ARRANGEMENT OF REGULATIONS

SCHEDULES

GRENADA

STATUTORY RULES AND ORDERS NO. 33 OF 2025

IN EXERCISE OF THE POWERS CONFERRED PURSUANT TO SECTION 49 OF THE CIVIL AVIATION ACT CAP 54A, THE DIRECTOR GENERAL HEREBY MAKES THESE REGULATIONS–

(Gazetted 31st July, 2025).

PART I

PRELIMINARY

1. Citation. These Regulations may be cited as the

CIVIL AVIATION (FLIGHT CHECKING ORGANISATIONS APPROVAL) REGULATIONS, 2025.

2. Purpose.—(1) Standards and Recommended Practices for Aeronautical Telecommunications were first adopted by the Council on 30 May 1949 pursuant to the provisions of Article 37 of the Convention on International Civil Aviation (Chicago 1944) and designated as Annex 10 to the Convention. They became effective on 1 March 1950. The Standards and Recommended Practices were based on recommendations of the Communications Division at its Third Session in January 1949.

(2) As a result of the adoption of Amendment 70 on 20 March 1995, Annex 10 was structured to include five volumes–

(a) Volume I – Radio Navigation Aids;

(b) Volume II – Communication Procedures;

(c) Volume III – Communication Systems;

(d) Volume IV – Surveillance Radar and Collision Avoidance Systems;

(e) Volume V – Aeronautical Radio Frequency Spectrum Utilization.

(3) States being signatories to the Chicago Convention have the legal obligation to transpose ICAO Annexes into civil aviation regulations. These regulations are the transpositions of Annex 10 Volume I. Volume I of Annex 10 is a technical document published by ICAO, which defines the requirement for radio navigational aids that are used for international aircraft operations.

3. Definitions. In these Regulations, unless the context otherwise requires–

"Aircraft-based augmentation system" means an augmentation system that augments and integrates the information obtained from the other global navigation satellite system elements with information available on board the aircraft;

"Air navigation services" means services provided to air traffic during all phases of operations to ensure their safe and efficient movement and includes communication services, whether ground to air or ground to ground, provided for the safety of aircraft; navigation and surveillance services among which are radios, radars and visual aids to navigation; air traffic services provided for the safety of aircraft and for the regularity of flight; aeronautical information services; meteorological services; and search and rescue services;

"Air Navigation Services Provider" means an entity providing air navigation services;

"Alert" means an indication provided to other aircraft systems or annunciation to the pilot to identify an operating parameter of a navigation system that is out of tolerance;

"Alert Limit" means the error tolerance that should not be exceeded without issuing an alert for a given parameter measurement;

"Altitude" means the vertical distance of a level, a point or an object considered as a point, measured from mean sea level;

"Angular Displacement Sensitivity" means the ratio of measured difference in depth modulation to the corresponding angular displacement from the appropriate reference line;

"Antenna Port" means a point where the received signal power is specified–

(a) for an active antenna, the antenna port is a fictitious point between the antenna elements and the antenna pre-amplifier; and

(b) for a passive antenna, the antenna port is the output of the antenna itself;

"Area navigation" or "RNAV" means a method of navigation which permits aircraft operation on any desired flight path within the coverage of ground or space-based navigation aids or within the limits of the capability of self-contained aids or a combination of these;

"Authority" means the Eastern Caribbean Civil Aviation Authority;

"Average radius of rated coverage" means the radius of a circle having the same area as the rated coverage;

"Back Course Sector" means the course sector which is situated on the opposite side of the localiser from the runway;

"Certificate" means a certificate for the provision of air navigation services issued by the Authority;

"Channel of Standard Accuracy" or "CSA" means the specified level of positioning, velocity and timing accuracy that is available to any GLONASS user on a continuous, worldwide basis;

"Control Motion Noise" or means that portion of the guidance signal error which causes control surface, wheel and column motion and could affect aircraft attitude angle during coupled flight, but does not cause aircraft displacement from the desired course or glide path;

"Course Line" means the locus of points nearest to the runway centre line in any horizontal plane at which the difference in depth of modulation is zero;

"Course sector" means a sector in a horizontal plane containing the course line and limited by the loci of points nearest to the course line at which the difference in depth of modulation is 0.155;

"Difference in Depth of Modulation" means the percentage modulation depth of the larger signal minus the percentage modulation depth of the smaller signal, divided by 100;

"DME/N" means a distance measuring equipment, primarily serving operational needs of en-route or TMA navigation, where the "N" stands for narrow spectrum characteristics;

"Effective acceptance bandwidth" means the range of frequencies with respect to the assigned frequency for which reception is;

"Effective adjacent channel rejection" means the rejection that is obtained at the appropriate adjacent channel frequency when all relevant receiver tolerances have been taken into account;

"Elevation" means the vertical distance of a point or a level, on or affixed to the surface of the earth, measured from mean sea level;

"Essential radio navigation service" means a radio navigation service whose disruption has a significant impact on operations in the affected airspace or aerodrome;

"Front Course Sector" means the course sector which is situated on the same side of the localiser as the runway;

"Global Navigation Satellite System" or "GNSS" means a worldwide position and time determination system that includes one or more satellite constellations, aircraft receivers and system integrity monitoring, augmented as necessary to support the require navigation performance for the intended operation;

"Global Navigation Satellite System" or "GLONASS" means the satellite navigation system operated by the Russian Federation.

"Global positioning system" or "GPS" means the satellite navigation system operated by the United States;

"GNSS position error" means the difference between the true position and the position determined by the GNSS receiver;

"Ground-based Augmentation System" or "GBAS" means an augmentation system in which the user receives augmentation information directly from a ground-based transmitter;

"Ground-based Regional Augmentation System" means an augmentation system in which the user receives augmentation information directly from one of a group of ground-based transmitters covering a region;

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

"Height" means the vertical distance of a level, a point or an object considered as a point, measured from a specified datum;

"Human factors principles" means principles which apply to design, certification, training, operations and maintenance and which seek safe interface between the human and other system components by proper consideration to human performance;

"ILS glide path" means that locus of points in the vertical plane containing the runway centre line at which the Difference in Depth of Modulation (DDM) is zero, which, of all such loci, is the closest to the horizontal plane;

"ILS glide path angle" means the angle between a straight line which represents the mean of the ILS glide path and the horizontal;

"ILS glide path sector" means 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;

"ILS point "A"" means 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"" means 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"" means 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;

"Initial approach mode" means the condition of DME/P operation which supports those flight operations outside the final approach region and which is interoperable with DME/N;

"Key down time" means the time during which a dot or dash of a Morse character is being transmitted;

"Locator" means an LF/MF NDB used as an aid to final approach;

"Mean power" (of a radio transmitter) means the average power supplied to the antenna transmission line by a transmitter during an interval of time sufficiently long compared with the lowest frequency encountered in the modulation taken under normal operating conditions.

Note. — A time of 1/10 second during which the mean power is greatest will be selected normally.

"Navigation specification" means a set of aircraft and flight crew requirements needed to support performance-based navigation operations within a defined airspace. There are two kinds of navigation specifications.

"Partial Rise Time" means the time as measured between 5 and 30 per cent amplitude points on the leading edge of the pulse envelope;

"Path following error" means that portion of the guidance signal error which could cause aircraft displacement from the desired course and/or glide path;

"Pressure-altitude" means an atmospheric pressure expressed in terms of altitude which corresponds to that pressure in the Standard Atmosphere;

"Protected Service Volume" means a part of the facility coverage where the facility provides a particular service in accordance with relevant SARPs and within which the facility is afforded frequency protection;

"Pulse code" means the method of differentiating between W, X, Y and Z modes and between FA and IA modes;

"Pulse Decay Time" means the time as measured between 90 and 10 per cent amplitude points on the trailing edge of the pulse envelope;

"Pulse Duration" means the time interval of 50 per cent amplitude point on leading and trailing edges of the pulse envelope;

"Pulse Rise Time" means the time as measured between 10 and 90 per cent amplitude points on the leading edge of the pulse envelope;

"Radio Navigation Service" means a service providing guidance information or position data for the efficient and safe operation of aircraft supported by one or more radio navigation aids;

"Rated coverage" means the area surrounding an NDB within which the strength of the vertical field of the ground wave exceeds the minimum value specified for the geographical area in which the radio beacon is situated;

"Reply Efficiency" means the ratio of replies transmitted by the transponder to the total of received valid interrogations;

"Search" means the condition which exists when the DME interrogator is attempting to acquire and lock onto the response to its own interrogations from the selected transponder;

"Satellite-based Augmentation System" or "SBAS" means a wide coverage augmentation system in which the user receives augmentation information from a satellite-based transmitter;

"Standard Positioning Service" means the specified level of positioning, velocity and timing accuracy that is available to any global positioning system user on a continuous, worldwide basis:

"System efficiency" means the ratio of valid replies processed by the interrogator to the total of its own interrogations

"Time-to-alert" means the maximum allowable time elapsed from the onset of the navigation system being out of tolerance until the equipment enunciates the alert;

"Touchdown" means the point where the nominal glide path intercepts the runway;

"Transmission Rate" means the average number of pulse pairs transmitted from the transponder per second;

"Two-frequency Glide Path System" means 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;

"Virtual Origin" means the point at which the straight line through the 30 per cent and 5 per cent amplitude points on the pulse leading edge intersects the 0 per cent amplitude axis;

"Z Marker Beacon" means a type of radio beacon, the emissions of which radiate in a vertical cone-shaped pattern.

Part II

GENERAL PROVISIONS FOR RADIO NAVIGATION AIDS

4. Standard radio navigation aids.—(1) The standard radio navigation aids shall be–

(a) the Instrument Landing System (ILS);

(b) the Global Navigation Satellite System (GNSS);

(c) the VHF Omnidirectional Radio Range (VOR);

(d) the Non-directional Radio Beacon (NDB);

(e) the Distance Measuring Equipment (DME); and

(f) the en-route VHF Marker Beacon.

(2) Differences in radio navigation aids in any respect from the Standards of Chapter 3 shall be published in an Aeronautical Information Publication (AIP).

(3) Wherever there is installed a radio navigation aid that is not an ILS, but which may be used in whole or in part with aircraft equipment designed for use with the ILS full details of parts that may be so used shall be published in an Aeronautical Information Publication (AIP).

(4) GNSS-specific provisions–

(a) It shall be permissible to terminate a GNSS satellite service provided by one of its elements Regulation 30 on the basis of at least a six-year advance notice by a service provider.

(5) Precision approach radar

(a) A precision approach radar (PAR) system, where installed and operated as a radio navigation aid together with equipment for two- way communication with aircraft and facilities for the efficient coordination of these elements with air traffic control, shall conform to the Standards contained in Regulation 11.

(b) The precision approach radar (PAR) element of the precision approach radar system may be installed and operated without the surveillance radar element (SRE), when it is determined that the SRE is not necessary to meet the requirements of air traffic control for the handling of aircraft.

(c) Although SRE is not considered, in any circumstances, a satisfactory alternative to the precision approach radar system, the SRE may be installed and operated without the PAR for the assistance of air traffic control in handling aircraft intending to use a radio navigation aid, or for surveillance radar approaches and departures.

(d) When a radio navigation aid is provided to support precision approach and landing, it should be supplemented, as necessary, by a source or sources of guidance information which, when used in conjunction with appropriate procedures, will provide effective guidance to, and efficient coupling (manual or automatic) with, the desired reference path.

Note.— DME, GNSS, NDB, VOR and aircraft navigation systems have been used for such purposes.

5. Ground and flight testing.—(1) Radio navigation aids of the types covered by the specifications in PART III and available for use by aircraft engaged in international air navigation shall be the subject of periodic ground and flight tests.

(2) Guidance on the ground and flight testing of ICAO standard facilities, including the periodicity of the testing, is contained in Attachment C and in the Manual on Testing of Radio Navigation Aids (Doc 8071).

6. Provision of information on the operational status of radio navigation services. Aerodrome control towers and units providing approach control service shall be provided with information on the operational status of radio navigation services essential for approach, landing and take-off at the aerodrome(s) with which they are concerned, on a timely basis consistent with the use of the service(s) involved.

7. Power supply for radio navigation aids and communication systems. Radio navigation aids and ground elements of communication systems of the types specified in these regulations shall be provided with suitable power supplies and means to ensure continuity of service consistent with the use of the service(s) involved.

8. Human Factors considerations. Human factors principles shall be observed in the design and certification of radio navigation aids.

Part III

SPECIFICATIONS FOR RADIO NAVIGATION AIDS

9. Precision approach radar.—(1) Where a precision approach radar system is installed and operated as a radio navigation aid with equipment for two-way communication with aircraft and facilities for the efficient coordination with air traffic control, the precision approach radar system shall conform to Regulation 10.

(2) Where a radio navigation aid is provided to support precision approach and landing, it shall be supplemented, as necessary, by a source of guidance information which, when used in conjunction with appropriate procedures, shall provide effective guidance to, and efficient coupling of manual or automatic with the desired reference path.

10. Composition of the precision approach radar systems.—(1) The precision approach radar system shall comprise–

(a) the precision approach radar element; and

(b) the surveillance radar element.

(2) Where the precision approach radar is only used, the installation shall be identified by the term "precision approach radar" and not by the term "precision approach radar system''.

11. The Precision Approach Radar Elements. The specifications for precision approach radar are prescribed in Schedule 1.

12. The Surveillance Radar Element of Precision Approach Radar. A surveillance radar used as the element of a precision approach radar system shall satisfy the performance requirements prescribed in Schedule 1 to these Regulations.

13. Basic Requirements for Instrument Landing System (ILS) – Composition.—(1) The instrument landing system shall comprise–

(a) VHF localiser equipment, associated monitor system, remote control and indicator equipment;

(b) UHF glide path equipment, associated monitor system, remote control and indicator equipment; and

(c) an appropriate means to enable glide path verification checks.

(2) Distance to threshold information to enable glide path verification checks shall be provided by VHF marker beacons or Distance Measuring Equipment (DME), together with associated monitor systems and remote control and indicator equipment.

(3) If one or more VHF marker beacons are used to provide distance to threshold information, the equipment shall conform to regulation 22 and where the distance measuring equipment is used in lieu of marker beacons, the equipment shall conform to the specifications in Schedule 2 to these Regulations.

14. Operational Status Indications for ILS. Instrument landing system shall provide indications at designated remote control points of the operational status of all instrument landing system ground system components, as follows–

(a) for all facility performance Category II and III instrument landing system, the air traffic services unit involved in the control of aircraft on the final approach shall and be one of the designated remote control points; and receive information on the operational status of the instrument landing system, with a delay commensurate with the requirements of the operational environment; and

(b) for a facility performance Category I instrument landing system, if that instrument landing system provides an essential radio navigation service, 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 receive information on the operational status of the instrument landing system, with a delay commensurate with the requirements of the operational environment.

15. Basic Requirements for Instrument Landing System (ILS) – Construction and Adjustment. The instrument landing system 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 instrument landing system glide path as appropriate, irrespective of the particular ground installation in use.

16. Localiser and Glide Path Components of Facility Performance Categories. The localiser and glide path components which form part of a facility performance

Category I, II and III – instrument landing systems shall comply with the requirements prescribed in Schedules 2 and 3 to these Regulations.

17. Instrument Landing System (ILS) Level of Safety. The Instrument Landing System shall be designed and maintained to ensure adequate level of safety within the performance requirements and consistent with the category of operational performance prescribed in Schedules 2, 3 and 4 to these Regulations.

18. Two Instrument Landing System (ILS) Facilities Serving Opposite Ends of a Single Runway.—(1) Where two separate instrument landing system facilities serve opposite ends of a single runway and operationally harmful interference would be present if both facilities were transmitting, an interlock shall be used.

(2) The Air Navigation Services Provider shall ensure that only one facility radiates at a time where two instrument landing systems are serving opposite ends of a runway or different runways at the airport using same paired frequencies.

(3) When switching from one instrument landing system facility to another, radiation from both shall be suppressed for not less than 20 seconds.

(4) At locations where an ILS facility and a GBAS facility serve opposite approach directions to the same runway and the approach direction in use is not the direction served by the ILS, the Air Navigation Services Provider shall ensure that the localiser does not radiate when GBAS low visibility operations that require GAST D are being conducted, except where it can be demonstrated by the Air Navigation Services Provider that the localiser signal supports compliance with the requirements of GNSS specifications.

(5) The requirements of GNSS specifications referred to in Sub-regulation (4) are requirements that define the ratio of desired, to undesired signals of GBAS and the maximum adjacent channel power tolerable by the GBAS receiver.

19. VHF Localiser and Associated Monitor Specifications. The specifications of the VHF Localiser and associated monitor are prescribed in Schedule 3 to these Regulations.

20. UHF Glide Path and Associated Monitor Specifications. The specifications of the UHF glide path and associated monitor are prescribed in Schedule 4 to these Regulations.

21. Localiser and Glide Path Frequency Pairing. The pairing of the runway localiser and glide path transmitter frequencies of an instrument landing system are prescribed in Schedule 4 to these Regulations.

22. VHF Marker Beacons Specifications. The specifications of the VHF marker beacons are prescribed in Schedule 2 to these Regulations.

23. VHF Omni Directional Range (VOR) Specifications. The specifications of the VHF omni-directional range specifications are prescribed in Schedule 5 to these Regulations.

24. Non-directional Radio Beacon (NDB) Specifications. The specifications of the non-directional radio beacon specifications are prescribed in Schedule 6 to these Regulations.

25. UHF Distance Measuring Equipment (DME) – Purpose. The distance measuring equipment system shall provide for continuous and accurate indication in the cockpit of the slant range distance of an equipped aircraft from an equipped ground reference point.

26. Distance Measuring Equipment Composition.—(1) The system shall comprise two basic components, one fitted in the aircraft and the other installed on the ground.

(2) The component fitted in the aircraft shall be referred to as the interrogator whereas the component installed on the ground shall be referred to as the transponder.

(3) In operation, interrogators shall interrogate transponders which shall, in turn, transmit to the interrogator replies synchronized with the interrogations, thus providing means for accurate measurement of distance.

27. UHF Distance Measuring Equipment (DME) Specifications. The specifications of the UHF distance measuring equipment are prescribed in Schedule 7 to these Regulations.

28. Enroute VHF Marker Beacon 75 MHz Specifications. The specifications of the Enroute VHF marker beacon 75 MHz are prescribed in Schedule 8 to these Regulations.

29. Functions of Global Navigation Satellite System. The Air Navigation Services Provider shall ensure that the global navigation satellite system provides position and time data to the aircraft.

30. Global Navigation Satellite System Elements. The Air Navigation Services Provider shall provide the global navigation satellite system navigation service using various combinations of the elements listed hereunder, installed on the ground, on satellites or on board the aircraft–

(a) global positioning system (GPS) that provides the standard positioning service (SPS);

(b) global navigation satellite system (GLONASS) that provides the channel of standard accuracy (CSA) navigation signal;

(c) aircraft-based augmentation system (ABAS);

(d) satellite-based augmentation system (SBAS);

(e) ground-based augmentation system (GBAS);

(f) ground-based regional augmentation system (GRAS); and

(g) aircraft global navigation satellite system receiver.

31. Space and Time Reference.—(1) The position information provided by the global navigation satellite system to the user shall be expressed in terms of the World Geodetic System-1984 (WGS-84) geodetic reference datum.

(2) The time data provided by the global navigation satellite system to the user shall be expressed in a time scale that takes the Coordinated Universal Time (UTC) as reference.

32. Signal-in-Space Performance. The combination of global navigation satellite system elements and a fault-free global navigation satellite system user receiver shall meet the signal-in-space requirements prescribed in Schedule 9 to these Regulations.

33. Global Navigation Satellite System Elements Specifications. The specifications of the global navigation satellite system elements are prescribed in Schedule 9 to these Regulations.

34. Resistance to Interference. Global navigation satellite system shall comply with performance requirements prescribed in Schedule 9 to these Regulations.

35. System Characteristics of Airborne ADF Receiving Systems. The system characteristics for airborne ADF receiving systems shall conform to the requirements prescribed in Schedule 10 to these Regulations.

SCHEDULE 1

(regulations 11 and 12)

SPECIFICATION FOR PRECISION APPROACH RADAR SYSTEM

The precision approach radar element (PAR) Coverage

1. (a) The PAR shall be capable of detecting and indicating the position of an aircraft of 15 m^2 echoing area or larger, which is within a space bounded by a 20-degree azimuth sector and a 7-degree elevation sector, to a distance of at least 16.7 km (9 NM) from its respective antenna.

(b) For guidance in determining the significance of the echoing areas of aircraft, the following shall be included—

(i) private flyer (single-engined): 5 to 10 m^2;

(ii) small twin-engined aircraft: from 15 m^2;

(iii) medium twin-engined aircraft: from 25 m^2; or

(iv) four-engined aircraft: from 50 to 100 m^2.

Sitting

2. The PAR shall be sited and adjusted to give complete coverage of a sector with its apex at a point 150 m (500 ft) from the touchdown in the direction of the stop end of the runway and extending plus or minus 5 degrees about the runway centre line in azimuth and from minus 1 degree to plus 6 degrees in elevation.

Accuracy

3. (a) ***Azimuth accuracy*** - *Azimuth* information shall be displayed in such a manner that left-right deviation from the on-course line shall be easily observable. The maximum permissible error with respect to the deviation from the on-course line shall be either 0.6 per cent of the distance from the PAR antenna plus 10 per cent of the deviation from the on-course line or 9 m (30 ft), whichever is greater. The equipment shall be so sited that the error at the touchdown shall not exceed 9 m (30 ft). The equipment shall be so aligned and adjusted that the displayed error at the touchdown shall be a minimum and shall not exceed 0.3 per cent of the distance from the PAR antenna or 4.5 m (15 ft), whichever is greater. It shall be possible to resolve the positions of two aircraft which are at 1.2 degrees in azimuth of one another.

(b) ***Elevation accuracy*** - Elevation information shall be displayed in such a manner that up-down deviation from the descent path for which the equipment is set shall be easily observable. The maximum permissible error with respect to the deviation from the on-course line shall be 0.4 per cent of the distance from the PAR antenna plus 10 per cent of the actual linear displacement from the chosen descent path or 6 m (20 ft), whichever is greater. The equipment shall be so sited that the error at the touchdown shall not exceed 6 m (20 ft). The equipment shall be so aligned and adjusted that the displayed error at the touchdown shall be a minimum and shall not exceed 0.2 per cent of the distance from the PAR antenna or 3 m (10 ft), whichever is greater. It shall be possible to resolve the positions of two aircraft that are at 0.6 degree in elevation of one another.

(c) ***Distance accuracy*** - The error in indication of the distance from the touchdown shall not exceed 30 m (100 ft) plus 3 per cent of the distance from the touchdown. It shall be possible to resolve the positions of two aircraft which are at 120 m (400 ft) of one another on the same azimuth.

(4) Information shall be made available to permit the position of the controlled aircraft to be established with respect to other aircraft and obstructions. Indications shall also permit appreciation of ground speed and rate of departure from or approach to the desired flight path.

(5) Information shall be completely renewed at least once every second.

2. **The surveillance radar element (SRE)**

(1) Coverage

(a) The SRE shall be capable of detecting aircraft of 15 m^2 echoing area and larger, which are in line of sight of the antenna within a volume described as follows: The rotation through 360 degrees about the antenna of a vertical plane surface bounded by a line at an angle of 1.5 degrees above the horizontal plane of the antenna, extending from the antenna to 37 km (20 NM); by a vertical line at 37 km (20 NM) from the intersection with the 1.5-degree line up to 2 400 m (8 000 ft) above the level of the antenna; by a horizontal line at 2 400 m (8 000 ft) from 37 km (20 NM) back towards the antenna to the intersection with a line from the antenna at 20 degrees above the horizontal plane of the antenna, and by a 20-degree line from the intersection with the 2 400 m (8 000 ft) line to the antenna.

(b) Efforts shall be made in development to increase the coverage on an aircraft of 15 m^2 echoing area to at least the volume obtained by amending Paragraph 2.(1)(a) with the following substitutions—

(i) for 1.5 degrees, read 0.5 degree;

(ii) for 37 km (20 NM), read 46.3 km (25 NM);

(iii) for 2 400 m (8 000 ft), read 3 000 m (10 000 ft); and

(iv) for 20 degrees, read 30 degrees.

(2) Accuracy

(a) Azimuth accuracy. The indication of position in azimuth shall be within plus or minus 2 degrees of the true position. It shall be possible to resolve the positions of two aircraft which are at 4 degrees of azimuth of one another.

(b) Distance accuracy. The error in distance indication shall not exceed 5 per cent of true distance or 150 m (500 ft), whichever is the greater. It shall be possible to resolve the positions of two aircraft that are separated by a distance of 1 per cent of the true distance from the point of observation or 230 m (750 ft), whichever is the greater.

(c) The error in distance indication shall not exceed 3 per cent of the true distance or 150 m (500 ft), whichever is the greater.

(d) The equipment shall be capable of completely renewing the information concerning the distance and azimuth of any aircraft within the coverage of the equipment at least once every 4 seconds.

(e) Efforts shall be made to reduce, as far as possible, the disturbance caused by ground echoes or echoes from clouds and precipitation.

SCHEDULE 2

SPECIFICATION FOR VHF MARKER BEACONS

1. **General**

(1) There shall be two marker beacons in each installation except where, in the opinion of the Competent Authority, a single marker beacon is considered to be sufficient. A third marker beacon may be added whenever, in the opinion of the Competent Authority, an additional beacon is required because of operational procedures at a particular site.

(2) The marker beacons shall conform to the requirements prescribed in this Schedule. When the installation comprises only two marker beacons, the requirements applicable to the middle marker and to the outer marker shall be complied with. When the installation comprises only one marker beacon, the requirements applicable to either the middle or the outer marker shall be complied with. If marker beacons are replaced by DME, the requirements of paragraph 6 (6) shall apply.

(3) The marker beacons shall produce radiation patterns to indicate predetermined distance from the threshold along the ILS glide path.

(4) When a marker beacon is used in conjunction with the back course of a localiser, it shall conform with the marker beacon characteristics specified in this Schedule.

(5) Identification signals of marker beacons used in conjunction with the back course of a localiser shall be clearly distinguishable from the inner, middle and outer marker beacon identifications, as prescribed in paragraph 5.

Radio frequency

2. The marker beacons shall operate at 75 MHz with a frequency tolerance of plus or minus 0.005 per cent and shall utilize horizontal polarisation.

Coverage

3. The marker beacon system shall be adjusted to provide coverage over the following distances, measured on the ILS glide path and localiser course line—

(a) *inner marker:* 150 m plus or minus 50 m (500 ft plus or minus 160 ft);

(b) *middle marker:* 300 m plus or minus 100 m (1 000 ft plus or minus 325 ft);

(c) *outer marker:* 600 m plus or minus 200 m (2 000 ft plus or minus 650 ft).

(2) The field strength at the limits of coverage specified in subparagraph (1) shall be 1.5 millivolts per metre (minus 82 dBW/m^2). In addition, the field strength within the coverage area shall rise to at least 3.0 millivolts per metre (minus 76 dBW/m^2).

Modulation

4. The modulation frequencies shall be as follows—

(a) *inner marker:* 3 000 Hz;

(b) *middle marker:* 1 300 Hz;

(c) *outer marker:* 400 Hz.

The frequency tolerance of the above frequencies shall be plus or minus 2.5 per cent, and the total harmonic content of each of the frequencies shall not exceed 15 per cent.

(2) The depth of modulation of the markers shall be 95 per cent plus or minus 4 per cent.

Identification
5. The carrier energy shall not be interrupted. The audio frequency modulation shall be keyed as follows—

(a) *inner marker:* 6 dots per second continuously;

(b) *middle marker:* a continuous series of alternate dots and dashes, the dashes keyed at the rate of 2 dashes per second, and the dots at the rate of 6 dots per second;

(c) *outer marker:* 2 dashes per second continuously. These keying rates shall be maintained to within plus or minus 15 per cent.

Siting
6. (1) The inner marker shall be located so as to indicate in low visibility conditions the imminence of arrival at the runway threshold.

(a) If the radiation pattern is vertical, the inner marker shall be located between 75 m (250 ft) and 450 m (1 500 ft) from the threshold and at not more than 30 m (100 ft) from the extended centre line of the runway.

(a) If the radiation pattern is other than vertical, the equipment shall be located so as to produce a field within the course sector and ILS glide path sector that is substantially similar to that produced by an antenna radiating a vertical pattern and located as prescribed in subparagraph (a).

(2) The middle marker shall be located so as to indicate the imminence, in low visibility conditions, of visual approach guidance.

(a) If the radiation pattern is vertical, the middle marker shall be located 1 050 m (3 500 ft) plus or minus 150 m (500 ft), from the landing threshold at the approach end of the runway and at not more than 75 m (250 ft) from the extended centre line of the runway.

(b) If the radiation pattern is other than vertical, the equipment shall be located so as to produce a field within the course sector and ILS glide path sector that is substantially similar to that produced by an antenna radiating a vertical pattern and located as prescribed in subparagraph (a).

(3) The outer marker shall be located so as to provide height, distance and equipment functioning checks to aircraft on intermediate and final approach.

(4) The outer marker shall be located 7.2 km (3.9 NM) from the threshold except that, where for topographical or operational reasons this distance is not practicable, the outer marker may be located between 6.5 and 11.1 km (3.5 and 6 NM) from the threshold.

(5) If the radiation pattern is vertical, the outer marker shall be not more than 75 m (250 ft) from the extended centre line of the runway. If the radiation pattern is other than vertical, the equipment shall be located so as to produce a field within the course sector and ILS glide path sector that is substantially similar to that produced by an antenna radiating a vertical pattern.

(6) The positions of marker beacons, or where applicable, the equivalent distance(s) indicated by the DME when used as an alternative to part or all of the marker beacon component of the ILS, shall be published in accordance with the Civil Aviation (Aeronautical Information Services) Regulations, 2025.

(a) When so used, the DME shall provide distance information operationally equivalent to that furnished by marker beacon(s);

(b) When used as an alternative for the middle marker, the DME shall be frequency paired with the ILS localiser and sited to minimize the error in distance information; and

(c) The DME in Sub-paragraph (5) shall conform to the specification Schedule 7.

Monitoring

7. (1) Suitable equipment shall provide signals for the operation of an automatic monitor and the monitor shall transmit a warning to a control point if either of the following conditions arise—

(a) failure of the modulation or keying; or

(b) reduction of power output to less than 50 per cent of normal.

(2) For each marker beacon, suitable monitoring equipment shall be provided which will indicate at the appropriate location a decrease of the modulation depth below 50 per cent.

Integrity and continuity of service for an ILS ground equipment

8. (1) Note

(a) This paragraph is intended to provide clarification of the integrity and continuity of service objectives of ILS localiser and glide path ground equipment and to provide guidance on engineering design and system characteristics of this equipment. Integrity is needed to ensure that an aircraft on approach will have a low probability of receiving false guidance; continuity of service is needed to ensure that an aircraft in the final stages of approach will have a low probability of being deprived of a guidance signal. Integrity and continuity of service are both key safety factors during the critical phase of approach and landing. The integrity and continuity of service must as of necessity be known from an operational view point in order to decide the operational application which an ILS could support.

(b) It is generally accepted, irrespective of the operational objective, that the average rate of a fatal accident during landing, due to failures or shortcomings in the whole system, comprising the ground equipment, the aircraft and the pilot, should not exceed 1 × 10–7. This criterion is frequently referred to as the global risk factor.

(c) In the case of Category I operations, responsibility for assuring that the above objective is not exceeded is vested more or less completely in the pilot. In Category III operations, the same objective is required but must now be inherent in the whole system. In this context it is of the utmost importance to endeavour to achieve the highest level of integrity and continuity of service of the ground equipment.

(d) The requirements for integrity and high continuity of service require highly reliable systems to minimize the probability of failure which may affect any characteristic of the total signal-in-space. It is suggested that Uganda endeavours to achieve reliability with as large a margin as is technically and economically reasonable.

Reliability of equipment is governed by basic construction and operating environment. Equipment design should employ the most suitable engineering techniques, materials and components, and rigorous inspection should be applied in manufacture. Equipment should be operated in environmental conditions appropriate to the manufacturers' design criteria.

(2) Achievement and retention of integrity service levels—

(a) An integrity failure can occur if radiation of a signal which is outside specified tolerances is either unrecognised by the monitoring equipment or the control circuits fail to remove the faulty signal. Such a failure might constitute a hazard if it results in a gross error.

(b) Clearly not all integrity failures are hazardous in all phases of the approach. For example, during the critical stages of the approach, undetected failures producing gross errors in course width or course line shifts are of special significance whereas an undetected change of modulation depth, or loss of localiser and glide slope clearance and localiser identification would not necessarily produce a hazardous situation. The criterion in assessing which failure modes are relevant must however include all those deleterious fault conditions which are not unquestionably obvious to the automatic flight system or pilot.

(c) The highest order of protection is required against the risk of undetected failures in the monitoring and associated control system. This would be achieved by careful design to reduce the probability of such occurrences to a low level and provide fail-safe operations compliant with Sub-paragraph 11 (5) of Schedule 3 and Sub-paragraph 7 (4) of Schedule 4 and by carrying out maintenance checks on the monitor system performance at intervals which are determined by a design analysis.

(d) A design analysis can be used to calculate the level of integrity of the system in any one landing. The following formula applies to certain types of ILS and provides an example of the determination of system integrity, I, from a calculation of the probability of transmission of undetected erroneous radiation, P.

$I = 1 - P$

$P = \frac{T_1 T_2}{\alpha_1 \alpha_2 M_1 M_2}$ when $T_1 < T_2$

where

I = integrity

P = the probability of a concurrent failure in transmitter and monitor systems resulting in erroneous undetected radiation

M_1 = transmitter mean time between failures (MTBF)

M_2 = MTBF of the monitoring and associated control system

$\frac{1}{\alpha_1}$ = ratio of the rate of failure in the transmitter resulting in the radiation of an erroneous signal to the rate of all transmitter failures

T_1 = period of time (in hours) between transmitter checks

T_2 = period of time (in hours) between checks on the monitoring and associated control system

When $T_1 \geq T_2$ the monitor system check may also be considered a transmitter check. In this case, therefore $T_1 = T_2$ and the formula would be:

$$P = \frac{T_2^2}{\alpha_1 \alpha_2 M_1 M_2}$$

(e) Since the probability of occurrence of an unsafe failure within the monitoring or control equipment is extremely remote, to establish the required integrity level with a high degree of confidence would necessitate an evaluation period many times that needed to establish the equipment MTBF. Such a protracted period is unacceptable and therefore the required integrity level can only be predicted by rigorous design analysis of the equipment.

(f) Protection of the integrity of the signal-in-space against degradation which can arise from extraneous radio interference falling within the ILS frequency band or from re-radiation of ILS signals must also be considered. With regard to radio interference it may be necessary to confirm periodically that the level of interference does not constitute a hazard.

(g) In general, monitoring equipment design is based on the principle of continuously monitoring the radiated signals-in-space at specific points within the coverage volume to ensure their compliance with the Standards specified at paragraph 11 of Schedule 3 and paragraph 7 (1) of Schedule 4 of these Regulations. Although such monitoring provides to some extent an indication that the signal-in-space at all other points in the coverage volume is similarly within tolerance, this is largely inferred. It is essential therefore to carry out rigorous flight and ground inspections at periodic intervals to ensure the integrity of the signal-in-space throughout the coverage volume.

(3) Achievement and retention of continuity of service levels—

(a) A design analysis should be used to predict the MTBF and continuity of service of the ILS equipment. Before assignment of a level of continuity of service and introduction into Category II or III service, however, the mean time between outages (MTBO) of the ILS should be confirmed by evaluation in an operational environment. In this evaluation, an outage is defined as any unanticipated cessation of signal-in-space. This evaluation takes into account the impact of operational factors, i.e. airport environment, inclement weather conditions, power availability, quality and frequency of maintenance. MTBO is related to MTBF, but is not equivalent, as some equipment failures, such as a failure of a transmitter resulting in the immediate transfer to a standby transmitter may not necessarily result in an outage. For continuity of service Level 2, 3 or 4, the evaluation period should be sufficient to determine achievement of the required level with a high degree of confidence. One method to demonstrate that continuity standards are met is the sequential test method. If this method is used, the following considerations apply—

(i) the minimum acceptable confidence level is 60 per cent. To achieve the confidence level of 60 per cent, the evaluation period has to be longer than the required MTBO hours. Typically, these minimal evaluation periods for new and subsequent installations are for Level 2, 1 600 operating hours, for Level 3, 3 200 hours and for Level 4, 6 400 hours. To assess the seasonal influence of the environment, a minimal evaluation period of one year is typically required for a new type of installation in a particular environment. It may be possible to reduce this period in cases where the operating environment is well controlled and similar to other proven installations. Where several identical systems are being operated under similar conditions, it may be possible to base the assessment on the cumulative operating hours of all the systems; this will result in a reduced evaluation period. Once a higher confidence level is obtained for a type of installation, subsequent installation of the same type of equipment under similar operational and environmental conditions may follow shorter evaluation periods;

(ii) during the evaluation period, it should be decided for each outage if it is caused by a design failure or if it is caused by a failure of a component due to its normal failure rate. Design failures are, for instance, operating components beyond their specification (overheating, overcurrent, overvoltage, etc. conditions). These design failures should be dealt with such that the operating condition is brought back to the normal operating condition of the component or that the component is replaced with a part suitable for the operating conditions. If the design failure is treated in this way, the evaluation may continue and this outage is not counted, assuming that there is a high probability that this design failure will not occur again. The same applies to outages due to any causes which can be mitigated by permanent changes to the operating conditions.

(b) An assigned continuity of service level should not be subject to frequent change. A suitable method to assess the behaviour of a particular installation is to keep the records and calculate the average MTBO over the last five to eight failures of the equipment. This weighs the MTBO for continuity of service purposes to be more relevant to the next approach, rather than computing MTBO over the lifetime of the equipment. If continuity of service deteriorates, the assigned designation should be reduced until improvements in performance can be effected.

(4) The following configuration is an example of a redundant equipment arrangement that is likely to meet the objectives for integrity and continuity of service Levels 3 and 4. The localiser and glide path facilities each consist of two continuously operating transmitters, one connected to the antenna and the standby connected to a dummy load. With these transmitters is associated a monitor system performing the following functions—

(a) confirming proper operation within the specified limits of the main transmitter and antenna system by means of majority voting among redundant monitors;

(b) confirming operation of the standby equipment;

(c) whenever the monitor system rejects one of the equipment, the facility continuity of service level will be reduced because the probability of cessation of signal consequent on failure of other equipment will be increased and this change of performance must be automatically indicated at remote locations;

(d) an identical monitoring arrangement to the localiser is used for the glide path facility;

(e) to reduce mutual interference between the main and standby transmitters any stray radiation from the latter is at least 50 dB below the carrier level of the main transmitter measured at the antenna system;

(f) in the case of subparagraph (e), the equipment would include provision to facilitate monitoring system checks at intervals specified by the manufacturer, consequent to the design analysis, to ensure attainment of the required integrity level. Such checks, which can be manual or automatic, provide the means to verify correct operation of the monitoring system including the control circuitry and changeover switching system. The advantage of adopting an automatic monitor integrity test is that no interruption to the operational service provided by the localiser or glide path is necessary. It is important when using this technique to ensure that the total duration of the check cycle is short enough not to exceed the total period specified in paragraph 11 (5) of Schedule 3 or paragraph 7 (4) of Schedule 4.

(g) Interruption of facility operation due to primary power failures is avoided by the provision of suitable standby supplies, such as batteries or “no-break” generators. Under these conditions, the facility should be capable of continuing in operation over the period when an aircraft may be in the critical stages of the approach. Therefore, the standby supply should have adequate capacity to sustain service for at least two minutes.

(h) Warnings of failures of critical parts of the system, such as the failure of the primary power supply, must be given at the designated control points.

(i) In order to reduce failure of equipment that may be operating near its monitor tolerance limits, it is useful for the monitor system to include provision to generate a pre-alarm warning signal to the designated control point when the monitored parameters reach a limit equal to a value in the order of 75 per cent of the monitor alarm limit.

(j) An equipment arrangement similar to that in this paragraph, but with no transmitter redundancy, would normally be expected to achieve the objectives for continuity of service Level 2.

(5) Guidance relating to localiser far field monitors is given below.

(a) Far field monitors are provided to monitor course alignment but may also be used to monitor course sensitivity. A far field monitor operates independently from integral and near field monitors. Its primary purpose is to protect against the risk of erroneous setting-up of the localiser, or faults in the near field or integral monitors. In addition, the far field monitor system will enhance the ability of the combined monitor system to respond to the effects of physical modification of the radiating elements or variations in the ground reflection characteristics. Moreover, multipath effects and runway area disturbances not seen by near field and integral monitors, and some occurrences of radio interferences may be substantially monitored by using a far field monitoring system built around a suitable receiver, installed under the approach path.

(b) A far field monitor is generally considered essential for Category III operations, while for Category II it is generally considered to be desirable. Also for Category I installations, a far field monitor has proved to be a valuable tool to supplement the conventional monitor system.

(c) The signal received by the far field monitor will suffer short-term interference effects caused by aircraft movements on or in the vicinity of the runway and experience has shown that it is not practical to use the far field monitor as an executive monitor. When used as a passive monitor, means must be adopted to minimize such temporary interference effects and to reduce the occurrence of nuisance downgrade indications; some methods of achieving this are covered in subparagraph (e). The response of the far field monitor to interference effects offers the possibility of indicating to the air traffic control point when temporary disturbance of the localiser signal is present. However, experience has shown that disturbances due to aircraft movements may be present along the runway, including the touchdown zone, and not always be observed at the far field monitor. It must not be assumed, therefore, that a far field monitor can provide comprehensive surveillance of aircraft movements on the runway.

(d) Additional possible applications of the far field monitor are as follows—

(i) it can be a useful maintenance aid to verify course and/or course deviation sensitivity in lieu of a portable far field monitor; and

(ii) it may be used to provide a continuous recording of far field signal performance showing the quality of the far field signal and the extent of signal disturbance.

(e) Possible methods of reducing the occurrence of nuisance downgrade indications include—

(i) incorporation of a time delay within the system adjustable from 30 to 240 seconds;

(ii) the use of a validation technique to ensure that only indications not affected by transitory disturbances are transmitted to the control system; and

(iii) use of low pass filtering.

(f) A typical far field monitor consists of an antenna, VHF receiver and associated monitoring units which provide indications of DDM, modulation sum, and RF signal level. The receiving antenna is usually of a directional type to minimise unwanted interference and should be at the greatest height compatible with obstacle clearance limits. For course line monitoring, the antenna is usually positioned along the extended runway centre line. Where it is desired to also monitor displacement sensitivity, an additional receiver and monitor are installed with antenna suitably positioned to one side of the extended runway centre line. Some systems utilize a number of spatially separated antennas.

SCHEDULE 3

(regulations 16, 17 and 19)

SPECIFICATIONS FOR VHF LOCALISER AND ASSOCIATED MONITOR (FOR ILS)

Introduction

The specifications in this Schedule cover Instrument Landing System localisers providing either positive guidance information over 360 degrees of azimuth or providing such guidance only within a specified portion of the front coverage.

Where Instrument Landing System localisers providing positive guidance information in a limited sector are installed, information from some suitably located navigation aid, together with appropriate procedures, will generally be required to ensure that any misleading guidance information outside the sector is not operationally significant.

1. **General**

(1) The radiation from the localiser 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.

(2) When an observer faces the localiser 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) All horizontal angles employed in specifying the localiser field patterns shall originate from the centre of the localiser antenna system which provides the signals used in the front course sector.

2. **Radio frequency**

(1) The localiser 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.

(2) The emission from the localiser shall be horizontally polarised. The vertically polarised 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) For Facility Performance Category II localisers, the vertically polarised component of the radiation on the course line shall not exceed that which corresponds to a DDM error of 0.008 when an aircraft is positioned on the course line and is in a roll attitude of 20 degrees from the horizontal.

(4) For Facility Performance Category III localisers, the vertically polarised 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.

(5) For Facility Performance Category III localisers, 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.

3. **Coverage**

(1) The localiser shall provide signals sufficient to allow satisfactory operation of a typical aircraft installation within the localiser and glide path coverage sectors. The localiser coverage sector shall extend from the centre of the localiser antenna system to distances of—

(a) 46.3 km (25 NM) within plus or minus 10 degrees from the front course line;

(b) 31.5 km (17 NM) between 10 degrees and 35 degrees from the front course line; or

(c) 18.5 km (10 NM) outside of plus or minus 35 degrees if coverage is provided,

except that, where topographical features dictate or operational requirements permit, the limits may be reduced 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 facilities provide satisfactory coverage within the intermediate approach area. The localiser 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. Such signals shall be receivable, to the distances specified, up to a surface extending outward from the localiser antenna and inclined at 7 degrees above the horizontal.

(2) In all parts of the coverage volume specified in subparagraph (1) other than as specified in subparagraph (a) (b), and (c) of this paragraph, the field strength shall be not less than 40 microvolts per metre (minus 114 dBW/m^2). This minimum field strength shall be required to permit satisfactory operational usage of ILS localiser facilities as follows—

(a) for Facility Performance Category I localisers, the minimum field strength on the ILS glide path and within the localiser course sector from a distance of 18.5 km (10 NM) to a height of 30 m (100 ft) above the horizontal plane containing the threshold shall be not less than 90 µv per metre (minus 107 dBW/m2);

(b) for Facility Performance Category II localisers, the minimum field strength on the ILS glide path and within the localiser course sector shall be not less than 100 µv per metre (minus 106 dBW/m^2) at a distance of 18.5 km (10 NM) increasing to not less than 200 µv per metre (minus 100 dBW/m2) at a height of 15 m (50 ft) above the horizontal plane containing the threshold;

(c) for Facility Performance Category III localisers, the minimum field strength on the ILS glide path and within the localiser course sector shall be not less than 100 µv per metre (minus 106 dBW/m2) at a distance of 18.5 km (10 NM), increasing to not less than 200 µv per metre (minus 100 dBW/m^2) 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 localiser, and thereafter at a height of 4 m (12 ft) along the length of the runway in the direction of the localiser, the field strength shall be not less than 100 µv per metre (minus 106 dBW/m^2).

(3) When coverage is achieved by a localiser 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 in subparagraph (1) shall not be less than 10 dB.

(4) For Facility Performance Category III localisers, the ratio of the two carrier signal strengths in space within the front course sector shall not be less than 16 dB.

4. **Course structure**

(1) For Facility Performance Category I localisers, bends in the course line shall not have amplitudes which exceed the following—

Zone	Amplitude (DDM) (95% probability)
Outer limit of coverage to ILS point "A"	0.031
ILS point "A" to ILS point "B"	0.31 at ILS point "A" decreasing at a linear rate to 0.015 at ILS point "B"
ILS point "B" to ILS point "C"	0.015

For Facility Performance Categories II and III localisers, bends in the course line shall not have amplitudes which exceed the following—

Zone	Amplitude (DDM) (95%probability)
Outer limit of coverage to ILS point "A"	0.031
ILS point "A" to ILS point "B"	0.031 at ILS point "A" decreasing at a linear rate to 0.005 at ILS point "B"
ILS point "B" to the ILS reference datum	0.005

And for facility performance category III only

Zone	Amplitude (DDM) (95% probability)
ILS reference datum to ILS point "D"	0.005
ILS point "D" to ILS point "E"	0.005 ILS point "D" increasing at a linear rate to 0.010 at ILS point "E"

5. **Carrier modulation**

(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.

(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 percent.

(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 percent;

(b) the modulating tones shall be 90 Hz and 150 Hz within plus or minus 1.5 percent for Facility Performance Category II installations;

(c) the modulating tones shall be 90 Hz and 150 Hz within plus or minus 1 percent for Facility Performance Category III installations;

(d) the total harmonic content of the 90 Hz tone shall not exceed 10 percent; additionally, for Facility Performance Category III localisers, the second harmonic of the 90 Hz tone shall not exceed 5 percent; or

(e) the total harmonic content of the 150 Hz tone shall not exceed 10 percent.

(4) For Facility Performance Category I-ILS, the modulating tones shall be 90 Hz and 150 Hz within plus or minus 1.5 percent.

(5) For Facility Performance Category III localisers, 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 percent. 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.

(6) 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—

(a) for Facility Performance Categories I and II localisers: 20 degrees; and

(b) for Facility Performance Category III localisers: 10 degrees,

of phase relative to the 150 Hz component, every half cycle of the combined 90 Hz and 150 Hz wave form.

(7) With two-frequency localiser systems, subparagraph (6) 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—

(a) for Facility Performance Categories I and II localisers: 20 degrees; and

(b) for Facility Performance Category III localisers: 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—

(i) for Facility Performance Categories I and II localisers: 20 degrees; and

(ii) for Facility Performance Category III localisers: 10 degrees, of phase relative to 150 Hz.

(8) Alternative two-frequency localiser systems that employ audio phasing different from the normal in-phase conditions described in subparagraph (7) 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 subparagraph (7).

(9) For the equipment first installed after 1 January 2000, the sum of the modulation depths of the radio frequency carrier due to the 90 Hz and 150 Hz tones shall not exceed 60 percent or be less than 30 percent within the required coverage.

(10) When utilising a localiser for radiotelephone communications, the sum of the modulation depths of the radio frequency carrier due to the 90 Hz and 150 Hz tones shall not exceed 65 percent within 10 degrees of the course line and shall not exceed 78 percent at any other point around the localiser.

6. **Course alignment accuracy**

(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—

(a) for Facility Performance Category I localisers: plus or minus 10.5 m (35 ft), or the linear equivalent of 0.015 DDM, whichever is less;

(b) for Facility Performance Category II localisers: plus or minus 7.5 m (25 ft);

(c) for Facility Performance Category III localisers: plus or minus 3 m (10 ft).

(2) For Facility Performance Category II localisers, the mean course line shall be adjusted and maintained within limits equivalent to plus or minus 4.5 m (15 ft) displacement from runway centre line at the ILS reference datum.

7. **Displacement sensitivity**

(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 except that for Facility Performance Category I localisers, where the specified nominal displacement sensitivity cannot be met, the displacement sensitivity shall be adjusted as near as possible to that value. For Facility Performance Category I localisers on runway codes 1 and 2, the nominal displacement sensitivity shall be achieved at the Instrument Landing System Point "B". The maximum course sector angle shall not exceed six degrees.

(2) The lateral displacement sensitivity shall be adjusted and maintained within the limits of plus or minus—

(a) 17 per cent of the nominal value for Facility Performance Categories I and II;

(b) 10 per cent of the nominal value for Facility Performance Category III.

(3) For Facility Performance Category II- Instrument Landing System, displacement sensitivity shall be adjusted and maintained within the limits of plus or minus 10 percent.

(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.

8. **Voice**

(1) Facility Performance Categories I and II localisers may provide a ground-to-air radiotelephone communication channel to be operated simultaneously with the navigation and identification signals, provided that such operation shall not interfere in any way with the basic localiser function.

(2) Facility Performance Category III localisers shall not provide such a channel, except where extreme care has been taken in the design and operation of the facility to ensure that there is no possibility of interference with the navigational guidance.

(3) If the channel is provided, it shall conform to with the following standards—

(a) Be on the same radio frequency carrier or carriers as used for the localiser function and the radiation shall be horizontally polarized. Where two carriers are modulated with speech, the relative phases of the modulations on the two carriers shall be such as to avoid the occurrence of nulls within the coverage of the localiser.

(b) The peak modulation depth of the carrier or carriers due to the radiotelephone communications shall not exceed 50 percent but shall be adjusted so that—

(i) the ratio of peak modulation depth due to the radiotelephone communications to that due to the identification signal is approximately 9:1;

(ii) the sum of modulation components due to use of the radiotelephone channel, navigation signals and identification signals shall not exceed 95 percent.

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

9. **Identification**

(1) The localiser 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 localiser function. The transmission of the identification signal shall not interfere in any way with the basic localiser function.

(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 paragraph 8(3)(b)). The emissions carrying the identification signal shall be horizontally polarised. 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 localiser.

(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.

(4) The identification signal shall be transmitted by dots and dashes at a speed corresponding to approximately n 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 localiser is available for operational use. When the transmissions of the localiser 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.

10. **Sitting**

(1) For Facility Performance Categories II and III, the localiser 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.

(2) For Facility Performance Category I, the localiser antenna system shall be located and adjusted as in subparagraph (1), unless site constraints dictate that the antenna be offset from the centre line of the runway.

(3) The offset localiser system shall be located and adjusted in accordance with the offset Instrument Landing System provisions of the ICAO *Procedures for Air Navigation Services — Aircraft Operations* (PANS-OPS) (Doc 8168), Volume II, and the localiser standards shall be referenced to the associated fictitious threshold point.

11. **Monitoring**

(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 subparagraph (4)(a) if any of the conditions stated in subparagraph (2) persist—

(a) radiation to cease; and

(b) removal of the navigation and identification components from the carrier.

(2) The conditions requiring initiation of monitor action shall be the following—

(a) for Facility Performance Category I localisers, a shift of the mean course line from the runway centre line equivalent to more than 10.5 m (35 ft), or the linear equivalent to 0.015 DDM, whichever is less, at the Instrument Landing System reference datum;

(b) for Facility Performance Category II localisers, a shift of the mean course line from the runway centre line equivalent to more than 7.5 m (25 ft) at the Instrument Landing System reference datum;

(c) for Facility Performance Category III localisers, a shift of the mean course line from the runway centre line equivalent to more than 6 m (20 ft) at the Instrument Landing System reference datum;

(d) in the case of localisers 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 paragraphs 3, 4 or 5 are no longer satisfied, or to a level that is less than 50 percent of the normal level (whichever occurs first);

(e) in the case of localisers 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 percent of normal, except that a greater reduction to between 80 percent and 50 percent of normal may be permitted, provided the localiser continues to meet the requirements of paragraphs 3, 4 and 5;

(f) Change of displacement sensitivity to a value differing by more than 17 per cent from the nominal value for the localiser facility.

(3) In the case of localisers in which the basic functions are provided by the use of a two-frequency system, the conditions requiring initiation of monitor action shall include the case when the DDM in the required coverage beyond plus or minus 10 degrees from the front course line, except in the back course sector, decreases below 0.155.

(4) The total period of radiation, including period of zero radiation, outside the performance limits specified in (a), (b), (c), (d), (e) and (f) of subparagraph (2) shall be as short as practicable, consistent with the need for avoiding interruptions of the navigation service provided by the localiser.

(5) The total period referred to under subparagraph (1) shall not exceed under any circumstances: 10 seconds for Facility Performance Category I localisers; 5 seconds for Facility Performance Category II localisers; 2 seconds for facility performance Category III localisers.

(6) The total period under subparagraph (5) shall be reduced so as not to exceed two seconds for facility performance Category II localisers and one second for Facility Performance Category III localisers.

(7) 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.

Integrity and continuity of service requirements

12. (1) A localiser shall be assigned a level of integrity and continuity of service as given in subparagraphs (2) and (3).

(2) The localiser level shall be Level 1, where—

(a) the localiser's integrity of service or its continuity of service, or both, are not demonstrated; or

(b) the localiser's integrity of service and its continuity of service are both demonstrated, but at least one of them does not meet the requirements of Level 2.

(3) The probability of not radiating false guidance signals shall not be less than $1 - 1.0 \times 10^{-7}$ in any one landing for level 1 localisers.

(4) The probability of not losing the radiated guidance signal shall exceed $1 - 4 \times 10^{-6}$ in any period of 15 seconds for level 1 localisers (equivalent to 1000 hours, mean time between outages).

(5) In the event that the integrity value for a Level 1 localiser is not available or cannot be readily calculated, detailed analysis shall be performed to assure proper monitor fail-safe operation.

(6) The localiser level shall be Level 2 if—

(a) the probability of not radiating false guidance signals is not less than $1 - 1.0 \text{ x } 10^{-7}$ in any one landing; and

(b) the probability of not losing the radiated guidance is greater than $1 - 4 \times 10^{-6}$ in any period of 15 seconds (equivalent to 1 000 hours mean time between outages).

(7) The localiser level shall be Level 3, where—

(a) the probability of not radiating false guidance signals is not less than $1 - 0.5 \times 10^{-9}$ in any one landing; and

(b) the probability of not losing the radiated guidance is greater than $1 - 2 \times 10^{-6}$ in any period of 15 seconds (equivalent to 2000 hours mean time between outages).

(8) The localiser level shall be Level 4 if—

(a) the probability of not radiating false guidance signals is not less than $1 - 0.5 \times 10^{-9}$ in any one landing; and

(b) the probability of not losing the radiated guidance is greater than $1 - 2 \times 10^{-6}$ in any period of 30 seconds (equivalent to 4 000 hours mean time between outages).

13. Interference immunity performance for ILS localiser receiving systems

(1) The ILS localiser receiving system shall provide adequate immunity to interference from two-signal, third order inter modulation products caused by VHF FM broadcast signals having levels in accordance with the following—

$$2N_1 + N_2 + 72 \leq 0$$

for VHF FM sound broadcasting signals in the range 107.7 – 108.0 MHz

and

$$2N_1 + N_2 + 3\left(24 - 20\log\frac{\Delta f}{0,4}\right) \leq 0$$

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 inter modulation product on the desired ILS localiser frequency. N_1 and N_2 are the levels (dBm) of the two VHF FM sound broadcasting signals at the Instrument Landing System localiser receiver input. Neither level shall exceed the desensitisation criteria set forth in subparagraph (2) $\Delta f = 108.1 - f_1$, where f_1 is the frequency of N_1, the VHF FM sound broadcasting signal closer to 108.1 MHz.

(2) The ILS localiser receiving system shall not be desensitised in the presence of VHF FM broadcast signals having levels in accordance with the following table—

Maximum level of unwanted Frequency signal at receiver input

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

SCHEDULE 4

(regulations 17, 20 and 21)

UHF GLIDE PATH EQUIPMENT AND ASSOCIATED MONITOR

1. General

(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 1.75 θ.

(2) The ILS glide path angle shall be 3 degrees. Instrument Landing System glide path angles in excess of 3 degrees shall not be used except where alternative means of satisfying obstruction clearance requirements are impracticable.

(a) The glide path angle shall be adjusted and maintained within—

(i) 0.075 θ from θ for Facility Performance Categories I and II — ILS glide paths; and

(ii) 0.04 θ from θ for Facility Performance Category III — ILS glide paths.

(3) The downward extended straight portion of the ILS glide path shall pass through the Instrument Landing System reference datum at a height ensuring safe guidance over obstructions and also safe and efficient use of the runway served.

(4) The height of the Instrument Landing System reference datum for Facility Performance Categories II and III — Instrument Landing System shall be 15 m (50 ft). A tolerance of plus 3 m (10 ft) is permitted.

(5) The height of the Instrument Landing System reference datum for Facility Performance Category I — Instrument Landing System shall be 15 m (50 ft). A tolerance of plus 3 m (10 ft) is permitted.

(6) The height of the Instrument Landing System reference datum for Facility Performance Category I — Instrument Landing System used on short precision approach runway codes 1 and 2 shall be 12 m (40 ft). A tolerance of plus 6 m (20 ft) is permitted.

2. **Radio frequency**

(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.

(2) The emission from the glide path equipment shall be horizontally polarised.

(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. **Coverage**

(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 least18.5 km (10 NM) up to 1.75 θ and down

to 0.45 θ above the horizontal or to such lower angle, down to 0.30 θ, as required to safeguard the promulgated glide path intercept procedure.

(2) In order to provide the coverage for glide path performance specified in subparagraph (1), the minimum field strength within this coverage sector shall be 400 microvolts per metre (minus 95 dBW/m^2). For Facility Performance Category I glide paths, this field strength shall be provided down to a height of 30 m (100 ft) above the horizontal plane containing the threshold. 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.

4. **ILS glide path structure**

(1) For Facility Performance Category I — ILS glide paths, bends in the glide path shall not have amplitudes which exceed the following—

Zone	*Amplitude (DDM)* *(95% probability)*
Outer limit of coverage to ILS Point "C"	0.035

(2) For Facility Performance Categories II and III — ILS glide paths, bends in the glide path shall not have amplitudes which exceed the following—

Zone	*Amplitude (DDM)* *(95% probability)*
Outer limit of coverage to ILS Point "A"	0.035
ILS Point "A" to "B"	0.035 at ILS Point "A" decreasing at a linear rate to 0.023 at ILS Point 'B'
ILS Point "B" to the ILS reference datum	0.023

5. **Carrier modulation**

(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 percent along the ILS glide path. The depth of modulation shall not deviate outside the limits of 37.5 percent to 42.5 percent.

(2) 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 2.5 percent for Facility Performance Category I — ILS;

(b) the modulating tones shall be 90 Hz and 150 Hz within 1.5 percent for Facility Performance Category II — ILS;

(c) the modulating tones shall be 90 Hz and 150 Hz within 1 percent for Facility Performance Category III — ILS;

(d) the total harmonic content of the 90 Hz tone shall not exceed 10 percent: additionally, for Facility Performance Category III equipment, the second harmonic of the 90 Hz tone shall not exceed 5 percent;

(e) the total harmonic content of the 150 Hz tone shall not exceed 10 percent.

(3) For Facility Performance Category I — ILS, the modulating tones shall be 90 Hz and 150 Hz within plus or minus 1.5 percent.

(4) For 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 percent.

(5) 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—

(a) for Facility Performance Categories I and II -ILS glide paths: 20 degrees.

(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.

(c) With two-frequency glide path systems, subparagraph (5) 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—

(i) for Facility Performance Categories I and II — ILS glide paths: 20 degrees;

(ii) for Facility Performance 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—

(i) for Facility Performance Categories I and II — ILS glide paths: 20 degrees;

(ii) for Facility Performance Category III — ILS glide paths: 10 degrees,

of phase relative to 150 Hz.

(d) Alternative two-frequency glide path systems that employ audio phasing different from the normal in-phase condition described in subparagraph (6) 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 subparagraph (6).

(e) Undesired frequency and phase modulation on ILS glide path radio frequency carriers that can affect the displayed DDM values in glide path receivers shall be minimised to the extent practical.

6. **Displacement sensitivity**

(1) For Facility Performance Category I-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 between 0.07 θ and 0.14 θ.

(2) For Facility Performance Category I-ILS glide paths, the nominal angular displacement sensitivity shall correspond to a DDM of 0.0875 at an angular displacement below the glide path of 0.12 θ with a tolerance of plus or minus 0.02 θ. The upper and lower sectors shall be as symmetrical as practicable within the limits specified in subparagraph (1).

(3) For Facility Performance Category II-ILS glide paths, the angular displacement sensitivity shall be as symmetrical as practicable. The nominal angular displacement sensitivity shall correspond to a DDM of 0.0875 at an angular displacement of—

(a) 0.12 θ below path with a tolerance of plus or minus 0.02 θ; and

(b) 0.12 θ above path with a tolerance of plus 0.02 θ and minus 0.05 θ.

(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 θ with a tolerance of plus or minus 0.02 θ.

(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 θ above the horizontal. However, if it is achieved at an angle above 0.45 θ, the DDM value shall not be less than 0.22 at least down to 0.45 θ or to such lower angle, down to 0.30 θ, as required to safeguard the promulgated glide path intercept procedure.

(6) For Facility Performance Category I-ILS glide paths, the angular displacement sensitivity shall be adjusted and maintained within plus or minus 25 percent of the nominal value selected.

(7) For Facility Performance Category II-ILS glide paths, the angular displacement sensitivity shall be adjusted and maintained within plus or minus 20 percent of the nominal value selected.

(8) For Facility Performance Category III-ILS glide paths, the angular displacement sensitivity shall be adjusted and maintained within plus or minus 15 percent of the nominal value selected.

7. **Monitoring**

(1) The automatic monitor system shall provide a warning to the designated control points and cause radiation to cease within the periods specified in subparagraph (3)(a) if any of the following conditions persist—

(a) shift of the mean ILS glide path angle equivalent to more than minus 0.075 θ to plus 0.10 θ 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 paragraph 3, 4 and 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 paragraphs 3, 4 and 5;

(d) for Facility Performance Category I-ILS glide paths, a change of the angle between the glide path and the line below the glide path (150 Hz predominating) at which a DDM of 0.0875 is realised by more than the greater of—

(i) plus or minus 0.0375 θ; or

(ii) an angle equivalent to a change of displacement sensitivity to a value differing by 25 per cent from the nominal value;

(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 realised 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.

(2) Monitoring of the ILS glide path characteristics to smaller tolerances shall be arranged in those cases where operational penalties would otherwise exist.

(3) The total period of radiation, including period(s) of zero radiation, outside the performance limits specified in paragraph (1) shall be as short as practicable, consistent with the need for avoiding interruptions of the navigation service provided by the ILS glide path.

(4) The total period referred to under paragraph (2) shall not exceed under any circumstances: 6 seconds for Facility Performance Category I-ILS glide paths; 2 seconds for Categories II and III- ILS glide paths.

(5) The total period specified under subparagraph (4) for Facility Performance Categories II and III- ILS glide paths shall not exceed 1 second.

(6) 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.

8. **Integrity and continuity of service requirements**

(1) A glide path shall be assigned a level of integrity and continuity of service as given in subparagraph 8 (2) to 8(7).

(2) The glide path level shall be Level 1 where—

(a) the integrity of service or continuity of service of the glide path, or both, are not demonstrated; or

(b) the integrity of service and continuity of service of the glide path are demonstrated, but one of them does not meet the requirements of Level 2.

(3) The probability of not radiating false guidance signals shall not be less than $1 - 1.0 \times 10^{-7}$ in any one landing for level 1 glide paths.

(4) The probability of not losing the radiated guidance signal shall exceed $1 - 4 \times 10^{-6}$ in any period of 15 seconds for level 1 glide paths (equivalent to 1 000 hours mean time between outages).

(5) In the event that the integrity value for a Level 1 glide path is not available or cannot be readily calculated, a detailed analysis shall be performed to assure proper monitor fail-safe operation.

(6) The glide path level shall be Level 2 if—

(a) the probability of not radiating false guidance signals is not less than $1 - 1.0 \text{ x } 10^{-7}$ in any one landing; and

(b) the probability of not losing the radiated guidance is greater $1 - 4 \times 10^{-6}$ in any period of 15 seconds (equivalent to 1 000 hours mean time between outages).

(7) The glide path level shall be Level 3 or 4 if—

(a) the probability of not radiating false guidance signals is not less than $1 - 0.5 \times 10^{-9}$ in any one landing; and

(b) the probability of not losing the radiated guidance is greater than $1 - 2 \times 10^{-6}$ in any period of 15 seconds (equivalent to 2 000 hours mean time between outages).

9. **Localiser and glide path frequency pairing**

(1) The pairing of the runway localiser and glide path transmitter frequencies of an instrument landing system shall be taken from the following list—

Localizer (MHz)	*Glide path (MHz)*	*Localizer (MHz)*	*Glide path (MHz)*
108.1	334.7	110.1	334.4
108.15	334.55	110.15	334.25
108.3	334.1	110.3	335.0
108.35	333.95	110.35	334.85
108.5	329.9	110.5	329.6
108.55	329.75	110.55	329.45
108.7	330.5	110.7	330.2
108.75	330.35	110.75	330.05
108.9	329.3	110.9	330.8
108.95	329.15	110.95	330.65
109.1	331.4	111.1	331.7
109.15	331.25	111.15	331.55
109.3	332.0	111.3	332.3
109.35	331.85	111.35	332.15
109.5	332.6	111.5	332.9
109.55	332.45	111.55	332.75
109.7	333.2	111.7	333.5
109.75	333.05	111.75	333.35
109.9	333.8	111.9	331.1
109.95	333.65	111.95	330.95

(2) In regions where the requirements for runway localiser and glide path transmitter frequencies of an instrument landing system do not justify more than 20 pairs, they shall be selected sequentially, as required, from the following list—

Sequence number	**Localiser (MHz)**	**Glide path (MHz)**
1	110.3	335.0
2	109.9	333.8
3	109.5	332.6
4	110.1	334.4

5	109.7	333.2
6	109.3	332.0
7	109.1	331.4
8	110.9	330.8
9	110.7	330.2
10	110.5	329.6
11	108.1	334.7
12	108.3	334.1
13	108.5	329.9
14	108.7	330.5
15	108.9	329.3
16	111.1	331.7
17	111.3	332.3
18	111.5	332.9
19	111.7	333.5
20	111.9	331.1

(3) Where existing Instrument Landing System localisers meeting national requirements are operating on frequencies ending in even tenths of a megahertz, they shall be reassigned frequencies, conforming with subparagraph (1) or (2) as soon as practicable and may continue operating on their present assignments only until this reassignment can be effected.

(4) Existing Instrument Landing System localisers 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 subparagraph (1).

SCHEDULE 5

(regulation 23)

SPECIFICATION FOR VHF OMNI DIRECTIONAL RANGE (VOR)

1. **General**

(1) The VOR shall be constructed and adjusted so that similar instrumental indications in aircraft represent equal clockwise angular deviations (bearings), degree for degree from magnetic North as measured from the location of the VOR.

(2) The VOR shall radiate a radio frequency carrier with which are associated two separate 30 Hz modulations. One of these modulations shall be such that its phase is independent of the azimuth of the point of observation (reference phase). The other modulation (variable phase) shall be such that its phase at the point of observation differs from that of the reference phase by an angle equal to the bearing of the point of observation with respect to the VOR.

(3) The reference and variable phase modulations shall be in phase along the reference magnetic meridian through the station.

2. **Radio frequency**

(1) The VOR shall operate in the band 111.975 MHz to 117.975 MHz except that frequencies in the band 108 MHz to 111.975 MHz may be used when, in accordance with the provisions of Radio Frequency Spectrum Utilisation Regulations, the use of such frequencies is acceptable. The highest assignable frequency shall be 117.950 MHz. The channel separation shall be in increments of 50 kHz referred to the highest assignable frequency. In areas where 100 kHz or 200 kHz channel spacing is in general use, the frequency tolerance of the radio frequency carrier shall be plus or minus 0.005 percent.

(2) The frequency tolerance of the radio frequency carrier of all new installations implemented after 23rd May 1974 in areas where 50 kHz channel spacing is in use shall be plus or minus 0.002 percent.

(3) In areas where new VOR installations are implemented and are assigned frequencies spaced at 50 kHz from existing VORs in the same area, priority shall be given to ensuring that the frequency tolerance of the radio frequency carrier of the existing VORs is reduced to plus or minus 0.002 percent.

3. **Polarisation and pattern accuracy**

(1) The emission from the VOR shall be horizontally polarised. The vertically polarised component of the radiation shall be as small as possible.

(2) The ground station contribution to the error in the bearing information conveyed by the horizontally polarised radiation from the VOR for all elevation angles between 0 and 40 degrees, measured from the centre of the VOR antenna system, shall be within plus or minus 2 degrees.

4. **Coverage**

(1) The VOR shall provide signals such as to permit satisfactory operation of a typical aircraft installation at the levels and distances required for operational reasons, and up to an elevation angle of 40 degrees.

(2) The field strength or power density in space of VOR signals required to permit satisfactory operation of a typical aircraft installation at the minimum service level at the maximum specified service radius shall be 90 microvolts per metre or minus 107 dBW/m2.

5. **Modulations of navigation signals**

(1) The radio frequency carrier as observed at any point in space shall be amplitude modulated by two signals as follows—

(a) a subcarrier of 9 960 Hz of constant amplitude, frequency modulated at 30 Hz—

(i) for the conventional VOR, the 30 Hz component of this FM subcarrier is fixed without respect to azimuth and is termed the “reference phase” and shall have a deviation ratio of 16 plus or minus 1 (i.e. 15 to 17);

(ii) for the Doppler VOR, the phase of the 30 Hz component varies with azimuth and is termed the “variable phase” and shall have a deviation ratio of 16 plus or minus 1 (i.e. 15 to 17) when observed at any angle of elevation up to 5 degrees, with a minimum deviation ratio of 11 when observed at any angle of elevation above 5 degrees and up to 40 degrees;

(b) a 30 Hz amplitude modulation component—

(i) for the conventional VOR, this component results from a rotating field pattern, the phase of which varies with azimuth, and is termed the “variable phase”;

(ii) for the Doppler VOR, this component, of constant phase with relation to azimuth and constant amplitude, is radiated omni directionally and is termed the “reference phase”.

(2) The nominal depth of modulation of the radio frequency carrier due to the 30 Hz signal or the subcarrier of 9 960 Hz shall be within the limits of 28 per cent and 32 per cent.

(3) The depth of modulation of the radio frequency carrier due to the 30 Hz signal, as observed at any angle of elevation up to 5 degrees, shall be within the limits of 25 to 35 per cent. The depth of modulation of the radio frequency carrier due to the 9 960 Hz signal, as observed at any angle of elevation up to 5 degrees, shall be within the limits of 20 to 55 per cent on facilities without voice modulation, and within the limits of 20 to 35 per cent on facilities with voice modulation.

(4) The variable and reference phase modulation frequencies shall be 30 Hz within plus or minus 1 percent.

(5) The subcarrier modulation mid-frequency shall be 9 960 Hz within plus or minus 1 percent.

(6) For the conventional VOR, the percentage of amplitude modulation of the 9 960 Hz subcarrier shall not exceed 5 percent and for the Doppler VOR, the percentage of amplitude modulation of the 9 960 Hz subcarrier shall not exceed 40 percent when measured at a point at least 300 m (1 000 ft) from the VOR.

(7) Where 50 kHz VOR channel spacing is implemented, the sideband level of the harmonics of the 9 960 Hz component in the radiated signal shall not exceed the following levels referred to the level of the 9 960 Hz sideband—

Subcarrier	Level
9960 Hz	0 dB reference
2nd Harmonic	-30dB
3rd Harmonic	-50 dB
4th Harmonic and above	-60 dB

6. Voice and identification

(1) If the VOR provides a simultaneous communication channel ground-to-air, it shall be on the same radio frequency carrier as used for the navigational function. The radiation on this channel shall be horizontally polarised.

(2) The peak modulation depth of the carrier on the communication channel shall not be greater than 30 per cent.

(3) The audio frequency characteristics of the speech channel shall be within 3 dB relative to the level at 1 000 Hz over the range 300 Hz to 3 000 Hz.

(4) The VOR shall provide for the simultaneous transmission of a signal of identification on the same radio frequency carrier as that used for the navigational function. The identification signal radiation shall be horizontally polarised.

(5) The identification signal shall employ the International Morse Code and consist of two or three letters. It shall be sent at a speed corresponding to approximately 7 words per minute. The signal shall be repeated at least once every 30 seconds and the modulation tone shall be 1 020 Hz within plus or minus 50 Hz; the identification signal shall be transmitted at least three times each 30 seconds, spaced equally within that time period. One of these identification signals will take the form of a voice identification.

(6) The depth to which the radio frequency carrier is modulated by the code identification signal shall be close to, but not in excess of 10 per cent except that, where a communication channel is not provided, it shall be permissible to increase the modulation by the code identification signal to a value not exceeding 20 percent.

(a) If the VOR provides a simultaneous communication channel ground-to-air, the modulation depth of the code identification signal shall be 5 plus or minus 1 per cent in order to provide a satisfactory voice quality.

(7) The transmission of speech shall not interfere in any way with the basic navigational function. When speech is being radiated, the code identification shall not be suppressed.

(8) The VOR receiving function shall permit positive identification of the wanted signal under the signal conditions encountered within the specified coverage limits, and with the modulation parameters specified at subparagraphs (5) and (6).

7. **Monitoring**

(1) Suitable equipment located in the radiation field shall provide signals for the operation of an automatic monitor. The monitor shall transmit a warning to a control point, and either remove the identification and navigation components from the carrier or cause radiation to cease if anyone or a combination of the following deviations from established conditions arises—

(a) a change in excess of 1 degree at the monitor site of the bearing information transmitted by the VOR;

(b) a reduction of 15 per cent in the modulation components of the radio frequency signals voltage level at the monitor of either the subcarrier, or 30 Hz amplitude modulation signals, or both.

(2) Failure of the monitor itself shall transmit a warning to a control point and either—

(a) remove the identification and navigation components from the carrier; or

(b) cause radiation to cease.

8. **Interference immunity performance for VOR receiving systems**

(1) The VOR receiving system shall provide adequate immunity to interference from two signal, third-order intermodulation products caused by VHF FM broadcast signals having levels in accordance with the following—

$$2N_1 + N_2 + 72 \leq 0$$

for VHF FM sound broadcasting signals in the range 107.7 – 108.0 MHz

and

$$2N_1 + N_2 + 3\left(24 - 20\log\frac{\Delta f}{0{,}4}\right) \leq 0$$

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 inter modulation product on the desired VOR frequency.

N_1 and N_2 are the levels (dBm) of the two VHF FM sound broadcasting signals at the VOR receiver input. Neither level shall exceed the desensitisation criteria set forth in subparagraph 2.

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

The VOR receiving system shall not be desensitised in the presence of VHF FM broadcast signals having levels in accordance with the following table—

Frequency (MHz)	Maximum level of unwanted signal at receiver input (dBm)
88 -102	+15
104	+10
106	5
107.9	-10

SCHEDULE 6

(regulation 24)

SPECIFICATION FOR NON-DIRECTIONAL RADIO BEACON (NDB)

1. **Coverage**

(1) The minimum value of field strength in the rated coverage of an NDB shall be 70 microvolts per metre.

(2) All notifications or promulgations of NDBs shall be based upon the average radius of the rated coverage.

(3) Where the rated coverage of an NDB is materially different in various operationally significant sectors, its classification shall be expressed in terms of the average radius of rated coverage and the angular limits of each sector as radius of coverage of sector/angular limits of sector expressed as magnetic bearing clockwise from the beacon and where it is desirable to classify an NDB in such a manner, the number of sectors shall be kept to a minimum and preferably shall not exceed two.

2. **Limitations in radiated power**

The power radiated from an NDB shall not exceed by more than 2 dB that necessary to achieve its agreed rated coverage, except that this power may be increased if coordinated regionally or if no harmful interference to other facilities will result.

3. Radio frequencies

(1) The radio frequencies assigned to NDBs shall be selected from those available in that portion of the spectrum between 190 kHz and 1 750 kHz.

(2) The frequency tolerance applicable to NDBs shall be 0.01 per cent except that, for NDBs of antenna power above 200 W using frequencies of 1606.5 kHz and above, the tolerance shall be 0.005 per cent.

(3) Where two locators are used as supplements to an ILS, the frequency separation between the carriers of the two shall be not less than 15 kHz to ensure correct operation of the radio compass, and preferably not more than 25 kHz in order to permit a quick tuning shift in cases where an aircraft has only one radio compass.

(4) Where locators associated with ILS facilities serving opposite ends of a single runway are assigned a common frequency, provision shall be made to ensure that the facility not in operational use cannot radiate.

4. **Identification**

(1) Each NDB shall be individually identified by a two- or three- letter International Morse Code group transmitted at a rate corresponding to approximately 7 words per minute.

(2) The complete identification shall be transmitted at least once every 30 seconds, except where the beacon identification is effected by on/off keying of the carrier. In this latter case, the identification shall be at approximately 1-minute intervals, except that a shorter interval may be used at particular NDB stations where this is found to be operationally desirable.

(3) Except for those cases where the beacon identification is effected by on/off keying of the carrier, the identification signal shall be transmitted at least three times each 30 seconds, spaced equally within that time period.

(4) For NDBs with an average radius of rated coverage of 92.7 km (50 NM) or less that are primarily approach and holding aids in the vicinity of an aerodrome, the identification shall be transmitted at least three times each 30 seconds, spaced equally within that time period.

(5) The frequency of the modulating tone used for identification shall be 1 020 Hz plus or minus 50 Hz or 400 Hz plus or minus 25 Hz.

5. **Characteristics of emissions**

(1) Except as provided in subparagraph (2), all NDBs shall radiate an uninterrupted carrier and be identified by on or off keying of an amplitude modulating tone (NON/A2A).

(2) NDBs other than those wholly or partly serving as holding, approach and landing aids, or those having an average radius of rated coverage of less than 92.7 km (50 NM), may be identified by on or off keying of the unmodulated carrier (NON/A1A) if they are in areas of high beacon density or where the required rated coverage is not practicable of achievement because of—

(a) radio interference from radio stations;

(b) high atmospheric noise; or

(c) local conditions.

(3) For each NDB identified by on or off keying of an audio modulating tone, the depth of modulation shall be maintained as near to 95 per cent as practicable.

(4) For each NDB identified by on or off keying of an audio modulating tone, the characteristics of emission during identification shall be such as to ensure satisfactory identification at the limit of its rated coverage.

(5) The carrier power of an NDB with NON/A2A emissions shall not fall when the identity signal is being radiated except that, in the case of an NDB having an average radius of rated coverage exceeding 92.7 km (50 NM), a fall of not more than 1.5 dB will be accepted.

(6) Unwanted audio frequency modulations shall total less than 5 percent of the amplitude of the carrier.

(7) The bandwidth of emissions and the level of spurious emissions shall be kept at the lowest value that the state of technique and the nature of the service permit.

6. **Siting of locators**

(1) Where locators are used as a supplement to the Instrument Landing System, they shall be located at the sites of the outer and middle marker beacons. Where only one locator is used as a supplement to the Instrument Landing System, preference shall be given to location at the site of the outer marker beacon. Where locators are employed as an aid to final approach in the absence of an Instrument Landing System, equivalent locations to those applying when an ILS is installed shall be selected, taking into account the relevant obstacle clearance provisions of the PANS-OPS (ICAO Doc 8168)

(2) Where locators are installed at both the middle and outer marker positions, they shall be located, where practicable, on the same side of the extended centre line of the runway in order to provide a track between the locators which will be more nearly parallel to the centre line of the runway.

7. **Monitoring**

(1) For each NDB, suitable means shall be provided to enable detection of any of the following conditions at an appropriate location—

(a) a decrease in radiated carrier power of more than 50 per cent below that required for the rated coverage;

(b) failure to transmit the identification signal; or

(c) malfunctioning or failure of the means of monitoring itself.

(2) When an NDB is operated from a power source having a frequency which is close to airborne ADF equipment switching frequencies, and where the design of the NDB is such that the power supply frequency is likely to appear as a modulation product on the emission, the means of monitoring shall be capable of detecting such power supply modulation on the carrier in excess of 5 per cent.

(3) During the hours of service of a locator, the means of monitoring shall provide for a continuous check on the functioning of the locator as prescribed in subparagraph (1).

(4) During the hours of service of an NDB other than a locator, the means of monitoring shall provide for a continuous check on the functioning of the NDB as prescribed in in Sub-paragraph (1).

SCHEDULE 7

(regulations 25, 26 and 27)

SPECIFICATION FOR UHF DISTANCE MEASURING EQUIPMENT (DME)

1. **General**

(1) The DME system shall provide for continuous and accurate indication in the cockpit of the slant range distance of an equipped aircraft from an equipped ground reference point.

(2) The system shall comprise two basic components, one fitted in the aircraft, the other installed on the ground. The aircraft component shall be referred to as the interrogator and the ground component as the transponder.

(3) In operation, interrogators shall interrogate transponders which shall, in turn, transmit to the interrogator replies synchronised with the interrogations, thus providing means for accurate measurement of distance.

(4) DME/P shall have two operating modes, IA and FA.

(5) When a DME is associated with an ILS or VOR for the purpose of constituting a single facility, they shall—

(a) be operated on a standard frequency pairing in accordance with paragraph 2(3)(d);

(b) be collocated within the limits prescribed for associated facilities in subparagraph (6); and

(c) comply with the identification provisions of paragraph 2(6)

(6) Collocation limits for a DME facility associated with an ILS, MLS or VOR facility—

(a) Associated VOR and DME facilities shall be collocated in accordance with the following—

(i) for those facilities used in terminal areas for approach purposes or other procedures where the highest position fixing accuracy of system capability is required, the separation of the VOR and DME antennas does not exceed 80 m (260 ft);

(ii) for purposes other than those indicated in paragraph (a), the separation of the VOR and DME antennas does not exceed 600 m (2 000 ft).

(b) Use of DME or other standard radio navigation aids as an alternative to ILS marker beacons—

(i) when DME is used as an alternative to ILS marker beacons, the DME shall be located on the airport so that the zero range indication is a point near the runway. If the DME associated with ILS uses a zero range offset, this facility has to be excluded from RNAV solutions—

(A) in order to reduce the triangulation error, the DME shall be sited to ensure a small angle (e.g. less than 20 degrees) between the approach path and the direction to the DME at the points where the distance information is required;

(B) the use of DME as an alternative to the middle marker beacon assumes a DME system accuracy of 0.37 km (0.2 NM) or better and a resolution of the airborne indication to allow this accuracy to be attained;

(C) while it is not specifically required that DME be frequency paired with the localiser when it is used as an alternative for the outer marker, frequency pairing is preferred wherever DME is used with ILS to simplify pilot operation and to enable aircraft with two ILS receivers to use both receivers on the ILS channel;

(D) When the DME is frequency paired with the localiser, the DME transponder identification should be obtained by the “associated” signal from the frequency-paired localiser;

(E) in some locations, the authority may authorise the use of other means to provide fixes, such as NDB, VOR or GNSS. This may be useful in particular in locations where aircraft user equipage with DME is low, or if the DME is out of service.

(7) The standards in paragraphs 2, 3, and 4 denoted by ‡ shall apply only to DME equipment first installed after 1st January 1989.

2. **System characteristics**

(1) *Performance*

(a) The system shall provide a means of measurement of slant range distance from an aircraft to a selected transponder to the limit of coverage prescribed by the operational requirements for the selected transponder.

(b) Coverage—

(i) *When* associated with a VOR, DME/N coverage shall be at least that of the VOR to the extent practicable.

(ii) *When* associated with an ILS, DME/N coverage shall be at least that of the ILS azimuth angle guidance coverage sectors.

(c) Accuracy—

(i) *System accuracy.* The accuracy standards specified in subparagraph (1) (d) paragraph 3(5) and paragraph 4 (3) (f) shall be met on a 95 per cent probability basis.

(2) *Radio frequencies and polarisation.* The system shall operate with vertical polarisation in the frequency band 960 MHz to 1 215 MHz. The interrogation and reply frequencies shall be assigned with 1MHz spacing between channels.

(3) *Channelling*

(a) DME operating channels shall be formed by pairing interrogation and reply frequencies and by pulse coding on the paired frequencies.

(b) DME operating channels shall be chosen from Table 7-2 of 352 channels in which the channel numbers, frequencies, and pulse codes are assigned.

(c) *Channel pairing.* When a DME transponder is intended to operate in association with a single VHF navigation facility in the 108 MHz to 117.95 MHz frequency band or an MLS angle facility in the 5 031.0 MHz to 5 090.7 MHz frequency band, the DME operating channel shall be paired with the VHF channel and/or MLS angle frequency as given in Table 7-2.

(4) Interrogation pulse repetition frequency

(a) *DME/N.* The interrogator average pulse repetition frequency (PRF) shall not exceed 30 pairs of pulses per second, based on the assumption that at least 95 per cent of the time is occupied for tracking.

(b) *DME/N.* If it is desired to decrease the time of search, the PRF may be increased during search but shall not exceed 150 pairs of pulses per second.

(c) DME/N. After 15 000 pairs of pulses have been transmitted without acquiring indication of distance, the PRF shall not exceed 60 pairs of pulses per second thereafter, until a change in operating channel is made or successful search is completed.

(d) *DME/N.* When, after a time period of 30 seconds, tracking has not been established, the pulse pair repetition frequency shall not exceed 30 pulse pairs per second thereafter.

(5) **Aircraft handling capacity of the system**

(a) The aircraft handling capacity of transponders in an area shall be adequate for the peak traffic of the area or 100 aircraft, whichever is the lesser.

(b) Where the peak traffic in an area exceeds 100 aircraft, the transponder shall be capable of handling that peak traffic.

6. **Transponder Identification**

(a) All transponders shall transmit an identification signal in one of the following forms as required by paragraph 2(6) (e).

(i) an “independent” identification consisting of coded (International Morse Code) identity pulses which can be used with all transponders;

(ii) an “associated” signal which can be used for transponders specifically associated with a VHF navigation which itself transmits an identification signal.

(b) Both systems of identification shall use signals, which shall consist of the transmission for an appropriate period of a series of paired pulses transmitted at a repetition rate of 1 350 pulse pairs per second, and shall temporarily replace all reply pulses that would normally occur at that time except as in paragraph 2(6) (b) (ii). These pulses shall have similar characteristics to the other pulses of the reply signals.

(i) *DME/N.* Reply pulses shall be transmitted between key down times.

(ii) *DME/N.* If it is desired to preserve a constant duty cycle, an equalising pair of pulses, having the same characteristics as the identification pulse pairs, shall be transmitted 100 microseconds plus or minus 10 microseconds after each identity pair.

(c) The characteristics of the "independent" identification signal shall be as follows—

(i) the identity signal shall consist of the transmission of the beacon code in the form of dots and dashes (International Morse Code) of identity pulses at least once every 40 seconds, at a rate of at least 6 words per minute; and

(ii) the identification code characteristic and letter rate for the DME transponder shall conform to the following to ensure that the maximum total key down time does not exceed 5 seconds per identification code group. The dots shall be a time duration of 0.1 second to 0.160 second. The dashes shall be typically 3 times the duration of the dots. The duration between dots or dashes shall be equal to that of one dot plus or minus 10 per cent. The time duration between letters or numerals shall not be less than three dots. The total period for transmission of an identification code group shall not exceed 10 seconds.

(iii) The tone identification signal is transmitted at a repetition rate of 1 350 pps. This frequency may be used directly in the airborne equipment as an aural output for the pilot, or other frequencies may be generated at the option of the interrogator designer (see 2(6)(b)).

(d) The characteristics of the "associated" signal shall be as follows—

(i) when associated with a VHF the identification shall be transmitted in the form of dots and dashes (International Morse Code) and shall be synchronised with the VHF facility identification code;

(ii) each 40-second interval shall be divided into four or more equal periods, with the transponder identification transmitted during one period only and the associated VHF, where it is provided, transmitted during the remaining periods.

(e) Identification implementation

(i) The "independent" identification code shall be employed wherever a transponder is not specifically associated with a VHF navigational facility.

(ii) Wherever a transponder is specifically associated with a VHF navigational facility, identification shall be provided by the "associated" code.

(iii) When voice communications are being radiated on an associated VHF navigational facility, an "associated" signal from the transponder shall not be suppressed.

3. **Detailed technical characteristics of transponder and associated monitor**

(1) Transmitter

(a) *Frequency of operation.* The transponder shall transmit on the reply frequency appropriate to the assigned DME channel.

(b) *Frequency stability.* The radio frequency of operation shall not vary more than plus or minus 0.002 per cent from the assigned frequency.

(c) *Pulse shape and spectrum.* The following shall apply to all radiated pulses—

(i) *Pulse rise time.*

DME/N. Pulse rise time shall not exceed 3 microseconds.

(ii) Pulse duration shall be 3.5 microseconds plus or minus 0.5 microsecond.

(iii) Pulse decay time shall nominally be 2.5 microseconds but shall not exceed 3.5 microseconds.

(iv) The instantaneous amplitude of the pulse shall not, at any instant between the point of the leading edge which is 95 per cent of maximum amplitude and the point of the trailing edge which is 95 per cent of the maximum amplitude, fall below a value which is 95 per cent of the maximum voltage amplitude of the pulse.

(v) For DME/N: the spectrum of the pulse modulated signal shall be such that during the pulse the EIRP contained in a 0.5 MHz band centred on frequencies 0.8 MHz above and 0.8 MHz below the nominal channel frequency in each case shall not exceed 200 mW, and the EIRP contained in a 0.5 MHz band centred on frequencies 2 MHz above and 2 MHz below the nominal channel frequency in each case shall not exceed 2 mW. The EIRP contained within any 0.5 MHz band shall decrease monotonically as the band centre frequency moves away from the nominal channel frequency.

(vi) To ensure proper operation of the thresholding techniques, the instantaneous magnitude of any pulse turn-on transients which occur in time prior to the virtual origin shall be less than one per cent of the pulse peak amplitude. Initiation of the turn-on process shall not commence sooner than 1 microsecond prior to the virtual origin.

(d) *Pulse spacing*

(i) The spacing of the constituent pulses of transmitted pulse pairs shall be as given in the table in subparagraph 3 (4) (a).

(ii) *DME/N.* The tolerance on the pulse spacing shall be plus or minus 0.25 microsecond.

(iii) *DME/N.* The tolerance on the DME/N pulse spacing shall be plus or minus 0.10 microsecond.

(iv) The pulse spacings shall be measured between the half voltage points on the leading edges of the pulses.

(e) *Peak power output*

(i) DME/N. The peak EIRP shall not be less than that required to ensure a peak pulse power density of approximately minus 83 dBW/m^2 at the maximum specified service range and level.

(ii) DME/N. The peak equivalent isotropically radiated power shall not be less than that required to ensure a peak pulse power density of minus 89 dBW/m^2 under all operational weather conditions at any point within coverage specified in paragraph 2(1) (b).

(iii) The peak power of the constituent pulses of any pair of pulses shall not differ by more than 1 dB.

(iv) *The* reply capability of the transmitter shall be such that the transponder should be capable of continuous operation at a transmission rate of 2 700 plus or minus 90 pulse pairs per second (if 100 aircraft are to be served).

(v) The transmitter shall operate at a transmission rate, including randomly distributed pulse pairs and distance reply pulse pairs, of not less than 700 pulse pairs per second except during identity. The minimum transmission rate shall be as close as practicable to 700 pulse pairs per second.

(f) *Spurious radiation.* During intervals between transmission of individual pulses, the spurious power received and measured in a receiver having the same characteristics as a transponder receiver, but tuned to any DME interrogation or reply frequency, shall be more than 50 dB below the peak pulse power received and measured in the same receiver tuned to the reply frequency in use during the transmission of the required pulses. This provision refers to all spurious transmissions, including modulator and electrical interference.

(i) DME/N. The spurious power level specified in paragraph 3(f) shall be more than 80 dB below the peak pulse power level.

(ii) Out-of-band spurious radiation. At all frequencies from 10 to 1 800 MHz, but excluding the band of frequencies from 960 to 1 215 MHz, the spurious output of the DME transponder transmitter shall not exceed minus 40 dBm in any one kHz of receiver bandwidth.

(iii) The equivalent isotropically radiated power of any CW harmonic of the carrier frequency on any DME operating channel shall not exceed minus 10 dBm.

(2) Receiver

(a) *Frequency of operation.* The receiver centre frequency shall be the interrogation frequency appropriate to the assigned DME operating channel.

(b) *Frequency stability.* The centre frequency of the receiver shall not vary more than plus or minus 0.002 percent from the assigned frequency.

(c) *Transponder sensitivity*

(i) In the absence of all interrogation pulse pairs, with the exception of those necessary to perform the sensitivity measurement, interrogation pulse pairs with the correct spacing and nominal frequency shall trigger the transponder if the peak power density at the transponder antenna is at least—

(A) minus 103 dBW/m2 for DME/N with coverage range greater than 56 km (30 NM);

(B) minus 93 dBW/m2 for DME/N with coverage range not greater than 56 km (30 NM).

(ii) The minimum power densities specified in subparagraph (i) shall cause the transponder to reply with an efficiency of at least—70 per cent for DME/N.

(iii) DME/N dynamic range. The performance of the transponder shall be maintained when the power density of the interrogation signal at the transponder antenna has any value between the minimum specified in subparagraph (i) up to a maximum of minus 22 dBW/m^2 when installed with ILS or MLS and minus 35 dBW/m^2 when installed for other applications.

(iv) The transponder sensitivity level shall not vary by more than

1 dB for transponder loadings between 0 and 90 per cent of its maximum transmission rate.

(v) DME/N. When the spacing of an interrogator pulse pair varies from the nominal value by up to plus or minus 1 microsecond, the receiver sensitivity shall not be reduced by more than 1 dB.

(d) *Load limiting*

(i) DME/N. When transponder loading exceeds 90 per cent of the maximum transmission rate, the receiver sensitivity shall be automatically reduced in order to limit the transponder replies, so as to ensure that the maximum permissible transmission rate is not exceeded. (The available range of sensitivity reduction shall be at least 50 dB.)

(e) *Noise.* When the receiver is interrogated at the power densities specified in subparagraph (i) to produce a transmission rate equal to 90 per cent of the maximum, the noise generated pulse pairs shall not exceed 5 percent of the maximum transmission rate.

(f) *Bandwidth*

(i) The minimum permissible bandwidth of the receiver shall be such that the transponder sensitivity level shall not deteriorate by more than 3 dB when the total receiver drift is added to an incoming interrogation frequency drift of plus or minus 100 kHz.

(ii) *DME/N.* The receiver bandwidth shall be sufficient to allow compliance with paragraph 2(1)(c) when the input signals are those specified in paragraph 4(1)(c).

(iii) *Signals* greater than 900 kHz removed from the desired channel nominal frequency and having power densities up to the values specified in paragraph 3 (2) (c) (iii) for DME/N and paragraph 3 (2) (c) (iv) for DME/P shall not trigger the transponder. Signals arriving at the intermediate frequency shall be suppressed at least 80 dB. All other spurious response or signals within the 960 MHz to 1 215 MHz band and image frequencies shall be suppressed at least 75 dB.

(g) *Recovery time.* Within 8 microseconds of the reception of a signal between 0 dB and 60 dB above minimum sensitivity level, the minimum sensitivity level of the transponder to a desired signal shall be within 3 dB of the value obtained in the absence of signals. This requirement shall be met with echo suppression circuits, if any, rendered inoperative. The 8 microseconds are to be measured between the half voltage points on the leading edges of the two signals, both of which conform in shape, with the specifications in paragraph 4(1)(c).

(h) *Spurious radiations.* Radiation from any part of the receiver or allied circuits shall meet the requirements stated in paragraph 3(1)(f).

(i) CW and echo suppression shall be adequate for the sites at which the transponders are used.

(ii) Protection against interference outside the DME frequency band shall be adequate for the sites at which the transponders are used.

(3) *Decoding.*

(a) The transponder shall include a decoding circuit such that the transponder can be triggered only by pairs of received pulses having pulse duration and pulse spacings appropriate to interrogator signals as described in paragraph 4(1)(c) and paragraph 4(1)(d).

(b) The decoding circuit performance shall not be affected by signals arriving before, between, or after, the constituent pulses of a pair of the correct spacing.

(c) *DME/N — Decoder rejection.* An interrogation pulse pair with a spacing of plus or minus 2 microseconds, or more, from the nominal value and with any signal level up to the value specified in paragraph 3(2)(c)(iii) shall be rejected such that the transmission rate does not exceed the value obtained when interrogations are absent.

(4) *Time delay*

(a) When a DME is associated only with a VHF facility, the time delay shall be the interval from the half voltage point on the leading edge of the second constituent pulse of the interrogation pair and the half voltage point on the leading edge of the second constituent pulse of the reply transmission. This delay shall be consistent with the following table, when it is desired that aircraft interrogators are to indicate distance from the transponder site.

Table 7-1: Time delay

		Pulse pair spacing (μs)		**Time delay (μs)**	
Channel suffix	**Operating Mode**	**Interrogation**	**Reply**	**1st pulse timing**	**2nd pulse timing**
X	DME/N	12	12	50	50
Y	DME/N	36	30	56	50

(b) For the DME/N the transponder time delay shall be capable of being set to an appropriate value between the nominal value of the time delay minus 15 microseconds and the nominal value of the time delay, to permit aircraft interrogators to indicate zero distance at a specific point remote from the transponder site—

(i) *DME/N.* The time delay shall be the interval from the half voltage point on the leading edge of the first constituent pulse of the interrogation pair and the half voltage point on the leading edge of the first constituent pulse of the reply transmission.

(ii) *DME/N.* Transponders shall be sited as near to the point at which zero indication is required as is practicable.

(5) *Accuracy*

(a) *DME/N.* The transponder shall not contribute more than plus or minus 1 microsecond (150 m (500 ft)) to the overall system error.

(i) *DME/N* The contribution to the total system error due to the combination of the transponder errors, transponder location coordinate errors, propagation effects and random pulse interference effects shall be not greater than plus or minus 340 m (0.183 NM) plus 1.25 per cent of distance measure.

(ii) *DME/N.* The combination of the transponder errors, transponder location coordinate errors, propagation effects and random pulse interference effects shall not contribute more than plus or minus 185 m (0.1 NM) to the overall system error.

(b) *DME/N.* A transponder associated with a landing aid shall not contribute more than plus or minus 0.5 microsecond (75 m (250 ft)) to the overall system error.

(6) *Efficiency*

(a) The transponder reply efficiency shall be at least 70 per cent for DME/N) at all values of transponder loading up to the loading corresponding to 7.2.5 and at the minimum sensitivity level specified in paragraph 3(2)(c)(i) and paragraph 3(2)(c)(v).

(b) *Transponder dead time.* The transponder shall be rendered inoperative for a period normally not to exceed 60 microseconds after a valid interrogation decode has occurred. In extreme cases when the geographical site of the transponder is such as to produce undesirable reflection problems, the dead time may be increased but only by the minimum amount necessary to allow the suppression of echoes for DME/N.

(7) *Monitoring and control*

(a) Means shall be provided at each transponder site for the automatic monitoring and control of the transponder in use.

(b) *DME/N monitoring action*—

(i) In the event that any of the conditions specified in subparagraph (ii) occur, the monitor shall cause the following action to take place—

(A) a suitable indication shall be given at a control point;

(B) the operating transponder shall be automatically switched off; and

(C) the standby transponder, if provided, shall be automatically placed in operation.

(ii) The monitor shall cause the actions specified in subparagraph (i) if—

(A) the transponder delay differs from the assigned value by 1 microsecond (150 m (500 ft)) or more;

(B) in the case of a DME/N associated with a landing aid, the transponder delay differs from the assigned value by 0.5 microsecond (75 m (250 ft)) or more.

(iii) The monitor shall cause the actions specified in subparagraph (i) if the spacing between the first and second pulse of the transponder pulse pair differs from the nominal value specified in the Table 7-1 by 1 microsecond or more.

(iv) The monitor shall also cause a suitable indication to be given at a control point if any of the following conditions arise—

(A) a fall of 3 dB or more in transponder transmitted power output;

(B) a fall of 6 dB or more in the minimum transponder receiver sensitivity (provided that this is not due to the action of the receiver automatic gain reduction circuits);

(C) the spacing between the first and second pulse of the transponder reply pulse pair differs from the normal value specified in paragraph 3(1)(d) by 1 microsecond or more; or

(D) variation of the transponder receiver and transmitter frequencies beyond the control range of the reference circuits (if the operating frequencies are not directly crystal controlled).

(v) Means shall be provided so that any of the conditions and malfunctioning enumerated in subparagraph (ii), (iii), and (iv) which are monitored can persist for a certain period before the monitor takes action. This period shall be as low as practicable, but shall not exceed 10 seconds, consistent with the need for avoiding interruption, due to transient effects, of the service provided by the transponder.

(vi) The transponder shall not be triggered more than 120 times per second for either monitoring or automatic frequency control purposes, or both.

(vii) *DME/N monitor failure.* Failure of any part of the monitor itself shall automatically produce the same results as the malfunctioning of the element being monitored.

4. **Technical characteristics of interrogator**

(1) *Transmitter*

(a) *Frequency of operation.* The interrogator shall transmit on the interrogation frequency appropriate to the assigned DME channel.

(b) *Frequency stability.* The radio frequency of operation shall not vary more than plus or minus 100 kHz from the assigned value.

(c) *Pulse shape and spectrum.* The following shall apply to all radiated pulses—

(i) *Pulse rise time.*

(ii) *DME/N.* Pulse rise time shall not exceed 3 microseconds. Pulse decay time shall nominally be 2.5 microseconds, but shall not exceed 3.5 microseconds.

(iii) The instantaneous amplitude of the pulse shall not, at any instant between the point of the leading edge which is 95 per cent of maximum amplitude and the point of the trailing edge which is 95 per cent of the maximum amplitude, fall below a value which is 95 per cent of the maximum voltage amplitude of the pulse.

(iv) The spectrum of the pulse modulated signal shall be such that at least 90 per cent of the energy in each pulse shall be within 0.5 MHz in a band centred on the nominal channel frequency.

(v) To ensure proper operation of the thresholding techniques, the instantaneous magnitude of any pulse turn-on transients which occur in time prior to the virtual origin shall be less than one per cent of the pulse peak amplitude. Initiation of the turn-on process shall not commence sooner than 1 microsecond prior to the virtual origin.

(d) *Pulse spacing*

(i) The spacing of the constituent pulses of transmitted pulse pairs shall be as given in the Table 7-1.

(ii) *DME/N.* The tolerance on the pulse spacing shall be plus or minus 0.5 microsecond.

(iii) *DME/N.* The tolerance on the pulse spacing shall be plus or minus 0.25 microsecond.

(iv) The pulse spacing shall be measured between the half voltage points on the leading edges of the pulses.

(e) *Pulse repetition frequency*

(i) The pulse repetition frequency shall be as specified in paragraph 2(4).

(ii) The variation in time between successive pairs of interrogation pulses shall be sufficient to prevent false lock-on.

(f) *Spurious radiation.* During intervals between transmission of individual pulses, the spurious pulse power received and measured in a receiver having the same characteristics of a DME transponder receiver, but tuned to any DME interrogation or reply frequency, shall be more than 50 dB below the peak pulse power received and measured in the same receiver tuned to the interrogation frequency in use during the transmission of the required pulses. This provision shall apply to all spurious pulse transmissions. The spurious CW power radiated from the interrogator on any DME interrogation or reply frequency shall not exceed 20 microwatts (minus 47 dBW).

(g) The spurious pulse power received and measured under the conditions stated in paragraph 4(1)(f) shall be 80 dB below the required peak pulse power received.

(2) *Time delay*

(a) The time delay shall be consistent with the table in paragraph 3(4)(a).

(b) *DME/N.* The time delay shall be the interval between the time of the half voltage point on the leading edge of the second constituent interrogation pulse and the time at which the distance circuits reach the condition corresponding to zero distance indication.

(c) *DME/N.* The time delay shall be the interval between the time of the half voltage point on the leading edge of the first constituent interrogation pulse and the time at which the distance circuits reach the condition corresponding to zero distance indication.

(3) *Receiver*

(a) *Frequency of operation.* The receiver centre frequency shall be the transponder frequency appropriate to the assigned DME operating channel.

(b) *Receiver sensitivity*

(i) *DME/N.* The airborne equipment sensitivity shall be sufficient to acquire and provide distance information to the accuracy specified in paragraph 4 (3) (f) for the signal power density specified in subparagraph 3 (1) (e) (ii).

(ii) *DME/N.* The performance of the interrogator shall be maintained when the power density of the transponder signal at the interrogator antenna is between the minimum values given in subparagraph 3 (1) (e) (i) and a maximum of minus18 dBW/m^2.

(c) *Bandwidth*

(i) *DME/N.* The receiver bandwidth shall be sufficient to allow compliance with paragraph 2 (1)(c), when the input signals are those specified in paragraph 3 (1)(b).

(d) *Interference rejection*

(i) When there is a ratio of desired to undesired co-channel DME signals of at least 8 dB at the input terminals of the airborne receiver, the interrogator shall display distance information and provide unambiguous identification from the stronger signal.

(ii) DME/*N.* DME signals greater than 900 kHz removed from the desired channel nominal frequency and having amplitudes up to 42 dB above the threshold sensitivity shall be rejected.

(e) *Decoding*

(i) The interrogator shall include a decoding circuit such that the receiver can be triggered only by pairs of received pulses having pulse duration and pulse spacings appropriate to transponder signals as described in paragraph 3 (1) (d).

(ii) *DME/N — Decoder rejection.* A reply pulse pair with a spacing of plus or minus 2 microseconds, or more, from the nominal value and with any signal level up to 42 dB above the receiver sensitivity shall be rejected.

(f) *Accuracy*

(i) *DME/N.* The interrogator shall not contribute more than plus or minus 315 m (plus or minus 0.17 NM) or 0.25 per cent of indicated range, whichever is greater, to the overall system error.

Table 7-2 DME/MLS angle, DME/VOR and DME/ILS/MLS channelling and pairing

Channel pairing				DME parameters						
				Interrogation				Reply	
					Pulse codes				
						DME/P mode			
DME channel number	VHF frequency MHz	MLS angle frequency MHz	MLS channel number	Frequency MHz	DME/N µs	Initial approach µs	Final approach µs	Frequency MHz	Pulse codes µs
*1X	–	–	–	1 025	12	–	–	962	12
**1Y	–	–	–	1 025	36	–	–	1 088	30
*2X	–	–	–	1 026	12	–	–	963	12
**2Y	–	–	–	1 026	36	–	–	1 089	30
*3X	–	–	–	1 027	12	–	–	964	12
**3Y	–	–	–	1 027	36	–	–	1 090	30
*4X	–	–	–	1 028	12	–	–	965	12
**4Y	–	–	–	1 028	36	–	–	1 091	30
*5X	–	–	–	1 029	12	–	–	966	12
**5Y	–	–	–	1 029	36	–	–	1 092	30
*6X	–	–	–	1 030	12	–	–	967	12
**6Y	–	–	–	1 030	36	–	–	1 093	30
*7X	–	–	–	1 031	12	–	–	968	12
**7Y	–	–	–	1 031	36	–	–	1 094	30
*8X	–	–	–	1 032	12	–	–	969	12
**8Y	–	–	–	1 032	36	–	–	1 095	30
*9X	–	–	–	1 033	12	–	–	970	12
**9Y	–	–	–	1 033	36	–	–	1 096	30
*10X	–	–	–	1 034	12	–	–	971	12
**10Y	–	–	–	1 034	36	–	–	1 097	30
*11X	–	–	–	1 035	12	–	–	972	12
**11Y	–	–	–	1 035	36	–	–	1 098	30
*12X	–	–	–	1 036	12	–	–	973	12
**12Y	–	–	–	1 036	36	–	–	1 099	30
*13X	–	–	–	1 037	12	–	–	974	12
**13Y	–	–	–	1 037	36	–	–	1 100	30
*14X	–	–	–	1 038	12	–	–	975	12
**14Y	–	–	–	1 038	36	–	–	1 101	30
*15X	–	–	–	1 039	12	–	–	976	12
**15Y	–	–	–	1 039	36	–	–	1 102	30
*16X	–	–	–	1 040	12	–	–	977	12
**16Y	–	–	–	1 040	36	–	–	1 103	30

Channel pairing				DME parameters					
				Interrogation				Reply	
					Pulse codes				
						DME/P mode			
DME channel number	VHF frequency MHz	MLS angle frequency MHz	MLS channel number	Frequency MHz	DME/N µs	Initial approach µs	Final approach µs	Frequency MHz	Pulse codes µs
∇17X	108.00	–	–	1 041	12	–	–	978	12
17Y	108.05	5 043.0	540	1 041	36	36	42	1 104	30
17Z	–	5 043.3	541	1 041	–	21	27	1 104	15
18X	108.10	5 031.0	500	1 042	12	12	18	979	12
18W	–	5 031.3	501	1 042	–	24	30	979	24
18Y	108.15	5 043.6	542	1 042	36	36	42	1 105	30
18Z	–	5 043.9	543	1 042	–	21	27	1 105	15
19X	108.20	–	–	1 043	12	–	–	980	12
19Y	108.25	5 044.2	544	1 043	36	36	42	1 106	30
19Z	–	5 044.5	545	1 043	–	21	27	1 106	15
20X	108.30	5 031.6	502	1 044	12	12	18	981	12
20W	–	5 031.9	503	1 044	–	24	30	981	24
20Y	108.35	5 044.8	546	1 044	36	36	42	1 107	30
20Z	–	5 045.1	547	1 044	–	21	27	1 107	15
21X	108.40	–	–	1 045	12	–	–	982	12
21Y	108.45	5 045.4	548	1 045	36	36	42	1 108	30
21Z	–	5 045.7	549	1 045	–	21	27	1 108	15
22X	108.50	5 032.2	504	1 046	12	12	18	983	12
22W	–	5 032.5	505	1 046	–	24	30	983	24
22Y	108.55	5 046.0	550	1 046	36	36	42	1 109	30
22Z	–	5 046.3	551	1 046	–	21	27	1 109	15
23X	108.60	–	–	1 047	12	–	–	984	12
23Y	108.65	5 046.6	552	1 047	36	36	42	1 110	30
23Z	–	5 046.9	553	1 047	–	21	27	1 110	15
24X	108.70	5 032.8	506	1 048	12	12	18	985	12
24W	–	5 033.1	507	1 048	–	24	30	985	24
24Y	108.75	5 047.2	554	1 048	36	36	42	1 111	30
24Z	–	5 047.5	555	1 048	–	21	27	1 111	15
25X	108.80	–	–	1 049	12	–	–	986	12
25Y	108.85	5 047.8	556	1 049	36	36	42	1 112	30
25Z	–	5 048.1	557	1 049	–	21	27	1 112	15
26X	108.90	5 033.4	508	1 050	12	12	18	987	12
26W	–	5 033.7	509	1 050	–	24	30	987	24
26Y	108.95	5 048.4	558	1 050	36	36	42	1 113	30
26Z	–	5 048.7	559	1 050	–	21	27	1 113	15
27X	109.00	–	–	1 051	12	–	–	988	12
27Y	109.05	5 049.0	560	1 051	36	36	42	1 114	30
27Z	–	5 049.3	561	1 051	–	21	27	1 114	15

Channel pairing				DME parameters					
				Interrogation				Reply	
					Pulse codes				
						DME/P mode			
DME channel number	VHF frequency MHz	MLS angle frequency MHz	MLS channel number	Frequency MHz	DME/N µs	Initial approach µs	Final approach µs	Frequency MHz	Pulse codes µs
28X	109.10	5 034.0	510	1 052	12	12	18	989	12
28W	–	5 034.3	511	1 052	–	24	30	989	24
28Y	109.15	5 049.6	562	1 052	36	36	42	1 115	30
28Z	–	5 049.9	563	1 052	–	21	27	1 115	15
29X	109.20	–	–	1 053	12	–	–	990	12
29Y	109.25	5 050.2	564	1 053	36	36	42	1 116	30
29Z	–	5 050.5	565	1 053	–	21	27	1 116	15
30X	109.30	5 034.6	512	1 054	12	12	18	991	12
30W	–	5 034.9	513	1 054	–	24	30	991	24
30Y	109.35	5 050.8	566	1 054	36	36	42	1 117	30
30Z	–	5 051.1	567	1 054	–	21	27	1 117	15
31X	109.40	–	–	1 055	12	–	–	992	12
31Y	109.45	5 051.4	568	1 055	36	36	42	1 118	30
31Z	–	5 051.7	569	1 055	–	21	27	1 118	15
32X	109.50	5 035.2	514	1 056	12	12	18	993	12
32W	–	5 035.5	515	1 056	–	24	30	993	24
32Y	109.55	5 052.0	570	1 056	36	36	42	1 119	30
32Z	–	5 052.3	571	1 056	–	21	27	1 119	15
33X	109.60	–	–	1 057	12	–	–	994	12
33Y	109.65	5 052.6	572	1 057	36	36	42	1 120	30
33Z	–	5 052.9	573	1 057	–	21	27	1 120	15
34X	109.70	5 035.8	516	1 058	12	12	18	995	12
34W	–	5 036.1	517	1 058	–	24	30	995	24
34Y	109.75	5 053.2	574	1 058	36	36	42	1 121	30
34Z	–	5 053.5	575	1 058	–	21	27	1 121	15
35X	109.80	–	–	1 059	12	–	–	996	12
35Y	109.85	5 053.8	576	1 059	36	36	42	1 122	30
35Z	–	5 054.1	577	1 059	–	21	27	1 122	15
36X	109.90	5 036.4	518	1 060	12	12	18	997	12
36W	–	5 036.7	519	1 060	–	24	30	997	24
36Y	109.95	5 054.4	578	1 060	36	36	42	1 123	30
36Z	–	5 054.7	579	1 060	–	21	27	1 123	15
37X	110.00	–	–	1 061	12	–	–	998	12
37Y	110.05	5 055.0	580	1 061	36	36	42	1 124	30
37Z	–	5 055.3	581	1 061	–	21	27	1 124	15
38X	110.10	5 037.0	520	1 062	12	12	18	999	12
38W	–	5 037.3	521	1 062	–	24	30	999	24
38Y	110.15	5 055.6	582	1 062	36	36	42	1 125	30
38Z	–	5 055.9	583	1 062	–	21	27	1 125	15

Channel pairing				DME parameters					
				Interrogation				Reply	
					Pulse codes				
						DME/P mode			
DME channel number	VHF frequency MHz	MLS angle frequency MHz	MLS channel number	Frequency MHz	DME/N µs	Initial approach µs	Final approach µs	Frequency MHz	Pulse codes µs
39X	110.20	–	–	1 063	12	–	–	1 000	12
39Y	110.25	5 056.2	584	1 063	36	36	42	1 126	30
39Z	–	5 056.5	585	1 063	–	21	27	1 126	15
40X	110.30	5 037.6	522	1 064	12	12	18	1 001	12
40W	–	5 037.9	523	1 064	–	24	30	1 001	24
40Y	110.35	5 056.8	586	1 064	36	36	42	1 127	30
40Z	–	5 057.1	587	1 064	–	21	27	1 127	15
41X	110.40	–	–	1 065	12	–	–	1 002	12
41Y	110.45	5 057.4	588	1 065	36	36	42	1 128	30
41Z	–	5 057.7	589	1 065	–	21	27	1 128	15
42X	110.50	5 038.2	524	1 066	12	12	18	1 003	12
42W	–	5 038.5	525	1 066	–	24	30	1 003	24
42Y	110.55	5 058.0	590	1 066	36	36	42	1 129	30
42Z	–	5 058.3	591	1 066	–	21	27	1 129	15
43X	110.60	–	–	1 067	12	–	–	1 004	12
43Y	110.65	5 058.6	592	1 067	36	36	42	1 130	30
43Z	–	5 058.9	593	1 067	–	21	27	1 130	15
44X	110.70	5 038.8	526	1 068	12	12	18	1 005	12
44W	–	5 039.1	527	1 068	–	24	30	1 005	24
44Y	110.75	5 059.2	594	1 068	36	36	42	1 131	30
44Z	–	5 059.5	595	1 068	–	21	27	1 131	15
45X	110.80	–	–	1 069	12	–	–	1 006	12
45Y	110.85	5 059.8	596	1 069	36	36	42	1 132	30
45Z	–	5 060.1	597	1 069	–	21	27	1 132	15
46X	110.90	5 039.4	528	1 070	12	12	18	1 007	12
46W	–	5 039.7	529	1 070	–	24	30	1 007	24
46Y	110.95	5 060.4	598	1 070	36	36	42	1 133	30
46Z	–	5 060.7	599	1 070	–	21	27	1 133	15
47X	111.00	–	–	1 071	12	–	–	1 008	12
47Y	111.05	5 061.0	600	1 071	36	36	42	1 134	30
47Z	–	5 061.3	601	1 071	–	21	27	1 134	15
48X	111.10	5 040.0	530	1 072	12	12	18	1 009	12
48W	–	5 040.3	531	1 072	–	24	30	1 009	24
48Y	111.15	5 061.6	602	1 072	36	36	42	1 135	30
48Z	–	5 061.9	603	1 072	–	21	27	1 135	15
49X	111.20	–	–	1 073	12	–	–	1 010	12
49Y	111.25	5 062.2	604	1 073	36	36	42	1 136	30
49Z	–	5 062.5	605	1 073	–	21	27	1 136	15

Channel pairing				DME parameters						
				Interrogation					Reply	
					Pulse codes					
						DME/P mode				
DME channel number	VHF frequency MHz	MLS angle frequency MHz	MLS channel number	Frequency MHz	DME/N µs	Initial approach µs	Final approach µs		Frequency MHz	Pulse codes µs
50X	111.30	5 040.6	532	1 074	12	12	18		1 011	12
50W	–	5 040.9	533	1 074	–	24	30		1 011	24
50Y	111.35	5 062.8	606	1 074	36	36	42		1 137	30
50Z	–	5 063.1	607	1 074	–	21	27		1 137	15
51X	111.40	–	–	1 075	12	–	–		1 012	12
51Y	111.45	5 063.4	608	1 075	36	36	42		1 138	30
51Z	–	5 063.7	609	1 075	–	21	27		1 138	15
52X	111.50	5 041.2	534	1 076	12	12	18		1 013	12
52W	–	5 041.5	535	1 076	–	24	30		1 013	24
52Y	111.55	5 064.0	610	1 076	36	36	42		1 139	30
52Z	–	5 064.3	611	1 076	–	21	27		1 139	15
53X	111.60	–	–	1 077	12	–	–		1 014	12
53Y	111.65	5 064.6	612	1 077	36	36	42		1 140	30
53Z	–	5 064.9	613	1 077	–	21	27		1 140	15
54X	111.70	5 041.8	536	1 078	12	12	18		1 015	12
54W	–	5 042.1	537	1 078	–	24	30		1 015	24
54Y	111.75	5 065.2	614	1 078	36	36	42		1 141	30
54Z	–	5 065.5	615	1 078	–	21	27		1 141	15
55X	111.80	–	–	1 079	12	–	–		1 016	12
55Y	111.85	5 065.8	616	1 079	36	36	42		1 142	30
55Z	–	5 066.1	617	1 079	–	21	27		1 142	15
56X	111.90	5 042.4	538	1 080	12	12	18		1 017	12
56W	–	5 042.7	539	1 080	–	24	30		1 017	24
56Y	111.95	5 066.4	618	1 080	36	36	42		1 143	30
56Z	–	5 066.7	619	1 080	–	21	27		1 143	15
57X	112.00	–	–	1 081	12	–	–		1 018	12
57Y	112.05	–	–	1 081	36	–	–		1 144	30
58X	112.10	–	–	1 082	12	–	–		1 019	12
58Y	112.15	–	–	1 082	36	–	–		1 145	30
59X	112.20	–	–	1 083	12	–	–		1 020	12
59Y	112.25	–	–	1 083	36	–	–		1 146	30
**60X	–	–	–	1 084	12	–	–		1 021	12
**60Y	–	–	–	1 084	36	–	–		1 147	30
**61X	–	–	–	1 085	12	–	–		1 022	12
**61Y	–	–	–	1 085	36	–	–		1 148	30
**62X	–	–	–	1 086	12	–	–		1 023	12
**62Y	–	–	–	1 086	36	–	–		1 149	30
**63X	–	–	–	1 087	12	–	–		1 024	12
**63Y	–	–	–	1 087	36	–	–		1 150	30

Channel pairing				DME parameters					
				Interrogation				Reply	
					Pulse codes				
						DME/P mode			
DME channel number	VHF frequency MHz	MLS angle frequency MHz	MLS channel number	Frequency MHz	DME/N µs	Initial approach µs	Final approach µs	Frequency MHz	Pulse codes µs
**64X	–	–	–	1 088	12	–	–	1 151	12
**64Y	–	–	–	1 088	36	–	–	1 025	30
**65X	–	–	–	1 089	12	–	–	1 152	12
**65Y	–	–	–	1 089	36	–	–	1 026	30
**66X	–	–	–	1 090	12	–	–	1 153	12
**66Y	–	–	–	1 090	36	–	–	1 027	30
**67X	–	–	–	1 091	12	–	–	1 154	12
**67Y	–	–	–	1 091	36	–	–	1 028	30
**68X	–	–	–	1 092	12	–	–	1 155	12
**68Y	–	–	–	1 092	36	–	–	1 029	30
**69X	–	–	–	1 093	12	–	–	1 156	12
**69Y	–	–	–	1 093	36	–	–	1 030	30
70X	112.30	–	–	1 094	12	–	–	1 157	12
**70Y	112.35	–	–	1 094	36	–	–	1 031	30
71X	112.40	–	–	1 095	12	–	–	1 158	12
**71Y	112.45	–	–	1 095	36	–	–	1 032	30
72X	112.50	–	–	1 096	12	–	–	1 159	12
**72Y	112.55	–	–	1 096	36	–	–	1 033	30
73X	112.60	–	–	1 097	12	–	–	1 160	12
**73Y	112.65	–	–	1 097	36	–	–	1 034	30
74X	112.70	–	–	1 098	12	–	–	1 161	12
**74Y	112.75	–	–	1 098	36	–	–	1 035	30
75X	112.80	–	–	1 099	12	–	–	1 162	12
**75Y	112.85	–	–	1 099	36	–	–	1 036	30
76X	112.90	–	–	1 100	12	–	–	1 163	12
**76Y	112.95	–	–	1 100	36	–	–	1 037	30
77X	113.00	–	–	1 101	12	–	–	1 164	12
**77Y	113.05	–	–	1 101	36	–	–	1 038	30
78X	113.10	–	–	1 102	12	–	–	1 165	12
**78Y	113.15	–	–	1 102	36	–	–	1 039	30
79X	113.20	–	–	1 103	12	–	–	1 166	12
**79Y	113.25	–	–	1 103	36	–	–	1 040	30
80X	113.30	–	–	1 104	12	–	–	1 167	12
80Y	113.35	5 067.0	620	1 104	36	36	42	1 041	30
80Z	–	5 067.3	621	1 104	–	21	27	1 041	15

				DME parameters					
				Interrogation				Reply	
					Pulse codes				
Channel pairing						DME/P mode			
DME channel number	VHF frequency MHz	MLS angle frequency MHz	MLS channel number	Frequency MHz	DME/N µs	Initial approach µs	Final approach µs	Frequency MHz	Pulse codes µs
81X	113.40	–	–	1 105	12	–	–	1 168	12
81Y	113.45	5 067.6	622	1 105	36	36	42	1 042	30
81Z	–	5 067.9	623	1 105	–	21	27	1 042	15
82X	113.50	–	–	1 106	12	–	–	1 169	12
82Y	113.55	5 068.2	624	1 106	36	36	42	1 043	30
82Z	–	5 068.5	625	1 106	–	21	27	1 043	15
83X	113.60	–	–	1 107	12	–	–	1 170	12
83Y	113.65	5 068.8	626	1 107	36	36	42	1 044	30
83Z	–	5 069.1	627	1 107	–	21	27	1 044	15
84X	113.70	–	–	1 108	12	–	–	1 171	12
84Y	113.75	5 069.4	628	1 108	36	36	42	1 045	30
84Z	–	5 069.7	629	1 108	–	21	27	1 045	15
85X	113.80	–	–	1 109	12	–	–	1 172	12
85Y	113.85	5 070.0	630	1 109	36	36	42	1 046	30
85Z	–	5 070.3	631	1 109	–	21	27	1 046	15
86X	113.90	–	–	1 110	12	–	–	1 173	12
86Y	113.95	5 070.6	632	1 110	36	36	42	1 047	30
86Z	–	5 070.9	633	1 110	–	21	27	1 047	15
87X	114.00	–	–	1 111	12	–	–	1 174	12
87Y	114.05	5 071.2	634	1 111	36	36	42	1 048	30
87Z	–	5 071.5	635	1 111	–	21	27	1 048	15
88X	114.10	–	–	1 112	12	–	–	1 175	12
88Y	114.15	5 071.8	636	1 112	36	36	42	1 049	30
88Z	–	5 072.1	637	1 112	–	21	27	1 049	15
89X	114.20	–	–	1 113	12	–	–	1 176	12
89Y	114.25	5 072.4	638	1 113	36	36	42	1 050	30
89Z	–	5 072.7	639	1 113	–	21	27	1 050	15
90X	114.30	–	–	1 114	12	–	–	1 177	12
90Y	114.35	5 073.0	640	1 114	36	36	42	1 051	30
90Z	–	5 073.3	641	1 114	–	21	27	1 051	15
91X	114.40	–	–	1 115	12	–	–	1 178	12
91Y	114.45	5 073.6	642	1 115	36	36	42	1 052	30
91Z	–	5 073.9	643	1 115	–	21	27	1 052	15
92X	114.50	–	–	1 116	12	–	–	1 179	12
92Y	114.55	5 074.2	644	1 116	36	36	42	1 053	30
92Z	–	5 074.5	645	1 116	–	21	27	1 053	15
93X	114.60	–	–	1 117	12	–	–	1 180	12
93Y	114.65	5 074.8	646	1 117	36	36	42	1 054	30
93Z	–	5 075.1	647	1 117	–	21	27	1 054	15

Channel pairing				DME parameters					
				Interrogation				Reply	
					Pulse codes				
						DME/P mode			
DME channel number	VHF frequency MHz	MLS angle frequency MHz	MLS channel number	Frequency MHz	DME/N µs	Initial approach µs	Final approach µs	Frequency MHz	Pulse codes µs
94X	114.70	–	–	1 118	12	–	–	1 181	12
94Y	114.75	5 075.4	648	1 118	36	36	42	1 055	30
94Z	–	5 075.7	649	1 118	–	21	27	1 055	15
95X	114.80	–	–	1 119	12	–	–	1 182	12
95Y	114.85	5 076.0	650	1 119	36	36	42	1 056	30
95Z	–	5 076.3	651	1 119	–	21	27	1 056	15
96X	114.90	–	–	1 120	12	–	–	1 183	12
96Y	114.95	5 076.6	652	1 120	36	36	42	1 057	30
96Z	–	5 076.9	653	1 120	–	21	27	1 057	15
97X	115.00	–	–	1 121	12	–	–	1 184	12
97Y	115.05	5 077.2	654	1 121	36	36	42	1 058	30
97Z	–	5 077.5	655	1 121	–	21	27	1 058	15
98X	115.10	–	–	1 122	12	–	–	1 185	12
98Y	115.15	5 077.8	656	1 122	36	36	42	1 059	30
98Z	–	5 078.1	657	1 122	–	21	27	1 059	15
99X	115.20	–	–	1 123	12	–	–	1 186	12
99Y	115.25	5 078.4	658	1 123	36	36	42	1 060	30
99Z	–	5 078.7	659	1 123	–	21	27	1 060	15
100X	115.30	–	–	1 124	12	–	–	1 187	12
100Y	115.35	5 079.0	660	1 124	36	36	42	1 061	30
100Z	–	5 079.3	661	1 124	–	21	27	1 061	15
101X	115.40	–	–	1 125	12	–	–	1 188	12
101Y	115.45	5 079.6	662	1 125	36	36	42	1 062	30
101Z	–	5 079.9	663	1 125	–	21	27	1 062	15
102X	115.50	–	–	1 126	12	–	–	1 189	12
102Y	115.55	5 080.2	664	1 126	36	36	42	1 063	30
102Z	–	5 080.5	665	1 126	–	21	27	1 063	15
103X	115.60	–	–	1 127	12	–	–	1 190	12
103Y	115.65	5 080.8	666	1 127	36	36	42	1 064	30
103Z	–	5 081.1	667	1 127	–	21	27	1 064	15
104X	115.70	–	–	1 128	12	–	–	1 191	12
104Y	115.75	5 081.4	668	1 128	36	36	42	1 065	30
104Z	–	5 081.7	669	1 128	–	21	27	1 065	15
105X	115.80	–	–	1 129	12	–	–	1 192	12
105Y	115.85	5 082.0	670	1 129	36	36	42	1 066	30
105Z	–	5 082.3	671	1 129	–	21	27	1 066	15
106X	115.90	–	–	1 130	12	–	–	1 193	12
106Y	115.95	5 082.6	672	1 130	36	36	42	1 067	30
106Z	–	5 082.9	673	1 130	–	21	27	1 067	15

Channel pairing				DME parameters					
				Interrogation				Reply	
					Pulse codes				
						DME/P mode			
DME channel number	VHF frequency MHz	MLS angle frequency MHz	MLS channel number	Frequency MHz	DME/N µs	Initial approach µs	Final approach µs	Frequency MHz	Pulse codes µs
107X	116.00	–	–	1 131	12	–	–	1 194	12
107Y	116.05	5 083.2	674	1 131	36	36	42	1 068	30
107Z	–	5 083.5	675	1 131	–	21	27	1 068	15
108X	116.10	–	–	1 132	12	–	–	1 195	12
108Y	116.15	5 083.8	676	1 132	36	36	42	1 069	30
108Z	–	5 084.1	677	1 132	–	21	27	1 069	15
109X	116.20	–	–	1 133	12	–	–	1 196	12
109Y	116.25	5 084.4	678	1 133	36	36	42	1 070	30
109Z	–	5 084.7	679	1 133	–	21	27	1 070	15
110X	116.30	–	–	1 134	12	–	–	1 197	12
110Y	116.35	5 085.0	680	1 134	36	36	42	1 071	30
110Z	–	5 085.3	681	1 134	–	21	27	1 071	15
111X	116.40	–	–	1 135	12	–	–	1 198	12
111Y	116.45	5 085.6	682	1 135	36	36	42	1 072	30
111Z	–	5 085.9	683	1 135	–	21	27	1 072	15
112X	116.50	–	–	1 136	12	–	–	1 199	12
112Y	116.55	5 086.2	684	1 136	36	36	42	1 073	30
112Z	–	5 086.5	685	1 136	–	21	27	1 073	15
113X	116.60	–	–	1 137	12	–	–	1 200	12
113Y	116.65	5 086.8	686	1 137	36	36	42	1 074	30
113Z	–	5 087.1	687	1 137	–	21	27	1 074	15
114X	116.70	–	–	1 138	12	–	–	1 201	12
114Y	116.75	5 087.4	688	1 138	36	36	42	1 075	30
114Z	–	5 087.7	689	1 138	–	21	27	1 075	15
115X	116.80	–	–	1 139	12	–	–	1 202	12
115Y	116.85	5 088.0	690	1 139	36	36	42	1 076	30
115Z	–	5 088.3	691	1 139	–	21	27	1 076	15
116X	116.90	–	–	1 140	12	–	–	1 203	12
116Y	116.95	5 088.6	692	1 140	36	36	42	1 077	30
116Z	–	5 088.9	693	1 140	–	21	27	1 077	15
117X	117.00	–	–	1 141	12	–	–	1 204	12
117Y	117.05	5 089.2	694	1 141	36	36	42	1 078	30
117Z	–	5 089.5	695	1 141	–	21	27	1 078	15
118X	117.10	–	–	1 142	12	–	–	1 205	12
118Y	117.15	5 089.8	696	1 142	36	36	42	1 079	30
118Z	–	5 090.1	697	1 142	–	21	27	1 079	15
119X	117.20	–	–	1 143	12	–	–	1 206	12
119Y	117.25	5 090.4	698	1 143	36	36	42	1 080	30
119Z	–	5 090.7	699	1 143	–	21	27	1 080	15

Channel pairing				DME parameters					
				Interrogation				Reply	
					Pulse codes				
						DME/P mode			
DME channel number	VHF frequency MHz	MLS angle frequency MHz	MLS channel number	Frequency MHz	DME/N µs	Initial approach µs	Final approach µs	Frequency MHz	Pulse codes µs
120X	117.30	–	–	1 144	12	–	–	1 207	12
120Y	117.35	–	–	1 144	36	–	–	1 081	30
121X	117.40	–	–	1 145	12	–	–	1 208	12
121Y	117.45	–	–	1 145	36	–	–	1 082	30
122X	117.50	–	–	1 146	12	–	–	1 209	12
122Y	117.55	–	–	1 146	36	–	–	1 083	30
123X	117.60	–	–	1 147	12	–	–	1 210	12
123Y	117.65	–	–	1 147	36	–	–	1 084	30
124X	117.70	–	–	1 148	12	–	–	1 211	12
**124Y	117.75	–	–	1 148	36	–	–	1 085	30
125X	117.80	–	–	1 149	12	–	–	1 212	12
**125Y	117.85	–	–	1 149	36	–	–	1 086	30
126X	117.90	–	–	1 150	12	–	–	1 213	12
**126Y	117.95	–	–	1 150	36	–	–	1 087	30

* 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 for ILS service. The associated DME operating channel 17X may be assigned for emergence use. The reply frequency of channel 17X (i.e. 978 MHz) is also utilised for the operation of the universal access transceiver (UAT). Standards and recommended practices for UAT are found in the Civil Aviation (Aeronautical Communication Systems) Regulations.

SCHEDULE 8

(regulation 28)

SPECIFICATION FOR EN-ROUTE VHF MARKER BEACONS (75 MHZ)

1. **Equipment**

(1) *Frequencies.* The emissions of an en-route VHF marker beacon shall have a radio frequency of 75 MHz plus or minus 0.005 per cent.

(2) *Characteristics of emissions*

(a) Radio marker beacons shall radiate an uninterrupted carrier modulated to a depth of not less than 95 percent or more than 100 per cent. The total harmonic content of the modulation shall not exceed 15 percent.

(b) The frequency of the modulating tone shall be 3 000 Hz plus or minus 75 Hz.

(c) The radiation shall be horizontally polarised.

(d) *Identification.* If a coded identification is required at a radio marker beacon, the modulating tone shall be keyed so as to transmit dots or dashes or both in an appropriate sequence. The mode of keying shall be such as to provide a dot-and-dash duration together with spacing intervals corresponding to transmission at a rate equivalent to approximately six to ten words per minute. The carrier shall not be interrupted during identification.

(e) *Determination of coverage.* The limits of coverage of marker beacons shall be determined on the basis of the field strength specified in paragraph 3(2) of Schedule 2 to these Regulations.

(f) *Radiation pattern.* The radiation pattern of a marker beacon normally shall be such that the polar axis is vertical, and the field strength in the pattern is symmetrical about the polar axis in the plane or planes containing the flight paths for which the marker beacon is intended.

(3) *Monitoring.* For each marker beacon, suitable monitoring equipment shall be provided which will show at an appropriate location—

(a) a decrease in radiated carrier power below 50 per cent of normal;

(b) a decrease of modulation depth below 70 per cent; or

(c) a failure of keying.

SCHEDULE 9

(regulations 32, 33 and 34)

REQUIREMENTS FOR THE GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)

Table 9-1 Signal in space performance requirements

Typical oper- ations	Accuracy horizontal 95% (Note 1 and 3)	Accuracy vertical (Note 1 and 3)	Integrity (Note 2)	Time – to-alert (Note 3)	Continuity (Note 4)	Availability (Note 5)
En-route	3.7 km (2.0NM)	N/A	$1 – 1 \times 10^{-7}$/h	5 min	$1 – 1 \times 10^{-4}$/h to $1 – 1 \times 10^{-8}$/h	0.99 to 0.99999
En-route Terminal	0.74 km (0.4NM)	N/A	$1 – 1 \times 10^{-7}$/h	15 s	$1 – 1 \times 10^{-4}$/h to $1 – 1 \times 10^{-8}$/h	0.99 to 0.99999
Initial approach intermediate approach Non-pre-cision ap- proach (NPA) Departure	220 m (720ft)	N/A	$1 – 1 \times 10^{-7}$/h	10 s	$1 – 1 \times 10^{-4}$/h to $1 – 1 \times 10^{-8}$/h	0.99 to 0.99999
Approach op-erations with vertical guid- ance (APV-I) (Note 8)	16.0 m (52 ft)	20 m (66ft)	$1 – 2 \times 10^{-7}$ in any ap- proach	10 s	$1 – 8 \times 10^{-6}$ per 15 s	0.99 to 0.99999
Approach operations with vertical guidance (APV-II) (Note 8)	16.0 m (52 ft)	8.0 m (26 ft)	$1 – 2 \times 10^{-7}$ in any ap- proach	6 s	$1 – 8 \times 10^{-6}$ per 15 s	0.99 to 0.99999
Category I precision approach (Note 7)	16.0 m (52 ft)	6.0 m to 4.0 m (20ft to 13 ft) (Note 6)	$1 – 2 \times 10^{-7}$ in any ap- proach	6 s	$1 – 8 \times 10^{-6}$ per 15 s	0.99 to 0.99999

Notes –

1. The 95th percentile values for GNSS position errors are those required for the intended operation at the lowest height above threshold (HAT), if applicable.

2. The definition of the integrity requirement includes an alert limit against which the requirement can be assessed. For Category I precision approach, a vertical alert limit (VAL) greater than 10 m for a specific system design may only be used if a system-specific safety analysis has been completed. These alert limits are:

Typical Operation	**Horizontal alert limit**	**Vertical alert limit**
En-route (oceanic/continental low density)	7.4 km (4NM)	N/A
En-route (continental)	3.7 km (2NM)	N/A
En-route Terminal	1.85 km (1NM)	N/A
NPA	556 m (0.3NM)	N/A
APV-I	40 m (130ft)	50 m(164 ft)
APV-II	40 m (130 ft)	20.0 m (66 ft)
Category I precision approach	40 m(130 ft)	35.0 m to 10.0 m (115 ft to 33ft)

The accuracy and time-to-alert requirements include the nominal performance of a fault-free receiver.

Ranges of values are given for the continuity requirement for en- route, terminal, initial approach, NPA and departure operations, as this requirement is dependent upon several factors including the intended operation, traffic density, complexity of airspace and availability of alternative navigation aids. The lower value given is the minimum requirement for areas with low traffic density and airspace complexity. The higher value given is appropriate for areas with high traffic density and airspace complexity. Continuity requirements for APV and Category I operations apply to the average risk (over time) of loss of service, normalised to a 15-second exposure time.

1. **Global Navigation Satellite System elements specifications**

(1) Global positioning system Standard Positioning Service (SPS) (L1)

(a) *Space and control segment accuracy*—

(i) *Positioning accuracy*. The GPS SPS position errors shall not exceed the following limits—

	Global average 95% of the time	**Worst site 95% of the time**
Horizontal position error	9 m (30ft)	17 m (56ft)
Vertical position error	15 m (49ft)	37 m (121ft)

(ii) *Time transfer accuracy*. The GPS SPS time transfer errors shall not exceed 40 nanoseconds 95 per cent of the time.

(iii) *Range domain accuracy*. The range domain error shall not exceed the following limits—

(A) range error of any satellite — 30 m (100 ft) with reliability specified paragraph (c);

(B) 95th percentile range rate error of any satellite — 0.006 m (0.02 ft) per second (global average);

(C) 95th percentile range acceleration error of any satellite — 0.002 m (0.006 ft) per second-squared (global average) and

(D) 95th percentile range error for any satellites over all time differences between time of data generation and time of use of data — 7.8 m (26 ft) (global average).

(b) *Availability*. The Global Positioning System SPS availability shall be as follows—

(i) ≥99 percent horizontal service availability, average location (17 m 95 percent threshold)

(ii) ≥99 percent vertical service availability, average location (37 m 95 percent threshold)

(iii) ≥90 percent horizontal service availability, worst-case location (17m 95 percent threshold)

(iv) ≥90 percent vertical service availability, worst-case location (37m 95 percent threshold)

(c) *Reliability*. The GPS SPS reliability shall be within the following limits—

(i) reliability — at least 99.94 percent (global average); and

(ii) reliability — at least 99.79 percent (worst single point average).

(d) *Probability of major service failure.* The probability that the user range error (URE) of any satellite will exceed 4.42 times the upper bound on the user range accuracy (URA) broadcast by that satellite without an alert received at the user receiver antenna within 10 seconds shall not exceed 1×10^{-5}per hour.

(e) *Continuity.* The probability of losing Global Positioning System SPS signal-in-space (SIS) availability from a slot of the nominal 24-slot constellation due to unscheduled interruption shall not exceed 2×10^{-4} per hour.

(f) *Coverage.* The GPS SPS shall cover the surface of the earth up to an altitude of 3 000 kilometres.

(g) *Radio frequency (RF) characteristics*—

(i) *Carrier frequency*. Each Global Positioning System satellite shall broadcast an SPS signal at the carrier frequency of 1575.42 MHz (Global Positioning System L1) using code division multiple access (CDMA).

(ii) *Signal spectrum*. The Global Positioning System SPS signal power shall be contained within a ±12 MHz band (1563.42 – 1587.42 MHz) centred on the L1 frequency.

(iii) *Polarisation*. The transmitted RF signal shall be right-hand (clockwise) circularly polarised.

(iv) *Signal power level*. Each Global Positioning System satellite shall broadcast SPS navigation signals with sufficient power such that, at all unobstructed locations near the ground from which the satellite is observed at an elevation angle of 5 degrees or higher, the level of the received RF signal at the antenna port of a 3 dBi linearly- polarised antenna is within the range of –158.5 dBW to –153 dBW for all antenna orientations orthogonal to the direction of propagation.

(v) *Modulation*. The SPS L1 signal shall be bipolar phase shift key (BPSK) modulated with a pseudo random noise (PRN) 1.023 MHz coarse or acquisition (C/A) code. The C/A code sequence shall be repeated each millisecond. The transmitted PRN code sequence shall be the Modulo-2 addition of 50 bits per second navigation message and the C/A code.

(h) *Global Positioning System time*. Global Positioning System time shall be referenced to UTC (as maintained by the U.S. Naval Observatory).

(i) *Coordinate system*. The Global Positioning System coordinate system shall be WGS-84.

(j) *Navigation information*. The navigation data transmitted by the satellites shall include the necessary information to determine—

(i) satellite time of transmission;

(ii) satellite position;

(iii) satellite health;

(iv) satellite clock correction;

(v) propagation delay effects;

(vi) time transfer to UTC; and

(vii) Constellation status.

(2) GLONASS Channel of Standard Accuracy (CSA) (L1)

(a) *Space and control segment accuracy*

(i) *Positioning accuracy*. The GLONASS CSA position errors shall not exceed the following limits:

	Global average 95% of the time	Worst site 95% of the time
Horizontal position error	5 m (17 ft)	12 m (40 ft)
Vertical position error	9 m (29 ft)	25 m (97 ft)

(ii) *Time transfer accuracy*. The GLONASS CSA time transfer errors shall not exceed 700 nanoseconds 95 per cent of the time.

(iii) *Range domain accuracy*. The range domain error shall not exceed the following limits—

(A) range error of any satellite — 18 m (59.7 ft);

(B) range rate error of any satellite — 0.02 m (0.07 ft) per second;

(C) range acceleration error of any satellite — 0.007 m (0.023 ft) per second squared;

(D) root-mean-square range error over all satellites — 6 m (19.9 ft).

(b) *Availability*. The GLONASS CSA availability shall be as follows—

(i) ≥99 percent horizontal service availability, average location (12m, 95 percent threshold);

(ii) ≥99 percent vertical service availability, average location (25m, 95 per cent threshold);

(iii) ≥90 percent horizontal service availability, worst-case location (12m, 95 percent threshold);

(iv) ≥90 percent vertical service availability, worst-case location (25m, 95 percent threshold).

(c) *Reliability*. The GLONASS CSA reliability shall be within the following limits—

(i) frequency of a major service failure — not more than three per year for the constellation (global average); and

(ii) reliability- at least 99.7 per cent (global average).

(d) *Coverage*. The GLONASS CSA shall cover the surface of the earth up to an altitude of 2 000 km.

(e) *RF characteristics*—

(i) *Carrier frequency*. Each GLONASS satellite shall broadcast CSA navigation signal at its own carrier frequency in the L1 (1.6 GHz) frequency band using frequency division multiple access (FDMA).

(ii) *Signal spectrum*. GLONASS CSA signal power shall be contained within a ±5.75 MHz band centred on each GLONASS carrier frequency.

(iii) *Polarisation*. The transmitted RF signal shall be right-hand circularly polarised.

(iv) *Signal power level*. Each GLONASS satellite shall broadcast CSA navigation signals with sufficient power such that, at all unobstructed locations near the ground from which the satellite is observed at an elevation angle of 5 degrees or higher, the level of the received RF signal at the antenna port of a 3 dBi linearly polarised antenna is within the range of –161 dBW to –155.2 dBW for all antenna orientations orthogonal to the direction of propagation.

(v) *Modulation*—

(A) Each GLONASS satellite shall transmit at its carrier frequency the navigation RF signal using a BPSK modulated binary train. The phase shift keying of the carrier shall be performed at π-radians with the maximum error ±0.2 radian. The pseudo-random code sequence shall be repeated each millisecond.

(B) The modulating navigation signal shall be generated by the Modulo-2 addition of the following three binary signals—

(i) ranging code transmitted at 511 kbits/s;

(ii) navigation message transmitted at 50 bits/s; and

(iii) 100 Hz auxiliary meander sequence.

(f) *GLONASS time.* GLONASS time shall be referenced to UTC (SU) (as maintained by the National Time Service of Russia).

(g) *Coordinate system.* The GLONASS coordinate system shall be PZ-90.

(h) *Navigation information.* The navigation data transmitted by the satellite shall include the necessary information to determine—

(i) satellite time of transmission;

(ii) satellite position;

(iii) satellite health;

(iv) satellite clock correction;

(v) time transfer to UTC; and

(vi) constellation status.

(3) **Aircraft-based augmentation system (ABAS)**

The ABAS function combined with one or more of the other global navigation satellite system elements and both a fault free global navigation satellite system receiver and fault-free aircraft system used for the ABAS function shall meet the requirements for accuracy, integrity, continuity and availability as stated in Regulation 32, throughout the SBAS coverage area.

(4) **Satellite-based augmentation system (SBAS)**

(a) *Performance.*

(i) SBAS combined with one or more of the other GNSS elements and a fault-free receiver shall meet the requirements for system accuracy, integrity, continuity and availability for the intended operation as prescribed in Regulation 32, throughout the corresponding service area;

(ii) SBAS combined with one or more of the other GNSS elements and a fault-free receiver shall meet the requirements for signal-in-space integrity as prescribed in Regulation 32, throughout the SBAS coverage area;

(b) *Functions.* SBAS shall perform one or more of the following functions—

(i) ranging: provide an additional pseudo-range signal with an accuracy indicator from an SBAS satellite;

(ii) global navigation satellite system satellite status: determine and transmit the global navigation satellite system satellite health status;

(iii) basic differential correction: provide global navigation satellite system satellite ephemeris and clock corrections (fast and long-term) to be applied to the pseudo-range measurements from satellites; and

(iv) precise differential correction: determine and transmit the ionospheric corrections.

(c) *Ranging*

(i) Excluding atmospheric effects, the range error for the ranging signal from SBAS satellites shall not exceed 25 m (82 ft) (95 percent).

(ii) The probability that the range error exceeds 150 m (490 ft) in any hour shall not exceed 10^{-5}.

(iii) The probability of unscheduled outages of the ranging function from an SBAS satellite in any hour shall not exceed 10^{-3}.

(iv) The range rate error shall not exceed 2 m (6.6 ft) per second.

(v) The range acceleration error shall not exceed 0.019 m (0.06 ft) per second-squared.

(d) *Service area.* A SBAS service area for any approved type of operation shall be a declared area within the SBAS coverage area where SBAS meets the corresponding requirements of Regulation 32;

(e) *RF characteristics*—

(i) *Carrier frequency*. The carrier frequency shall be 1575.42 MHz.

(ii) *Signal spectrum*. At least 95 per cent of the broadcast power shall be contained within a ±12 MHz band centred on the L1 frequency. The bandwidth of the signal transmitted by an SBAS satellite shall be at least 2.2 MHz.

(f) *SBAS satellite signal power level.*

(i) Each SBAS satellite placed in orbit before 1st January 2014 shall broadcast navigation signals with sufficient power such that, at all unobstructed locations near the ground from which the satellite is observed at an elevation angle of 5 degrees or higher, the level of the received RF signal at the antenna port of a 3 dBi linearly polarised antenna is within the range of −161 dBW to −153 dBW for all antenna orientations orthogonal to the direction of propagation.

(ii) Each SBAS satellite placed in orbit after 31st December 2013 shall comply with the following requirements—

(A) The satellite shall broadcast navigation signals with sufficient power such that, at all unobstructed locations near the ground from which the satellite is observed at or above the minimum elevation angle for which a trackable GEO signal needs to be provided, the level of the received RF signal at the antenna port of the antenna specified in Table 9-2, is at least −164.0 dBW.

(B) *Minimum elevation angle*. The minimum elevation angle used to determine GEO coverage shall not be less than 5 degrees for a user near the ground.

(C) The level of a received SBAS RF signal at the antenna port of a 0 dBic antenna located near the ground shall not exceed −152.5 dBW.

(D) The ellipticity of the broadcast signal shall be no worse than 2 dB for the angular range of ±9.1° from boresight.

Table 9-2 Minimum antenna gain- GPS, GLONASS and SBAS

Evaluation angle degrees	Minimum gain dBic
0	-7
5	-5-5
10	-4
15 to 90	-2.5

(g) *Polarisation* The broadcast signal shall be right-hand circularly polarised.

(h) *Modulation* The transmitted sequence shall be the Modulo-2 addition of the navigation message at a rate of 500 symbols per second and the 1 023 bit pseudo-random noise code. It shall then be BPSK-modulated onto the carrier at a rate of 1.023 megabits per second.

(i) *SBAS network time (SNT)* The difference between SNT and Global Positioning System time shall not exceed 50 nanoseconds.

(j) *Navigation information* The navigation data transmitted by the satellites shall include the *necessary* information to determine—

(i) SBAS satellite time of transmission;

(ii) SBAS satellite position;

(iii) corrected satellite time for all satellites;

(iv) corrected satellite position for all satellites;

(v) ionospheric propagation delay effects;

(vi) user position integrity;

(vii) time transfer to UTC; and

(viii) service level status.

5) **Ground-based augmentation system (GBAS) and ground-based regional augmentation system (GRAS)**

(a) *Performance* GBAS combined with one or more of the other global navigation satellite system elements and a fault-free global navigation satellite system receiver shall meet the requirements for system accuracy, continuity, availability and integrity for the intended operation as prescribed in regulation 48 within the service volume for the service used to support the operation as defined in paragraph (c).

(b) *Functions* GBAS shall perform the following functions—

(i) provide locally relevant pseudo-range corrections;

(ii) provide GBAS-related data;

(iii) provide final approach segment data when supporting precision approach;

(iv) provide predicted ranging source availability data; and

(v) provide integrity monitoring for global navigation satellite system ranging sources.

(c) *Service volume*

(i) General requirement for approach services. The minimum GBAS approach service volume shall be as follows, except where topographical features dictate and operational requirements permit—

(A) laterally, beginning at 140 m (450 ft) each side of the landing threshold point or fictitious threshold point (LTP/FTP) and projecting out ±35 degrees either side of the final approach path to 28 km (15 NM) and ±10 degrees either side of the final approach path to 37 km (20 NM); and

(B) vertically, within the lateral region, up to the greater of 7 degrees or 1.75 promulgated glide path angle (GPA) above the horizontal with an origin at the glide path interception point (GPIP) to an upper bound of 3 000 m (10 000 ft) height above threshold (HAT) and 0.45 GPA above the horizontal or to such lower angle, down to

0.30 GPA, as required, to safeguard the promulgated glide path intercept procedure. The lower bound is half the lowest decision height supported or 3.7 m (12 ft), whichever is larger;

(ii) Approach services supporting auto land and guided take-off

The minimum additional GBAS service volume to support approach operations that include automatic landing and roll- out, including during guided take-off, shall be as follows, except where operational requirements permit—

(A) horizontally, within a sector spanning the width of the runway beginning at the stop end of the runway and extending parallel with the runway centre line towards the LTP to join the minimum service volume as described in subparagraph (c) (i);

(B) vertically, between two horizontal surfaces one at 3.7 m (12 ft) and the other at 30 m (100 ft) above the runway centre line to join the minimum service volume as described in subparagraph (c) (i).

(iii) *GBAS positioning service.* The service volume for the GBAS positioning service shall be where the data broadcast can be received, and the positioning service meets the requirements of regulation 48 and supports the corresponding approved operations.

(6) *Data broadcast characteristics*

(a) *Carrier frequency.* The data broadcast radio frequencies used shall be selected from the radio frequencies in the band 108 to 117.975 MHz. The lowest assignable frequency shall be 108.025 MHz and the highest assignable frequency shall be 117.950 MHz. The separation between assignable frequencies (channel spacing) shall be 25 kHz.

(b) *Access technique.* A time division multiple access (TDMA) technique shall be used with a fixed frame structure. The data broadcast shall be assigned one to eight slots.

(c) *Modulation.* GBAS data shall be transmitted as 3-bit symbols, modulating the data broadcast carrier by D8PSK, at a rate of 10 500 symbols per second.

(d) *Data broadcast RF field strength and polarisation—*

(i) GBAS/H

(A) A horizontally polarised signal shall be broadcast.

(B) The effective isotropically radiated power (EIRP) shall provide for a horizontally polarised signal with a minimum field strength of 215 microvolts per metre (–99 dBW/m^2) and a maximum field strength of 0.879 volts per metre (–27 dBW/m^2) within the GBAS service volume as specified in subparagraph (5) (c) (i). The field strength shall be measured as an average over the period of the synchronisation and ambiguity resolution field of the burst. Within the additional GBAS service volume, as specified in subparagraph (5) (c) (i) the effective isotopically radiated power (EIRP) shall provide for a horizontally polarised signal with a minimum field strength of 215 microvolts per metre (–99 dBW/m^2) below 36 ft and down to 12 ft above the runway surface and 650 microvolts per metre (–89.5 dBW/m^2) at 36 ft or more above the runway surface.

(ii) GBAS/*E*—

(A) An elliptically polarised signal shall be broadcast whenever practical;

(B) When an elliptically polarised signal is broadcast, the horizontally polarised component shall meet the requirements in subparagraph (6)(d)(i) (bb), and the effective isotropically radiated power (EIRP) shall provide for a vertically polarised signal with a minimum field strength of 136 microvolts per metre (–103 dBW/m^2) and a maximum field strength of 0.555 volts per metre (–31 dBW/ m^2) within the GBAS service volume. The field strength shall be measured as an average over the period of the synchronisation and ambiguity resolution field of the burst.

(iii) *Power transmitted in adjacent channel*s. The amount of power during transmission under all operating conditions when measured over a 25 kHz bandwidth centred on the 1st adjacent channel shall not exceed the values shown in Table 9.3.

Table 9.3 GBAS broadcast power transmitted in adjacent channels

Channel	Relative Power	Maximum Power
1st adjacent	-40 dBe	12 dBm
2nd adjacent	-65 dBe	-13 dBm
4th adjacent	-74 dBe	-22dBm
8th adjacent	-88.5 dBe	-36.5 dBm
16th adjacent	-101.5 dBe	-49.5 dBm
32nd adjacent	-105 dBe	-53dBm
64th adjacent	-113 dBe	-61 dBm
76th adjacent and beyond	-115 dBe	-63 dBm
NOTES.— 1. The maximum power applies if the authorised transmitter power exceeds 150 W. 2. The relationship is linear between single adjacent points designated by the adjacent channels identified above		

Unwanted emissions Unwanted emissions, including spurious and out-of-band emissions, shall be compliant with the levels shown in Table 9.4. The total power in any VDB harmonic or discrete signal shall not be greater than –53 dBm.

Table 9.4 GBAS broadcast unwanted emissions

Table 3.7.3.5-2. GBAS broadcast unwanted emissions

Frequency	Relative unwanted emission level (Note 2)	Maximum unwanted emission level (Note 1)
9 kHz to 150 kHz	–93 dBc (Note 3)	–55 dBm/1 kHz (Note 3)
150 kHz to 30 MHz	–103 dBc (Note 3)	–55 dBm/10 kHz (Note 3)
30 MHz to 106.125 MHz	–115 dBc	–57 dBm/100 kHz
106.425 MHz	–113 dBc	–55 dBm/100 kHz
107.225 MHz	–105 dBc	–47 dBm/100 kHz
107.625 MHz	–101.5 dBc	–53.5 dBm/10 kHz
107.825 MHz	–88.5 dBc	–40.5 dBm/10 kHz
107.925 MHz	–74 dBc	–36 dBm/1 kHz
107.9625 MHz	–71 dBc	–33 dBm/1 kHz
107.975 MHz	–65 dBc	–27 dBm/1 kHz
118.000 MHz	–65 dBc	–27 dBm/1 kHz
118.0125 MHz	–71 dBc	–33 dBm/1 kHz
118.050 MHz	–74 dBc	–36 dBm/1 kHz
118.150 MHz	–88.5 dBc	–40.5 dBm/10 kHz
118.350 MHz	–101.5 dBc	–53.5 dBm/10 kHz
118.750 MHz	–105 dBc	–47 dBm/100 kHz
119.550 MHz	–113 dBc	–55 dBm/100 kHz
119.850 MHz to 1 GHz	–115 dBc	–57 dBm/100 kHz
1 GHz to 1.7 GHz	–115 dBc	–47 dBm/1 MHz

NOTES.—

1. The maximum unwanted emission level (absolute power) applies if the authorized transmitter power exceeds 150 W.
2. The relative unwanted emission level is to be computed using the same bandwidth for desired and unwanted signals. This may require conversion of the measurement for unwanted signals done using the bandwidth indicated in the maximum unwanted emission level column of this table.
3. This value is driven by measurement limitations. Actual performance is expected to be better.
4. The relationship is linear between single adjacent points designated by the adjacent channels identified above.

(e) *Navigation information* The navigation data transmitted by GBAS shall include the following information—

(i) pseudo-range corrections, reference time and integrity data;

(ii) GBAS-related data;

(iii) final approach segment data when supporting precision approach; and

(iv) predicted ranging source availability data.

(7) *Aircraft global navigation satellite system receiver* shall process the signals of those global navigation satellite system elements that it intends to use.

2. **Resistance to interference**
Global navigation satellite system shall comply with performance requirements defined in regulation 32 in the presence of the interference environment.

3. **Database**
Aircraft global navigation satellite system equipment that uses a database shall provide a means to—

(a) update the electronic navigation database; and

(b) determine the Aeronautical Information Regulation and Control (AIRAC) effective dates of the aeronautical database.

Global Navigation Satellite System specific provisions
4. It shall be permissible to terminate a Global Navigation Satellite System satellite service provided by one of its elements on the basis of at least six years advance notice by the service provider.

Recording of Global Navigation Satellite Systems Data
5. (1) Where Global Navigation Satellite System based operations are used in Uganda the authority shall ensure that the data relevant to those operations are recorded.

(2) The recording mentioned in subparagraph (1) shall be retained for a period of 14 days, however where these recordings are pertinent to accident and incident investigations they shall be retained for a longer period until it is evident that they will no longer be required.

SCHEDULE 10

Regulation 35

SYSTEM CHARACTERISTICS OF AIRBORNE ADF RECEIVING SYSTEMS

Accuracy of bearing indication
The bearing given by the ADF system shall not be in error by more than plus or minus 5 degrees with a radio signal from any direction having a field strength of 70 microvolts per metre or more radiated from an LF/MF NDB or locator operating within the tolerances permitted by this Manual and in the presence

also of an unwanted signal from a direction 90 degrees from the wanted signal and—

(a) on the same frequency and 15 dB weaker;

(b) plus or minus 2 kHz away and 4 dB weaker; or

(c) plus or minus 6 kHz or more away and 55 dB stronger.

Made by the Director General this 11th day of July, 2025.

MR. ANTHONY WHITTIER
Director General,
Eastern Caribbean Civil Aviation Authority.

GRENADA
PRINTED BY THE GOVERNMENT PRINTER, AT THE GOVERNMENT PRINTING OFFICE, ST. GEORGE'S
31/7/2025.