

Specifications for ILS Localizers and Glide Path

INSTRUMENT LANDING SYSTEM

1. Applicable Documents and Regulations

Standard

The referenced specifications were utilized during the development of this specification and are only included in the requirements of this document when specifically referenced. In most cases, equivalent international or commercial specifications to those referenced here exist and may be used.

Annex 10, Volume I	ICAO International Standards and Recommended Practices, Radio Navigation Aids
Doc 8071 Volume 1 89/336/EEC	ICAO: Manual on Testing of Radio Navigation Aids (European Commission) Council Directive on the Approximation of the Laws of the Member States Relating to Electromagnetic Compatibility
EN 300 339 V1.1.1 (98)	Electromagnetic compatibility and Radio spectrum Matters (ERM); General Electromagnetic Compatibility (EMC) for radio communications equipment
EN 50081-2	Electromagnetic compatibility – Generic immunity standard
EN 50081-1	Electromagnetic compatibility – Generic emission standard
EN 60950	Safety of Information Technology Equipment including Business Equipment.
MIL-HDBK-217	Reliability Stress and Failure Rate Data for Electronic Equipment R&TTE Directive 1999/5/EC CE marking and EMC directive RAL STD Colors
ASTM A 123	Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strip
CCITT V.22 bis	Consultive Committee for International Telephone & Telegraph; second version of a 2400 bps full-duplex modem standard (1984, revised 1988)
RS-232	EIA/TIA Standard: Interface Between Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange Underwriter's Laboratories, Inc. Standards

2. Special Applications

ICAO- Annex 10, Volume 1, Part 1:

Attachment C to Part 1, Section 1 and 2- *Material concerning ILS installations.*
Attachment C to Part 1, Section 8- *Material concerning power supply switch over times.*
Attachment F to Part 1: *Guidance material concerning reliability and availability of radio communications and navigation aids.*

ICAO- Annex 10, Volume 1, Part 2:

Chapter 4, Section 4.2.- *(Frequency-) Utilisation in the band 108- 117,995MHz*

ICAO- Annex 14, Volume 1:

Chapter 4, Section 4. 1: *Obstacle limitation surfaces*

ICAO- DOC 8071, Volume 1:

Manual on Testing of Radio Navigation Aids, ILS

ICAO DOC 9157, Part 6:

Chapter 4: Design for frangibility

Chapter 6: Numerical simulation methods for evaluating frangibility.

3. Definitions

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

Back course sector. The course sector which is situated on the opposite side of the localizer from the runway.

Course line. The locus of points nearest to the runway centre line in any horizontal plane at which the DDM is zero.

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

DDM — Difference in depth of modulation. The percentage modulation depth of the larger signal minus the percentage modulation depth of the smaller signal, divided by 100.

Displacement sensitivity (localizer). The ratio of measured DDM to the corresponding lateral displacement from the appropriate reference line.

Facility Performance Category III — ILS. An ILS which, with the aid of ancillary equipment where necessary, provides guidance information from the coverage limit of the facility to, and along, the surface of the runway.

Front course sector. The course sector which is situated on the same side of the localizer as the runway. **Half course sector.** The sector, in a horizontal plane containing the course line and limited by the loci of points nearest to the course line at which the DDM is 0.0775.

Half ILS glide path sector. The sector in the vertical plane containing the ILS glide path and limited by the loci of points nearest to the glide path at which the DDM is 0.0875.

ILS continuity of service. That quality which relates to the rarity of radiated signal interruptions. The level of continuity of service of the localizer or the glide path is expressed in terms of the probability of not losing the radiated guidance signals.

ILS glide path. That locus of points in the vertical plane containing the runway centre line at which the DDM is zero, which, of all such loci, is the closest to the horizontal plane.

ILS glide path angle. The angle between a straight line which represents the mean of the ILS glide path and the horizontal.

ILS glide path sector. The sector in the vertical plane containing the ILS glide path and limited by the loci of points nearest to the glide path at which the DDM is 0.175. Note. — The ILS glide path sector is located in the vertical plane containing the runway centre line, and is divided by the radiated glide path in two parts called upper sector and lower sector, referring respectively to the sectors above and below the glide path.

ILS integrity. That quality which relates to the trust which can be placed in the correctness of the information supplied by the facility. The level of integrity of the localizer or the glide path is expressed in terms of the probability of not radiating false guidance signals.

ILS Point “A”. A point on the ILS glide path measured along the extended runway centre line in the approach direction a distance of 7.5 km (4 NM) from the threshold.

ILS Point “B”. A point on the ILS glide path measured along the extended runway centre line in the approach direction a distance of 1 050 m (3 500 ft) from the threshold.

ILS Point “C”. A point through which the downward extended straight portion of the nominal ILS glide path passes at a height of 30 m (100 ft) above the horizontal plane containing the threshold.

ILS Point “D”. A point 4 m (12 ft) above the runway centre line and 900 m (3 000 ft) from the threshold in the direction of the localizer.

ILS Point “E”. A point 4 m (12 ft) above the runway centre line and 600 m (2 000 ft) from the stop end of the runway in the direction of the threshold.

ILS reference datum (Point “T”). A point at a specified height located above the intersection of the runway centre line and the threshold and through which the downward extended straight portion of the ILS glide path passes.

Two-frequency glide path system. An ILS glide path in which coverage is achieved by the use of two independent radiation field patterns spaced on separate carrier frequencies within the particular glide path channel.

Two-frequency localizer system. A localizer system in which coverage is achieved by the use of two independent radiation field patterns spaced on separate carrier frequencies within the particular localizer VHF channel.

4. Basic Requirements

Basic requirements as per ICAO Annexure 10 and numbered as such:

3.1.2.1 The ILS shall comprise the following basic components:

- a) VHF localizer equipment, associated monitor system, remote control and indicator equipment.
- b) UHF glide path equipment, associated monitor system, remote control and indicator equipment.
- c) an appropriate means to enable glide path verification checks.

Note. — The Procedures for Air Navigation Services — Aircraft Operations (PANS-OPS) (Doc 8168) provide guidance on the conduct of glide path verification checks.

3.1.2.1.1 Recommendation. — *Distance to threshold information to enable glide path verification checks should be provided by distance measuring equipment (DME), together with associated monitor systems and remote control and indicator equipment.*

DME is used in lieu of marker beacons, the equipment shall conform to the specifications in 3.1.7.6.5.

Note. — Guidance material relative to the use of DME and/or other standard radio navigation aids as an alternative to the marker beacon is contained in Attachment C, 2.11.

3.1.2.1.3 Facility Performance Categories I, II and III — ILS shall provide indications at designated remote-control points of the operational status of all ILS ground system components, as follows:

- a) for all Category II and Category III ILS, the air traffic services unit involved in the control of aircraft on the final approach shall be one of the designated remote-control points and shall receive information on the operational status of the ILS, with a delay commensurate with the requirements of the operational environment.

Note 1. — The indications required by this Standard are intended as a tool to support air traffic management functions, and the applicable timeliness requirements are sized accordingly (consistently with 2.8.1). Timeliness requirements applicable to the ILS integrity monitoring functions that protect aircraft from ILS malfunctions are specified in 3.1.3.11.3.1 and 3.1.5.7.3.1.

Note 2. — It is intended that the air traffic system is likely to call for additional provisions which may be found essential for the attainment of full operational Category III capability, e.g. to provide additional lateral and longitudinal guidance during the landing roll-out, and taxiing, and to ensure enhancement of the integrity and reliability of the system.

3.1.2.2 The ILS shall be constructed and adjusted so that, at a specified distance from the threshold, similar instrumental indications in the aircraft represent similar displacements from the course line or ILS glide path as appropriate, irrespective of the particular ground installation in use.

3.1.2.5 The localizer and glide path components and other ancillary equipment specified in 3.1.2.1.3, which form part of a Facility Performance Category III — ILS, shall otherwise comply with the Standards applicable to these components in Facility Performance Categories I and II — ILS, except as supplemented by the Standards in 3.1.3 and 3.1.5 in which application to Facility Performance Category III — ILS is prescribed.

3.1.2.6 To ensure an adequate level of safety, the ILS shall be so designed and maintained that the probability of operation within the performance requirements specified is of a high value, consistent with the category of operational performance concerned.

Note. — The specifications for Facility Performance Categories II and III — ILS are intended to achieve the highest degree of system integrity, reliability and stability of operation under the most adverse environmental conditions to be encountered. Guidance material to achieve this objective in Categories II and III operations is given in 2.8 of Attachment C of ICAO Annexure 10.

3.1.2.7 Two separate ILS facilities serve opposite ends of a single runway, an interlock shall ensure that only the localizer serving the approach direction in use shall radiate, except where the localizer in operational use is Facility Performance Category I — ILS and no operationally harmful interference results.

Note. — If both localizers radiate there is a possibility of interference to the localizer signals in the threshold region. Additional guidance material is contained in 2.1.9 and 2.13 of Attachment C of ICAO Annexure 10.

3.1.2.7.2 At locations where ILS facilities serving opposite ends of the same runway or different runways at the same airport use the same paired frequencies, an interlock shall ensure that only one facility shall radiate at a time. When switching from one ILS facility to another, radiation from both shall be suppressed for not less than 20 seconds.

Note. — Additional guidance material on the operation of localizers on the same frequency channel is contained in 2.1.9 of Attachment C and Volume V, Chapter 4..

5. Bidder to indicate if the proposed ILS system comply with the following specifications as per ICAO Annexure 10

Specific Requirements	Compliant	Not Compliant
3.1.3 VHF localizer and associated monitor General 3.1.3.1.1 The radiation from the localizer antenna system shall produce a composite field pattern which is amplitude modulated by a 90 Hz and a 150 Hz tone. The radiation field pattern shall produce a course sector with one tone predominating on one side of the course and with the other tone predominating on the opposite side. 3.1.3.1.2 When an observer faces the localizer from the approach end of a runway, the depth of modulation of the radio frequency carrier due to the 150 Hz tone shall predominate on the observer's right hand and that due to the 90 Hz tone shall predominate on the observer's left hand. 3.1.3.1.3 All horizontal angles employed in specifying the localizer field patterns shall originate from the centre of the localizer antenna system which provides the signals used in the front course sector.		

3.1.3.2 Radio Frequency 3.1.3.2.1 The localizer shall operate in the band 108 MHz to 111.975 MHz. Where a single radio frequency carrier is used, the frequency tolerance shall not exceed plus or minus 0.005 per cent. Where two radio frequency carriers are used, the frequency tolerance shall not exceed 0.002 per cent and the nominal band occupied by the carriers shall be symmetrical about the assigned frequency. With all tolerances applied, the frequency separation between the carriers shall not be less than 5 kHz nor more than 14 kHz. 3.1.3.2.2 The emission from the localizer shall be horizontally polarized. The vertically polarized component of the radiation on the course line shall not exceed that which corresponds to a DDM error of 0.016 when an aircraft is positioned on the course line and is in a roll attitude of 20 degrees from the horizontal. 3.1.3.2.2.2 Facility Performance Category III localizers, the vertically polarized component of the radiation within a sector bounded by 0.02 DDM either side of the course line shall not exceed that which corresponds to a DDM error of 0.005 when an aircraft is in a roll attitude of 20 degrees from the horizontal. 3.1.3.2.3 Facility Performance Category III localizers, signals emanating from the transmitter shall contain no components which result in an apparent course line fluctuation of more than 0.005 DDM peak to peak in the frequency band 0.01 Hz to 10 Hz.		
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3.1.3.3 Coverage 3.1.3.3.1 The localizer shall provide signals sufficient to allow satisfactory operation of a typical aircraft installation within the localizer and glide path coverage sectors. The localizer coverage sector shall extend from the centre of the localizer antenna system to distances of: 46.3 km (25 NM) within plus or minus 10 degrees from the front course line; 31.5 km (17 NM) between 10 degrees and 35 degrees from the front course line; 18.5 km (10 NM) outside of plus or minus 35 degrees from the front course line if coverage is provided; except that, where topographical features dictate or operational requirements permit, the limits may be reduced down to 33.3 km (18 NM) within the plus or minus 10-degree sector and 18.5 km (10 NM) within the remainder of the coverage when alternative navigational means provide satisfactory coverage within the intermediate approach area. The localizer signals shall be receivable at the distances specified at and above a height of 600 m (2 000 ft) above the elevation of the threshold, or 300 m (1 000 ft) above the elevation of the highest point within the intermediate and final approach areas, whichever is the higher, except that, where needed to protect ILS performance and if operational requirements permit, the lower limit of coverage at angles beyond 15 degrees from the front course line shall be raised linearly from its height at 15 degrees to as high as 1 350 m (4 500 ft) above the elevation of the threshold at 35 degrees from the front course line. Such signals shall be receivable, to the distances specified, up to a surface extending outward from the localizer antenna and inclined at 7 degrees above the horizontal. 3.1.3.3.2 In all parts of the coverage volume specified in 3.1.3.3.1,		
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other than as specified in 3.1.3.3.2.1, 3.1.3.3.2.2 and 3.1.3.3.2.3, the field strength shall be not less than 40 microvolts per metre (minus 114 dBW/m²). 3.1.3.3.2.3 For Facility Performance Category III localizers, the minimum field strength on the ILS glide path and within the localizer course sector shall be not less than 100 microvolts per metre (minus 106 dBW/m²) at a distance of 18.5 km (10 NM), increasing to not less than 200 microvolts per metre (minus 100 dBW/m²) at 6 m (20 ft) above the horizontal plane containing the threshold. From this point to a further point 4 m (12 ft) above the runway centre line, and 300 m (1 000 ft) from the threshold in the direction of the localizer, and thereafter at a height of 4 m (12 ft) along the length of the runway in the direction of the localizer, the field strength shall be not less than 100 microvolts per metre (minus 106 dBW/m²). 3.1.3.3.4 When coverage is achieved by a localizer using two radio frequency carriers, one carrier providing a radiation field pattern in the front course sector and the other providing a radiation field pattern outside that sector, the ratio of the two carrier signal strengths in space within the front course sector to the coverage limits specified at 3.1.3.3.1 shall not be less than 16 dB		
3.1.3.4 Course structure 3.1.3.4.2 Facility Performance Categories II and III localizers, bends in the course line shall not have amplitudes which exceed Zone and Amplitude as per ICAO Annexure 10, 3.1.3.4.2		

3.1.3.5 Carrier modulation 3.1.3.5.1 The nominal depth of modulation of the radio frequency carrier due to each of the 90 Hz and 150 Hz tones shall be 20 per cent along the course line. 3.1.3.5.2 The depth of modulation of the radio frequency carrier due to each of the 90 Hz and 150 Hz tones shall be within the limits of 18 and 22 per cent. 3.1.3.5.3 The following tolerances shall be applied to the frequencies of the modulating tones: a) the modulating tones shall be 90 Hz and 150 Hz within plus or minus 2.5 per cent; b) the modulating tones shall be 90 Hz and 150 Hz within plus or minus 1.5 per cent for Facility Performance Category II installations; c) the modulating tones shall be 90 Hz and 150 Hz within plus or minus 1 per cent for Facility Performance Category III installations; d) the total harmonic content of the 90 Hz tone shall not exceed 10 per cent; additionally, for Facility Performance Category III localizers, the second harmonic of the 90 Hz tone shall not exceed 5 per cent; e) the total harmonic content of the 150 Hz tone shall not exceed 10 per cent. 3.1.3.5.3.2 Facility Performance Category III localizers, the depth of amplitude modulation of the radio frequency carrier at the power supply frequency or its harmonics, or by other unwanted components, shall not exceed 0.5 per cent. Harmonics of the supply, or other unwanted noise components that may intermodulate with the 90 Hz and 150 Hz navigation tones or their harmonics to produce fluctuations in the course line, shall not exceed 0.05 per cent modulation depth of the radio frequency carrier. 3.1.3.5.3.3 The modulation tones shall be phase-locked so that within the half course sector, the demodulated 90 Hz and 150 Hz wave forms pass through zero in the same direction within: b) Facility Performance Category III localizers: 10 degrees, of phase relative to the 150 Hz component, every half cycle of the combined 90 Hz and 150 Hz wave form. 3.1.3.5.3.4 With two-frequency localizer systems, 3.1.3.5.3.3 shall apply to each carrier. In addition, the 90 Hz modulating tone of one carrier shall be phase-locked to the 90 Hz modulating tone		
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of the other carrier so that the demodulated wave forms pass through zero in the same direction within: b) for Category III localizers: 10 degrees of phase relative to 90 Hz. Similarly, the 150 Hz tones of the two carriers shall be phase-locked so that the demodulated wave forms pass through zero in the same direction within: 2) for Category III localizers: 10 degrees of phase relative to 150 Hz. 3.1.3.5.3.5 Alternative two-frequency localizer systems that employ audio phasing different from the normal in-phase conditions described in 3.1.3.5.3.4 shall be permitted. In this alternative system, the 90 Hz to 90 Hz phasing and the 150 Hz to 150 Hz phasing shall be adjusted to their nominal values to within limits equivalent to those stated in 3.1.3.5.3.4. 3.1.3.5.3.6 Recommendation. — <i>the sum of the modulation depths of the radio frequency carrier due to the 90 Hz and 150 Hz tones shall not exceed 60 per cent or be less than 30 per cent within the required coverage.</i>		
3.1.3.6 Course alignment accuracy 3.1.3.6.1 The mean course line shall be adjusted and maintained within limits equivalent to the following displacements from the runway centre line at the ILS reference datum: c) for Facility Performance Category III localizers: plus or minus 3 m (10 ft). <i>Note 1.— It is intended that Facility Performance Categories II and III installations be adjusted and maintained so that the limits specified in 3.1.3.6.1 and 3.1.3.6.2 are reached on very rare occasions. It is further intended that design and operation of the total ILS ground system be of sufficient integrity to accomplish this aim.</i>		
3.1.3.7 Displacement sensitivity 3.1.3.7.1 The nominal displacement sensitivity within the half course sector shall be the equivalent of 0.00145 DDM/m (0.00044 DDM/ft) at the ILS reference datum. 3.1.3.7.2 The lateral displacement sensitivity shall be adjusted and maintained within the limits of plus or minus: b) 10 per cent of the nominal value for Facility Performance Category III. 3.1.3.7.4 The increase of DDM shall be substantially linear with respect to angular displacement from the front course line (where DDM is zero) up to an angle on either side of the front course line where the DDM is 0.180. From that angle to plus or minus 10 degrees, the DDM shall not be less than 0.180. From		

plus or minus 10 degrees to plus or minus 35 degrees, the DDM shall not be less than 0.155. Where coverage is required outside of the plus or minus 35 degrees sector, the DDM in the area of the coverage, except in the back course sector, shall not be less than 0.155.		
3.1.3.9 Identification 3.1.3.9.1 The localizer shall provide for the simultaneous transmission of an identification signal, specific to the runway and approach direction, on the same radio frequency carrier or carriers as used for the localizer function. The transmission of the identification signal shall not interfere in any way with the basic localizer function. 3.1.3.9.2 The identification signal shall be produced by Class A2A modulation of the radio frequency carrier or carriers using a modulation tone of 1 020 Hz within plus or minus 50 Hz. The depth of modulation shall be between the limits of 5 and 15 per cent except that, where a radiotelephone communication channel is provided, the depth of modulation shall be adjusted so that the ratio of peak modulation depth due to radiotelephone communications to that due to the identification signal modulation is approximately 9:1 (see 3.1.3.8.3.2). The emissions carrying the identification signal shall be horizontally polarized. Where two carriers are modulated with identification signals, the relative phase of the modulations shall be such as to avoid the occurrence of nulls within the coverage of the localizer. 3.1.3.9.3 The identification signal shall employ the International Morse Code and consist of two or three letters. It may be preceded by the International Morse Code signal of the letter "I", followed by a short pause where it is necessary to distinguish the ILS facility from other navigational facilities in the immediate area. 3.1.3.9.4 The identification signal shall be transmitted by dots and dashes at a speed corresponding to approximately seven words per minute, and shall be repeated at approximately equal intervals, not less than six times per minute, at all times during which the localizer is available for operational use. When the transmissions of the localizer are not available for operational use, as, for example, after removal of navigation components, or during maintenance or test transmissions, the identification signal shall be suppressed. The dots shall have a duration of 0.1 second to 0.160 second. The dash duration shall be typically three times the duration of a dot. The interval between dots and/or dashes shall be equal to that of one dot plus or minus 10 per cent. The interval between letters shall not be less than the duration of three dots.		

3.1.3.10 Siting 3.1.3.10.1 For Facility Performance Categories III, the localizer antenna system shall be located on the extension on the centre line of the runway at the stop end, and the equipment shall be adjusted so that the course lines will be in a vertical plane containing the centre line of the runway served. The antenna height and location shall be consistent with safe obstruction clearance practices.		
3.1.3.11 Monitoring 3.1.3.11.1 The automatic monitor system shall provide a warning to the designated control points and cause one of the following to occur, within the period specified in 3.1.3.11.3.1, if any of the conditions stated in 3.1.3.11.2 persist: a) radiation to cease; and b) removal of the navigation and identification components from the carrier. 3.1.3.11.2 The conditions requiring initiation of monitor action shall be the following: c) for Facility Performance Category III localizers, a shift of the mean course line from the runway centre line equivalent to more than 6 m (20 ft) at the ILS reference datum; d) in the case of localizers in which the basic functions are provided by the use of a single-frequency system, a reduction of power output to a level such that any of the requirements of 3.1.3.3, 3.1.3.4 or 3.1.3.5 are no longer satisfied, or to a level that is less than 50 per cent of the normal level (whichever occurs first); e) in the case of localizers in which the basic functions are provided by the use of a two-frequency system, a reduction of power output for either carrier to less than 80 per cent of normal, except that a greater reduction to between 80 per cent and 50 per cent of normal may be permitted, provided the localizer continues to meet the requirements of 3.1.3.3, 3.1.3.4 and 3.1.3.5; f) change of displacement sensitivity to a value differing by more than 17 per cent from the nominal value for the localizer facility. 3.1.3.11.3 The total period of radiation, including period(s) of zero radiation, outside the performance limits specified in a), b), c), d), e) and f) of 3.1.3.11.2 shall be as short as practicable, consistent with the need for avoiding interruptions of the navigation service provided by the localizer. 3.1.3.11.3.1 The total period referred to under 3.1.3.11.3 shall not exceed under any circumstances: 2 seconds for Category III localizers. 3.1.3.11.4 Design and operation of the monitor system shall be consistent with the requirement that navigation guidance and identification will be removed and a warning provided at the		

designated remote-control points in the event of failure of the monitor system itself 3.1.3.12 Integrity and continuity of service requirements 3.1.3.12.1 The probability of not radiating false guidance signals shall not be less than $1 - 0.5 \times 10^{-9}$ in any one landing for Facility Performance Categories III localizers 3.1.3.12.3 The probability of not losing the radiated guidance signal shall be greater than: b) $1 - 2 \times 10^{-6}$ in any period of 30 seconds for Facility Performance Category III localizers intended to be used for the full range of Category III operations (equivalent to 4 000 hours mean time between outages).		
3.1.4 Interference immunity performance for ILS localizer receiving systems. 3.1.4.1 The ILS localizer receiving system shall provide adequate immunity to interference from two-signal, third order intermodulation products caused by VHF FM broadcast signals having levels (as per formula in ICAO Annexure 10, 3.1.4.1) for VHF FM sound broadcasting signals in the range 107.7 – 108.0 MHz and for VHF FM sound broadcasting signals below 107.7 MHz where the frequencies of the two VHF FM sound broadcasting signals produce, within the receiver, a two-signal, third-order intermodulation product on the desired ILS localizer frequency. $N1$ and $N2$ are the levels (dBm) of the two VHF FM sound broadcasting signals at the ILS localizer receiver input. Neither level shall exceed the desensitization criteria set forth in 3.1.4.2. 3.1.4.2 The ILS localizer receiving system shall not be desensitized in the presence of VHF FM broadcast signals, having levels in accordance with the table in ICAO Annexure 10, 3.1.4.2		

Specific Requirements	Compliant	Not Compliant
3.1.5 UHF glide path equipment and associated monitor General 3.1.5.1.1 The radiation from the UHF glide path antenna system shall produce a composite field pattern which is amplitude modulated by a 90 Hz and a 150 Hz tone. The pattern shall be arranged to provide a straight line descent path in the vertical plane containing the centre line of the runway, with the 150 Hz tone predominating below the path and the 90 Hz tone predominating above the path to at least an angle equal to 1.75θ <i>The ILS glide path angle should be 3 degrees. ILS glide path angles in excess of 3 degrees should not be used except where alternative means of satisfying obstruction clearance requirements are Impracticable</i> 3.1.5.1.2.1 The glide path angle shall be adjusted and maintained within: b) 0.04θ from θ for Facility Performance Category III — ILS glide paths 3.1.5.1.3 The downward extended straight portion of the ILS glide path shall pass through the ILS reference datum at a height ensuring safe guidance over obstructions and also safe and efficient use of the runway served. 3.1.5.1.4 The height of the ILS reference datum for Facility Performance Categories II and III — ILS shall be 15 m (50 ft). A tolerance of plus 3 m (10 ft) is permitted.		

3.1.5.2 Radio Frequency 3.1.5.2.1 The glide path equipment shall operate in the band 328.6 MHz to 335.4 MHz. Where a single radio frequency carrier is used, the frequency tolerance shall not exceed 0.005 per cent. Where two carrier glide path systems are used, the frequency tolerance shall not exceed 0.002 per cent and the nominal band occupied by the carriers shall be symmetrical about the assigned frequency. With all tolerances applied, the frequency separation between the carriers shall not be less than 4 kHz nor more than 32 kHz. 3.1.5.2.2 The emission from the glide path equipment shall be horizontally polarized. 3.1.5.2.3 For Facility Performance Category III — ILS glide path equipment, signals emanating from the transmitter shall contain no components which result in apparent glide path fluctuations of more than 0.02 DDM peak to peak in the frequency band 0.01 Hz to 10 Hz.		
3.1.5.3 Coverage 3.1.5.3.1 The glide path equipment shall provide signals sufficient to allow satisfactory operation of a typical aircraft installation in sectors of 8 degrees in azimuth on each side of the centre line of the ILS glide path, to a distance of at least 18.5 km (10 NM) up to 1.75° and down to 0.45° above the horizontal or to such lower angle, down to 0.30°, as required to safeguard the promulgated glide path intercept procedure. 3.1.5.3.2 In order to provide the coverage for glide path performance specified in 3.1.5.3.1, the minimum field strength within this coverage sector shall be 400 microvolts per metre (minus 95 dBW/m²). For Facility Performance Categories II and III glide paths, this field strength shall be provided down to a height of 15 m (50 ft) above the horizontal plane containing the threshold.		

3.1.5.4 ILS glide path structure 3.1.5.4.2 For Facility Performance Categories II and III — ILS glide paths, bends in the glide path shall not have amplitudes which exceed the Zones and Amplitudes mentioned in ICAO Annexure 10, 3.1.5.4.2		
3.1.3.4.2 Facility Performance Categories II and III localizers, bends in the course line shall not have amplitudes. which exceed Zone and Amplitude as per ICAO Annexure 10, 3.1.3.4.2		

3.1.5.5 Carrier modulation 3.1.5.5.1 The nominal depth of modulation of the radio frequency carrier due to each of the 90 Hz and 150 Hz tones shall be 40 per cent along the ILS glide path. The depth of modulation shall not deviate outside the limits of 37.5 per cent to 42.5 per cent. 3.1.5.5.2 The following tolerances shall be applied to the frequencies of the modulating tones: c) the modulating tones shall be 90 Hz and 150 Hz within 1 per cent for Facility Performance Category III — ILS; d) the total harmonic content of the 90 Hz tone shall not exceed 10 per cent: additionally, for Facility Performance Category III equipment, the second harmonic of the 90 Hz tone shall not exceed 5 per cent. e) the total harmonic content of the 150 Hz tone shall not exceed 10 per cent. 3.1.5.5.2.2 Facility Performance Category III glide path equipment, the depth of amplitude modulation of the radio frequency carrier at the power supply frequency or harmonics, or at other noise frequencies, shall not exceed 1 per cent. 3.1.5.5.3 The modulation shall be phase-locked so that within the ILS half glide path sector, the demodulated 90 Hz and 150 Hz wave forms pass through zero in the same direction within: b) for Facility Performance Category III — ILS glide paths: 10 degrees of phase relative to the 150 Hz component, every half cycle of the combined 90 Hz and 150 Hz wave form. 3.1.5.5.3.1 With two-frequency glide path systems, 3.1.5.5.3 shall apply to each carrier. In addition, the 90 Hz modulating tone of one carrier shall be phase-locked to the 90 Hz modulating tone of the other carrier so that the demodulated wave forms pass through zero in the same direction within: b) for Category III — ILS glide paths: 10 degrees of phase relative to 90 Hz. Similarly, the 150 Hz tones of the two carriers shall be phase-locked so that the demodulated wave forms pass through zero in the same direction, within: 2) for Category III — ILS glide paths: 10 degrees, of phase relative to 150 Hz. 3.1.5.5.3.2 Alternative two-frequency glide path systems that employ audio phasing different from the normal in-phase condition described in 3.1.5.5.3.1 shall be permitted. In these alternative systems, the 90 Hz to 90 Hz phasing and the 150 Hz to 150 Hz phasing shall be adjusted to their nominal values to within limits equivalent to those stated in 3.1.5.5.3.1.		
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3.1.5.6 Displacement sensitivity 3.1.5.6.4 For Facility Performance Category III — ILS glide paths, the nominal angular displacement sensitivity shall correspond to a DDM of 0.0875 at angular displacements above and below the glide path of 0.12° with a tolerance of plus or minus 0.02°. 3.1.5.6.5 The DDM below the ILS glide path shall increase smoothly for decreasing angle until a value of 0.22 DDM is reached. This value shall be achieved at an angle not less than 0.30° above the horizontal. However, if it is achieved at an angle above 0.45°, the DDM value shall not be less than 0.22 at least down to 0.45° or to such lower angle, down to 0.30°, as required to safeguard the promulgated glide path intercept procedure. 3.1.5.6.8 Facility Performance Category III — ILS glide paths, the angular displacement sensitivity shall be adjusted and maintained within plus or minus 15 per cent of the nominal value selected.		
3.1.5.7 Monitoring 3.1.5.7.1 The automatic monitor system shall provide a warning to the designated control points and cause radiation to cease within the periods specified in 3.1.5.7.3.1 if any of the following conditions persist: a) shift of the mean ILS glide path angle equivalent to more than minus 0.075° to plus 0.10° from θ; b) in the case of ILS glide paths in which the basic functions are provided by the use of a single-frequency system, a reduction of power output to less than 50 per cent of normal, provided the glide path continues to meet the requirements of 3.1.5.3, 3.1.5.4 and 3.1.5.5; c) in the case of ILS glide paths in which the basic functions are provided by the use of two-frequency systems, a reduction of power output for either carrier to less than 80 per cent of normal, except that a greater reduction to between 80 per cent and 50 per cent of normal may be permitted, provided the glide path		

continues to meet the requirements of 3.1.5.3, 3.1.5.4 and 3.1.5.5. e) for Facility Performance Categories II and III — ILS glide paths, a change of displacement sensitivity to a value differing by more than 25 per cent from the nominal value f) lowering of the line beneath the ILS glide path at which a DDM of 0.0875 is realized to less than 0.7475 θ from horizontal; g) a reduction of DDM to less than 0.175 within the specified coverage below the glide path sector. 3.1.5.7.3 The total period of radiation, including period(s) of zero radiation, outside the performance limits specified in 3.1.5.7.1 shall be as short as practicable, consistent with the need for avoiding interruptions of the navigation service provided by the ILS glide path. 3.1.5.7.3.1 The total period referred to under 3.1.5.7.3 shall not exceed under any circumstances: 2 seconds for Categories II and III — ILS glide paths. 3.1.5.7.4 Design and operation of the monitor system shall be consistent with the requirement that radiation shall cease and a warning shall be provided at the designated remote control points in the event of failure of the monitor system itself.		
3.1.5.8 Integrity and continuity of service requirements 3.1.5.8.1 The probability of not radiating false guidance signals shall not be less than $1 - 0.5 \times 10^{-9}$ in any one landing for Facility Performance Categories II and III glide paths. 3.1.5.8.3 The probability of not losing the radiated guidance signal shall be greater than $1 - 2 \times 10^{-6}$ in any period of 15 seconds for Facility Performance Categories II and III glide paths (equivalent to 2 000 hours mean time between outages).		

3.1.6 Localizer and glide path frequency pairing 3.1.6.1 The pairing of the runway localizer and glide path transmitter frequencies of an instrument landing system shall be taken from the list in ICAO Annexure 10, 3.1.6.1 in accordance with the provisions of Volume V, Chapter 4, 4.2 3.1.6.2 Where existing ILS localizers meeting national requirements are operating on frequencies ending in even tenths of a megahertz, they shall be reassigned frequencies, conforming with 3.1.6.1 or 3.1.6.1.1 as soon as practicable and may continue operating on their present assignments only until this reassignment can be effected. 3.1.6.3 Existing ILS localizers in the international service operating on frequencies ending in odd tenths of a megahertz shall not be assigned new frequencies ending in odd tenths plus one twentieth of a megahertz except where, by regional agreement, general use may be made of any of the channels listed in 3.1.6.1 (see Volume V, Chapter 4, 4.2).		
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6. ***Environmental Requirements***

Wind Resistance

The DME antenna structures shall withstand wind velocities up to 160 km/h for operation (survival 200 km/h, survival 144 km/h with 1.5cm ice load).

Ice Loading

Ice loads up to 5cm thickness shall not cause any damage to shelter and antenna structures.

Antenna Cover

Antenna elements shall be protected by fibreglass- reinforced polyester covers.

Indoor Temperature

Indoor equipment shall operate within their specifications:

Ambient temperature	-10°C to + 55°C
Relative humidity	<95% in the range of –10°C to +35°C <60% in the range of + 35°C to 55°C

Outdoor Temperature

Outdoor equipment and material shall withstand without any damage or deformation:

Ambient temperature	-40°C to + 70°C
Relative humidity	up to 100%

Environmental Requirements

Outdoor elements, structures, shelters and others shall be designed and constructed to withstand site typical effects as salt, rain, hail, thunderstorms, attacks of small to medium animals (e.g. dogs, rabbits), without damage or noticeable deformation.

Temperature Variation

All equipment shall operate within their specifications (without damage or malfunction) during Temperature variation of up to 20°C within 24 hrs.

7. Remote Display

A remote-control input device shall allow the change of monitor and transmitter parameters.

The same software used for local maintenance of the equipment shall be used for connecting to the remote control.

The remote-control system shall have access to the results of the transmitter BIT and shall provide the capability of a remote trend analysis and a remote fault analysis.

The remote-control equipment shall have interfaces for external readout and external input of data.

The following monitoring and print out operation shall be available.

- Mains status indication
- Subsystem status indication
- Transmitter data indication
- Monitor data indication.
- Automatic recording of main status changes