards and Recommended Practices'' must be accomplished in accordance with the ''U.S. Standard Flight Inspection Manual.''

[Doc. No. 10116, 35 FR 12715, Aug. 11, 1970, as amended by Amdt. 171–13, 50 FR 4875, Nov. 27, 1985]

### § 171.159 Installation requirements.

(a) The facility must be installed according to accepted good engineering practices, applicable electric and safety codes, and Federal Communications Commission requirements.

(b) The facility must have a reliable source of suitable primary power, either from a power distribution system or locally generated, with a supplemental standby system, if needed.

(c) Dual transmitting equipment with automatic changeover is preferred and may be required to support certain IFR procedures.

(d) There must be a means for determining from the ground, the performance of the equipment, initially and periodically.

(e) A facility intended for use as an instrument approach aid for an airport must have or be supplemented by the following ground air or landline communications services:

(1) At facilities outside of and not immediately adjacent to controlled airspace, there must be ground-air communications from the airport served by the facility. Separate communications channels are acceptable.

(2) At facilities within or immediately adjacent to controlled airspace, there must be the ground-air communications required by paragraph (e)(1) of this section and reliable communications (at least a landline telephone) from the airport to the nearest Federal Aviation Administration air traffic control or communications facility. Separate communications channels are acceptable.

Compliance with paragraphs (e) (1) and (2) of this section need not be shown at airports where an adjacent Federal Aviation Administration facility can communicate with aircraft on the ground at the airport and during the entire proposed instrument approach procedure. In addition, at low traffic density airports within or immediately adjacent to controlled airspace, and where extensive delays are not a factor, the requirements of paragraphs (e) (1) and (2) of this section may be reduced to reliable communications (at least a landline telephone) from the airport to the nearest Federal Aviation Administration air traffic control or communications facility, if an adjacent Federal Aviation Administration facility can communicate with aircraft during the proposed instrument approach procedure, at least down to the minimum en route altitude for the controlled airspace area.

[Doc. No. 10116, 35 FR 12715, Aug. 11, 1970, as amended by Amdt. 171–16, 56 FR 65665, Dec. 17, 1991]

### § 171.161 Maintenance and operations requirements.

(a) The owner of the facility shall establish an adequate maintenance system and provide qualified maintenance personnel to maintain the facility at the level attained at the time it was commissioned. Each person who maintains a facility shall meet at a minimum the Federal Communications Commission's licensing requirements and show that he has the special knowledge and skills needed to maintain the facility, including proficiency in maintenance procedures and the use of specialized test equipment.

(b) The owner must prepare and obtain Federal Aviation Administration approval of, and each person operating or maintaining the facility shall comply with, an operations and maintenance manual that sets forth procedures for operations, preventive maintenance, and emergency maintenance, including instructions on each of the following:

(1) Physical security of the facility.

(2) Maintenance and operations by authorized persons only.

(3) Federal Communications Commission's requirements and maintenance personnel.

(4) Posting of licenses and signs.

(5) Relations between the facility and Federal Aviation Administration air traffic control facilities, with a description of the boundaries of controlled airspace over or near the facility, instructions for relaying air traffic control instructions and information (if applicable), and instructions for the operation of an air traffic advisory service if the DME is located outside of controlled airspace.

(6) Notice to the Administrator of any suspension of service.

(7) Detailed and specific maintenance procedures and servicing guides stating the frequency of servicing.

(8) Air-ground communications, if provided, expressly written or incorporating appropriate sections of Federal Aviation Administration manuals by reference.

(9) Keeping of station logs and other technical reports, and the submission of reports required by § 171.163.

(10) Monitoring of the facility.

(11) Inspections by U.S. personnel.

(12) Names, addresses, and telephone numbers of persons to be notified in an emergency.

(13) Shutdowns for routine maintenance and issue of ''Notices to Airmen'' for routine or emergency shutdowns, except that private use facilities may omit the ''Notices to Airmen.''

(14) An explanation of the kinds of activity (such as construction or grading) in the vicinity of the facility that may require shutdown or reapproval of the facility by Federal Aviation Administration flight check.

(15) Commissioning of the facility.

(16) An acceptable procedure for amending or revising the manual.

(17) The following information concerning the facility:

(i) Location by latitude and longitude to the nearest second, and its position with respect to airport layouts.

(ii) The type, make, and model of the basic radio equipment that will provide the service.

(iii) The station power emission and frequency.

(iv) The hours of operation.

(v) Station identification call letters and methods of station identification, whether by Morse code or recorded voice announcement, and the time spacing of the identification.

(vi) A description of the critical parts that may not be changed, adjusted, or repaired without an FAA flight check to confirm published operations.

(c) The owner shall make a monthly ground operational check in accordance with procedures approved by the FAA at the time of commissioning, and shall report the results of the checks as provided in § 171.163.

(d) If the owner desires to modify the facility, he shall submit the proposal to the FAA and may not allow any modifications to be made without specific approval.

(e) The owner's maintenance personnel shall participate in initial inspections made by the FAA. In the case of subsequent inspections, the owner or his representative shall participate.

(f) Whenever it is required by the FAA, the owner shall incorporate improvements in DME maintenance.

(g) The owner shall provide a stock of spare parts of such a quantity to make

possible the prompt replacement of components that fail or deteriorate in service.

(h) The owner shall provide FAA-approved test instruments needed for maintenance of the facility.

(i) The owner shall shut down the facility (i.e., cease radiation and issue a NOTAM that the facility is out-of-service) upon receiving two successive pilot reports of its malfunctioning.

### § 171.163 Reports.

The owner of each facility to which this subpart applies shall make the following reports on forms furnished by the FAA, at the time indicated, to the FAA Regional office for the area in which the facility is located:

(a) Record of meter readings and adjustments (Form FAA–198). To be filled out by the owner with the equipment adjustments and meter readings as of the time of commissioning, with one copy to be kept in the permanent records of the facility and two copies to the appropriate Regional office of the FAA. The owner shall revise the form after any major repair, modification, or returning, to reflect an accurate record of facility operation and adjustment.

(b) Facility maintenance log (FAA Form 6030–1). This form is a permanent record of all equipment malfunctioning met in maintaining the facility, including information on the kind of work and adjustments made, equipment failures, causes (if determined), and corrective action taken. The owner shall keep the original of each report at the facility and send a copy to the appropriate Regional Office of the Federal Aviation Administration at the end of the month in which it is prepared.

(c) Radio equipment operation record (Form FAA–418), containing a complete record of meter readings, recorded on each scheduled visit to the facility. The owner shall keep the original of each month's record at the facility and send a copy of it to the appropriate Regional Office of the Federal Aviation Administration.

[Doc. No. 10116, 35 FR 12715, Aug. 11, 1970, as amended by Amdt. 171–10, 40 FR 36110, Aug. 19, 1975]

## Subpart H—VHF Marker Beacons

SOURCE: Docket No. 10116, 35 FR 12716, Aug. 11, 1970, unless otherwise noted.

### § 171.201 Scope.

(a) This subpart sets forth minimum requirements for the approval and operation of non-Federal VHF marker beacon facilities that are to be involved in the approval of instrument flight rules and air traffic control procedures related to those facilities.

(b) [Reserved]

### § 171.203 Requests for IFR procedure.

(a) Each person who requests an IFR procedure which will incorporate the use of a VHF marker beacon facility that he owns must submit the following information with that request:

(1) A description of the facility and evidence that the equipment meets the performance requirements of § 171.207 and is installed in accordance with § 171.209.

(2) A proposed procedure for operating the facility.

(3) A proposed maintenance organization and a maintenance manual that meets the requirements of § 171.211.

(4) A statement of intent to meet the requirement of this subpart.

(5) A showing that the facility has an acceptable level of operational reliability, and an acceptable standard of performance. Previous equivalent operational experience may be shown to comply with this subparagraph.

(b) After the Federal Aviation Administration inspects and evaluates the facility, it advises the owner of the results and of any required changes in the facility or the maintenance manual or maintenance organization. The owner shall then correct the deficiencies, if any, and operate the facility for an in-service evaluation by the Federal Aviation Administration.

### § 171.205 Minimum requirements for approval.

(a) The following are the minimum requirements that must be met before the Federal Aviation Administration will approve an IFR procedure which incorporates the use of a non-Federal VHF marker beacon facility under this subpart:

(1) The facility's performances, as determined by air and ground inspection, must meet the requirements of §171.207.

(2) The installation of the equipment must meet the requirements of §171.209.

(3) The owner must agree to operate and maintain the facility in accordance with §171.211.

(4) The owner must agree to furnish periodic reports, as set forth in §171.213, and agree to allow the Federal Aviation Administration to inspect the facility and its operation whenever necessary.

(5) The owner must assure the Federal Aviation Administration that he will not withdraw the facility from service without the permission of the Federal Aviation Administration.

(6) The owner must bear all costs of meeting the requirements of this section and of any flight or ground inspections made before the facility is commissioned, except that the Federal Aviation Administration may bear certain of these costs subject to budgetary limitations and policy established by the Administrator.

(b) If the applicant for approval meets the requirements of paragraph (a) of this section, the Federal Aviation Administration commissions the facility as a prerequisite to its approval for use in an IFR procedure. The approval is withdrawn at any time the facility does not continue to meet those requirements.

### §171.207 Performance requirements.

(a) VHF Marker Beacons must meet the performance requirements set forth in the ''International Standards and Recommended Practices, Aeronautical Telecommunications, Part I, paragraphs 3.1.6 and 3.6.'' (Annex 10 to the Convention on International Civil Aviation) except those portions that pertain to identification. Identification of a marker beacon (75 MHz) must be in accordance with ''U.S. Standard Flight Inspection Manual,'' §219.

(b) The facility must perform in accordance with recognized and accepted good electronic engineering practices for the desired service. The facility must be checked periodically during the in-service test evaluation period for calibration and stability. These tests and ground tests of the marker radiation characteristics must be conducted in accordance with the maintenance manual required by §171.211(b).

(c) It must be shown during ground inspection of the design features of the equipment that there will not be conditions that will allow unsafe operations because of component failure or deterioration.

(d) Flight inspection to determine the adequacy of the facility's operational performance and compliance with applicable ''Standards and Recommended Practices'' are conducted in accordance with the ''U.S. Standard Flight Inspection Manual.'' The original test is made by the Federal Aviation Administration and later tests must be made under arrangements, satisfactory to the Federal Aviation Administration, that are made by the owner.

### §171.209 Installation requirements.

(a) The facility must be installed according to accepted good engineering practices, applicable electric and safety codes, and Federal Communications Commission requirements.

(b) The facility must have a reliable source of suitable primary power.

(c) Dual transmitting equipment may be required, if applicable, to support certain IFR procedures.

(d) At facilities within or immediately adjacent to controlled airspace and that are intended for use as instrument approach aids for an airport, there must be ground-air communications or reliable communications (at least a landline telephone) from the airport to the nearest Federal Aviation Administration air traffic control or communication facility. Compliance with this paragraph need not be shown at airports where an adjacent Federal Aviation Administration facility can communicate with aircraft on the ground at the airport and during the entire proposed instrument approach procedure. In addition, at low traffic density airports within or immediately adjacent to controlled airspace, and where extensive delays are not a factor, the requirements of this paragraph may be reduced to reliable communications (at least a landline telephone)

from the airport to the nearest Federal Aviation Administration air traffic control or communications facility, if an adjacent Federal Aviation Administration facility can communicate with aircraft during the proposed instrument approach procedure, at least down to the minimum en route altitude for the controlled airspace area.

[Doc. No. 10116, 35 FR 12716, Aug. 11, 1970, as amended by Amdt. 171–16, 56 FR 65665, Dec. 17, 1991]

### § 171.211 Maintenance and operations requirements.

(a) The owner of the facility shall establish an adequate maintenance system and provide qualified maintenance personnel to maintain the facility at the level attained at the time it was commissioned. Each person who maintains a facility shall meet at a minimum the Federal Communications Commission's licensing requirements and show that he has the special knowledge and skills needed to maintain the facility, including proficiency in maintenance procedures and the use of specialized test equipment.

(b) The owner must prepare, and obtain approval of, and each person who operates or maintains the facility shall comply with, an operations and maintenance manual that sets forth procedures for operations, preventive maintenance, and emergency maintenance, including instructions on each of the following:

(1) Physical security of the facility.

(2) Maintenance and operations by authorized persons only.

(3) Federal Communications Commission's requirements for operating and maintenance personnel.

(4) Posting of licenses and signs.

(5) Relations between the facility and Federal Aviation Administration air traffic control facilities, with a description of the boundaries of controlled airspace over or near the facility, instructions for relaying air traffic control instructions and information (if applicable).

(6) Notice to the Administrator of any suspension of service.

(7) Detailed arrangements for maintenance, flight inspection, and servicing, stating the frequency of servicing.

(8) Keeping of station logs and other technical reports, and the submission of reports required by § 171.213.

(9) Monitoring of the facility, at least once each half hour, to assure continuous operation.

(10) Inspections by U.S. personnel.

(11) Names, addresses, and telephone numbers of persons to be notified in an emergency.

(12) Shutdowns for routine maintenance and issue of ''Notices to Airmen'' for routine or emergency shutdowns (private use facilities may omit the ''Notice to Airmen'').

(13) Commissioning of the facility.

(14) An acceptable procedure for amending or revising the manual.

(15) The following information concerning the facility:

(i) Location by latitude and longitude to the nearest second, and its position with respect to airport layouts.

(ii) The type, make, and model of the basic radio equipment that will provide the service.

(iii) The station power emission and frequency.

(iv) The hours of operation.

(v) Station identification call letters and methods of station identification, whether by Morse Code or recorded voice announcement, and the time spacing of the identification.

(c) If the owner desires to modify the facility, he shall submit the proposal to the Federal Aviation Administration and meet applicable requirements of the Federal Communications Commission, and must not allow any modification to be made without specific approval by the Federal Aviation Administration.

(d) The owner's maintenance personnel shall participate in initial inspections made by the Federal Aviation Administration. In the case of subsequent inspections, the owner or his representative shall participate.

(e) The owner shall provide a stock of spare parts, of such a quantity to make possible the prompt replacement of components that fail or deteriorate in service.

(f) The owner shall shut down the facility by ceasing radiation, and shall

issue a ''Notice to Airmen'' that the facility is out of service (except that private use facilities may omit ''Notices to Airmen'') upon receiving two successive pilot reports of its malfunctioning.

### § 171.213 Reports.

The owner of each facility to which this subpart applies shall make the following reports, at the times indicated, to the Federal Aviation Administration Regional Office for the area in which the facility is located:

(a) Record of meter readings and adjustments (Form FAA–198). To be filled out by the owner or his maintenance representative with the equipment adjustments and meter readings as of the time of commissioning, with one copy to be kept in the permanent records of the facility and two copies to the appropriate Regional Office of the Federal Aviation Administration. The owner must revise the form after any major repair, modification, or retuning, to reflect an accurate record of facility operation and adjustment.

(b) Facility maintenance log (FAA Form 6030–1). This form is a permanent record of all equipment malfunctioning met in maintaining the facility, including information on the kind of work and adjustments made, equipment failures, causes (if determined), and corrective action taken. The owner shall keep the original of each report at the facility and send a copy to the appropriate Regional Office of the Federal Aviation Administration at the end of the month in which it is prepared.

(c) Radio equipment operation record (Form FAA–418), containing a complete record of meter readings, recorded on each scheduled visit to the facility. The owner shall keep the original of each month's record at the facility and send a copy of it to the appropriate Regional Office of the Federal Aviation Administration.

[Doc. No. 10116, 35 FR 12716, Aug. 11, 1970, as amended by Amdt. 171–10, 40 FR 36110, Aug. 19, 1975]

## Subpart I—Interim Standard Microwave Landing System (ISMLS)

SOURCE: Docket No. 14120, 40 FR 36110, Aug. 19, 1975, unless otherwise noted.

### § 171.251 Scope.

This subpart sets forth minimum requirements for the approval and operation of non-Federal Interim Standard Microwave Landing System (ISMLS) facilities that are to be involved in the approval of instrument flight rules and air traffic control procedures related to those facilities.

### § 171.253 Definitions.

As used in this subpart:

*Angular displacement sensitivity* (Glide Slope) means the ratio of measured DDM to the corresponding angular displacement from the appropriate reference line.

*Collocated ground station* means the type of ground station which transmits two or more guidance signals simultaneously from a common location.

*Course line* means the locus of points nearest to the runway centerline in any horizontal plane at which the DDM is zero.

*Course sector (full)* means a sector in a horizontal plane containing the course line and limited by the loci of points nearest to the course line at which the DDM is 0.155.

*Course sector (half)* means the sector in a horizontal plane containing the course line and limited by the loci of points nearest to the course line at which DDM is 0.0775.

*DDM* means difference in depth of modulation. The percentage modulation depth of the larger signal minus the percentage modulation depth of the smaller signal, divided by 100.

*Displacement sensitivity* (Localizer) means the ratio of measured DDM to the corresponding lateral displacement from the appropriate reference line.

*Facility Performance Category I—ISMLS* means an ISMLS which provides guidance information from the coverage limit of the ISMLS to the point at which the localizer course line intersects the ISMLS glide path at a height

of 200 feet or less above the horizontal plane containing the threshold.

*Glide path* means that locus of points in the vertical plane containing the runway center line at which the DDM is zero, which, of all such loci, is the closest to the horizontal plane.

*Glide path angle* (θ) means the angle between a straight line which represents the mean of the ISMLS glide path and the horizontal.

*Glide path sector (full)* means the sector in the vertical plane containing the ISMLS glide path and limited by the loci of points nearest to the glide path at which the DDM is 0.175. The ISMLS glide path sector is located in the vertical plane containing the runway centerline, and is divided by the radiated glide path in two parts called upper sector and lower sector, referring respectively to the sectors above and below the glide path.

*Glide path sector (half)* means the sector in the vertical plane containing the ISMLS glide path and limited by the loci of points nearest to the glide path at which the DDM is 0.0875.

*ISMLS Point 'A'* means an imaginary point on the glide path/localizer course measured along the runway centerline extended, in the approach direction, four nautical miles from the runway threshold.

*ISMLS Point 'B'* means an imaginary point on the glide path/localizer course measured along the runway centerline extended, in the approach direction, 3500 feet from the runway threshold.

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

*Interim standard microwave landing system* (ISMLS) means a ground station which transmits azimuth and elevation angle information which, when decoded and processed by the airborne unit, provides signal performance capable of supporting approach minima for V/STOL and CTOL operations and operates with the signal format and tolerances specified in §§171.259, 171.261, 171.263, 171.265, and 171.267.

*Integrity* means that quality which relates to the trust which can be placed in the correctness of the information supplied by the facility.

*Mean corrective time* means the average time required to correct an equipment failure over a given period, after a service man reaches the facility.

*Mean time between failures* means the average time between equipment failure over a given period.

*Reference datum* means a point at a specified height located vertically above the intersection of the runway centerline and the threshold and through which the downward extended straight portion of the ISMLS glide path passes.

*Split type ground station* means the type of ground station in which the electronic components for the azimuth and elevation guidance are contained in separate housings or shelters at different locations, with the azimuth portion of the ground station located at the stop end of the runway, and the elevation guidance near the approach end of the runway.

### § 171.255 Requests for IFR procedures.

(a) Each person who requests an IFR procedure based on an ISMLS facility that he owns must submit the following information with that request:

(1) A description of the facility and evidence that the equipment meets the performance requirements of §§171.259, 171.261, 171.263, 171.265, 171.267, and 171.269, and is installed in accordance with §171.271.

(2) A proposed procedure for operating the facility.

(3) A proposed maintenance organization and a maintenance manual that meets the requirements of §171.273.

(4) A statement of intent to meet the requirements of this subpart.

(5) A showing that the ISMLS facility has an acceptable level of operational reliability, maintainability and acceptable standard of performance. Previous equivalent operational experience with a facility with identical design and operational characteristics will be considered in showing compliance with this paragraph.

(b) After the FAA inspects and evaluates the ISMLS facility, it advises the owner of the results and of any required changes in the ISMLS facility

or in the maintenance manual or maintenance organization. The owner must then correct the deficiencies, if any, and operate the ISMLS facility for an inservice evaluation by the FAA.

### § 171.257 Minimum requirements for approval.

(a) The following are the minimum requirements that must be met before the FAA approves an IFR procedure for a non-Federal ISMLS facility:

(1) The performance of the ISMLS facility, as determined by flight and ground inspection conducted by the FAA, must meet the requirements of §§ 171.259, 171.261, 171.263, 171.265, 171.267, and 171.269.

(2) The installation of the equipment must meet the requirements of § 171.271.

(3) The owner must agree to operate and maintain the ISMLS facility in accordance with § 171.273.

(4) The owner must agree to furnish periodic reports as set forth in § 171.275 and agree to allow the FAA to inspect the facility and its operation whenever necessary.

(5) The owner must assure the FAA that he will not withdraw the ISMLS facility from service without the permission of the FAA.

(6) The owner must bear all costs of meeting the requirements of this section and of any flight or ground inspection made before the ISMLS facility is commissioned, except that the FAA may bear certain costs subject to budgetary limitations and policy established by the Administrator.

(b) If the applicant for approval meets the requirements of paragraph (a) of this section, the FAA approves the ISMLS facility for use in an IFR procedure. The approval is withdrawn at any time that the ISMLS facility does not continue to meet those requirements. In addition, the ISMLS facility may be de-commissioned whenever the frequency channel is needed for higher priority common system service.

### § 171.259 Performance requirements: General.

(a) The ISMLS consists of the following basic components:

(1) C-Band (5000 MHz–5030 MHz) localizer equipment, associated monitor system, and remote indicator equipment;

(2) C-Band (5220 MHz–5250 MHz) glide path equipment, associated monitor system, and remote indicator equipment;

(3) VHF marker beacons (75 MHz), associated monitor systems, and remote indicator equipment.

(4) An ISMLS airborne receiver or a VHF/UHF ILS receiver modified to be capable of receiving the ISMLS signals. This modification requires the addition of a C-Band antenna, a converter unit, a microwave/ILS mode control, and a VHF/UHF receiver modification kit.

(b) The electronic ground equipments in paragraph (a)(1), (2), and (3) of this section, must be designed to operate on a nominal 120/240 volt, 60 Hz, 3-wire single phase AC power source.

(c) ISMLS ground equipment must meet the following service conditions:

(1) AC line parameters, DC voltage, elevation, and duty:

120 V nominal value, 102 V to 138 V (±1 V).*
208 V nominal value, 177 V to 239 V (±2 V).*
240 V nominal value, 204 V to 276 V (±0.2 V).*
AC line frequency (60 Hz), 57 Hz to 63 Hz (±0.2 Hz).*
DC voltage (48 V), 44 V to 52 V (±0.5 V).*

*NOTE: Where discrete values of the above frequency or voltages are specified for testing purposes, the tolerances given in parentheses indicated by an asterisk apply to the test instruments used to measure these parameters.

Elevation, 0 to 10,000 ft. above sea level.
Duty, continuous, unattended.

(2) Ambient conditions for localizer and glide path equipment:

Temperature, −10 °C to + 50 °C.
Relative humidity, 5% to 90%.

(3) Ambient conditions for marker beacon facilities and all other equipment installed outdoors (for example, antennae, field detectors, and shelters):

Temperature, −50 °C. to + 70 °C.
Relative humidity, 5% to 100%.

(4) All equipment installed outdoors must operate satisfactorily under the following conditions:

Wind velocity, 0–100 MPH (not including gusts).
Hail stones, ½″ diameter.

Rain, provide coverage through a distance of 5 nautical miles with rain falling at a rate of 50 millimeters per hour, and with rain falling at the rate of 25 millimeters per hour for the additional design performance range of the system.

Ice loading, encased in ½″ radial thickness of clear ice.

(d) The ISMLS must perform in accordance with the following standards and practices for Facility Performance Category I operation:

(1) The ISMLS must be constructed and adjusted so that, at a specified distance from the threshold, similar instrumental indications in the aircraft represent similar displacements from the course line or ISMLS glide path, as appropriate, regardless of the particular ground installation in use.

(2) The localizer and glide path components listed in paragraphs (a)(1) and (a)(2) of this section which form part of an ISMLS, must comply at least with the standard performance requirements specified herein. The marker beacon components listed in paragraph (a)(3) of this section which form part of an ISMLS, must comply at least with the standard performance requirements specified in subpart H of this part.

(3) The ISMLS must be so designed and maintained that the probability of operation is within the performance requirements specified in §171.273(k).

(e) The signal format and pairing of the runway localizer and glide path transmitter frequencies of an ISMLS must be in accordance with the frequency plan approved by the FAA, and must meet the following signal format requirements:

(1) The localizer and glide slope stations must transmit angular guidance information on a C-band microwave carrier on narrow, scanned antenna beams that are encoded to produce a modulation in space which, after averaging over several beam scans, is equivalent to the modulation used for conventional ILS as specified in subpart C of this part, except that the frequency tolerance may not exceed ±0.0001 percent.

(2) Guidance modulation must be impressed on the microwave carrier of the radiated signal in the form of a summation of 90 Hz and 150 Hz sinusoidal modulation corresponding to the pointing direction of the particular beam which radiates the signal.

(3) Each of the effective beam positions must be illuminated in a particular sequence for a short time interval. The modulation impressed on each beam must be a sample of the combined 90 Hz and 150 Hz waveform appropriate for that particular beam direction and time slot, and must be accomplished by appropriately varying the length of time the carrier is radiated during each beam illumination interval.

(4) For those cases where the scanning beam fills the coverage space in steps, the incremental step must not exceed 0.6 times the beam width where the beam is in the proportional guidance sector. In the clearance region, the step may not exceed 0.8 times the beam width.

(5) At least one pulse duration modulation (pdm) sample pulse per beam width of scan must be provided.

(6) The minimum pulse duration must be 40 microseconds.

(7) The minimum beam scan cycle must be 600 Hz.

(8) The minimum duty ratio detectable by a receiver located anywhere in the coverage areas defined by this specification may not be less than 0.1. Detected duty ratio means the ratio of the average energy per scan detected at a point in space to the average energy per scan transmitted in all directions through the transmitting antenna.

(9) The localizer must produce a C-band unmodulated reference frequency signal of sufficient strength to allow satisfactory operation of an aircraft receiver within the specified localizer and glide path coverage sectors. Pairing of this reference frequency with the localizer and glide slope frequencies must be in accordance with a frequency plan approved by the FAA.

### §171.261 Localizer performance requirements.

This section prescribes the performance requirements for localizer equipment components of the ISMLS.

(a) The localizer antenna system must:

(1) Be located on the extension of the centerline of the runway at the stop end;

(2) Be adjusted so that the course line be on a vertical plane containing the centerline of the runway served;

(3) Have the minimum height necessary to comply with the coverage requirements prescribed in paragraph (j) of this section;

(4) Be located at a distance from the stop end of the runway that is consistent with safe obstruction clearance practices;

(5) Not obscure any light of the approach landing system; and

(6) Be installed on frangible mounts or beyond the 1000′ light bar.

(b) On runways where limited terrain prevents the localizer antennae from being positioned on the runway centerline extended, and the cost of the land fill or a tall tower antenna support is prohibitive, the localizer antenna array may be offset, including a collocated ground station, so that the course intercepts the centerline at a point determined by the amount of the angular offset and the glide path angle. If other than a runway centerline localizer is used, the criteria in subpart C of part 97 of this chapter is applicable.

(c) At locations where two separate ISMLS facilities serve opposite ends of of a single runway, an interlock must ensure that only the facility serving the approach direction being used will radiate.

(d) The radiation from the localizer antenna system must produce a composite field pattern which is pulse duration modulated, the time average equivalent to amplitude modulation by a 90 Hz and 150 Hz tone. The localizer station must transmit angular guidance information over a C-band microwave carrier on narrow, scanned antenna beams that are encoded to produce a modulation in space which, after averaging over several beam scans, is equivalent to the modulation used for conventional ILS as specified in subpart C of this part. The radiation field pattern must produce a course sector with one tone predominating on one side of the course and with the other tone predominating on the opposite side. When an observer faces the localizer from the approach end of the runway, the depth of modulation of the radio frequency carrier due to the 150 Hz tone must predominate on his right hand and that due to the 90 Hz tone must predominate on his left hand.

(e) All horizontal angles employed in specifying the localizer field patterns must originate from the center of the localizer antenna system which provides the signals used in the front course sector.

(f) The ISMLS course sector angle must be adjustable between 3 degrees and 9 degrees. The applicable course sector angle will be established and approved on an individual basis.

(g) The ISMLS localizer must operate in the band 5000 MHz to 5030 MHz. The frequency tolerance may not exceed ±0.0001 percent.

(h) The emission from the localizer must be vertically polarized. The horizontally polarized component of the radiation of the course line may not exceed that which corresponds to a DDM error of 0.016 when an aircraft is positioned on the course line and is in a roll attitude of 20 degrees from the horizontal.

(i) The localizer must provide signals sufficient to allow satisfactory operation of a typical aircraft installation within the localizer and glide path coverage sectors. The localizer coverage sector must extend from the center of the localizer antenna system to distances of 18 nautical miles minimum within ±10 degrees from the front course line, and 10 nautical miles minimum between ±10 degrees and ±35 degrees from the front course line. The ISMLS localizer signals must be receivable at the distances specified up from a surface extending outward from the localizer antenna and within a sector in the elevation plane from 0.300 to 1.750 of the established glide path angle ($\theta$).

(j) Except as provided in paragraph (k) of this section, in all parts of the coverage volume specified in paragraph (i) of this section, the peak field strength may not be less than $-87$ dBW/m$^2$, and must permit satisfactory operational usage of ISMLS localizer facilities.

(k) The minimum peak field strength on the ISMLS glide path and within the localizer course sector from a distance of 10 nautical miles to a height of

100 feet (30 meters) above the horizontal plane containing the threshold, may not be less than + 87 dBW/m$^2$.

(l) Above 16 degrees, the ISMLS localizer signals must be reduced to as low a value as practicable.

(m) Bends in the course line may not have amplitudes which exceed the following:

| Zone | Amplitude (DDM) (95 pct. probability) |
|---|---|
| Outer limit of coverage to: | |
| ISMLS point "A" ..... | 0.031. |
| ISMLS point "A" to ISMLS point "B". | 0.031 at ISMLS point "A" decreasing at linear rate to 0.015 at ISMLS point "B". |
| ISMLS point "B" to ISMLS point "C". | 0.015. |

(n) The amplitudes referred to in paragraph (m) of this section are the DDMs due to bends as realized on the mean course line, when correctly adjusted.

(o) The radio frequency carrier must meet the following requirements:

(1) The nominal depth of modulation of the radio frequency carrier due to each of the 90 Hz and 150 Hz tones must be 20 percent along the course line.

(2) The depth of modulation of the radio frequency carrier due to each of the 90 Hz and 150 Hz tones must be between 18 and 22 percent.

(3) The frequency tolerance of the 90 Hz and 150 Hz modulated tones must be within ±25 percent.

(4) Total harmonic content of the 90 Hz tone may not exceed 10 percent.

(5) Total harmonic content of the 150 Hz tone may not exceed 10 percent. However, a 300 Hz tone may be transmitted for identification purposes.

(6) At every half cycle of the combined 90 Hz and 150 Hz wave form, the modulation tones must be phase-locked so that within the half course sector, the demodulated 90 Hz and 150 Hz wave forms pass through zero in the same direction within 20 degrees with phase relative to the 150 Hz component. However, the phase need not be measured within the half course sector.

(p) The mean course line must be adjusted and maintained within ±.015DDM from the runway centerline at the ISMLS reference datum.

(q) The nominal displacement sensitivity within the half course sector at the ISMLS reference datum, must be 0.00145 DDM/meter (0.00044DDM/foot). However, where the specified nominal displacement sensitivity cannot be met, the displacement sensitivity must be adjusted as near as possible to that value.

(r) The lateral displacement sensitivity must be adjusted and maintained within 17 percent of the nominal value. Nominal sector width at the ISMLS reference datum is 210 meters (700 feet).

(s) The increase of DDM must be substantially linear with respect to angular displacement from the front course line where DDM is zero, up to angle on either side of the front course line where the DDM is 0.180. From that angle to ±10 degrees, the DDM may not be less than 0.180. From ±10 degrees to ±35 degrees, the DDM may not be less than 0.155.

(t) The localizer must provide for the simultaneous transmission of an identification signal which meets the following:

(1) It must be specific to the runway and approach direction, on the same radio frequency carrier, as used for the localizer function.

(2) Transmission of the identification signal may not interfere in any way with the basic localizer function.

(3) The signal must be produced by pulse duration modulation of the radio frequency carrier resulting in a detected audio tone in the airborne VHF receiver of 1020 Hz ±50Hz.

(4) The depth of modulation must be between the limits of 10 and 12 percent.

(5) The emissions carrying the identification signal must be vertically polarized.

(6) The identification signal must employ the International Morse Code and consist of three letters. It must be preceded by the International Morse Code signal of the letter ''M'' followed by a short pause where it is necessary to distinguish the ISMLS facility from other navigational facilities in the immediate area. At airports where both an ISMLS and an ILS are in operation, each facility must have a different identification call sign.

(7) The signal must be transmitted at a speed corresponding to approximately seven words per minute, and must be repeated at approximately equal intervals, not less than six times

per minute, during which time the localizer is available for operational use. When the localizer is not available for transmission, the identification signal must be suppressed.

### § 171.263 Localizer automatic monitor system.

(a) The ISMLS localizer equipment must provide an automatic monitor system that transmits a warning to designated local and remote control points when any of the following occurs:

(1) A shift of the mean course line of the localizer from the runway centerline equivalent to more than 0.015 DDM at the ISMLS reference datum.

(2) For localizers in which the basic functions are provided by the use of a single-frequency system, a reduction of power output to less than 50 percent of normal or a loss of ground station identification transmissions.

(3) Changes of displacement sensitivity to a value differing by more than 17 percent from nominal value for the localizer.

(4) Failure of any part of the monitor itself. Such failure must automatically produce the same results as the malfunctioning of the element being monitored.

(b) Within 10 seconds of the occurrence of any of the conditions prescribed in paragraph (a) of this section, including periods of zero radiation, localizer signal radiation must cease or the navigation and identification components must be removed.

### § 171.265 Glide path performance requirements.

This section prescribes the performance requirements for glide path equipment components of the ISMLS. These requirements are based on the assumption that the aircraft is heading directly toward the facility.

(a) The glide slope antenna system must be located near the approach end of the runway, and the equipment must be adjusted so that the vertical path line will be in a sloping horizontal plane containing the centerline of the runway being served, and satisfy the coverage requirements prescribed in paragraph (g) of this section. For the purpose of obstacle clearance, location of the glide slope antenna system must be in accordance with the criteria specified in subpart C of part 97 of this chapter.

(b) The radiation from the glide path antenna system must produce a composite field pattern which is pulse duration modulated by a 90 Hz and a 150 Hz tone, which is the time average equivalent to amplitude modulation. The pattern must be arranged to provide a straight line descent path in the vertical plane containing the centerline of the runway, with the 150 Hz tone predominating below the path and the 90 Hz tone predominating above the path to at least an angle equal to 1.75θ. As used in this section theta (θ), denotes the nominal glide path angle. The glide path angle must be adjusted and maintained within 0.075θ.

(c) The glide path equipment must be capable of producing a radiated glide path from 3 to 9 degrees with respect to the horizontal. However, ISMLS glide path angles in excess of 3 degrees may be used to satisfy instrument approach procedures or to overcome an obstruction clearance problem, only in accordance with the criteria specified in subpart C of part 97 of this chapter.

(d) The downward extended straight portion of the ISMLS glide path must pass through the ISMLS reference datum at a height ensuring safe guidance over obstructions and safe and efficient use of the runway served. The height of the ISMLS reference datum must be in accordance with subpart C of part 97 of this chapter.

(e) The glide path equipment must operate in the band 5220 MHz to 5250 MHz. The frequency tolerance may not exceed ±0.0001 percent.

(f) The emission from the glide path equipment must be vertically polarized.

(g) The glide path equipment must provide signals sufficient to allow satisfactory operation of a typical aircraft installation insectors of 8 degrees on each side of the centerline of the ISMLS glide path, to a distance of at least 10 nautical miles up to 1.75θ and down to 0.45θ above the horizontal or to such lower angle at which 0.22 DDM is realized.

(h) To provide the coverage for glide path performance specified in paragraph (g) of this section, the minimum peak field strength within this coverage sector must be $-82$ dBW/m$^2$. The peak field strength must be provided on the glide path down to a height of 30 meters (100 feet) above the horizontal plane containing the threshold.

(i) Bends in the glide path may not have amplitudes which exceed the following:

| Zone | Amplitude (DDM) (95 pct. probability) |
|---|---|
| Outer limit of coverage to ISMLS point "C." ..... | 0.035. |

The amplitude referred to is the DDM due to bends as realized on the mean ISMLS glide path correctly adjusted. In regions of the approach where ISMLS glide path curvature is significant, bend amplitude is calculated from the mean curved path, and not the downward extended straight line.

(j) Guidance modulation must be impressed on the microwave carrier of the radiated glide slope signal in the form of a unique summation of 90 Hz and 150 Hz sinusoidal modulation corresponding to the point direction of the particular beam which radiates the signal. Each of the effective beam positions must be illuminated in sequence for a short time interval. The scan rate must be synchronous with the 90 and 150 Hz tone base. The modulation impressed on each beam must be a sample of the combined 90 Hz and 150 Hz waveform appropriate for that particular beam direction and time slot. The actual modulation must be accomplished by appropriately varying the length of time the carrier is radiated during each beam illumination interval.

(k) The nominal depth of modulation of the radio frequency carrier due to each of the 90 Hz and 150 Hz tones must be 40 percent along the ISMLS glide path. The depth of modulation may not deviate outside the limits of 37.5 percent to 42.5 percent.

(l) The following tolerances apply to the frequencies of the modulating tones:

(1) The modulating tones must be 90 Hz and 150 Hz within 2.5 percent.

(2) The total harmonic content of the 90 Hz tone may not exceed 10 percent.

(3) The total harmonic content of the 150 Hz tone may not exceed 10 percent.

(m) At every half cycle of the combined 90 Hz and 150 Hz wave form, the modulation must be phase-locked so that, within the ISMLS half glide path sector, the demodulated 90 Hz and 150 Hz wave forms pass through zero in the same direction within 20 degrees of phase relative to the 150 Hz component. However, the phase need not be measured within the ISMLS half glide path sector.

(n) The nominal angular displacement sensitivity must correspond to a DDM of 0.0875 at an angular displacement above and below the glide path of 0.12$\theta$. The glide path angular displacement sensitivity must be adjusted and maintained within ±25 percent of the nominal value selected. The upper and lower sectors must be as symmetrical as practicable within the limits prescribed in this paragraph.

(o) The DDM below the ISMLS glide path must increase smoothly for decreasing angle until a value of 0.22 DDM is reached. This value must be achieved at an angle not less than 0.30$\theta$ above the horizontal. However, if it is achieved at an angle above 0.45$\theta$, the DDM value may not be less than 0.22 at least down to an angle of 0.45$\theta$.

[Doc. No. 14120, 40 FR 36110, Aug. 19, 1975; 40 FR 41093, Sept. 5, 1975; 40 FR 43719, Sept. 23, 1975]

### § 171.267 Glide path automatic monitor system.

(a) The ISMLS glide path equipment must provide an automatic monitor system that transmits a warning to designated local and remote control points when any of the following occurs:

(1) A shift of the mean ISMLS glide path angle equivalent to more than 0.075$\theta$.

(2) For glide paths in which the basic functions are provided by the use of a single frequency system, a reduction of power output to less than 50 percent.

(3) A change of the angle between the glide path and the line below the glide path (150 Hz predominating), at which a DDM of 0.0875 is realized by more than ±0.0375$\theta$.

(4) Lowering of the line beneath the ISMLS glide path at which a DDM of 0.0875 is realized to less than 0.75θ from the horizontal.

(5) Failure of any part of the monitor itself. Such failure must automatically produce the same results as the malfunctioning of the element being monitored.

(b) At glide path facilities where the selected nominal angular displacement sensitivity corresponds to an angle below the ISMLS glide path, which is close to or at the maximum limits specified, an adjustment to the monitor operating limits may be made to protect against sector deviations below 0.75θ from the horizontal.

(c) Within 10 seconds of the occurrence of any of the conditions prescribed in paragraph (a) of this section, including periods of zero radiation, glide path signal radiation must cease.

### § 171.269 Marker beacon performance requirements.

ISMLS marker beacon equipment must meet the performance requirements prescribed in subpart H of this part.

### § 171.271 Installation requirements.

(a) The ISMLS facility must be permanent in nature, located, constructed, and installed according to accepted good engineering practices, applicable electric and safety codes, FCC licensing requirements, and paragraphs (a) and (c) of § 171.261.

(b) The ISMLS facility must have a reliable source of suitable primary power, either from a power distribution system or locally generated. Adequate power capacity must be provided for the operation of test and working equipment of the ISMLS.

(c) The ISMLS facility must have a continuously engaged or floating battery power source for the ground station for continued normal operation if the primary power fails. A trickle charge must be supplied to recharge the batteries during the period of available primary power. Upon loss and subsequent restoration of power, the batteries must be restored to full charge within 24 hours. When primary power is applied, the state of the battery charge may not affect the operation of the ISMLS ground station. The battery must permit continuation of normal operation for at least two hours under the normal operating conditions. The equipment must meet all specification requirements with or without batteries installed.

(d) There must be a means for determining, from the ground, the performance of the equipment including antennae, both initially and periodically.

(e) The facility must have, or be supplemented by, ground-air or landline communications services. At facilities within or immediately adjacent to controlled airspace and that are intended for use as instrument approach aids for an airport, there must be ground-air communications or reliable communications (at least a landline telephone) from the airport to the nearest Federal Aviation Administration air traffic control or communication facility. Compliance with this paragraph need not be shown at airports where an adjacent Federal Aviation Administration facility can communicate with aircraft on the ground at the airport and during the entire proposed instrument approach procedure. In addition, at low traffic density airports within or immediately adjacent to controlled airspace, and where extensive delays are not a factor, the requirements of this paragraph may be reduced to reliable communications (at least a landline telephone) from the airport to the nearest Federal Aviation Administration air traffic control or communications facility, if an adjacent Federal Aviation Administration facility can communicate with aircraft during the proposed instrument approach procedure, at least down to the minimum en route altitude for the controlled area.

(f) Except where no operationally harmful interference will result, at locations where two separate ISMLS facilities serve opposite ends of a single runway, an interlock must ensure that only the facility serving the approach direction in use can radiate.

[Doc. No. 14120, 40 FR 36110, Aug. 19, 1975, as amended by Amdt. 171–16, 56 FR 65665, Dec. 17, 1991]

### § 171.273 Maintenance and operations requirements.

(a) The owner of the facility must establish an adequate maintenance system and provide qualified maintenance personnel to maintain the facility at the level attained at the time it was commissioned. Each person who maintains a facility must meet at least the Federal Communications Commission's licensing requirements and show that he has the special knowledge and skills needed to maintain the facility, including proficiency in maintenance procedures and the use of specialized test equipment.

(b) In the event of out-of-tolerance conditions or malfunctions, as evidenced by receiving two successive pilot reports, the owner must close the facility be ceasing radiation, and issue a ''Notice to Airman'' (NOTAM) that the facility is out of service.

(c) The owner must prepare, and obtain approval of, an operations and maintenance manual that sets forth mandatory procedures for operations, periodic maintenance, and emergency maintenance, including instructions on each of the following:

(1) Physical security of the facility.

(2) Maintenance and operations by authorized persons.

(3) FCC licensing requirements for operations and maintenance personnel.

(4) Posting of licenses and signs.

(5) Relation between the facility and FAA air traffic control facilities, with a description of the boundaries of controlled airspace over or near the facility, instructions for relaying air traffic control instructions and information, if applicable, and instructions for the operation of an air traffic advisory service if the facility is located outside of controlled airspace.

(6) Notice to the Administrator of any suspension of service.

(7) Detailed and specific maintenance procedures and servicing guides stating the frequency of servicing.

(8) Air-ground communications, if provided, expressly written or incorporating appropriate sections of FAA manuals by reference.

(9) Keeping of station logs and other technical reports, and the submission of reports required by § 171.275.

(10) Monitoring of the ISMLS facility.

(11) Inspections by United States personnel.

(12) Names, addresses, and telephone numbers of persons to be notified in an emergency.

(13) Shutdowns for periodic maintenance and issue of ''Notices to Airmen'' for routine or emergency shutdowns.

(14) Commissioning of the ISMLS facility.

(15) An acceptable procedure for amending or revising the manual.

(16) An explanation of the kinds of activities (such as construction or grading) in the vicinity of the ISMLS facility that may require shutdown or recertification of the ISMLS facility by FAA flight check.

(17) Procedures for conducting a ground check of the localizer course alignment, width, and clearance, glide path elevation angle and course width, and marker beacon power, and modulation.

(18) The following information concerning the ISMLS facility:

(i) Facility component locations with respect to airport layout, instrument runways, and similar areas.

(ii) The type, make, and model of the basic radio equipment that provides the service.

(iii) The station power emission and frequencies of the ISMLS localizer, glide path, beacon markers, and associated compass locators, if any.

(iv) The hours of operation.

(v) Station identification call letters and method of station identification and the time spacing of the identification.

(vi) A description of the critical parts that may not be changed, adjusted, or repaired without an FAA flight check to confirm published operations.

(d) The owner or his maintenance representative must make a ground check of the ISMLS facility periodically in accordance with procedures approved by the FAA at the time of commissioning, and must report the results of the checks as provided in § 171.275.

(e) Modifications to an ISMLS facility may be made only after approval by the FAA of the proposed modification submitted by the owner.

(f) The owner or the owner's maintenance representative must participate in inspections made by the FAA.

(g) Whenever it is required by the FAA, the owner must incorporate improvements in ISMLS maintenance.

(h) The owner or his maintenance representative must provide a sufficient stock of spare parts, including solid state components, or modules to make possible the prompt replacement of components or modules that fail or deteriorate in service.

(i) FAA approved test instruments must be used for maintenance of the ISMLS facility.

(j) The mean corrective maintenance time of the ISMLS equipment may not exceed 0.5 hours, with a maximum corrective maintenance time of not greater than 1.5 hours. This measure applies to failures of the monitor, transmitter and associated antenna assemblies, limited to unscheduled outage and out-of-tolerance conditions.

(k) The mean time between failures of the ISMLS equipment may not be less than 1,500 hours. This measure applies to unscheduled outages, out-of-tolerance conditions, and failures of the monitor, transmitter, and associated antenna assemblies.

(l) Inspection consists of an examination of the ISMLS equipment to ensure that unsafe operating conditions do not exist.

(m) Monitoring of the ISMLS radiated signal must ensure a high degree of integrity and minimize the requirements for ground and flight inspection. The monitor must be checked periodically during the in-service test evaluation period for calibration and stability. These tests and ground checks of glide slope, localizer, and marker beacon radiation characteristics must be conducted in accordance with the maintenance requirements of this section.

### § 171.275 Reports.

The owner of the ISMLS facility or his maintenance representative must make the following reports at the indicated time to the appropriate FAA Regional Office where the facility is located.

(a) *Facility Equipment Performance and Adjustment Data* (*FAA Form 198*). The FAA Form 198 shall be filled out by the owner or his maintenance representative with the equipment adjustments and meter readings as of the time of facility commissioning. One copy must be kept in the permanent records of the facility and two copies must be sent to the appropriate FAA Regional Office. The owner or his maintenance representative must revise the FAA Form 198 data after any major repair, modernization, or retuning to reflect an accurate record of facility operation and adjustment. In the event the data are revised, the owner or his maintenance representative shall notify the appropriate FAA Regional Office of such revisions, and forward copies of the revisions to the appropriate FAA Regional Office.

(b) *Facility Maintenance Log* (*FAA Form 6030–1*). FAA Form 6030–1 is a permanent record of all the activities required to maintain the ISMLS facility. The entries must include all malfunctions met in maintaining the facility including information on the kind of work and adjustments made, equipment failures, causes (if determined) and corrective action taken. In addition, the entries must include completion of periodic maintenance required to maintain the facility. The owner or his maintenance representative must keep the original of each form at the facility and send a copy to the appropriate FAA Regional Office at the end of each month in which it is prepared. However, where an FAA approved remote monitoring system is installed which precludes the need for periodic maintenance visits to the facility, monthly reports from the remote monitoring system control point must be forwarded to the appropriate FAA Regional Office, and a hard copy retained at the control point.

(c) *Technical Performance Record* (*FAA Form 418*). FAA Form 418 contains a record of system parameters, recorded on each scheduled visit to the facility. The owner or his maintenance representative shall keep the original of each month's record at the facility and send a copy of the form to the appropriate FAA Regional Office.

## Subpart J—Microwave Landing System (MLS)

SOURCE: Docket No. 20669, 51 FR 33177, Sept. 18, 1986, unless otherwise noted.

### § 171.301 Scope.

This subpart sets forth minimum requirements for the approval, installation, operation and maintenance of non-Federal Microwave Landing System (MLS) facilities that provide the basis for instrument flight rules (IFR) and air traffic control procedures.

### § 171.303 Definitions.

As used in this subpart:

*Auxiliary data* means data transmitted in addition to basic data that provide ground equipment siting information for use in refining airborne position calculations and other supplementary information.

*Basic data* means data transmitted by the ground equipment that are associated directly with the operation of the landing guidance system.

*Beam center* means the midpoint between the −3 dB points on the leading and trailing edges of the scanning beam main lobe.

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

*Clearance guidance sector* means the volume of airspace, inside the coverage sector, within which the azimuth guidance information provided is not proportional to the angular displacement of the aircraft, but is a constant fly-left or fly-right indication of the direction relative to the approach course the aircraft should proceed in order to enter the proportional guidance sector.

*Control Motion Noise (CMN)* means those fluctuations in the guidance which affect aircraft attitude, control surface motion, column motion, and wheel motion. Control motion noise is evaluated by filtering the flight error record with a band-pass filter which has corner frequencies at 0.3 radian/sec and 10 radians/sec for azimuth data and 0.5 radian/sec and 10 radians/sec for elevation data.

*Data rate* means the average number of times per second that transmissions occur for a given function.

*Differential Phase Shift Keying (DPSK)* means differential phase modulation of the radio frequency carrier with relative phase states of 0 degree or 180 degrees.

*Failure* means the inability of an item to perform within previously specified limits.

*Guard time* means an unused period of time provided in the transmitted signal format to allow for equipment tolerances.

*Integrity* means that quality which relates to the trust which can be placed in the correctness of the information supplied by the facility.

*Mean corrective time* means the average time required to correct an equipment failure over a given period, after a service technician reaches the facility.

*Mean course error* means the mean value of the azimuth error along a specified radial of the azimuth function.

*Mean glide path error* means the mean value of the elevation error along a specified glidepath of the elevation function.

*Mean-time-between-failures (MTBF)* means the average time between equipment failures over a given period.

*Microwave Landing System (MLS)* means the MLS selected by ICAO for international standardization.

*Minimum glidepath* means the lowest angle of descent along the zero degree azimuth that is consistent with published approach procedures and obstacle clearance criteria.

*MLS Approach Reference Datum* is a point at a specified height located vertically above the intersection of the runway centerline and the threshold.

*MLS back azimuth reference datum* means a point 15 meters (50 feet) above the runway centerline at the runway midpoint.

*MLS datum point* means a point defined by the intersection of the runway centerline with a vertical plane perpendicular to the centerline and passing through the elevation antenna phase center.

*Out of coverage indication (OCI)* means a signal radiated into areas outside the

intended coverage sector, where required, to specifically prevent invalid removal of an airborne warning indication in the presence of misleading guidance information.

*Path Following Error (PFE)* means the guidance perturbations which could cause aircraft displacement from the desired course or glidepath. It is composed of the path following noise and of the mean course error in the case of azimuth functions, or the mean glidepath error in the case of elevation functions. Path following errors are evaluated by filtering the flight error record with a second order low pass filter which has a corner frequency at 0.5 radian/sec for azimuth data or 1.5 radians/sec for elevation data.

*Path following noise (PFN)* means that portion of the guidance signal error which could cause displacement from the actual mean course line or mean glidepath as appropriate.

*Split-site ground station* means the type of ground station in which the azimuth portion of the ground station is located near the stop end of the runway, and the elevation portion is located near the approach end.

*Time division multiplex (TDM)* means that each function is transmitted on the same frequency in time sequence, with a distinct preamble preceding each function transmission.

### § 171.305 Requests for IFR procedure.

(a) Each person who requests an IFR procedure based on an MLS facility which that person owns must submit the following information with that request:

(1) A description of the facility and evidence that the equipment meets the performance requirements of §§ 171.309, 171.311, 171.313, 171.315, 171.317, 171.319, and 171.321 and is fabricated and installed in accordance with § 171.323.

(2) A proposed procedure for operating the facility.

(3) A proposed maintenance organization and a maintenance manual that meets the requirements of § 171.325.

(4) A statement of intent to meet the requirements of this subpart.

(5) A showing that the facility has an acceptable level of operational reliability and an acceptable standard of performance. Previous equivalent operational experience with a facility with identical design and operational characteristics will be considered in showing compliance with this subparagraph.

(b) FAA inspects and evaluates the MLS facility; it advises the owner of the results, and of any required changes in the MLS facility or in the maintenance manual or maintenance organization. The owner must then correct the deficiencies, if any, and operate the MLS facility for an in-service evaluation by the FAA.

### § 171.307 Minimum requirements for approval.

(a) The following are the minimum requirements that must be met before the FAA approves an IFR procedure for a non-Federal MLS facility:

(1) The performance of the MLS facility, as determined by flight and ground inspection conducted by the FAA, must meet the requirements of §§ 171.309, 171.311, 171.313, 171.315, 171.317, 171.319, and 171.321.

(2) The fabrication and installation of the equipment must meet the requirements of § 171.323.

(3) The owner must agree to operate and maintain the MLS facility in accordance with § 171.325.

(4) The owner must agree to furnish operational records as set forth in § 171.327 and agree to allow the FAA to inspect the facility and its operation whenever necessary.

(5) The owner must assure the FAA that he will not withdraw the MLS facility from service without the permission of the FAA.

(6) The owner must bear all costs of meeting the requirements of this section and of any flight or ground inspection made before the MLS facility is commissioned.

(b) [Reserved]

### § 171.309 General requirements.

The MLS is a precision approach and landing guidance system which provides position information and various ground-to-air data. The position information is provided in a wide coverage sector and is determined by an azimuth angle measurement, an elevation angle measurement and a range (distance) measurement.

(a) An MLS constructed to meet the requirements of this subpart must include:

(1) Approach azimuth equipment, associated monitor, remote control and indicator equipment.

(2) Approach elevation equipment, associated monitor, remote control and indicator equipment.

(3) A means for the encoding and transmission of essential data words, associated monitor, remote control and indicator equipment. Essential data are basic data words 1, 2, 3, 4, and 6 and auxiliary data words A1, A2 and A3.

(4) Distance measuring equipment (DME), associated monitor, remote control and indicator equipment.

(5) Remote controls for paragraphs (a) (1), (2), (3), and (4) of this section must include as a minimum on/off and reset capabilities and may be integrated in the same equipment.

(6) At locations where a VHF marker beacon (75 MHz) is already installed, it may be used in lieu of the DME equipment.

(b) In addition to the equipment required in paragraph (a) of this section the MLS may include:

(1) Back azimuth equipment, associated monitor, remote control and indicator equipment. When Back Azimuth is provided, a means for transmission of Basic Data Word 5 and Auxiliary Data Word A4 shall also be provided.

(2) A wider proportional guidance sector which exceeds the minimum specified in §§ 171.313 and 171.317.

(3) Precision DME, associated monitor, remote control and indicator equipment.

(4) VHF marker beacon (75 MHz), associated monitor, remote control and indicator equipment.

(5) The MLS signal format will accommodate additional functions (e.g., flare elevation) which may be included as desired. Remote controls for paragraphs (b) (1), (3) and (4) of this section must include as a minimum on/off and reset capabilities, and may be integrated in the same equipment.

(6) Provisions for the encoding and transmission of additional auxiliary data words, associated monitor, remote control and indicator equipment.

(c) MLS ground equipment must be designed to operate on a nominal 120/240 volt, 60 Hz, 3-wire single phase AC power source and must meet the following service conditions:

(1) AC line parameters, DC voltage, elevation and duty:

120 VAC nominal value—102 V to 138 V (±1 V)*

240 VAC nominal value—204 V to 276 V (±2 V)*

60 Hz AC line frequency—57 Hz to 63 Hz (±0.2 Hz)*

*NOTE: Where discrete values of the above frequency or voltages are specified for testing purposes, the tolerances given in parentheses indicated by an asterisk apply to the test instruments used to measure these parameters.

Elevation—0 to 3000 meters (10,000 feet) above sea level

Duty—Continuous, unattended

(2) Ambient conditions within the shelter for electronic equipment installed in shelters are:

Temperature, −10 °C to + 50 °C
Relative humidity, 5% to 90%

(3) Ambient conditions for electronic equipment and all other equipment installed outdoors (for example, antenna, field detectors, and shelters):

Temperature, −50 °C to + 70 °C
Relative humidity, 5% to 100%

(4) All equipment installed outdoors must operate satisfactorily under the following conditions:

Wind Velocity: The ground equipment shall remain within monitor limits with wind velocities of up to 70 knots from such directions that the velocity component perpendicular to runway centerline does not exceed 35 knots. The ground equipment shall withstand winds up to 100 knots from any direction without damage.

Hail Stones: 1.25 centimeters (½ inch) diameter.

Rain: Provide required coverage with rain falling at a rate of 50 millimeters (2 inches) per hour, through a distance of 9 kilometers (5 nautical miles) and with rain falling at the rate of 25 millimeters (1 inch) per hour for the additional 28 kilometers (15 nautical miles).

Ice Loading: Encased in 1.25 centimeters (½ inch) radial thickness of clear ice.

Antenna Radome De-Icing: Down to −6 °C (20 °F) and wind up to 35 knots.

(d) The transmitter frequencies of an MLS must be in accordance with the frequency plan approved by the FAA.

(e) The DME component listed in paragraph (a)(4) of this section must comply with the minimum standard performance requirements specified in subpart G of this part.

(f) The marker beacon components listed in paragraph (b)(4) of this section must comply with the minimum standard performance requirements specified in subpart H of this part.

### § 171.311 Signal format requirements.

The signals radiated by the MLS must conform to the signal format in which angle guidance functions and data functions are transmitted sequentially on the same C-band frequency. Each function is identified by a unique digital code which initializes the airborne receiver for proper processing. The signal format must meet the following minimum requirements:

(a) *Frequency assignment.* The ground components (except DME/Marker Beacon) must operate on a single frequency assignment or channel, using time division multiplexing. These components must be capable of operating on any one of the 200 channels spaced 300 KHz apart with center frequencies from 5031.0 MHz to 5090.7 MHz and with channel numbering as shown in Table 1a. The operating radio frequencies of all ground components must not vary by more than ±10 KHz from the assigned frequency. Any one transmitter frequency must not vary more than ±50 Hz in any one second period. The MLS angle/data and DME equipment must operate on one of the paired channels as shown in Table 1b.

TABLE 1a—FREQUENCY CHANNEL PLAN

| Channel No. | Frequency (MHz) |
|---|---|
| 500 | 5031.0 |
| 501 | 5031.3 |
| 502 | 5031.6 |
| 503 | 5031.9 |
| 504 | 5032.2 |
| 505 | 5032.5 |
| 506 | 5032.8 |
| 507 | 5033.1 |
| 508 | 5033.4 |
| 509 | 5033.7 |
| 510 | 5034.0 |
| 511 | 5034.3 |
| * * * * * | |
| 598 | 5060.4 |
| 599 | 5060.7 |
| 600 | 5061.0 |
| 601 | 5061.3 |
| * * * * * | |
| 698 | 5090.4 |
| 699 | 5090.7 |

TABLE 1b—CHANNELS

| Channel pairing | | | | DME parameters | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Interrogation | | | | Reply | |
| | | | | | Pulse codes | | | | |
| DME No. | VHF freq. MHz | MLS angle freq. MHz | MLS Ch. No. | Freq. MHz | DME/N μs | DME/P Mode | | Freq. MHz | Pulse codes μs |
| | | | | | | IA μs | FA μs | | |
| *1X | | | | 1025 | 12 | | | 962 | 12 |
| **1Y | | | | 1025 | 36 | | | 1088 | 30 |
| *2X | | | | 1026 | 12 | | | 963 | 12 |
| **2Y | | | | 1026 | 36 | | | 1089 | 30 |
| *3X | | | | 1027 | 12 | | | 964 | 12 |
| **3Y | | | | 1027 | 36 | | | 1090 | 30 |
| *4X | | | | 1028 | 12 | | | 965 | 12 |
| **4Y | | | | 1028 | 36 | | | 1091 | 30 |
| *5X | | | | 1029 | 12 | | | 966 | 12 |
| **5Y | | | | 1029 | 36 | | | 1092 | 30 |
| *6X | | | | 1030 | 12 | | | 967 | 12 |
| **6Y | | | | 1030 | 36 | | | 1093 | 30 |
| *7X | | | | 1031 | 12 | | | 968 | 12 |
| **7Y | | | | 1031 | 36 | | | 1094 | 30 |
| *8X | | | | 1032 | 12 | | | 969 | 12 |
| **8Y | | | | 1032 | 36 | | | 1095 | 30 |
| *9X | | | | 1033 | 12 | | | 970 | 12 |
| **9Y | | | | 1033 | 36 | | | 1096 | 30 |
| *10X | | | | 1034 | 12 | | | 971 | 12 |
| **10Y | | | | 1034 | 36 | | | 1097 | 30 |
| *11X | | | | 1035 | 12 | | | 972 | 12 |

TABLE 1b—CHANNELS—Continued

| DME No. | Channel pairing | | | DME parameters | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Interrogation | | | | Reply | |
| | VHF freq. MHz | MLS angle freq. MHz | MLS Ch. No. | Freq. MHz | Pulse codes | | | Freq. MHz | Pulse codes μs |
| | | | | | DME/N μs | DME/P Mode | | | |
| | | | | | | IA μs | FA μs | | |
| **11Y | | | | 1035 | 36 | | | 1098 | 30 |
| *12X | | | | 1036 | 12 | | | 973 | 12 |
| **12Y | | | | 1036 | 36 | | | 1099 | 30 |
| *13X | | | | 1037 | 12 | | | 974 | 12 |
| **13Y | | | | 1037 | 36 | | | 1100 | 30 |
| *14X | | | | 1038 | 12 | | | 975 | 12 |
| **14Y | | | | 1038 | 36 | | | 1101 | 30 |
| *15X | | | | 1039 | 12 | | | 976 | 12 |
| **15Y | | | | 1039 | 36 | | | 1102 | 30 |
| *16X | | | | 1040 | 12 | | | 977 | 12 |
| **16Y | | | | 1040 | 36 | | | 1103 | 30 |
| ▽17X | 108.00 | | | 1041 | 12 | | | 978 | 12 |
| 17Y | 108.05 | 5043.0 | 540 | 1041 | 36 | 36 | 42 | 1104 | 30 |
| 17Z | | 5043.3 | 541 | 1041 | | 21 | 27 | 1104 | 15 |
| 18X | 108.10 | 5031.0 | 500 | 1042 | 12 | 12 | 18 | 979 | 12 |
| 18W | | 5031.3 | 501 | 1042 | | 24 | 30 | 979 | 24 |
| 18Y | 108.15 | 5043.6 | 542 | 1042 | 36 | 36 | 42 | 1105 | 30 |
| 18Z | | 5043.9 | 543 | 1042 | | 21 | 27 | 1105 | 15 |
| 19X | 108.20 | | | 1043 | 12 | | | 980 | 12 |
| 19Y | 108.25 | 5044.2 | 544 | 1043 | 36 | 36 | 42 | 1106 | 30 |
| 19Z | | 5044.5 | 545 | 1043 | | 21 | 27 | 1106 | 15 |
| 20X | 108.30 | 5031.6 | 502 | 1044 | 12 | 12 | 18 | 981 | 12 |
| 20W | | 5031.9 | 503 | 1044 | | 24 | 30 | 981 | 24 |
| 20Y | 108.35 | 5044.8 | 546 | 1044 | 36 | 36 | 42 | 1107 | 30 |
| 20Z | | 5045.1 | 547 | 1044 | | 21 | 27 | 1107 | 15 |
| 21X | 108.40 | | | 1045 | 12 | | | 982 | 12 |
| 21Y | 108.45 | 5045.4 | 548 | 1045 | 36 | 36 | 42 | 1108 | 30 |
| 21Z | | 5045.7 | 549 | 1045 | | 21 | 27 | 1108 | 15 |
| 22X | 108.50 | 5032.2 | 504 | 1046 | 12 | 12 | 18 | 983 | 12 |
| 22W | | 5032.5 | 505 | 1046 | | 24 | 30 | 983 | 24 |
| 22Y | 108.55 | 5046.0 | 550 | 1046 | 36 | 36 | 42 | 1109 | 30 |
| 22Z | | 5046.3 | 551 | 1046 | | 21 | 27 | 1109 | 15 |
| 23X | 108.60 | | | 1047 | 12 | | | 984 | 12 |
| 23Y | 108.65 | 5046.6 | 552 | 1047 | 36 | 36 | 42 | 1110 | 30 |
| 23Z | | 5046.9 | 553 | 1047 | | 21 | 27 | 1110 | 15 |
| 24X | 108.70 | 5032.8 | 506 | 1048 | 12 | 12 | 18 | 985 | 12 |
| 24W | | 5033.1 | 507 | 1048 | | 24 | 30 | 985 | 24 |
| 24Y | 108.75 | 5047.2 | 554 | 1048 | 36 | 36 | 42 | 1111 | 30 |
| 24Z | | 5047.5 | 555 | 1048 | | 21 | 27 | 1111 | 15 |
| 25X | 108.80 | | | 1049 | 12 | | | 986 | 12 |
| 25Y | 108.85 | 5047.8 | 556 | 1049 | 36 | 36 | 42 | 1112 | 30 |
| 25Z | | 5048.1 | 557 | 1049 | | 21 | 27 | 1112 | 15 |
| 26X | 108.90 | 5033.4 | 508 | 1050 | 12 | 12 | 18 | 987 | 12 |
| 26W | | 5033.7 | 509 | 1050 | | 24 | 30 | 987 | 24 |
| 26Y | 108.95 | 5048.4 | 558 | 1050 | 36 | 36 | 42 | 1113 | 30 |
| 26Z | | 5048.7 | 559 | 1050 | | 21 | 27 | 1113 | 15 |
| 27X | 109.00 | | | 1051 | 12 | | | 988 | 12 |
| 27Y | 109.05 | 5049.0 | 560 | 1051 | 36 | 36 | 42 | 1114 | 30 |
| 27Z | | 5049.3 | 561 | 1051 | | 21 | 27 | 1114 | 15 |
| 28X | 109.10 | 5034.0 | 510 | 1052 | 12 | 12 | 18 | 989 | 12 |
| 28W | | 5034.3 | 511 | 1052 | | 24 | 30 | 989 | 24 |
| 28Y | 109.15 | 5049.6 | 562 | 1052 | 36 | 36 | 42 | 1115 | 30 |
| 28Z | | 5049.9 | 563 | 1052 | | 21 | 27 | 1115 | 15 |
| 29X | 109.20 | | | 1053 | 12 | | | 990 | 12 |
| 29Y | 109.25 | 5050.2 | 564 | 1053 | 36 | 36 | 42 | 1116 | 30 |
| 29Z | | 5050.5 | 565 | 1043 | | 21 | 27 | 1116 | 15 |
| 30X | 109.30 | 5034.6 | 512 | 1054 | 12 | 12 | 18 | 991 | 12 |
| 30W | | 5034.9 | 513 | 1054 | | 24 | 30 | 991 | 24 |
| 30Y | 109.35 | 5050.8 | 566 | 1054 | 36 | 36 | 42 | 1117 | 30 |
| 30Z | | 5051.1 | 567 | 1054 | | 21 | 27 | 1117 | 15 |
| 31X | 109.40 | | | 1055 | 12 | | | 992 | 12 |
| 31Y | 109.45 | 5051.4 | 568 | 1055 | 36 | 36 | 42 | 1118 | 30 |
| 31Z | | 5051.7 | 569 | 1055 | | 21 | 27 | 1118 | 15 |
| 32X | 109.50 | 5035.2 | 514 | 1056 | 12 | 12 | 18 | 993 | 12 |
| 32W | | 5035.5 | 515 | 1056 | | 24 | 30 | 993 | 24 |

TABLE 1b—CHANNELS—Continued

| Channel pairing | | | | DME parameters | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Interrogation | | | | Reply | |
| DME No. | VHF freq. MHz | MLS angle freq. MHz | MLS Ch. No. | Freq. MHz | Pulse codes | | | | |
| | | | | | DME/N μs | DME/P Mode | | Freq. MHz | Pulse codes μs |
| | | | | | | IA μs | FA μs | | |
| 32Y | 109.55 | 5052.0 | 570 | 1056 | 36 | 36 | 42 | 1119 | 30 |
| 32Z | ..... | 5052.3 | 571 | 1056 | ..... | 21 | 27 | 1119 | 15 |
| 33X | 109.60 | ..... | ..... | 1057 | 12 | ..... | ..... | 994 | 12 |
| 33Y | 109.65 | 5052.6 | 572 | 1057 | 36 | 36 | 42 | 1120 | 30 |
| 33Z | ..... | 5052.9 | 573 | 1057 | ..... | 21 | 27 | 1120 | 15 |
| 34X | 109.70 | 5035.8 | 516 | 1058 | 12 | 12 | 18 | 995 | 12 |
| 34W | ..... | 5036.1 | 517 | 1058 | ..... | 24 | 30 | 995 | 24 |
| 34Y | 109.75 | 5053.2 | 574 | 1058 | 36 | 36 | 42 | 1121 | 30 |
| 34Z | ..... | 5053.5 | 575 | 1058 | ..... | 21 | 27 | 1121 | 15 |
| 35X | 109.80 | ..... | ..... | 1059 | 12 | ..... | ..... | 996 | 12 |
| 35Y | 109.85 | 5053.8 | 576 | 1059 | 36 | 36 | 42 | 1122 | 30 |
| 35Z | ..... | 5054.1 | 577 | 1059 | ..... | 21 | 27 | 1122 | 15 |
| 36X | 109.90 | 5036.4 | 518 | 1060 | 12 | 12 | 18 | 997 | 12 |
| 36W | ..... | 5036.7 | 519 | 1060 | ..... | 24 | 30 | 997 | 24 |
| 36Y | 109.95 | 5054.4 | 578 | 1060 | 36 | 36 | 42 | 1123 | 30 |
| 36Z | ..... | 5054.7 | 579 | 1060 | ..... | 21 | 27 | 1123 | 15 |
| 37X | 110.00 | ..... | ..... | 1061 | 12 | ..... | ..... | 998 | 12 |
| 37Y | 110.05 | 5055.0 | 580 | 1061 | 36 | 36 | 42 | 1124 | 30 |
| 37Z | ..... | 5055.3 | 581 | 1061 | ..... | 21 | 27 | 1124 | 15 |
| 38X | 110.10 | 5037.0 | 520 | 1062 | 12 | 12 | 18 | 999 | 12 |
| 38W | ..... | 5037.3 | 521 | 1062 | ..... | 24 | 30 | 999 | 24 |
| 38Y | 110.15 | 5055.6 | 582 | 1062 | 36 | 36 | 42 | 1125 | 30 |
| 38Z | ..... | 5055.9 | 583 | 1062 | ..... | 21 | 27 | 1125 | 15 |
| 39X | 110.20 | ..... | ..... | 1063 | 12 | ..... | ..... | 1000 | 12 |
| 39Y | 110.25 | 5056.2 | 584 | 1063 | 36 | 36 | 42 | 1126 | 30 |
| 39Z | ..... | 5056.5 | 585 | 1063 | ..... | 21 | 27 | 1126 | 15 |
| 40X | 110.30 | 5037.6 | 522 | 1064 | 12 | 12 | 18 | 1001 | 12 |
| 40W | ..... | 5037.9 | 523 | 1064 | ..... | 24 | 30 | 1001 | 24 |
| 40Y | 110.35 | 5056.8 | 586 | 1064 | 36 | 36 | 42 | 1127 | 30 |
| 40Z | ..... | 5057.1 | 587 | 1064 | ..... | 21 | 27 | 1127 | 15 |
| 41X | 110.40 | ..... | ..... | 1065 | 12 | ..... | ..... | 1002 | 12 |
| 41Y | 110.45 | 5057.4 | 588 | 1065 | 36 | 36 | 42 | 1128 | 30 |
| 41Z | ..... | 5057.7 | 589 | 1065 | ..... | 21 | 27 | 1128 | 15 |
| 42X | 110.50 | 5038.2 | 524 | 1066 | 12 | 12 | 18 | 1003 | 12 |
| 42W | ..... | 5038.5 | 525 | 1066 | ..... | 24 | 30 | 1003 | 24 |
| 42Y | 110.55 | 5058.0 | 590 | 1066 | 36 | 36 | 42 | 1129 | 30 |
| 42Z | ..... | 5058.3 | 591 | 1066 | ..... | 21 | 27 | 1129 | 15 |
| 43X | 110.60 | ..... | ..... | 1067 | 12 | ..... | ..... | 1004 | 12 |
| 43Y | 110.65 | 5058.6 | 592 | 1067 | 36 | 36 | 42 | 1130 | 30 |
| 43Z | ..... | 5058.9 | 593 | 1067 | ..... | 21 | 27 | 1130 | 15 |
| 44X | 110.70 | 5038.8 | 526 | 1068 | 12 | 12 | 18 | 1005 | 12 |
| 44W | ..... | 5039.1 | 527 | 1068 | ..... | 24 | 30 | 1005 | 24 |
| 44Y | 110.75 | 5059.2 | 594 | 1068 | 36 | 36 | 42 | 1131 | 30 |
| 44Z | ..... | 5059.5 | 595 | 1068 | ..... | 21 | 27 | 1131 | 15 |
| 45X | 110.80 | ..... | ..... | 1069 | 12 | ..... | ..... | 1006 | 12 |
| 45Y | 110.85 | 5059.8 | 596 | 1069 | 36 | 36 | 42 | 1132 | 30 |
| 45Z | ..... | 5060.1 | 597 | 1069 | ..... | 21 | 27 | 1132 | 15 |
| 46X | 110.90 | 5039.4 | 528 | 1070 | 12 | 12 | 18 | 1007 | 12 |
| 46W | ..... | 5039.7 | 529 | 1070 | ..... | 24 | 30 | 1007 | 24 |
| 46Y | 110.95 | 5060.4 | 598 | 1070 | 36 | 36 | 42 | 1133 | 30 |
| 46Z | ..... | 5060.7 | 599 | 1070 | ..... | 21 | 27 | 1133 | 15 |
| 47X | 111.00 | ..... | ..... | 1071 | 12 | ..... | ..... | 1008 | 12 |
| 47Y | 111.05 | 5061.0 | 600 | 1071 | 36 | 36 | 42 | 1134 | 30 |
| 47Z | ..... | 5061.3 | 601 | 1071 | ..... | 21 | 27 | 1134 | 15 |
| 48X | 111.10 | 5040.0 | 530 | 1072 | 12 | 12 | 18 | 1009 | 12 |
| 48W | ..... | 5040.3 | 531 | 1072 | ..... | 24 | 30 | 1009 | 24 |
| 48Y | 111.15 | 5061.6 | 602 | 1072 | 36 | 36 | 42 | 1135 | 30 |
| 48Z | ..... | 5061.9 | 603 | 1072 | ..... | 21 | 27 | 1135 | 15 |
| 49X | 111.20 | ..... | ..... | 1073 | 12 | ..... | ..... | 1010 | 12 |
| 49Y | 111.25 | 5062.2 | 604 | 1073 | 36 | 36 | 42 | 1136 | 30 |
| 49Z | ..... | 5062.5 | 605 | 1073 | ..... | 21 | 27 | 1136 | 15 |
| 50X | 111.30 | 5040.6 | 532 | 1074 | 12 | 12 | 18 | 1011 | 12 |
| 50W | ..... | 5040.9 | 533 | 1074 | ..... | 24 | 30 | 1011 | 24 |
| 50Y | 111.35 | 5062.8 | 606 | 1074 | 36 | 36 | 42 | 1137 | 30 |
| 50Z | ..... | 5063.1 | 607 | 1074 | ..... | 21 | 27 | 1137 | 15 |

TABLE 1b—CHANNELS—Continued

| Channel pairing | | | | DME parameters | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Interrogation | | | | Reply | |
| DME No. | VHF freq. MHz | MLS angle freq. MHz | MLS Ch. No. | Freq. MHz | Pulse codes | | | | |
| | | | | | DME/N μs | DME/P Mode | | | |
| | | | | | | IA μs | FA μs | Freq. MHz | Pulse codes μs |
| 51X | 111.40 | ..... | ..... | 1075 | 12 | ..... | ..... | 1012 | 12 |
| 51Y | 111.45 | 5063.4 | 608 | 1075 | 36 | 36 | 42 | 1138 | 30 |
| 51Z | ..... | 5063.7 | 609 | 1075 | ..... | 21 | 27 | 1138 | 15 |
| 52X | 111.50 | 5041.2 | 534 | 1076 | 12 | 12 | 18 | 1013 | 12 |
| 52W | ..... | 5041.5 | 535 | 1076 | ..... | 24 | 30 | 1013 | 24 |
| 52Y | 111.55 | 5064.0 | 610 | 1076 | 36 | 36 | 42 | 1139 | 30 |
| 52Z | ..... | 5064.3 | 611 | 1076 | ..... | 21 | 27 | 1139 | 15 |
| 53X | 111.60 | ..... | ..... | 1077 | 12 | ..... | ..... | 1014 | 12 |
| 53Y | 111.65 | 5064.6 | 612 | 1077 | 36 | 36 | 42 | 1140 | 30 |
| 53Z | ..... | 5064.9 | 613 | 1077 | ..... | 21 | 27 | 1140 | 15 |
| 54X | 111.70 | 5041.8 | 536 | 1078 | 12 | 12 | 18 | 1015 | 12 |
| 54W | ..... | 5042.1 | 537 | 1078 | ..... | 24 | 30 | 1015 | 24 |
| 54Y | 111.75 | 5065.2 | 614 | 1078 | 36 | 36 | 42 | 1141 | 30 |
| 54Z | ..... | 5065.5 | 615 | 1078 | ..... | 21 | 27 | 1141 | 15 |
| 55X | 111.80 | ..... | ..... | 1079 | 12 | ..... | ..... | 1016 | 12 |
| 55Y | 111.85 | 5065.8 | 616 | 1079 | 36 | 36 | 42 | 1142 | 30 |
| 55Z | ..... | 5066.1 | 617 | 1079 | ..... | 21 | 27 | 1142 | 15 |
| 56X | 111.90 | 5042.4 | 538 | 1080 | 12 | 12 | 18 | 1017 | 12 |
| 56W | ..... | 5042.7 | 539 | 1080 | ..... | 24 | 30 | 1017 | 24 |
| 56Y | 111.95 | 5066.4 | 618 | 1080 | 36 | 36 | 42 | 1143 | 30 |
| 56Z | ..... | 5066.7 | 619 | 1080 | ..... | 21 | 27 | 1143 | 15 |
| 57X | 112.00 | ..... | ..... | 1081 | 12 | ..... | ..... | 1018 | 12 |
| 57Y | 112.05 | ..... | ..... | 1081 | 36 | ..... | ..... | 1144 | 30 |
| 58X | 112.10 | ..... | ..... | 1082 | 12 | ..... | ..... | 1019 | 12 |
| 58Y | 112.15 | ..... | ..... | 1082 | 36 | ..... | ..... | 1145 | 30 |
| 59X | 112.20 | ..... | ..... | 1083 | 12 | ..... | ..... | 1020 | 12 |
| 59Y | 122.25 | ..... | ..... | 1083 | 36 | ..... | ..... | 1146 | 30 |
| **60X | ..... | ..... | ..... | 1084 | 12 | ..... | ..... | 1021 | 12 |
| **60Y | ..... | ..... | ..... | 1084 | 36 | ..... | ..... | 1147 | 30 |
| **61X | ..... | ..... | ..... | 1085 | 12 | ..... | ..... | 1022 | 12 |
| **61Y | ..... | ..... | ..... | 1085 | 36 | ..... | ..... | 1148 | 30 |
| **62X | ..... | ..... | ..... | 1086 | 12 | ..... | ..... | 1023 | 12 |
| **62Y | ..... | ..... | ..... | 1086 | 36 | ..... | ..... | 1149 | 30 |
| **63X | ..... | ..... | ..... | 1037 | 12 | ..... | ..... | 1024 | 12 |
| **63Y | ..... | ..... | ..... | 1087 | 36 | ..... | ..... | 1150 | 30 |
| **64X | ..... | ..... | ..... | 1088 | 12 | ..... | ..... | 1151 | 12 |
| **64Y | ..... | ..... | ..... | 1088 | 36 | ..... | ..... | 1025 | 30 |
| **65X | ..... | ..... | ..... | 1089 | 12 | ..... | ..... | 1152 | 12 |
| **65Y | ..... | ..... | ..... | 1089 | 36 | ..... | ..... | 1026 | 30 |
| **66X | ..... | ..... | ..... | 1090 | 12 | ..... | ..... | 1153 | 12 |
| **66Y | ..... | ..... | ..... | 1090 | 36 | ..... | ..... | 1027 | 30 |
| **67X | ..... | ..... | ..... | 1091 | 12 | ..... | ..... | 1154 | 12 |
| **67Y | ..... | ..... | ..... | 1091 | 36 | ..... | ..... | 1028 | 30 |
| **68X | ..... | ..... | ..... | 1092 | 12 | ..... | ..... | 1155 | 12 |
| **68Y | ..... | ..... | ..... | 1092 | 36 | ..... | ..... | 1029 | 30 |
| **69X | ..... | ..... | ..... | 1093 | 12 | ..... | ..... | 1156 | 12 |
| **69Y | ..... | ..... | ..... | 1093 | 36 | ..... | ..... | 1030 | 30 |
| 70X | 112.30 | ..... | ..... | 1094 | 12 | ..... | ..... | 1157 | 12 |
| **70Y | 112.35 | ..... | ..... | 1094 | 36 | ..... | ..... | 1031 | 30 |
| 71X | 112.40 | ..... | ..... | 1095 | 12 | ..... | ..... | 1158 | 12 |
| **71Y | 112.45 | ..... | ..... | 1095 | 36 | ..... | ..... | 1032 | 30 |
| 72X | 112.50 | ..... | ..... | 1096 | 12 | ..... | ..... | 1159 | 12 |
| **72Y | 112.55 | ..... | ..... | 1096 | 36 | ..... | ..... | 1033 | 30 |
| 73X | 112.60 | ..... | ..... | 1097 | 12 | ..... | ..... | 1160 | 12 |
| **73Y | 112.65 | ..... | ..... | 1097 | 36 | ..... | ..... | 1034 | 30 |
| 74X | 112.70 | ..... | ..... | 1098 | 12 | ..... | ..... | 1161 | 12 |
| **74Y | 112.75 | ..... | ..... | 1098 | 36 | ..... | ..... | 1035 | 30 |
| 75X | 112.80 | ..... | ..... | 1099 | 12 | ..... | ..... | 1162 | 12 |
| **75Y | 112.85 | ..... | ..... | 1099 | 36 | ..... | ..... | 1036 | 30 |
| 76X | 112.90 | ..... | ..... | 1100 | 12 | ..... | ..... | 1163 | 12 |
| **76Y | 112.95 | ..... | ..... | 1100 | 36 | ..... | ..... | 1037 | 30 |
| 77X | 113.00 | ..... | ..... | 1101 | 12 | ..... | ..... | 1164 | 12 |
| **77Y | 113.05 | ..... | ..... | 1101 | 36 | ..... | ..... | 1038 | 30 |
| 78X | 113.10 | ..... | ..... | 1102 | 12 | ..... | ..... | 1165 | 12 |
| **78Y | 113.15 | ..... | ..... | 1102 | 36 | ..... | ..... | 1039 | 30 |

TABLE 1b—CHANNELS—Continued

| Channel pairing | | | | DME parameters | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Interrogation | | | | Reply | |
| | | | | | Pulse codes | | | | |
| DME No. | VHF freq. MHz | MLS angle freq. MHz | MLS Ch. No. | Freq. MHz | DME/N μs | DME/P Mode | | Freq. MHz | Pulse codes μs |
| | | | | | | IA μs | FA μs | | |
| 79X | 113.20 | ..... | ..... | 1103 | 12 | ..... | ..... | 1166 | 12 |
| **79Y | 113.25 | ..... | ..... | 1103 | 36 | ..... | ..... | 1040 | 30 |
| 80X | 113.30 | ..... | ..... | 1104 | 12 | ..... | ..... | 1167 | 12 |
| 80Y | 113.35 | 5067.0 | 620 | 1104 | 36 | 36 | 42 | 1041 | 30 |
| 80Z | ..... | 5067.3 | 621 | 1104 | ..... | 21 | 27 | 1041 | 15 |
| 81X | 113.40 | ..... | ..... | 1105 | 12 | ..... | ..... | 1168 | 12 |
| 81Y | 113.45 | 5067.6 | 622 | 1105 | 36 | 36 | 42 | 1042 | 30 |
| 81Z | ..... | 5067.9 | 623 | 1005 | ..... | 21 | 27 | 1042 | 15 |
| 82X | 113.50 | ..... | ..... | 1106 | 12 | ..... | ..... | 1169 | 12 |
| 82Y | 113.55 | 5068.2 | 624 | 1106 | 36 | 36 | 42 | 1043 | 30 |
| 82Z | ..... | 5068.5 | 625 | 1106 | ..... | 21 | 27 | 1043 | 15 |
| 83X | 113.60 | ..... | ..... | 1107 | 12 | ..... | ..... | 1170 | 12 |
| 83Y | 113.65 | 5068.8 | 626 | 1107 | 36 | 36 | 42 | 1044 | 30 |
| 83Z | ..... | 5069.1 | 627 | 1107 | ..... | 21 | 27 | 1044 | 15 |
| 84X | 113.70 | ..... | ..... | 1108 | 12 | ..... | ..... | 1171 | 12 |
| 84Y | 113.75 | 5069.4 | 628 | 1108 | 36 | 36 | 42 | 1045 | 30 |
| 84Z | ..... | 6069.7 | 629 | 1108 | ..... | 21 | 27 | 1045 | 15 |
| 85X | 113.80 | ..... | ..... | 1109 | 12 | ..... | ..... | 1172 | 12 |
| 85Y | 113.85 | 5070.0 | 630 | 1109 | 36 | 36 | 42 | 1046 | 30 |
| 85Z | ..... | 5070.3 | 631 | 1109 | ..... | 21 | 27 | 1046 | 15 |
| 86X | 113.90 | ..... | ..... | 1110 | 12 | ..... | ..... | 1173 | 12 |
| 86Y | 113.95 | 5070.6 | 632 | 1110 | 36 | 36 | 42 | 1047 | 30 |
| 86Z | ..... | 5070.9 | 633 | 1110 | ..... | 21 | 27 | 1047 | 15 |
| 87X | 114.00 | ..... | ..... | 1111 | 12 | ..... | ..... | 1174 | 12 |
| 87Y | 114.05 | 5071.2 | 634 | 1111 | 36 | 36 | 42 | 1048 | 30 |
| 87Z | ..... | 5071.5 | 635 | 1111 | ..... | 21 | 27 | 1048 | 15 |
| 88X | 114.10 | ..... | ..... | 1112 | 12 | ..... | ..... | 1175 | 12 |
| 88Y | 114.15 | 5071.8 | 636 | 1112 | 36 | 36 | 42 | 1049 | 30 |
| 88Z | ..... | 5072.1 | 637 | 1112 | ..... | 21 | 27 | 1049 | 15 |
| 89X | 114.20 | ..... | ..... | 1113 | 12 | ..... | ..... | 1176 | 12 |
| 89Y | 114.25 | 5072.4 | 638 | 1113 | 36 | 36 | 42 | 1050 | 30 |
| 89Z | ..... | 5072.7 | 639 | 1113 | ..... | 21 | 27 | 1050 | 15 |
| 90X | 114.30 | ..... | ..... | 1114 | 12 | ..... | ..... | 1177 | 12 |
| 90Y | 114.35 | 5073.0 | 640 | 1114 | 36 | 36 | 42 | 1051 | 30 |
| 90Z | ..... | 5073.3 | 641 | 1114 | ..... | 21 | 27 | 1051 | 15 |
| 91X | 114.40 | ..... | ..... | 1115 | 12 | ..... | ..... | 1178 | 12 |
| 91Y | 114.45 | 5073.6 | 642 | 1115 | 36 | 36 | 42 | 1052 | 30 |
| 91Z | ..... | 5073.9 | 643 | 1115 | ..... | 21 | 27 | 1052 | 15 |
| 92X | 114.50 | ..... | ..... | 1116 | 12 | ..... | ..... | 1179 | 12 |
| 92Y | 114.55 | 5074.2 | 644 | 1116 | 36 | 36 | 42 | 1053 | 30 |
| 92Z | ..... | 5074.5 | 645 | 1116 | ..... | 21 | 27 | 1053 | 15 |
| 93X | 114.60 | ..... | ..... | 1117 | 12 | ..... | ..... | 1180 | 12 |
| 93Y | 114.65 | 5074.8 | 646 | 1117 | 36 | 36 | 42 | 1054 | 30 |
| 93Z | ..... | 5075.1 | 647 | 1117 | ..... | 21 | 27 | 1054 | 15 |
| 94X | 114.70 | ..... | ..... | 1118 | 12 | ..... | ..... | 1181 | 12 |
| 94Y | 114.75 | 5075.4 | 648 | 1118 | 36 | 36 | 42 | 1055 | 30 |
| 94Z | ..... | 5075.7 | 649 | 1118 | ..... | 21 | 27 | 1055 | 15 |
| 95X | 114.80 | ..... | ..... | 1119 | 12 | ..... | ..... | 1182 | 12 |
| 95Y | 114.85 | 5076.0 | 650 | 1119 | 36 | 36 | 42 | 1056 | 30 |
| 95Z | ..... | 5076.3 | 651 | 1119 | ..... | 21 | 27 | 1056 | 15 |
| 96X | 114.90 | ..... | ..... | 1120 | 12 | ..... | ..... | 1183 | 12 |
| 96Y | 114.95 | 5076.6 | 652 | 1120 | 36 | 36 | 42 | 1057 | 30 |
| 96Z | ..... | 5076.9 | 653 | 1120 | ..... | 21 | 27 | 1057 | 15 |
| 97X | 115.00 | ..... | ..... | 1121 | 12 | ..... | ..... | 1184 | 12 |
| 97Y | 115.05 | 5077.2 | 654 | 1121 | 36 | 36 | 42 | 1058 | 30 |
| 97Z | ..... | 5077.5 | 655 | 1121 | ..... | 21 | 27 | 1058 | 15 |
| 98X | 115.10 | ..... | ..... | 1122 | 12 | ..... | ..... | 1185 | 12 |
| 98Y | 115.15 | 5077.8 | 656 | 1122 | 36 | 36 | 42 | 1059 | 30 |
| 98Z | ..... | 5078.1 | 657 | 1122 | ..... | 21 | 27 | 1059 | 15 |
| 99X | 115.20 | ..... | ..... | 1123 | 12 | ..... | ..... | 1186 | 12 |
| 99Y | 115.25 | 5078.4 | 658 | 1123 | 36 | 36 | 42 | 1060 | 30 |
| 99Z | ..... | 5078.7 | 659 | 1123 | ..... | 21 | 27 | 1060 | 15 |
| 100X | 115.30 | ..... | ..... | 1124 | 12 | ..... | ..... | 1187 | 12 |
| 100Y | 115.35 | 5079.0 | 660 | 1124 | 36 | 36 | 42 | 1061 | 30 |
| 100Z | ..... | 5079.3 | 661 | 1124 | ..... | 21 | 27 | 1061 | 15 |

TABLE 1b—CHANNELS—Continued

| Channel pairing | | | | DME parameters | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Interrogation | | | | Reply | |
| | | | | | Pulse codes | | | | |
| DME No. | VHF freq. MHz | MLS angle freq. MHz | MLS Ch. No. | Freq. MHz | DME/N μs | DME/P Mode | | Freq. MHz | Pulse codes μs |
| | | | | | | IA μs | FA μs | | |
| 101X | 115.40 | ..... | ..... | 1125 | 12 | ..... | ..... | 1188 | 12 |
| 101Y | 115.45 | 5079.6 | 662 | 1125 | 36 | 36 | 42 | 1062 | 30 |
| 101Z | ..... | 5079.9 | 663 | 1125 | ..... | 21 | 27 | 1062 | 15 |
| 102X | 115.50 | ..... | ..... | 1126 | 12 | ..... | ..... | 1189 | 12 |
| 102Y | 115.55 | 5080.2 | 664 | 1126 | 36 | 36 | 42 | 1063 | 30 |
| 102Z | ..... | 5080.5 | 665 | 1126 | ..... | 21 | 27 | 1063 | 15 |
| 103X | 115.60 | ..... | ..... | 1127 | 12 | ..... | ..... | 1190 | 12 |
| 103Y | 115.65 | 5080.B | 666 | 1127 | 36 | 36 | 42 | 1064 | 30 |
| 103Z | ..... | 5081.1 | 667 | 1127 | ..... | 21 | 27 | 1064 | 19 |
| 104X | 115.70 | ..... | ..... | 1128 | 12 | ..... | ..... | 1191 | 12 |
| 104Y | 115.75 | 5081.4 | 668 | 1128 | 36 | 36 | 42 | 1065 | 30 |
| 104Z | ..... | 5081.7 | 669 | 1128 | ..... | 21 | 27 | 1065 | 19 |
| 105X | 115.80 | ..... | ..... | 1129 | 12 | ..... | ..... | 1192 | 12 |
| 105Y | 115.85 | 5082.0 | 670 | 1129 | 36 | 36 | 42 | 1066 | 30 |
| 105Z | ..... | 5082.3 | 671 | 1129 | ..... | 21 | 27 | 1066 | 15 |
| 106X | 115.90 | ..... | ..... | 1130 | 12 | ..... | ..... | 1193 | 12 |
| 106Y | 115.95 | 5082.6 | 672 | 1130 | 36 | 36 | 42 | 1067 | 30 |
| 106Z | ..... | 5082.9 | 673 | 1130 | ..... | 21 | 27 | 1067 | 15 |
| 107X | 116.00 | ..... | ..... | 1131 | 12 | ..... | ..... | 1194 | 12 |
| 107Y | 116.05 | 5083.2 | 674 | 1131 | 36 | 36 | 42 | 1068 | 30 |
| 107Z | ..... | 5083.5 | 675 | 1131 | ..... | 21 | 27 | 1068 | 15 |
| 108X | 116.10 | 508 | ..... | 1132 | 12 | ..... | ..... | 1195 | 12 |
| 108Y | 116.15 | 5083.8 | 676 | 1132 | 36 | 36 | 42 | 1069 | 30 |
| 108Z | ..... | 5084.1 | 677 | 1132 | ..... | 21 | 27 | 1069 | 15 |
| 109X | 116.20 | ..... | ..... | 1133 | 12 | ..... | ..... | 1196 | 12 |
| 109Y | 116.25 | 5084.4 | 678 | 1133 | 36 | 36 | 42 | 1070 | 30 |
| 109Z | ..... | 5084.7 | 679 | 1133 | ..... | 21 | 27 | 1070 | 15 |
| 110X | 116.30 | ..... | ..... | 1134 | 12 | ..... | ..... | 1197 | 12 |
| 110Y | 116.35 | 5085.0 | 680 | 1134 | 36 | 36 | 42 | 1071 | 30 |
| 110Z | ..... | 5085.3 | 681 | 1134 | ..... | 21 | 27 | 1071 | 15 |
| 111X | 116.40 | ..... | ..... | 1135 | 12 | ..... | ..... | 1198 | 12 |
| 111Y | 116.45 | 5086.6 | 682 | 1135 | 36 | 36 | 42 | 1072 | 30 |
| 111Z | ..... | 5085.9 | 683 | 1135 | ..... | 21 | 27 | 1072 | 15 |
| 112X | 116.50 | ..... | ..... | 1136 | 12 | ..... | ..... | 1199 | 12 |
| 112Y | 116.55 | 5086.2 | 684 | 1136 | 36 | 36 | 42 | 1073 | 30 |
| 112Z | ..... | 5086.5 | 685 | 1136 | ..... | 21 | 27 | 1073 | 15 |
| 113X | 116.60 | ..... | ..... | 1137 | 12 | ..... | ..... | 1200 | 12 |
| 113Y | 116.65 | 5086.8 | 686 | 1137 | 36 | 36 | 42 | 1074 | 30 |
| 113Z | ..... | 5087.1 | 687 | 1137 | ..... | 21 | 27 | 1074 | 15 |
| 114X | 116.70 | ..... | ..... | 1138 | 12 | ..... | ..... | 1201 | 12 |
| 114Y | 116.75 | 5087.4 | 688 | 1138 | 36 | 36 | 42 | 1075 | 30 |
| 114Z | ..... | 5087.7 | 689 | 1138 | ..... | 21 | 27 | 1075 | 15 |
| 115X | 116.80 | ..... | ..... | 1139 | 12 | ..... | ..... | 1202 | 12 |
| 115Y | 116.85 | 5088.0 | 690 | 1139 | 36 | 36 | 42 | 1076 | 30 |
| 115Z | ..... | 5088.3 | 691 | 1139 | ..... | 21 | 27 | 1076 | 15 |
| 116X | 116.90 | ..... | ..... | 1140 | 12 | ..... | ..... | 1203 | 12 |
| 116Y | 116.95 | 5088.6 | 692 | 1140 | 36 | 36 | 42 | 1077 | 30 |
| 116Z | ..... | 5088.9 | 693 | 1140 | ..... | 21 | 27 | 1077 | 15 |
| 117X | 117.00 | ..... | ..... | 1141 | 12 | ..... | ..... | 1204 | 12 |
| 117Y | 117.05 | 5089.2 | 694 | 1141 | 36 | 36 | 42 | 1078 | 30 |
| 117Z | ..... | 5089.5 | 695 | 1141 | ..... | 21 | 27 | 1078 | 15 |
| 118X | 117.10 | ..... | ..... | 1142 | 12 | ..... | ..... | 12.5 | 12 |
| 118Y | 117.15 | 5089.8 | 696 | 1142 | 36 | 36 | 42 | 1079 | 30 |
| 118Z | ..... | 5090.1 | 697 | 1142 | ..... | 21 | 27 | 1079 | 12 |
| 119X | 117.20 | ..... | ..... | 1143 | 12 | ..... | ..... | 1206 | 12 |
| 119Y | 117.25 | 5090.4 | 698 | 1143 | 36 | 36 | 42 | 1080 | 30 |
| 119Z | ..... | 5090.7 | 699 | 1143 | ..... | 21 | 27 | 1080 | 15 |
| 120X | 117.30 | ..... | ..... | 1144 | 12 | ..... | ..... | 1207 | 12 |
| 120Y | 117.35 | ..... | ..... | 1144 | 36 | ..... | ..... | 1081 | 30 |
| 121X | 117.40 | ..... | ..... | 1145 | 12 | ..... | ..... | 1208 | 12 |
| 121Y | 117.45 | ..... | ..... | 1145 | 36 | ..... | ..... | 1082 | 30 |
| 122X | 117.50 | ..... | ..... | 1146 | 12 | ..... | ..... | 1209 | 12 |
| 122Y | 117.55 | ..... | ..... | 1146 | 36 | ..... | ..... | 1083 | 30 |
| 123X | 117.60 | ..... | ..... | 1147 | 12 | ..... | ..... | 1210 | 12 |
| 123Y | 117.65 | ..... | ..... | 1147 | 36 | ..... | ..... | 1084 | 30 |

TABLE 1b—CHANNELS—Continued

| Channel pairing | | | | DME parameters | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Interrogation | | | | Reply | |
| DME No. | VHF freq. MHz | MLS angle freq. MHz | MLS Ch. No. | Freq. MHz | Pulse codes | | | | |
| | | | | | DME/N μs | DME/P Mode | | Freq. MHz | Pulse codes μs |
| | | | | | | IA μs | FA μs | | |
| 124X | 117.70 | ..... | ..... | 1148 | 12 | ..... | ..... | 1211 | 12 |
| **124Y | 117.75 | ..... | ..... | 1148 | 36 | ..... | ..... | 1085 | 30 |
| 125X | 117.80 | ..... | ..... | 1149 | 12 | ..... | ..... | 1212 | 12 |
| **125Y | 117.85 | ..... | ..... | 1149 | 36 | ..... | ..... | 1086 | 30 |
| 126X | 117.90 | ..... | ..... | 1150 | 12 | ..... | ..... | 1213 | 12 |
| **126Y | 117.95 | ..... | ..... | 1150 | 36 | ..... | ..... | 1087 | 30 |

*Notes:*
*These channels are reserved exclusively for national allotments.
**These channels may be used for national allotment on a secondary basis. The primary reason for reserving these channels is to provide protection for the secondary Surveillance Radar (SSR) system.
▽108.0 MHz is not scheduled for assignment to ILS service. The associated DME operating channel No. 17X may be assigned to the emergency service.

(b) *Polarization.* (1) The radio frequency emissions from all ground equipment must be nominally vertically polarized. Any horizontally polarized radio frequency emission component from the ground equipment must not have incorrectly coded angle information such that the limits specified in paragraphs (b) (2) and (3) of this section are exceeded.

(2) Rotation of the receiving antenna thirty degrees from the vertically polarized position must not cause the path following error to exceed the allowed error at that location.

(c) *Modulation requirements.* Each function transmitter must be capable of DPSK and continuous wave (CW) modulations of the RF carrier which have the following characteristics.

(1) DPSK. The DPSK signal must have the following characteristics:

| | |
|---|---|
| bit rate | 15.625 KHz |
| bit length | 64 microseconds |
| logic "0" | no phase transition |
| logic "1" | phase transition |
| phase transition | less than 10 microseconds |
| phase tolerance | ±10 degrees |

The phase shall advance (or retard) monotonically throughout the transition region. Amplitude modulation during the phase transition period shall not be used.

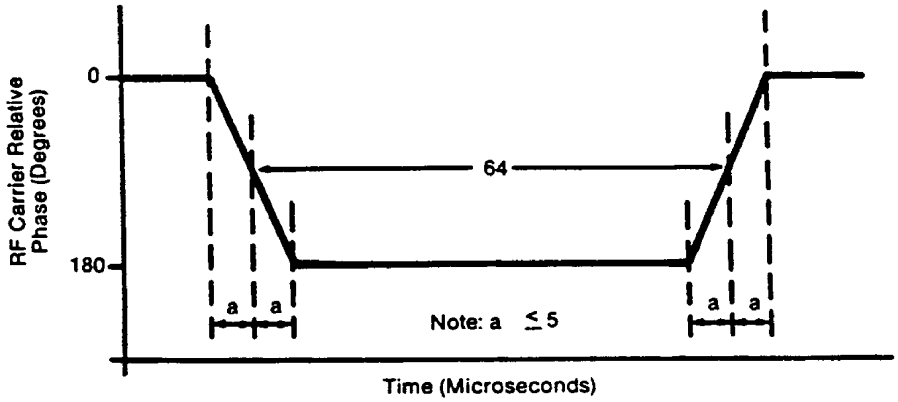



Figure 1.–DPSK Phase Characteristic

(2) CW. The CW pulse transmissions and the CW angle transmissions as may be required in the signal format of any function must have characteristics such that the requirements of paragraph (d) of this section are met.

(d) *Radio frequency signal spectrum.* The transmitted signal must be such that during the transmission time, the mean power density above a height of 600 meters (2000 feet) does not exceed $-100.5$ dBW/m$^2$ for angle guidance and $-95.5$ dBW/m$^2$ for data, as measured in a 150 KHz bandwidth centered at a frequency of 840 KHz or more from the assigned frequency.

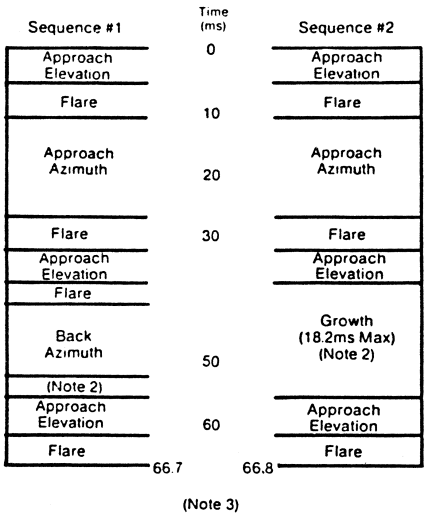
(e) *Synchronization.* Synchronization between the azimuth and elevation components is required and, in split-site configurations, would normally be accomplished by landline interconnections. Synchronization monitoring must be provided to preclude function overlap.

(f) *Transmission rates.* Angle guidance and data signals must be transmitted at the following average repetition rates:

| Function | Average data rate (Hertz) |
|---|---|
| Approach Azimuth | 13 ±0.5 |
| High Rate Approach Azimuth | [1] 39 ±1.5 |
| Approach Elevation | 39 ±1.5 |
| Back Azimuth | 6.5 ±0.25 |
| Basic Data | ([2]) |
| Auxiliary Data | ([3]) |

[1] The higher rate is recommended for azimuth scanning antennas with beamwidths greater than two degrees. It should be noted that the time available in the signal format for additional functions is limited when the higher rate is used.
[2] Refer to Table 8a.
[3] Refer to Table 8c.

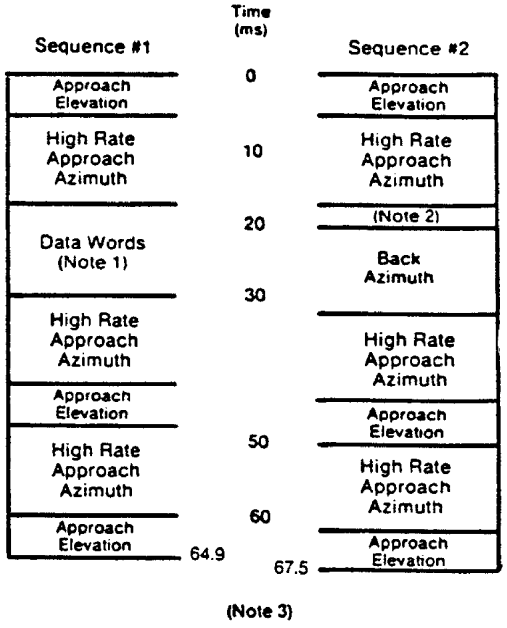
(g) *Transmission sequences.* Sequences of angle transmissions which will generate the required repetition rates are shown in Figures 2 and 3.




Notes:

1. When Back Azimuth is Provided, Basic Data Word # 2 Must Be Transmitted Only In This Position.
2. Data Words May Be Transmitted In Any Open Time Periods.
3. The Total Time Duration of Sequence #1 Plus Sequence #2 Must Not exceed 134 ms.

Figure 2. Transmission sequence pair which provides for all MLS angle guidance functions.




Notes:

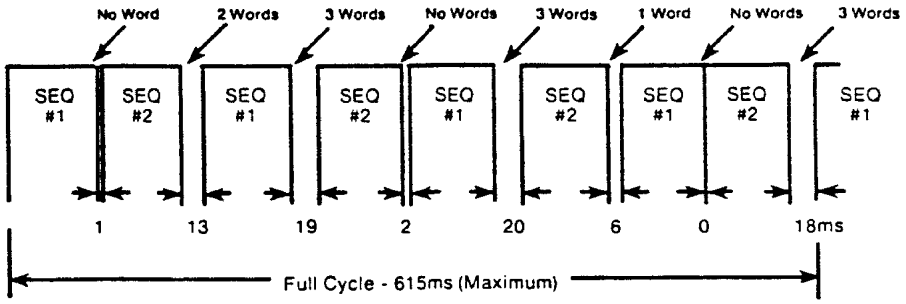
1. Data Words May Be Transmitted In Any Open Time Period.

2. When Back Azimuth Is Provided, Basic Data Word #2 Must Be Transmitted Only In This Position.

3. The Total Time Duration Of Sequence #1 Plus Sequence #2 Must Not Exceed 134 ms.

Figure 3. Transmission sequence pair which provides for the MLS high rate approach azimuth angle guidance function.

(h) *TDM cycle.* The time periods between angle transmission sequences must be varied so that exact repetitions do not occur within periods of less than 0.5 second in order to protect against synchronous interference. One such combination of sequences is shown in Figure 4 which forms a full multiplex cycle. Data may be transmitted during suitable open times within or between the sequences.




Note: Angle Sequence Are Those From Figure 2 Or 3. Do Not Mix Sequences.

**Figure 4. A complete function multiplex cycle.**

(i) *Function Formats (General).* Each angle function must contain the following elements: a preamble; sector signals; and a TO and FRO angle scan organized as shown in Figure 5a. Each data function must contain a preamble and a data transmission period organized as shown in Figure 5b.

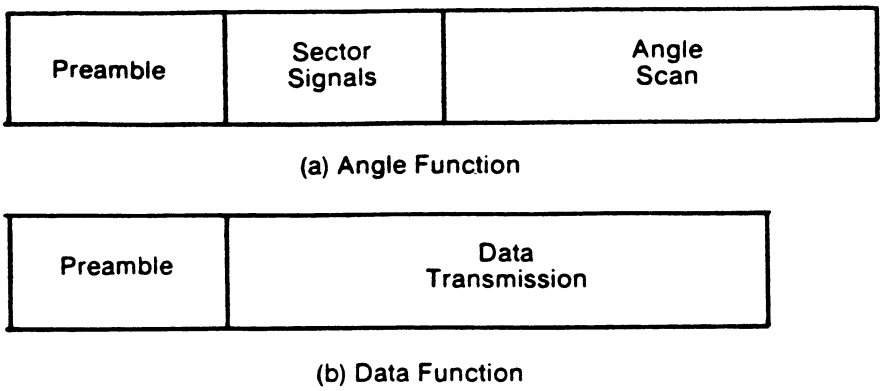



Figure 5 - Function format.

(1) *Preamble format.* The transmitted angle and date functions must use the preamble format shown in Figure 6. This format consists of a carrier acquisition period of unmodulated CW transmission followed by a receiver synchronization code and a function identification code. The preamble timing must be in accordance with Table 2.

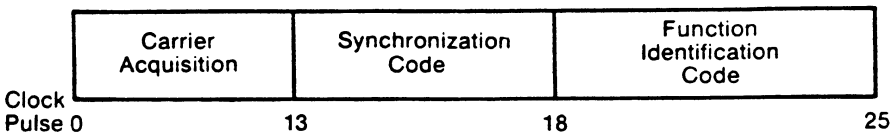



Figure 6 - Preamble organization.

(i) *Digital codes.* The coding used in the preamble for receiver synchronization is a Barker code logic 11101. The time of the last phase transition midpoint in the code shall be the receiver reference time (see Table 2). The function identification codes must be as shown in Table 3. The last two bits ($I_{11}$ and $I_{12}$) of the code are parity bits obeying the equations:

$I_6 + I_7 + I_8 + I_9 + I_{10} + I_{11}$ = Even

$I_6 + I_8 + I_{10} + I_{12}$ = Even

(ii) *Data modulation.* The digital code portions of the preamble must be DPSK modulated in accordance with §171.311(c)(1) and must be transmitted throughout the function coverage volume.

(2) *Angle function formats.* The timing of the angle transmissions must be in accordance with Tables 4a, 4b, and 5. The actual timing of the TO and FRO scans must be as required to meet the accuracy requirements of §§171.313 and 171.317.

(i) Preamble. Must be in accordance with requirements of §171.311(i)(1).

TABLE 2—PREAMBLE TIMING [1]

| Event | Event time slot begins at— | |
|---|---|---|
| | 15.625 kHz clock pulse (number) | Time (milliseconds) |
| Carrier acquisition: | | |
| (CW transmission) | 0 | 0 |
| Receiver reference time code: | | |
| $I_1 = 1$ | 13 | 0.832 |
| $I_2 = 1$ | 14 | 0.896 |
| $I_3 = 1$ | 15 | 0.960 |
| $I_4 = 0$ | 16 | 1.024 |
| $I_5 = 1$ | 17 | [2] 1.088 |
| Function identification: | | |
| $I_6$ | 18 | 1.152 |
| $I_7$ | 19 | 1.216 |
| $I_8$ | 20 | 1.280 |
| $I_9$ | 21 | 1.344 |
| $I_{10}$ (see table 1) | 22 | 1.408 |
| $I_{11}$ | 23 | 1.472 |
| $I_{12}$ | 24 | 1.536 |
| END PREAMBLE | 25 | 1.600 |

[1] Applies to all functions transmitted.
[2] Reference time for receiver synchronization for all function timing.

TABLE 3—FUNCTION IDENTIFICATION CODES

| Function | Code | | | | | | |
|---|---|---|---|---|---|---|---|
| | $I_6$ | $I_7$ | $I_8$ | $I_9$ | $I_{10}$ | $I_{11}$ | $I_{12}$ |
| Approach azimuth | 0 | 0 | 1 | 1 | 0 | 0 | 1 |
| High rate approach azimuth | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| Approach elevation | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| Back azimuth | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| Basic data 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| Basic data 2 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| Basic data 3 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| Basic data 4 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| Basic data 5 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| Dasic data 6 | 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| Auxiliary data A | 1 | 1 | 1 | 0 | 0 | 1 | 0 |
| Auxiliary data B | 1 | 0 | 1 | 0 | 1 | 1 | 1 |
| Auxiliary data C | 1 | 1 | 1 | 1 | 0 | 0 | 0 |

(ii) *Sector signals.* In all azimuth formats, sector signals must be transmitted to provide Morse Code identification, airborne antenna selection, and system test signals. These signals are not required in the elevation formats. In addition, if the signal from an installed ground component results in a valid indication in an area where no valid guidance should exist, OCI signals must be radiated as provided for in the signal format (see Tables 4a, 4b, and 5). The sector signals are defined as follows:

(A) *Morse Code.* DPSK transmissions that will permit Morse Code facility identification in the aircraft by a four letter code starting with the letter ''M'' must be included in all azimuth functions. They must be transmitted and repeated at approximately equal intervals, not less than six times per

minute, during which time the ground subsystem is available for operational use. When the transmissions of the ground subsystem are not available, the identification signal must be suppressed. The audible tone in the aircraft is started by setting the Morse Code bit to logic ''1'' and stopped by a logic ''0'' (see Tables 4a and 4b). The identification code characteristics must conform to the following: the dot must be between 0.13 and 0.16 second in duration, and the dash between 0.39 and 0.48 second. The duration between dots and/or dashes must be one dot plus or minus 10%. The duration between characters (letters) must not be less than three dots. When back azimuth is provided, the code shall be transmitted by the approach azimuth and back azimuth within plus or minus 0.08 seconds.

(B) *Airborne antenna selection.* A signal for airborne antenna selection shall be transmitted as a ''zero'' DPSK signal lasting for a six-bit period (see Tables 4a and 4b).

TABLE 4a—APPROACH AZIMUTH FUNCTION TIMING

| Event | Event time slot begins at— | |
|---|---|---|
| | 15.625 kHz clock pulse (number) | Time (milliseconds) |
| Preamble | 0 | 0 |
| Morse code | 25 | 1.600 |
| Antenna select | 26 | 1.664 |
| Rear OCI | 32 | 2.048 |
| Left OCI | 34 | 2.176 |
| Right OCI | 36 | 2.304 |
| To test | 38 | 2.432 |
| To scan [1] | 40 | 2.560 |
| Pause | ..... | 8.760 |
| Midscan point | ..... | 9.060 |
| FRO scan [1] | ..... | 9.360 |
| FRO test | ..... | 15.560 |
| End Function (Airborne) | ..... | 15.688 |
| End guard time; end function (ground) | ..... | 15.900 |

AA[1] The actual commencement and completion of the TO and the FRO scan transmissions are dependent on the amount of proportional guidance provided. The time slots provided shall accommodate a maximum scan of plus or minus 62.0 degrees. Scan timing shall be compatible with accuracy requirements.

TABLE 4b—HIGH RATE APPROACH AZIMUTH AND BACK AZIMUTH FUNCTION TIMING

| Event | Event time slot begins at— | |
|---|---|---|
| | 15.625 kHz clock pulse (number) | Time (milliseconds) |
| Preamble | 0 | 0 |
| Morse Code | 25 | 1.600 |
| Antenna select | 26 | 1.664 |
| Rear OCI | 32 | 2.048 |
| Left OCI | 34 | 2.176 |
| Right OCI | 36 | 2.304 |
| To test | 38 | 2.432 |
| To scan [1] | 40 | 2.560 |
| Pause | ..... | 6.760 |
| Midscan point | ..... | 7.060 |
| FRO scan [1] | ..... | 7.360 |
| FRO test pulse | ..... | 11.560 |
| End function (airborne) | ..... | 11.688 |
| End guard time; end function (ground) | ..... | 11.900 |

[1] The actual commencement and completion of the TO and the FRO scan transmissions are dependent on the amount of proportional guidance provided. The time slots provided will accommodate a maximum scan of plus or minus 42.0 degrees. Scan timing shall be compatible with accuracy requirements.

(C) *OCI.* Where OCI pulses are used, they must be: (1) greater than any guidance signal in the OCI sector; (2) at least 5 dB less than the level of the scanning beam within the proportional guidance sector; and (3) for azimuth functions with clearance signals, at least 5 dB less than the level of the left (right) clearance pulses within the left (right) clearance sector.

TABLE 5—APPROACH ELEVATION FUNCTION TIMING

| Event | Event time slot begins at: | |
|---|---|---|
| | 15.625 kHz clock pluse (number) | Time (milliseconds) |
| Preamble | 0 | 0 |
| Processor pause | 25 | 1.600 |
| OCI | 27 | 1.728 |
| To scan [1] | 29 | 1.856 |
| Pause | ..... | 3.406 |
| Midscan point | ..... | 3.606 |
| FRO scan [1] | ..... | 3.806 |
| End function (airborne) | ..... | 5.356 |
| End guard time; end function (ground) | ..... | 5.600 |

[1] The actual commencement and completion of the TO and FRO scan transmissions are dependent upon the amount of proportional guidance provided. The time slots provided will accommodate a maximum scan of −1.5 degrees to + 29.5 degrees. Scan timing shall be compatible with accuracy requirements.

The duration of each pulse measured at the half amplitude point shall be at least 100 microseconds, and the rise and

fall times shall be less then 10 microseconds. It shall be permissible to sequentially transmit two pulses in each out-of-coverage indication time slot. Where pulse pairs are used, the duration of each pulse shall be at least 50 microseconds, and the rise and fall times shall be less then 10 microseconds. The transmission of out-of-coverage indication pulses radiated from antennas with overlapping coverage patterns shall be separated by at least 10 microseconds.

NOTE: If desired, two pulses may be sequentially transmitted in each OCI time slot. Where pulse pairs are used, the duration of each pulse must be 45 (±5) microseconds and the rise and fall times must be less than 10 microseconds.

(D) *System test.* Time slots are provided in Tables 4a and 4b to allow radiation of TO and FRO test pulses. However, radiation of these pulses is not required since the characteristics of these pulses have not yet been standardized.

(iii) *Angle encoding.* The encoding must be as follows:

(A) *General.* Azimuth and elevation angles are encoded by scanning a narrow beam between the limits of the proportional coverage sector first in one direction (the TO scan) and then in the opposite direction (the FRO scan). Angular information must be encoded by the amount of time separation between the beam centers of the TO and FRO scanning beam pulses. The TO and FRO transmissions must be symmetrically disposed about the midscan point listed in Tables 4a, 4b, 5, and 7. The midscan point and the center of the time interval between the TO and FRO scan transmissions must coincide with a tolerance of ±10 microseconds. Angular coding must be linear with angle and properly decoded using the formula:

$$\theta = \frac{V}{2}\left(T_0 - t\right)$$

where:

$\theta$ = Receiver angle in degrees.
V = Scan velocity in degrees per microsecond.
$T_0$ = Time separation in microseconds between TO and FRO beam centers corresponding to zero degrees.
t = Time separation in microseconds between TO and FRO beam centers.

The timing requirements are listed in Table 6 and illustrated in Figure 7.

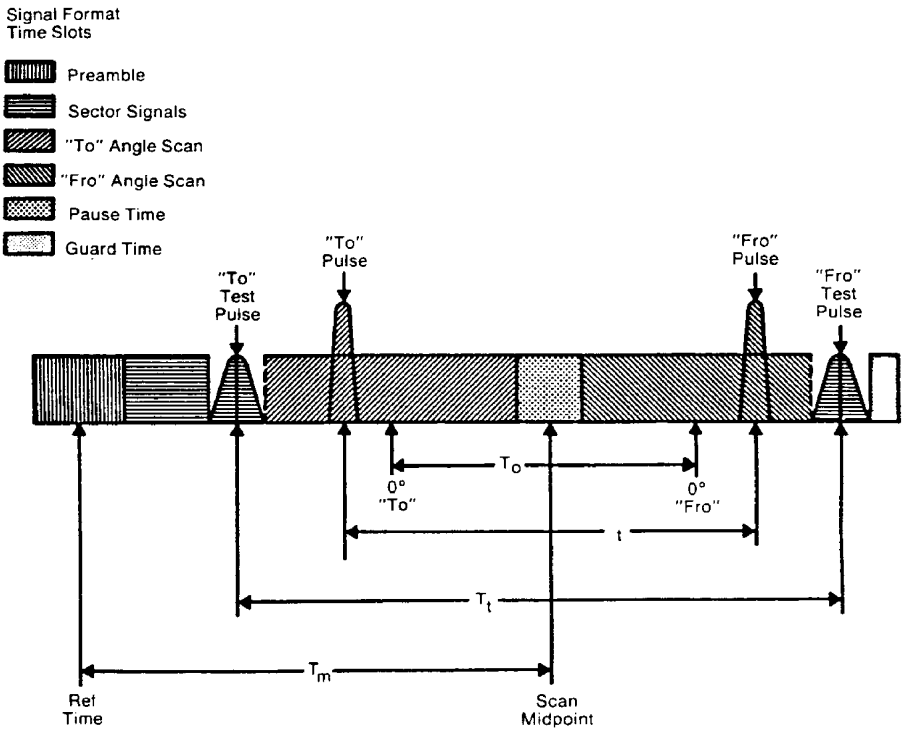



Figure 7. Azimuth Angle Scan Timing (Not to Scale)

(B) *Azimuth angle encoding.* Each guidance angle transmitted must consist of a clockwise TO scan followed by a counterclockwise FRO scan as viewed from above the antenna. For approach azimuth functions, increasing angle values must be in the direction of the TO scan; for the back azimuth function, increasing angle values must be in the direction of the FRO scan. The antenna has a narrow beam in the plane of the scan direction and a broad beam in the orthogonal plane which fills the vertical coverage.

(C) *Elevation angle encoding.* The radiation from elevation equipment must produce a beam which scans from the horizon up to the highest elevation angle and then scans back down to the horizon. The antenna has a narrow beam in the plane of the scan direction and a broad beam in the orthogonal plane which fills the horizontal coverage. Elevation angles are defined from the horizontal plane containing the antenna phase center; positive angles are above the horizontal and zero angle is along the horizontal.

(iv) *Clearance guidance.* The timing of the clearance pulses must be in accordance with Figure 8. For azimuth elements with proportional coverage of less than ±40 degrees (±20 degrees for back azimuth), clearance guidance information must be provided by transmitting pulses in a TO and FRO format adjacent to the stop/start times of the scanning beam signal. The fly-right clearance pulses must represent positive angles and the fly-left clearance pulses must represent negative angles. The duration of each clearance pulse must be 50 microseconds with a tolerance of ±5 microseconds. The transmitter switching time between the clearance pulses and the scanning

beam transmissions must not exceed 10 microseconds. The rise time at the edge of each clearance pulse must be less than 10 microseconds. Within the fly-right clearance guidance section, the fly-right clearance guidance signal shall exceed scanning beam antenna sidelobes and other guidance and OCI signals by at least 5 dB; within the fly-left clearance guidance sector, the fly left clearance guidance signal shall exceed scanning beam antenna sidelobes and all other guidance and OCI signals by at least 5 dB; within the proportional guidance sector, the clearance guidance signals shall be at least 5dB below the proportional guidance signal. Optionally, clearance guidance may be provided by scanning throughout the approach guidance sector. For angles outside the approach azimuth proportional coverage limits as set in Basic Data Word One (Basic Data Word 5 for back azimuth), proper decode and display of clearance guidance must occur to the limits of the guidance region. Where used, clearance pulses shall be transmitted adjacent to the scanning beam signals at the edges of proportional coverage as shown in Figure 8. The proportional coverage boundary shall be established at one beamwidth inside the scan start/stop angles, such that the transition between scanning beam and clearance signals occurs outside the proportional coverage sector. When clearance pulses are provided in conjunction with a narrow beamwidth (e.g., one degree) scanning antenna, the scanning beam antenna shall radiate for 15 microseconds while stationary at the scan start/stop angles.

(3) *Data function format.* Basic data words provide equipment characteristics and certain siting information. Basic data words must be transmitted from an antenna located at the approach azimuth or back azimuth site which provides coverage throughout the appropriate sector. Data function timing must be in accordance with Table 7a.

TABLE 6—ANGLE SCAN TIMING CONSTANTS

| Function | Max value of $_t$(usec) | $T_o$(usec) | V(deg/usec) | $T_m$ (usec) | Pause time (usec) | $T_t$ (usec) |
|---|---|---|---|---|---|---|
| Approach azimuth | 13,000 | 6,800 | 0.02 | 7,972 | 600 | 13,128 |
| High rate approach azimuth | 9,000 | 4,800 | 0.02 | 5,972 | 600 | 9,128 |
| Approach elevation | 3,500 | 3,350 | 0.02 | 2,518 | 400 | N/A |
| Back azimuth | 9,000 | 4,800 | −0.02 | 5,972 | 600 | 9,128 |

TABLE 7a—BASIC DATA FUNCTION TIMING

| Event | Event time slot begins at: [1] | |
|---|---|---|
| | 15.625 kHz clock pulse (number) | Time (milliseconds) |
| Preamble | 0 | 0 |
| Data transmission (bits $I_{13}$–$I_{30}$) | 25 | 1.600 |
| Parity transmission (bits $I_{31}$–$I_{32}$) | 43 | 2.752 |
| End function (airborne) | 45 | 2.880 |
| End guard time: end function (ground) | | 3.100 |

[1] The previous event time slot ends at this time.

TABLE 7b—AUXILIARY DATA FUNCTION TIMING—(DIGITAL)

| Event | Event time slot begins at: | |
|---|---|---|
| | 15.625 kHz clock pulse (number) | Time (milliseconds) |
| Preamble | 0 | 0 |
| Address transmission (bits $I_{13}$–$I_{20}$) | 25 | 1.600 |
| Data transmission: (bits $I_{21}$–$I_{69}$) | 33 | 2.112 |

TABLE 7b—AUXILIARY DATA FUNCTION TIMING—(DIGITAL)—Continued

| Event | Event time slot begins at: | |
|---|---|---|
| | 15.625 kHz clock pulse (number) | Time (milliseconds) |
| Parity transmission (bits $I_{70}$–$I_{76}$) | 82 | 5.248 |
| End function (airborne) | 89 | 5.696 |
| End guard time; end function (ground) | | 5.900 |

TABLE 7c—AUXILIARY DATA FUNCTION TIMING—(ALPHANUMERIC)

| Event | Event time slot begins at: | |
|---|---|---|
| | 15.615 kHz clock pulse (number) | Time (milliseconds) |
| Preamble | 0 | 0 |
| Address transmission (bits $I_{13}$–$I_{20}$) | 25 | 1.600 |
| Data transmission: (bits $I_{21}$–$I_{76}$ | 33 | 2.112 |
| End function (airborne) | 89 | 5.696 |

TABLE 7c—AUXILIARY DATA FUNCTION TIMING—(ALPHANUMERIC)—Continued

| Event | Event time slot begins at: | |
|---|---|---|
| | 15.615 kHz clock pulse (number) | Time (milli-sec-onds) |
| End guard time; (end function ground) | ..... | 5.900 |

(i) *Preamble.* Must be in accordance with requirements of §171.311(i)(1).

(ii) *Data transmissions.* Basic data must be transmitted using DPSK modulation. The content and repetition rate of each basic data word must be in accordance with Table 8a. For data containing digital information, binary number 1 must represent the lower range limit with increments in binary steps to the upper range limit shown in Table 8a. Data containing digital information shall be transmitted with the least significant bit first.

(j) *Basic Data word requirements.* Basic Data shall consist of the items specified in Table 8a. Basic Data word contents shall be defined as follows:

(1) *Approach azimuth to threshold distance* shall represent the minimum distance between the Approach Azimuth antenna phase center and the vertical plane perpendicular to the centerline which contains the landing threshold.

(2) *Approach azimuth proportional coverage limit* shall represent the limit of the sector in which proportional approach azimuth guidance is transmitted.

(3) *Clearance signal type* shall represent the type of clearance when used. Pulse clearance is that which is in accordance with §171.311 (i) (2) (iv). Scanning Beam (SB) clearance indicates that the proportional guidance sector is limited by the proportional coverage limits set in basic data.

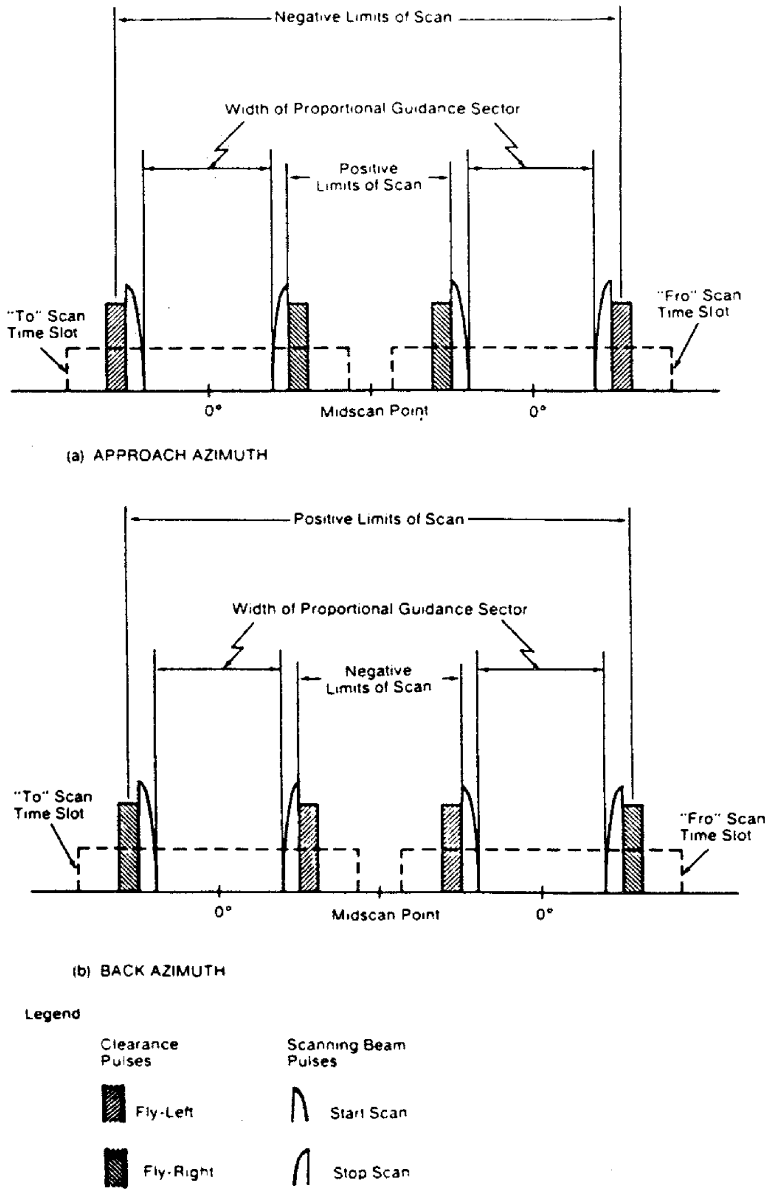



Figure 8. Clearance Pulse Timing for Azimuth Functions

TABLE 8a—BASIC DATA WORDS

| Data bit # | Data item definition | LSB value | Data bit value |
|---|---|---|---|
| **Basic Data Word No. 1** | | | |
| 1 | Preamble | N/A | 1 |
| 2 | | | 1 |
| 3 | | | 1 |
| 4 | | | 0 |
| 5 | | | 1 |
| 6 | | | 0 |
| 7 | | | 1 |
| 8 | | | 0 |
| 9 | | | 1 |
| 10 | | | 0 |
| 11 | | | 0 |
| 12 | | | 0 |
| 13 | Approach azimuth to threshold distance (Om − 630m). | 100m | 100m |
| 14 | | | 200m |
| 15 | | | 400m |
| 16 | | | 800m |
| 17 | | | 1600m |
| 18 | | | 3200m |
| 19 | Approach azimuth proportional coverage limit (negative limit) (0° to − 62°). | 2° | − 2° |
| 20 | | | − 4° |
| 21 | | | − 8° |
| 22 | | | − 16° |
| 23 | | | − 32° |
| 24 | Approach azimuth proportional coverage limit (positive limit) (0° to + 62°). | 2° | 2° |
| 25 | | | 4° |
| 26 | | | 8° |
| 27 | | | 16° |
| 28 | | | 32° |
| 29 | Clearance signal type | N/A | 0 = pulse; 1 = SB |
| 30 | Spare | | Transmit zero |
| 31 | Parity: (13 + 14 + 15. . . + 30 + 31 = odd). | N/A | N/A |
| 32 | Parity: (14 + 16 + 18. . . + 30 + 32 = odd). | N/A | N/A |

*Note 1:* Transmit throughout the Approach Azimuth guidance sector at intervals of 1.0 seconds or less.

*Note 2:* The all zero state of the data field represents the lower limit of the absolute value of the coded parameter unless otherwise noted.

| **Basic Data Word No. 2** | | | |
|---|---|---|---|
| 1 | Preamble | N/A | 1 |
| 2 | | | 1 |
| 3 | | | 1 |
| 4 | | | 0 |
| 5 | | | 1 |
| 6 | | | 0 |
| 7 | | | 1 |
| 8 | | | 1 |
| 9 | | | 1 |
| 10 | | | 1 |
| 11 | | | 0 |
| 12 | | | 0 |
| 13 | Minimum glide path (2.0° to 14.7°). | 0.1° | 0.1° |
| 14 | | | 0.2° |
| 15 | | | 0.4° |
| 16 | | | 0.8° |
| 17 | | | 1.6° |
| 18 | | | 3.2° |
| 19 | | | 6.4° |
| 20 | Back azimuth status | | see note 4 |
| 21 | DME status | | see note 6 |
| 22 | | | |
| 23 | Approach azimuth status | | see note 4 |
| 24 | Approach azimuth status | | see note 4 |
| 25 | Spare | | Transmit zero |
| 26 | .....do | | Do. |
| 27 | .....do | | Do. |
| 28 | .....do | | Do. |
| 29 | .....do | | Do. |
| 30 | .....do | | Do. |
| 31 | Parity: (13 + 14 + 15. . . + 30 + 31) = odd). | N/A | N/A |
| 32 | Parity: (14 + 16 + 18. . . + 30 + 32 = odd). | N/A | N/A |

TABLE 8a—BASIC DATA WORDS—Continued

*Note 1:* Transmit throughout the Approach Azimuth guidance sector at intervals of 0.16 seconds or less.

*Note 2:* The all zero state of the data field represents the lower limit of the absolute range of the coded parameter unless otherwise noted.

| **Basic Data Word No. 3** | | | |
|---|---|---|---|
| 1 | Preamble | N/A | 1 |
| 2 | | | 1 |
| 3 | | | 1 |
| 4 | | | 0 |
| 5 | | | 1 |
| 6 | | | 1 |
| 7 | | | 0 |
| 8 | | | 1 |
| 9 | | | 0 |
| 10 | | | 0 |
| 11 | | | 0 |
| 12 | | | 0 |
| 13 | Approach azimuth beamwidth (0.5° − 4.0°) See note 7. | 0.5° | 0.5° |
| 14 | | | 1.0° |
| 15 | | | 2.0° |
| 16 | Approach elevation beamwidth (0.5° to 2.5°) See note 7. | 0.5° | 0.5° |
| 17 | | | 1.0° |
| 18 | Note: values greater than 2.5° are invalid. | | 2.0° |
| 19 | DME distance (Om to 6387.5m. | 12.5m | 12.5m |
| 20 | | | 25.0m |
| 21 | | | 50.0m |
| 22 | | | 100.0m |
| 23 | | | 200.0m |
| 24 | | | 400.0m |
| 25 | | | 800.0m |
| 26 | | | 1600.0m |
| 27 | | | 3200.0m |
| 28 | Spare | | Transmit zero |
| 29 | .....do | | Do. |
| 30 | .....do | | Do. |
| 31 | Parity: (13 + 14 + 15. . . + 30 + 31 = odd). | | |
| 32 | Parity: (14 + 16 + 18. . . + 30 + 32 = odd). | N/A | N/A |

TABLE 8a—BASIC DATA WORDS—Continued

| Data bit # | Data item definition | LSB value | Data bit value |
|---|---|---|---|
| *Note 1:* Transmit throughout the Approach Azimuth guidance sector at intervals of 1.0 seconds or less. | | | |
| *Note 2:* The all zero state of the data field represents the lower limit of the absolute range of the coded parameter unless otherwise noted. | | | |
| **Basic Data Word No. 4** | | | |
| 1 | Preamble | N/A | 1 |
| 2 | ..... | ..... | 1 |
| 3 | ..... | ..... | 1 |
| 4 | ..... | ..... | 0 |
| 5 | ..... | ..... | 1 |
| 6 | ..... | ..... | 1 |
| 7 | ..... | ..... | 0 |
| 8 | ..... | ..... | 0 |
| 9 | ..... | ..... | 0 |
| 10 | ..... | ..... | 1 |
| 11 | ..... | ..... | 0 |
| 12 | ..... | ..... | 0 |
| 13 | Approach azimuth magnetic orientation (0° to 359°). | 1° | 1° |
| 14 | ..... | ..... | 2° |
| 15 | ..... | ..... | 4° |
| 16 | ..... | ..... | 8° |
| 17 | ..... | ..... | 16° |
| 18 | ..... | ..... | 32° |
| 19 | ..... | ..... | 64° |
| 20 | ..... | ..... | 128° |
| 21 | ..... | ..... | 256° |
| 22 | Back azimuth magnetic orientation (0° to 359°). | 1° | 1° |
| 23 | ..... | ..... | 2° |
| 24 | ..... | ..... | 4° |
| 25 | ..... | ..... | 8° |
| 26 | ..... | ..... | 16° |
| 27 | ..... | ..... | 32° |
| 28 | ..... | ..... | 64° |
| 29 | ..... | ..... | 128° |
| 30 | ..... | ..... | 256° |
| 31 | Parity: (13 + 14 + 15. . . + 30 + 31 = odd). | N/A | N/A |
| 32 | Parity: (14 + 16 + 18. . . + 30 + 32 = odd). | N/A | N/A |
| *Note 1:* Transmit at intervals of 1.0 second or less throughout the Approach Azimuth guidance sector, except when Back Azimuth guidance is provided. See Note 8. | | | |
| *Note 2:* The all zero state of the data field represents the lower limit of the absolute range of the coded parameter unless otherwise noted. | | | |
| **Basic Data Word No. 5** | | | |
| 1 | Preamble | N/A | 1 |
| 2 | ..... | ..... | 1 |
| 3 | ..... | ..... | 1 |
| 4 | ..... | ..... | 0 |
| 5 | ..... | ..... | 1 |
| 6 | ..... | ..... | 1 |
| 7 | ..... | ..... | 1 |
| 8 | ..... | ..... | 0 |
| 9 | ..... | ..... | 1 |
| 10 | ..... | ..... | 1 |
| 11 | ..... | ..... | 0 |
| 12 | ..... | ..... | 0 |
| 13 | Back azimuth proportional coverage negative limit (0° to −42°). | 2° | −2° |
| 14 | ..... | ..... | −4° |
| 15 | ..... | ..... | −8° |

TABLE 8a—BASIC DATA WORDS—Continued

| Data bit # | Data item definition | LSB value | Data bit value |
|---|---|---|---|
| 16 | ..... | ..... | −16° |
| 17 | ..... | ..... | −32° |
| 18 | Back azimuth proportional coverage positive limit (0° to + 42°). | 2° | 2° |
| 19 | ..... | ..... | 4° |
| 20 | ..... | ..... | 8° |
| 21 | ..... | ..... | 16° |
| 22 | ..... | ..... | 32° |
| 23 | Back azimuth beamwidth (0.5° to 4.0°) See note 7. | 0.5° | 0.5° |
| 24 | ..... | ..... | 1.0° |
| 25 | ..... | ..... | 2.0° |
| 26 | Back azimuth status | ..... | See Note 10 |
| 27 | .....do | ..... | Do. |
| 28 | .....do | ..... | Do. |
| 29 | .....do | ..... | Do. |
| 30 | .....do | ..... | Do. |
| 31 | Parity: (13 + 14 + 15. . . + 30 + 31 = odd). | N/A | N/A |
| 32 | Parity: (14 + 16 + 18. . . + 30 + 32 = odd). | N/A | N/A |
| *Note 1:* Transmit only when Back Azimuth guidance is provided. See note 9. | | | |
| *Note 2:* The all zero state of the data filed represents the lower limit of the absolute range of the coded parameter unless otherwise noted. | | | |
| **Basic Data Word No. 6** | | | |
| 1 | Preamble | N/A | 1 |
| 2 | ..... | ..... | 1 |
| 3 | ..... | ..... | 1 |
| 4 | ..... | ..... | 0 |
| 5 | ..... | ..... | 1 |
| 6 | ..... | ..... | 0 |
| 7 | ..... | ..... | 0 |
| 8 | ..... | ..... | 0 |
| 9 | ..... | ..... | 1 |
| 10 | ..... | ..... | 1 |
| 11 | ..... | ..... | 0 |
| 12 | ..... | ..... | 1 |
| (13–30) | MLS ground equipment identification (Note 3). | ..... | |
| 13 | Character 2 | N/A | B1 |
| 14 | ..... | ..... | B2 |
| 15 | ..... | ..... | B3 |
| 16 | ..... | ..... | B4 |
| 17 | ..... | ..... | B5 |
| 18 | ..... | ..... | B6 |
| 19 | Character 3 | N/A | B1 |
| 20 | ..... | ..... | B2 |
| 21 | ..... | ..... | B3 |
| 22 | ..... | ..... | B4 |
| 23 | ..... | ..... | B5 |
| 24 | ..... | ..... | B6 |
| 25 | Character 4 | N/A | B1 |
| 26 | ..... | ..... | B2 |
| 27 | ..... | ..... | B3 |
| 28 | ..... | ..... | B4 |
| 29 | ..... | ..... | B5 |
| 30 | ..... | ..... | B6 |
| 31 | Parity: (13 + 14 + 15. . . + 30 + 31 = odd). | N/A | N/A |
| 32 | Parity: (14 + 16 + 18. . . + 30 + 32 = odd). | N/A | N/A |

*Note 1:* Transmit at intervals of 1.0 second or less throughout the Approach Azimuth guidance sector, except when Back Azimuth guidance is provided. See note 8.

*Note 3:* Characters are encoded using the International Alphabet Number 5, (IA–5):

*Note 4:* Coding for status bit:

0 = Function not radiated, or radiated in test mode (not reliable for navigation).

1 = Function radiated in normal mode (for Back Azimuth, this also indicates that a Back Azimuth transmission follows).

*Note 5:* Date items which are not applicable to a particular ground equipment shall be transmitted as all zeros.

*Note 6:* Coding for status bits:

| $I_{21}$ | $I_{22}$ | |
|---|---|---|
| 0 | 0 | DME transponder inoperative or not available. |
| 1 | 0 | Only IA mode or DME/N available. |
| 0 | 0 | FA mode, Standard 1, available. |
| 1 | 1 | FA mode, Standard 2, available. |

*Note 7:* The value coded shall be the actual beamwidth (as defined in §171.311 (j)(9) rounded to the nearest 0.5 degree.

*Note 8:* When back Azimuth guidance is provided, Data Words 4 and 6 shall be transmitted at intervals of 1.33 seconds or less throughout the Approach Azimuth coverage and 4 seconds or less throughout the Back Azimuth coverage.

*Note 9:* When Back Azimuth guidance is provided, Data Word 5 shall be transmitted at an interval of 1.33 seconds or less throughout the Back Azimuth coverage sector and 4 seconds or less throughout the Approach Azimuth coverage sector.

*Note 10:* Coding for status bit:

0 = Function not radiated, or radiated in test mode (not reliable for navigation).

1 = Function radiated in normal mode.

(4) *Minimum glidepath* the lowest angle of descent along the zero degree azimuth that is consistent with published approach procedures and obstacle clearance criteria.

(5) *Back azimuth status* shall represent the operational status of the Back Azimuth equipment.

(6) *DME status* shall represent the operational status of the DME equipment.

(7) *Approach azimuth status* shall represent the operational status of the approach azimuth equipment.

(8) *Approach elevation status* shall represent the operational status of the approach elevation equipment.

(9) *Beamwidth* the width of the scanning beam main lobe measured at the −3 dB points and defined in angular units on the antenna boresight, in the horizontal plane for the azimuth function and in the vertical plane for the elevation function.

(10) *DME distance* shall represent the minimum distance between the DME antenna phase center and the vertical plane perpendicular to the runway centerline which contains the MLS datum point.

(11) *Approach azimuth magnetic orientation* shall represent the angle measured in the horizontal plane clockwise from Magnetic North to the zero-degree angle guidance radial originating from the approach azimuth antenna phase center. The vertex of the measured angle shall be at the approach azimuth antenna phase center.

NOTE: For example, this data item would be encoded 090 for an approach azimuth antenna serving runway 27 (assuming the magnetic heading is 270 degrees) when sited such that the zero degree radial is parallel to centerline.

(12) *Back azimuth magnetic orientation* shall represent the angle measured in the horizontal plane clockwise from Magnetic North to the zero-degree angle guidance radial originating from the Back Azimuth antenna. The vertex of the measured angle shall be at the Back Azimuth antenna phase center.

NOTE: For example, this data item would be encoded 270 for a Back Azimuth Antenna serving runway 27 (assuming the magnetic heading is 270 degrees) when sited such that the zero degree radial is parallel to centerline.

(13) *Back azimuth proportional coverage limit* shall represent the limit of the sector in which proportional back azimuth guidance is transmitted.

(14) *MLS ground equipment identification* shall represent the last three characters of the system identification specified in §171.311(i)(2). The characters shall be encoded in accordance with International Alphabet No. 5 (IA–5) using bits $b_1$ through $b_6$.

NOTE: Bit $b_7$ of this code may be reconstructed in the airborne receiver by taking the complement of bit $b_6$.

(k) *Residual radiation.* The residual radiation of a transmitter associated with an MLS function during time intervals when it should not be transmitting shall not adversely affect the reception of any other function. The residual radiation of an MLS function at times when another function is radiating shall be at least 70 dB below the level provided when transmitting.

(l) *Symmetrical scanning.* The TO and FRO scan transmissions shall be symmetrically disposed about the mid-scan point listed in Tables 4a, 4b and 5. The mid-scan point and the center of the time interval between the TO and FRO scan shall coincide with a tolerance of plus or minus 10 microseconds.

(m) *Auxiliary data*—(1) *Addresses.* Three function identification codes are reserved to indicate transmission of Auxiliary Data A, Auxiliary Data B,

and Auxiliary Data C. Auxiliary Data A contents are specified below, Auxiliary Data B contents are reserved for future use, and Auxiliary Data C contents are reserved for national use. The address codes of the auxiliary data words shall be as shown in Table 8b.

(2) *Organization and timing.* The organization and timing of digital auxiliary data must be as specified in Table 7b. Data containing digital information must be transmitted with the least significant bit first. Alphanumeric data characters must be encoded in accordance with the 7-unit code character set as defined by the American National Standard Code for Information Interchange (ASCII). An even parity bit is added to each character. Alphanumeric data must be transmitted in the order in which they are to be read. The serial transmission of a character must be with the lower order bit transmitted first and the parity bit transmitted last. The timing for alphanumeric auxiliary data must be as shown in Table 7c.

(3) *Auxiliary Data A content:* The data items specified in Table 8c are defined as follows:

(i) *Approach azimuth antenna offset* shall represent the minimum distance between the Approach Azimuth antenna phase center and the vertical plane containing the runway centerline.

(ii) *Approach azimuth to MLS datum point distance* shall represent the minimum distance between the Approach Azimuth antenna phase center and the vertical plane perpendicular to the centerline which contains the MLS datum point.

(iii) *Approach azimuth alignment with runway centerline* shall represent the minimum angle between the approach azimuth antenna zero-degree guidance plane and the runway certerline.

(iv) *Approach azimuth antenna coordinate system* shall represent the coordinate system (planar or conical) of the angle data transmitted by the approach azimuth antenna.

(v) *Approach elevation antenna offset* shall represent the minimum distance between the elevation antenna phase center and the vertical plane containing the runway centerline.

(vi) *MLS datum point to threshold distance* shall represent the distance measured along the runway centerline from the MLS datum point to the runway threshold.

(vii) *Approach elevation antenna height* shall represent the height of the elevation antenna phase center relative to the height of the MLS datum point.

(viii) *DME offset* shall represent the minimum distance between the DME antenna phase center and the vertical plane containing the runway centerline.

(ix) *DME to MLS datum point distance* shall represent the minimum distance between the DME antenna phase center and the vertical plane perpendicular to the centerline which contains the MLS datum point.

(x) *Back azimuth antenna offset* shall represent the minimum distance between the back azimuth antenna phase center and the vertical plane containing the runway centerline.

(xi) *Back azimuth to MLS datum point distance* shall represent the minimum distance between the Back Azimuth antenna and the vertical plane perpendicular to the centerline which contains the MLS datum point.

(xii) *Back azimuth antenna alignment with runway centerline* shall represent the minimum angle between the back azimuth antenna zero-degree guidance plane and the runway centerline.

### § 171.313 Azimuth performance requirements.

This section prescribes the performance requirements for the azimuth equipment of the MLS as follows:

(a) *Approach azimuth coverage requirements.* The approach azimuth equipment must provide guidance information in at least the following volume of space (see Figure 9):

TABLE 8b—AUXILIARY DATA WORD ADDRESS CODES

| No. | $I_{13}$ | $I_{14}$ | $I_{15}$ | $I_{16}$ | $I_{17}$ | $I_{18}$ | $I_{19}$ | $I_{20}$ |
|---|---|---|---|---|---|---|---|---|
| 1. | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| 2. | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| 3. | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| 4. | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 |
| 5. | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| 6. | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 |
| 7. | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 |
| 8. | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |

TABLE 8b—AUXILIARY DATA WORD ADDRESS CODES—Continued

| No. | $I_{13}$ | $I_{14}$ | $I_{15}$ | $I_{16}$ | $I_{17}$ | $I_{18}$ | $I_{19}$ | $I_{20}$ |
|---|---|---|---|---|---|---|---|---|
| 9. | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 |
| 10. | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| 11. | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 |
| 12. | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| 13. | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| 14. | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 |
| 15. | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| 16. | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| 17. | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| 18. | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| 19. | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 |
| 20. | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| 21. | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 |
| 22. | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 |
| 23. | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| 24. | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| 25. | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 |
| 26. | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| 27. | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| 28. | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 |
| 29. | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 |
| 30. | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 31. | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 32. | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 33. | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 34. | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 35. | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 36. | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 37. | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 |
| 38. | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| 39. | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| 40. | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |

TABLE 8b—AUXILIARY DATA WORD ADDRESS CODES—Continued

| No. | $I_{13}$ | $I_{14}$ | $I_{15}$ | $I_{16}$ | $I_{17}$ | $I_{18}$ | $I_{19}$ | $I_{20}$ |
|---|---|---|---|---|---|---|---|---|
| 41. | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 |
| 42. | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| 43. | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| 44. | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 45. | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| 46. | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 |
| 47. | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| 48. | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 49. | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| 50. | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 |
| 51. | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 52. | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 |
| 53. | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 54. | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |
| 55. | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| 56. | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| 57. | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 |
| 58. | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 |
| 59. | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 |
| 60. | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 61. | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| 62. | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| 63. | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| 64. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

NOTE 1: Parity bits $I_{19}$ and $I_{20}$ are chosen to satisfy the equations:

$I_{13} + I_{14} + I_{15} + I_{16} + I_{17} + I_{18} + I_{19} = \text{EVEN}$

$I_{14} + I_{16} + I_{18} + I_{20} = \text{EVEN}$

TABLE 8C—AUXILIARY DATA

| Word (See note 6) | Data content | Type of data | Maximun time between transmissions (Seconds) | Bits used | Range of values | Least significant bit |
|---|---|---|---|---|---|---|
| A1 ..... | Preamble | Digital | 1.0 | 12 | ..... | ..... |
| | Address | ..... | ..... | 8 | ..... | ..... |
| | Approach azimuth antenna offset | ..... | ..... | 10 | −511 m to + 511 m (See note 3) | 1 m |
| | Approach azimuth to MLS datum point distance. | ..... | ..... | 13 | 0 m to 8 191 m | 1 m |
| | Approach azimuth antenna alignment with runway centerline. | ..... | ..... | 12 | −20.47° to 20.47° (See note 3) .. | 0.01° |
| | Approach azimuth antenna coordinate system. | ..... | ..... | 1 | (See note 2) | ..... |
| | Spare | ..... | ..... | 13 | ..... | ..... |
| | Parity | ..... | ..... | 7 | (See note 1) | ..... |
| A2 ..... | Preamble | Digital | 1.0 | 12 | ..... | ..... |
| | Address | ..... | ..... | 8 | ..... | ..... |
| | Approach elevation antenna offset | ..... | ..... | 10 | −511 m to + 511 m (See note 3) | 1 m |
| | MLS datum point to threshold distance | ..... | ..... | 10 | 0 m to 1 023 m | 1 m |
| | Approach elevation antenna height | ..... | ..... | 7 | −6.3 m to + 6.3 m (See note 3) | 0.1 m |
| | Spare | ..... | ..... | 22 | ..... | ..... |
| | Parity | ..... | ..... | 7 | (See note 1) | ..... |
| A3 ..... | Preamble | Digital | (See note 4) | 12 | ..... | ..... |
| | Address | ..... | ..... | 8 | ..... | ..... |
| | DME offset | ..... | ..... | 10 | −511 m to + 511 m | 1 m |
| | DME to MLS datum point distance | ..... | ..... | 14 | −8 191 m to + 8 191 m (See note 3). | 1 m |
| | Spare | ..... | ..... | 25 | ..... | ..... |
| | Parity | ..... | ..... | 7 | (See note 1) | ..... |
| A4 ..... | Preamble | Digital | (See note 5) | 12 | ..... | ..... |
| | Address | ..... | ..... | 8 | ..... | ..... |
| | Back azimuth antenna | ..... | ..... | 10 | −511 m to + 511 m (See note 3) | 1 m |
| | Back azimuth to MLS datum point distance | ..... | ..... | 11 | 0 m to 2 047 m | 1 m |

TABLE 8C—AUXILIARY DATA—Continued

| Word (See note 6) | Data content | Type of data | Maximun time between transmissions (Seconds) | Bits used | Range of values | Least significant bit |
|---|---|---|---|---|---|---|
| | Back azimuth antenna alignment with runway centerline. | ..... | ..... | 12 | −20.47° to 20.47° (See note 3) .. | 0.01° |
| | Spare | ..... | ..... | 16 | ..... | ..... |
| | Parity | ..... | ..... | 7 | (See note 1) ..... | ..... |

NOTE 1: Parity bits $I_{70}$ to $I_{76}$ are chosen to satisfy the equations which follow:

For BIT $I_{70}$:

Even = $(I_{13} + \ldots + I_{18}) + I_{20} + I_{22} + I_{24} + I_{25} + I_{28} + I_{29} + I_{31} + I_{32} + I_{33} + I_{35} + I_{36} + I_{38} + I_{41} + I_{44} + I_{45} + I_{46} + I_{50} + (I_{52} + \ldots + I_{55}) + I_{58} + I_{60} + I_{64} + I_{65} + I_{70}$

For BIT $I_{71}$:

Even = $(I_{14} + \ldots + I_{19}) + I_{21} + I_{23} + I_{25} + I_{26} + I_{29} + I_{30} + I_{32} + I_{33} + I_{34} + I_{36} + I_{37} + I_{39} + I_{42} + I_{45} + I_{46} + I_{47} + I_{51} + (I_{53} + \ldots + I_{56}) + I_{59} + I_{61} + I_{65} + I_{66} + I_{71}$

For BIT $I_{72}$:

Even = $(I_{15} + \ldots + I_{20}) + I_{22} + I_{24} + I_{26} + I_{27} + I_{30} + I_{31} + I_{33} + I_{34} + I_{35} + I_{37} + I_{38} + I_{40} + I_{43} + I_{46} + I_{47} + I_{48} + I_{52} + (I_{54} + \ldots + I_{57}) + I_{60} + I_{62} + I_{66} + I_{67} + I_{72}$

For BIT $I_{73}$:

Even = $(I_{16} + \ldots + I_{21}) + I_{23} + I_{25} + I_{27} + I_{28} + I_{31} + I_{32} + I_{34} + I_{35} + I_{36} + I_{38} + I_{39} + I_{41} + I_{44} + I_{47} + I_{48} + I_{49} + I_{53} + (I_{55} + \ldots + I_{58}) + I_{61} + I_{63} + I_{67} + I_{68} + I_{73}$

For BIT $I_{74}$:

Even = $(I_{17} + \ldots + I_{22}) + I_{24} + I_{26} + I_{28} + I_{29} + I_{32} + I_{33} + I_{35} + I_{36} + I_{37} + I_{39} + I_{40} + I_{42} + I_{45} + I_{48} + I_{49} + I_{50} + I_{54} + (I_{56} + \ldots + I_{59}) + I_{62} + I_{64} + I_{68} + I_{69} + I_{74}$

For BIT $I_{75}$:

Even = $(I_{13} + \ldots + I_{17}) + I_{19} + I_{21} + I_{23} + I_{24} + I_{27} + I_{28} + I_{30} + I_{31} + I_{32} + I_{34} + I_{35} + I_{37} + I_{40} + I_{43} + I_{44} + I_{45} + I_{49} + (I_{51} + \ldots + I_{54}) + I_{57} + I_{59} + I_{63} + I_{64} + I_{69} + I_{75}$

For BIT $I_{76}$:

Even = $I_{13} + I_{14} + \ldots + I_{75} + I_{76}$

NOTE 2: Code for $I_{56}$ is: 0 = conical; 1 = planar.

NOTE 3: The convention for the coding of negative numbers is as follows: − MSB is the sign bit; 0 = + ; 1 = − .

—Other bits represent the absolute value.

The convention for the antenna location is as follows: As viewed from the MLS approach reference datum looking toward the datum point, a positive number shall represent a location to the right of the runway centerline (lateral offset) or above the runway (vertical offset), or towards the stop end of the runway (longitudinal distance).

The convention for the antenna alignment is as follows: As viewed from above, a positive number shall represent clockwise rotation from the runway centerline to the respective zero-degree guidance plane.

NOTE 4: Data Word A3 is transmitted at intervals of 1.0 seconds or less throughout the approach Azimuth coverage sector, except when back Azimuth guidance is provided. Where back Azimuth is provided transmit at intervals of 1.33 seconds or less throughout the approach Azimuth sector and 4.0 seconds or less throughout the back Azimuth coverage sector.

NOTE 5: When back Azimuth guidance is provided, transmit at intervals of 1.33 seconds or less throughout the back Azimuth coverage sector and 4.0 seconds or less throughout the approach Azimuth coverage sector.

NOTE 6: The designation ''A1'' represents the function identification code for ''Auxiliary Data A'' and address code number 1.

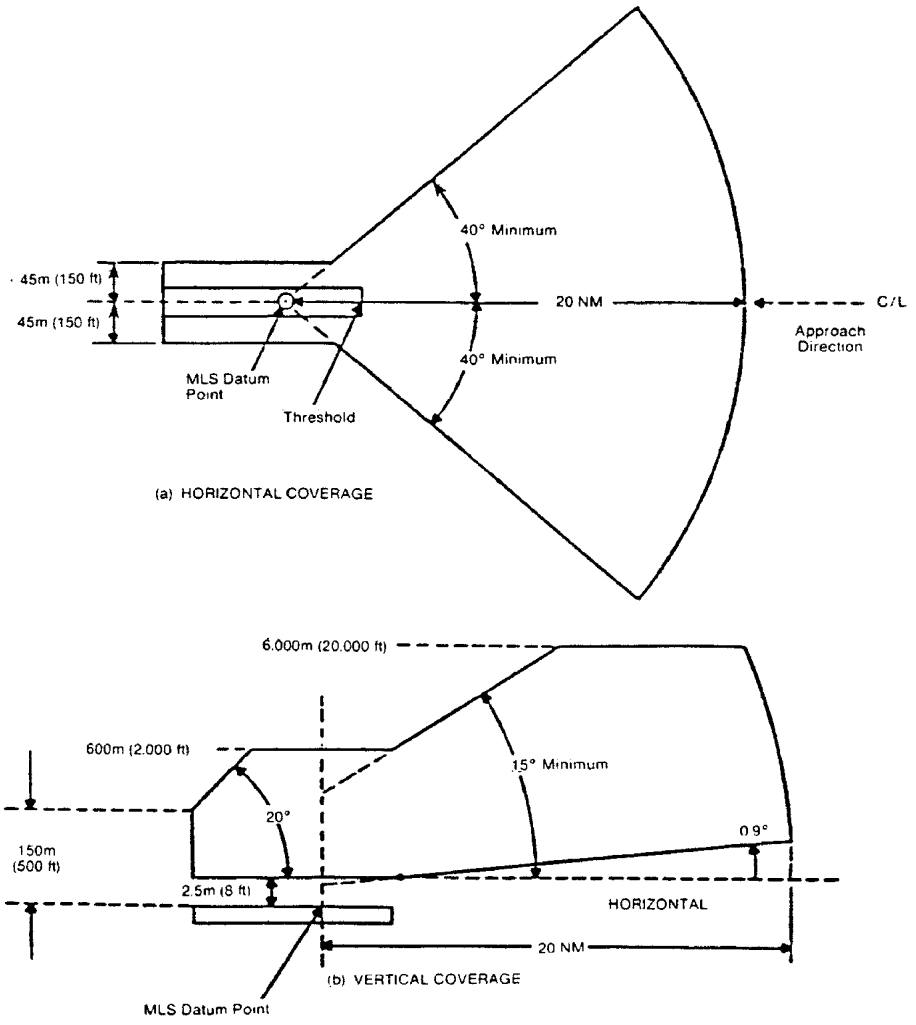



Figure 9. Approach Azimuth/Data Coverage

(1) Horizontally within a sector plus or minus 40 degrees about the runway centerline originating at the datum point and extending in the direction of the approach to 20 nautical miles from the runway threshold. The minimum proportional guidance sector must be plus or minus 10 degrees about the runway centerline. Clearance signals must be used to provide the balance of the required coverage, where the proportional sector is less than plus or minus 40 degrees. When intervening obstacles prevent full coverage, the ±40° guidance sector can be reduced as required. For systems providing ±60° lateral guidance

the coverage requirement is reduced to 14 nm beyond ±40°.

(2) Vertically between:

(i) A conical surface originating 2.5 meters (8 feet) above the runway centerline at threshold inclined at 0.9 degree above the horizontal.

(ii) A conical surface originating at the azimuth ground equipment antenna inclined at 15 degrees above the horizontal to a height of 6,000 meters (20,000 feet).

(iii) Where intervening obstacles penetrate the lower surface, coverage need be provided only to the minimum line of sight.

(3) Runway region:

(i) Proportional guidance horizontally within a sector 45 meters (150 feet) each side of the runway centerline beginning at the stop end and extending parallel with the runway centerline in the direction of the approach to join the approach region. This requirement does not apply to offset azimuth installations.

(ii) Vertically between a horizontal surface which is 2.5 meters (8 feet) above the farthest point of runway centerline which is in line of sight of the azimuth antenna, and in a conical surface originating at the azimuth ground equipment antenna inclined at 20 degrees above the horizontal up to a height to 600 meters (2,000 feet). This requirement does not apply to offset azimuth installations.

(4) Within the approach azimuth coverage sector defined in paragraphs (a) (1), and (2) and (3) of this section, the power densities must not be less than those shown in Table 9 but the equipment design must also allow for:

(i) Transmitter power degradation from normal by −1.5 dB;

TABLE 9—MINIMUM POWER DENSITY WITHIN COVERAGE BOUNDARIES(dBW/M$^2$)

| Function | Data signals | Angle signals for various antenna beamwidths | | | | Clearance signals |
|---|---|---|---|---|---|---|
| | | 1° | 1.5° | 2° | 3° | |
| Approach azimuth | −89.5 | −88 | ..... | −85.5 | −82 | −88 |
| High rate approach azimuth | −89.5 | −88 | ..... | −88 | −86.5 | −88 |
| Back azimuth | −89.5 | −88 | ..... | −85.5 | −82 | −88 |
| Approach elevation | −89.5 | −88 | −88 | −88 | ..... | ..... |

(ii) Rain loss of −2.2 dB at the longitudinal coverage extremes.

(b) *Siting requirements.* The approach azimuth antenna system must, except as allowed in paragraph (c) of this section:

(1) Be located on the extension of the centerline of the runway beyond the stop end;

(2) Be adjusted so that the zero degree azimuth plane will be a vertical plane which contains the centerline of the runway served;

(3) Have the minimum height necessary to comply with the coverage requirements prescribed in paragraph (a) of this section;

(4) Be located at a distance from the stop end of the runway that is consistent with safe obstruction clearance practices;

(5) Not obscure any light of an approach lighting system; and

(6) Be installed on frangible mounts or beyond the 300 meter (1,000 feet) light bar.

(c) On runways where limited terrain prevents the azimuth antenna from being positioned on the runway centerline extended, and the cost of the land fill or a tall tower antenna support is prohibitive, the azimuth antenna may be offset.

(d) *Antenna coordinates.* The scanning beams transmitted by the approach azimuth equipment within ±40° of the centerline may be either conical or planar.

(e) *Approach azimuth accuracy.* (1) The system and subsystem errors shall not exceed those listed in Table 10 at the approach reference datum.

At the approach reference datum, temporal sinusoidal noise components shall not exceed 0.025 degree peak in the frequency band 0.01 Hz to 1.6 Hz, and the CMN shall not exceed 0.10 degree. From the approach reference

datum to the coverage limit, the PFE, PFN and CMN limits, expressed in angular terms, shall be allowed to linearly increase as follows:

(i) With distance along the runway centerline extended, by a factor of 1.2 for the PFE and PFN limits and to ±0.10 degree for the CMN limits.

(ii) With azimuth angle, by a factor of 1.5 at the ±40 degree and a factor of 2.0 at the ±60 degree azimuth angles for the PFE, PFN and CMN limits.

(iii) With elevation angle from + 9 degrees to + 15 degrees, by a factor of 1.5 for the PFE and PFN limits.

(iv) Maximum angular limits. The PFE limits shall not exceed ±0.25 degree in any coverage region below an elevation angle of + 9 degrees nor exceed ±0.50 degree in any coverage region above that elevation angle. The CMN limits shall not exceed ±0.10 degree in any coverage region within ±10 degrees of runway centerline extended nor exceed ±0.20 degree in any other region within coverage.

NOTE: It is desirable that the CMN not exceed ±0.10 degree throughout the coverage.

(f) Approach azimuth antenna characteristics are as follows:

(1) *Drift.* Any azimuth angle as encoded by the scanning beam at any point within the proportional coverage must not vary more than ±0.07 degree over the range of service conditions specified in §171.309(d) without the use of internal environmental controls. Multipath effects are excluded from this requirement.

(2) *Beam pointing errors.* The azimuth angle as encoded by the scanning beam at any point within ±0.5 degree of the zero degree azimuth must not deviate from the true azimuth angle at that point by more than ±.05 degree. Multipath and drift effects are excluded from this requirement.

TABLE 10—APPROACH AZIMUTH ACCURACIES AT THE APPROACH REFERENCE DATUM

| Error type | System | Angular error (degrees) | |
|---|---|---|---|
| | | Ground subsystem | Airborne subsystem |
| PFE ..... | ±20 ft. (6.1m) [1] [2] | ±0.118° [3] .. | ±0.017° |
| CMN ..... | ±10.5 ft. (3.2m) [1] [2] [4] | ±0.030° .... | ±0.050° |

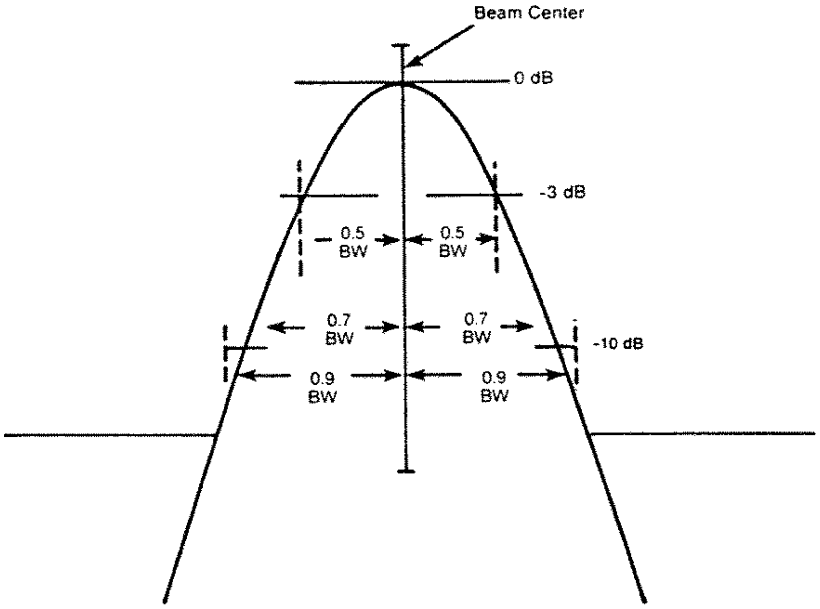
Notes:
[1] Includes errors due to ground and airborne equipment and propagation effects.
[2] The system PFN component must not exceed ±3.5 meters (11.5 feet).
[3] The mean (bias) error component contributed by the ground equipment should not exceed ±10 feet.
[4] The system control motion noise must not exceed 0.1 degree.
[5] The airborne subsystem angular errors are provided for information only.

(3) *Antenna alignment.* The antenna must be equipped with suitable optical, electrical or mechanical means or any combination of the three, to bring the zero degree azimuth radial into coincidence with the approach reference datum (for centerline siting) with a maximum error of 0.02 degree. Additionally, the azimuth antenna bias adjustment must be electronically steerable at least to the monitor limits in steps not greater than 0.005 degree.

(4) *Antenna far field patterns in the plane of scan.* On boresight, the azimuth antenna mainlobe pattern must conform to Figure 10, and the beamwidth must be such that, in the installed environment, no significant lateral reflections of the mainlobe exist along the approach course. In any case the beamwidth must not exceed three degrees. Anywhere within coverage the −3 dB width of the antenna mainlobe, while scanning normally, must not be less than 25 microseconds (0.5 degree) or greater than 250 microseconds (5 degrees). The antenna mainlobe may be allowed to broaden from the value at boresight by a factor of $1/\cos\theta$, where $\theta$ is the angle off boresight. The sidelobe levels must be as follows:

(i) *Dynamic sidelobe levels.* With the antenna scanning normally, the dynamic sidelobe level that is detected by a receiver at any point within the proportional coverage sector must be down at least 10 dB from the peak of the main beam. Outside the coverage sector, the radiation from the scanning beam antenna must be of such a nature that receiver warning will not be removed or suitable OCI signals must be provided.

(ii) *Effective sidelobe levels.* With the antenna scanning normally, the sidelobe levels in the plane of scan must be such that, in the installed environment, the CMN contributed by sidelobe reflections will not exceed the angular equivalent of 9 feet at approach reference datum over the required range of aircraft approach speeds.




NOTES: 1. The beam envelope is smoothed by a 26 kHz video filter before measurement.
2. BW = Beamwidth.

Figure 10. Far Field Dynamic Signal in Space

(5) *Antenna far field pattern in the vertical plane.* The azimuth antenna free space radiation pattern below the horizon must have a slope of at least −8 dB/degree at the horizon and all sidelobes below the horizon must be at least 13 dB below the pattern peak. The antenna radiation pattern above the horizon must satisfy both the system coverage requirements and the spurious radiation requirement.

(6) *Data antenna.* The data antenna must have horizontal and vertical patterns as required for its function.

(g) *Back azimuth coverage requirements.* The back azimuth equipment where used must provide guidance information in at least the following volume of space (see Figure 11):

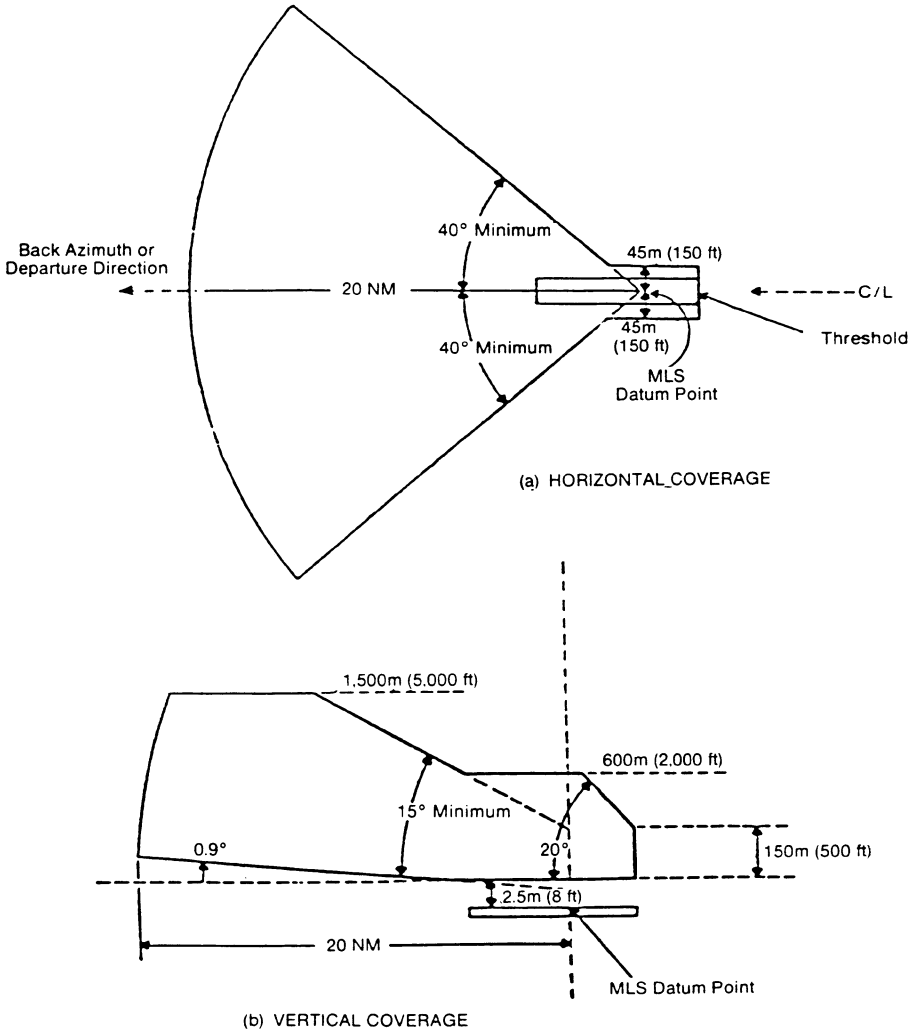



Figure 11. Back Azimuth/Data Coverage

(1) Horizontally within a sector ±40 degrees about the runway centerline originating at the back azimuth ground equipment antenna and extending in the direction of the missed approach at least to 20 nautical miles from the runway stop end. The minimum proportional guidance sector must be ±10 degrees about the runway centerline. Clearance signals must be

used to provide the balance of the required coverage where the proportional sector is less than ±40 degrees.

(2) Vertically in the runway region between:

(i) A horizontal surface 2.5 meters (8 feet) above the farthest point of runway centerline which is in line of sight of the azimuth antenna, and,

(ii) A conical surface originating at the azimuth ground equipment antenna inclined at 20 degrees above the horizontal up to a height of 600 meters (2000 feet).

(3) Vertically in the back azimuth region between:

(i) A conical surface originating 2.5 meters (8 feet) above the runway stop end, included at 0.9 degree above the horizontal, and,

(ii) A conical surface orginating at the missed approach azimuth ground equipment antenna, inclined at 15 degrees above the horizontal up to a height of 1500 meters (5000 feet).

(iii) Where obstacles penetrate the lower coverage limits, coverage need be provided only to minimum line of sight.

(4) Within the back azimuth coverage sector defined in paragraph (q) (1), (2), and (3) of this section the power densities must not be less than those shown in Table 9, but the equipment design must also allow for:

(i) Transmitter power degradation from normal −1.5 dB.

(ii) Rain loss of −2.2 dB at the longitudinal coverage extremes.

(h) *Back azimuth siting.* The back azimuth equipment antenna must:

(1) Normally be located on the extension of the runway centerline at the threshold end;

(2) Be adjusted so that the vertical plane containing the zero degree course line contains the back azimuth reference datum;

(3) Have minimum height necessary to comply with the course requirements prescribed in paragraph (g) of this section;

(4) Be located at a distance from the threshold end that is consistent with safe obstruction clearance practices;

(5) Not obscure any light of an approach lighting system; and

(6) Be installed on frangible mounts or beyond the 300 meter (1000 feet) light bar.

(i) *Back azimuth antenna coordinates.* The scanning beams transmitted by the back azimuth equipment may be either conical or planar.

(j) *Back azimuth accuracy.* The requirements specified in §171.313(e) apply except that the reference point is the back azimuth reference datum.

(k) *Back azimuth antenna characteristics.* The requirements specified in §171.313(f) apply.

(l) *Scanning conventions.* Figure 12 shows the approach azimuth and back azimuth scanning conventions.

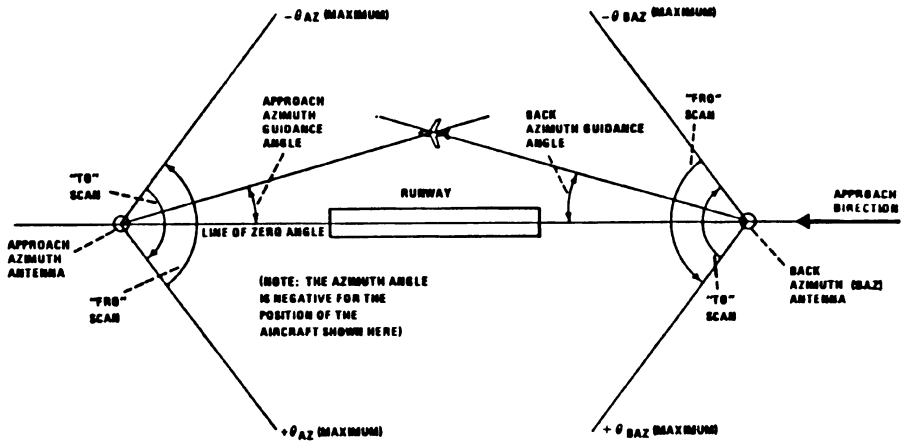



Figure 12. Azimuth Guidance Functions Scanning Conventions

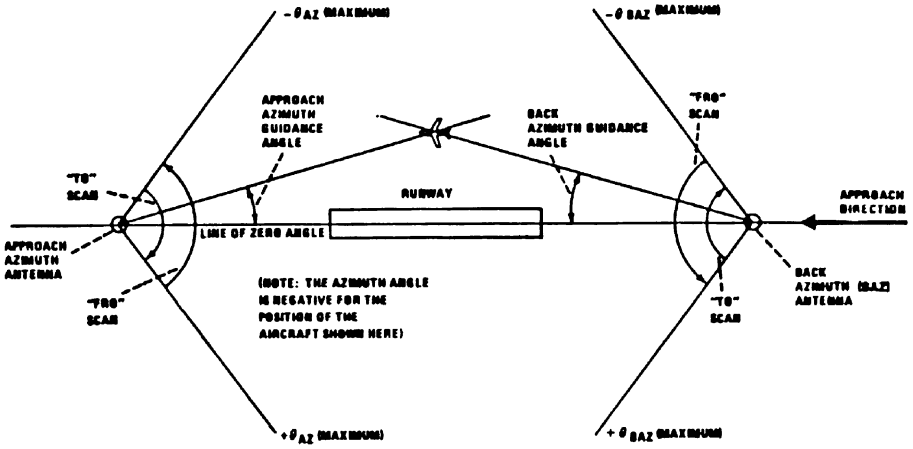



Figure 12. Azimuth Guidance Functions Scanning Conventions

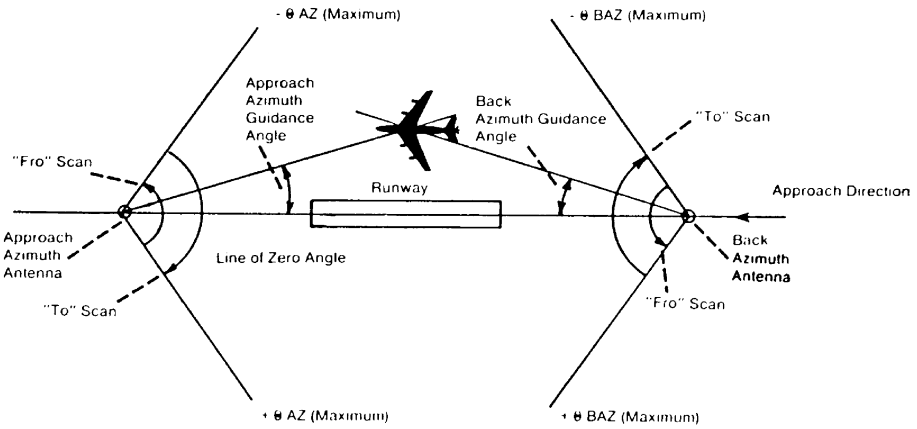



Figure 12. Azimuth Guidance Functions Scanning Conventions

(m) *False guidance.* False courses which can be acquired and tracked by an aircraft shall not exist anywhere either inside or outside of the MLS coverage sector. False courses which exist outside of the minimum coverage sector may be suppressed by the use of OCI.

NOTE: False courses may be due to (but not limited to) MLS airborne receiver acquisition of the following types of false guidance: reflections of the scanning beam, scanning beam antenna sidelobes and grating lobes, and incorrect clearance.

### § 171.315 Azimuth monitor system requirements.

(a) The approach azimuth or back azimuth monitor system must cause the radiation to cease and a warning must be provided at the designated control point if any of the following conditions persist for longer than the periods specified:

(1) There is a change in the ground equipment contribution to the mean course error component such that the path following error at the reference datum or in the direction of any azimuth radial, exceeds the limits specified in §§ 171.313(e)(1) or 171.313(j) for a period of more than one second.

NOTE: The above requirement and the requirement to limit the ground equipment mean error to ±10 ft. can be satisfied by the following procedure. The integral monitor alarm limit should be set to the angular equivalent of ±10 ft. at the approach reference datum. This will limit the electrical component of the mean course error to ±10 ft. The field monitor alarm limit should be set such that with the mean course error at the alarm limit the total allowed PFE is not exceeded on any commissioned approach course from the limit of coverage to an altitude of 100 feet.

(2) There are errors in two consecutive transmissions of Basic Data Words 1, 2, 4 or 5.

(3) There is a reduction in the radiated power to a level not less than that specified in §§ 171.313(a)(4) or 171.313(g)(4) for a period of more than one second.

(4) There is an error in the preamble DPSK transmissions which occurs more than once in any one second period.

(5) There is an error in the time division multiplex synchronization of a particular azimuth function that the requirement specified in § 171.311(e) is not satisfied and if this condition persists for more than one second.

(6) A failure of the monitor is detected.

(b) Radiation of the following fuctions must cease and a warning provided at the designated control point if there are errors in 2 consecutive transmissions:

(1) Morse Code Identification,

(2) Basic Data Words 3 and 6,

(3) Auxiliary Data Words.

(c) The period during which erroneous guidance information is radiated must not exceed the periods specified in § 171.315(a). If the fault is not cleared within the time allowed, the ground equipment must be shut down. After shutdown, no attempt must be made to restore service until a period of 20 seconds has elapsed.

### § 171.317 Approach elevation performance requirements.

This section prescribes the performance requirements for the elevation equipment components of the MLS as follows:

(a) *Elevation coverage requirements.* The approach elevation facility must provide proportional guidance information in at least the following volume of space (see Figure 13):

(1) Laterally within a sector originating at the datum point which is at least equal to the proportional guidance sector provided by the approach azimuth ground equipment.

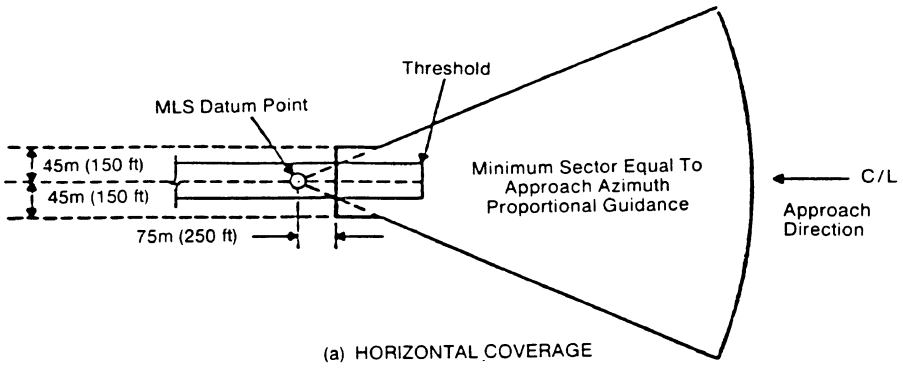
(2) Longitudinally from 75 meters (250 feet) from the datum point to 20 nautical miles from threshold in the direction of the approach.

(3) Vertically within the sector bounded by:

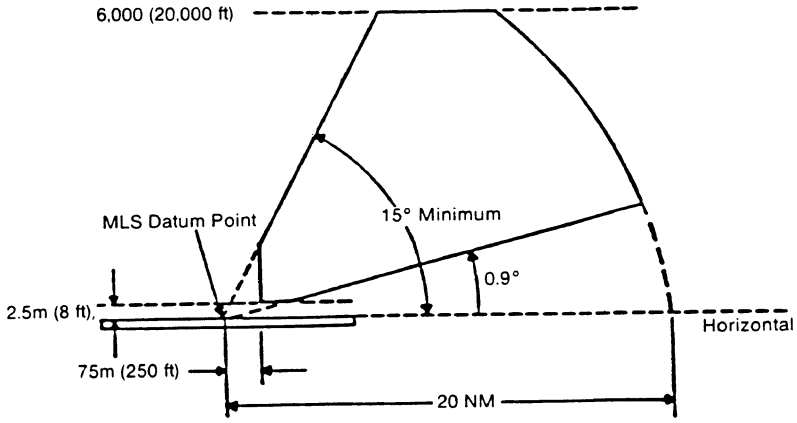
(i) A surface which is the locus of points 2.5 meters (8 feet) above the runway surface;

(ii) A conical surface originating at the datum point and inclined 0.9 degree above the horizontal and,

(iii) A conical surface originating at the datum point and inclined at 15.0 degrees above the horizontal up to a height of 6000 meters (20,000 feet).




(a) HORIZONTAL COVERAGE




(b) VERTICAL COVERAGE

Figure 13. Approach Elevation Coverage

Where the physical characteristics of the approach region prevent theachievement of the standards under paragraphs (a) (1), (2), and (3) of this section, guidance need not be provided below a conical surface originating at the elevation antenna and inclined 0.9 degree above the line of sight.

(4) Within the elevation coverage sector defined in paragraphs (a) (1), (2) and (3) of this section, the power densities must not be less than those shown in Table 9, but the equipment design must also allow for:

(i) Transmitter power degradation from normal by −1.5 dB.

(ii) Rain loss of −2.2 dB at the coverage extremes.

(b) *Elevation siting requirements.* The Elevation Antenna System must:

(1) Be located as close to runway centerline as possible (without violating obstacle clearance criteria).

(2) Be located near runway threshold such that the asymptote of the minimum glidepath crosses the threshold of the runway at the Approach Reference Datum height. Normally, the minimum glidepath should be 3 degrees and the Approach Reference Datum height should be 50 feet. However, there are circumstances where other glideslopes and reference datum heights are appropriate. Some of these instances are discussed in FAA Order 8260.34 (Glide Slope Threshold Crossing Height Requirements) and Order 8260.3 (IFR Approval of MLS.)

(3) Be located such that the MLS Approach Reference Datum and ILS Reference Datum heights are coincident within a tolerance of 3 feet when MLS is installed on a runway already served by an ILS. This requirement applies only if the ILS glide slope is sited such that the height of the reference datum meets the requirements of FAA Order 8260.34.

(c) *Antenna coordinates.* The scanning beams transmitted by the elevation subsystem must be conical.

(d) *Elevation accuracy.* (1) The accuracies shown in Table 13 are required at the approach reference datum. From the approach reference datum to the coverage limit, the PFE, PFN and CMN limits shall be allowed to linearly increase as follows:

(i) With distance along the runway centerline extended at the minimum glide path angle, by a factor of 1.2 for the PFE and PFN limits and to ±0.10 degree for the CMN limits;

(ii) With azimuth angle, from runway centerline extended to the coverage extreme, by a factor of 1.2 for the PFE and PFN limits and by a factor of 2.0 for the CMN limits;

(iii) With increasing elevation angles from + 3 degrees to + 15 degrees, by a factor of 2.0 for the PFE and PFN limits;

TABLE 13—ELEVATION ACCURACIES AT THE APPROACH REFERENCE DATUM

| Error type | System | Angular error (degrees) | |
|---|---|---|---|
| | | Ground subsystem | Airborne subsystem [4] |
| PFE | [1] [2] ±0.133 | ([3]) | ±0.017 |
| CMN | [1]±0.050 | ±0.020 | ±0.010 |

Notes:

[1] Includes errors due to ground and airborne equipment and propagation effects.

[2] The system PFN component must not exceed ±0.087 degree.

[3] The mean (bias) error component contributed by the ground equipment should not exceed ±0.067 degree.

[4] The airborne subsystem angular errors are provided for information only.

(iv) With decreasing elevation angle from + 3 degrees (or 60% of the minimum glide path angle, whichever is less) to the coverage extreme, by a factor of 3 for the PFE, PFN and CMN limits; and

(v) Maximum angular limits. the CMN limits shall not exceed ±0.10 degree in any coverage region within ±10 degrees laterally of runway centerline extended which is above the elevation angle specified in (iv) above.

NOTE: It is desirable that the CMN not exceed ±0.10 degree throughout the coverage region above the elevation angle specified in paragraph (d)(1)(iv) of this section.

(2) The system and ground subsystem accuracies shown in Table 13 are to be demonstrated at commissioning as maximum error limits. Subsequent to commissioning, the accuracies are to be considered at 95% probability limits.

(e) Elevation antenna characteristics are as follows:

(1) *Drift.* Any elevation angle as encoded by the scanning beam at any point within the coverage sector must not vary more than 0.04 degree over the range of service conditions specified in §171.309(d) without the use of internal environmental controls. Multipath effects are excluded from this requirement.

(2) *Beam pointing errors.* The elevation angle as encoded by the scanning beam at any point within the coverage sector

must not deviate from the true elevation angle at that point by more than ±0.04 degree for elevation angles from 2.5° to 3.5°. Above 3.5° these errors may linearly increase to ±0.1 degree at 7.5°. Multipath and drift effects are excluded from this requirement.

(3) *Antenna alignment.* The antenna must be equipped with suitable optical, electrical, or mechanical means or any combination of the three, to align the lowest operationally required glidepath to the true glidepath angle with a maximum error of 0.01 degree. Additionally, the elevation antenna bias adjustment must be electronically steerable at least to the monitor limits in steps not greater than 0.005 degrees.

(4) *Antenna far field patterns in the plane of scan.* On the lowest operationally required glidepath, the antenna mainlobe pattern must conform to Figure 10, and the beamwidth must be such that in the installed environment, no significant ground reflections of the mainlobe exist. In any case, the beamwidth must not exceed 2 degrees. The antenna mainlobe may be allowed to broaden from the value at boresight by a factor of $1/\cos\theta$, where $\theta$ is the angle of boresight. Anywhere within coverage, the −3 dB width of the antenna mainlobe, while scanning normally, must not be less than 25 microseconds (0.5 degrees) or greater than 250 microseconds (5 degrees). The sidelobe levels must be as follows:

(i) *Dynamic sidelobe levels.* With the antenna scanning normally, the dynamic sidelobe level that is detected by a receiver at any point within the proportional coverage sector must be down at least 10 dB from the peak of the mainlobe. Outside the proportional coverage sector, the radiation from the scanning beam antenna must be of such a nature that receiver warnings will not be removed or a suitable OCI signal must be provided.

(ii) *Effective sidelobe levels.* With the antenna scanning normally, the sidelobe levels in the plane of scan must be such that, when reflected from the ground, the resultant PFE along any glidepath does not exceed 0.083 degrees.

(5) *Antenna far field pattern in the horizontal plane.* The horizontal pattern of the antenna must gradually de-emphasize the signal away from antenna boresight. Typically, the horizontal pattern should be reduced by at least 3 dB at 20 degrees off boresight and by at least 6 dB at 40 degrees off boresight. Depending on the actual multipath conditions, the horizontal radiation patterns may require more or less de-emphasis.

(6) *Data antenna.* The data antenna must have horizontal and vertical patterns as required for its function.

(f) *False guidance.* False courses which can be acquired and tracked by an aircraft shall not exist anywhere either inside or outside of the MLS coverage sector. False courses which exist outside of the minimum coverage sector may be suppressed by the use of OCI.

NOTE: False courses may be due to (but not limited to) MLS airborne receiver acquisition of the following types of false guidance: reflections of the scanning beam and scanning beam antenna sidelobes and grating lobes.

### § 171.319 Approach elevation monitor system requirements.

(a) The monitor system must act to ensure that any of the following conditions do not persist for longer than the periods specified when:

(1) There is a change in the ground component contribution to the mean glidepath error component such that the path following error on any glidepath exceeds the limits specified in § 171.317(d) for a period of more than one second.

NOTE: The above requirement and the requirement to limit the ground equipment mean error to ±0.067 degree can be satisfied by the following procedure. The integral monitor alarm limit should be set to ±0.067 degree. This will limit the electrical component of mean glidepath error to ±0.067 degree. The field monitor alarm limit should be set such that with the mean glidepath error at the alarm limit the total allowed PFE is not exceeded on any commissioned glidepath from the limit of coverage to an altitude of 100 feet.

(2) There is a reduction in the radiated power to a level not less than that specified in § 171.317(a)(4) for a period of more than one second.

(3) There is an error in the preamble DPSK transmission which occurs more than once in any one second period.

(4) There is an error in the time division multiplex synchronization of a particular elevation function such that the requirement specified in §171.311(e) is not satisfied and this condition persists for more than one second.

(5) A failure of the monitor is detected.

(b) The period during which erroneous guidance information is radiated must not exceed the periods specified in §171.319(a). If the fault is not cleared within the time allowed, radiation shall cease. After shutdown, no attempt must be made to restore service until a period of 20 seconds has elapsed.

### §171.321 DME and marker beacon performance requirements.

(a) The DME equipment must meet the performance requirements prescribed in subpart G of the part. This subpart imposes requirements that performance features must comply with International Standards and Recommended Practices, Aeronautical Telecommunications, Vol. I of Annex 10 to ICAO. It is available from ICAO, Aviation Building, 1080 University Street, Montreal 101, Quebec, Canada, Attention: Distribution Officer and also available for inspection at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202–741–6030, or go to: *http://www.archives.gov/federal__register/code__of__federal__regulations/ibr__locations.html.*

(b) MLS marker beacon equipment must meet the performance requirements prescribed in subpart H of this part. This subpart imposes requirements that performance features must comply with International Standards and Recommended Practices, Aeronautical Telecommuncations, Vol. I of Annex 10 to ICAO.

[Doc. No. 5034, 29 FR 11337, Aug. 6, 1964, as amended at 69 FR 18803, Apr. 9, 2004]

### §171.323 Fabrication and installation requirements.

(a) The MLS facility must be permanent and must be located, constructed, and installed in accordance with best commercial engineering practices, using applicable electric and safety codes and Federal Communications Commission (FCC) licensing requirements and siting requirements of §§171.313(b) and 171.317(b).

(b) The MLS facility components must utilize solid state technology except that traveling wave tube amplifiers (TWTA) may be used. A maximum level of common modularity must be provided along with diagnostics to facilitate maintenance and troubleshooting.

(c) An approved monitoring capability must be provided which indicates the status of the equipment at the site and at a remotely located maintenance area, with monitor capability that provides pre-alarm of impending system failures. This monitoring feature must be capable of transmitting the status and pre-alarm over standard phone lines to a remote section. In the event the sponsor requests the FAA to assume ownership of the facility, the monitoring feature must also be capable of interfacing with FAA remote monitoring requirements. This requirement may be complied with by the addition of optional software and/or hardware in space provided in the original equipment.

(d) The mean corrective maintenance time of the MLS equipment must be equal to or less than 0.5 hours with a maximum corrective maintenance time not to exceed 1.5 hours. This measure applies to correction of unscheduled failures of the monitor, transmitter and associated antenna assemblies, limited to unscheduled outage and out of tolerance conditions.

(e) The mean-time-between-failures of the MLS angle system must not be less than 1,500 hours. This measure applies to unscheduled outage, out-of-tolerance conditions, and failures of the monitor, transmitter, and associated antenna assemblies.

(f) The MLS facility must have a reliable source of suitable primary power, either from a power distribution system or locally generated. Adequate power capacity must be provided for the operation of the MLS as well as the test and working equipment of the MLS.

(g) The MLS facility must have a continuously engaged or floating battery power source for the continued normal operation of the ground station

operation if the primary power fails. A trickle charge must be supplied to recharge the batteries during the period of available primary power. Upon loss and subsequent restoration of power, the battery must be restored to full charge within 24 hours. When primary power is applied, the state of the battery charge must not affect the operation of the MLS ground station. The battery must allow continuation of normal operation of the MLS facility for at least 2 hours without the use of additional sources of power. When the system is operating from the battery supply without prime power, the radome deicers and the environmental system need not operate. The equipment must meet all specification requirements with or without batteries installed.

(h) There must be a means for determining, from the ground, the performance of the system including antenna, both initially and periodically.

(i) The facility must have, or be supplemented by, ground, air, or landline communications services. At facilities within or immediately adjacent to controlled airspace, that are intended for use as instrument approach aids for an airport, there must be ground air communications or reliable communications (at least a landline telephone) from the airport to the nearest FAA air traffic control or communication facility. Compliance with this paragraph need not be shown at airports where an adjacent FAA facility can communicate with aircraft on the ground at the airport and during the entire proposed instrument approach procedure. In addition, at low traffic density airports within or immediately adjacent to controlled airspace, and where extensive delays are not a factor, the requirements of this paragraph may be reduced to reliable communications from the airport to the nearest FAA air traffic control or communications facility. If the adjacent FAA facility can communicate with aircraft during the proposed instrument approach procedure down to the airport surface or at least down to the minimum en route altitude, this would require at least a landline telephone.

(j) The location of the phase center for all antennas must be clearly marked on the antenna enclosures.

(k) The latitude, longitude and mean sea level elevation of all MLS antennas, runway threshold and runway stop end must be determined by survey with an accuracy of ±3 meters (±10 feet) laterally and ±0.3 meter (±1.0 foot) vertically. The relative lateral and vertical offsets of all antenna phase centers, and both runway ends must be determined with an accuracy of ±0.3 meter (±1.0 foot) laterally and ±0.03 meter (±0.1 foot) vertically. The owner must bear all costs of the survey. The results of this survey must be included in the ''operations and maintenance'' manual required by section 171.325 of this subpart and will be noted on FAA Form 198 required by §171.327.

[Doc. No. 20669, 51 FR 33177, Sept. 18, 1986, as amended by Amdt. 171–16, 56 FR 65665, Dec. 17, 1991]

### §171.325 Maintenance and operations requirements.

(a) The owner of the facility must establish an adequate maintenance system and provide MLS qualified maintenance personnel to maintain the facility at the level attained at the time it was commissioned. Each person who maintains a facility must meet the FCC licensing requirements and demonstrate that he has the special knowledge and skills needed to maintain an MLS facility, including proficiency in maintenance procedures and the use of specialized test equipment.

(b) In the event of out-of-tolerance conditions or malfunctions, as evidenced by receiving two successive pilot reports, the owner must close the facility by encasing radiation, and issue a ''Notice to Airmen'' (NOTAM) that the facility is out of service.

(c) The owner must prepare, and obtain approval of, an operations and maintenance manual that sets forth mandatory procedures for operations, periodic maintenance, and emergency maintenance, including instructions on each of the following:

(1) Physical security of the facility.

(2) Maintenance and operations by authorized persons.

(3) FCC licensing requirements for operations and maintenance personnel.

(4) Posting of licenses and signs.

(5) Relations between the facility and FAA air traffic control facilities, with a description of the boundaries of controlled airspace over or near the facility, instructions for relaying air traffic control instructions and information, if applicable, and instructions for the operation of an air traffic advisory service if the facility is located outside of controlled airspace.

(6) Notice to the Administrator of any suspension of service.

(7) Detailed and specific maintenance procedures and servicing guides stating the frequency of servicing.

(8) Air-ground communications, if provided, expressly written or incorporating appropriate sections of FAA manuals by reference.

(9) Keeping the station logs and other technical reports, and the submission of reports required by § 171.327.

(10) Monitoring of the MLS facility.

(11) Inspections by United States personnel.

(12) Names, addresses, and telephone numbers of persons to be notified in an emergency.

(13) Shutdowns for periodic maintenance and issuing of NOTAM for routine or emergency shutdowns.

(14) Commissioning of the MLS facility.

(15) An acceptable procedure for amending or revising the manual.

(16) An explanation of the kinds of activities (such as construction or grading) in the vicinity of the MLS facility that may require shutdown or recertification of the MLS facility by FAA flight check.

(17) Procedures for conducting a ground check of the azimuth and elevation alignment.

(18) The following information concerning the MLS facility:

(i) Facility component locations with respect to airport layout, instrument runways, and similar areas.

(ii) The type, make and model of the basic radio equipment that provides the service including required test equipment.

(iii) The station power emission, channel, and frequency of the azimuth, elevation, DME, marker beacon, and associated compass locators, if any.

(iv) The hours of operation.

(v) Station identification call letters and method of station identification and the time spacing of the identification.

(vi) A description of the critical parts that may not be changed, adjusted, or repaired without an FAA flight check to confirm published operations.

(d) The owner or his maintenance representative must make a ground check of the MLS facility periodically in accordance with procedures approved by the FAA at the time of commissioning, and must report the results of the checks as provided in § 171.327.

(e) The only modifications permitted are those that are submitted to FAA for approval by the MLS equipment manufacturer. The owner or sponsor of the facility must incorporate these modifications in the MLS equipment. Associated changes must also be made to the operations and maintenance manual required in paragraph (c) of this section. This and all other corrections and additions to this operations and maintenance manual must also be submitted to FAA for approval.

(f) The owner or the owner's maintenance representative must participate in inspections made by the FAA.

(g) The owner must ensure the availability of a sufficient stock of spare parts, including solid state components, or modules to make possible the prompt replacement of components or modules that fail or deteriorate in service.

(h) FAA approved test instruments must be used for maintenance of the MLS facility.

(i) Inspection consists of an examination of the MLS equipment to ensure that unsafe operating conditions do not exist.

(j) Monitoring of the MLS radiated signal must ensure a high degree of integrity and minimize the requirements for ground and flight inspection. The monitor must be checked daily during the in-service test evaluation period (96 hour burn in) for calibration and stability. These tests and ground checks or azimuth, elevation, DME, and marker beacon radiation characteristics must be conducted in accordance with the maintenance requirements of this section.

### § 171.327 Operational records.

The owner of the MLS facility or his maintenance representative must submit the following operational records at the indicated time to the appropriate FAA regional office where the facility is located.

(a) *Facility Equipment Performance & Adjustment Data (FAA Form 198).* The FAA Form 198 shall be filled out by the owner or his maintenance representative with the equipment adjustments and meter readings as of the time of facility commissioning. One copy must be kept in the permanent records of the facility and two copies must be sent to the appropriate FAA regional office. The owner or his maintenance representative must revise the FAA Form 198 data after any major repair, modernization, or retuning to reflect an accurate record of facility operation and adjustment.

(b) *Facility Maintenance Log (FAA Form 6030–1).* FAA Form 6030–1 is permanent record of all the activities required to maintain the MLS facility. The entries must include all malfunctions met in maintaining the facility including information on the kind of work and adjustments made, equipment failures, causes (if determined) and corrective action taken. In addition, the entries must include completion of periodic maintenance required to maintain the facility. The owner or his maintenance representative must keep the original of each form at the facility and send a copy to the appropriate FAA regional office at the end of each month in which it is prepared. However, where an FAA approved remote monitoring system is installed which precludes the need for periodic maintenance visits to the facility, monthly reports from the remote monitoring system control point must be forwarded to the appropriate FAA regional office, and a hard copy retained at the control point.

(c) *Technical Performance Record (FAA Form 6830 (formerly FAA Form 418)).* This form contains a record of system parameters as specified in the manufacturer's equipment manual. This data will be recorded on each scheduled visit to the facility. The owner or his maintenance representative shall keep the original of each record at the facility and send a copy of the form to the appropriate FAA regional office.