DEPARTMENT OF TRANSPORTATION

Maritime Administration

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

DEPARTMENT OF THE TREASURY

Internal Revenue Service

Applicable Rate of Interest on Nonqualified Withdrawals from a Capital Construction Fund

AGENCY: Departments of Transportation; Commerce; Treasury; Maritime Administration; National Oceanic and Atmospheric Administration; Internal Revenue Service.

SUMMARY: The Secretaries of Transportation, Commerce and the Treasury, as required by the Merchant Marine Act, 1936, as amended, have determined and are jointly publishing the interest rate that shall apply during taxable year 1986 to "nonqualified withdrawals" made from a Capital Construction Fund.

DATES: The rate of interest that has been determined will apply to all nonqualified withdrawals from a Capital Construction Fund made between January 1, 1986 and December 31, 1986.

FOR FURTHER INFORMATION CONTACT: Russell Bigelow, Division of Capital Assets and Management, Maritime Administration, 400 Seventh Street SW., Washington, DC 20590, Tel. (202) 366-1908.

SUPPLEMENTARY INFORMATION: The Capital Construction Fund (CCF) Program, is authorized by section 607 of the Merchant Marine Act (Act). The Act provides for the deferment of Federal income taxes on deposits of income in a CCF. The deposited funds are for the purpose of providing capital for the construction or reconstruction of vessels. The Maritime Administration (MARAD) administers the CCF program, under authority delegated by the Secretary of Transportation, for all vessels other than fishing vessels. The National Oceanic and Atmospheric Administration (NOAA) administers the CCF program for fishing vessels on behalf of the Secretary of Commerce. The Act requires the Secretaries of Transportation, Commerce and the Treasury, annually, to determine jointly and publish in the Federal Register the rate of interest that is applicable to all "nonqualified withdrawals" from a CCF (46 U.S.C. 1177(h)(4)(B), together with the tax. A nonqualified withdrawal is a withdrawal of funds not authorized by section 607. This annual determination is made in accordance with the procedure described at 46 CFR 394.7(e)(2)(ii) of the joint regulations that have been issued by MARAD, NOAA and the Internal Revenue Service. The applicable rate of interest for "nonqualified withdrawals", made in the taxable year 1986, shall be 11.09 percent, determined to the nearest one-hundredth of one percent. The determination was computed by multiplying eight percent by the ratio that the average yield on 5-year Treasury securities for the calendar year, immediately preceding the beginning of such taxable year, bears to the average yield on 5-year Treasury securities for the year 1970.

Dated: September 10, 1986.

John Gaughan,

Maritime Administrator.

Anthony J. Calio,

Administrator, National Oceanic and Atmospheric Administration.

J. Rober Mentz,

Assistant Secretary for Tax Policy.

James E. Saari,

Secretary, Maritime Administration, Maritime Subsidy Board.

[FR Doc. 86-21171 Filed 9-17-86; 8:45 am]

BILLING CODE 4910-81-M

VETERANS ADMINISTRATION

Scientific Review and Evaluation Board for Health Services Research and Development and Scientific Review and Evaluation Board for Rehabilitation Research and Development; Charter Renewals

This is to give notice in accordance with the Federal Advisory Committee Act (Pub. L. 92-463) that the charters for the Scientific Review and Evaluation Board for Health Services Research and Development and the Scientific Review and Evaluation Board for Rehabilitation Research and Development have been renewed by the Administrator of Veterans Affairs for a two year period effective September 5, 1986 to September 5, 1988.

Dated: September 9, 1986.

By direction of the Administrator.

Rosa Maria Fontanez,

Committee Management Officer.

[FR Doc. 86-21083 Filed 9-17-86; 8:45 am]

BILLING CODE 8320-01-M

Sunshine Act Meetings

Federal Register
Vol. 51, No. 181
Thursday, September 18, 1986

This section of the FEDERAL REGISTER contains notices of meetings published under the "Government in the Sunshine Act" (Pub. L. 94-409) 5 U.S.C. 552b(e)(3).

CONTENTS

1

FEDERAL MARITME COMMISSION

TIME AND DATE: 10:00 a.m., September 24, 1986.

PLACE: Hearing Room One–1100 L Street, NW., Washington, DC 20573

STATUS: Open.

MATTERS TO BE CONSIDERED: Portions open to the public.

1. Petition of National Customs Brokers and Forwarders Association of America, Inc. for Rulemaking—Licensing of Independent Ocean Freight Forwarders (46 CFR Part 510).
2. Agreement Processing; Delegation of Authority.
3. Marine Terminal Service Agreements; Notice of Waiver of Penalties and Petitions of New Orleans Steamship Association and National Association of Stevedores for Exemption.
4. Award of Attorney's Fees in Reparations Proceedings—Proposed Amendments to Rules of Practice.

CONTACT PERSON FOR MORE INFORMATION: Joseph C. Polking, Secretary.

Joseph C. Polking,
Secretary.

[FR Doc. 86–21191 Filed 9–16–86; 9:52 am]

BILLING CODE 6730-01-M

2

FOREIGN CLAIMS SETTLEMENT COMMISSION

[F.C.S.C. Meeting Notice No. 7-86]

The Foreign Claims Settlement Commission, pursuant to its regulations (45 CFR Part 504), and the Government in the Sunshine Act (5 U.S.C. 552b), hereby gives notice in regard to the scheduling of open meetings and oral hearings for the transaction of Commission business and other matters specified, as follows:

Date, Time, and Subject Matter

Tues., September 30, 1986 at 10:30 a.m.—Consideration of claims filed under the Ethiopian Claims Program and final decisions involving claims for prisoner of war compensation.

Subject matter listed above, not disposed of at the scheduled meeting, may be carried over to the agenda of the following meeting.

All meetings are held at the Foreign Claims Settlement Commission, 1111–20th Street, NW., Washington, DC. Requests for information, or advance notices of intention to observe a meeting, may be directed to: Administrative Officer, Foreign Claims Settlement Commission, 1111–20th Street, NW., Room 409, Washington, DC 20579. Telephone: (202) 653–6155.

Dated at Washington, DC, on September 15, 1986.

Judith H. Lock,
Administrative Officer.

[FR Doc. 86–21192 Filed 9–16–86; 10:14 am]

BILLING CODE 4410-01-M

federal register

Thursday
September 18, 1986

Part II

Department of Transportation

Federal Aviation Administration

14 CFR Part 171

Microwave Landing System Requirements for Non-Federal Navigational Facilities; Final Rule

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 171

[Docket No. 20669; Amdt. 171-14]

Microwave Landing System Requirements for Non-Federal Navigational Facilities

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: This rule updates the standards and procedures for the selection and maintenance of a Microwave Landing System (MLS) owned and operated by a private or a non-Federal entity. Since the approval of the original non-Federal MLS regulation, refinements and international standardization have occurred which now make the MLS more widely usable and acceptable to all users worldwide. This final rule incorporates these internationally accepted standards and provides the conformity necessary so that the MLS will be available to all users.

EFFECTIVE DATE: September 18, 1986.

FOR FURTHER INFORMATION CONTACT: Mr. Sotires P. Mantis, Program Engineering and Maintenance Service, Maintenance Engineering Division, APM-120, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, DC 20591; Telephone (202) 267-8299.

SUPPLEMENTARY INFORMATION: On December 17, 1981, the FAA issued a new Subpart J, Microwave Landing System, in Part 171 of the Federal Aviation Regulations, 14 CFR Part 171 (46 FR 61560). The new subpart established minimum standards and procedures for the approval, installation, operation, and maintenance of an MLS facility that is not operated and maintained by the FAA. The FAA revised Subpart J in 1982 (47 FR 46259, October 18, 1982) and in 1984 (49 FR 15544, April 19, 1984) to provide changes to those standards.

The MLS is a system designed to take the place of the Instrument Landing System used throughout the world and is projected to meet both civil and military requirements. The MLS has been selected for standardization by the International Civil Aviation Organization (ICAO) and chosen to satisfy the need for a new system to fulfill precision approach and landing guidance requirements. Since these facilities may be operated and maintained by persons other than the FAA, the requisite uniform standards and procedures to operate these facilities in the National Airspace System (NAS) must be provided in regulatory form to govern those activities. This amendment is needed to bring the non-Federal MLS standards into conformity with the Federal and international standards for the MLS.

Currently, there are three sets of standards governing MLS equipment in use in the United States. There is an international standard which all equipment must meet (ICAO International Standards, Recommended Practices and Procedures for Air Navigation Services, Annex 10). There is a federal standard which all FAA equipment must meet (FAA-STD-022b, MLS Interoperability and Performance Requirements). Finally, there is a standard for non-Federal MLS equipment (FAR Part 171) which governs those facilities not operated and maintained by the FAA. Uniform standards must be provided so that there is complete interoperability among all MLS ground and airborne equipment in use throughout the world.

In September of 1984, the tenth meeting of the ICAO All Weather Operations Panel published a report (AWOP/10, September 4-20, 1984, ICAO Document 9449) which included a recommendation to make some changes in the current ICAO standards for MLS. The majority of the recommended changes dealt with the data transmission functions of the MLS. It is expected that these changes will be approved by the ICAO and an amendment to Annex 10 will be published in 1986. In anticipation of that amendment, the FAA has taken action to incorporate these changes in all MLS equipment currently being procured for use in the NAS. These changes will be reflected in FAA-STD-022b which is currently undergoing revision. In light of the above, an amendment to the current non-Federal MLS standard is required so that it may be brought into conformity with the ICAO and FAA standards. Accordingly, the changes listed in this amendment are intended to bring the non-Federal MLS standard into conformity with the pending changes to the ICAO standard and/or the FAA standard. In some cases, where an improvement in performance can be of benefit, the FAA has elected to impose more stringent requirements than those in the ICAO standard. In those instances, the non-Federal standard will conform to the FAA rather than the ICAO standard. This has been done so that all MLS's operating in the United States will conform to one set of standards. A more stringent requirement has not been imposed in any area of the standards which affects equipment interoperability. In those areas, all three standards will be identical.

Cost of Compliance

The cost of compliance with this amendment will be minimal. Non-Federal MLS ground equipment already deployed will require some reprogramming of a device; usually a Programmable Read Only Memory (PROM) in which software coding is stored. There are only five non-Federal MLS ground facilities operating in the United States. There is also a limited number of airborne equipment in use which will be affected by this change. A large number of these are Government owned. The modification to the airborne equipment is similar to that previously described for the ground equipment. In addition, all manufacturers of MLS equipment have been aware of these pending changes since publication of the ICAO AWOP/10 report in September 1984 and, therefore, are prepared to make the appropriate change in their equipment. The FAA has determined that this amendment is necessary in order to comply with international standards.

The FAA has determined that this regulation only involves an established body of technical regulations for which frequent and routine amendments are necessary to keep them operationally current. It, therefore, (1) is not a "major rule" under Executive Order 12291; (2) is not a "significant rule" under DOT Regulatory Policies and Procedures (44 FR 11034, February 26, 1979); and (3) does not warrant a regulatory evaluation as the anticipated impact is so minimal.

As was stated previously, only a very few facilities are affected to a minor degree. Therefore, I certify that this rule will not have a significant economic impact on a substantial number of small entities under the criteria of the Regulatory Flexibility Act.

Organizations representing all segments of the aviation industry affected by this amendment, all manufacturers of MLS equipment in the U.S., and the five current operators of non-Federal MLS facilities have participated in or have been made fully aware of the development of the standards adopted. In consideration of the above, I find that notice and public procedures under 5 U.S.C. 553 are unnecessary, because all affected parties have had prior notice of the standards adopted, and are impractible, because any delay in implementation of the standards would permit the existence of incompatible MLS ground stations and airborne receivers. For the same reason, I find that good cause exists for making this rule effective upon publication.

List of Subjects in 14 CFR Part 171

Air traffic control, Navigation (air), Navigation facilities.

Issued in Washington, DC, on September 15, 1986.

Donald D. Engen,
Administrator.

Adoption of the Amendment

For the reasons set forth above, Part 171 of the Federal Aviation Regulations (14 CFR 171) is amended as follows:

1. The authority citation for Part 171 is revised to read as follows:

Authority: 49 U.S.C. 1343, 1346, 1348, 1354 (a), 1355, 1401, 1421–1430, 1472(c) 1502, and 1522; 49 U.S.C. 106(g) (Revised Public Law 97-449, January 12, 1983).

2. Subpart J is revised to read as follows:

PART 171—[AMENDED]

Subpart J—Microwave Landing System (MLS)

Sec.

Subpart J—Microwave Landing System (MLS)

§ 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/P Mode			
DME No.	VHF freq. MHz	MLS angle freq. MHz	MLS Ch. No.	Freq. MHz	DME/N μs	IA μs	FA μs	Freq. MHz	Pulse codes 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
** 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

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		
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
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

TABLE 1b.—CHANNELS—Continued

Channel pairing				DME parameters					
				Interrogation				Reply	
					Pulse codes				
						DME/P Mode			
DME No.	VHF freq. MHz	MLS angle freq. MHz	MLS Ch. No.	Freq. MHz	DME/N µs	IA µs	FA µs	Freq. MHz	Pulse codes µs
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
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
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

TABLE 1b.—CHANNELS—Continued

Channel pairing				DME parameters					
				Interrogation				Reply	
					Pulse codes				
						DME/P Mode			
DME No.	VHF freq. MHz	MLS angle freq. MHz	MLS Ch. No.	Freq. MHz	DME/N µs	IA µs	FA µs	Freq. MHz	Pulse codes µs
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
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	5080.8	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

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		
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			125	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
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.

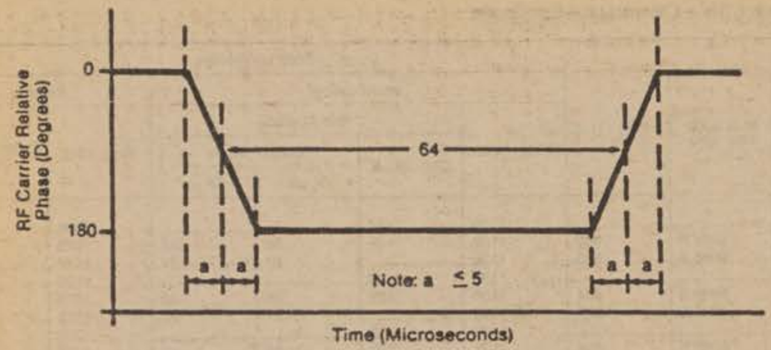

Figure 1.-DPSK Phase Characteristic

(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.

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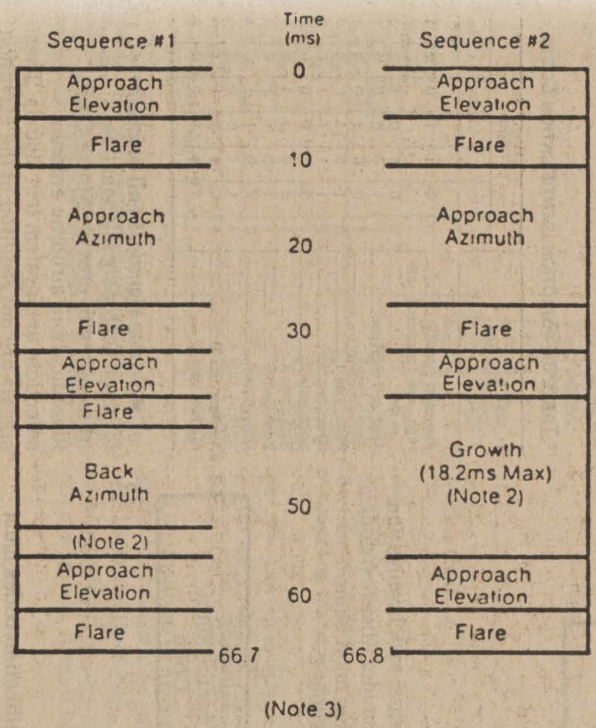
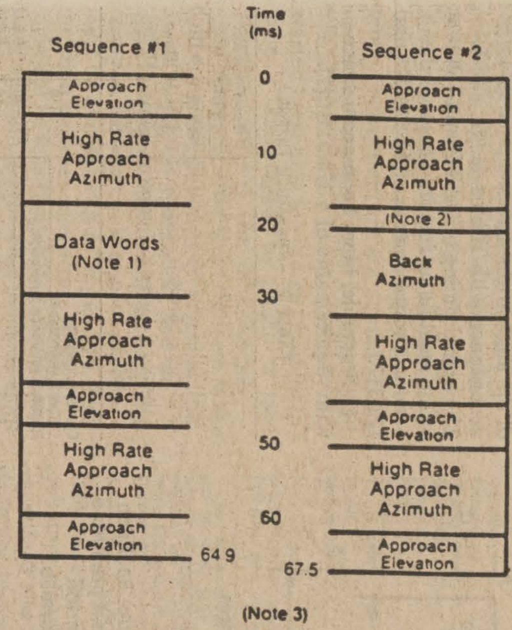


Notes:

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.

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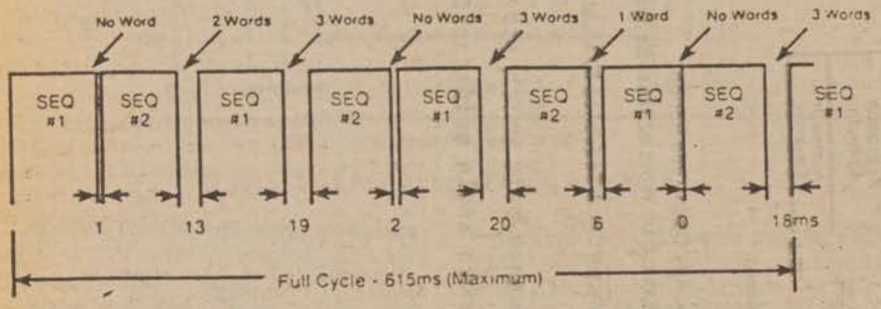
(h) *TDM cycle.* The time periods between angle transmission sequences must be varied so that exact repetitions do not occur within periods of less than 0.5 second in order to protect against synchronous interference. One such combination of sequences is shown in Figure 4 which forms a full multiplex 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.

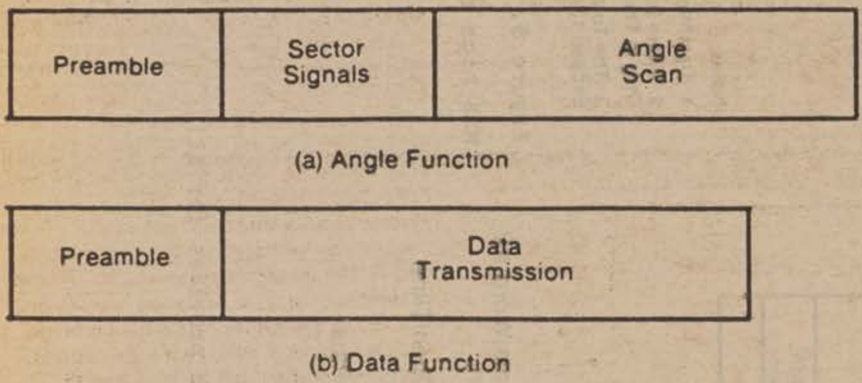


Figure 5 - Function format.

(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.

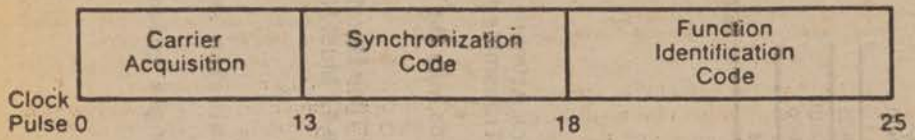


Figure 6 - Preamble organization.

(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

[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:

$$\theta = \frac{V}{2}(T_o - t)$$

where:

θ = Receiver angle in degrees.
V = Scan velocity in degrees per microsecond.
T_o = 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.

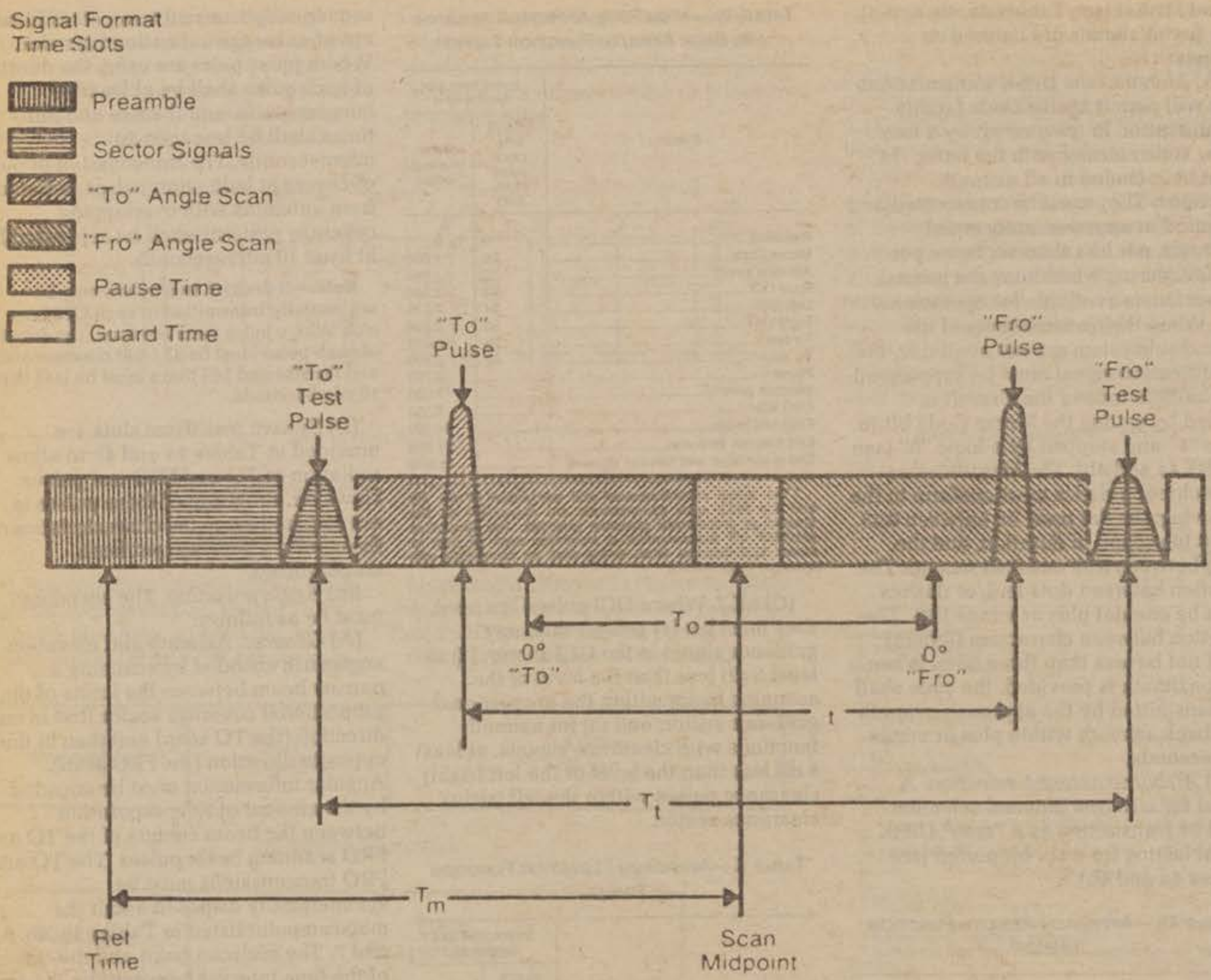


Figure 7. Azimuth Angle Scan Timing (Not to Scale)

(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_f (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
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
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.

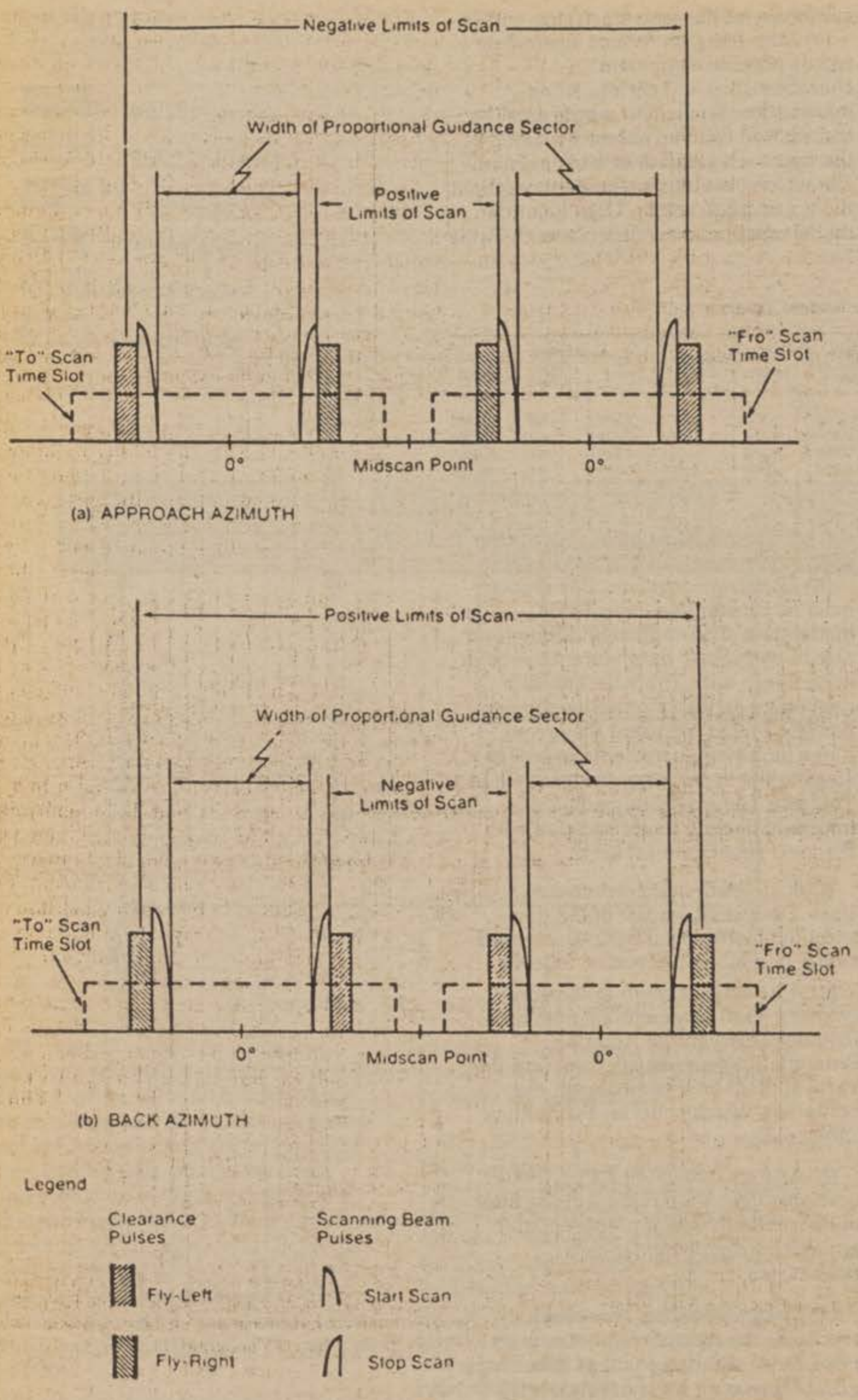


Figure 8. Clearance Pulse Timing for Azimuth Functions

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 (0m–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.

TABLE 8a.—BASIC DATA WORDS—Continued

Data bit #	Data item definition	LSB value	Data bit value
	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 inote 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

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.

Data bit #	Data item definition	LSB value	Data bit value
	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 (0m 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).		

TABLE 8a.—BASIC DATA WORDS—Continued

Data bit #	Data item definition	LSB value	Data bit value
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 range of the coded parameter unless otherwise noted.

Data bit #	Data item definition	LSB value	Data bit value
	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 onentation (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.

Data bit #	Data item definition	LSB value	Data bit value
	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°
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°

TABLE 8a.—BASIC DATA WORDS—Continued

Data bit #	Data item definition	LSB value	Data bit value
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.

Data bit #	Data item definition	LSB value	Data bit value
	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 througnout the Back Azimuth coverage.

Note 9: When Back Azzimuth guidance is provided, Data Word 5 shall be transmitted at an interval of 1.33 seconds or less through out the Back Azimuth coverage sector and 4 seconds or less througnout 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 perdenicular 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 giudance 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
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
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
	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}:
$\text{Even}=(I_{13}+\ldots+I_{18})+I_{20}+I_{22}+I_{24}+I_{25}+I_{28}+I_{29}+I_{31}+I_{32}+I_{33}+I_{35}+I_{36}+I_{38}+I_{41}+I_{44}+I_{45}+I_{46}+I_{50}+(I_{52}+\ldots+I_{55})+I_{58}+I_{60}+I_{64}+I_{65}+I_{70}$

For BIT I_{71}:
$\text{Even}=(I_{14}+\ldots+I_{19})+I_{21}+I_{23}+I_{25}+I_{26}+I_{29}+I_{30}+I_{32}+I_{33}+I_{34}+I_{36}+I_{37}+I_{39}+I_{42}+I_{45}+I_{46}+I_{47}+I_{51}+(I_{53}+\ldots+I_{56})+I_{59}+I_{61}+I_{65}+I_{66}+I_{71}$

For BIT I_{72}:
$\text{Even}=(I_{15}+\ldots+I_{20})+I_{22}+I_{24}+I_{26}+I_{27}+I_{30}+I_{31}+I_{33}+I_{34}+I_{35}+I_{37}+I_{38}+I_{40}+I_{43}+I_{46}+I_{47}+I_{48}+I_{52}+(I_{54}+\ldots+I_{57})+I_{60}+I_{62}+I_{66}+I_{67}+I_{72}$

For BIT I_{73}:
$\text{Even}=(I_{16}+\ldots+I_{21})+I_{23}+I_{25}+I_{27}+I_{28}+I_{31}+I_{32}+I_{34}+I_{35}+I_{36}+I_{38}+I_{39}+I_{41}+I_{44}+I_{47}+I_{48}+I_{49}+I_{53}+(I_{55}+\ldots+I_{58})+I_{61}+I_{63}+I_{67}+I_{68}+I_{73}$

For BIT I_{74}:
$\text{Even}=(I_{17}+\ldots+I_{22})+I_{24}+I_{26}+I_{28}+I_{29}+I_{32}+I_{33}+I_{35}+I_{36}+I_{37}+I_{39}+I_{40}+I_{42}+I_{45}+I_{48}+I_{49}+I_{50}+I_{54}+(I_{56}+\ldots+I_{59})+I_{62}+I_{64}+I_{68}+I_{69}+I_{74}$

For BIT I_{75}:
$\text{Even}=(I_{13}+\ldots+I_{17})+I_{19}+I_{21}+I_{23}+I_{24}+I_{27}+I_{29}+I_{30}+I_{31}+I_{32}+I_{34}+I_{35}+I_{37}+I_{40}+I_{43}+I_{44}+I_{45}+I_{49}+(I_{51}+\ldots+I_{54})+I_{57}+I_{59}+I_{63}+I_{64}+I_{69}+I_{75}$

For BIT I_{76}:
$\text{Even}=I_{13}+I_{14}+\ldots+I_{75}+I_{76}$

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.

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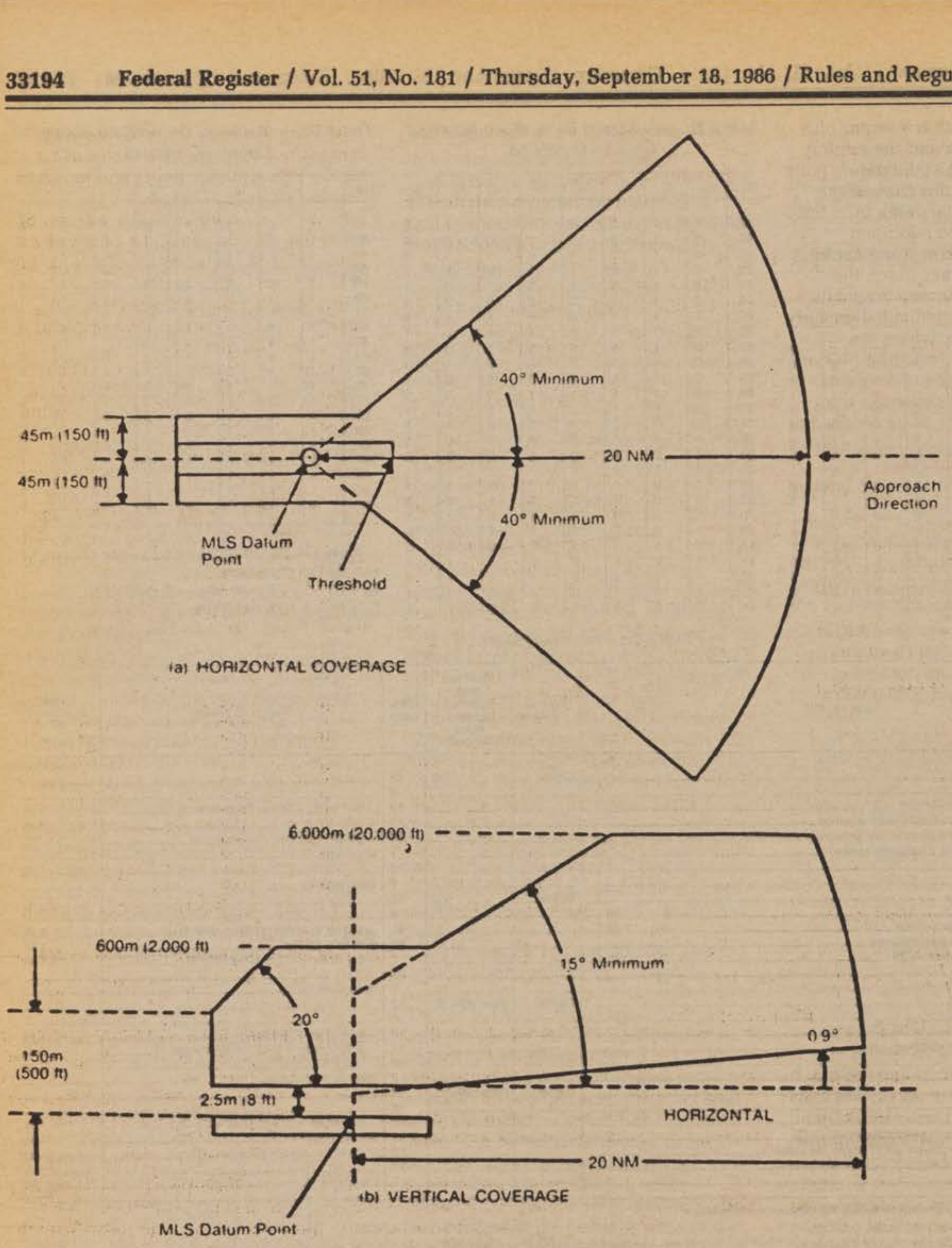

Figure 9. Approach Azimuth/Data Coverage

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(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 6000 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 (2000 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;

(ii) Rain loss of −2.2 dB at the longitudinal coverage extremes.

TABLE 9.—MINIMUM POWER DENSITY WITHIN COVERAGE BOUNDARIES (dBW/m²)

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		

(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 clearnace 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.

(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) [1,4]	±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.

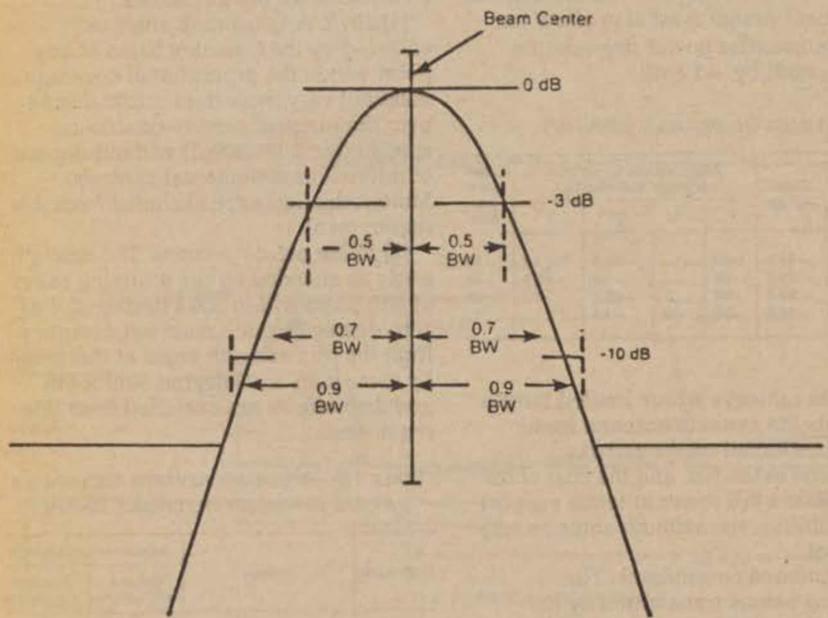
(3) *Antenna alignment*. The antenna must be equipped with suitable optical, electrical or mechanical means or any combination of the three, to bring the zero degree azimuth radial into coincidence with the approach reference datum (for centerline siting) with a

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 θ 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 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):

(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.

(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:

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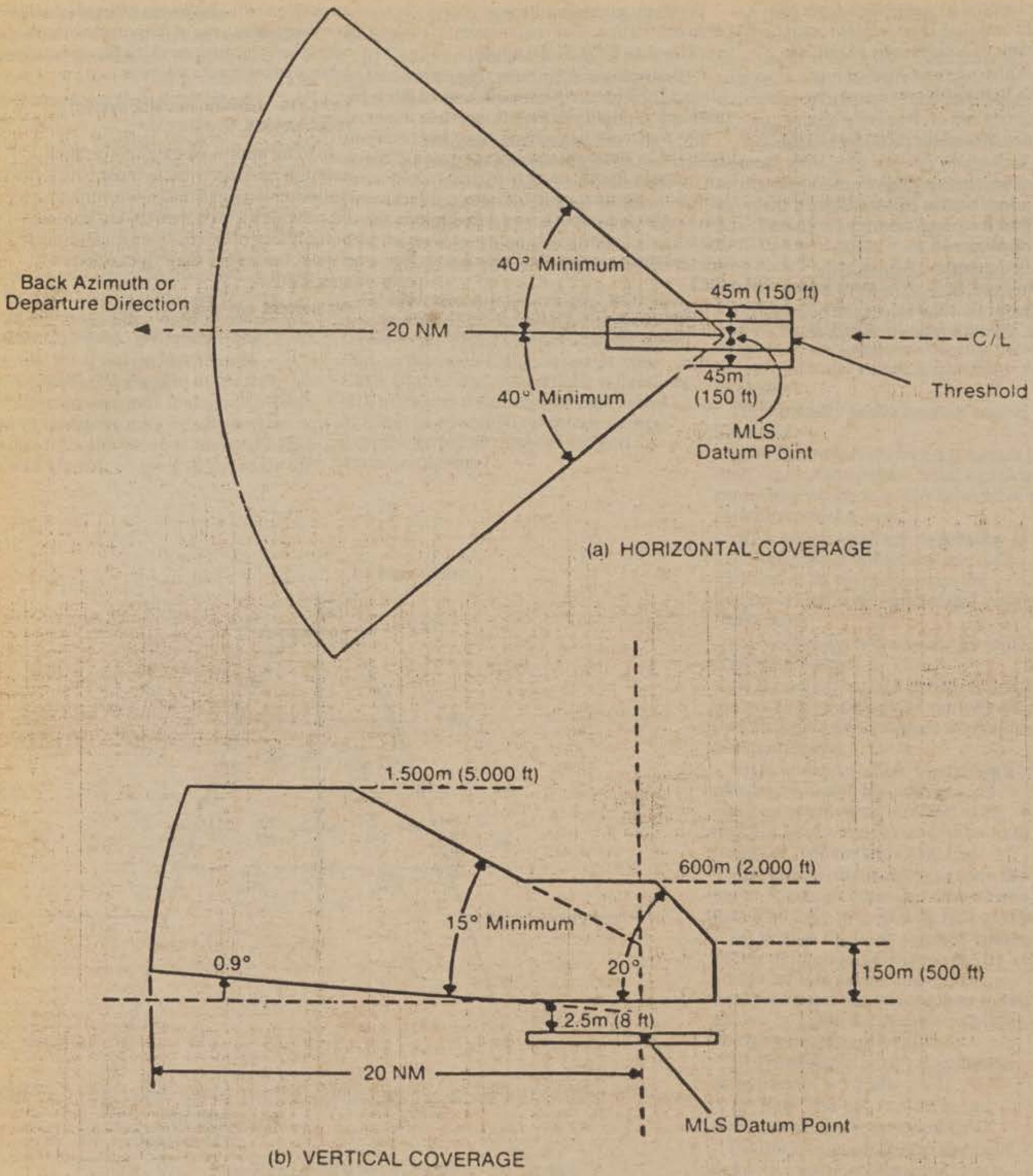

Figure 11. Back Azimuth/Data Coverage

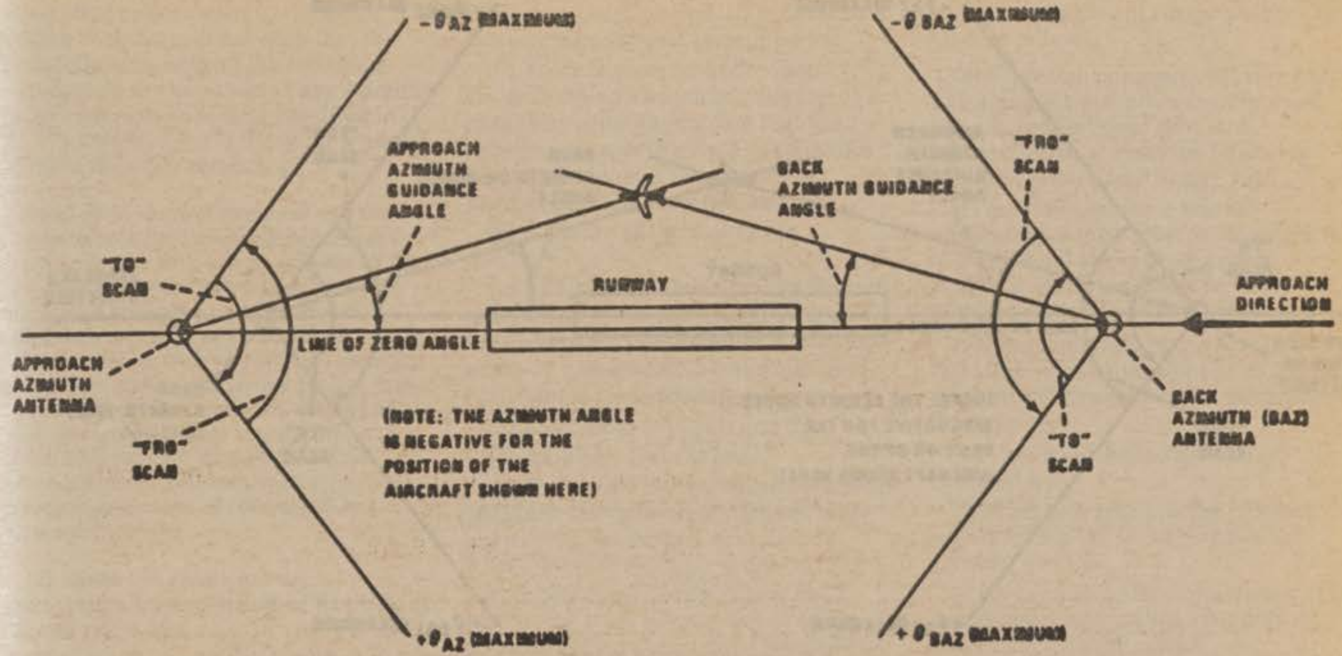

Figure 12. Azimuth Guidance Functions Scanning Conventions

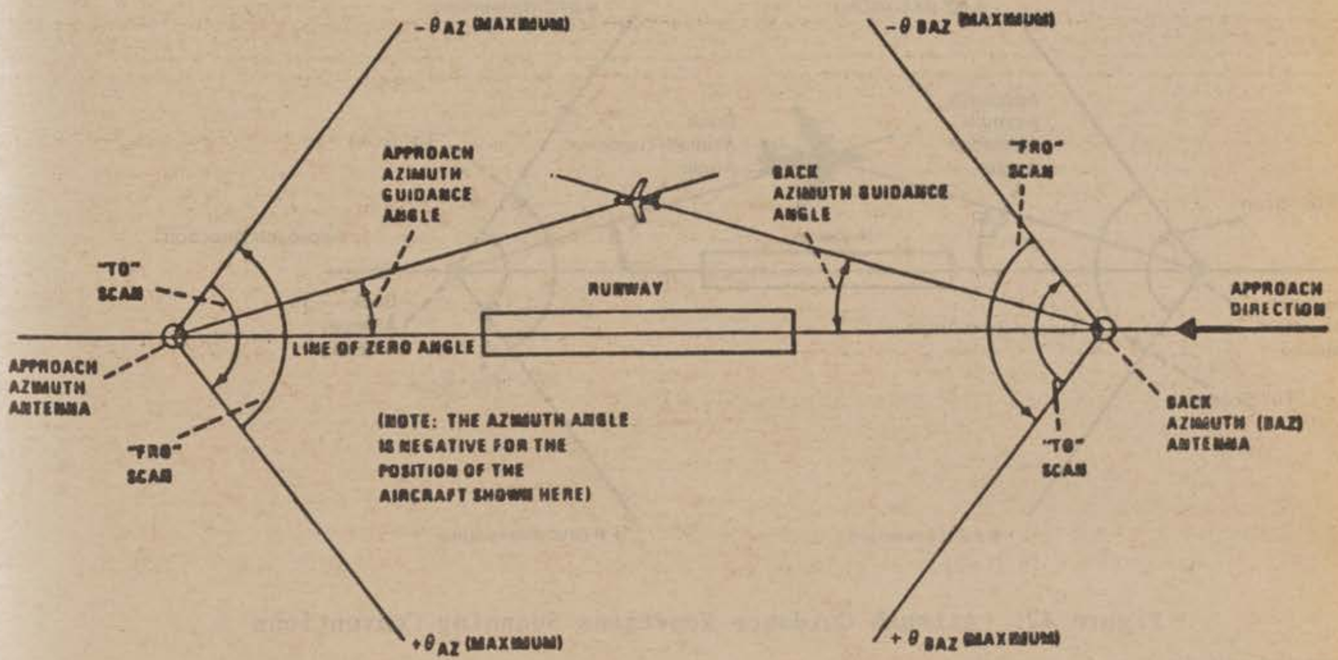
Figure 12. Azimuth Guidance Functions Scanning Conventions

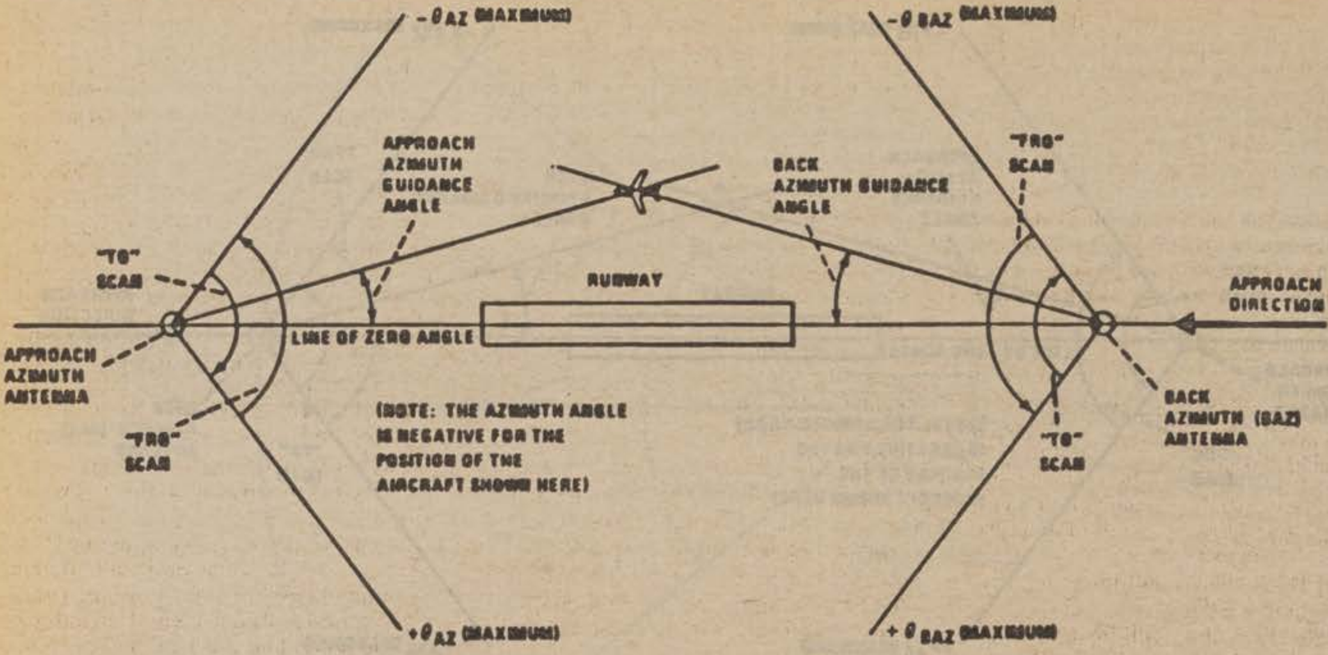

Figure 12. Azimuth Guidance Functions Scanning Conventions

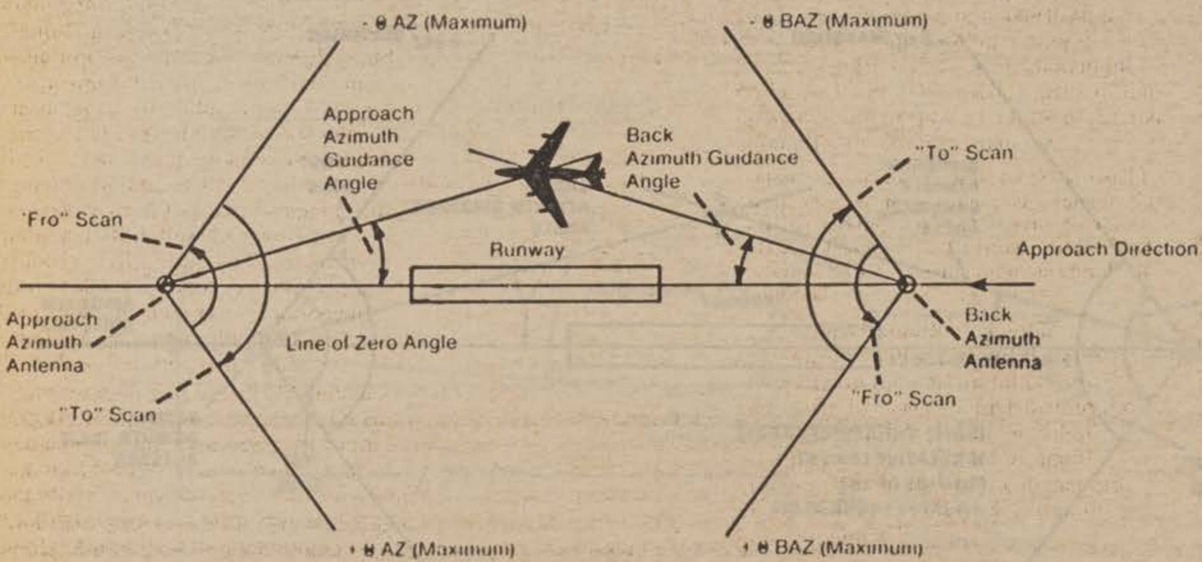

Figure 12. Azimuth Guidance Functions Scanning Conventions

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(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).

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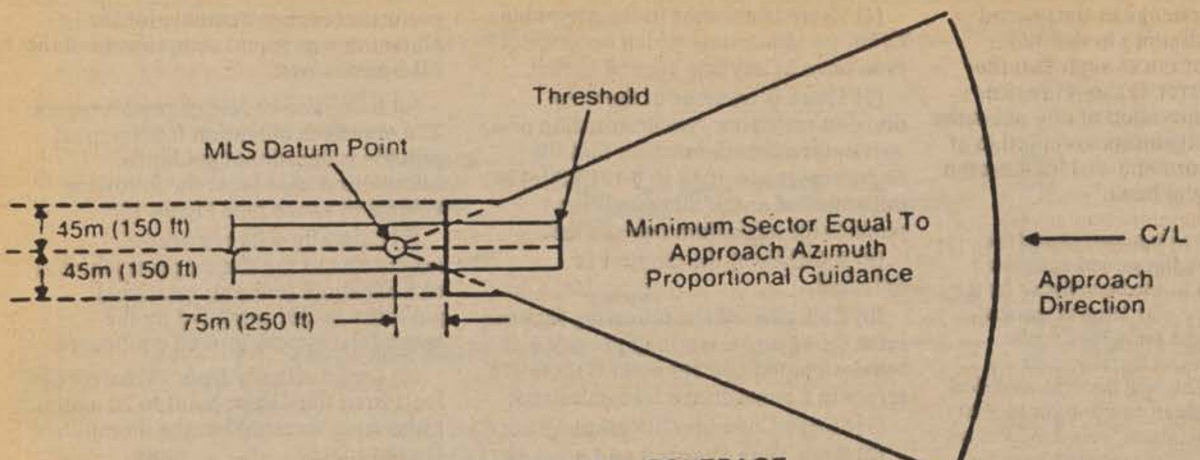
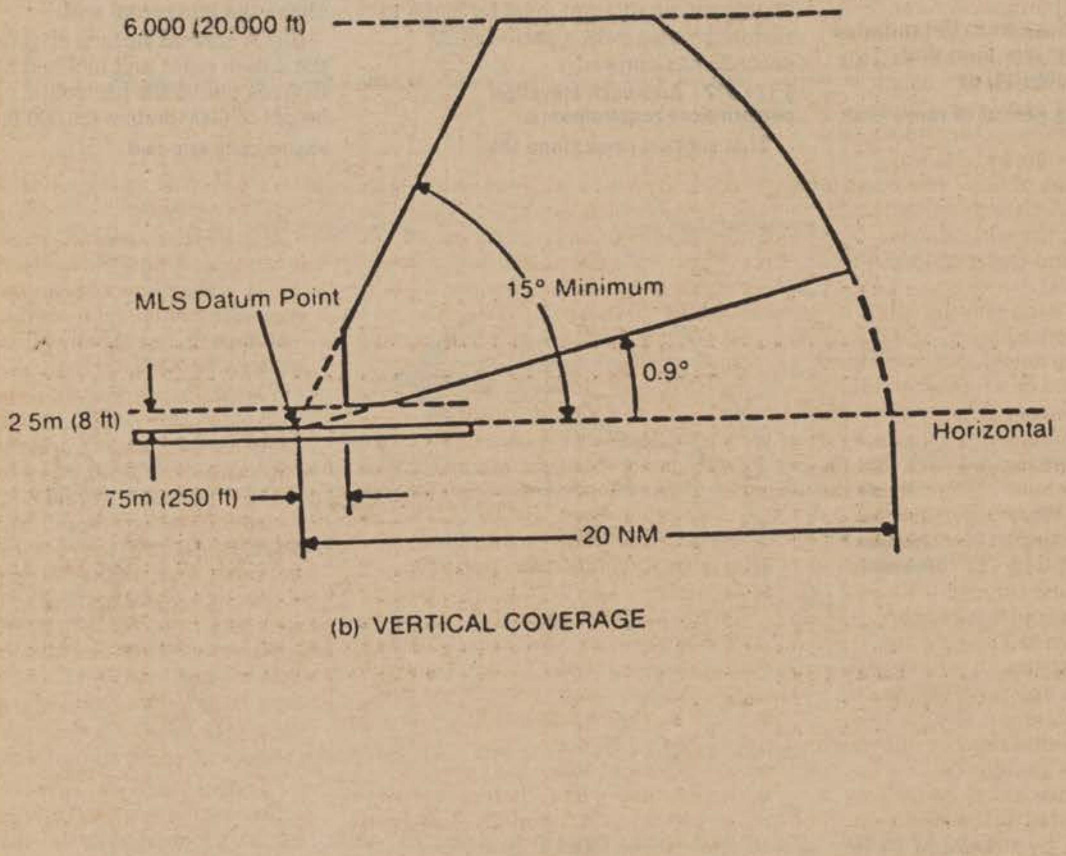


(a) HORIZONTAL COVERAGE



(b) VERTICAL COVERAGE

Figure 13. Approach Elevation Coverage

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Where the physical characteristics of the approach region prevent the achievement 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 θ 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 Section 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 Office of the Federal Register Information Center, Room 8301, 1100 L Street, NW., Washington, DC 20408.

(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.

§ 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 air traffic control areas, 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 air traffic control zones or areas, 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 approach 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.

§ 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.

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